

Multiple Choice. Write your answer to the LEFT of each problem. 4 points each

- Which of the following allows anonymous functions?
A. C B. Scheme C. PL/0 D. Pascal
- Suppose the C declaration below occurs at global scope. Where would the space be allocated?
`int arr[10000];`
A. Static B. Heap C. Stack D. Registers
- Which language does not have a dangling-else ambiguity?
A. C B. Scheme C. JavaScript D. Pascal
- Which of the following is not a JavaScript feature?
A. first-class functions B. strong type checking
C. event-driven execution D. integration with HTML
- Who is associated with the Pascal language?
A. Dijkstra B. Hoare C. Ritchie D. Wirth
- Which of the following is not a characteristic of recursive descent?
A. Error recovery B. Small lookahead C. Many precedence levels D. Top-down
- Which of the following is true regarding attribute grammars?
A. Synthesized attributes carry information down the parse tree
B. Inherited attributes carry information up the parse tree
C. They cannot represent context-sensitive information
D. They can capture the information that usually goes in symbol tables
- Which of the following strings is not included in the language of the regular expression $10^*(01)^+1^*0^*$?
A. 111010101010 B. 10000010 C. 1010101010 D. 100010111
- Suppose you do a `malloc` in a C program. Where is the space allocated?
A. Static B. Heap C. Stack D. Registers
- Which language does not allow nesting functions?
A. C B. Scheme C. JavaScript D. Pascal

Long Answer.

- Give the result of each Scheme program. 20 points
 - `(cons '(a b c) '(d e f))`
`(car '((a b c) d (e f g)))`
`(cdr '((a b c) d (e f g)))`
 - `(define prob2`
 `(lambda (x)`
 `(cond`
 `((eq? x 0) 0)`
 `(else`
 `(+ x (prob2 (- x 1))))))`
`(prob2 5)`
 - `(define prob3`
 `(lambda (a lat)`
 `(cond`
 `((null? lat) #f)`
 `((eq? a (car lat)) #t)`
 `(else (prob3 a (cdr lat))))))`
`(prob3 'a '(b c e f g a d h))`
`(prob3 'x '(b c e f g a d h))`
- Give grammar productions or railroad diagrams for the following. 20 points
 - Identifiers consisting of lower-case letters or digits, but may not start with a digit.
 - A string of parentheses, appropriately balanced, concatenated, and nested. (Imagine taking an arbitrary C expression and deleting everything but the parentheses (which are not quoted, escaped, in comments, etc.)
 - A string of As and Bs, such that going left-to-right the number of As that have appeared is never smaller than the number of Bs that have appeared. (Ambiguity is OK.)
- Suppose your senior design project needs a *small* language for user-extendability in the field. Since adapting PL/0 or Pascal-S would involve Free Pascal portability issues, you decide to put together your own language “JS/0” (using C as an

implementation language). You decide, however, to exploit the elegant *structure* of the PL/0 and Pascal-S implementations to bring JS/0 to life.

- What are the significant components to be implemented? Also, give a *rough* estimate in terms of the amount of code (number or % of lines) needed for each of these. 10 points
- What design documents/diagrams would be useful before attempting to code? 10 points

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Test 2

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Multiple Choice. Write your answer to the LEFT of each problem. 4 points each

- Which of the following supports continuations?
 - C
 - Scheme
 - PL/0
 - Pascal
- Suppose the C declaration below occurs within a function. Where would the space be allocated?


```
int arr[10000];
```

 - Static
 - Heap
 - Stack
 - Registers
- Which language has general associative arrays?
 - C
 - Scheme
 - JavaScript
 - Pascal
- Arbitrary array subscript ranges are included in which language?
 - C
 - Scheme
 - JavaScript
 - Pascal
- The first thing to do when processing data with a `void*` type is?
 - cast
 - `malloc`
 - Duff's device
 - set the reference count to 0
- An efficient implementation of subscripting to access a field in a k -dimensional Pascal array of records with r fields per record will use this many multiplications.
 - none
 - $k - 1$
 - k
 - r
- Which of the following languages does not have a `?:` ternary operator?
 - C
 - Java
 - JavaScript
 - Pascal
- In JavaScript, what is the value of the expression `0 || 1 || 2 || 3`?
 - 0
 - 1
 - 3
 - true
- Stop-and-copy is an example of:
 - reference counts
 - garbage collection
 - deep comparison
 - run-time stack implementation
- Which language feature does not defeat strong typing?
 - COBOL redefines
 - C union
 - Pascal with
 - Pascal variant records

Long Answer.

- Explain the differences between C and Pascal `for` statements. 15 points
- 15 points
 - Give a way to include an additional property `beast` on a JavaScript object `cheese` and give it the value "test 2".
 - How should the property `beast` be removed from `cheese`?
- Give equivalent C code (e.g. using `if ... else ...`) to demonstrate the short-circuit nature of C boolean operators. Do not use `&&`, `||`, or `!` in your solution! Do not use work variables! (15 points)
 - `result = a < 10 && b > 13;`
 - `result = c < 20 || d > 17;`
 - `result = !(e < 25 || f > 55) || g < 66;`
- Suppose a Pascal array is to be stored starting at location 10000 and is declared:


```
c: array[15..70,25..33] of integer;
```

 If one `integer` takes four bytes, what is the location of `c[35,30]`? (15 points)

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Test 3

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Closed Book

Multiple Choice. Write your answer to the LEFT of each problem. 5 points each

- What will appear on the console for the JavaScript code below?


```
arr=[];
arr[10]=1;
console.log(arr["5"]);
```

 - exception
 - 5
 - 1
 - undefined
- The difference between actual parameters and formal parameters is:
 - actuals are call-by-value, formals are call-by-name
 - actuals are in the caller, formals are in the called subprogram
 - actuals are in the called subprogram, formals are in the caller

- D. no difference
- Omitting the `new` on a call to an intended constructor will bind `this` to:
 - an array of arguments
 - the global object
 - the last instance created by this constructor
 - the prototype
 - Static chain links go through which type of allocation?
 - static
 - heap
 - stack
 - registers
 - `(cdr (cdr (cdr (cdr '(a b (c d e) f (g h i))))))` will result in:
 - '(g h i)
 - 'b
 - '(c d e)
 - '(g h i)
 - `(car (cdr (cdr '(a b (c d e) f (g h i)))))` will result in:
 - '(g h i)
 - 'b
 - '(c d e)
 - '(g h i)
 - A thrown JavaScript exception may be:
 - a string
 - a declared exception type
 - a number
 - any of these
 - Exceptions may be implemented in Scheme by using
 - closures
 - `cond`
 - continuations
 - `set!`
 - Which of the following is a JavaScript type?
 - boolean
 - char
 - int
 - real
 - JavaScript makes a simple stack available through:
 - array methods
 - prototypal inheritance
 - cloning the stack class
 - closure

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Test 3

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Open Book/Notes

What is the result of executing this Scheme code? 5 points

```
(define y 4)

((lambda (x z)
  (x y))
 (lambda (y)
  ((lambda (x) (+ 8 y))
   5))
 7)
```

Long Answer. 15 points each.

- Give Scheme code to compute the average for a simple list of numbers.

```
> (average '(40 10 30 20 80 50 70 60))
```

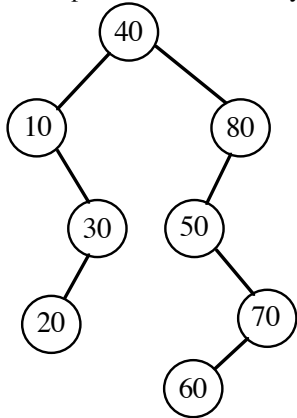
45

- Give Scheme code to determine whether a binary search tree has been correctly constructed, i.e. return `#t` if and only if the keys to the left of a node are smaller than the key of the node and those to the right are larger.

The S-expression:

```
(40 (10 () (30 (20 () ()) ())) (80 (50 () (70 (60 () ()) ())) ()))
```

corresponds to the correctly constructed tree:



- Give Scheme code to *flatten* an S-expression. After flattening, the new S-expression will be identical to the original, but will be missing all but the top-level parentheses.

Example:

```
> (flatten '(10 20 (( a b c (d e (f))) g 22 43 k j i))
```

```
'(10 20 a b c d e f g 22 43 k j i)
```