Energy-efficient sensor monitoring

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Abstract

- In a decentralized network, a sensing application (server) assigns tasks to available nodes.
- Tasks are assigned to nodes based on whether the node has the sensors to do the tasks.
- Each task-performing sensor has an associated cost with it. The sum of costs of all sensors in a node is equal to the cost of using a node.
- Node assignments are revisited later, but the initial assignment is important to ensure subsequent low costs.
- Different heuristics’ performances vary in terms of computation times and solution cost during initial assignment.

Background

- In [1], Shin et al defines a sensing condition and the system model for sensing.
- A sensing condition defines what sensors need to be used as part of the tasks assigned.
- The sensing condition is given as a conjunctive normal form (CNF) of n clauses, and each clause is a disjunction of m sensors.
- Example - (s_1, s_2, V s_3) (s_4, V s_5) (s_6) is a sensing condition with 3 clauses. Sensors to be covered in the initial assignment are s_1, s_2, s_3, s_4.

Methods

Given a set of nodes, each with a few random sensors with random costs, and a sensing condition, the goal is to find a set of nodes such that all sensors are covered by these nodes and the overall cost associated with the selected nodes is the minimum possible. I implemented and compared three algorithms.

- Simulated Annealing [2]

\[ \text{Move if cost of } (\text{current solution}) > \text{cost(neighbors)}. \]

- Best local search

\[ \text{Move if cost of } (\text{current solution}) = \text{cost(neighbors)}. \]

- Multiple entry points search

This is the best local search but with different random initial valid solutions.

Results

![Graph showing time and cost comparison](graph.png)

- Simulated Annealing
- Best local search
- Multiple start Cost

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<th>Number of helpers</th>
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<th>Best local search Time (in seconds)</th>
<th>Multiple start Time (in seconds)</th>
<th>Simulated Annealing Cost</th>
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References


Conclusions

- Simulated annealing gives the overall best results in terms of time and cost consistently over varying number of helpers.
- Best local search has times comparable to Simulated Annealing when the helper count is low, but deviates largely when the helper count increases.
- Best local search gives better costs for some tests compared to Simulated Annealing, but this is offset by the time it takes to achieve the results.
- Multiple entry points search gives the best results in terms of costs for all the tests, but it gets beat by the time taken to achieve them.