# ****Simulated Annealing Algorithm****

\***The simulated annealing algorithm** is a local search algorithm, accepts cost decreasing solution neighbors and avoids getting trapped in a local minimum by also accepting cost increasing solution neighbors with certain probability.

\***The probability of accepting**:

P ----> 1, if f\_new <= f\_prev

----> exp(-(f\_new – f\_prev)/t), if f\_new > f\_prev

\* **Simulated annealing results over 10 runs**:

\*\* **Approach\_1:-**

temp = 1000

temp\_modifier = 0.99

temp = temp \* temp\_modifier

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Instance | Time Limit | Best | Average | Std |
| 1 | 3s | 1396 | 1448.3 | 36.3815 |
| 2 | 3s | 1498 | 1498 | 0 |
| 3 | 3s | 8582 | 8769.9 | 133.851 |
| 4 | 5s | 17445 | 18323.1 | 326.485 |
| 5 | 5s | 730 | 836.7 | 69.9029 |
| 6 | 5s | 2461 | 3507.6 | 474.737 |
| 7 | 15s | 31880 | 33441.4 | 967.959 |
| 8 | 15s | 4238 | 4282.1 | 35.1581 |
| 9 | 15s | 85437 | 96150.2 | 7168.9 |
| 10 | 15s | 110944 | 126501 | 7842.09 |
| 11 | 15s | 58718 | 67162 | 5301.25 |
| 12 | 15s | 97222 | 108555 | 4720.39 |
| 13 | 15s | 133038 | 146169 | 9113.4 |
| 14 | 15s | - | - | - |

\*\* **Approach\_2:-**

temp = 1000

rate\_of\_cooling = 0.005

temp = temp \* (1 - rate\_of\_cooling)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Instance | Time Limit | Best | Average | Std |
| 1 | 3s | 1396 | 1461.4 | 27.6955 |
| 2 | 3s | 1498 | 1498 | 0 |
| 3 | 3s | 8582 | 8769.9 | 133.851 |
| 4 | 5s | 17445 | 18323.1 | 326.485 |
| 5 | 5s | 728 | 796.3 | 58.5133 |
| 6 | 5s | 2950 | 3441 | 247.894 |
| 7 | 15s | 32409 | 33856.5 | 1518.84 |
| 8 | 15s | 4191 | 4282.3 | 37.9079 |
| 9 | 15s | 90727 | 100322 | 6926.16 |
| 10 | 15s | 118998 | 126118 | 7089.58 |
| 11 | 15s | 45220 | 66267.4 | 7924.74 |
| 12 | 15s | 99017 | 113497 | 6396.7 |
| 13 | 15s | 126353 | 138766 | 6737.85 |
| 14 | 15s | - | - | - |

\*\***Approach\_3:-** (**List Based Simulated Annealing**)

P0 = 0.9

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Instance | Time Limit | Best | Average | Std | Initial temp list size |
| 1 | 3s | 1396 | 1434.9 | 38.6974 | 120 |
| 2 | 3s | 1498 | 1498 | 0 | 120 |
| 3 | 3s | 8582 | 8769.9 | 133.851 | 120 |
| 4 | 5s | 17445 | 18323.1 | 326.485 | 120 |
| 5 | 5s | 815 | 869.4 | 48.3988 | 120 |
| 6 | 5s | 2646 | 3984 | 515.574 | 120 |
| 7 | 15s | 32676 | 33898.8 | 1005.43 | 100 |
| 8 | 15s | 4238 | 4312.3 | 33.7107 | 100 |
| 9 | 15s | 82183 | 95135.2 | 9295.1 | 100 |
| 10 | 15s | 134799 | 202296 | 70971.2 | 100 |
| 11 | 15s | 52455 | 62462 | 5848.79 | 100 |
| 12 | 15s | 84837 | 102776 | 7048.61 | 100 |
| 13 | 15s | 124727 | 136248 | 7195.73 | 100 |
| 14 | 15s | - | - | - | 100 |