Exam 1 Learning Objectives

Chapter 1 - Urban Services

- Determine by observation if a graph is connected and which vertices are adjacent.
- Identify vertices and edges of a given graph.
- Construct the graph of a given street network.
- Determine by observation the valence of each vertex of a graph.
- Define an Euler circuit.
- List the two conditions for the existence of an Euler circuit.
- Determine whether a graph contains an Euler circuit.
- If a graph contains an Euler circuit, list one such circuit by identifying the order of vertices in the circuit's path.
- If a graph does not contain an Euler circuit, add a minimum number of edges to eulerize the graph.
- Identify management science problems whose solutions involve Euler circuits.

Chapter 2 - Business Efficiency

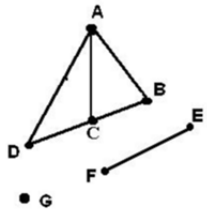
- Write in your own words the definition of a Hamiltonian circuit.
- Explain the difference between an Euler circuit and a Hamiltonian circuit.
- Identify a given application as being an Euler circuit problem or a Hamiltonian circuit problem.
- Calculate $n!$ for a given value of n.
- Apply the formula to calculate the number of routes that visit each vertex exactly once, the number of Hamiltonian circuits, and the number of Hamiltonian circuits with a given starting city in a complete graph with n vertices.
- Explain the term heuristic algorithm and list both an advantage and a disadvantage of using this algorithm.
- Use the nearest-neighbor algorithm to find an approximate solution to the Traveling Salesman Problem.
- Find an approximate solution to the Traveling Salesman Problem by applying the sorted-edges algorithm.
- Create a spanning tree from a given graph.
- Determine from a weighted-edges graph a minimum-cost spanning tree using Kruskal's algorithm.
- Identify the critical path on an order-requirement digraph.
- Find the earliest possible completion time for a collection of tasks by analyzing its critical path.

Chapter 3 - Planning and Scheduling

- Schedule tasks using the list processing method on a Gantt chart.
- Use the critical path scheduling method to create a priority list.
- Compute the lower bound on the completion time for a list of independent tasks on a given number of processors.
- Apply the list-processing algorithm to schedule independent tasks on identical processors using a given priority list or using the decreasing time list.
- When given an order-requirement digraph, apply the list-processing algorithm to schedule a list of tasks subject to the digraph.
- Given an application, determine whether its solution is found by the list-processing algorithm or by one of the bin-packing algorithms.
- Solve a bin-packing problem by using the following algorithms
    - next-fit (decreasing or not)
    - first-fit algorithm (decreasing or not)
    - best-fit decreasing algorithm (decreasing or not)
    - worst-fit decreasing algorithm (decreasing or not)

Exam 1 Practice Problems

1. Answer the following questions about the graph below:



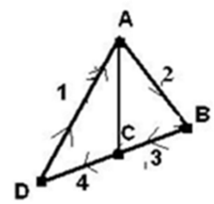
a) How many vertices does the graph have?

b) How many edges does the graph have?

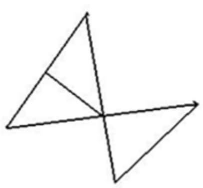
c) Is the graph connected? If it is not connected, how many components does it have?

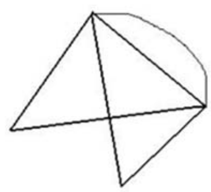
d) Write down the valences of all vertices:

2. Classify the path on the graph to the right. Mark all true answers.
(A) Not a circuit
(B) A circuit
(C) An Euler circuit
(D) A Hamiltonian circuit
(E) Not a path

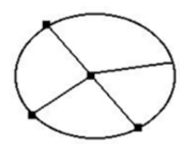


3. Do the graphs below have an Euler circuits? If not, explain why. If yes, find such a circuit

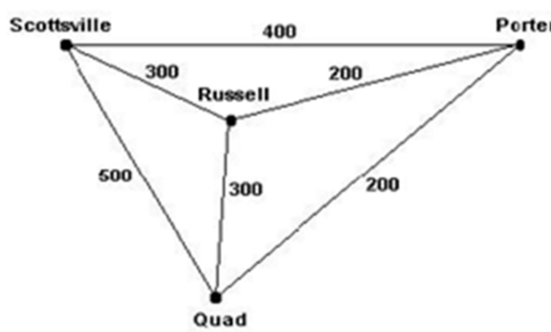




4. Eulerize the following graph by adding some extra edges (do not find Euler circuit!).



5. Use the nearest neighbor algorithm starting at Scottsville to solve the traveling salesman problem for the graph of the four cities shown on the right. How many different Hamiltonian circuits exist on this graph?

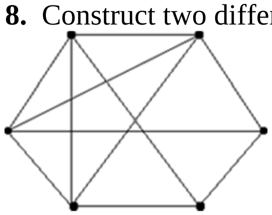


6. How many different Hamiltonian circuits exist on a complete graph with 6 vertices?

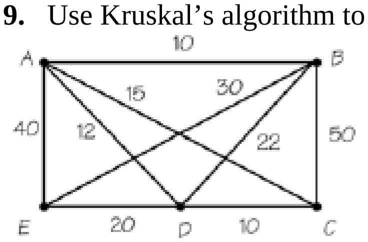
7. Using the mileage chart on the below, find the lowest cost solution for a traveling salesman problem t using the sorted edges algorithm. All distances are given in km.

	A	B	C	D	E	F
A	0	78	173	186	35	111
B	78	0	87	199	162	44
C	173	87	0	168	90	39
D	186	199	168	0	55	36
E	35	162	90	55	0	52
F	111	44	39	36	52	0

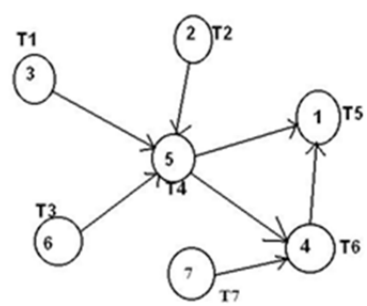
8. Construct two different spanning trees for the given graph.



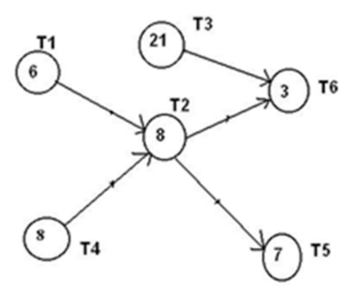
9. Use Kruskal's algorithm to find the minimum cost spanning tree for the given graph:



10. Given the order-requirement digraph on the right and the priority list
T7, T5, T6, T4, T1, T2, T3,
apply the list processing algorithm to construct a schedule using two processors. Is this schedule optimal?



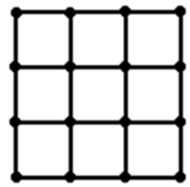
11. Find the critical path scheduling priority list for the digraph on the right.

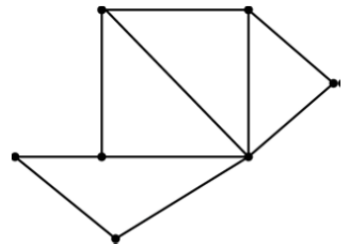


12. Schedule the following independent tasks on three processors and determine if the schedule is optimal or not
16, 10, 16, 20, 7, 20, 17, 17, 8, 8, 18, 16, 8, 19, 13

13. Use the first fit, next fit, best fit and worst fit packing algorithm to pack the following weights into bins that can hold no more than 9 pounds: 5 lbs, 7 lbs, 1 lb, 2 lbs, 4 lbs, 5 lbs, 1 lb, 1 lb, 3 lbs, 6 lbs, 2 lbs

14. Find the chromatic number of the given graphs:

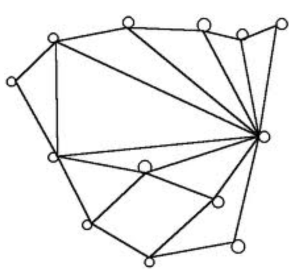




15. An architecture firm must schedule meeting times for its working groups. The following chart indicates which projects have overlapping members for their working groups. Create a graph that would be used to decide how many different meeting times would be required. What is the fewest meeting times needed?

	A	B	C	D	E	F
A		X		X	X	
B	X		X		X	
C		X				
D	X					
E	X	X				X
F					X	

16. The given graph represents a scheduling problem with each vertex representing a team and each edge representing a game that needs to be played. What is the fewest number of game days that will allow all the remaining match-ups to occur?



17. What is the fewest colors needed to color the graph