CS 202: Introduction to Computation
Fall 2010: Practice Final Exam

Name: ____

Question	Possible Points	Received Points
1	15	
2	15	
3	15	
4	15	
5	15	
6	15	

The format of the final exam will be strictly multiple choice and therefore will be very different in style than this practice. However, the technical content and level of difficulty are likely to be similar.

The final exam will likely have MORE questions than this practice.

Question 1: Am I repeating myself? Am I repeating myself?

The TCP/IP protocol is used to send messages over the Internet. **IP** is a best-effort, unreliable protocol that knows how to route **packets** from a source machine to a destination machine. **TCP** is built on top of IP and ensures complete **messages** (broken up into smaller fixed-sized packets) really get to the destination. One of the basic mechanisms of TCP is that it adds **a unique sequence number** to each packet.

Imagine a message M is being sent from a sender S to a destination D. Explain how TCP (and the use of sequence numbers) ensures that the message is received correctly, even when the following problems occur. How does TCP detect the problem? How does TCP fix the problem? What must the sender do? What must the receiver do?

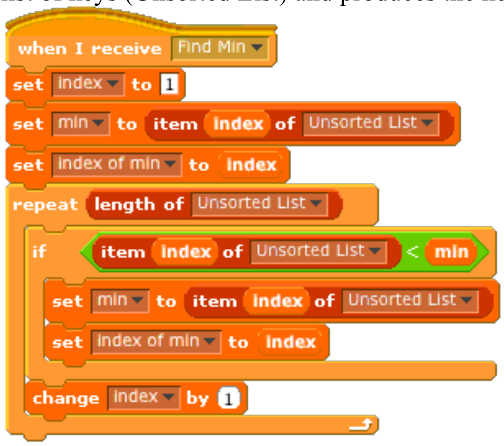
A) Two packets within M arrive in reversed order at the destination.

B) A packet within M is duplicated and arrives at the destination twice.

C) A packet within M is dropped and never arrives at the destination.

Question 2: Sorting through the Confusion

Consider the following code (shown in class) that performs a **selection sort**. This simple version takes as input one list of keys (Unsorted List) and produces the keys in sorted order in another list (Sorted List).



A) Imagine the message "Sort List" is broadcast and *Unsorted List* begins with 8 elements:

List	**23**	**88**	**33**	**46**	**12**	**79**	**44**	**8**

Show the contents of *Unsorted List* and *Sorted List* at the end of each iteration of the repeat loop in the "Sort List" script.

Unsorted List ***Sorted List***

i									i								
1									1								
2									2								
3									3								
4									4								
5									5								
6									6								
7									7								
8									8								

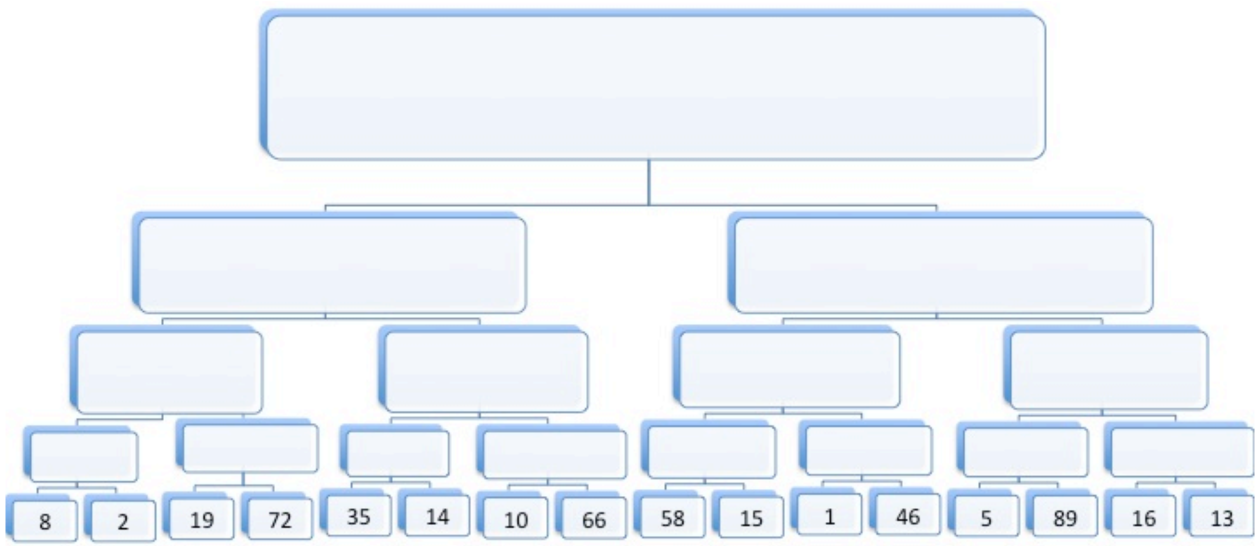
B) For a number of keys N in the unsorted list, how many operations are performed by selection sort? (Select one.)

- O ($\log_2$ N)
- O (N)
- O (N $\log_2$ N)
- O (N^2)
- O (N!)

Question 3.   Watch out for Merging Traffic Ahead

You've been asked to use the merge sort algorithm to sort the following sixteen keys:
8, 2, 19, 72, 35, 14, 10, 66, 58, 15, 1, 46, 5, 89, 16, and 13.

A) Use the tree below to show how the merge sort algorithm will produce the final sorted list by recursively merging two lists of size n/2 into one list of size n.



B) The next set of questions examine the complexity of the merge sort algorithm.
Given 16 integers to sort, what is the height of this tree (i.e., how many sets of merges are needed to sort the keys)?

If we instead had to sort 32 integers, what would be the height of the tree?

If we instead had to sort 64 integers, what would be the height of the tree?

If we had to sort N integers, what would be the height of the tree? (Select one.)

- O (1)
- O ($\log_2$ N)
- O (N)
- O (N $\log_2$ N)
- O (N^2)

How many total comparisons between keys are needed to merge two sorted lists of size N/2 into one list of size N?

- O (1)
- O ($\log_2$ N)
- O (N)
- O (N $\log_2$ N)
- O (N^2)

How many operations are performed by the merge sort algorithm given N keys?

- O ($\log_2$ N)
- O (N)
- O (N $\log_2$ N)
- O (N^2)
- O ($N^2 \log_2$ N)
- O (N!)

Question 4: Secrets and Lies

This is an almost true story. The other day, my nine-year old daughter named Anna sent me an encrypted letter that looked like this:

```
Tvt,
Kv fvb ilsplcl pu Zhuah Jshbz?

Svcl,
HuuH
```

A) Anna used a simple **shift cipher**. What is the plain text of her message?

B) Briefly describe the approach you used to break the cipher.

C) Using the same shift cipher, send her an encrypted message back (with at least three words). Give the plain text of your message too.

Question 5: This statement is false

Imagine you are on an island populated by two tribes. Members of one tribe always tell the truth. Members of the other tribe always lie. Tribe members can all recognize one another, but you can't tell them apart.

For each of the following situations, construct a truth table to indicate whether or not the situation is possible for each of the combinations of people. Second, show the possible combinations for which tribe each person belongs to.

A) You meet two people A and B from the island. A says, "B is a liar." B says, "1+1 = 3."

B) You meet two people C and D from the island. C says "We are both liars".

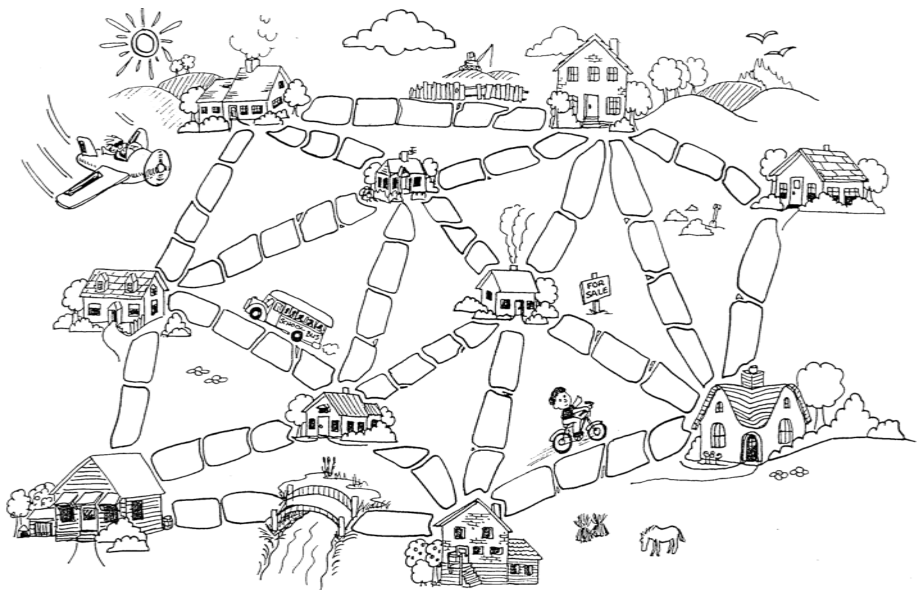
C) You meet two people E and F from the island. E says "Exactly one of us is a liar." F says "E is the liar."

D) You meet two people G and H from the island. G says "H told me yesterday that he is a liar." H says "I like to eat soup."

E) You meet three people I, J, and K from the island. Each says "The other two are from different tribes than the other." What is known about the number of liars in the group?

Question 6: Maybe people should just fly

Imagine that you own a concrete company. This quaint village is upgrading some of the existing paths between houses from old muddy bricks to new clean concrete. But, the village is only willing to pay the minimum amount to ensure that one can go from each house in the village to every other house without having to walk across muddy bricks (but perhaps through a roundabout way). This is a map of the village.



A) Your first task is to draw a more official version of the map in which houses are represented as vertices, or nodes, in a graph and the paths are edges in the graph. Each house and corresponding vertex should be marked with a letter and each edge should be labeled with the number of muddy bricks it represents. The bridge counts as one brick.

B) On top of your drawing, show the **minimal spanning tree** you produce to connect hourses. What is the total number of muddy bricks that will be replaced?

C) The village says that a competing concrete company came up with a different solution to the problem. Is this possible? If so, can you figure out what path the other company found?