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UBO
Université de Bretagne Occidentale

Université Bretagne Sud
UBS

ENIB

ENSTA Bretagne

IMT Atlantique

2024 Wasaa Academy Summer School

New Trends in Information Technologies

Courses Information

Name:	New Trends in Information Technologies
Teaching Institutions:	Wasaa Consortium
Location:	Brest, France
Dates:	15th January – 2nd February 2024
Duration:	3 weeks
Balance of activities:	18 hours of academic classes, 18 hours of research project, 9 hours of keynote lectures, 12 hours of professional visits to industrial companies, 15 hours initiation to French language & cultural activities, 12 hours of cultural visits
Pre-requisites:	The program is accessible to BSc 3 - 4 students in engineering sciences (refer to each track for the specific pre-requisites)
Course equivalencies:	**6 European Credits (ECTS)**
Language of instruction:	English
Nomination deadline	**September 30**
Application deadline	**October 15**
Video (3'):	[Click the link](#)
Flyer:	[Click here](#)
Website:	http://www.wasaa-academy.fr/summer-school/

Wasaa Consortium

The five universities participating in the 2024 Summer School (UBO, UBS, ENIB, ENSTA Bretagne and IMT Atlantique) are members of the Wasaa group.

Wasaa (Western Alliance for Scientific Actions with Australia) is a consortium of French higher education institutions in Western France interested in establishing partnerships with higher education institutions in Australia. Wasaa's objectives are to strengthen research partnerships between signatory institutions and encourage student exchanges between France and Australia.

The program was awarded with the label "Creative France short program" in 2019 by theEmbassy of France in Australia.

Materials

Students will be provided with all learning materials (including relevant reading lists) on arrival at IMT Atlantique. During the program students will have access to computing facilities, **though students are advised to bring their own laptop if they have one**.

Course Description and Learning Outcomes

The course will allow students to explore **the latest trends in information technologies.**

The summer school will also be a **first introduction to laboratory research work** as well as **a discovery of the French academic environment**.

For their research project, the students will be integrated in local research laboratories where they will carry out research work in small groups (maximum 5 students) supervised by professors and PhD students.

It will finally be an opportunity for the students to discover French Language and French Culture (15 hours of courses) including a supper in a gourmet restaurant.

For the technical courses, the students will have to choose one among **4 possible tracks**:

> ➢ **Artificial Intelligence and Robotics**
> ➢ **Mixed reality, Cognitive Psychology & Neurofeedback**
> ➢ **Cybersecurity**
> ➢ **Space Tech**

Track A	**Artificial Intelligence & Robotics**
Teachers	Panagiotis Papadakis, Mihai Andries
Institution	IMT Atlantique
Number of hours	18 h

Presentation:

The course will introduce students to the geometry of 3D vision using single or two cameras. It will present the basics of monocular vision by explaining the notions of intrinsic and extrinsic parameters of a camera as well as the process of calibration. Notions of epipolar geometry will then be presented for the case of two camera views, together with algorithms for estimation of camera movement and sparse 3D structure computation via triangulation.

The students will have hands-on experience with the above concepts via interactive lab sessions where they will be using cameras as well as previously captured images or videos. In detail, projects of varying difficulty will be proposed: (i) camera calibration, (ii) augmented reality, (iii) camera pose estimation and (iv) sparse structure from motion.

Requirements:

> Necessary: Object-Oriented Programming using Python
> Desired: OpenCV
> Programming skills (C++ and Python)
> Optional: PyBullet, ROS

Recommended background: C*omputer science & Robotics*

Track B	**Mixed reality, Cognitive Psychology & Neurofeedback**
Teachers	Etienne Peillard, Cédric Fleury, Nathalie Le Bigot, Giulia Lioi, Nicolas Farrugia
Institution	IMT Atlantique
Number of hours	18 h

Presentation:

This stream presents within the same course several innovative modalities of interaction between human and machines as well as their evaluation. Current technologies allow the most diverse and immersive HCIs today. This stream will present the issues related to the design of such interactions and give the keys to developing and evaluating them.

First, the fundamentals of cognitive psychology will be presented, especially those related to perception. Then, a course dedicated to mixed reality will present the issues and technologies of this field. Then a course dedicated to neuroscience, particularly neurofeedback, will be offered. Practical work will accompany these sessions to give tools to realize applications and software to exploit this knowledge. Finally, all the skills learned by the students will be mobilized to propose and conduct an experiment involving the evaluation of several neurofeedback modalities in mixed reality.

- *Fundamentals of cognitive psychology; action and embodied perception (3h)*
- *Mixed reality - principles and practice (6h)*
- *Neuroscience, signal processing, and neurofeedback (6h)*
- *Experimental protocols, design, and analysis of user experiments (3h)*

Requirements:

> Basics in Object-oriented programming (C# and C++ will be used during the module)
Optional: Unity3D

> Basics in Python programming
Optional: Scientific Python (Numpy – Scipy - Matplotlib)

Recommended background: *Computer science & HMI*

Track C	**Cybersecurity**
Teachers	Johanne Vincent, Françoise Sailhan, Gouenou Coatrieux, Yvon Kermarrec, Guillaume Doyen
Institution	IMT Atlantique
Number of hours	18 h

Presentation:

- ***General introduction to cybersecurity - 3h***

Cyber-attacks have drastically increased in the past few years against states, companies, or the public. In this brief introduction to cybersecurity, you will learn the basic concepts of cybersecurity and will learn about the best practices in computer security.

Goals:
- Understand the motivations behind the need for security
- Comprehend methods and norms for security
- Learn the basic definitions and typology of threats
- Learn the best practices for both personal and professional IT
- Understand basic system and network vulnerabilities
- Introduction to cryptography
- Grasp the difficulties of implementing security mechanisms in organizations

- ***Cybersecurity & IoT - 6h***

The Internet of Things is subject to an increasing number of threats and attacks and therefore must be secured. In this regard, this course proposes to discover the stakes related to the security of the IoT and to explore some approaches allowing to secure the system consequently during labs.

- ***Cybersecurity & Health - 3h***

This course will present the current challenges of cybersecurity in the domain of Heath Information Systems and the on-going lab research actions in the field.

- ***Cybersecurity and naval - 6h***

The various companies and players in the maritime world have been going through strong transitions for several years. The energy transition and the pressures on the environment require new, more responsible propulsion systems; the "digital" transition is also similar to what we know in other forms of transport (cars, planes, autonomous vehicles, etc.) with sensors or other navigation systems. Ships are more and more connected and use the latest information technologies to precisely optimize maritime transport routes, locate themselves, perceive their environment, etc., and manage their increasing complexity.

The presence of these computer systems opens up breaches to an attacker who knows how to exploit them. These flaws can be software, hardware, organizational or human, and pose the problem of their detection and the expected reactions to manage and mitigate them. The maritime world is particularly vulnerable since the consequences of a cyber-attack can lead to the loss of the boat and directly impact its crew. Recent events and attacks show their acute importance and their criticality.

Requirements:

- Basic knowledge in information systems, computer networks, OS, and applications

Recommended background: *Computer science & Cybersecurity*

Track D	**Space Tech**
Teachers	Nicolas Bellec, Benjamin Potelon, Thomas Boutéraon, Patrice Pajusco, Vincent Nourrit, Mikael Guégan , Matthieu Arzel
Institution	IMT Atlantique & Enib
Number of hours	18 h

Presentation:

- ***Introduction to the New Space ecosystem - 1h30***

The evolution of space ecomnomy from the Cold War to the emergence of NewSpace:

- ✓ *History*
- ✓ *Economy*
- ✓ *Legislation*
- ✓ *New trends.*

- ***Introduction to space systems design - 1h30***

We will see what a space system is, and what a satellite is made of. We will discuss how the space environment, the choice of orbit, and the mission objectives constrain the design of the satellite. The mission analysis allows through the budgets (mass, energy, data, link) to objectify the feasibility of the mission. We will discuss management through the concepts of project phases, Technology Readiness Level (TRL), and concurrent engineering...

- ***GNSS Systems - 3h***

GNSS systems (GPS, Glonass, Galileo...) have become essential for countless services. After a brief historical reminder of the problem of positioning and time measurement, the fundamentals of GNSS systems will be introduced: system architecture, type of orbit, modulation, positioning principle, accuracy... The correction techniques, due to the ionospheric effect, for instance, will also be discussed

- ***Spectroscopy/sensors for earth observation - 3h***

The Earth's atmosphere limits our ability to observe and study celestial objects. This course will briefly address the properties of the atmosphere and the techniques developed to compensate for its effects, from adaptive optics to image deconvolution. These techniques have applications nowadays in a variety of fields outside astronomy such as remote sensing, defense, ophthalmology, etc.

- ***Physics of satellite communication - 6h***

The main goal of this course is to introduce students to the field of Radio-Frequency communications and particularly microwave systems dedicated to space applications. An overview of the paradigm of microwave links will be detailed and key RF link budget issues will be introduced. Focus will then be made on the architecture of the transmitter and receiver systems and specific features of the main components will be highlighted (antennas, filters, amplifiers, mixer).

- ***Optical communication satellite ground center - 3h***

The main goal of this class is to introduce students to the field of fiber-optic communications and to the recently developed power over fiber systems for sensors monitoring and feeding. An overview of a typical optical communication link will be presented involving the description of the main used devices such as the optical fibre characteristics and transmitter and receiver (modem) properties. A specific focus will be made on the power over fiber systems used to transmit energy and to exchange data with a network of sensors: it is an interesting solution within the framework of hostile environments.

Mainly devoted to the dissemination of the key concepts, this course will lean on practical classes and laboratories of demonstration using a dedicated simulation tool and specific material equipment and instrumentations (optical spectrum analyzer, reflectometer...).

Requirements: *No specific requirements*

Recommended background: ***Electronics engineering & Physics***

General Timetable*

Date	AM	PM
Monday 15	Opening ceremony Presentation of the program	Plateau des Capucins Visit Free time in Brest
Tuesday 16	Introduction to French Language 1	Industry visit
Wednesday 17	Technical Course 1	Research Project presentation
Thursday 18	Introduction to French Language 2	Technical Course 2
Friday 19	Introduction to French Language 3	Research Project 1
Samedi 20	Cultural visit	Cultural visit
Monday 22	Introduction to French Language 4	Technical Course 3
Tuesday 23	Research Projet 2	Industry Visit
Wednesday 24	FabLab Open Factory (half group) or free time	FabLab Open Factory (half group) or free time
Thursday 25	Research Project 3	Keynote lecture 1
Friday 26	Research Project 4	Technical Course 4
Samedi 27		
Monday 29	Introduction to French Language 5	Industry visit
Tuesday 30	Keynote lecture 2	Technical Course 5
Wednesday 31	Technical Course 6	Keynote lecture 3
Thursday 1	Research Project 5	Research Project 6
Friday 2	Research Project evaluation	Research Project evaluation end of program

*The schedule may be subject to change to take into account organizational constraints

Introduction to French Language

Technical Course

Visits

The industrial visits will focus mainly on companies involved in Advanced Digital Technologies sectors.

Cultural activities

Cultural visits will give the students a chance to discover Brest and its beautiful surroundings such as:

- The bulky Ruins of the Medieval Abbey of St-Mathieu*
- Quimper & Concarneau city*
- Les Capucins, the historical mechanical workshops of the arsenal of Brest

During all the three weeks the students will also be proposed evening and social activities with French and international students.

*the cultural program is to be confirmed and may vary depending on weather conditions and organizational constraints.

Projects
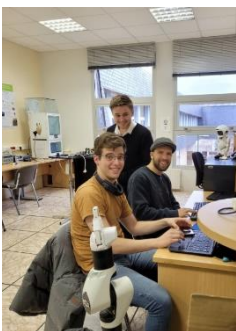
From the first week the students will be informed of the research project they will be able to work on during the three weeks

The assignment of research projects will be based on the students' background and their professional project.

The content of the research projects will be related to the respective stream attending by students and will be done in small groups.

The defense of the research project will be handing on the last day and it will set the end of the summer school.

Learning outcomes

The objective of the course is:

1) To introduce students to the diversity and attractiveness of new developments in information technologies and to raise their awareness of their impacts on industry and society.

2) To acculturate them to the French higher education system.

3) To raise their awareness of research work in this field by immersing them in the research laboratories.

Validation and Credits

Students will be required to comply with IMT Atlantique's policies regarding plagiarism and academic integrity.
Students will receive an academic record for the course as well as a certificate.
Students who meet the requirements of the three weeks will be awarded 6 credits (ECTS).

Visits: Regular participation in the proposed activities 30%
Courses: Small MCQ at the end of each course module 30%
Project: Twenty minutes of oral presentation of their project results 40%

Grade description

Excellent achievement **Participation:** • Exceeded expectations • Participated actively in all classes conferences and site visits; asked relevant questions • Contributed to class with relevant information. • Demonstrated cross cultural understanding **MCQ: 75-100%** **Project Defense:** • Exceeded expectations • Demonstrated above average knowledge of topic. • Innovative: used variety of materials to convey information • Conveyed information in clear, informative and entertaining manner. • Presentation was engaging for classmates.	75-100%
Good achievement **Participation:** • Participated actively in class and visits • Was engaged • Some participation was not clearly focused **MCQ: 50-75%** **Project Defense:** • Presentation was interesting and engaging, but lacked some clarity and explanation • Failed to engage the full class • Was unable to answer some of the questions	50-75%
Fail **Participation:** • Scarcely participated • Showed no engagement in class • Student was engaged in other activities during classes and visits • Demonstrated no cross cultural understanding **MCQ < 50%** **Project Defense:** • Presentation lacked clarity and was not engaging of fellow students in the classroom	59-0%