

CS 6210 Fall 2009 Final

Name: Kishore GT Number: _____

Wednesday Decembet 9, 2009 (8:00 AM to 10:50 AM)

Note:

1. Write your name and GT number on each page.
2. The test is **CLOSED BOOK** and **NOTES**.
3. Please provide the answers in the space provided. You can use scratch paper (provided by us) to figure things out (if needed) but you get credit **only** for what you put down in the space provided for each answer.
4. For conceptual questions, **concise bullets** (not wordy sentences) are preferred.
5. Where appropriate **use figures** to convey your points (a figure is worth a thousand words!)
6. **Illegible answers are wrong answers. WE MEAN IT!!**
7. Please look through the whole test before starting so that you can manage your time better.

Good luck!

Question number	Points earned	Running total
1 (Max: 1 pts)		
2 (Max: 10 pts)		
3 (Max: 6 pts)		
4 (Max: 6 pts)		
5 (Max: 16 pts)		
6 (Max: 9 pts)		
7 (Max: 4 pts)		
8 (Max: 8 pts)		
9 (Max: 10 pts)		
10 (Max: 15 pts)		
11 (Max: 15 pts)		
Total(Max: 100 pts)		

1. (1 min, 1 point)

How many touchdowns did Michael Vick account for in his game against the Falcons on Sunday?

- a) Two passing touchdowns
- b) Two rushing touchdowns
- c) 1 passing and 1 rushing touchdowns
- d) Benched the whole time
- e) Who is Michael Vick?
- f) What is a touchdown?

CS 6210 Fall 2009 Final

Name: _____ GT Number: _____

2. (15 min, 10 points) (Distributed Objects - Java, Spring Kernel)

a) (Choose **ONE true statement from the following**) Interface Definition Language (IDL) serves the following purpose

- I. It allows expressing a subsystem interface in a language independent manner
- II. It is a specific way of writing the header file containing the method prototypes for object-oriented languages such as Java
- III. It is purely used for documentation purposes and does not play any part in the software development process

b) (Choose **ONE true statement from the following**) Subcontract in Spring Kernel is a mechanism that serves the following purpose

- I. It ensures that there is exactly one implementation of a given service
- II. It makes client/server interactions location transparent
- III. It is the way marshalling and unmarshalling are done in Spring kernel when the client and server are on the same machine

c) (Choose **ONE true statement from the following**) Spring kernel allows extension of the operating system (i.e., addition of new subsystems and services) via the following method

- I. By using C++ as the language to implement the operating system
- II. By use of subcontracts as an underlying mechanism for object method invocations
- III. By using open language independent interfaces to enable third party software development

d) Choose the **ONE false statement that does not apply** for remote objects in Java

- I. References to objects can be passed as args/result
- II. Java built-in operators are available for use with them
- III. Parameter passing semantics are the same for remote objects as for local objects

e) Choose the **ONE false statement that does not apply** for object technology

- I. They provide strong interfaces allowing 3rd party software development
- II. They promote reuse of software components
- III. They result in superior implementation (i.e., performance) compared to implementation of a subsystem in a procedural or imperative style

CS 6210 Fall 2009 Final

Name: _____ GT Number: _____

3. (9 min, 6 points) (Global Memory System (GMS))

- a) (Choose **ONE true statement from the following**) The concept of **memory pressure** pertains to
- I. The system having insufficient virtual memory space for a given process
 - II. The system having insufficient physical memory frames for a given process
 - III. The system having too small a TLB to hold all the address translations for a given process
- b) Choose the **ONE false statement that does not apply** as the design premise of GMS
- I. Accessing data from a local disk is more expensive than from remote memory of a peer node on the LAN
 - II. Nodes in a LAN cluster experience unequal memory pressure
 - III. It is sensible to dedicate some nodes in a LAN cluster to always function as memory servers
- c) (Choose the **ONE false statement that does not apply**) To collect the age information for the VM pages, GMS does the following
- I. It uses a special hardware TLB that records the timestamp of page accesses
 - II. It forces a TLB flush periodically
 - III. It maintains a bit vector in software to gather LRU stats for the physical frames being accessed upon TLB misses

CS 6210 Fall 2009 Final

Name: _____ GT Number: _____

4. (9 min, 6 points) (Distributed Shared Memory - TreadMarks)

a) (2 points)(choose **ONE true statement from the following**) Memory consistency pertains to

I. Ensuring that the caches in a multiprocessor have the same value for the same location

II. A contract between the programmer and the architecture as to when a change made to a shared memory location will be made visible to other nodes in the system

III. Propagating changes to shared memory locations only upon a release synchronization operation

b) (4 points) Assume sequential memory consistency model for the following problem

Initial values: $a = b = 0$;

P1:

$a = a + 1$

$b = b + 1$

P2:

$d = b$

$c = a$

The possible values for c and d after all the above assignment statements are complete on both P1 and P2 are
(choose the **ONE that does not apply**)

I. $c = d = 0$

II. $c = d = 1$

III. $c = 0; d = 1$

IV. $c = 1; d = 0$

CS 6210 Fall 2009 Final

Name: _____ GT Number: _____

5. (20 mins, 16 points) (xFS)

In a centralized file system, the server performs the functions of managing the data blocks, metadata for the files, server-side file cache, and consistency of datablocks of files cached by multiple clients. The following questions are with respect to how these functions are carried out in xFS.

Answer True/False and explain why that is the case (If you only say True or False you will not receive full credit.)

(a) Meta data for files are located in the same node as the data

False. To load-balance metadata management, xFS decouples the location of metadata for a file from the location of the Content

(b) A file is contained entirely on a single disk in the entire system.

False. IT uses Software RAID to stripe a file on a selected number of disks as determined by the Stripe group

CS 6210 Fall 2009 Final

Name: _____ GT Number: _____

(c) Small file write problem is solved in xFS.

True. It uses a log structured file system to overcome the small write problem

(d) The in-memory cache for a file resides at the same node as the disk copy.

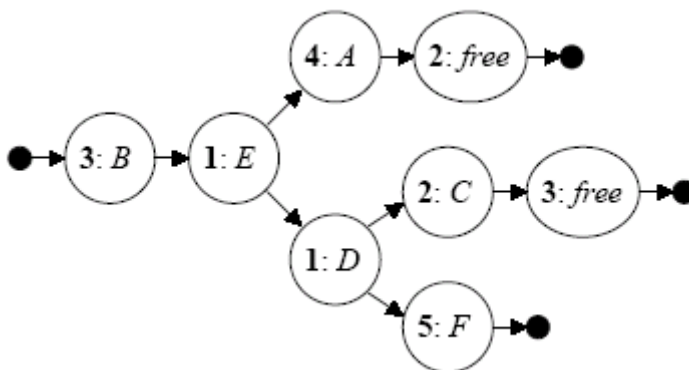
False. XFS uses cooperative caching meaning the file may be cached at a client node different from the server that hosts the file in its disk.

CS 6210 Fall 2009 Final

Name: _____ GT Number: _____

6. (15 min, 9 points) (Rialto CPU scheduler)

Consider a scheduling graph with a base period of 10 ms as shown below.



Given the partially filled time chart showing a 40 ms window (each slot represents 1 ms), fill in the blank time slots with the specific activity that is executing on the CPU commensurate with the above scheduling graph.

B	B	B	E	A	A	A	A	X	X	B	B	B	E	D	C	C	X	X	X	B	B	B	E	A	A	A	A	X	X	B	B	B	E	D	F	F	F	F	F
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

Note: **X** represents the CPU is free in that time slot.

7. (6 min, 4 points) (Tiger)

a) Choose the **ONE false statement from the following** regarding Tiger system to keep the cubs coordinated to deliver the multimedia streams to the client viewers

- I. The system does a distributed admission control to ensure that a new viewer can be fitted into the delivery schedule
- II. The central controller keeps an accurate global schedule and instructs each cub when it is their turn to deliver the block
- III. Each cub has a partial local view of a logical global schedule
- IV. Each cub tells the next two cubs in the delivery schedule that their turns are coming up

b) Choose **ONE true statement from the following** regarding fault tolerance in the Tiger system

- I. A movie is fully replicated in two cubs to tolerate a single cub failure
- II. Each cub has a backup disk that fully replicates its primary disk
- III. The system does not address fault tolerance issues
- IV. Each block served by a cub is de-clustered for mirroring into sub-blocks and striped across other cubs to deal with failures

CS 6210 Fall 2009 Final

Name: _____ GT Number: _____

8. (12 min, 8 points) (Failures, LRVM, Quicksilver)

a) (choose **ONE true statement from the following**) There is **no undo log** in Satya's LRVM because

- I. LRVM copies the old values for the specified range of addresses in a set-range call into virtual memory
- II. Entire virtual memory of a process is made persistent by using LRVM library
- III. The transactions as defined in LRVM never abort
- IV. LRVM assumes that there is battery backup for the physical memory

b) (choose **ONE false statement from the following**) Satya's LRVM is light weight because

- I. It does not have to keep undo logs on the disk
- II. It provides lazy semantics for reducing the number I/O activities to keep the virtual memory persistent
- III. It does not implement the full transactional semantics in the database sense
- IV. It is implemented in the kernel

c) (choose **ONE false statement from the following**) The sources of problems in computer systems that lead to unreliability include

- I. Power failure resulting in loss of volatile state in physical memory
- II. Software crash due to bugs in the code
- III. Lack of semantics that allows inferring the state of the system prior to the crash
- IV. Not implementing transactional semantics at the operating system level

d) (choose **ONE true statement from the following**) A server (such as a file system) with a recoverable state in Quicksilver will use

- I. Two-phase commit protocol
- II. One-phase standard protocol
- III. One-phase immediate protocol
- IV. One-phase delayed protocol

CS 6210 Fall 2009 Final

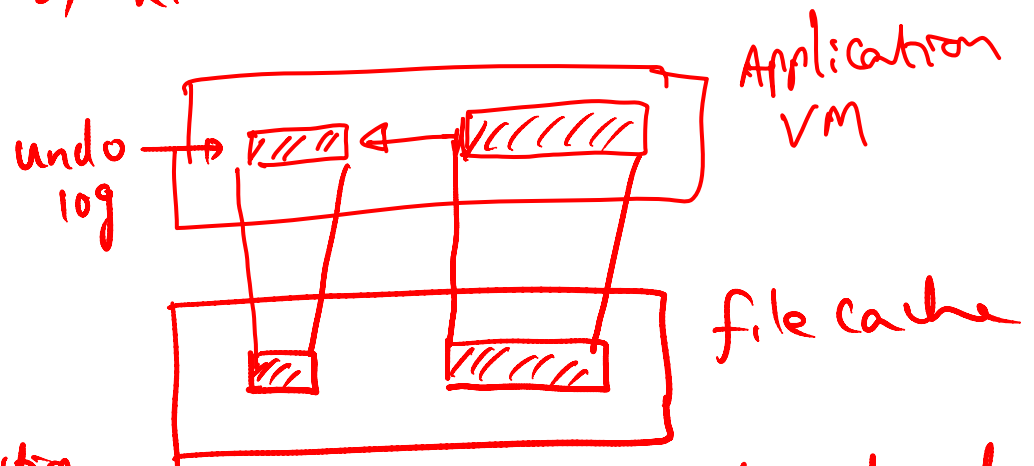
Name: _____ GT Number: _____

9. (10 min, 10 points) (Rio Vista)

Explain the role performed by the battery-backed Rio File cache in implementing reliable virtual memory. Use pictures to make your point.

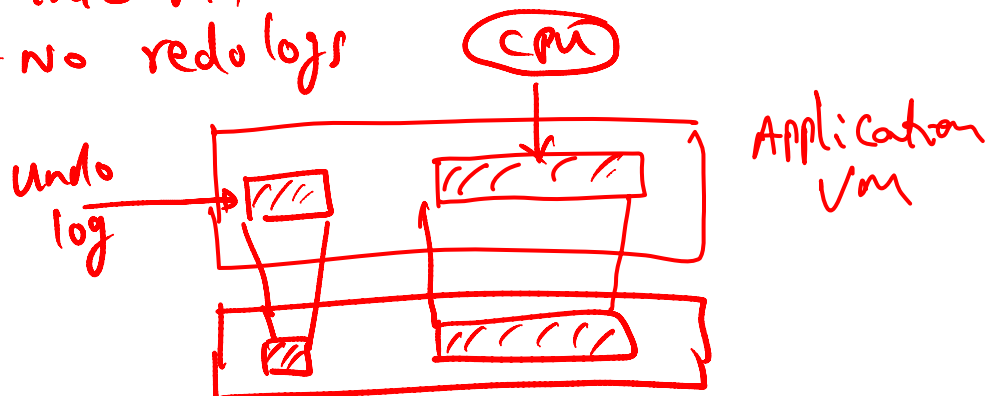
At Begin transaction:

- make copy of "before" image of range of virtual addresses to be modified in a VM buffer backed by Rio File Cache



During xaction

- perform writes during transaction directly into VM backed by file cache
- no redo logs



Commit

- throw away undo log

Abort - restore from undo log

CS 6210 Fall 2009 Final

Name: _____ GT Number: _____

10. (15 min, 15 points) (Coral)

Consider an 8-node system with node-ids: 0, 1, 2, 3, 4, 8, 10, 14.

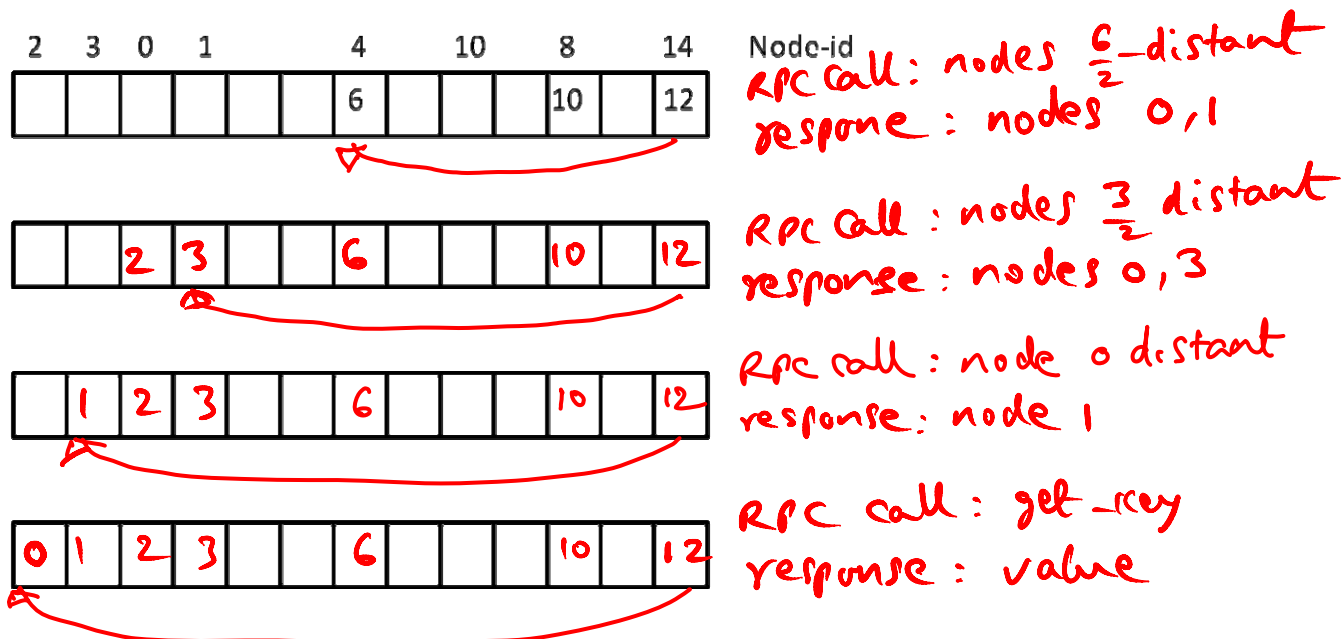
Node 14 wants to do a "get_key" operation for some key which matches with node-id 2. Initially, assume the following about the routing tables at the different nodes:

- Node 14 has IP addresses for node 4 and 8.
- Node 10 has IP addresses for 8 and 14
- Node 8 has IP addresses for nodes 2 and 3
- Node 4 has IP addresses for nodes 0 and 1
- Node 3 has IP addresses for nodes 2 and 4
- Node 2 has IP addresses for nodes 0, 1, and 3
- Node 1 has IP addresses for 0 and 3
- Node 0 has IP addresses for 2 and 4

Show pictorially the evolution of the routing table at Node 14 in implementing the key-based routing in Coral. To get you started, the **first row** in the figure below shows the routing table at Node 14 at the start. The contents of the table are the XOR distances of that node from the destination (i.e., node 2). For e.g., the distance between nodes 4 and 2 is 6. Recall that the "distance" between any two nodes is the XOR distance of the node-ids.

For each row, as a progression of the key-based routing

- Show what RPC call is made
- Show what is returned as a result of the RPC
- Show the changes that result in the routing table because of what is returned



CS 6210 Fall 2009 Final

Name: _____ GT Number: _____

(Extra space for Q10)

CS 6210 Fall 2009 Final

Name: _____ GT Number: _____

11. (15 min, 15 points) (Security in Andrew file system)

In the following notation,

$E[(X, Y), K]$, means the string (X, Y) is encrypted using the encryption key K .

a) Fill in the blank (7 points):

- i. A user walks up to a Virtue workstation. He types in his login name "rama" and password "kishore".
- ii. Virtue sends a message $\langle \underline{\text{Yama}}, E[(25), \underline{\text{Kishore}}] \rangle$ to the authentication server.
- iii. The authentication server responds with $\langle E[(\underline{26}, 78), \underline{\text{Kishore}}] \rangle$.
- iv. Virtue responds with $\langle E[(\underline{79}), \underline{\text{Kishore}}] \rangle$.
- v. The authentication server returns $\langle E[(111, 0), \underline{\text{Kishore}}] \rangle$.

b) (4 points) Explain the need for step number (iii)

Needed for client to know that the server is genuine and that the reply is not a "replay attack".

c) (4 points) Explain the need for step number (iv)

Needed for server to know that the client is genuine and that the initial message in (ii) is not a "replay attack".