

CISS445: Programming Languages
Quiz q1401

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Open `main.tex` and enter answers (look for `answercode`, `answerbox`, `answerlong`). Turn the page for detailed instructions. To rebuild and view pdf, in bash shell execute `make`. To build a gzip-tar file, in bash shell execute `make s` and you'll get `submit.tar.gz`.

Q1. You are given this:

```
type 'a btree = Empty
          | Node of ('a * 'a btree * 'a btree)
;;
```

write three functions `preorder`, `inorder`, and `postorder` that returns a list of the keys in a `'a btree` traversed using preorder, inorder, and postorder traversal (respectively). You need not use tail recursion. Here's an example test case:

```
let t =
  Node (
    0,
    Node (
      2,
      Empty,
      Empty
    ),
    Node (
      1,
      Node (3, Empty, Empty),
      Node (4, Empty, Empty)
    )
  )
;;
preorder t;;
inorder t;;
postorder t;;
```

Here's the console output:

```
val t : int btree =  
  Node  
    (0, Node (2, Empty, Empty),  
      Node (1, Node (3, Empty, Empty), Node (4, Empty, Empty)))  
# preorder t;;  
- : int list = [0; 2; 1; 3; 4]  
# inorder t;;  
- : int list = [2; 0; 3; 1; 4]  
# postorder t;;  
- : int list = [2; 3; 4; 1; 0]
```

ANSWER:

```
let rec preorder = fun b -> match b with Empty -> []  
| Node (root,left,right) -> [root]  @(preorder left) @ (preorder right);;  
  
let rec inorder = fun b -> match b with Empty -> []  
| Node (root,left,right) ->  (inorder left) @ [root] @ (inorder right);;  
  
let rec postorder = fun b -> match b with Empty -> []  
| Node (root,left,right) ->  (postorder left) @ (postorder right) @ [root];;
```

INSTRUCTIONS

In `main.tex` change the email address in

```
\renewcommand\AUTHOR{jdoe5@cougars.ccis.edu}
```

yours. In the bash shell, execute “`make`” to recompile `main.pdf`. Execute “`make v`” to view `main.pdf`. Execute “`make s`” to create `submit.tar.gz` for submission.

For each question, you’ll see boxes for you to fill. You write your answers in `main.tex` file. For small boxes, if you see

```
1 + 1 = \answerbox{}
```

you do this:

```
1 + 1 = \answerbox{2}
```

`answerbox` will also appear in “true/false” and “multiple-choice” questions.

For longer answers that needs typewriter font, if you see

```
Write a C++ statement that declares an integer variable name x.
\begin{answercode}
\end{answercode}
```

you do this:

```
Write a C++ statement that declares an integer variable name x.
\begin{answercode}
int x;
\end{answercode}
```

`answercode` will appear in questions asking for code, algorithm, and program output. In this case, indentation and spacing is significant. For program output, I do look at spaces and newlines.

For long answers (not in typewriter font) if you see

```
What is the color of the sky?
\begin{answerlong}
\end{answerlong}
```

you can write

```
What is the color of the sky?
\begin{answerlong}
The color of the sky is blue.
\end{answerlong}
```

For students beyond 245: You can put \LaTeX commands in `answerbox` and `answerlong`.

A question that begins with “T or F or M” requires you to identify whether it is true or false, or meaningless. “Meaningless” means something’s wrong with the statement and it is not well-defined. Something like “ $1+_2$ ” or “ $\{2\}^{\{3\}}$ ” is not well-defined. Therefore a question such as “Is $42 = 1+_2$ true or false?” or “Is $42 = \{2\}^{\{3\}}$ true or false?” does not make sense. “Is $P(42) = \{42\}$ true or false?” is meaningless because $P(X)$ is only defined if X is a set. For “Is $1 + 2 + 3$ true or false?”, “ $1 + 2 + 3$ ” is well-defined but as a “numerical expression”, not as a “proposition”, i.e., it cannot be true or false. Therefore “Is $1 + 2 + 3$ true or false?” is also not a well-defined question.

When writing results of computations, make sure it’s simplified. For instance write 2 instead of $1 + 1$. When you write down sets, if the answer is $\{1\}$, I do not want to see $\{1, 1\}$.

When writing a counterexample, always write the simplest.

Here are some examples (see `instructions.tex` for details):

1. T or F or M: $1 + 1 = 2$ T

2. T or F or M: $1 + 1 = 3$ F

3. T or F or M: $1+_2 =$ M

4. $1 + 2 =$ 3

5. Write a C++ statement to declare an integer variable named **x**.

`int x;`

6. Solve $x^2 - 1 = 0$.

Since $x^2 - 1 = (x - 1)(x + 1)$, $x^2 - 1 = 0$ implies $(x - 1)(x + 1) = 0$. Therefore $x - 1 = 0$ or $x = -1$. Hence $x = 1$ or $x = -1$.

7. Which is true? C

(A) $1 + 1 = 0$

(B) $1 + 1 = 1$

(C) $1 + 1 = 2$

(D) $1 + 1 = 3$

(E) $1 + 1 = 4$