

Teaching program

Master VICO

Academic year 2025-2026

Ecole polytechnique de Nantes Université

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Part I

Tables of teaching units

Semester 9 - unit *VICO*

Research methodology

ECTS : 3

Manager : *VIGIER Toinon*

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	Coef
• Experimental methodology and statistics	5	5.5				0.5	10.5	45
• Initiation to scientific research	4.5	4.5				0.5	9	35
• Open science sustainability and ethics		4.5				1	4.5	20
TOTAL	9.5	14.5	0	0	0	2	24	

Deep learning

ECTS : 3

Manager : *MOUCHERE Harold*

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	Coef
• Deep learning	5	7.5	11.5			1.5	24	100
TOTAL	5	7.5	11.5	0	0	1.5	24	

Image processing

ECTS : 3

Manager : *NORMAND Nicolas*

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	Coef
• Image processing		24				1.5	24	100
TOTAL	0	24	0	0	0	1.5	24	

Deep learning for computer vision

ECTS : 3

Manager : *BRUCKERT Alexandre*

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	Coef
• Deep learning for computer vision	7.5	7.5	9			1.5	24	100
TOTAL	7.5	7.5	9	0	0	1.5	24	

3D data

ECTS : 3

Manager : *PICAROUGNE Fabien*

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	Coef
• 3D data	8	10	6			1.5	24	100
TOTAL	8	10	6	0	0	1.5	24	

Immersive HCI

ECTS : 3

Manager : *PRIE Yannick*

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	Coef
• Immersive HCI	9	8	7			1.5	24	100
TOTAL	9	8	7	0	0	1.5	24	

Cross unit projects

ECTS : 3

Manager : *PERREIRA DA SILVA Matthieu*

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	Coef
• Build your own experiment project		9					15	50
• Deep learning project		9					15	50
TOTAL	0	18	0	0	0	0	30	

Visual perception and cognition

ECTS : 3

Manager : *PERREIRA DA SILVA Matthieu*

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	Coef
• Visual perception and cognition	7	5	12			1.5	24	100
TOTAL	7	5	12	0	0	1.5	24	

Visual data representation

ECTS : 3

Manager : *RICORDEL Vincent*

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	Coef
• Visual data representation		24				1.5	24	100
TOTAL	0	24	0	0	0	1.5	24	

Quality of experience

ECTS : 3

Manager : *VIGIER Toinon*

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	Coef
• Quality of experience	6	12	6			1.5	24	100
TOTAL	6	12	6	0	0	1.5	24	

French Langage and European Culture

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	Coef
• French as a Foreign Language for Master's students		30						100
TOTAL	0	30	0	0	0	0	0	

Sum of semester

	Lect	Tut	PW	Proj	WP	Exa	Asst	ECTS
Sum	52	160.5	51.5	0	0	14	246	30
Face-to-face sum	278							

Semester 10 - unit *VICO*

Internship

ECTS : 30

Manager : *RICORDEL Vincent*

Course	Lect	Tut	PW	Proj	WP	Exa	Asst	Coef
• Internship								100
TOTAL	0	0	0	0	0	0	0	

Sum of semester

	Lect	Tut	PW	Proj	WP	Exa	Asst	ECTS
Sum	0	0	0	0	0	0	0	30
Face-to-face sum								

Part II

Sheets of courses

3D data

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
8	10	6			1.5	24

Evaluation

2 evaluations :

- *Indiv assessment*
- *Written exam*

Presentation

At the end of this course, the student must know the visual human mechanisms involved in the depth perception. He will be able to use basic lightning algorithms and basic shaders programming.

Outline

1. Realtime 3D general concepts
 2. 3D Perception
Visual depth perception
3D and Interaction
 3. Computer graphics
Overview and Basic Math for 3D programming OpenGL, Lighting and shadowing
Introduction of Shaders programming
 - 4 Camera calibration
Extrinsic and intrinsic parameters
Multi camera
 - 5 Applications (projcet)
Virtual reality at scale 1:1
Augmented Reality with dedicated peripherals

Manager : Fabien PICAROUGNE

Build your own experiment project

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	9					15

Evaluation

2 evaluations :

- *Group assessment*
- *Defense*

Presentation

In this projects, the students will have to use the knowledge acquired in all human related teaching units to (properly) conduct an experiment. Based on a lab / project done during the semester, or based on an existing experiment from the literature they will have to propose an experiment plan and run the experiment with the other students as participants. They are expected to use the statistical tools studied in the previous courses in order to analyse the collected data.

Outline

- Autonomous group work on a project
 - Multiple tutorials with professors during the project

Manager : Matthieu PERREIRA DA SILVA

Deep learning

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
5	7.5	11.5			1.5	24

Evaluation

2 evaluations :

- *Written exam*
- *Group report*

Presentation

This course is an in-depth introduction to the principles and techniques of deep learning, a branch of artificial intelligence that has transformed many fields such as computer vision, natural language processing, and speech recognition. Students will learn to design, train, and evaluate various types of deep neural networks, with a focus on modern architectures and regularization techniques.

Outline

- Course : MLP, CNN, RNN
 - Tutorials : number of weights, size of CNN, classical architecture, Connectionist Temporal Classification
 - Labs : IRIS, MINST, Seq

Manager : Harold MOUCHERE

Deep learning for computer vision

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
7.5	7.5	9			1.5	24

Evaluation

3 evaluations :

- *Group report*
- *Written exam*
- *Defense*

Presentation

At the end of this course, the student will be able to provide advanced principles, theory and methods for computer vision, with a particular focus on Deep Learning applications. They will be able to analyze and understand recent advanced deep learning architectures and concepts (U-nets, Transformers, GANs, ...). They will also be able to apply their knowledge on practical examples, on all parts of the training and evaluation pipeline.

Outline

- Introduction: From ML to deep learning, traditional image features, specific problems (high dimensions, semantics, decision rules...)
 - Objects detection: single stage vs two-stage, YOLO, (F) RCNN
 - Segmentation: semantic, instance, panoptic, U-net
 - Attention & (Visual) Transformers: self-attention, transformers
 - Advanced computer vision notions: generative models, GANs, diffusion, self-supervised learning, 3D data, video handling...
- Research papers analysis

Manager : Alexandre BRUCKERT

Deep learning project

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	9					15

Evaluation

2 evaluations :

- *Defense*
- *Group assessment*

Presentation

At the end of this course, the student will be able to analyze a computer vision problem, and to propose a method to solve it using deep learning methods. They will apply the tools they discovered in the Deep Learning courses to a specific task, by implementing a machine learning model, training it, and evaluating its results. The student should be able to apply a critical view of their work and results, and discuss limitations of their work, as well as possible alternatives.

Outline

- Autonomous group work on a project
 - Multiple tutorials with professors during the project

Manager : Alexandre BRUCKERT

Experimental methodology and statistics

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
5	5.5				0.5	10.5

Evaluation

One evaluation : *Written exam*

Presentation

This teaching unit offers a comprehensive exploration of experimental methodologies, starting with the hypothetico-deductive method and extending to exploratory science and data collection aimed at modeling and prediction. Students will gain an understanding of both qualitative and quantitative variables, as well as dependent variables (VD) and factors influencing experiments. The curriculum delves into experimental design plans, covering both between-subjects and within-subjects designs. Additionally, the course provides a solid foundation in descriptive statistics, including the examination of various distributions such as Poisson and Bernoulli. To equip students with the tools for rigorous data analysis, the course also covers inferential statistics tailored for experimental data.

Outline

- Experiments:
 - * Hypothetico-deductive method
 - * Exploratory science
 - * Data collection for modeling / prediction
- Qualitative / quantitative variables ; VD & Factors
- Experimental design plan (between / intra...)
- Descriptive statistics + distribution (Poisson, Bernoulli...)
- Inferential statistics for experimental data analysis

Manager : Toinon VIGIER

Image processing

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	24				1.5	24

Evaluation

2 evaluations :

- *Individual report*
- *Written exam*

Presentation

At the end of this course, the students will be able to:

- Understand the digital objects that constitutes the basis for computation in any image eld. Discrete topology theorems, algorithms for line drawing, convex shape or distance maps, morphological tools and discrete reconstruction are presented in order to be able to manage an image problem via these tools
- Manipulate the discrete geometry concepts in a real applicative environment either for medical imaging (image acquisition, tomography, quantizing image information) or for image analysis (medical, materials, ...). A large set of examples is available from the teams projects and are applied with the previous concepts in real time constraints environments

Outline

Discrete geometry topics :

- Discrete topology
- Discrete line, surface and volume Mathematical morphology Discrete measures
- Discrete reconstruction
- Image analysis applications topics: medical imaging, materials imaging, art imaging

Manager : Nicolas NORMAND

Immersive HCI

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
9	8	7			1.5	24

Evaluation

4 evaluations :

- *Defense*
- *Written exam*
- *Group assessment*
- *Individual report*

Presentation

At the end of this course, the student will be able to design an immersive system using adequate design methods. He will be able to choose an evaluation method and to carry out the evaluation of the system. He will be able to reuse the theoretical (HCI discipline, its history, its main concepts, principles and methods) and practical knowledge acquired during this course in order to write a paper in HCI.

Outline

- Introduction
 - Humans in immersion
 - Design of immersive applications
 - Evaluation of immersive applications
 - Mini-project: evaluation (lab)
 - XR development
 - Articles reading (lab)
 - Exam (exam)

Manager : Yannick PRIE

Initiation to scientific research

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
4.5	4.5				0.5	9

Evaluation

One evaluation : *Written exam*

Presentation

This teaching unit is dedicated to understanding what scientific knowledge production means, how scientific knowledge develops with scientific publishing, what scientific disciplines are and to discuss the relations between science and society. Then we focus on the content of scientific documents, how to read them, and how to write scientific material, before addressing the topic of how to search for scientific material with the tools at hand and organize them in a bibliography.

Outline

- Professional insertion: research & development processes in company processes. Goals and organisation of the scientific research community
 - Writing a scientific bibliography
 - Writing and presenting for research
 - Designing and interpreting experimental work Ethics of research
- Professional insertion: research & development processes in company processes. Goals and organisation of the scientific research community
 - Writing a scientific bibliography
 - Writing and presenting for research
 - Designing and interpreting experimental work Ethics of research

Manager : Yannick PRIE

Internship

Hours

Lect Tut PW Proj WP Exa Asst

Evaluation

3 evaluations :

- *External evaluation*
- *Defense*
- *Individual report*

Presentation

During the internship, the student will conduct a research work either in a university lab or in a private company's R&D department.

Goals

At the end of the intership, the student should be able to:

1. Identify and define a research question or puzzle within an existing field of scientific inquiry and devise a plan for investigating it.
2. Formulate a program of reading in consultation with a professional scientist to provide context for the investigation
3. Develop a time-line for the research project and manage work to that time-line
Communicate research results -both orally and in writing- in a style consistent with scientific standards
4. Work as part of a research team

Manager : Vincent RICORDEL

Open science sustainability and ethics

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	4.5				1	4.5

Evaluation

One evaluation : *Written exam*

Presentation

This teaching unit deals with open science, sustainability and general ethics.

Outline

- Introduction course on open science, sustainability and general ethics
 - Ethical dilemma: thought experiment - play the role of ethics committee

Manager : Nicolas HERNANDEZ

Quality of experience

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
6	12	6			1.5	24

Evaluation

3 evaluations :

- *Group assessment*
- *Written exam*
- *Defense*

Presentation

This teaching unit will address QoE challenges for visual content. First, the standardized and SoA subjective methodologies and objective metrics for visual content (images, videos) will be presented, as well as the current scientific challenges in this topic. In a mini-project, the students will apply these courses to analyze an existing subjective dataset and benchmark existing objective metrics. Then we will address QoE assessment beyond visual quality and standardized methods.

Outline

- Visual Quality assessment (Subjective assessment : test methodologies, subjective data analysis / Objective assessment : metrics, signal-based, perceptual-based, learning-based)
 - Mini project : subjective scores analysis and metrics benchmark on existing dataset
 - From visual quality to QoE
- Focus on several topics:
 - Multimodal QoE
 - QoE for new visual content (3D, light field...)
 - Beyond standards & visual quality (memorability, emotions, acceptability / annoyance, crowdsourcing...)
 - QoE for sustainability
 - Objective and indirect measures for QoE : physiological measures, eye tracking & QoE,...

Manager : Toïnon VIGIER

Visual data representation

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
	24				1.5	24

Evaluation

3 evaluations :

- *Individual report*
- *Written exam*
- *Defense*

Presentation

Multimedia communications require a careful design of source coding and security. For this purpose, this module gives advanced notions in Image and Video Coding, and in Cryptography. At the end of this course, the student will be able :

- To provide principles, theory and methods for designing data security and chaos-based data security. To be able to design, realize and analyse a chaos-based cryptographic systems.
- To know applications: Images and videos security ; Network security and Network access control ; Internet of Things (IoT) security ; Mobile security.
- To know the fundamental principles, methods and technics of 2D & 3D video compression
- To describe the characteristics of the 3D video compression standards (G-PCC & V-PCC)
- To know how to capture and represent a 3D information from the real world.
- To understand how to acquire data from the real world."

Outline

- Security
 - Pseudo-chaotic number generators
 - Symmetric and Asymmetric Ciphers
 - Hash Functions
 - Steganography Systems
 - 3D coding & visualisation (GPCC / VPCC)
 - 3D capture & representation
 - How to store a 3D representation
 - 3D reconstruction (Epipolar geometry, (NeRF, Photogrammetry))

Manager : Vincent RICORDEL

Visual perception and cognition

Hours

Lect	Tut	PW	Proj	WP	Exa	Asst
7	5	12			1.5	24

Evaluation

3 evaluations :

- *Group report*
- *Written exam*
- *Defense*

Presentation

At the end of this course, the student will be able to design an experiment that allows him to measure some properties of the human visual system. He should be able to analyse these measures in order to create some theoretical or computational models. He / she will also be able to reuse the theoretical and practical knowledge acquired during this course in order to design and evaluate image and video processing algorithms that take into account the properties of the human visual system.

Outline

- Vision physiology
 - Brain mechanisms of visual perception
 - Spatial vision
 - Psycho-physics + JND
 - Executive functions (visual memory, visual attention, visual inhibition)
 - Visual attention

Manager : Matthieu PERREIRA DA SILVA