| | | |
|---|---|---|
| **Name (PRINTED):** | _____ | |
| **University ID #:** | _____ | |
| **Circle your TA's name:** | Nik | Asad |
| **Circle your discussion time:** | 2:00 | 3:00 |

# CMSC 330 Exam #2 Fall 2005

**Do not open this exam until you are told. Read these instructions:**

1. This is a closed book exam. **No notes or other aids are allowed.**
2. **You must turn in your exam immediately when time is called at the end.**
3. This exam contains 6 pages, including this one. **Make sure you have all the pages.** Each question's point value is next to its number. **Write your name on the top of all pages before starting the exam.**
4. In order to be eligible for as much partial credit as possible, show all of your work for each problem, and **clearly indicate** your answers. Credit **cannot** be given for illegible answers.
5. If you finish at least 15 minutes early, bring your exam to the front when you are finished; otherwise, wait until the end of the exam to turn it in. Please be as quiet as possible.
6. If you have a question, raise your hand. If you feel an exam question assumes something that is not written, write it down on your exam sheet. Barring some unforeseen error on the exam, however, you shouldn't need to do this at all, so be careful when making assumptions.
7. If you need scratch paper during the exam, please raise your hand. Scratch paper must be turned in with your exam, with your name and ID number written on it. Scratch paper **will not** be graded.
8. Small syntax errors will be ignored in any code you have to write on this exam, as long as the concepts are correct.
9. The Campus Senate has adopted a policy asking students to include the following handwritten statement on each examination and assignment in every course: "*I pledge on my honor that I have not given or received any unauthorized assistance on this examination.*" Therefore, **just before turning in your exam**, you are requested to write this pledge **in full** and **sign it** below:

_____

_____

Good luck!

| 1 | 2 | 3 | Total |
|---|---|---|---|
| | | | |

1. [20 pts.] **Short Answer.**

   a. [9 pts.] Below is the output of the OCaml interpreter after we've typed in various definitions of the function `f`. In each case, write a definition of a function `f` that has that type.

      i. `val f : 'a -> 'b -> 'a * 'a * 'b = <fun>`

      ii. `val f : ('a -> 'b) -> ('b -> 'c) -> 'a -> 'c = <fun>`

      iii. `val f : 'a -> 'b = <fun>`

   b. [5 pts.] Define what it means for one name to *shadow* another, and give an example of shadowing in the language of your choice.

   c. [6 pts.] Suppose in C we define the following function:

```
int and(int x, int y) { return x && y; }
```

   Is it ever possible that calling `and(`$e_1$`,` $e_2$`)` behaves differently than evaluating $e_1$ `&&` $e_2$ directly, where $e_1$ and $e_2$ are C expressions? Explain, and give an example if so.

2. [40 pts.] **Context–Free Grammars.**

   a. [10 pts.] Consider the short grammar we gave in class for expressions in the simply–typed lambda calculus:

$$\begin{array}{rcl} \mathrm{S} & ::= & \mathrm{U} \mid \mathrm{V} \mid \lambda \mathrm{V}{:}\mathrm{T}.\mathrm{S} \mid \mathrm{S}\ \mathrm{S} \\ \mathrm{T} & ::= & \texttt{int} \mid \mathrm{T} \to \mathrm{T} \\ \mathrm{U} & ::= & \texttt{1} \mid \texttt{2} \mid \texttt{3} \\ \mathrm{V} & ::= & \texttt{x} \mid \texttt{y} \mid \texttt{z} \end{array}$$

   Here we have simplified the grammar a bit by restricting integers to just `1`, `2`, and `3`, and variable names to just `x`, `y`, and `z`, and we just used different nonterminal names than in the grammar given in class.

   Prove that this grammar is ambiguous.