CSI 3125
Fall 1999 Midterm
Professor: Ken Barker

Monday, Novermber 1, 14:30

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Notes:
1. This is a closed book midterm. Textbooks, notes, cheat sheets and microfiche are **not** allowed.
2. Calculators, computers, Palm V's and all other computing devices are **not** allowed.
3. There are 10 pages. Write your name and student number on **every** page.
4. There are 6 questions. Answer **all** 6 of them.
5. Write **all** answers and work in the space provided. Use **no** other paper.
6. You have 80 minutes to complete the midterm.

Marks:

Question						
1 (7 marks)	2 (4 marks)	3 (3 marks)	4 (5 marks)	5 (6 marks)	6 (1 mark)	*Total (25 marks)*
4 / 3	2 / 2	3	5	6	1	26

Question 1: Extended BNF Grammars

a) Write an extended BNF (EBNF) grammar for the language of freight trains. Here is some information about freight trains:

- the terminal symbols are:
  `engine cattlecar tanker fridgecar lumbercar caboose`
- the goal symbol is:
  `<train>`
- every train starts with one or two `engines` and ends with a `caboose`
- a `tanker` must not come right after an `engine`
- a `lumbercar` must not come right after an `engine`
- sequences of `cattlecar` must be preceded and followed by a `lumbercar`

Here are some legal sentences in the language:

- `engine fridgecar lumbercar lumbercar caboose`
- `engine engine caboose`
- `engine fridgecar lumbercar tanker tanker tanker caboose`
- `engine fridgecar lumbercar cattlecar cattlecar lumbercar caboose`

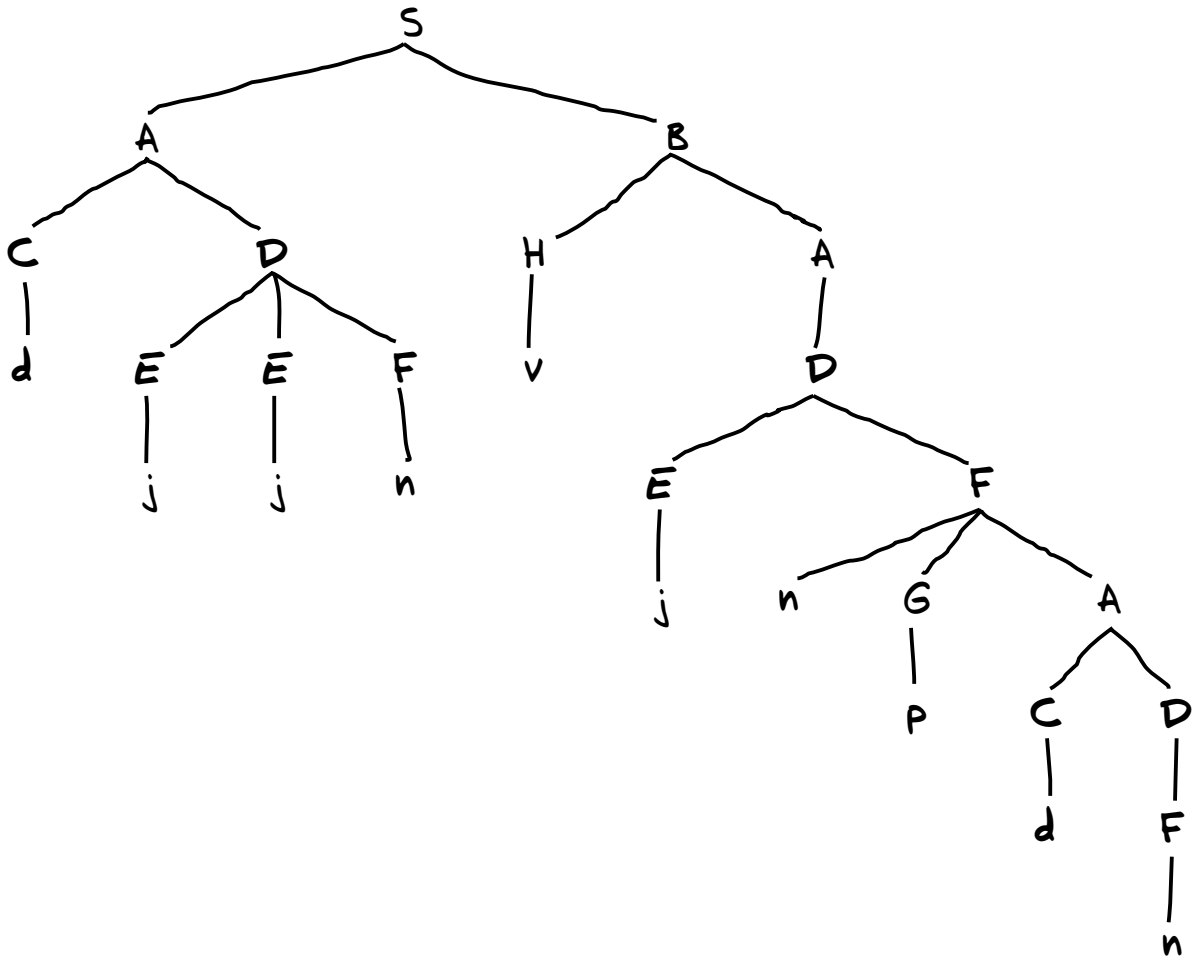
Many answers possible. Here's one that assumes that engines and cabooses don't appear in the middle of a train:

<train> ::= engine [engine] [<cars>] caboose
<cars> ::= fridgecar { <anycars> }
<anycars> ::= tanker | fridgecar | <cattleseq>
<cattleseq> ::= lumbercar cattlecar { cattlecar } <cattleseq>
<cattleseq> ::= lumbercar

b) Here is an EBNF grammar for some language:

```
<S> ::= <A> <B>
<A> ::= [ <C> ] <D>
<B> ::= <H> [ <A> ]
<C> ::= d
<D> ::= { <E> } <F>
<E> ::= j
<F> ::= n [ <G> <A> ]
<G> ::= p
<H> ::= v
```

Show a parse tree for the sentence `djjnvjnpdn`



Question 2: Names, Binding, Scope

Here is a Pascal program that does nothing of interest

```
program main;

var X, Y: integer;

   procedure foo(A: integer);
   var X: integer;

   begin
      X := 10;
      bar(X)
   end;

   procedure bar(foo: integer);
   var Z: integer;

      procedure foobar(X: integer);
      begin
         Z := X * foo
      end;

   begin
      foobar(foo);
      X := Z
   end;

begin

   X := 5;
   Y := 13;

   foo(Y)

end.
```

a) Give the *scope* of the following names:

`main.X` S(main) S(main.bar)

`main.foo` S(main) S(main.foo)

`main.bar.foo` S(main.bar) S(main.bar.foobar)

`main.bar.foobar.X` S(main.bar.foobar)

b) Give the *referencing environment* for the following statements.
`S(`*procedurename*`)` refers to the statements in procedure *procedurename*.

`S(main)` main.X main.Y main.foo main.bar

`S(main.foo)` main.Y main.foo main.bar
main.foo.A main.foo.X

`S(main.bar)` main.X main.Y main.bar
main.bar.foo main.bar.Z main.bar.foobar

`S(main.bar.foobar)` main.Y main.bar main.bar.foo
main.bar.Z main.bar.foobar
main.bar.foobar.X

Question 3: Data Types

The following Pascal program is perfectly correct given the proper variable declarations. Show the variable declarations necessary to make the program correct.

```
program p;

   var t: integer ;
       u: char ;
       v: boolean ;
       w: set of char ;
       x: set of char ;
       y: set of char ;
       z: integer ;

begin
   ...
   w := x * y;
   u := chr(z + 3);
   v := u in w;
   t := ord(v)

end.
```

Question 4: Parameter Passing

Show the output (if any) for the following Pascal-style program for each of the five parameter passing modes. Use the table below to show your answers.

```
program main;

var X, i: integer;
    A: array[1..5] of integer;

   procedure p(mode U, V: integer);
   var i: integer;

   begin
      U := U + V;
      V := U;

      write(U); write(', '); writeln(V)
   end;

begin
   X := 1;
   for i := 1 to 5 do
      A[i] := 5 - i;

   p(X, A[X]);

   write(X); write(', '); writeln(A[X])

end.
```

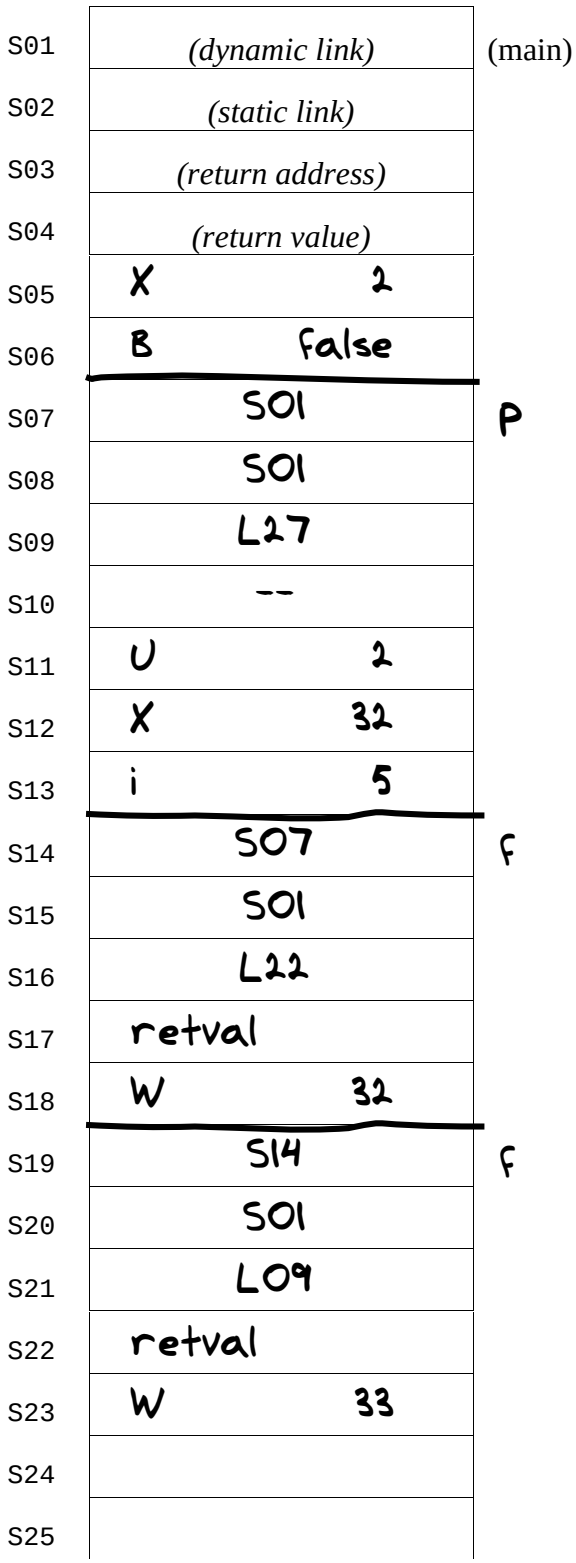
parameter passing mode	*program output*
pass-by-value	5, 5 1, 4
pass-by-result	illegal!
pass-by-value-result	5, 5 5, 5 (or 5, 0)
pass-by-reference	5, 5 5, 0
pass-by-name	5, 5 5, 5

Question 5: Subprogram Implementation

Here is yet another useless Pascal program

```
L01      program main;

L02      var X: integer;
L03          B: boolean;

L04         function f(W: integer): integer;
L05         begin
L06            if B then begin
L07               B := false;
L08               f := f(W + 1)
L09            end
L10            else begin
L11               write(W);
L12               f := W
L13            end
L14         end;

L15         procedure p(U: integer);
L16         var X, i: integer;

L17         begin
L18            X := U;

L19            for i := 1 to 4 do
L20               X := X * U;

L21            write(f(X))
L22         end;

L23      begin
L24         B := true;
L25         X := 2;
L26         p(X);
L27         writeln(X)
L28      end.
```

Using the empty stack on the next page, draw the complete activation stack when IP = L12. Twenty-five rows in the stack should be *more* than enough.


S01
(dynamic link)
(main)
S02
(static link)
S03
(return address)
S04
(return value)
S05
X 2
S06
B false
S07
SO1
P
S08
SO1
S09
L27
S10
--
S11
U 2
S12
X 32
S13
i 5
S14
SO7
f
S15
SO1
S16
L22
S17
retval
S18
W 32
S19
S14
f
S20
SO1
S21
L09
S22
retval
S23
W 33
S24
S25

Question 6: Concepts of Programming Languages

1. The term *orthogonality* refers to
   a) a kind of abstraction in which the same symbol is used for different operations
   b) the extent to which constructs in a language can be combined freely
   c) the incompatibility between row-major and column-major arrays
   d) the use of prostheses for amputated limbs

2. A *non-terminal* symbol
   a) is a name that cannot be resolved by the compiler due to a circular reference
   b) is a symbol in a grammar that is *not* composed of sequences of other symbols
   c) appears on the left side of production rules
   d) is used for public washrooms in museums and theatres, but not bus stations

3. Which of the following is a *primitive type* in most languages?
   a) float
   b) enum
   c) pointer
   d) CSI 3125 prof

4. *Row-major* and *column-major* refer to
   a) conventions for mapping multi-dimensional arrays to one-dimensional memory
   b) conventions for determining whether two arrays are compatible
   c) conventions for the Baton Twirlers Association
   d) two different designations of the Bachelor of Arts degree

5. A *dangling reference*
   a) is prohibited in strongly-typed languages
   b) may go undetected by a Pascal compiler
   c) is the sort of nonsense up with which I will not put
   d) can get you arrested in this town

6. *Control statements*
   a) prevent the evaluation of the rest of an expression once the value of the expression has been unambiguously determined
   b) determine the order of execution of statements in a program
   c) were often overheard due to Cone of Silence malfunctions
   d) or the government will control them for you!

7. Yashin should
   a) swallow it and hook up with the Sens on their next road trip
   b) listen to his agent, 'cause agents are really smart
   c) seriously consider a U of O degree: The right choice. The right University.
   d) come out Sunday nights... it's only 10 bucks!

8. This exam
   a) bites b) stinks c) rocks d) grooves, daddy-o