

This Quiz is being given under the guidelines of the **Honor Code**. You are expected to respect those guidelines and to report those who do not. Answer the questions in the spaces provided. If you run out of room for an answer, continue on the back of the page. There are 11 questions for a total of 160 points.

Name: \_\_\_\_\_

1. (5 points) Bob Memoryleak has forgotten where he saved the file for his latest computer science homework. He recalls that He named the class BinTree, and that the file is in some subdirectory under his home. What command could Bob use to find the file.
  
2. (5 points) Once again our forgetful friend Bob has gotten himself into trouble. He has been writing all of his Paidea papers in emacs and saving them as text files. His directory of term papers has many files in it including files named like blah.txt, foobar.txt, longone.txt, and others. He's searching for the paper he wrote on the importance of Ooblech in the medieval feudal system. What command could Bob use to locate the paper he is looking for?
  
3. (10 points) The following table shows running times for a set of algorithms that solve: a problem of teh size given in the left column. Fill in the next two rows:

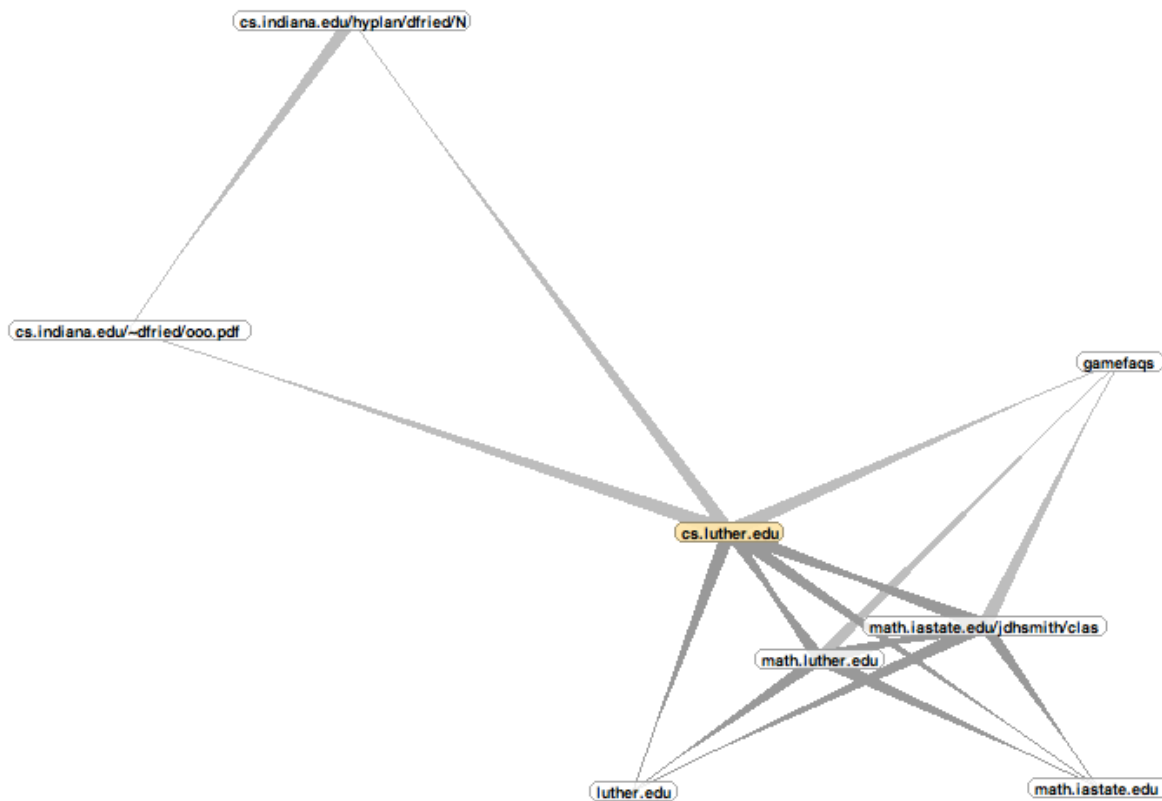
$N$	$O(N^3)$	$O(N^2)$	$O(N \log N)$	$O(N)$	$O(1)$
10	100	10	8	1	5
100					
10,000					

4. (20 points) A palindrome is a word (or phrase) that reads the same both forward and backward. We can ignore punctuation marks and white space. Palindromes have been around since biblical times. For example, when Adam and Eve first met Adam is quoted as saying “madam I’m adam”. Later in history a large engineering feat in central america was described as: “a man a plan a canal panama”. When the use of electricity became widespread, engineers were often heard muttering “so many dynamos”. Write a recursive function `boolean pal(String s)` to determine whether a given string is a palindrome. For example: `pal(palprep("go hang a salami! I'm a lasagna hog"))` would return true, whereas `pal("palindrome")` would return false. You do not need to write the `palprep` method. It simply returns a string with punctuation and spaces removed. *Hint: a zero or one character string is always a palindrome, a two character string is a palindrom if the two characters are the same...*

5. (10 points) Using the *Median of 3* approach, show each step in the quicksort partitioning process as quicksort processes the following array of numbers. When you are done make sure that you clearly identify  $L$ ,  $R$ , and the pivot.

3	6	8	7	0	2	1	11	9	5
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6. (20 points) The following graph shows the closest websites that link between themselves and the uther college computer science homepage. Show two different data structures for representing the graph.



7. Optical cable used in networking can be extremely expensive: hundreds of dollars per meter. Whoever is paying for that is going to want to use the least amount possible. Suppose we have to wire an entire college campus with this to give incoming freshmen terabit ethernet capabilities. There are hundreds if not thousands of ways we could choose to run the wires between buildings. We want to find the best without examining the cost of every possibility. We can use the minimal spanning tree algorithm to solve this problem. The following table shows the connections from the building in the first column to the building in the second column, with the weight provided in the third column.

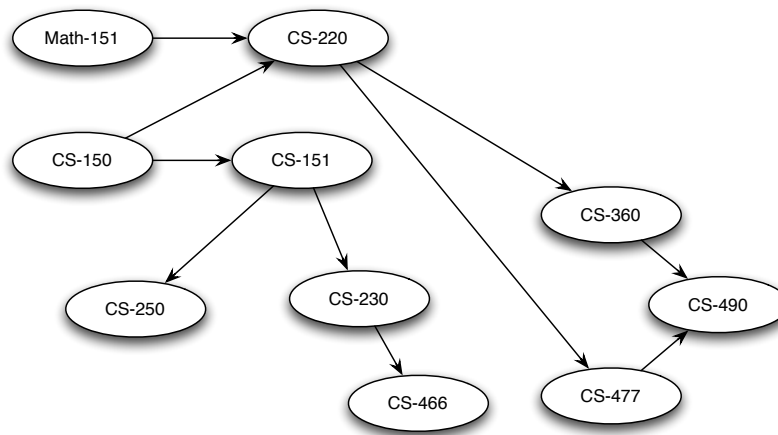
1	2	10
1	3	15
1	6	25
1	10	11
2	3	7
3	4	7
3	6	10
4	5	7
4	6	5
5	6	13
5	7	17
6	10	15
6	9	10
6	7	6
6	8	10
7	8	7
8	9	6
9	10	10

- (a) (10 points) Draw the directed graph represented by the above table.
- (b) (10 points) Show the minimal spanning tree constructed from the graph using kruskals algorithm. You must show the edges that are in the spanning tree at each step of the algorithm so that I know you understand how the algorithm works.

8. (10 points) Given the following insert operations into a hash table that uses linear probing, and the hash function  $h(x) = x * 11 \% 20$  Show the keys stored at each position of the hash key array. insert(10) insert(20) insert(40) insert(111) insert(15) insert(11) insert(110) insert(45)

0	
1	
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19	

9. (20 points) The classes that need to be taken in order to get a computer science major can be represented as a graph. Part of the graph for a CS major is shown in figure 9. Although the



prerequisites may seem complicated at first, a topological sort can help you plan your schedule for the coming years. Show the result of running the topological sort algorithm on the graph of classes required for the CS major.

10. (20 points) Assume that you have a `LinkedList` class just like the one we built in class. That is you have a `LinkedList` class with a head node, and a `LinkNode` class. defined as follows:

```
1  class LinkNode {  
2      Comparable payload  
3      LinkNode next  
4  }
```

We can create a new class called `SortedLinkedList` by extending the `LinkedList` class and overloading the `add(Object)` method to be `add(Comparable)`. The new `add` method must insert the new object in the list in such a way that the list is in sorted order. Write the java code for this new `add` method.



11. (20 points) Assume that you have A BinaryHeap class with the following methods:

- BinaryHeap() – Constructor
- void insert(Comparable) – add an element to the heap
- Comparable delMin() – remove the smallest element from the heap
- void buildHeap(Comparable []). – initialize a heap from an array

Using the BinaryHeap class, write the code to implement a sort algorithm: Comparable[] heapSort(Comparable []). What is the running time of the algorithm? Justify your answer.