Problems and issues with Procedural Programming

Storing Data in Procedural Way

We have made following Parallel arrays to store records of the students.

```
int array_size = 5;
string [] sname = new string[array_size];
float [] matricMarks = new float[array_size];
float [] fscMarks = new float[array_size];
float [] ecatMarks = new float[array_size];
float[] aggregate = new float[array_size];
```

Storing Data in Procedural Way

Can you highlight any problem with this approach ?

```
int array_size = 5;
string [] sname = new string[array_size];
float [] matricMarks = new float[array_size];
float [] fscMarks = new float[array_size];
float [] ecatMarks = new float[array_size];
float[] aggregate = new float[array_size];
```

Disjoint Data

Record of a student is highly correlated but it is stored in different disjoint arrays and linked with the index number only.

```
int array_size = 5;
string [] sname = new string[array_size];
float [] matricMarks = new float[array_size];
float [] fscMarks = new float[array_size];
float [] ecatMarks = new float[array_size];
float[] aggregate = new float[array_size];
```

Disjoint Data issues: Data Management

Data is distributed in different arrays. If you want to pass complete record of any student than you need to pass data from different arrays.

```
int array_size = 5;
string [] sname = new string[array_size];
float [] matricMarks = new float[array_size];
float [] fscMarks = new float[array_size];
float [] ecatMarks = new float[array_size];
float[] aggregate = new float[array_size];
aggregate[0] = calculateMerit(matricMarks[0], fscMarks[0], ecatMarks[0]);
```

Disjoint Data issues: Data Security

We can not restrict data access. For example, if we want a print function should not access a specific record in the Array then it is not possible.

```
static void printRecords(string[] name, float[] matric, float[] fsc, float[] ecat, float[] agg)
{
  for (int x = 0; x < 5; x++)
  {
    Console.WriteLine("{0} \t {1} \t {2} \t {3} \t {4}", name[x], matric[x], fsc[x], ecat[x], agg[x]);
  }
}
```

Disjoint Data issues: Constraint on Data

Data can not look after itself. We can not add any constraint on the manipulation or access of the Data.

```
int array_size = 5;
string [] sname = new string[array_size];
float [] matricMarks = new float[array_size];
float [] fscMarks = new float[array_size];
float [] ecatMarks = new float[array_size];
float[] aggregate = new float[array_size];
```

Disjoint Data issues: Constraint on Data

For example, there could be no guarantee that in the firstYearMarks the value shall always less than 1100 and greater than 0.

$$0 < \text{firstYearMarks}[] < 1100$$

```
int array_size = 5;
string [] sname = new string[array_size];
float [] matricMarks = new float[array_size];
float [] fscMarks = new float[array_size];
float [] ecatMarks = new float[array_size];
float[] aggregate = new float[array_size];
```

Operations on Data

We define functions to perform operations on the Data but the function and data are highly decoupled.

```
aggregate[0] = calculateMerit(matricMarks[0], fscMarks[0], ecatMarks[0]);
```

```
static float calculateMerit(float mMarks, float fscMarks, float ecatMarks)
{
    float score;
    score = ((0.25F * (mMarks / 1050)) + (0.45F * (fscMarks / 550)) + (0.3F *
             (ecatMarks / 400))) * 100;
    return score;
}
```

Operations on Data: is it Problematic?

We define functions to perform operations on the Data but the function and data are highly decoupled.

```
aggregate[0] = calculateMerit(matricMarks[0], fscMarks[0], ecatMarks[0]);
```

```
static float calculateMerit(float mMarks, float fscMarks, float ecatMarks)
{
    float score;
    score = ((0.25F * (mMarks / 1050)) + (0.45F * (fscMarks / 550)) + (0.3F *
             (ecatMarks / 400))) * 100;
    return score;
}
```

Operations on Data: Maintainability

If any change occurs in the data, all other functions need to be changed but they are distributed all over the code and it is easy to miss any change that leads to the crash of the software.

```
int array_size = 5;
string [] sname = new string[array_size];
float [] matricMarks = new float[array_size];
float [] fscMarks = new float[array_size];
float [] ecatMarks = new float[array_size];
float[] aggregate = new float[array_size];
```

```
static float calculateMerit(float mMarks, float fscMarks, float ecatMarks);
```

```
static void printRecords(string[] name, float[] matric, float[] fsc, float[] ecat, float[] agg);
```

Operations on Data: Maintainability

For example, we need to change the datatype of aggregate from float to double. Now this change require to keep changes at all place where the data has been referred. How to find all those places ?

```
int array_size = 5;
float[] aggregate = new float[array_size];
```

```
int array_size = 5;
double[] aggregate = new double[array_size];
```

```
static float calculateMerit(float mMarks, float fscMarks, float ecatMarks);
```

```
static void printRecords(string[] name, float[] matric, float[] fsc, float[] ecat, float[] agg);
```

Hiding the Details

In procedure programming, when Program A provide access to Program B, all features, functions and data get accessible to program B.

Hiding the Details

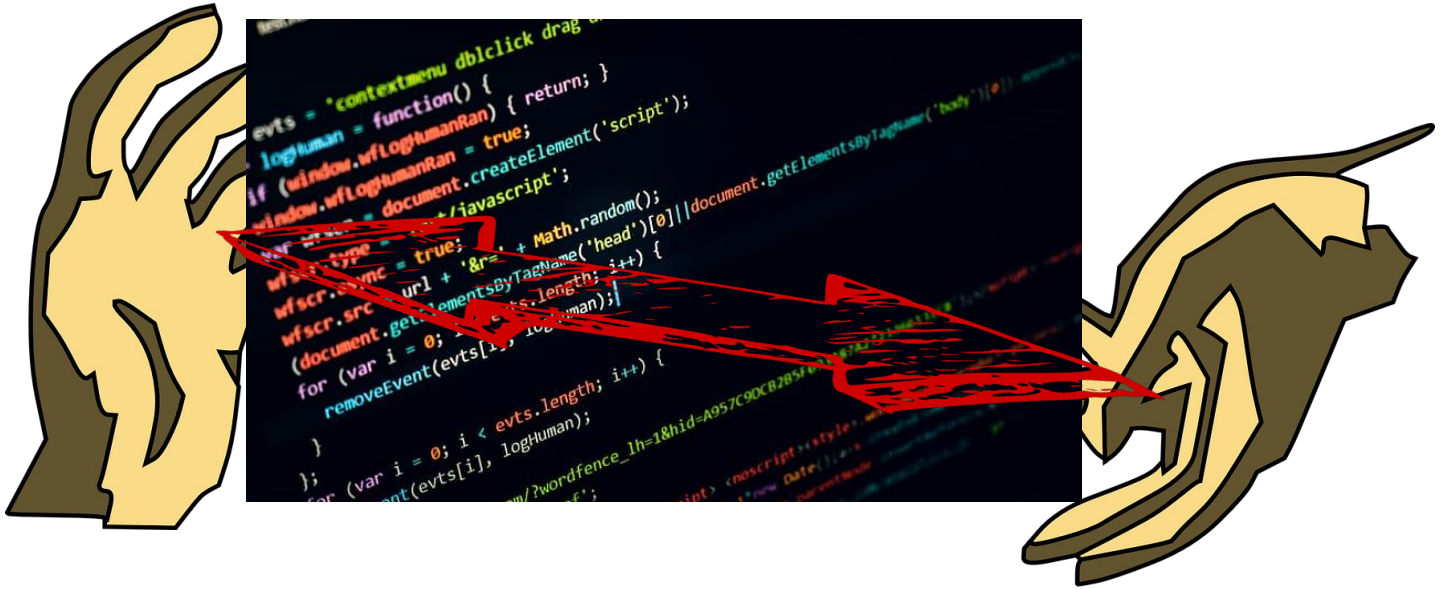
We do not have any way to provide partial access in procedural programming.

Extending the Functionality

Sometimes, Program A needs same functionality that program B has. Like, in case of aggregate calculations that may be needed in different programs such as admission program, scholarship program, hostel program and roll number assignment program.

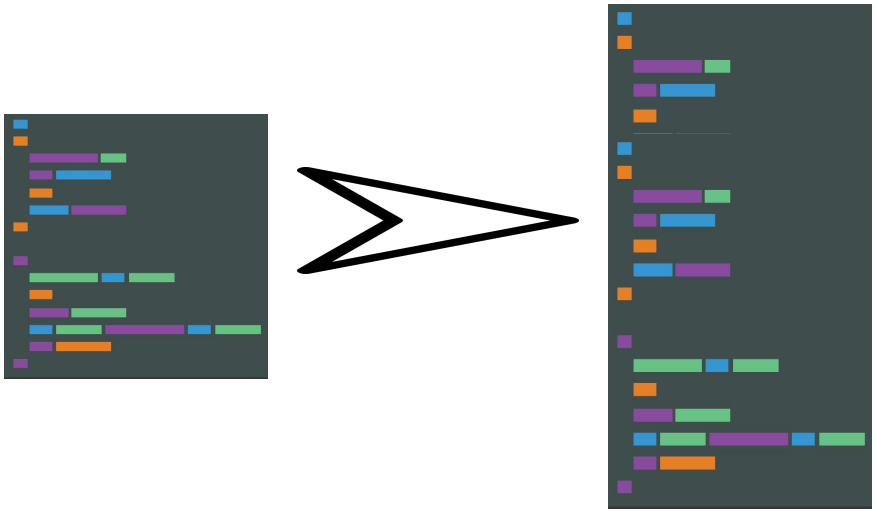
Extending the Functionality

Some times, We do not want to write a complete program again but we do want to add some new functionality.



Extending the Functionality

It is same like when we are calculating fee for a day scholar student but to calculate fee for a hostelite student, we just need to add some extra calculation into the program.

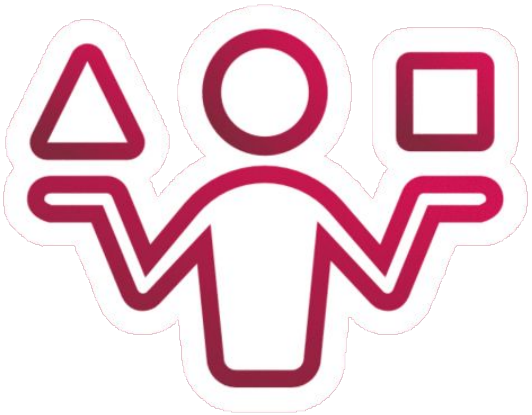


Extending the Functionality

In procedural programming, it is not possible or very difficult to extend the functionality of existing code.

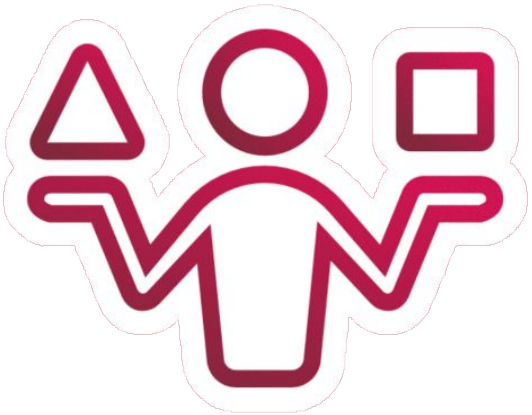
Different Behaviour

It is very much practical that we need same function behave differently for different scenarios.



Different Behaviour

For example, we know there should be a function area() to calculate area of a shape. This functional shall behave different for different type of shapes.
For example, for triangle its formula shall be different and for the square its formula shall be different.



Conclusion

Following are the major limitations of procedural programming

- NOT A Single Unit of of both Data and Functions
  - Disjoint Data
  - Disjoint Behaviour
- Providing Partial Access to Part of Program.
- Extending the Functionality of the Program.
- Different Functions behave differently for different scenarios

Learning Objective

Explain the limitations of the procedural programming.

Self Assessment

1. Identify the code areas in your previous projects that have issues due to these limitations.
   - Identify at least 2 examples of Disjoint behaviour from your business application and 2 examples from your Game
   - Identify at least 2 examples of copying the code instead of extending the functionality in both your Business application and Game project.
   - Identify at least 2 examples where you have given the complete access to arrays whereas only partial access is required.