

## Test 2

If you leave the classroom for any reason, your test will be graded on only what you did up until that time. This also applies to use of the restroom.

1. True or False [16 points]

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- a. T F Most languages with records use dot notation for specifying a field.
- b. T F Scope is about the contexts from which a variable can be accessed.
- c. T F Some languages let you specify the scope of a variable when you declare it.
- d. T F If the type of a variable can change based on what is assigned to it, then the language has “static typing”.
- e. T F In C, a variable may have different values at different points in time.
- f. T F In Java, a variable may have different values at different points in time.
- g. T F In C, the **&** operator uses the l-value (left-side value) of a variable.
- h. T F Prolog has while loops but not for or do loops.
- i. T F In Prolog, **length ([a,b],3)** is a function call.
- j. T F In Prolog, **length (X,Y)** is a function call.
- k. T F In Java, the same name may refer to two or more possible addresses (different locations in memory) at different places in a program.
- l. T F A boolean value is always stored in just one bit.
- m. T F A character is always stored in just one byte.
- n. T F In C, it takes an array of  $n+1$  bytes to store a  $n$ -character string.
- o. T F It is possible to imagine a language in which variables have only l-values, but not r-values.
- p. T F It is possible, conversely, to imagine a language in which variables have only r-values, not l-values.

2. [5 pts] Match the data types and the descriptions

- |                |  |
|----------------|--|
| a. slice       | ___ supports the operators head and tail           |
| b. record      | ___ selects or references part of an array         |
| c. enumeration | ___ can exactly represent <b>1.40</b>              |
| d. list        | ___ packages a heterogeneous set of variables      |
| e. decimal     | ___ has only a small finite set of possible values |

3. [2] For each of the following criteria, state whether it favors pass-by-value (V) or pass-by-reference (R):

- a. \_\_\_ need to pass large arrays or objects
- b. \_\_\_ absolutely wish to avoid side effects

4. [1] in Python, what output will you see for

```
def summer(length, checksum, sum):  
    print ("length:", length, ",checksum: ", checksum);  
summer(0, sum=7, checksum=5)
```

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5. [8 points] For each of the following, is it true of variables on the stack (S), on the heap (H), both (B), or neither (N)?
- a. \_\_\_ allocated dynamically
  - b. \_\_\_ allocated at runtime
  - c. \_\_\_ can be automatically deallocated at runtime
  - d. \_\_\_ are always globals
  - e. \_\_\_ may include objects
  - f. \_\_\_ are subject to garbage collection
  - g. \_\_\_ includes the local variables that are allocated when a new function is called
  - h. \_\_\_ includes the arguments of functions
6. [3] Aliases (two names or access paths for the same memory location) are a major cause of program errors. Which three of the following language features can lead to aliases?
- a. variable names with underscores (e.g. temperature\_in\_celsius)
  - b. dynamic typing
  - c. static typing
  - d. lifetimes
  - e. call by value
  - f. call by reference
  - g. garbage collection
  - h. pointers
  - i. constants
  - j. union types
  - k. enumeration types
  - l. primitive types
7. [3] Abigail likes static typing in general, but would like to be able to declare some variables to be dynamically typed. Could some language provide this ability? Why or why not?
8. [3] Liisa hates implicit coercion. Do you think she prefers static typed languages or dynamically typed languages? Why?

9. [2] For each of the following problems, list a paradigm that would be appropriate. Hint: each can be answered with one of {imperative, object-oriented, logic-programming, scripting}
- a. The Financial Aid Office at University X uses a software package for which they do not have the source code. Many of the tasks they perform are highly repetitive, for example, to perform a sequence of 11 mouse operations and 2 cut-and-paste operations for each of 150 students. They would like to find a way to automate such sequences.
  - b. A mathematician wishes to know if the Gordonian Conjecture is true, and needs a tool that can find a proof.
10. [10] For each of the following problems, list a language that would be appropriate, and give a reason. Hint: each can be answered with one of {C++, Java, Prolog, PHP, bash}
- a. A web startup wants to get code running as fast as possible, to quickly gain market share. They have no interest in reliability, maintainability, or security.
  - b. A game development company needs to deliver a good realtime user experience on a small memory footprint, while simultaneously needing to keep track of many rooms, monsters, machines, and projectiles.
  - c. A systems administrator wishes to write code to run every midnight to count the number of executable files greater than 2.5 megabytes in any user's tmp directory.
  - d. The need to write reliable and secure code means that management wants to use a strongly typed language.
  - e. The boss, knowing that "assignment statements are a source of bugs," wants to use a language without them.

11. [2] Assuming the following Ada program was compiled and executed using static scoping rules, what value of **X** is printed in procedure Sub1?

```
procedure Main is
  X: Integer;
  procedure Sub1 is
    begin -- of Sub1
      Put (X);
    end;          -- of Sub1
  procedure Sub2 is
    X: Integer;
    begin          -- of Sub2
      X:= 10;
      Sub1
    end;          -- of Sub2
begin            -- of Main
  X := 5;
  Sub2
end;            -- of Main
```

12. [2] We have focused on static/dynamic binding issues for variables, but similar issues arise for methods. Fill in the blanks in the following:

In C++ a method can only be dynamically bound if all of its ancestors are marked virtual; all method bindings are by default static. In Java method binding is \_\_\_\_\_ by default; \_\_\_\_\_ binding occurs only if the method is marked private or final, which means it cannot be overridden.

13. [2 points] A variable that is not locally defined in a function has the value \_\_\_\_ with static scope and \_\_\_\_ with dynamic scope. Fill in each blank with one of:
- that it had at the time the function was created.
  - most recently assigned to a variable with that name.
  - of the variable with that name in the scope enclosing the function definition.
14. [3] According to Wikipedia “declarative programming is a programming paradigm—a style of building the structure and elements of computer programs—that expresses the logic of a computation without describing its control flow.” Briefly relate this concept to one of the programming paradigms discussed in class.

15. [2] Janet insists that the output for the following code should be **y is 13**.

```
void tridec(int x) {x = 13;}  
void main(void) {int y; tridec(y); printf("y is %d\n", y);}
```

What parameter-passing mode might she be thinking of?

16. [6 pts] Given the following Prolog database, indicate which of the queries below will succeed.

```
square(3, 9).  
square(2,4).  
square(1,1).  
likes(X,marianne).
```

```
?- square(X,9).  
?- square(3,Y).  
?- square(3, 9).  
?- square(X,Y).  
?- square(0,1).  
?- likes(1, Marianne).
```

17. [4] If f1.txt contains

```
-12- telephone Laura tomorrow at home  
-13- call Mary or text her 555-2020  
-12- tel: Janine 915-555-1212 , mobile 915-555-2222
```

and f2.txt contains

```
file not found error, 01092017 13:56  
intelligence-report.txt permissionError spies 01102017 14:01
```

and assuming that special characters, including punctuation, sort before letters, what will be the result of the following bash script?

```
cat f2.txt f1.txt | grep tel | sort | awk '{print $3}' > fofo.txt
```