People's Democratic Republic of Algeria
MINISTRY OF HIGHER EDUCATION
AND SCIENTIFIC RESEARCH

Amendment Canvas

Institution	Faculty / Institute	Department
Mohamed Khider University - Biskra	**The faculty of exact sciences natural and life sciences**	**Computer Science department**

Domain : Maths – Computer Science

Field: Computer science

Specialty: Computer Graphics and Artificial Life

Academic year: 2023/2024

الجمهورية الجزائرية الديمقراطية الشعبية

وزارة التعليم العالي والبحث العلمي

نموذج تعديل

المؤسسة	الكلية/ المعهد	القسم
جامعة محمد خيضر - بسكرة	كلية العلوم الدقيقة و علوم الطبيعة و الحياة	قسم الإعلام الآلي

الميدان: رياضيات إعلام آلي

الشعبة : إعلام آلي

التخصص: الصورة و الحياة الاصطناعية

السنة الجامعية : 2024/2023

SUMMARY

I - Master'sidentity sheet----------
1 - Location of the training----------
2 - Training partners ----------
3 - Context and objectives of the training ----------
A - Conditions of access ----------
B - Training objectives ----------
C - Profiles and skillsaims ----------
D - Regional and national employability potential ----------
E - Gateways to other specialties ----------
F - Training monitoring indicators ----------
G –Management abilities ----------
4 - Human resources available ----------
A - Teachers involved in the specialty ----------
B - External supervision ----------
5 - Specific material means available ----------
A - Educational Laboratories and Equipment ----------
B- Internship sites and company training ----------
C - Research laboratories supporting the master's degree ----------
D - Research projects to support the master's degree ----------
E - Personal work spaces and ICT ----------

II - Semester organization sheet for teaching ----------
1- Semester1 -
2- Semester2 -
3- Semester3 -
4- Semester4 -
5- Overall training summary----------
III - Detailed program by subject----------
IV – Agreements/conventions ----------

I – Master's identity sheet
(All fields must be completed)

1 - Location of the training :

Faculty (or Institute) : Faculty of exact sciences natural and life sciences
Department: Department of Computer Science

2- Training partners *:

- other university establishments:

- businesses and other socio-economic partners:

- International partners:

* = Present the conventions as an appendix to the training

3 – Context and objectives of the training

A – Access conditions *(indicate the license specialties which can give access to the Master)*

In M1 :

- Academic License in Computer Science
- An equivalent recognized title

In M2 :

- M1 with bases in image synthesis, computer vision or artificial life
- (File study)

B - Training objectives *(argeted skills, pedagogical knowledge acquired at the end of the training - maximum 20 lines)*

The objective of these teachings is to train students in the various components, namely image, information systems, and human-machine interaction.
The proposed program will enable them to comprehensively grasp the multiple facets of topics related to applications and technologies in connection with the image industry. The provided education aims to complement the initial computer science training from the Bachelor's degree, provide methodological training for research professions, and ensure specialization in the field of computer science related to image in all its components.
The aim of this Master's program is to train specialists in the scientific and technical professions of digital imaging across all its components, whether it be in modeling and rendering, simulation models of virtual environments, animation of virtual entities, or more advanced techniques in virtual and augmented reality, especially artificial life. The education is built upon a solid theoretical foundation followed by a specific track in 'Images and Artificial Life'. Other pathways related to image can be defined, such as the following tracks:

- Remote Sensing and Geographic Information Systems.
- Computer Vision

Upon completion of this training, students will be capable of successfully conducting projects centered around digital image technologies. They can find opportunities in Research and Development departments within research laboratories such as the LESIA laboratory (University of Biskra), research centers (CDTA, CDER), future doctoral schools, or in computer service companies with activities oriented towards image techniques and industry.

C –Targeted professional profiles and skills*(in terms of professional integration maximum 20 lines*):

This course requires knowledge in software engineering, image, artificial intelligence and communication networks, thus giving a broad spectrum of knowledge to the student while specializing in techniques focused on image, artificial life and virtual reality.

It will aim to cover all the problems that may be encountered in the field of digital images, in image analysis (image acquisition and processing, computer vision, image interpretation and content analysis) or in image synthesis (image modeling and generation, realistic rendering, virtual reality, animation) as well as the specialties that refer to it (medical imaging, spatial imaging, etc.).

The course aims, among other things, to train skills in:

- The design and development of new tools for imaging
- The integration of image analysis or synthesis modules (libraries, development environment, etc.) for the design of specialized systems
- The development of specific or dedicated applications from existing hardware and software components.
- The orientations of the powers of computer tools for applications in biology (bioinformatics), industry (robotics), prevention (animation), education (Modelling) and entertainment (video games) or even security (biometrics).

D- Regional and national potential for employability of graduates

The normal track upon completion of the Research Master's is the preparation of a doctoral thesis in sciences.

Students passed the Master's degree will be able to join the LESIA research laboratory with a view to preparing a doctoral thesis in science.

The Doctorate will thus give them the opportunity to access teaching and research institutions.

Superior Education.

- Recruitment as teacher-researchers and access to preparation for university accreditation with a view to accessing the rank of lecture;

Public research (research organizations and higher education).

- To public research organizations: LESIA Laboratory (Biskra), CDTA, CDER, etc;

2- The Research Master, will also give them the opportunity to work in the private research and development sector.

Private search.

- The M2 year of the Research Master can also be considered as a complement to specialized professional training, preparing for research and development careers in specialized companies outside the image industry.

Jobs in industry in engineering positions.

- Consumer sector (multimedia, video games, digital television);
- Industrial field (quality control, driving mobile or assembly robots, remote operation or remote manipulation, driving simulators with virtual reality, prototyping, CAD, cooperative work, evolutionary robotics, bioinformatics)
- Creation and access to still and animated image banks (medical, space, digital libraries), their coding and their distribution (between sites and on the Internet).

Interpretation of images (search by content in the spatial, medical, or cultural domain, etc.)

E – Gateways to other specialties

- Towards other Masters with equivalent units.

F – Training monitoring indicators

- Half-yearly and modular success rates;
- Attendance at classes, tutorials and practical work;
- Half-yearly evaluation:

G – Supervision capacity ((give the number of students that can be supported)

30 Students

4 – Available human resources

A : Teachers of the establishment intervening in the specialty:

Last name, First Name	Graduation Diploma + Specialty	Post graduation diploma + Specialty	Grade	Type of intervention *	Signing
CHERIF Foudil	Engineer	State PhD	Prof	Courses, TD, TP,Supervision	
BABAHENINI Mohamed Chaouki	Engineer	State PhD	Prof	Courses, TD, TP,Supervision	
DJEROU Leila	Engineer	HDR	Prof	Courses, TD, TP,Supervision	
SAOULI Rachida	Engineer	HDR	Prof	Courses, TD, TP,Supervision	
REZEG Khaled	Engineer	HDR	Prof	Courses, TD, TP,Supervision	
BITAM Salim	Engineer	HDR	Prof	Courses, TD, TP,Supervision	
DJEFFAL AbdElhamid	Engineer	HDR	Prof	Courses, TD, TP,Supervision	
KAHLOUL Laid	Engineer	HDR	Prof	Courses, TD, TP,Supervision	
SLATNIA Sihem	Engineer	PhD	M.C.A	Courses, TD, TP,Supervision	

MOKHTARIBilal	**Master 2**	**PhD**	**M.C.A**	**Courses, TD, TP,Supervision**	
Sahraoui Somia	**Master 2**	**PhD**	**M.C.A**	**Courses, TD, TP,Supervision**	
ABABSA Tarek	**Engineer**	**PhD**	**M.C.B**	**Courses, TD, TP,Supervision**	
BENAMEUR Sabrina	**Engineer**	**PhD**	**M.C.B**	**Courses, TD, TP,Supervision**	
BOUGUETITICHE Amina	**Engineer**	**PhD**	**M.C.B**	**Courses, TD, TP,Supervision**	
BAHI Naima	**Engineer**	**PhD**	**M.C.B**	**Courses, TD, TP,Supervision**	
ZERARI Abd El Mouméne	**Engineer**	**PhD**	**M.C.B**	**Courses, TD, TP,Supervision**	
YOUKANA Imane	**Master 2**	**PhD**	**M.C.B**	**Courses, TD, TP,Supervision**	
BABAHENINIDjihane	**Master 2**	**PhD**	**M.C.B**	**Courses, TD, TP,Supervision**	
Naidji Ilyes	**Master 2**	**PhD**	**M.C.B**	**Courses, TD, TP,Supervision**	
AKROUR Djouher	**Master 2**	**PhD**	**M.C.B**	**Courses, TD, TP,Supervision**	
Belounnar Saliha	**Engineer**	**Magister**	**M.A.A**	**Courses, TD, TP,Supervision**	
HAMIDA Ammar	**Engineer**	**Magister**	**M.A.A**	**Courses, TD, TP,Supervision**	
HATTAB Dalila	**Engineer**	**Magister**	**M.A.A**	**Courses, TD, TP,Supervision**	

- **= Courses, TD, TP, Internship supervision, Dissertation supervision, other (to be specified)**

B : External

supervision:Attached institution:

Last name, First Name	Graduation Diploma + Specialty	Post graduation diploma + Specialty	Grade	Type of intervention *	Signing

Attached institution:

Last name, First Name	Graduation Diploma + Specialty	Post graduation diploma + Specialty	Grade	Type of intervention *	Signing

Attached institution:

Last name, First Name	Graduation Diploma + Specialty	Post graduation diploma + Specialty	Grade	Type of intervention *	Signing

*** = Courses, TD, TP, Internship supervision, Dissertation supervision, other (to be specified)**

5 – Specific material resources available

A- Educational Laboratories and Equipment: Sheet of existing educational equipment for the practical work of the planned training (1 sheet per laboratory)

Laboratory title: Computing center

No	Title of equipment	Number	observations
01	**HP ProLiant ML370G5 SERVER** *** 2 Intel Xeon processors** **Quad-core:.33 GHZ** *** RAM :6 Go** *** HDD: 6x 140 Go** *** DAT reader: Hp Dat 72 USB.** *** TFT screen + keyboard**	**06**	
02	**HP thin client workstation:** **19 screen + Light unit + keyboard +Mouse**	**25**	**Local networks + access permanent internet Operating systems.**
03	**PC HP Compaq dx 2300 dual core 1.8 ghz,** **Ram: 1 GB, D D: 160 GB + Mouse + keyboard + 19`` screen** **PC HP Compaq dx 2300 dual core 1.8 ghz,**	**25**	**Local networks + access**
04	**Dell proc dual core 1.80 Ghz** **Ram : 512 Mo D.D: 80 Go**	**25**	
05	**PC : HP Compaq dx 2400 dual core** **RAM: 1 Go DD: 160 Go écran 17``**	**10**	
	Armoire réseau **Onduleur 3000 VA** **Modem ADSL 2 Mo** **Switchcatalyst2960 24ports**	**01** **01** **01** **05**	**Local network**

Laboratory title: Machine room (02 rooms)

No	Title of equipment	Number	observations
01	**PC + internet connection**	**25**	

Laboratory title: Network Lab

No	Title of equipment	Number	observations
01	**PC Dell P4 3.06 Ghz** **Ram: 512Mo D.D: 80Go**	**20**	
02	**CISCO laboratory (switch, training equipment)**		

B- Internship sites and in-company training:

Training place	Number of students	Training period

C- Master's support research laboratory(ies):

Laboratory head:BABAHENINI Mohamed Chaouki
No. Laboratory approval: ministerial decree no. 42 of February 5, 2001
Date : 15/03/2015 Opinion of the laboratory head:

Laboratory head
No. Laboratory approval:
Date : Opinion of the laboratory head:

D- Master's support research project(s):

Title of the research project	Project code	Project start date	Project end date
L'influence de la perception visuelle sur la qualité de la simulation des foules d'humains virtuels	C00L07UN070120180003	01/01/2018	31/12/2022
La dissémination sécurisée de données dans les réseaux véhiculaires de cinquième génération	C00L07UN070120180001	01/01/2018	31/12/2022
Développement des applications de l'apprentissage profond (deep learning) dans la biométrie	A10N01UN070120180005	01/01/2018	31/12/2022
Traitement at analyse des données en grande dimension dans le Domain biomédical	C00L07UN070120180008	01/01/2018	31/12/2022
Tri automatique des dattes par apprentissage artificiel	C00L07UN070120180006	01/01/2018	31/12/2022
Sur la conception et l'optimisation de l'internet des objets	C00L07UN070120180007	01/01/2018	31/12/2022
Poursuite des séquences d'images par les algorithmes évolutionnaires	A10N01UN070120180004	01/01/2018	31/12/2022
Conception et optimisation d'un système de suivi et de contrôle en Télésurveillance	A10N01UN070120190001	01/01/2019	31/12/2023
Exploration de l'utilisation la réalité virtuelle/ la réalité augmentée et des techniques d'apprentissage automatique en médecine clinique	C00L07UN070120220005	01/01/2022	31/12/2026
Machine learning pour la détection de la fraude	C00L07UN070120220001	01/01/2022	31/12/2026
Navigation des robots au milieu d'une foule dense d'humains en toute sécurité	C00L07UN070120220007	01/01/2022	31/12/2026

E- Personal work spaces and ICT:

1. Videoconference room:

This room includes:

- An internet connection via a specialized line for the purpose of organizing Video conferences

2. Documentation center:

This center includes all the dissertations and theses defended since 2000 to 2022 (using: 50 engineers, 310 masters, 230 licenses).
The versions available are paper and electronic version.

3. Remote teaching room:

Internet room for final year students equipped with a specialized internet line (4MO modem).
Two large television screens.

II – Half-yearly teaching organization sheet

(Please present the forms for the 4 semesters)

1- Semester1 :

Teaching Unit	SHV	Weekly H.V.				Coeff	Credits	Evaluation mode	
	14-16 week	C	TD	TP	Others			Continuous	Exam
Fundamental TU									
FTU1. Advanced systems and architectures	**189h**	**6h**	**3h**	**4h30**	**4h**	**09**	**18**		
Distributed systems	63h	1h30	1h30	1h30	1h30	3	6	50%	50%
Parallel Programming on GPGPUs	63h	1h30	1h30	1h30	1h	3	6	50%	50%
Communication networks	63h	3h	-	1h30	1h30	3	6	33%	67%
Methodology TU									
MTU1. Images	**84h**	**3h**	**-**	**3h**	**2h**	**4**	**10**		
Analysis, image processing and 3D vision	42h	1h30	-	1h30	1h	2	5	50%	50%
Fundamentals of computer graphics	42h	1h30	-	1h30	1h	2	5	50%	50%
Transversal TU									
TTU1. English and entrepreneurship	**42h**	**1h30**	**1h30**	**-**	**1h**	**2**	**2**		
English 1	21h	-	1h30	-	-	1	1	33%	67%
Entrepreneurship	21h	1h30	-	-	1h	1	1	33%	67%
Total Semester 1	315	10h30	4h30	7h30	7h	15	**30**		

2- Semester 2:

Teaching unit	SHV	Weekly H.V.				Coeff	Credits	Evaluation mode	
	14-16 week	C	TD	TP	Others			Continuous	Exam
Fundamental TU									
FTU 2. Modeling and Animation Techniques	**105h**	**3h**	**1h30**	**3h**	**2h30**	**6**	**10**		
Computer Animation	63h	1h30	1h30	1h30	1h30	3	5	50%	50%
Modeling Techniques and Algorithmic Geometry	42h	1h30	-	1h30	1h	3	5	50%	50%
FTU 3. Machine learning et Simulation	**84h**	**3h**	**-**	**3h**	**2h30**	**4**	**9**		
Machine Learning for Image and 3D Vision	42h	1h30	-	1h30	1h30	2	5	50%	50%
Modeling and Simulation	42h	1h30	-	1h30	1h	2	4	50%	50%
Methodology TU									
MTU 2. Programmation GPU et Complexité	**84h**	**3h**	**1h30**	**1h30**	**2h**	**4**	**9**		
GPU Graphics Programming	42h	1h30	-	1h30	1h	2	5	50%	50%
Complexity and Optimization	42h	1h30	1h30	-	1h	2	4	50%	50%
Transversal TU									
TTU2. Methodology	**21h**	**1h30**	**-**	**-**	**1h**	**1**	**2**		
Research methodology	21h	1h30	-	-	1h	1	2	33%	67%
Total Semester 2	294	10h30	3h	7h30	8h	15	**30**		

3- Semester 3:

Teaching unit	SHV	Weekly H.V.				Coeff	Credits	Evaluation mode	
	14-16 week	C	TD	TP	Others			Continuous	Exam
Fundamental TU									
FTU4. Advanced rendering techniques	**147h**	**4h30**	**1h30**	**4h30**	**4h**	**9**	**18**		
Colorometry and global illumination techniques	63h	1h30	1h30	1h30	1h	3	6	50%	50%
Artificial life	42h	1h30	-	1h30	1h	3	6	33%	67%
Virtual Environments and Humans	42h	1h30	-	1h30	1h	3	6	50%	50%
Methodology TU									
MTU 3. Augmented Reality and Virtual Reality	**126h**	**4h30**	**1h30**	**3h**	**2h**	**5**	**10**		
Augmented reality	42h	1h30	-	1h30	1h	2	4	50%	50%
Virtual reality	42h	1h30	1h30	-	1h	2	4	50%	50%
Introduction to Bioinspired Systems	42h	1h30	-	1h30	1h	1	2	50%	50%
Transversal TU									
TTU 3. English 2	**21h**	**-**	**1h30**	**-**	**-**	**1**	**2**		
Expression Technique in English	21h	-	1h30	-	-	1	2	33%	67%
Total Semester 3	294	9h	4h30	7h30	6h	15	**30**		

4- Semester 4:

Domain : Maths - Computer Science
Field : Computer science
Speciality : Images and artificial life

Internship in a company culminating in a dissertation and a defense.

The S4 semester is reserved for an internship or introductory research work, culminated by a dissertation and a defense.

	SHV	Coeff	Credits
Personal work			
Internship in company			
Seminars			
Other (specify) Project (dissertation + defense)	12 hours/week, or 144 hours for the Semester	15	30
Total Semester 4	144h	30h	30h

5- Overall summary of the training:(indicate the separate global HV in progress, TD, for the 04 Semesters of teaching, for the different types of TU)

TU / HV	FTU	MTU	DTU	TTU	Total
Course	231	147	-	21	399
TD	84	42	-	42	168
TP	210	105	-	-	315
Personal work	182	84	-	28	294
Other (specify) PES	144	-	-	-	144
Total	851	378	-	91	1313
Credits	86	28	-	6	**120**
% in Credits for each TU	71.67%	23.34%	-	5%	100%

III - Detailed program by course

(1 detailed sheet per course)

Title of the Master: Image and Artificial Life

Semester *: S1*

Title of TU : Advanced systems and architectures

Course Title : Distributed systems

Credits : 6

Coefficients : 3

Teaching objectives

This subject is devoted to the fundamental aspects of distributed systems and the problems posed by their design and implementation. Particular emphasis will be placed on the means to compensate for the absence of global time in asynchronous systems and also on the basic techniques for designing systems resistant to failures.

Recommended prior knowledge

Concepts of processes, synchronization and communication in a centralized system. In cycle L of the LMD regime, students took two subjects devoted to these concepts.

Content of the course

I- Notion of concurrence.

- The different interpretations of concurrence.

II- Time and state in a distributed system.

- Causality and sequencing of events in a distributed system;
- Overall state of a distributed system; consistent cuts applications: save-resume algorithms, detection of stable properties;
- Global scheduling by logical application clocks: mutual exclusion, distributed queues;
- Causal scheduling by vector clocks applications: observation, fine-tuning;
- Synchronization of physical clocks

III- Cooperation of distributed processes

- Virtual ring, insertion and removal protocols, failure management;
- Application election algorithms: group management;
- Termination detection algorithms. Application: distributed crumb catcher.

IV- Fault tolerance

- Failure hypotheses;
- Specification of coherence: linearization, sequential coherence, causal coherence;
- Primary copy and active duplication;
- Reliable broadcast algorithms and management of process groups.

V- Distributed information management

- Principles of distributed object management;
- Implementation: virtual memory, distributed objects;

- Widespread distribution;
- Cache management, duplication, consistency;
- Applications: P2P systems.

Model evaluation:

50% Exam + 25% Practical work + 25% Personal work

References *(Books and handouts, websites, etc.).*

1. Guerraoui R., Rodrigues L., ***Reliable Distributed Programming***, Springer,2006.
2. Tanenbaum A. S., Van Steen M., ***Distributed Systems - Principles & Paradigms***, Prentice Hall, 2002.
3. Mullender S. (editor), ***Distributed Systems***, 2nd ed. , Addison-Wesley,1993.
4. Singhal M., Shivaratri N. G., ***Advanced Concepts in Operating Systems***, McGraw-Hill, 1994.
5. Barbosa V. C., ***Introduction to Distributed Algorithms***, MIT Press,1996.
6. Hoare C.A.R., *Communicating Sequential Process* , Prentice Hall Intern. 2004.
7. Silberschatz A. & Peterson J.L., ***Operating System Concepts*** , Addison-Wesley,1983.

Title of the Master: Image and Artificial Life

Semester *: S1*

Title of TU : Advanced systems and architectures

Course Title : Parallel Programming on GPGPUs

Credits :6

Coefficients : 3

Teaching objectives

This subject introduces students to parallel architectures and algorithms. In particular vector, systolic architectures, and associated algorithms.

Recommended prior knowledge

Basic architecture of a Von Newman type machine. Indeed, in cycle L of the L.M.D regime, students followed subjects devoted to computer architecture.

Content of the course

Chapter 1 : Introduction to Programming Parallel Architectures

- Motivation for parallelism.
- Source of parallelism and fundamental operations.
- Parallelism in uniprocessor machines
- Execution models.

Chapter 2 : Operation of Multiprocessor Machines

- How to execute the parallel tasks of a program?
- Implementation of a multitasking program using threads.
- What aspects can have a significant negative impact on performance?

Chapter 3 : Parallel Programming on GPU

- Presentation of GPUs
- Architecture of GP-GPUs
- The architecture of the NVIDIA TESLA card
- The architecture of the NVIDIA FERMI card
- The architecture of the NVIDIAKEPLER card
- GPU performance optimization
- Use of GPU cores
- Use of GPU memories

Chapter 4: CUDA Programming

- General structure of a CUDA program
- The CUDA programming interface
- Types qualifying functions
- Types qualifying variables
- Grids, Blocks, Threads, Warp • Grid configuration
- Standard variables
- Optimization rules
- CPU-GPU data transfers
- Performance measures
- Measurement of real execution time

Chapter 5 : Measuring the Performance of a Parallel Program

- Acceleration and Efficiency
- Cost, work and optimality
- Amdahl's law

Evaluation mode

50% Exam + 25% Practical work + 25% Personal work

References

[1] CUDA by Example : An Introduction to General-Purpose GPU Programming. Support tech- nique de nVidia.

[2] J. Cheng, M. Grossman, and T. McKercher, Professional CUDA C Programming. ser. EBL- Schweitzer. Wiley, 2014.

[3] Numerical Computations withGPUs, VolodymyrKindratenko .National Center for Supercomputing Applications University of Illinois Urbana, IL, USA.

[4] MassivelyParallelEvolutionary Computation on GPGPUs, Th. Back A.E. Eiben J.N. Kok H.P. Spaink, Leiden Center for Natural Computing

[5] Sansonnet J.P., Architectures des machines parallèles CNRS 1992.

[6] Matthieu Ospici. Modèles de programmation et d'exécution pour les architectures parallèles et hybrides. Applications à des codes de simulation pour la physique. Université de Grenoble, 2013.

[7] Programmation des architectures Parallèles, Université de Bordeaux 1, 2006.

Title of the Master: Image and Artificial Life

Semester *: S1*

Title of TU : Advanced systems and architectures

Course Title : Communication networks

Credits : 6

Coefficients : 3

Teaching objectives *(Describe what skills the student is supposed to have acquired after passing this subject – maximum 3 lines).*

The communications networks subject aims to enable the student to:

- Understand and be able to implement the different devices and protocols used in fixed and mobile networks.
- Design, configure and manage fixed and mobile networks taking into account application needs.

Recommended prior knowledge.

Networks (L3), Distributed systems.

Content of the course.

1- Reminder on the link layer

- Concurrent access to support, the CSMA/CD protocol, ...

2- The network layer

- Reminder on the IPv4 protocol
- Routing in IP networks:
  - Distance vector routing protocols
  - Link-state routing protocols.
- The IPv6 protoco
- Managing coexistence between IPv4 and IPv6 networks
  - Coexistence based on Tunneling.
  - Coexistence based on Gateways.

3- The transport layer

- TCP protocols
- The UDP protocol

4- Quality of service (QoS) in IP networks

- QoS settings
- Network factors that influence the QoS of communications.
- TCP/IP and QoS protocols

5- 5- Introduction to wireless communication networks

- Cellular wireless networks
- Ad Hoc wireless networks

Evaluation mode.

67 *% Exam + 33% Personal work*

References.

- Kurose, J. F., & Ross, K. W. (2021). Computer Networking A Top-Down Approach. Peasron Editions. 2021.
- Bonaventure, O., Networking : Principles, Protocols and Practice, 3rd Edition, 2021.
- Lannone, E., Telecommunication networks, O'Reilly Edition, 2017.

Title of the Master: Image and Artificial Life

Semester *: S1*

Title of TU : Images

Course Title : Analysis, image processing and 3D vision

Credits : 5

Coefficients : 2

Teaching objectives.

The objective of this subject is the presentation of the foundations of the Domain of analysis, image processing and 3D vision. The course places particular emphasis on the techniques applied to digital images to analyze them, process them and extract information. which describe them with a view to their integration into 3D vision systems.

Prior knowledge recommended..

Content of the course.

I- Chapter 1 : Computer vision

- Human vision and computer vision
- Image acquisition and formation
- Vision sensors
- Colorimetry
- Computer vision system
- Artificial intelligence in vision
- History and applications

II-Chapter 2 : Fundamental tools for image representation

- Mathematical modeling of the image
- Scanning and sampling
- Coding of images by:
  - Segments, contour, region, by shape
- Storage and image formats
- Histogram
- Texture
- The Fourier transform

III- Chapter 3 : Digital image processing

- Image enhancement and correction
  - Filtering, convolution.
- Pretreatments
  - Contour detection, thresholding, mathematical morphology.
- Segmentation of the image in contours, in lines (Hough), in regions.

IV-3D vision

- Parameterization and recognition
- Moving image
- 3D vision
- Multi-scale
- Industrial vision
- Vision and multimedia

V- Chapter 5 : Software libraries for image processing

Evaluation mode.

50 % *Exam* + 25% Practical work + 25% Personal work

References.

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer Science & Business Media. (ISBN 978-1-84882-935-0)
2. Steger, Carsten; Markus Ulrich; Christian Wiedemann (2018). Machine Vision Algorithms and Applications(2nd ed.). Weinheim: Wiley-VCH. p. 1. (ISBN 978-3-527-41365-2). Retrieved 2018-01-30.
3. AUMONT Jacques, « Chapter 1. La perception de l'image », dans : ,*L'image. Peinture, photographie, cinéma : des origines au numérique*, sous la direction de AUMONT Jacques. Paris, Armand Colin, « Hors collection », 2020,
4. David G. Stork, « Computer Vision and Computer Graphics Analysis of Paintings and Drawings: An Introduction to the Literature », dans*Computer Analysis of Images and Patterns*, Springer Berlin Heidelberg, 2009.
5. Jay D. Aronson, « Computer Vision and Machine Learning for Human Rights Video Analysis: Case Studies, Possibilities, Concerns, and Limitations », *Law & Social Inquiry*, vol. 43, n° 04, 2018, p. 1188–1209 .
6. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, Pearson Prentice Hall, 2008

Title of the Master: Image and Artificial Life

Semester *: S1*

Title of TU : Images

Course Title : Fundamentals of computer graphics

Credits : 5

Coefficients : 2

Teaching objectives.

This course represents a general introduction to the field of computer graphics, both chronological and didactic, it will present to students the hardware and software foundations of image synthesis, animation and virtual reality.

Recommended prior knowledge (*(brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

Content of the course.

1- General Presentation.

- Domain Infographic.
  - Image synthesis,
  - Image processing and vision,

2- Modeling

- Principles of image generation.
- Models
  - Mathematical and Geometric Models,
  - Surface Models,
  - Volume models,
  - Modeling of natural objects,
  - Image-based and point-based model.
- Geometric transformations
- Z-Buffer visualization,

3- Realistic rendering.

- Local illumination models.
- Ray tracing algorithm.
- Acceleration methods,
- Global illumination
  - Simulation of lighting, shadows and transparency
  - Radiosity
  - Stochastic methods
  - Rendering equation

Evaluation mode.

50 % Exam + 50 % Practical work.

References.

1. Van Dam A. & Feiner S. K., **Introduction à l'infographie**, Addison Wesley,2000.
2. Peroche B. & Michelucci D., **La synthèse d'images**, Editions Hermès,1990.
3. Bernard Péroche&Dominique Bechmann. **Informatique graphique et rendu**, Éditeur : Hermès – Lavoisier. Date de parution : 09/02/2007.
4. Steve Marschner, Peter Shirley et all.**Fundamentals of Computer Graphics 5th Edition**. eBook Published 30 September 2021. Publisher: A K PETERS LTD (MA).
5. David J. Eck, Hobart and William Smith Colleges. **Introduction to Computer Graphics**. Version 1.3, August 2021.
6. Glassner A. S. **An introduction to Ray Tracing**, Morgan Kaufmann publishers,2000.
7. Parent R., **Computer animation**, Morgan Kaufmann publishers,2002.
8. Fleming B., **3D Modeling and surfacing**, Morgan Kaufmann publishers,1999.
9. Gallier J., **Curves and surfaces in geometric modelling**, Morgan Kaufmann publishers,2000.

Title of the Master: Image and Artificial Life

Semester *: S1*

Title of TU : English and entrepreneurship

Course Title : English 1

Credits : 1

Coefficients : 1

Teaching objectives

Allows the student to learn to read, understand and write reports, articles, computer texts, and to present their work in English. To do this, the student will have to understand more about the rules of grammar and sentence composition while using the vocabulary of computer science in general and the Specialty in particular; in other words Make the student more efficient in the context of studies.

Recommended prior knowledge

A technical English module was followed during cycle L of the system (LMD).

Content of the course.

- Use of computer vocabulary
- Master reading computer documentation
- Understand computer messages on Anglo-Saxon forums
- Writing computer messages on Anglo-Saxon forums
- Learn how to make IT support calls
- Description of technical problems
- Description of technical solutions

Evaluation mode.

70% Exam + 30% interrogations.

References.

Any reference deemed useful..

Title of the Master: Image and Artificial Life

Semester *: S1*

Title of TU : Anglais et Entreprenariat

Course Title : Entrepreneurship

Credits : 1

Coefficients : 1

Teaching objectives:

Upon successful completion of this subject, the student is expected to have acquired an overview of creation processes, support for business creation and skills relating to the risks linked to entrepreneurial action, as well as skills relating to allowing you to carry out a market study, to analyze existing offers from competitors and to determine a strategy specific to your company…..

Content of the course:

1. Context of entrepreneurship: (the entrepreneur, the characteristics favorable to entrepreneurship, the various forms of entrepreneurship, etc.)
2. Market study: (analysis of existing competitors' offers, etc.)
3. Synthesis of market knowledge and target choices.
4. Business plan: (formalization of the idea into the project, analysis of the process and the approach to business creation)
5. Strategic positioning of the offer
6. MarketingMix
7. Introduction to human resources management and management of relationships with stakeholders (customers, bankers, government, etc.)
8. Innovation and new business development strategy.

Evaluation mode : 50 % Exam + 50 % Tutorials

References:

1. Tixier D., Mathe H. et Colin J., La logistique d'entreprise - vers un management plus compétitif, Dunod (Gestion Sup),1998.
2. Cohen R. , Concevoir et lancer un projet, Eyrolles (Editions d'Organisation),2006.

Title of the Master: Image and Artificial Life

Semester *: S2*

Title of TU : Modeling and Animation Techniques

Course Title : Computer Animation

Credits : 5

Coefficients : 3

Teaching objectives

This subject aims to give students the means to understand the concepts of computer animation with the aim of using them in the modeling of virtual environments populated by virtual humans.

Recommended Prerequisites.

- Foundations of Computer Graphics
- Image Analysis, Processing, and 3D Vision

Content of the course.

1- Introduction
2- History
3- Types of Animation (Real-time, Frame-by-Frame)
4- Animation Methods
   4.1 Keyframe Animation
   4.2 Motion Capture
   4.3 Cinematic and Dynamic Animation
   4.4 Particle Systems
   4.5 Mass-Spring Model
5- Character Animation
   5.1 Character Representation
   5.2 Motion Control
   5.3 Motion Capture and Editing
   5.4 Animation Platforms
6- Animation Models
   6.1 Descriptive Model
   6.2 Generative Model
   6.3 Behavioral Model
7- Applications

Evaluation mode.

50% Exam + 25% Tutorials + 25% Personal work

References

1. Parent R., Computer animation, Morgan Kaufmann publishers, 2002.
2. Badler N. I. & Philips C. B., Simulatinghumans, Oxford UniversityPress, 1993.
3. Heudin J.C., Virtual Worlds, Springer LNCS/AI 1834, 2000.

Title of the Master: Image and Artificial Life

Semester *: S2*

Title of TU : Modeling and Animation Techniques

Course Title : Modeling Techniques and Algorithmic Geometry

Credits : 5

Coefficients : 3

Teaching objectives.

Geometric Modeling is the first step in the process of creating a computer-generated image. It brings together all the theories and techniques making it possible to represent and process complex shapes mathematically or geometrically.

The objective of this course is to present the elements of Modeling used in the various Domains of digital imaging.

Recommended Prerequisites.

- Image Synthesis Techniques (TSI).
- Image Processing Techniques (TTI).

Content of the course.

I. Mathematics for computer graphics

- Introduction
- Matrices and linear systems
- Vector algebra
- Matrices, vector algebra and transformations
- Geometric primitives in 2D
- Geometric primitives in 3D

II. Geometric modeling

- Introduction,
- Volume models (B-Rep, CSG, extrusion, etc.), meshes and octree,
- Simple primitives (Revolution, Extrusion, Torsion),
- Curves and Surfaces: Hermite's cubics,
- Curves and Surfaces: Bézier curves and B-Spline and NURBS curves,
- Curves and Surfaces: curves and surfaces of subdivision,
- Fractals,
- The levels of detail,
- Implicit equipotential surfaces,
- Surface deformations,
- Numerical methods for modeling (interpolation, approximation of points in space).

III. Mesh and algorithmic geometry

- **Meshes:**
  - Mesh generation, 3D reconstruction and virtual sculpture
  - Simplification and refinement of meshes
  - Improvement of meshes, coding
  - Differential properties on a mesh

- **Geometric Calculation and Algorithmic Geometry:**
    - Basic notions of algorithmic geometry in 2D (planar maps, graphs, triangulation, convex hull)
    - Construction of the convex hull in 2D: optimal algorithm (divide and construct) Incremental algorithms
    - Delaunay triangulation in 2D (and dual: Voronoi diagram): general definitions, properties
    - Power diagrams
    - Optimal algorithm for constructing the Delaunay triangulation (divide and construct), and incremental algorithms

Evaluation mode.

50% Exam + 50% Practical work.

References.

1. Fleming B., **3D Modelling and surfacing**, Morgan Kaufmann publishers,1999.
2. Earnshaw E. & Vince J., **Visualization and modelling**, Academic Press,1997.
3. Bartels H., **An introduction to splines**, R. Morgan Kaufmann publishers,1987.
4. Bloomenthal J., **Introduction to implicit surfaces**, Morgan Kaufmann publishers,1997
5. Gallier J., **Curves and surfaces in geometric modeling**, Morgan Kaufmann, Publishers,2000.
6. Farin G., **Curves and surfaces for CAGD**, Morgan Kaufmann publishers,1999.
7. Philip Schneider and David Eberly. Geometric Tools for Computer Graphics. The Morgan Kaufmann Series in Computer Graphics and Geometric Modeling Series Editor: Brian A. Barsky, University of California, Berkeley, 2003.

Title of the Master: Image and Artificial Life

Semester *: S2*

Title of TU : Machine learning et Simulation

Course Title : Machine Learning for Image and 3D Vision

Credits : 5

Coefficients : 2

Teaching objectives

This subject covers the fundamental aspects of Machine Learning. In particular, the functioning and learning of deep neural networks, the importance of convolution, as well as their use cases and applications in image processing. Practical work involves using machines with community-based learning datasets.

Recommended Prerequisites

- Image Processing
- Computer Vision"

Content of the course.

I Chapter 1 : General information on Machine Learning

- Definition of Machine Learning
- The development of a Machine Learning model.
- Types of Machine Learning (supervised, unsupervised and reinforcement)
- Use cases and applications

II Chapter 2 : Machine Learning Algorithms

- Regression algorithms
- Classification Algorithms
- Clustering algorithms

III Chapter 3 : Deep Learning

- Artificial neural networks
- Learning using the multilayer perceptron
- Convolutional neural networks
- Deep learning architectures
- Deep learning for image processing

IV Chapter4 : Python Machine Learning Library

Evaluation mode :

50% Exam + 25% Practical work + 25% Personal work

References.

1. Md.Z. Alom and al. A state-of-the-art survey on deep learning theory and architectures. Electronics, 8:292, 03 2019.
2. Vincent Barra, Antoine Cornuéjols, Laurent Miclet, Apprentissage Artificiel : Concepts et algorithmes, Eyrolles, 2021 (ISBN 978-2-416-001-04-8).
3. Christopher M. Bishop, Pattern Recognition And Machine Learning, Springer, 2006 (ISBN 0-387-31073-8
4. Tom M. Mitchell, Machine Learning, McGraw-Hill International Editions, 1997, chap. 13 Reinforcement Learning, p. 367-390
5. Alpaydin, E. (2010). Introduction to Machine Learning. MIT Press.
6. Python Machine Learning, 3rd Edition, ISBN-10: 1789955750, ISBN-13: 978-1789955750, Paperback: 770 pages; ebook available in Kindle format, Epub, PDF, Packt Publishing Ltd (December 12th, 2019);

Title of the Master: Image and Artificial Life

Semester *: S2*

Title of TU : Machine learning et Simulation

Course Title : Modeling and Simulation

Credits : 5

Coefficients : 2

Teaching objectives

This subject is intended to deepen the student's knowledge in the field of modeling and simulation. In addition, it introduces performance evaluation techniques.

Recommended Prerequisites

Content of the course.

1. Introduction
2. Dynamic systems
3. Automata
4. Continuous systems
5. Continuous linear systems
6. Continuous non-linear systems
7. Discrete-time systems
8. Statistical simulation
9. Discrete event simulation

Evaluation mode :

50% Exam + 25% Practical work + 25% Personal work

References.

1. Lavenberg S. S., **Computer systems performance evaluation,** Academic Press1983.
2. Mitrani I., Modelling **of computer and communication systems,** Cambridge University Press 1987.
3. Pidd M., **Computer simulation in management science**, J. Wiley and Sons Ed1984.
4. Trivedi K. S., **Probability and statistics with reliability, queuing and computer science applications**, Prentice Hall,1982.
5. Cours de modélisation et simulation (in French). Gianluca Bontempi, Eythan Levy, Département d'Informatique, Faculté des Sciences. Université Libre de Bruxelles, ULB, Belgique. 5 janvier 2022

Title of the Master: Image and Artificial Life

Semester *: S2*

Title of TU : Programmation GPU et Complexité

Course Title : GPU Graphics Programming

Credits : 4

Coefficients : 2

Teaching objectives

The objective of this course is to give students an overview of GPUs (graphics pipeline architecture and programming), it also covers shaders.

Recommended Prerequisites

Algorithms and Parallel Architecture.

Content of the course.

1. GPU Graphics Pipeline
2. Internal Architecture and Parallelism of GPUs
3. Graphic Primitives and Rasterization
4. GPU Programming with Shaders: Vertex Shader, Geometry Shader, Fragment Shader
5. Textures and Their Usage: Texture Mapping, Procedural Textures, Noise, Aperiodic Tiling, Billboards, Image-Based Rendering, Environment Mapping, Bump Mapping, Displacement Mapping, Render to Texture.
6. Geometry Buffer and Deferred Rendering.

Evaluation mode

50% Exam + 50% Practical.

References

1. McCool, M., Du Toit, S., Popa, T., Chan, B., & Moule, K. (2004, August). Shader algebra. In ACM Transactions on Graphics (TOG) (Vol. 23, No. 3, pp. 787-795). ACM.
2. Upstill, Steve. The RenderMan Companion: A Programmer's Guide to Realistic Computer Graphics. Addison-Wesley. ISBN 0-201-50868-0.
3. Ebert, David S; Musgrave, F. Kenton; Peachey, Darwyn; Perlin, Ken; Worley, Steven. Texturing and modeling: a procedural approach. AP Professional. ISBN 0-12-228730-4.
4. Fernando, Randima; Kilgard, Mark. The Cg Tutorial: The Definitive Guide to Programmable Real-Time Graphics. Addison-Wesley Professional. ISBN 0-321-19496-9.

Title of the Master: Image and Artificial Life

Semester *: S2*

Title of TU : Programmation GPU et Complexité

Course Title : Complexity and Optimization

Credits : 4

Coefficients : 2

Teaching objectives

This subject allows students to deepen their knowledge of algorithms acquired in the second year of the degree, particularly with regard to exploration for the resolution of NP-Complete problems.

Recommended Prerequisites

Algorithmic concepts.

Course content.

1. Course presentation
2. Fundamental notions: algorithmic and complexity
    - The basics of algorithm analysis
    - Complexity of an algorithm
        - The performance of the algorithm
        - The problem resolution strategy
        - Landau notions
    - Class and complexity of a problem: P, NP, PSPACE, EXPTIME
3. Recursion and the Divide and Conquer algorithm
    - Sorting algorithm analysis
    - Search algorithm
    - Graph algorithm
    - Tree algorithm
4. Complexity classes: P, NP, PSPACE, EXPTIME
    - Definition of Optimization
    - Combinatorial optimization:
        - Exact methods: Branch and bound
        - Approximate methods:
            - Specialized heuristics: Glutons algorithm, hill climbing
            - Metaheuristics
5. Metaheuristics and Evolutionary algorithms
    - Single solution-based metaheuristics, trajectory methods
        - Local Search Algorithm
        - Search Algorithm with Taboo
        - SIMULATED ANNEAL search algorithm
        - Algorithms based on solution population, Evolutionary algorithms, Genetic Algorithms

Evaluation mode.

50% Exam + 25% Tutorials + 25% Personal work

References.

1. Leiserson C., Stein R., **Introduction aux algorithmes**. Seconde édition, Dunod,2002

Title of the Master: Image and Artificial Life

Semester *: S2*
Title of TU : Méthodologie
Course Title : Research methodology
Credits : 2
Coefficients : 1

Teaching objectives.

The objectives of the research methodology subject are to provide students with the tools allowing them to write written reports and in particular their work reflecting their professional mission and their master's thesis during Semester 4.

Recommended Prerequisites

None

Content of the course.

I. SCIENTIFIC KNOWLEDGE

- Specificity of scientific knowledge
- Principles of scientific knowledge
- Evolution of scientific knowledge

II. METHODS AND PROCESSES OF SCIENTIFIC KNOWLEDGE, VALUE AND LIMITS

III. SCIENTIFIC RESEARCH WITH A VIEW TO DEVELOPING FINANCIAL WORK

- Phases of the creation process

IV. PREPARATION OF THE END OF STUDY WORK

- The documentation
- Writing: steps
- The bibliography ; the ethical imperatives of borrowing ideas
- Self-assessment and evaluation of the quality of the dissertation or thesis

V. THE DEFENSE

- Oral presentation

VI. ETHICS OF SCIENTIFIC RESEARCH

Evaluation mode.

100 % Exam

References.

1. Lacroix M., **Initiation à la recherche, note de cours**, Université deSherbrooke.
2. French, M., **Invention and Evolution : Design in Nature and Engineering**,Cambridge

University Press, 1994.

3. Blaxter, L. Hughes, C. & Tight, M. (1998) **How to Research,** Buckingham Open University Press.
4. Denscombe, M., **Ground Rules for Good Research Maidenhead**, Open University Press, 2002.
5. Constant A.S., Lévy A. ,**Mémentos LMD - Réussir mémoire, thèse et HDR**, Edition Galino 4e édition,2012.
6. Beaud M. , L'art de la thèse - **Comment préparer et rédiger un mémoire de master, une thèse de doctorat ou tout autre travail universitaire à l'ère du Net**, Editions LA DÉCOUVERTE,2006.

Title of the Master: Image and Artificial Life

Semester *: S3*

Title of TU : Advanced rendering techniques

Course Title : Colorometry and global illumination techniques

Credits : 6

Coefficients : 3

Teaching objectives.

This material allows you to review the fundamental notions of illumination (light sources, specularity, diffusion), then to expose the different global illumination techniques: stochastic techniques based on Monte Carlo and finally the techniques of global rendering in real time.

Recommended Prerequisites.

- Image Synthesis Techniques.
- Graphics programming of GPUs

Content of the course.

Part 1: Light and color

1. Light and electromagnetic waves
2. The different optical models
3. Radiometry and photometry
4. Patterns of light emission and scattering
5. Basic mechanism of color vision
6. Perception of color mixtures
7. Color representation

Part 2 : Global illumination

1. Rendering equation and path integral formulation
2. The Monte Carlo method
3. Preferential Sampling and Multi Importance Sampling
4. Lengths of light paths
5. Path Tracing.
6. Real-time global illumination

Evaluation mode.

50% Exam + 50% Tutorials.

References.

1. Dutre, Philip, Kavita Bala, and Philippe Bekaert. **Advanced global illumination**.2nd edition AK Peters/CRC Press, 2018.

2. Akenine-Mo, Tomas, Eric Haines, and Naty Hoffman. **Real-time rendering.**4th edition, AK Peters/CRC Press, 2018.

3. Rolf G. Kuehni, **Color: An Introduction to Practice and Principles,** 3rd Edition, Wiley publishing, 2012.

Title of the Master: Image and Artificial Life

Semester *: S3*

Title of TU : Advanced rendering techniques

Course Title : Artificial life

Credits : 6

Coefficients : 3

Teaching objectives

This subject allows students to be made aware of the techniques of Artificial life, which, by taking their inspiration from "living things", make it possible to build complex evolving and adaptive systems. The goal is to easily describe the behavior of actors evolving in a virtual world..

Recommended Prerequisites.

- Image Synthesis Techniques.
- Learning and development techniques.

1) Concept of complex systems and emergence.
2) Systems design approaches
3) "Artificial" Life" Panorama.
4) Generator Techniques
   - Reaction / diffusion;
   - Cellular automata;
   - L-Systems.
   - Genetic algorithms;
   - Genetic programming.
   - Neural networks;
   - Declassifier systems.
5) Generation of behaviors
6) Artificial Creatures and Ecosystems

Evaluation mode.

67% Exam + 33% Practical work

References.

1. Rennard J. P., **Vie Artificielle**, Vuibert Informatique,2006.
2. Adamatzky A. & Komosinsky M., **Artificial Life Models in software**, SPRINGER,2005.
3. Langton C., **Artificial Life series**, Addison WesleyPublishing.
4. Meyer J. A., **From Animals to Animats series**, The MITPress.
5. Heudin J.C., **Virtual Worlds**, Springer LNCS/AI 1834,2000.

Title of the Master: Image and Artificial Life

Semester *: S3*

Title of TU : Advanced rendering techniques

Course Title : Virtual Environments and Humans

Credits : 6

Coefficients : 3

Teaching objectives

This course presents the main models for the representation and control of the movement of animated virtual agents in 3D virtual environments. It describes the methods and techniques necessary to design, model, and animate virtual agents, which can be autonomous and equipped with communication capabilities, or multiple in adaptive environments (crowd simulation).

Recommended Prerequisites.

- Image Synthesis Techniques.
- Computer animation.

Content of the course.

Behavioral Animation

- Presentation
- Virtual actors
- The virtual environment
- The decision loop
- Areas of application

Virtual humans

- Presentation
- Modeling of the virtual human
- Movement and motion control
- Individual and collective human behavior

Virtual environments

- Presentation
- Topological representation of the environment
- Path planning
- Informed environments

Evaluation mode

50% Exam + 50% Practical work.

References

1. Fuchs, P. (2006). Le traité de la réalité virtuelle (Vol. 2). Presses des MINES.
2. Rick Parent, Animatique Algorithmes et techniques. Vuibert, Paris,2003, chap. 6.
   Magnenat-Thalmann, N., & Thalmann, D. (Eds.). (2005). Handbook of virtual humans.

John Wiley & Sons.
3. Lamarche, F. (2003). Humanoïdes virtuels, réaction et cognition: une architecture pour leurautonomie (Doctoral dissertation, Université Rennes 1).
4. Van Welbergen, H., Van Basten, B. J., Egges, A., Ruttkay, Z. M., & Overmars, M. H. (2010,December). Real time animation of virtual humans: a trade- off between naturalness and control. In Computer Graphics Forum (Vol. 29, No. 8, pp. 2530-2554). Oxford, UK: BlackwellPublishing Ltd.
5. Yu, Q., & Terzopoulos, D. (2007). A decision network framework for the behavioral animationof virtual humans (Vol. 68, No. 05).
6. Burden, D., & Savin-Baden, M. (2019). Virtual humans: Today and tomorrow. Chapman andHall/CRC.
7. Rıos, A., Mateu, D., & Pelechano, N. (2018). Follower behavior in a virtual environment. VirtualHumans and Crowds for Immersive Environments (VHCIE), IEEE. IEEE.
8. Oyekan, J. O., Hutabarat, W., Tiwari, A., Grech, R., Aung, M. H., Mariani, M. P., ...& Dupuis, C. (2019). The effectiveness of virtual environments in developing collaborative strategiesbetween industrial robots and humans. Robotics and Computer-Integrated Manufacturing, 55, 41-54.
9. Alizadehsalehi, S., Hadavi, A., & Huang, J. C. (2019). Virtual reality for design and constructioneducation environment. AEI 2019: Integrated Building Solutions—The National Agenda, 193-203.

Title of the Master: Image and Artificial Life

Semester *: S3*

Title of TU : Augmented Reality and Virtual Reality

Course Title : Augmented reality

Credits : 4

Coefficients : 2

Teaching objectives

Present the different processes and algorithms for perception and inference and 3D monitoring of the environment, in order to enable the implementation of augmented reality applications..

Recommended Prerequisites

- Image synthesis and processing
- Computer vision

Content of the course

- Augmented Reality issues: real–virtual mixing, realignment
- Mobile augmented reality
- Basics of projective geometry
- Modeling and calibration of sensors
- 3D inference methods
- PnP pose calculation methods
- Analytical and digital methods of 3D monitoring.
- Multi-view geometry
  - 2-view geometry: epipolar geometry and homographies
  - 3-view geometry: trifocal tensor
  - N-view geometry.
- Automatic recognition
  - automatic localization and mapping methods
  - automatic object recognition methods: auto calibration

Evaluation mode

50% Exam + 25% Practical work + 25% Personal work

References

- R. Horaud, "vision par ordinateur", hermes 1995
- David A. Forsyth, Jean Ponce "Computer Vision : A Modern Approach", Prentice Hall, 2002
- Richard Szeliski, Computer Vision: Algorithms and Applications, Springer 2010.

Title of the Master: Image and Artificial Life

Semester *: S3*

Title of TU : Augmented Reality and Virtual Reality

Course Title : Virtual reality

Credits : 4

Coefficients : 2

Teaching objectives

Raise students' awareness of this new scientific and technical field, and present its technological and theoretical foundations. Learn the basics for designing VR applications and multimodal 3D interactions.
Also present the different paradigms of interaction and sensory feedback used in virtual and augmented reality as well as adapted technological solutions.

Recommended Prerequisites

Computer animation.

Content of the course

1- Basic concepts, history and applications of Virtual Reality
2- Sensorimotor channels and interfaces
3- VR application design principles
4- Basic concepts of human-machine interaction
5- 3D interactions, feedback and multimodality
6- User-centered design of interactive systems
7- 3D interactions: (Navigation; 3D selection; Manipulation; Application control)
8- Application: design of a 3D interaction technique for a VR application.

Evaluation mode.

50% Exam + 25% Tutorials + 25% Personal work

References.

1. Burdea G. &Coiffet P., La Réalité Virtuelle, Éditions Hermès, 1993.
2. P. Fuchs et al., Traité de la Réalité Virtuelle (3ème édition), Presses de l'Ecole des Mines de Paris, 2005.
3. Bowman, D. A., Kruijff, E., LaViola Jr, J. J., and Poupyrev, I. (2004). 3D user interfaces : theory and practice. Addison-Wesley.

Title of the Master: Image and Artificial Life

Semester *: S2*

Title of TU : Augmented Reality and Virtual Reality

Course Title : Introduction to Bioinspired Systems

Credits : 2

Coefficients : 1

Teaching objectives

The goal is to present the main principles of Bio-inspired computing and its applications. By "bio-inspired computing", we mean any system or architecture whose organizational principles come, directly or indirectly, from the knowledge we have on the (cognitive) functioning of living systems. These therefore include, among other things, neural networks (inspired by the cellular structure of the nervous system) but also approaches such as genetic algorithms or immuno-inspired algorithms.

Recommended Prerequisites

Knowledge in the field of artificial intelligence, multi-agent systems, etc.

Content of the course.

The course includes thematic parts, dedicated to one or other of the bio-inspired techniques, but also more general parts during which these main principles will be stated, illustrated and discussed.

- Introduction to bio-inspired computing. Definitions, general principles of bio-inspired computing, areas of application, history.
- Overview of the different models. Diversity of sources of inspiration, diversity of models, examples of emerging mechanisms
- "Evolutionary" approaches. Genetic algorithms, genetic programming
- "Cellular" approaches. Neural networks and immune networks
- "Populational" approaches. Reactive and/or cognitive multi-agent systems, ant-based systems
- Artificial life. Can bio-inspired computing help biologists better understand living systems: from artificial intelligence to artificial life.
- Dynamic approaches
- Practical work. By using a prototyping tool intended for multi-agent programming and artificial life (NetLogo or Swarm type).

Evaluation mode

50 % Exam 50% Practical work.

References

1. M. Resnick, Turtles, Termites, and Traffic Jams: Explorations in Massively Parallel Microworlds, MITPress
2. G. Dreyfus , M. Samuelides , J.-M. Martinez , M. B. Gordon , F. Badran , S. Thiria , L. Hérault, Réseaux de neurones - Méthodologies et applications, Ed.Eyrolle
3. J. Ferber, Les systèmes multi-agents – vers une intelligence collective,InterEditions

Title of the Master: Image and Artificial Life

Semester *: S3*

Title of TU : English 2

Course Title : Expression Technique in English

Credits : 2

Coefficients : 1

Teaching objectives.

The aim of this course being the same as that of S1, it is the continuation of the presentation of the techniques and tools allowing the student to master the English language especially in the computer sector and in the applications of the Speciality.

Recommended Prerequisites

Technical English was followed during cycle L of the system (LMD) and in S1.

Content of the course.

- Use of computer hardware vocabulary
- Master reading computer documentation
- Understand computer messages on Anglo-Saxon forums
- Writing computer messages on Anglo-Saxon forums
- Learn how to make IT support calls
- Description of technical problems
- Description of technical solutions

Evaluation mode.

70 % Exam + 30 % interrogations

References

Any reference deemed useful.

V- Agreements or conventions

~~Yes~~

No

(If yes, transmit the agreements and/or conventions in the paper training file)

STANDARD LETTER OF INTENT

(In the case of a master's degree co-sponsored by another university establishment)

(Official paper on the letterhead of the university establishment concerned)

Subject: Approval of co-sponsorship of the master’s degree entitled:

Hereby, the university (or the university center) declares to co-sponsor the above-mentioned master's degree throughout the period of accreditation of this master's degree.

To this end, the university (or university center) will assist this project by:

- Giving his point of view in the development and updating of teaching programs,
- Participating in seminars organized for this purpose,
- By participating in the defense juries,
- By working to pool human and material resources.

SIGNATURE of the legally authorized person:

FUNCTION :

Date :

STANDARD LETTER OF TYPE

(In the case of a master's degree in collaboration with a company in the user sector)

(Official company letterhead)

SUBJECT: Approval of the project to launch a master's course entitled

titled: Dispensed to:

The company hereby declares its desire to demonstrate its support for this training as a potential user of the product.

To this end, we confirm our support for this project and our role will consist of:

- Give our point of view in the development and updating of teaching programs,
- Participate in seminars organized for this purpose,
- Participate in defense juries,
- Facilitate as much as possible the reception of interns either as part of end-of-study dissertations or as part of tutored projects.

The means necessary to carry out the tasks incumbent on us to achieve these objectives will be implemented on a material and human level.

Mr. (or Madam)…….is designated as external coordinator of this project.

SIGNATURE of the legally authorized person:

FUNCTION:

Date :

OFFICIAL STAMP or COMPANY SEAL