Mini-task report: SDC with simulated annealing

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1 Introduction

The task was to implement a simulated annealing approach (SA) for SDC (system of difference constraints). LPsolve is used to get a schedule for a given set of constraints. The SA-algorithm mutates the order of the constraints to reduce the number of clock cycles of the schedule.

2 Simulated Annealing

The principal structure of any simulated annealing looks like this:

```
S = RandomConfiguration();
T = InitialTemperature();
while (ExitCriterion()==false) {
  while (InnerLoopCriterion() == false) {
    S_new = Generate(S);
    Δ C = Cost(S_new)-Cost(S);
    r = random(0,1);
    if (r < e^(-ΔC/T)) S = S_new
  }
  T = updateTemperature();
}
```

The implementation is located in scheduler/SASDC.java:schedule. The parameters are:

- *Random Configuration* ...
- *Initial Temperature* is determined by applying n(nodes) random changes and saving the costs of each change. T is then $20 * standardDeviation(costs)$.
- *Exit Criterion* is the condition, when the simulated annealing should stop. For each temperature, the number of applied changes and the number of accepted changes is counted. When less then 12% of the changes are accepted, the algorithm stops.
- *Update Temperature* decreases T by a factor tu, which depends on the acceptance ratio as well:

acceptance ratio (ar)	temperature factor (tu)
> 96%	0.5
96 .. 80%	0.9
80 .. 15%	0.95
< 15%	0.8

- *Inner Loop Criterion* determines, how many changes are tested for the same temperature. Each change usually moves one node in the ordering of constraint-equations. The larger the number of nodes becomes, the more often each node should be moved, so the number of iterations should depend on the node count. Further more, there is a quality factor $\in [1..10]$ for the algorithm, which can be passed via the third program argument. The formula $n_{inner} = \left\lceil quality * n_{nodes}^{4/3} \right\rceil$ is known to yield a result, thats quality belongs to the given quality.

3 Conclusion