Course Guide

Master Cognitive Science

Summer 2025

Version as of 31.03.2025

FIRST YEAR PROGRAM 2

C. Topics Selection 3

C1. Social Cognition & Meta-Science 3

C2. Perception & Action 11

C3. Memory, Learning & Decision Making 16

C4. Language, Logic & Categories 27

AM. Advanced Methods 36

AM1. Theory Formation & Conceptual Analysis 36

AM2. Advanced Analysis of Language & Logic 39

AM3. Behaviour Studies & Data Analysis 40

AM4. Computational Modeling 43

AM5. Special Methods in Neuroscience & Genetics 53

AM6. EEG-training 57

D1. Free Selection 58

SECOND YEAR PROGRAM 63

I. Interdisciplinary Research Module 63

I1. Cognitive Philosophy 63

I2. Psychology 66

I3. Computational Modeling 67

I4. Cognitive Neuroscience 73

Enrollment for Courses

Students are requested to register with the university's eCampus-system and should be aware of the deadlines. Exceptions include the courses in neural computation, e.g. held by Prof. Wiskott and Prof. Schöner. Here, there will be a manual enrollment in the first session/ enrolment via e-learning platform.

Please notice that one and the same course can only be used to be part of one module for each student. Double use of the same course is not allowed.

If you have studied at the RUB during your Bachelor's, please be aware that you are not allowed to take classes you have already completed in the Bachelor program again in the Master program.

IMPORTANT: The summer term starts on 01.04.2025. Please consult eCampus for up-to-date information regarding the course format, starting dates and further detail.

Please remember always to check time, place, and CP for your classes in eCampus and/or with the respective course instructor. These details in the course guide are subject to change and for your convenience only.

FIRST YEAR PROGRAM

Remarks for Essay Writing

For all students who need to learn how to write an essay or still feel insecure about it, we recommend in the summer term the following seminar:

"Writing a Bachelor or Master Thesis in English" by Prof. Dr. Christian Straßer and Prof. Dr. Dunja Šešelja. It can be evaluated as AM1 course.

C. Topics Selection

C1

C1. Social Cognition & Meta-Science

SEMINAR

SOCIAL NEUROSCIENCE (11902)

LAURA STEVENS

TERM:	Summer 2025
MEETING TIME:	Wednesday, 14 – 16 (First Meeting: 09.04.2025)
ROOM:	GABF 04/253
CP:	3

Social neuroscience is a rapidly growing field that integrates principles from psychology, sociology, and neuroscience to understand the neural basis of social behavior and interactions. The aim of this seminar is to provide an overview of this interdisciplinary field and the methods commonly used, as well as to discuss current research and future directions. The seminar will cover topics such as empathy, emotion recognition and contagion, social connection (e.g., loneliness and love), and social touch. It will also address neural mechanisms of impaired social functions due to trauma or psychological disorders. Methods such as behavioral tasks, neuroimaging (fMRI, fNIRS), EEG, tDCS, and psychophysiological measures will be explored and illustrated by discussing recent papers critically.

C1

C1. Social Cognition & Meta-Science

SEMINAR

DISKURS JOURNAL CLUB SOCIAL NEUROSCIENCE (118164)

PROF. DR. DIRK SCHEELE

TERM:	Summer 2025
MEETING TIME:	Wednesday, 12 – 14 (First Meeting: 19.04.2025)
ROOM:	GAFO 04/425
CP:	3

Language of instruction: German

In diesem Seminar wird über aktuelle Forschungsergebnisse der sozialen Neurowissenschaften diskutiert. Der Schwerpunkt liegt auf Studien, welche den Einfluss von sozialer Bindung und traumatischen Erfahrungen auf sensorische und interozeptive Wahrnehmung (bspw. Berührungen), episodisches Gedächtnis und soziale Synchronizität bei gesunden Proband*innen und Patient*innen mit psychischen Erkrankungen untersuchen. Neben den Befunden von klassischen univariaten Analysen werden die Ergebnisse von multivariaten fMRT-Auswertungen (bspw. MVPA) und innovative Protokolle von nicht-invasiver Hirnstimulation besprochen. Die genaue Auswahl der Literatur findet in Absprache mit den Teilnehmer*innen statt. Aktuelle Publikationen werden besprochen und methodenkritisch analysiert.

C1

Social Cognition & Meta Science

LECTURE

SOCIAL EPISTEMOLOGY OF SCIENCE (030008)

PROF. DR. DUNJA ŠEŠELJA

TERM:	Summer 2025
MEETING TIME:	Thursday, 16 – 18 (First Meeting: 10.04.2025)
ROOM:	Wasserstr. 221
CP:	3 or 6

This course offers a systematic introduction to the social epistemology of science, a field that examines the interplay between social dynamics —both within the scientific community and at the interface of science and society— and scientific inquiry. Through interactive lectures and discussions, we will explore central philosophical problems situated at the intersection of social epistemology and the philosophy of science. Topics include the relationship between science and society, the role of values in scientific inquiry, the social organization of science, the responsibilities of scientists, and expert disagreements. Students will engage with (parts of) scholarly papers in preparation for each class and will give a presentation of their research project at one of the classes in July. The aim of the research project is to apply theoretical insights gained throughout the course to a concrete scientific episode.

The lectures will take place every Thursday, 16:15-17:45 in Wasserstr. 221, 4th floor.

Literature: The reading list will be provided at the start of the course.

C1

C1. Social Cognition & Meta Science

BLOCK SEMINAR

FEMINIST PHILOSOPHY OF SCIENCE (030050)

PROF. DR. DUNJA ŠEŠELJA

TERM:	Summer 2025
MEETING TIME:	Thursday, 14:30 – 16:00 (First Meeting: 12.06.2025)
+ BLOCK:	21.7. & 22.7.25, 10 - 18
ROOM:	Seminar: Wasserstr. 221/4; Venue Workshop: tba
CP:	3 or 6

This block seminar explores key themes and debates in feminist philosophy of science, focusing on how feminist perspectives have influenced and challenged traditional epistemology and methodology of science.

The course is divided into two parts:

1) Introduction to the feminist philosophy of science: **every Thursday, 14:30-16:00, starting from June 12** in Wasserstr. 221, 4th floor.
2) The workshop: **July 21-22, 10:00-18:00**
   (The exact venue of the workshop will be specified at the start of the course).

In the first part, over five seminar meetings, students will engage with foundational texts, examining issues such as standpoint theory, the role of values in science, epistemic injustice, and intersectionality in knowledge production. In the second part, we will have a two-day workshop on *Contemporary Trends in Feminist Philosophy of Science*. The workshop will take place on July 21-22 (Monday and Tuesday after the end of the teaching period) and it will feature expert talks on cutting-edge topics, providing students with an opportunity to connect their learning to contemporary discussions and research.

C1

C1. Social Cognition & Meta Science

SEMINAR

STORIES OF SELVES: IDENTITY AND SOCIAL CONSTRUCTION IN PHILOSOPHY AND WESTERN LITERATURE (030104)

DR. LEDA BERIO

TERM:	Summer 2025
MEETING TIME:	Tuesday, 12 – 14 (First Meeting: 08.04.2025)
ROOM:	GABF 04/358
CP:	6

Western folk wisdom about personal identity tends to promote the idea that we have one stable and unified self, a relatively coherent core including values, preferences, and dispositions that define us no matter the context and situation. This is reflected in the value we attribute to coherence and authenticity as virtues to cultivate and pursue, and it is often tied to culturally-specific emphasis on individual psychology and on individuals as clearly distinct from their social environment. This class will look at philosophical theories of identity and the self and analyze fictional work through the lens of these theories: in particular, we will engage with how some works in European and American literature in the 20th century have conceived of the relationship between the self, society, social roles, and the act of narration. We will start by analyzing some of the main objections to the idea of a distinct, stable self. In doing so, we will also discuss philosophical accounts of self that stress the role of culture and socialization in the creation of our personal identities, as well as the role of narratives. We will then read and analyze a number of fictional texts (mostly from European and American literature of the 20th century) that engage with a variety of themes related to identity and the self: the (at times frightening) fragmentation and pluralization of the self, its narrative and perhaps fictional nature, its malleability, the (im)possibility of authenticity, and the loss of a sense of identity.

Literature:

Daniel Dennett. Self as a Centre of Narrative Gravity
John Barresi and Raymond, Martin. Western Theories of the Self
Marya Schechtman. The Narrative Self
Jennifer Radden. Multiple Selves
Charles Taylor. Sources of the Self: The Making of Modern Identity. (extracts)
Regina Fabry,. What is self narrative?
Dan P. McAdams,. " First we invented stories, then they changed us " : The Evolution of Narrative Identity Daniela Dover. The conversational Self
Judith Butler. Gender Trouble (extracts)
Erving Goffman. The Presentation of Self in Everyday Life (extracts)
Galen Strawson. Against Narrativity
Elizabeth Camp. Stories and Selves: A Twisted Love Story about the Meaning of Life
Jennan Ismael. Saving the Baby: Dennett on Autobiography, Agency, and the Self
Henry James. The Bostonians
Luigi Pirandello. One, no-one and one hundred thousand (extracts)
Luigi Pirandello. Six characters in search of an author
Milan Kundera. Life is Elsewhere (extracts)
Virginia Woolf. The waves (extracts)
Italo Svevo. Zeno ' s Conscience (extracts)
James Joyce. Portrait of the artist as a young man
David Foster Wallace. Good Old Neon
David Foster Wallace. Laughing with Kafka

C1

C1. Social Cognition & Meta-Science

SEMINAR

JONATHAN BIRCH: THE EDGE OF SENTIENCE (030079)

PROF. DR. TOBIAS SCHLICHT

TERM:	Summer 2025
MEETING TIME:	Friday, 10 - 12 (First meeting: 11.04.2025)
ROOM:	GA 03/46
CP:	tba

In this seminar, we will read Jonathan Birch's much-discussed new book *The Edge of Sentience*. It discusses conceptual, empirical and ethical issues related to the question which entities can be said or supposed to be sentient. It is open access and free for download on the website of Oxford University Press but it will also be available in a moodle course. The seminar will have three phases. In the first few weeks, we will try to get as far as possible into the book, then on June 12-13, Jonathan Birch will come to Bochum and give three lectures on the book, accompanied by talks from early career researchers. This workshop will provide ample opportunity for discussion and engagement with the author. Depending on how the seminar is developing, we will include the possibility for students to present posters at the workshop. The discussion language in class will be English.

Literature:

Jonathan Birch 2024: The edge of Sentience. OxfordUniversity Press.

C1

C1. Social Cognition & Meta-Science

SEMINAR

SOZIALPSYCHOLOGIE (GRUPPE 4/ GRUPPE 7)
- ATTITUDES & ATTITUDE CHANGE (112315 OR 112318)

DR. MORITZ INGENDAHL

TERM:	Summer 2025
MEETING TIME:	Wednesday, 12 - 14 / 14 – 16 (First meeting: 09.04.2025)
ROOM:	IA 1/87
CP:	3

You can only enroll for either course number 112315 OR course number 112318.

Autumn 2016: The (then) latest iPhone is launched on the market and the first Apple disciples set up their tents outside the Apple Store in Berlin or New York just five days before the launch. Five days without all the comforts of everyday life just to be the first person to hold a small, overpriced electronic gadget, probably soldered together by children's hands, which will be obsolete in three years' time. A few months later, the animal rights organization PETA is criticizing the video game Far Cry 5 from Ubisoft. The reason: you can fish in the game, which PETA says is "unethical and glorifies violence". The fact that the game is a first-person shooter with an 18+ age rating and therefore involves violence, especially against human characters, seems to be a minor matter. Both examples show this: We humans often commit irrational acts that are difficult for other people to understand because we find certain things very good or very bad - in other words, we have attitudes towards the iPhone, the Apple brand, violence, fishing, veganism. But what are attitudes anyway? Where do they come from? How can I measure them? And what consequences can they have? That's what we'll be looking at in this seminar!

Literature: Textbook: Vogel, T., & Wanke, M. (2016). Attitudes and attitude change. Psychology Press.

Students can receive 3 CP graded in this course.

C1

C1. Social Cognition & Meta-Science

SEMINAR

PHILOSOPHY OF PSYCHIATRY (030102)

DR. LEONARD DUNG

TERM:	Summer 2025
MEETING TIME:	Monday, 12 - 14 (First meeting: 07.04.2025)
ROOM:	GABF 04/511
CP:	3 or 6

The field of philosophy of psychiatry examines the conceptual, methodological, and ethical foundations of psychiatric theory and practice. This course introduces core themes and debates in this research area.

Central questions we will discuss include:

- What is a mental disorder?
- Are mental disorders biological or social?
- Do mental disorders even exist?

Literature:

The course literature will be provided on moodle. The language of the seminar and of all texts we will discuss is English.

Students can receive 3 CP ungraded, or 6 CP graded (for additionally submitting an essay).

C1

C1. Social Cognition & Meta-Science

SEMINAR

AKTUELLE THEMEN DER ERKENNTNISTHEORIE UND METAPHILOSOPHIE (030110)

JUN.PROF. DR. JOACHIM HORVATH

TERM:	Summer 2025
MEETING TIME:	Wednesday, 16 - 18
ROOM:	GAFO 04/619
CP:	3 or 6

Language of Instruction: German

In diesem Seminar, das auch Elemente eines Kolloquiums enthalten wird, werden wir aktuelle Themen aus der Erkenntnistheorie und der Metaphilosophie sowie verwandten Gebieten diskutieren. Gelegentlich wird es auch Vorträge von externen Gästen (auf Deutsch oder Englisch) geben, die in der Regel führende Experten auf ihrem Gebiet sind. Studierende im fortgeschrittenen Bachelor-, im Master- oder im Promotionsstudium sind im Seminar herzlich willkommen. Darüber hinaus haben die Teilnehmer*innen die Möglichkeit, Themen oder Arbeiten vorzustellen, die für sie von Interesse sind, einschließlich ihrer eigenen Arbeiten, zum Beispiel im Zusammenhang mit ihrer Abschlussarbeit (auf Deutsch oder Englisch).

C2

C2. Perception & Action

LECTURE

WAHRNEHMUNG (PERCEPTION) (118311)

PROF. DR. JONAS ROSE

TERM:	Summer 2025
MEETING TIME:	Wednesday, 10 – 12 (First Meeting: 09.04.2025)
ROOM:	IA 02/461
CP:	3

In this lecture, we will cover the neural basis of different sensory modalities. Starting with the physical stimulus and its detection at the receptor we will then continue along the sensory hierarchy in the brain. Finally, the modulation of the stimulus through attention, categorization and multimodal integration will be covered. In addition to our focus on human sensory systems, we will compare the sensory systems and capabilities of different species.

The lecture will be held in English.

C2

C2. Perception & Action

SEMINAR

WAHRNEHMUNG (PERCEPTION) (118312)

PROF. DR. JONAS ROSE

TERM:	Summer 2025
MEETING TIME:	Friday, 10 – 12 (First Meeting: 11.04.2025)
ROOM:	GA 04/187
CP:	3

This seminar complements the lecture 'perception' by adding a more hands-on approach. You will give short lectures and conduct mini-experiments to highlight specific topics and deepen the understanding of selected mechanisms.

C2

C2. Perception & Action

SEMINAR

JOURNAL CLUB: NEUROBIOLOGY (190573)

[WISSENSCHAFTLICHE PRÄSENTATIONEN IN ENGLISCH]

PROF. DR. MELANIE MARK

TERM:	Summer 2025
MEETING TIME:	Wednesday, 10- 11
ROOM:	ND 6/56a
CP:	3

This course is a weekly journal club with focus on neuroscience. Please contact sekretariat@neurobiologie.ruhr-uni-bochum.de or Melanie.Mark@rub.de for further information.

Requirements: basic understanding of neurosciences

C2

C2. Perception & Action

LECTURE & EXERCISE

AUTONOMOUS ROBOTICS: ACTION, PERCEPTION, AND COGNITION (211048)

PROF. DR. RER. NAT. GREGOR SCHÖNER

TERM:	Summer 2025
LECTURE:	Thursday, 14.15 – 16.00 (First Meeting: 10.04.2025)
EXERCISE:	Thursday, 16.15 – 17.00 (First Meeting: 10.04.2025)
ROOM:	NB 3/57
CP:	6

If this seminar is used for Module I3, it cannot be used for C2.

Autonomous robotics is an interdisciplinary research field in which embodied systems equipped with their own sensors and with actuators generate behavior that is not completely pre-programmed. Autonomous robotics thus entails perception, movement generation, as well as core elements of cognition such as making decisions, planning, and integrating multiple constraints. The main focus of the course are solutions to autonomous movement generation that are inspired by analogies with how nervous systems generate movement.

This course touches on various approaches to this interdisciplinary problem. The first half of the course focusses on movement generation for autonomous vehicles. The main emphasis will be on dynamical systems methods (attractor dynamics) for that problem, reviewing related approaches as well. The second half of the course will study motion in robot arms, including motion planning, timing, and control. Analogies with human movement will be exploited to illustrate ideas and problems, including the degree of freedom problem, coordination, and reflex control of muscles.

Requirements

The emphasis of the course is on learning concepts, practicing interdisciplinary scholarship including reading and writing at a scientific and technical level. Mathematical concepts are used throughout, so understanding these concepts is important. Mathematical skills are not critical to mastering the material, but helpful. The mathematics is mostly from the qualitative theory of dynamical systems, attractors and their instabilities. Short tutorials on some of these concepts will be provided.

Registration

Please register for the course here: https://www.ini.rub.de/elearning/

Further reading

Readings will be posted on the INI web page. Also have a look at the web page of the Dynamic Field Theory community that is interested in related problems and solutions: https://dynamicfieldtheory.org/

There you find more exercises, reading material, slides and lecture videos that have some overlap with the lecture.

Find more information on the INI web page: https://www.ini.rub.de/teaching/courses/autonomous_robotics_action_perception_and_cognition_summer_term_2025/

C2

C2. Perception & Action

BLOCK SEMINAR

HOW EMOTIONS ARE MADE: THE THEORY OF CONSTRUCTED EMOTION (030099)

DR. ELMARIE VENTER

TERM:	Summer 2025
BLOCK:	Mo – Fr, 21.7.25 – 25.7., 10 - 16
ROOM:	GABF 04/352
CP:	3 or 6

What if everything you thought you knew about emotions was wrong? Are emotions universal reactions hardwired into our brains, or are they constructed, shaped by our experiences, culture, and context? In this seminar, we'll explore Lisa Feldman Barrett's bold challenge to traditional theories of emotion and a compelling introduction to the cutting-edge science of the mind. Barrett argues that emotions are not pre-programmed, universal responses, but instead are actively constructed by the brain in real time. Through this lens, we'll investigate fascinating questions such as: Why do emotions feel so automatic if they are constructed? How do cultural differences shape the emotions we experience and express? Can we train our brains to construct healthier emotional responses? What does Barrett's theory reveal about other cognitive capacities, such as memory, perception, and decision-making? We'll also discuss the implications of Barrett's work for broader questions in psychology, neuroscience, and philosophy. For example, what does her theory tell us about the nature of consciousness? How does it reshape our understanding of mental health and emotional well-being?

Students can receive 3 CP ungraded, or 6 CP graded including an essay or oral exam.

Literature:

Feldman Barrett, L. 2017. How Emotions Are Made: The Secret Life of the Brain. Pan Macmillan UK

Additional literature will be provided on Moodle.

C2

Perception & Action

SEMINAR

DIE MACHT DER GERÜCHE. WIE DAS RIECHEN UNSER VERHALTEN BEEINFLUSST (118141)

PD DR. CHRISTOPH VAN THRIEL

TERM:	Summer 2025
MEETING TIME:	Tuesday, 16 – 18 (First Meeting: 08.04.2025)
ROOM:	IA 1/87
CP:	3

Language of instruction: German

Das olfaktorische System des Menschen unterscheidet sich erheblich von den anderen Sinnessystemen. Die physiologischen Grundlagen des Riechens sind im Einführungstext (Albrecht and Wiesmann 2006) beschrieben. In einem aktuellen Review (Stevenson 2010) werden drei Bereiche des Geruchssinns beschrieben, bei denen angenommen wird, dass das olfaktorische System das Verhalten des Menschen beeinflussen kann.

Diese Bereiche sind:

1. Nahrungsaufnahme/Ernährung
2. Vermeidung von Gefährdungen aus der Umwelt
3. Soziale Kommunikation

Ein weiterer, relevanter Bereich, der in diesem Review nicht angesprochen wird, ist die Wirkung von Gerüchen auf kognitive Leistungen (Beispieltext: Habel et al. 2007).

In den letzten Jahren beschäftigt sich die kognitive Neurowissenschaft zunehmend mit dem olfaktorischen System. Im Seminar sollen aktuelle Forschungsarbeiten zu den vier o.g. Funktionsbereichen referiert werden. Dabei können neben Humanstudien auch tierexperimentelle Studien vorgestellt werden. Die Themen/Studien werden während der Vorbesprechung vergeben. Dabei wird eine aktive Mitarbeit der TeilnehmerInnen bei diesem Auswahlprozess erwartet.

Literature:

Stevenson, R.J., 2010. An initial evaluation of the functions of human olfaction. Chem Senses 35, 3–20. https://doi.org/bjp083 [pii] 10.1093/chemse/bjp083

Hatt, H., 2019. Geruch, in: Brandes, R., Lang, F., Schmidt, R.F. (Eds.), Neuro- Und Sinnesphysiologie. Springer, Berlin, pp. 781–788. https://doi.org/10.1007/978-3-662-56468-4_62

Albrecht, J., Wiesmann, M., 2006. [The human olfactory system. Anatomy and physiology]. Nervenarzt 77, 931–939. https://doi.org/10.1007/s00115-006-2121-z

C3

C3. Memory, Learning & Decision Making

SEMINAR

DISCOURSE NEURAL BASIS OF LEARNING (118161)

PROF. DR. JONAS ROSE, ANNIKA VERFERS

TERM:	Summer 2025
MEETING TIME:	Monday, 8 - 10 (First Meeting: 07.04.2025)
ROOM:	GA 04/187
CP:	3

Current literature in cognitive neuroscience will be presented and discussed in depth. We aim to follow up on novel approaches, interesting angles and to have a critical discussion of research methods and interpretations.

C3

C3. Memory, Learning & Decision Making

SEMINAR

JOURNAL CLUB - NEUROCOGNITION OF SPACE AND MEMORY (118915)

DR. MARKUS WERKLE-BERGNER

TERM:	Summer 2025
MEETING TIME:	Preliminary meeting: 10.04.2025, 16-18 online via webex Thursday, 16 – 18
ROOM:	online via webex
CP:	3

Since Tolman introduced the concept of the cognitive map, the relationship between human cognition, memory, and space has been a central focus of research. The discovery of specialized neural coding mechanisms in the hippocampus, such as place cells and grid cells, has further spurred the search for unifying principles that link these domains. This course explores the foundational literature and key theories on shared representations of space, concepts, and memory.

Literature: will be provided at the start of the course

C3

C3. Memory & Learning

SEMINAR

DECISION THEORY: A PHILOSOPHICAL INTRODUCTION (030089)

DR. MINKYUNG WANG

TERM:	Summer 2025
MEETING TIME:	Thursday, 14 – 16 (First meeting: 10.04.2025)
ROOM:	GABF 04/609
CP:	3 or 6

This course introduces selected topics in decision theory, which has been developed to model normative and descriptive aspects of rational decision-making across various disciplines. Philosophers, in particular, have focused on the foundational issues of decision theory, and the application of its toolbox to solving philosophical problems. In this introductory course, we will explore formal explications and philosophical interpretations of some standard models for rational decisions made under certainty and uncertainty. Topics include rational preference and choice, as well as the von Neumann-Morgenstern and Savage models, along with their representation theorems.

Students can receive either 3 CP ungraded or 6 CP graded in this course.

Requirements:

A basic knowledge of first-order logic is assumed. Familiarity with probability calculus and set-theoretic reasoning is beneficial but not mandatory.

Literature:

Peterson, M. (2009). An Introduction to Decision Theory, Cambridge: Cambridge University Press.
Kreps, D. M.(1988). Notes On The Theory Of Choice, Boulder: Westview Press.
Savage, L. J. (1954). The Foundations of Statistics, New York: John Wiley and Sons.
Jeffrey, R. C. (1965).The Logic of Decision, New York: McGraw-Hill.

C3

C3. Memory & Learning

BLOCK SEMINAR

ADVANCED TOPICS IN DECISION THEORY (030090)

DR. MINKYUNG WANG

TERM:	Summer 2025
BLOCK:	21.07.25 – 25.7.25 (Mo – Fr), 12-18
ROOM:	GABF 04/358
CP:	3 or 6

This course introduces advanced topics in decision theory, including evidential and causal decision theory, decision-making under risk or ignorance, and dynamic choice. Students are expected to have a solid understanding of introductory decision theory and the mathematical preliminaries required to read and comprehend mathematical proofs related to decision theory. Therefore, it is highly recommended that students take "Decision Theory: A Philosophical Introduction" before enrolling in this course.

Students can receive either 3 CP ungraded or 6 CP graded in this course.

Literature:

Peterson, M. (2009). An Introduction to Decision Theory, Cambridge: Cambridge University Press.

Kreps, D. M.(1988). Notes On The Theory Of Choice, Boulder: Westview Press.

Savage, L. J. (1954). The Foundations of Statistics, New York: John Wiley and Sons.

Jeffrey, R. C. (1965).The Logic of Decision, New York: McGraw-Hill.

C3

C3. Memory & Learning

SEMINAR

GAME THEORY FOR PHILOSOPHY (030103)

MATTEO MICHELINI, PROF. DR. DUNJA ŠEŠELJA

TERM:	Summer 2025
MEETING TIME:	Wednesday, 10 – 12 (First Meeting: 09.04.2025)
ROOM:	GABF 04/352
CP:	3 or 6

This course explores the fascinating intersection of game theory and philosophy, where strategic thinking meets ethical dilemmas, scientific inquiry, and social dynamics. Game theory, extensively developed over recent decades, has become a powerful tool for addressing philosophical challenges, from collective action to the foundations of rationality.

In this course, you'll gain foundational game-theoretic tools to analyze a range of philosophical problems. We'll begin with accessible formal concepts, such as normal games, bargaining games, and evolutionary games, examining classic scenarios like the Prisoner's Dilemma and the Stag Hunt. In the second part, we'll explore how these tools illuminate pressing philosophical questions: What insights can game theory provide about scientific collaboration and epistemic games? How does evolutionary game theory explain the emergence of trust and cooperation?

Designed for students with no prior mathematical background, this course aims both at providing students with technical tools to handle game theoretical problems and to present how to use them to deal with philosophical problems.

References:

For the formal technical part I will mostly follow (but we will cover only few parts):
Leyton-Brown, K., & Shoham, Y. (2022). *Essentials of game theory: A concise multidisciplinary introduction*. Springer Nature. (https://www.gtessentials.org/)

We will choose the philosophical topics to discuss together. Accordingly, I will upload the necessary material on Sciebo. You can find an overview of possible topics related to philosophy in the following article:
Bruin, B. D. (2005). Game theory in philosophy. *Topoi*, *24*(2), 197-208.

Other possible works we could discuss include:
O'Connor, C. (2020). *Games in the Philosophy of Biology* . Cambridge University Press.
Skyrms, B. (2014). *Evolution of the social contract*. Cambridge University Press.
Bicchieri, C. (2005). *The grammar of society: The nature and dynamics of social norms*. Cambridge University Press.

C3

C3. Memory & Learning

SEMINAR

RATIONALITY AND EMOTIONS: HOW DO THEY INTERACT? (030098)

DR. SANJA SRECKOVIC

TERM:	Summer 2025
MEETING TIME:	Monday, 10 – 12 (First Meeting: 14.04.2025)
ROOM:	GABF 04/358
CP:	3 or 6

The course introduces the main philosophical perspectives on the relationship between rationality and emotions and how they interact. Central questions include: Do emotions and rationality oppose or complement each other? How do they shape one another? Are emotions rationally evaluable? What is the role of emotions in acquiring knowledge and rational decision-making?

Students can receive 6 CP for writing an essay or completing an oral exam, and 3 CPs (graded) for a class presentation or another similar assignment, and 3 CPs (ungraded) for regular attendance and completing weekly assignments.

C3

C3. Memory & Learning

SEMINAR

REINFORCEMENT LEARNING (211135)

PROF. DR. ROBERT SCHMIDT

TERM:	Summer 2025
MEETING TIME:	Monday, 10 - 12 (First meeting: 07.04.2025)
ROOM:	IC 03/449
CP:	3

Reinforcement Learning is one of the three main learning principles in machine learning and one of the most active research areas in artificial intelligence. It is a computational approach to learning in which an agent tries to maximize the total amount of reward it receives while interacting with a complex, uncertain environment.
This Bachelor seminar is based on the 2nd edition of the famous, seminal book on reinforcement learning written by Sutton and Barto (http://incompleteideas.net/book/the-book.html). The book introduces core topics of reinforcement learning from an artificial intelligence or engineering perspective, considering idealized learning situations, and evaluating the effectiveness of different learning methods. To effectively solve learning problems that are of scientific or economic interest, algorithms for machines are explored and evaluated through mathematical analysis and computational experiments. Compared to unsupervised or supervised learning approaches, reinforcement learning is more focused on goal-directed learning from interaction with the environment. The first part of the book addresses core concepts of reinforcement learning for problems with small state and action spaces, allowing for exact solutions using table-based methods. In the second part of the book these approaches are then extended using approximate methods for larger and more complex problems.

Learning Outcomes:

- Knowledge on different reinforcement learning algorithms
- Explain the underlying mathematical problem formulations and the implementation of the algorithms to solve them
- Gain insight into how to frame learning problems in the reinforcement learning framework
- Discuss practical applications of the theoretical frameworks
- Present the algorithms and mathematical problem formulations to an audience

Teaching form:
In the seminar sessions students will present chapters of the book “Reinforcement Learning”, followed by discussions on the chapter topics.

Exam: Oral presentation and active participation

Requirements:
Knowledge of calculus, linear algebra, and probability concepts. Background in artificial intelligence, e. g. via the course “Introduction to Artificial Intelligence”.

Registration: Seats are limited. If you want to participate, please send an e-mail to Prof. Schmidt: robert.schmidt@rub.de

C3

C3. Memory & Learning

LECTURE + EXERCISE

COMPUTATIONAL NEUROSCIENCE: VISION AND MEMORY (211049)

PROF. DR. RER. NAT. LAURENZ WISKOTT

TERM:	Summer 2025
EXERCISE:	Tuesday, 10.15 – 11.45 (First Meeting: 15.04.2025)
	(self-study time without teacher)
TUTORIAL:	Tuesday, 12.00 – 13.30 (First Meeting: 15.04.2025)
LECTURE:	Tuesday, 14.00 – 15.30 (First Meeting: 08.04.2025)
ROOM:	NB 3/72
CP:	6

If this course is used for Module I3, it cannot be used for C3.

This lecture covers basic neurobiology and models of selforganization in neural systems, in particular addressing

- Learning and self-organization
  - Hebbian Learning
  - Neural learning dynamics and constrained optimization
  - Dynamic field theory
- Vision
  - Receptive fields
  - Neural maps
- Hippocampus
  - Navigation
  - Episodic memory
  - Hopfield Network
  -

See also the corresponding learnscape (click here to get to a clickable version):

Learning outcomes (Lernziele):

After the successful completion of this course the students

- know basic neurobiological facts about the visual system and the hippocampus,
- know a number of related models and methods in computational neuroscience,
- understand the mathematics of these methods,
- can communicate about all this in English.

Teaching format:

One unit consists of a lecture of 90 min, self-study time over the week, group work on exercises without teacher for 90 min the week after the lecture, discussion of exercises and general Q&A session with teacher for 90 min right after, followed by the lecture of the next unit.

(more information next page)

[COMPUTATIONAL NEUROSCIENCE: VISION AND MEMORY (211049), Prof. Dr. Laurenz Wiskott]

Enrollment:
To enroll in this course with me, you just have to enroll in the Moodle course and participate. Details of registration via ecampus will follow via e-mail by the program coordinator.

Exam (Prüfungsformen): The course is concluded with an oral exam (possibly also a digital written exam, if there are many participants, as will be decided within the first two weeks).

Condition for granting the credit points: Passing the exam.

Requirements:
The mathematical level of the course is mixed but generally high. The tutorial is almost entirely mathematical. Mathematics required include calculus (functions, derivatives, integrals, differential equations, ...), linear algebra (vectors, matrices, inner product, orthogonal vectors, basis systems, ...), and a bit of probability theory (probabilities, probability densities, Bayes' theorem, ...).

Literature: Mostly lecture notes will be provided.

C3

C3. Memory, Learning & Decision Making

LECTURE & EXERCISE

INTRODUCTION TO COMPUTATIONAL NEUROSCIENCE (211046)

PROF. DR. SEN CHENG

TERM:	Summer 2025
LECTURE:	Monday, 16 – 18 (First Meeting: 07.04.2025)
ROOM:	NB 3/57
EXERCISE:	Friday, 10 – 12 (First Meeting: 11.04.2025)
ROOM:	NB 3/72
CP:	6

If this course is used for Module AM4, it cannot be used for C3.

Computational neuroscience uses quantitative methods to describe what nervous systems do, study how they function, and explain the underlying principles. This class introduces the basics of the mathematical and computational methods used in contemporary neuroscience research. These methods are applied to problems in perception, motor control, learning, and memory.

Knowledge of calculus, linear algebra, and statistics is required for this class, knowledge of neuroscience is not.

Assessment written final exam - 120 min - date: TBA

Course material available on Moodle (registration required)

Literature "Theoretical Neuroscience" by Dayan and Abbott, MIT Press

Contact:

Prof. Sen Cheng, NB 3/33, sen.cheng@rub.de

Office hours: Thursdays 14:00-15:00

Ms. Vinita Samarasinghe, NB 3/26, samarasinghe@inir.rub.de

Office hours: by appointment only

C3

C3. Memory & Learning

SEMINAR

FROM BIOLOGICAL TO ARTIFICIAL NEURAL NETWORKS (211131)

PROF. DR. SEN CHENG

TERM:	Summer 2025
MEETING TIME:	Tuesday, 10 – 12 (First meeting: 08.04.2025)
ROOM:	NB 3/57
CP:	3

Artificial neural networks were not only inspired by the brain, but were created in an effort to understand and model the functioning of the brain. In this seminar, we will read and discuss historic scientific articles that track the development of neural networks from the 1940s to the present. Specific topics include:

- McCulloch-Pitts Neurons/ Boolean networks
- Perceptron
- Hubel and Wiesel
- NeoCognitron
- Convolutional Neural Networks
- Hopfield
- Reservoir Computing
- LSTM
- RBM
- NetTalk
- AlexNet

Learning Outcomes:
After successful completion of this seminar, students will be able to

- read and understand scientific articles in neural network research
- know in which situations neural networks are applied
- understand and discuss the advantages and disadvantages of specific neural networks
- understand the historical development of neural networks
- present the results of research in neural networks to an audience

Examination: Oral Presentation

Requirements:
Solid knowledge of calculus, linear algebra, and statistics are required, e.g. Mathematik 1 und 2, Statistik. Knowledge of artificial neural networks.
Students should have taken the class “Artificial Neural Networks”, or something equivalent, before enrolling in this seminar.
Registration: Please get in touch with Vinita Samarasinghe (samarasinghe@ini.rub.de).

Literature:
The articles will be announced in the first meeting.
Background reading: “Neural Networks and Deep Learning” by Charu C. Aggarwal, Springer

C3

C3. Memory & Learning

SEMINAR

INTRODUCTION TO BAYESIAN MODELING (211144)

PROF. DR. RER. NAT. LAURENZ WISKOTT,
MERLIN SCHÜLER. M.SC.

TERM:	Summer 2025
MEETING TIME:	Monday, 10.15 – 11.45 (First meeting: 14.04.2025)
ROOM:	NB 3/72
CP:	3

The Bayesian perspective on probability is a cornerstone of modern applied statistics and probabilistic machine learning. Probabilistic models formulated in this framework allow to explicitly communicate and challenge assumptions, perform consistent reasoning, and quantify the uncertainty of predictions — they are a useful tool in data-driven research as well as decision-making.

This seminar aims to explore the conceptual foundations of building these models and employ them for statistical inference and is meant for students without significant prior exposure to the topic.

Literature:
The course is based on chapters of book „Statistical Rethinking“ by Richard McElreath with required reading and in-session discussion.

Assessment:
Depending on the students' course requirements, the course will be either graded or ungraded for the group. The grade will be determined by participation and the presentation of a topic during the course of the seminar.

Registration:
Please send an eMail to merlin.schueler@ini.rub.de until April 10th, 2025.
In this eMail, include your study program (e.g. Masters CogSci) and possible previous experience on the topic.

C4

C4. Language, Logic & Categories

SEMINAR

NATURAL LANGUAGE ONTOLOGY (030091)

JUN. PROF. DR. KRISTINA LIEFKE

TERM:	Summer 2025
MEETING TIME:	Monday, 14 – 16 (First Meeting: 07.04.2025)
ROOM:	GA 04/187
CP:	3 or 6

Natural languages (like English and German) assume many different kinds of objects. For example, to interpret the sentence *Every boy admires Mary*, we need to assume individuals (i.e. boys, Mary), properties (being a boy), relations (admire), etc.. This course investigates the ontological systems that arise from such assumptions. The study of such systems has recently gained momentum in the discipline of 'natural language ontology', which lies at the interface of metaphysics, philosophy of language, and philosophy of science.

The first half of the course will survey different strategies for identifying a language's ontological commitments. These strategies reveal a plethora (or 'zoo') of ontological categories that includes -- next to individuals, properties, and relations -- e.g. events, degrees, and kinds. The second half of the course will investigate how this 'zoo' can be reduced to a smaller set of categories, and will explain why such reduction is desirable. It will compare the ontological commitments of different reductions and will identify relations between different reduced ontologies. In this way, students will gain insight into the requirements on minimal ontologies and the challenges for ontology engineering.

Requirements: basic familiarity with logic and the philosophy of language

Literature:
Selected readings: All readings will be made available on Moodle.

Bach, E. (1986). Natural language metaphysics. In R.B. Marcus, G.J.W. Dorn, & P. Weingartner (eds.), *Logic, Methodology and Philosophy of Science VII* (pp. 573–593). Elsevier.
Liefke, K. (2024). *Natural Language Ontology and Semantic Theory*. Cambridge University Press. https://doi.org/10.1017/9781009307789
Liefke, K. (2025). *Reduction and Unification in Natural Language Ontology*. Cambridge University Press. https://doi.org/10.1017/9781009559683
Moltmann, F. (2022b). Natural language ontology. In E.N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy*: Winter 2022 edition. Metaphysics Research Lab, Stanford University.

Assessment:

Students can receive 3 CP for active participation and giving a presentation.
Students can receive 6 CP for giving a presentation + essay/oral exam.

C4

C4. Language, Logic & Categories

BLOCK SEMINAR

AN INTRODUCTION TO MATHEMATICAL PHILOSOPHY (030114)

DR. SAM SANDERS

TERM:	Summer 2025
BLOCK:	28.7.25- 01.8.25 (Mo-Fr), 9 - 18
ROOM:	GA 04/187
CP:	3 or 6

The idea of using mathematics to solve problems in philosophy is perhaps as old as the discipline itself. Recently, there have been concerted and systematic efforts, initiated by e.g. Hannes Leitgeb, to delineate this as a separate sub-field, christened mathematical philosophy.
In this class, we aim to keep the mathematics required basic but will still obtain meaningful results regarding e.g. vagueness and Quine-Putnam indispensability. An important goal is to show the limitations of mathematical philosophy while also stress its rich results.

Students can receive 3 CP for active participation and 6 CP graded for submitting a research paper.

C4

C4. Language, Logic & Categories

SEMINAR

THE EXPERIMENTAL INVESTIGATION OF LANGUAGE-RELATED PHENOMENA IN PHILOSOPHY, LINGUISTICS, AND COGNITIVE SCIENCE: EEG (030116)

PROF. DR. MARKUS WERNING, DR. MARIA SPYCHALSKA

TERM:	Summer 2025
MEETING TIME:	biweekly, Wednesday, 14 – 18
ROOM:	GABF 04/352
CP:	3 or 6

This course introduces EEG research in the area of philosophy of language, linguistics and cognitive science, especially focusing on semantics and pragmatics. It will include overview lectures of the method, in particular aspects such as experimental design, measurement, ERP components, basis principles of analysis and interpretation the results. The course will involve team project, where students will conceptualize their own study based on provided literature. Part of the course will involve consultation team-instructor meetings (also via zoom) aimed at discussing and improving the team projects. Final projects will be presented and discussed in class.

Prospective dates: 09.+30.04, 14.+28.05, 04.+25.06 (18.06. or 02.07. to be confirmed)

Requirements: Presentation and a team project

Literature: selected articles (to be provided)

C4

C4. Language, Logic & Categories

SEMINAR

INTRODUCTION TO PRAGMATICS IN PHILOSOPHY AND LINGUISTICS (030117)

PROF. DR. MARKUS WERNING, DR. MARIA SPYCHALSKA

TERM:	Summer 2025
MEETING TIME:	biweekly, Wednesday, 10 – 14
ROOM:	GABF 04/354
CP:	3 or 6

This course introduces basic notions and concepts in pragmatics such as implicatures, presuppositions, speech acts, deixis. We will read chapters from Levison “Pragmatics” and Huang “Pragmatics” as well as selected articles.Students will be expected to give a presentation in English and work on a pragmatics-related experimental project in a team. Part of the meetings will involve instructor-team consultations on the project (also via zoom).

Requirements: Active participation and a presentation in class

Literature:

Levinson, S. C. (1983). Pragmatics. Cambridge: Cambridge University Press.
Huang, Yan (2007). Pragmatics. Oxford University Press
Selected articles (to be provided)

C4

C4. Language, Logic & Categories

SEMINAR

FREGE: FOUNDATIONS OF ARITHMETIC, LOGICISM AND NEO-LOGICISM (030106)

PD DR. NILS KÜRBIS

TERM:	Summer 2025
MEETING TIME:	Thursday, 10 – 12
ROOM:	GABF 04/354
CP:	3 or 6

Frege's 'Foundations of Arithmetic' was the first book exclusively devoted to the philosophy of mathematics. It remains one of, perhaps the, most influential books on the topic. And it is not an overstatement to say that it is still the best. Few books can serve as an introduction as well as a source of inspiration for new research. Frege begins his book by asking what numbers are. Discussing, and mostly rejecting, various views earlier writers had put forward, he finally comes to his own solution, with some help from Hume and Leibniz: numbers are objects and the laws of arithmetic are nothing but laws of logic. This position was later called logicism, a version of which was also espoused by Russell. In this seminar, we will read the entire book from cover to cover, accompanied by Michael Dummett's commentary. Time permitting, we'll look at the more recent developments of Hale's and Wright's neologicism.

Literature:

Essential Reading

Gottlob Frege: Grundlagen der Arithmetik (Breslau: Koebner 1884). Nachdrucke und Neuausgaben bei Olms, Meiner, Reclam. English translations by Austin (Blackwell 1980) and Jacquette (Routledge 2016)
Michael Dummett: Frege. Philosophy of Mathematics (Oxford: Duckworth 1991)

Further Reading

Bob Hale and Crispin Wright: The Reason's Proper Study (Oxford University Press 2001)
Richard Heck: Frege's Theorem. (Oxford: Clarendon Press 2011)
Crispin Wright: Frege's Conception of Numbers as Objects (Aberdeen University Press 1983)

C4

C4. Language, Logic & Categories

SEMINAR

PHILOSOPHY AND ARGUMENTATION (030109)

JUN.PROF. DR. JOACHIM HORVATH

TERM:	Summer 2025
MEETING TIME:	Thursday, 14 – 16
ROOM:	GABF 05/703
CP:	3 or 6

It is almost a commonplace that rational argumentation – that is, the giving and demanding of reasons – is the central method of philosophy par excellence, and that most philosophers like nothing better than to argue endlessly and tirelessly with one another. All the more surprising, then, is the fact that in contemporary metaphilosophy many methods have received significantly more attention, even though they are far less central. Examples include the role of intuitions in philosophy, thought experiments or – more recently – the use of experimental methods in philosophy. It therefore seems timely to refocus on the role of argumentation as the central philosophical method. In this seminar, we will discuss metaphilosophical questions about the role of argumentation and disagreement in philosophy, as well as examine foundational approaches to argumentation theory and their relevance for philosophy. Basic knowledge of elementary logic and argumentation theory is helpful for the seminar but not required. Reading and discussing English texts, on the other hand, should not be a problem.

C4

C4. Language, Logic & Categories

LECTURE & EXERCISE

INTRODUCTION TO ARTIFICIAL INTELLIGENCE (211045)

PROF. DR. SEN CHENG, PROF. DR. RER. NAT. LAURENZ WISKOTT, PROF. DR. TOBIAS GLASMACHERS, PROF. DR. RER. NAT. GREGOR SCHÖNER, PROF. DR. CHRISTIAN STRAßER, PROF. DR. ROBERT SCHMIDT, PROF. DR. NILS JANSEN, PROF. DR.-ING. SETAREH MAGHSUDI

TERM:	Summer 2025
LECTURE:	Friday, 10 – 12 (First Meeting: 11.04.2025)
EXERCISE:	Friday 12-14 (First Meeting: 11.04.2025)
ROOM:	UFO 0/11
CP:	6

This course gives an overview over representative methods in artificial intelligence: formal logic and reasoning, classical methods of AI, probabilistic reasoning, machine learning, deep neural networks, computational neuroscience, neural dynamics, perception, natural language processing, and robotics.

Requirements: Basic knowledge of calculus and linear algebra.

Learning outcomes: After successful completion of this course, students will be able to

- summarize a number of fundamental methods in artificial intelligence,
- explain their mathematical basis and algorithmic nature,
- apply them to simple problems,
- decide which methods are suitable for which problems, and
- communicate about the above aspects in English.

Enrollment: All students must enroll in the Moodle course to receive the class material and announcements. If you have problems with that, please contact Aya Altamimi (aya.altamimi@ini.rub.de).

Examination: Condition for granting the credit points: Passing grade on final written digital exam (90 minutes). You can find more details about the examination here.

Every student who wishes to take the exam must register in the corresponding course in the RUB online exam system (https://online-exam.ruhr-uni-bochum.de/). You will take the exam in this Moodle environment.
Important: This is another instance of Moodle that looks the same, but it is different from the Moodle course that we use to share class materials and announcements!

For taking the exam, it is also required to be registered for the exam in ecampus. Details will follow via e-mail by the program coordinator.

C4

C4. Language, Logic & Categories

LECTURE

EINFÜHRUNG IN DIE SPRACHPHILOSOPHIE (030006)

JUN.PROF. DR. KRISTINA LIEFKE

TERM:	Summer 2025
MEETING TIME:	Thursday, 14 – 16 (First meeting: 10.04.2025)
ROOM:	GA 03/149
CP:	3 or 6

Language of instruction: German

Students receive 3 CPs for the solution of problem sets; 6 CPs for problem sets plus two take-home exams.

Die Vorlesung bietet eine Einführung in zentrale Fragen und Begriffe der zeitgenössischen Sprachphilosophie. Zentrale Fragen sind: *Was ist die Bedeutung von sprachlichen Ausdrücken? Wie kommt es, dass wir Sätze verstehen, die wir noch nie zuvor gehört/gelesen haben? Inwiefern wird Bedeutung vom jeweiligen Kontext und von den Absichten der Sprecher:in beeinflusst? Liegt Bedeutung im Geist [mind] des Sprechers/Hörers?*
Um diese (und andere) Fragen zu beantworten, ist die Vorlesung in vier Teile gegliedert: Teil I diskutiert die Bedeutung von sprachlichen Ausdrücken am Beispiel von Eigennamen. Im Mittelpunkt dieser Diskussion stehen Russells Kennzeichungstheorie, Freges Theorie von *Sinn* und *Bedeutung* sowie Kripkes kausal-historisches 'Bild' . Teil II erweitert diese Diskussion auf die Bedeutung anderer Ausdrücke (z.B. von Prädikaten) und auf die kompositionale Gewinnung von Satzbedeutung (aus der Bedeutung der Satzbestandteile). Teil III behandelt die Bedeutung von mentalen Einstellungsberichten (z.B. *Gil glaubt, dass es regnet*). Im Rahmen dieser Behandlung werden auch die für viele philosophische Disziplinen zentralen Konzepte 'Proposition' und 'mögliche Welt' eingeführt. Teil IV gibt einen Ausblick auf andere Dimensionen sprachlicher Bedeutung, insbesondere auf nicht-wörtlich kommunizierte Bedeutung, auf kontextabhängige Bedeutung (z.B. *Ich bin jetzt in GAFO 04-275*) und auf expressive Bedeutung (z.B. *Der verdammte Rechner ist abgestürzt*).

Requirements: Die Vorlesung setzt keine linguistischen Vorkenntnisse voraus.

Literature: Texte werden zu Semesterbeginn auf Moodle bereitgestellt. Die Texte sind größtenteils deutschsprachig, teils englischsprachig. Das wöchentliche Lesepensum umfasst ein (kurzes) Lehrbuch-kapitel (s.u.) sowie Auszüge aus einem Originalaufsatz (sofern verfügbar: in deutscher Übersetzung).

Kompa, Nikola (Hrsg.). 2015. *Handbuch Sprachphilosophie*. Stuttgart: J.B. Metzler.
Lycan, William G. 2019. *Philosophy of Language: A contemporary introduction* . 3. Auflage. New York und London: Routledge.
Textor, Mark (Hrsg.). 2004. *Neue Theorien der Referenz*. Mentis Anthologien Philosophie. Paderborn: Mentis.
Zimmermann, T. E. (2014). *Einführung in die Semantik* . Wissenschaftliche Buchgesellschaft, Darmstadt.

C4

C4. Language, Logic & Categories

LECTURE + EXERCISE

PRÄDIKATENLOGIK: LOGIK II (030007 & 030108)

PD DR. NILS KÜRBIS

TERM:	Summer 2025
LECTURE:	Wednesday, 14 – 16
ROOM:	HGA 30
EXERCISE:	Thursday, 14.00 – 16.00; + Thu (10.04.2025): 18.00 – 20.00
ROOM:	GABF 04/354
CP:	6

Language of Instruction: German

Vorlesung (030007): Aufbauend auf dem Kurs "Grundzüge der Logik. Logik I" werden in diesem Kurs Kenntnisse der formalen Logik vertieft. Grundlegende Begriffe wie Gültigkeit, Korrektheit/Richtigkeit, Vollständigkeit, axiomatische Beweissysteme und Systeme des natürlichen Schließens werden zunächst anhand der Aussagenlogik eingeführt und studiert, und dann zur Prädikatenlogik erster Stufe (mit Identität) erweitert.

Grundkenntnisse in Logik werden vorausgesetzt.

Übung (030108**):** In einer Übung zur Vorlesung, die integraler Bestandteil des Kurses ist, werden Übungsaufgaben bearbeitet und besprochen.

Teilnahme an der Übung ist nicht verpflichtend, aber sehr empfohlen.

In der Übung zur Vorlesung werden Übungsaufgaben hauptsächlich aus Endertons Buch zu Aussagen und Prädikatenlogik erster Stufe bearbeitet und besprochen.

Literatur:

Herbert B. Enderton: A Mathematical Introduction to Logic, 2nd ed. (San Diego etc.: Harcourt 2001)
Eliot Mendelson: Introduction to Mathematical Logic, 6th ed. (Boca Raton: CRC Press 2015)

AM. Advanced Methods

Advanced methods are usually studied in the second semester. Solely the "fMRI"-course is only offered during the winter term.

AM1

AM1. Theory Formation & Conceptual Analysis

SEMINAR, ESSAY WRITING COURSE

WRITING A BACHELOR OR MASTER THESIS IN ENGLISH (030107)

PROF. DR. CHRISTIAN STRAßER, PROF. DR. DUNJA ŠEŠELJA

TERM:	Summer 2025
BLOCK:	Friday, 25.4., 2.5., 23.5., 13.6., 4.7.,
	14.30 – 17:45
ROOM:	Wasserstr. 221 (online tutoring in between)
CP:	3 or 6

This is an Essay Writing Course in Philosophy: For all students who did not study philosophy during the BA program but need to learn how to write an essay or still feel insecure about it, we recommend this seminar.

In this course we will cover the basics of academic writing of philosophy theses and essays (including seminar papers, BA and MA theses), focusing on the following issues: How to structure and organize an academic article? How to concisely express the main thesis and aims of the paper? How to develop strong arguments? How to find the relevant sources? And so forth.

The seminar is targeted at students who are in the process of writing a Bachelor or Master thesis, or who will do so soon.

Students have opportunities to present ideas and drafts of chapters. In the seminar these contributions will be examined in terms of academic language, argumentative structure, style, etc. Students will give (guided) peer review of the contributions.

The seminar will take place in five blocks (April 25, May 2, May 23, June 13, July 4), each time at 14:30-17:45. In addition, students will have individual (online) coaching sessions in between the blocks.

AM1

AM1. Theory Formation & Conceptual Analysis

BLOCK SEMINAR

INTEGRATED HISTORY AND PHILOSOPHY OF SCIENCE (030113)

PROF. DR. DUNJA ŠEŠELJA

TERM:	Summer 2025
MEETING TIME:	Three Block: 10.05., 14.06., 19.07., 10:00 - 16:00
	(individual tutoring sessions in between the blocks)
ROOM:	Wasserstr. 221
CP:	3 or 6

The method of historical case studies is one of the central methodological approaches employed by philosophers of science. As Imre Lakatos famously put it "Philosophy of science without history of science is empty; history of science without philosophy of science is blind". But how and why do we conduct historical case studies? Which philosophical questions can benefit from such inquiry, and which conceptual tools can help us to formulate fruitful answers?

In this course you will learn the basics of Integrated History and Philosophy of Science (HPS). In particular, you will learn how to conduct historical case studies to tackle philosophical questions. The seminar will consist of three main blocks, as well as online coaching sessions in between them:

1) First block (May 10) will be dedicated to the employment of the HPS approach to the study of values in the context of scientific inquiry.
2) Second block (June 14) will be dedicated to the employment of the HPS approach to the study of scientific pluralism.

After the second block, you will choose a historical case-study, which you will investigate for the remainder of the course.

3) Third block (July 19) will be dedicated to student presentations in which each student will present the results of their work.

Before each block, you will have to complete an assignment, which will consist of writing short reviews of the assigned readings (Blocks 1 & 2) or slides for your presentation (Block 3). Moreover, at each block you will have to complete an additional assignment during the class: a team-work presentation of one of the readings (Blocks 1 & 2) or the presentation of your research (Block 3).

Literature: The reading list will be provided at the start of the semester.

AM1

AM1. Theory Formation & Conceptual Analysis

SEMINAR

PHILOSOPHICAL METHODS: AN INTRODUCTION (030112)

JUN. PROF. DR. JOACHIM HORVATH

TERM:	Summer 2025
MEETING TIME:	Thursday, 10.30 – 12 (First Meeting: 08.04.2025)
ROOM:	GAFO 04/619
CP:	3 or 6

In this seminar, we will discuss both general questions about methods, such as “What are methods in the first place?” and “How should methods be evaluated?”, and specific questions about philosophical methods, like “Are there any philosophical methods at all?”, “Are there uniquely or distinctively philosophical methods?”, “What are the main philosophical methods?”. In this context, we will also consider some philosophical methods in more detail, for example, argumentation, conceptual analysis, experimental philosophy, formal methods, and thought experiments. The course will be based on a manuscript version of the introductory volume Methods in Analytic Philosophy: A Primer and Guide (edited by Joachim Horvath, Steffen Koch, and Michael G. Titelbaum), which is forthcoming as an open access book with the PhilPapers Foundation. There will be some flexibility for the participants of the seminar to decide which philosophical methods they want to focus on, and for these selected methods we will also discuss further readings. Apart from the ability to read philosophical texts in English, some prior experience with actually doing philosophy would be very helpful for a seminar that reflects on methods as a key aspect of philosophical practice.

AM2

AM2. Advanced Analysis of Language & Logic

SEMINAR

ARGUMENTS IN ACTION: DEBATING (030115)

PROF. DR. DUNJA SESELJA, PROF. DR. CHRISTIAN STRASSER

TERM:	Summer 2025
MEETING TIME:	Fr. 9.5., 16.5., 30.5., 6.6., 20.6. 11.7., 14:30-17:30
ROOM:	Wasserstraße 221, 4th floor
CP:	3 or 6

Debating is practiced across the world as one of the most efficient methods of learning the skills of critical thinking and public speaking. In this course students will learn to debate according to some of the standard formats of structured debating, to compose a case for and against a given motion, to pose critical and clarificatory questions to an opponent, and to protocol and evaluate debates. Throughout the course, we will cover the basics of argumentation theory, applied to concrete examples and analyze arguments exchanges throughout the debate. To gain credit points, you are expected to be present at each class. To get a grade, you also have to submit an essay developing a case for and a case against a specific motion, which will be given at the end of the course.

The seminar will take place on 6 Fridays, each time from 14:30-17:30 in Wasserstr. 221: May 9, May 16, May 30, June 6, June 20, July 11.

Literature: The reading list will be provided at the start of the course.

AM3

AM3. Behaviour Studies & Data Analysis

LAB COURSE

OPEN NEURAL DATA (211426)

PROF. DR. ROBERT SCHMIDT

TERM:	Summer 2025
MEETING TIME:	Tuesday, 10 – 12 (First Meeting: 08.04.2025)
ROOM:	IB 02/139
CP:	3

In November 2022 the International Brain Laboratory has released an unprecedented Big Open data set with brain recordings. In an international collaboration between 12 different research groups neural activity in 194 different brain regions (that's basically all of them!) was recorded in mice performing a standardized decision-making task. The data contains activity of 32784 neurons, which allows, for the first time, to examine how activity in any part of the brain is related to sensory, cognitive, and motor processing. For the published data the Open Neurophysiology Environment (ONE) API is available to access and process the different types of data files. In this computer programming practical you will learn about the research questions surrounding this exciting dataset and how to access and process the data. First, we will study the available documentation about the data set and the provided API, and learn the basics about brain recordings. Second, we will access and process the data so that it can be analysed. Finally, we will apply modern data science methods (such as clustering, dimensionality reduction, or computational statistics) to analyse the data and learn about information processing in the brain.

Learning Outcomes:

- obtain hands-on skills in accessing and processing of Big Open Data
- acquire relevant domain knowledge at the intersection of computer science and neuroscience
- become familiar with neural signals and how they are processed using data science methods
- visualize and interpret the results of data analysis

Examination: Exercises and reports during the semester

Requirements: Programming in Python, APIs

Registration: Seats are limited. If you want to participate, please send an e-mail to Prof. Schmidt: robert.schmidt@rub.de

Literature: Link to the IBL dataset: https://int-brain-lab.github.io/iblenv/notebooks_external/data_release_brainwidemap.html

AM3

AM3. Behaviour Studies & Data Analysis

SEMINAR

VISUALIZING RESEARCH: A PRACTICAL GUIDE FOR THE ILLUSTRATION AND COMMUNICATION OF FINDINGS (110012)

DR. NAEM HAIHAMBO

TERM:	Summer 2025
MEETING TIME:	Tuesday, 14 – 16 (First Meeting: 08.04.2025)
ROOM:	IA 1/87
CP:	3

This course provides practical skills for visualizing data and designing figures for use in academic posters, presentations, and papers. Participants will learn techniques for creating clear, engaging, and scientifically accurate visualizations using tools such as MATLAB, R, readily available basic tools such as powerpoint and R, as well as online tools. Topics include the principles of effective design, selecting appropriate graph types, and tailoring visuals for different audiences. The course emphasizes hands-on activities, with participants working on their own data to create publication-ready figures.

Students can receive 3 CP graded in this course.
Literature: Literature will be announced in the first session.

AM3

AM3. Behaviour Studies & Data Analysis

BLOCK SEMINAR

DEVELOP AND CONDUCT NEUROPSYCHOLOGICAL BEHAVIORAL STUDIES (118151)

DANIEL PACHECO

TERM:	Summer 2025
PRELIMINARY MEETING:	25.4.25, 11:00 online
BLOCK:	Saturday 7.6.25. & Saturday 21.6.25, 9-18
ROOM:	GABF 04/516

The objective measurement and analysis of complex behavioral data in naturalistic paradigms are fundamental to cognitive neuroscience.

This seminar provides participants with hands-on experience in designing and implementing a behavioral experiment using Virtual Reality (VR).

Participants will receive a comprehensive step-by-step overview of the research process, from formulating research questions and identifying key design elements to conducting a VR experiment, collecting data, and performing statistical analyses. Through a combination of theoretical discussions, literature reviews, and practical sessions, students will gain a deep understanding of advanced behavioral research methods in cognitive neuroscience

AM3

AM3. Behaviour Studies & Data Analysis

BLOCK SEMINAR

SCIENTIFIC APPLICATIONS IN MATLAB (118162)

WEI LIN (WINSTON) SEAH, M.SC.

TERM:	Summer 2025
BLOCK:	Mo & Thu: 18.8.25, 21.8.25, 25.8.25, 28.8.25; 10.00 – 16.00
ROOM:	IB 02/109. PC-Pool
CP:	3

Working on real-world projects is essential for building up programming skills. Such projects are often open-ended with numerous possible approaches but also constrained by factors such as time and data quality. Solving problems under these conditions fosters creative thinking and strategic time management.

This block seminar introduces students to practical applications of MATLAB programming in scientific research and other related fields, such as data science and computer vision.

Students can receive 3 CP graded in this course.

Prerequisites:
Students are expected to have basic programming skills in MATLAB, or fluency in another programming language. It is recommended that you complete the “Programming in Matlab” (118155) Seminar for an introduction to MATLAB fundamentals, prior to participating in this block seminar.

While in-person meetings take place in a PC room, students are required to have their own devices with MATLAB installed to work on their projects on their own outside of meeting times.

AM4

AM4. Computational Modeling

SEMINAR

PROGRAMMIEREN IN MATLAB (118155)

DR. ROLAND PUSCH, PROF. DR. JONAS ROSE, SARA SANTOS SILVA

TERM:	Summer 2025
MEETING TIME:	Thursday, 14– 18 (First Meeting: 10.04.2025)
ROOM:	PC-Pool IB 02/109
CP:	6

Programming in Matlab

The aim of this seminar is to learn programming in Matlab. The course is suitable for students without prior programming experience. It consists of several components: During a lecture you will learn and practice new concepts, in the exercises following the lecture you will present and discuss demanding assignments that are to be prepared weekly at home. In an additional block seminar you will prepare the theoretical background of a small experiment that you will also program in Matlab, run, analyze and document with a protocol. For questions regarding the programming part of the seminar contact: jonas.rose@rub.de. For the theoretical part of the seminar contact: roland.pusch@rub.de

AM4

AM4. Computational Modeling

SEMINAR

WORKSHOP COMPUTATIONAL NEUROLOGY (200012)

PROF. DR. MED. XENIA KOBELEVA

TERM:	Summer 2025
MEETING TIME:	4.4 (online) - 11.4 (onsite) – 25.4 (online)- 9.5 (onsite) - 23.5 (online)- 6.6 (onsite) – 27.6 (online) 14.00 - 16.00 with 20min break inbetween
ROOM:	MB (South entrance), Floor 6, Seminar Room
CP:	3

Why attend?

This is a perfect starter course to understand more about modeling and computational techniques in neurology. The course will be a blend of theoretical concepts and practical application. Through group work you will gain the skills to develop your own modeling projects. We will work with real-life data of patients with neuropsychiatric diseases, creating opportunities for hands-on learning. Furthermore, the models you will develop have the potential to lead to real concrete applications for clinical practice! Projects developed during the course can be further refined beyond the workshop, possibly leading to bachelor and master theses and publishable research. Open to students from diverse disciplines, the course fosters interdisciplinary teamwork and emphasizes the importance of effectively communicating and collaborating with individuals from different academic and professional backgrounds. Besides computational neurology, by working in multidisciplinary teams you will learn to discuss with and understand the point of view of scientists with different backgrounds is a crucial skill in modern day science (in all fields).

Course syllabus:

First day (04/04): Intro to Python (online).

This day is tailored for students with little or no prior experience in programming. We will introduce fundamental concepts related to using Jupyter Notebooks and the basics of some widely used Python libraries (e.g., Numpy and Pandas), as well a small introduction to loading and plotting images. It serves as a gentle entry point for those who are new to programming. If you already use Python on a weekly basis or if you already have completed some projects you most likely will not benefit from this course and you can skip it.

Second day (11/04): Intro to Neuroanatomy, fMRI and neuropsychiatric diseases (onsite).

This day is designed to provide students with a comprehensive introduction to fMRI and neuroanatomy. This session will cover what fMRI is, what it measures, and (some of) its various applications. You will also learn about brain parcellations and how to connect them using diffusion tractography data. Furthermore, we will introduce neuropsychiatry. We will divide you into small groups of 4-5 people and we will assign each group to a specific disease and computational model combination. The overall goal of the group work, which will already start today with some brainstorming, will be to model brain activity changes in each disease using the assigned computational model.

(more information next page)

[Workshop Computational Neurology (118155), Prof. Dr. Xenia Kobeleva]

Third day (25/04): Single Node Neural Mass Models (online).
On this day, we will use the Kuramoto model to simulate the activity of a single brain region. We will evaluate its dynamic (e.g., oscillations) and its change according to different model parameters. Through hands-on exercises, you will have the opportunity to work with these models and gain practical experience in their application for your project.

Fourth day (09/05): Whole Brain Neural Mass Modeling of Healthy Subjects (onsite).
On the third day, we will create a real brain simulation. We will connect neural masses into a network, and we will fit this network to real empirical data so that the simulated brain activity resembles the real empirical one. We will also delve deeper into model fitting, and we will learn how to use both static and dynamic functional connectivity to make our brain simulations more realistic.

Fifth day (23/05): Whole Brain Neural Mass Modeling of Neurological Disorders (online).
The last day will be focused on strategies on how to implement disorder-specific aspects into whole-brain modeling.

Sixth day (06/06): Last session with group work and open questions (onsite).
During this session you will have opportunity to meet for group work and to get help with open questions to finalize your projects.

Final day (27/06): Virtual outro session (online).
As an output of the work, we ask you to prepare short presentations of the group work and reflections on interdisciplinary teamwork and modeling of neurological diseases.

Further Information:
As you can see in the syllabus, we will iterate between online (Zoom) and onsite sessions. Additional details regarding software to be installed before the workshop will be provided in due course. Since the project will involve combining expertise from both the biological/neuroscientific and the programming/computational world, there is no formal need for prior programming knowledge and some introduction will be given during a dedicated day. Nonetheless, to allow for a smooth completion of the group work, we will limit the number of participants that have no knowledge of programming to one per group.

Registration Information:
This is a course with limited spaces with strict selection of participants. For registration (and inquiries), please send us an email with your university, full name, field of study + semester, between 3 and 5 sentences about why you want to attend and why you should be accepted to the course (what can you bring to the group work) and one sentence on your previous knowledge in neuroscience and programming and whether you want to attend the programming day. In your statement we ask you to confirm that you will attend all sessions and participate in the group work. Please send all the information to: computationalneurology@ruhr-uni-bochum.de

AM4

AM4. Computational Modeling

LAB COURSE

AUTONOMOUS ROBOTICS (211423)

PROF. DR. RER. NAT. GREGOR SCHÖNER, STEPHAN SEHRING

TERM:	Summer 2025
MEETING TIME:	Preliminary Meeting: 28.08.2025 10.00 – 11.00 (NB 02/77)
	Block: 01.09.2025 - 05.09.2025, 10 – 18
ROOM:	NB 02/77
CP:	3

The practical course gives an introduction to mobile robotics with a focus on dynamical systems approaches. The open-source simulation environment Webots is used to control e-puck miniature mobile robots, equipped with a differential drive, combined infrared/proximity sensors and a video camera. The course covers elementary problems in robot odometry, use of sensors and motor control. It then teaches basic dynamic methods for robot navigation, in which the robot's sensors are used for obstacle avoidance and approach to a target location.

Assessment:

The practical part of the lab course consists of a week of full-time work in which students solve programming tasks with simulated mobile robots. In the two weeks following the practical part, the students then write reports in which they describe and analyze the work they have done. The grade for the lab course is based on both the practical work and the report. Students will get support during programming.

Registration:

Limited number of participants! Please enroll through our e-learning system on www.ini.rub.de from 31st of March to 16th of May 2025. A decision on participation will be published shortly afterwards.

AM4

AM4. Computational Modeling

LECTURE & EXERCISE

COMPUTATIONAL NEUROSCIENCE: SINGLE-NEURON MODELS (211039)

PROF. DR. ROBERT SCHMIDT, GERGÖ GÖMÖRI

TERM:	Summer 2025
LECTURE:	Thursday, 10.15 – 11.45 (First Meeting: 10.04.2025)
ROOM:	IA 1/91
EXERCISE:	Thursday, 12.30 – 14.00 (First Meeting: 10.04.2025)
ROOM:	MB 2/90
CP:	6

If this course is used for Module I3, it cannot be used for AM4.

This module starts with a primer on neuroscience and the role of computational neuroscience. The next part of the module covers biologically-grounded models of single neurons, including leaky-integrate-and-fire and conductance-based neurons, but also more abstract models of neural activity and spike trains. You will learn how these different computational models describe and simplify the underlying biological processes to a different degree. We will examine in detail how these different neuron models can be used in numerical simulations to address research questions on computation in single neurons and circuits. In the exercises accompanying the lectures you will gain hands-on experience in implementing the different neuron models in Python, running numerical simulations, and performing calculations related to analytical solutions of the model equations and biophysics. The focus is on single neuron models, but we will also make use of available software (e.g. NEST Desktop) to examine how single neuron models can be integrated into simulations of neural networks. While the emphasis throughout the module is on methodological issues, how models can be built, tested and validated at each level, we will also draw connections to specific brain regions to motivate and illustrate the models.

Learning Outcomes:

- apply techniques from computational neuroscience to simulate neural activity
- become familiar with different types of single neuron models, their mathematical description, and their different levels of biological abstraction
- acquire skills in modelling neurons, synapses and circuits and connect these models to biology and computation
- understanding of the biological basis for computation in neurons

Assessment: written exam at the end of the semester (120 min). Register for the exam in ecampus.
Requirements: Programming in Python, mathematical knowledge (linear algebra and calculus) and an interest in neurobiology

Literature:

Gerstner, W., Kistler, W. M., Naud, R., & Paninski, L. (2014). Neuronal dynamics: From single neurons to networks and models of cognition . Cambridge University Press.
Dayan, P., & Abbott, L. F. (2005). Theoretical neuroscience: computational and mathematical modeling of neural systems . MIT press.

AM4

AM4. Computational Modeling

LECTURE & EXERCISE

MATHEMATICS FOR MODELING AND DATA ANALYSIS (211047)

PROF. DR. LAURENZ WISKOTT

TERM:	Summer 2025
EXERCISE:	Thursday 9 – 10.30: self-study time without teacher (First Meeting: 17.04.2025)
TUTORIAL:	Thursday 10.30 – 12.00 (First Meeting: 17.04.2025)
LECTURE:	Thursday 12.15 – 13.45 (First Meeting: 10.04.2025)
ROOM:	NB 3/57
CP:	6

If this course is used for Module I3, it cannot be used for AM4.

This course covers some mathematical methods that are relevant for modeling and data analysis. Particular emphasis is put on an intuitive understanding as is required for a creative command of mathematics. The following topics are covered:

- Functions and how to visualize them
- Vector spaces
- Matrices as transformations
- Systems of linear differential equations
- Qualitative analysis of nonlinear differential equations
- Bayesian theory
- Markov chains

Teaching format:

One unit consists of a lecture of 90 min, self-study time over the week, group work on exercises without teacher for 90 min the week after the lecture, discussion of exercises and general Q&A session with teacher for 90 min right after, followed by the lecture of the next unit.

Enrollment: To enroll in this course with me, you just have to enroll in the Moodle course and participate.

Learning outcomes: After the successful completion of this course the students

- know the material covered in this course, see Content,
- do have an intuitive understanding of the basic concepts and can work with that,
- can communicate about all this in English.

Exam:

The course is concluded with an oral exam (possibly also a digital written exam, if there are many participants, as will be decided within the first two weeks). Registration for the exam with us happens at the end of the course.

You also need to register via ecampus. Details about this will be sent by the program coordination. There are no prerequisites for the exam, like 50% points in tutorials or the like.

Condition for granting the credit points: Passing the exam.

Requirements: Basic knowledge of linear algebra and calculus.

AM4

AM4. Computational Modeling

LAB COURSE

AN INTRODUCTION TO PYTHON FOR DATA ANALYSIS (211421)

PROF. DR. RER. NAT. LAURENZ WISKOTT, SHIRIN REYHANIAN MASHHADI

TERM:	Summer 2025
MEETING TIME:	Block (Mo-Fr): 01.09. - 12.09.2025, 10.30 – 16.30
ROOM:	IC 03/444-414
CP:	3

Python is a programming language that is widespread among scientists due to its readability and powerful standard libraries. This practical course teaches Python to students with prior experience in other programming languages. In addition to introducing the language itself, we will focus on scientific computing including vectors and matrices as well as data processing and mild machine learning. During the second week, participants will implement a project in Python.

Content

- **Python basics:** syntax, interpreter, control structures, data types, OOP
- **Scientific computing:** NumPy, Matplotlib, scikit-learn
- **Project:** realization of a project in Python

Grading

Grading is based on the project in the second week. If crucial components of Python are not covered in your project, we might also test your knowledge on the subject.

Requirements:

We expect fluency in one other programming language and familiarity with concepts like

- control structures
- data types
- functions
- object-oriented programming

These concepts will not be taught separately.

Furthermore, the course will be taking place in a room without PCs, meaning that students are required to use their own laptops during the course.

Registration:

Enroll by sending an email to python@ini.rub.de with the info below during this time window: **1.6.25 – 31.6.25**. 5 seats are reserved for CogSci Students.

In your mail please include:

name, student ID number (Matrikelnummer), study program and semester (e.g., "Bachelor Angewandte Informatik PO13, 3rd semester"), a short explanation about your coding experience (one or two sentences). We will inform you whether you are allocated a spot or not.

AM4

AM4. Computational Modeling

LECTURE & EXERCISE

INTRODUCTION TO COMPUTATIONAL NEUROSCIENCE (211046)

PROF. DR. SEN CHENG

TERM:	Summer 2025
LECTURE:	Monday, 16 – 18 (First Meeting: 07.04.2025)
ROOM:	NB 3/57
EXERCISE:	Friday, 10 – 12 (First Meeting: 11.04.2025)
ROOM:	NB 3/72
CP:	6

If this course is used for Module C3, it cannot be used for AM4.

Computational neuroscience uses quantitative methods to describe what nervous systems do, study how they function, and explain the underlying principles. This class introduces the basics of the mathematical and computational methods used in contemporary neuroscience research. These methods are applied to problems in perception, motor control, learning, and memory.

Knowledge of calculus, linear algebra, and statistics is required for this class, knowledge of neuroscience is not.

Assessment written final exam - 120 min - date: TBA

Course material available on Moodle (registration required)

Literature "Theoretical Neuroscience" by Dayan and Abbott, MIT Press

Contact:

Prof. Sen Cheng, NB 3/33, sen.cheng@rub.de

Office hours: Thursdays 14:00-15:00

Ms. Vinita Samarasinghe, NB 3/26, samarasinghe@inir.rub.de

Office hours: by appointment only

Enrollment: eCampus/Flexnow

AM4

AM4. Computational Modeling

SEMINAR

SEMINAR COMPUTATIONAL NEUROSCIENCE (211130)

PROF. DR. SEN CHENG

TERM:	Summer 2025
MEETING TIME:	Wednesday, 10 – 12 (First Meeting: 09.04.2025)
ROOM:	NB 3/57
CP:	3

Computational neuroscience uses quantitative methods to describe what nervous systems do, study how they function, and explain the underlying principles. This seminar will cover recent scientific publications in the field of computational neuroscience.

Specific topics:

- Neural Encoding
- Neural Decoding
- Information Theory
- The Action Potential
- Dynamics of Neural Networks
- Synaptic Plasticity
- Associative Networks
- Continuous Attractor Networks
- Associative Learning
- Classification
- Competitive Learning
- Generative Models

Learning Outcomes:
After successful completion of this seminar, students will be able to

- read and understand scientific articles in computational neuroscience
- apply computational models to describe the functioning of the nervous system
- understand the advantages and disadvantages of specific computational models
- discuss how neuroscience experiments are used to test computational models
- present the results of studies in computational neuroscience to an audience

Examination: Oral presentation
Registration: Please get in touch with Vinita Samarasinghe (samarasinghe@ini.rub.de)

Requirements:
Knowledge of calculus, linear algebra, and statistics are required, e.g. Mathematik 1 und 2, Statistik.
Knowledge of biology is not necessary, but basic computational neuroscience is.

Students should have taken the class „Introduction to Computational Neuroscience“, or something equivalent, before enrolling in this seminar. It is also possible to take this seminar in parallel with „Introduction to Computational Neuroscience“.

Literature:
The articles will be announced in the first meeting.
Background reading: “Theoretical Neuroscience” by Dayan and Abbott, MIT Press

AM4

AM4. Computational Modeling

LECTURE

MENSCHENZENTRIERTE ROBOTIK (136070)

JUN. PROF. DR. LAURA KUNOLD, PROF. DR.-ING BERND KUHLENKÖTTER, PROF. DR. ANNETTE KLUGE

TERM:	Summer 2025
MEETING TIME:	Tuesday, 14 – 17 (First Meeting: 08.04.2025)
ROOM:	Forschungszentrum für das Engineering Smarter Produkt-Service Systeme (ZESS)
CP:	6

Language of Instruction: German

Im Rahmen der Lehrveranstaltung werden die Studierenden in fachübergreifenden Gruppen an konkreten Problemstellungen im Bereich der menschenzentrierten Robotik arbeiten. Zur Gestaltung des soziotechnischen Systems aus Mensch(en) und Roboter(n), werden sowohl ingenieurwissenschaftliche als auch psychologische Fragen berücksichtigt. Dabei wird vor allem auf die mobile Servicerobotik und die Mensch-Roboter-Kollaboration eingegangen.

Zur menschengerechten Gestaltung der Interaktion mit der Roboterplattform, wird eine Einführung in psychologische Effekte der Mensch-Technik-Interaktion gegeben, sowie die soziale Robotik und ihre Anwendungsfelder vorgestellt.

Auf dieser Basis bearbeiten die Studierenden dann in interdisziplinären Gruppen individuelle Problemstellungen unter wissenschaftlichen Gesichtspunkten zur Behindertenhilfe. Hierbei steht thematisch die erfolgreiche Kommunikation und Interaktion zwischen Mensch und Roboter (und der Eindruck des Roboters auf dem Menschen) im Vordergrund. Es besteht die Möglichkeit die ausgearbeiteten Lösungsansätze zu implementieren und somit eine Validierung des Konzeptes durchzuführen.

Die erste Lehrveranstaltung findet am **08.04.2025** im Zentrum für das Engineering Smarter Produkt-Service Systeme (**ZESS**) statt. (Hans-Dobbertin-Str. 8, 44803 Bochum).

Link: https://moodle.ruhr-uni-bochum.de/course/view.php?id=34716)

AM5

AM5. Special Methods in Neuroscience & Genetics

SEMINAR

BIRDS IN SCIENCE (110013)

FARINA LINGSTÄDT

TERM:	Summer 2025
MEETING TIME:	Tuesday, 10 – 12 (First Meeting: 15.04.2025)
ROOM:	GAFO 04/271
CP:	3

Birds are part of a wide range of scientific studies. This course will provide an overview on the cognitive abilities of birds and how they are studied in the laboratory. We will start looking at the evolutionary history, that made bird brains vastly different from ours. From there on, each week we will talk about a different cognitive ability and how birds use their bird brains to exhibit them. We will look at purely behavioral as well as electrophysiological studies. In a short presentation, the students introduce each week's topic, which will be the basis of the course grade.

AM5

AM5. Special Methods in Neuroscience & Genetics

SEMINAR

TIERMODELLE IN DER PSYCHIATRIE (112636)

PATRICK REINHARDT

TERM:	Summer 2025
MEETING TIME:	Wednesday, 14 – 16 (First Meeting: 09.04.2025)
ROOM:	IA 02/452
CP:	3

Language of instruction: German

Wie verhalten sich schizophrene Mäuse? Können Ratten depressiv werden? Und warum werden Hamster nicht alkoholabhängig?
Tiermodelle sind in den Neurowissenschaften weit verbreitet, aber besonders im Kontext psychiatrischer Störungen nicht unumstritten. In diesem Seminar sollen unterschiedliche Tiermodelle psychiatrischer Störungen, ihre Aussagekraft und Limitationen besprochen werden. Ziel des Seminars ist es, den Teilnehmenden einen Überblick über Tierforschung im Kontext Psychiatrie zu geben, sowie sie in die Lage zu versetzen Studien methodenkritisch zu analysieren.
Die Basis des Seminars werden Impulsvorträge zu unterschiedlichen Modellen, sowie Gruppenarbeiten und Diskussionen im Plenum bilden.
Grundlegende Kenntnisse der klinischen Psychologie werden zur Teilnahme vorausgesetzt.
Literatur wird zu Beginn des Seminars bekanntgegeben.

Kontakt: patrick.reinhardt@rub.de

AM5

AM5. Special Methods in Neuroscience & Genetics

SEMINAR

INTRODUCTION TO NON-INVASIVE BRAIN STIMULATION (NIBS) TECHNIQUES AND THEIR APPLICATIONS (118313)

SUMIT ROY [PROF. DR. JONAS ROSE]

TERM:	Summer 2025
MEETING TIME:	Wednesday, 14 – 16
ROOM:	IA 1/161
CP:	3

In this course we will be exploring in detail different non-invasive brain stimulation techniques like transcranial magnetic stimulation (TMS) and transcranial electrical stimulation (tES). We will also talk about their current applications and recent developments in stimulation techniques. In the later weeks, students will be designing and presenting their research ideas pertaining to these techniques.

Students can receive 3 CP ungraded.

Lecturer: Sumit Roy (roy@ifado.de)

AM5

AM5. Special Methods in Neuroscience & Genetics

SEMINAR

UNLOCKING THE MYSTERIES OF SLEEP: FROM DREAMS TO DISORDERS (110018)

MOJGAN EHSANIFARD [PROF. DR. JONAS ROSE]

TERM:	Summer 2025
MEETING TIME:	Thursday, 10 – 12
ROOM:	IA 02/452
CP:	3

Why do we sleep? How does sleep shape our memory, emotions, and overall health? And what happens when sleep goes wrong? This seminar takes you on a fascinating journey through the science of sleep, exploring everything from sleep cycles and brain activity to the mysteries of dreams and the impact of technology on our rest. In this interactive seminar, we will explore sleep through thought-provoking discussions, hands-on exercises, and activities. You will learn how to score real EEG sleep data, investigate how sleep affects our minds and bodies, and dive into dreams, nightmares, and interventions for better sleep health. Whether you are curious about how sleep shapes learning and memory, how it connects to mental health, or lucid dreams, this seminar offers an exciting way to learn!

Key Topics Include:

- The History of Sleep Science
- Sleep Physiology & Brain Activity
- Sleep Across the Lifespan
- Sleep & Technology
- Sleep & Mental Health: How Sleep Shapes Our Emotions
- Dreams & Lucid Dreaming
- Nightmares & Therapies

You will also complete two at-home sleep scoring exercises to deepen your understanding of how sleep is measured in research and clinical practice.

Lecturer: Mojgan Ehsanifard

Assessment: Student Presentations + Sleep Scoring Exercises

Students can receive 3 CP graded in this seminar.

AM5

AM5. Special Methods in Neuroscience & Genetics

PRACTICAL COURSE

MOLEKULARE PSYCHOLOGIE: MOLEKULARGENETISCHES GRUNDPRAKTIKUM 1A (118156) OR 1B: (118159)

DR. DIRK MOSER

TERM:	Summer 2025
MEETING TIME:	Preliminary Meeting: 08.04.2025, 13.00 (IB 5/103)
	both blocks: 1 week at the start of the summer semester break
	(dates will be discussed in the preliminary meeting)
	Monday to Friday, 9 – 13
ROOM:	IB 5/103
CP:	3

Language of instruction: German

Es kann nur eine der beiden Veranstaltungen belegt werden.

Das Grundpraktikum "Molekulare Psychologie" soll interessierten Studierenden die Schnittmenge zwischen Psychologie und Biologie experimentell begreifbar machen. Hierzu wird jeder PraktikumsteilnehmerIn aus eigenem Blut DNA extrahieren und diese im Verlauf der Woche auf verschiedene, in der psychobiologischen Forschung prominente Genvarianten überprüfen. Hierzu finden eine Vielzahl molekularbiologischer Methoden Anwendung. Praktikumsbegleitend werden molekulare Grundlagen sowie experimentelle Möglichkeiten, sowie die Ergebnisse der eigenen praktischen Versuche in Spezialvorträgen präsentiert und diskutiert.

Voraussetzungen: Teilnahmevorraussetzung sind gute bis sehr gute Kenntnisse in Biologie/ Molekularbiologie/Psychobiologie

Literatur: Skript (wird nach der Vorbesprechung verteilt)

AM6

AM6. EEG-training

SEMINAR & PRACTICAL COURSE

NEUROPSYCHOLOGICAL METHODS: EEG

(118157 + 118158)

DR. LAURA-ISABELLE KLATT & DR. JULIAN ELIAS REISER

TERM:	Summer 2025
PRELIMINARY MEETING:	23.04.2025, 10.00 online
PRACTICAL COURSE:	17. & 18.05.2025, 9-18
SEMINAR:	26.05., 02.06., 16.06., 07.07. und 21.07., 10-14
ROOM:	Leibniz Institut für Arbeitsforschung in Dortmund
CP:	6

This course takes place at the *Leibniz Institut für Arbeitsforschung* in Dortmund (Ardeystr. 67, 44139 Dortmund).

Please make early decision and contact the lecturers running the courses: Please notice the entry conditions of the courses.

SEMINAR: Seminar course neuropsychological methods: EEG (118158)
& LAB (Laboratory Course): Practical course neuropsychological methods: EEG (118157):

Students must enroll for both the “practical course” and the “seminar course”. The practical laboratory course is directly linked to the accompanying seminar course (also 2 SWS). Participation in both courses is mandatory to complete the module.
Participants will learn how to collect and preprocess EEG data and how to conduct basic EEG analyses. On the basis of published neuroscientific literature students will develop a basic research questions and analyze the data accordingly. The course language is English. In-person lectures will be accompanied by materials and asynchronous video lectures on Moodle. Data collection (practical course) will take place as a blocked weekend session (Saturday and Sunday). In addition, 5 in-person sessions - 4 h each - will take place throughout the semester. The whole course takes place at the IfADo in Dortmund. The grade will be based on intermitting assignments throughout the semester.

Requirements:
Practical Course "MATLAB for Beginners" attendance mandatory OR check with course instructors if you have equivalent programming experience; Basic knowledge of statistical analyses (ANOVAs, t-tests, GLM) is required.

Literature:
An Introduction to the Event-Related Potential Technique, 2nd Edition (2014, MIT Press)
Steven J. Luck

D. Free Selection

Please notice that under the category "free selection" we only list courses held in German as additional offers. Please notice that you are only allowed to have maximally 15 CP from courses in German in the whole program.

Furthermore, any other course of the Cognitive Science Master Program can be counted as part of the free selection module, i.e., if you have completed (or have a clear plan of how you will complete) the obligatory modules, you may choose any additional courses from any module and credit them as part of the free selection module.

Additionally, it is possible to credit internships in the category of free selection. The internship must of course be equivalent in working hours to the number of credit points and it must qualify for the Cognitive Science Master Program (ideally supporting your master thesis). If you aim to credit an internship as part of this module, then please contact the program coordinator (cogsci-info@rub.de) in advance.

D1 Free Selection

LECTURE

KOGNITION UND GEHIRN (112611)

PROF. DR. OLIVER WOLF

TERM:	Summer 2025
MEETING TIME:	Monday, 12 – 14 (First Meeting: 14.04.2025)
ROOM:	HIB
CP:	3

Language of instruction: German

Die Vorlesung ist für Studierende ab dem 4. Semester geeignet. Sie bietet einen Überblick über Befunde und Theorien zu aktuellen Themen der kognitiven Neurowissenschaft. Die Vorlesung setzt Grundkenntnisse der Kognitionspsychologie und der Biopsychologie voraus, die bis zum 4. Semester vermittelt werden.

Literatur: wird zu Beginn der Veranstaltung bekannt gegeben und wird im Moodle zur Verfügung gestellt.

D1

Free Selection

LECTURE

EVOLUTION UND EMOTION (112251)

PROF. DR. PHIL. DR. H.C. ONUR GÜNTÜRKÜN

TERM:	Summer 2025
MEETING TIME:	Thursday, 16 – 18 (First Meeting: 10.04.2025)
ROOM:	HIA
CP:	3

Language of instruction: German

Wie verlief bisher die Geschichte des Lebens? Innerhalb welchen Gesamtszenarios bettet sich die Entstehung des Menschen ein und welche Anteile unseres heutigen Denkens, Handelns und Fühlens reflektieren die Gesetzmäßigkeiten, die bei der Phylogenese unseres Gehirns wirksam waren? Wie determiniert die Interaktion von Umweltfaktoren und genetischer Anlage unsere Entwicklung? Um solche Fragen beantworten zu können, müssen wir die Evolutionstheorie mit allen ihren Implikationen kennenlernen.

In der Vorlesung sollen folgende Themen behandelt werden:

1) Mechanismen der Genetik und Epigenetik
2) Verhaltensgenetik
3) Entwicklung des Lebens und des Menschen
4) Emotionsmechanismen
5) Soziobiologie

Literatur: Bekanntgabe der aktuellen Literatur während der Veranstaltung und über Moodle

D1

Free Selection

LECTURE

BIOPSYCHOLOGIE (112631)

PROF. DR. PHIL. DR. H.C. ONUR GÜNTÜRKÜN

TERM:	Summer 2025
MEETING TIME:	Monday, 16 – 18 (First Meeting: 07.04.2025)
ROOM:	HIA
CP:	3

Language of instruction: German

Das Wissen um Hirnaufbau und Hirnfunktion ist die Grundlage für das Verstehen sämtlicher bio- und neuropsychologischer Fragestellungen. In dieser Vorlesung wollen wir uns exemplarisch das Sehsystem des Menschen vornehmen. Wir wollen seine Funktionen verstehen, indem wir die Anatomie und Physiologie des Sehsystems kennenlernen und neuropsychologische Ausfälle anschauen. Danach wollen wir kennenlernen, wie die visuelle Information in die Prozesse des präfrontalen Cortex integriert wird, sodass die Fähigkeit zum Behalten, Planen und Handeln entsteht. Kurz gesagt, wollen wir die neuralen Grundlagen des Wahrnehmens und Erkennens kennenlernen.

Literatur:

Onur Güntürkün, Biopsychologie, Hogrefe Verlag 2012, Kapitel 5 - 12

Bekanntgabe weiterer aktueller Literatur während der Veranstaltung und über Moodle.

D1

Free Selection

BLOCK SEMINAR

NEUROPSYCHOLOGISCHE REHABILITATION I (118121)

PROF. DR. PATRIZIA THOMA

TERM:	Summer 2025
BLOCK:	Preliminary Meeting: Monday, 14.04.2025, 8.30-10.00 (IA 02/452)
	Saturday, 24.05.2025, 9 – 17 (GABF 04/516)
	Sunday, 25.05.2025, 9 - 17 (GABF 04/516)
CP:	3

Language of instruction: German

Bei dieser Veranstaltung haben die Studierenden der Master Psychologie Vorrang.

In diesem Seminar sollen Möglichkeiten und Grenzen kognitiver neuropsychologischer Rehabilitation am Beispiel verschiedener neuropsychologischer Störungsbilder wie z.B. Schlaganfall, Demenz oder Multiple Sklerose aufgezeigt werden. Es werden aktuelle Konzepte und Inhalte neuropsychologischer Therapien bei Gedächtnis- Aufmerksamkeitsdefiziten etc. dargestellt. Ebenso werden psychotherapeutische Möglichkeiten zur Bewältigung psychologischer Folgen bei neurologischen Erkrankungen aufgezeigt und diskutiert.

Literaturhinweise: Eine Literatur ist zu Beginn des Seminars erhältlich

D1

Free Selection

SEMINAR

PHILOSOPHIE DER KÜNSTLICHEN INTELLIGENZ (030019)

JUN.PROF. DR. JOACHIM HORVATH

TERM:	Summer 2025
MEETING TIME:	Wednesday, 14 – 16 (First Meeting: 16.04.2025)
ROOM:	GA 03/46
CP:	3 or 6

Language of Instruction: German

In diesem Begleitseminar wollen wir uns mit grundlegenden philosophischen Fragen und Problemen beschäftigen, die sich aus der rasanten Entwicklung und stark zunehmenden alltäglichen Anwendung von Systemen der Künstlichen Intelligenz (KI) ergeben. Dabei werden wir unter anderem die folgenden Themen behandeln: Was ist KI, wie funktioniert sie und was kann sie schon? Welche Risiken und Chancen ergeben sich aus ihrer Anwendung? Führt der Einsatz von KI zum „Ende der Arbeit“ – und welche Fragen der sozialen Gerechtigkeit ergeben sich daraus? Kann aus KI eine Superintelligenz entstehen, die eine existenziellen Bedrohung für uns darstellt – und mit welchen politischen Maßnahmen ließe sich das verhindern? Können KI-Systeme auch Geist und Bewusstsein entwickeln – und kann vielleicht sogar unser eigener Geist „digitalisiert“ werden? Welche Bedeutung haben KI-Systeme im Bildungsbereich und für unser Verständnis von geistiger Urheberschaft?

SECOND YEAR PROGRAM

I. Interdisciplinary Research Module

Choosing a course from C1 - C4 as a substitute for I1 - I4 is only possible if the substitute course is closely connected to your master thesis project.

Please notice that one and the same course can only be accepted as part of a single Module. It is prohibited to use the same course for two different Modules.

Usually, the interdisciplinary research modules should be completed in the third semester (winter semester). To keep flexibility for the students we offer some courses for these modules in the summer semester as well. Please check individually with the lecturer whether the colloquium will be held in English.

I1

I1. Cognitive Philosophy

COLLOQUIUM

COLLOQUIUM: PHILOSOPHY OF INFORMATION AND COMMUNICATION (030129)

JUN. PROF. DR. KRISTINA LIEFKE

TERM:	Summer 2025
MEETING TIME:	Tuesday, 12 – 14 (First Meeting: 08.04.2025)
ROOM:	GA 04/187
CP:	3 or 6

This colloquium (co-organized with Prof. Daniel Gutzmann, Germanistik) serves the discussion of current topics in semantics, pragmatics, and the philosophy of language. The colloquium combines talks by international experts with presentations of local researchers and (PhD/MA) students. Students will be given the opportunity to present their (ongoing) work in English. A detailed schedule will be available by mid-March at https://www.ruhr-uni-bochum.de/phil-inf/colloquium/index.html.en.

Assessment:
Students can receive 3 CP for active participation and giving a presentation.
Students can receive 6 CP for giving a presentation + essay/oral exam.

I1

I1. Cognitive Philosophy

COLLOQUIUM

PHILOSOPHY MEETS COGNITIVE SCIENCE: MEMORY AND LANGUAGE (030128)

PROF. DR. MARKUS WERNING

TERM:	Summer 2025
MEETING TIME:	Tuesday, 12 – 14 (First Meeting: 08.04.2025)
ROOM:	GA 04/187
CP:	3 or 6

In the research colloquium current topics at the interface between Philosophy and Cognitive Science will be discussed. The colloquium hosts talks by leading international experts and local researchers as well as presentations by doctoral and master students. Students will be given the (assisted) opportunity to present their projects in English.

This semester the sessions of the research colloquium will alternate in a bi-weekly rhythm between the topics “Memory” and “Language”. A detailed schedule will be published in due course at https://www.ruhr-uni-bochum.de/phil-lang/colloquium.html. Talks will be held either online via Zoom or in person.

Assessment:

Students can receive either 3 CP by giving a presentation or 6 CP by giving a presentation and writing an essay.

I1

I1. Cognitive Philosophy

COLLOQUIUM

RESEARCH COLLOQUIUM "LOGIC AND EPISTEMOLOGY" (030121)

PD DR. NILS KÜRBIS, DR. DANIEL SKURT

TERM:	Summer 2025
MEETING TIME:	Thursday, 16 – 18 (First Meeting: 10.04.2025)
ROOM:	GABF 04/358
CP:	3 or 6

In this colloquium students will have an opportunity to present a paper on a topic of their choice from philosophical logic or epistemology. This paper may or may not be related to an MA thesis. Background knowledge in analytic epistemology and philosophical logic is required. In addition to presentations by students, there will be talks by guests and invited speakers.

CP can be earned by giving an oral presentation.

I2

COLLOQUIUM

RESEARCH COLLOQUIUM IN COGNITIVE PSYCHOLOGY AND PSYCHONEUROENDOCRINOLOGY (118913)

PROF. DR. OLIVER T. WOLF

TERM:	Summer 2025
MEETING TIME:	Tuesday, 16 – 18
ROOM:	IB 6/127
CP:	3

Research talks on current topics in the areas of Cognitive Psychology and Psychoneuroendocrinology will be given by members from the department. In addition, external invited guests will present their latest findings. A timetable will be posted on the homepage of the department at the beginning of the semester.

Cognitive Science students can achieve 3 CP graded in this colloquium.

https://www.cog.psy.ruhr-uni-bochum.de/cog/teaching/colloquium/index.html.en

I3

I3. Computational Modeling

LECTURE & EXERCISE

COMPUTATIONAL NEUROSCIENCE: SINGLE-NEURON MODELS (211039)

PROF. DR. ROBERT SCHMIDT, GERGÖ GÖMÖRI

TERM:	Summer 2025
LECTURE:	Thursday, 10.15 – 11.45 (First Meeting: 10.04.2025)
ROOM:	IA 1/91
EXERCISE:	Thursday, 12.30 – 14.00 (First Meeting: 10.04.2025)
ROOM:	MB 2/90
CP:	6

If this course is used for module AM4, it cannot be used for module I3.

This module starts with a primer on neuroscience and the role of computational neuroscience. The next part of the module covers biologically-grounded models of single neurons, including leaky-integrate-and-fire and conductance-based neurons, but also more abstract models of neural activity and spike trains. You will learn how these different computational models describe and simplify the underlying biological processes to a different degree. We will examine in detail how these different neuron models can be used in numerical simulations to address research questions on computation in single neurons and circuits. In the exercises accompanying the lectures you will gain hands-on experience in implementing the different neuron models in Python, running numerical simulations, and performing calculations related to analytical solutions of the model equations and biophysics. The focus is on single neuron models, but we will also make use of available software (e.g. NEST Desktop) to examine how single neuron models can be integrated into simulations of neural networks. While the emphasis throughout the module is on methodological issues, how models can be built, tested and validated at each level, we will also draw connections to specific brain regions to motivate and illustrate the models.

Learning Outcomes:

- apply techniques from computational neuroscience to simulate neural activity
- become familiar with different types of single neuron models, their mathematical description, and their different levels of biological abstraction
- acquire skills in modelling neurons, synapses and circuits and connect these models to biology and computation
- understanding of the biological basis for computation in neurons

Assessment: written exam at the end of the semester (120 min). Register for the exam in ecampus.

Requirements: Programming in Python, mathematical knowledge (linear algebra and calculus) and an interest in neurobiology

Literature:

Gerstner, W., Kistler, W. M., Naud, R., & Paninski, L. (2014). Neuronal dynamics: From single neurons to networks and models of cognition . Cambridge University Press.

Dayan, P., & Abbott, L. F. (2005). Theoretical neuroscience: computational and mathematical modeling of neural systems . MIT press.

I3

I3. Computational Modeling

LECTURE & EXERCISE

AUTONOMOUS ROBOTICS: ACTION, PERCEPTION, AND COGNITION (211048)

PROF. DR. RER. NAT. GREGOR SCHÖNER

TERM:	Summer 2025
LECTURE:	Thursday, 14.15 – 16.00 (First Meeting: 10.04.2025)
EXERCISE:	Thursday, 16.15 – 17.00 (First Meeting: 10.04.2025)
ROOM:	NB 3/57
CP:	6

If this seminar is used for Module C2, it cannot be used for I3.

Autonomous robotics is an interdisciplinary research field in which embodied systems equipped with their own sensors and with actuators generate behavior that is not completely pre-programmed. Autonomous robotics thus entails perception, movement generation, as well as core elements of cognition such as making decisions, planning, and integrating multiple constraints. The main focus of the course are solutions to autonomous movement generation that are inspired by analogies with how nervous systems generate movement.

This course touches on various approaches to this interdisciplinary problem. The first half of the course focusses on movement generation for autonomous vehicles. The main emphasis will be on dynamical systems methods (attractor dynamics) for that problem, reviewing related approaches as well. The second half of the course will study motion in robot arms, including motion planning, timing, and control. Analogies with human movement will be exploited to illustrate ideas and problems, including the degree of freedom problem, coordination, and reflex control of muscles.

Requirements

The emphasis of the course is on learning concepts, practicing interdisciplinary scholarship including reading and writing at a scientific and technical level. Mathematical concepts are used throughout, so understanding these concepts is important. Mathematical skills are not critical to mastering the material, but helpful. The mathematics is mostly from the qualitative theory of dynamical systems, attractors and their instabilities. Short tutorials on some of these concepts will be provided.

Registration

Please register for the course here: https://www.ini.rub.de/elearning/

Further reading

Readings will be posted on the INI web page. Also have a look at the web page of the Dynamic Field Theory community that is interested in related problems and solutions: https://dynamicfieldtheory.org/

There you find more exercises, reading material, slides and lecture videos that have some overlap with the lecture.

Find more information on the INI web page: https://www.ini.rub.de/teaching/courses/autonomous_robotics_action_perception_and_cognition_summer_term_2025/

I3

I3. Computational Modeling

LECTURE & EXERCISE

MATHEMATICS FOR MODELING AND DATA ANALYSIS (211047)

PROF. DR. LAURENZ WISKOTT

TERM:	Summer 2025
EXERCISE:	Thursday 9 – 10.30: self-study time without teacher (First Meeting: 17.04.2025)
TUTORIAL:	Thursday 10.30 – 12.00 (First Meeting: 17.04.2025)
LECTURE:	Thursday 12.15 – 13.45 (First Meeting: 10.04.2025)
ROOM:	NB 3/57
CP:	6

If this course is used for Module AM4, it cannot be used for I3.

This course covers some mathematical methods that are relevant for modeling and data analysis. Particular emphasis is put on an intuitive understanding as is required for a creative command of mathematics. The following topics are covered:

- Functions and how to visualize them
- Vector spaces
- Matrices as transformations
- Systems of linear differential equations
- Qualitative analysis of nonlinear differential equations
- Bayesian theory
- Markov chains

Teaching format:

One unit consists of a lecture of 90 min, self-study time over the week, group work on exercises without teacher for 90 min the week after the lecture, discussion of exercises and general Q&A session with teacher for 90 min right after, followed by the lecture of the next unit.

Enrollment: To enroll in this course with me, you just have to enroll in the Moodle course and participate.

Learning outcomes: After the successful completion of this course the students

- know the material covered in this course, see Content,
- do have an intuitive understanding of the basic concepts and can work with that,
- can communicate about all this in English.

Exam:

The course is concluded with an oral exam (possibly also a digital written exam, if there are many participants, as will be decided within the first two weeks). Registration for the exam with us happens at the end of the course.

You also need to register via ecampus. Details about this will be sent by the program coordination. There are no prerequisites for the exam, like 50% points in tutorials or the like.

Condition for granting the credit points: Passing the exam.

Requirements: Basic knowledge of linear algebra and calculus.

I3

I3. Computational Modeling

LECTURE + EXERCISE

COMPUTATIONAL NEUROSCIENCE: VISION AND MEMORY (211049)

PROF. DR. RER. NAT. LAURENZ WISKOTT

TERM:	Summer 2025
EXERCISE:	Tuesday, 10.15 – 11.45 (First Meeting: 15.04.2025)
	(self-study time without teacher)
TUTORIAL:	Tuesday, 12.00 – 13.30 (First Meeting: 15.04.2025)
LECTURE:	Tuesday, 14.00 – 15.30 (First Meeting: 08.04.2025)
ROOM:	NB 3/72
CP:	6

If this course is used for Module C3, it cannot be used for I3.

This lecture covers basic neurobiology and models of selforganization in neural systems, in particular addressing

- Learning and self-organization
  - Hebbian Learning
  - Neural learning dynamics and constrained optimization
  - Dynamic field theory
- Vision
  - Receptive fields
  - Neural maps
- Hippocampus
  - Navigation
  - Episodic memory
  - Hopfield Network
  -

See also the corresponding learnscape (click here to get to a clickable version):

Learning outcomes (Lernziele):

After the successful completion of this course the students

- know basic neurobiological facts about the visual system and the hippocampus,
- know a number of related models and methods in computational neuroscience,
- understand the mathematics of these methods,
- can communicate about all this in English.

Teaching format:

One unit consists of a lecture of 90 min, self-study time over the week, group work on exercises without teacher for 90 min the week after the lecture, discussion of exercises and general Q&A session with teacher for 90 min right after, followed by the lecture of the next unit.

(more information next page)

[COMPUTATIONAL NEUROSCIENCE: VISION AND MEMORY (211049), Prof. Dr. Laurenz Wiskott]

Enrollment:
To enroll in this course with me, you just have to enroll in the Moodle course and participate. Details of registration via ecampus will follow via e-mail by the program coordinator.

Exam (Prüfungsformen): The course is concluded with an oral exam (possibly also a digital written exam, if there are many participants, as will be decided within the first two weeks).

Condition for granting the credit points: Passing the exam.

Requirements:
The mathematical level of the course is mixed but generally high. The tutorial is almost entirely mathematical. Mathematics required include calculus (functions, derivatives, integrals, differential equations, ...), linear algebra (vectors, matrices, inner product, orthogonal vectors, basis systems, ...), and a bit of probability theory (probabilities, probability densities, Bayes' theorem, ...).

Literature: Mostly lecture notes will be provided.

I3

I3. Computational Modeling

COLLOQUIUM
FORSCHUNGSKOLLOQUIUM COMPUTATIONALE NEUROLOGIE (200011)
JUN.-PROF. DR. MED. XENIA KOBELEVA

TERM:	Summer 2025
MEETING TIME:	Thursday, 16-18
ROOM:	partly Zoom, partly in building MB; OE Neurostimulation
CP:	3

For registration, please write an e-Mail to Prof. Kobeleva: xenia.kobeleva@rub.de

I3

I3. Computational Modeling

SEMINAR

JOURNAL CLUB: LEARNING AND MEMORY (211125)

PROF. DR. SEN CHENG

TERM:	Summer 2025
MEETING TIME:	Tuesday, 12-14 (First Meeting: 08.04.2025)
ROOM:	NB 3/57 (online/ hybrid)
CP:	3

This course can be assigned to module I2, too.

We will discuss the latest research results in learning and memory at the systems level. Each session will consist of either a presentation based on a published article or a research talk. Presentations will be given by one participant and will be followed by a group discussion. Research talks will be given by members of the computational neuroscience group or external invited guests. Some meetings will be held via video conferencing with participants from the USA. To accommodate the schedule of external participants, some meetings might have to be moved to a different date and time. The topics to be discussed will focus on the functional role of the mammalian hippocampus in spatial navigation and episodic memory. They will cover a diverse set of approaches: electrophysiology, imaging, computational modeling, and robotics. Students will select articles to present in consultation with the instructor.

Assessment: presentation in class

Prerequisites: advanced knowledge of learning and memory

Course material: available on Trello (www.trello.com/b/ETW0pTnY)

Capacity: max. 15 students

Enrollment: eCampus

Literature: journal articles to be selected by students in consultation with the instructor

Contact: Prof. Sen Cheng, NB 3/33, sen.cheng@rub.de
Office hours: Thursdays 14:00-15:00

14

I4. Cognitive Neuroscience

COLLOQUIUM

COLLOQUIUM: NEURAL BASIS OF LEARNING (118923)

PROF. DR. JONAS ROSE, DR. JESÚS BALLESTEROS CARRASCO

TERM:	Summer 2025
MEETING TIME:	Friday, 12 – 14 (First meeting: 11.04.2025)
ROOM:	GA 04/187
CP:	3

A broad range of current research topics in cognitive neuroscience will be covered by internal and external speakers. Our focus lies in a mechanistic understanding of crucial processes that in turn form the basis of higher cognition.
Students receive 3 CP graded for meeting the requirements of mandatory attendance and submitting an essay.

A schedule will be available on the homepage from the beginning of April.

https://www.ngl.psy.ruhr-uni-bochum.de/ngl/

14

I4. Cognitive Neuroscience

COLLOQUIUM

BIOPSYCHOLOGY RESEARCH COLLOQUIUM (118914)

PROF. DR. PHIL. DR. H.C. ONUR GÜNTÜRKÜN

TERM:	Summer 2025
MEETING TIME:	Monday, 13 – 15 (First meeting: 07.04.2025)
ROOM:	IB 6/127
CP:	3

The research colloquium is open to all employees and graduate students of the Biopsychology department. The aim is to present and discuss their research. In addition, external guests are invited to give talks on different aspects of biopsychology.

You can have a look at the schedule at the department's information board and our homepage: http://www.bio.psy.ruhr-uni-bochum.de/.

14

I4. Cognitive Neuroscience

COLLOQUIUM

RESEARCH COLLOQUIUM NEUROPSYCHOLOGY (118912)

PROF. DR. NIKOLAI AXMACHER

TERM:	Summer 2025
MEETING TIME:	Thursday, 14 – 16 (First Meeting: 10.04.2025)
ROOM:	IB 6/127
CP:	3

Presentation of ongoing research, as well as lectures by guest lecturers on clinical neuropsychological topics. A schedule with information about topics and speakers will be announced at the beginning of the semester via notice board and on the homepage: http://www.ruhr-uni-bochum.de/neuropsy/.

An important aim of this course, and basis for successful participation and grading, is a regular and active participation in the scientific discourse.

14

I4. Cognitive Neuroscience

COLLOQUIUM

COLLOQUIUM: BRAINS IN SPACE: AN INTERDISCIPLINARY RESEARCH COLLOQUIUM ON SPATIAL NAVIGATION (212164)

PROF. DR.SEN CHENG

TERM:	Summer 2025
MEETING TIME:	Tuesday, 16.00 – 17.30 (First appointment: tba)
ROOM:	virtually
CP:	if CP can be acquired or not will be announced before course start

In this colloquium, speakers will present their research in various areas of spatial navigation, including behavioral, neuroscientific, and theoretical approaches. The goal is to foster interdisciplinary discussions along the lines of the review article "A Map of Spatial Navigation for Neuroscience" (Parra-Barrero et al., 2023) that proposes a taxonomy of spatial navigation processes in mammals. The talks will cover a diverse range of topics, from the neural underpinnings of navigation to complex navigation behaviors. Attendees will gain a better understanding of how the mammalian brain represents and navigates through space, as well as learn about several cognitive processes such as learning and memory through the lens of spatial navigation.

Zoom link:
https://ruhr-uni-bochum.zoom-x.de/j/67839364827?pwd=RfclgK8OUfjkwWTNCf80ARXy118xe8.1

Literature:

Parra-Barrero, E., Vijayabaskaran, S., Seebrook, E., Wiskott, L., Cheng, S. (2023). A map of spatial navigation for neuroscience. *Neuroscience & Biobehavioral Reviews, 152.* https://doi.org/10.1016/j.neubiorev.2023.105200