Unidade Curricular

"Teoria Algorítmica da Informação"

António José Ribeiro Neves

an@ua.pt

https://www.ua.pt/pt/uc/13643

Outline

General info

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Contents

Bibliography

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General info (version of February 14th, 2025)

Instructors

António Neves (an@ua.pt)

Diogo Pratas (pratas@ua.pt)

Grading

- Theoretical component: Individual activities, 40%

  - In-class quizzes

  - Final written exam

- Practical component: Based on programming assignments, 60%

  - The assignments are performed in groups of three students

  - In the report of each assignment, it should be stated the percentage of participation of each member of the group

- Minimum of 8 points in each component

Learning objectives

- Understand the basic concepts of information theory
- Critically evaluate and apply the principles of information theory and signal processing involved in efficient information representation
- Understand the usefulness of data compression algorithms
- Learn the principles of the main data compression algorithms
- Design, implement, and optimize data compression algorithms
- Apply compression techniques to real-world problems
- Understand the relation between data compression, the algorithmic theory of information and its applicability to data analysis and data mining
- Develop self-regulated learning strategies

Active learning

- This course will focus not only on technical knowledge but also on the development of critical thinking skills and self-regulated learning
- Students work on real-world problems to develop practical skills
- Students collaborate and learn from each other through discussions, peer reviews, and collaborative projects
- Encouraging students to reflect on their learning, think about their thought processes, and adjust strategies accordingly
- Students engage with lecture material (e.g., videos, readings) outside of class and focus on interactive problem-solving during in-class time
- Students take ownership of their learning by selecting topics, conducting research, and implementing their own ideas
- Encouraging students to ask questions, investigate concepts, and seek solutions through research and experimentation
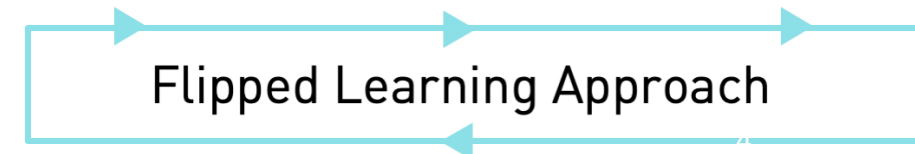

PEDAGOGY

ACTIVE LEARNING

SPACE

TECHNOLOGY

ACTIVE LEARNING ECOSYSTEM

PREPARATION MATERIALS
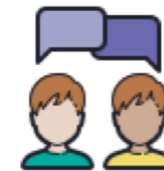
IN CLASS ACTIVITIES

POST-CLASS ASSIGNMENTS

Flipped Learning Approach

Contents

- Basic concepts of digital signal processing
- The notion of information: combinatorial, probabilistic, algorithmic
- Variable length codes
- Dictionary encoding
- Arithmetic coding
- Modeling of information sources
- Introduction to the Kolmogorov complexity
- Distance measures based on the algorithmic information
- Examples of application of the algorithmic theory of information

Bibliography

- Weekly documentation is available on elearning

- Armando J. Pinho. Some notes for the course "Algorithmic Information Theory", Universidade de Aveiro, 2023.

- An Introduction to Information Theory. John R. Pierce. O'REILLY, 2019.

- Document and Image Compression. Mauro Barni. CRC Press, 2018, Access here.

- Khalid Sayood. Introduction to data compression, Elsevier, 5th Ed, 2017, Access here.

- David Salomon. Data compression—The complete reference, Springer, 4th Ed, 2007.

- M. Li and P. Vitanyi. An introduction to Kolmogorov complexity and its applications, Springer, 3rd Ed, 2008.

- T. M. Cover and J. A. Thomas. Elements Of Information Theory, John Wiley & Sons, 2nd Ed, 2006.

- Signals and Systems. Simon Haykin, Barry Van Veen. 2nd Edition, John Wiley & Sons, 2003

- M. Li and P. Vitanyi. An introduction to Kolmogorov complexity and its applications, Springer, 3rd Ed, 2008

Final remarks

- This is a 6 ECTS course, implying, on average, a total of about 6 × 30 = 180 hours of work.

- Academic dishonesty will not be tolerated. Academic dishonesty involves acts, such as,
  - Cheating on an examination or quiz.
  - Substituting for another person during an examination or allowing such substitution for one's self.
  - Plagiarism. Act of appropriating passages from the work of another individual, either word for word or in substance, and representing them as one's own work. This includes any submission of written work other than one's own.
  - Collusion with another person in the preparation or editing of assignments submitted for credit, unless such collaboration has been approved in advance by the instructor.

- If you have doubts regarding a certain action, ask the instructors.