NYU, Tandon School of Engineering

Bridge to Computer Science Program

4th Exam

Thursday 27 April 2023

- 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) What data would be searched for in the translation lookaside buffer?
    a. CPU instructions
    b. virtual memory page numbers
    c. Cache codes
    d. Stack pointers

2) (3 pts) Which of the following results in the largest amount of external fragmentation?
    a. Fixed Partitioning
    b. Dynamic partitioning
    c. Paging
    d. Segmentation

3) (3 pts) Which of the following protocols are responsible for local addressing and connection-oriented transfer of data?
    a. Ethernet
    b. IP
    c. HTTP
    d. TCP

4) (3 pts) _____ Are a common data structure solution programmers use to protect critical sections of code.

5) (3 pts) To retrieve a web page, the HTTP verb _____ is used and is recognizable as the first bytes in the request.

6) (10 pts) IPV6 is a protocol that is necessary for today's world. Explain what is wrong with IPV4 and why we need to migrate to this new protocol. In your answer, please explain some (at least 2) of the differences between IPV4 and IPV6.

7) (10 pts) Changing from the CPU's privileged mode to user mode is quite simple, but changing back must be done automatically. Explain some situations in which this change has to occur and what changes in the CPU to recognize the mode.

8) (15 pts) Deadlocks are always a problem in a program that uses threads. Explain how deadlocks occur and what can be done to **prevent** deadlocks from ever occurring.

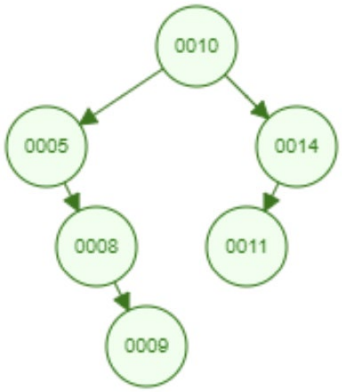
9) (10 points) When a new device arrives at a network, it knows nothing about the IP addressing scheme in use. Explain, and describe the packets, that are sent and received in order to obtain an IP address.

10) (10 pts) A good page replacement algorithm is an important part of any modern operating system. The Least-Recently-Used (LRU) algorithm usually has excellent performance but is nearly impossible to implement. Explain why it is nearly impossible given existing hardware.

11) (10 pts) In a network, we often want to move packets through as quickly as possible. However, there are times when the network will impose artificial delays to packets even if the connections are not busy. Explain a situation in which a router might artificially delay a packet despite the connection being available.

11. (20 pts) You are given a pointer to the first node in a binary search tree and a vector representing a sequence of items. You are asked to write a function which will return true if the sequence represents the pre-order traversal of the values in the tree. For this question, you may assume a TreeNode class which contains a left, right and parent pointer and a data section of the same datatype as the items in the vector.

    For example if the vector was (10, 5, 8, 9, 14, 11} the result would be true of the following tree:



    Your code will be graded on accuracy as well as efficiency.