THE HONG KONG POLYTECHNIC UNIVERSITY

DEPARTMENT OF COMPUTING

EXAMINATION

Course : MSc Scheme - 61030

Subject : COMP5527 Mobile Computing & Data Management

Group : 201, 202, 204, 205, 2888

Session : 2009 / 2010 Semester II

Date : 7 May 2010 Time : 18:30-20:30

Time Allowed: 2 Hours Subject Lecturer: Shao Zili

This question paper has 6 pages (cover included).

Instructions to Candidates:

1. Closed books and notes.
2. Answer ALL questions.

Do not turn this page until you are told to do so!

1. **(10 marks)**
Assume that there are 12 data items (items 1, 2, 3, …, 11, 12), and the size of each item is 1. Their access probabilities are as follows: *1/168 for items 1, 2, 3, 4, 5 and 6*; *3/56 for items 11 and 12; 3/14 for items 7, 8, 9 and 10*. Please use **the Wong's algorithm** to obtain a best schedule with the cycle length 36 (you need to give the computation steps about how to determine the broadcast frequencies and how to obtain the final schedule).

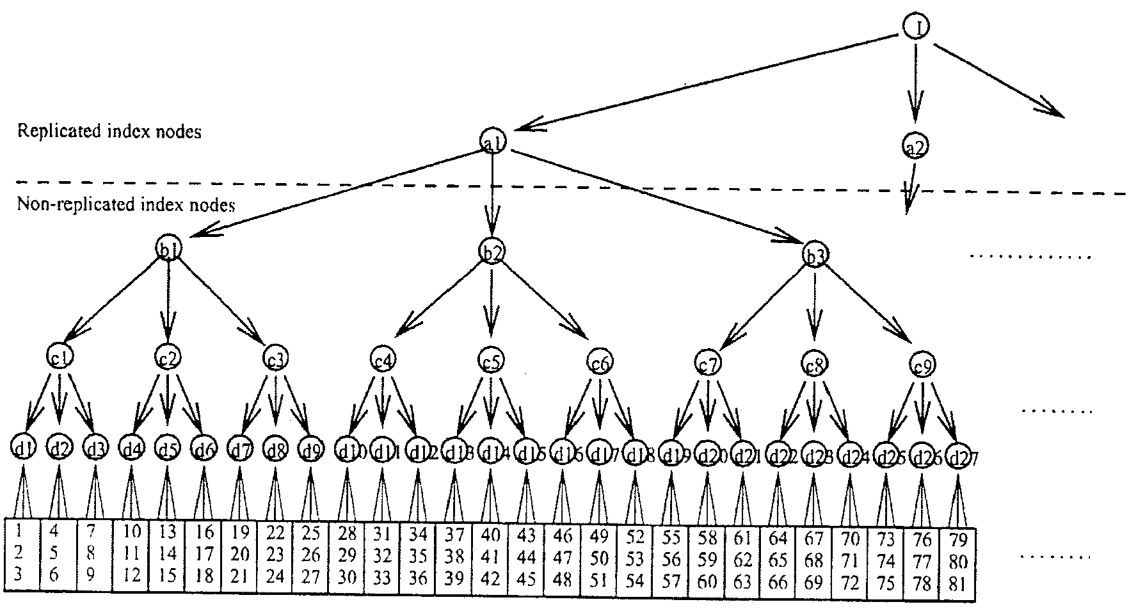
2. **(10 marks)**
Assume that there are three disks, A, B and C. And there are six items: *1, 2, 3, 4, 5 and 6* in Disk A, eight items: 7, 8, 9, 10, 11, 12, 13 *and* 14 in Disk B, and six items: *15, 16, 17, 18, 19 and 20* in Disk C. Suppose that we have determined the broadcast frequencies of Disks A, B, C as 2, 3, 6 times per broadcast cycle, respectively. Please obtain the corresponding the broadcast schedule using **the broadcast disk dissemination scheme**.

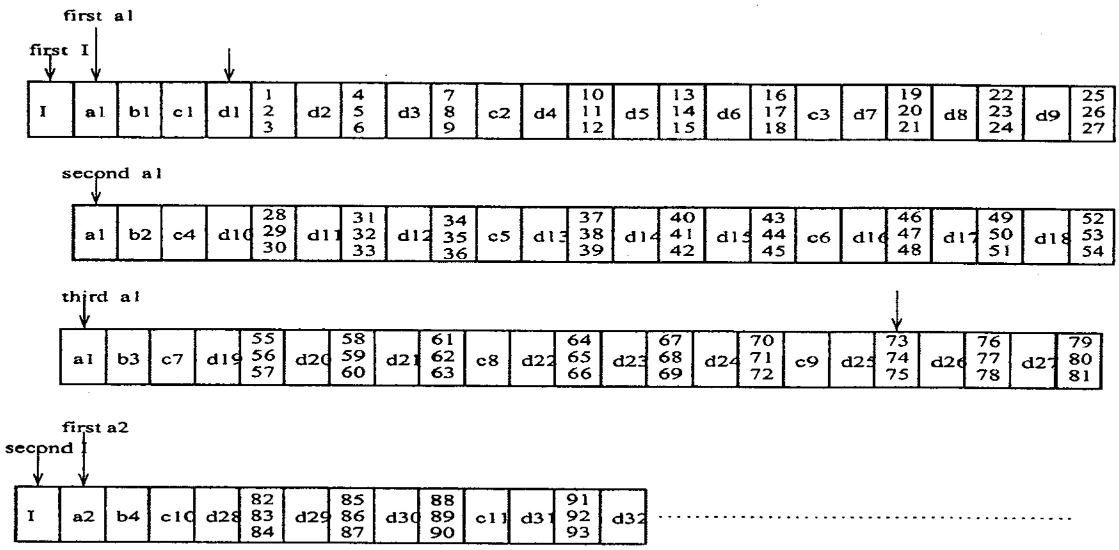
3. **(8 marks)**
Given the distributed indexing shown below, please answer the following questions.

(1) Give the range information associated to the first, second and third a1, respectively;

(2) Give the sequence of nodes visited in order to access node d when node p is the first node that a client tunes in.

Probe p	c1	c4	First a1	Second a1	Second a1
Destination d	27	60	3	42	27





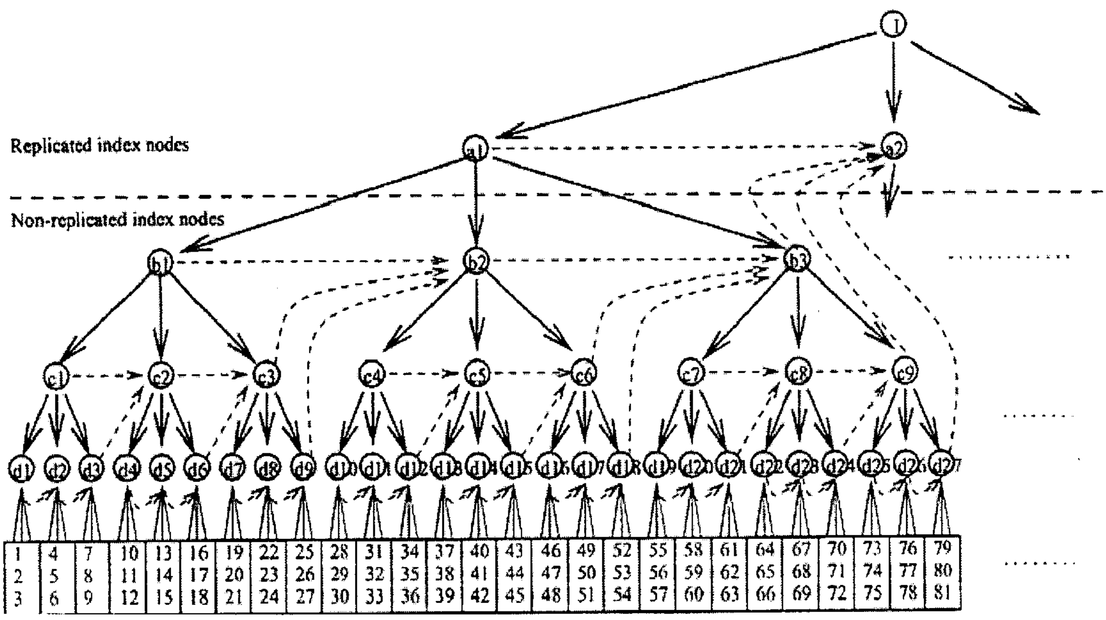
4. (6 marks)

For fault-tolerance, assume that ***(i) ACR*** *(All-Children Replication) or* ***(ii) SR*** *(Self Replication)* is used in the indexing scheme in Question 3, respectively. Please give the sequence of nodes visited in order to access node *d* when node *p* is the first node tuned into. (Assume that there is an error occurring at the 2nd node and then at every four nodes, i.e., the error in the 2nd node, the 6th node, the 10th node and so on.)

Probe p	b1
Destination d	24

5. (16 marks)

Given the Tree-based Fault-tolerant Indexing Replication Scheme as shown below, please answer the following questions:



(1) In this Scheme, we add pair <*Max_Value*, *Pointer*> to each index node. Given an index node ***x***, assume that we use ***x.Max_Value*** and ***x.Pointer*** to represent the pair associated to ***x***.

a. What are the values of ***b1.Max_Value*** and ***c2.Max_Value*** (**b1** and **c2** are the index nodes in the tree)?

b. When determining the value of *Pointer*, for the rightmost index node of a subtree, we need to obtain its **E_ancestor** and **F_ancestor**, where

- **E_ancestor** is the set containing all of its ancestors with the same *Max_Value,* and
- **F_ancestor** is the node closest to the root in **E_ancestor**.

Please give **E_ancestor** and **F_ancestor** of **d18** (**d18** is the index node in the tree).

(2) Give the sequence of nodes visited in order to access node *d* when node *p* is the first node tuned into and error occurs in the e^{th} node tuned into (Note: when counting for the e^{th} erroneous node, three data buckets in a leaf node are counted as one node (leaf node)).

Probe p	c2	c2
Erroneous eth	2, 3, 5,7,9	2, 4
Destination d	52	6

6. (10 marks)

Consider the group-based cache invalidation scheme. Assume there are 16 data items: 1, 2, 3, …, 15, 16, in the server log, and they are separated into 4 groups: G1 = {1, 2, 3, 4}, G2 = {5, 6, 7, 8}, G3 = {9, 10, 11, 12}, G4 = {13, 14, 15, 16}. Let L = 4, W = 22, and w = 10.

(1) Suppose that at time 34, the server log is as follows:

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
TS	25	17	10	6	22	19	28	32	2	15	14	32	8	4	11	30

Show the content of the invalidation report with now=34.

(2) Suppose that at time 38, the server log becomes as follows:

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
TS	25	36	10	6	22	36	29	36	2	15	14	36	8	36	11	36

Show the content of the invalidation report with now=38.

7. (12 marks)

Consider the following history H1.

H1: *r1(y) r2(z) r3(y) r2(x) w1(x) r4(x)r4(u) w3(z) w2(u)w3(y) w4(y)*

Please construct the serialization graph and show whether or not H1 is serializable. If it is serializable, give the equivalent serial history; if not, show if you can make it be serializable by removing **one operation (only one)** from H1, and explain reason why or why not.

8. (12 marks)

Considering the following history H:

H: r1(y), r2(u), r2(z), w1(x), r2(x),w1(y), r3(x), w3(y),w3(u)

Explain whether or not H can be accepted by 2PL (Two Phase Locking Protocol). If it can be accepted, show the execution history by putting the lock operations shown below in the history. If it cannot be accepted, show whether or not we can **swap** the execution order of two operations in the history so as to make the new history be accepted (please show the execution history by putting the lock operations into the new history if we can).

(***Lock Operations***: Use **GRL_i(x), FRL_i(x), GWL_i(x),** and **FWL_i(x)** to represent lock operations, in which GRL_i(x) (GWL_i(x)) represents the operation that obtains read(write) lock of x in Transaction i, and FRL_i(x) (FWL_i(x)) represents the operation that releases read (write) lock of x in Transaction i.)

9. (8 marks)

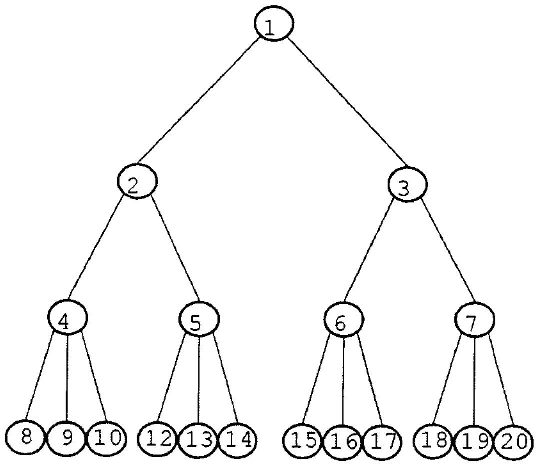
Consider that mobile clients A, B and C execute the following transactions, T_A, T_B, and T_C, locally, by reading data items from a consistent broadcast and that the server generates the broadcast at the beginning of the broadcast cycle. They submit the transactions to server in the following order: T_A first, then T_B, and then T_C, and the transactions are committed following this order. Would any of the transactions be aborted with the Optimistic Concurrency Control Protocol? Please explain why, and give the final observable history?

T_A:	rA(x)	rA(y)	rA(z)	wA(a)	wA(y)	commitA		
T_B:		rB(y)	rB(z)	rB(y)	rB(a)	wB(b)	commitB	
T_C:	rC(x)		rC(z)	rC(u)	rC(b)		wC(c)	commitC

10. (8 marks)

With reference to the hierarchical scheme for location management, show the database entries in the tree for object *X* in zone 8, if the pointer scheme is used. Show how the database should be updated if *X* is moving from zone 8 to 14, then to 16 and finally to 10.

Show how the *forwarding pointers* would be set, when X moves as the above.



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