

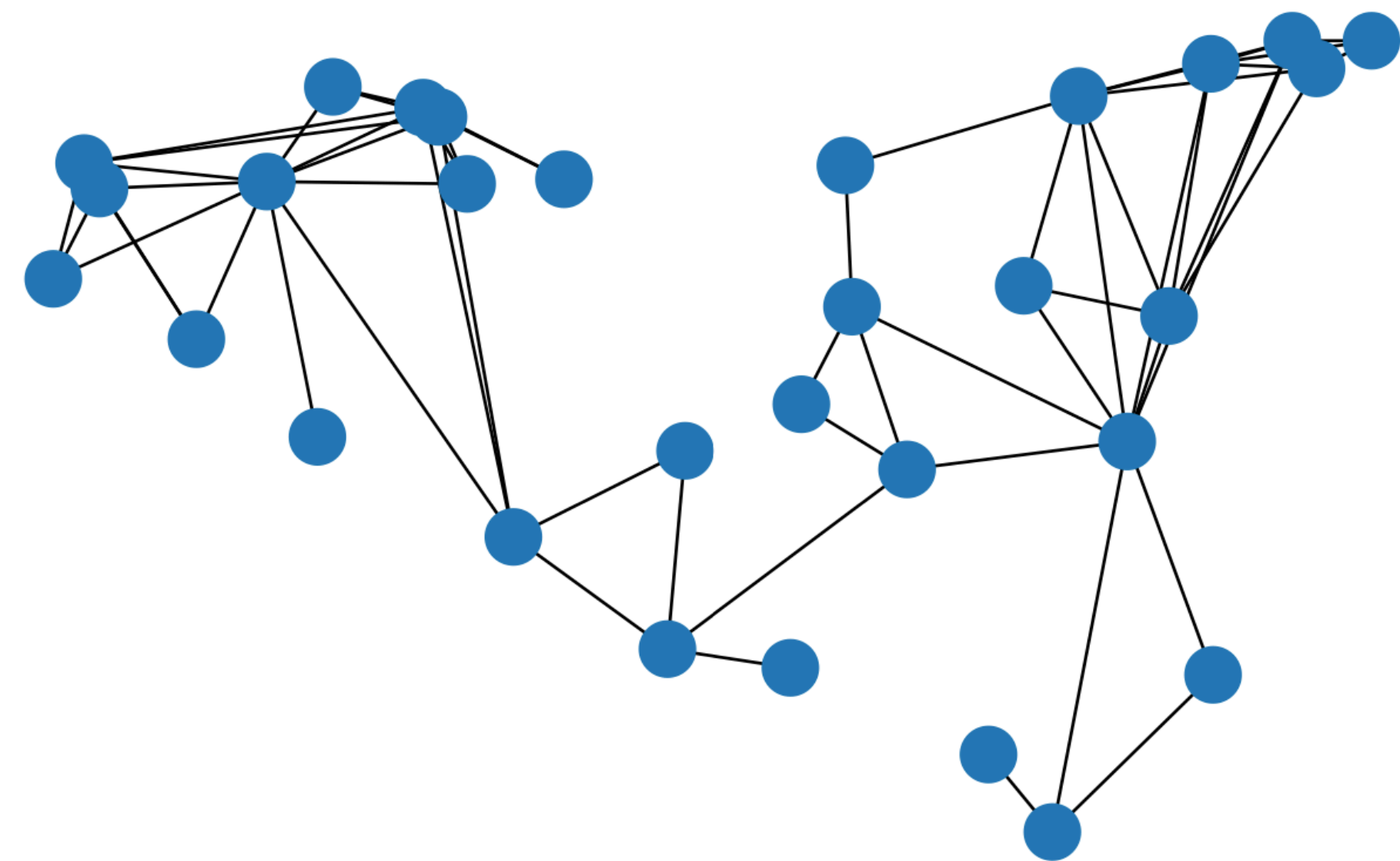
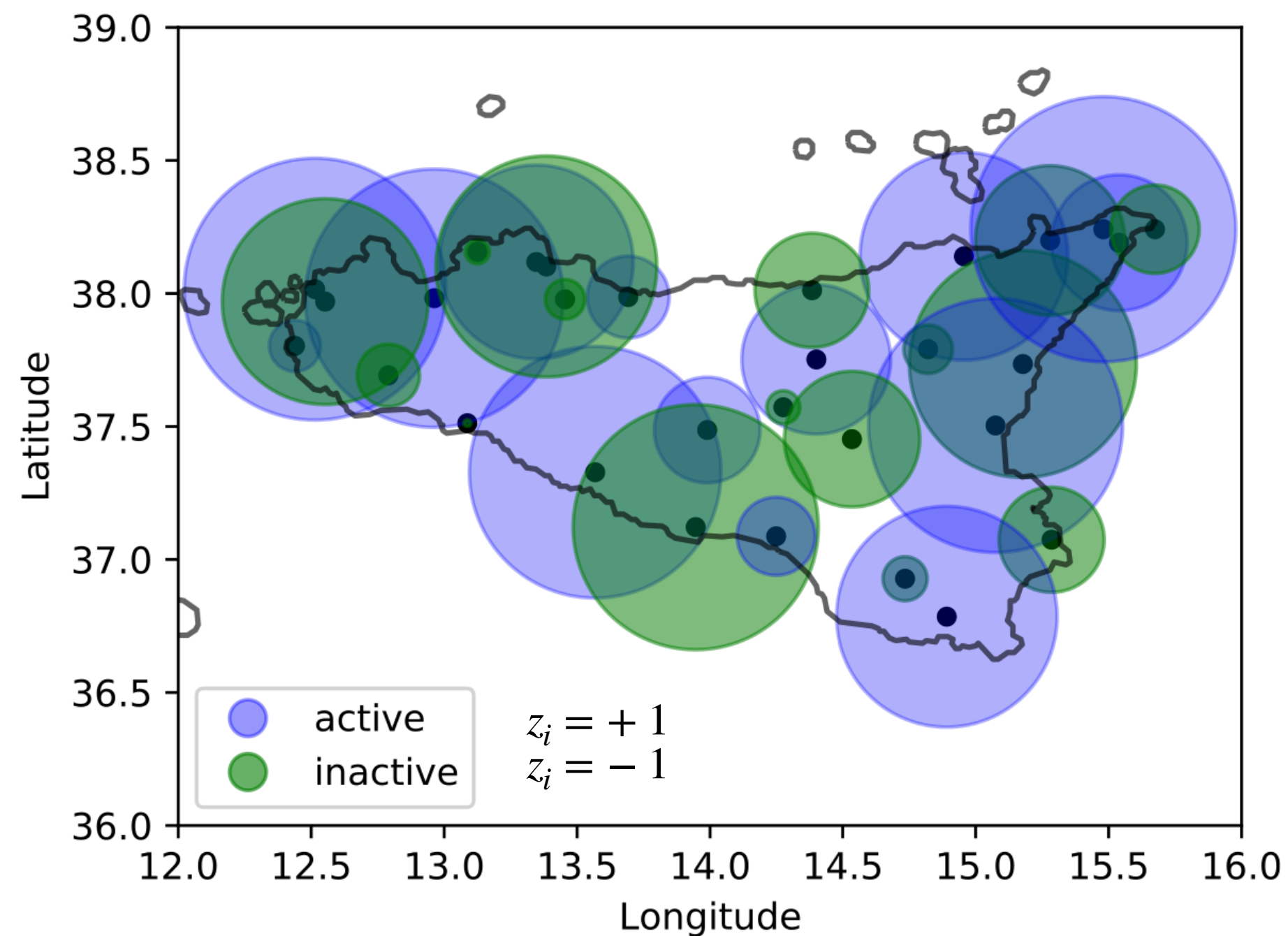
Tensor Network Hackathon

**Team 9: Optimizing Camera Placement
for Emergency Prevention and Response**

Pranay Naredi, Matteo Masto & Lukas Müllender, 22 May 2024

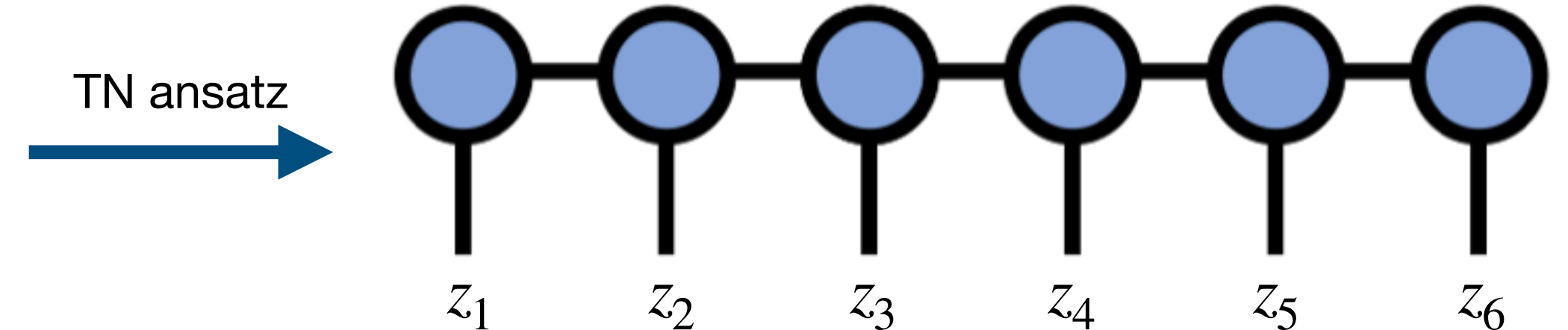
Introduction

Camera Placement problem in Ising formulation



$$H(z) = \sum_{i < j}^N W_{ij} z_i z_j - \xi \sum_{i=1}^N A_i z_i + P \left(\sum_{i=1}^N z_i - N + 2C \right)^2$$

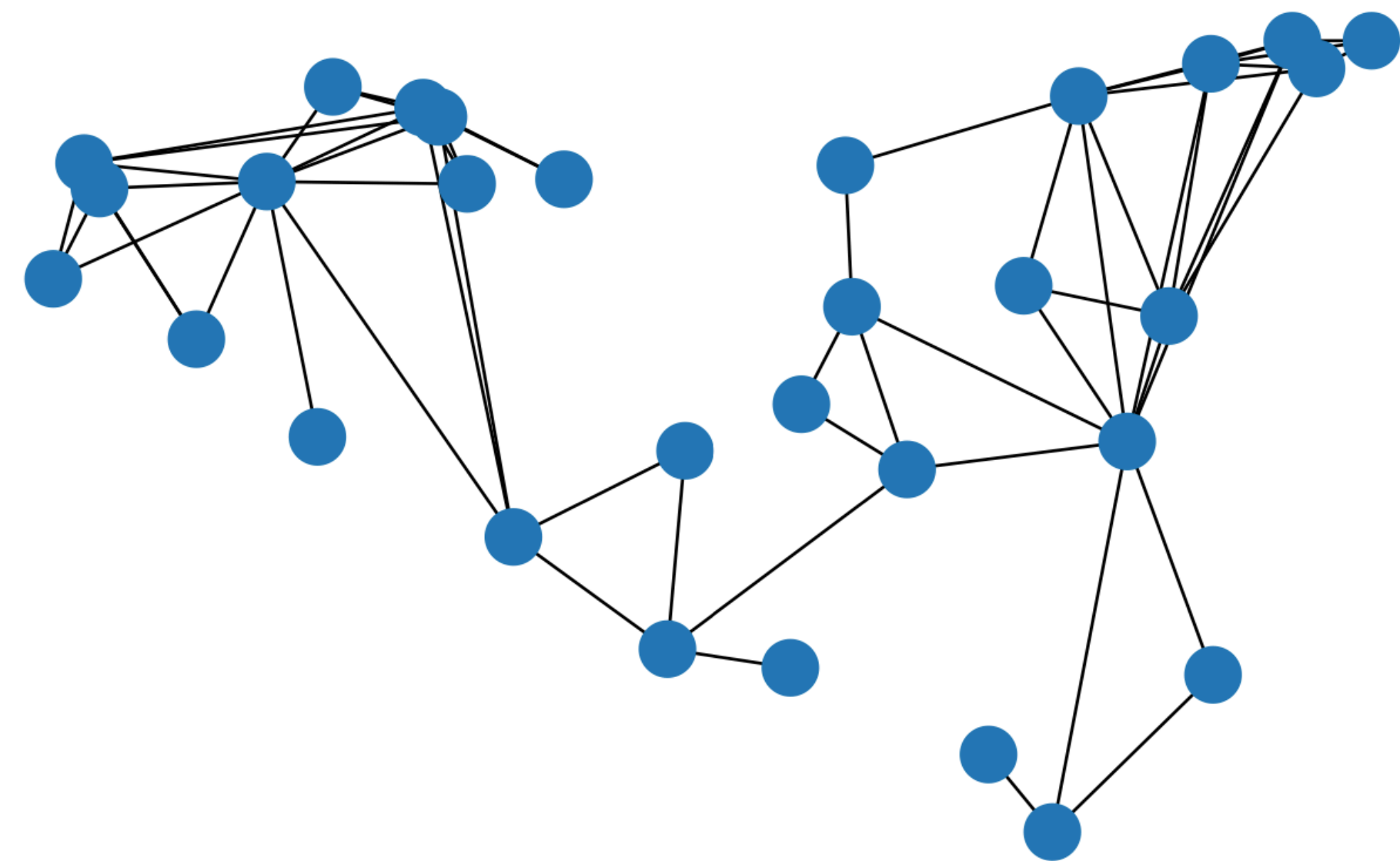
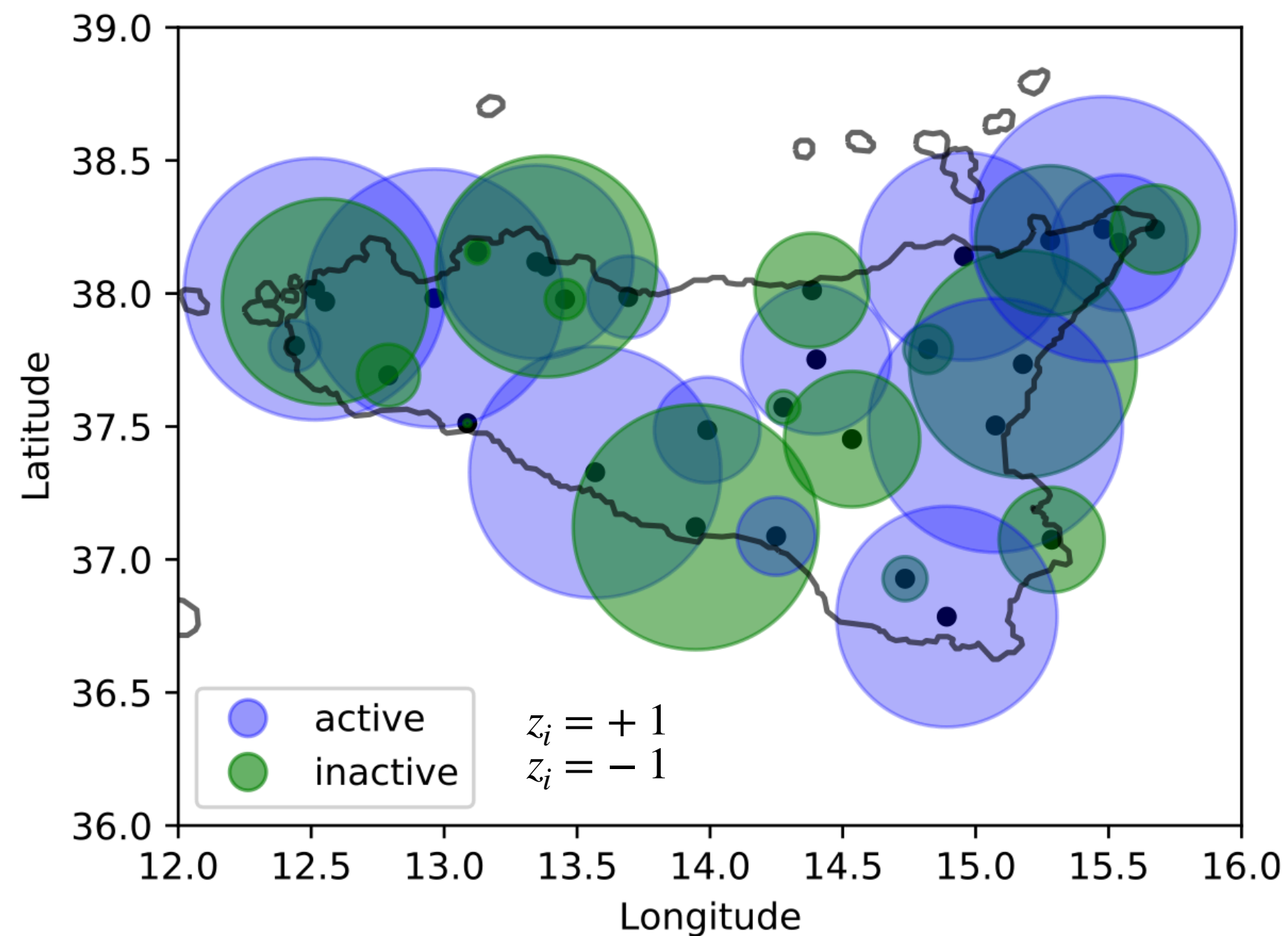
with penalty term P , available antennas C ,
relative multiplier $\xi = 0.25$



Ground state search with DMRG and imag. time evolution (ITE)

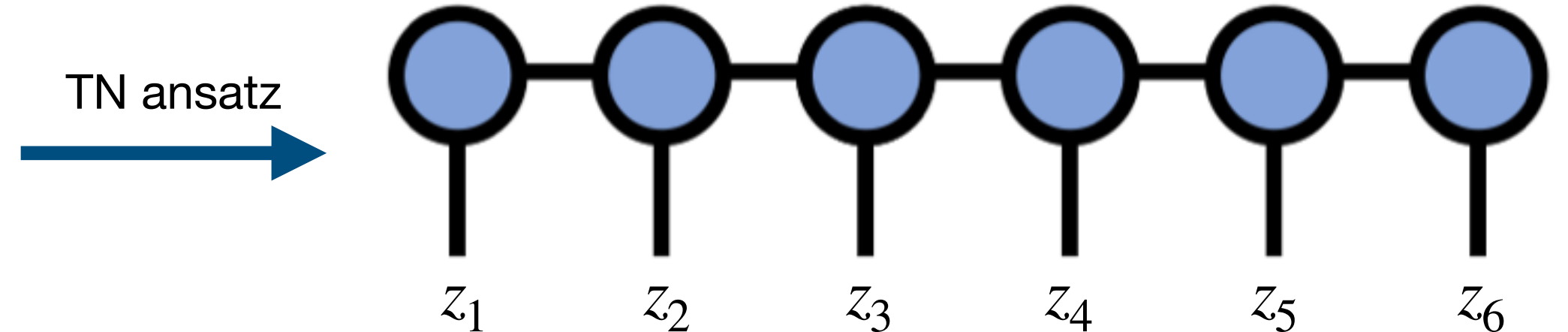
Introduction

Camera Placement problem: Constrained case



$$H(z) = \sum_{i < j}^N W_{ij} z_i z_j - \xi \sum_{i=1}^N A_i z_i + P \left(\sum_{i=1}^N z_i - N + 2C \right)^2$$

with penalty term P , available antennas C ,
relative multiplier $\xi = 0.25$

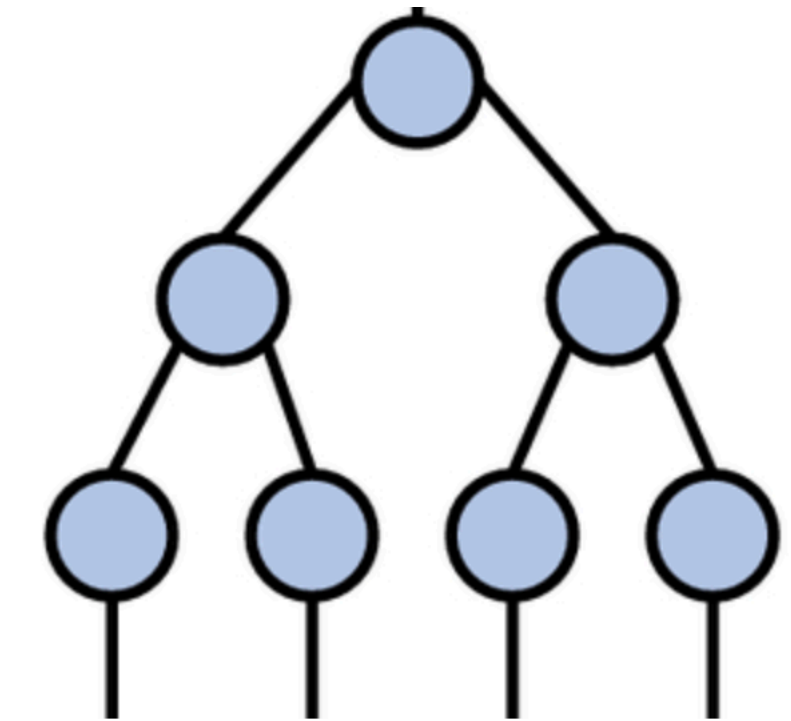
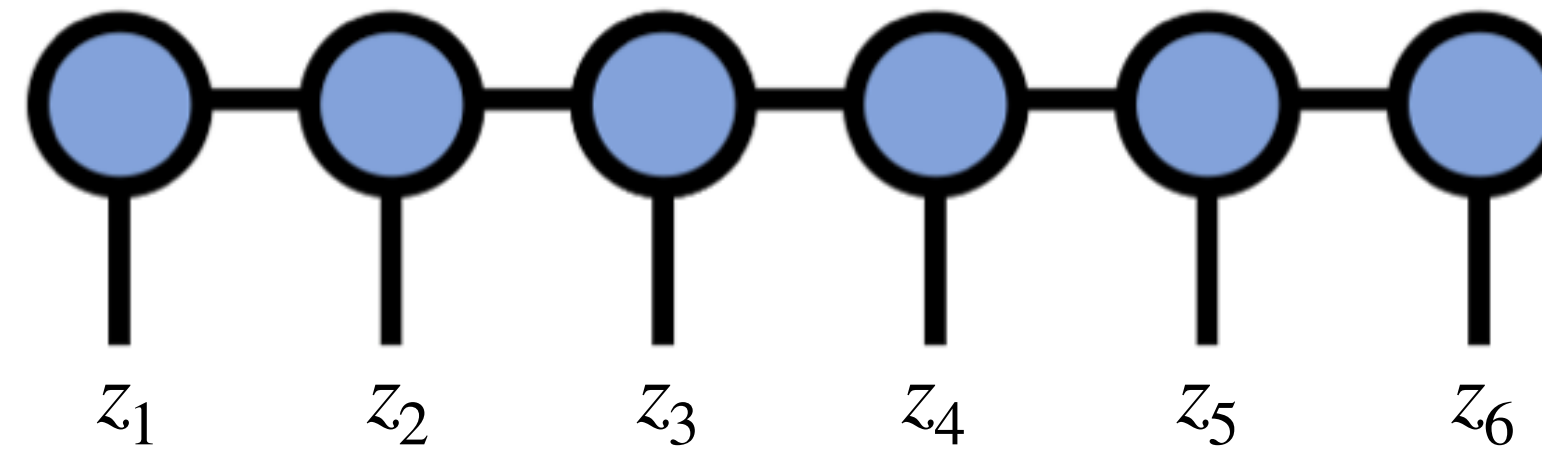


Ground state search with DMRG and imag. time evolution (ITE)

Introduction

Implementation

- Quantum Tea Leaves:

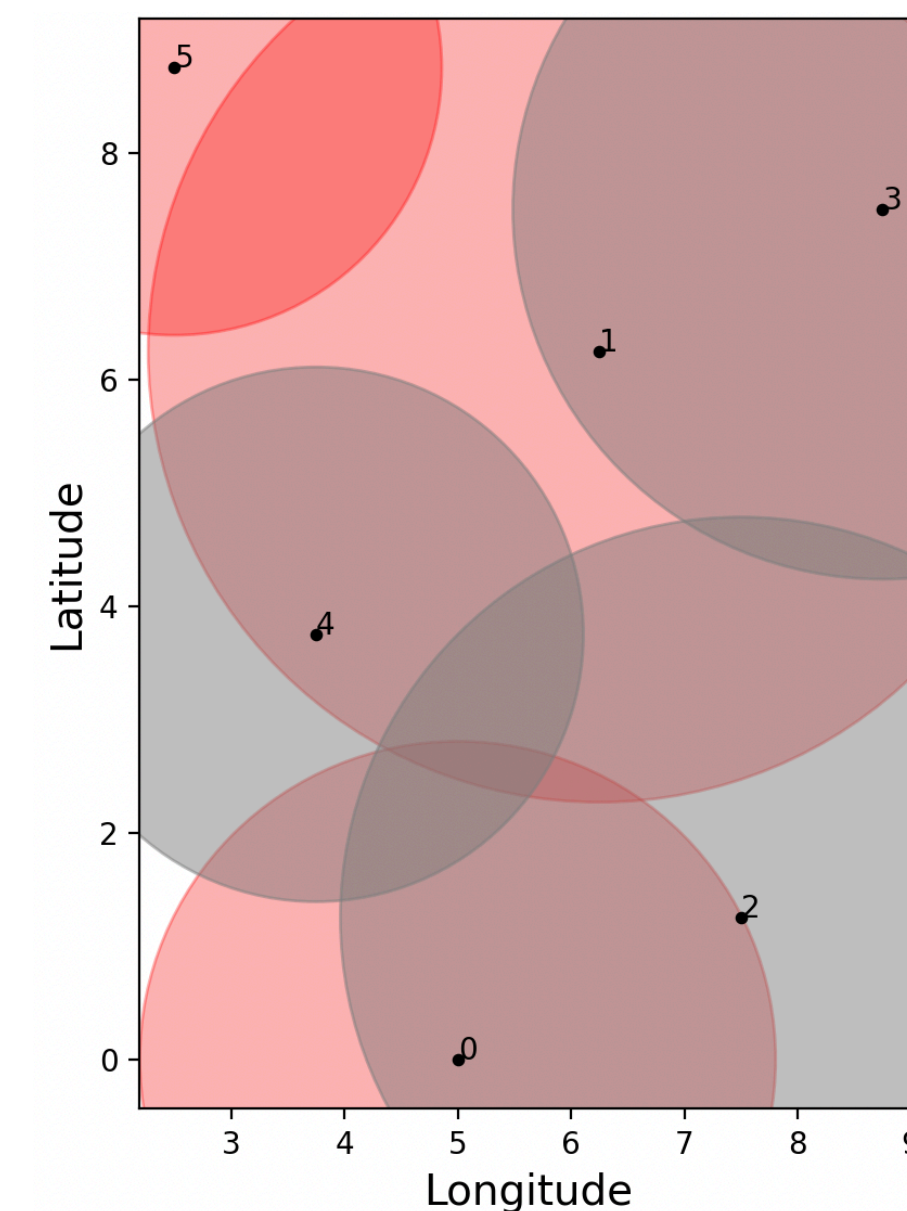
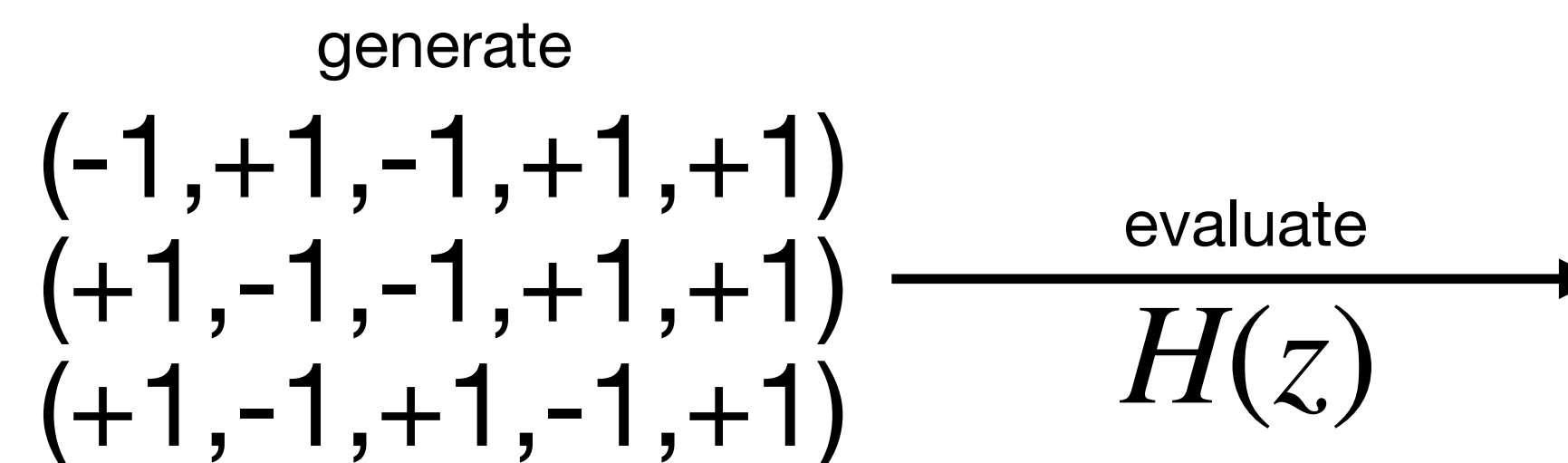


- Tensor network ansatz with MPS, TTN

$$\text{ITE: } t \rightarrow -i\tau, |\psi(t)\rangle = e^{-\tau\hat{H}} |\psi(t=0)\rangle$$

- Ground state search with DMRG, ITE

- Brute force:



- Commercial Solver: GUROBI



Ground state search via DMRG & ITE

Hyperparameter optimization

- To optimize:
 - Number of steps/sweeps
 - Bond dimension
 - Sweep order
 - Time-step (“temperature”)

Performance comparison

Time to solution

Performance comparison

Energy of the optimal solution