CS 6901 Capstone Exam Systems Winter 2016: Choose any 2 of the 3 problems.

1) Rewrite $F(a, b, c, d) = \sum(1, 3, 5, 7, 11, 12, 13, 14, 15)$ in fully simplified product-of-sums form.

2) Consider the semaphore solution to solve the producer/consumer problem with a buffer of n elements. Write the basic code for producers and consumers. Declare and initialize all semaphores.

3) Consider the following page reference string for a virtual memory system in which physical memory has exactly 3 frames:

5, 1, 2, 1, 5, 8, 1, 6, 8, 5, 6

For each of the following page replacement algorithms, show which references will cause page faults and show the contents of the 3 frames at the time of each fault. Assume that the frames are initially empty. You do not need to show the first 3 faults that are caused by demand paging.

a) Least Recently Used
b) Second Chance

CS 6901 Capstone Exam Theory Winter 2016

Choose any 2 of the 3 problems.

1. a. State the Pumping Lemma for Context Free languages.

b. Prove that the following language is not context-free:

$L = \{0^m 1^n 0^p : m \geq n \geq p \geq 0\}$

2. a. Define clearly but completely: Language L is decidable.

b. Let $ALL_{DFA} = \{M: M \text{ is a DFA and } L(M) = \Sigma^*\}$ — that is, this is the language of deterministic finite automata that accept all strings. Show that ALL_{DFA} is decidable.

3. If G is an undirected graph, then a vertex cover of G is a subset of the nodes where every edge of G is incident to at least one of those nodes. (An edge and a vertex on that edge are called incident.) The vertex cover problem asks whether a graph contains a vertex cover of a specified size: VERTEX-COVER = {<G, k>: G is an undirected graph that has a k-node vertex cover}.

a. Give a yes-instance and a no-instance of the vertex cover problem.

b. Show that VERTEX-COVER is NP-complete.

(A list of problems that are known to be NP-complete: SAT, 3-CNF-SAT, CLIQUE, HAMPATH, HAMILTONIAN-CIRCUIT, SUBSET-SUM, 3-Dim-Matching, PARTITION, INDEPENDENT-SET.)