

DATA STRUCTURES AND ALGORITHMS

PRACTICE No. 12

Arithmetic of Big Numbers

Problem

How to calculate the following expressions?

$$1000! = ?$$

$$2^{1000000} = ?$$

$$1245782421545478544 * 12445245214524521521 = ?$$

$$145142142152154221114412632153256211 * 85741 = ?$$

Data structure for big number

```
int main()
{
    // 1234567890
    int A[11]={10,0,9,8,7,6,5,4,3,2,1};
    // A[0] - number of digits
    // A[1]=0
    // A[2]=9
    //...
    // A[10]=1
    return 0;
}
```

Multiplication by constants b

```
void LongSand(int A[], int b)
{
    int in_mind = 0;
    for (int i=1; i <= A[0]; i++)
        { A[i]      = A[i]*b + in_mind;
          in_mind  = A[i] / 10;
          A[i]     = A[i] % 10;
        }
    if ( in_mind > 0)
    { A[0] = A[0] + 1;
      A[A[0]] = in_mind;
    } }
```

Factorial

```
void LongSand(int A[], int b);
```

```
int main()
{
    int n;
    int A[10000]={1,1};
    cin >> n;
    for (int i = 2; i <= n; i++)
    {
        LongSand(A,i);
    }
    for(int i=A[0]; i>=1; i--) cout << A[i];
    cout << endl;
    return 0;
}
```

Remainder

```
int LongMod(int A[], int b)
{
    int x = 0;

    for (int i = A[0]; i >= 1; i--)
        x = (x*10 + A[i]) % b;
    return x;
}
```

Adding A + B

```
void LongSum_A_B(int A[], int B[])
{
    int m = max(A[0],B[0]);
    int c = 0;
    for (int i=1; i<=m; i++)
    {
        c = c+A[i]+B[i];
        A[i] = c % 10;
        c = c / 10;
    }
    if(c > 0){
        m = m+1;
        A[m] = c;
    }
    A[0]=m;
}
```

Multiplication A x B

```
void LongSandA_B(int A[], int B[], int C[])
{
    int cr, k;
    for (int i=1; i<=A[0]; i++){
        for (int j=1; j<=B[0]; j++){
            cr = A[i]*B[j];
            k = i+j-1;
            while(cr > 0){
                cr = cr+C[k];
                C[k] = cr%10;
                cr = cr/10;
                if(k > C[0]) C[0]=k;
                k = k+1;
            } } } }
```


Exercises

Exercise No.1

Write function to subtract B from A, here A and B are big numbers.