PH.D. QUALIFYING EXAM (SPRING 2017)
(Area: Data Structures and Operating Systems)

Data Structure and Algorithms

Question 1.

Part A (50%) Given a singly linked list, design a time- and space-efficient algorithm to find the $m$-th-to-last element of the list. Implement your algorithm, taking care to handle relevant error conditions. Define $m$-th to last such that when $m=0$ the last element of the list is returned. Describe your algorithm and code it in your preferred programming language (slightly more specific than pseudo-code; no directly calling APIs).

Part B (50%) You are given a binary tree in which each node contains a numeric value. Edges have no weights. Design an algorithm to print all paths which sum to a given value. The path should start at the root and does not have to end at a leaf, and only touches a vertex once. Please code it in your preferred programming language (slightly more specific than pseudo-code).
Part A (50%) What is the difference between a thread and a process? What are typical items shared by all threads in a process? What are typical items that are private to each thread? What are key items in a typical process table entry?

Part B (50%) Write a Producer thread and a Consumer thread that share a fixed-size buffer and an index to access the buffer. The Producer should place numbers into the buffer, and the Consumer should remove the numbers. The order in which the numbers are added or removed is not important. Please code it in your preferred programming language (slightly more specific than pseudo-code).