Simulation of Travelling Salesman Problem

Group B

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Presentation Outline

Introduction

- is a procedure of determining the shortest route to minimise the total distance travelled and travel cost
- the total length of the loop should be a minimum
- the salesperson cannot be at two different places at a particular time
- the salesperson should visit each city only once

Objectives

- to be an educational resource to help visualise, learn, and develop different algorithms for the travelling salesman problem in a way that's easily accessible
- to figure out the syntax and semantics of how JavaScript, HTML and CSS works as a whole
- to understand the basic framework, current applications and future scope of the algorithm
- to demonstrate the functionality of 'Branch and Bound' and 'Simulated Annealing' algorithm and site design using JavaScript as the core programming language

Literature Review

- **1800s - Sir William Rowan Hamilton** and **Thomas PenyngtonKirkman** looked for shortest distance
- **1930s - Hassler Whitney** at Princeton University, main proponent of the problem
- **1930s - Studied by Karl Menger** from Hassler Whitney and Merrill Flood at Princeton

Literature Review

- **1950s** - **George Dantzig**, **Delbert Ray Fulkerson** and **Selmer M. Johnson** made notable contributions at the RAND Corporation in Santa Monica
- **1960s** - Integer linear program and developed the cutting plane method for its solution and solved an instance with 49 cities to optimality by constructing a tour and proving that no other tour could be shorter
- **1972** - **Richard M. Karp** showed in that the Hamiltonian cycle problem was NP-complete
- **1990** - **Applegate, Bixby, Chvátal,** and **Cook** developed the program Concorde

Literature Review

Research Team	Year	Size of Instance
G. Dantzig, R. Fulkerson, and S. Johnson	1954	49 cities
M. Held and R.M. Karp	1971	64 cities
P.M. Camerini, L. Fratta, and F. Maffioli	1975	100 cities
M. Grötschel	1977	120 cities
H. Crowder and M.W. Padberg	1980	318 cities
M. Padberg and G. Rinaldi	1987	532 cities
M. Grötschel and O. Holland	1987	666 cities
M. Padberg and G. Rinaldi	1987	2,392 cities
D. Applegate, R. Bixby, V. Chvátal, and	1994	7,397 cities

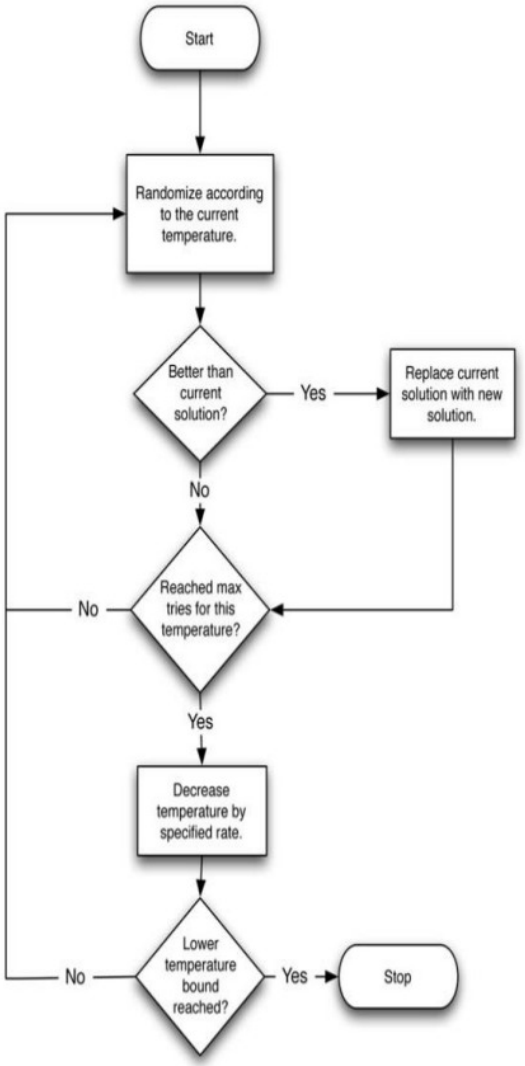
Methodology

- Simulated Annealing
- Branch and Bound

Simulated Annealing

- Thermal process for obtaining low energies of solid in heat bath
- Process
  - Increase temperature of heat bath to maximum value at which solid melts
  - Decrease temperature of heat bath until particles arrange themselves in ground state, i.e, its minimum energy state.

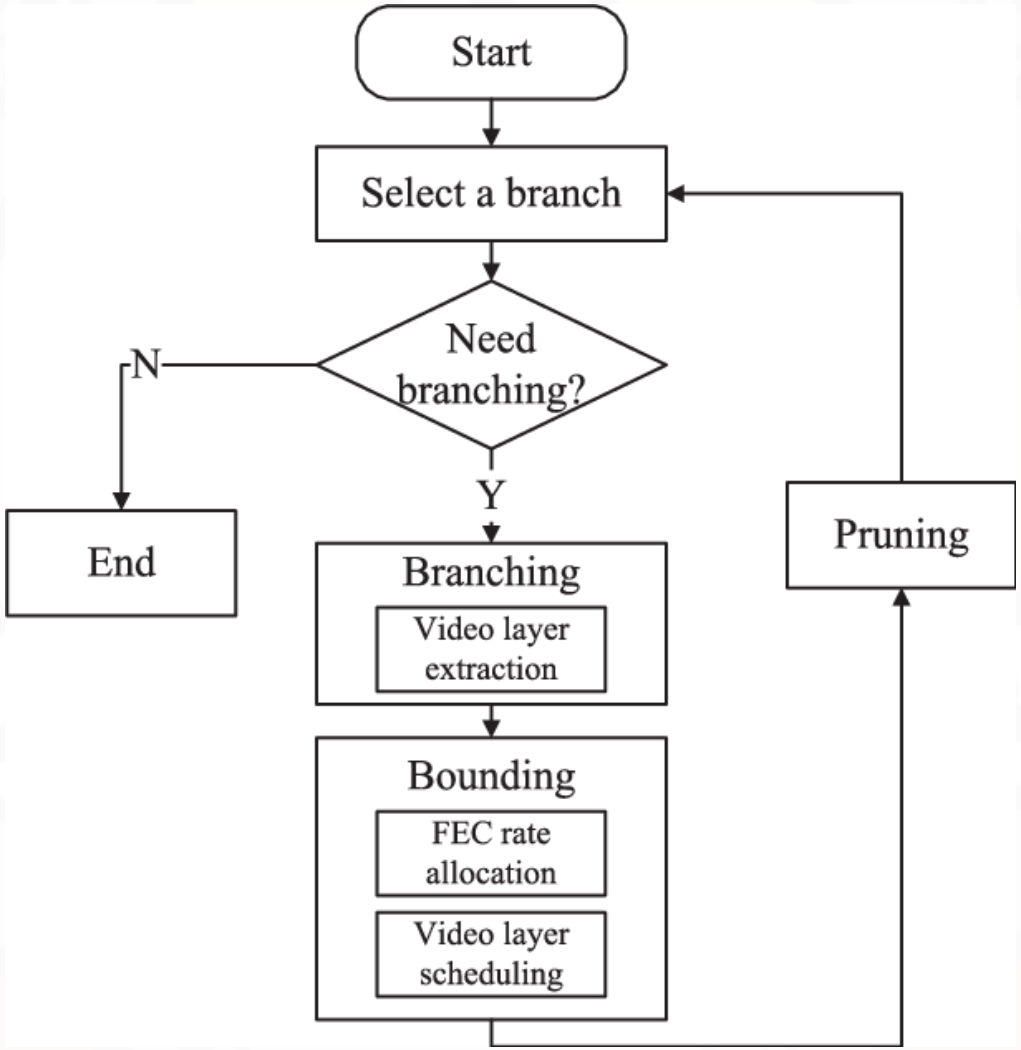
Simulated Annealing



Branch and Bound

- the process of generating sub-problem
- refers to ignoring partial solutions that cannot be better than the current best solution
- a search procedure to find the optimal solution
- eliminates those parts of a search space which does not contain better solution
- method of extending the cheapest partial path

Branch and Bound



Comparison of Algorithms

- Speed Difference

Algorithm	No of cities	Execution Time (in min)
Simulated Annealing	4	1.3523
	6	0.5742
	10	0.4734
	12	0.3046
Branch and Bound	4	0.0114
	6	0.0347
	10	0.0645
	12	0.0987

Comparison of Algorithms

- Performance Evaluation

Algorithm	Feasible Solution	Optimal Result	Ease of Implementation	Simplicity
Simulated Annealing	☒	☐	☒	☒
Branch and Bound	☒	☒	☐	☐

Result

- Index Page
- Simulated Annealing
- Branch and Bound

Conclusion

- many algorithms for solving Traveling Salesman Problem
- not a fixed algorithm exist for optimal solution
- knowledge on coding and subject interest

References

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