



Please print clearly :

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No books ; No calculator ; No computer ; No email ; No internet ; No notes ; No phone. Neatness counts ! Do your scratch work elsewhere and enter only your final answer into the spaces provided.

- For each language described here, fill in the name of the language. Choose from among the following languages : Algol 60, AWK, Basic, C++, C, COBOL, FORTRAN, Haskell, Intercal, Java, Lisp, ML, OCaml, Pascal, Perl, PL/I, Prolog, Simula 67. (Grading : deduct 1/2 point for each wrong or missing answer, but do not score less than 0.) **[3✓]**

	Bjarne Stroustrup's most noted contribution to language design.
	Business data processing language, designers included Grace Hopper.
	Designed in Europe to express algorithms in a structured way.
	First version of Unix was 9000 lines of this language (plus some assembly code).
	List processing language typically used in artificial intelligence.
	Numeric and scientific computation language developed at IBM.
	Simulation language that influenced the design of C++.
	Small language for structured programming designed by Niklaus Wirth.
	Sun Microsystems claimed this language is "write once, run anywhere".

- Write a program in perl which reads in lines using `<>`. Each line consists of three numbers. At end of file print out the totals of each of the three columns of numbers. **[3✓]**

- Define a Smalltalk class **Complex**. **[4✓]**
 - It has two instance fields **real** and **imag**.
 - Define the instance methods **real**: (sets **imag** to 0), **imag**: (sets **real** to 0), and **real:imag**: (sets both).
 - Define the binary operator **+**, which assumes the operand is another **Complex** and returns the sum.

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4. Using a loop, not recursion, write a function whose single argument is a number and which returns the factorial of that number. Return 1 for any number less-equal 0. Do not consider what happens when the result is very large.
- (a) In Perl, write a `sub`. [1✓]
- (b) In Smalltalk, extend the class `Number` with the unary selector `fac`. [2✓]
5. Name two kinds of *universal polymorphism* and give an extremely brief example of each in Java or C++. [2✓]
6. Name two kinds of *ad hoc polymorphism* and give an extremely brief example of each in Java or C++. [2✓]
7. Using Perl, write a program that reads lines from files using `<>`, and splits each line into words. A word is any sequence of characters delimited by `m/\W+/,` that is non-alphanumeric characters. Count the frequency of occurrence of each word. At end of file, print out the ten most frequently occurring words in descending order, along with the number of times each appeared in the input. [3✓]

Multiple choice. To the *left* of each question, write the letter that indicates your answer. Write **Z** if you don't want to risk a wrong answer. Wrong answers are worth negative points. **[12✓]**

number of correct answers		$\times 1 =$	$= a$
number of wrong answers		$\times \frac{1}{2} =$	$= b$
number of missing answers		$\times 0 =$	0
column total $c = \max(a - b, 0)$	12		$= c$

- Which of the following C operators uses lazy evaluation ?
(A) `!=`
(B) `*=`
(C) `>>`
(D) `? :`
- The Perl variable equivalent to `strerror(errno)` is :
(A) `$!`
(B) `$0`
(C) `$?`
(D) `$_`
- In Smalltalk, `a-b*c+d` is equivalent to :
(A) `((a-b)*c)+d`
(B) `(a-(b*c))+d`
(C) `(a-b)*(c+d)`
(D) `a-(b*(c+d))`
- In Smalltalk, what produces 13 ?
(A) `'4+9' value`
(B) `(4+9) value`
(C) `[4+9] value`
(D) `{4+9} value`
- Assuming pure Java code with no native methods written in C, if M = memory leaks and D = dangling references, then which are possible ?
(A) D is possible, but not M.
(B) M is possible, but not D.
(C) both M and D.
(D) neither M nor D.
- In C and C++, when is an external variable bound to a particular address ?
(A) When the preprocessor is run.
(B) When the program is compiled.
(C) When the program is linked.
(D) When the main function is called.
- In Perl, to apply a block to every element of an array, what function is used ?
(A) `grep`
(B) `join`
(C) `map`
(D) `split`
- If `$p` is a *reference* to a Perl hash and `$k` is a key whose corresponding value is a scalar, how is the value extracted ?
(A) `$p->{$k}`
(B) `$p{$k}`
(C) `%p->{$k}`
(D) `%p{$k}`
- If we define the block `sum := [:i :j] i + j` in Smalltalk, how might we obtain the number 7 ?
(A) `3 4 sum`
(B) `3 sum: 4`
(C) `sum 3 value 4 value`
(D) `sum value: 3 value: 4`
- What is not false in Perl ?
(A) 0
(B) 0.0/0.0
(C) ""
(D) `undef`
- What does the static link in a stack frame point at ?
(A) The call instruction that activated this function.
(B) The heap allocated closure in which escaping variables are stored.
(C) The stack frame of the function in which this function is nested.
(D) The stack frame of the function that called this function.
- Structured programming[†] demands the elimination of what statement ?
(A) `goto`
(B) `switch`
(C) `throw`
(D) `while`

[†] **EWD498: How do we tell truths that might hurt?** Prof. Dr. Edsger W. Dijkstra, June 1975.

- FORTRAN, "the infantile disorder", by now nearly 20 years old, is hopelessly inadequate for whatever computer application you have in mind today: it is now too clumsy, too risky, and too expensive to use.
- PL/I, "the fatal disease", belongs more to the problem set than to the solution set.
- It is practically impossible to teach good programming to students that have had a prior exposure to BASIC: as potential programmers they are mentally mutilated beyond hope of regeneration.
- The use of COBOL cripples the mind; its teaching should, therefore, be regarded as a criminal offence.