Gerrymandering as a Combinatorial Optimization Problem

Sebastian Feld, Maximilian Bley

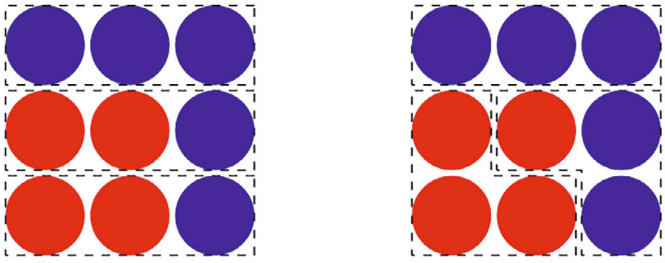

Figure 1: Example of Gerrymandering. Left: With regular district boundaries blue wins 1 district. Right: Irregular boundaries lead to blue winning 2 districts.

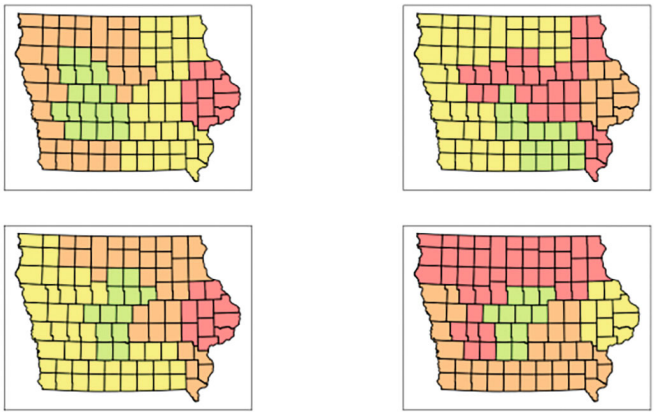

Figure 2: Real-world example of US state Iowa. The algorithm finds several electoral district allocations that lead to an advantage for a certain party.

1 Extended Abstract

This talk presents an approach that deals with electoral shifts, i.e. Gerrymandering, on a quantum annealer developed by D-Wave-Systems.

Gerrymandering is the manipulation of electoral district boundaries to give a certain party an advantage. The phenomenon occurs on the whole extent only in countries with a majority voting system. An electoral district victory means a seat in parliament, i.e. the candidate needs more than 50% of the votes. For an example, see Figure 1.

An algorithm is presented which examines combinations of possible electoral district allocations with the aim of maximizing the electoral district victories of a party while taking into account the classic criteria of the political districting problem. The problem is modeled as the NP-complete problem of exact coverage and formulated as a QUBO model. The algorithm addresses a real political districting issue in the US state of Iowa, see Figure 2.

Dr. Sebastian Feld

Dr. Sebastian Feld is head of the Quantum Applications and Research Lab (QARLab) at the Mobile and Distributed Systems Group of the LMU Munich. Currently, he pursues the goal of habilitation with a main focus being on optimization problems and the application of quantum technology. He joined LMU in 2013 and earned his doctorate in 2018 working on planning of alternative routes, time series analysis and geospatial trajectories.