PROJECT 3

ALEXANDER WOOD

First I will print out the code used for the projects. A table of the requested results is located on the last page. The project `Project3` has the following code:

```
#include <cstdlib> // for random numbers
#include <vector> // for vectors
#include <iostream>
#include <time.h>
#include <stdlib.h>


using namespace std;


vector<vector<int>> BuildSequence(int Dimension, int NumberOfTests)
{
    vector<vector<int>> Sequence(NumberOfTests, vector<int>(Dimension));
    // create 10000 x n matrix

    // INITIALIZE RANDOM SEED
    srand (time(NULL));

    for(int ColumnAssign = 0; ColumnAssign < Dimension; ++ColumnAssign)
    // assigns random values to entries of 10000 x n matrix
    {
        for(int RowAssign=0; RowAssign < NumberOfTests; ++RowAssign)
        {
            Sequence[RowAssign][ColumnAssign] = rand() % 1000000;
        }
    }

    return Sequence;
}

int InsertionMod (vector<vector<int>> A, int n, int RowCounter)
// Modify this algorithm to return the number of steps
{
    int steps = 0;

    int i,j, temp;
```

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```
    A[RowCounter][0]=-32768;
    //smallest possible integer using 2 bytes integer representation

    for (i=1; i<=n; i++)
    {
        j=i;

        while ( A[RowCounter][j] < A[RowCounter][j-1])
        { // swap
            temp=A[RowCounter][j];

            A[RowCounter][j]=A[RowCounter][j-1];
            A[RowCounter][j-1]=temp;
            j--;

            steps += 1;
        }

        steps += 1;
    }

    return steps;
}


int AverageCase(int n)
{
    int RealAverage = n*n/4 + 3*n/4;
}



int main()
{
    int NumberOfTests = 100000; // Number of lists we test, is the rows of Sequence


    cout << "Input Size, Calculated Average, Real Average" << endl;
  //  cout << "100, " <<  endl;

    for(int Dimension = 500; Dimension < 3600; Dimension+=500)
    {
        // Build a vector of 10000 rows of Dimension random numbers.
        vector<vector<int> > Sequence = BuildSequence(Dimension, NumberOfTests);
```

```
        int CalculatedAverage = 0;

        // Find the number of steps it takes to run each algorithm
        for(int TestNumber = 0; TestNumber < NumberOfTests; TestNumber++)
        {
            int steps = InsertionMod(Sequence, Dimension, TestNumber);

            CalculatedAverage += steps;
        }

        CalculatedAverage /= NumberOfTests;

        int RealAverage = AverageCase(Dimension);

        cout << Dimension << ", " << CalculatedAverage << ", " << RealAverage << endl;
    }
}
```

The results of the experiment are as follows:

```
Input Size, Calculated Average, Real Average
100, 2515, 2575
500, 63162, 62875
1000, 251107, 250750
1500, 564129, 563625
2000, 1566263, 1564375
3000, 2252389, 2252250
3500, 3065308, 3065125

Process returned 0 (0x0)   execution time : 235.173 s
Press any key to continue.
```