ES112 Summer 2003-2004
Second Midterm Examination

1 Scramble a String In-Place *(40 points)*

Write a C function that takes a string as an argument, and scrambles it (i.e., changes the order of its letters randomly). For instance, if the string is “Yeditepe”, it could be modified to become “epeYtide” or “tpYieeed”. The prototype of the function is:
void scramble(char *s);
Your function should scramble the string really well, which means the movements should be random, and there should be enough moving of letters to give every letter in the string a chance to move.

2 Angle Between Vectors*(40 points)*

The three-dimensional vector $\vec{r} = (x, y, z)$ is represented by the following structure:

```
struct vector {
  double x;
  double y;
  double z;
};
```

Write a C function that takes two such vectors as arguments, and returns the angle between the two in radians. Remember the relation:

$$\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}| \cos\theta = a_x b_x + a_y b_y + a_z b_z$$

where $\vec{a}$ and $\vec{b}$ are two vectors, and θ is the angle between them.
Also, you may find the math library function

```
double acos(double x);
```

which calculates arc-cosines useful. The prototype of the function is:

```
double angle(struct vector *a, struct vector *b);
```

3 Mystery Function*(20 points)*

```
int mystery(int n)
{
  if (n <= 1) {
    return 2;
  } else {
    int k;
    k = mystery(n-1);
    return k*k;
  }
}
```

a.*(15 points)* What does this function compute? Give a mathematical expression. (You may ignore overflows in your expression!)
b.*(5 points)* Given 32 bit integers, what will the following fragment print?

```
printf("%d\n", mystery(6));
```