Exercises

1.1-1 Real world example that requires sorting :

(i) Arranging books in increasing order of dimension.

Real world example that requires finding the shortest distance between two points :

(i) Finding the shortest route to go from my home to the milk shop and returning back.

1.1-2 other than speed other measures of efficiency might be:

(i) Cost efficiency

(ii) Energy efficiency

(iii) Labor efficiency

(iv) Environmental efficiency

1.1-3 Array :

Strengths	Limitations
(i) Instant access time	(i) Fixed size
(ii) Memory efficient	(ii) Bad for insertions and deletions
(iii) Good for iteration	(iii) Static in nature
(iv) Works well with fixed set of elements and static in nature.	(iv) Capable of storing only homogenous elements.

1.1-4 Shortest path problem and Travelling salesman problem:

Similarities	Differences
(i) Both aims to find the shortest route between specific nodes.	(i) Shortest route algorithm includes finding the shortest possible path between two nodes, but TSP involves finding the shortest possible path between multiple nodes and returning back to the original initial node.
(ii) Both have same combinatorial nature. i.e) both uses graphs as the basis to optimise the problem using nodes and edges.	(ii) Finding shortest route can be achieved through various established algorithms, but TSP is an NP-complete problem with no well established algorithms.

Exercises

1.2-1 Route finding algorithm.

1.2-2 Suppose a computer takes 1 instruction/second for an operation.

Now, $n = 1000$

Insertion sort : $8 \times (1000)^2 = 8 \times 1000 \times 1000$
$= 8 \times 10^6$ sec

Merge sort : $64\ 1000\ \log_2(1000) = 64 \times 10^3 \times 3$
$= 192 \times 10^3$ sec

For, $n = 100$

Insertion Sort : $8 \times 100 \times 100 = 8 \times 10^4$ sec

Merge Sort : $64 \times 100 \times \log_2(100) = 128 \times 10^2$ sec

For, $n = 10$

Insertion Sort : 8×10^2 sec $= 800$ sec

Merge sort : $64 \times 10 \times 1 = 640$ sec

For, $n = 5$

Insertion Sort : $8 \times 25 = 200$ sec

Merge Sort : $64 \times 5 \times \log(\frac{10}{2}) = 64 \times 5 \times 0.69$
$= 320 \times 0.69$
$= 320 \times (\approx 0.7)$
$= 224.0$
$= 224$ sec (approx.)

Therefore, for $n = 5$, the insertion sort beats merge sort.

1.2-3 For $n = 1$:

100 sec
$2^1 = 2$ sec

For $n = 10$

$100 \times 10^2 = 100 \times 100 = 10^4$ sec $= 10000$ sec

$2^{10} = 1024$ sec

For $n = 15$

$100 \times 15^2 = 15^2 \times 10^2 = 225 \times 100$
$= 22500$ sec

$2^{15} = \boxed{32768 \text{ sec}}$

For $n = 14$

$100 \times 14^2 = 19600$ sec

$2^{14} = 16384$ sec