First year courses

Research Master Specialisation Cognitive Neuroscience Year 1

Faculty of Psychology and Neuroscience

Auditory and Higher Order Language Processing

Full course description

Although the human visual system has been studied extensively in cognitive neuroscience, so far only little is known about the auditory and speech system: How do we segregate the sound of a Ferrari from the background sounds of other running car engines, or the voice of a friend from that of many others in a crowd? How is auditory information integrated with other senses such as vision or touch? In the last few years, cognitive neuroscience research has set a number of milestones in our understanding about how our brain manages these tasks. This knowledge is crucial because hearing and communicating with the environment and with others is one of the most essential human cognitive skills.

This course aims to develop students' knowledge about the human auditory and speech system. The course starts with basic neural anatomy and considers how this might constrain but also assist auditory processing. Students learn about the basics of speech segregation and perception. Bottom-up and top-down processes are addressed. Finally, the course discusses how the human mind selects relevant auditory, visual and linguistic information in order to communicate.

Short paper on a topic integrating aspects of PSY4252 with PSY4251. In academic years starting in an even year, the paper counts as an extra exam question in PSY4251. In academic years starting in an odd year, the paper counts as an extra exam question in PSY4252.

Course objectives

Students are able to understand:

- anatomy and function of the auditory system, of the speech system (separately for comprehension and production), and of cross modal integration;
- methods used in CN to study anatomy and function (in animals, humans: staining, electrophysiology, psychophysics, fMRI, TMS);
- relevant aspects of the method to quantify cognition (EEG oscillation, ERP components, fMRI);
- experimental design to study open questions in hearing and speech processing (tasks, stimuli);
- open issues of how the brains solves problems like Gestalt processing/grouping, figure ground segregation/streaming, comprehension, production, error monitoring, multisensory/cross modal integration.

Students are able to:

- acquire critical thinking skills of limits of methods, designs, tasks and theories in the context of auditory and language processing;
- acquire creative thinking skills to come with new ideas by merging knowledge from different fields (i.e. comprehension and production, or by transferring ideas from one to another field (speech motor integration and its role in production).

PSY4251
Period 1
1 Sep 2020
23 Oct 2020
Print course description
ECTS credits:
4.0
Instruction language:
English
Coordinator:

- B.M. Jansma

Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Written exam, Assignment
Keywords:
Auditory processing, language comprehension, language production, cross modal integration
Faculty of Psychology and Neuroscience

Perception and Attention

Full course description

The objective of the course is to present the groundwork based on which students will be able to understand current neuro-cognitive theories and experimental methods in the field of visual perception and attention. This will be achieved via discussion of a set of core papers in this field.

Vision is a complex cognitive process, which provides us with a richer stream of information than any other sense. The primate visual cortex is composed of a network of at least 30 highly interconnected functionally specialized regions. The regions where visual information first enters the cortex are called early visual areas. Neurons in these areas have relatively simple properties, and their small receptive fields are arranged to form retinotopic maps of the environment on the cortex. Higher level visual processing occurs in a ventral and dorsal stream, which are respectively contributing to object perception and the perception of motion.

The network contributing to visual perception can adapt to the task that the organism is faced with. This is the case, for example, when looking for someone in a crowd and attending to one face at a time. There are many kinds of attention, but attention can be generally described as involving some type of information selection.

In this course, neural mechanisms underlying prototypical examples of low and high level perception will be studied, as well as neural mechanisms underlying selective attention. The course will discuss both historically important papers, as well as more recent research in visual perception and attention, involving different empirical methods including psychophysics, neurophysiology, and functional brain imaging but with an emphasis on animal neurophysiology.

Short paper on a topic integrating aspects of PSY4252 with PSY4251. In academic years starting in an even year, the paper counts as an extra exam question in PSY4251. In academic years starting in an odd year, the paper counts as an extra exam question in PSY4252.

Course objectives

Students will:

- gain knowledge and understanding of the human and non-human primate visual system (structure and function), in terms of low-level and high-level visual perception as well as visual attention;
- gain knowledge regarding acquisition and analysis of data in the methodological fields of neurophysiology and psychophysics;
- acquire the capability of detailed, in-depth reading of scientific papers, which involves (I) the understanding and evaluation of methods, (II) the understanding/contrasting of (quantitative) theories and models and the evaluation of their fit with the data, and (III) the critical evaluation of interpretations of presented data by the article's authors;
- improve their ability to use scientific terminology while verbalizing and discussing insights and questions raised by the readings;
- be able to apply the acquired scientific reading and evaluation skills to papers outside the field of visual perception and attention;
- generally improve their ability of theorizing, hypothesis formation, and experimental design.

PSY4252
Period 1
1 Sep 2020
23 Oct 2020
Print course description
ECTS credits:
4.0
Instruction language:
English
Coordinator:

- P.H.M. de Weerd

Teaching methods:
Lecture(s), PBL
Assessment methods:
Attendance, Written exam, Assignment
Keywords:
Visual system, illusions, Perception, Attention, neurophysiology, monkey
Faculty of Psychology and Neuroscience

Advanced Statistics I

Full course description

The course consists of six units. In the first four units, participants will be given an in-depth training in the following standard statistical methods: factorial ANOVA for between-subject designs, analysis of covariance (ANCOVA), multivariate ANOVA (MANOVA), discriminant analysis and multiple linear regression. Students are assumed to have background knowledge of balanced two-way factorial ANOVA and multiple regression. These methods will be briefly reviewed. The following advanced topics will then be covered: unbalanced factorial designs, contrast analysis, interaction, simple slope analysis, dummy coding, centring covariates, different coding schemes, collinearity and residuals checks and data transformation. The distinction between confounders and mediators in regression and ANCOVA is also discussed, forming a bridge from regression to structural equations modelling (SEM). The latter is an advanced multivariate method that is gaining importance in psychology but still requires special software (such as Lisrel, EQS, AMOS or Mplus). SEM is introduced in two units, starting with causal modelling and mediation analysis in cross-sectional research and then extending to longitudinal research and latent variables (factors). Special attention is given to identifying models, model equivalence, global and local goodness of fit indices, parsimony, model modification and cross-validation. Some concepts from matrix algebra are needed for SEM, and these will be briefly discussed without going into technical detail.

Course objectives

Students are able to understand:

oneway analysis of variance, contrast analysis, unbalanced designs, multivariate analysis of variance, discriminant analysis, linear regression with interaction terms, linear regression with dummy variables, data transformations, simple slope analysis, analysis of covariance, path analysis, structural equation modeling, confirmatory factor analysis, structural models with latent variables.

PSY4106
Period 1
1 Sep 2020
18 Dec 2020
Print course description
ECTS credits:
3.0
Instruction language:
English
Coordinator:

- J. Schepers

Teaching methods:
Assignment(s), Lecture(s), Skills, Training(s)
Assessment methods:
Attendance, Written exam
Keywords:
Univariate analysis of variance, multivariatie analysis of variance, regression analysis, structural equation modeling
Faculty of Psychology and Neuroscience

Practical Training: SPSS I and Lisrel

Research Master Cognitive and Clinical Neuroscience, Specialisation Cognitive Neuroscience

Full course description

In order to make practical use of the statistical models that form the topic of the Advanced Statistics course, researchers must make use of statistical software. This course will utilise the traditional SPSS program, but also the specialised LISREL software. LISREL is a statistical program that allows structural equations models to be tested.

Course objectives

Students are able to understand:

- defining contrasts;
- building regression models;
- doing multivariate analyses;
- transforming data;
- testing simple slopes;
- creating and testing SEM models.

PSY4119
Period 1
1 Sep 2020
18 Dec 2020
Print course description
ECTS credits:
0.0
Instruction language:
English
Coordinator:

- J. Schepers

Teaching methods:
Assignment(s), Training(s)
Assessment methods:
Attendance
Keywords:
SPSS, LISREL, statistical software
Faculty of Psychology and Neuroscience

EEG and ERP

Full course description

Electroencephalography (EEG) and Event Related Potentials (ERP) offer a combination of precise measurements for the time course of brain processes. These are low cost, non-invasive measurements and are widely available. For these reasons they make a unique contribution to cognitive neuroscience. Scientific interest in EEG and ERP is growing, and results have been increasingly integrated with other neuro-imaging techniques during the last few decades.

Lectures and basic literature provide an introduction for students to the basics of EEG and ERP research, EEG and ERP terminology and the possibilities and limitations of EEG and ERP. For a

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Midterm paper students study an empirical data article from the literature and answer questions about its EEG and ERP methods and interpretation based on lectures, basic literature and other sources. Students also study practical measurement issues, such as electrode placement and types of artefacts. Finally, students must interpret the resulting data. Successful measurement requires an understanding of the basics of EEG and ERP signal analysis techniques, such as artefact management, spectral analysis, filtering, ERP averaging, time-frequency analysis etc. Students also receive hands-on training in smaller groups in running an ERP experiment, including electrode application, minimising artefacts, and health and safety in the lab. A number of simple experimental paradigms will be used that provide interesting and reliable results. Data processing will include a number of common EEG analyses, e.g. analyses in the time and frequency domain.

Course objectives

Students are able to understand:

basic EEG/ERP paradigms, EEG recording systems, measurement settings, electrode application, data quality verification, analogue-digital conversion, basic EEG / ERP components, interpreting topographical plots, neural origins of EEG, time domain analysis, frequency domain analysis, time-frequency analysis, filtering, ocular artefact control, muscle artefact control, choice of reference, re-referencing.

PSY4221
Period 1
1 Sep 2020
23 Oct 2020
Print course description
ECTS credits:
2.0
Instruction language:
English
Coordinator:

- F.T.Y. Smulders

Teaching methods:
Lecture(s), Paper(s), Skills, Training(s), Work in subgroups
Assessment methods:
Attendance, Final paper
Keywords:
Electroencephalography (EEG), Event-related potentials (ERP), electrophysiology, measurement, analysis of brain potentials
Faculty of Psychology and Neuroscience

Neuroimaging: Functional MRI

Full course description

The investigation of human brain functions using a range of imaging methods (such as electro- and magneto- encephalography, Positron Emission Tomography and Magnetic Resonance Imaging) represents the most influential development in Cognitive Neuroscience in the last years. In this course, students will learn about the essential facts of functional Magnetic Resonance Imaging (fMRI). FMRI presents clear advantages over the other methods, particularly in terms of increased spatial resolution. Since its invention in 1992, fMRI has led to major advances in understanding the neural mechanisms that underlie higher levels of human mental activity and has established a strong link between cognitive psychology and neuroscientific research. The other Cognitive Neuroimaging programmes confront student with several applications of fMRI in specific cognitive domains (visual perception and attention, sensorimotor integration, auditory perception). In this course, however, students will gain a deeper knowledge of fundamental and methodological aspects of fMRI.

The tasks will address questions such as: How can the fMRI signal be related to neural activity? How are functional images obtained with an MRI scanner? What do I need for performing a good fMRI measurement? How are "activation maps" created? Some of the tasks are directly linked to a practical part of the course and are intended to provide the necessary theoretical framework for the design, analysis, measurement and interpretation of results in fMRI investigations. Practical sessions on acquisition and analysis of fMRI data of cognitive functions such as auditory and visual processing will be integrated in to the group meetings.

The assignment consists of a training of ICA analysis.

Course objectives

Students will gain knowledge and understanding of :

- physical principles of Nuclear Magnetic Resonance and Magnetic Resonance Imaging,

- physiological basis of functional MRIand the relation between the blood oxygenation level dependent contrast and neural activity

general rules for designing fMRI experiments, advantages and disadvantages of block and event related designs

- pre-processing of fMRI data, including motion correction, spatial and temporal filtering,

- fMRI statistics, including univariate statistics, general linear models, single-subject statistics, multi-subject statistics, correction for multiple comparisons, false discovery rate,

- methods for brain comparison and normalisation, Talairach transformation.

PSY4253
Period 2
26 Oct 2020
18 Dec 2020
Print course description
ECTS credits:
4.0
Instruction language:
English
Coordinator:

- E. Formisano

Teaching methods:
Lecture(s), PBL

Research Master Cognitive and Clinical Neuroscience, Specialisation Cognitive Neuroscience

Assessment methods:
Attendance, Written exam, Assignment
Keywords:
Functional Neuroimaging, magnetic resonance imaging, experimental design, analysis methods
Faculty of Psychology and Neuroscience

Sensorimotor Processing

Full course description

Every day activities such as riding a bicycle, typing a summary and drinking a cup of coffee require the continuous interaction of brain systems that serve sensory perception and systems that control the body's muscles. In other words, most of the things people do require sensorimotor integration. Since sensory perception (visual as well as auditory) is covered extensively in other courses, the main focus here will be on the somatosensory and motor system as well as on the transformation and processing of sensory information for motor control. Initially, basic processes are covered such as the representations used by primary and secondary somatosensory and motor areas (which parameters are represented, e.g., muscle contractions, joint angles or whole movements?), types of motor control (since processing perceptual feedback takes time, how should individuals use past information to control future actions?) and coordinate transformations (how to get from incoming visual information, coded with respect to our current eye position, to motor commands, coded with respect to our current body posture?). Later in the course, the focus will shift to higher level issues such as motor learning, action selection and decision making, and predicting the actions of others. All topics will be discussed in the context of cognitive neuroscience research so that students learn how these topics can be investigated using a range of different techniques from behavioural experiments to electrophysiological recordings and brain imaging methods.

Course objectives

- describe and explain the neural mechanisms underlying sensorimotor processing (internal models, coordinate transformations, action selection);
- critically assess opposing views, the supporting experimental data and the research methods used to obtain them;
- explain the neuro-behavioural correlates of motor learning and decision making, and the role of mirror neurons in action understanding.

PSY4254
Period 2
26 Oct 2020
18 Dec 2020
Print course description
ECTS credits:
4.0
Instruction language:
English
Coordinators:

- J. Reithler
- A.L. Kaas

Teaching methods:

Research Master Cognitive and Clinical Neuroscience, Specialisation Cognitive Neuroscience

Lecture(s), PBL
Assessment methods:
Attendance, Written exam, Assignment
Keywords:
Neural correlates of motor control, Somatosensory perception, Sensorimotor coordination, reference frames, coordinate transformations, Motor learning, action selection, mirror neuron system
Faculty of Psychology and Neuroscience

fMRI

Full course description

The primary goal is to provide hands-on experience in experimental design, acquisition and analysis of fMRI experiments. In the first tutorial, each student group separately formulates an experimental question/hypothesis to be tested with fMRI and elaborates an appropriate experimental design. In a subsequent meeting, each group present to the other groups (in an oral presentation) its proposal for an fMRI study and all studies are discussed and evaluated; at the end of the meeting one study is selected.

In the group meetings and independent study, all students are involved in implementing the experimental set-up required for performing the selected study (e.g. selection and preparation of stimuli, implementation of the design) and participating in the fMRI measurements. In the last meetings, all students perform the statistical analysis of the datasets. Assistance and prior preparation, especially in the implementation stage (stimulus programming) and data analysis stage (preparation of data in usable format for analysis in Brain Voyager QX), is provided by the tutors. Finally, students describe and discuss their findings in an individually written report.

Course objectives

Students are able to understand and gain hands-on experience of:

- experimental design, hypothesis formulation, operationalisation

fMRI blocked and event related designs,

- parameters for MRI scanning, MR safety and procedures, fMRI measurements,
- pre-processing fMRI data, statistical analysis fMRI data, results interpretation.

PSY4227
Period 2
26 Oct 2020
18 Dec 2020
Print course description
ECTS credits:
2.0
Instruction language:
English
Coordinators:

- E. Formisano
- F. de Martino

Research Master Cognitive and Clinical Neuroscience, Specialisation Cognitive Neuroscience

Teaching methods:
Lecture(s), Presentation(s), Research, Skills, Working visit(s), Work in subgroups
Assessment methods:
Attendance, Final paper, Presentation
Keywords:
functional MRI, experimental design, fMRI data acquisition, fMRI data analysis
Faculty of Psychology and Neuroscience

Noninvasive Brain Stimulation (NIBS)

Full course description

This course will provide students with an in-depth knowledge of; noninvasive brain stimulation techniques, including transcranial magnetic stimulation (TMS) and transcranial electrical stimulation (TES). Students will learn about the mechanisms of action; the physical-physiological principles; various application protocols; functional brain stimulation paradigms and approaches for combining brain stimulation with brain imaging techniques both within and between experimental session(s).

Since the very beginning of experimental brain research, neuroscientists have dreamed about not only observing the brain at work, but actually changing and modulating the neuronal activity in the brain without causing harm to patients or subjects. With the development of noninvasive brain stimulation (NIBS) it is now possible to reach into the skull of a patient or healthy subject and to temporarily alter brain activity at a specific location. This possibility opens the door to a wide range of experimental and clinical applications. New protocols and technologies allow researchers to modulate not only the level, but also the type of brain processes that occur. For instance, brain oscillations can be entrained to an external stimulation frequency.

NIBS enables the researcher or clinician to change neuronal activity in the task-related brain area and reveal behavioural changes in actual task performance. This enables identification of those brain areas, or brain mechanisms, that are functionally relevant to a particular function. In a clinical context, NIBS has also been used to treat neurological, psychiatric, and psychological disorders that are accompanied by a pathologically increased or decreased activity, or pathological changes in brain oscillations, in a specific brain region or network. Since NIBS offers the possibility to change neuronal activity beyond the stimulation period itself, it is increasingly applied as a therapeutic tool, for instance to treat diseases like depression.

Course objectives

Students are able to understand:

- physics and mechanisms of action of NIBS;
- physiological effects of NIBS;
- NIBS protocols and application paradigms;
- NIBS in human cognitive neuroscience;
- combining NIBS with functional imaging;
- clinical applications of NIBS.

PSY4216
Period 3

Research Master Cognitive and Clinical Neuroscience, Specialisation Cognitive Neuroscience

4 Jan 2021
29 Jan 2021
Print course description
ECTS credits:
4.0
Instruction language:
English
Coordinators:

- T.A. de Graaf
- A.T. Sack

Teaching methods:
Assignment(s), Lecture(s), Presentation(s), Work in subgroups, PBL
Assessment methods:
Attendance, Presentation, Written exam
Keywords:
Non-invasive Brain Stimulation, functional magnetic brain interference, multi-modal imaging
Faculty of Psychology and Neuroscience

Neuroanatomy

Full course description

The aim of this practical training is to make you acquainted with the neuroanatomical terminology and to gain insight into the spatial and functional organisation of the brain. It is essential to have a basic knowledge of the brain anatomy when working in the field of neuropsychology or neurobiology. Many specific brain areas can be linked to particular functions. Thus, knowledge of the brain anatomy and its main functions allows direct linkage of specific neurological or psychiatric disorders to particular brain areas. After a short theoretical introduction, you will study whole brains and brain material of mammals at both macroscopical (visual inspection) and microscopical level. The emphasis will be on major brain systems, including the basal ganglia and limbic system.

Course objectives

Students are able to understand:

- organisation of the brain in particular the limbic system and basal ganglia;
- brain dissection;
- microscopical staining techniques.

PSY4108
Period 3
4 Jan 2021
29 Jan 2021
Print course description
ECTS credits:
1.0
Instruction language:
English
Coordinator:

Research Master Cognitive and Clinical Neuroscience, Specialisation Cognitive Neuroscience

- J.H.H.J. Prickaerts

Teaching methods:
Lecture(s), Skills, Work in subgroups
Assessment methods:
Attendance, Written exam
Keywords:
Neuroanatomy, limbic system, basal ganglia
Faculty of Psychology and Neuroscience

Methods of Deactivation

Full course description

In three consecutive practical training sessions, students acquire direct hands-on experience with non-invasive magnetic brain stimulation (transcranial magnetic stimulation (TMS) and transcranial electric stimulation (TES)). Students learn how to use the brain stimulator devices, how to evoke muscle responses and how to induce visual experiences. Students act as both the experimenter, applying the brain stimulation, and the participant, receiving the magnetic pulses.

Practical I: Technical introduction/motor thresholds/motor excitability

In three consecutive practical training sessions, students acquire direct hands-on experience with non-invasive magnetic brain stimulation (transcranial magnetic stimulation (TMS) and transcranial electric stimulation (TES)). Students learn how to use the brain stimulator devices, how to evoke muscle responses and how to induce visual experiences. Students act as both the experimenter, applying the brain stimulation, and the participant, receiving the magnetic pulses.

Practical I: Technical introduction/motor thresholds/motor excitability

Practical II: TMS-induced visual experiences (phosphenes)

Practical III: TMS Neuronavigation (frameless stereotaxy)

There are a variety of ways in which activity in a brain region can be prevented or influenced. Some studies use anatomical lesion methods (in animals), while others use reversible methods such as cooling, and pharmacological or genetic manipulations in animals, or TMS in human participants.

The training will end with a lecture that provides an overview of these different methodologies, including a discussion of the advantages and limitations of the different techniques and of the issues related to data interpretation.

Practical II: TMS-induced visual experiences (phosphenes)

Practical III: TMS Neuronavigation (frameless stereotaxy)

There are a variety of ways in which activity in a brain region can be prevented or influenced. Some studies use anatomical lesion methods (in animals), while others use reversible methods such as cooling, and pharmacological or genetic manipulations in animals, or TMS in human participants.

The training will end with a lecture that provides an overview of these different methodologies, including a discussion of the advantages and limitations of the different techniques and of the issues

related to data interpretation.

Course objectives

Students are able to understand:

Transcranial Magnetic Stimulation, application of TMS, motor threshold determination, phosphene threshold determination, neuronavigation, transcranial electric stimulation, cooling, various other deactivation methods.

PSY4233
Period 3
4 Jan 2021
29 Jan 2021
Print course description
ECTS credits:
1.0
Instruction language:
English
Coordinator:

- T. Schuhmann

Teaching methods:
Assignment(s), Lecture(s), Skills, Training(s)
Assessment methods:
Attendance, Assignment
Keywords:
Transcranial Magnetic Stimulation, Non-invasive Brain Stimulation, fMRI-guided neuronavigation
Faculty of Psychology and Neuroscience

Colloquia

Full course description

Each specialisation organizes two colloquia, in which senior researchers from Maastricht University or visiting lecturers present their scientific insights. Each colloquium focuses in depth on one of a wide range of topics, with issues transcending the courses and specialisations. Each colloquium lecture will be followed by active discussion, chaired by the lecturer or the host of the guest lecturer. A total of twelve colloquia will be offered.

Course objectives

Students are able to understand:

- key research domains from different specialisations;
- interdisciplinary research.

Students are able to interact with students from different specialisations.

Research Master Cognitive and Clinical Neuroscience, Specialisation Cognitive Neuroscience

PSY4100
Period 3
4 Jan 2021
2 Jul 2021
Print course description
ECTS credits:
1.0
Instruction language:
English
Coordinator:

- R. Schreiber

Teaching methods:
Lecture(s)
Assessment methods:
Attendance
Keywords:
interdisciplinary knowledge
Faculty of Psychology and Neuroscience

Advanced fMRI

Full course description

Building on the course "Neuroimaging: Functional MRI", this course will examine advanced topics of fMRI methodology and applications. In the first week, students learn how knowledge about vascular effects on the MRI signal may help to detect BOLD artefacts. In the second week, principles of real-time fMRI will be presented. This is followed by an overview of fMRI neurofeedback studies and a discussion of its use as a new therapeutic tool. In addition, machine learning techniques for the real-time decoding of mental states and the application of these techniques in brain-computer interfaces will be discussed. In the third week, advanced cortical mapping techniques are examined, including estimation of population receptive fields for visual and cognitive topographic maps. Furthermore, deep neural networks will be discussed in the context of modeling responses of the visual system. During the last two meetings the possibilities of "mesoscopic" ultra-high field brain imaging will be discussed focusing on studies with sub-millimeter spatial resolution aiming to understand brain activity at the level of cortical columns and cortical layers.

Course objectives

Students are able to understand:

- effects of vascular system on the interpretability of the BOLD fMRI signal;
- real time fMRI data analysis during ongoing experiments;
- possibilities and limitations of fMRI-based brain-computer interfaces (BCIs);
- fMRI neurofeedback training as a new therapeutic tool;
- real-time decoding of mental states;
- Encoding and decoding representations using population receptive field mapping;
- learning about multivariate representational spaces using representational similarity analysis;
- principles of convolutional deep networks as a model of the visual cortex;

- opportunities and challenges of high-resolution fMRI at ultra-high magnetic field strengths to investigate the cortex at the columnar and laminar level.

Prerequisites

Research master course 'Neuroimaging: Functional MRI'.

PSY4215
Period 4
1 Feb 2021
5 Mar 2021
Print course description
ECTS credits:
4.0
Instruction language:
English
Coordinator:

- R.W. Goebel

Teaching methods:
Paper(s), PBL, Presentation(s)
Assessment methods:
Attendance, Written exam, Presentation
Keywords:
neurovascular coupling, Real-time fMRI, neurofeedback, BCI, population receptive field (pRF) mapping, representational similarity analysis (RSA), ultra-high magnetic field fMRI, columnar-level imaging, cortical layers
Faculty of Psychology and Neuroscience

Brain Connectivity and Connectomics

Full course description

This course introduces the fields of human brain connectivity and connectomics. The human brain is one of the largest and most complex biological networks known to exist. It contains about 85 billion neurons each making on average ten thousand connections with other neurons. Today, the map or annotated graph of all connections in the brain is called the connectome and the emerging field of connectomics endeavours to measure and understand the connectome. It has become increasingly clear over a century of neuroscience endeavours since Ramon y Cajal that the particular organisation of brain connectivity plays a crucial role in enabling human abilities. Two general principles of this organisation became clear early on and remain important to this day: i) the multi-scale organization of brain connectivity (from macroscale white matter organization to microscale cortical circuits) and ii) the interplay between structure and function (with structure determining function and function driving structural plasticity). With recent advances in methods, neuroimaging investigations of human perception and cognition are increasingly interpreted in terms of connectivity, inter-areal interactions and cortical circuit computations. This course will discuss both structural connectivity and functional interactions, with an emphasis on the human brain, and how these can be measured and analysed in cognitive neuroscience experiments. The different spatial and temporal scales at which connectivity is organized will be treated in depth, with an emphasis on neuroanatomy of layered cortical circuits and the large scale organization of white matter fiber tracts.

Course objectives

Students are able to understand:

Structural connectivity, Functional connectivity, Effective connectivity, Resting state experiments and networks, Layers in the neocortex, Cytoarchitecture, Myeloarchitecture, Receptor architecture, Canonical cortical microcircuits, Cortical computation, Realistic neural network models, Diffusion MRI tractography and connectomics, Graph analysis, Connectivity analyses in fMRI and M/EEG, Independent Component Analysis , Granger causality, Dynamic Causal Modeling, Histology and microscopy, Tracer studies, Polarized Light Imaging, White matter organization, Myelination, White matter plasticity.

PSY4255
Period 4
8 Mar 2021
1 Apr 2021
Print course description
ECTS credits:
4.0
Instruction language:
English
Coordinator:

- A.F. Roebroeck

Teaching methods:
Lecture(s), Paper(s), Presentation(s)
Assessment methods:
Attendance, Written exam
Keywords:
Brain connectivity, Connectomics, Functional connectivity, Effective connectivity, Cortical microcircuits, white matter organisation
Faculty of Psychology and Neuroscience

Advanced Statistics II

Full course description

The course consists of seven units.

The first three units cover classical repeated measures ANOVA for the one- and two-way within-subject design and the split-plot (between x within) design. Special attention is given to: a) the choice between multivariate and univariate data formats and method of analysis, and the sphericity assumption; b) the distinction between the within-subjects and between-subjects part of a split-plot ANOVA, and how to obtain both using regression analysis; c) the surprising consequences of including covariates into repeated measures ANOVA; and d) the choice between different methods of analysis for randomised versus non-randomised group comparisons.

Subsequently, a further three units are devoted to mixed (multilevel) regression for nested designs and longitudinal studies. This mixed regression starts with a unit on marginal models for repeated measures as an alternative to repeated measures ANOVA in cases of missing data or within-subject covariates. Students are shown the pros and cons of various models for the correlational structure of repeated measures, such as compound symmetry and AR1. The second unit covers the random intercept model for repeated measures as a method to include individual effects in marginal models for longitudinal data (growth curves) or single trial analyses of lab data (response times, ERP, fMRI). Students learn how this can be combined with e.g. ARMA modelling to distinguish between interpersonal and intrapersonal outcome variation. The random intercept model will also be applied to a cluster randomised trial, i.e. an RCT where organisations like schools or companies instead of individuals are randomised. The third and last unit on mixed regression covers random slope models for longitudinal data (individual differences in change over time), single trial analysis (individual differences in stimulus effects) and multicentre trials (RCT within each of a number of organisations).

Finally, the topic of sample size and power calculations is introduced in a seventh unit.

Course objectives

Students are able to understand:

- repeated measures ANOVA for within-subject and split-plot (between x within) designs, including factorial designs and covariates in repeated measures ANOVA;
- mixed (multilevel) linear regression with random effects and autocorrelation;
- sample size calculations for experimental and observational studies.

Specifically, students are able to choose the correct method of analysis, and specify a statistical model, for repeated measurements, to compare different models and choose the best model (based on checking assumptions, model fit and parsimony on top of plausibility), and to interpret effect estimates and significance tests obtained with that model.

Students are furthermore able to choose the correct formula for computing the sample size for basic and often used research designs, and to compute the sample size with that formula.

Prerequisites

Good understanding of descriptive and inferential statistics at the elementary and intermediate level, including t-tests, factorial ANOVA and multiple linear regression. Skilled in the use of SPSS for statistical data analyses.

PSY4107
Period 4
1 Feb 2021
4 Jun 2021
Print course description
ECTS credits:
3.0
Instruction language:
English
Coordinator:

- G.J.P. van Breukelen

Research Master Cognitive and Clinical Neuroscience, Specialisation Cognitive Neuroscience

Teaching methods:
Assignment(s), Lecture(s), Training(s)
Assessment methods:
Attendance, Written exam
Keywords:
Within-subject designs, repeated measures ANOVA, mixed (multilevel) regression, marginal versus random effects models, sample size, power
Faculty of Psychology and Neuroscience

Practical Training: SPSS II

Full course description

This practical training forms part of the PSY4107 Advanced Statistics II course. The practical consists of seven sessions in the computer rooms. In the first six sessions SPSS procedures for repeated measures and multilevel data are practised. The goal is to understand how proper analyses of such data can be done using SPSS. In the last session GPower will be used to practice sample size (power) calculations for some elementary research designs.

Course objectives

Students are able to understand and apply:

- how to run with SPSS: repeated measures ANOVA for within-subject and split-plot (between x within) designs, including factorial designs and covariates;
- how to run SPSS for: mixed (multilevel) linear regression with random effects and autocorrelation;
- how to use GPower for sample size (power) calculations for your own research (master thesis, grant application).

Prerequisites

Good understanding of descriptive and inferential statistics at the elementary and intermediate level, including t-tests, factorial ANOVA and multiple linear regression. Skilled in the use of SPSS for statistical data analyses.

PSY4117
Period 4
1 Feb 2021
4 Jun 2021
Print course description
ECTS credits:
0.0
Instruction language:
English
Coordinator:

- G.J.P. van Breukelen

Teaching methods:

Training(s)
Assessment methods:
Attendance
Keywords:
Within-subject designs, repeated measures ANOVA, mixed (multilevel) regression, marginal versus random effects models, sample size, power, effect size
Faculty of Psychology and Neuroscience

Real-Time fMRI and Neurofeedback

Full course description

Recent progress in computer hard- and software allows real-time analysis of functional magnetic resonance imaging (fMRI) data which provides the basis for brain-computer interface (BCI) applications such as neurofeedback, control of external devices and motor-independent communication.

In fMRI-based neurofeedback studies, subjects can observe representations of their own brain activation while being measured in the MRI scanner. FMRI-based neurofeedback is performed by reading, analysing and visualising the hemodynamic brain signals in real-time during an ongoing experiment. This real-time approach is in contrast to the standard analysis approach in which the huge amount of incoming fMRI signals are recorded first and then analysed hours or days after the experiment.

During this workshop, there will be an introduction into the real-time fMRI methodology and a discussion of fMRI neurofeedback applications which have demonstrated that with sufficient practice, subjects are indeed able to learn to modulate activity in certain brain areas. These results are extremely important for basic neuroscience research, because they allow researchers to study the degree to which humans can modulate their own brain activity and to potentially unravel the function of hitherto unknown brain areas. Neurofeedback research also touches on deep philosophical issues, such as the neural correlates of free will. It might also be possible in the future to help people with pain or depression by regulating at will neural activity in relevant brain areas. In fMRI-based communication studies, activation patterns evoked by participants are ‘decoded’ and interpreted online, e.g. as letters of the alphabet, offering the possibility for people with severe motor impairments to ‘write’ letters purely controlled by mental imagery.

In this workshop, a number of online analysis strategies will be discussed for decoding mental states, including analysis of the mean signal of regions-of-interest (ROIs) and the use of pattern classifiers operating at the voxel level.

Course objectives

Students are able to understand:

- principles of real-time fMRI, setup and conduction of real-time fMRI experiments;
- serving as subjects (two students) in a real-time BCI session;
- basics of real-time fMRI data analysis (Turbo-BrainVoyager software).

PSY4231
Period 4

Research Master Cognitive and Clinical Neuroscience, Specialisation Cognitive Neuroscience

1 Feb 2021
2 Apr 2021
Print course description
ECTS credits:
1.0
Instruction language:
English
Coordinators:

- R.W. Goebel
- B. Sorger

Teaching methods:
Lecture(s), Work in subgroups
Assessment methods:
Final paper, Attendance
Keywords:
Real-time fMRI, neurofeedback, brain-computer interface (BCI), brain reading
Faculty of Psychology and Neuroscience

Diffusion Weighted Imaging and Fibre Tracking

Full course description

Diffusion weighted imaging and fibre tracking are a set of techniques that use the Magnetic Resonance (MR) scanner to probe fibre-bundles which connect different regions of the brain. Thus, instead of the cerebral grey matter, it is the white matter that is the object of study. The connections between brain-regions are the substrate of the interaction and communication between different brain systems. Thus, knowledge about the anatomy of these anatomical connections is of great importance to cognitive neuroscientists. The anatomy of fibre-tracts is imaged indirectly, by measuring the diffusion of water in the brain. Water diffuses more easily in a parallel way rather than perpendicular to the direction of surrounding axon bundles. Thus, by measuring the direction of local diffusion of water, inferences about the trajectories of fibre-bundles can be drawn. After completing this training, student will have knowledge of: i) how the MR scanner can be made sensitive to directed diffusion of water and how the resulting diffusion weighted images can be processed; ii) different models for local water diffusion within a voxel, along with useful quantities that can be derived from these models; iii) fibre tracking or tractography- how to get from local models of water diffusion to measures of global connectivity between brain regions. Furthermore, student will gain hands-on experience in analysing and visualising diffusion weighted MR data and in using tractography algorithms and assessing the results.

Course objectives

Students are able to understand:

- how to make the MR scanner sensitive to directed diffusion of water and how the resulting diffusion weighted images can be processed;
- different models for local water diffusion within a voxel, along with useful quantities that can be derived from these models;
- fibre tracking or tractography - how to get from local models of water diffusion to measures of

global connectivity between brain regions.

PSY4228
Period 4
1 Feb 2021
2 Apr 2021
Print course description
ECTS credits:
1.0
Instruction language:
English
Coordinator:

- A.F. Roebroeck

Teaching methods:
Assignment(s), Lecture(s), Skills, Training(s)
Assessment methods:
Assignment, Attendance
Keywords:
diffusion, MRI, DTI, tractography
Faculty of Psychology and Neuroscience

Translational Neuroscience: Towards Clinical Applications for Disorders of Consciousness

Full course description

Translational Neuroscience aims at expanding our understanding of brain structure, function, and disease in order to finally translate this knowledge into clinical applications and novel diagnostics and therapies of nervous-system disorders.

After the students had been introduced with the main state-of-the-art neuroscience methods (EEG, TMS, [real-time] fMRI, DWI etc.) in previous courses and workshops, this core course focuses on the (multi-modal) application of these neuroscientific tools in one particular context: the neuroscientific investigation of disorders of consciousness and the development of related clinical neuroscientific applications (diagnostics and treatment).

After a general introduction to Translational Neuroscience, the students will be familiarised with the different disorders of consciousness. Then, the students will present and critically review several Translational Neuroscience (including brain-computer interface) studies focusing on improving diagnostics and treatment for patients with disorders of consciousness.

At the end of the course, we will discuss (un-)related novel ideas for Translational Neuroscience research.

Course objectives

Students are able to understand:

- introduction to Translational Neuroscience;

- intensive discussion of Translational Neuroscience possibilities in the context of disorders of consciousness;
- critical evaluation of empirical Translational Neuroscience articles;
- practical application of methodological knowledge in a clinical context;
- generation of own Translational Neuroscience ideas.

PSY4257
Period 5
17 May 2021
25 Jun 2021
Print course description
ECTS credits:
4.0
Instruction language:
English
Coordinator:

- B. Sorger

Teaching methods:
Assignment(s), Presentation(s), PBL
Assessment methods:
Attendance, Presentation, Final paper
Keywords:
Translational Neuroscience, Clinical Neuroscience, consciousness, disorders of consciousness, brain imaging methods, brain-computer interfacing
Faculty of Psychology and Neuroscience

Timing Neural Processing with EEG and MEG

Full course description

Cognitive neuroscientists can currently choose from a range of different imaging methods to investigate human brain function. Each of these methods has its own strengths and limitations, which determine its suitability for studying a particular research question. Both electroencephalography (EEG) and magnetoencephalography (MEG) are important in characterising the time course of activation of neural systems involved in perceptual and cognitive processes. Relevant topics include auditory and visual perception, attention, language, memory and their development. EEG and MEG signals reflect complementary aspects of brain activity, with MEG having some advantages over EEG in the localisation of underlying neural sources. This course provides detailed knowledge on EEG and MEG, both of which have a clear advantage over other neuroimaging methods in terms of temporal precision. The study of EEG and MEG experimental design, data acquisition and data analysis will be combined with detailed literature discussions on theoretical and methodological issues. Based on different types of empirical questions, there will be discussion of the potential of a range of methods for advanced EEG and MEG analysis, including analysis in the time and frequency domain, source localisation, the combination with functional magnetic resonance imaging (fMRI) and transcranial magnetic stimulation (TMS) methods, independent component analysis and analyses of functional connectivity.

Course objectives

Students are able to understand:

electro-encephalography, event-related potentials, magneto-encephalography, dipole source analysis, distributed source analysis, Fourier analysis, wavelet analysis, independent component analysis, connectivity analysis, application: mental chronometry, attention, lateralised event-related potentials, combination electro-encephalography and functional magnetic resonance imaging, combination electro-encephalography and trans-cranial magnetic stimulation.

PSY4256
Period 5
12 Apr 2021
21 May 2021
Print course description
ECTS credits:
4.0
Instruction language:
English
Coordinator:

- F.T.Y. Smulders

Teaching methods:
Lecture(s), Paper(s), Presentation(s), PBL
Assessment methods:
Attendance, Final paper, Presentation
Keywords:
electroencephalography, magnetoencephalography, biological signal analysis, source localisation
Faculty of Psychology and Neuroscience

Basic Mathematical Methods

Full course description

Neuroscientific research has greatly benefited from recent developments in data analysis methods. The aim of this course is to provide participants with the basic 'tools' needed to gain a better understanding of the data analysis methodologies and to help them develop methods and strategies to tackle their research problems.

The course will cover the basic aspects of number representation, with an emphasis on complex numbers, needed for Fourier analysis, and will then focus on basic algebra. The course will cover in detail vectors and matrices and their operations, including sums, products, inversion and eigenvalue decomposition and linear systems of equations. The course will also focus on the basic concepts of calculus, including infinitesimals, differential and integral calculus.

Each session of the course has a practical component attached, in which the participants solve, with the aid of the tutor, a number of exercises. These are both pen-and-paper and MATLAB computer-based exercises. Furthermore, a selected range of applications of the illustrated concepts in the field of neuroscience are provided throughout the course.

Research Master Cognitive and Clinical Neuroscience, Specialisation Cognitive Neuroscience

Course objectives

Students are able to understand:

trigonometry, exponentials and logarithms, complex numbers, polar representation, functions of one variable, algebra, solution of a system of linear equations.

PSY4237
Period 5
5 Apr 2021
4 Jun 2021
Print course description
ECTS credits:
2.0
Instruction language:
English
Coordinator:

- G. Valente

Teaching methods:
Assignment(s), Lecture(s), Skills, Work in subgroups
Assessment methods:
Attendance, Take home exam
Keywords:
Algebra, complex numbers, pre-calculus, vectors, matrices
Faculty of Psychology and Neuroscience

Programming in Matlab Basic Course

Full course description

Matlab provides a powerful environment for numerical computation, data analysis and visualisation. It is, in essence, a programming environment that has built-in primitives for common scientific tasks that in other languages, such as C or Delphi, require many operations. Examples are tasks such as matrix algebra (used in statistical analysis of data), Fourier transforms (used in signal processing) and 2D or 3D plots for visualisation of data or analysis-results. Many complete packages for the analysis of cognitive neuroimaging data (e.g. fMRI data or EEG/MEG data) are implemented in Matlab. Thus, usage of these packages requires at least a basic understanding of Matlab. Furthermore, if more advanced analysis or visualisation is needed than what is offered by existing packages, developing new functionalities in Matlab is often the most convenient option. The first part of the course will deal with how Matlab primarily represents and processes data, i.e. as matrices. Subsequently, attention is focused on the usage of the environment: the prompt; the workspace; the help options; and loading, saving and visualising data. The principles behind programming will be introduced, with particular emphasis on neuroimaging applications.

Course objectives

Students are able to understand:

Matlab environment, Matlab variables, vectors, matrices, matrix algebra, 2D and 3D plots, conditional loops, scripts, functions, file Input-Output, structures, cells.

PSY4224
Period 5
5 Apr 2021
4 Jun 2021
Print course description
ECTS credits:
2.0
Instruction language:
English
Coordinator:

- G. Valente

Teaching methods:
Assignment(s), Lecture(s), Skills, Work in subgroups
Assessment methods:
Attendance, Take home exam
Keywords:
Programming principles, scripts and functions, data analysis
Faculty of Psychology and Neuroscience

Research Grant Writing Workshop

Full course description

Research is expensive. Finding appropriate funding sources and writing a convincing application is therefore a core comptenency of scientists. During this workshop students will learn why and how to apply for research grants. The need for acquiring funding for research, the opportunities for, and availability of grant application funding will be discussed. Students will start by chosing a topic (from a list of topics) andwrite an abstract on their research idea. Subsequently, they work in teams to discuss individual ideas and decide on a joint research idea that will serve as a basis for writing a full grant proposal during the second-year Research Grant Writing Course with guidance of a mentor (see description of PSY5112. Mentors are researchers from all RM tracks who have experience in applying for different types of grants will provide students with first-hand knowledge and tips. Students will learn fundamentals of good grant writing, general preparation of the grant application and how to deal with reviewer comments. Ethical issues including feasibility and acceptability of the research, and the role of the local research ethics committee will be discussed.

Course objectives

- students will learn about the importance of grant writing for an academic career
- students will recognize opportunities for funding, ethical aspects of grants, how grants can be acquired, and grant writing skills;
- students will develop a first outline of a grant proposal with peers.

PSY4114
Period 6
7 Jun 2021
2 Jul 2021

Research Master Cognitive and Clinical Neuroscience, Specialisation Cognitive Neuroscience

Print course description
ECTS credits:
2.0
Instruction language:
English
Coordinators:

- S. Köhler
- R.L.H. Handels

Teaching methods:
Lecture(s), Skills, Assignment(s)
Assessment methods:
Final paper, Attendance
Keywords:
Funding possibilities, grant applications, proposal writing, team science
Second year courses

Research Master Specialisation Cognitive Neuroscience Year 2

Faculty of Psychology and Neuroscience

Research Grant Writing Course

Full course description

Research is expensive. Finding appropriate funding sources and writing a convincing application is therefore a core comptenency of scientists. In this course, students will apply what they have learned during the Research Grant Writing Workshop (PSY4112) by going through a full grant proposal writing and review process. Students will work together (groups of 4-6 students) to write a research proposal on their selected topic, including an original research hypothesis, design, methods, motivation and valorization. Students are encouraged to think across boundaries of different scientific fields. A mentor (senior researcher) will guide students during this writing process. The students will write their proposal in 3 steps, and they will receive feedback from their mentor and peers along the way. The resulting grant proposals will be reviewed by two assessors and presented during a symposium by way of an oral presentation.

Course objectives

Students are able to:

- review literature;
- formulate a research hypothesis;
- design a innovative research study;
- write a competitive grant proposal;
- present and illustrate a grant proposal at a symposium.

Research Master Cognitive and Clinical Neuroscience, Specialisation Cognitive Neuroscience

Prerequisites

This course is a continuation of the Research Grant Writing Workshop (PSY4112).

PSY5112
Period 1
1 Sep 2020
23 Oct 2020
Print course description
ECTS credits:
3.0
Instruction language:
English
Coordinators:

- S. Köhler
- R.L.H. Handels

Teaching methods:
Work in subgroups, Skills, Assignment(s)
Assessment methods:
Attendance, Final paper, Presentation
Keywords:
grant proposal, Interdisciplinary, hypothesis, design, methods, research symposium
Faculty of Psychology and Neuroscience

The Brain's Engram: Memorising Experiences and Experiencing Memory

Full course description

The brain is able to retain a myriad of experiences in the memory for shorter and longer durations of time. Memory formation requires encoding followed by the selection of relevant items in working memory, and the consolidation of the experience into a lasting neural representation. At the same time, memory retrieval appears to involve the reactivation of the neural processes of memory formation. In this course, students will discuss the neuroscience of working memory and episodic memory, and in how far these types of memory rely on similar neural mechanisms and brain networks. The role of prefrontal cortex as well as the hippocampal complex in memory formation and retrieval will be discussed in detail. With the current knowledge and methods, it has become possible to artificially create, delete, and retrieve memories, and we will read some of the research papers that have led to this unprecedented capability.The literature comprises introductory materials on plasticity in aplysia and LTP, as well as cutting-edge memory research papers from various neuroscience disciplines, including cognitive neuroimaging, neurophysiology, molecular biology (optogenetics), pharmacology, and pharmacology.

Course objectives

Students will

- acquire knowledge and understanding of basic processes underlying learning and memory,

including neurophysiological correlates at the level of spiking and local field potentials, oscillations, and cellular plasticity processes;
- acquire knowledge, understanding as well as the ability to critically analyse and evaluate core papers on learning and memory that combine theories, methods, and data from different fields, including cognitive neuroscience, neurophysiology, pharmacology, and molecular neuroscience;
- improve their ability to integrate insights from different fields (as mentioned in previous points) to gain deeper insight in fundamental theories of memory and in core concepts including encoding, (re)consolidation, maintenance and retrieval;
- gain anatomical and functional knowledge on the contributions of hippocampus, frontal lobe, and sensory cortices to learning and memory;
- gain the ability to read current, cutting-edge, multidisciplinary empirical research papers documenting approaches to implant artificial memories, delete specific memories, or reactivate/retrieve memories under experimental control;
- further improve their skills in reading, analyzing, evaluating and verbally discussing interdisciplinary papers, leading to suggestions for better design and/or analysis.

PSY5213
Period 1
1 Sep 2020
23 Oct 2020
Print course description
ECTS credits:
4.0
Instruction language:
English
Coordinators:

- P.H.M. de Weerd
- V.G. van de Ven

Teaching methods:
Lecture(s), PBL, Paper(s)
Assessment methods:
Attendance, Written exam
Keywords:
Working memory, prefrontal cortex, theta oscillations, episodic memory, hippocampus, Space, time, place cells, grid cells, LTP, cellular mechanisms of plasticity
Faculty of Psychology and Neuroscience

Signal Analysis

Full course description

Traditional and advanced statistics provide essential knowledge and tools for the correct formulation of scientific inferences and for summarising a research work. Nonetheless, modern techniques in neuroscience research have strongly increased the amount of information that can be extracted from experimental data and analysed, especially on account of the improved spatial and temporal resolution of the acquisition methods. Most of the new information can be recovered by including in the statistical modelling the ‘signal’ structure of the data, generally due to the physical dimensions of data, time and space. This Signal Analysis course introduces the practical implementation of the traditional and latest research approaches to time and space signal analysis in the context of neuroscience research.

The course focuses on time series analysis from one- and multi-dimensional data. The basics of discrete time and space signal acquisition and modelling are presented and discussed in their practical neuroscience applications. The course has the objective to provide the participants with an operational understanding of the classical signal analysis techniques like preprocessing, analysis in the frequency, time and amplitude domains, Fourier series, Fourier Transform and FFT, spectral analysis, linear system theory and implementation of filters in time and frequency domains. Practical demonstrations from real world data reinforce concepts introduced in the lectures. MATLAB implementation of these techniques is also addressed throughout the meetings.

Course objectives

Students are able to understand:

statistical modeling, stationary signals, sampling theorem and frequency, harmonics, Fourier Series, Fourier Transform, Discrete Fourier Transform, linear systems, filters.

PSY5231
Period 1
1 Sep 2020
23 Oct 2020
Print course description
ECTS credits:
2.0
Instruction language:
English
Coordinator:

- G. Valente

Teaching methods:
Assignment(s), Lecture(s), Paper(s), Presentation(s), Skills, Training(s), Work in subgroups
Assessment methods:
Attendance, Take home exam
Keywords:
Frequency representation, Linear systems, filters
Faculty of Psychology and Neuroscience

Programming in Matlab Advanced Course

Full course description

This course deals with advanced topics in Matlab programming. In particular, it will focus on how to implement efficient and re-usable programs for neuroimaging applications. Students will learn how to put the principles of efficient programming, such as debugging and profiling, into practice. Advanced topics in graphics and user interfaces will also be discussed.

Course objectives

Students are able to understand:

debugging, efficient programming, graphical objects, graphical user interfaces.

Prerequisites

PSY4224 Programming in Matlab Basic Course.

PSY5223
Period 1
1 Sep 2020
23 Oct 2020
Print course description
ECTS credits:
1.0
Instruction language:
English
Coordinator:

- G. Valente

Teaching methods:
Assignment(s), Lecture(s), Skills, Work in subgroups
Assessment methods:
Attendance, Assignment
Keywords:
Efficient programming, debugging, graphical user interfaces