Simulated Annealing for Makespan Scheduling

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Overview

- **Simulated Annealing**
  - Cooling Schedule
  - Initial Temperature
- **Experimental Results**
- **Comparison to Greedy Local Search and Variable-Depth Search**

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Simulated Annealing: Pseudo-code

- Allows moving to a worse solution* more here
- Slight modification to track the best solution found by the algorithm
- Free parameters:
  1. Neighbourhood: 2-exchange “jump”
  2. Cooling schedule
  3. Initial temperature value

Simulated Annealing: Cooling Schedules

- **4 different cooling schedules considered:**

1. Exponential multiplicative: $f_1(T_0, I) = T_0 \cdot \mu^I$
2. Simple exponential: $f_2(T_0, I) = T_0 - I$
3. Linear multiplicative: $f_3(T_0, I) = \frac{1}{1+I} \cdot T_0$
4. Quadratic multiplicative: $f_4(T_0, I) = \frac{1}{1+I^2} \cdot T_0$

Simulated Annealing: Initial Temperature

- Good choice of initial temperature depends largely on instance
- Recursive? algorithm by Ben-Ameur [1]:
  - Generates a temperature so that the probability of accepting a cost increase is equal to a specified value

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Experiments: Research Questions

1. Which **cooling schedule** performs best?

2. Is the algorithm for the generation of the **initial temperature** efficient?

3. How does the performance of Simulated Annealing **compare to GLS and VDS**?

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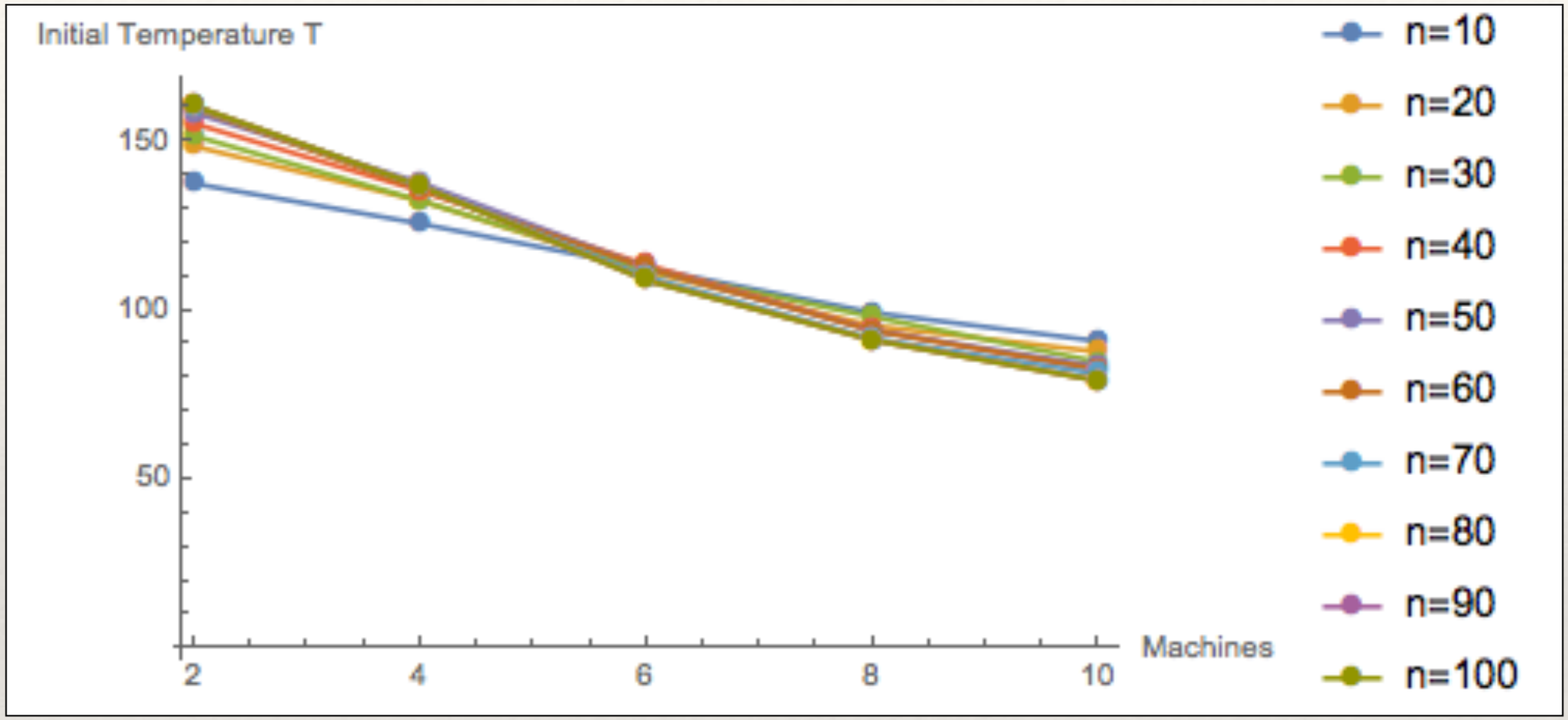
Experiments: Initial Temperature

- Including initial temperature algorithm as part of Simulated Annealing is not time efficient
- Temperatures generated for a range of instances of different sizes

Experiments: Initial Temperature



- Conclusion: choose initial temperature to be 1.5 times the maximum processing time

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   - Best method: choose T_0 to be 1.5 times the maximum processing time
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Experiments: GLS & VDS Comparison

Summary

- We applied Simulated Annealing to the Makespan Scheduling problem
- Different cooling schedules were investigated
- Simulated Annealing found to be superior to GLS and VDS

Thank you!

References

1. Ben-Ameur, W. (2004). *Computing the initial temperature of simulated annealing. Computational Optimization and Applications*, 29(3):369–385.