

NYU, Tandon School of Engineering

Bridge to Computer Science Program

4th Exam

Thursday 29 October 2020

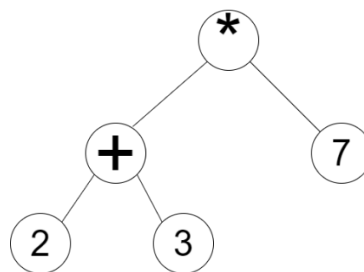
- You have two hours
- There are 100 points total.
- Note that there are longer problems at the end. Be sure to allow enough time for these.
- We supplied you with a file, named 'solutions.txt', where you should type all your answers.
- Write your name, netID and NYU ID at the head of this file.
- For editing this file, you are allowed to use any compiler including CLion, XCode and Visual Studio.
- Calculators are not allowed.
- This is a closed-book exam. No additional resources 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](https://newclasses.nyu.edu), Gradescope and email to dkatz@nyu.edu**

- 1) (3 pts) Which of the following functions can be used to put the current process/thread into a blocked state?
 - a. Thread.StartThread()
 - b. sleep()
 - c. fork()
 - d. malloc()
- 2) (3 pts) Which of the following is a fundamental, hardware, way of providing mutual exclusion?
 - a. A semaphore
 - b. A system bus
 - c. Peterson's algorithm
 - d. VSWs
- 3) (3 pts) Which of the following algorithms is a solution for page replacement
 - a. Dijkstra's algorithm
 - b. VSWs
 - c. Peterson's algorithm
 - d. Clock
- 4) (3 pts) When a page is elected to be _____, it means we are removing that page from main memory and storing it on the secondary storage (swap) space for later recovery.
- 5) (3 pts) Today, when we need to send data over a reliable layer 4 connection, we would use _____, because it guarantees delivery in order with confirmation of delivery.
- 6) (10 pts) In a system that uses paging, explain why each process has a Page Map Table and what is contained in it.
- 7) (10 points) In a system with both User Level Threads (ULT) and Kernel level threads, explain how we can leverage both to prioritize certain operations over others.
- 8) (10 pts) Explain why cookies are necessary in HTTP non-persistent connections in order to provide an ability for a user to be "logged in" without having to send username and password credentials with each request.
- 9) (10 pts) In a TCP connection, the window size field is only 16 bits meaning the maximum number is 64Kbytes in the window. If this were the actual limit of a TCP window, explain why it would result in a slow connection from New York to El Paso, Texas (3,000 KM distance)
- 10) (15 pts) Your company is assigned an IP subnet of 10.1.1.0/24. You are asked to divide that into three networks. Two of the networks, New York and Los Angeles, will have 50 devices connected. The third network is a Point-To-Point WAN link between the NY and LA network. Provide the network number and subnet mask (or CIDR mask) for each of the three networks.

- 11) (10 pts) A router's forwarding table has the following entries. Given a destination address of 192.168.0.32, which next hop IP address will be used? Explain how you came to that answer.

Network Number	Next Hop	Metric
0.0.0.0/0	10.10.1.2	25
192.168.0.0/22	10.10.1.5	10
192.168.0.0/24	10.10.1.6	20

- 12) (20 pts) An expression tree is a type of binary tree in which we can hold operands and operators. A node in the tree can be either an operand or an operator, but an operand node cannot have any children. An operator node can have children of either type. Below is an example of an expression tree equivalent to $(2+3)*7$.



Please design the classes ExpressionTree, ExpressionTreeNode, Operand and Operator.

1. An ExpressionTree needs to store the tree similar to how a Binary Tree is stored. The expression tree needs to have one function "getValue" which will solve for the value of the expression tree (35 in the above example). You do NOT have to implement code to handle adding or removing nodes on the tree, just the getValue function.
2. The ExpressionTreeNode class should have a function "getValue" but this will run different code depending on if this node is an Operand or an Operator.
3. Both Operand and Operator should implement the getValue function.
 - a. For an Operand, simply return the value stored in the "data" section of the node. "data" for an operand will be a double and you should allow for setting its value upon creation of the node.
 - b. For an Operator, you should recursively call the getValue function for the left and right nodes and perform the operation in the "data" section of the node. Here, the "data" section is a single character and will either be + or * (you don't have to worry about other values) and should be set upon creation. You do not need to write functions to attach the left and right children, but you should create the private data members in your class.