University of California Santa Cruz
Baskin School of Engineering
Computer Science Department

CMPS111 Spring 2018

Homework 5

Marks Available: **25 (5% of final course mark)**

Submission:
   Due: **23:59 Wednesday May 23, 2018**
   Format: **Single PDF Document**
   Where**:**   **Canvas**

(4 Marks) *Question 1.* Consider a computer with a 32-bit processor and 8 KB pages. Calculate the number of linear page table entries required if virtual addresses are 48-bit.

(6 Marks) *Question2.* A system has four processes and five allocatable resources. The current allocation and maximum needs are as follows:

	Allocated	Maximum	Available
Process A	1 0 2 1 1	1 1 2 1 4	0 0 X 1 1
Process B	2 0 1 1 1	2 2 2 1 0	
Process C	1 1 0 1 0	2 1 3 1 0	
Process D	1 1 1 1 1	1 1 2 2 1	

Calculate the smallest value of X for which this is a state from which most processes can run to completion without deadlock. Show your work and explain your answer.

(5 Marks) *Question 3.* Can two kernel-level threads in the same user-level process synchronize using a kernel-level semaphore? What if the threads are implemented entirely at user-level? Assume that no threads in any other processes have access to the semaphore. Discuss your answers.

(6 Marks) *Question 4.* Early computers did not have Direct Memory Access (DMA); the CPU handled every byte of data read or written. (a) Briefly describe the mechanism by which these early computers handled non-DMA read operations. (b) What impact did the lack of DMA have on multiprogramming? Use diagrams if you feel they make your answers clearer.

(4 Marks) *Question 5.* Consider the FIFO page replacement algorithm and the reference string:

    1 2 3 4 1 2 5 1 2 3 4 5

If the number of page frames increases from three to four, does the number of page faults go down, stay the same, or increase? Explain you answer using diagrams as appropriate.