

INGÉNIEUR ENSEEIHT INFORMATIQUE ET TÉLÉCOMMUNICATIONS (APPRENTIS)

IN BRIEF

Type of diploma : Diplôme d'ingénieur

Ministry field : Sciences, Ingénierie et Technologies

MORE INFO

ECTS credits : 180

Level : BAC +5

Type of education

* Formation en alternance

* Formation initiale

Kind of education : Diplôme

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<http://www.enseeiht.fr/fr/index.html>



Presentation

Le candidat recruté obtient le double statut d'élève ingénieur et de salarié apprenti au sein d'une entreprise. L'élève signe un contrat d'apprentissage et s'engage à travailler dans son entreprise d'accueil pour une durée de 3 ans, contre rémunération.

La formation est répartie sur 6 semestres sur 3 ans, alternant semaines de cours et semaines en entreprise. La formation se compose de cours théoriques, travaux dirigés, travaux pratiques et projets dans les différentes matières. Durant les périodes académiques et les périodes en entreprise, la formation est structurée en Unités d'Enseignement (UE) auxquelles sont associés des crédits ECTS. La validation d'une année est conditionnée par l'obtention de 60 crédits ECTS dont des crédits obtenus en entreprise..

Pour l'obtention du diplôme, les élèves devront :

- obtenir 300 crédits ECTS ;
- justifier un niveau d'anglais certifié équivalent au niveau européen B2.

Les élèves sous statut apprenti sont fortement incités à effectuer un séjour à l'étranger soit sous la forme d'un détachement temporaire par l'entreprise, soit sous la forme d'un séjour études dans une université partenaire.

L'obtention d'un diplôme d'ingénieur ENSEEIHT, quelque soit la discipline, implique les qualités suivantes :

- Maitrise des méthodes et outils de l'ingénieur et d'un large champ disciplinaire.
- Capacité à concevoir, réaliser et valider des solutions, des méthodes,des produits, des systèmes et des services.
- Aptitude à innover, entreprendre, collecter et intégrer des savoirs et à mener des projets de recherche.
- Maitrise des enjeux de l'entreprise relatifs à son fonctionnement dans ses dimensions économique, juridique, environnementale et sociétale.
- Aptitude à s'intégrer et à travailler au sein d'une organisation multiculturelle et internationale.
- Savoir gérer sa formation et sa carrière professionnelle.

L'ingénieur INP-ENSEEIH "Informatique et Télécommunications" est un ingénieur de haut niveau technique et scientifique par la formation qu'il a suivie dans les domaines de l'informatique, des mathématiques, des télécommunications et des réseaux.

Grace au socle commun de formation, l'ingénieur INP-ENSEEIH "Informatique et Télécommunications" :

-Maitrise les principes de conception et de fonctionnement d'un ordinateur, au niveau de son architecture, de son système d'exploitation, et de ses modèles de programmation.

-Maitrise les différentes méthodes de développement logiciel, le respect du cahier des charges et de la qualité.

-Maitrise les techniques associées aux éléments d'une chaîne de communication numérique : les protocoles, la conception, le déploiement, la sécurisation et l'optimisation d'un réseau.

-Connait les mathématiques et l'algorithmique pour modéliser et résoudre des problèmes et extraire l'information pertinente des données massives structurées ou non.

-Maitrise une infrastructure informatique, les concepts et technologies internet, le développement d'une application mobile et multimédia.

-Maitrise la conception d'une architecture de réseau et les différents niveaux d'interaction des éléments la constituant.

Selon son parcours dans la spécialité, l'ingénieur INP-ENSEEIH "Informatique et Télécommunications" :

-Identifie, modélise et analyse un problème complexe, nécessitant le recours à des outils et méthodes informatiques et numériques ; propose, teste et valide ses solutions.

-Conçoit et exploite l'architecture d'un système complexe, tout en intégrant les enjeux de qualité et sécurisation du système.

-Elabore, met en oeuvre et évalue des algorithmes séquentiels ou parallèles, en vue de la résolution de problèmes de calcul scientifique, de traitement et d'analyse de données.

-Conçoit et met en oeuvre des technologies internet, réseaux et mobiles, des systèmes multimédia innovants, éventuellement distribués et interactifs.

-Conçoit, dimensionne et exploite l'infrastructure d'un réseau de communication en vue d'échanger des données de tous types.

Compétences détaillées :

-Comprendre, analyser et concevoir des systèmes de communications de la couche physique à la couche transport pour réaliser un dimensionnement système de bout-en-bout

-Analyser et concevoir une chaîne de communication numérique en développant et implémentant les algorithmes de traitement du signal nécessaires en réception et les algorithmes d'optimisation utilisés pour l'allocation de ressources afin de répondre aux exigences système

-Modéliser, concevoir et développer un réseau de communication, notamment sans fil, offrant une qualité de service adaptée aux besoins applicatifs (application aux réseaux mobiles, réseaux ad-hoc et IoT)

-Conduire des projets en respectant les contraintes du cahier des charges, en utilisant des outils appropriés, dans un cadre collaboratif et communiquer les résultats en s'adaptant au public visé

-Concevoir un système cyberphysique composé d'applications et de réseaux de communication pouvant intégrer des contraintes temps-réel et liées à la sûreté de fonctionnement pour assurer le fonctionnement fiable et performant de systèmes embarqués ou d'applications industrielles

-Programmer et configurer un système cyberphysique composé d'applications et de réseaux de communication pour assurer le déploiement de façon fiable et performante sur des architectures matérielles dédiées aux systèmes embarqués ou aux applications industrielles, tout en intégrant des contraintes temps-réel et/ou liées à la sûreté de fonctionnement

-Valider et vérifier un système cyberphysique composé d'applications et de réseaux de communication afin de certifier et assurer un niveau de sûreté de fonctionnement adapté aux systèmes embarqués ou aux applications industrielles, avec des méthodes analytiques et des méthodes de test de vérification et validation.

-Modélisation, conception et développement d'une infrastructure de communication capable de passer à une échelle de plusieurs milliards de noeuds pour répondre aux exigences de l'internet des objets

-Concevoir et réaliser des architectures de réseau-système (réseau d'entreprise, d'opérateur, de data-center, ...) dans le but d'offrir un fonctionnement robuste et perenne

-Concevoir des infrastructures système et réseau dans le but de répondre aux exigences du domaine d'application (IA, IoT, ...) en termes de performances et évolutivité

-Exploiter et modéliser des données ou des algorithmes complexes passant à l'échelle à travers l'étude de systèmes temps réels, embarqués, répartis, distribués, mobiles, hétérogènes ou par apprentissage à base de données pour construire des systèmes logiciels de confiance

-Développer des systèmes logiciels en mettant en oeuvre des méthodes et techniques rigoureuses de développement et d'analyse pour des applications et des systèmes critiques

-Construire des outils logiciels (IDE, langages, systèmes, middleware, framework, etc) et les processus et méthodes associés nécessaires au développement de systèmes logiciels, matériels ou hybrides

-Traiter et analyser des contenus visuels, sensoriels et/ou temporels pour extraire des informations pertinentes à partir d'images, d'objets 3D, audio ou vidéo en mettant en oeuvre des méthodes d'optimisation et/ou d'apprentissage, ou des outils d'aide à la décision

Concevoir des systèmes multimédia interactifs (son, image, environnement 3D) pour envisager des applications immersives ou autonomes, en tenant compte de contraintes de temps réel et de passage à l'échelle

-Synthétiser des réalités mixtes (réalité augmentée, virtuelle, diminuée) pour interagir de façon efficace et avisée avec des mondes réels ou virtuels 2D, 3D en implémentant des algorithmes sur des architectures matérielles et logicielles

-Développer et optimiser des codes de calcul intensif, robustes et fiables, en exploitant les architectures modernes (CPU, GPU, multi-coeurs, multi-processeurs à mémoire distribuée et/ou partagée, ...), pour adresser les challenges de l'exa-scale computing, du green-computing

-Implémenter des méthodes mathématiques pour concevoir des outils pour la simulation numérique ou le contrôle de systèmes, exploités par des spécialistes métiers dans des contextes variés (ondes, mécanique des fluides ou des structures, finance, spatial, biologie, commande des systèmes, automates, ...)

-Analyser et traiter des données, potentiellement massives et liées, par des méthodes statistiques ou déterministes, dans le but de prédire ou d'expliquer des événements

--Concevoir et analyser des systèmes, en particulier d'exploitation, et des logiciels sécurisés par des méthodes et techniques préventives et palliatives pour des applications et standards en ingénierie système

Concevoir et déployer des systèmes de communications par des méthodes et techniques préventives et palliatives pour des réseaux filaires ou non filaires sécurisés

-Élaborer et sécuriser des architectures matérielles avec des déploiements sur différents supports (processeurs, calculateurs embarqués, antennes, téléphones) en mettant en oeuvre des méthodes et techniques préventives et palliatives pour les adapter à des applications en ingénierie et transport

-Développer sa réflexivité, en particulier la connaissance de soi, prototyper sur les principes de design thinking dans un cycle vertueux. Evaluer son bien-être, physique, mental et social, à gérer ses émotions et celles des autres, à être résilient et persévérer pour atteindre des objectifs d'un projet dans un contexte volatile, incertain, complexe, ambigu (VUCA), veiller au bien-être (physique, mental, social) et à l'épanouissement de ses collaborateurs et de soi-même.

-Construire son réseau professionnel via des outils et des techniques de branding personnel et de e-réputation, pour se représenter et représenter la profession d'ingénieur en tant qu'ambassadeur, faire rayonner auprès de publics divers le rôle et la fonction de l'ingénieur.e dans le respect de l'éthique, de la multiculturalité, de la diversité, du développement durable et de la responsabilité sociétale.

-Faire preuve de créativité et d'innovation, d'esprit d'entreprise, d'ouverture d'esprit, de conscience critique, de sens des responsabilités, d'engagement, pour développer des solutions respectueuses des transitions sociales et environnementales.

Training content

L'organisation des études sous statut apprenti (FISA) repose sur le principe de l'alternance école/entreprise. Le volume est d'environ 21 semaines de présence à l'école par année académique, avec un rythme d'alternance différent suivant l'année d'étude.

Organization

Ingénieur ENSEEIHT par l'apprentissage Informatique et Télécommunication 1ère Année
Ingénieur ENSEEIHT par l'apprentissage Informatique et Télécommunications 2ème année
Ingénieur ENSEEIHT par l'apprentissage Informatique et Télécommunications 3ème année

Access conditions

Selon les termes de son règlement, fixé chaque année en accord avec le Ministère chargé de l'éducation nationale, l'ENSEEIHТ recrute environ 380 élèves par an sous statut étudiant (dont 170 environ dans la spécialisation Informatique et Télécommunications), 60 sous statut apprenti dont 20 dans la spécialisation Informatique et Télécommunications.

Les élèves recrutés sont issus d'un concours sur titres. L'accès est autorisé à des étudiants titulaires d'un DUT (Diplôme Universitaire Technologique) ou d'un BTS (Brevet de Technicien Supérieur).

Organizational unit

École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications

Places

Toulouse

Administrative contact(s)

n7@enseeiht.fr

Ingénieur ENSEEIHT par l'apprentissage Informatique et Télécommunication 1ère Année

MORE INFO

ECTS credits : 60

Organization

· Année 1A SN-FISA

· Semestre 5-1A SN-FISA

Person(s) in charge
HURAULT AURELIE

· Teaching Unit SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S5-FISA

Person(s) in charge
HULL ALEXANDRA

· Subject Careers and Management 1

Person(s) in charge
CASEY GENEVIEVE

· Subject Careers and Management 2

Person(s) in charge
CASEY GENEVIEVE

· Subject Anglais Professionnel-S5-App

· Teaching Unit BASES DES RESEAUX

Person(s) in charge
CHAPUT EMMANUEL

· Subject Introduction aux réseaux d'entreprise

Person(s) in charge
CHAPUT EMMANUEL

- Subject Protocoles de l'Internet

Person(s) in charge
FASSON JULIEN

- Subject Mise en place d'un réseau d'entreprise

Person(s) in charge
FASSON JULIEN

- Teaching Unit METHODOLOGIE DE LA PROGRAMMATION

Person(s) in charge
AIT AMEUR YAMINE

- Subject Méthodologie de la programmation

Person(s) in charge
AIT AMEUR YAMINE

- Subject Projet Méthodologie de la programmation

Person(s) in charge
AIT AMEUR YAMINE

- Teaching Unit OUTILS D'INGENIERIE 1

Person(s) in charge
HURALT AURELIE

- Subject Probabilités

Person(s) in charge
COULON MARTIAL

- Subject Théorie des graphes

- Subject Logique, Preuve de programme, Induction

Person(s) in charge
THIRIOUX XAVIER

- Subject Automates

Objectives

Understanding finite state automata and their relation to regular expressions

Description

Notion on computer languages. Definition of finite state automata. Use for system modeling. Non-determinism, determinism, minimization. Relationship with regular expressions.

Person(s) in charge
HURALT AURELIE

- Subject Math-Remise à Niveau

Person(s) in charge
CHARVILLAT VINCENT

- Teaching Unit ARCHITECTURES DES ORDINATEURS

Person(s) in charge
BUISSON JEAN CHRISTOPHE

- Subject Architecture des Ordinateurs

Person(s) in charge
BUISSON JEAN CHRISTOPHE

- Subject Projet Architecture des Ordinateurs

Person(s) in charge
BUISSON JEAN CHRISTOPHE

- Teaching Unit ENTREPRISE -Semestre 5 FISA

- Semestre 6-1A SN-FISA

Person(s) in charge
HURALT AURELIE

- Teaching Unit SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S6-FISA

Person(s) in charge
HULL ALEXANDRA

- Subject Anglais Professionnel-S6-FISA

- Careers and Management

Choice: 1 Among 1 :

- Subject Careers and Management 1-Leadership

Person(s) in charge
CASEY GENEVIEVE

- Subject Careers and Management 2- Entrepreneurship

Person(s) in charge
CASEY GENEVIEVE

- Subject Careers and Management 3- Citizenship

Person(s) in charge
CASEY GENEVIEVE

- Teaching Unit RESEAUX OPERES

Person(s) in charge
BEYLOT ANDRE LUC

- Subject Réseaux Longue distance

Person(s) in charge
BEYLOT ANDRE LUC

- Subject Introduction aux réseaux téléphoniques

Person(s) in charge
BEYLOT ANDRE LUC

- Teaching Unit TECHNOLOGIE OBJET

Person(s) in charge
CREGUT XAVIER

- Subject Conception et Programmation objet en Java

Objectives

To learn object-oriented programming using UML and Java languages.

Description

Main concepts of object-oriented programming are taught: modularity (class, object, fields, methods, constructors, visibility, etc.), abstraction (interfaces, inheritance, abstract classes, static and dynamic binding, etc.), genericity, exceptions, collections, design patterns, event programming (through graphical user interface programming), unit tests.

A project is done using the SCRUM method (from « Project Management » module) with team of 5 to 7 students on a topic they choose at the beginning on the project.

Person(s) in charge
CREGUT XAVIER

Bibliography

- B. Eckel, Thinking in Java. Prentice-Hall, 3 ed., 2002.
- J. Gosling, B. Joy, G. Steele, and G. Bracha, The Java Language Specification. Addison-Wesley, 3 ed., Mar. 2005. <http://java.sun.com/docs/books/jls/>
- B. Meyer, Object-oriented software construction. Prentice Hall, 2 nd ed., 1997.
- M. Fowler, UML 2.0. CampusPress Référence, 2004.

- Subject Génie Logiciel Appliqué

Person(s) in charge
HURAUULT AURELIE

- Teaching Unit SYSTEMES CENTRALISES

Person(s) in charge
QUEINNEC PHILIPPE

- Subject Systèmes Centralisés 1

Person(s) in charge
QUEINNEC PHILIPPE

- Subject Systèmes Centralisés 2

Person(s) in charge
AMESTOY PATRICK

- Teaching Unit ENTREPRISE -Semestre 6 FISA

- Subject Période Entreprise 1

- Subject Période Entreprise 2

- Teaching Unit OUTILS D'INGENIERIE-2

Person(s) in charge
JAKLLARI GENTIAN

- Subject Théorie des graphes

Objectives

Découvrir et maîtriser quelques apports notoires de la théorie des graphes au travers de méthodes de résolution de familles classiques de problèmes.

Description

- Recherche de chemins de longueur optimale : méthodes de MOORE-DIJKSTRA et de FORD.
- Applications : Réseaux PERT.
- Recherche de parcours hamiltoniens : méthodes de KAUFMANN/MALGRANGE et DEMOUCRON
- Application : voyageur de commerce. Recherche de mots optimaux : méthode de FORD-FULKERSON.
- Recherche de parcours eulériens : méthode d' EULER. Problèmes d'affectation : méthode hongroise.
- Arbres, arborescences, cycles et co-cycles. Théorème du nombre cyclomatique.
- Recherche d'arbres de poids optimaux : méthode de KRUSKAL.
- Graphes planaires.

Person(s) in charge
JAKLLARI GENTIAN

- Subject Automates

Objectives

Comprendre les automates à états finis et leurs extensions, en particulier dans leur utilisation pour modéliser des systèmes.

Description

- Notion sur les langages en informatique.
- Définition des automates à états finis.
- Utilisation pour la modélisation de systèmes (résolution de problèmes, architecture, IHM, réseau, synchronisation...).
- Non-déterminisme, détermination, minimisation.
- Relation avec les expressions régulières.

Person(s) in charge
OUEDERNI MERIEM

- Subject Base de données

Objectives

L'objectif de ce cours est d'introduire les concepts nécessaires pour la définition et l'implémentation d'une base de données. Ce cours est complété par des TP permettant de se familiariser avec Oracle et JDBC.

Description

- Introduction aux systèmes de gestion de base de données.
- Architecture d'une base de données. Fonctionnalités des systèmes de gestion de base de données.
- Le modèle entité-association : classes d'entités, classes de liaisons.
- Le modèle de données relationnel : définition, langages de définition et de manipulation de données (Algèbre Relationnelle, SQL) .
- Processus de normalisation : dépendances fonctionnelles, dépendances multi- valuées, formes normales.
- Le modèle objet : définition et langage de manipulation.
- Techniques d'implémentation : Organisation physique des données.
- Transactions, reprise et contrôle des accès concurrents. Confidentialité, contraintes d'intégrité.

Person(s) in charge
AIT AMEUR YAMINE

Organizational unit

École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications

Ingénieur ENSEEIHT par l'apprentissage Informatique et Télécommunications 2ème année

MORE INFO

ECTS credits : 60

Organization

· Année 2A Informatique et Télécommunication (SN)-FISA

· Semestre 7-2A Informatique et Télécommunication (SN)-FISA

· Teaching Unit SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S7-FISA

Person(s) in charge
HULL ALEXANDRA

· Subject Anglais Professionnel-S7-App

· Subject Careers and Management 1- App Sem7

Person(s) in charge
CASEY GENEVIEVE

· Subject Careers and Management 2- APP Sem7

Person(s) in charge
CASEY GENEVIEVE

· Teaching Unit RESEAUX

Person(s) in charge
DHAOU RIADH

· Subject Evaluation de Performances des Réseaux

Person(s) in charge
DHAOU RIADH

- Subject Projet Evaluation de performances des réseaux

Person(s) in charge
DHAOU RIADH

- Subject Réseaux opérés avancés

Person(s) in charge
CHAPUT EMMANUEL

- Teaching Unit PROCOLES INTERNET ET RESEAUX LOCAUX

Person(s) in charge
FASSON JULIEN

- Subject Protocoles Avancés de l'internet

Person(s) in charge
FASSON JULIEN

- Subject Architecture des Réseaux Locaux

Person(s) in charge
PAILLASSA BEATRICE

- Teaching Unit OUTILS MATHEMATIQUES POUR L'INGENIEUR

Person(s) in charge
CHARVILLAT VINCENT

- Subject Statistiques

Person(s) in charge
CHARVILLAT VINCENT

- Subject Recherche Opérationnelle

Person(s) in charge
DUROU JEAN DENIS

- Teaching Unit ENTREPRISE -Semestre 7 FISA

- Subject Entreprise

- Teaching Unit Systèmes Concurrents et Applications Internet

Person(s) in charge
MAURAN PHILIPPE

- Subject Systèmes Concurrents

Person(s) in charge
MAURAN PHILIPPE

- Subject Applications Internet

Person(s) in charge
BUISSON JEAN CHRISTOPHE

- Semestre 8-2A Informatique et Télécommunication (SN)-FISA

- Teaching Unit SCIENCES HUMAINES SOCIALES ET JURIDIQUES-S8-FISA

Person(s) in charge
HULL ALEXANDRA

- Subject Anglais Professionnel-S8-App

- Careers and Management- APP Semestre 8

Person(s) in charge
CASEY GENEVIEVE

Choice: 1 Among 1 :

- Subject Careers and Management-Leadership

Person(s) in charge
CASEY GENEVIEVE

- Subject Careers and Management- Entrepreneurship

Person(s) in charge
CASEY GENEVIEVE

- Subject Careers and Management - Citizenship

Person(s) in charge

- Teaching Unit ARCHITECTURE DES RESEAUX

Person(s) in charge
FRABOUL CHRISTIAN

- Subject Architecture des réseaux

Person(s) in charge
FASSON JULIEN

- Subject Interconnexion des Systèmes

Person(s) in charge
BEYLOT ANDRE LUC

- Subject Réseaux d'Opérateurs mobiles/Sans Fils

Person(s) in charge
JAKLLARI GENTIAN

- Teaching Unit METHODES FORMELLES

Person(s) in charge
HURALT AURELIE

- Subject Systèmes de transition

Person(s) in charge
THIRIOUX XAVIER

- Subject Traduction des Langages

Objectives

The student must master the various stages of language translation: lexical analysis, syntactic analysis and semantic analysis. In the particular case of the compilation, he must know four phases of the semantic analysis: the resolution of the identifiers thanks to a table of symbols, the typing, the memory placement of the variables and the code generation. The student will create a compiler that will take in input a sub-part of C language, and produce code for an abstract stack machine. The compiler will itself be written in Java using XText.

Person(s) in charge
HURALT AURELIE

- Subject Sécurité

Person(s) in charge
BONNETAIN PIERRE YVES

- Subject Ingénierie Dirigée par les Modèles

Person(s) in charge
DIEUMEGARD ARNAUD

- Teaching Unit INTERGICIELS ET SECURITE

Person(s) in charge
QUEINNEC PHILIPPE

- Subject Intergiciels

Person(s) in charge
QUEINNEC PHILIPPE

- Subject Projet Système-Intergiciel

Person(s) in charge
QUEINNEC PHILIPPE

- Teaching Unit ENTREPRISE -Semestre 8 FISA

Organizational unit

École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications

Ingénieur ENSEEIHT par l'apprentissage Informatique et Télécommunications 3ème année

MORE INFO

ECTS credits : 60

Organization

· 3ème Année-SN-FISA

· Choix de Parc. Semestre 10 - 3A Info. et Télécom(SN)

Choice: 1 Among 1 :

· Semestre 10 à l'N7 3A Informatique et télécommunication (SN)

Choice: 1 Among 1 :

· Teaching Unit PROJET DE FIN D'ETUDE-SN SANS PL

· Teaching Unit PFE SN avec PL

· Choix de Parc. Semestre 9 - 3A Info. et Télécom(SN)

Choice: 1 Among 2 :

· Semestre 9 SN Parcours HPC et Big Data

Person(s) in charge
GRATTON SERGE

· Teaching Unit SOFT AND HUMAN SKILLS

Person(s) in charge
HULL ALEXANDRA

· Subject Professional English-LV1-Semestre 9

· Subject Anglais Scientifique

- Choix 2 Anglais Professionnel - 3A

Choice: 1 Among 1 :

- Subject Anglais Clinique

- Subject Anglais de Cambridge ou Projet

- Subject Careers, Leadership & Management-S9

Choice: 2 Among 3 :

- Subject Conduite d'opération en hydraulique (MF2E)

Objectives

Give future engineers the notions and tools to be operational in project management, here applied to hydraulic engineering.

Description

- Project manager & company manager".

Role of each stakeholder. Regulatory files: authorization file, nomenclature of the law on water, relationship with the services of the Administration (DREAL, DDT, AFB ...). Schedule of operation.

- "The standardized missions of the project manager".

APS, AVP, PRO, DCE, VISA, DET, OPR.

- "Business Consultation "

Constitution of technical documents for consultation (CCTP, BP, DQE). Presentation of the repositories

(Eurocodes, fascicles, standards, GTR).

Person(s) in charge

LAUVERGNIER FRANCOIS

- Subject Controverses dans un monde en transition (MF2E)

- Subject RSE (MF2E)

- Subject IT and Computer Law (SN)

- Subject Strategic and Critical Thinking (SN)

- Subject Bureau d'Etudes Industrielles (BEI/BEE)/Conférence

- Teaching Unit SYSTEMES REPARTIS ET SECURITE

Person(s) in charge
QUEINNEC PHILIPPE

- Subject Syst.èmes et algorithmes répartis

Pre-requisites

A practical programming experience and fundamental knowledge about operating systems, parallel computing, middlewares and networks are required. Basic knowledge of formal methods such (temporal) logic and transitions systems are also worthwhile.

Objectives

This class aims at providing a state of the art about principles of distributed computing and some examples of their application through distributed services : distributed file systems, dependable systems, distributed replicated memories, distributed transactional systems, etc

Description

Principles and concepts of distributed computing are described and their use in distributed systems. After a short introduction, the standard model of distributed computing based upon the causality relation is pointed out. Then, a survey of generic distributed algorithms is performed : datation, causally ordered and atomic protocols, mutual exclusion, consensus, termination, global snapshots and checkpointing, memory consistency, etc

Some distributed system examples are especially emphasized : distributed file systems (NFS, AFS), atomic multicast protocols (Ensemble, Java Groups, etc), distributed memories and their various consistency semantics, distributed simulation (HLA standard), etc

Current trends and/or more specific applications close this survey of distributed computing foundations : peer-to-peer computing, sensor networks, mobility, ambient systems, etc

Number of hours

10 lectures of 1h45

Person(s) in charge
QUEINNEC PHILIPPE

Bibliography

Ajay D. Kshemkalyani and Mukesh Singhal, Distributed Computing : Principles, Algorithms and Systems, Cambridge University Press, 2008

Pradeep K. Sinha, Distributed Operating Systems, Concepts and Design, IEEE Press, 1997

Georges Coulouris, Jean Dollimore and Tim Kindberg, Distributed Systems, Concepts and Design, , 4ième Edition, Addison-Wesley, 2005.

Andrew S. Tanenbaum and Maarten van Steen, Distributed Systems, Principles and Paradigms, Seconde Edition, Prentice Hall, 2006.

- Subject Calcul réparti et grid computing

Pre-requisites

Computer architecture, operating system and synchronisation mechanisms, programming

Objectives

Programming and algorithmic issues for large scale parallel computers (hundreds to hundred thousands of core) are addressed in this lecture

Description

This module begins with a general introduction to high performance computing and programming where the general concepts used in the design of high performance computers (from multicore cache based memory computers to large clusters of nodes) are described along with the main issues related to efficient high performance programming (from sequential code optimization techniques up to shared memory parallel programming and distributed computing). Afterward, notions on architecture and execution modeling of a parallel program are provided aiming at accurate performance prediction. The notions of speed-up, isoefficiency, scalability are also introduced at this moment. The module is concluded with some brief concepts of Grid computing and the related issues.

The module consists of nine lectures of two hours each and 2 to 4 hours of supervised lab during which students experience distributed memory computing in a message passing environment. PVM ("Parallel Virtual Machine") and XPVM (interactive trace analysis) are used to develop and validate a relatively simple application such as the iterative block Jacobi method for the solution of banded linear systems of equations. At the end of the lab sessions the students are asked to design and develop a distributed memory dynamic scheduler to automatically adapt the distribution of the parallel tasks of this application to the load of the nodes of the target computer.

Person(s) in charge
BUTTARI ALFREDO

- Subject Sécurité et informatique légale

Pre-requisites

Basic notions of operating systems and architecture.

Objectives

The class is related to security of information systems. It addresses the basic notions of security and risk analysis and the deployment of security policies in information system.

Number of hours

9 lectures of 1h45

Person(s) in charge

BONNETAIN PIERRE YVES

- Teaching Unit ADVANCED STATISTICAL MACHINE LEARNING**Pre-requisites**

- R & Python, Statistics

Objectives

By the end of this module, the student will have understood and be able to explain (main concepts) how to use deep learning methods for high dimensional classification and / or linear and nonlinear statistical methods

At the end of this module, the student should be able to:

- * Adapt learning methods for the classification and regression of large data such as media or images
- * optimize different models to compare them and finally select the most efficient method on the available data.
- * Implement high dimensional deep learning methods on real data sets with Python libraries.

Description

The main topic of the course is learning methods, including statistical learning and deep neural networks, for processing large-dimensional media, such as images. Depending on the options open, the following topics will be covered:

- statistical learning, regression and classification - Linear models - GAM - Decision trees - Model aggregation methods (Bagging, Random forests, Boosting) - Vector-based machines
- Neural networks and introduction to deep learning: definition of neural networks, activation functions, multilayer perceptron, backpropagation algorithms, optimization algorithms, regularization
- Convolutional neural networks (applications to image classification, object detection), recurrent neural networks (sequence modeling, backpropagation in time), neural networks for 3D processing
- Supervised and unsupervised learning
- Implementation on large real data with Python and / or R libraries.

Person(s) in charge

LAVEAU PASCAL

Bibliography

- Goodfellow I., Bengio Y., Courville A. "Deep Learning", MIT Press
- Hastie, T. Tibshirani, R., Friedman, J. "The elements of statistical learning", Springer, 2001
- Chollet, F. "Deep Learning with Python", Manning Publications, 2018
- G.James & al., "An introduction to statistical learning", Springer
- T.Hastie & al. , "The elements of statistical learning", Springer

- Subject Statistique exploratoire multi modèle**Pre-requisites**

- R & Python, inferential statistics, gaussian linear model, logistic regression

Objectives

- With the explosion of big data problems statistical learning has become a very hot field. In this course, many linear and non-linear statistical methods are discussed and practiced. Teaching is resolutely focused on practice with R or Python practical works for each method (20% theory, 80% practice).
- Students will be able to optimize each model to compare them and ultimately select the most efficient method on the available data.

Description

- Lesson + practical work for each part :

Introduction : statistical learning, regression & classification – Linear models - GAM – Decision trees – Model aggregation methods (Bagging, Random forests, Boosting) – Support Vector Machines – Neural Networks & Deep Learning

Person(s) in charge

LAVEAU PASCAL

Bibliography

- An introduction to statistical learning, G.James & al., Springer
- The elements of statistical learning, T.Hastie & al., Springer
- <https://cran.r-project.org/>

- Subject Projet Big Data

- Teaching Unit HIGH PERFORMANCE SCIENTIFIC COMPUTING

Pre-requisites

Applied mathematics ; Basic optimization ; Programming,

Objectives

The aim of this course is to describe up-to-date techniques for the solution of large linear systems on parallel computers. It also introduce duality theory that is a key ingredient in many linear programming solution methods.

Description

This course begins with lectures that present parallel algorithms to solve linear systems arising from partial differential equations on parallel computers. The solution methods depend on the discretization technique that is used : the finite difference and finite element approaches are considered. A special emphasis will be put on the solution of time dependent problems by implicit technique, where scalability for massively parallel computations is reached using suitable mesh partitioning techniques. The course continues with lectures on direct solution methods for sparse linear systems. The objective of these lectures is to provide students with the basic theory behind the factorization of sparse matrices as well as the issues related to the implementation of a sparse, direct solver on modern, parallel computing architectures. Specifically the message will focus on the cost and efficiency of the involved basic linear algebra operations, the issues related to memory consumption, the exploitation of parallelism and concurrency as well as some aspects of numerical stability.

Person(s) in charge

BUTTARI ALFREDO

Bibliography

D. Bader, ed., Petascale Computing : Algorithms and Applications, Chapman & Hall/CRC, 2007.

- Subject Algèbre linéaire creuse

Person(s) in charge
AMESTOY PATRICK

- Subject Méthodes itératives en algèbre linéaire

Person(s) in charge
GUIVARCH RONAN

- Subject Optimisation discrète

Person(s) in charge
DURAND NICOLAS
CAFIERI SONIA

- Teaching Unit INVERSE PROBLEMS

Pre-requisites

Optimization, notion of probability and statistics, numerical linear algebra

Objectives

The objectives of this course is to learn and understand various way to solve inverse problems. Depending on the student's area, applications will be oriented toward photographic 3D-reconstruction methods or numerical problems with uncertainty. In the first, case, the problem is to obtain a 3D model of a scene i.e., its shape and its colour. In the second case, the main filtering methods based on the non-linear Bayesian filters (particle filter, Kalman filter, extended Kalman filter, ensemble Kalman filter) will be studied. For a given ODE/SDE, students have to identify the corresponding notion of integration, then should be able to propose an adapted filtering method.

Description

The content is twofold, with a focus on the student's preferred area:

- Filtering methods

- Introduction to filtering : Bayesian inference ; Filtering and smoothing principles, non-linear filtering ; Application to the linear and Gaussian case: Kalman filter.

- Uncertainty dynamics for ordinary differential equations (ODE) and stochastic differential equations (SDE): from partial differential equation to ODE (numerical schemes); Lyapunov exponent and chaotic system; stochastic processes; discrete/continuous Markov processes; Observable/measurement dynamics duality

- Stochastic filtering: Particle filter; Ensemble Kalman filter; Stochastic smoother

Person(s) in charge
GRATTON SERGE

Bibliography

Jazwinski, A. Stochastic Processes and Filtering Theory Academic Press, 1970

Oksendal, Stochastic differential equations Springer, 2003.

- Subject Assimilation de données

Pre-requisites

Applied mathematics ; Linear algebra ; Optimization; Statistics

Objectives

This course provides theoretical and practical background on stochastic filtering and modelling and explore the connections between Bayesian approaches and Machine Learning

Targeted skills

Being able to model a practical forecasting problem into a mathematical framework

Apply the expressions for the estimation using dual or primal approaches

Perform a uncertainty quantification using the representation of DA as propagation of probability density function

Develop a software for variational and ensemble Data Assimilation

Develop a software to perform prediction with recurrent networks

Description

The course reminds basics on data assimilation for dynamical system of finite dimension, based on the Bayesian formalism in order to introduce the non-linear filtering and its particle implementation. The Kalman filter is presented as a particular solution, and it is compared with the particle filter by considering the geometrical interpretation of the curse of the dimensionality. The connection between Bayesian DA and recurrent network will be presented

Person(s) in charge

GRATTON SERGE

Bibliography

G. Pavliotis and A. Stuart, Multiscale Methods: Averaging and Homogenization. Springer, 2008.

D. J. Higham, "An Algorithmic Introduction to Numerical Simulation of Stochastic Differential Equations," SIAM REVIEW, vol. 43, pp. 525–546, 2001.

Oksendal, Stochastic differential equations. Springer, 2003.

A. Jazwinski, Stochastic Processes and Filtering Theory. Dover Publications, 2007, p. 400.

- Subject Filtrage Stochastique

Pre-requisites

Applied mathematics ; Programming in Python ; Numerical solution of PDEs

Objectives

This course provides theoretical and practical background on stochastic filtering and modelling

Description

The forecast step for Markov processes is described in the deterministic and the stochastic frameworks following a similar approach: the dynamics of the uncertainty is deduced from the semi-group acting on observable functions, that leads to the equation of Liouville (deterministic) or Fokker-Planck (stochastic) by duality. Ensemble prediction is then introduced and justified from the weak interpretation of the uncertainty dynamics. The Itô calculus is first introduced from numerical experiments (Itô formula, integration of stochastic differential equation, weak/strong convergence of numerical schemes) and from integral path

leading to the continuous limit of the discret 4DVar cost function. The Stratonovitch and Itô integrals are compared for their use in stochastic modelling of a timely correlated/decorrelated multiplicative noise. Infinite dimensional system will be considered in the deterministic case.

Person(s) in charge
PANNEKOUCKE OLIVIER

Bibliography

G. Pavliotis and A. Stuart, Multiscale Methods: Averaging and Homogenization. Springer, 2008.

D. J. Higham, "An Algorithmic Introduction to Numerical Simulation of Stochastic Differential Equations," SIAM REVIEW, vol. 43, pp. 525–546, 2001.

Oksendal, Stochastic differential equations. Springer, 2003.

A. Jazwinski, Stochastic Processes and Filtering Theory. Dover Publications, 2007, p. 400.

- Subject Analyse bayésienne

Person(s) in charge
LAVEAU PASCAL

- Teaching Unit UE A CHOIX SELON FINALITE

Choice: 1 Among 2 :

- Subject Complex Graph Networks

Person(s) in charge
GERGAUD JOSEPH

- Subject Cybersecurity : introduction and practice

Person(s) in charge
MORGAN BENOIT

- Subject Infrastructure for cloud, big data and machine learning

Person(s) in charge
HAGIMONT DANIEL

- Subject Infrastructure for BigData

Person(s) in charge
ROUX HELENE

- Subject Compression et Multimédia

Person(s) in charge
CHARVILLAT VINCENT
POULLIAT CHARLY

- Subject Projet USRP par SILICOM

Person(s) in charge
COULON MARTIAL

- Subject Data analysis 2 and classification

Person(s) in charge
MOUYSET SANDRINE

- Subject Introduction à la Mécanique quantique pour le calcul

Person(s) in charge
ROUX HELENE

- Semestre 9 SN Parcours Systèmes Embarqués et IoT Critique

Person(s) in charge
JAFFRES-RUNSER KATIA

- Teaching Unit SOFT AND HUMAN SKILLS

Person(s) in charge
HULL ALEXANDRA

- Subject Professional English-LV1-Semestre 9

- Subject Anglais Scientifique

- Choix 2 Anglais Professionnel - 3A

Choice: 1 Among 1 :

- Subject Anglais Clinique

- Subject Anglais de Cambridge ou Projet

- Subject Careers, Leadership & Management-S9

Choice: 2 Among 3 :

- Subject Conduite d'opération en hydraulique (MF2E)

Objectives

Give future engineers the notions and tools to be operational in project management, here applied to hydraulic engineering.

Description

- Project manager & company manager".

Role of each stakeholder. Regulatory files: authorization file, nomenclature of the law on water, relationship with the services of the Administration (DREAL, DDT, AFB ...). Schedule of operation.

- "The standardized missions of the project manager".

APS, AVP, PRO, DCE, VISA, DET, OPR.

- "Business Consultation "

Constitution of technical documents for consultation (CCTP, BP, DQE). Presentation of the repositories (Eurocodes, fascicles, standards, GTR).

Person(s) in charge

LAUVERGNIER FRANCOIS

· **Subject Controverses dans un monde en transition (MF2E)**

· **Subject RSE (MF2E)**

· **Subject IT and Computer Law (SN)**

· **Subject Strategic and Critical Thinking (SN)**

· **Subject Bureau d'Etudes Industrielles (BEI/BEE)/Conférence**

· **Teaching Unit SYSTEMES TEMPS REELS (STR)**

Person(s) in charge
ERMONT JEROME

· **Subject Systèmes et Ordonnancement Temps Réel**

Person(s) in charge
ERMONT JEROME

· **Subject Langage pour le Temps Réel**

Person(s) in charge

PAGETTI CLAIRE

- Subject Participation Concours

Person(s) in charge
JAFFRES-RUNSER KATIA

- Teaching Unit RESEAUX EMBARQUES (REM)

Person(s) in charge
SCHARBARG JEAN LUC

- Subject Bus de terrain

Person(s) in charge
SCHARBARG JEAN LUC

- Subject Ethernet Temps Réel

Person(s) in charge
SCHARBARG JEAN LUC

- Subject Déploiement Réseaux Temps Réel

Person(s) in charge
ERMONT JEROME

- Teaching Unit IoT INDUSTRIEL USINE DU FUTUR (IIOT)

Person(s) in charge
JAFFRES-RUNSER KATIA

- Subject Domaine d'Application de l'IoT Critique

Person(s) in charge
JAFFRES-RUNSER KATIA

- Subject Usine du Futur

Person(s) in charge
JAFFRES-RUNSER KATIA

- Subject Protocoles Sans Fil pour IoT Industriel

Person(s) in charge
JAFFRES-RUNSER KATIA

- Subject Synchronisation pour l'IoT Industriel

Person(s) in charge
JAFFRES-RUNSER KATIA

- Teaching Unit UE A CHOIX SELON FINALITE

Choice: 1 Among 2 :

- Subject Complex Graph Networks

Person(s) in charge
GERGAUD JOSEPH

- Subject Cybersecurity : introduction and practice

Person(s) in charge
MORGAN BENOIT

- Subject Infrastructure for cloud, big data and machine learning

Person(s) in charge
HAGIMONT DANIEL

- Subject Infrastructure for BigData

Person(s) in charge
ROUX HELENE

- Subject Compression et Multimédia

Person(s) in charge
CHARVILLAT VINCENT
POULLIAT CHARLY

- Subject Projet USRP par SILICOM

Person(s) in charge
COULON MARTIAL

- Subject Data analysis 2 and classification

Person(s) in charge
MOUYSSSET SANDRINE

- Subject Introduction à la Mécanique quantique pour le calcul

Person(s) in charge

ROUX HELENE

- Teaching Unit VALIDATION DES SYSTEMES

Person(s) in charge
SCHARBARG JEAN LUC

- Subject Langages de spécialisation de systèmes

Person(s) in charge
BOYER MARC

- Subject Sûreté de fonctionnement

Person(s) in charge
PAGETTI CLAIRE

- Subject Technique de validation

Person(s) in charge
SCHARBARG JEAN LUC

- Subject Bus tolérants aux pannes

Person(s) in charge
PAGETTI CLAIRE

- Semestre 9 SN Parcours Infrastructure Big-Data et IoT

Objectives

Design and implementation of the communication, storage, and computing infrastructure for the Internet of Things and Big Data.

Targeted skills

Modeling, designing, and deploying a communication infrastructure capable of scaling up to several billion nodes to meet the requirements of the Internet of Things and the Big Data.

Designing and implementing network-system architectures (enterprise networks, operator networks, data-centers, ...) to enable robust and sustainable operations.

Designing system and network infrastructures capable of meeting the requirements of the application domain (AI, IoT, ...) in terms of performance and scalability.

Person(s) in charge
JAKLLARI GENTIAN

- Teaching Unit SOFT AND HUMAN SKILLS

Person(s) in charge
HULL ALEXANDRA

- Subject Professional English-LV1-Semestre 9

- Subject Anglais Scientifique

- Choix 2 Anglais Professionnel - 3A

Choice: 1 Among 1 :

- Subject Anglais Clinique

- Subject Anglais de Cambridge ou Projet

- Subject Careers, Leadership & Management-S9

Choice: 2 Among 3 :

- Subject Conduite d'opération en hydraulique (MF2E)

Objectives

Give future engineers the notions and tools to be operational in project management, here applied to hydraulic engineering.

Description

- Project manager & company manager".

Role of each stakeholder. Regulatory files: authorization file, nomenclature of the law on water, relationship with the services of the Administration (DREAL, DDT, AFB ...). Schedule of operation.

- "The standardized missions of the project manager".

APS, AVP, PRO, DCE, VISA, DET, OPR.

- "Business Consultation "

Constitution of technical documents for consultation (CCTP, BP, DQE). Presentation of the repositories

(Eurocodes, fascicles, standards, GTR).

Person(s) in charge
LAUVERGNIER FRANCOIS

- **Subject Controverses dans un monde en transition (MF2E)**

- **Subject RSE (MF2E)**

- **Subject IT and Computer Law (SN)**

- **Subject Strategic and Critical Thinking (SN)**

- **Subject Bureau d'Etudes Industrielles (BEI/BEE)/Conférence**

- **Teaching Unit RESEAUX POUR IOT**

Objectives

Understanding the challenges involved in connecting objects (the things in the Internet of Things) to the Internet.

Understanding the main IoT access network architectures, including Low Power Wide Area Networks (LPWAN), cellular networks, and Wireless Personal Area Networks (WPAN).

Provide a critical analysis of the standardized solutions for each of the main IoT access network architectures.

Targeted skills

Be capable of designing, evaluating, and implementing an IoT access network that takes into account the requirements of a specific IoT use case or application.

Person(s) in charge
JAKLLARI GENTIAN

- **Subject Introduction de IoT et SG**

Person(s) in charge
JAKLLARI GENTIAN

- **Subject IoT Cellular architectures**

Person(s) in charge
BEYLOT ANDRE LUC

- **Subject WPAN/LPWAN IoT Archi.**

Person(s) in charge
JAKLLARI GENTIAN

- **Subject IoT Interconnection**

Person(s) in charge
CHAPUT EMMANUEL

- Teaching Unit INFRASTRUCTURE BIG DATA/IA

Person(s) in charge
HAGIMONT DANIEL

- Subject Infrastructure Cloud

Person(s) in charge
HAGIMONT DANIEL

- Subject Infrastructure Big data

Person(s) in charge
HAGIMONT DANIEL

- Subject Projet Infrastructure

- Teaching Unit RESEAUX D'OPERATEURS

Person(s) in charge
CHAPUT EMMANUEL

- Subject Réseaux d'accès

Person(s) in charge
DHAOU RIADH

- Subject Réseaux de coeurs

Person(s) in charge
BEYLOT ANDRE LUC

- Subject Réseaux métropolitains

Person(s) in charge
CHAPUT EMMANUEL

- Subject Interconnexion

Person(s) in charge
CHAPUT EMMANUEL

- Subject Métrologie

Person(s) in charge
JAKLLARI GENTIAN

- Teaching Unit SERVICES D'INFRASTRUCTURE

Person(s) in charge
PAILLASSA BEATRICE

- Subject Cloud networking

Description

Chap1 Context-

Data center History : data and storage networks-from centralised to cloud networking Virtualisation principle of containers versus virtual machine-levels of virtual communications-specificities of L 2 virtual communications MAC addressing and extended VLAN segmentation L3 virtual communications addressing, IP floating .

Chap2 Data Center Architecture

DC Network. Network Element Architecture- Isolated processes: Routing and Switching- Integrated processes: Flow switching- Separated processes Hardware design-Multistage Fabric Software design-SDN concept

Performance of Communication Architecture-Limitations- Congestion management principles- Traffic management principles

Chap3 Data center Communication

Topology types big switch, clos network fat tree-main communication protocols- Routing and Topology-Problems and New solutions for DC-Hierarchical L2Routing with Pod and pseudo addresses- L3 routing on pseudo IP addresses

Infrastructure Standardisation TIA942 standard elements-Redundancy and reliability levels-Rated (tiers) DC --Data Center Bridging standards- Enhanced Ethernet flow control and congestion management. PFC,ETS,CN,DCBX

Chap4 Load sharing

Principles of load sharing: Load sharing objective, levels and processes: discovery, distribution, type of distribution: traffic independent, traffic dependant, load dependant

Path Load sharing: Bridging sharing, STP, Trill SPB Packet; Routing sharing- ECMP, Flow routing sharing : MPLS-TE, Segment routing

Chap5 Reliability

Introduction : Failure characteristics, Fault handling strategies, protection and restoration

Failure recovery for routed network: Recovery methods in MPLS-TE, recovery cycles : rerouting and protection switching, local versus global strategies, bandwidth sharing versus protection ; Fast reroute Mechanism – overview , types of protection; detour and bypass illustration, Signalling

Failure recovery for bridged networks: EPRS

Number of hours

10 seances

Person(s) in charge
PAILLASSA BEATRICE

Teaching language
Supports en anglais

- Subject SDN et Virtualisation

Person(s) in charge
PAILLASSA BEATRICE

- Subject Distribution des contenus

Person(s) in charge
FASSON JULIEN

- Teaching Unit UE A CHOIX SELON FINALITE

Choice: 1 Among 2 :

- Subject Complex Graph Networks

Person(s) in charge
GERGAUD JOSEPH

- Subject Cybersecurity : introduction and practice

Person(s) in charge
MORGAN BENOIT

- Subject Infrastructure for cloud, big data and machine learning

Person(s) in charge
HAGIMONT DANIEL

- Subject Infrastructure for BigData

Person(s) in charge
ROUX HELENE

- Subject Compression et Multimédia

Person(s) in charge
CHARVILLAT VINCENT
POULLIAT CHARLY

- Subject Projet USRP par SILICOM

Person(s) in charge
COULON MARTIAL

- Subject Data analysis 2 and classification

Person(s) in charge
MOUYSSSET SANDRINE

- Subject Introduction à la Mécanique quantique pour le calcul

Person(s) in charge
ROUX HELENE

- Semestre 9 SN Parcours Systèmes Logiciels

Person(s) in charge
QUEINNEC PHILIPPE

- Teaching Unit SOFT AND HUMAN SKILLS

Person(s) in charge
HULL ALEXANDRA

- Subject Professional English-LV1-Semestre 9

- Subject Anglais Scientifique

- Choix 2 Anglais Professionnel - 3A

Choice: 1 Among 1 :

- Subject Anglais Clinique

- Subject Anglais de Cambridge ou Projet

- Subject Careers, Leadership & Management-S9

Choice: 2 Among 3 :

- Subject Conduite d'opération en hydraulique (MF2E)

Objectives

Give future engineers the notions and tools to be operational in project management, here applied to hydraulic engineering.

Description

- Project manager & company manager".

Role of each stakeholder. Regulatory files: authorization file, nomenclature of the law on water, relationship with the services of the Administration (DREAL, DDT, AFB ...). Schedule of operation.

- "The standardized missions of the project manager".

APS, AVP, PRO, DCE, VISA, DET, OPR.

- "Business Consultation "

Constitution of technical documents for consultation (CCTP, BP, DQE). Presentation of the repositories (Eurocodes, fascicles, standards, GTR).

Person(s) in charge
LAUVERGNIER FRANCOIS

· **Subject Controverses dans un monde en transition (MF2E)**

· **Subject RSE (MF2E)**

· **Subject IT and Computer Law (SN)**

· **Subject Strategic and Critical Thinking (SN)**

· **Subject Bureau d'Etudes Industrielles (BEI/BEE)/Conférence**

· **Teaching Unit SYSTEMES TEMPS REELS (STR)**

Person(s) in charge
ERMONT JEROME

· **Subject Systèmes et Ordonnancement Temps Réel**

Person(s) in charge
ERMONT JEROME

· **Subject Langage pour le Temps Réel**

Person(s) in charge
PAGETTI CLAIRE

· **Subject Participation Concours**

Person(s) in charge
JAFFRES-RUNSER KATIA

- Teaching Unit SYSTEMES REPARTIS ET SECURITE

Person(s) in charge
QUEINNEC PHILIPPE

- Subject Syst.èmes et algorithmes répartis

Pre-requisites

A practical programming experience and fundamental knowledge about operating systems, parallel computing, middlewares and networks are required. Basic knowledge of formal methods such (temporal) logic and transitions systems are also worthwhile.

Objectives

This class aims at providing a state of the art about principles of distributed computing and some examples of their application through distributed services : distributed file systems, dependable systems, distributed replicated memories, distributed transactional systems, etc

Description

Principles and concepts of distributed computing are described and their use in distributed systems. After a short introduction, the standard model of distributed computing based upon the causality relation is pointed out. Then, a survey of generic distributed algorithms is performed : datation, causally ordered and atomic protocols, mutual exclusion, consensus, termination, global snapshots and checkpointing, memory consistency, etc

Some distributed system examples are especially emphasized : distributed file systems (NFS, AFS), atomic multicast protocols (Ensemble, Java Groups, etc), distributed memories and their various consistency semantics, distributed simulation (HLA standard), etc

Current trends and/or more specific applications close this survey of distributed computing foundations : peer-to-peer computing, sensor networks, mobility, ambient systems, etc

Number of hours

10 lectures of 1h45

Person(s) in charge
QUEINNEC PHILIPPE

Bibliography

Ajay D. Kshemkalyani and Mukesh Singhal, Distributed Computing : Principles, Algorithms and Systems, Cambridge University Press, 2008

Pradeep K. Sinha, Distributed Operating Systems, Concepts and Design, IEEE Press, 1997

Georges Coulouris, Jean Dollimore and Tim Kindberg, Distributed Systems, Concepts and Design, , 4ième Edition, Addison-Wesley, 2005.

Andrew S. Tanenbaum and Maarten van Steen, Distributed Systems, Principles and Paradigms, Seconde Edition, Prentice Hall, 2006.

- Subject Calcul réparti et grid computing

Pre-requisites

Computer architecture, operating system and synchronisation mechanisms, programming

Objectives

Programming and algorithmic issues for

large scale parallel computers (hundreds to hundred thousands of core)

are addressed in this lecture

Description

This module begins with a general introduction to high performance computing and programming where the general concepts used in the design of high performance computers (from multicore cache based memory computers to large clusters of nodes) are described along with the main issues related to efficient high performance programming (from sequential code optimization techniques up to shared memory parallel programming and distributed computing). Afterward, notions on architecture and execution modeling of a parallel program are provided aiming at accurate performance prediction. The notions of speed-up, isoefficiency, scalability are also introduced at this moment. The module is concluded with some brief concepts of Grid computing and the related issues.

The module consists of nine lectures of two hours each and 2 to 4 hours of supervised lab during which students experience distributed memory computing in a message passing environment. PVM ("Parallel Virtual Machine") and XPVM (interactive trace analysis) are used to develop and validate a relatively simple application such as the iterative block Jacobi method for the solution of banded linear systems of equations. At the end of the lab sessions the students are asked to design and develop a distributed memory dynamic scheduler to automatically adapt the distribution of the parallel tasks of this application to the load of the nodes of the target computer.

Person(s) in charge
BUTTARI ALFREDO

- Subject Sécurité et informatique légale

Pre-requisites

Basic notions of operating systems and architecture.

Objectives

The class is related to security of information systems. It addresses the basic notions of security and risk analysis and the deployment of security policies in information system.

Number of hours
9 lectures of 1h45

Person(s) in charge
BONNETAIN PIERRE YVES

- Teaching Unit RAFFINEMENT ET METHODES FORMELLES

Person(s) in charge
AIT AMEUR YAMINE

- Subject Spécifications formelles

Person(s) in charge
ROUX PIERRE

- Subject Développement formel des Systèmes

Person(s) in charge
AIT AMEUR YAMINE
SINGH NEERAJ

- Teaching Unit INTERFACE D'ACCES A L'INFORMATION

Person(s) in charge
AIT AMEUR YAMINE

- Subject Web sémantique

Person(s) in charge
GILLES-AUSSENAC NATHALIE

- Subject Recherche d'information

Person(s) in charge
BOUGHANEM MOHAND

- Subject IHM

Person(s) in charge
NAVARRE DAVID

- Subject Sureté de fonctionnement

- Teaching Unit UE A CHOIX SELON FINALITE

Choice: 1 Among 2 :

- Subject Complex Graph Networks

Person(s) in charge

GERGAUD JOSEPH

- Subject Cybersecurity : introduction and practice

Person(s) in charge
MORGAN BENOIT

- Subject Infrastructure for cloud, big data and machine learning

Person(s) in charge
HAGIMONT DANIEL

- Subject Infrastructure for BigData

Person(s) in charge
ROUX HELENE

- Subject Compression et Multimédia

Person(s) in charge
CHARVILLAT VINCENT
POULLIAT CHARLY

- Subject Projet USRP par SILICOM

Person(s) in charge
COULON MARTIAL

- Subject Data analysis 2 and classification

Person(s) in charge
MOUYSSSET SANDRINE

- Subject Introduction à la Mécanique quantique pour le calcul

Person(s) in charge
ROUX HELENE

- Semestre 9 SN Parcours Image et Multimédia

Person(s) in charge
CHARVILLAT VINCENT

- Teaching Unit SOFT AND HUMAN SKILLS

Person(s) in charge
HULL ALEXANDRA

- Subject Professional English-LV1-Semestre 9

- Subject Anglais Scientifique

- Choix 2 Anglais Professionnel - 3A

Choice: 1 Among 1 :

- Subject Anglais Clinique

- Subject Anglais de Cambridge ou Projet

- Subject Careers, Leadership & Management-S9

Choice: 2 Among 3 :

- Subject Conduite d'opération en hydraulique (MF2E)

Objectives

Give future engineers the notions and tools to be operational in project management, here applied to hydraulic engineering.

Description

- Project manager & company manager".

Role of each stakeholder. Regulatory files: authorization file, nomenclature of the law on water, relationship with the services of the Administration (DREAL, DDT, AFB ...). Schedule of operation.

- "The standardized missions of the project manager".

APS, AVP, PRO, DCE, VISA, DET, OPR.

- "Business Consultation "

Constitution of technical documents for consultation (CCTP, BP, DQE). Presentation of the repositories

(Eurocodes, fascicles, standards, GTR).

Person(s) in charge

LAUVERGNIER FRANCOIS

- Subject Controverses dans un monde en transition (MF2E)

- Subject RSE (MF2E)

- Subject IT and Computer Law (SN)

- Subject Strategic and Critical Thinking (SN)

- Subject Bureau d'Etudes Industrielles (BEI/BEE)/Conférence

- Teaching Unit INTELLIGENCE ARTIFICIELLE ET MULTIMEDIA

Pre-requisites

Probability and Statistics

Objectives

The objective of this course is to present neural network architectures adapted to multimedia data processing.

Description

After an introduction to neural networks (2 classes, 2 lab sessions), different neural architectures are presented: convolutional networks (3 classes, 4 lab sessions), recurrent networks (2 classes, 3 lab sessions), auto-encoders (1 class, 1 lab session) and GANs (1 class, 1 lab session) with applications mainly in image and natural language processing. Audio/video data (1 lecture, 1 lab) and 3D data (1 lecture, 1 lab) and their processing by deep learning are also treated.

Person(s) in charge

CARLIER AXEL

Bibliography

Ian Goodfellow and Yoshua Bengio and Aaron Courville : Deep Learning

- Subject Intelligence Artificielle et Multimédia

Pre-requisites

Statistics, Statistical learning

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):

- The use of deep learning algorithms for the classification of complex high-dimensional data with prediction error estimation
- The main classification algorithms for media data
- Applications of deep learning methods to real-world data sets

The student should be able to:

- Fit deep neural networks for classification or regression of media data: images, videos, 3D.

- Implement deep learning algorithms on real data using Python libraries.

Targeted skills

deep learning, deep neural networks

Description

This course is dedicated to learning methods and in particular deep learning methods, for the processing of high dimensional data such as images for example.

- Neural networks and introduction to deep learning: definition of neural networks, activation functions, multilayer perceptron, gradient backpropagation algorithm, optimization algorithms, regularization.

- Convolutional neural networks: convolutional layer, pooling, dropout, architecture of convolutional networks, learning transfer, applications to image classification, object detection, image segmentation, posture estimation, etc.

- Recurrent neural networks: sequence modeling, recurrent neuron, backpropagation through time, LSTM and GRU, applications to natural language processing and audio and video signal processing.

- Neural networks and 3D: 3D convolutional networks for volumetric data processing (e.g. MRI), PointNet and PointNet++ networks for 3D point cloud processing (e.g. LIDAR).

Person(s) in charge

CARLIER AXEL

Bibliography

- Goodfellow I., Bengio Y., Courville A. "Deep Learning", MIT Press

- Hastie, T. Tibshirani, R., Friedman, J. "The elements of statistical learning", Springer, 2001

- Chollet, F. "Deep Learning with Python", Manning Publications, 2018

· Teaching Unit COMPRESSION STREAMING INTERACTION

Person(s) in charge

CHARVILLAT VINCENT

· Subject Audionumérique

Pre-requisites

Bayesian modeling

Objectives

- Understand the properties of the audio signal (speech and music)

- Know how to process and model the audio signal

Description

- Introduction to the speech signal, description of the production and human perception of speech. Practical exercises.

- Acquisition of the audio signal by the computer
- Parameterization of the speech signal (MFCC, PLP). Practical application in the lab.
- Modeling of the speech signal (HMM, GMM, DNN). Implementation of a keyword recognition application in practical training (DNN).

Person(s) in charge
FARINAS JEROME

Bibliography

- Calliope & Fant (1989). La parole et son traitement automatique. Masson, Paris.
- Mariani, « Analyse, synthèse et codage de la parole », Hermès, Lavoisier, juillet 2002
- Haton, Cerisara, Fohr, Laprie, Smaïli, Reconnaissance automatique de la parole : du signal à son interprétation, Dunod, Paris, 2006
- Hinton & co, « Deep Neural Networks for Acoustic Modeling in Speech Recognition: The Shared Views of Four Research Groups », Signal Processing Magazine, IEEE, vol. 29, n°6, pp. 82-97, nov 2012
- Environnement Google colab : <https://colab.research.google.com>

- Subject Compression, Streaming, Vidéo 3D

Pre-requisites

The prerequisite for the 3D modeling part is to know basic parametric curve and surface models, such as curves or Bézier surfaces.

Objectives

- Know the different representations of 3D models: discrete models, with or without topology, parametric and/or implicit continuous models.
- Implement a compression algorithm for a 3D model in order to transmit it.
- Implement interactions in a 3D world.

Description

The part on 3D representations is a suite of 5CTD. For each course, a 45mn lecture presenting a 3D model is proposed, then, each group presents a research paper which proposes a 3D model of the studied type.

Course 1: discrete surface models

Course 2: discrete volume models

Lecture 3: subdivision models

Lecture 4: parametric representations

Course 5: implicit representations

TP / Project: a context of transmission of a file and its progressive decoding

Each group chooses an article that proposes a progressive representation of a 3D model and implements this model to progressively transmit 3D objects in the proposed context.

Interaction in 3D: A 2-session javascript lab allows to implement interactions in a 3D scene.

Person(s) in charge
CHARVILLAT VINCENT
MORIN GÉRALDINE
MORIN WEIMER GERALDINE

Bibliography

- Curves and Surfaces for CAGD: A practical guide G. FARIN, 2001.
- A dynamic programming approach to curves and surfaces for geometric modeling, Ron Goldman, 2002
- Subdivision for geometric design: A constructive approach, Joe Warren, Henrik Weimer, 2001

Beyond these 'classical' books, we study more advanced research articles.

- Teaching Unit VISION, REALITE AUGMENTEE ET APPLICATIONS

Person(s) in charge
CHAMBON SYLVIE

- Subject Vision par ordinateur

Pre-requisites

To have followed the second year course Image, Modeling and Rendering or to have notions of image processing and segmentation.

Objectives

This course covers the notions of calibration, interest point detection (in mono or multi-resolution), matching (global and local) and tracking. In addition, you will learn about the well-known SIFT (Scale Invariant Feature Transform) approach and a classical KLT (Kanade-Lucas-Tomasi) tracking approach.

Targeted skills

To know the calibration approaches

To know the methods of detection of points of interest and how to use them

To know the different mapping techniques and to know how to handle them

Description

This part is composed of 2 reversed classroom lessons in order to allow the learner to be more active in his learning. Then, 4 practical works illustrate the notions of detection and matching discussed in class in order to build a mosaic of images. This subject will be evaluated via an online course questionnaire and an exam on paper as well as a grade for the practical work. This allows a continuous evaluation of the acquired knowledge.

Person(s) in charge
CHAMBON SYLVIE

Bibliography

Richard Szeliski. Computer vision: Algorithms and Applications, 2010.

- Subject Réalité Augmentée

Pre-requisites

None

Objectives

This course will introduce the main tools needed to make augmented reality via lectures and then a concrete application in practical work. In detail, after an introduction to augmented reality, you will learn about marker-based tracking and SLAM (Simultaneous Localization And Mapping).

This course will be evaluated by a paper exam.

Targeted skills

- To know the 3D augmented or mixed interfaces
- Know the tools needed for augmented reality
- Learn tracking using specific markers
- Learn SLAM

Description

The lectures will allow you to approach the targeted skills from a theoretical point of view and you will implement an augmented reality application step by step in practical work using OpenCV and OpenGL (C++).

Person(s) in charge
GASPARINI SIMONE

Bibliography

A. Zisserman and R. Hartley "Multiple View Geometry"

- Subject Projet transversal

Pre-requisites

No prerequisites, but having taken PBL (Problem-Based Learning and Projects) in 2A Multimedia is a plus.

Objectives

The objective of this subject is to approach a transversal project access on multimedia in an innovative and active way via a PPA (Problem and Project Based Learning). The subjects can cover the subjects of this UE (Vision and Augmented Reality) but also any other subject of the course approached in the other UE. Examples of past topics are: virtual visit of a museum, object detection and recognition applied to a video game, estimation of optimal trajectory in a video game.

Targeted skills

- Knowing how to restore and adapt the tools studied in the course to an application
- Know how to work in a group in a caring and listening manner
- Acquire group work methods

- Learn to write relevant content to present a work
- Learn to communicate orally on a very specific scientific subject
- Know how to evaluate the scientific production and the restitution of peers

Description

This subject allows to approach a specific application in order to confront the elements studied in courses and practical works with a concrete application, and to deepen the learning related to these various concepts. This project, carried out in groups, will be evaluated in the form of a report, presentation, report and peer evaluation. There will also be an individual online evaluation.

Person(s) in charge
CHAMBON SYLVIE

Bibliography

- All references related to the subjects covered in the multimedia course
- Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. Theory Into Practice, 41(4), 212-218.

· Teaching Unit PROBLEMES INVERSES POUR LE 3D

Person(s) in charge
DUROU JEAN DENIS

· Subject Problèmes inverses pour la 3D

Pre-requisites

Optimization, image processing

Objectives

This course aims to give an overview of the methods of photographic 3D reconstruction. The problem is the following: from one or more photographs, how to obtain a 3D model of a scene, i.e. its relief and color? We show that the 3D reconstruction methods can be reduced to the resolution of inverse problems. We introduce the main tools for solving such problems. A certain number of sessions of this course will take place in the form of practical work or laboratory work, which will be inspired by the work carried out in the REVA team of IRIT.

Description

This UE is articulated around 3 parts:

PART 1: GEOMETRY: Generalities on photography, 3D as an inverse problem. Introduction to Meshroom, Structure-From-Motion, reminder of optimization tools, beam fitting for SfM

PART 2: Shape-From-Shading: Lecture on light, Photometry, BRDF, lighting representation, underlying inverse problems, Fast marching, depth sensors

PART 3: Stereophotometry

Person(s) in charge
DUROU JEAN DENIS

Bibliography

- R. Szeliski, "Computer Vision: Algorithms and Applications", 643 pages, 2010, Springer.

- D. Forsyth, J. Ponce, "Computer Vision: a Modern Approach", 792 pages, 2011, Pearson

- Teaching Unit UE A CHOIX SELON FINALITE

Choice: 1 Among 2 :

- Subject Complex Graph Networks

Person(s) in charge
GERGAUD JOSEPH

- Subject Cybersecurity : introduction and practice

Person(s) in charge
MORGAN BENOIT

- Subject Infrastructure for cloud, big data and machine learning

Person(s) in charge
HAGIMONT DANIEL

- Subject Infrastructure for BigData

Person(s) in charge
ROUX HELENE

- Subject Compression et Multimédia

Person(s) in charge
CHARVILLAT VINCENT
POULLIAT CHARLY

- Subject Projet USRP par SILICOM

Person(s) in charge
COULON MARTIAL

- Subject Data analysis 2 and classification

Person(s) in charge
MOUYSSSET SANDRINE

- Subject Introduction à la Mécanique quantique pour le calcul

Person(s) in charge
ROUX HELENE

- Semestre 9 SN Parcours Toulouse Sécurité

Person(s) in charge
AIT AMEUR YAMINE

- Teaching Unit BASE DE LA SECURITE

- Subject Rappels et Harmonisation en systèmes d'exploitation

Objectives

Reminders about :

Hardware architecture

Operating system

Description

The objective of this course is to bring all students up to date on the main fundamental concepts of fundamental concepts of computer systems, in particular those that are useful for the different security courses of security later on. The main points covered concern the hardware architectures of computers, fundamental concepts of operating systems (kernel space, user space, processes and associated scheduling scheduling mechanisms, etc.).

At the end of this course, the student will be able to describe the functioning of the important elements of an of an information system. On this basis, he will be able to analyze these elements to determine their impact on the on the security of the system.

Person(s) in charge
NICOMETTE VINCENT

- Subject Rappels et Harmonisation en Réseau

Objectives

Reminders about :

The OSI model

Protocoles of the management plan, routing protocols

Description

The objective of this course is to bring all students up to speed on the main concepts of computer concepts of computer networks, focusing on the concepts of IP networks.

The main points covered concern the MAC, network and transport layers (such as DHCP, ARP, IP or TCP), but also some particularly sensitive application protocols (such as directory protocols with DNS or routing with RIP or BGP).

At the end of this course, the student will be able to describe the fundamental principles of the construction of network protocols, will be able to analyze network traces and will be able to understand the encapsulation of flows. He will be able to propose the use of certain protocols and services services according to the needs. In particular, he/she will be able to understand the main elements of network network protocols that can have an impact on security.

Person(s) in charge
NICOMETTE VINCENT

- Subject Rappels et Harmonisation en programmation C et Assembleur

Objectives

Reminders about :

C language, pointers, structures. Deepening of advanced concepts such as memory sections, etc.

Inline assembler

Description

The objective of this course is to bring all students up to speed on the main concepts of concepts of programming. Low-level oriented languages will be privileged because they are the ones that will be the analysis of security problems. The languages covered will therefore be the C and assembly language, in particular on x86 architecture.

At the end of this course, the student will master the basic techniques of programming with C and assembler. He will be able to design programs using these techniques. He will be able to analyze precisely a program written with these languages to understand its functioning. He/she will be also be able to understand the functioning of programs written in different languages.

Person(s) in charge
NICOMETTE VINCENT

- Subject Définitions et techniques de base de la Sécurité et Safety

Objectives

Introduction and definition of the following:

Main definitions (AAA, CID, security policies, assessments)

Types of attacks / classification

Awareness (threats, major historical attacks)

Fault tolerance and dependability (1CM)

Description

This course will introduce the terminology and fundamentals of security and fault tolerance.

Upon completion of this course, the student will be able to:

Differentiate between the domains of security and safety

distinguish and correctly use the terms corresponding to: the security properties of information and systems; and the techniques that provide security

understand security in its entirety by going beyond technical issues and taking into account organizational aspects

Model the different types of attackers

Recognize the main tools and architectural elements that provide security in a network as well as in a system

describe the different approaches to authenticate a user and authorize actions on a computer system

Person(s) in charge
NICOMETTE VINCENT

- Subject Cryptographie

Objectives

Learning and mastering the following aspects of cryptology:

Cryptography (keyless, symmetric and asymmetric key primitives)

Cryptanalysis (cryptographic attacks)

Applied cryptography (network protocols, security enclaves, proof of protocols, etc.)

Description

This course first presents the basics of complexity for cryptography and the notion of randomness. Then symmetric and asymmetric cryptography and the usual attacks are described. Finally, modern standards and some notions of advanced cryptography are introduced. The whole course will alternate between introduction to cryptographic techniques and security definitions and attack notions (which only make sense in the face of cryptographic techniques).

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

distinguish the different cryptographic tools, understand what they can bring to security and what they cannot apply good practices, and understand the dangers of inappropriate use ;

use technical terms in cryptography and look for properties that can make contributions to complex security problems;

Find international cryptographic standards, understand their content and implement a standards-compliant use of a cryptographic tool;

Identify classical dangers (man-in-the-middle, covert channel attacks) and use broad attacker models to define whether a new use of a cryptographic tool is secure or not

Person(s) in charge

NICOMETTE VINCENT

- Teaching Unit SECURITE DU LOGICIEL

- Subject Vulnérabilités Logicielles

Objectives

Learn the following concepts:

Various software vulnerabilities

various BOFs (stacks, heaps, BSS)

format strings

integer overflow

SUID program

return oriented programming

Static analysis undefined behavior

Countermeasures (Control Flow integrity, etc.)

OpenBSD

Description

The objective of this course is to introduce students to different types of software vulnerabilities that are frequently encountered, especially in programs written in the C language, the language that will be used in this course. The usual memory protection countermeasures to protect against these types of vulnerabilities are also proposed.

At the end of this course, the student will be able to analyze a program and judge its security level by considering the software vulnerabilities presented in this course. He will be able to identify the tests to be performed to highlight the existence of a software vulnerability. He will also be able to compare different countermeasures, to identify the most suitable one to correct a vulnerability and to implement it.

Finally, good development practices for security are exposed. With the help of the OpenBSD case study, students learn for example the right architectural choices and functions of the standard C library to use or avoid.

Person(s) in charge
ALATA ERIC

- Subject Virus et techniques virales

Objectives

Learn the following concepts:

Presentation of viruses and worms

Presentation of anti-viruses

Experiments

Description

The objective of this course is to introduce students to the theory of worms and viruses. A first part is dedicated to the study of the algorithms used by worms and viruses to infect computer systems and spread. This knowledge is necessary to understand the protections against these malware. These protections are the subject of the second part which is devoted more particularly to anti-virus software with the methods they use to detect worms and viruses. At the end of this course, the student will be able to appreciate the stakes of the viral protection, to describe the various types of computer infection, to analyze the viral and antiviral techniques and to react in case of infection.

Person(s) in charge
ALATA ERIC

- Subject Développement Logiciel sécurité

Objectives

Learn the following concepts:

Static analysis

Formal proofs for design of secure systems by construction

Description

The objective of this course is to present a set of best practices for developing software in a secure manner. These best practices are illustrated with the OpenBSD system, which is known to have adopted rigorous development methods. A presentation of formal methods for vulnerability detection will also be given. will also be presented.

At the end of this course, the student should be able to understand the stakes of secure software development, to know the main methods and to be able to propose the use of these methods according to the software being developed, its function and the context in which it is used.

Person(s) in charge
AIT AMEUR YAMINE

- Teaching Unit SECURITE SYSTEME ET MATERIELLE, RETRO COCEPTION

- Subject Protection des systèmes d'exploitation

Objectives

Learning of the following aspects :

Security of operating systems

The GNU / Linux case

The Windows case

Description

The objective of this course is to present the main protection mechanisms that exist today in operating system kernels. This course also discusses a number of attacks that exploit vulnerabilities in the kernels themselves. It is based on the Linux and Windows kernels. It also provides an overview of the tools and techniques available to protect data contained in file systems and memory. Most of these techniques are based on encryption methods and access controls.

At the end of this course, the student will be able to identify the security properties to be preserved concerning the data manipulated in a system in order to determine the most appropriate protections to implement. The student will also be able to analyze an operating system to identify threats and vulnerabilities that may affect it. He will be able to describe the consequences of exploiting these vulnerabilities. He/she will be able to expose the different protection mechanisms to contain these threats. He/she will be able to choose and implement the most appropriate mechanism for the system under study.

Person(s) in charge
ALATA ERIC

- Subject Attaques matérielles, composants matériels pour la sécurité

Objectives

Learning of the following aspects :

Hardware components for security (virtualization, IO-MMU, TPM)

Hardware attacks (auxiliary channels) and countermeasures

Spectre, Meltdown, rowhammer and temporal auxiliary channel attacks using caches

Description

The objective of this course is to present the main attacks performed from the hardware and the associated countermeasures. A scan of the components of a system will be performed by identifying the usefulness and the risks associated with the presence of each of these components. Some of these risks will be illustrated by recent attacks, either by reconfiguring the concerned components or by performing a hardware and physical study of these components. Also, countermeasures will be presented with the latest advances in terms of hardware protection made by the processors and chipset manufacturers.

At the end of this course, the student should be able to obtain a global view of the exchanges between the hardware components of an information system, considering software and network components as well as hardware. They will be able to understand how an attack on hardware works, to describe it and to explain the associated

protection mechanisms. He will also be able to identify the critical components of a system, to analyze the vulnerabilities that can target these components, to determine the countermeasures to protect them and to implement these countermeasures.

Person(s) in charge
ALATA ERIC

- Subject Reverse Engineering

Objectives

Learning of the following aspects :

Compilation chain

Software reverse engineering techniques

Description

The objective of this course is to introduce students to the activities surrounding reverse engineering. First, the compilation chain is presented with the models used by compilers to generate the machine code. Secondly, strategies are presented to reverse this process in order to better understand some parts of the software code. Finally, countermeasures to reverse engineering are presented to make this activity more difficult.

At the end of this course, the student will be able to analyze precisely and describe globally the functioning of a program based only on the assembly code. They will be able to apply the knowledge acquired in the lessons related to the study of vulnerabilities to identify vulnerabilities in these programs. He/she will be able to justify the existence of vulnerabilities by implementing a proof of concept of the exploitation.

Person(s) in charge
ALATA ERIC

- Teaching Unit SECURITE DES RESEAUX ET DE LEURS PROTOCOLES

Person(s) in charge
MORGAN BENOIT

- Subject Attaques et Sécurisation des couches OSI

Objectives

Learning of the following aspects :

Layer 1-5 (Principle, Attacks, Defense)

Layer 7 (illustration with DNS and BGP)

Denial of service

Metrics

botnets and distributed Denial of Service

Description

This course presents the main attacks and countermeasures on the OSI layers, starting with attacks on the physical link and moving on to application attacks on the protocols that are essential to the proper functioning of a network. At the end of this course the student will be able to:

Recognize and implement the classic network attacks in the context of an intrusion test

Identify and implement protection mechanisms against these attacks

Inform about the dangers inherent to a computer network and know the limits of the protections that can be obtained at a reasonable cost

To inform on the contributions of the great infrastructures of security DNS, and BGP set up by the ICANN

Use and implement these infrastructures.

Person(s) in charge
MORGAN BENOIT

- Subject Sécurité des réseaux non filaires

Objectives

Learning of the following aspects :

Protection of Wifi networks (captive portal + WPA + 802.1X + EAP)

Cellular network security (GSM/GPRS/UMTS/LTE)

Description

This course presents the security of cellular networks from GSM to 5G as well as the attacks and the security of WiFi networks.

At the end of this course the student will know in the field of WiFi :

Choose a suitable security solution for an access point

Understand and choose the multiple options available for each solution

Highlight the security benefits and limitations of the chosen solution

Perform an intrusion test on an access point

At the end of this course, the student will be able to in the field of cellular networks:

Differentiate the security objectives in different cellular networks

Describe the authentication and key exchange mechanisms and compare the security contributions of each

Describe the possible attacks in the context of each technology

Recognize the architectural elements of security in an operator network

Person(s) in charge
MORGAN BENOIT

- Subject Sécurisation des protocoles

Objectives

Learning of the following aspects :

Fragile protocols

A priori security

A posteriori security (e.g. SSH tunnels)

Description

This course highlights the many fragile protocols in use today and describes best practices for designing a posteriori secure protocols and techniques for securing a posteriori fragile protocols through the use of tunnels.

At the end of this course the student will be able to:

- Recognize the fragile protocols typically implemented in a computer network
- Secure fragile protocols by using tunnels for applications where this is necessary
- Use SSH and related functions (file transfers, proxies, etc.)
- Describe best practices for defining a secure protocol

Person(s) in charge
MORGAN BENOIT

- Teaching Unit ARCHITECTURES RESEAUX SECURISEES

Person(s) in charge
MORGAN BENOIT

- Subject Composant fondamentaux d'une architecture sécurisée

Objectives

Learning of the following aspects :

- Firewalls
- IPSEC and VPN
- NIDS (Probes, SIEM, etc.)
- IAM Course and TD

Description

This course presents the architectural elements that are essential for securing a network: Firewalls, NIDS, IPsec, VPN and identity management tools.

At the end of this course the student will be able to:

- Distinguish between the different types of firewalls and their capabilities and limitations
- Define and audit a filtering architecture adapted to a given computer network
- Choose for an IPsec tunnel the protocols to use, the operating modes and a routing plan adapted to the associated gateways
- Design a complete security architecture for a complex network including identity and authentication management

Person(s) in charge
MORGAN BENOIT

- Subject Bureau d'étude

Objectives

Learning of the following aspects :

Improvement of a security architecture and implementation of a logs and SIEM system

BE ASA Cisco (VPN + Firewall + IDS)

Web vulnerabilities

Description

The purpose of this course is to put into practice the various teachings of the network module.

At the end of this course the student will know how to :

Set up and audit an IPsec tunnel

Set up or audit a VPN created on IPsec manually or using all-in-one tools on the market

Set up and audit a distributed intrusion detection system with prevention options

Set up a logging architecture with a centralized event management system

Person(s) in charge

MORGAN BENOIT

- Teaching Unit CAS PRATIQUES D'APPLICATION

- Subject La sécurité dans l'aérospatiale

Person(s) in charge

LARRIEU LAURENT

- Subject Intrusion système et éseaux

Objectives

Learning of the following aspects :

Network challenge

Forensics analysis

Description

First, the course will present an overview of the attacks that exploit the technologies used for web design and provide elements to protect these systems. The course will continue by introducing students to the risks they will face and making them realize that the behavior of legitimate users can be exploited by attackers to target systems.

Then, the student will be confronted with several challenges, which will allow him to concretely put himself in the shoes of an attacker and to exploit vulnerabilities of different natures: 1) a first challenge illustrating the techniques of intrusion in a network; 2) a second challenge centered on the implementation of the techniques of intrusions and elevation of privileges on a computer system; and 3) a course/TP dealing with the reaction in case of incident with a practical application of techniques of numerical investigation on a system, after an intrusion

At the end of this course, the student will be able to list and quantify the vulnerabilities inherent in system and network architectures and will be aware of the main intrusion techniques

Person(s) in charge
LARRIEU LAURENT

- Teaching Unit SCIENCES HUMAINES, SOCIALES ET JURIDIQUE (Parc.TLS-Sec)

- Subject Professional English-LV1-Semestre 9

- Subject Anglais Scientifique

- Choix 2 Anglais Professionnel - 3A

Choice: 1 Among 1 :

- Subject Anglais Clinique

- Subject Anglais de Cambridge ou Projet

- Subject Conférences

Objectives

Learning of the following aspects :

Privacy management

Legal aspects

Geoprivacy

Physical security in airports

Physical security for an aircraft manufacturer

Social engineering

Military Programming Law, protection of Vital Asset Operators (VPO)

Description

This course will present the legal bases, the stakes, and the main tools of privacy protection. More specifically, the objective of this course is:

To present the challenges of privacy protection in information systems

To characterize all the issues related to the protection of personal data

To illustrate this problematic in some particular and sensitive cases, by making the distinction between Security and Privacy, and also between CISO and CIL (future DPO), or between a risk analysis in SSI and a privacy impact analysis (or Privacy Impact Analysis)

To materialize certain technical solutions deployed in certain specific fields of activity, through anonymization and/or pseudonymization techniques (for example: re-use of anonymized health data, or geolocation data)

To describe the techniques of attack against anonymization

Present the main technical tools for privacy protection.

- Semestre 9 SN Parcours Télécoms sans fil et objets connectés

Person(s) in charge
POULLIAT CHARLY

- Teaching Unit SOFT AND HUMAN SKILLS

Person(s) in charge
HULL ALEXANDRA

- Subject Professional English-LV1-Semestre 9

- Subject Anglais Scientifique

- Choix 2 Anglais Professionnel - 3A

Choice: 1 Among 1 :

- Subject Anglais Clinique

- Subject Anglais de Cambridge ou Projet

- Subject Careers, Leadership & Management-S9

Choice: 2 Among 3 :

- Subject Conduite d'opération en hydraulique (MF2E)

Objectives

Give future engineers the notions and tools to be operational in project management, here applied to hydraulic engineering.

Description

- Project manager & company manager".

Role of each stakeholder. Regulatory files: authorization file, nomenclature of the law on water, relationship with the services of the Administration (DREAL, DDT, AFB ...). Schedule of operation.

- "The standardized missions of the project manager".

APS, AVP, PRO, DCE, VISA, DET, OPR.

- "Business Consultation "

Constitution of technical documents for consultation (CCTP, BP, DQE). Presentation of the repositories

(Eurocodes, fascicles, standards, GTR).

Person(s) in charge
LAUVERGNIER FRANCOIS

- Subject Controverses dans un monde en transition (MF2E)

- Subject RSE (MF2E)

- Subject IT and Computer Law (SN)

- Subject Strategic and Critical Thinking (SN)

- Subject Bureau d'Etudes Industrielles (BEI/BEE)/Conférence

- Teaching Unit TECOMMUNICATIONS AVANCEES

Person(s) in charge
POULLIAT CHARLY

- Subject Communications multi-antennes et multi-utilisateurs

Person(s) in charge
COULON MARTIAL

- Subject Bancs de filtres et OFDM Avancés

Person(s) in charge
BOUCHERET MARIE LAURE

- Subject Codage moderne et détection avancée

Person(s) in charge
POULLIAT CHARLY

- Teaching Unit TERRESTRIAL COMMUNICATION SYSTEMS AND IOT

Person(s) in charge
DHAOU RIADH

- Subject Sécurité pour les systèmes mobiles

Person(s) in charge
KRAEMER ISABELLE

- Subject Techniques d'accès et comm. coopératives

Person(s) in charge
BOUCHERET MARIE LAURE

- Subject Couches PHY 4G-5G

Person(s) in charge
ESCRIG BENOIT

- Subject Réseaux pour IoT

Person(s) in charge
DHAOU RIADH

- Teaching Unit COMMUNICATIONS SPACIALES ET AERONAUTIQUES

Person(s) in charge
BOUCHERET MARIE LAURE

- Subject Systèmes Satellites

- Subject Multimédia et mobile par satellites

- Subject Réseaux Satellites

Person(s) in charge
FASSON JULIEN

- Subject Navigation et Localisation par Satellite

- Teaching Unit RESEAUX MOBILES

Person(s) in charge
PAILLASSA BEATRICE

- Subject Mobilité réseaux

Person(s) in charge
PAILLASSA BEATRICE

- Subject Mobilité d'accès

Person(s) in charge
DHAOU RIADH

- Subject Architecture télécom mobiles

Person(s) in charge
DHAOU RIADH

- Teaching Unit UE A CHOIX SELON FINALITE

Choice: 1 Among 2 :

- Subject Complex Graph Networks

Person(s) in charge
GERGAUD JOSEPH

- Subject Cybersecurity : introduction and practice

Person(s) in charge
MORGAN BENOIT

- Subject Infrastructure for cloud, big data and machine learning

Person(s) in charge
HAGIMONT DANIEL

- Subject Infrastructure for BigData

Person(s) in charge
ROUX HELENE

- Subject Compression et Multimédia

Person(s) in charge
CHARVILLAT VINCENT
POULLIAT CHARLY

- Subject Projet USRP par SILICOM

Person(s) in charge
COULON MARTIAL

- Subject Data analysis 2 and classification

Person(s) in charge
MOUYSSSET SANDRINE

- Subject Introduction à la Mécanique quantique pour le calcul

Person(s) in charge
ROUX HELENE

Organizational unit

École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications