BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI

FIRST SEMESTER 2017-2018

CS G623 ADVANCED OPERTING SYSTEM

Comprehensive examination-Closed book

Max Marks: 20 Tentative Time: 1 hour 30 minutes

The student has to submit the closed book question paper and answer sheet for collecting the open book part. The student can take as much time as (s)he wants for closed book part. However, total time for attempting both closed book and open book part is three hours.

Ques 1: Multiple choice questions: **Zero, One or more answers can be correct**. No partial marking. Marks will be awarded for all correct options written. Any wrong option attempt will lead to negative marking. **0.5 marks for correct answer and -0.5 marks for wrong answer** for all questions except **14th which carries +1 for correct and -1 for wrong answer**. Overwriting will be considered as wrong answer. Write carefully. In case of no correct option write NO, otherwise write the option A/B/C/D/E. **Write the answers of question 1 in the space provided below.**

1.	6.	11.	16.
2.	7.	12.	17.
3.	8.	13.	18.
4.	9.	14. i. iii. ii. iv.	19.
5.	10.	15.	20.

(10.5 Marks)

1. The primary advantage of non-blocking primitive is/are the following
   a. Programs have maximum flexibility to perform computation and communication in any order they want
   b. The behavior of the programs is predictable making it easy to code
   c. Programs are reproducible
   d. Programs are easy to debug and time-independent

2. Which of the following(s) best describes the rendezvous strategy
a. The SEND primitive does not block even if there is no corresponding execution of RECEIVE primitive
b. It is more complex as it involves creating, managing, and destroying buffers
c. SEND primitive is blocked until a corresponding RECEIVE primitive is executed at the receiving computer
d. The strategy used in synchronous blocked primitives
e. The asynchronous buffered primitive strategy

3. The RPC have various advantages but still there are few shortcomings. The following is/are the short coming in RPC
a. Remote procedures are not first class objects
b. Non-existence of efficient mechanism for intra-machine calls
c. To invoke the procedure on many servers concurrently
d. The existing RPC mechanism can't return incremental results while execution is in progress

4. The execution level compatibility is said to exist in the distributed system if
a. All the processors execute the same instruction collection, even though the processors may differ in performance and in input-output.
b. The same source code can be compiled to run properly on any computer in the system
c. It achieves the interoperability by requiring all system components to support a common set of protocols
d. It employs common protocols for essential system services

5. Lamport's happened before relation is
a. Transitive
b. Reflexive
c. Irreflexive
d. Commutative
e. Symmetric

6. The following is false regarding a consistent cut
a. If every message that was received before a cut event, was sent before the cut event at sender site in a cut
b. If no two sites are concurrent
c. If events are causally related
d. If a sent is recorded but corresponding receive was not recorded

7. For the distributed mutual exclusion algorithms discussed in class, which of the following is/are true.

a. The Suzuki-Kasami algorithm requires same number of messages per CS execution irrespective of the load
b. Raymond's algorithm require fixed number of messages per CS execution in case of lightly loaded scenario.
c. The minimum synchronization delay possible is T log(N)/2
d. The maximum throughput possible is 1/(T+E)

8. The system model considered for agreement problem has following features

a. The processors are prone to failure
b. The communication medium is unreliable
c. The system is logically fully connected
d. A receiver processor always knows the identity of the sender processor of the message

9. Which of the following is true for phantom deadlocks

a. Multiple cycles that are broken by deletion of one edge results in phantom deadlocks
b. Aborting of victim results in resolution of phantom deadlocks
c. Non awareness of latest WFG results in phantom deadlocks
d. These deadlocks are detected if deadlock resolution is not carefully incorporated

10. In byzantine agreement problem, if the source processor is faulty

a. It is not possible to come to an agreement
b. It is irrelevant whether the faulty processors agree on a value at all
c. All non-faulty processors can agree on any common value
d. It is not possible to satisfy the validity

11. In distributed file systems, which of the following is true regarding hints

a. SUN NFS was the first distributed file system to implement hints
b. There may arise a problem of cache consistency which is addressed by hints
c. Sprite file system implements hints
d. CODA achieves great scalability because of hints

12. Which of the following is false regarding the Sprite file system

a. It uses remote link and symbolic link
b. Client-initiated approach is used for maintaining cache consistency
c. It uses delayed writing policy
d. Sprite file system uses backing files
e. It least recently used policy for cache block replacement

13. Which of the following is false regarding CODA file system

a. For naming and location, it used file identifier having two components: volume number and uniquifier
b. The major goal of CODA was scalability, fault tolerance, and constant data availability
c. It was designed for graceful integration of the use of the file system with portable computers
d. In order to detect inconsistency, it used latest storeid, and Coda version vector.
e. CODA used force operationThe force operation is a server to server operation that can be initiated on server crash recovery

14. Match the following

i.	UNIX semantics	a.	All changes have all or nothing property
ii.	Session Semantics	b.	No changes are visible to other process until the file is closed
iii.	Transactions	c.	Every operation on a file is instantly visible to all processes
iv.	Immutable files	d.	No updates are possible

15. Which of the following is/are the advantage(s) of stateless server

a. Fault tolerance
b. No OPEN/CLOSE calls needed
c. No server space wasted on tables
d. No limits on number of open files
e. No problem if client crashes
f. File locking possible

16. Which of the following is/are the advantage(s) of stateful server

a. Fault tolerance
b. No OPEN/CLOSE calls needed
c. No server space wasted on tables
d. No limits on number of open files
e. No problem if client crashes
f. File locking possible

17. Which of the following is true

a. Memnet is an example of Switched multiprocessor

b. Dash is an example of Switched multiprocessor that uses clusters
c. Cm* and BBN Butterfly were implementations of NUMA multiprocessors
d. In Single bus multiprocessors MMU converts remote memory access to messages

18. Which of the following is true in case of page based distributed shared memory
a. OS converts remote memory accesses to messages
b. MMU converts remote memory accesses to messages
c. It used Bus as a medium to transfer messages
d. Unit of transfer is a block in page based distributed shared memory

19. In case of heterogeneous work arrival, symmetrically initiated algorithm is best suited
a. The statement is false as symmetrically initiated algorithms have sender initiated component that can't scale well
b. It is false as adaptive algorithms work better than symmetrically initiated algorithms in case of heterogeneous load
c. It is true as symmetrically initiated algorithm are best suited for heterogeneous work arrivals
d. It is true as the mean response time is less in case of symmetrically initiated algorithm

20. The domino effect has serious implication in recovery. The following is the main cause of domino effect
a. It is caused because of synchronous check-pointing
b. Domino effect is because of asynchronous check-pointing
c. It is caused because the receipt is recorded and sent is not recorded.
d. Domino effect is the consequence of orphan messages

Ques 2. Consider a scenario in which there are four CPUs C1, C2, C3, C4 connected to a memory M through a bus. The following sequence of events happen.

i. There is a single word in memory whose initial value is A cached by C3.

ii. After that the value is read by C1.

iii. Following which C2 wants to read the value and update it to B

iv. C2 again updates the word to C

v. C4 now wants to write the value of word to D.

In order to achieve cache consistency write-once protocol is used. Discuss and analyze each step with justification and supporting diagram how cache consistency is achieved/maintained.

(3 Marks)

Ques 3. In case of task migration, there are two major steps namely state transfer and unfreezing. One of the critical issue in task migration is the residual dependency. Discuss the impact of residual dependencies on migrating task. Critically analyze the execution of task migration in two practically implemented distributed operating systems namely the V system and sprite. How are all the phases of task migration implemented in both the above mentioned practical Distributed OS?

(3 Marks)

Ques 4. There are various means of implementing access control. Suppose in a system you have 2000 files and 4 users, who have access rights on these files. Discuss the pros and cons of each strategy for implementing the access control in above given scenario.

(2 Marks)

Ques 5. Consider the up-down graph theoretic algorithm. In the distributed system, the following sequence of events occur in processor 1

i. initially a task arrives at processor 1 at time 0,
ii. Another task arrives at time 2
iii. Task1 is allocated at time 4
iv. Task 2 is allocated at time 6
v. Task 1 finishes execution at time 8
vi. Task 2 finishes execution at time 10

Draw the usage table entry vs time graph for the above scenario for the processor 1.

(1.5 Marks)

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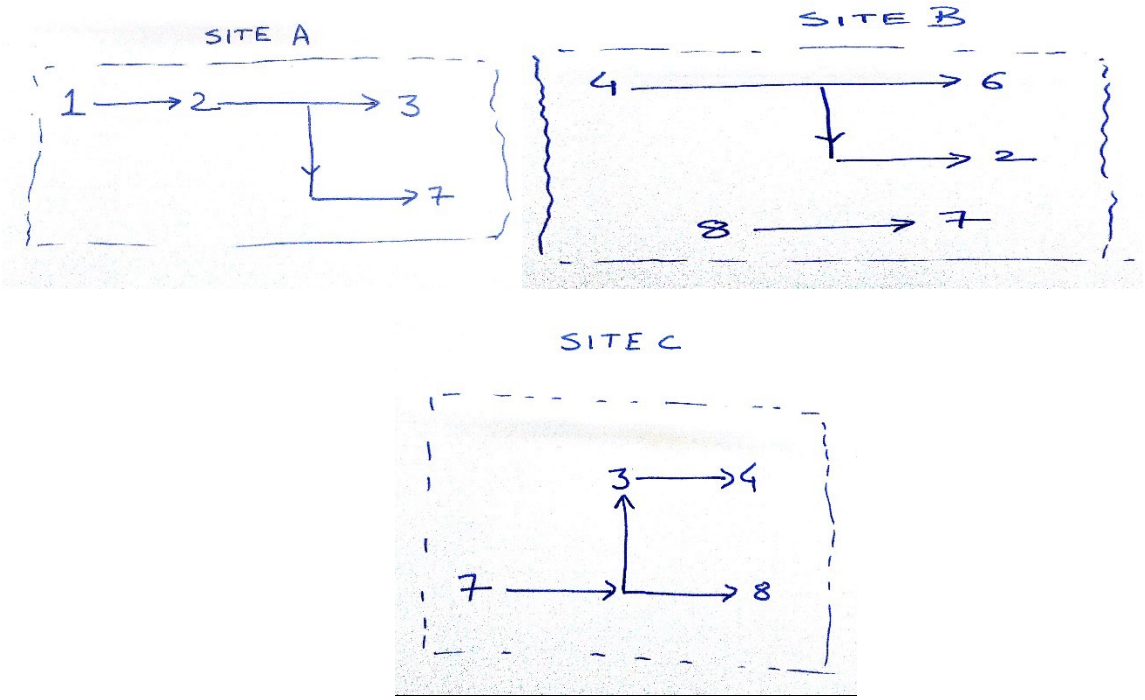
Ques1. The figure below shows the wait for graph split among three sites. Is there a possibility of a cycle? Draw the combined wait for graph with communication links. Use Obermarck's algorithm for deadlock detection to draw the step by step wait for graph. In an iterative evolve at the cycles using the strings communicated. How is this deadlock broken? Discuss with reference to the distributed deadlock detection algorithm proposed by R. Obermarck.



(4 Marks)

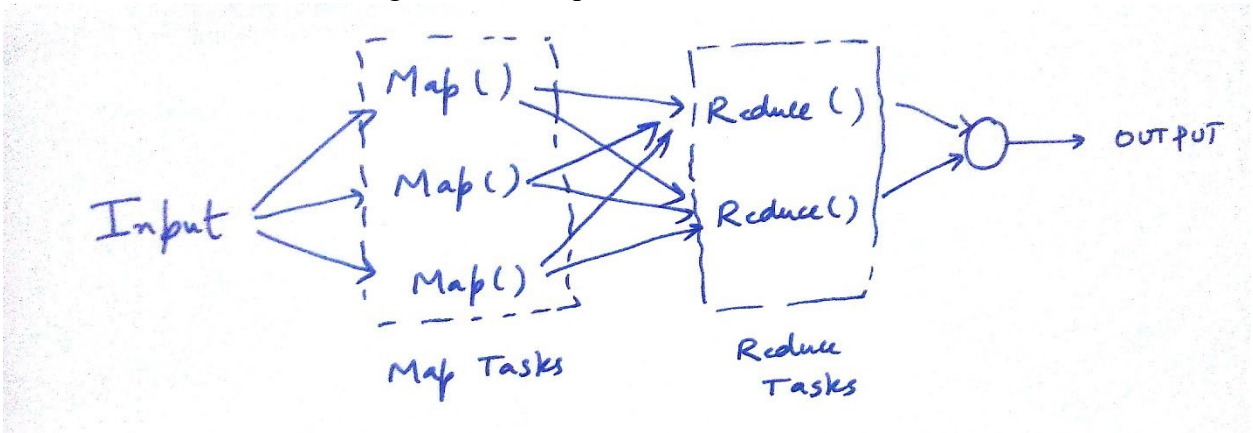
Ques 2. Discuss the situations in which the stable symmetrically initiated algorithm best justifies the overhead incurred in memory and computation in execution of the stable symmetrically initiated algorithm.

(1 Marks)

Ques 3. In HDFS system, the major improvement apart from performance is fault tolerance. How does the HDFS system ensure fault tolerance when a client writes a file? Discuss all the steps.

(1.5 Marks)

Ques 4. Consider the following model of map reduce



The task is to count the frequency of each word. The following data set is used

Doll, Bat, Apple, Car, Car, Apple, Doll, Car, Bat

Discuss the solution (with detailed steps) of above problem using map reduce algorithm. Consider appropriate number of map( ) and reduce( ) nodes with justification.

(2 Marks)

Ques 5. E. R. Zayas defines Accessibility maps in his research work on Accent titled "Attacking the Process Migration Bottleneck". These maps were created to supply the necessary addressing information in Accent. The research work discusses four different memory distances. Critically analyze them with specific focus on what happens when the process/system tries to access these memory areas.

(1+2 = 3 Marks)

Ques 6. The x-kernel architecture proposed by Peterson et al. defines the two abstract communication objects namely protocols and sessions. Discuss their significance.

(1.5 Marks)

Ques 7. In case of signed messages it is possible to come to a consensus. Is it possible to come to a consensus with signed messages if one node is faulty and there are three total nodes (including faulty node)? Justify. Also critically analyze the scenario if the originating node is faulty.

(1.5 Marks)

Ques 8. Mirage is a software that makes use of shared memory in a single site system and its extension to a multi-machine environment. Mirage provides a form of network transparency to

make network boundaries invisible for shared memory. Discuss the handling of page faults in Mirage implementation of distributed shared memory.

(1.5 Marks)

Ques 9. A log-structured file system writes all modifications to disk sequentially in a log-like structure, thereby speeding up both file writing and crash recovery. The log is the only structure on disk, it contains indexing information so that files can be read back from the log efficiently. In Log-structured file system discuss the purpose of Inode, Inode map, and Indirect block. Critically analyze the importance of Segment summary, Segment usage table and the Super block. Why are the checkpoint region and directory change log required in log-structured file system?

(4 Marks)