

# AERSP 424: Advanced Computer Programming

Submission Instructions: Homework 2  
Due: 1/22/19

Submission Instructions:

- Submit the file with the .cpp extension containing your C++ source code.
- Notes on submissions:
  - Submit single cpp file for questions 1,2,3
  - Submit one pdf for questions 4 and 5. NO HANDWRITTEN SUBMISSIONS.
  - Complete submissions should include a cpp file and a pdf.
- Teams of up to 3 are allowed. Put the names of all team members on a single submission.

```
int transform( int array[], int size);
int main()
{
    int anArray[] = {0,1,2,3,4};
    int result = 0;
    result = transform(anArray, 5);
    for(int i=0; i<size; i++ )
        cout << array[i] << endl;
    cout << result << endl;
    return 0;
}

int transform( int array[], int size )
{
    int sum=0;
    for(int i=0; i<size; i++ ) {
        sum += array[i]
        array[i]=array[i]*array[i];
    }
    return sum;
}
```

1. Copy the code above:
  - a. Compile the program. Show the result.

```
0
1
4
9
16
10
```

- b. Create another function which transforms **double** array types and returns a **double** value.

```
double transform( double array[], int size);
int main()
{
    SAME AS BEFORE...
}

double transform( double array[], int size )
{
    double sum=0;
    for(int i=0; i<size; i++ ) {
        sum += array[i];
        array[i]=array[i]*array[i];
    }
    return sum;
}
```

- c. Create a function called **transformByValue** which transforms an **double** valued array which is pass by value and returns the result as an **double**.

```
double transformByValue(double x, double y) {
    if(y==0)
        return 1;
    else {
        int i=1;
        while (i<y) {
            x*=x;
            i++;
        }
        return x;
    }
}
```

- d. Create a function called **transformByReference** which transforms an **double** valued parameter which is passed by reference and returns a **double**.

```
double transformByReference(double& x, double y) {
    if(y==0)
        return 1;
    else {
        int i=1;
        while (i<y) {
            x*=x;
            i++;
        }
    }
}
```

```

        return x;
    }
}

```

- e. In main create a **double** variable called **dVal** set to 5.1. Print the value of **dVal** to console. Call the function **transformByValue** with **dVal** as the parameter. Now print the value of **dVal** to console again. Has the value changed?

```

double dVal=5.1;
double result;
cout << "Before: " << dVal << endl;
result = transformByValue(dVal,2);
cout << "After: " << dVal << endl;

```

No, the value hasn't changed.

- f. In main create a **double** variable called **dRef** set to 3.2. Print the value of **dRef** to console. Call the function **transformByReference** with **dRef** as the parameter. Now print the value of **dRef** to console again. Has the value changed?

```

double dRef=3.1;
cout << "Before: " << dRef << endl;
result = transformByReference(dRef,2);
cout << "After: " << dRef << endl;

```

Yes, the value has changed.

2. Create a function that implements Ackermann's function:

$$A(m,n) = \begin{cases} n + 1 & \text{if } m = 0 \\ A(m-1,1) & \text{if } m > 0 \text{ and } n = 0 \\ A(m-1, A(m,n-1)) & \text{if } m > 0 \text{ and } n > 0 \end{cases}$$

- a. Create a recursive function called **Ackermann** takes two **unsigned long** parameters and returns a single **unsigned long** value. The function calculates the value of Ackermann's function for a given input.

```

unsigned long Ackermann(unsigned long m, unsigned long n) {
    if(m==0) {
        return (n+1);
    }
    else if(m>0 && n==0) {
        return Ackermann(m-1,1);
    }
    else if(m>0 && n>0) {

```

```

        return Ackermann(m-1, Ackermann(m,n-1));
    }
    else {
        cout << "Invalid Parameter"<<endl;
        return -1;
    }
}

```

- b. Feed random numbers into the function for both n and m between the values of 0 and 3. List the numbers and their values.

will vary:

```

Ackermann(3,3) = 61
Ackermann(3,2) = 29
Ackermann(3,1) = 13
Ackermann(3,0) = 5
Ackermann(2,3) = 9
Ackermann(2,2) = 7
Ackermann(2,1) = 5
Ackermann(2,0) = 3
Ackermann(1,3) = 5
Ackermann(1,2) = 4
Ackermann(1,1) = 3
Ackermann(1,0) = 2

```

3. Create a function called **BabylonianMethod** which calculates the square root ( $\sqrt{S}$ ) of a number using the Babylonian method ([https://en.wikipedia.org/wiki/Methods\\_of\\_computing\\_square\\_roots#Babylonian\\_method](https://en.wikipedia.org/wiki/Methods_of_computing_square_roots#Babylonian_method)) by taking two **double** as parameters one representing  $S$  and the second representing an initial guess and returning a **double** of the estimate of  $\sqrt{S}$ . Using the same function name but different parameter types and return types to add functions with:
- double** parameter, **double** return
  - float** parameter, **float** return
  - int** parameter, **int** return
  - unsigned long** parameter, **unsigned long** return
  - In main call each version of the function.

```

double BabylonianMethod(double S, double initialGuess) {

    double guess=initialGuess;
    for(int i=0;i<6;i++) {
        guess = 0.5*(guess + (S/guess));
    }
}

```

```
return guess;
}
```

4. What is the output of the following? **Add comments briefly explaining each line**

```
a. int main()
{
    int x=20, y =35;
    x = y++ + x++;
    y = ++y + ++x;
    cout << x << " "<<y << endl;
    return 0;
}
```

56 93

```
b. int main()
{
    int check=2;
    switch(check) {
        case 1:
            cout << "George ";
        case 2:
            cout << "Edward ";
        case 3:
            cout << "Richard ";
        default:
            cout << "Henry ";
    }
    cout << endl;
    return 0;
}
```

Edward Richard Henry

```
c. int main()
{
    int m=-10, n =20;
    n = (m < 0) ? 0 : 1;
    printf("%d %d", m,n);
    return 0;
}
```

-10 0

5. Identify and correct the errors in each of the following:

```
a. cout >> output;
```

```
cout << output;
```

```
b. while (x = 4 ) {  
    ++c;
```

```
    while (x == 4 ) {  
        ++c;  
    }  
}
```

```
c. if (y>3)  
    sum += 5;
```

```
    if(y>3)  
        sum+= 5;
```

```
d. if ( hw == 1)  
    cout << "Good" << endl;  
else;  
    cout << "Bad" << endl;  
endif;
```

```
if ( hw == 1)  
    cout << "Good" << endl;  
else  
    cout << "Bad" << endl;
```