NYU, Tandon School of Engineering

Bridge to Computer Science Program

4th Exam

Thursday 21 April 2022

- You have two hours
- There are 100 points total.
- Note that there are longer problems at the end. Be sure to allow enough time for these.
- We supplied you with a file, named 'solutions.txt', where you should type all your answers.
- Write your name, netID and NYU ID at the head of the solutions file.
- For editing this file, you are allowed to use only plain text editors (Notepad for Windows users, or textEdit for Mac users).
- You are permitted to use Visual Studio (C++) or XCode as compilers. And Textedit/Notepad for text editing
- Calculators are not allowed.
- This is a closed-book exam. No additional resourced are allowed.
- Pay special attention to the style of your code. Indent your code correctly, choose meaningful names for your variables, define constants where needed, choose most suitable control statements, etc.
- In all questions you may assume that the users enter inputs as they are asked. For example, if the program expects a positive integer, you may assume that users will enter positive integers.
- No need to document your code in this exam, but you may add comments if you think they are needed for clarity.
- Read every question completely before answering it.
- When done, please upload your answer file to Brightspace.nyu.edu, Gradescope and email to dkatz@nyu.edu

1) (3 pts) Which of the following functions could a process call to create a "child" copy of itself?
   a. sleep
   b. fork
   c. createThread
   d. copy

2) (3 pts) Data has just been received on the ethernet network adapter and the hardware memory buffers on that card are filling up. What is likely to happen?
   a. A CPU interrupt will occur
   b. The network card will slow the connection by delaying ACKs
   c. The OS will call sleep on the running process
   d. The connection will fail and have to be restarted

3) (3 pts) HTTP will be used to upload data to a server. This would fall into which OSI layer?
   a. (this is not in any OSI layer)
   b. Application (7)
   c. Presentation (6)
   d. Transport (4)
   e. Network (3)

4) (3 pts)A process which could, otherwise, run but has been swapped out of main memory in order to make space would be in which state?
   a. Ready
   b. Running
   c. Blocked
   d. Ready/Suspended
   e. Exit

5) (3 pts) In TCP, the initial packet in a connection needs to have which flag(s) set on?
   a. SYN
   b. ACK
   c. RST
   d. PSH

6) (15 pts) In Resident set management, stealing can happen "locally" or "globally." Assuming a global stealing algorithm, discuss why it would be detrimental to allow the system to run out of free frames and how you would avoid letting that happen.

7) (10 points) You are writing a program which uses threading in which multiple threads will access the console to print out information. When you run the program with just one thread, you see output that looks like this:

        OUTPUT FROM THREAD 1

Sometimes, when you run it with multiple threads, it looks like:

        OUTPUT FROM THREAD 1
        OUTPUT FROM THREAD 2

But some times, you see:

        OUTPUT OUTPUT FROM THREAD 1
        FROM THREAD 2

Explain what the problem is and how you would solve it.

8) (15 pts) DNS resolution could be recursive or iterative. Explain the difference between the two from the perspective of the client making the query. Describe what you would expect in each packet and give a brief description of each packet.

9) (10 pts) The are multiple delays involved in moving a packet from one router to another over a wire of a 30km distance. Which of the delays do you think would be the most significant? Justify your answer fully with an explanation why you think this is true.

10) (15 pts)List and describe the steps involved in a context (process) switch. Explain what aspects you think are involved in memory management when these steps occur.

11. (20 pts) You are given a pointer to the root of a "full" balanced binary search tree and an empty vector (passed by reference, of course). That is to say, given a tree in which every node has either two children (internal node) or no children (leaf), write a C++ non-member function which will fill the vector with the "in-order" traversal of the tree. You may use any STL data structures that you'd like in your answer. You may assume that each node of the tree (a class called TreeNode) has a left, right, and parent pointer as well as a "data" member and your function is a friend of all of the classes involved.