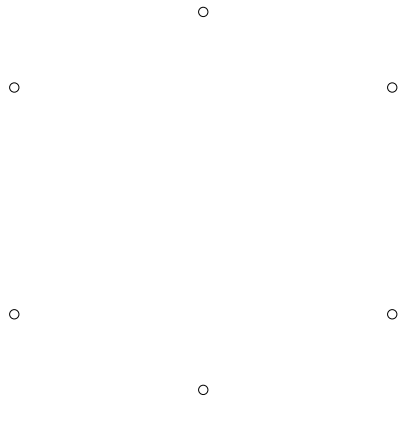
Math 101 **Name**_____

DUE:_____

HAMILTONIAN CIRCUITS

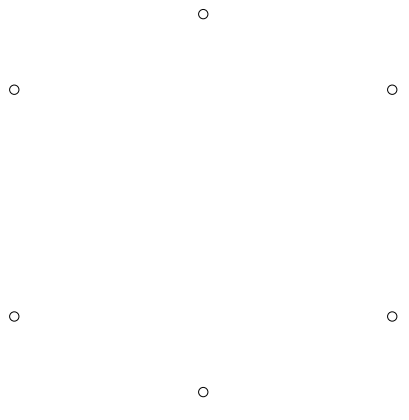
DIRECTIONS: Problems 1-5 relate to the page of airline price grids you've been given involving the CHI, HOU, LAX, MIA, NYC and SEA airports. Use those grids to help you work through the problems below using the Nearest Neighbor Approximation Algorithm (NNA). For each problem 6 vertices have been provided for you to use in making your weighted digraph. You might not need use all the vertices in each problem.



1) Dominic lives in Los Angeles (LAX) and needs to visit Seattle (SEA), New York (NYC), and Miami (MIA) on a business trip. Based on this information, carry out the following tasks: a) determine how many different circuits are possible for this trip, b) use the NNA and show the route as a weighted digraph using the vertices provided, and c) give the total cost of the trip.

Number of possible circuits: _____

Total cost of trip: _____



2) Maria lives in New York City (NYC) and needs to visit Seattle (SEA), Houston (HOU), and Miami (MIA) on a business trip. Based on this information, carry out the following tasks: a) determine how many different circuits are possible for this trip, b) use the NNA and show the route as a weighted digraph using the vertices provided, and c) give the total cost of the trip.

Number of possible circuits: _____

Total cost of trip: _____

3) Sydney lives in Chicago (CHI) and needs to visit Seattle (SEA), New York (NYC), Houston (HOU), and Miami (MIA) on a business trip. Based on this information, carry out the following tasks: a) determine how many different circuits are possible for this trip, b) use the NNA and show the route as a weighted digraph using the vertices provided, and c) give the total cost of the trip.

Number of possible circuits: _____

Total cost of trip: _____

4) LizBeth lives in New York City (NYC) and needs to visit Seattle (SEA), Houston (HOU), Chicago (CHI), Los Angeles (LAX), and Miami (MIA)on a business trip. Based on this information, carry out the following tasks: a) determine how many different circuits are possible for this trip, b) use the NNA and show the route as a weighted digraph using the vertices provided, and c) give the total cost of the trip.

Number of possible circuits: _____

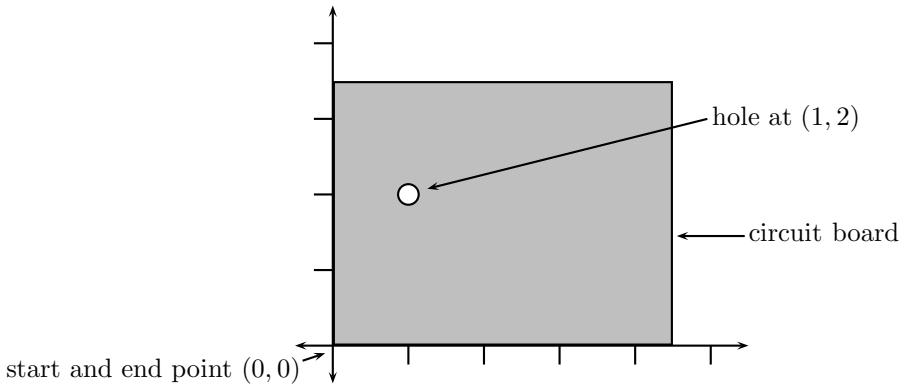
Total cost of trip: _____

5) Come up with a route for LizBeth that is different from the one you found in problem 4 above. Show the route as a weighted digraph, give the total cost, and state whether the cost is higher or lower than what you found in problem 4. Are you surprised at the cost comparison, why or why not? **Be ready to discuss your findings in class**.

Total cost of trip: _____

Findings for discussion:

DIRECTIONS: Hamiltonian circuits apply to many ventures, not just business trips. Problems 6-8 illustrate another application. You are programming a robotic drill to drill holes in a circuit board. After the holes have been drilled, electronic components will be inserted into them. You use an ordered pair to specify a hole's location. For example, the ordered pair $(1, 2)$ specifies a location that is $1mm$ to the right and $2mm$ above the board's lower left corner as shown in the figure below. The drill is programmed to return to $(0, 0)$ after competing a circuit board. The cost of drilling a board is determined by the distance the drill must travel, and the drill moves only horizontally and vertically. For example, if the drill starts at $(0, 0)$ and then travels to $(1, 2)$ to drill a hole, it travels horizontally $1mm$ and vertically $2mm$, for a total of $3mm$..



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6) The machine drills holes at $(4, 1)$ and then $(3, 7)$

a) How far does the drill travel when it moves from $(0, 0)$ to $(4, 1)$?

b) How far does the drill travel when it moves from $(4, 1)$ to $(3, 7)$?

c) How far does the drill travel when it moves from $(3, 7)$ to $(0, 0)$?

d) How far does the drill travel total in order to complete the task?

***HINT* for problems 7 and 8**: *Creating your own chart like the airline price chart you used for problems 1-5 could be of significant help here! And don't forget that the drill must always begin and end at position* $(0, 0)$.

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7) A circuit board needs holes drilled at $(4, 5)$, $(3, 1)$, $(6, 4)$, $(7, 5)$, and $(2, 2)$. Use the Nearest Neighbor Algorithm to approximate the least expensive sequence for drilling these holes. Space has been given for your work. Write your answer in the blanks provided.

$(0, 0) \rightarrow$ _____ $\rightarrow$ _____ $\rightarrow$ _____ $\rightarrow$ _____ $\rightarrow$ _____ $\rightarrow (0, 0)$

8) A circuit board needs holes drilled at $(1, 8)$, $(2, 7)$, $(5, 1)$, $(3, 4)$, and $(4, 3)$. Use the Nearest Neighbor Algorithm to approximate the least expensive sequence for drilling these holes. Space has been given for your work. Write your answer in the blanks provided.

$(0, 0) \rightarrow$ _____ $\rightarrow$ _____ $\rightarrow$ _____ $\rightarrow$ _____ $\rightarrow$ _____ $\rightarrow (0, 0)$