

# Computational Quantum Physics Exercise 10

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## Problem 10.1 Continuous time Quantum Monte Carlo

In this exercise, we will solve the  $0 + 1d$  Ising model, given by the Hamiltonian

$$H = \Gamma \sigma_x \tag{1}$$

using a continuous-time cluster update Monte Carlo method as discussed in the lecture.

- Think about good data structures to implement the segments, kinks, etc. In C++, you might want to consider using a `set` to store the timeline.
- Be careful with correctly implementing the periodic boundary conditions.
- In the end, you should be able to reproduce the magnetization curve  $\langle \sigma_x \rangle = \tanh \beta \Gamma$ . You can calculate the magnetization in the Monte Carlo scheme as

$$\langle \sigma_x \rangle = \frac{\# \text{ of kinks}}{\beta \Gamma} \tag{2}$$