CISS445: Programming Languages
Quiz q1206

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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`.

For each of the following, either Infer the types of the following expressions or indicate there is an error. If there are type variables, make sure you use 'a, 'b, 'c, etc in that order for instance the function

```
fun x -> fun y -> x < y;;
```

has type `'a -> 'b`; do not write `'b -> 'a`. Also use `'a` before `'b` before `'c`, etc. Also, note that

```
fun x -> fun y -> x + y
```

has type `int -> int -> int`. This is the same as `int -> (int -> int)`. You need not (should not) include parentheses. However this expression

```
fun x -> fun y -> (x 1) + 2 + y;;
```

has type `(int -> int) -> int -> int`. In this case the parentheses cannot be left out.

Q1. `fun x -> fun y -> y x;;`
Answer:

'a -¿ ('a -¿ 'b) -¿ 'b

Q2. `fun x -> fun y -> fun z -> x + y + z;;`
Answer:

int -¿ int -¿ int -¿ int

Q3. `fun x -> fun y -> (x, x + y);;`
Answer:

int -¿ int -¿ int * int

Q4. `fun x -> fun y -> (x, 0);;`
Answer:

'a -¿ 'b -¿ 'a * int

Q5. `fun x -> fun y -> (fun t -> t + x * y);;`
Answer:

int -¿ int -¿ int -¿ int

Q6. `fun x -> x::[fun y -> x + y];;`
Answer:

ERROR

Q7. `fun x -> fun y -> (x y) + 1;;`
Answer:

('a -¿ int) -¿ 'a -¿ int

Q8. `fun x -> fun y -> (y x) + 1;;`
Answer:

'a -¿ ('a -¿ int) -¿ int

Q9. `fun x -> fun y -> x (y  + 1);;`
Answer:

(int -¿ 'a) -¿ int -¿ 'a

Q10. `fun x -> fun y -> x (y x);;`
Answer:

('a -¿ 'b) -¿ (('a -¿ 'b) -¿ 'a) -¿ 'b

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) $1 + 1 = 4$