

Homework 4 . Names. Control. Types.

Submit your solution to Blackboard by 11:59pm of Tue Apr 14

1. (5) a) the name(s) of people who have contributed to your solution of this homework, and b) their contribution (briefly). If you worked by yourself, the answer of this question would be "N.A."

b) (5) Please make your writing for the homework easy to read. Acknowledge this.

2. (15) Consider the following program

```
program scopes (input, output );
var a : integer;
procedure first;
    begin a := 1; end;
procedure second;
    var a : integer;
    begin first; end;
begin
    a := 2; second; write(a);
end.
```

Assume we use a *dynamic scope rule* that "for any variable, we always use the most recent binding." Trace the creation and destruction of the bindings on *a* when the program is executed.

3. (10) Now that a language with `goto` statement is sufficient for writing any algorithms, why do we need to introduce various iteration constructs?
4. (15) Use example(s) to show the difference between *value model of variables* and *reference model of variables*.
5. (10) List two issues when designing iteration constructs.
6. (20) Basics of type systems.

(a) What's a strongly typed language?

(b) What are the three different views of types?

(c) Consider the following type declarations:

```
enum ColorType {red, blue, green};
struct ObjectType {int object; colorType color};
```

What is the set of values represented by `colorType`? the set of values represented by `ObjectType`? (when the set is big, you only need to give the pattern of the set.)

- (d) Give an example of *type orthogonality*.
 - (e) Give two different kinds of *type equivalence*.
7. (20) (Type inference) Consider the following program in functional programming language ML

```
let fun fib_helper f1 f2 i =  
    if i = n  
    then f2  
    else fib_helper f2 (f1 + f2) (i + 1)  
in  
    fib_helper 0 1 j
```

Give the details of how the type of the each variable of this program is obtained. What is the type of the function `fib_helper`?