

Jackson State University
CSC 323 Algorithm Design and Analysis, Fall 2018
Instructor: Dr. Natarajan Meghanathan
Exam 3 (Take Home)

Maximum Points: 150

Due on: November 29th, 2018: 11.30 AM

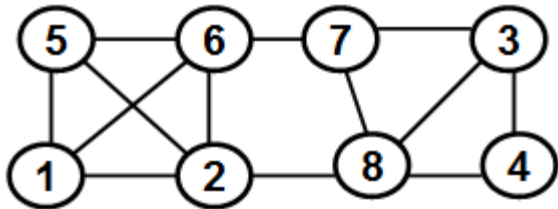
Print this exam and answer in the blank space/page provided after each question. You should staple your exam. Come to classroom ENB 212 at 11.30 AM (on Nov. 29th) and submit the exam on time

Q1: 25 pts) For the graph assigned to you, find the following using the **approximation heuristics** discussed in class.

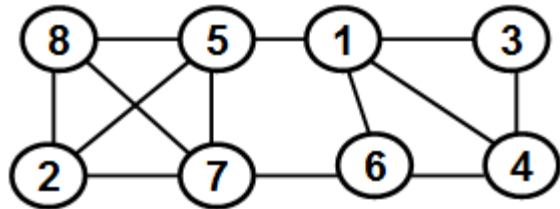
(a-7) Maximal Independent Set (b-2) Minimal Vertex Cover (c-8) Maximal Clique (d-8) Minimum Connected Dominating Set

Show all the work for each.

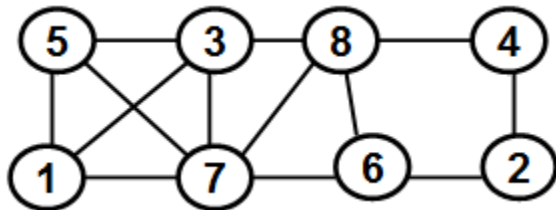
Clark, Lavaskie



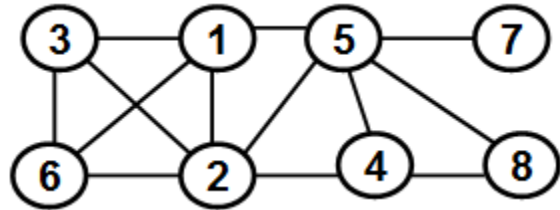
Epps, Justin



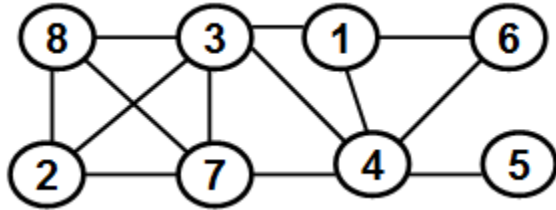
Harris, James



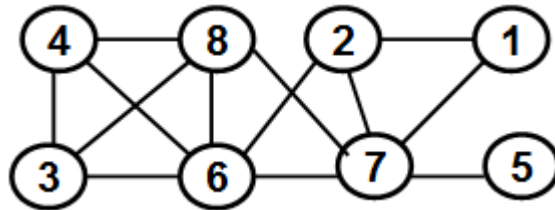
Hester, Larriel



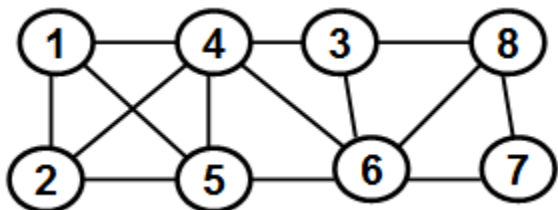
Hopson, Shanice



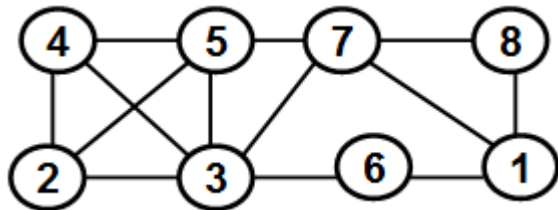
Jackson, Martice



Jones, Demarius



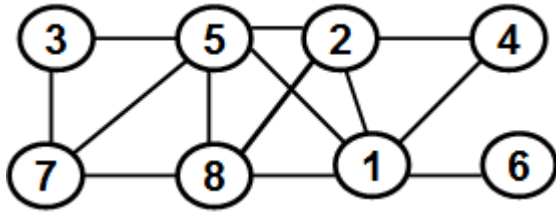
Kang, Ning



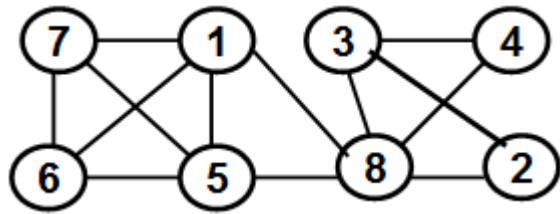
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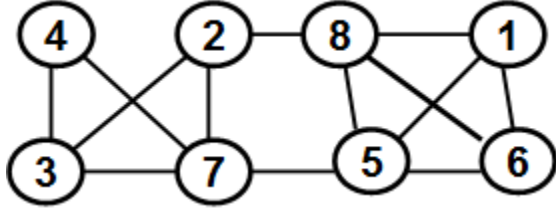
Kirk, Damon



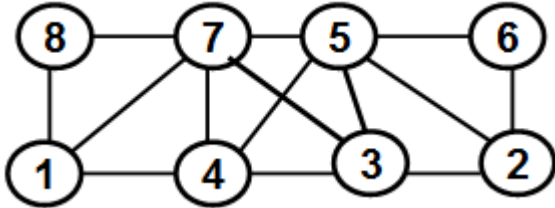
Sheffey, Varlin



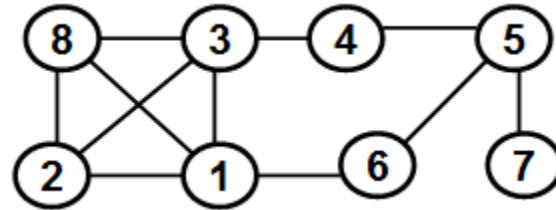
Manuel, Jackie



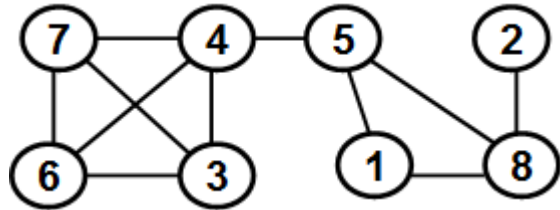
McIntosh, Blair



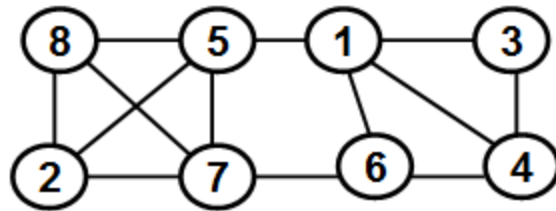
Simmons, Jetnya



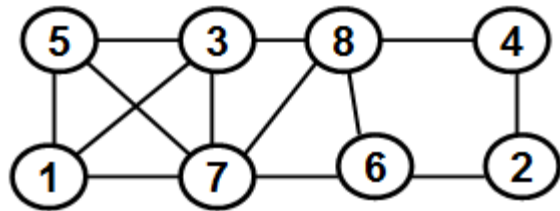
Thomas, Eriana



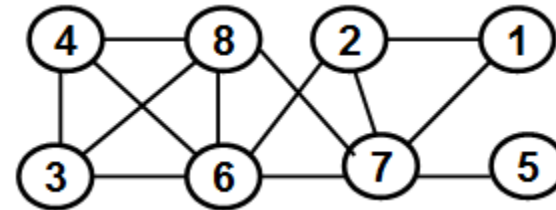
Walker, Brandon



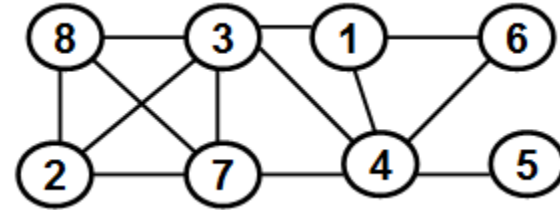
Wynn, Marcus



Zimmerman, Taba



Phat Tran



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Q2: 25 pts) You are assigned the edge weight matrix for a complete graph. Determine an **approximation to the minimum weight tour** using the (i-8) Nearest neighbor heuristic (ii-12) Twice around the tree heuristic.

Also, show one attempt of reducing the tour weight using the 2-change heuristic for the tour obtained with each of the two heuristics.

Show all the work as well as clearly indicate the tour and its weight before and after the attempt of using the 2-change heuristic in each case.

Clark, Lavaskie

	V1	V2	V3	V4	V5	V6
V1	0	9	15	1	8	6
V2	9	0	15	10	4	6
V3	15	15	0	9	13	4
V4	1	10	9	0	13	5
V5	8	4	13	13	0	13
V6	6	6	4	5	13	0

Epps, Justin

	V1	V2	V3	V4	V5	V6
V1	0	9	10	4	6	15
V2	9	0	3	1	7	2
V3	10	3	0	8	11	14
V4	4	1	8	0	11	15
V5	6	7	11	11	0	5
V6	15	2	14	15	5	0

Harris, James

	V1	V2	V3	V4	V5	V6
V1	0	8	6	2	9	14
V2	8	0	4	14	5	9
V3	6	4	0	5	15	10
V4	2	14	5	0	12	10
V5	9	5	15	12	0	3
V6	14	9	10	10	3	0

Hester, Larriel

	V1	V2	V3	V4	V5	V6
V1	0	10	2	14	12	14
V2	10	0	7	8	15	7
V3	2	7	0	7	14	12
V4	14	8	7	0	2	14
V5	12	15	14	2	0	14
V6	14	7	12	14	14	0

Hopson, Shanice

	V1	V2	V3	V4	V5	V6
V1	0	2	10	15	14	6
V2	2	0	7	3	14	8
V3	10	7	0	12	3	15
V4	15	3	12	0	5	10
V5	14	14	3	5	0	8
V6	6	8	15	10	8	0

Jackson, Martice

	V1	V2	V3	V4	V5	V6
V1	0	4	8	14	1	12
V2	4	0	4	7	14	15
V3	8	4	0	13	11	9
V4	14	7	13	0	5	6
V5	1	14	11	5	0	13
V6	12	15	9	6	13	0

Jones, Demarius

	V1	V2	V3	V4	V5	V6
V1	0	14	10	2	9	7
V2	14	0	1	2	13	12
V3	10	1	0	13	2	5
V4	2	2	13	0	15	3
V5	9	13	2	15	0	2
V6	7	12	5	3	2	0

Kang, Ning

	V1	V2	V3	V4	V5	V6
V1	0	11	5	5	6	14
V2	11	0	5	9	10	9
V3	5	5	0	2	6	12
V4	5	9	2	0	6	13
V5	6	10	6	6	0	2
V6	14	9	12	13	2	0

Kirk, Damon

	V1	V2	V3	V4	V5	V6
V1	0	6	12	15	15	12
V2	6	0	11	4	6	3
V3	12	11	0	3	5	12
V4	15	4	3	0	13	3
V5	15	6	5	13	0	3
V6	12	3	12	3	3	0

Sheffey, Varlin

	V1	V2	V3	V4	V5	V6
V1	0	2	1	12	11	13
V2	2	0	7	12	8	6
V3	1	7	0	11	8	8
V4	12	12	11	0	6	12
V5	11	8	8	6	0	8
V6	13	6	8	12	8	0

Name: _____

J#: _____

Manuel, Jackie

	V1	V2	V3	V4	V5	V6
V1	0	3	7	2	2	3
V2	3	0	9	13	6	4
V3	7	9	0	12	7	9
V4	2	13	12	0	9	9
V5	2	6	7	9	0	9
V6	3	4	9	9	9	0

McIntosh, Blair

	V1	V2	V3	V4	V5	V6
V1	0	8	14	4	10	15
V2	8	0	7	4	9	8
V3	14	7	0	5	12	14
V4	4	4	5	0	4	10
V5	10	9	12	4	0	2
V6	15	8	14	10	2	0

Simmons, Jetnya

	V1	V2	V3	V4	V5	V6
V1	0	6	15	12	10	7
V2	6	0	11	12	8	1
V3	15	11	0	4	3	9
V4	12	12	4	0	6	13
V5	10	8	3	6	0	13
V6	7	1	9	13	13	0

Thomas, Eriana

	V1	V2	V3	V4	V5	V6
V1	0	6	8	4	2	5
V2	6	0	15	12	1	1
V3	8	15	0	8	15	4
V4	4	12	8	0	10	4
V5	2	1	15	10	0	6
V6	5	1	4	4	6	0

Walker, Brandon

	V1	V2	V3	V4	V5	V6
V1	0	2	1	12	11	13
V2	2	0	7	12	8	6
V3	1	7	0	11	8	8
V4	12	12	11	0	6	12
V5	11	8	8	6	0	8
V6	13	6	8	12	8	0

Wynn, Marcus

	V1	V2	V3	V4	V5	V6
V1	0	10	2	14	12	14
V2	10	0	7	8	15	7
V3	2	7	0	7	14	12
V4	14	8	7	0	2	14
V5	12	15	14	2	0	14
V6	14	7	12	14	14	0

Zimmerman, Taba

	V1	V2	V3	V4	V5	V6
V1	0	14	10	2	9	7
V2	14	0	1	2	13	12
V3	10	1	0	13	2	5
V4	2	2	13	0	15	3
V5	9	13	2	15	0	2
V6	7	12	5	3	2	0

Phat Tran

	V1	V2	V3	V4	V5	V6
V1	0	8	6	2	9	14
V2	8	0	4	14	5	9
V3	6	4	0	5	15	10
V4	2	14	5	0	12	10
V5	9	5	15	12	0	3
V6	14	9	10	10	3	0

Name: _____

J#: _____

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J#: _____

Q3: 25 pts) For the edge weight matrix assigned to you for a directed graph, determine the shortest path weights between any two vertices of the graph using the **Floyd-Warshall algorithm**.

Show clearly the distance matrix and the predecessor matrix for each iteration.

Also, extract a path of length two or above between any two vertices of your choice. Clearly show the path extraction steps, as shown in the slides.

Clark, Lavaskie

	V1	V2	V3	V4	V5
V1	0	7	14	∞	3
V2	∞	0	9	3	1
V3	12	∞	0	10	9
V4	∞	9	10	0	12
V5	3	3	∞	4	0

Epps, Justin

	V1	V2	V3	V4	V5
V1	0	7	5	3	∞
V2	∞	0	4	12	14
V3	4	3	0	9	∞
V4	1	6	5	0	∞
V5	∞	3	11	9	0

Harris, James

	V1	V2	V3	V4	V5
V1	0	∞	2	4	11
V2	1	0	8	∞	1
V3	4	∞	0	8	3
V4	10	7	5	0	∞
V5	∞	15	10	9	0

Hester, Larriell

	V1	V2	V3	V4	V5
V1	0	1	11	∞	9
V2	10	0	9	∞	10
V3	∞	5	0	5	14
V4	14	∞	13	0	11
V5	8	12	13	∞	0

Hopson, Shanice

	V1	V2	V3	V4	V5
V1	0	∞	8	4	10
V2	8	0	14	4	∞
V3	14	12	0	5	∞
V4	2	∞	13	0	2
V5	3	∞	12	13	0

Jackson, Martice

	V1	V2	V3	V4	V5
V1	0	∞	13	2	13
V2	8	0	15	12	0
V3	9	∞	0	2	5
V4	14	∞	10	0	4
V5	3	6	12	∞	0

Jones, Demarius

	V1	V2	V3	V4	V5
V1	0	∞	7	10	7
V2	2	0	15	15	∞
V3	∞	2	0	7	8
V4	4	15	2	0	∞
V5	9	15	∞	5	0

Kang, Ning

	V1	V2	V3	V4	V5
V1	0	1	14	12	∞
V2	6	0	∞	11	1
V3	∞	10	0	9	5
V4	∞	9	15	0	4
V5	10	6	7	∞	0

Name: _____

J#: _____

Kirk, Damon

	V1	V2	V3	V4	V5
V1	0	5	4	∞	15
V2	∞	0	12	8	7
V3	3	10	0	1	∞
V4	6	6	∞	0	4
V5	8	∞	3	13	0

Sheffey, Varlin

	V1	V2	V3	V4	V5
V1	0	∞	9	14	8
V2	7	0	∞	13	1
V3	10	13	0	∞	15
V4	7	3	1	0	∞
V5	12	9	6	∞	0

Manuel, Jackie

	V1	V2	V3	V4	V5
V1	0	3	2	∞	9
V2	∞	0	5	8	6
V3	9	6	0	∞	7
V4	∞	13	14	0	8
V5	3	2	∞	6	0

McIntosh, Blair

	V1	V2	V3	V4	V5
V1	0	1	11	6	∞
V2	1	0	10	∞	12
V3	14	∞	0	10	6
V4	2	2	1	0	∞
V5	15	∞	3	15	0

Simmons, Jetnya

	V1	V2	V3	V4	V5
V1	0	∞	8	9	9
V2	2	0	∞	4	13
V3	10	3	0	2	∞
V4	1	∞	1	0	5
V5	6	9	13	∞	0

Thomas, Eriana

	V1	V2	V3	V4	V5
V1	0	12	1	∞	13
V2	10	0	3	∞	15
V3	8	1	0	∞	1
V4	10	8	6	0	∞
V5	7	∞	6	8	0

Walker, Brandon

	V1	V2	V3	V4	V5
V1	0	∞	9	14	8
V2	7	0	∞	13	1
V3	10	13	0	∞	15
V4	7	3	1	0	∞
V5	12	9	6	∞	0

Wynn, Marcus

	V1	V2	V3	V4	V5
V1	0	1	14	12	∞
V2	6	0	∞	11	1
V3	∞	10	0	9	5
V4	∞	9	15	0	4
V5	10	6	7	∞	0

Zimmerman, Taba

	V1	V2	V3	V4	V5
V1	0	∞	8	4	10
V2	8	0	14	4	∞
V3	14	12	0	5	∞
V4	2	∞	13	0	2
V5	3	∞	12	13	0

Phat Tran

	V1	V2	V3	V4	V5
V1	0	∞	2	4	11
V2	1	0	8	∞	1
V3	4	∞	0	8	3
V4	10	7	5	0	∞
V5	∞	15	10	9	0

Name: _____

J#: _____

Name: _____

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Name: _____

J#: _____

Q4: 25 pts) For the edge weight matrix assigned to you for a directed graph, determine the shortest path weights from vertex V1 to every other vertex using the **Bellman-Ford algorithm**.

Show clearly the table (with the distance estimate and predecessor) for each iteration, as discussed in the slides.

Also, extract the shortest paths from V1 to every other vertex in the graph, as shown in the slides. Clearly show the path extraction steps.

Clark, Lavaskie

	V1	V2	V3	V4	V5
V1	0	7	14	∞	3
V2	∞	0	9	3	1
V3	12	∞	0	10	9
V4	∞	9	10	0	12
V5	3	3	∞	4	0

Epps, Justin

	V1	V2	V3	V4	V5
V1	0	7	5	3	∞
V2	∞	0	4	12	14
V3	4	3	0	9	∞
V4	1	6	5	0	∞
V5	∞	3	11	9	0

Harris, James

	V1	V2	V3	V4	V5
V1	0	∞	2	4	11
V2	1	0	8	∞	1
V3	4	∞	0	8	3
V4	10	7	5	0	∞
V5	∞	15	10	9	0

Hester, Larriel

	V1	V2	V3	V4	V5
V1	0	1	11	∞	9
V2	10	0	9	∞	10
V3	∞	5	0	5	14
V4	14	∞	13	0	11
V5	8	12	13	∞	0

Hopson, Shanice

	V1	V2	V3	V4	V5
V1	0	∞	8	4	10
V2	8	0	14	4	∞
V3	14	12	0	5	∞
V4	2	∞	13	0	2
V5	3	∞	12	13	0

Jackson, Martice

	V1	V2	V3	V4	V5
V1	0	∞	13	2	13
V2	8	0	15	12	0
V3	9	∞	0	2	5
V4	14	∞	10	0	4
V5	3	6	12	∞	0

Jones, Demarius

	V1	V2	V3	V4	V5
V1	0	∞	7	10	7
V2	2	0	15	15	∞
V3	∞	2	0	7	8
V4	4	15	2	0	∞
V5	9	15	∞	5	0

Kang, Ning

	V1	V2	V3	V4	V5
V1	0	1	14	12	∞
V2	6	0	∞	11	1
V3	∞	10	0	9	5
V4	∞	9	15	0	4
V5	10	6	7	∞	0

Name: _____

J#: _____

Kirk, Damon

	V1	V2	V3	V4	V5
V1	0	5	4	∞	15
V2	∞	0	12	8	7
V3	3	10	0	1	∞
V4	6	6	∞	0	4
V5	8	∞	3	13	0

Sheffey, Varlin

	V1	V2	V3	V4	V5
V1	0	∞	9	14	8
V2	7	0	∞	13	1
V3	10	13	0	∞	15
V4	7	3	1	0	∞
V5	12	9	6	∞	0

Manuel, Jackie

	V1	V2	V3	V4	V5
V1	0	3	2	∞	9
V2	∞	0	5	8	6
V3	9	6	0	∞	7
V4	∞	13	14	0	8
V5	3	2	∞	6	0

McIntosh, Blair

	V1	V2	V3	V4	V5
V1	0	1	11	6	∞
V2	1	0	10	∞	12
V3	14	∞	0	10	6
V4	2	2	1	0	∞
V5	15	∞	3	15	0

Simmons, Jetnya

	V1	V2	V3	V4	V5
V1	0	∞	8	9	9
V2	2	0	∞	4	13
V3	10	3	0	2	∞
V4	1	∞	1	0	5
V5	6	9	13	∞	0

Thomas, Eriana

	V1	V2	V3	V4	V5
V1	0	12	1	∞	13
V2	10	0	3	∞	15
V3	8	1	0	∞	1
V4	10	8	6	0	∞
V5	7	∞	6	8	0

Walker, Brandon

	V1	V2	V3	V4	V5
V1	0	∞	9	14	8
V2	7	0	∞	13	1
V3	10	13	0	∞	15
V4	7	3	1	0	∞
V5	12	9	6	∞	0

Wynn, Marcus

	V1	V2	V3	V4	V5
V1	0	1	14	12	∞
V2	6	0	∞	11	1
V3	∞	10	0	9	5
V4	∞	9	15	0	4
V5	10	6	7	∞	0

Zimmerman, Taba

	V1	V2	V3	V4	V5
V1	0	∞	8	4	10
V2	8	0	14	4	∞
V3	14	12	0	5	∞
V4	2	∞	13	0	2
V5	3	∞	12	13	0

Phat Tran

	V1	V2	V3	V4	V5
V1	0	∞	2	4	11
V2	1	0	8	∞	1
V3	4	∞	0	8	3
V4	10	7	5	0	∞
V5	∞	15	10	9	0

Name: _____

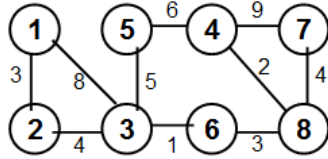
J#: _____

Name: _____

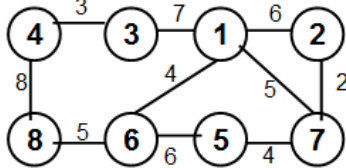
J#: _____

Q5: 20 pts) Run the **Dijkstra's shortest path algorithm** on the graph assigned to you, starting from Vertex 1, and determine the shortest path tree rooted from Vertex 1 to the rest of the vertices. If any edge does not have weight assigned, assume the weight of that edge to be 5. Show your work for each iteration in the skeletal graphs (see next page). For each skeletal graph, indicate the vertices and all the edges that are selected as part of the particular iteration as well as carried over from the previous iterations. Show all the steps.

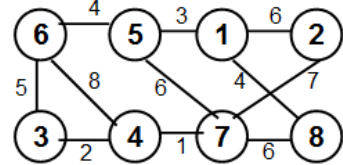
Clark, Lavaskie



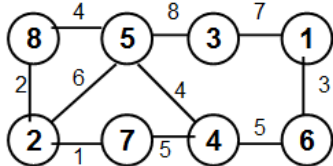
Epps, Justin



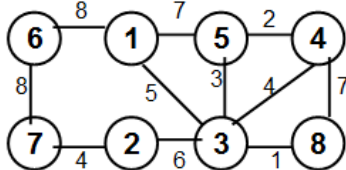
Harris, James



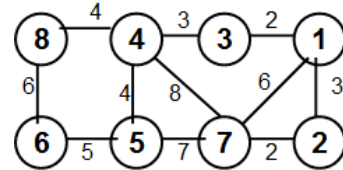
Hester, Larriel



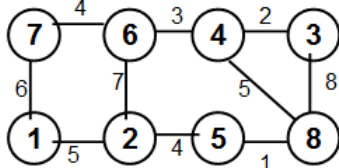
Hopson, Shanice



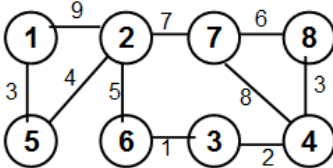
Jackson, Martice



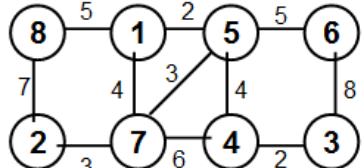
Jones, Demarius



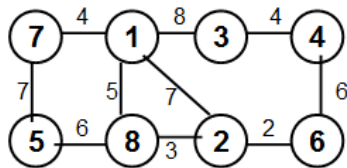
Kang, Ning



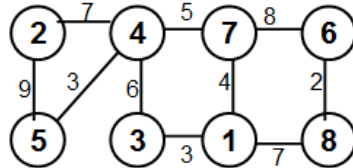
Kirk, Damon



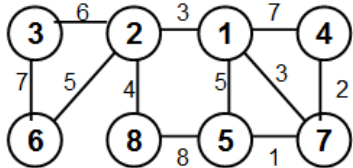
Manuel, Jackie



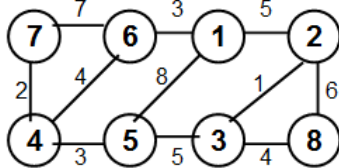
McIntosh, Blair



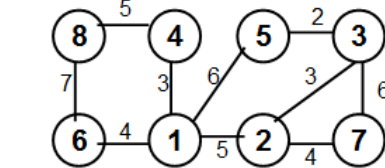
Sheffey, Varlin



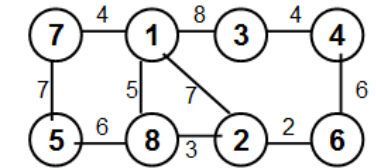
Simmons, Jetnya



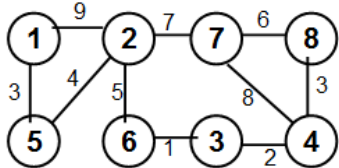
Thomas, Eriana



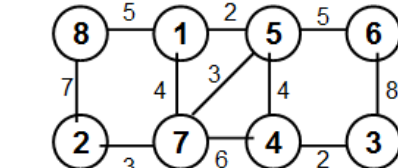
Walker, Brandon



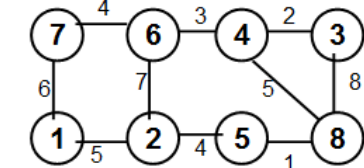
Wynn, Marcus



Zimmerman, Taba



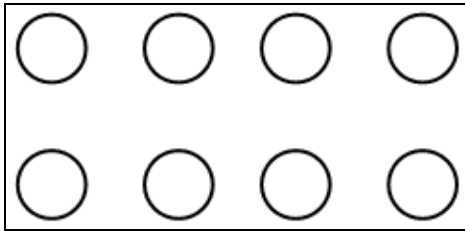
Phat Tran



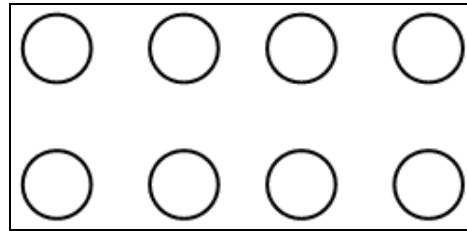
Name: _____

J#: _____

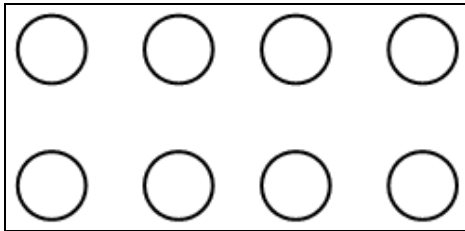
Skeletal Graphs (Iterations)



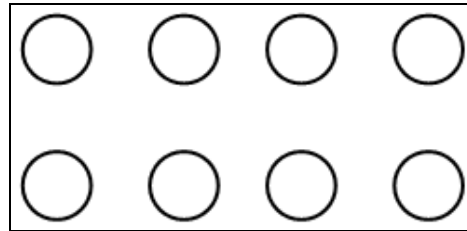
Given Graph



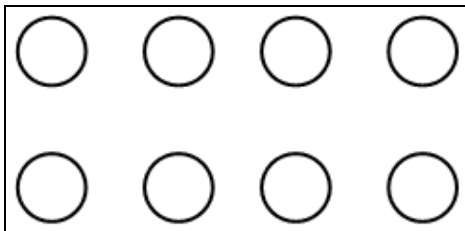
Initialization



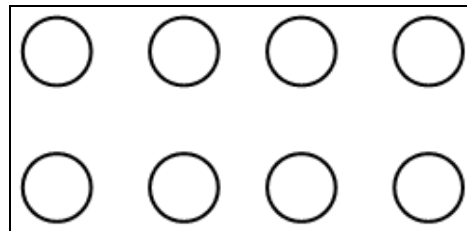
Iteration 1



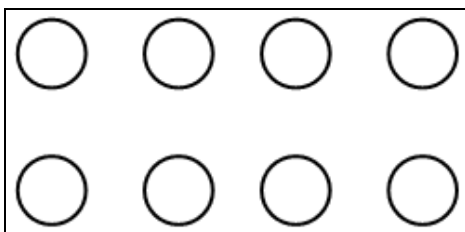
Iteration 2



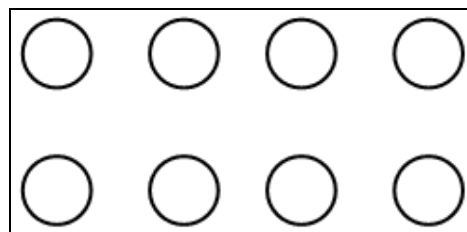
Iteration 3



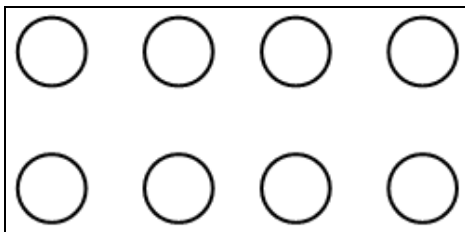
Iteration 4



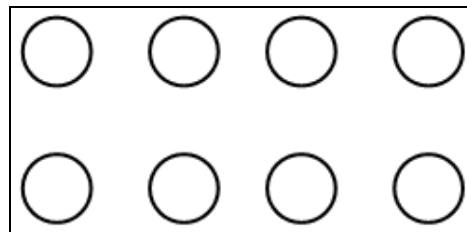
Iteration 5



Iteration 6



Iteration 7



Shortest Path Tree

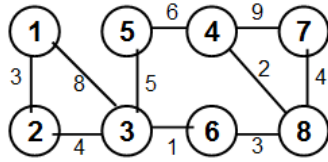
Sum of the Weights of the Shortest Path Tree: _____

Name: _____

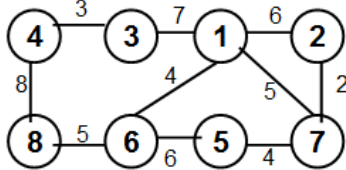
J#: _____

Q6: 15 pts) Run the Kruskal's algorithm for **minimum weight spanning tree** on the graph assigned to you. If any edge does not have weight assigned, assume the weight of that edge to be 5. Show your work for each iteration in the skeletal graphs (see next page). For each skeletal graph, indicate the vertices and all the edges that are selected as part of the particular iteration as well as carried over from the previous iterations. Show all the steps.

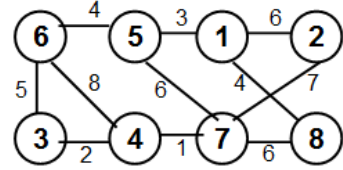
Clark, Lavaskie



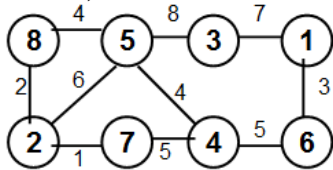
Epps, Justin



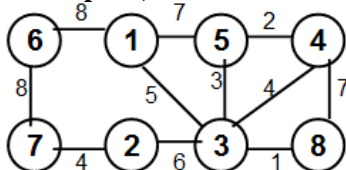
Harris, James



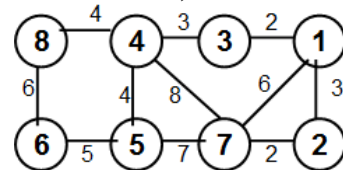
Hester, Larriel



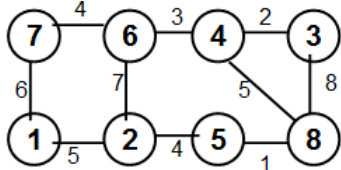
Hopson, Shanice



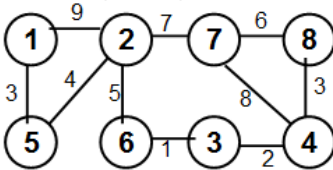
Jackson, Martice



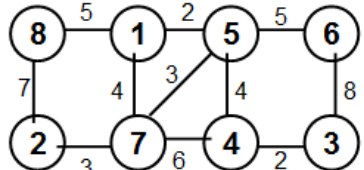
Jones, Demarius



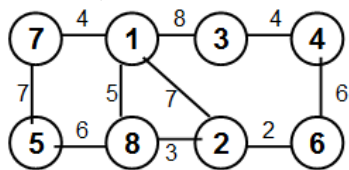
Kang, Ning



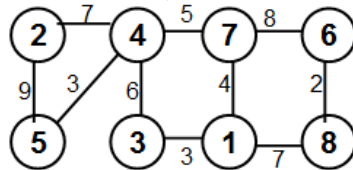
Kirk, Damon



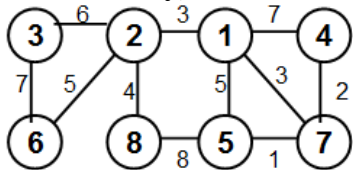
Manuel, Jackie



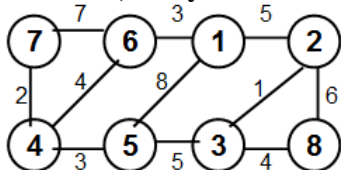
McIntosh, Blair



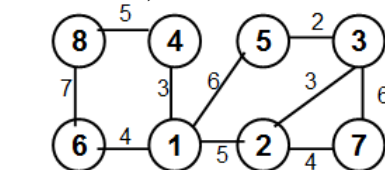
Sheffey, Varlin



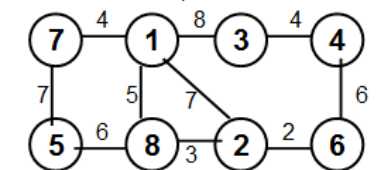
Simmons, Jetnya



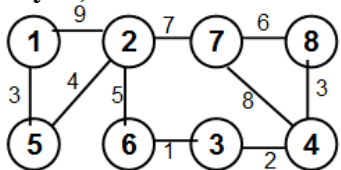
Thomas, Eriana



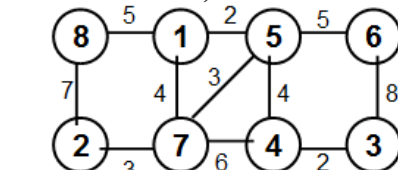
Walker, Brandon



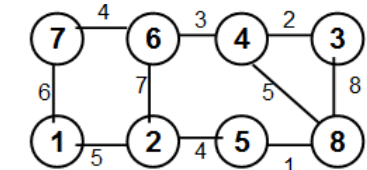
Wynn, Marcus



Zimmerman, Taba



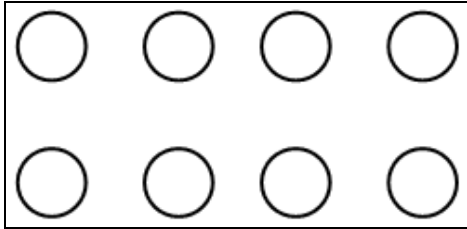
Phat Tran



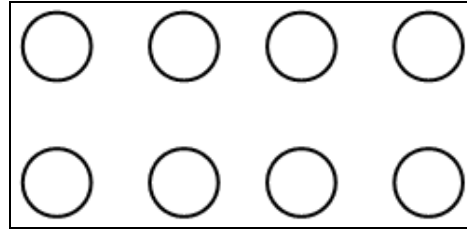
Name: _____

J#: _____

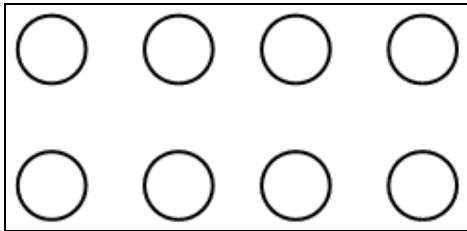
Skeletal Graphs (Iterations)



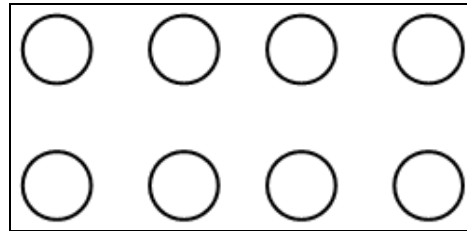
Given Graph



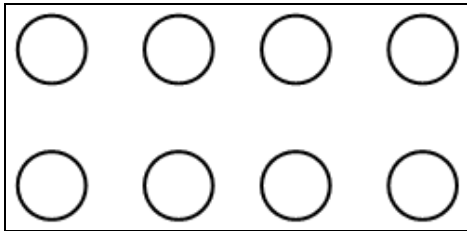
Initialization



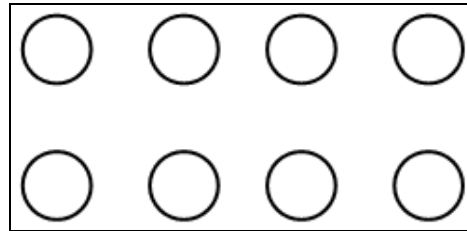
Iteration 1



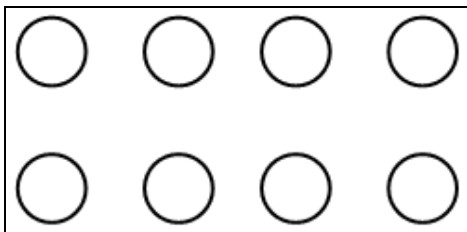
Iteration 2



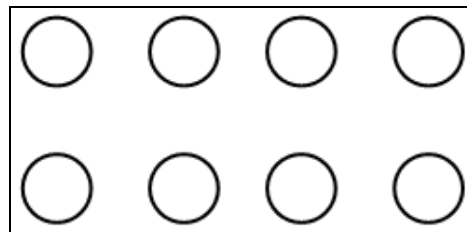
Iteration 3



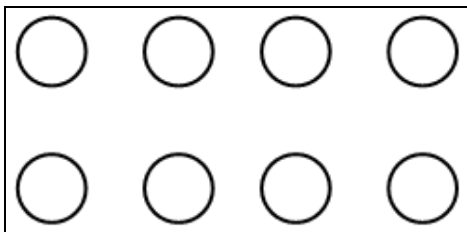
Iteration 4



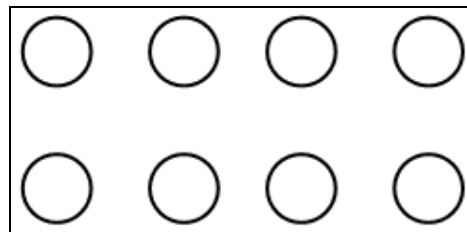
Iteration 5



Iteration 6



Iteration 7



Minimum Weight Spanning Tree

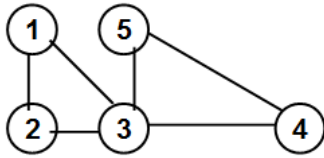
Sum of the weights of the Minimum Weight Spanning Tree: _____

Name: _____

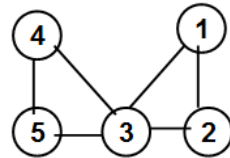
J#: _____

Q7: 15 pts) For the graph assigned below, use the **Transform and Conquer technique** (Matrix Multiplication) and compute the number of walks of length 4 between vertices 2 and 3.

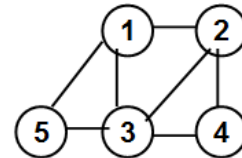
Clark, Lavaskie



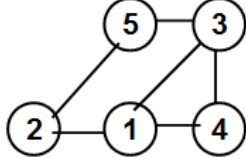
Epps, Justin



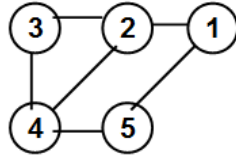
Harris, James



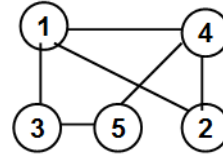
Hester, Larriell



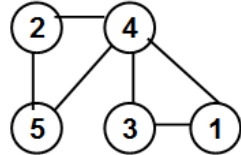
Hopson, Shanice



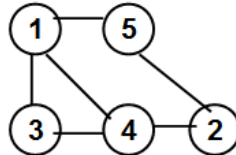
Jackson, Martice



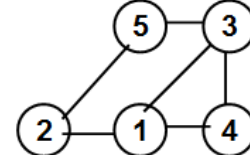
Jones, Demarius



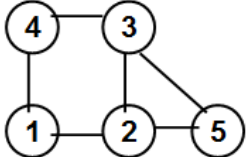
Kang, Ning



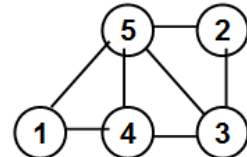
Kirk, Damon



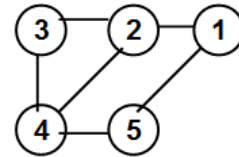
Manuel, Jackie



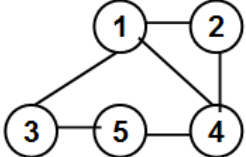
McIntosh, Blair



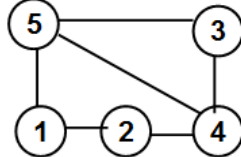
Sheffey, Varlin



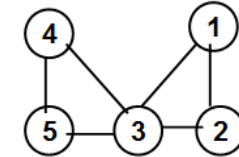
Simmons, Jetnya



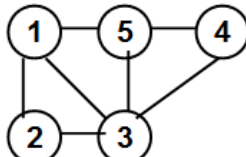
Thomas, Eriana



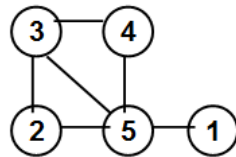
Walker, Brandon



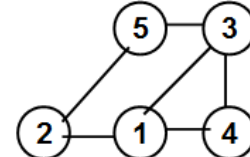
Wynn, Marcus



Zimmerman, Taba



Phat Tran



Name: _____

J#: _____