DEL 01: Publication of the updated module handbook UGA

20337 – EIT Health Master in Health and Medical Data Analytics

EIT Health

Erlangen | 16 December 2021

Contents

EIT Health is supported by the EIT,
a body of the European Union

Study track at the UGA

1st year, 1st semester (autumn/winter semester)

NB: Some of the courses of the 1st year cannot be taken at this moment due to the sanitary situation.

SCIENTIFIC READING AND WRITING

Responsible Lecturer: Don Martin
ECTS: 3
Course type and weekly hours: 16h
Exam type: scientific report, presentation.

This course will introduce the basis to perform good oral and written presentations with several sequences of combined lecture, tutorial, workshop to allow the master students to deal with any situation of their Master 1 year or their future work.

Content:
A first sequence will help the students to find an internship. A tutorial and a workshop will be organized in order to improve their CV and practice an interview. A second teaching sequence will address the way to write a scientific report, from an internship report towards a scientific publication. This part will be followed by a lecture concerning the different modes of scientific communication, written or oral (report, meeting, lab-book, etc.) within a laboratory.
A third sequence will deal with oral scientific presentation. A tutorial will explain how to prepare the presentation as well as how to present it. A workshop will give the opportunity to practice in front of an audience. It will also be the basis for an evaluation.
Another lecture will provide an opening towards electronic communication tools in order to be able to succeed in a skype interview and to be visible on the web using tools like LinkedIn or Viadeo.

A closing lecture will offer a transversal view of the different points highlighted throughout the course.

Learning outcomes:
Students will improve their skills in written and oral presentation. The course will provide competences required for the Master 1. Students will be trained in order to be able to write their CV and internship report, achieve interviews and be able to provide convincing scientific presentation. These specific points will also be extended to other oral and written communication tools as well as electronic communication that can be needed during and after a Master 2 program.

PROTEOMICS FOR HEALTH RESEARCH

Responsible lecturer: Sandrine Bourgoin
ECTS: 3
Course type: IS E-learning (45h)
Exam type: t.b.d.

Proteomics describes large-scale analysis of proteins in a biological sample. The aim of these studies is to determine the protein parts that are present in such samples and to define their concentrations, molecular states, structures, functions, or connections. Today, there are different technologies being used and developed to study the different types of samples such as to find biomarker molecules that could help to diagnose diseases or even improve therapy of patients.

Course main content:
The objective of the course is to present current trends for global protein analysis and to demonstrate its principles, challenges, and complexity. The course will therefore provide an overview of typical proteomics applications used today, such as for biomarker discovery and validation. The course is focused on different methods, technologies and strategies currently used within the field of proteomics in general and with an emphasis on biomarker discovery. The lectures will cover background and recent advances for both classical proteomics methods, such as 2D-gel electrophoresis and mass spectrometry, and strategies based on high-throughput antibody generation, bioinformatics, and structural approaches.

Intended learning outcomes:
The aim of the course is to provide the students with an introduction to current methodologies and trends in the field of proteomics. The students should also obtain an overview and awareness of typical proteomics applications. After completed course the student should be able to describe and discuss the possibilities and advantages, and the complexity and drawbacks of various proteomics technologies compare traditional methods with emerging technologies suggest suitable approaches for specified applications and motivate the choice speculate and argue about the future of proteomics technologies participate in scientific discussions regarding proteomics technologies critically evaluate scientific results.

Literature:
Principles of Proteomics by R.M Twyman, Garland Science, ISBN: 9780815344728 (second edition)Handout and articles distributed at the lectures

BIOMEDICINES INNOVATIVE PROJECT APPLIED TO IN VITRO DIAGNOSTICS AND BIOMARKERS

Responsible lecturer: Jean Breton
ECTS: 6
Course type and working hours: 30h
Exam type: t.b.d.

Content:
This curse takes a very practical, applied approach to the challenges of successful project management. The essentials cover the following: structuring projects to set realistic goals and identify milestones; using effective tools for scheduling and be able to run single or parallel projects; identify project risks ; manage time, cost, and quality; implement control systems to keep on top of the project.

Target:
The Biomedicines innovative project has a wide range of possible applications for any initiative whose completion is fixed within specific time limits

MODEL SELECTION FOR LARGE-SCALE LEARNING (IM²AG)

Responsible lecturer: Emilie Devijver
ECTS: 3
Course type and working hours: 60h
Exam type: t.b.d.

Description
When estimating parameters in a statistical model, sharp calibration is important to get optimal performances. In this course, we will focus on the selection of estimators with respect to the data. Particularly, we will consider calibration of parameters (e.g., regularization parameter for minimization of regularized empirical risk, like Lasso or Ridge estimators) and model selection (where each estimator minimizes the empirical risk on a specified model, as mixture models with several number of clusters). We will focus on the penalized empirical risk, where the penalty may be deterministic (as BIC or ICL) or estimated with data (as the slope heuristic).

Prerequisites:
Basic knowledge in probability and statistics

Target skills:
Learn.

- When model selection is needed.
- What can be proved theoretically for existing methods.
- How those results can help in practice to choose a criterion for some specific statistical problem
- How the theory can serve to define new procedures of selection.

References:

- T. Hastie, R. Tibshiraniand J. Friedman, The Elements of Statistical Learning. Data Mining, Inference, and Prediction
- P. Buhlmann and S. van de Geer, Statistics for High-Dimensional Data. Methods, Theory and Applications
- P. Massart, Concentration Inequalities and Model Selection

SOFTWARE DEVELOPMENT TOOLS AND METHODS (IM²AG)

Responsible lecturer: Mourad Ismail
ECTS: 3
Course type and working hours: seminar, 39h
Exam type: practical session reports, oral presentation.

Description
The aim of this course is to study various useful applications, libraries and methods for software engineering related to applied mathematics. For example:

- C++ project management (git and/or svn)
- Development and profiling
- Boost library
- Linear algebra (Eigen)
- Prototyping and interfacing using Python
- Post processing and visualization tools (VTK,Paraview, GMSH)

This course deals with :

Topic 1: Software Engineering
Topic 2: Programming

Prerequisite
Linear algebra: fundamental notions (matrices, linear functions), Programming in C++ and python

Learning outcomes
At the end of the course, students will be able to manage and couple different libraries, to correctly debug a code (find memory leaks for example).

DATA MANAGEMENT TECHNOLOGIES AND POLICIES

Responsible lecturer : S. Kotzki; Sylvain.Kotzki@univ-grenoble-alpes.fr

ECTS: 3

Content of the Course Unit

In this 30-hours program you will learn the fundamental of information technology and database management with a focus on healthcare. You will discover the database design, modeling, systems and the evolving world of data warehousing, governance and more. Fundamental concepts are supported by real-world examples, query and codes when required. The courses will also teach you how medical data cand be used to produce performance indicators through Business Intelligence type tools. Since these concepts should be perfectly mastered before using any kind of machine learning libraries or artificial intelligence tools, this chapter will be a perfect introduction for advanced learning in the field of computer science.

Concrete examples are presented, and you will have the opportunity to work on real databases.

Detailed program

- Introduction to Information Technology in Healthcare (3h)
- Database Management: from concepts to architecture (3h)
- Organisational aspects (2h30)
- Introduction to relational databases concepts (1h30)
- SQL and NoSQL languages (3h30)
- XML language (2h30)
- Warehousing & Business Intelligence applied to healthcare (3h)
- Key Performance Indicators in healthcare (2h)

Organisation

20 Hours of courses spread over a dozen of supports. On-line tests are systematically available for self-training.
Final examen consists of a two-parts homemade project dealing with medical data management and analysis
The program is 100% online and in English

Rules of validation

Continuous evaluation (30%), Final exam (70%)

AI FOR OMICS DATA INTEGRATION (AI4OMICS)

Responsible lecturer: Pr Mossuz Pascal; pascal.mossuz@univ-grenoble-alpes.fr

ECTS : 6

Content of the Course Unit

This course aims to present the different methods of artificial intelligence applied to the exploitation of data produced by Omics techniques (genomics, metabolomics, proteomics, transcriptomics, metagenomics for pathogens). The methods to analyze the data produced by each of the OMICs as well as the AI methods allowing their use in a medical context are discussed. Multi-omics integration for integrative medicine and the principles of modeling biological networks are also offered. The teaching is organized in the form of video batches, interactive tutorial sessions between students and teachers. A practical training in the form of a challenge is offered on a transcriptomic dataset.
Interventions by speakers coming from UGA, IAB, INRIA, CEA, GIN, TIMC, CHUGA

Organisation

Total 30 sequences of video recorded
1 challenge
Sequences of interactive works between student and teacher
100% Online teaching

Rules of validation

Continuous evaluation (25%),
Final exam (75 %)

INTRODUCTION TO AI FOR HEALTH

Responsible lecturer : Michel Seve, michel.seve@univ-grenoble-alpes.fr

ECTS : 3

Content of the Course Unit

In this program you will discover the field of artificial intelligence applied to health trough online conferences. You will learn the definition and the main concepts developed in AI. This programme is a general introduction to the other courses in the Master programme.
The technological and ethical aspects will be illustrated by watching some excerpts form movies and through discussions.

You will have also the opportunity to self-evaluate your level and competences in the fields of computing, programming, biology and your knowledge of the healthcare system. This evaluation will help you to choose specific courses to upgrade your level and reach the prerequisite expected in the following units.

Detailed program

Presentation of the AI4Health Programme, Education board and evaluation (2h)

Introductive conferences
Data for Artificial Intelligence (2h)

Example of technologies on the market

Challenge of AI for Health

Ethical aspects of AI
Examples from movies: anticipation of the future ?

Self-evaluation

Upgrade courses (computer programming, mathematics, biology, Healthcare system)

Organisation

10 Hours of courses and conferences. On-line tests after the conferences
A self-evaluation to assess the prerequisite level expected in computer sciences, programming, biology and knowledge of the healthcare system.
A set of upgrade courses (recorded courses, exercises, online documents).
Final examen consists of general questions about AI for Health and a written report on a subject.
The program is 100% online

Rules of validation

Continuous evaluation (50%), Final exam (50%)

FRENCH AS A FOREIGN LANGUAGE

ECTS: 3
Course type and working hours: 20h

1st year, 2nd semester (spring/summer semester)

Innovation and Entrepreneurship (12 ECTS)

SHORT INTERNSHIP 2 Months

12 ECTS

Description:
Science industrial and/or business project.

HOW TO BECOME A CANCER CELL

Responsible lecturer: Arnaud Seigneurin
ECTS: 6
Course type and working hours: 50h
Exam type: t.b.d.

Description:
The objective of this course is to acquire the fundamental knowledge necessary to understand key mechanisms of cancer development. This course includes a set of lectures on alterations of cellular and molecular mechanisms that are responsible for the cancer pathophysiology. These modified cellular functions include for example the cell division, apoptosis, gene expression, stem cells, angiogenesis, and degradation of the extracellular matrix. The fundamental notions will be illustrated via their implications in diagnosis and therapeutics. The publication analysis will allow emphasizing the medical interest.

Learning outcomes:

- Knowledge in fundamental cancer cell biology, cancer cell-host relationship, basis on corresponding targeted therapeutics.
- Ability to analyse biological data from published scientific manuscripts.

CANCER DISEASE:EXPERIMENTAL AND THERAPEUTICALLY APPROACHES

Responsible lecturer: Claire Rome
ECTS: 6
Course type and working hours: 40h
Exam type: t.b.d.

Description:
To provide a comprehensive overview of cancer from basic research to clinical trials: cancer

physiopathology; cancer metabolism; proteomics; circadian rhythm and cancer cell characteristics; development of new anti-cancer drugs; imaging in cancer disease.

MOLECULAR AND CELLULAR IMAGING (MICROSCOPY)

Responsible lecturer: Arnaud Seigneurin
ECTS: 6
Course type and working hours: 50h
Exam type: t.b.d.

Lectures:
Optical Microscopy:

- Basics of light microscopy, Köhler illumination, Contrast generation for transmitted light (Dark field, Polarized light, Phase contrast, DIC...)
- Fluorescence Microscopy, F-techniques, Optical Sectioning and Confocal Microscopy (Laser scanning confocal, multiphoton microscopy...)
- Processing and analysis of biological images

Electron Microscopy:

- Ultrastructural studies of the architecture of cellular components, viruses, and macromolecular assemblies by electron microscopy (Transmission Electron Microscopy, Scanning, Cryo-EM...)
- Sample preparation, Image analysis

Discovering of X-Ray and near-field microscopies

Lab sessions:

- Optical Microscopy: Köhler illumination, Contrasts for transmitted light, Fluorescence microscopy, Image Processing
- Visits on research platforms allow the students to become familiar with modern microscopy techniques (laser scanning multiphoton, super resolution, F-techniques, imaging methods in electron microscopy ...).

Learning outcomes:

- Acquisition by the students of autonomy on wide field optical microscopes,
- Thorough knowledge of the principles of electron microscopes
- Discovery of X-rays and near field microscopies.
- Practice of processing and analysis of biological images with open-source software

2nd year, 1st semester (autumn/winter semester)

Main Courses (15 ECTS)

THE HMDA´S SCHOOL ON LEARNING FROM HEALTH DATA

This summer school is offered and held by UGA for all HMDA students, which includes the preparation, execution, and documentation of a practical project, which is based on a real use case in the healthcare context.

Responsible lecturer: various
ECTS: 6
Course type: workshop/laboratory course (150 hours in total, including self-study and preparation of tasks in teams)
Exam type: /

Contents:
With its yet unfulfilled promise to revolutionize the healthcare economy and save billions of euros in the process, Artificial Intelligence (AI) and health data management in general are exploding in popularity. Indeed, the growth of the global AI health market is expected to reach US$6.6 billion by 2021.

But can AI and data-driven technologies truly live up to expectations in the field of health?

Over 5 demanding days at this exciting bioHealth Computing school, graduate students (Master & PhD) and early career professionals in science, informatics and healthcare are immersed in a challenging mix of theoretical and practical sessions on AI technology and innovation and coached to develop business models of market-acceptable products and services using AI technologies.

Learning from Health Data is an accelerated learning programme proposed by a consortium of EIT-Health partner universities and co-organised by the Université Grenoble-Alpes and ESI-Archamps. The school is fully in line with EU goals to deliver innovation-led solutions enabling European citizens to live longer, healthier lives.

The school adheres to the 2030 Agenda for Sustainable Development of the UN, and in particular to the objectives of the UHC2030 programme whose mission is to create a movement for accelerating equitable and sustainable progress towards universal health coverage (UHC).

The application form includes a section where candidates should provide a 50 to 200-word outline of an innovative idea or project related to health and medical data analytics. This might be expressed in terms of:

- An unmet need in healthcare which could benefit from the development of data-driven products or services.
- The (re)deployment of an existing technology to provide an innovative product or service for healthcare.

- Currently unavailable but potentially marketable product or service involving data-driven technology for healthcare.

The best ideas may serve as the basis for a group project in the Business Development & Innovation component of the school.

Learning outcomes and competencies:
Students can

- apply industry standard techniques and team management.
- develop, independently and within a team, their problem-solving and creative skills.
- implement their ideas as prototypes by applying agile software development methods.
- use the results of their projects for the creation of start-ups.
- develop world-class solutions in the field of IT and health technologies, address societal challenges, contribute to the competitiveness of Europe,
- focus on unmet needs in healthcare, AI candidate technologies, experienced-based co-design, business creation, health assessment and regulatory affairs.
- participate a series of advanced courses and hands-on activities on IT proposed by experts from partner universities, hospitals, and industries. One breakout session on advanced application in health will examine several uses of machine learning, big data and internet of things presented by leaders in Health Research and Development, reviewing the latest techniques.
- develop innovative ideas in multidisciplinary teams translating them into value creation through a business model and under the health regulation framework.

METHODS AND MEANS FOR BIOHEALTH RESEARCH

Responsible lecturer: Don Martin
ECTS: 6
Course type and working hours: 26h
Exam type: t.b.d.

Analyzing and synthesizing scientific concept.

Reporting the results of the science (classes tutorials, oral and written exercises)

FRENCH AS A FOREIGN LANGUAGE

ECTS: 3
Course type and working hours: 20h

OPTIONAL COURSES – SPECIALIZATION (15 ECTS)

BIOMEDICINES INNOVATIVE PROJECT APPLIED TO IN VITRO DIAGNOSTICS AND BIOMARKERS

Responsible lecturer: Jean Breton
ECTS: 6
Course type and working hours: 30h
Exam type: t.b.d.

Content:
This curse takes a very practical, applied approach to the challenges of successful project management. The essentials cover the following: structuring projects to set realistic goals and identify milestones; using effective tools for scheduling and be able to run single or parallel projects; identify project risks ; manage time, cost, and quality; implement control systems to keep on top of the project.

Target:
The Biomedicines innovative project has a wide range of possible applications for any initiative whose completion is fixed within specific time limits

MODEL SELECTION FOR LARGE-SCALE LEARNING (IM^{2}AG)

Responsible lecturer: Emilie Devijver
ECTS: 3
Course type and working hours: 60h
Exam type: t.b.d.

Description
When estimating parameters in a statistical model, sharp calibration is important to get optimal performances. In this course, we will focus on the selection of estimators with respect to the data. Particularly, we will consider calibration of parameters (e.g., regularization parameter for minimization of regularized empirical risk, like Lasso or Ridge estimators) and model selection (where each estimator minimizes the empirical risk on a specified model, as mixture models with several number of clusters). We will focus on the penalized empirical risk, where the penalty may be deterministic (as BIC or ICL) or estimated with data (as the slope heuristic).

Prerequisites:
Basic knowledge in probability and statistics

Target skills:
Learn.

- When model selection is needed.
- What can be proved theoretically for existing methods.
- How those results can help in practice to choose a criterion for some specific statistical problem
- How the theory can serve to define new procedures of selection.

References:

- T. Hastie, R. Tibshiraniand J. Friedman, The Elements of Statistical Learning. Data Mining, Inference, and Prediction
- P. Buhlmann and S. van de Geer, Statistics for High-Dimensional Data. Methods, Theory and Applications
- P. Massart, Concentration Inequalities and Model Selection

SOFTWARE DEVELOPMENT TOOLS AND METHODS (IM²AG)

Responsible lecturer: Mourad Ismail
ECTS: 3
Course type and working hours: seminar, 39h
Exam type: practical session reports, oral presentation.

Description
The aim of this course is to study various useful applications, libraries and methods for software engineering related to applied mathematics. For example:

- C++ project management (git and/or svn)
- Development and profiling
- Boost library
- Linear algebra (Eigen)
- Prototyping and interfacing using Python
- Post processing and visualization tools (VTK,Paraview, GMSH)

This course deals with :

Topic 1: Software Engineering
Topic 2: Programming

Prerequisite
Linear algebra: fundamental notions (matrices, linear functions), Programming in C++ and python

Learning outcomes
At the end of the course, students will be able to manage and couple different libraries, to correctly debug a code (find memory leaks for example).

PROTEOMICS FOR HEALTH RESEARCH

Responsible lecturer: (S. Bourgoin; Sandrine.Bourgoin@univ-grenoble-alpes.fr) - (M. Sève; Michel.Seve@univ-grenoble-alpes.fr)
ECTS: 3

Content

What is proteomics ?

Major techniques in current proteomics

Main strategies and approaches, Enzymatic digestion, Separation methods, Mass spectrometry, Bioinformatics, …

Applications of proteomics

Protein identification, protein quantitation, Post-Translational modifications (PTM) investigation, Protein-protein interaction, methodology for biomarker research, methodology for characterization of biopharmaceutical products…

Limits and challenges of proteomics

9 e-learning sequences (21 days for each sequence)

A sequence is a lecture, an article/review, student's questions/ teacher's answers, auto-evaluation with questions on the lecture and the article/review

A tutorial session will be scheduled by the end of November to summarize the main aspects of proteomics and answer questions

Continuous evaluation/Auto-evaluation/Final exam

Written report on a proteomic topic

DATA MANAGEMENT TECHNOLOGIES AND POLICIES

Responsible lecturer : S. Kotzki; Sylvain.Kotzki@univ-grenoble-alpes.fr

ECTS: 3

Content of the Course Unit

In this 30-hours program you will learn the fundamental of information technology and database management with a focus on healthcare. You will discover the database design, modeling, systems and the evolving world of data warehousing, governance and more. Fundamental concepts are supported by real-world examples, query and codes when required. The courses will also teach you how medical data cand be used to produce performance indicators through Business Intelligence type tools. Since these concepts should be perfectly mastered before using any kind of machine learning libraries or artificial intelligence tools, this chapter will be a perfect introduction for advanced learning in the field of computer science.

Concrete examples are presented, and you will have the opportunity to work on real databases.

Detailed program

- Introduction to Information Technology in Healthcare (3h)
- Database Management: from concepts to architecture (3h)
- Organisational aspects (2h30)
- Introduction to relational databases concepts (1h30)
- SQL and NoSQL languages (3h30)
- XML language (2h30)
- Warehousing & Business Intelligence applied to healthcare (3h)
- Key Performance Indicators in healthcare (2h)

Organisation

20 Hours of courses spread over a dozen of supports. On-line tests are systematically available for self-training.
Final examen consists of a two-parts homemade project dealing with medical data management and analysis
The program is 100% online and in English

Rules of validation

Continuous evaluation (30%), Final exam (70%)

AI FOR OMICS DATA INTEGRATION (AI4OMICS)

Responsible lecturer: Pr Mossuz Pascal; pascal.mossuz@univ-grenoble-alpes.fr

ECTS : 6

Content of the Course Unit

This course aims to present the different methods of artificial intelligence applied to the exploitation of data produced by Omics techniques (genomics, metabolomics, proteomics, transcriptomics, metagenomics for pathogens). The methods to analyze the data produced by each of the OMICs as well as the AI methods allowing their use in a medical context are discussed. Multi-omics integration for integrative medicine and the principles of modeling biological networks are also offered. The teaching is organized in the form of video batches, interactive tutorial sessions between students and teachers. A practical training in the form of a challenge is offered on a transcriptomic dataset.
Interventions by speakers coming from UGA, IAB, INRIA, CEA, GIN, TIMC, CHUGA

Organisation

Total 30 sequences of video recorded
1 challenge
Sequences of interactive works between student and teacher
100% Online teaching

Rules of validation
Continuous evaluation (25%),
Final exam (75 %)

NEURAL NETWORK MODELLING AI FOR HEALTH APPLICATIONS

Responsible lecturer: M. Mermillod; Martial.Mermillod@univ-grenoble-alpes.fr

ECTS : 3

Content of the Course Unit

The main goal of this course is to describe the origins and basic principles of neural network modeling, from the pioneer work of Frank Rosenblatt to the advent of Convolutional Neural Networks. The course present an historical view of this (largely) unknown conception of artificial intelligence as well as the understanding of the basic principles of neural network modelling : transfer functions, synaptic weights modifications, non-linear problems, convolutional and pooling layers, advantages of parallel and distributed systems, etc.

Detailed program
The program is organised as follow:
- The origin of neural network modelling and cognitive sciences.
- The Perceptron and the concept of non-linear problems.
- Transfer functions and synaptic weight modifications.
- Back-propagation algorithm and iterative training rules.
- From the Multi-Layer Perceptron to Deep Neural Networks and Spiking Neural Networks.
- The ground-breaking perspectives of parallel & distributed neural systems.
- Exploring the “Black Box”.
- Beyond Deep Learning: Perspectives for more resilient and efficient neural network algorithms.
- Beyond the Turing-Von Neumann bottleneck: Perspectives for Edge-AI and Neural processor Units.
- Toward Self-Consciousness in Artificial Neural Networks?

Organisation
100% online

Rules of validation
Final exam (100%)-Online forum (depending on the plateform)

MACHINE LEARNING AND DEEP LEARNING FOR HEALTH DATA ANALYSIS

Responsible lecturer : Karolos Potamianos; karolos.potamianos@cern.ch

ECTS : 3

Content of the Course Unit

The purpose of the course unit is to familiarise yourself with machine learning (ML) and deep learning (DL) algorithms. We will cover the basic principles behind ML and DL algorithms and apply them to textbook datasets as well as to medical ones. The course takes a pragmatic, user-oriented, approach rather than a more theoretical one (aimed at ML&DL researchers). The course unit comprises a series of hands-on tutorials. ***Knowledge of the Python programming language is a prerequisite for this course (for the hands-on part).***

Detailed program

- Introduction to machine learning (ML) and deep learning (DL)
- Overview of ML algorithms: supervised, unsupervised, and reinforcement learning
- DL: neural networks (NN) and deep neural networks (DNN)
- Example applications of ML&DL to the analysis of health data
- Ethical considerations of ML&DL

Organisation

100% online

The course unit contains about 8h of teaching, together with 4h of tutorials. To prepare the assignments, self-study is expected, as the goal of the course is to train you to be able to use the wealth of online and other resources in ML and DL.

Rules of validation

Assignments (100%)

INTRODUCTION TO AI FOR HEALTH

Responsible lecturer : Michel Seve, michel.seve@univ-grenoble-alpes.fr

ECTS : 3

Content of the Course Unit

In this program you will discover the field of artificial intelligence applied to health trough online conferences. You will learn the definition and the main concepts developed in AI. This programme is a general introduction to the other courses in the Master programme.
The technological and ethical aspects will be illustrated by watching some excerpts form movies and through discussions.
You will have also the opportunity to self-evaluate your level and competences in the fields of computing, programming, biology and your knowledge of the healthcare system. This evaluation will help you to choose specific courses to upgrade your level and reach the prerequisite expected in the following units.

Detailed program

Presentation of the AI4Health Programme, Education board and evaluation (2h)

Introductive conferences
Data for Artificial Intelligence (2h)

Example of technologies on the market

Challenge of AI for Health

Ethical aspects of AI
Examples from movies: anticipation of the future ?

Self-evaluation

Upgrade courses (computer programming, mathematics, biology, Healthcare system)

Organisation

10 Hours of courses and conferences. On-line tests after the conferences
A self-evaluation to assess the prerequisite level expected in computer sciences, programming, biology and knowledge of the healthcare system.
A set of upgrade courses (recorded courses, exercises, online documents).
Final examen consists of general questions about AI for Health and a written report on a subject.
The program is 100% online

Rules of validation

Continuous evaluation (50%), Final exam (50%)

IOT AND AI FOR HEALTHCARE

Responsible lecturer : Sébastien Chanoine, schanoine@chu-grenoble.fr

ECTS : 3

Content of the Course Unit

This teaching unit aims to introduce students to Internet Of things (IoT) in the field of healthcare, and make them aware of the opportunities and issues related to data generated by these IoT.

Detailed program

- IoT for healthcare: definition and overview
- Artificial intelligence to exploit data generated by IoT for healthcare
- Concerns related to data generated by IoT for healthcare
- Regulation of the use of health data for research
- Research on the development of new IoT: overview and perspectives
- Tutorial: presentation of IoT currently marketed

Organization

Hours of courses, on-line Exercises, project, other activities….
The program is 100% online and in English
Hours of courses: 15h (tutorials: 3h)
Project: 12h

Rules of validation

Continuous evaluation (%), Final exam (%), online activities (%),….
Continuous evaluation (40%): presentation of an IoT (video)
Final exam (60%): MCQ online

ETHICAL AND SOCIETAL ASPECTS OF ARTIFICIAL INTELLIGENCE

Content of the Course Unit

Ethical and societal aspects of Artificial Intelligence: Health is one of the areas most impacted by the use of artificial intelligence. Significant advances in the field of research, treatment and care have been announced, along with fears about the use that can be made of this technology. The objective of this course will be to address the fundamental principles for an ethical use of AI in medicine by seeing concrete cases of use, whether in medical search algorithms, the processing of patient personal data, medical robots or the governance of AI-based technologies in health care.

Detailed program

Course given by Alexandre Bretel (alexandre.bretel@normalesup.org)
Ethics & AI chair
https://www.ethics-ai.fr/

1. Towards a Hippocratic Oath 2.0? Introduction to AI Ethics in Healthcare
2. The fundamental principles for deploying AI in healthcare
3. The connection between AI ethics and bioethics
4. Conceiving ethics-by-design AI for health
5. The notion of responsibility at the core of the doctor-AI-patient relationship
6. Conducting an ethical medical research in compliance with the GDPR
7. The Health Data Hub: towards which use?
8. AI and tele-medicine: for an ethical practice
9. The use of AI to support medical personnel in their missions: Olive's case study
10. Medical robots: can care be automated?
11. Reparative medicine or enhancement: what is the ethical framework for treatment using AI?
12. For a transdisciplinary approach to AI-based governance of health technologies

Organisation

100% online
47 hours in total (courses, exams, personal and group exercises).
6 hours of classes spread over 12 capsules.
Online exercises to verify the acquisition of knowledge of a module.
Personal work before or after the course on documents (scientific articles, press, video) which can be used as a prerequisite for the course or for further study. This work can be done individually, or in a group of students at a distance. The work can be submitted in the form of a report that can be graded.
Possibility to ask questions by the students by the opening of a forum allowing exchanges between students and the teacher. The forums can be open for a defined period of time, on a specific topic, or throughout the module for general questions.
Three one-hour interactive videoconference sessions in which the teacher takes over the questions and difficult points of the course.

Rules of validation

A series of reading materials with self-assessment questions (30% of the final score).
Two group work sessions on articles with a report to be presented by the students (30% of the final score).
A final evaluation (40% of the final score).

APPLICATION OF AI FOR HEALTHCARE

Content of the Course Unit

This course aims to provide examples about application of AI on health research. Several methods will be developed including unsupervised clustering, causal inference, text mining and to have a critical reading of IA methods applied in health. Each teacher will share his/her experience on his/her research field and you will be able to identify the finality of the different methods in a health project.

Organisation
Hours of courses, on-line Exercises, project, other activities….
The program is 100% online and in English

Number of capsules: 12 to 14
On-line exercices (directed works): 12h

Rules of validation
Continuous evaluation (%), Final exam (%), online activities (%),….
Continous evaluation (50% including MCQ and online activities), Final exam based on an individual report: 50%

2nd year, 2nd semester (spring/summer semester)

THE PHILIPPE SABATIER SUMMER SCHOOL ON SAFER NANOMATERIALS

6 ECTS, Philippe SABATIER philippe.sabatier@univ-grenoble-alpes.fr

Objective and learning outcomes
SaferNano Design& Law (Safer Design for Nanomaterials) is a Summer School which focuses on advanced methods and innovative approaches to NTs' safety-by-design, in order to reduce the need of, and/or foster substitution of Critical Raw Materials (CRMs) in the main EU industrial Value Chains.
The three main objectives are:

- Educate students to become highly skilled European professionals with expertise in NT's EHS. This expertise will enable them to develop new methods for life cycle assessment and safer designing of nanomaterials.
- Enable participants to become leading practicing engineers, across all sectors of society including academia, industry, and public service, with transferable skills such as innovation, ethics, intellectual property, sustainability, and advanced research strategies.
- Develop a deep entrepreneurship mindset with the help and expertise of associated businesses, incubators, and innovation services as well as a large panel of industries.

Outcomes

SaferNanoDesign & Law provides participants with a broad but high-level scientific background in the field, of nano safety and important skills such as teamwork, management of complex processes, conceptual approaches, entrepreneurship, and high intercultural awareness. Students are trained on how to get and analyse omics data to perform gene ontology and pathway analysis. They also become familiar with predictive toxicology via the Adverse Outcome Pathways (AOP) and Effectopedia tool.
By taking this course participants will have gained:

- Broad view of the nanotechnology market and the evolving regulatory framework,
- Knowledge on theoretical and practical understanding of nanomaterial reactivity and transformation in the environment; and on the surface reactivity and on the 'nano-specific' properties useful for diverse applications.
- Knowledge on how to assess environmental impacts of nanomaterials using a life cycle assessment model, and to develop nanomaterials and nanoproducts using a safer by design approach.
- Insight on the different types of assays available to assess the impact of nanomaterial exposure at different levels (environment, organism, cell, molecule etc.
- Overview of nowadays and future nanotoxicology: the different types of assays available to assess the impact of nanomaterials exposure at the organism but also cellular and molecular levels. Finally, the students will have gained knowledge on how to assess the biological response to nanomaterial exposure.
- Mastery of the general legislation concerning eco-design at EU and national levels, as well as working knowledge of value chain issues and marketing. It also includes the capacity to analyse in specific contexts how innovative strategies may lead to improved firm performance or to new business perspectives.

Content

Nanotechnology is now bringing new opportunities to reduce the need of, and/or foster sub-situation of Critical Raw Materials in the main EU Industrial Value Chains. SaferNano Design & Law address the tricky challenge of the Nanotechnology's transition by promoting 'safety-by-design' that minimizes the risks associated to environment and population health. By working on case studies, participants learn the main computing tools and databases for addressing the life cycle of the products. Additionally, they are introduced to Creative Thinking & 1st Session Business Creation and invited to pitch their ideas in front of a business panel. The program is organized in four sessions: 1st session: Nanomaterials and their life-cycle analysis; 2nd Session: Nanomaterials transformation in the environment; Ecosystem and Human Exposure; 3rd Session: Human toxicity; 4th Session: Innovation, Technology transfer and Business development. The school combines an intensive program of lectures, hands-on sessions (experiments, simulation, and modelling) and group working. Courses are given by teachers from France, Spain, United States, Sweden, Germany, the Netherlands, Great-Britain, and Switzerland.

ENTREPRENEURIAL PROCESS & TOOLS

Responsible lecturer: Caroline Tarillon
ECTS: 6
Course type and working hours: 90h
Exam type: t.b.d.

Objective and learning outcomes:
The aim of this course, is to

- Analyse the functions developed by a biomedical engineer within an organization.
- Understand managerial concepts in a business environment.

Learning outcomes:
During this course, students will

- Develop the ability to search, analyse and combine business information for decision making.
- Understand management of the main functional areas of a company: marketing, operations, finance, human resources, and R&D.

Content:

1. Strategic management: Management Strategy; Business values and orientation; External analysis; Internal analysis; Corporate, Business and Functional strategies
2. Marketing: Strategic marketing; Operative marketing: Four P's
3. Operations Management: Definition & Evolution; Strategies; Supply chain; Quality management; Five P's (product, process, plan, programme and people)
4. Human Resources: Planning; Recruiting; Selection; Training; Performance appraisal; Compensation.
5. Innovation management (R&D): Sources; Innovation types ; Disruptive innovation ; Managing innovation.
6. Finance: General concepts on financial cycles; Main financial documents; Cost Accounting.

Master's thesis in collaboration with industry partner or hospital 18 ECTS

Objective and learning outcomes:

- The master thesis in Biomedical Engineering is typically a research project or study, or an extended analysis of a topic of scientific or technological nature. The goal is for students to perform research and apply the knowledge acquired during their studies while at the same time developing skills like initiative, autonomy skills, decision, and organization.

- The main learning output of this master thesis is the students' ability to work on a BME program, and to translate research into applications –in cooperation with a non-academic business partner. This innovative approach is based on the mobility of students, exchanging experiences in different disciplines, and establishing a common high-quality standard in education and training.
- At the end of the master thesis students work should reflect the EIT OLOs 1-6.

Content

The program is defined according to the supervisor orientation and to the type of theme and it is developed during one of the semesters of the last year of the MSc Course. Following the MSc procedures, the Education Committees has assessed the scientific quality and feasibility of the master thesis proposals. It is anticipated that the thesis will be relevant to the student's track and will address a question of importance in the student's field of expertise. Students are expected to design a research project, write a formal research protocol, perform the study described in it, and prepare a comprehensive scholarly scientific paper reporting the results. Optionally, part of the master project could be done at another institute or company outside Partner Universities, but in this case, it is always under supervision of a Partner University staff member. To achieve their research project, students are required to write a scientific paper under guidance of their research supervisors, and to give a presentation about the research performed. The scientific paper must be approved by the academic supervisor and be suitable for submission to an international, scientific journal. The thesis can take place at universities, research centers or companies. As mentioned above, the thesis requires an advisor from the Engineering side and a co-advisor from a non-academic partner.

www.eithealth.eu

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