Signature ____________________ **Name ________________________**

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Midterm
CSE 131B
Winter 2006

Page 1	___________	**(26 points)**
Page 2	___________	**(17 points)**
Page 3	___________	**(20 points)**
Page 4	___________	**(19 points)**
Page 5	___________	**(18 points)**
Subtotal	___________	**(100 points)**
Page 6 **Extra Credit**	___________	**(5 points)**
Total	___________	

1. Give the order of the phases of compilation in a typical compiler as discussed in class

A – Machine-specific code improvement (optional)
B – Parser (Semantic analysis)
C – Machine-independent code improvement (optional)
D – Source language file (for example, C)
E – Target language file (for ex., assembly)
F – Scanner (lexical analysis)
G – Parser (syntax analysis)
H – Code generation (for ex., assembly)
I – Intermediate Representation

______ –> ______ –> ______ –> ______ –> ______ –> ______ –> ______ –> ______ –> ______

Give the order of the typical C/C++ compilation stages and on to actual execution as discussed in class

A – Program Execution
B – as (assember)
C – Source file (.c/.cpp)
D – cpp (C preprocessor)
E – Segmentation Fault (Core Dump)
F – ccomp (C compiler)
G – ld (Linkage Editor)
H – exe/a.out (executable image)
I – loader

gcc ______ –> ______ –> ______ –> ______ –> ______ –> ______ –> ______ –> ______ –> ______

Given the following ANSI/ISO C/C++ variable definitions, which line(s) would cause semantic compiler errors?

A. Compiler error
B. No compiler error

```
int i;
int * iPtr = &i;
int ** pPtr = &iPtr;

*pPtr++;         ____

++(&i);          ____

++*pPtr++;       ____

++(*pPtr)++;     ____

++*++*pPtr++;    ____

*++*++iPtr;      ____

++**++pPtr;      ____

++**++pPtr++;    ____
```

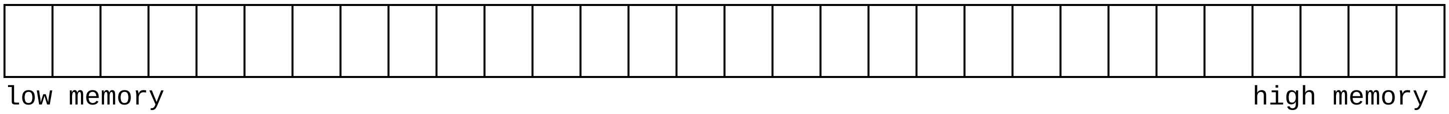
2. Given the array declaration

C	**Oberon-like**
`int a[3][3];`	`VAR a : ARRAY 3,3 OF INTEGER;`

Mark with an **A** the memory location(s) where we would find

`a[2][1]`	`a[2,1]`

a:

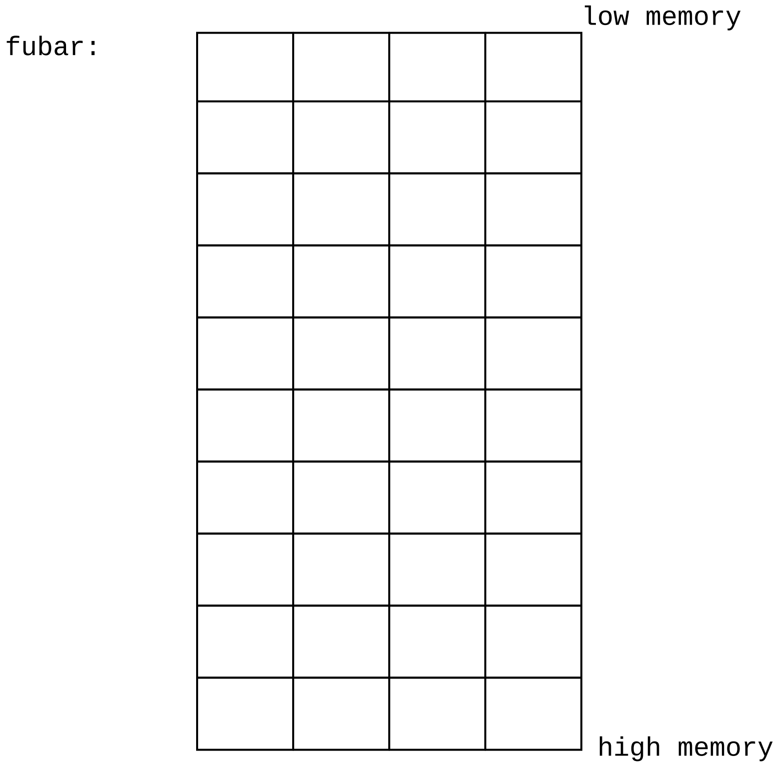


Each box represents a byte in memory. (4 points)

Show the SPARC memory layout of the following struct/record definition taking into consideration the SPARC data type memory alignment restrictions discussed in class. Fill bytes in memory with the appropriate struct/record member/field name. For example, if member/field name `p` takes 4 bytes, you will have 4 `p`'s in the appropriate memory locations. If the member/field is an array, use the name followed by the index number. For example, some number of `p0`'s, `p1`'s, `p2`'s, etc. Place an `X` in any bytes of padding. Structs and unions are padded so the total size is evenly divisible by the most strict alignment requirement of its members. (7 points)

```
struct foo {
   char   a;
   short  b[2];
   double c;
   char   d[10];
   char   e[3];
   int   *f;
   char   g;
}

struct foo fubar;
```



What is the `offsetof( struct foo, c )`? _______ (2 point)

What is the `sizeof( struct foo )`? _______ (2 point)

If `struct foo` had been defined as `union foo` instead, what would be the `sizeof( union foo )`? _______ (2 points)

3. For the following Oberon statements, indicate the correct error message using the list of given error messages below (if there is no error, select option A): (2 pts each)

Possible Error Messages:
A - No error
B - Incompatible type to binary operator
C - Incompatible type to unary operator
D - Is not assignable (not a modifiable L-value)
E - BOOLEAN required for conditional test
F - Argument not assignable to value parameter
G - Argument not equivalent to VAR parameter
H - Non-addressable argument passed to VAR parameter

```
CONST t = TRUE;
TYPE foo = INTEGER;
TYPE bar = REAL;
TYPE baz = BOOLEAN;
VAR x : foo;
VAR y : bar;
VAR z : baz;
PROCEDURE p(a : REAL; VAR b : REAL);
 (* do nothing *)
END p;

BEGIN
 y := 99;                ______

 z := x # y;             ______

 z := ~x;                ______

 t := z;                 ______

 p(x, x);                ______

 p(9, 9.0);              ______

 p(x, y);                ______

 p(x DIV 1, y);          ______

 p(z, y);                ______

 IF (z & ~t) THEN END;   ______
END.
```

4. Consider the following C-like code:

```
int x = 0;

int f()
{
  print( x );
  return x;
}

int g()
{
  int x = 1;
  print( x );
  return f();
}

int main()
{
  print( g() );
}
```

What does the program output
if the language uses <u>static</u> scoping? (3 points)

______
______
______

What does the program output
if the language uses <u>dynamic</u> scoping? (3 points)

______
______
______

Consider the following record/struct definitions:

A

```
struct foo {
  int a;
  double b;
  struct foo c;
  short d[4];
};
```

B

```
struct foo {
  int a;
  double b;
  struct foo c[2];
  short d[4];
};
```

C

```
struct foo {
  int a;
  double b;
  struct foo *c;
  short d[4];
};
```

Which of the above record/struct definitions is/are semantically correct and why? (4 points)

Using the Right-Left rule write the definition of a variable named CSE that is a pointer to an array of 8 pointers to functions that take a pointer to an float as the single parameter and returns a pointer to a double.
(9 points)

5. Given the following array definition

```
        /* C */                                      (* Oberon *)
     float x[3][5];                              VAR x : ARRAY 3,5 OF REAL;
```

write the assembly level address calculation expression taking into account scalar arithmetic to access

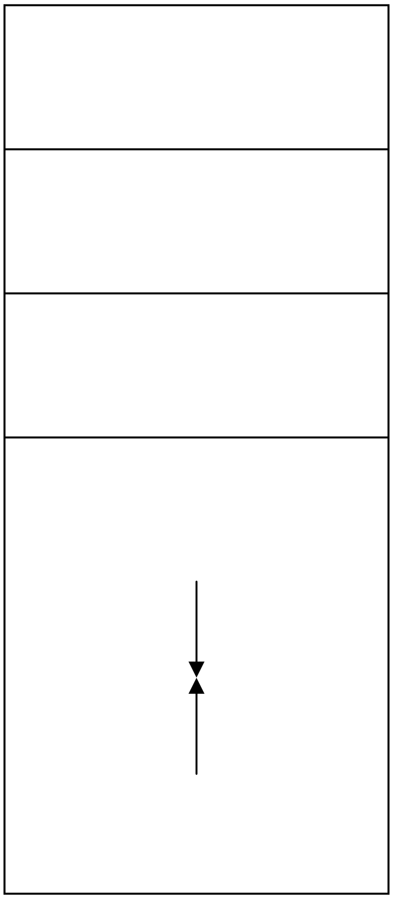
```
     x[a][b]                                         x[a,b]
```

((x + ______________________________________) + ____________________________________)

The result is the address of where we can find this array element. (8 points)

Fill in the names of the 5 areas of the C Runtime Environment as laid out by most Unix operating systems (and Solaris on SPARC architecture in particular) as discussed in class. Then state what parts of a C program are in each area. (10 points)

low memory



____

____

____

____

____

high memory

Extra Credit (5 points)

Explain what is wrong with the following CUP rule/action. How would you fix this problem?

```
ExprList ::=        Expr:_1
            {:
              Vector v = new Vector();
              v.addElement(_1);
              RESULT = v;
            :}
    |               ExprList T_COMMA Expr:_2
            {:
              v.addElement(_2);
              RESULT = v;
            :}
    ;
```