

Modulverzeichnis

**zu der Prüfungs- und Studienordnung für den
konsekutiven Master-Studiengang "Computational
Biology and Bioinformatics" (Amtliche
Mitteilungen I Nr. 9/2024 S. 98)**

Übersicht nach Modulgruppen

I. Master-Studiengang "Computational Biology and Bioinformatics"

Es müssen Module im Umfang von insgesamt 120 C nach Maßgabe der nachfolgenden Bestimmungen erfolgreich absolviert werden.

1. Fachstudium (54 C)

Es müssen Module im Umfang von insgesamt 54 C nach Maßgabe der nachfolgenden Bestimmungen erfolgreich absolviert werden. Module, die bereits im Bachelor-Studium absolviert wurden, können nicht erneut belegt werden.

a. Brückenmodule

Je nach Vorkenntnissen muss wenigstens eines der folgenden Module im Umfang von insgesamt **10 C** absolviert werden. Hierüber entscheidet der*die Mentor*in nach Maßgabe durch die Prüfungskommission zu formulierenden Grundsätze.

In begründeten Einzelfällen kann der*die Mentor*in auch Module im Umfang von insgesamt 10 C aus den Wahlpflichtbereichen als Brückenmodule empfehlen, welche dann die Brückenmodule ersetzen oder ergänzen.

B.Inf.1101: Grundlagen der Informatik und Programmierung (10 C, 6 SWS).....	6898
B.Inf.1801: Programmierkurs (5 C, 3 SWS).....	6915
B.Inf.1802: Programmierpraktikum (6 C, 4 SWS).....	6916
B.Inf.1842: Programmieren für Data Scientists: Python (5 C, 3 SWS).....	6918
M.Bio.001: Statistics for Biology using R (6 C, 4 SWS).....	6923
M.CoBi.502: Biology for (bio)informaticians (10 C, 8 SWS).....	6959
M.CoBi.506: Linux and Python for biologists (5 C, 3 SWS).....	6963

b. Pflichtmodul

Es müssen folgende Module im Umfang von **8 C** erfolgreich absolviert werden:

M.CoBi.501: Bioinformatics and its areas of application (8 C, 7 SWS).....	6958
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c. Wahlpflichtmodule „Bioinformatik“

Es müssen Module im Umfang von insgesamt wenigstens **24 C** aus dem Wahlpflichtbereich Bioinformatik erfolgreich absolviert werden. Nach Nr. 1 Buchstabe d und/oder Nr. 2 absolvierte Module werden nicht erneut berücksichtigt.

B.Bio.113: Angewandte Bioinformatik (10 C, 7 SWS).....	6897
B.Inf.1252: Biomedical Engineering (6 C, 4 SWS).....	6912
B.Inf.1504: Maschinelles Lernen in der Bioinformatik (6 C, 4 SWS).....	6914

B.Phy.5601: Theoretical and Computational Neuroscience I (3 C, 2 SWS).....	6919
B.Phy.5602: Theoretical and Computational Neuroscience II (3 C, 2 SWS).....	6920
B.Phy.5624: Introduction to Theoretical Neuroscience (4 C, 2 SWS).....	6921
B.Phy.5651: Advanced Computational Neuroscience (3 C, 2 SWS).....	6922
M.Bio.105: Applied Bioinformatics in Molecular Biosciences (12 C, 14 SWS).....	6929
M.Bio.310: Systems Biology (12 C, 14 SWS).....	6944
M.Bio.323: Introduction to Bayesian Statistics and Information Theory (12 C, 12 SWS).....	6946
M.Bio.340: Systems Biology (3 C, 2 SWS).....	6948
M.Bio.374: Introduction to Computer Modelling (2 C, 2 SWS).....	6950
M.Biodiv.491: Next generation sequencing for evolutionary biology (6 C, 4 SWS).....	6956
M.CoBi.504: Comparative and Evolutionary Genomics (12 C, 14 SWS).....	6961
M.CoBi.507: Computational Biomedicine (6 C, 4 SWS).....	6965
M.CoBi.508: Deep learning, data leakage, and reproducibility in computational biology (6 C, 4 SWS).....	6967
M.Inf.1505: Models and Algorithms in Bioinformatics (6 C, 4 SWS).....	6975
M.iPAB.0003: Statistical genetics, breeding informatics and experimental design (6 C, 4 SWS).....	6984
M.iPAB.0015: Applied Machine Learning in Agriculture with R (6 C, 4 SWS).....	6985
M.iPAB.0019: Scientific Project: scientific methods, procedures and practical skills in animal and plant breeding (9 C, 6 SWS).....	6987

d. Wahlpflichtmodule „Biologie“

Es müssen Module im Umfang von insgesamt wenigstens **12 C** aus dem Wahlpflichtbereich Biologie erfolgreich absolviert werden. Nach Nr. 1 Buchstabe c absolvierte Module werden nicht erneut berücksichtigt.

B.Bio-NF.112: Biochemie (6 C, 4 SWS).....	6892
B.Bio-NF.116: Allgemeine Entwicklungs- und Zellbiologie (6 C, 4 SWS).....	6893
B.Bio-NF.125: Zell- und Molekularbiologie der Pflanze (6 C, 4 SWS).....	6894
B.Bio-NF.130: Kognitionspsychologie (3 C, 2 SWS).....	6896
M.Bio.101: General and Applied Microbiology (12 C, 14 SWS).....	6925
M.Bio.102: Molecular Genetics and Microbial Cell Biology (12 C, 14 SWS).....	6927
M.Bio.105: Applied Bioinformatics in Molecular Biosciences (12 C, 14 SWS).....	6929
M.Bio.106: Structural Biochemistry (12 C, 14 SWS).....	6931
M.Bio.107: Biochemistry and Biophysics (12 C, 14 SWS).....	6933

M.Bio.141: General and Applied Microbiology (3 C, 3 SWS).....	6935
M.Bio.142: Molecular Genetics and Microbial Cell Biology (3 C, 3 SWS).....	6937
M.Bio.144: Molecular Cell Biology of Plant-Microbe Interactions and Stress Adaptation (3 C, 3 SWS).....	6938
M.Bio.156: Structural Biochemistry (3 C, 3 SWS).....	6939
M.Bio.157: Biochemistry and Biophysics (3 C, 3 SWS).....	6940
M.Bio.158: Enzyme Catalysis and Biological Chemistry (3 C, 3 SWS).....	6941
M.Bio.172: Molecular Genetics and Microbial Cell Biology (6 C, 4 SWS).....	6942
M.Bio.176: Structural Biochemistry (6 C, 4 SWS).....	6943
M.Bio.372: Matlab in Biopsychology and Neuroscience (3 C, 2 SWS).....	6949
M.Biodiv.425: Evolution of embryophyta (6 C, 4 SWS).....	6951
M.Biodiv.446: Molecular zoology and insect-biotechnology (6 C, 8 SWS).....	6952
M.Biodiv.479: Phylogenomics (6 C, 6 SWS).....	6954
M.Biodiv.491: Next generation sequencing for evolutionary biology (6 C, 4 SWS).....	6956
M.CoBi.504: Comparative and Evolutionary Genomics (12 C, 14 SWS).....	6961
M.iPAB.0019: Scientific Project: scientific methods, procedures and practical skills in animal and plant breeding (9 C, 6 SWS).....	6987
SK.Bio-NF.7001: Neurobiology (3 C, 2 SWS).....	6988

2. Professionalisierungsbereich (36 C)

Es müssen Module im Umfang von insgesamt 36 C nach Maßgabe der nachfolgenden Bestimmungen erfolgreich absolviert werden.

a. Pflichtmodul

Es muss folgendes Modul im Umfang von **12 C** erfolgreich absolviert werden.

M.CoBi.503: Advanced course in Computational Biology (12 C).....	6960
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b. Wahlpflichtmodule „Informatik“

Es müssen Module im Umfang von insgesamt wenigstens **12 C** aus dem Wahlpflichtbereich Informatik erfolgreich absolviert werden. Nach Nr. 1 absolvierte Module werden nicht erneut berücksichtigt.

B.Inf.1131: Data Science: Grundlagen (6 C, 4 SWS).....	6901
B.Inf.1209: Softwaretechnik (5 C, 3 SWS).....	6903
B.Inf.1231: Infrastrukturen für Data Science (6 C, 4 SWS).....	6905
B.Inf.1236: Machine Learning (6 C, 4 SWS).....	6907

B.Inf.1237: Deep Learning for Computer Vision (6 C, 4 SWS).....	6908
B.Inf.1240: Visualization (6 C, 4 SWS).....	6909
B.Inf.1249: Introduction to Robotics (6 C, 4 SWS).....	6910
B.Inf.1504: Maschinelles Lernen in der Bioinformatik (6 C, 4 SWS).....	6914
B.Inf.1801: Programmierkurs (5 C, 3 SWS).....	6915
B.Inf.1802: Programmierpraktikum (6 C, 4 SWS).....	6916
B.Inf.1842: Programmieren für Data Scientists: Python (5 C, 3 SWS).....	6918
M.Bio.323: Introduction to Bayesian Statistics and Information Theory (12 C, 12 SWS).....	6946
M.Inf.1114: Algorithms on Sequences (5 C, 4 SWS).....	6971
M.Inf.1232: Parallel Computing (6 C, 4 SWS).....	6973
M.Inf.1505: Models and Algorithms in Bioinformatics (6 C, 4 SWS).....	6975
M.Inf.2102: Advanced Statistical Learning for Data Science (6 C, 4 SWS).....	6976
M.Inf.2103: Statistical Network Inference and Analysis (6 C, 4 SWS).....	6978
M.Inf.2201: Probabilistic Machine Learning (9 C, 6 SWS).....	6979
M.Inf.2244: Seminar Deep Learning in Biology and Medicine (5 C, 2 SWS).....	6981
M.WIWI-QMW.0001: Generalized Regression (6 C, 4 SWS).....	6982
M.iPAB.0015: Applied Machine Learning in Agriculture with R (6 C, 4 SWS).....	6985

c. Fächerübergreifende Schlüsselkompetenzen

Es müssen Module im Umfang von insgesamt 12 C absolviert werden, darunter das Pflichtmodul M.CoBi.531. Hierbei eignen sich Module des universitätsweiten Schlüsselkompetenzangebots sowie folgende Module, sofern sie noch nicht in einem anderen Bereich absolviert wurden.

Students must complete modules totalling 12 credits, including the compulsory module M.CoBi.531. Modules from the university-wide key competencies programme are suitable for this purpose, as are the following modules, provided they have not already been completed in another area.

B.Inf.1842: Programmieren für Data Scientists: Python (5 C, 3 SWS).....	6918
M.Bio.001: Statistics for Biology using R (6 C, 4 SWS).....	6923
M.Bio.374: Introduction to Computer Modelling (2 C, 2 SWS).....	6950
M.CoBi.506: Linux and Python for biologists (5 C, 3 SWS).....	6963
M.CoBi.531: Scientific Project Management (6 C, 5 SWS).....	6969
M.Inf.2102: Advanced Statistical Learning for Data Science (6 C, 4 SWS).....	6976
M.iPAB.0019: Scientific Project: scientific methods, procedures and practical skills in animal and plant breeding (9 C, 6 SWS).....	6987
SK.Bio.328: Wissenschaftliche Präsentation und Kommunikation (3 C, SWS).....	6990

SK.Bio.329: Forschungspraktikum (4 Wochen) (6 C, SWS).....	6991
SK.Bio.331: Forschungspraktikum (8 Wochen) (12 C, SWS).....	6992
SK.Bio.332: Internship for master degree students (8 C).....	6993
SK.Bio.380: Magnetresonanztomographie: Grundprinzipien und Anwendungen (6 C, 4 SWS) ..	6994

3. Masterarbeit

Durch die erfolgreiche Anfertigung der Masterarbeit werden 30 C erworben.

Georg-August-Universität Göttingen		6 C 4 SWS
Modul B.Bio-NF.112: Biochemie <i>English title: Biochemistry</i>		
Lernziele/Kompetenzen: Nach Abschluss des Moduls sind die Studierenden in der Lage, grundlegende Stoffkenntnisse und die Grundprinzipien biochemischer Reaktionen, ihr Vorkommen im Stoffwechsel, sowie die Anwendung biochemischer Methoden zu beschreiben und zu erläutern. Sie können die Grundlagen der Proteinchemie und der Genetik erklären.		Arbeitsaufwand: Präsenzzeit: 56 Stunden Selbststudium: 124 Stunden
Lehrveranstaltung: Grundlagen der Biochemie (Vorlesung) <i>Inhalte:</i> Anabolismus und Katabolismus von Aminosäuren, Kohlenhydraten, Lipiden und Nukleinsäuren; Synthese, Struktur und Funktion von Makromolekülen; Erzeugung und Speicherung von Stoffwechselenergie, DNA, RNA, Enzyme, Kohlenhydrate, Lipide und Zellmembranen, Grundlagen des Metabolismus und Signaltransduktion.		4 SWS
Prüfung: Klausur (90 Minuten) Prüfungsanforderungen: In der Klausur demonstrieren die Studierenden durch die Beantwortung von Fragen unter zeitlichem Druck und ohne Hilfsmittel ihr theoretisches Wissen zu biochemischen Stoffen, Reaktionen und Methoden.		6 C
Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: Biologische Grundkenntnisse	
Sprache: Deutsch	Modulverantwortliche[r]: Dr. rer. nat. Ellen Hornung	
Angebotshäufigkeit: jedes Wintersemester	Dauer: 1 Semester	
Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester: 3 - 5	
Maximale Studierendenzahl: 20		
Bemerkungen: Das Modul kann nicht in Kombination mit B.Bio.112 belegt werden.		

Georg-August-Universität Göttingen		6 C 4 SWS
Modul B.Bio-NF.116: Allgemeine Entwicklungs- und Zellbiologie <i>English title: General developmental and cell biology</i>		
Lernziele/Kompetenzen: Die Studierenden können entwicklungsbiologisch relevante Aspekte der Zellbiologie beschreiben und erläutern. Sie sind in der Lage, zentrale Themen der tierischen und pflanzlichen Entwicklungsbiologie zu erklären und in einen biologischen Kontext einzuordnen. Zudem können sie klassische und molekularbiologische Methoden der Entwicklungsbiologie beschreiben, Modellorganismen identifizieren und deren Bedeutung für die Forschung erläutern.		Arbeitsaufwand: Präsenzzeit: 56 Stunden Selbststudium: 124 Stunden
Lehrveranstaltung: Allgemeine Entwicklungs- und Zellbiologie (Vorlesung) <i>Inhalte:</i> Aufbau der Zelle, Zellkompartimente, Zytoskelett, Mitochondrien, Membranstruktur und -transport, Zellkontakte und -kommunikation, Zellzyklus, Zellteilung, programmierter Zelltod, Kontrolle der eukaryotischen Genexpression, Allgemeine Mechanismen der Entwicklung, Keimzellen und Befruchtung, Furchung, Prinzipien der Musterbildung, Gestaltbildung, Gastrulation, Neurulation, Organogenese, Zellbewegungen, Zellformveränderungen, Methoden der experimentellen Embryologie, Methoden der Entwicklungsgenetik, Kenntnis von Modellorganismen, Achsenbildung, Segmentierungsgene, Homöotische Selektorgene, Evolutionäre Entwicklungsbiologie, Neuronale Entwicklung, Stammzellen und Regeneration, Homöostase, Krebsentstehung, Pflanzenembryogenese, Dormanz und Keimung, Lichtabhängige Entwicklung, Phytohormone, Evolution und Genetik der Blütenbildung		4 SWS
Prüfung: Klausur (90 Minuten) Prüfungsanforderungen: In der Klausur demonstrieren die Studierenden durch die Beantwortung von Fragen unter zeitlichem Druck und ohne Hilfsmittel ihr theoretisches Wissen zu grundlegenden zell- und entwicklungsbiologischen Themen, Konzepten und Methoden.		6 C
Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: Biologische Grundkenntnisse	
Sprache: Deutsch	Modulverantwortliche[r]: Prof. Dr. Ernst Anton Wimmer	
Angebotshäufigkeit: jedes Wintersemester	Dauer: 1 Semester	
Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester: 3 - 5	
Maximale Studierendenzahl: 25		
Bemerkungen: Das Modul kann nicht in Kombination mit B.Bio.116 belegt werden.		

Georg-August-Universität Göttingen Modul B.Bio-NF.125: Zell- und Molekularbiologie der Pflanze <i>English title: Cell and molecular biology of plants</i>		6 C 4 SWS
Lernziele/Kompetenzen: Die Studierenden können die Besonderheiten der pflanzlichen Zelle, die Organisation des pflanzlichen Genoms sowie Mechanismen der Genexpression und deren, die Beziehung zwischen Struktur und Funktion von Organellen und der Zellwand, Transportprozesse sowie intrazelluläre Signaltransduktion beschreiben und erläutern. Sie kennen die Modellpflanze <i>Arabidopsis thaliana</i> und sind in der Lage, die Biosynthese, Signaltransduktion und Wirkung von Phytohormonen sowie molekulare Anpassungsmechanismen an abiotische und biotische Stressbedingungen zu erklären. Zudem können sie die Phylogenie und Biotechnologie von Algen beschreiben und in einen biologischen Kontext einordnen.		Arbeitsaufwand: Präsenzzeit: 56 Stunden Selbststudium: 124 Stunden
Lehrveranstaltung: Zell- und Molekularbiologie der Pflanze (Vorlesung) <i>Inhalte:</i> <i>Arabidopsis thaliana</i> als Modellsystem zur Erforschung zell- und molekularbiologischer Prozesse, Methoden zur Erforschung zell- und molekularbiologischer Prozesse, Struktur-Funktions-Beziehungen pflanzlicher Zellorganellen, Mechanismen des Transports von Proteinen in unterschiedliche Zellorganellen und in die Zellwand; Mechanismen pflanzlicher Signaltransduktion und pflanzlicher Immunität; Biosynthese, Signaltransduktion und Wirkung von Phytohormonen; Regulation der Genexpression und Funktion von Transkriptionsfaktoren; Mechanismen der Proteinhomöostase einschließlich Autophagie; molekulare Anpassungsstrategien von Pflanzen an abiotische Stressbedingungen; Phylogenie und Biotechnologie von Algen		4 SWS
Prüfung: Klausur (75 Minuten) Prüfungsanforderungen: In der Klausur müssen die Studierenden die Struktur und Funktion pflanzlicher Zellen, Transportprozesse und Signaltransduktion erklären, die Wirkung von Phytohormonen, Mechanismen der Genexpression und deren Regulation sowie molekulare Stressanpassungen beschreiben und in einen biologischen Kontext einordnen. Zudem werden ihre Kenntnisse zu Algen-Phylogenie und -Biotechnologie überprüft. Die Klausur besteht aus einer Kombination aus Multiple-Choice-, Lückentext- und offenen Fragen.		6 C
Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: Biologische Grundkenntnisse	
Sprache: Deutsch	Modulverantwortliche[r]: Prof. Dr. Salma Balazadeh	
Angebotshäufigkeit: jedes Wintersemester	Dauer: 1 Semester	
Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester: 3 - 5	

Maximale Studierendenzahl:	
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Bemerkungen:

Das Modul kann nicht in Kombination mit B.Bio.125 belegt werden.
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Georg-August-Universität Göttingen		3 C
Modul B.Bio-NF.130: Kognitionspsychologie		2 SWS
<i>English title: Cognitive psychology</i>		
Lernziele/Kompetenzen: Im Rahmen der Vorlesung erhalten die Studierenden eine Einführung in die Kognitionsforschung. Sie besitzen nach Abschluss des Moduls Kenntnisse der zentralen Konzepte und Forschungsmethoden in diesem Bereich. Es werden Grundlagen des experimentellen Arbeitens zu einzelnen Teilbereichen menschlicher Kognition (z.B. Aufmerksamkeit, Gedächtnis, Sprache, Emotion) vermittelt. Dabei stehen neben klassischen Paradigmen und Theorien psychophysiologische Ansätze und Methoden im Mittelpunkt.		Arbeitsaufwand: Präsenzzeit: 28 Stunden Selbststudium: 62 Stunden
Lehrveranstaltung: Kognitionspsychologie (Vorlesung)		2 SWS
Prüfung: Klausur (45 Minuten)		3 C
Prüfungsanforderungen: Die Studierenden sollen das in der Vorlesung vermittelte Grundwissen der Kognitionsforschung beherrschen. Sie sollen über die gelernten Fakten hinaus Zusammenhänge des Erwerbens von kognitiven Fähigkeiten, Verhaltensmustern und psychophysiologischer Korrelate höherer Hirnfunktionen verstehen, diese darstellen können und in der Lage sein, das erworbene Wissen auf neue Situationen anzuwenden.		
Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: keine	
Sprache: Deutsch	Modulverantwortliche[r]: Prof. Dr. Anne Schacht	
Angebotshäufigkeit: jedes Wintersemester	Dauer: 1 Semester	
Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester: ab 3	
Maximale Studierendenzahl: 25		
Bemerkungen: Das Modul kann nicht in Kombination mit B.Bio.130 belegt werden.		

Georg-August-Universität Göttingen Modul B.Bio.113: Angewandte Bioinformatik <i>English title: Applied bioinformatics</i>		10 C 7 SWS
Lernziele/Kompetenzen: Nach erfolgreichem Absolvieren des Moduls haben die Studierenden die meisten in der biowissenschaftlichen Forschung benötigten Datenbanken in ihrem Aufbau verstanden und können deren Inhalte kritisch einschätzen. Sie haben die Fähigkeit erworben, selbst biologische Fakten zu strukturieren und in ein Datenbankschema zu übertragen. Sie sind in der Lage, bioinformatische Methoden insbesondere auf die Analyse von Sequenzdaten, biologischen Netzwerken und Genexpressionsdaten kritisch anzuwenden. Sie besitzen die Fähigkeit, grundlegende biologische Prozesse in einem mathematischen Formalismus/Modell zu beschreiben und diese Modelle in gängiger Standardsoftware (R) anzuwenden.		Arbeitsaufwand: Präsenzzeit: 98 Stunden Selbststudium: 202 Stunden
Lehrveranstaltung: Einführung in die angewandte Bioinformatik (Vorlesung)		4 SWS
Prüfung: Klausur (90 Minuten) Prüfungsvorleistungen: regelmäßige Teilnahme an den praktischen Übungen und erfolgreiches Absolvieren von drei Übungszetteln Prüfungsanforderungen: Identifizierung und Benennung geeigneter Informationsquellen für bestimmte Wissensbereiche im Internet; Darstellung der Grundlagen für ein einfaches Datenbankschema und exemplarische Entwicklung eines solchen Schemas; Benennung und Anwendung von Maßzahlen zur kritischen Bewertung von bioinformatischen Analyseverfahren; Kennen verschiedener grundlegender Methoden des Sequenzvergleichs; Anwendung einzelner Verfahren zur phylogenetischen Rekonstruktion sowie des Informationsbegriffs bei der Analyse von Sequenzdaten; Wiedergabe und Anwendung grundlegender Eigenschaften biologischer Netzwerke und ihrer graphentheoretischen Repräsentation		10 C
Lehrveranstaltung: Internet-basierte Bioinformatik (Übung)		3 SWS
Zugangsvoraussetzungen: Für BSc Bio: mindestens 40 C aus dem ersten Studienabschnitt	Empfohlene Vorkenntnisse: keine	
Sprache: Deutsch	Modulverantwortliche[r]: Prof. Dr. Tim Beißbarth	
Angebotshäufigkeit: jedes Wintersemester	Dauer: 1 Semester	
Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester: 3 - 5	
Maximale Studierendenzahl: 100		

Georg-August-Universität Göttingen Modul B.Inf.1101: Grundlagen der Informatik und Programmierung <i>English title: Introduction to Computer Science and Programming</i>	10 C 6 SWS
Lernziele/Kompetenzen: Deutsch: Studierende • kennen grundlegende Begriffe, Methoden und Denkweisen der Informatik und verstehen die Rolle von Algorithmen, Abstraktion und Modellbildung bei der Lösung von Problemen, • verstehen grundlegende Prinzipien der Informationsdarstellung und Datenverarbeitung, insbesondere Zahlendarstellungen, Zeichenkodierungen, boolesche Ausdrücke und deren Bedeutung für Programme, • verstehen grundlegende Funktionsprinzipien von Computern und deren Konsequenzen für die Programmierung und algorithmische Problemlösung, • beherrschen die Grundlagen der Programmiersprache Python und können einfache Programme, Funktionen und Algorithmen selbstständig entwickeln, • können einfache Problemstellungen analysieren, geeignete Datenrepräsentationen auswählen und bekannte algorithmische Verfahren auf neue Situationen übertragen, • kennen grundlegende Datenstrukturen und Algorithmen sowie typische Anwendungsgebiete und können diese in einfachen Programmen verwenden, • können einfache Programme und Algorithmen hinsichtlich Korrektheit, Laufzeit- und Speicherbedarf analysieren und bewerten, • können Programmcode lesen, verstehen, testen sowie typische Fehler erkennen und beheben. English: Students • know fundamental concepts, methods, and ways of thinking in computer science and understand the role of algorithms, abstraction, and modeling in problem solving, • understand basic principles of information representation and data processing, in particular number representations, character encodings, Boolean expressions, and their significance for programs, • understand fundamental functional principles of computers and their consequences for programming and algorithmic problem solving, • master the fundamentals of the Python programming language and are able to independently develop simple programs, functions, and algorithms, • are able to analyze simple problems, choose suitable data representations, and transfer known algorithmic techniques to new situations, • know fundamental data structures and algorithms as well as typical areas of application and are able to use them in simple programs, • are able to analyze and evaluate simple programs and algorithms with respect to correctness, runtime, and memory consumption, • are able to read, understand, and test program code as well as identify and correct typical errors.	Arbeitsaufwand: Präsenzzeit: 84 Stunden Selbststudium: 216 Stunden

Lehrveranstaltung: Informatik I (Vorlesung, Übung) <i>Inhalte:</i> Die Unterrichtssprache dieser Veranstaltung ist Deutsch . <i>Angebotshäufigkeit:</i> jedes Wintersemester	6 SWS
Lehrveranstaltung: Computer Science I (Vorlesung, Übung) <i>Inhalte:</i> The language of instruction for this course is English . <i>Angebotshäufigkeit:</i> jedes Sommersemester	6 SWS
Prüfung: Klausur (90 Minuten) Prüfungsvorleistungen: Deutsch: Die theoretischen und die praktischen Übungen aller Übungsblätter müssen jeweils mit mindestens 40% der erreichbaren Punkte bestanden werden, mit Ausnahme von maximal zwei theoretischen und zwei praktischen Übungen. / English: The theoretical and practical exercises of each problem set must each be passed with at least 40% of the achievable points, with the exception of at most two theoretical and two practical exercises. Prüfungsanforderungen: Deutsch: Studierende • kennen grundlegende Begriffe, Methoden und Denkweisen der Informatik und verstehen die Rolle von Algorithmen, Abstraktion und Modellbildung bei der Lösung von Problemen, • verstehen grundlegende Prinzipien der Informationsdarstellung und Datenverarbeitung, insbesondere Zahlendarstellungen, Zeichenkodierungen, boolesche Ausdrücke und deren Bedeutung für Programme, • verstehen grundlegende Funktionsprinzipien von Computern und deren Konsequenzen für die Programmierung und algorithmische Problemlösung, • beherrschen die Grundlagen der Programmiersprache Python und können einfache Programme, Funktionen und Algorithmen selbstständig entwickeln, • können einfache Problemstellungen analysieren, geeignete Datenrepräsentationen auswählen und bekannte algorithmische Verfahren auf neue Situationen übertragen, • kennen grundlegende Datenstrukturen und Algorithmen sowie typische Anwendungsgebiete und können diese in einfachen Programmen verwenden, • können einfache Programme und Algorithmen hinsichtlich Korrektheit, Laufzeit- und Speicherbedarf analysieren und bewerten, • können Programmcode lesen, verstehen, testen sowie typische Fehler erkennen und beheben. Die Klausur wird als E-Prüfung durchgeführt. English: The examination assesses the understanding of fundamental concepts, methods, and techniques of computer science as well as their practical application using the Python programming language. In particular, students are expected to be able to • explain fundamental concepts and principles of computer science in their own words,	10 C

- represent information appropriately and apply simple data types, data structures, and models in concrete situations,
- evaluate arithmetic and logical expressions and formulate conditions formally,
- trace and appropriately represent the execution of programs and algorithms,
- analyze program code even in non-obvious situations and predict its behavior,
- identify, classify, and correct errors in programs,
- select and apply data structures and algorithms in a problem-oriented manner,
- analyze programs and algorithms with respect to correctness, runtime, and memory consumption,
- describe, complete, and implement given algorithms,
- model problems algorithmically and design suitable functions and data representations,
- transfer known algorithms and techniques to new application scenarios.

The examination is conducted as an **electronic exam**.

Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: keine
Sprache: Deutsch, Englisch	Modulverantwortliche[r]: Dr. Henrik Brosenne
Angebotshäufigkeit: jedes Semester	Dauer: 1 Semester
Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester: ab bis
Maximale Studierendenzahl: 300	

Georg-August-Universität Göttingen Modul B.Inf.1131: Data Science: Grundlagen <i>English title: Data Science: Basics</i>	6 C 4 SWS
Lernziele/Kompetenzen: Das Modul vermittelt grundlegende Kompetenzen im Umgang mit Daten und ihrer Analyse. Es gliedert sich in vier Teilbereiche Konzepte. Nach erfolgreicher Teilnahme • kennen Studierende verschiedene Datentypen und können sie mit deskriptiven Statistiken beschreiben • kennen Studierende verschiedene Arten der Datenerhebung (experimentelles Design) und können deren Vorteile und Risiken benennen • kennen Studierende verschiedene Formen von Voreingenommenheit (Bias) in den Daten und die resultierenden Risiken, und können neue Kontexte hinsichtlich Bias bewerten • kennen Studierende Probleme der Fairness in Datenverarbeitung und Erhebung und können neue Kontexte hinsichtlich Fairness bewerten. Software Werkzeuge. Erfolgreiche Teilnahme befähigt Studierende zum • benutzen einer Shell zur grundlegenden Datenvorverarbeitung • analysieren von Daten mit grundlegenden Softwarebibliotheken für Datenverarbeitung in Python (Pandas, Numpy, Scipy, Matplotlib, ...) • testen von Software und statischen Algorithmen auf Korrektheit Statistische Werkzeuge. Erfolgreiche Teilnahme befähigt Studierende zum • unterscheiden zwischen statistischer Inferenz und deskriptiver Statistik • beherrschen der Grundlagen statistischer Inferenz (Fehler, p-Wert, Trennschärfe, Null-Hypothese, Konfidenzintervalle, ...) und vorhersagen welche Parameter diese beeinflussen • durchführen einfacher statistischer Tests mit Bootstrap- und Permutationstests • anwenden grundlegender Methoden des überwachten und unüberwachten Maschinellen Lernen (Klassifikation, Regression, Clustering). Stil. Erfolgreiche Teilnahme befähigt Studierende zum • anwenden guter Praktiken von Visualisierung von Daten • verfassen aussagekräftiger Projektberichte • strukturieren von reproduzierbaren Daten- und Softwareprojekten • strukturieren von Software für Wiederverwendbarkeit • anwenden von Prinzipien guter Codestrukturierung und -praktiken • anwenden grundlegende Formen des Projekt- und Team-Managements	Arbeitsaufwand: Präsenzzeit: 56 Stunden Selbststudium: 124 Stunden
Lehrveranstaltung: Data Science: Grundlagen (Vorlesung)	2 SWS
Prüfung: Take-Home-Klausur (Bearbeitungszeitraum: 1 Woche) oder Klausur (120 Minuten) Prüfungsvorleistungen:	6 C

60% der Punkte der Übungsblätter. Um Punkte zu erhalten, müssen die Aufgaben korrekt gelöst werden und erfolgreich gegenüber Tutor*innen verteidigt werden. Um die Punkte zu verteidigen, müssen alle Teilnehmer*innen einer Übungsgruppe in der Lage sein, einen beliebigen Teil der Lösung zu erklären und Nachfragen dazu beantworten können.

Prüfungsanforderungen:

Eigenständige Bearbeitung eines Data Science Problems, u.a.:

- Fähigkeit grundlegende statistische Begrifflichkeiten und Konzepte anzuwenden (Statistiken, einfache Tests mit Permutationen oder Bootstrapping, Konfidenzintervalle, ...) und zu interpretieren
- Kenntnis verschiedener Datentypen, und die Fähigkeit sie mit deskriptiven Statistiken zu beschreiben und geeignet visuell darstellen
- Fertigkeit Daten mit geeigneten Softwarebibliotheken und Shell in Python zu verarbeiten
- Kenntnis verschiedener Arten der Datenerhebung und Fähigkeit zur Bewertung der Vorteile und Risiken
- Kenntnis verschiedener Formen von Voreingenommenheit (Bias) in den Daten und die resultierenden Risiken, und Fähigkeit zur Bewertung neuer Kontexte hinsichtlich Bias
- Fähigkeit zur Evaluation von Fairness in Datenverarbeitung und Erhebung in neuen Kontexten
- Kenntnis von Prinzipien guter Codestrukturierung und Fähigkeit diese auf Code anwenden
- Fähigkeit statistische Algorithmen zu testen und debuggen
- Fähigkeit grundlegende Methoden des überwachten und unüberwachten Maschinellen Lernen auf neue Probleme anzuwenden
- Kenntnis guter Praktiken von Berichtverfassung und Fähigkeit sie auf neue Projekte anwenden
- Fähigkeit Daten und Softwareprojekte reproduzierbar zu strukturieren

Lehrveranstaltung: Data Science: Grundlagen Übung (Übung)

2 SWS

Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: Grundkenntnisse in Python
Sprache: Deutsch, Englisch	Modulverantwortliche[r]: Prof. Dr. Fabian Sinz
Angebotshäufigkeit: jedes Sommersemester	Dauer: 1 Semester
Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester: 2
Maximale Studierendenzahl: 100	

Georg-August-Universität Göttingen Modul B.Inf.1209: Softwaretechnik <i>English title: Software Engineering</i>		5 C 3 SWS
Lernziele/Kompetenzen: Die Studierenden • kennen Geschichte, Definition, Aufgaben und Wissensgebiete der Softwaretechnik. • wissen was ein Softwareprojekt ist, welche Personen und Rollen in Softwareprojekten ausgefüllt werden müssen und wie Softwareprojekte in Unternehmensstrukturen eingebettet werden können. • kennen unterschiedliche Vorgehens- und Prozessmodelle der Softwaretechnik, • kennen deren Vor- und Nachteile und wissen wie die Qualität von Softwareentwicklungsprozessen bewertet werden können. • kennen verschiedene Methoden der Kosten- und Aufwandsschätzung für Softwareprojekte. • kennen die Prinzipien und verschiedene Verfahren für die Anforderungsanalyse für Softwareprojekte. • kennen die Prinzipien und mindestens eine Vorgehensweise für den Software Entwurf. • kennen die Prinzipien der Software Implementierung. • kennen die grundlegenden Methoden für die Software Qualitätssicherung.		Arbeitsaufwand: Präsenzzeit: 42 Stunden Selbststudium: 108 Stunden
Lehrveranstaltung: Softwaretechnik (Vorlesung,Übung) <i>Inhalte:</i> Software-Qualitätsmerkmale, Projekte, Vorgehensmodelle, Requirements-Engineering, Machbarkeitsstudie, Analyse, Entwurf, Implementierung, Qualitätssicherung		3 SWS
Prüfung: Klausur (90 Minuten) oder mündliche Prüfung (ca. 20 Min.) Prüfungsvorleistungen: B.Inf.1209.Ue: Erarbeiten und Vorstellen der Lösung mindestens einer Übungsaufgabe (Präsentation und schriftliche Ausarbeitung), sowie die aktive Teilnahme an den Übungen. Prüfungsanforderungen: Definition und Aufgaben der Softwaretechnik, Definition Softwareprojekt, Personen und Rollen in Softwareprojekten, Einbettung von Softwareprojekten in Unternehmensstrukturen, Vorgehens- und Prozessmodelle und deren Bewertung, Aufwands- und Kostenabschätzung, Anforderungsanalyse, Design, Implementierung und Qualitätssicherung		5 C
Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: B.Inf.1101, B.Inf.1801, B.Inf.1802	
Sprache: Deutsch	Modulverantwortliche[r]: Prof. Dr. Jens Grabowski	
Angebotshäufigkeit: jährlich	Dauer: 1 Semester	

Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester:
Maximale Studierendenzahl: 100	

Georg-August-Universität Göttingen Module B.Inf.1231: Infrastructures of Data Science	6 C 4 WLH
Learning outcome, core skills: Upon completion the course, students • understand the basic functions of data science infrastructures and their significance. • understand basic data types and their specifics. • understand the most important technical infrastructures for storing and processing data locally and in the cloud as well as their advantages and disadvantages in relation to data science applications. • can apply the concept of the data lake to basic data science problems. • are able to apply the different steps of data pre-processing to selected data sets. • can identify the characteristics of time series and graph data and are able to recall the functions of DBMSs designed for their processing. • can present the basic tasks of data analysis platforms and can describe them using examples. • can apply methods and tools for the presentation and visualisation of data. • can model basic data science workflows and are able to transfer their knowledge to basic data science projects.	Workload: Attendance time: 56 h Self-study time: 124 h
Course: Infrastructures of Data Science (Lecture,Exercise) <i>Contents:</i> • Data types and their characteristics • Common functions of data science infrastructures • Storage, compute, and cloud infrastructures for data science • Concept of a data lake • Data pre-processing methods and selected tools • Time series and graph data, the respective DBMS, and query languages • Data analytics platforms • Data presentation and visualization • Data science workflows and selected infrastructure components	4 WLH
Examination: In-class, written exam (90 min) or oral exam (approx. 30 min.) Examination prerequisites: Students complete 50% of the homework exercises. Examination requirements: Through the examination students demonstrate that they are able to describe basic functions of (cloud-based) data science infrastructures as well as to specify and identify basic data types. Students can also prove their understanding of data lakes and can apply their knowledge of MapReduce and Hadoop in that particular context. They can analyse basic data pre-processing problems and sketch common solutions. Student can show that they understand time series and graph data as well as the corresponding DBMS and that they can present common tasks of data analysis platforms. Through the examination, students also demonstrate their ability to select appropriate methods for visualising data and show that they are able to create basic data science workflows.	6 C

Admission requirements: none	Recommended previous knowledge: Python and basic database knowledge (recommended, not mandatory)
Language: English	Person responsible for module: Hon.-Prof. Dr. Philipp Wieder
Course frequency: each summer semester	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester: Bachelor: 3 - 6; Master: 1 - 2
Maximum number of students: 50	

Georg-August-Universität Göttingen Module B.Inf.1236: Machine Learning		6 C 4 WLH
Learning outcome, core skills: Students • learn concepts and techniques of machine learning and understand their advantages and disadvantages compared with alternative approaches • learn techniques of supervised learning for classification and regression • learn techniques of unsupervised learning for density estimation, dimensionality reduction and clustering • implement machine learning algorithms like linear regression, logistic regression, kernel methods, tree-based methods, neural networks, principal component analysis, k-means and Gaussian mixture models • solve practical data science problems using machine learning methods		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Machine Learning (Lecture) Bishop: Pattern recognition and machine learning. https://cs.ugoe.de/prml		2 WLH
Examination: Written examination (90 minutes) Examination prerequisites: B.Inf.1236.Ex: At least 50% of homework exercises solved and N-1 attempts presented to tutors Examination requirements: Knowledge of the working principles, advantages and disadvantages of the machine learning methods covered in the lecture		6 C
Course: Machine Learning - Exercise (Exercise) <i>Contents:</i> Students present their solutions of the homework exercises to tutors and discuss them with their tutors.		2 WLH
Admission requirements: none	Recommended previous knowledge: Knowledge of basic linear algebra and probability English language proficiency at level B2 (CEFR)	
Language: English	Person responsible for module: Prof. Dr. Alexander Ecker	
Course frequency: each summer semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester: 4	
Maximum number of students: 100		

Georg-August-Universität Göttingen Module B.Inf.1237: Deep Learning for Computer Vision		6 C 4 WLH
Learning outcome, core skills: Students • learn concepts and techniques of deep learning and understand their advantages and disadvantages compared to alternative approaches • learn to solve practical data science problems using deep learning • implement deep learning techniques like multi-layer perceptrons, convolutional neural networks and other modern deep learning architectures • learn techniques for optimization and regularization of deep neural networks • learn applications of deep neural networks for computer vision tasks such as segmentation and object detection		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Deep Learning for Computer Vision (Lecture) Goodfellow, Bengio, Courville: Deep Learning. https://www.deeplearningbook.org Bishop: Pattern Recognition and Machine Learning. https://cs.ugoe.de/prml		2 WLH
Examination: Written examination (90 minutes) Examination prerequisites: B.Inf.1237.Ex: At least 50% of homework exercises solved and N-1 attempts presented to tutors Examination requirements: Knowledge of basic deep learning techniques, their advantages and disadvantages and approaches to optimization and regularization. Ability to implement these techniques.		6 C
Course: Deep Learning for Computer Vision - Exercise (Exercise) <i>Contents:</i> Students present their solutions of the homework exercises to tutors and discuss them with their tutors.		2 WLH
Admission requirements: none	Recommended previous knowledge: Basic knowledge of linear algebra and probability Completion of B.Inf.1236 Machine Learning or equivalent	
Language: English	Person responsible for module: Prof. Dr. Constantin Pape Prof. Dr. Alexander Ecker	
Course frequency: each winter semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester: 5	
Maximum number of students: 100		

Georg-August-Universität Göttingen Module B.Inf.1240: Visualization		6 C 4 WLH
Learning outcome, core skills: Knowledge of • the potentials and limitations of data visualization • the fundamentals of visual perception and cognition and their implications for data visualization. Students can apply these to the design of visualizations and detect manipulative design choices • a broad variety of techniques for visual representation of data, including abstract and high-dimensional data. Students can select appropriate methods on new problems • integration of visualization into the data analysis process, algorithmic generation and interactive methods		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Visualization (Lecture, Exercise) <i>Course frequency:</i> once a year		4 WLH
Examination: Practical project (2-3 weeks) with presentation and questions during oral exam in groups (approx. 20 minutes per examinee). Examination prerequisites: At least 50% of homework exercises solved. Examination requirements: Knowledge of potentials and limitations of data visualization, fundamentals of visual perception and their implications for good design choices, techniques for visual representation and how to use them.		6 C
Admission requirements: none	Recommended previous knowledge: Foundations of linear algebra and analysis (e.g. B.Mat.0841 and B.Mat.0842) and programming skills (e.g. B.Inf.1842).	
Language: English	Person responsible for module: Prof. Dr. Bernhard Schmitzer	
Course frequency: each summer semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester: 3 - 6	
Maximum number of students: 50		

Georg-August-Universität Göttingen Module B.Inf.1249: Introduction to Robotics		6 C 4 WLH
Learning outcome, core skills: After successful completion of this course, students: • Explain the basics of serial kinematic chains, their mathematical representations, and perform computations of forward and backward kinematics. • Apply these mathematical models to transfer them to parallel kinematics. • Describe the basic principles of motion planning along trajectories, including obstacle avoidance and dynamics. • Discuss the challenges of operating robots in the real world and apply solutions in application scenarios, including calibration, localization, and robot control.		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Introduction to Robotics (Lecture) <i>Contents:</i> Robot types, serial kinematic chains, mathematical models of kinematic chains, forward kinematics, backward kinematics, kinematics of parallel robotics, mobile robotics, trajectory planning, control strategies, calibration <i>Literature:</i> M. Spong et al.: Robot Modeling and Control - Wiley & Sons, 2005 S. Niku: Introduction to Robotics: Analysis, Control, Applications - Wiley & Sons, 2010		2 WLH
Examination: Written Exam (90 Min.) or Oral Exam (ca. 20 Min.) Examination prerequisites: At least 50% of homework exercises solved and N-1 attempts presented to tutors. Examination requirements: The students must be able to: • repeat and explain lecture material • perform kinematic calculations • apply and adopt algorithms discussed in the lecture to specific application scenarios		6 C
Course: Introduction to Robotics - Exercise (Exercise) <i>Contents:</i> Students present their solutions of the homework exercises to tutors and discuss them with their tutors.		2 WLH
Admission requirements: none	Recommended previous knowledge: Basic knowledge of linear algebra and analysis	
Language: English	Person responsible for module: Prof. Dr. Jannis Hagenah	
Course frequency: each winter semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester: Bachelor: 5 - 6; Master: 1 - 3	

Maximum number of students:	
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100	
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Georg-August-Universität Göttingen Module B.Inf.1252: Biomedical Engineering		6 C 4 WLH
Learning outcome, core skills: After successful completion of this course, students: - List the key medical data sources (medical imaging, biosignal, etc), explain their acquisition, and summarize their role in diagnostics, treatment and monitoring. - Make use of 3D printing basics, including its role in patient care. - Identify the principles of navigation systems and their application in minimally invasive procedures. - Describe the basics of medical robotics, including robot-assisted surgery. - Interpret the role of artificial intelligence and data science in healthcare decision making. - Explain the regulatory and clinical considerations for medical devices and apply them on given examples. - Discuss ethical considerations and challenges in biomedical engineering.		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Biomedical Engineering (Lecture) <i>Contents:</i> Medical imaging modalities, biosignal acquisition and analysis, navigation systems, augmented reality, medical robotics, 3D printing, surgical data science, artificial intelligence in medicine, regulatory affairs, ethics in biomedical engineering. <i>Literature:</i> Enderle J, Bronzino J, editors. Introduction to biomedical engineering. Academic press; 2012. Saltzman WM. Biomedical engineering: bridging medicine and technology. Cambridge University Press; 2009 Jun 29.		2 WLH
Examination: Written Exam (90 Min.) or Oral Exam (ca. 20 Min.) Examination prerequisites: At least 50% of homework exercises solved and N-1 attempts presented to tutors. Examination requirements: The students must be able to: - recall and explain lecture material. - identify different biomedical engineering fields and understand their practical applications in healthcare. - develop a foundational understanding of how engineering and technology contribute to medical advancements.		6 C
Course: Biomedical Engineering - Exercise (Exercise) <i>Contents:</i> Students present their solutions of the homework exercises to tutors and discuss them with their tutors.		2 WLH
Admission requirements: none	Recommended previous knowledge: none	

Language: English	Person responsible for module: Prof. Dr. Jannis Hagenah
Course frequency: each summer semester	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester: Bachelor: 4 - 6; Master: 1 - 3
Maximum number of students: 100	

Georg-August-Universität Göttingen Module B.Inf.1504: Machine Learning in Bioinformatics		6 C 4 WLH
Learning outcome, core skills: After successful completion of the module, students will be able to • understand fundamental concepts of machine learning and apply them to molecular biology data • compare and configure different methods for the analysis of multidimensional data and evaluate them on given data sets • understand and implement approaches for the transformation of biological data and feature extraction • implement, modify and test supervised and unsupervised learning algorithms using vector/matrix computations • understand statistical and learning theory aspects as well as their formal representation and derivation • review requirements for machine learning application, recognize potential problems in implementation and discuss the limits of the approach		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Machine Learning in Bioinformatics (Lecture)		2 WLH
Examination: Written examination (90 minutes) Examination prerequisites: Participation in the exercises and successful completion of three exercise sheets. Examination requirements: Students can explain, classify, implement and evaluate machine learning approaches, apply them to biological data and critically assess the quality of methods and results.		6 C
Course: Machine Learning in Bioinformatics - Exercise (Exercise)		2 WLH
Admission requirements: none	Recommended previous knowledge: Basic biological and mathematical knowledge, programming in Python	
Language: English	Person responsible for module: Peter Meinicke	
Course frequency: each summer semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester: Bachelor: 2 - 6; Master: 1 - 3	
Maximum number of students: 30		

Georg-August-Universität Göttingen Modul B.Inf.1801: Programmierkurs <i>English title: Programming</i>		5 C 3 SWS
Lernziele/Kompetenzen: Die Studierenden erlernen eine aktuelle Programmiersprache, sie • beherrschen den Einsatz von Editor, Compiler und weiteren Programmierwerkzeugen (z.B. Build-Management-Tools). • kennen grundlegende Techniken des Programmmentwurfs und können diese anwenden. • kennen Standarddatentypen (z.B. für ganze Zahlen und Zeichen) und spezielle Datentypen (z.B. Felder und Strukturen). • kennen die Operatoren der Sprache und können damit gültige Ausdrücke bilden und verwenden. • kennen die Anweisungen zur Steuerung des Programmablaufs (z.B. Verzweigungen und Schleifen) und können diese anwenden. • kennen die Möglichkeiten zur Strukturierung von Programmen (z.B. Funktionen und Module) und können diese einsetzen. • kennen die Techniken zur Speicherverwaltung und können diese verwenden. • kennen die Möglichkeiten und Grenzen der Rechnerarithmetik (z.B. Ganzzahl- und Gleitkommarithmetik) und können diese beim Programmmentwurf berücksichtigen. • kennen die Programmbibliotheken und können diese einsetzen.		Arbeitsaufwand: Präsenzzeit: 42 Stunden Selbststudium: 108 Stunden
Lehrveranstaltung: Grundlagen der C-Programmierung (Blockveranstaltung)		3 SWS
Prüfung: Klausur (90 Minuten), unbenotet Prüfungsanforderungen: Standarddatentypen, Konstanten, Variablen, Operatoren, Ausdrücke, Anweisungen, Kontrollstrukturen zur Steuerung des Programmablaufs, Strings, Felder, Strukturen, Zeiger, Funktionen, Speicherverwaltung, Rechnerarithmetik, Ein-/Ausgabe, Module, Standardbibliothek, Präprozessor, Compiler, Linker Die Klausur wird als E-Prüfung durchgeführt.		5 C
Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: keine	
Sprache: Deutsch	Modulverantwortliche[r]: Dr. Henrik Brosenne	
Angebotshäufigkeit: jedes Wintersemester	Dauer: 1 Semester	
Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester:	
Maximale Studierendenzahl: 200		

Georg-August-Universität Göttingen Modul B.Inf.1802: Programmierpraktikum <i>English title: Training in Programming</i>		6 C 4 SWS
Lernziele/Kompetenzen: Die Studierenden erlernen eine objektorientierte Programmiersprache, sie • kennen die gängigen Programmierwerkzeuge (Compiler, Build-Management-Tools) und können diese benutzen. • kennen die Grundsätze und Techniken des objektorientierten Programmmentwurfs (z.B. Klassen, Objekte, Kapselung, Vererbung, Polymorphismus) und können diese anwenden. • kennen ausgewählte Bibliotheken und Application Programming Interfaces (APIs) (z.B. Standardbibliothek, Grafikbibliotheken) und können diese anwenden. • können Dokumentationskommentare benutzen und kennen die Werkzeuge zur Generierung von API-Dokumentation. • kennen Techniken und Werkzeuge zur Versionskontrolle und können diese anwenden. • können Programme erstellen, die konkrete Anforderungen erfüllen, und deren Korrektheit durch geeignete Testläufe überprüfen. • kennen die Prinzipien und Methoden der projektbasierten Teamarbeit und können diese umsetzen.		Arbeitsaufwand: Präsenzzeit: 56 Stunden Selbststudium: 124 Stunden
Lehrveranstaltung: Programmierpraktikum (Praktikum,Vorlesung)		
Prüfung: Mündlich (ca. 20 Minuten) Prüfungsvorleistungen: Alle Übungsblätter müssen jeweils mit mindestens 40% der erreichbaren Punkte bestanden werden. Bei fünf oder weniger Übungsblättern mit Ausnahme von maximal einem Übungsblatt, sonst mit Ausnahme von maximal zwei Übungsblättern. Prüfungsanforderungen: Die Studierenden bearbeiten in Kleingruppen ein Softwareprojekt und wenden dabei die in der Veranstaltung vermittelten Konzepte und Techniken moderner objektorientierter Programmierung praktisch an. Dazu gehören insbesondere der Einsatz moderner Sprachmittel und Bibliotheken, die gemeinsame Planung, arbeitsteilige Implementierung, Integration von Komponenten, Versionskontrolle sowie die Präsentation der Ergebnisse. Die Prüfung umfasst die Projektarbeit (4-6 Wochen) und einen mündliche online Prüfung (ca. 20 Minuten je zu prüfender Person) als Gruppenprüfung .		6 C
Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: B.Inf.1801	
Sprache: Deutsch	Modulverantwortliche[r]: Dr. Henrik Brosenne	
Angebotshäufigkeit: jedes Sommersemester	Dauer: 1 Semester	

Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester:
Maximale Studierendenzahl: 80	

Georg-August-Universität Göttingen Modul B.Inf.1842: Programmieren für Data Scientists: Python <i>English title: Programming for Data Scientists: Python</i>		5 C 3 SWS
Lernziele/Kompetenzen: Die Studierenden erlernen Python. Sie • beherrschen den Zugriff auf Daten aus verschiedenen Quellen, unter anderem aus lokalen Dateien und aus Datenbanken. • sind in der Lage, Algorithmen zur Auswertung von Daten zu implementieren. • kennen Programmbibliotheken, z.B. zum Maschinellen Lernen, und können diese anwenden. • kennen Programmbibliotheken zur Visualisierung und können Ergebnisgrafiken erstellen.		Arbeitsaufwand: Präsenzzeit: 42 Stunden Selbststudium: 108 Stunden
Lehrveranstaltung: Programmierpraktikum für Data Scientists (Praktikum, Vorlesung)		3 SWS
Prüfung: Projektarbeit und mündliche Prüfung, unbenotet Prüfungsvorleistungen: Lösung von 65% der Programmieraufgaben Prüfungsanforderungen: Kenntnis der Syntax und Semantik der Programmiersprache, Kenntnis von Bibliotheken und Befehlen zur Lösung von Data Science Problemen, statistischen Tests und zur Visualisierung, grundlegende Kenntnisse von Pytorch und Tensorflow. Die Prüfung umfasst eine Gruppenprojektarbeit (3–5 Personen, 10 Wochen, ca. 90 Arbeitsstunden pro Person) und eine mündliche Präsentation der Projektergebnisse (ca. 15 Minuten pro Gruppe) als Gruppenprüfung .		5 C
Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: keine	
Sprache: Deutsch, Englisch	Modulverantwortliche[r]: Hon.-Prof. Dr. Philipp Wieder Prof. Dr. Bela Gipp	
Angebotshäufigkeit: jedes Semester	Dauer: 1 Semester	
Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester: 1	
Maximale Studierendenzahl: 50		

Georg-August-Universität Göttingen Modul B.Phys.5601: Theoretical and Computational Neuroscience I <i>English title: Theoretical and Computational Neuroscience I</i>		3 C 2 SWS
Lernziele/Kompetenzen: Nach erfolgreichem Absolvieren des Moduls sollten die Studierenden... • ein vertieftes Verständnis folgender Themen entwickelt haben: TCN I: biophysikalische Grundlagen neuronaler Anregbarkeit, mathematische Grundlagen neuronaler Anregbarkeit, Input-Output Beziehungen und Bifurkationen, Klassifizierung, Existenz, Stabilität und Koexistenz synchroner und asynchroner Zustände in spikenden neuronalen Netzwerken; • Methoden und Methodenentwicklung für die Analyse hochdimensionaler Modelle ratenkodierter Einheiten in Feldmodellen verstehen; • die Handhabung von Bifurkationsszenarien und zugehörigen Instabilitäten verstanden haben.		Arbeitsaufwand: Präsenzzeit: 28 Stunden Selbststudium: 62 Stunden
Lehrveranstaltung: Collective Dynamics Biological Neural Networks I (Vorlesung)		
Von den folgenden Prüfungen ist genau eine erfolgreich zu absolvieren:		
Prüfung: Klausur (120 Minuten)		3 C
Prüfung: Mündlich Mündliche Prüfung (ca. 30 Minuten)		3 C
Prüfung: Vortrag (2 Wochen Vorbereitungszeit) (30 Minuten)		3 C
Prüfungsanforderungen: Grundlagen der Membranbiophysik; Bifurkationen anregbarer Systeme; Verständnis der Grundlagen der Modellierungsansätze der Neurophysik; kollektive Zustände spikender neuronaler Netzwerke; insbesondere Synchronizität; Balanced State; Phase-Locking und diesen Zuständen unterliegenden lokalen und Netzwerkeigenschaften: Netzwerktopologie; Delays; inhibitorische und exzitatorische Kopplung; sparse random networks		
Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: keine	
Sprache: Englisch	Modulverantwortliche[r]: Prof. Dr. Fred Wolf	
Angebotshäufigkeit: jedes Wintersemester	Dauer: 1 Semester	
Wiederholbarkeit: dreimalig	Empfohlenes Fachsemester: Bachelor: 4 - 6; Master: 1	
Maximale Studierendenzahl: 90		

Georg-August-Universität Göttingen Modul B.Phy.5602: Theoretical and Computational Neuroscience II <i>English title: Theoretical and Computational Neuroscience II</i>		3 C 2 SWS
Lernziele/Kompetenzen: Nach erfolgreichem Absolvieren des Moduls sollten Studierende... - das vertiefte Verständnis folgender Themen entwickelt haben: TCN II: Grundlagen neuronaler Anregbarkeit, Input-Output Beziehungen bei Einzelneuronen, eindimensionale Feldmodelle (Feature Selectivity, Contrastinvariance), zweidimensionale Feldmodell (Zusammenwirken von kurz- und langreichweitigen Verbindungen sowie lokaler Nichtlinearitäten), Amplitudengleichungen und ihre Lösungen; - Methoden und Methodenentwicklung für die Analyse spikender neuronaler Netzwerke mit und ohne Delays, Handhabung von Bifurkationsszenarien und zugehörigen Instabilitäten verstehen.		Arbeitsaufwand: Präsenzzeit: 28 Stunden Selbststudium: 62 Stunden
Lehrveranstaltung: Collective Dynamics Biological Neural Networks II (Vorlesung)		
Von den folgenden Prüfungen ist genau eine erfolgreich zu absolvieren:		
Prüfung: Klausur (120 Minuten)		3 C
Prüfung: Mündlich (ca. 30 Minuten)		3 C
Prüfung: Seminarvortrag (2 Wochen Vorbereitungszeit) (30 Minuten)		3 C
Prüfungsanforderungen: Ratenmodelle von Einzelneuronen; Feldansatz in der theoretischen Neurophysik; Grundlagen der Bifurkationen anregbarer System; Verständnis der Grundlagen der Modellierungsansätze der Neurophysik; Zusammenhang diskrete/kontinuierliche Modelle; kollektive Zustände ein- und zweidimensionaler Feldmodelle, insbesondere ring model of feature selectivity; orientation preference maps.		
Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: keine	
Sprache: Englisch	Modulverantwortliche[r]: Prof. Dr. Fred Wolf	
Angebotshäufigkeit: jedes Sommersemester	Dauer: 1 Semester	
Wiederholbarkeit: dreimalig	Empfohlenes Fachsemester: Bachelor: 4 - 6; Master: 1	
Maximale Studierendenzahl: 90		

Georg-August-Universität Göttingen Module B.Phy.5624: Introduction to Theoretical Neuroscience		4 C 2 WLH
Learning outcome, core skills: After successfully completing this course, students should understand and be able to employ the fundamental concepts, model representations and mathematical methods of the theoretical physics of neuronal systems. Students learn to work independently on complex scientific questions and to present them appropriately to specialists in their own and other subjects; they also acquire the ability to engage in critical scientific discussion.		Workload: Attendance time: 28 h Self-study time: 92 h
Course: Seminar		
Examination: Lecture (approx. 60 minutes) Examination prerequisites: Active Participation Examination requirements: Elementary knowledge of the construction, biophysics and function of nerve cells; probabilistic analysis of sensory encoding; simple models of the dynamics and information processing in networks of biological neurons; modelling of the biophysical foundations of learning processes.		4 C
Admission requirements: none	Recommended previous knowledge: none	
Language: English	Person responsible for module: Prof. Dr. Fred Wolf	
Course frequency: each summer semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: three times	Recommended semester: Bachelor: 4 - 6; Master: 1 - 4	
Maximum number of students: 25		

Georg-August-Universität Göttingen		3 C
Module B.Phy.5651: Advanced Computational Neuroscience		2 WLH
Learning outcome, core skills: Participants in the course can explain and relate biological foundations and mathematical modelling of selected (neuronal) algorithms for learning and pattern formation. Based on the the algorithms' properties, they can discuss and derive possible technical applications (robots).		Workload: Attendance time: 28 h Self-study time: 62 h
Course: Advanced Computational Neuroscience I (Lecture)		
Examination: Written examination (90 Min.) or oral examination (approx. 20 Min.) Examination requirements: Algorithms for learning: • Unsupervised Learning (Hebb, Differential Hebb), • Reinforcement Learning, • Supervised Learning Algorithms for pattern formation. Biological motivation and technical Application (robots).		3 C
Admission requirements: none	Recommended previous knowledge: Basics Computational Neuroscience	
Language: English	Person responsible for module: Prof. Dr. Florentin Andreas Wörgötter	
Course frequency: each winter semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: three times	Recommended semester: Bachelor: 5 - 6; Master: 1 - 4	
Maximum number of students: 50		
Additional notes and regulations: Hinweis: Die B.Phy.5652 kann als vorlesungsbegleitendes Praktikum besucht werden.		

Georg-August-Universität Göttingen Module M.Bio.001: Statistics for Biology using R	6 C 4 WLH
Learning outcome, core skills: Students understand the concept of a random variable and its relation to empirical research in the bio-sciences. They understand probability distributions, distribution parameters like mean and variance and the difference between true values of these parameters and their estimates from samples. They understand the logic behind null-hypothesis tests. They understand the difference between parametric and non-parametric tests. They are able to select a suitable test for two-sample problems concerning the mean and the median, and to solve linear and multilinear regression problems. They are able to perform these analyses in R. Contents: 1. why statistics is necessary in bio-sciences 2. random variables, random variates (realizations), sampling 3. probability distributions and probability density functions, cumulative probability functions 4. descriptive statistics: measures of central tendencies, i.e. mean, mode(s), median; measures of variance; true values the difference between distribution parameters and their sample-based estimates 5. confidence intervals based on the bootstrap 6. statistical hypotheses, the corresponding null-hypotheses, the logic of null-hypothesis significance tests (NHSTs). 7. permutation testing for comparing means – unpaired tests 8. permutation testing for comparing means – paired tests. 9. correlation and univariate (linear) regression, resampling tests for univariate regression 10. the logic of parametric null hypothesis testing 11. parametric tests for multivariate regression 12. parametric tests for analysis of variance (ANOVA) parametric tests	Workload: Attendance time: 56 h Self-study time: 124 h
Course: Statistics for Biology using R (Lecture)	2 WLH
Examination: Written E-examination in ILIAS (90 minutes) Examination prerequisites: Regular participation in the tutorial sessions	6 C
Course: Statistics for Biology using R (Tutorial)	2 WLH
Examination requirements: • Formulating nullhypotheses and alternative hypotheses and understanding their meaning • Loading and selecting data for analysis in R • running multiple regression in R • being able to interpret the outout of lm() in R • Interpreting p-values, regression coefficients, R and F-values correctly	

• Transferring the outcomes of an analysis in R into a written text describing the statistical findings	
Admission requirements: For master students only. The modules M.Bio.001 and B.Bio.107 are mutually exclusive.	Recommended previous knowledge: none
Language: English	Person responsible for module: Prof. Dr. Michael Wibrat
Course frequency: each winter semester	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester: from 1
Maximum number of students: 65	

Georg-August-Universität Göttingen Module M.Bio.101: General and Applied Microbiology	12 C 14 WLH
Learning outcome, core skills: Students are able to analyse evolutionary and phylogenetic relationships of bacteria and archaea, explain cellular and molecular processes, and independently apply biomolecular, genetic, and biochemical techniques. They analyse microbial communities, metabolic diversity, and pathogenicity mechanisms and explain their relevance for biotechnology and medicine. They critically evaluate scientific publications, integrate current research findings, and present their insights in a structured, scientifically sound manner. The students actively contribute to scholarly discussions, analyse complex topics from multiple perspectives and apply effective communication strategies to support collaborative work.	Workload: Attendance time: 196 h Self-study time: 164 h
Course: General and Applied Microbiology (Lecture) <i>Contents:</i> • Evolution and phylogenetic system • Morphology and cell biology • Communities and biocoenosis of bacteria and archaea • Gene expression and molecular control (transcription, translation) • Posttranslational control, protein stability and proteomics • Genetic networks • Molecular switches and signal transduction • Microbial developmental biology • Mechanisms of pathogenicity of important pathogens • Development of new antimicrobial agents • Diversity of the metabolism in bacteria and archaea as basis for biotechnological applications • Industrial microbiology	3 WLH
Examination: Written examination (90 minutes) Examination prerequisites: Regular participation in seminar and methods course; certified methods course report (max. 10 pages) and successful seminar presentation (approx. 15 minutes). The seminar presentation can earn up to 10% of the total points for the exam in advance.	12 C
Course: Seminar on General and Applied Microbiology (Seminar)	1 WLH
Course: Isolation and Characterisation of Biotechnologically Relevant Microorganisms (methods course) (Practical course) or	10 WLH
Course: Signal Transduction in Bacteria (methods course) (Practical course)	10 WLH
Examination requirements: Students demonstrate their competences through a written exam, a structured laboratory report, and a scientific seminar presentation.	

The exam assesses theoretical understanding of molecular, genetic, and cellular principles; the lab report evaluates practical application and documentation of methods; and the presentation assesses critical literature analysis and scientific communication skills. All components are assessed jointly and reflect the student's subject-specific, methodological, and communicative competence.	
Admission requirements: cannot be combined with M.Bio.141	Recommended previous knowledge: none
Language: English	Person responsible for module: Prof. Dr. Jörg Stülke
Course frequency: each winter semester	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 48	

Georg-August-Universität Göttingen Module M.Bio.102: Molecular Genetics and Microbial Cell Biology		12 C 14 WLH
Learning outcome, core skills: Students can independently apply molecular biological, genetic and cell biological methods to model organisms in molecular mycology (yeasts and filamentous fungi) and interpret the results in a scientific context. They plan, carry out and document research-related experiments in small groups, apply specific methods such as transformation, DNA isolation, PCR, fluorescence microscopy, cloning and protein purification, and reflect on methodological decisions and the biological relevance of the results. They analyse current research questions in molecular genetics and cell biology, synthesise scientific literature and present their findings in a structured, scientifically sound review paper. They analyse complex topics from multiple perspectives, communicate effectively in collaborative settings, and develop well-reasoned, constructive solutions together.		Workload: Attendance time: 196 h Self-study time: 164 h
Course: Molecular Genetics and Microbial Cell Biology (Lecture)		3 WLH
Course: Seminar on Molecular Genetics and Microbial Cell Biology (Seminar)		1 WLH
Course: Methods Course Molecular Genetics and Microbial Cell Biology (Practical course)		10 WLH
Examination: Written examination (90 minutes) Examination prerequisites: Regular participation in seminar and methods course; certified methods course report (max. 10 pages) and successful seminar presentation (approx. 15 minutes). The seminar presentation can earn up to 10% of the total points for the exam in advance.		12 C
Examination requirements: The assessment consists of a written exam covering the lecture content, a scientific seminar presentation on an independently researched topic, and a structured practical laboratory report documenting experimental procedures, results, and their interpretation. The exam evaluates theoretical understanding, the presentation assesses scientific communication and literature analysis, and the lab report assesses practical application, documentation, and methodological reflection. All components are considered collectively in the final assessment.		
Admission requirements: cannot be combined with M.Bio.142, M.Bio.162 or M.Bio.172	Recommended previous knowledge: • Watson, Molecular Biology of the Gene, Pearson, 7th Edition; • Alberts, Molecular Biology of the Cell, Wiley, 7th Edition	
Language: English	Person responsible for module: Prof. Dr. Stefanie Pöggeler	

Course frequency: each winter semester	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 24	

Georg-August-Universität Göttingen Module M.Bio.105: Applied Bioinformatics in Molecular Biosciences		12 C 14 WLH
Learning outcome, core skills: Students are able to apply bioinformatics methods and tools for the analysis of omics data (e.g., genomics, transcriptomics, proteomics, metabolomics) and justify their use in molecular phylogeny, evolution, genome dynamics, and systems biological research. They conduct sequence analyses of RNA and proteins, identify functional motifs and genes, construct and validate metabolic models and networks, and integrate and visualise large-scale datasets. Furthermore, they present their methodological approaches and results in a clear, structured scientific presentation, critically engage with academic publications, and actively contribute to scholarly discussions. They analyse complex topics from multiple perspectives, apply effective communication strategies to support collaborative work, present well-reasoned arguments, and work jointly to develop informed and constructive solutions.		Workload: Attendance time: 196 h Self-study time: 164 h
Course: Applied Bioinformatics in Molecular Biosciences (Lecture)		3 WLH
Course: Seminar on Applied Bioinformatics in Molecular Biosciences (Seminar)		1 WLH
Course: Methods Course Applied Bioinformatics in Molecular Biosciences (Internship)		10 WLH
Examination: Presentation (approx. 30 minutes) on methods and results of the practical course [80% of the overall grade] and seminar presentation (approx. 15 minutes) [20% of the overall grade] Examination prerequisites: regular attendance, certified protocol or manuscript Examination requirements: Students demonstrate their understanding and ability to apply bioinformatics methods in the key areas of (meta)omics analyses, motif recognition, and metabolic network modelling through the independent execution and interpretation of data analyses. They present their results in a scientifically rigorous and reflective manner, clearly communicating key aspects of methodology, data interpretation, and biological relevance. Furthermore, they are able to critically evaluate scientific publications and effectively present their content in a structured seminar talk.		12 C
Admission requirements: knowledge of Linux, B.Bio-NF117 or equivalent	Recommended previous knowledge: knowledge of Python and R	
Language: English	Person responsible for module: Prof. Dr. Rolf Daniel	
Course frequency: 1	Duration: 1 semester[s]	
Number of repeat examinations permitted:	Recommended semester:	

twice	
Maximum number of students: 10	

Georg-August-Universität Göttingen Module M.Bio.106: Structural Biochemistry		12 C 14 WLH
Learning outcome, core skills: Students are able to analyse the structure and function of biological macromolecules, particularly proteins, and explain the relationships between structure, folding, and function. They describe structure-function relationships in protein-protein and protein-nucleic acid interactions, apply principles of molecular recognition, and explain approaches to structure-based drug design. Furthermore, they are able to apply modern methods of structural biochemistry, use state-of-the-art equipment appropriately, critically analyse experimental data, and present findings in a scientific format. Students independently acquire specialised knowledge from current scientific publications, actively contribute to scholarly discussions, and reflect on recent developments in biochemistry. They analyse complex topics from multiple perspectives, apply effective communication strategies to support collaborative work, present well-reasoned arguments, and work jointly to develop informed and constructive solutions.		Workload: Attendance time: 196 h Self-study time: 164 h
Course: Structural Biochemistry (Lecture)		3 WLH
Course: Seminar on Structural Biochemistry (Seminar)		1 WLH
Course: Methods Course Structural Biochemistry (Practical course) <i>Contents:</i> Preparation of recombinant proteins using affinity, ion exchange and gel filtration chromatography as well as ultracentrifugation, characterisation of recombinant proteins and macromolecular complexes (gel electrophoresis, spectroscopic methods), biochemical analysis of protein-RNA complexes, crystallisation of proteins. Structural elucidation of biological macromolecules using X-ray crystallography and cryo-electron microscopy. Studies on the dynamics and function of macromolecular machines.		10 WLH
Examination: Written examination on content of lecture (90 min) [80% of overall grade]; seminar presentation (ca. 15 min) and protocol (max. 20 pages) [20% of overall grade] Examination prerequisites: regular participation in seminar and methods course; certified protocol		12 C
Examination requirements:		
Admission requirements: cannot be combined with M.Bio.156, M.Bio.166 or M.Bio.176	Recommended previous knowledge: none	
Language: English	Person responsible for module: Prof. Dr. Ralf Ficner	
Course frequency: each summer semester	Duration: 1 semester[s]	

Number of repeat examinations permitted: twice	Recommended semester: 1
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.Bio.107: Biochemistry and Biophysics		12 C 14 WLH
Learning outcome, core skills: Students are able to describe the structure, function, and biophysics of selected biomolecule classes and explain the role of lipids as signalling molecules, as well as the significance of secondary metabolites in plant metabolism. They analyse primary and secondary metabolism, identify functions and regulation of enzymes in lipid metabolism, and evaluate biotechnological approaches for modifying storage compounds. Furthermore, they apply modern biophysical methods for the analysis of biomolecules, use state-of-the-art equipment appropriately, and document experimental results critically and precisely. Students independently acquire specialised knowledge from scientific publications, critically analyse complex experiments, and present their findings in a scientifically sound manner.		Workload: Attendance time: 196 h Self-study time: 164 h
Course: Biochemistry and Biophysics (Lecture)		3 WLH
Course: Tutorial on Biochemistry and Biophysics (Tutorial)		1 WLH
Course: Methods Course Biochemistry and Biophysics (Practical course) <i>Contents:</i> Biochemical analysis of secondary metabolites, lipids, proteins, and nucleic acids using photometric tests, electrophoresis, thin-layer chromatography, and fully automated analytical instruments (HPLC/GC/GCMS). Spectroscopy on biomolecules (fluorescence, FT-IR, CD, UV/Vis), modern microscopic methods (optical microscopy, scanning probe methods), functional analyses of various classes of membrane proteins.		10 WLH
Examination: Written exam on content of lecture (90 Minuten) [80% of overall grade], and protocol (max. 20 pages) [20% of overall grade] Examination prerequisites: regular participation in methods course and certified protocol		12 C
Examination requirements: Students describe the structure and function of biomolecules, analyse metabolic pathways and the role of lipids and secondary metabolites, identify enzyme functions in lipid metabolism, and evaluate biotechnological approaches. The examination is written and tests understanding, analysis, and critical evaluation using case studies and data. They critically analyse complex experiments in a report and present their findings in a scientifically sound manner.		
Admission requirements: cannot be combined with M.Bio.157 or M.Bio.167		Recommended previous knowledge: none
Language: English		Person responsible for module: Prof. Dr. Ivo Feußner
Course frequency:		Duration:

each summer semester	1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 48	

Georg-August-Universität Göttingen Module M.Bio.141: General and Applied Microbiology		3 C 3 WLH
Learning outcome, core skills: Students are able to analyse evolutionary processes and phylogenetic systems of bacteria and archaea, and describe and interpret their morphological and cellular characteristics. They analyse microbial communities and biocoenoses, as well as molecular regulatory mechanisms such as transcription, translation, post-translational control, signal transduction, and genetic networks. They explain the principles of microbial development, the mechanisms of pathogenicity in key pathogens, and the development of novel antimicrobial agents. Furthermore, they can explain the metabolic diversity of bacteria and archaea and its relevance for biotechnological applications and industrial microbiology.		Workload: Attendance time: 42 h Self-study time: 48 h
Course: General and Applied Microbiology (Lecture) <i>Contents:</i> • Evolution and phylogenetic system • Morphology and cell biology • Communities and biocoenosis of bacteria and archaea • Gene expression and molecular control (transcription, translation) • Posttranslational control, protein stability and proteomics • Genetic networks • Molecular switches and signal transduction • Microbial developmental biology • Mechanisms of pathogenicity of important pathogens • Development of new antimicrobial agents • Diversity of the metabolism in bacteria and archaea as basis for biotechnological applications • Industrial microbiology		3 WLH
Examination: Written examination (90 minutes)		3 C
Examination requirements: Students demonstrate their knowledge through a written examination covering core topics in evolution, cell biology, molecular biology, and microbiology. The exam assesses theoretical understanding, the ability to analyse and integrate biological processes, and the application of concepts in the context of biotechnology, medicine, and ecology. It evaluates factual accuracy, logical argumentation, and critical reflection on interrelationships within the subject area.		
Admission requirements: cannot be combined with M.Bio.101	Recommended previous knowledge: none	
Language: English	Person responsible for module: Prof. Dr. Jörg Stülke	
Course frequency: each winter semester	Duration: 1 semester[s]	

Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 10	

Georg-August-Universität Göttingen Module M.Bio.142: Molecular Genetics and Microbial Cell Biology		3 C 3 WLH
Learning outcome, core skills: Students are able to analyse molecular biological and cellular processes in model systems of molecular mycology (yeasts and filamentous fungi) using case studies and explain underlying genetic mechanisms. They independently research a scientific topic to the level of a literature review, synthesise current research literature, in a structured critical manner. They also reflect on the biological and methodological implications within the context of contemporary research.		Workload: Attendance time: 42 h Self-study time: 48 h
Course: Molecular Genetics and Microbial Cell Biology (Lecture)		3 WLH
Examination: Written examination (90 minutes)		3 C
Examination requirements: The assessment consists of a written examination that evaluates students' understanding of molecular genetics and cell biology in microbial model organisms, as well as their ability to critically analyse and synthesise scientific content. The exam includes tasks on case study analysis, explanation of genetic mechanisms, and evaluation of current research findings. Performance is assessed based on factual accuracy, argumentative strength, and depth of content.		
Admission requirements: cannot be combined with M.Bio.102 or M.Bio.172	Recommended previous knowledge: • Watson, Molecular Biology of the Gene, Pearson, 7th Edition; • Alberts, Molecular Biology of the Cell, Wiley, 7th Edition	
Language: English	Person responsible for module: Prof. Dr. Stefanie Pöggeler	
Course frequency: each winter semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: 10		

Georg-August-Universität Göttingen Module M.Bio.144: Molecular Cell Biology of Plant-Microbe Interactions and Stress Adaptation		3 C 3 WLH
Learning outcome, core skills: Upon completion of the module, students will be familiar with fundamental concepts of plant-microbe interactions at the cellular and molecular level and with plant adaptation mechanisms to abiotic stress factors. They will understand the results of current and relevant publications and will be able to critically evaluate them.		Workload: Attendance time: 42 h Self-study time: 48 h
Course: Plant-Microbe Interactions (Lecture) <i>Contents:</i> • Plant-microbe interactions: models, defense mechanisms, PAMP- and effector-induced immunity • Resistance to biotrophic and necrotrophic pathogens • Hormone-dependent signaling pathways, systemically acquired resistance • Plant responses to abiotic stress (drought, heat) • Gene regulatory networks, stress memory		3 WLH
Examination: Written examination (54 minutes)		3 C
Examination requirements: The exam tests the extent to which students understand the basic concepts and analytical methods of plant-microbe interactions and plant adaptation mechanisms to abiotic stress factors and can summarize them concisely.		
Admission requirements: cannot be combined with M.Bio.104	Recommended previous knowledge: none	
Language: English	Person responsible for module: Prof. Dr. Volker Lipka	
Course frequency: each summer semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: 10		

Georg-August-Universität Göttingen Module M.Bio.156: Structural Biochemistry		3 C 3 WLH
Learning outcome, core skills: Students are able to analyse the structure and function of biological macromolecules, particularly proteins, and explain the relationships between structure, folding, and function. They describe structure-function relationships in protein-protein and protein-nucleic acid interactions, apply principles of molecular recognition, and explain approaches to structure-based drug design.		Workload: Attendance time: 42 h Self-study time: 48 h
Course: Structural Biochemistry (Lecture)		3 WLH
Examination: Written examination (90 minutes)		3 C
Examination requirements: The written examination tests the students' knowledge of structure-function relationships, protein interactions and structure-based drug design.		
Admission requirements: cannot be combined with M.Bio.106 or M.Bio.176	Recommended previous knowledge: none	
Language: English	Person responsible for module: Prof. Dr. Ralf Ficner	
Course frequency: each summer semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: 10		

Georg-August-Universität Göttingen Module M.Bio.157: Biochemistry and Biophysics		3 C 3 WLH
Learning outcome, core skills: Students are able to describe the structure, function, and biophysics of selected biomolecule classes and explain the role of lipids as signalling molecules, as well as the significance of secondary metabolites in plant metabolism. They analyse primary and secondary metabolism, identify functions and regulation of enzymes in lipid metabolism, and evaluate biotechnological approaches for modifying storage compounds.		Workload: Attendance time: 42 h Self-study time: 48 h
Course: Biochemistry and Biophysics (Lecture)		3 WLH
Examination: Written examination (90 minutes)		3 C
Examination requirements: Students describe the structure and function of biomolecules, analyse metabolic pathways and the role of lipids and secondary metabolites, identify enzyme functions in lipid metabolism, and evaluate biotechnological approaches. The examination is written and tests understanding, analysis, and critically evaluation using case studies and data.		
Admission requirements: cannot be combined with M.Bio.107	Recommended previous knowledge: none	
Language: English	Person responsible for module: Prof. Dr. Ivo Feußner	
Course frequency: each summer semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester: 2	
Maximum number of students: 10		

Georg-August-Universität Göttingen Module M.Bio.158: Enzyme Catalysis and Biological Chemistry		3 C 3 WLH
Learning outcome, core skills: Students are able to explain and apply catalytic mechanisms of enzymes, the function of macromolecular complexes such as the ribosome, and the principles of biocatalysis, reaction kinetics, and thermodynamics of biochemical processes. They analyse chemical model systems of enzymes, describe strategies for bio-oligomer and ligand synthesis, and apply ligation techniques and array technologies in research contexts. They acquire in-depth knowledge of current topics in enzymology and bio-(organ)chemistry and are able to reflect on and integrate these into a scientific context.		Workload: Attendance time: 42 h Self-study time: 48 h
Course: Enzyme Catalysis and Biological Chemistry (Lecture)		3 WLH
Examination: Written examination (90 minutes)		3 C
Examination requirements: Students demonstrate their knowledge and application skills through a written examination that assesses theoretical foundations, reaction mechanisms, methodological approaches, and current research trends. The exam evaluates the ability to analyse complex biochemical processes, critically assess scientific concepts, and integrate recent research findings into scientific discourse. It is designed to assess factual accuracy, logical reasoning, and depth of scientific reflection.		
Admission requirements: cannot be combined with M.Bio.108	Recommended previous knowledge: none	
Language: English	Person responsible for module: Prof. Dr. Kai Tittmann	
Course frequency: each winter semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: 10		

Georg-August-Universität Göttingen Module M.Bio.172: Molecular Genetics and Microbial Cell Biology		6 C 4 WLH
Learning outcome, core skills: Students are able to analyse molecular biological and cellular processes in model systems of molecular mycology (yeasts and filamentous fungi) using case studies and explain the underlying genetic mechanisms. They independently research a specific topic in molecular genetics and microbial cell biology to the level of a scientific review, integrate current research literature, and present their finding in a structured, critical, and scientifically sound manner. They analyse complex topics from multiple perspectives, communicate effectively in collaborative settings, and develop well-reasoned, constructive solutions together.		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Molecular Genetics and Microbial Cell Biology (Lecture)		3 WLH
Course: Seminar on Molecular Genetics and Microbial Cell Biology (Seminar)		1 WLH
Examination: Written examination (90 minutes) Examination prerequisites: Regular participation in seminar; successful seminar presentation (ca. 15 minutes). The seminar presentation can earn up to 10% of the total points for the exam in advance.		6 C
Examination requirements: Students demonstrate their competences through a written exam covering the lecture content, assessing their theoretical understanding of molecular genetics and cell biology, and a scientific seminar presentation on an independently researched topic. The presentation is assessed for depth of content, scientific structure, critical analysis of literature, and clarity of communication. Both components are evaluated jointly and reflect the student's subject-specific, analytical, and presentation skills.		
Admission requirements: cannot be combined with M.Bio.102 or M.Bio.142	Recommended previous knowledge: • Watson, Molecular Biology of the Gene, Pearson, 7th Edition; • Alberts, Molecular Biology of the Cell, Wiley, 7th Edition	
Language: English	Person responsible for module: Prof. Dr. Stefanie Pöggeler	
Course frequency: each winter semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: 6		

Georg-August-Universität Göttingen Module M.Bio.176: Structural Biochemistry		6 C 4 WLH
Learning outcome, core skills: Students are able to analyse the structure and function of biological macromolecules, particularly proteins, and explain the relationships between structure, folding, and function. They describe structure-function relationships in protein-protein and protein-nucleic acid interactions, apply principles of molecular recognition, and explain approaches to structure-based drug design. Students actively contribute to scholarly discussions, and reflect on recent developments in biochemistry. They analyse complex topics from multiple perspectives, apply effective communication strategies to support collaborative work, present well-reasoned arguments, and work jointly to develop informed and constructive solutions.		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Structural Biochemistry (Lecture)		3 WLH
Course: Seminar on Structural Biochemistry (Seminar)		1 WLH
Examination: Written examination on content of lecture (90 min) [80% of overall grade]; seminar presentation (ca. 15 min) [20% of overall grade] Examination prerequisites: regular participation in seminar		6 C
Examination requirements: In a scientific seminar presentation, students critically analyse current publications in the field of structural biochemistry and molecular recognition. A written examination tests their knowledge of structure-function relationships, protein interactions and structure-based drug design.		
Admission requirements: cannot be combined with M.Bio.106 or M.Bio.156	Recommended previous knowledge: none	
Language: English	Person responsible for module: Prof. Dr. Ralf Ficner	
Course frequency: each summer semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: 5		

Georg-August-Universität Göttingen Module M.Bio.310: Systems Biology		12 C 14 WLH
Learning outcome, core skills: Students are able to formally describe, model, analyse, and simulate complex interactions within living systems across multiple levels of abstraction—from molecules and cells to organs. They identify and interpret biomolecular networks such as metabolic, signal transduction, and gene regulatory networks, and apply graph-based abstraction models (e.g. Entity-Interaction Graphs, Boolean Networks, Petri Nets). They apply fundamental concepts of graph theory - including path analysis, clustering coefficient, and centrality - to biomolecular networks and integrate them into the analysis of biological systems. They explain high-throughput experimental methods and their application in network analysis, and conduct simulations of molecular networks using selected case studies. Furthermore, they present their findings in a scientific seminar presentation and document their work in a structured laboratory report. They analyse complex topics from multiple perspectives, apply effective communication strategies to support collaborative work, present well-reasoned arguments, and work jointly to develop informed and constructive solutions.		Workload: Attendance time: 147 h Self-study time: 213 h
Course: Bioinformatics of Systems Biology (Lecture)		2 WLH
Examination: Oral examination (approx. 30 minutes)		6 C
Course: Exercises on Bioinformatics of Systems Biology (Exercise)		2 WLH
Course: Seminar on Bioinformatics of Systems Biology (Seminar)		1 WLH
Course: Methods Course Modelling and Analysis of Biological Systems (Internship) 3-week block course		9 WLH
Examination: Minutes / Lab report (max. 10 pages) Examination prerequisites: Seminar presentation (approx. 30 min); regular participation in exercise, seminar and methods course		6 C
Examination requirements: Students demonstrate their competences through an oral examination on the lecture content, a scientific seminar presentation on an independently researched topic, and a structured laboratory report on the modelling, analysis, and simulation of biomolecular networks. The oral exam assesses theoretical understanding, the ability to analyse and integrate complex systems, and the application of modelling concepts. The presentation and report are evaluated for scientific quality, methodological clarity, critical reflection, and structured communication.		
Admission requirements: cannot be combined with M.Bio.340		Recommended previous knowledge: none

Language: English	Person responsible for module: Prof. Dr. Tim Beißbarth
Course frequency: each summer semester; irregularly	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 20	
Additional notes and regulations: Max. number of students per programme: 10 DNB + 10 CoBi	

Georg-August-Universität Göttingen Module M.Bio.323: Introduction to Bayesian Statistics and Information Theory		12 C 12 WLH
Learning outcome, core skills: Students are able to explain and apply the fundamentals of Bayesian statistics, including the Bayesian concept of probability, parameter estimation, and the interpretation of Bayesian credible intervals as the Bayesian equivalent of confidence intervals. They select and justify appropriate prior distributions based on prior knowledge and analyse their impact on results. They conduct Bayesian hypothesis and model tests and apply Markov Chain Monte Carlo (MCMC) methods for estimating complex models. They solve statistical problems in practical computer-based exercises, programme simple Bayesian models, and interpret results in the context of data. They integrate concepts from information theory into their analysis and are able to clearly present complex relationships in scientific discourse. They actively contribute to scholarly discussions, analyse complex topics from multiple perspectives, and apply effective communication strategies to support collaborative work.		Workload: Attendance time: 195 h Self-study time: 165 h
Course: Introduction to Bayesian Statistics and Information Theory (Lecture)		3 WLH
Course: Classical Problems in Bayesian Inference (Seminar)		1 WLH
Course: Programming Course Introduction to Bayesian Statistics and Information Theory		8 WLH
Examination: Written examination (90 minutes) Examination prerequisites: regular participation, seminar presentation		12 C
Examination requirements: Students demonstrate their knowledge through a written examination assessing theoretical foundations, applications, and interpretations of Bayesian statistics. They submit a programming project documenting the implementation of Bayesian methods on the computer and present their work in a scientific seminar presentation. Assessment evaluates scientific depth, quality of programming, clarity of presentation, and communication skills in scientific discussion.		
Admission requirements: experience with at least one programming language; basic computer skills	Recommended previous knowledge: fundamentals of probability theory	
Language: English	Person responsible for module: Prof. Dr. Michael Wibral	
Course frequency: each winter semester	Duration:	
Number of repeat examinations permitted: twice	Recommended semester:	

Maximum number of students:	
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Georg-August-Universität Göttingen Module M.Bio.340: Systems Biology		3 C 2 WLH
Learning outcome, core skills: Students are able to formally describe, model, analyse, and simulate complex interactions within living systems across multiple levels of abstraction - from molecules and cells to organs. They identify and interpret biomolecular networks such as metabolic, signal transduction, and gene regulatory networks, and apply graph-based abstraction models (e.g. Entity-Interaction Graphs, Boolean Networks, Petri Nets). They apply fundamental concepts of graph theory - including path analysis, clustering coefficient, and centrality - to biomolecular networks and integrate them into the analysis of biological systems. They explain high-throughput experimental methods and their application in network analysis and can reflect on the results within a scientific context.		Workload: Attendance time: 42 h Self-study time: 48 h
Course: Bioinformatics of Systems Biology (Lecture)		2 WLH
Examination: Oral examination (approx. 30 minutes)		3 C
Examination requirements: Students demonstrate their knowledge through an oral examination, in which they explain and critically discuss complex modelling approaches, analytical methods, and applications in network bioinformatics. The exam assesses depth of understanding, the ability to integrate concepts from modelling, graph theory, and experimental data analysis, and scientific reasoning. It evaluates clarity of presentation, logical structure of arguments, and critical reflection on methodological and biological implications.		
Admission requirements: none	Recommended previous knowledge: none	
Language: English	Person responsible for module: Prof. Dr. Tim Beißbarth	
Course frequency: each summer semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: 10		

Georg-August-Universität Göttingen		3 C
Module M.Bio.372: Matlab in Biopsychology and Neuroscience		2 WLH
Learning outcome, core skills: Students are able to understand and apply fundamental concepts and functions of MATLAB, particularly in the context of psychophysical and neuroscience applications. They can read and interpret existing MATLAB code critically and understand its functionality within a scientific context. They independently develop MATLAB programs to address research questions, implementing algorithms, data processing, visualization, and simulations. They document their programs in a structured manner and apply best practices in programming to produce scientifically sound and reproducible results.		Workload: Attendance time: 28 h Self-study time: 62 h
Course: Matlab in Biopsychology and Neuroscience (Lecture)		1 WLH
Course: Tutorial on Matlab in Biopsychology and Neuroscience (Tutorial)		1 WLH
Examination: Written examination (90 minutes) Examination prerequisites: regular participation at tutorials and completion of the exercises		3 C
Examination requirements: Students demonstrate their competences through a written examination assessing theoretical foundations, programming skills, and the application of MATLAB in psychophysics and neuroscience. The exam evaluates the ability to analyse existing code, understand program logic, and develop simple programs for data analysis or simulation. It is designed to assess factual accuracy, logical structure of solutions, and the application of programming principles.		
Admission requirements: none	Recommended previous knowledge: none	
Language: English	Person responsible for module: Prof. Dr. Alexander Gail	
Course frequency: each summer semester; first half of semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: 20		
Additional notes and regulations: The event is suitable for highly motivated Bachelor's and Master's students of Psychology, Biology and Physics who have an above-average interest in research.		

Georg-August-Universität Göttingen Module M.Bio.374: Introduction to Computer Modelling		2 C 2 WLH
Learning outcome, core skills: Students are able to explain and apply core concepts of computer modelling in evolutionary biology, behavioral ecology, sociobiology, and cognition, particularly in the context of cooperative behavior in humans. They independently design and implement computer models to address self-chosen scientific questions, selecting appropriate algorithms, parameters, and simulation scenarios. They programme models using a suitable programming language, critically analyze the results, and interpret them within a biological and evolutionary context. They document their work in a structured, scientifically sound report and present their findings in a clear, precise, and convincing manner. They code and learn how to use Artificial Intelligence for correcting and completing their code.		Workload: Attendance time: 24 h Self-study time: 36 h
Course: Developing and Creating Evolutionary Computer Models (Exercise)		1,5 WLH
Course: Introduction to Computer Modeling and Human Cooperative Behavior (Seminar)		0,5 WLH
Examination: Minutes / Lab report (max. 4 pages), not graded Examination prerequisites: Short presentation (ca. 10 min)		2 C
Examination requirements: Students submit a structured laboratory report covering the modeling rationale, programming approach, simulation results, and interpretation. They deliver a scientific short presentation in which they clearly and effectively communicate their modeling method, research question, and findings. The examination assesses the depth of knowledge, the quality of the programming, the clarity of the presentation and the ability to communicate effectively in an academic setting.		
Admission requirements: none	Recommended previous knowledge: none	
Language: English, German	Person responsible for module: Prof. Dr. Dirk Semmann	
Course frequency: each winter semester	Duration:	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: 14		

Georg-August-Universität Göttingen Module M.Biodiv.425: Evolution of embryophyta		6 C 4 WLH
Learning outcome, core skills: Students are familiarised with latest research in the area of organismic evolution of embryophytes through the study, presentation and discussion of current case studies on speciation, evolutionary history, chromosomal and genomic evolution, reproductive biology, evolution of characteristics and coevolution. They gain an overview of new theoretical and methodical research approaches to understanding the evolution of plants. They gain the ability to develop evolutionary biology hypotheses and can select suitable model systems and methods to test hypotheses. Students learn the practical skills of presentation, interpretation and discussion of results (in scientific English). They can describe and understand evolutionary processes, hypotheses and methods and give examples for case studies of land plants. They are capable of giving presentations in English and discussing scientific results in English.		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Speciation and evolution of land plants (Lecture) <i>Course frequency:</i> each winter semester		2 WLH
Course: Plant systematics and phycology (Seminar) <i>Course frequency:</i> each semester		2 WLH
Examination: Written examination (70% of the overall grade) (60 minutes) Examination prerequisites: Participation in seminar and oral presentation (approx. 45 min) (30% of the overall grade) Examination requirements: In the written examination students demonstrate their abilities to understand and discuss evolutionary processes and hypotheses as well as their knowledge of case studies of land plants. In the seminar they must give a talk in scientific English and present the new results of research from the literature or from their own Master thesis.		6 C
Admission requirements: none	Recommended previous knowledge: none	
Language: English	Person responsible for module: Prof. Dr. Elvira Hörandl	
Course frequency: Lecture: each winter semester; Seminar: each semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: 15		

Georg-August-Universität Göttingen Modul M.Biodiv.446: Molecular zoology and insect-biotechnology <i>English title: Molecular zoology and insect-biotechnology</i>	6 C 8 SWS
Lernziele/Kompetenzen: The module is aimed at students who want to gain in-depth knowledge of molecular genetic work in theory and practice. Relevant methods and experimental planning are taught theoretically and practically. Selected topics of molecular zoology are treated in depth in lectures and on the basis of current publications. Current developments of molecular methods in pest control and insect biotechnology will be covered. Learning objectives: • Application, experimental strategies and evaluation of different molecular biological methods. • Gene function analysis in zoology: how to identify relevant genes and how to study their function in model and non-model organisms? (including genetic screens, reverse genetics (RNAi), genome editing (CRISPR/Cas9), transgenesis) • Knowledge of databases of DNA, protein and gene function • Identification of orthologous genes in different species • Establishment of new molecular genetic model systems for zoological questions • Advanced discussion of current research topics in molecular zoology • Advanced discussion of recent approaches in insect biotechnology using molecular genetic methods (including pest control). Students should be able to: • design experimental strategies for the identification and analysis of gene function in non-model organisms • design the establishment of new molecular genetic model systems • be able to present and assess scientific questions on selected topics of molecular zoology.	Arbeitsaufwand: Präsenzzeit: 112 Stunden Selbststudium: 68 Stunden
Lehrveranstaltung: Gene function analysis in diverse animals and applications in pest control (Vorlesung) <i>Inhalte:</i> molecular genetic methods; gene function analysis; selected topics from molecular zoology; most recent developments in insect biotechnology	2 SWS
Lehrveranstaltung: Designing experiments to study gene function (Seminar)	2 SWS
Lehrveranstaltung: Introduction to molecular work and methods for gene function studies (Übung)	4 SWS
Prüfung: Präsentation (ca. 20 Minuten)	6 C
Prüfungsanforderungen: The students should be able to apply the contents and methods listed as “core skills” to new questions.	

Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: keine
Sprache: Englisch	Modulverantwortliche[r]: Dr. Vera Sophie Terblanche Prof. Dr. Gregor Bucher
Angebotshäufigkeit: jedes Sommersemester	Dauer: 1 Semester
Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester:
Maximale Studierendenzahl: 8	
Bemerkungen: The modules B.Biodiv.370 and M.Biodiv.446 are mutually exclusive.	

Georg-August-Universität Göttingen Modul M.Biodiv.479: Phylogenomics <i>English title: Phylogenomics</i>		6 C 6 SWS
Lernziele/Kompetenzen: The research field of phylogenomics comprises the utilization of genome and transcriptome data for the inference of phylogenetic trees. In this modul students will be introduced to the theoretical and practical knowledge of how to assemble genomes and transcriptomes and their annotation. Moreover, techniques to search for genes in such data will be presented (e.g., BLAST, hidden markov models). Additionally, the students will work with different alignment- and read mapping methods. Based on the assembled datasets different tree reconstruction methods will be conducted (Neighbor Joining, Maximum Parsimony, Maximum Likelihood, Bayesian Inference) and critically discussed. Within an accompanying seminar actual studies in the field of evolutionary genomics are presented and discussed. Students get an introduction into the Linux environment and the installation of all programs will be done independently. The command line will be mainly used for all analyses. Students will learn to perform genome-scale analyses for the reconstruction of phylogenetic trees. Within a seminar students will present recently published genomic studies in English language. In the last week, datasets will be analysed independently and results will be summarized as poster, which will be presented within a short talk.		Arbeitsaufwand: Präsenzzeit: 84 Stunden Selbststudium: 96 Stunden
Lehrveranstaltung: Introduction to phylogenomics (Vorlesung)		1 SWS
Lehrveranstaltung: Introduction to phylogenomics (Seminar) This course is open for students of the double degree programme at the partner universities. The sessions of this course might be conducted in a remote format like online video conference.		1 SWS
Lehrveranstaltung: Introduction to phylogenomics (Übung)		4 SWS
Prüfung: Short talk (approx. 15 minutes) and poster presentation		6 C
Prüfungsanforderungen: Knowledge of how to reconstruct phylogenetic trees using genomic and transcriptomics data. Critical discussion of phylogenetic analyses and overview of actual controversies.		
Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: keine	
Sprache: Englisch	Modulverantwortliche[r]: Prof. Dr. Christoph Bleidorn Dr. Joëlle van der Sprong	
Angebotshäufigkeit: jedes Sommersemester	Dauer: 1 Semester	
Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester: 1	

Maximale Studierendenzahl:	
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Georg-August-Universität Göttingen Module M.Biodiv.491: Next generation sequencing for evolutionary biology		6 C 4 WLH
Learning outcome, core skills: The students acquire knowledge of the various systems and techniques for “next generation sequencing”. The focus of the module lies on the fast developing field of bioinformatics and data analysis (dry lab). Corresponding wet lab methods are explained and discussed. The students learn the different possible applications for “next generation sequencing” data in evolutionary biology of animals and plants, for example biodiversity, phylogenomics, evolution of traits, adaption, phylogeography, population genetics and hybridization. They get an overview of the theory and gain practical experiences in this research area. They acquire the competence to choose suitable methods for evolutionary questions and to test hypotheses on non-model organisms. The students are able to list the differences and (dis)advantages of various “next generation sequencing” methods and to select suitable methods to analyze specific evolutionary questions by use of non-model organisms. They are able to compare and analyze the raw data of “next generation sequencing” and to annotate genes of an assembled genome. The students shall present and discuss case studies from the field of “next generation sequencing” during the seminar in scientific English		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Next generation sequencing: methods, data analysis and applications (Lecture)		0,5 WLH
Course: Next generation sequencing: examples of botanical and zoological studies (Seminar)		0,5 WLH
Course: Analysis of next generation sequencing data (Exercise)		3 WLH
Examination: Oral presentation (20 minutes) Examination requirements: Knowledge of the various applications of "next generation sequencing" in evolutionary biology of animals and plants. Overview of the theory and practical experiences in this new research area.		6 C
Admission requirements: none	Recommended previous knowledge: Knowledge of the various applications of "next generation sequencing" in evolutionary biology of animals and plants. Overview of the theory and practical experiences in this research area.	
Language: English	Person responsible for module: Dr. Natascha Dorothea Wagner	
Course frequency: each summer semester	Duration: 1 semester[s]	
Number of repeat examinations permitted:	Recommended semester:	

twice	
Maximum number of students: 10	

Georg-August-Universität Göttingen Module M.CoBi.501: Bioinformatics and its areas of application		8 C 7 WLH
Learning outcome, core skills: The students will acquire knowledge on a diverse range of topics - both applied as well as purely bioinformatical. For this, there will be research-oriented lectures. On the applied side, these topics prominently feature - but are not limited to - the different types of "omics"-approaches available to answer biological questions (genomics, transcriptomics, phylogenomics, metabolomics, proteomics, CHIP-Seq, comparative genomics, phenomics etc). They will learn about feasibility and different approaches to data analysis. Furthermore, students will learn about the digitization of the biological sciences, featuring aspects such as machine readable phenotypic annotation of morphology, phenotypic database, biological image analysis and more. Finally, the students will acquire knowledge on algorithmic and statistical aspects of bioinformatics, featuring the latest developments and challenges in the development of new bioinformatic tools for life sciences.		Workload: Attendance time: 98 h Self-study time: 142 h
Course: Bioinformatics and its areas of application (Lecture) <i>Contents:</i> This course provides an appetizer of the various applications and uses of bioinformatics - especially those represented by research on Göttingen Campus.		3 WLH
Course: IMPRS Genome Science (Lecture)		2 WLH
Course: Industry excursion (Excursion) <i>Contents:</i> excursion to companies that make use of bioinformatics/computational biology (and hire bioinformaticians and computational biologists)		2 WLH
Examination: Term Paper (max. 10 pages), not graded Examination requirements: Students show that they gained an overview of the diversity of areas of application for algorithmic and applied bioinformatics - including tools for computational biology to solve biological questions - as well as in depth knowledge on a topic of choice for the essay.		8 C
Admission requirements: none	Recommended previous knowledge: none	
Language: English	Person responsible for module: Prof. Dr. Jan de Vries	
Course frequency: each winter semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester: 1	
Maximum number of students: 30		

Georg-August-Universität Göttingen Module M.CoBi.502: Biology for (bio)informaticians		10 C 8 WLH
Learning outcome, core skills: This course aims to teach the principles of biology required for aspiring bioinformaticians and computational biologists. The students will learn about the basics of the building blocks of life. An introduction to molecular biology will cover aspects of cell biology, developmental biology, principles of genetics and genome biology, microbiology, protein biology and enzymology, and biochemistry as well as metabolism. Furthermore, they will get a glimpse into biodiversity through an introduction organismal diversity across uni- and multicellular life. This will be contextualized by a basic (molecular) evolutionary biological framework. Finally, students will get a glimpse into how wet laboratory work is carried out.		Workload: Attendance time: 112 h Self-study time: 188 h
Course: Biology for (bio)informaticians (Lecture)		4 WLH
Examination: Written examination (90 minutes) Examination prerequisites: protocol		10 C
Course: Biology for (bio)informaticians (Tutorial)		2 WLH
Course: Methods in biochemistry and microbiology (Internship)		2 WLH
Examination requirements: knowledge of the basics in molecular biology (cell biology, microbiology, genetics, neurobiology, developmental biology, biochemistry) as well as biodiversity (microorganisms, plants, fungi, animals)		
Admission requirements: none	Recommended previous knowledge: none	
Language: English	Person responsible for module: Prof. Dr. Kai Heime	
Course frequency: each winter semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester: 1	
Maximum number of students: 20		

Georg-August-Universität Göttingen Module M.CoBi.503: Advanced course in Computational Biology		12 C
Learning outcome, core skills: The student learns how to independently perform a project in the area of bioinformatics and/or computational biology. Objective of this project can be the development, evaluation / benchmarking, and analysis of bioinformatic software tools, the automation of data processing, and the analysis of biological data with bioinformatic techniques; the scientific question addressed can revolve around bioinformatic problems, biological phenomena and related fields.		Workload: Attendance time: 280 h Self-study time: 80 h
Course: Lab course: 8 weeks, full-time (Internship) <i>Course frequency: each semester</i>		20 WLH
Examination: Oral examination (approx. 30 minutes) Examination prerequisites: scientific presentation and discussion of obtained results (in form of a protocol) Examination requirements: independent execution of a project in bioinformatics, proven ability to present own results		12 C
Admission requirements: M.CoBi.501 must be completed	Recommended previous knowledge: none	
Language: English	Person responsible for module: Alle	
Course frequency: not specified	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: 30		

Georg-August-Universität Göttingen Module M.CoBi.504: Comparative and Evolutionary Genomics		12 C 14 WLH
Learning outcome, core skills: Students will acquire an understanding of the usage and usefulness of comparative approaches in analyzing large-scale biological data (foremost sequencing data). This will entail a hands-on experience with carrying out comparative analyses on genomic data. The students will learn how to analyze, evaluate, and present comparative data. Furthermore, students will read, present, and critically discuss published comparative studies that cover current topics in comparative, evolutionary and population genomics. Main topics are: comparative genomics: more than evolutionary biology, introduction to evolutionary/tree thinking, the evolutionary forces that shape genomes, a common language for comparisons (ontologies, pathways and more), reconciliation of gene families and species trees, forward and reverse genetics in light of comparative genomics, major evolutionary transitions gleaned from genomics, phylogenomics, reticulate evolution. Students will acquire an understanding on the principles and concepts important for population genomic analyses and inferences.		Workload: Attendance time: 196 h Self-study time: 164 h
Course: Comparative and Evolutionary Genomics (Lecture) <i>Contents:</i> principles of evolutionary thinking, evolutionary concepts, analyses and useful software for comparative genomic analyses, phylogenomics, ancestral character state reconstruction, Evolutionary processes in populations, Population genetic and genomic analyses, interpretation of data		4 WLH
Examination: written exam, 90min (70% of final grade); short report and oral presentation in seminar(25 min + 20 min discussion; 30% of final grade) Examination prerequisites: regular attendance and active participation Examination requirements: Detailed knowledge on macro-evolutionary processes, evolutionary thinking, methods available to compare genomic data, background on methods to analyse comparative evolutionary questions with genomic data, interpretation of results		12 C
Course: Genomic insights into evolutionary processes (Seminar) <i>Contents:</i> reading and presenting a published article on comparative, evolutionary and/or population genomics, discussion among all participants on the presented work, feedback on presentation, discussions around evolutionary thinking		3 WLH
Course: Applying Comparative and Evolutionary Genomics (Internship)		7 WLH
Admission requirements: Basic knowledge of Linux and Bash, i.e. M.CoBi.506, SK.Bio.307	Recommended previous knowledge: none	
Language: English	Person responsible for module: Prof. Dr. Jan de Vries	

Course frequency: each winter semester	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 30	

Georg-August-Universität Göttingen Module M.CoBi.506: Linux and Python for biologists		5 C 3 WLH
Learning outcome, core skills: After successful completion of the module, students have basic knowledge of the Linux operating system as well as basic programming skills in Python or comparable languages.		Workload: Attendance time: 42 h Self-study time: 108 h
Course: Linux and Python for biologists <i>Contents:</i> The practical course "Linux and Python for Biologists and Physicians" teaches basic knowledge of the Linux operating system and programming in Python with special emphasis on bioinformatics applications. Linux and Python are necessary basics for all further activities in the field of bioinformatics. The skills taught in the lab are therefore essential for many computer-based activities in science and industry. In this course, the basics of Unix-based operating systems are introduced first. The focus is on the safe operation of the Unix shell and the use of basic Bash commands. In addition, simple concepts of data processing in the shell are introduced and simple Bash scripts are presented. The Python programming language is then comprehensively introduced. This includes 1) the basics of programming and its syntax in Python (data types, control structures, functions, etc.), 2) advanced concepts of programming with a focus on bioinformatics (containers, iterators, external modules, etc.), and 3) processing and visualizing data using Python. Examples from biology will be used to illustrate the concepts and apply them in exercises. No programming knowledge is assumed. The primary goal of this course is for students to feel confident using Linux and Python and to be able to independently process and visualize data from their subject area appropriately.		3 WLH
Examination: Practical examination with oral presentation (20min), not graded Examination prerequisites: three small project works covering the topics of the respective week		
Examination requirements: Independent work with the command line interpreter under the Linux operating system; creation of small programs in the Python programming language (reading data from files, creating suitable data structures, handling regular expressions, implementation of simple algorithms)		
Admission requirements: none	Recommended previous knowledge: B.Bio.113	
Language: English, German	Person responsible for module: Dr. Sophie de Vries	
Course frequency: each winter semester	Duration: 1 semester[s]	

Number of repeat examinations permitted: twice	Recommended semester: 1 - 4
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.CoBi.507: Computational Biomedicine		6 C 4 WLH
Learning outcome, core skills: Students are able to apply common methods in computational biomedicine and independently plan and conduct simple research projects in this field. They perform basic data analyses on relevant biomedical questions using the programming languages R and Python, including data import, cleaning, visualisation, and statistical evaluation. They document their work systematically and present their results in a clear, structured, and scientifically sound manner. They apply fundamental programming concepts and integrate current research findings into their work.		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Computational Biomedicine Lecture <i>Contents:</i> • Pattern recognition in disease • Computational biomarker discovery • Single- and multi-omics analysis • Computational methods for single-cell analysis: dimension reduction, pseudo-time, and downstream analyses • Cancer evolution modeling • Signal transduction and modeling		2 WLH
Course: Computational Biomedicine Tutorial		2 WLH
Von den folgenden Prüfungen ist genau eine erfolgreich zu absolvieren:		
Examination: Oral examination (approx. 30 minutes)		
Examination: Written examination (90 minutes) Examination prerequisites: 50% of homeworks		
Examination requirements: Requirements are a solid understanding of common omics data including single-cell and spatial omics, a basic understanding of computational concepts and their implementation, and familiarity with computational approaches for, e.g., pattern recognition, biomarker discovery, single-cell analysis, cancer evolution, and network inference.		
Admission requirements: None	Recommended previous knowledge: Basic programming knowledge in R or Python. Basic knowledge in statistics.	
Language: English	Person responsible for module: Prof. Dr. Michael Altenbuchinger Prof. Dr. Kerstin Lenhof	
Course frequency: each winter semester	Duration:	
Number of repeat examinations permitted:	Recommended semester:	

twice	
Maximum number of students: 30	

Georg-August-Universität Göttingen Module M.CoBi.508: Deep learning, data leakage, and reproducibility in computational biology	6 C 4 WLH
Learning outcome, core skills: Upon completion, students will be able to design, critically evaluate, and communicate AI-driven biological research with awareness of challenges such as data leakage and reproducibility. In particular, they will be able to - apply advanced neural network architectures to analyse complex biological data. - identify various forms of data leakage - evaluate the reproducibility of ML workflows - assess the appropriateness of the statistical evaluation of ML workflows - communicate complex research findings clearly and effectively in a structured scientific presentation.	Workload: Attendance time: 56 h Self-study time: 124 h
Course: Deep learning, data leakage, and reproducibility in computational biology - Lecture (Lecture) <i>Contents:</i> <i>Topics:</i> - Neural network architectures used in biology/medicine (e.g., graph neural networks, domain-adaptation techniques, convolutional neural networks, recurrent neural networks) - Negative results in science and science communication - Different forms of data leakage - Benchmarking and reproducibility - Statistical evaluation of machine learning pipelines	2 WLH
Examination: Oral Presentation (approx. 30 minutes) Examination prerequisites: Regular participation in the Exercise	6 C
Course: Deep learning, data leakage, and reproducibility in computational biology (Exercise) <i>Contents:</i> Practical application of the lecture topics	2 WLH
Examination requirements: Students present their work in a scientific presentation, explaining their analysis, methodological choices, results, and interpretation. An oral examination follows, during which they defend their work and demonstrate overall knowledge of the topics covered in the lecture (cf. topics). Assessment evaluates scientific depth, methodological rigor, clarity of presentation, and scientific communication proficiency.	

Admission requirements: Programming knowledge in Python. Basic knowledge in machine learning.	Recommended previous knowledge: MCoBi.507 "Computational Biomedicine"
Language: English	Person responsible for module: Prof. Dr. Kerstin Lenhof
Course frequency: each winter semester	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 20	
Additional notes and regulations: 15 places for MSc Computational Biology and Bioinformatics, 5 places for other programmes	

Georg-August-Universität Göttingen Module M.CoBi.531: Scientific Project Management		6 C 5 WLH
Learning outcome, core skills: After attending at least 14 research colloquia or symposia on the Göttingen Campus, students are able to independently summarise current issues in the respective fields, critically evaluate them and articulate their relevance to their own research interests. They can develop a complete research proposal for their planned Master's thesis according to good scientific practice: formulating clear research hypotheses, designing appropriate sampling and study plans, selecting suitable analytical methods, outlining expected results and producing a realistic timetable and resource plan. They are capable of presenting the research proposal convincingly, employing scientific argumentation structures, answering questions competently and defending the project before an expert audience. They master the written presentation of scientific content (research application, literature review, methodology) according to the standards of scholarly journals and funding bodies and can reflect on the principles of project and grant management.		Workload: Attendance time: 70 h Self-study time: 110 h
Course: Good Scientific Practice (e-learning course)		1 WLH
Course: Center or Institute Colloquia Colloquia given by invited guest speakers as part of the colloquia, seminar series and symposia held at the Göttingen Campus are recognised.		1 WLH
Course: Preparation of a research proposal for the Master's thesis		3 WLH
Examination: Oral Presentation (approx. 20 minutes) Examination prerequisites: Proof of attendance of at least 14 scientific colloquia, as well as proof of successful completion of the e-learning course "Good Scientific Practice". Certified research proposal (max. 20 pages) for the Master's thesis.		6 C
Examination requirements: Students submit a written research proposal that comprehensively documents the scientific question, methodology, planning, and expected outcomes of their Master's thesis and defend their proposal in an oral presentation. Assessment evaluates the scientific quality, methodological plausibility, structure of the proposal, and the clarity and effectiveness of the oral presentation.		
Admission requirements: M.CoBi.503 M.CoBi.503; colloquia can be attended from the first semester onwards without any entry requirements.	Recommended previous knowledge: none	
Language: English	Person responsible for module: Speaker of the M.Sc. "Computational Biology and Bioinformatics"	
Course frequency:	Duration:	

each semester1	
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 30	
Additional notes and regulations: Module is usually supervised and examined by the first supervisor of the Master's thesis.	

Georg-August-Universität Göttingen Module M.Inf.1114: Algorithms on Sequences		5 C 4 WLH
Learning outcome, core skills: We expect that the participants will gain an understanding of classical string-processing tools. They are supposed to understand and be able to use in various situations: classical text algorithms (e.g., pattern matching algorithms, edit distance), classical text indexing data structures (e.g., suffix arrays / trees), and classical combinatorial results that are useful in this context (e.g., periodicity lemmas).		Workload: Attendance time: 56 h Self-study time: 94 h
Course: Algorithms on Sequences (Lecture,Exercise) <i>Contents:</i> This course is an introduction into the theory of stringology, or algorithms on sequences of symbols (also called words or strings). Our main intention is to present a series of basic algorithmic and combinatorial results, which can be used to develop efficient word-processing tools. While the emphasis of the course is on the theoretical side of stringology, we also present a series of applications of the presented concepts in areas like data-compression or computational biology The main topics our course will cover are: basic combinatorics on words, pattern matching algorithms, data structures for text indexing (suffix arrays, suffix trees), text compression (Huffman encoding, Lempel-Ziv method), detection of regularities in words, algorithms for words with don't care symbols (partial words), word distance algorithms, longest common subsequence algorithms, approximate pattern matching. The presentation of each theoretical topic from the above will be accompanied by a brief discussion on its possible applications. Literature • T.H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein: Introduction to Algorithms (3rd Edition), MIT Press, 2009. • M. Crochemore, C. Hancart, T. Lecroq: Algorithms on Strings, Cambridge University Press, 2007. • M. Crochemore, W. Rytter: Jewels of Stringology, World Scientific, 2002. • D. Gusfield. Algorithms on strings, trees, and sequences: computer science and computational biology. Cambridge University Press, 1997.		4 WLH
Examination: Oral examination (approx. 20 minutes) Examination requirements: basic combinatorics on words, pattern matching algorithms, data structures for text indexing (suffix arrays, suffix trees), text compression (Huffman encoding, Lempel-Ziv method), detection of regularities in words, algorithms for words with don't care symbols (partial words), word distance algorithms, longest common subsequence algorithms, approximate pattern matching		5 C
Admission requirements: none	Recommended previous knowledge: none	
Language:	Person responsible for module:	

English	Prof. Dr. Florin-Silviu Manea
Course frequency: irregular	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 50	

Georg-August-Universität Göttingen Module M.Inf.1232: Parallel Computing	6 C 4 WLH
Learning outcome, core skills: Successfully completing the module, students are able to: • define and describe the benefit of parallel computing • specify the classification of parallel computers (Flynn classification) • analytically evaluate the performance of parallel computing approaches (scaling/performance models) • know the parallel hardware and performance improvement approaches (cache coherence, pipeline, etc.) • know the interconnects and networks and their role in parallel computing • understand and develop sample parallel programs using different paradigms and development environments (e.g., shared memory and distributed models) • expose to some applications of Parallel Computing through hands-on exercises	Workload: Attendance time: 56 h Self-study time: 124 h
Course: Parallel Computing (Lecture,Exercise) <i>Contents:</i> Successfully completing the lecture, students are able to: • define and describe the benefit of parallel computing and identify the role of software and hardware in parallel computing • specify the Flynn classification of parallel computers (SISD, SIMD, MIMD) • analytically evaluate the performance of parallel computing approaches (Scaling/Performance models) • understand the different architecture of parallel hardware and performance improvement approaches (e.g., caching and cache coherence issues, pipeline, etc.) • define Interconnects and networks for parallel computing • architecture of parallel computing (MPP, Vector, Shared memory, GPU, Many-Core, Clusters, Grid, Cloud) • design and develop parallel software using a systematic approach • parallel computing algorithms and development environments (i.e. shared memory and distributed memory parallel programming) • write parallel algorithms/programs using different paradigms and environments (e.g., POSIX Multi-threaded programming, OpenMP, MPI, OpenCL/CUDA, MapReduce, etc.) • get exposed to some applications of Parallel Computing through exercises <i>References</i> • An Introduction to Parallel Programming, Peter S. Pacheco, Morgan Kaufmann (MK), 2011, ISBN: 978-0-12-374260-5. • Designing and Building Parallel Programs, Ian Foster, Addison-Waesley, 1995, ISBN 0-201-57594-9 (Available online).	4 WLH

• Advanced Computer Architecture: Parallelism, Scalability, Programmability, Kai Hwang, Int. Edition, McGraw Hill, 1993, ISBN: 0-07-113342-9. • In addition to the mentioned text book, tutorial and survey papers will be distributed in some lectures as extra reading material.	
Examination: Klausur (90 Min.) oder mündliche Prüfung (ca. 20 Min.) Examination requirements: Parallel programming; Shared Memory Parallelism; Distributed Memory Parallelism, Single Instruction Multiple Data (SIMD); Multiple Instruction Multiple Data (MIMD); Hypercube; Parallel interconnects and networks; Pipelining; Cache Coherence; Parallel Architectures; Parallel Algorithms; OpenMP; MPI; Multi-Threading (pthreads); Heterogeneous Parallelism (GPGPU, OpenCL/CUDA)	6 C
Admission requirements: • Data structures and algorithms • Programming in C/C++	Recommended previous knowledge: • Computer architecture • Basic knowledge of computer networks and topologies
Language: English	Person responsible for module: Prof. Dr. Ramin Yahyapour
Course frequency: unregelmäßig	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 50	

Georg-August-Universität Göttingen Module M.Inf.1505: Models and Algorithms in Bioinformatics		6 C 4 WLH
Learning outcome, core skills: After successful completion of the module, students • know the principles, paradigms, and challenges of models and algorithms for statistical data analysis in bioinformatics • understand and apply principles of scientific programming using concepts from statistics and linear algebra • can implement, train and evaluate basic models for sequence analysis • know and apply algorithms for cluster analysis and visualization of multidimensional data • understand, recognize and solve numerical problems in the implementation of algorithms for model training and inference		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Models and Algorithms in Bioinformatics (Lecture)		2 WLH
Examination: Written examination (90 minutes) Examination prerequisites: M.Inf.1505.Ex: Participation in the exercises and successful completion of three exercise sheets. Examination requirements: Students should be able to understand, specify, use, implement and evaluate models and algorithms for biological data analysis and critically assess the limits of their applicability.		6 C
Course: Models and Algorithms in Bioinformatics - Exercise (Exercise)		2 WLH
Admission requirements: none	Recommended previous knowledge: Basic knowledge of molecular biology, algorithms and statistics; programming in Python.	
Language: English	Person responsible for module: Peter Meinicke	
Course frequency: each winter semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester: 1 - 3	
Maximum number of students: 30		

Georg-August-Universität Göttingen Module M.Inf.2102: Advanced Statistical Learning for Data Science		6 C 4 WLH
Learning outcome, core skills: Students will • learn concepts of advanced statistical methods and their scope of applications. These methods comprise the EM algorithm, Markov models, Hidden Markov Models, Markov chain Monte Carlo. • gain a solid understanding of ensemble learning algorithms. In particular, we will address additive tree approaches like boosting and Random Forest algorithms, as well as methods for ensemble optimization • learn strategies for model assessment and selection such as nested cross-validation, Monte Carlo validation, or permutation tests. Moreover, this will comprise measures of model quality and robustness. • develop a workflow for statistical modelling including model development, model optimization, model selection, and model validation. • learn reporting guidelines for the documentation of model development as a prerequisite for application in clinical practice. • acquire practical experience in the interpretation of machine learning models and learn required methods for feature selection, importance, stability, and robustness • learn techniques of statistical network inference, their implementation as well as their application to high-dimensional data.		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Advanced Statistical Learning for Data Science (Lecture) Hastie, et al. Elements of Statistical Learning https://web.stanford.edu/~hastie/ElemStatLearn/ Bishop: Pattern Recognition and Machine Learning. https://cs.ugoe.de/prml		2 WLH
Examination: Written exam (90 min) or oral exam (approx. 20 min) Examination prerequisites: M.Inf.2102.Ex: At least 50% of homework exercises solved. Examination requirements: Knowledge of advanced statistical methods, ensemble learning, model assessment, and interpretation as well as statistical network inference. Evaluate their advantages and disadvantages and the ability to implement and interpret the results of these techniques.		6 C
Course: Statistical Learning in Data Science Exercise (Exercise)		2 WLH
Admission requirements: none	Recommended previous knowledge: Basic knowledge of linear algebra and probability Completion of B.Inf.1236 Machine Learning or equivalent	
Language: English	Person responsible for module: Prof. Dr. Björn-Hergen Laabs Prof. Dr. Michael Altenbuchinger	
Course frequency:	Duration:	

each winter semester	1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester: 1 - 3
Maximum number of students: 20	

Georg-August-Universität Göttingen Module M.Inf.2103: Statistical Network Inference and Analysis		6 C 4 WLH
Learning outcome, core skills: Students will • Learn the concepts of different network inference methods for observational data, such as probabilistic graphical models, e.g., Gaussian and Mixed Graphical Models or the Markov Random Field • Gain a solid understanding about regularization strategies to deal with large feature spaces, e.g., graphical lasso and covariance shrinkage • Learn state-of-the-art optimization strategies and use them to implement networks inference methods • Acquire practical experience in network inference using diverse data types, e.g., demographic or biomedical data • Understand the concept of Directed Acyclic Graphs (DAGs) and learn to estimate lower bounds for causal effects from observational data • Understand and apply network inference methods for time-course data • Understand and apply analysis strategies for networks, e.g., community detection methods		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Statistical Network Inference and Analysis (Lecture,Exercise) Literature: Hastie, et al. Elements of Statistical Learning https://web.stanford.edu/~hastie/ElemStatLearn/		4 WLH
Examination: Written exam (90 min) or oral exam (30 min) Examination prerequisites: M.Inf.2103.Ex: At least 50% of homework exercises solved. Examination requirements: Knowledge about probabilistic graphical models, DAGs, Regularization strategies, Implementation strategies.		6 C
Admission requirements: none	Recommended previous knowledge: Basic knowledge about statistical learning	
Language: English	Person responsible for module: Prof. Dr. Michael Altenbuchinger	
Course frequency: each summer semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester: 1 - 3	
Maximum number of students: 20		

Georg-August-Universität Göttingen Module M.Inf.2201: Probabilistic Machine Learning		9 C 6 WLH
Learning outcome, core skills: After successful completion of the module, students • know the principles, paradigms, and challenges of probabilistic reasoning • apply basis principles and tools to perform probabilistic reasoning • manipulate distributions and densities of random variables • apply different methods for inference in probabilistic models (direct solving, sampling, variational inference, Laplace approximation) • apply latent variable models for given problems • perform inference in various forms of Gaussian models using closure properties of the Gaussian family • use graphical models to describe and reason about multivariate distributions of random variables • apply and implement learning algorithms in probabilistic models • can choose from a toolbox of basic algorithms for probabilistic inference on given problems • can implement and debug probabilistic algorithms and inference techniques • apply state of the art deep probabilistic models such as variational autoencoders or normalizing flows		Workload: Attendance time: 84 h Self-study time: 186 h
Course: Probabilistic Machine Learning (Lecture,Exercise)		6 WLH
Examination: Written exam (120 min.) or oral exam (approx. 30 min.) Examination requirements: • Ability to use principles and tools of probabilistic reasoning on given problems • Ability to extend and modify existing algorithms of probabilistic inference • Ability to diagnose problems in algorithms of probabilistic reasoning • Ability to mathematically derive results in probabilistic models • Ability to use graphical models to simplify problems of probabilistic reasoning • Knowledge of common models and algorithms of probabilistic inference (Gaussian, Bayesian logistic regression, autoencoders, normalizing flows, and others). • Knowledge of common sampling algorithms (importance sampling, MCMC)		9 C
Admission requirements: none	Recommended previous knowledge: • Basic knowledge of linear algebra • Basic knowledge of multivariate calculus • Python, in particular numpy • Basic knowledge of probability	
Language: English	Person responsible for module: Prof. Dr. Fabian Sinz Dr. Johannes Söding	
Course frequency: each winter semester	Duration: 1 semester[s]	

Number of repeat examinations permitted: twice	Recommended semester: 1 - 4
Maximum number of students: 50	
Additional notes and regulations: The course can be taken in parallel to B.Inf.1237 Deep Learning.	

Georg-August-Universität Göttingen Module M.Inf.2244: Seminar Deep Learning in Biology and Medicine		5 C 2 WLH
Learning outcome, core skills: Deep learning is already one of the most important data analysis methods in biological and medical research and is increasingly also used in clinical practice. Its applications range from protein folding and molecule design for drug discovery to gene sequence analysis to image analysis for microscopy data and medical imaging. As part of the seminar students will pick a specific application, learn how to perform literature research and prepare a presentation on the topic. After successful completion of the modul students will be able to • Appraise research in the area of deep learning in biology and medicine. • Compose a presentation covering their selected topic in depth. • Evaluate methods and findings of other researchers. • Understand and explain the methods and domain knowledge fundamental to their topic.		Workload: Attendance time: 28 h Self-study time: 122 h
Course: Deep Learning in Biology and Medicine (Seminar)		2 WLH
Examination: Presentation (approx. 45 minutes) and written report (max. 20 pages) Examination prerequisites: Attendance in 80% of the seminar presentations Examination requirements: Advanced knowledge of a specific research topic in the field of deep learning applied in biology or medicine; written scientific report; oral presentation		5 C
Admission requirements: none	Recommended previous knowledge: B.Inf.1236; B.Inf.1237	
Language: English	Person responsible for module: Prof. Dr. Constantin Pape	
Course frequency: each summer semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: 15		

Georg-August-Universität Göttingen Module M.WIWI-QMW.0001: Generalized Regression		6 C 4 WLH
Learning outcome, core skills: The students • gain an overview on extended regression modelling techniques that allow to analyse data with non-normal responses. • learn about approaches for modeling nonlinear effects in scatterplot smoothing. • get an introduction to additive models and mixed models for complex regression analyses. • learn how to implement these approaches using statistical software packages.		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Generalized Regression (Lecture) <i>Contents:</i> Generalized linear models (binary and Poisson regression, exponential families, maximum likelihood estimation, iteratively weighted least squares regression, tests of hypotheses, confidence intervals, model selection and model checking, categorical regression models), nonparametric smoothing techniques (penalized spline smoothing, local smoothing approaches, general properties of scatterplot smoothers, choosing the smoothing parameter, bivariate and spatial smoothing, generalized additive models), mixed models, quantile regression		2 WLH
Course: Generalized Regression (Tutorial) <i>Contents:</i> Generalized linear models (binary and Poisson regression, exponential families, maximum likelihood estimation, iteratively weighted least squares regression, tests of hypotheses, confidence intervals, model selection and model checking, categorical regression models), nonparametric smoothing techniques (penalized spline smoothing, local smoothing approaches, general properties of scatterplot smoothers, choosing the smoothing parameter, bivariate and spatial smoothing, generalized additive models), mixed models, quantile regression		2 WLH
Examination: Written examination (90 minutes) or oral examination (approx. 20 minutes)		6 C
Examination requirements: In the exam, the students demonstrate their ability to choose, fit and interpret extended regression modeling techniques. They show a general understanding of the derived estimates and their interpretation in various contexts. The students are able to implement complex regression models using statistical software and to interpret the corresponding results. The exam covers contents of both the lecture and the exercise class.		
Admission requirements: none	Recommended previous knowledge: Basic knowledge of statistical modelling using linear regression models and knowledge of advanced statistical inference (Likelihood & Bayes)	

Language: English	Person responsible for module: Prof. Dr. Thomas Kneib
Course frequency: each summer semester	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester: 2
Maximum number of students: not limited	
Additional notes and regulations: The actual examination will be published at the beginning of the semester.	

Georg-August-Universität Göttingen Module M.iPAB.0003: Statistical genetics, breeding informatics and experimental design		6 C 4 WLH
Learning outcome, core skills: Novel biotechnological methods allow the production of very large data sets (gene sequences, genotypes, transcriptomes) at decreasing costs. Students learn about statistical and computational methods to use these records for breeding issues. Furthermore, the main experimental designs to plan, implement, and evaluate targeted and efficient experiments for data generation will be treated.		Workload: Attendance time: 56 h Self-study time: 124 h
Course: Statistical genetics, breeding informatics and experimental design (Lecture, Exercise) <i>Contents:</i> • Gene Expression Analysis • Genome-wide association analysis • QTL mapping • Statistical hypothesis testing • Regression methods • Analysis of variance • Multiple testing • Experimental designs (block designs, randomized designs, Latin squares) • Sample size estimation • Introduction to programming • Fundamentals of databases Literature: Andrea Foulkes: Applied Statistical Genetics with R; Francis O'Donnel: Statistical Experiment Design and Interpretation; An Introduction with Agricultural Examples		4 WLH
Examination: Written examination (60 minutes) Examination requirements: Profound knowledge of statistic and informatics methods to use them for breeding issues.		6 C
Admission requirements: none	Recommended previous knowledge: Basics in statistics and genetics	
Language: English	Person responsible for module: Prof. Dr. Armin Schmitt	
Course frequency: each winter semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester: from 1	
Maximum number of students: 20		

Georg-August-Universität Göttingen Module M.iPAB.0015: Applied Machine Learning in Agriculture with R	6 C 4 WLH
Learning outcome, core skills: Modern agricultural research involves more and more the analysis of large datasets comprising measurements of several variables. This module aims to teach interested students fundamental analysis skills that permit them to cope with such data sets. In more detail, the techniques that will be treated include: • clustering • artificial neural networks • support vector machine • decision trees • random forests • feature selection Involved mathematical formalism will be avoided. The focus is rather on: • gaining an intuitive understanding of the techniques • to develop an understanding about which type of problem can be treated with which technique • the application of the techniques using machine learning-functions under R • the graphical visualisation of the results • and the interpretation of the results The teaching will be based on the analysis of published real data sets from agricultural research projects as far as possible.	Workload: Attendance time: 56 h Self-study time: 124 h
Course: Applied Machine Learning in Agriculture with R (Block course) <i>Contents:</i> The course consists of lectures, exercises and project work. After the lectures and the exercises the students will have to carry out a project work that must be finished within eight weeks after the end of the lectures. The students as well as the other research groups are welcome to suggest topics, possibly questions related to their master thesis can be treated. The project work should be a concise written report of about ten pages in which one or several of the techniques that were treated in the course are applied.	4 WLH
Examination: Oral examination (approx. 20 minutes, 60%) and term paper (max. 10 pages, 40%) Examination requirements: • Knowledge about the analysis of big-data sets with the statistical package R and interpretation of the results. • Knowledge about different clustering algorithms • Analysis of real agricultural data sets by applying different machine learning-functions under R • Knowledge about feature selection approaches	6 C

Admission requirements: Recommended previous knowledge: Basic knowledge of R	Recommended previous knowledge: none
Language: English	Person responsible for module: Felix Heinrich
Course frequency: each winter semester	Duration: 1 semester[s]
Number of repeat examinations permitted: twice	Recommended semester:
Maximum number of students: 25	

Georg-August-Universität Göttingen Module M.iPAB.0019: Scientific Project: scientific methods, procedures and practical skills in animal and plant breeding		9 C 6 WLH
Learning outcome, core skills: Advanced knowledge of scientific methods, procedures and practical skills in the field of animal as well as plant breeding acquired by the active participation in a research project. Students also gain key competencies such as team working, interdisciplinary working, and self-organization.		Workload: Attendance time: 60 h Self-study time: 210 h
Course: Scientific Project: scientific methods, procedures and practical skills in animal and plant breeding <i>Contents:</i> Working on a scientific project in the different fields of breeding research. Testing of scientific hypotheses, experimental design, analysis of genotyping data, data analysis, interpretation and presentation of the research results.		6 WLH
Examination: Term paper (max. 20 pages) and short presentation Examination requirements: Active and independent working on a plant or animal breeding related scientific issue.		9 C
Admission requirements: The students, who are enrolled in the "Integrated plant and animal breeding (IPAB)" program, must get an approval from the program coordinator at least one month prior to the desired start date of the project.	Recommended previous knowledge: Basics of plant and animal breeding, statistics, and scientific writing	
Language: English	Person responsible for module: Thomas Martin Lange	
Course frequency: each semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: 25		

Georg-August-Universität Göttingen Module SK.Bio-NF.7001: Neurobiology		3 C 2 WLH
Learning outcome, core skills: The students should acquire comprehension in form and function of neurons and their anatomical and physiological features (genetics, subcellular organization, resting membrane potential, action potential generation, stimulus conduction, transmitter release, ion channels, receptors, second messenger cascades, axonal transport). The students acquire knowledge of the physiological basics of sensory systems (olfactory, gustatory, acoustic, mechanosensory and visual perception) as well as motor control. Based on this the students educe understanding for the relation between neuronal circuits and simple modes of behavior (central pattern generators, reflexes, and taxis movements). The students should conceptually learn how neuronal connections are modified by experience (cellular mechanisms of learning and memory) and should learn different types of modification of behavior based on experience and neuronal substrates. The students should acquire fundamental insight into the organization and function of brains and autonomous nervous systems of mammals and invertebrates. The neurobiological basis of behavioral control (orientation, communication, circadian rhythm and sleep as well as motivation and metabolism) is explained. The students will learn physiological and cellular mechanisms of aging and of neurodegenerative diseases.		Workload: Attendance time: 30 h Self-study time: 60 h
Course: Neurobiology (Lecture)		2 WLH
Examination: Written examination (90 minutes)		3 C
Examination requirements: The students should have the ability to assess coherence and facts of statements from the field of neurobiology; they should be able to answer questions on the structure and function of neurons and neuronal circuits. Furthermore they should be able to describe and compare neuronal basics of behavioral control, their experience-dependent modification and conceptual mechanisms of complex behavior; they should be able to describe and compare physiological mechanisms of sensory perception and different sensory modalities; they should be able to describe physiological and cellular mechanisms of aging and of neurodegenerative diseases.		
Admission requirements: none	Recommended previous knowledge: Basic knowledge in Biology	
Language: English	Person responsible for module: Prof. Dr. André Fiala	
Course frequency: each summer semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester: 4 - 6	
Maximum number of students: 30		

Additional notes and regulations:

The combination of this module with module SK.Bio.7001 is not possible.

Georg-August-Universität Göttingen Module SK.Bio.328: Scientific presentation and communication		3 C
Learning outcome, core skills: The students systematically summarise their research results and present them to an expert audience within the framework of a scientific conference. They are able to represent their own research project in disciplinary and interdisciplinary discourse and deepen their knowledge of representing their own positions in controversial discussions and constructively countering criticism. They develop contacts in the international scientific community and get to know new research and subject areas.		Workload: Attendance time: 28 h Self-study time: 62 h
Course: Active participation in a scientific conference		
Examination: Talk or poster presentation and discussion (15 minutes), not graded Examination requirements: The students give a lecture or poster presentation at a scientific conference (national or international) according to the specifications of the respective conference.		3 C
Admission requirements: none	Recommended previous knowledge: none	
Language: German, English	Person responsible for module:	
Course frequency: each semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: not limited		

Georg-August-Universität Göttingen Module SK.Bio.329: Research internship (4 weeks)		6 C
Learning outcome, core skills: After successful completion of the module, the student can... • demonstrate in-depth knowledge of current topics and research focuses in biology at an institution (MPI, institute abroad, etc.) with special consideration of modern methods • carry out the work carried out independently in connection with current research projects • document and record experiments and theoretical work related to current research projects in accordance with the usual standards.		Workload: Attendance time: 160 h Self-study time: 20 h
Course: Forschungspraktikum		
Examination: Ergebnisprotokoll in Form eines wissenschaftlichen Fachartikels (max. 5 Seiten), not graded Examination prerequisites: Erfolgreiche Teilnahme an einem mindestens 4-wöchigen Praktikum (160 Std.), Vortrag an der aufnehmenden Institution (entspr. den Gepflogenheiten vor Ort, mind. aber 20 min).		6 C
Examination requirements: Competent presentation of the research approach, the state of research, the methodology used and the results, discussion skills and critical thinking beyond one's own field of work		
Admission requirements: none	Recommended previous knowledge: none	
Language: German, English	Person responsible for module: Dean of studies	
Course frequency: each semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: not limited		

Georg-August-Universität Göttingen Module SK.Bio.331: Research internship (8 weeks)		12 C
Learning outcome, core skills: After successful completion of the module, the student can... • demonstrate in-depth knowledge of current topics and research focuses in biology at an institution (MPI, institute abroad, etc.) with special consideration of modern methods • carry out the work carried out independently in connection with current research projects • document and record experiments and theoretical work related to current research projects in accordance with the usual standards.		Workload: Attendance time: 320 h Self-study time: 40 h
Course: Forschungspraktikum		
Examination: Ergebnisprotokoll in Form eines wissenschaftlichen Fachartikels (max. 5 Seiten), not graded Examination prerequisites: Erfolgreiche Teilnahme an einem mindestens 8-wöchigen Praktikum (320 Std.), Vortrag an der aufnehmenden Institution (entspr. den Gepflogenheiten vor Ort, mind. aber 20 min).		12 C
Examination requirements: Competent presentation of the research approach, the state of research, the methodology used and the results, discussion skills and critical thinking beyond one's own field of work		
Admission requirements: none	Recommended previous knowledge: none	
Language: German, English	Person responsible for module: Studiendekanin / Studiendekan	
Course frequency: each semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester:	
Maximum number of students: not limited		

Georg-August-Universität Göttingen Module SK.Bio.332: Internship for master degree students		8 C
Learning outcome, core skills: After successful completion of the module ... - the student will have gained insights into the professional practice of biologists and experience in the practical application of methods and techniques as well as the practical implementation of theoretical knowledge in operational processes. - the student is familiar with the interrelationships and interactions of a company with authorities, suppliers, customers, marketing, sales, logistics, administration and research (external and internal) and can reflect on these. - the student is able to establish a connection to his/her previous studies and further study intentions.		Workload: Attendance time: 0 h Self-study time: 240 h
Course: Internship (240 hours) <i>Contents:</i> The work placement must be completed during the course of study at a facility, institution or company outside the University of Göttingen as described above. The contents are therefore largely determined by the same and in consultation with the student.		
Examination: Internship report (max. 15 pages), not graded		8 C
Examination requirements: The report contains information on the objectives, structure, range of activities, etc., of the institution at which the work placement was carried out as well as information on the activities carried out during the work placement. The report concludes with a critical review and reflection on the activities carried out and the host institution.		
Admission requirements: none	Recommended previous knowledge: none	
Language: German, English	Person responsible for module: Alle Dean of studies	
Course frequency: each semester	Duration: 1 semester[s]	
Number of repeat examinations permitted: twice	Recommended semester: 2 - 4	
Maximum number of students: not limited		

Georg-August-Universität Göttingen Modul SK.Bio.380: Magnetresonanztomographie: Grundprinzipien und Anwendungen <i>English title: Magnetic Resonance Imaging: Principles and Applications</i>		6 C 4 SWS
Lernziele/Kompetenzen: Die Studierenden erlangen Kenntnisse über die generellen physikalischen Grundlagen der MRT (NMR, Bildgebung, Kontraste), die verschiedenen MRT Modalitäten (MR-Spektroskopie, strukturelle MRI, funktionelle MR, Echtzeit-MR), Spezifika der MRT beim Tier, Tiermodelle, strukturelle und funktionelle MRT beim Menschen, Analysemethoden der aufgaben-basierten funktionellen MRT (Preprocessing, uni- und multivariate Analyseansätze), resting-state funktionelle MRT, interventionelle MRT und Kombination der Methoden in der multimodalen MRT. Nach Abschluss des Moduls haben die Studierenden das Wissen und das Verständnis für die zugrunde liegenden Mechanismen und Konzepte sowohl der MRT-Messtechniken, als auch der Analysemethoden entwickelt. Dies beinhaltet das Wissen über die angemessene Anwendung und die Grenzen der Methoden und Analysen. Die Studierenden sind in der Lage, im Transfer die Angemessenheit von wissenschaftsjournalistischen und Medienberichten über MRT-Studien und deren Ergebnisse fundiert beurteilen zu können.		Arbeitsaufwand: Präsenzzeit: 56 Stunden Selbststudium: 124 Stunden
Lehrveranstaltung: Einführung in Prinzipien und Anwendungen der MRT (Vorlesung) <i>Inhalte:</i> Grundprinzipien sowohl der unterschiedlichen MRT-Modalitäten als auch der verschiedenen MRT-Analyseansätze		2 SWS
Lehrveranstaltung: MRT in Biologie und Psychologie (Seminar) <i>Inhalte:</i> Vorstellung und Diskussion der angemessenen Passung von MR-Methodik, Analyse und wissenschaftlichen Fragestellung an entsprechenden Literaturbeispielen.		2 SWS
Prüfung: Klausur (120 Minuten) Prüfungsvorleistungen: Regelmäßige Teilnahme am Seminar und Vortrag (ca. 20 Minuten) mit anschließender Diskussion (ca. 10 Minuten)		6 C
Prüfungsanforderungen: Verständnis und wissenschaftliche Darstellung von Themen der MRT		
Zugangsvoraussetzungen: keine	Empfohlene Vorkenntnisse: keine	
Sprache: Deutsch	Modulverantwortliche[r]: Prof. Dr. Susann Boretius	
Angebotshäufigkeit: jedes Sommersemester	Dauer: 1 Semester	

Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester: 4
Maximale Studierendenzahl: 24	