Background

The message passing variant belief propagation can be used as iterative decoding algorithm which shows good results for the decoding of low-density parity-check (LDPC) codes. Recently, more message passing variants like survey propagation as well as expectation maximization types were investigated in the context of satisfiability testing (SAT)\(^a\). All these variants have their respective strengths and weaknesses and it depends on the type of boolean formula which variant should be preferred. Refer to [Lei05] for a tutorial about using message passing for decoding LDPC codes and to [GMD13] for more about the different variants of message passing in satisfiability testing.

Idea

Beside belief propagation, the other message passing variants are widely unknown to the coding theory community. The question is: can the variants be transferred to coding theory? If yes, it is of interest to compare decoding results with the well-known belief propagation algorithm. Also, the interaction between the different methods and code constructions are of study interest.

Task

First, the student should become familiar with the concept of message passing and should be able to summarize and explain the concept itself as well as different variants. A comparison between message passing in satisfiability testing and coding theory should be given. Next, the student should consider, how the variants can be transferred from satisfiability testing to coding theory. In the practical part of the thesis, simulations should be used in order to compare performance and runtime behavior of different message passing variants to belief propagation.

Prerequisites

- Good programming skills in any programming language are required.
- Lectures Channel Coding and Advanced Channel Coding are highly recommended.

Literature


\(^a\)SAT is one of the most studied combinatorial problems and deals with finding satisfying assignments for boolean formulas.