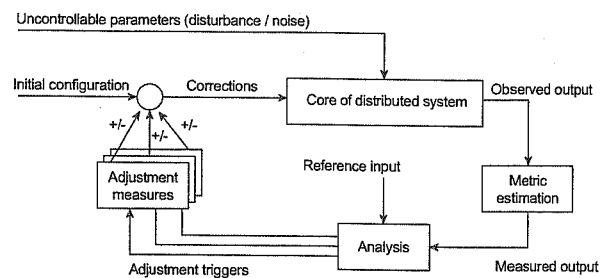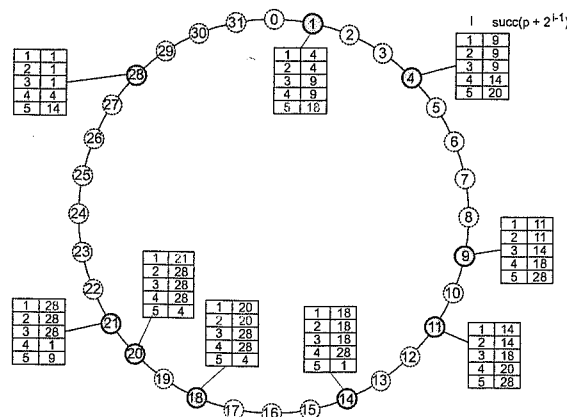## MAKE SURE THAT YOUR HANDWRITING IS READABLE

1a Explain what is meant by request-level and message-level interceptors in middleware. *5pt*

1b Where does the need for adaptive middleware come from? *5pt*

1c In the underlying feedback control loop, give an example of the analysis component in combination with the reference input. *5pt*

2a What is the difference between transport-layer switching and content-aware request distribution? *5pt*

2b Explain how TCP handoff works and why it is difficult to apply to wide-area networks. *5pt*

2c Explain how the content-aware request distribution can be combined with TCP handoff. *5pt*

3a Traditional RPC mechanisms cannot handle pointers. What is the problem and how can it be addressed? *5pt*

3b Where does the need for at-least-once and at-most-once semantics come from? Why can't we have exactly-once semantics? *5pt*

3c Consider a client/server system based on RPC, and assume the server is replicated for performance. Sketch an RPC-based solution for hiding replication of the server from the client. *5pt*

4a Resolve the following key lookups for the shown Chord-based P2P system: *5pt*

source	key
4	15
4	22
21	30
21	27
20	18

4b Adjust the finger tables of nodes 18 and 14 when a node with ID 24 enters the ring. Also give the finger table of node 24. *5pt*

4c Chord allows keys to be looked up recursively or iteratively. Explain the differences, as well as the main advantage of iterative over recursive lookup. *5pt*

5a Explain how two-phase commit works. 5pt

5b Explain what happens when a participant, who is in the READY state, times out because it hasn't received a response from the coordinator yet. 5pt

5c If we use two-phase commit for a distributed transaction, can we allow a coordinator to issue two distributed transactions (involving the same participants) at the same time? 5pt

6a How can a Web hosting service help in handling flash crowds? 5pt

6b Akamai uses DNS-based redirection. Explain how resolution of the name www.philips.akamai.net would work. 5pt

6c Explain the difference between content-aware and content-blind caching for Web applications by means of an example. 5pt

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Grading: *The final grade is calculated by accumulating the scores per question (maximum: 90 points), and adding 10 bonus points. The maximum total is therefore 100 points.*