

Test 1

Closed Book, Open Notes (one handwritten page), 75 minutes. Please answer concisely.

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

1. True or false [24 points]

- a. t f The lifetime of a variable is the time during which it is allocated space in memory.
- b. t f Global variables are always statically typed.
- c. t f Type binding is dynamic in some languages.
- d. t f The l-value of a variable is its value; thus **i=0** changes the l-value of **i** to **0**.
- e. t f In Java **new** is a reserved word.

- f. t f If **func1** is the static parent of **func2**, then **func2** must be the dynamic parent of **func1**.
- g. t f If **func1** is the static parent of **func2**, then **func2** cannot be the dynamic parent of **func1**.
- h. t f Many languages use only static scoping.
- i. t f The difference between static scope and dynamic scope is not important for local variables.
- j. t f In a dynamically scoped language, it may not be possible for the compiler to determine the referent of a variable.

- k. t f In PHP, global variables are not implicitly visible in any function. (Hint: as the book says, in PHP “the scope of global variable extends from their declaration to the end of the program, but skips over any subsequent function definitions.”)
- l. t f In PHP, arrays can have strings as keys.
- m. t f In Javascript are statically typed, statically allocated, and statically scoped.
- n. t f Static typing is incompatible with coercion. (Hint: consider **float x = (int) 3.0;**)
- o. t f A web browser never sees PHP code.

- p. t f In PHP, **<<<** is used for specifying long strings.
- q. t f Circular recursion (where one rule refers to another, which refers back to the first) is allowed in BNF.
- r. t f In the classic von Neumann architecture, one instruction executes at a time.
- s. t f The symbol table stores the types of the variable.
- t. t f The symbol table stores the nonterminal symbols of the grammar

- u. t f The r-value of a variable may change as the program runs.
- v. t f The l-value of a variable may change as the program runs.
- w. t f Interpreting a program usually takes more time than running a compiled one.
- x. t f In a compiler, the code generator’s output is the parser’s input.

2. [1] In PHP, what would be the values of **\$d**, **\$t** and **\$e** after

```
list($d, $t, $e) = explode(" ", "M, 02:00-02:50PM, Myoung");
```

3. [2] Given a reference to a nonlocal variable in a static-scoped program, how does the compiler (or interpreter) find the correct definition? (review question 5.13)
4. [6] The following is an attribute grammar for checking whether a message is valid in that the check bit and the main message have the same parity.

<msg> → <bits> <checkbit>	Predicate: $\text{msg.valid} = (\text{bits.parity} == \text{checkbit.parity})$
<bits>₁ → <bits>₂ <bit>	Semantic Rule: $\text{bits}_1.\text{parity} = \text{bits}_2.\text{parity} \text{ XOR } \text{bit.parity}$
<bits> → <bit>	Semantic rule: $\text{bits.parity} = \text{bit.parity}$
<bit> → 0	Semantic rule: $\text{bit.parity} = \text{false}$
<bit> → 1	Semantic rule: $\text{bit.parity} = \text{true}$
<checkbit> → <bit>	Semantic rule: $\text{checkbit.parity} = \text{bit.parity}$

Draw parse trees for 01011 and 1010, then, for each, annotate all nodes with the values of the attributes, including the value of valid at the root nodes.

5. [4] Draw a simple diagram that shows a client machine/browser communicating with a web server machine, and include indications of a) where php executes, b) what the output of php usually is, and c) what role(s) html plays.

6. [3] In PHP, “A variable variable takes the value of a variable and treats that as the name of a variable.” (php.net). Thus, for example,

```
$item = "rambutan";  
$$item = 3041;  
echo $rambutan;
```

produces the output **3041**. Suppose we used this to allow users of our PLU webpage to create and set variables with code like

```
$item = $_POST['fruitname'];  
$plu = $_POST['itemnumber'];  
$$item = $plu;
```

Could this create a security risk? Why or why not?

7. [1] How many variables are there in the following C program?

```
int x;  
x = x + x;  
for (int i = x; i = i++; i < x * x) {  
    static int x = 0;  
}
```

8. [4] Given the BNF

$$\begin{aligned}\langle \text{cond_expr} \rangle &\rightarrow \langle \text{expr} \rangle ? \langle \text{expr} \rangle : \langle \text{expr} \rangle \\ \langle \text{expr} \rangle &\rightarrow \langle \text{var} \rangle \mid \langle \text{expr} \rangle + \langle \text{expr} \rangle \\ \langle \text{var} \rangle &\rightarrow \text{id}\end{aligned}$$

and the program

```
int i;  
float f;  
bool b;  
...  
i ? i : i+i  
b + b ? b : b  
b ? i : f+i
```

- a) Which, if any, of the conditional expressions are syntactically correct?
- b) For which, if any, of the conditional expressions is the actual type computable at compile time?

Document any assumptions.

7. [1] How many lexemes are in the following statement?

```
$comment = $_POST['comment'];
```

9. [4] Thinking of the book's criteria of writability, readability, and reliability, for each of {Java, PHP}, what do you think was the primary concern of the inventor(s)? Why?

8. [1] One morning you wake up in an alien spaceship. After apologizing for kidnapping you, the aliens offer to cure all diseases on Earth if you help design a great new programming language for them. Assuming you accept their offer, what is the most important thing you'd ask them first, to help you start work on a good design?

8. [2] In C#, variable types are static, but they do not need to be declared explicitly, so, for example the following is legal.

var total = subtotal + tax;

Explain how this is possible; that is, how the compiler can infer the type of a variable like **total**.

11. [1] Name three programming languages other than C and Java.

12. [4] In the following grammar (Karl Abrahamson), a) which has precedence: plus or times ?, b) is plus right associative or left associative? c) is times left associative or right associative? d) is the grammar ambiguous?

$E \rightarrow T$
 $E \rightarrow T + E$
 $T \rightarrow F$
 $T \rightarrow T * F$
 $F \rightarrow n$
 $F \rightarrow (E)$

1. [5] What happens in each compilation phase? (some phases involve more than one activity) (*from Jonathan Mohr, adapted*)
- a. Lexical analysis (scanning) ___ tokens are combined to form syntactic structures, typically represented by a parse tree.
 - b. Syntactic analysis (parsing) ___ intermediate code is generated for each syntactic structure.
 - c. Semantic analysis ___ the source text is broken into tokens.
 - d. Code generation ___ intermediate code is translated to object code for the target machine.
 ___ type checking is done, as are complicated features such as generic declarations and operator overloading.