Project 2 Report

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The Simulated Annealing (SA) algorithm is applied to solve a real-world job shop scheduling problem, which involves scheduling jobs on multiple machines to minimize the overall completion time (makespan). The algorithm starts with an initial temperature (T) and generates a random initial job schedule. The algorithm then explores neighboring solutions by swapping job orders and accepts worse solutions probabilistically based on a cooling schedule. The makespan value is calculated based on the operations schedule, considering start and end times on each machine. A reflection on the Simulated Annealing algorithm's success is provided, highlighting its ability to find near-optimal solutions while acknowledging potential limitations.

R3: Algorithm 1 is to simulate annealing for job shop scheduling. Initialize the temperature ‘T’ to a value and create an initial job schedule randomly. Then generate neighboring solutions by swapping random jobs in the current schedule. The code will allocate operations and accept better or worse solutions based on the annealing principles. This will decrease the temperature and repeat the process for a specific number of iterations. Algorithm 3 converts job schedules into an operations schedule for job shop scheduling. This ensures strict sequencing of job operations and allocates operations to machines based on availability. Algorithm 3 is designed to calculate the makespan value based on an input operation schedule list. The makespan value is based on an input operation schedule list, and it represents the total time taken to complete all operations in the schedule.

R4: The operation times are randomly generated in the range of [5, 50] and the jobs need to be scheduled to 5 machines. After applying the simulated annealing algorithm, we will calculate the makespan and compare it to the initial random solution. The makespan value returned by the SA algorithm is 1021 when scheduled to 5 machines.

R5: The operation times are randomly generated in the range of [5, 50] and the jobs need to be scheduled to 3 machines and 5 operations per job. After applying the simulated annealing algorithm, we will calculate the makespan and compare it to the initial random solution. The optimized solution makespan value returned by the SA algorithm is 2384 when scheduled to 3 machines. The best schedule for 3 machines and 5 jobs is [3, 32, 34, 10, 4, 42, 31, 11, 28, 37, 49, 48, 24, 21, 30, 2, 27, 20, 39, 9, 13, 38, 8, 26, 6, 41, 5, 40, 36, 0, 14, 17, 12, 45, 1, 18, 44, 16, 47, 43, 23, 7, 29, 33, 19, 22, 46, 15, 25, 35].

R6: The simulated annealing algorithm demonstrates optimizing the job shop scheduling problem for jobs and operations scheduled across multiple machines. The SA agent's job is to generate a solution by optimizing the allocation of operations to machines which results in a schedule that minimizes the overall makespan.

The SA algorithm’s performance relies on the initial random solution and the impact of the final makespan achieved. The optimal solution is not always guaranteed because of complex problems with many jobs, machines, and operations. The SA algorithm’s success rate could increase by enhancing neighborhood search and implementing search strategies such as local search operators. The SA algorithm is used to provide reasonable solutions for job shop scheduling problems with given parameters.

Google Colab link:

https://colab.research.google.com/drive/1aKHw2gqb15_5t8syQt26iuXN03bNMV2v?usp=sharing#scrollTo=lAnwoI0Alkmu