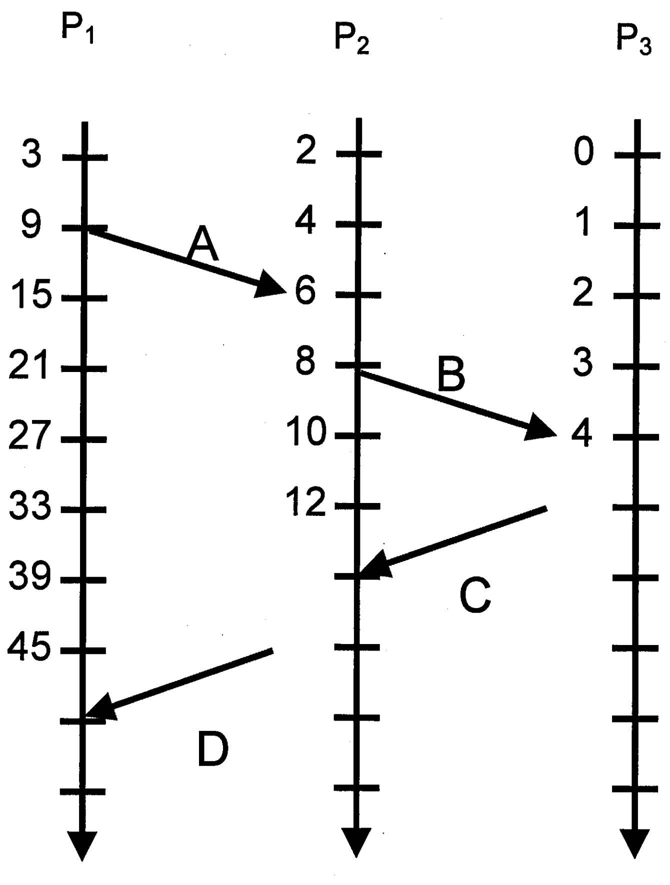
資訊網路與多媒體研究所

資格考試科目：高等作業系統

95. 3. 10

1. (15 points) (Distributed Event handling) Lamport developed the distributed algorithm for extending the happened-before relation to a consistent total ordering of all the events in the system.
   - a. Please define the relation "happened-before."
   - b. Assume that there are four events (i.e., A, B, C, and D) on three processors (i.e., P_1, P_2, and P_3) as shown in the following diagram. The clock rates on three processors are different but each of which does not change over time. The following timelines show the clock values on the processors. The arrows represent the event ordering. For example, event A was sent by processor P_1 and received by processor P_2. Please adjust the logic clocks on three processors so that the 'happened-before' relationships are satisfied.



2. (15 points) In distributed systems, **parallelism** improves performance and **blocking system calls** make programming easier. However, the two mechanisms are not compatible in uni-process/uni-processor programming model. (In other words, when blocking system calls are used, the program is blocked until the

system call completes.) Can we utilize the two mechanisms to enhance system performance in distributed systems? If no, please state your arguments. If yes, please give an example and explain the mechanism.

3. (20 points) (File Systems) Unix systems typically implement a write-back file-system buffer cache, where changes are periodically flushed to disk.

   a. (5 points) Please explain the purpose of implementing write-back cache and how the write-back cache works.

   b. (5 points) Please define RAID.

   c. (10 points) One well-known problem of write-back cache is data corruption. Unfortunately, the chance of data corruption increases in RAID. Please explain the reason.

4. (15 points) Describe the software reasons why a stand-alone computer hangs (7 points)? How can we design a computer which never hangs? (5 points) What shortcomings might incur? (3 points) Define your situation of "hang", if necessary.

5. (20 points) What is the problem when using the following two binary semaphores with S1 = 1 and S2 =0 to implement a counting semaphore? (15 points) Please correct. (5 points)

```
wait operation:
    wait(S1);
    C--;
    if (C < 0) {
        signal(S1);
        wait(S2);
    }
    else
       signal(S1);
```

```
signal operation:
    wait(S1);
    C ++;
    if (C <= 0)
      signal(S2);
    signal(S1);
```

6. (15 points) Consider the following page reference string:

1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6, 5.

How many page faults would occur for the following replacement algorithms, assuming four frames? Assume all frames are initially empty.

(a) LRU replacement

(b) FIFO replacement

(c) Optimal replacement