Microkernel Architecture Using OSGi Framework

Calculator

Member No	IT Number	Full Name
01	IT17137492	Atheeq Mahroof
02	IT17134668	Gamage V.S
03	IT17386746	Karthiga R
04	IT17095068	G.R Satyagit

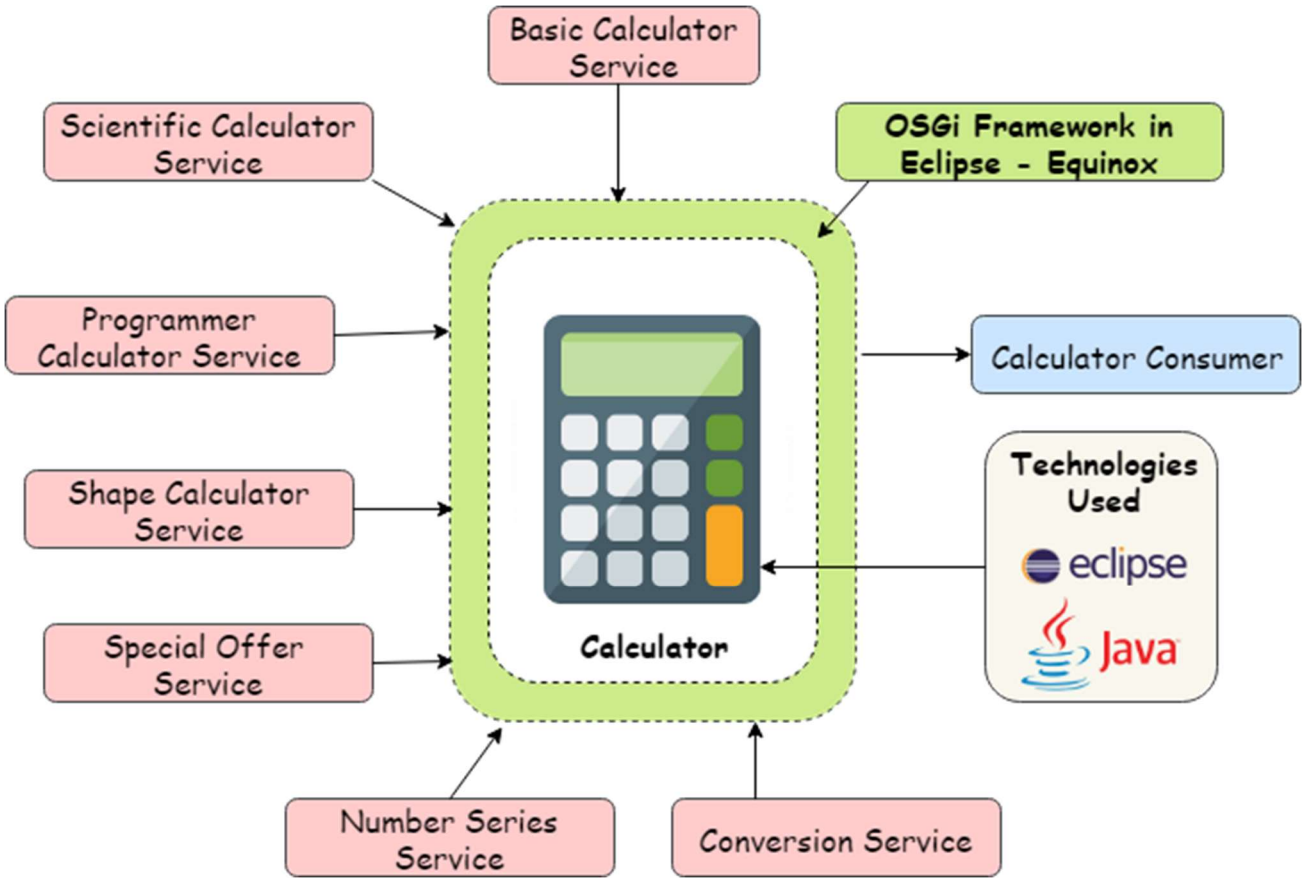
1 Introduction

As per the academic requirement, this report consists the implementation of a "Calculator" using the OSGi Framework. We have created 7 services and these services are consumed by the consumer depending on the consumer's need. Therefore, there are altogether 8 bundles in this project (7- Service and 1- Consumer). Following are the services implemented.

1. Basic calculator service – This service provides the basic mathematical operation like addition, subtraction, multiplication and division of 2 numbers.
2. Scientific calculator service – This service provides the user to enter a complex sum and the answer is generated using the BODMAS operation.
3. Programmer service - This service helps the user to convert any decimal or binary or octal or hexadecimal number to any of the format.
4. Shape Calculator Service - This service calculates the area and perimeter for 2D shapes and for 3D shapes volume and surface areas are calculated.
5. Special offer service – This service provides the functionality to calculate discount and bonus.
6. Number Series Service – This service includes the number series like Fibonacci, prime etc. and it provides a functionality to check whether the input is a valid term in that specific series.
7. Conversion Service – This service includes the conversion Length, Temperature and Weight.

In order to build this project, we have used Eclipse as our IDE and Equinox is used as the OSGi framework.

2 Descriptive Diagram



3 Manifest Implementation

3.1 Consumer

```
1 Manifest-Version: 1.0
2 Bundle-ManifestVersion: 2
3 Bundle-Name: CalculatorConsumer
4 Bundle-SymbolicName: CalculatorConsumer
5 Bundle-Version: 1.0.0.qualifier
6 Bundle-Activator: calculatorconsumer.Activator
7 Bundle-RequiredExecutionEnvironment: JavaSE-10
8 Import-Package: org.osgi.framework;version="1.3.0"
9 Automatic-Module-Name: CalculatorConsumer
10 Require-Bundle: org.eclipse.equinox.console;bundle-version="1.3.0",
11  org.eclipse.osgi;bundle-version="3.13.0",
12  org.apache.felix.gogo.command;bundle-version="1.0.2",
13  org.apache.felix.gogo.runtime;bundle-version="1.0.6",
14  org.apache.felix.gogo.shell;bundle-version="1.0.0",
15  ProgrammerService;bundle-version="1.0.0",
16  ScientificService;bundle-version="1.0.0",
17  BasicService;bundle-version="1.0.0",
18  ShapeCalculatorService;bundle-version="1.0.0",
19  DiscountBonusCalService;bundle-version="1.0.0",
20  NumberSeriesService;bundle-version="1.0.0",
21  ConversionService;bundle-version="1.0.0"
```

Figure 1 Consumer - Manifest File

In this bundle, org.osgi.framework is explicitly imported to this bundle (line 8) in order to have a OSGi framework. As this is the consumer bundle, it needs the access of producer bundles to obtain the functionality. The bundles from line 10 to line 14 are the default bundles required to run the OSGi framework and the bundles mentioned from line 15 to 21 are the services implemented by our group members.

3.2 Producer

In all the producer services, org.osgi.framework is explicitly imported to access the OSGi framework and all the producer services explicitly exports the packages which are implemented in the specific service.

```
Manifest-Version: 1.0
Bundle-ManifestVersion: 2
Bundle-Name: BasicService
Bundle-SymbolicName: BasicService
Bundle-Version: 1.0.0.qualifier
Bundle-Activator: basicservice.Activator
Bundle-RequiredExecutionEnvironment: JavaSE-10
Import-Package: org.osgi.framework;version="1.3.0"
Automatic-Module-Name: BasicService
Export-Package: basicservice,
 com.sliit.sa.implementations,
 com.sliit.sa.interfaces
```

Figure 2 Basic Calculator Service

```
Manifest-Version: 1.0
Bundle-ManifestVersion: 2
Bundle-Name: ScientificService
Bundle-SymbolicName: ScientificService
Bundle-Version: 1.0.0.qualifier
Bundle-Activator: scientificservice.Activator
Bundle-RequiredExecutionEnvironment: JavaSE-10
Import-Package: org.osgi.framework;version="1.3.0"
Automatic-Module-Name: ScientificService
Export-Package: com.sliit.sa.implementations,
 com.sliit.sa.interfaces,
 scientificservice

```

Figure 3 Scientific Calculator Service

```
Manifest-Version: 1.0
Bundle-ManifestVersion: 2
Bundle-Name: ProgrammerService
Bundle-SymbolicName: ProgrammerService
Bundle-Version: 1.0.0.qualifier
Bundle-Activator: programmerservice.Activator
Bundle-RequiredExecutionEnvironment: JavaSE-10
Import-Package: org.osgi.framework;version="1.3.0"
Automatic-Module-Name: ProgrammerService
Export-Package: com.sliit.sa.implementations,
 com.sliit.sa.interfaces,
 programmerservice

```

Figure 4 Programmer Service

```
Manifest-Version: 1.0
Bundle-ManifestVersion: 2
Bundle-Name: ShapeCalculatorService
Bundle-SymbolicName: ShapeCalculatorService
Bundle-Version: 1.0.0.qualifier
Bundle-Activator: shapecalculatorservice.Activator
Bundle-RequiredExecutionEnvironment: JavaSE-10
Import-Package: org.osgi.framework;version="1.3.0"
Automatic-Module-Name: ShapeCalculatorService
Export-Package: com.sliit.sa.factory,
 com.sliit.sa.implementations,
 com.sliit.sa.interfaces,
 shapecalculatorservice

```

Figure 5 Shape Calculator Service

```
Manifest-Version: 1.0
Bundle-ManifestVersion: 2
Bundle-Name: DiscountBonusCalService
Bundle-SymbolicName: DiscountBonusCalService
Bundle-Version: 1.0.0.qualifier
Bundle-Activator: discountbonuscalservice.Activator
Bundle-RequiredExecutionEnvironment: JavaSE-10
Import-Package: org.osgi.framework;version="1.3.0"
Automatic-Module-Name: DiscountBonusCalService
Export-Package: com.sliit.sa.implementations,
 com.sliit.sa.interfaces,
 discountbonuscalservice

```

Figure 6 Discount Calculator Service

```
Manifest-Version: 1.0
Bundle-ManifestVersion: 2
Bundle-Name: NumberSeriesService
Bundle-SymbolicName: NumberSeriesService
Bundle-Version: 1.0.0.qualifier
Bundle-Activator: numberseriesservice.Activator
Bundle-RequiredExecutionEnvironment: JavaSE-10
Import-Package: org.osgi.framework;version="1.3.0"
Automatic-Module-Name: NumberSeriesService
Export-Package: com.sliit.sa.implementations,
 com.sliit.sa.interfaces,
 numberseriesservice

```

Figure 7 Number Series Service

```
Manifest-Version: 1.0
Bundle-ManifestVersion: 2
Bundle-Name: ConversionService
Bundle-SymbolicName: ConversionService
Bundle-Version: 1.0.0.qualifier
Bundle-Activator: conversionservice.Activator
Bundle-RequiredExecutionEnvironment: JavaSE-10
Import-Package: org.osgi.framework;version="1.3.0"
Automatic-Module-Name: ConversionService
Export-Package: com.sliit.sa.implementations,
 com.sliit.sa.interfaces,
 conversionservice
```

Figure 8 Conversion Service

4 OSGi Framework Running Process

In OSGi each bundle is treated as an isolated module. Each bundle has bundle ID and a state (installed, resolved, start, stop). In eclipse when we run the project using OSGi framework, all the bundles will be installed and will be in active state. Following screenshot shows the bundles after running the project.

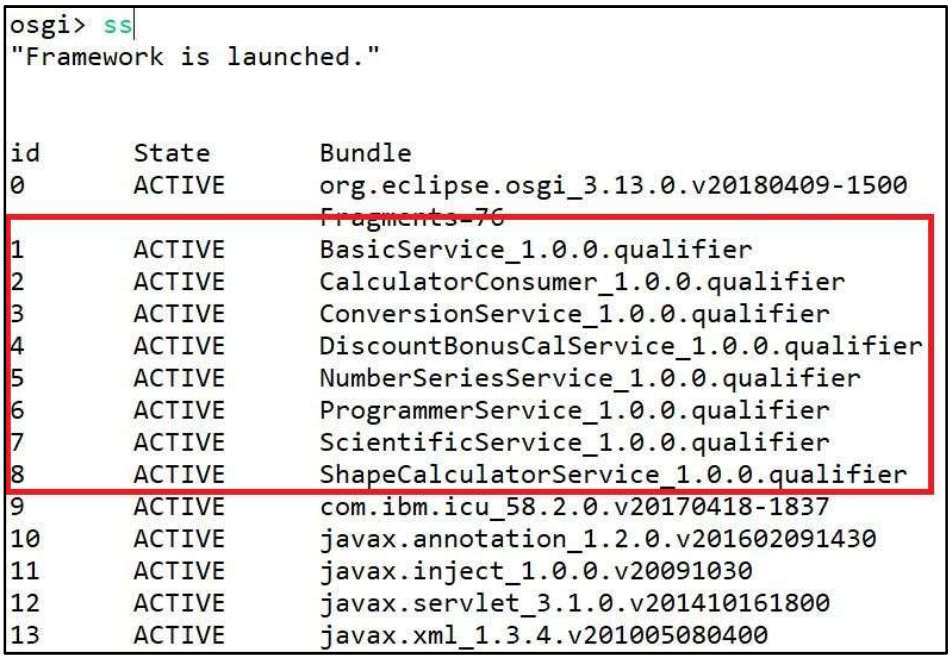


Figure 9 Initial running of the project

The bundle ID 2 represents the Consumer bundle and Bundle IDs 1,3,4.5.6.7.8 represents the services provided to the consumer.

In order to lunch the consumer again we should stop the specify consumer bundle and start it again. Following diagram shows this process.

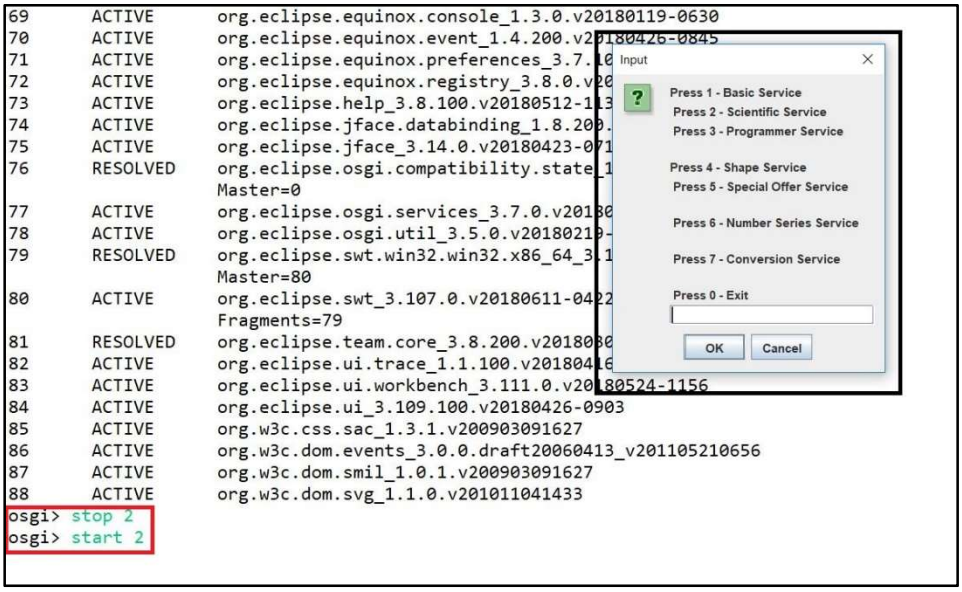


Figure 10 Restarting the consumer bundle

After the successful start, the user is prompted an interface to enter the required service. As all the services are in active state, the user can access any service by entering the appropriate number. Following image shows the interfaces prompted.

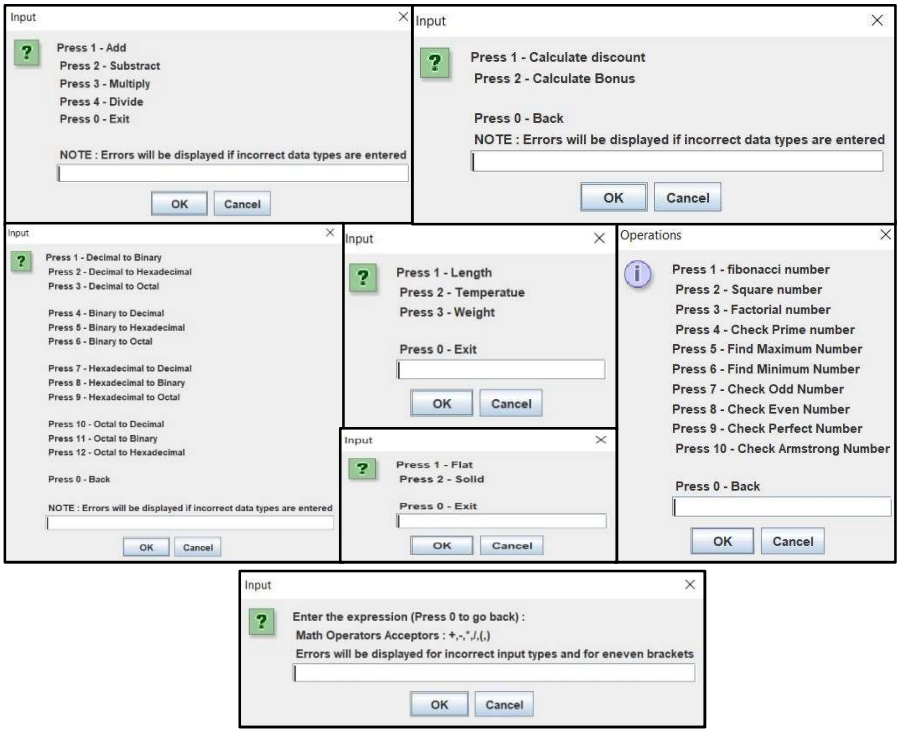
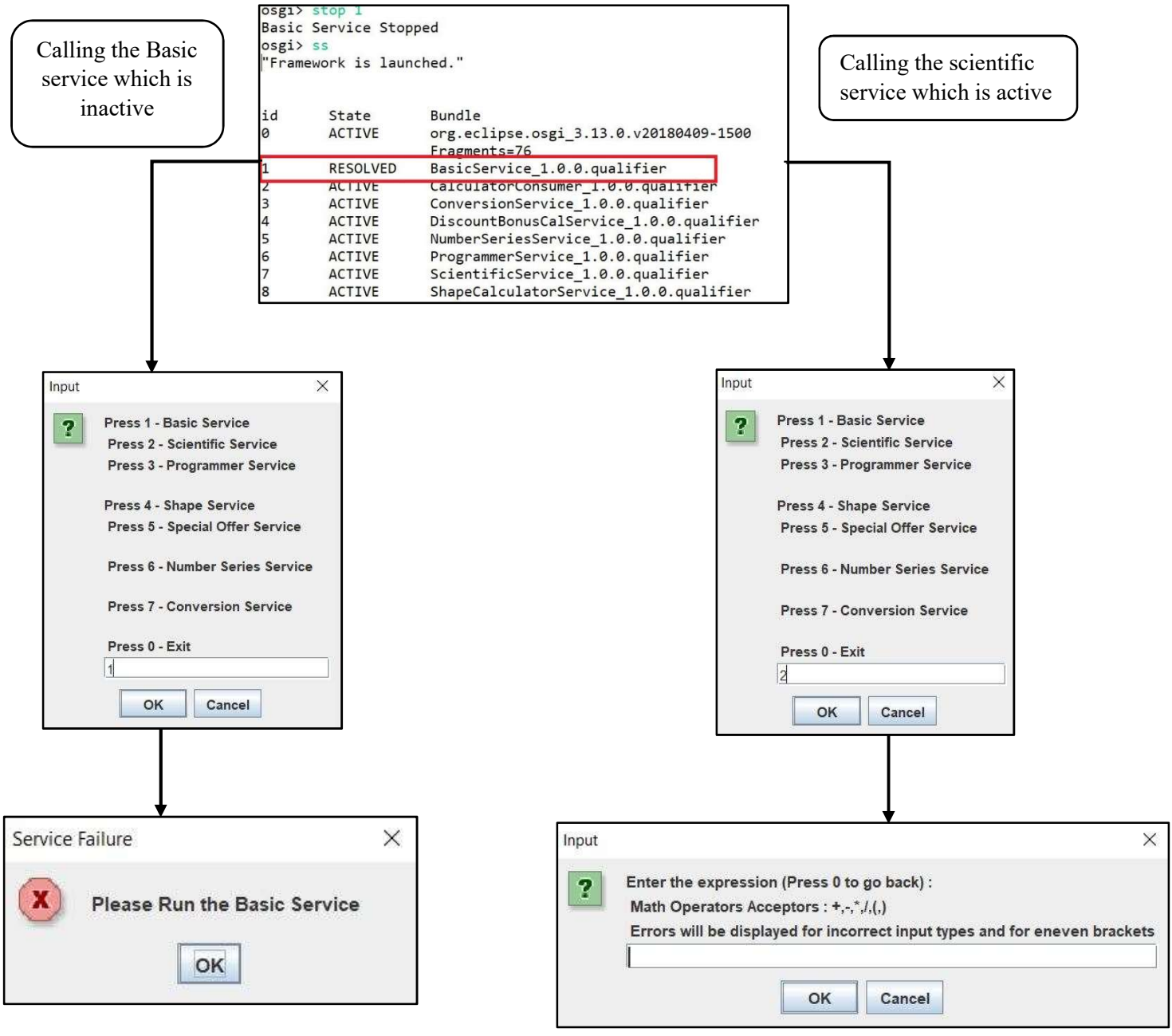


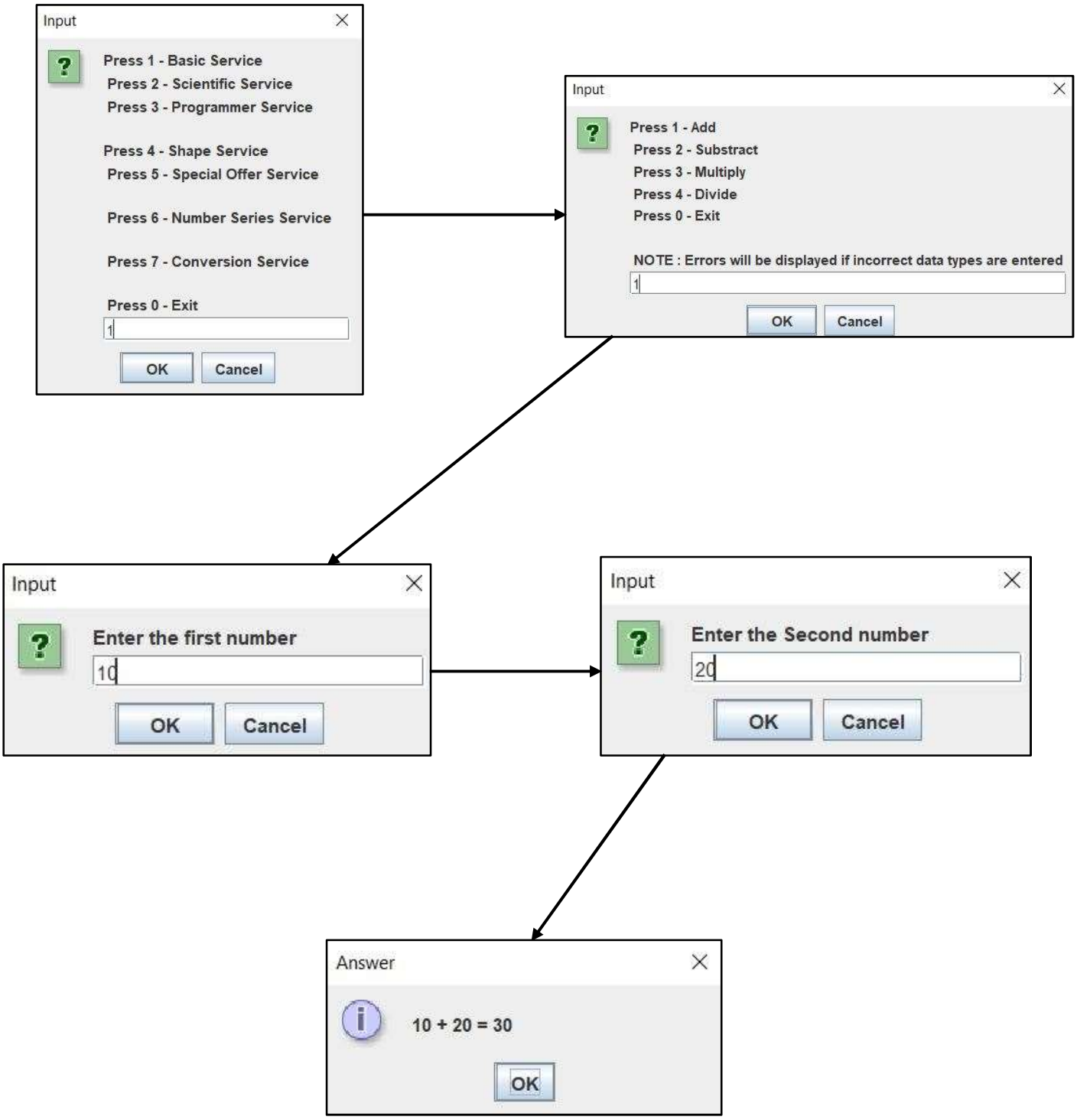
Figure 11 Initial Service Interface

But when we stop one of the service bundles, the user will not be able to access the specific bundle. This project will throw errors to the user when the bundle they are trying to access is stopped. In order to explain this behavior, we will stop the basic calculator service (refer figure 9, bundle ID is 1) and check the output.

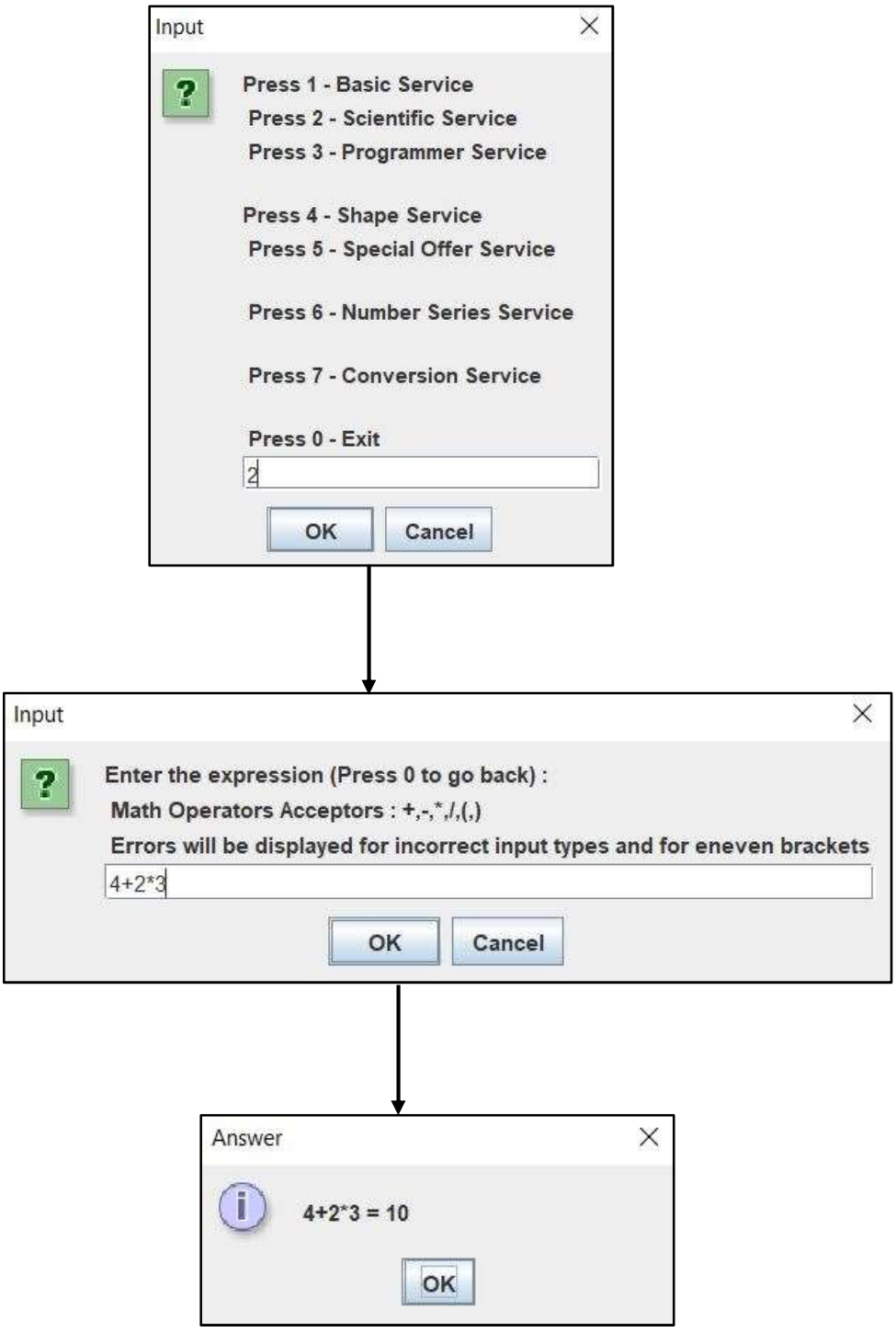


5 Screenshots on the behavior and output

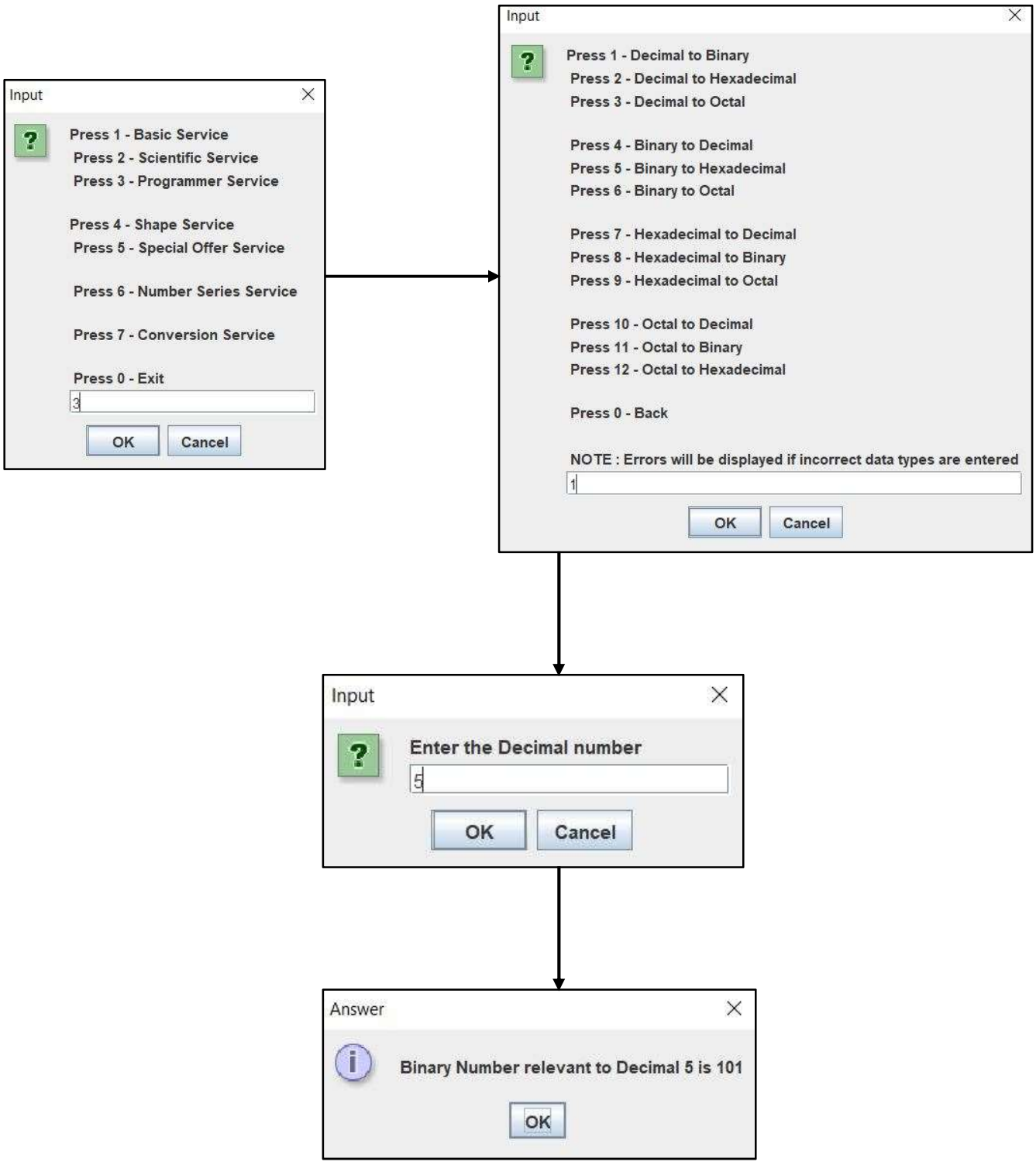
5.1 Basic Service



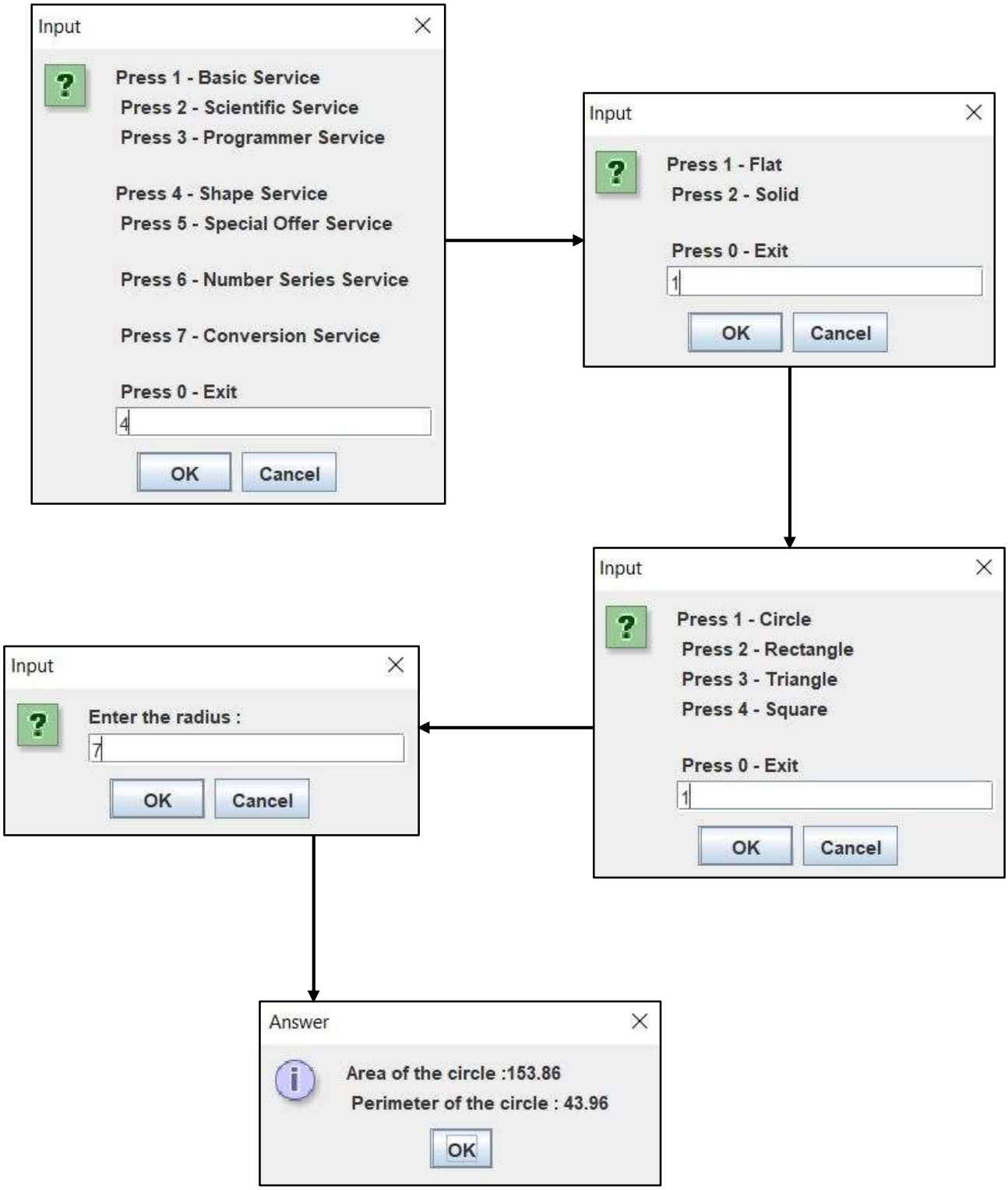
5.2 Scientific Service



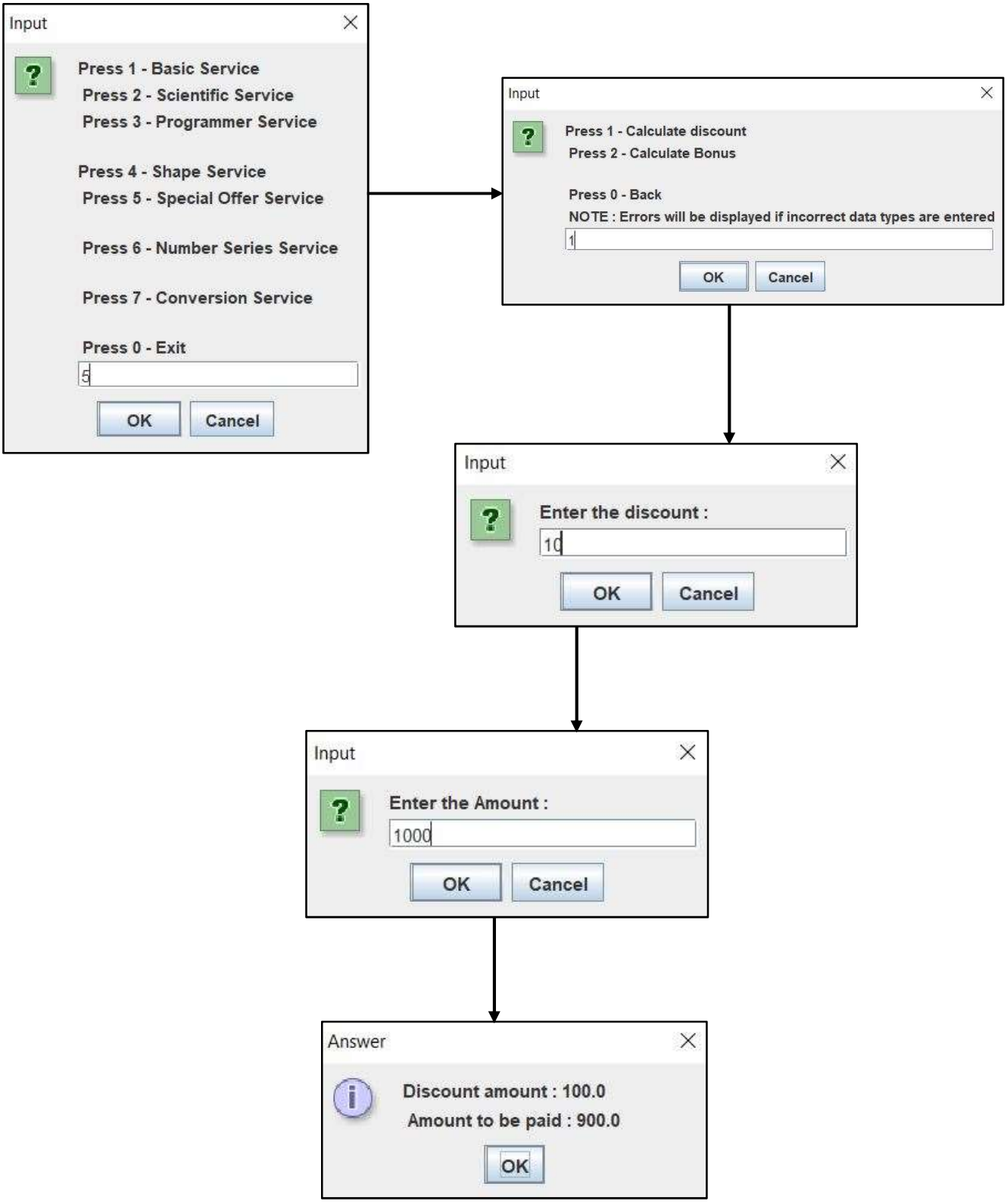
5.3 Programmer Service



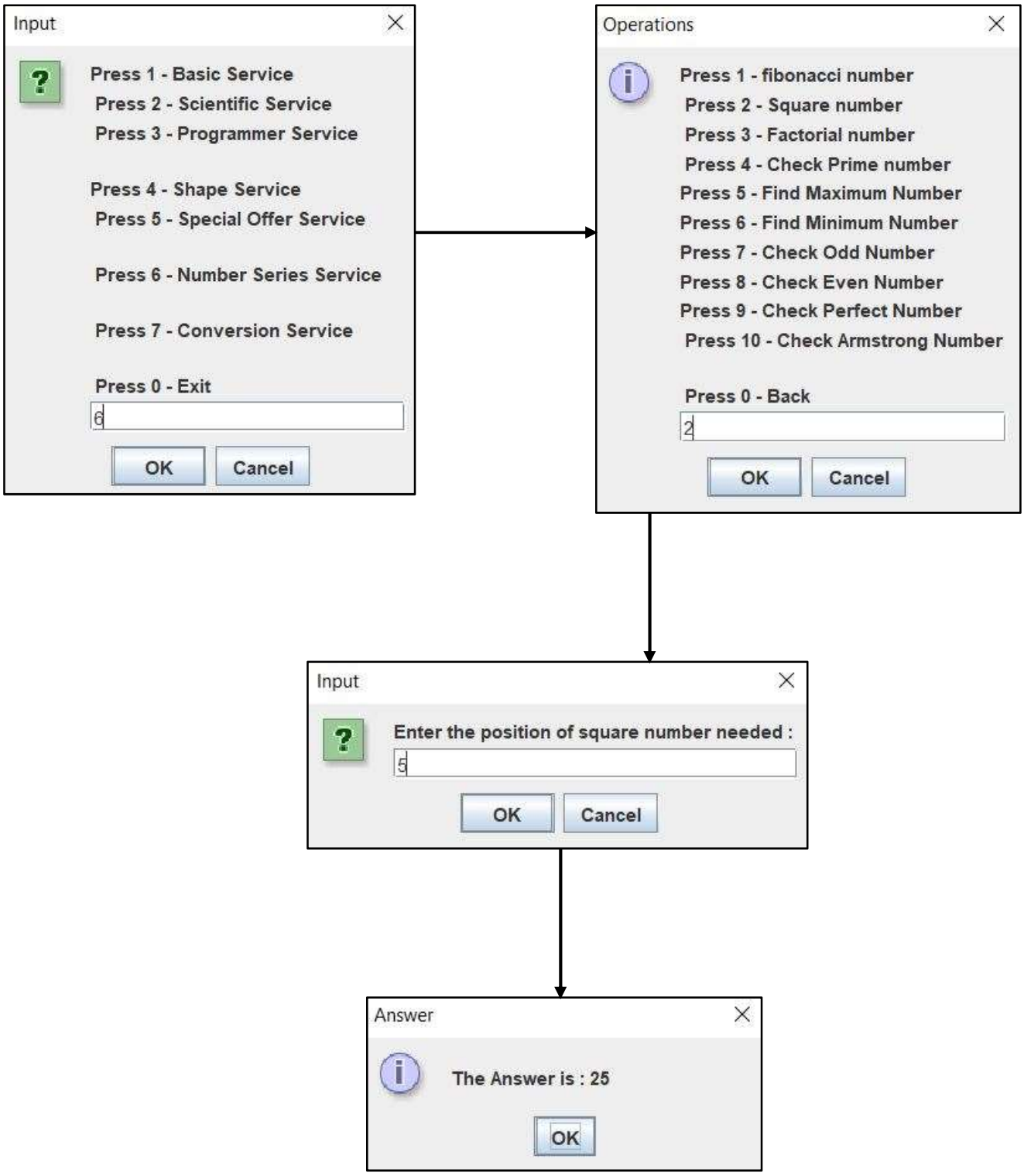
5.4 Shape Calculator Service



5.5 Special Offer Service



5.6 Number Series Service



5.7 Conversion Service