

- Faculté des sciences
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Applied Coding and Information Theory (3IN2051)

Filières concernées	Nombre d'heures	Validation	Crédits ECTS
Bachelor en mathématiques	Cours: 2 ph Exercice: 2 ph	Voir ci-dessous	6
Master en informatique	Cours: 2 ph Exercice: 2 ph	Voir ci-dessous	5
Master en mathématiques	Cours: 2 ph Exercice: 2 ph	Voir ci-dessous	6

ph=période hebdomadaire, pg=période globale, j=jour, dj=demi-jour, h=heure, min=minute

Période d'enseignement:

- Semestre Printemps

Equipe enseignante

Lecturer: Dr Hugues Mercier
Teaching assistant: Cristina Landolina

Contenu

This course introduces the concepts of error-correcting codes and information theory with a focus on applications.

Covered topics will be taken from the following list and depend on the interests of the students:

1. Introduction to entropy and information
2. Data compression
 - Shannon source coding theorem
 - Huffman coding
 - Dictionary techniques
 - Arithmetic coding
 - Asymmetric numerical systems and modern standards (e.g. Apple, Facebook and Google)
3. Information theory, gambling and portfolio theory
4. Communication over a noisy channel
 - Communication channel and capacity
 - Channel coding theorem
 - Error-correcting codes
 - Real channels
5. Modern error-correcting codes and applications
 - Message passing algorithms
 - Convolutional and turbo codes
 - Low-density parity-check codes
 - Rateless codes and streaming
 - Polar codes
6. Codes and information theory for distributed storage systems on the cloud

Forme de l'évaluation

- 25% Assignments
- 25% Presentation and analysis of a research article
- 50% Final oral examination

To pass the course, you must obtain a 60% overall grade (assignments + presentation + oral exam) AND at least 4.0 for the oral exam. For instance, if you get 50/50 for the assignments and presentation, and 10/50 for the oral exam, you do NOT pass the course.

Documentation

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Thomas Cover and Joy Thomas, Elements of Information Theory, Wiley Series in Telecommunications and Signal Processing, 2006.
David MacKay, Information Theory, Inference and Learning Algorithms, Cambridge University Press, 2002. Available online.
Shu Lin and Daniel J. Costello, Jr, Error Control Coding, Second Edition, Pearson Prentice Hall, 2004.
Khalid Sayood, Data Compression, Morgan Kaufmann, 2000.

Objectifs d'apprentissage

Au terme de la formation l'étudiant-e doit être capable de :

- Formulate and demonstrate the fundamental concepts of information theory
- Categorise and demonstrate the different tradeoffs and applications of data compression and error-correcting coding techniques
- Establish the principles of data compression and error correction