P1 terminated -> 70
25 -> 0 -> 70
P2 terminated -> 110

1. Answer:

a) Creating the 4th process and grant its initial request would result in a safe state:

Process	Claim	Allocation	C-A
1	70	45	25
2	60	40	20
3	60	15	45
4	60	25	35

Available
25

50 - 25

There is sufficient free memory (25 units) to guarantee the termination of either P1 or P2. After that, the remaining three processes can be completed in any order.

b) Creating the 4th process and grant its initial request would result in an unsafe state:

Process	Claim	Allocation	C-A
1	70	45	25
2	60	40	20
3	60	15	45
4	60	35	25

Available
15

50 - 35

There is NO sufficient free memory (15 units) to satisfy any process.

suspend p4 and restore to the original state

2. Answers:

1. No row in the allocation matrix is all zero, thus no process is marked
2. W = (2 1 0 0), i.e., the available vector
3. Mark P3; W = (2 1 0 0) + (0 1 2 0) = (2 2 2 0)
4. Mark P2; W = (2 2 2 0) + (2 0 0 1) = (4 2 2 1)
5. Mark P1; no deadlock detected

3. Answers:

- Assume that the table is in deadlock, i.e., there is a nonempty set D of philosophers such that each Pi in D holds one fork and waits for a fork held by neighbor.
- Without loss of generality, assume that Pj ∈ D is a lefty. Since Pj clutches his left fork and cannot have his right fork, his right neighbor Pk never completes his dinner and is also a lefty. Therefore, Pk ∈ D.
- Continuing the argument rightward around the table shows that all philosophers in D are lefties. This contradicts the existence of at least one righty. Therefore deadlock is not possible.

Self-test

1. A
2. D
3. B
4. D
5. A
6. C