21. Using a calculator with a factorial key,

(a) compute 20!.

(b) compute 22!.

(c) compute the number of Hamilton circuits in K_{21}.

23. Suppose you have a supercomputer that can generate one *billion* Hamilton circuits per second.

(a) Estimate (in years) how long it would take the supercomputer to generate all the Hamilton circuits in K_{21}.

(b) Estimate (in years) how long it would take the supercomputer to generate all the Hamilton circuits in K_{22}.

25. **(a)** How many edges are there in K_{20}?

(b) How many edges are there in K_{21}?

(c) If the number of edges in K_{50} is x, and the number of edges in K_{51} is y, what is the value of $y - x$?

27. In each case, find the value of N.

(a) K_N has 120 distinct Hamilton circuits.

(b) K_N has 45 edges.

(c) K_N has 20,100 edges.

31. For the weighted graph shown in Fig. 6-38, (i) find the indicated tour, and (ii) give its cost. (*Note*: This is the graph discussed in Example 6.7.)

(a) The nearest-neighbor tour with starting vertex B

(b) The nearest-neighbor tour with starting vertex C

(c) The nearest-neighbor tour with starting vertex D

(d) The nearest-neighbor tour with starting vertex E

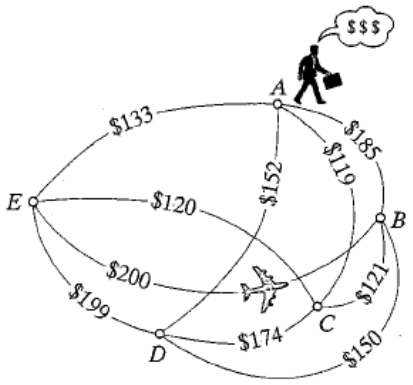


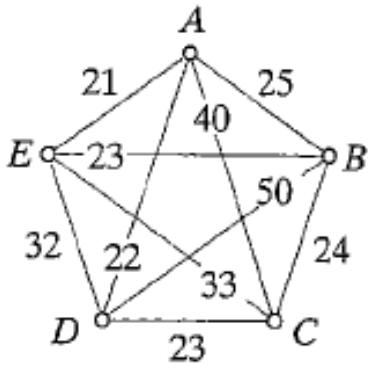
FIGURE 6-38

32. A delivery service must deliver packages at Buckman (B), Chatfield (C), Dayton (D), and Evansville (E), and then return to Arlington (A), the home base. Figure 6-39 shows a graph of the estimated travel times (in minutes) between the cities.

(a) Find the nearest-neighbor tour with starting vertex A. What is the total travel time of this trip?

(b) Find the nearest-neighbor tour with starting vertex D. Write the tour as it would be traveled if starting and ending at A.

(c) Suppose that the delivery truck's last stop before returning to A has to be at D. Find the optimal tour that satisfies this requirement. What is the total travel time of this tour?



35. Darren is a sales rep whose territory consists of the six cities in the mileage chart shown in Fig. 6-42. Darren wants to visit customers at each of the cities, starting and ending his trip in his home city of Atlanta. His travel costs (gas, insurance, etc.) average $0.75 per mile.

(a) Find the nearest-neighbor tour with Atlanta as the starting city. What is the total cost of this tour?

(b) Find the nearest-neighbor tour using Kansas City as the starting city. Write the tour as it would be traveled by Darren, who must start and end the trip in Atlanta. What is the total cost of this tour?

Mileage Chart

	Atlanta	Columbus	Kansas City	Minneapolis	Pierre	Tulsa
Atlanta	*	533	798	1068	1361	772
Columbus	533	*	656	713	1071	802
Kansas City	798	656	*	447	592	248
Minneapolis	1068	713	447	*	394	695
Pierre	1361	1071	592	394	*	760
Tulsa	772	802	248	695	760	*

D Repetitive Nearest-Neighbor Algorithm

37. For the weighted graph shown in Fig. 6-44, find the repetitive nearest-neighbor tour. Write the tour using B as the starting vertex.

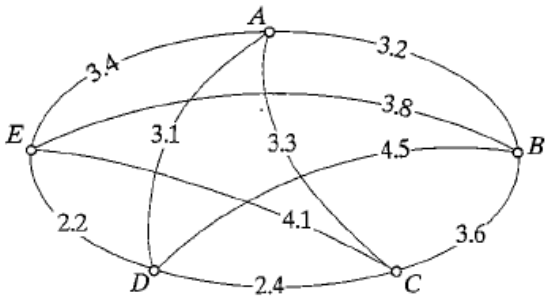


FIGURE 6-44

E Cheapest-Link Algorithm

43. For the weighted graph shown in Fig. 6-46, find the cheapest-link tour. Write the tour using B as the starting vertex. (*Note*: This is the graph in Exercise 37.)

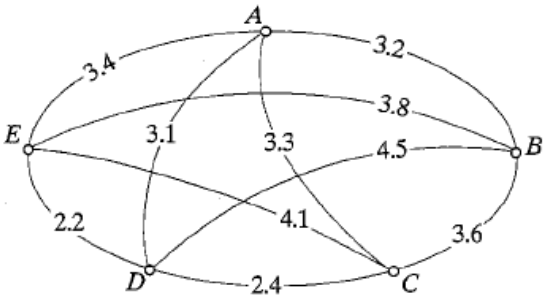


FIGURE 6-46

47. For Darren's sales trip problem discussed in Exercise 35, find the cheapest-link tour, and give the total cost for this tour.

Mileage Chart

	Atlanta	Columbus	Kansas City	Minneapolis	Pierre	Tulsa
Atlanta	*	533	798	1068	1361	772
Columbus	533	*	656	713	1071	802
Kansas City	798	656	*	447	592	248
Minneapolis	1068	713	447	*	394	695
Pierre	1361	1071	592	394	*	760
Tulsa	772	802	248	695	760	*

FIGURE 6-42

53. You have a busy day ahead of you. You must run the following errands (in no particular order): Go to the post office, deposit a check at the bank, pick up some French bread at the deli, visit a friend at the hospital, and get a haircut at Karl's Beauty Salon. You must start and end at home. Each block on the map shown in Fig. 6-48 is exactly 1 mile.

(a) Draw a weighted graph corresponding to this problem.

(b) Find an optimal tour for running all the errands. (Use any algorithm you think is appropriate.)

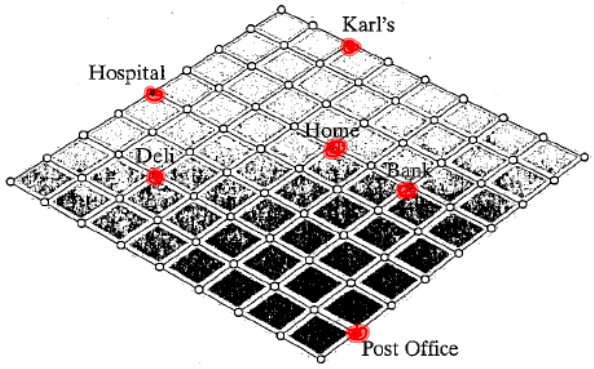


FIGURE 6-48

Come to the SmartBoard and try to find Hamilton Circuits and Euler Circuits in the following graphs.

http://www.cut-the-knot.org/Curriculum/Combinatorics/GraphPractice.shtml

Solve the Travelling Salesman Problem by Cheapest Link

http://www.cut-the-knot.org/Curriculum/Combinatorics/WGraphs.shtml