Tutorial 1: Introduction to Distributed Systems

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1. Describe the key features of a Distributed System?

Transparent, open, scalable

2. What is the difference between the following terms: host, site, server, client?

Host: A host is a specific machine that is connected into the DS

Site: A site is a geographical location that contains one or more hosts in the DS

Server: A host makes resources available to the DS

Client: A host accesses the servers and utilizes any available resources

3. What is the difference between a loosely-coupled and a tightly coupled Distributed System? Give a real-world example of each

loosely-coupled: Computers are connected over a network. Such as Internet.

tightly-coupled: Multiple processors within a single computer sharing memory and resources. Such as multi-processor systems.

4. The lecture notes state "a Distributed System has, by default, no global clock". Explain why this is the case.

Distributed systems have no common clock. In each computer, it maintains an internal clock, known as a Real Time Clock. It is impossible to guarantee that the real-time clocks of two computers will run at the same speed.

5. In what way are the concepts of redundancy and reliability related?

By increasing the number of copies or key components, the system can continue to operate when a part fails, thereby improving reliability.

6. When would the use of concurrency for a processing task might be a disadvantage?

Task management, network communication. They may be have costs. Increased Complexity.

7. Why is middleware important? List the main benefits of using middleware.

It delivers an abstract layer of support that acts as a building block for the construction of the target application(s).

- Remote Method Invocation
- Support for communication between groups of processes
- Event Notification
- Support for partitioning, placement, and retrieval of shared data objects amongst cooperating computers
- Support for the replication of shared data objects
- Real-time Multimedia Transmission

8. Using Lamport's concept of a "happens before" relation, identify all the events that

a) happen before p3.

p_1 , p_2, q_1, r_1, r_2, r_3

b) p3 happens before

No

c) are concurrent with p3.

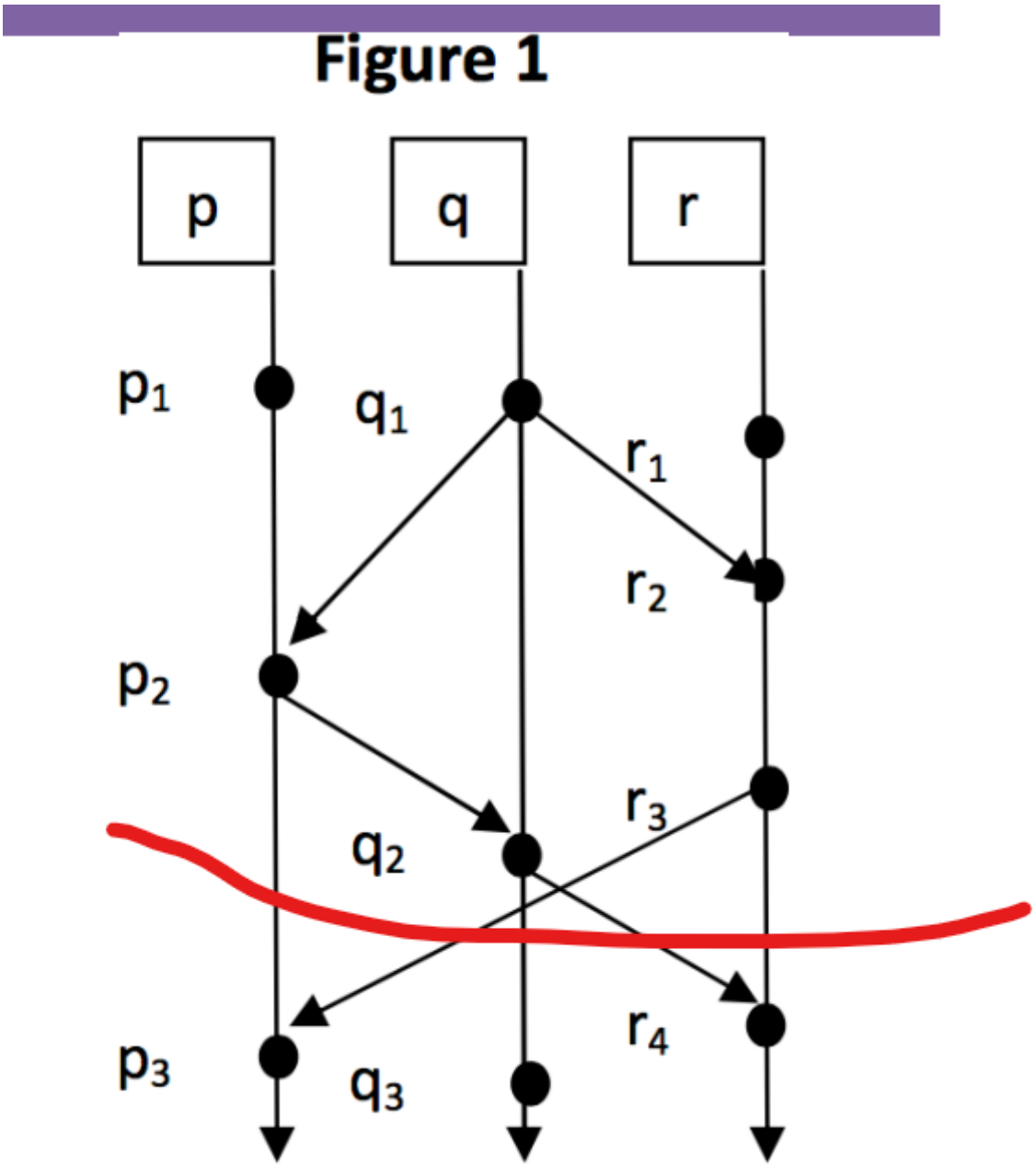
q_2, q_3, r_4

9. What is the difference between a “logical clock“ and a real-time clock

The RTC is maintained internally by the computer. This clock is powered by a separate battery so that it continues to
function even when the computer is turned off. But, it is impossible to guarantee that the real-time clocks of two computers will run at the same speed.

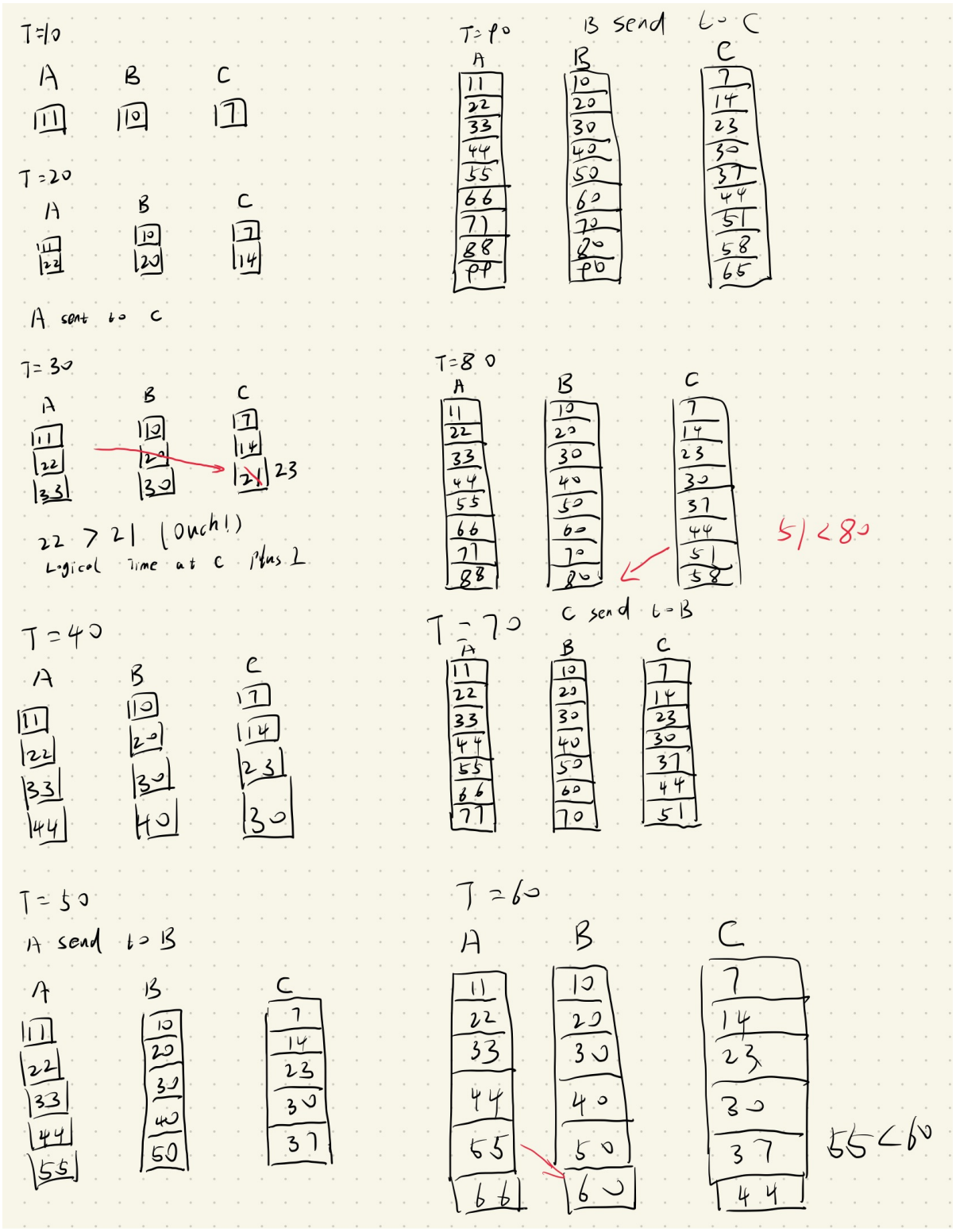
The logical clock be used to capture Temporal Ordering or Causal Ordering between events.

10. In the system shown in Figure 1, a snapshot was taken that has recorded the following events: {p1, p2, q1, q2, r1, r2, r3}. Is this a “consistent snapshot”? Explain your answer.

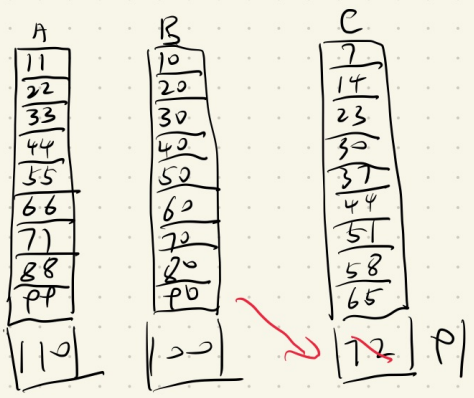


This is a **consistent snapshot**. For any pair of given events. Such that event e is in the cut C, and f -> e, then f is also in the cut C.

Q11


T=10
A B C
11 10 7
T=20
A B C
11 22 10 20 7 14
A sent to C
T=30
A B C
11 22 33 10 20 30 7 14 21 23
22 > 21 (ouch!)
Logical Time at C Plus 1
T=40
A B C
11 22 33 44 10 20 30 40 7 14 23 30
T=50
A send to B
A B C
11 22 33 44 55 10 20 30 40 50 7 14 23 30 37
T=90
A B send to C
A B C
11 22 33 44 55 66 77 88 99 10 20 30 40 50 60 70 80 90 7 14 23 30 37 44 51 58 65
T=80
A B C
11 22 33 44 55 66 77 88 10 20 30 40 50 60 70 80 7 14 23 30 37 44 51 58
51 < 80
T=70
C send to B
A B C
11 22 33 44 55 66 77 10 20 30 40 50 60 70 7 14 23 30 37 44 51
T=60
A B C
11 22 33 44 55 66 10 20 30 40 50 60 7 14 23 30 37 44
55 < 60

T=100



p0 > 72 (ouch!)

Update < logical time