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Illinois Institute of Technology
Computer Science

Second Exam

CS 331 — Data Structures
Spring 2015
Friday, April 3, 2015 15:15–16:30

This is a **closed book** and **closed notes** exam.
You are **not** allowed to use calculators or computers during this exam.
Do **ALL** problems in this booklet. Read each question very carefully.
You may detach pages, but **you must return all pages of this exam.**
Your exam will be digitized for grading. **The back sides of pages will be considered scratch paper, and will be ignored for grading.** If you need extra space to write an answer, "overflow" sheets are provided at the end of the exam.

Name	
IIT Email	

Multiple Choice

Each question has exactly one correct answer. **You are allowed to select more than one answer.** You get one point for showing up to the exam, three points for circling the correct answer, and lose one point for every incorrect answer you circle. Thus, leaving a question blank will score one point. Circling the correct answer and an incorrect answer scores three points. Circling three incorrect answers scores negative two points. Thus, you can get partial credit, but you will be penalized for guessing.

If the idea of negative points scares you, circle only one answer for each problem and it will score exactly like a traditional multiple choice exam.

Select your choice by circling the corresponding letter. If you make a mistake, draw an "X" through the choice. If you really mess it up, cross them all out and draw a box clearly labeled with your answer. In the event that your answer is hard to read, all reasonable interpretations will be used. For example, a letter that looks like both an 'a' and a 'd' will be considered both. So be neat.

Question 1)$_{1273}$ (4 points)

What is the worst case time complexity for inserting something into a binary search tree?

a) $\mathcal{O}(1)$

b) $\mathcal{O}(\lg n)$

c) $\mathcal{O}(n)$

d) $\mathcal{O}(n \lg n)$

Question 2)$_{1272}$ (4 points) What is the expected time complexity for inserting something into a binary search tree?

a) $\mathcal{O}(1)$

b) $\mathcal{O}(\lg n)$

c) $\mathcal{O}(n)$

d) $\mathcal{O}(n \lg n)$

Question 3)$_{12b6}$ (4 points)

What is a sequence of insertions that cause worst-case behavior for binary search trees?

a) 1,4,2,6,3,5,7

b) 4,2,6,1,3,5,7

c) 4,6,2,7,5,3,1

d) 1,7,2,6,3,5,4

Question 4)$_{1276}$ (4 points)

If you delete a node from a BST, and the node has two children, what should you do?

a) replace the node with `nil`

b) replace the node with the child

c) replace the node with an inorder successor or predecessor

d) replace the node with the parent

Question 5) $_{1275}$ (4 points)
If you delete a node from a BST, and the node has one child, what should you do?

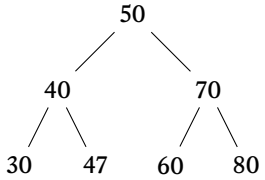
a) replace the node with `nil`

b) replace the node with the child

c) replace the node with an inorder successor or predecessor

d) replace the node with the parent

Question 6) $_{127a}$ (4 points)
Consider the following tree:



Which node is the inorder predecessor to 50?

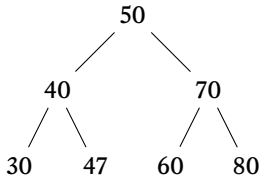
a) 47

b) 60

c) 70

d) 80

Question 7) $_{1279}$ (4 points)
Consider the following tree:



If we insert a 55, where will it go?

a) as a right child of 60

b) as a left child of 60

c) as a left child of 70 and a parent of 60

d) as a left child of 80

Question 8) $_{1280}$ (4 points)
What do lists have that sequences do not have in CLOJURE?

a) A specific implementation

b) a `next` operation

c) a `first` operation

d) an ordering to the data

Question 9)$_{12f3}$ (4 points)
The following code calls `rest` on a CLOJURE vector. What will be the result?

```
1       (rest [2 4 9 8])
```

a) A vector `[4 9 8]`

b) A list `(4 9 8)`

c) A sequence `(4 9 8)`

d) An exception

Question 10)$_{12e4}$ (4 points)
What advantage is there to using sequences?

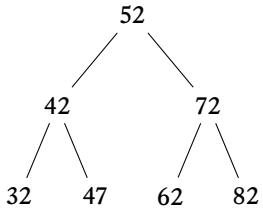
a) they keep their data together for speed

b) they run more quickly

c) they are more accurate

d) many built-in functions work with them

Question 11)$_{12e5}$ (4 points) Consider the following tree:



Which of the following is a preorder traversal?

a) 32,42,47,52,62,72,82

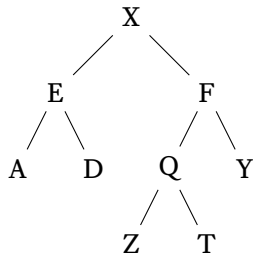
b) 32,47,42,62,82,72,52

c) 52,42,72,32,47,62,82

d) 52,42,32,47,72,62,82

Question 12) $_{12e7}$ (4 points)

Consider the following tree:



Note that this tree is not a BST. Which of the following is a postorder traversal?

a) A,E,D,X,Z,Q,T,F,Y

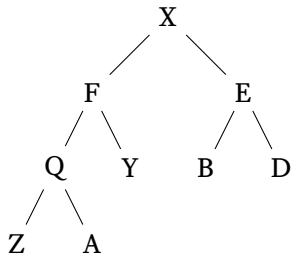
b) X,E,F,A,D,Q,Y,Z,T

c) A,D,E,Z,T,Q,Y,F,X

d) X,E,A,D,F,Q,Z,T,Y

Question 13) $_{12ea}$ (4 points)

Consider the following tree:



Note that this tree is not a BST. Which of the following is a level-order traversal?

a) X,F,Q,Z,A,Y,E,B,D

b) Z,Q,A,F,Y,X,B,E,D

c) Z,A,Q,Y,F,B,D,E,X

d) X,F,E,Q,Y,B,D,Z,A

Question 14) $_{1285}$ (4 points)

Which of the following is an advantage of breadth-first search vs. depth-first search?

a) It returns the solution closest to the root.

b) It takes less memory.

c) It is always faster.

d) It handles wider data structures.

Question 15) $_{1286}$ (4 points)
Which of the following is an advantage of depth-first search vs. breadth-first search?

a) It returns the solution closest to the root.

b) It takes less memory.

c) It is always faster.

d) It handles deeper data structures.

Question 16) $_{12ec}$ (4 points)
According to the principle of temporal locality, which of the following can we expect?

a) We wrote to location a and then wrote to location b soon after.

b) We read from location a and then wrote to location $a + 1$ soon after.

c) We read from location a and then read from it soon after.

d) We wrote to location a and got an error because it was immutable.

Question 17) $_{12eb}$ (4 points)
According to the principle of spatial locality, which of the following can we expect?

a) We wrote to location a and then wrote to location b soon after.

b) We read from location a and then wrote to location $a + 1$ soon after.

c) We read from location a and then read from it soon after.

d) We wrote to location a and got an error because it was immutable.

Question 18) $_{128a}$ (4 points)
The swap heuristic is...

a) Fast and stable

b) Fast and unstable

c) Slow and stable

d) Slow and unstable

Question 19) $_{12f4}$ (4 points)
Suppose we have a list with content `(1 3 2 4 8 16)`. We access element `8`. What will be the result of the swap heuristic?

a) `(1 3 8 2 4 16)`

b) `(4 1 3 2 8 16)`

c) `(8 3 2 4 1 16)`

d) `(1 3 2 8 4 16)`

Question 20)$_{12f0}$ (4 points)
Suppose we have the vector `[3 5 7 4 2 6 1]`. What will be the first three elements selected if we run selection sort on it?

a) 1,2,3

b) 4,2,6

c) 3,5,7

d) 5,6,7

Question 21)$_{12ee}$ (4 points)
Suppose we have the vector `[3 5 7 4 2 6 1]`. What will be the first three elements inserted if we run insertion sort on it?

a) 1,2,3

b) 4,2,6

c) 3,5,7

d) 5,6,7

Question 22)$_{128e}$ (4 points)
Which of the following is a special ability of insertion sort?

a) It can sort most arrays in $\mathcal{O}(n)$ time.

b) It can give useful results if interrupted before it has finished.

c) It can return the elements closest to the beginning of the vector.

d) It runs in $\mathcal{O}(n)$ time if the data is already sorted.

Question 23)$_{128f}$ (4 points)
Which of the following is a special ability of selection sort?

a) It can sort most arrays in $\mathcal{O}(n)$ time.

b) It can give useful results if interrupted before it has finished.

c) It can return the elements closest to the beginning of the vector.

d) It runs in $\mathcal{O}(n)$ time if the data is already sorted.

Meta Questions Name (optional):

These questions are optional, and do not count toward your grade. Don't spend any time on them unless you are already finished with the exam. This page will be separated from the exam, so the data will be anonymous unless you put your name on it.

- How do you think you did just now? What percentage would you estimate to be your score?

- The purpose of this course is to enable you to become an expert at data structures. What is one area in which this course is accomplishing its purpose? Give examples if you can.

- What is an improvement that could be made that would allow the course to accomplish its purpose even better?

- What is one strength as a student you have developed or improved since the last midterm?

- What is one thing you could do to improve your role as a student for the rest of the course?