CS 692 Capstone Exam Algorithms Fall 2019: Choose any 2 of the 3 problems.

1) Consider the implementation of a closed hash table a[0]..a[n-1] to store distinct positive integers, using quadratic probing to resolve collisions. A value of 0 indicates that a hash table location is currently unused. The hash function is $h(x)$ $x \% n$..

3) For each function with input argument *n*, determine the asymptotic number of “fundamental

Theory Exam

Answer of the following three questions:

1. Give a context-free grammar generating the following language over $O = \{0, 1\}$:

$$\{0^m 1^n 0^k : k \quad m; m, n, k \geq 0\}$$

2. A *Hamiltonian circuit* in an undirected graph is a cycle that visits each node exactly once. A *cycle* in a graph is a non-empty path in which the only repeated node is the first and last.

   Consider the following problem:

   $= \{V, E : G = (V,E)$ is an undirected graph containing a Hamiltonian circuit$\}$

   Show that $\subset NP$.

3. Answer or $\overline{m}H$

SYSTEMS EXAM

Fall 2019

90 minutes

Check which problems you are submitting:

#1
#2
#3

How many pages total? _

Problem #1

a) (4pts) List the **four** conditions of **deadlock**:

b) (16pts) Below is a **semaphore** solution for the producer/consumer problem. The buffer can hold **n** items. Semaphores are X, Y , and Z.

// The buffer is initialized to be empty and is processed as a first in first out
// queue

// PRODUCER CODE

```
while (true)
{
    1. getItem();
    2. wait(X);
    3. wait(Z);
    4. addItemToBuffer();
    5. signal(Z);
    6. signal(Y);
}
```

// CONSUMER CODE

```
while(true)
{
    1. wait(Y);
    2. wait(Z);
    3. readItemFromBuffer();
    4. signal(Z);
    5. signal(X);
    6. processItem();
}
```

There is a problem with each of the semaphore initializations below. **Give a sequence of statements showing how an error might occur.**

For instance, can the Producer and Consumer be in their critical sections at the same time? Will deadlock occur?

Please note, for full credit, you must you must list a sequence of statements that lead to an error. You will not get credit for guessing.

1) X = 0, Y = 0, Z = 1
2) X = n, Y = 0, Z = 0
3) X = n Y = 0, Z = 2
4) X = 0, Y = n, Z = 1

Problem #2 Resource Allocation Banker's algorithm

safe state

(14pts) Show **a safe state process sequence** for the following:

Resources: X, Y, Z where available is X = 11, Y = 7, Z = 7

	Allocated	Max	Need
	X Y Z	X Y Z	X Y Z
P0	4 1 1	7 3 2	3 2 1
P1	3 1 2	5 2 7	2 1 5
P2	2 2 3	2 2 4	0 0 1
P3	2 2 0	4 4 1	2 2 1

(3pts) If a **P2** asks for **(3,2,4)** can it be granted? Why or why not?