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RONAH

Solutions

SECTION A

Question One

(a) The traveling salesman problem (TSP) is ~~t~~ one of the most well studied combinatorial optimization problems. It has broad applications in logistics, planning and DNA sequencing. It asks the following question;

Given a list of cities and the distances between each pair of cities, what is the shortest possible route that visits each city and returns to the origin city.

Formally, for a set of cities [n] = {1, 2, ---n} [n] = {1, 2, ---n}, an n-by-n matrix $C = (C_{ij})$, where $c_{ij} \geq 0$ $c_{ij} \geq 0$ specifies the cost of traveling from city i to city j. By convention, we assume $C_{ii} = 0$ $c_{ii} = 0$ and $C_{ij} = C_{ji}$ $c_{ij} = c_{ji}$, meaning that the cost of traveling from city i to city j is equal to the cost of traveling from city j to city i. Furthermore, we only consider the metric TSP in this article; that is the triangle inequality.

(b)

From/To	Denver	Edmonton	Fargo
Austin	250	400	350
Boston	400	600	350
Chicago	200	400	250
Total	850	1400	950

~~I would se~~ I would send each of the salespeople to Denver in order to optimize airfare.

(c) TSP approximation is ~~used~~ applied in the following areas;

~~Drill~~ Drilling of printed circuit boards to connect a conductor on one layer with a conductor on another layer.

X-ray crystallography to obtain information about the structure of crystalline material.

Computer wiring to connect components on a computer boar.

Mask plotting in PCB production for the production of each layer of printed circuit board as well as for layers of integrated semiconductor devices.

Question 2

(i) System modelling is the process of developing abstract models of a system with each model presenting a different view or perspective of that system.

(ii) System Optimization refers to the activity of enhancing system capabilities and integration of subsystem elements to the extent that all components operate at or above user expectations.

(b) (i) Total cost for both machines

Total cost = Set up cost + Tooling up cost + machining cost.

for 60min the cost = 40Rs

for 90min the cost = 60Rs

Tooling up cost = 600Rs.

Machining cost = 8000Rs

Total cost = 60 + 600 + 8000

For machine M1

Total cost = 8660Rs.

For machine M_2

Total cost = 7980Rs

∴ Machine M_2 is will give an optimum solution in producing 1000 pieces.

(ii) Machine M_2 is appropriate to produce 100 pieces since it incurs the lowest total cost.

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SECTION B

Question One

(a) A heuristic algorithm is one that is designed to solve a problem in a faster and more efficient fashion than traditional methods by sacrificing optimality, accuracy, precision or completeness for speed.

(b) MaxiMax Gain looks at the best that could happen under each action and then chooses the action with the largest value. It assumes that they will ~~to~~ get the most possible and then they take the action with the best case scenario. The maximum of the maximums or the best of the best.

(i) Identifying the maximum payoff for each alternative
For model A = shs. 60000
For model B = shs. 78000

∴ The highest maximum payoff is = shs. 78000.

Identifying the minimum payoff for each alternative
For model A = shs. 28000
For model B = shs. 30000

The highest minimum payoff is shs. 30000.

∴ Model B will yield optimum solution.

(ii) Using Hurwicz: $\alpha = 0.7$
Weighted average for each alternative = α(maximum in row) + $(1-\alpha)$(minimum in row)

For model A = $0.7(60000) + (1-\alpha)(28000)$
= $42000 + 8400$
= shs. 50400

For model B = $(0.7)(78000) + (1-0.7)(30000)$
= $54600 + 9000$
= shs. 63600

∴ Model B will give the optimum solution.

Question three

a) Modeling refers to the use of computers to stimulate and study complex systems using mathematics, physics and computer science.

b) Let x = ski pants any y = ski jackets. Since there can't be negative pants or jackets

$x \geq 0$, $y \geq 0$

(i) ~~Cutter~~ Equations for the cutters' time to make pants and jackets

$4x + 8y \leq 48$

Equations for sewing operators' time to make pants and jackets.

$8x + 4y \leq 60$

(ii) Anticipated profit

$2x + 1.5y = f(x, y)$

constraints:

$4x + 8y \leq 48$ --- (i)

$8x + 4y \leq 60$ --- (ii)

For constraint (i)

$4x + 8y \leq 48$

x	y
0	12
6	0

For constraint (ii)

$8x + 4y \leq 60$

x	y
0	
15	0

Question five

(a) (i) Shortest route problem is one of network optimization problems that aims to define the shortest path from one node to another.

(ii) Minimal spanning tree problem is to find a spanning tree with least types of labels if each edge in a graph is associated with a label from a finite label set instead of a weight.

(iii) Maximal flow problem involves finding a feasible flow through a single-source, single-sink flow network that is maximum.

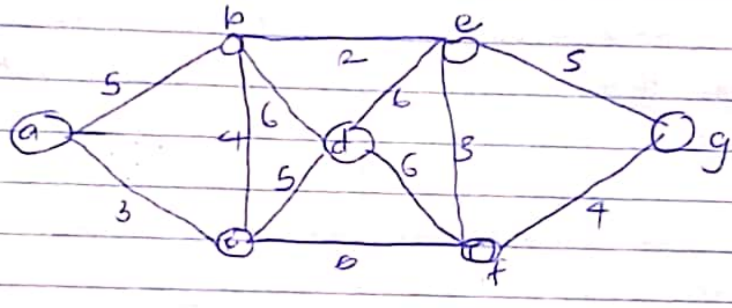
(b) The following are the algorithms in (a) above:

Bellman Ford's Algorithm; This is used to find the shortest paths from the source vertex to all other vertices in a weighted graph. It depends on the following concept: Shortest path contains at most n-1 edges, because the shortest path couldn't have a cycle.

Kruskal's Algorithm; It builds the spanning tree by adding edges one by one into a growing spanning tree. Kruskal's algorithm follows greedy approach as in each iteration; it finds an edge which has least weight and add it to the growing.

The Ford-Fulkerson algorithm: This is an algorithm that tackles the max-flow min-cut problem that is given a network with vertices ~~that have certain weights~~, and edges between those vertices that have certain weights, how much flow can the network process at a time? Flow typically means data through a computer spanning tree.

(c)



from the source a to the sink g, the minimal route is a to c, c to b, b to e, e to f, f to g

∴ The minimal route is (3, 4, 2, 3, 4)

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