EEN218
Spring 2006
Second Mid-Term

Who are you?

What is your student number?

Did you cheat on this test?

Sign to affirm that answer.

*Don't write anything below this line*_____

*OK, but definitely nothing below this line*_____

3.   Pointers and Things (49%)

Assuming that the following class has been defined:

```
struct pussycat
{ string name;
  string colour;
  int age;
  int number_of_legs; };
```

a.

Write correct C++ declarations for the following things:

i.   An array of 1000 pussycat objects,

ii.   A pointer to a pussycat object,

iii. A pointer to an array of pussycat objects,

iv.   An array of 1000 pointers to pussycat objects,

v.   A pointer to an array of pointers to pussycat objects.

b.

Draw pictures showing the layout of variables, objects, pointers, and arrays in memory after three objects pussycat objects have been added to the arrays defined in parts iii, iv, and v above.

c.

Give correct C++ code for adding the data for the following pussycat
        Stumpy, who is grey, eight years old, and has three legs
                        to the variable that you declared in part v of part a.
Assume that nothing else has been done. Start with your declaration of "a pointer to an array of pointers to pussycat objects", and show every step required to get the data correctly added.

d.

Give correct and complete C++ code (no need for a function) that would search through an array as defined for part v, and print the name of the oldest pussycat recorded.
(If you can't do it for the declaration in part v, you can get partial credit for using the declaration from part iv, slightly less for part iii, and some for part i).

4. Time and Space (49%)

Assuming that a class or struct called Customer has already been defined, and that the average size of a Customer object is 10,000 bytes, and that the following declarations have been made:

```
Customer * data = new Customer[1];
int number=0, capacity=1;
```

a.

Write a C++ function that will increase the size of the database to a new size that is provided as a parameter. We would expect your function to be able to be used like this: `enlarge_database(25);`

b.

A very large number of Customer objects must be added to the database. Each time a new object is to be added, the following statement is executed to ensure that there is enough space for it:

```
if (number>=capacity)
   enlarge_database(number+1);
```

Approximately how many simple operations (copying a Customer object from one location to another) must be performed in total when N (N is a very large number) customers are added to the database

i. with the new size as specified above, `number+1`?

ii. if the new size calculation is changed to `number+100`?

iii. if the new size calculation is changed to `number*2`?

c.

Explain your answer to part iii, show me why it is true.
(If you couldn't do part iii, then explain the last part that you could do.)

d.

Assuming that it takes 10^{-10} seconds (one tenth of a nanosecond) to copy a *single byte* from one location to another, calculate the approximate time to insert N items into a database for the three resizing schemes given above, and for these three values of N: one thousand, one million, and one billion. Put your answers into a simple table like this:

How long does it take when	N=1,000	N=1,000,000	N=1000,000,000
new size = old size + 1			
new size = old size + 100			
new size = old size × 2			

5. Special (2½%)

What do you think would happen if I glued two spiders together and called them both Norman? Short answers please.