I agree to abide by the student conduct code at the University of Hawaii in all my work at UH.

Signature:____________________________ Name (print):_________________________

Practice Final Examination
ICS313 -- Programming Language Theory

Open book includes
1 Scott’s Programming Language Pragmatics, 3rd ed
2 a Lisp reference (e.g. CLQR or Siebel, or another Lisp book)
3 Perl operator reference (pink sheet handout) or Just Enough Unix, any edition.
4 Emacs reference card (purple sheet handout only).

NO notes except one note card – maximum size 4” by 6” text/graphics on both sides. Your crib sheet must be submitted with the exam. (It is OK to use only that much of a full-sized piece of paper).

No calculators, cell phones, computers, music players or other electronic devices.
Blank scratch paper as needed.

Instructions
Write or print clearly.

Show your solution method/reasoning (even on multiple choice and T/F)
You have 120 minutes to complete the exam. There are a total of 150 points on the exam plus 25 points of extra credit.
Make sure that your name is on all pages of your exam and on the crib sheet (if any).

Good luck!!

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1) (32 p) **Multiple Choice** – Write the letter for the best answer on the line provided.

I. Which of the following does **NOT** describe a built-in data type in Perl?
   (a) array
   (b) associative array
   (c) list
   (d) scalar
   (e) none of the above

II. Which of the following is **NOT** a way to manage complexity in large programs?
   (a) encapsulation
   (b) data hiding
   (c) sub-programs
   (d) constants
   (e) none of the above

III. (Emacs) When editing `mystuff.lisp`, how would you auto indent
   i) current line and ii) the current region?
   (a) C-x i, M-x i
   (b) C-h indent, C-space
   (c) Tab, M-x p
   (d) Tab, C-M-
   (e) None of the above

IV. Which of the following is **not** an entry or exit point in a Prolog trace?
   (a) unify
   (b) redo
   (c) fail
   (d) exit
   (e) call

V. Scripting languages do **NOT** include
   (a) Perl
   (b) Python
   (c) sh
   (d) tsh
   (e) None of the above

VI. Larry Wall worked on
   (a) Cobol
   (b) Lisp
   (c) Perl
   (d) Prolog
   (e) None of the above

VII. Charles Babbage created
   a) Difference Engine
   b) Analytic Engine
   c) concept of data storage
   d) all of the above
   e) none of the above

VIII. What was the first programmable machine?
   a) analytic engine
   b) ENIAC
   c) Cray supercomputer
   d) weaving loom
   e) none of the above

   I_________ II_________ III_________ IV_________

   V_________ VI_________ VII_________ VIII________

2) (16 p) **True/False** (write your choice on the line provided for each question.) State your assumptions, if any.

a) T/F: Scripting languages like Perl are more readable than Java.

b) T/F: Prolog variables can bind with any type of data structure.

c) T/F: Pass-by-result is used to implements an *in parameter*.

d) T/F: (Unix) The pipe `|` can be used only once in a single command (at the command prompt).

e) T/F: In Prolog, _59 is a constant.

f) T/F: Perl is more strongly typed than C.

g) T/F Common Lisp has built-in object-oriented features.

h) T/F The best programming language is Java.

   a)_________ b)_________ c)_________ d)_________ e)_________ f)_________ g)_________ h) _________
3) (24 p) Programming Language Selection

Choose between IMPERATIVE, FUNCTIONAL, LOGIC, SCRIPTING and OBJECT-ORIENTED style languages for the following applications. Name a language and briefly justify each choice.

a) A design simulator for an autonomous underwater vehicle.

b) A program to keep track information and current location of each painting in a museum.

c) An email filtering program to separate messages into several folders.

d) A program for translation of files from unicode to extended ASCII encodings.

4) (24 p) Logic and Prolog

Translate each of the following sentences into Logic, and then into Prolog facts and rules. Demonstrate how your rules answer the query: \texttt{chases(snoopy, silly)}.

- Kris has a cat named Silly.
- Tom has a dog named Snoopy.
- Cats and dogs are animals.
- Dogs chase all other animals.
5) (24 p) Prolog Comprehension

```
mystery1([], 0).
mystery1([H|T], A) :- mystery1(T, A1), A is A1 + 1.

mystery2([],).
mystery2([_]).
mystery2([B|C]) :- append(D, [B], C), mystery2(D).
```

Show all the results returned for each query (as when typing ‘a’ after the first answer).

A) mystery1([], X).

B) mystery1([bill, sam], Y).

C) mystery1([Sally], 3).

D) mystery2([D, 5, 5, D]).

E) mystery2([E, F, 9, 10]).

F) mystery2([G|H]).

6) (30 p) Lisp Programming

Write recursive Common Lisp functions that will calculate the count, sum and average of all numbers, at any level, in a list. For all functions, do error checking and ignore any non-numeric items (except sublists) in the list.

Examples:

```
(average-recursive '(( 10 ) 20 "twenty-five" 30 40)) \rightarrow 25
(sum-recursive '( 10 ( 20 ) 30 40)) \rightarrow 100
(count-recursive '( 10 20 ( 30 (40 "Lisp" )))) \rightarrow 4
```

7) (25 p) Extra Credit - Prolog Programming

Write a Prolog database to find all of someone’s second cousins (grandchildren of your grandparents’ siblings). Write facts for the database using only parent(Parent, Child) and married(Person1, Person2). Write rules for secondcousin(Cousin1, Cousin2). You may use rules with additional predicates.

Your database must return the exact answer shown to the following query:

```
secondcousin(jeff, X) \rightarrow X = mary; X = sam; no...
```