Chapter 3: Planning and Scheduling

Free-Response

Format: Short Answer

1. Which of the algorithms—first fit (FF), next fit (NF), or worst fit (WF)—would be most preferable when filling boxes on an assembly line? Why?
   Ans: NF. One doesn't have to go back.

Format: Short Answer

2. Which of the algorithms—first fit (FF), next fit (NF), or worst fit (WF)—would be most preferable when packing cloth dolls? Why?
   Ans: FF. One can pack as tightly as needed.

Format: Short Answer

3. Which of the algorithms—first fit (FF), next fit (NF), or worst fit (WF)—would be most preferable when packing china dishes? Why?
   Ans: WF. There can be equal room in each box.

Format: Short Answer

4. Which of the algorithms—first fit (FF), next fit (NF), or worst fit (WF)—would be most preferable when cutting wooden shelves from planks? Why?
   Ans: WF. This allows for some "error" or sawdust scraps.

Format: Short Answer

5. Which of the algorithms—first fit (FF), next fit (NF), or worst fit (WF)—would be most preferable when cutting quilt pieces? Why?
   Ans: FF. This keeps scraps large if possible.

Format: Short Answer

6. Use the first fit (FF) bin-packing algorithm to pack the following weights into bins that can hold no more than 9 lbs.

   5 lbs, 7 lbs, 1 lb, 2 lbs, 4 lbs, 5 lbs, 1 lb, 1 lb, 3 lbs, 6 lbs, 2 lbs

   Ans:

   1
   2
   1 1 5 6
   5 7 4 3 2

Format: Short Answer

7. Use the next fit (NF) bin-packing algorithm to pack the following weights into bins that can hold no more than 9 lbs.

   5 lbs, 7 lbs, 1 lb, 2 lbs, 4 lbs, 5 lbs, 1 lb, 1 lb, 3 lbs, 6 lbs, 2 lbs

Ans:

			1		
	1	4	1	6	
5	7	2	5	3	2

Format: Short Answer

8. Use the worst fit (WF) bin-packing algorithm to pack the following weights into bins that can hold no more than 9 lbs.

   5 lbs, 7 lbs, 1 lb, 2 lbs, 4 lbs, 5 lbs, 1 lb, 1 lb, 3 lbs, 6 lbs, 2 lbs

Ans: 1
2
1 1 5 6
5 7 4 3 2

Format: Short Answer

9. Use the first-fit decreasing (FFD) bin-packing algorithm to pack the following weights into bins that can hold no more than 9 lbs.

   5 lbs, 7 lbs, 1 lb, 2 lbs, 4 lbs, 5 lbs, 1 lb, 1 lb, 3 lbs, 6 lbs, 2 lbs

Ans:

			1	
			1	
2	3	4	2	
7	6	5	5	1

Format: Short Answer

10. Use the next-fit decreasing (NFD) bin-packing algorithm to pack the following weights into bins that can hold no more than 9 lbs.

   5 lbs, 7 lbs, 1 lb, 2 lbs, 4 lbs, 5 lbs, 1 lb, 1 lb, 3 lbs, 6 lbs, 2 lbs

Ans:

					1
					1
					2
				4	2
7	6	5	5	3	1

Format: Short Answer

11. Use the worst-fit decreasing (WFD) bin-packing algorithm to pack the following weights into bins that can hold no more than 9 lbs.

    5 lbs, 7 lbs, 1 lb, 2 lbs, 4 lbs, 5 lbs, 1 lb, 1 lb, 3 lbs, 6 lbs, 2 lbs

    Ans:

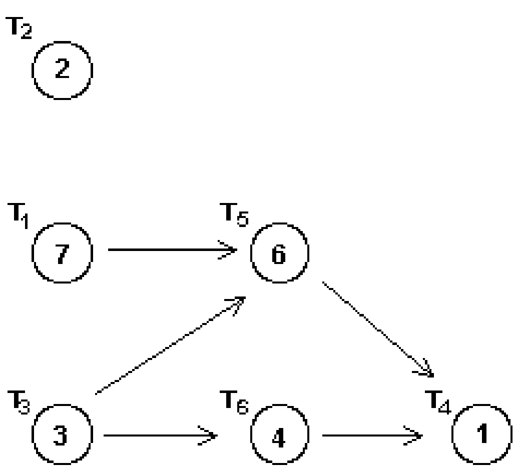
	1		1	
2	2	4	3	
7	6	5	5	1

Format: Short Answer

12. A talent show producer needs to fit 17 acts of varying lengths into three segments. The segments should be as short as possible and are to be separated by intermissions. This problem could be solved by using

    Ans: the list-processing algorithm for independent tasks.

Use the order-requirement digraph below (with time given in minutes) and the priority list T_1, T_2, T_3, T_4, T_5, T_6 to answer questions 13–16.

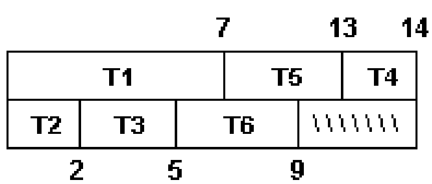


Reference: 3-1

Format: Short Answer

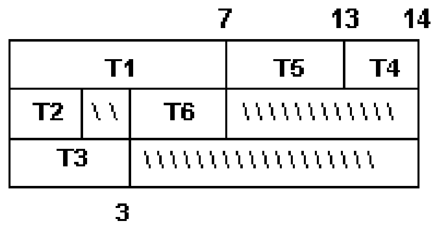
13. Apply the list-processing algorithm to construct a schedule using two processors.

    Ans:



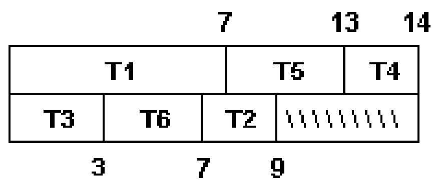
Reference: 3-1
Format: Short Answer
14. Apply the list-processing algorithm to construct a schedule using three processors.

Ans:



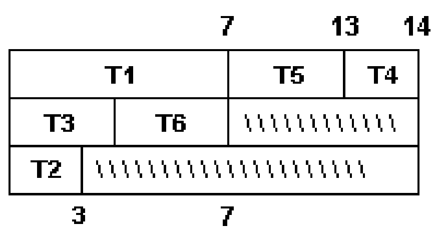
Reference: 3-1
Format: Short Answer
15. Apply the critical-path scheduling algorithm to construct a schedule using two processors.

Ans:



Reference: 3-1
Format: Short Answer
16. Apply the critical-path scheduling algorithm to construct a schedule using three processors.

Ans:



Format: Short Answer
17. What is the minimum time required to complete 12 independent tasks on three processors when the sum of all the times of the 12 tasks is 60 minutes?
Ans: 20 minutes

Format: Short Answer

18. What is the minimum time required to complete eight independent tasks on two processors when the sum of the times of the eight tasks is 64 minutes?
Ans: 32 minutes

Format: Short Answer

19. Give an example of an order-requirement digraph with six tasks T_1, T_2, T_3, T_4, T_5, T_6 for which the critical-path is T_1, T_3, T_4.
Ans: For example,

T_1 (5) → T_3 (6) → T_4 (5)
^
|
|
T_2 (1) → T_5 (1) → T_6 (1)

Format: Short Answer

20. Give an example of an order-requirement digraph with six tasks T_1, T_2, T_3, T_4, T_5, T_6 that requires 10 minutes when scheduled on two processors.
Ans:
For example, T_1 (3) → T_2 (3) → T_3 (4)
T_4 (2) T_5 (6) T_2 (1)

Format: Short Answer

21. Give an example in which six independent tasks require 12 minutes when scheduled on three processors.
Ans: For example, 6,6,6,6,6,6.

Format: Short Answer

22. Give an example in which the first fit (FF) and next fit (NF) bin-packing algorithms produce the same packing.
Ans: For example, when the capacity is 10 lbs. The weights are 7 lbs, 6 lbs, 5 lbs, and 5 lbs.

Format: Short Answer

23. Give an example in which the first-fit decreasing (FFD) and worst-fit decreasing (WFD) bin-packing algorithms produce the same packing.
Ans: For example, when the capacity is 10 lbs. The weights are 7 lbs, 6 lbs, 5 lbs, and 5 lbs.

Format: Short Answer

24. Why are there several different algorithms for the bin-packing problem?

Ans: There are different situations and no best algorithm.

Format: Short Answer

25. When scheduling independent tasks, why does the decreasing-time-list algorithm generally produce good schedules? Does it always produce an optimal schedule?

Ans: It produces good schedules because the bigger tasks are done early, allowing for smaller tasks to fill in the remaining time.

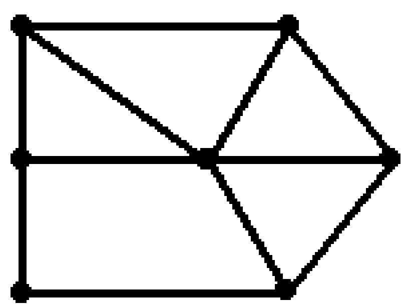
Format: Short Answer

26. When scheduling tasks using an order-requirement digraph, why does the critical-path scheduling algorithm generally produce good schedules? Does it always produce an optimal schedule?

Ans: It completes "prerequisite" tasks early, but this is not always an optimal schedule.

Format: Short Answer

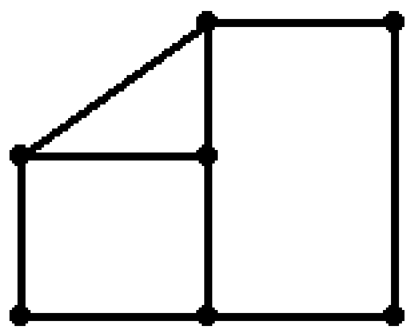
27. Find the chromatic number of the graph below:



Ans: The chromatic number is 3.

Format: Short Answer

28. Find the chromatic number of the graph below:



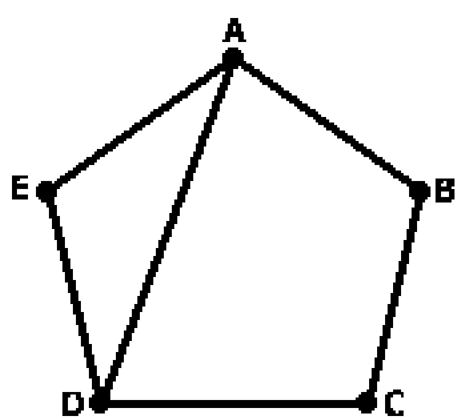
Ans: The chromatic number is 3.

Format: Short Answer

29. The table below represents species of plants that have competing light or water requirements. Draw the graph that would be useful in determining the minimum number of different habitats that would be needed to display all these plants in a garden.

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

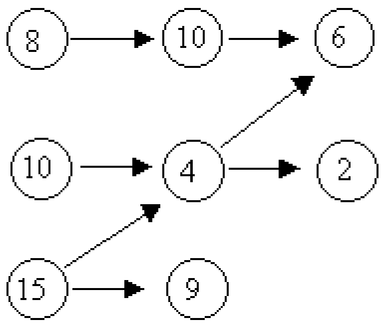
Ans: Answers may vary. One solution is given by the graph below:



Format: Short Answer

30. Use the decreasing-time list algorithm to schedule these tasks on three machines:
7, 2, 5, 3, 9, 1, 6, 5, 3, 7
How much time does the resulting schedule require?
Ans: 16 minutes

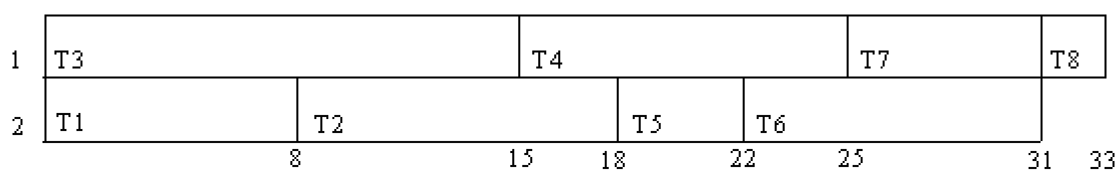
Use the order requirement digraph below (with time given in minutes) and the priority list T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8 to answer questions 31-34.



Reference: 3-2
Format: Short Answer

31. Apply the critical-path scheduling algorithm to construct a schedule using two processors.

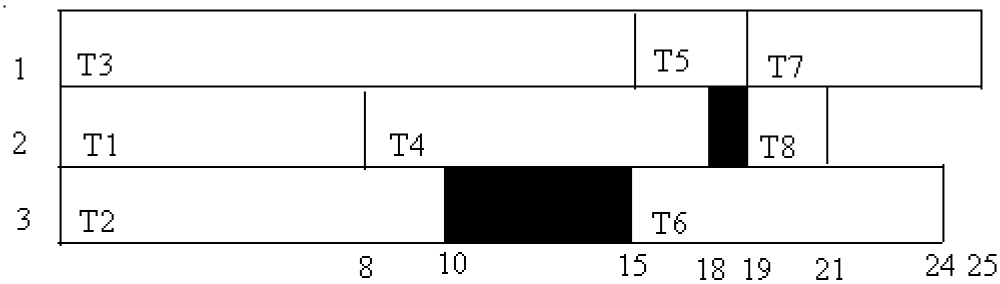
Ans:



Reference: 3-2
Format: Short Answer

32. Apply the critical-path scheduling algorithm to construct a schedule using three processors.

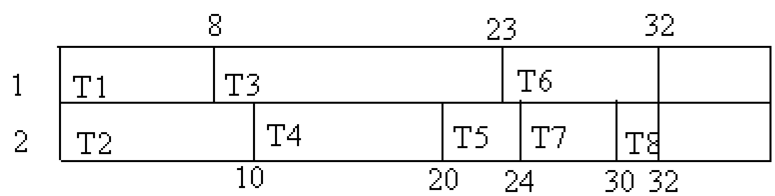
Ans:



Reference: 3-2
Format: Short Answer

33. Apply the list-processing algorithm to construct a schedule using two processors.

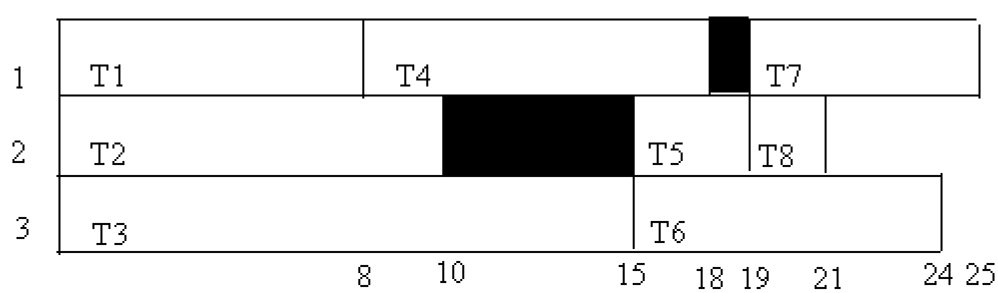
Ans:



Reference: 3-2
Format: Short Answer

34. Apply the list-processing algorithm to construct a schedule using three processors.

Ans:



Format: Short Answer

35. What is the minimum time to complete 12 independent tasks on four processors when the sum of all the times of the 12 tasks is 60 minutes?

Ans: 15 minutes