Human Brain Project
Education Programme

HBP CURRICULUM
INTERDISCIPLINARY BRAIN SCIENCE

INFORMATION BROCHURE

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CONTENTS

LEGAL NOTICE

Media owner: HBP Outreach & Education Office at Medical University Innsbruck, Müllerstraße 59, 6020 Innsbruck, Austria.

ORGANISING INSTITUTIONS:

TEL AVIV UNIVERSITY אוניברסיטת תל אביב

UPPSALA UNIVERSITET

MEDIZINISCHE UNIVERSITÄT INNSBRUCK

MANCHESTER 1824 The University of Manchester

The University Of Sheffield.

Linnæus University

Co-funded by the European Union

Human Brain Project

University of Glasgow

I. HBP CURRICULUM: INTERDISCIPLINARY BRAIN SCIENCE

ONLINE COURSES & COMPLETING WORKSHOPS

The HBP Curriculum on Interdisciplinary Brain Science offers web-based distance learning courses. It provides basic lessons in HBP's core fields of neuroscience, medicine, cognitive systems and ICT for early career researchers outside their area of specialisation, as well as courses on the subjects of ethics and intellectual property rights, translation and exploitation of research.

Six courses are currently available online:

Courses for non-specialists:

- Brain medicine for non-specialists
- ICT for non-specialists
- Neurobiology for non-specialists
- Cognitive systems for non-specialists

Complementary courses:

- Research ethics and societal impact
- Intellectual property rights, translation and exploitation of research

By combining the Curriculum online courses with an HBP Education event that qualifies as a complimentary part of the online course, ETCS credits can be awarded.

PARTICIPATION & ACCREDITATION

The courses are open to the whole scientific community, regardless of an existing affiliation with the HBP or not, but we particularly encourage the following groups:

- Master's students already carrying out research
- PhD students
- Researchers who have received their doctoral degree, within the past three years at the time of their application

Online lectures are publicly available throughout the year and free of charge.

HBP Education events that qualify as a complimentary part for the online courses are published on https://www.humanbrainproject.eu/en/education/participatecollaborate/curriculum

Participants have the possibility to take an exam related to the courses. Upon successful completion, ECTS credits can be awarded. The credits are awarded by the Medical University of Innsbruck / Austria (MUI) if the following conditions are fulfilled:

- Registration for one or several Online Course(s) on Interdisciplinay Brain Science via email to curriculum.edu@humanbrainproject.eu
- Attendance of the online course(s)
- Full attendance of one HBP Education event
- Successful completion of exam(s)

For upcoming dates and deadlines please check our website.

The credits for the six courses are allocated as follows:

Brain medicine for non-specialists	**2.5 ECTS**
ICT for non-specialists	**1.5 ECTS**
Neurobiology for non-specialists*	Basic: **1 ECTS** Advanced: **1 ECTS**
Cognitive systems for non-specialists	**2 ECTS**
Research ethics and societal impact	**1.5 ECTS**
Intellectual property rights, translation and exploitation of research	**2.5 ECTS**

In total, it is possible to achieve a maximum of **12 ECTS credits** for all 6 courses.

Examination fee: 30€ (per exam).

Contact for questions and enquiries:
curriculum.edu@humanbrainproject.eu

* It is possible to only take the Basic exam, or both Basic and Advanced, but not only the Advanced exam.

IIa) BRAIN MEDICINE FOR NON-SPECIALISTS

The human mind is a complex system that produces, processes and transmits information in an incomparable manner. Human thoughts and actions depend profoundly on the proper function of neurons. If this function is disrupted, degeneration and disease can be the consequence. This course provides insights into state-of-the-art views on neurodegenerative, neuropsychiatric and neuroimmunological disorders as well as clinical neuroanatomy and clinical aspects of brain imaging. Apart from the scientific understanding of specific disorders and their treatment, it also discusses the latest findings in research and therapeutics. The Medical Informatics Platform developed in the Human Brain Project is introduced with an example of how a big data approach may have the potential to improve diagnosis and therapeutic concepts of neurological diseases. Contributions for this course come from renowned researchers and clinicians from Israel, Austria and Switzerland.

2.5 ECTS credits

Course Director:
Uri Ashery (Tel Aviv University)

https://www.humanbrainproject.eu/en/education/participatecollaborate/curriculum/online-course/brain-medicine-for-non-specialists/

LECTURES

Lecture 1, Part 1: The natural history of neurodegenerative diseases: Can we modify it?
Nir Giladi (Tel Aviv University)

Lecture 1, Part 2: The natural history of neurodegenerative diseases: Can we modify it?
Nir Giladi (Tel Aviv University)

Lecture 2: Neuroimmunology: The brain as a cognitive antigen
Anat Achiron (Tel Aviv University)

Lecture 3: Motivation and addiction: Neuronetworks and treatment targets
Gerald Zernig (Medical University Innsbruck)

Lecture 4, Part 1: Clinical aspects of brain imaging
Dafna Ben Bashat (Tel Aviv University)

Lecture 4, Part 2: Clinical aspects of brain imaging
Dafna Ben Bashat (Tel Aviv University)

Lecture 5: Neurodegenerative diseases – En route to early detection and prevention
Nir Giladi (Tel Aviv University)

Lecture 6: Introduction to schizophrenia
W. Wolfgang Fleischhacker (Medical University Innsbruck)

Lecture 7: Affective disorders: Depression and somatic co-morbidity
Barbara Sperner-Unterweger (Medical University Innsbruck)

Lecture 8: A manic depressive history: The genetic dissection of complex neuropsychiatric disorders
Sven Cichon (University of Basel)

Lecture 9: HBP Medical Informatics Platform: Parkinson‘s disease & more…
Bogdan Draganski (Lausanne University Hospital)

Lecture 10: Principles of neuropharmacology
Sandra Santos-Sierra (Medical University Innsbruck)

IIb) ICT FOR NON-SPECIALISTS

“Computational Thinking“ refers to a mindset or set of tools used by computational or ICT specialists to describe their work. This course is intended for people outside of the ICT field to allow them to understand the way computer specialists analyse problems and to introduce students to the basic terminology of the field.

In particular, material is provided on: Complexity measures, computability, numerical analysis, software engineering, data management, electronics and chip design, and the ethical considerations involved in ICT.

1.5 ECTS credits

Course Director:
David Lester (The University of Manchester)

https://www.humanbrainproject.eu/en/education/participatecollaborate/curriculum/online-course/ict-for-non-specialists/

LECTURES

Lecture 1: Computational complexity
David Lester (The University of Manchester)

Lecture 2: Numbers, errors, chaos
David Lester (The University of Manchester)

Lecture 3: Turing, computability, halting problem
David Lester (The University of Manchester)

Lecture 4: Introduction to software engineering
Jeff Muller (École Polytechnique Fédérale de Lausanne)

Lecture 5: Cheap as chips!
Steve Furber (The University of Manchester)

Lecture 6: Advanced data management
Thomas Heinis (Imperial College London)

Lecture 7: Querying and analysing big scientific data
Thomas Heinis (Imperial College London)

Lecture 8: Electronics and VLSI
Andreas Grübl (Heidelberg University)

IIc) NEUROBIOLOGY FOR NON-SPECIALISTS

The field of neuroscience is one of the most interdisciplinary scientific fields. It is constantly expanding and developing further and it unites researchers from a vast variety of backgrounds such as chemistry, biology, physics, medicine or psychology. By examining the principles that influence the development and function of the human nervous system, it advances the understanding of the fundamental mechanisms of human behaviour, emotions, and thoughts, and what happens if they fail. This course addresses the basic principles relevant for the performance and evolution of the nervous system and provides an overview for PhD students from a different area of specialisation. It further includes advanced lectures on more specific questions and challenges of the field.

2 ECTS credits

Course Directors:
Alois Saria (Medical University Innsbruck)
Christoph Schwarzer (Medical University Innsbruck)

https://www.humanbrainproject.eu/en/education/participatecollaborate/curriculum/online-course/neurobiology-for-non-specialists/

LECTURES

Part 1: Basics

Lecture 1: Intercellular signal transduction
Christoph Schwarzer (Medical University Innsbruck)

Lecture 2: Intracellular signal transduction
Christoph Schwarzer (Medical University Innsbruck)

Lecture 3: Glial cells
Christine Bandtlow (Medical University Innsbruck)

Lecture 4: Myelination in the CNS and PNS
Christine Bandtlow (Medical University Innsbruck)

Lecture 5: Neuronal networks
Christoph Schwarzer (Medical University Innsbruck)

Lecture 6: Basic neuroanatomy
Lars Klimaschewski (Medical University Innsbruck)

Lecture 7: Nociceptors and perception of pain
Serena Quarta (Medical University Innsbruck)

Part 2: Advanced

Lecture 1: Neuroinflammation and demyelination
Markus Reindl (Medical University Innsbruck)

Lecture 2: Neurodegenerative diseases – En route to early detection and prevention
Nir Giladi (Tel Aviv University)

Lecture 3: Learning and memory: Basic concepts and medical implications
Nicolas Singewald (University of Innsbruck)

Lecture 4: Learning and memory: Underlying mechanisms and networks
Francesco Ferraguti (Medical University Innsbruck)

Lecture 5: Motivation and addiction: Neuronetworks and treatment targets
Gerald Zernig (Medical University Innsbruck)

Lecture 6: Computational neuroscience: Bridging brain scales with mathematics
Gaute Einevoll (Norwegian University of Life Sciences)

Lecture 7: The human brain atlas as a part of the HBP Neuroinformatics Platform
Timo Dickscheid (Forschungszentrum Jülich)

Lecture 8: Principles of neuropharmacology
Sandra Santos-Sierra (Medical University Innsbruck)

IId) COGNITIVE SYSTEMS FOR NON-SPECIALISTS

Cognitive systems are devices that are designed to mimic cognitive skills of higher developed biological organisms at varying levels of complexity and performance. Models of these skills can be either abstract functional descriptions from the vast field of cognitive science or detailed simulations of brain circuits from neuroscience. Novel hardware designs and the steadily increasing availability of cheap computing resources have recently yielded remarkable results especially with the latter models. The goal of this course is to provide a definitive introduction to the theory of cognitive systems. Drawing from advances in brain research, the topic is approached from a computational-neuroscientific perspective rather than an abstract-psychological one, bridging the gap between the physical structure of the brain and the logical organisation of its cognitive capabilities. Special focus is put on the role of robotics as a means to ground cognitive function in bodies that physically interact within different types of environments.

2 ECTS credits

Course Directors:
Lars Muckli (University of Glasgow)
Tony Prescott (University of Sheffield)

https://www.humanbrainproject.eu/en/education/participatecollaborate/curriculum/online-course/cognitive-systems-for-non-specialists/

LECTURES

Lecture 1: Internal models and counterfactual cognition predicting our environment
Lars Muckli (University of Glasgow)

Lecture 2: Making our selves: From psychology to robotics
Tony Prescott (University of Sheffield)

Lecture 3: Can robots ever become conscious? Insights from theory and experimental neurobiology
Cyriel Pennartz (University of Amsterdam)

Lecture 4: Introduction to the Neurorobotics platform
Marie Claire Capolei (Technical University of Denmark)

Lecture 5: Deep reinforcement learning for robotic control
Jonathan Hunt (Google DeepMind)

Lecture 6: Bio-inspired control architecture for mobile robotics
Yannick Morel (Technical University of Munich)

Lecture 7: Neuroscience and robotics
Tata Ramalingasetty Shravan (École Polytechnique Fédérale de Lausanne)

Lecture 8: The social robot: Emotions and drives
Vicky Vouloutsi (Institute for Bioengineering of Catalonia)

IIe) RESEARCH ETHICS AND SOCIETAL IMPACT

This course explores ethical and social issues that arose, and continue to arise, from the rapid research development in neuroscience, medicine and ICT. Lectures focus on key ethical issues contained in the HBP – such as ethics of robotics, dual use, ICT ethical issues, big data and individual privacy, and the use of animals in research.

1.5 ECTS credits

Course Director:
Manuel Guerrero (Karolinska Institute)
Kerstin Hakansson (Linnaeus University)

https://www.humanbrainproject.eu/en/education/participatecollaborate/curriculum/online-course/research-ethics-societal-impact/

LECTURES

Lecture 1: Introduction to ethical theory
Christine Mitchell (Harvard Medical School)

Lecture 2: Responsible Research and the Human Brain Project
Nicolas Rose (King's College London)

Lecture 3: Computer ethics and the HBP
Bernd Stahl (De Montford University)

Lecture 4: Scaling up neuroscience - Responsible Research and the big brain projects
Nikolas Rose (King's College London)

Lecture 5: Neuroethics and Philosophy in Responsible Research and Innovation
Michele Farisco (Uppsala University)

Lecture 6: Data Use and Ethical Awareness in the Human Brain Project
Manuel Guerrero (Uppsala University)

Lecture 7: Neuroscience and the problem of dual use
Malcolm Dando (University of Bradford)

Lecture 8: Responsible Artificial Intelligence: Ethics, governance and policy
Inga Ulnicane (De Montfort University)

Lecture 9: The Ethical Roboticist
Alan Winfield (University of the West of England)

Lecture 10: The Thinking Robot
Alan Winfield (University of the West of England)

Lecture 11: Ethics in biomedical research and the 3Rs
Viveka Hillegaart (Karolinska Institutet)

Lecture 12: Cognitive enhancement: Ethics and efficacy
Sebastian Porsdam Mann (Harvard Medical School)

IIf) INTELLECTUAL PROPERTY RIGHTS, TRANSLATION AND EXPLOITATION OF RESEARCH

Knowing how to incorporate innovation and entrepreneurial mindset and concepts into day-to-day research work can be very beneficial and rewarding; however, it can be very challenging for students coming from disciplines such as computer science, engineering, life science or medicine (a non-MBA background). This course will help early-stage researchers and group leaders from the neuroscience field to build personal leadership skills by inspiring them to look for better and smarter solutions, to think outside the box and consider end-products when it comes to their present and future research. Especially at early stages of the academic career, students can benefit from learning from the experience of innovators and entrepreneurs, through their failures and successes, and gain some practical tools and advice. Additionally, the course presents the basic concepts of intellectual property and how research can be exploited and translated into products.

2.5 ECTS credits

Course Director:
Dana Bar-On (Tel Aviv University)

https://www.humanbrainproject.eu/en/education/participatecollaborate/curriculum/online-course/ipr-translation-exploitation-of-research/

LECTURES

Introduction video to the IPR course

Lecture 1: Is your „Million Dollar Idea" a viable business concept?
Michael Ehrlich (New Jersey Institute of Technology)

Lecture 2: Bottom-up research: The most critical skill in entrepreneurship
Danny Warshay (Brown University)

Lecture 3, part 1: Basic elements in the patenting world
Eyal Bressler (Founder of Dr. Eyal Bressler & Co.)

Lecture 3, part 2: Basic elements in the patenting world
Eyal Bressler (Founder of Dr. Eyal Bressler & Co.)

Lecture 4, part 1: Patents in the realm of neuroscience
Eyal Bressler (Founder of Dr. Eyal Bressler & Co.)

Lecture 4, part 2: Patents in the realm of neuroscience
Eyal Bressler (Founder of Dr. Eyal Bressler & Co.)

Lecture 5, part 1: New innovation models at the interface between academia and industry
Christian Tidona (BioRN Network/BioMed X Innovation Center)

Lecture 5, part 2: New innovation models at the interface between academia and industry
Christian Tidona (BioRN Network/BioMed X Innovation Center)

Lecture 6, part 1: Transferring innovation from academy to industry
Shlomo Nimrodi (Tel Aviv University)
Daniel Offen (Tel Aviv University)
Ehud Gazit (Tel Aviv University)

Lecture 6, part 2: Transferring innovation from academy to industry
Shlomo Nimrodi (Tel Aviv University)
Daniel Offen (Tel Aviv University)
Ehud Gazit (Tel Aviv University)

Lecture 7, part 1: Looking into the future using emerging trends: What are they and how do we identify them?
Iris Ginzburg (Tel Aviv University)

Lecture 7, part 2: Looking into the future using emerging trends: What are they and how do we identify them?
Iris Ginzburg (Tel Aviv University)

THE HBP EDUCATION PROGRAMME

The HBP Education Programme offers innovative learning packages for early career researchers working in and across the fields of neuroscience, information and communications technology (ICT) and medicine. The programme particularly targets advanced Master's and PhD students, as well as early post-doctoral researchers, from within and outside the HBP.

EBRAINS Workshops aim to introduce participants to the opportunities provided by the EBRAINS Research Infrastructure and educate them on the resources that are offered. The multi-day events combine plenary sessions with hands-on interactive workshop modules in which participants will learn how to utilize and benefit from EBRAINS tools and services.

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An annual HBP Student Conference, organised by early career researchers for early career researchers, aims to encourage collaboration and scientific exchange across the fields of neuroscience, brain medicine and computer science. At the conference, early career researchers get the chance to present their own research and engage in extensive discussions with peers and principle investigators from within and outside the HBP.

Young Researchers Events provide a setting for the HBP & EBRAINS Research Infrastructure to present the Project's tools and results to early career scientists and future users. In addition, more specific EBRAINS Infrastructure Training Events provide hands-on training in the use of the various services and tools offered by EBRAINS.

Video material from all HBP Education Programme activities is collected and made available to the public via the HBP Education Programme E-Library.

NOTES

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humanbrainproject.eu/education