Information Theory — case for support

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Information theory describes the fundamental limits on our ability to store, process and communicate data, whether in natural or artificial systems. Understanding and approaching these limits is important in a wide variety of topics in informatics. Indeed, several courses currently offered by the School mention information theory, or information theoretic quantities. The proposed course offers a much more in depth study of Shannon’s key theorems and their implications than can be afforded in more general courses. Taking this course will give a solid grounding in compression technologies and reliable communication. The best compression algorithms use probabilistic models of data, and learning from data is obtaining information from the world over a noisy channel. The material will provide practical and theoretical tools useful for data processing in many contexts.

Existing coverage: There is currently little systematic coverage of information theory offered by the school. A few lectures cover some definitions or particular simple algorithms in “Mathematics for Informatics 1 and 3”, “Computational Foundations of Cognitive Science 1”, “Neural Information Processing” and “Probabilistic Modelling and Reasoning”. These courses only have minor overlap with the material covered in the proposed course, and would be complemented by it.

The proposed course: A thorough treatment of Shannon’s source coding and noisy channel theorems and the practical algorithms for compression and inference over a noisy channel inspired by them. While this material is important in its own right, a solid grounding in information theory will also be a useful complement to existing courses in machine learning, neuroscience and beyond. From the preface to the course textbook:

“In the 1960s, a single field, cybernetics, was populated by information theorists, computer scientists, and neuroscientists, all studying common problems. Information theory and machine learning still belong together. Brains are the ultimate compression and communication systems. And the state-of-the-art algorithms for both data compression and error-correcting codes use the same tools as machine learning.”


Logistics: The proposed course descriptor is for a 10-point course with 15–20 lectures at level 11. Assessment will be by exam (80%) and coursework (20%), with coursework assessing an ability to explore and implement different solutions to practical problems. In addition, as a mathematical subject, practice and feedback is important. This will be supported by six tutorials.