Fall 2015 COMP 3511 Homework Assignment #3

Handout Date: Oct 28, 2015 Due Date: Nov 11, 2015

Name: _____ ID: _____
E-Mail: _____Section: _____

Please read the following instructions carefully before answering the questions:

- You should finish the homework assignment **individually**.
- There are a total of **4** questions.
- When you write your answers, please try to be precise and concise.
- Fill in your name, student ID, email and Section number at the top of each page.
- Please fill in your answers in the space provided, or you can type your answers in the MS Word file.

- **Homework Collection: the hardcopy** is required and the homework is collected in **collection box #16** (for **L1**) and **collection box #17** (for **L2**). The collection boxes are located outside **Room 4210**, near **Lift 21** (there are labels on the boxes)

1. (20 points) Multiple choices

   1) A mutex lock ____.
   A) is exactly like a counting semaphore
   B) is essentially a boolean variable
   C) is not guaranteed to be atomic
   D) can be used to eliminate busy waiting

   2) Assume an adaptive mutex is used for accessing shared data on a Solaris system with multiprocessing capabilities. Which of the following statements is not true?
   A) A waiting thread may spin while waiting for the lock to become available.
   B) A waiting thread may sleep while waiting for the lock to become available.
   C) The adaptive mutex is only used to protect short segments of code.
   D) Condition variables and semaphores are never used in place of an adaptive mutex.

   3) How many philosophers may eat simultaneously in the Dining Philosophers problem with 5 philosophers?
   A) 1
   B) 2
   C) 3
   D) 5

   4) A cycle in a resource-allocation graph is ____.
   A) a necessary and sufficient condition for deadlock in the case that each resource has more than one instance
   B) a necessary and sufficient condition for a deadlock in the case that each

resource has exactly one instance
C) a sufficient condition for a deadlock in the case that each resource has more than once instance
D) is neither necessary nor sufficient for indicating deadlock in the case that each resource has exactly one instance

5) Which of the following statements is true?
A) A safe state is a deadlocked state.
B) A safe state may lead to a deadlocked state.
C) An unsafe state is necessarily, and by definition, always a deadlocked state.
D) An unsafe state may lead to a deadlocked state.

6) Suppose that there are ten resources available to three processes. At time 0, the following data is collected. The table indicates the process, the maximum number of resources needed by the process, and the number of resources currently owned by each process. Which of the following correctly characterizes this state?

Process	Maximum Needs	Currently Owned
P_0	10	4
P_1	3	1
P_2	6	4

A) It is safe.
B) It is not safe.
C) The state cannot be determined.
D) It is an impossible state.

7) _____ is the method of binding instructions and data to memory performed by most general-purpose operating systems.
A) Interrupt binding
B) Compile time binding
C) Execution time binding
D) Load-time binding

8) _____ is the dynamic storage-allocation algorithm which results in the smallest leftover hole in memory.
A) First fit
B) Best fit
C) Worst fit
D) None of the above

9) Assume a system has a TLB hit ratio of 90%. It requires 15 nanoseconds to access the TLB, and 85 nanoseconds to access main memory. What is the effective memory access time in nanoseconds for this system?
A) 108.5
B) 100

C) 22
D) 176.5

10) Given the logical address 0xAEF9 (in hexadecimal) with a page size of 256 bytes, what is the page number?
A) 0xAE
B) 0xF9
C) 0xA
D) 0x00F9

2. (20 points) Please answer the following questions in a few sentences.

1) (4 points) What are the main differences between deadlock prevention and deadlock avoidance?

2) (6 points) One way to eliminate the circular-wait condition is to impose a total ordering of all resource types, for instance it requires that each process requests resources in an increasing order of enumeration – R = {<R1, R2, …, Rm}. Please sketch a proof that this ensures no circular-wait (Hint: proof by contradiction)

3) (5 points) How does external fragmentations occur? How could we resolve this problem?

4) (5 points) What is TLB? How can it improve the performance of memory access?

3. (20 points) Consider the following snapshot of a system:

	Allocation	Max	Available
	A B C D	A B C D	A B C D
P_0	2 0 0 1	4 2 1 2	3 3 2 1
P_1	3 1 2 1	5 2 5 2	
P_2	2 1 0 3	2 3 1 6	
P_3	1 3 1 2	1 4 2 4	
P_4	1 4 3 2	3 6 6 5	

Answer the following questions using the banker's algorithm:

1) (8 points) Illustrate that the system is in a safe state by demonstrating an order in which the processes may complete.

2) (6 points) If a request from process P1 arrives for (1, 1, 0, 0), can the request be granted immediately?

3) (6 points) If a request from process P4 arrives for (0, 0, 2, 0), can the request be granted immediately?

4. (30 points) Memory management

1) (15 points) Consider the following segment table:

Segment	Base	Length
0	90	200
1	500	100
2	3500	150
3	160	10
4	1382	200

What are the physical addresses of the following logical address?

a) 0, 99

b) 1, 101

c) 2, 56

d) 3, 100

e) 4, 2

2) (15 points) Two-level paging

In a 32-bit machine we subdivide the virtual address into 3 segments as follows:

page number		page offset
10-bit	10-bit	12-bit

We use a two-level page table (in memory) such that the first 10 bits of an address is an index into the first level page table and the next 10 bits are an index into a second level page table. Each page table entry is 32 bits in size.

a) (2 points) What is the page size in such a system?

b) (3 points) How many entries are in the 1st level page table? How many entries are in the 2rd level page table?

c) (3 points) How much memory do the 1st page table occupy? How much memory do the 2rd page table occupy?

d) (7 points) How much space is occupied in memory by the page tables for a process that has 128MB of actual virtual address space allocated? Show your work with detailed explanation.