

Midterm Solutions: CS425 FA18

1. (Solution and Grading by: <Federico> and <Rui>)

1. B (200/150)

2. B

3. B

4. C

5. C

6. F (Prefer the same machine, otherwise prefer the same rack, rack 4 here.)

7. E (Local rarest first)

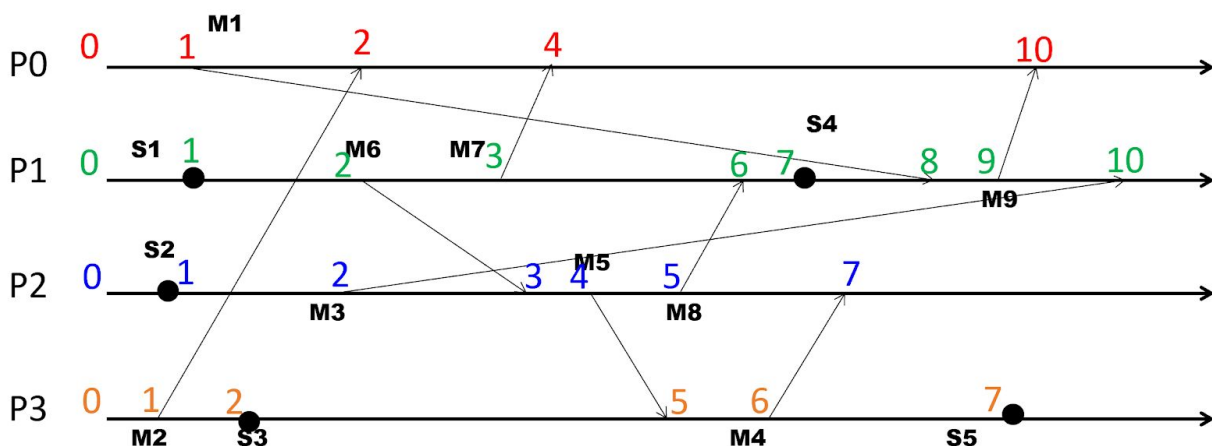
8. A (A higher Lamport timestamp does not guarantee any causality. A counter example is processes executing only instructions, and consider the first instruction at P1 and the second instruction at P2 - P2's has a higher Lamport timestamp, but the two events have incomparable vectors.)

9. C

10. C (Intersection sizes are as follows. Any two quorum sets: $2Q - N$. Any three quorum sets: $(2Q - N) + Q - N = 3Q - 2N$. Any four quorum sets: $(3Q - 2N) + Q - N = 4Q - 3N$. $4Q - 3N \geq 1 \Rightarrow Q \geq \lceil (3N + 1) / 4 \rceil$

2. (Solution and Grading by: <Shegufta>)

2(a)



2(b)

i) Concurrent and same Lamport Timestamps: (P0, M1, Timestamp 1) and (P3, M2, Timestamp 1)

ii) Concurrent and different Lamport Timestamps: (P1, M6, Timestamp 2) and (P2, S2, Timestamp 1)

3. (Solution and Grading by: <Beomyeol>)

(a)

<i>Node ID</i>	<i>Successor</i>
34	55
55	89
89	144
144	233
233	377
377	610
610	34

(b)

<i>i</i>	<i>f[i]</i>	<i>i</i>	<i>f[i]</i>
0	34	5	34
1	34	6	34
2	34	7	34
3	34	8	34
4	34	9	144

(c) At node 610, send a message for key 200 to node 144 because node 144 is the largest finger entry less than or equal to 200.

At node 144, there is no finger entry whose id is less than or equal to 200 (34 is not considered as a candidate because it is generated with wrap-around). The message is sent to its successor (node 233).

Key 200 is assigned to node 233. Therefore, routing the message finishes.

4. (Solution and Grading by: <Rahul, Le, Zhuolun>)

```
Map1(key, value) // where value={timestamp, IP, URL}
{
    Emit(value.URL, value.IP)
    Emit(value.URL, 1)
}
Reduce1(key, value)
{
    S = the sum of all 1's in the value list
    IP2 = the set of all IP's in the value list
    Emit(1, {key, S, IP2})
}
Map2(key, value) // where value={key, S, IP2}
{
    Emit(key, value)
}
Reduce2(key, value) // where value={key, S, IP2}
{
    Sort value list according to value.S in a decreasing order
    IP3 = the set of all value.IP2's where values are the top 50 from the value list
    Eliminate duplicates in IP3
    Emit(IP3)
}
```

5. (Solution and Grading by: <Faria>)

- a) An intersecting row and column have $M + K - 1$ processes. If $M + K - 2$ processes of an intersecting row and column fail and the remaining process is the intersecting process, its failure cannot be detected. Therefore, $L = K + M - 1$ and $L - 1 = K + M - 2$ (10 points)
- b) $K = 4$, $K + M - 2 \geq 10$
 $4 + M - 2 \geq 10$
 $M \geq 8$ (5 points)

- c) Trick question! Value of R is irrelevant. In an asynchronous system, heartbeat protocols are not guaranteed to satisfy accuracy as heartbeats may be dropped or delayed arbitrarily long (5 points)