NYU, Tandon School of Engineering

Bridge to Computer Science Program

4th Exam

Thursday, 19 December 2019

- 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 this file.
- For editing this file, you are allowed to use plain text editors (Notepad for Windows users, or textEdit for Mac users) and compilers such as Visual Studio, XCode and CLion.
- 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 Newclasses.nyu.edu and email to dkatz@nyu.edu

1) (3 pts) With a CPU access time of less than 1ns but having only a very small quantity (<1KB) which of the following types of memory is just as fast as the CPU?
   A. Primary
   B. Secondary
   C. Registers
   D. RAM

2) (3 pts) A signal sent on a semaphore is an example of which of the following?
   A. A consumable resource
   B. A reusable resource
   C. A system resource
   D. A non-system resource

3) (3 pts) In OSI/RM, addressing on a global scale will be done at which layer?
   A. Application
   B. Transport
   C. Network
   D. Data-Link

4) (3 pts)In the five-state process model, a process in the _____ state has all of its resources and is waiting for a processor to become available.

5) (3 pts) Today's Internet uses the _____ protocol to resolve (convert) names of websites into IP addresses.

6) (20 pts) In all computer systems, there is a component of the system which provides fundamental mutual exclusion protection. What is this component, why does it provide mutual exclusion and why is it insufficient to protect against asynchrony?

7) (10 pts) After setting up a firewall on our network, we notice that FTP connections that use "active" mode (PORT) transfers will fail, but those which use PASV will succeed. Explain what is happening in the scenario and what you might change to correct it.

8) (10 pts) Page tables for large processes can easily take up a large amount of physical memory. One, proposed, solution to this problem is to use a multilevel page map table and put some portions in virtual memory. Explain how you would implement that. In your answer, please, specifically, discuss how a virtual address would be converted to a physical address

9) (10 pts) Given a router that has the following entries in its routing table. If this router was sending traffic to IP address 10.1.3.10, which router would the packet be set to? Please explain why you chose your answer.

Network	CIDR Mask	Next Hop	Metric
10.1.3.0	/27	10.1.1.1	25
10.1.0.0	/16	10.1.2.1	10
10.1.3.0	/27	10.1.8.1	15

10) (15 pts) Four cars arrive at the exact same moment at an intersection with a four-way stop sign. The law states that the car on the left must yield to the car on the right. Show that this situation meets the four requirements for a deadlock and explain how to determine which car should go through the intersection first.

11) (20 pts) A music streaming service would like us to create classes for use in their system. We will need to track users, songs and advertisements. In our system, users must always have a positive number of "points." The user has to listen to advertisements in order to earn points which are, automatically, used when the user listens to a song.

- User is a class which will store a single data structure called heard which has references to all of the Songs and Advertisements that the user has listened to, ever. Store this in a data structure of your choice. Do not worry about how items get added to this data structure, someone else will handle that.
- The User class has a function called "isPositive" which determines if the total number of points (the sum of all calls to the getPoints functions) is a positive number. Do not store that number, it should be calculated from the "heard" data structure.
- Both Songs and Advertisements have a function named "getPoints" which return slightly different things. Calling getPoints on an advertisement always returns 1.00 (a double), to indicate that the user has listened to an advertisement. Calling getPoints on a song returns the number of points needed to listen to that song. Equal to the negative of the duration of the song, in seconds, divided by 300. For example, for a 300 second long song, the function would return -1; for a 600 second long, it returns -2.
- Songs have a duration, which must be set at construction time.
- Advertisements have no other, relevant, functions

Please design the above classes and include anything else necessary. You do not need to write a main, includes or any comments.