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1. (a) An agreed standard for representation of data structures and primitive values. It is needed because irrespective of the communication form used, data are transmitted as a sequence of bytes. Client and server may have different representations of the same data type. Thus, a standard is needed.

   (b)

   (i)

```
public interface Server extends Remote {

        void registerNotification(Teacher t, String courseCode) throws RemoteException;

        void registerCourse(int matricNumber, String courseCode) throws RemoteException;

    }
public interface Teacher extends Remote {

        void callback(int matricNumber) throws RemoteException;

}
```

   (ii) Remote objects, such as Teacher is passed by reference. Non remote objects, such as matricNumber and courseCode is passed by value.

2. (a)

   N60 -> N125 -> N10 -> N45

N	K	$(\lfloor \log2(k-n) \rfloor+1)$
60	43	7
125	43	6
10	43	6 (goes to N45)
45		

   N60 table.

60 + 1	N100
60 + 2	N100
60 + 4	N100
60 + 8	N100
60 + 16	N100

60 + 32	N100
60 + 64	N125

N106 table.

106 + 1	N125
106 + 2	N125
106 + 4	N125
106 + 8	N125
106 + 16	N125
106 + 32	N10
106 + 64	N45

(b) Let p be the predecessor of the new node n and let s be the successor of the new node n. For each i (where 1 ≤i≤7), the i-th fingers of nodes ∈(p− 2^(i−1), n− 2^(i−1)] need to be updated from s to n.

In this case, p=60, s=100, n=66

i	p-2^(i-1)	n-2^(i-1)	Node in range
1	59	65	N60
2	58	64	N60
3	56	62	N60
4	52	58	-
5	44	50	N45
6	28	34	N30
7	-4	2	-

For every line in the table, the node in range needs to update the i-th entry to N66

3. (a)

   (i) No. If we set back the clock at that point, we would not know the rate of the error for the clock. E.g 1 seconds error for every 10 hour.

   (ii) Assume, the rate of the error is R. Then the correct time = the time read from the clock - R * 20 seconds - 10 seconds.

(b)

(i) t_D-t_C

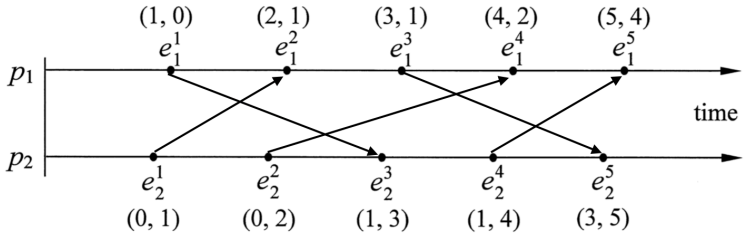
(ii) [t_{min}, t_D-t_C - 2t_{min}]

(iii) To minimize error, time taken from B to C = (t_{min} + t_D - t_C - 2 *t_{min}) /2 = (t_D-t_C - t_{min}) / 2
Therefore, time to set at C = time at B when it sends data + time taken to send from B->C = t_B + (t_D - t_C - t_{min}) / 2

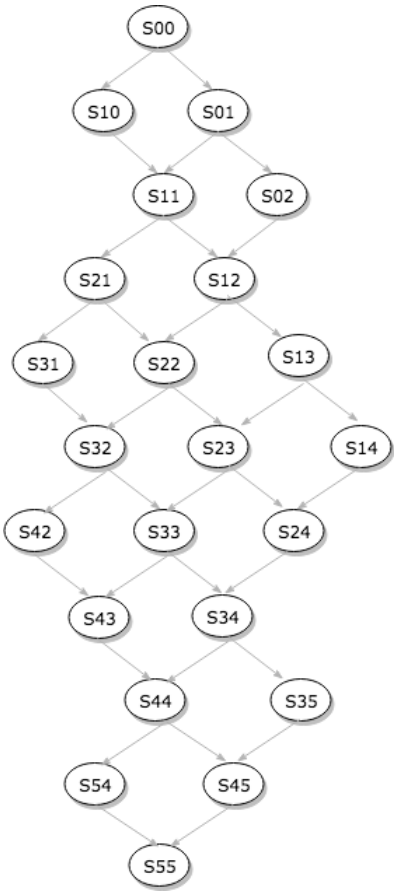
4. (a) e_1^1, e_1^2 , e_1^3 , e_2^1, e_2^2

(b) e_2^3, e_2^4, e_2^5,

(c)



(d)



5. (a) Time between one process exiting the critical section and the next process entering it.

   (b)

   Central server algorithm: 2 message transmission (No condition)

   Ring based algorithm: 1 message transmission (when a process wants to enter critical section, the token is currently in the previous node)

   Ricart-and-Agrawala algorithm: 1 message transmission (No condition)

   (c) No.

6. (a) abc = 012 , 014, 042

   (b) abc = 013, 032, 034

   (c)

   W=4, R=3

   W=5, R=2

   W=6, R=1

   (d) Crash failure = 6 -1 = 5, Byzantine failures = floor((6- 1)/2) =2

All the best for your exams!