

The University of Oxford

MSc (Mathematics and Foundations of Computer Science)

Information Theory

Michaelmas Term 2024

Students should undertake one of the following two projects.

Project 1

Consider the family of BCH codes, which extend the Hamming error correcting codes considered in the course. Write a report which details:

- the construction of the code, from the perspective of polynomials in finite fields,
- the process of encoding and decoding using the code,
- gives examples (based on your own implementation of the code) of encoding and decoding, and
- demonstrates the error correction capabilities of the approach.

Your report should include sufficient detail for (at least one interpretation of the) algorithm to be reproduced in full. Code should be submitted in an appendix. You will need to find and consult appropriate references, the wikipedia page on BCH codes may be a good place to start, but should not be your only reference.

Project 2

Consider the Baum–Welch algorithm for calibrating the parameters of a hidden Markov model, similar to those considered during the last part of the course. Write a report which details:

- the construction of the algorithm,
- the relationship between the Baum–Welch algorithm and the Wonham algorithm,
- gives examples (based on your own implementation) of applying the algorithm.

Your report should include sufficient detail for algorithm to be reproduced in full. For testing, you should consider both one and two-step hidden (semi-)Markov models. You will need to find and consult appropriate references, the wikipedia page on the Baum–Welch algorithm is a good place to start, as is Chapter 23 of Barber, *Bayesian Reasoning and Machine Learning*.