



Project Report for D1

SOEN 6481
Software Systems Requirements Specification
(2019 SUMMER)

ETERNITY: NUMBERS

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Abstract

Along with fast development of human society, it emerges lots of revolution in various territories. The development of traditional regular calculator is just one of them that is under great challenge. People are not only satisfied with the default process to obtain results from using traditional regular calculator, but desire for a more convenient and efficient solution. The widely used solution based on regular calculator with its design of scientific mode, therefore attracts lots of people's attention. Hence, how to validate the scientific number and the scientific mathematical calculation and decent user-device interaction experience become crucial topic for calculator designer. To better serve to this case study here, a simple but efficient calculator design with several specific scientific calculation function with number (PI), is used to model and verify a scientific calculator. The entire case study report is organized as: after introduction, the Brief Description regarding problem 1 gives the basic background regarding the assigned number; Chapter of Interview provides the Question and Answer interview session and the interview analysis; Chapter 4, User Personas, the two interviewees are introduced and answers to problem 3 are provided; To analyze the problem domain, the concepts relationship and class diagram are provided in chapter 5 for problem 4; Problem 5 gives all the use cases and describes carefully for each. Besides, sequence diagram and activity diagram are provided for further description.

Keywords: calculator, number, function, PI

1. Introduction

This is a math/scientific calculator similar to most regular calculator in market. It supports functions for both regular calculation and scientific number calculation regarding Pi. Enter a formula by typing on the keyboard. Type in the formula as you would say it, then press = button.

1.1 Functions

Functions can be entered by pressing the function button on the calculator. If the calculator is in scientific mode, specific scientific number PI, circular area and circular circumference could be produced by one-button press.

1.2 Arithmetic Operators

Once you press the '=' button, the expression is evaluated according to normal algebraic operator precedence. * Note: The three functions regarding PI will operate just by clicking one button. The exclusive thing user has to do is to input diameter which is required to calculate circular area, circular circumference.

1.3 Memory

There are one memory locations you can use to store temporary results. Under it is a button labeled 'set'. When you press 'set' the current result is copied into that memory. When a memory contains a value.

1.4 Automatic Features

If a value is preceded by pressing Circular Area Button or Circular Circumference Button, the calculator assumes you want to set this value as circular radius for calculation.

2. Brief Description: Problem 1

2.1 Definition

PI is represented by the Greek letter Π and is a constant, approximately 3.14159265 representing the ratio of the circumference to the diameter. It is an irrational number, that is, infinite loops.

2.2 Practice and History

Calculating the value of the PI has its special meaning. However, PI with accuracy of dozens digits used in the field of modern technology are sufficient. If the size of the observable universe is calculated with a 39-degree precision PI value, the error is less than the volume of one atom. Previous people calculated PI to find out whether the PI is a circular fraction. Since 1761, Lambert proved that PI is irrational. Then in 1882, Lindeman proved that PI is the transcendental number, and the mystery of the PI is unveiled.

2.3 Others

Besides, in 2009, the US House of Representatives formally adopted a non-binding resolution, setting March 14th of each year as the “PI-day”.

2.4 Mathematical Expression

In the project, to realize some special scientific calculation, the Maclaurin series $\arcsin(x)$ expression will be used to approach π .

$$\pi = 2 * (1 + 1/3 + 2/(3 * 5) + 3 * 2/3 * 5 * 7 + 4 * 3 * 2/3 * 5 * 7 * 9 + \dots)$$

Besides, the designed calculator will use π to complete two frequently used relevant mathematical expression:

- 1) to calculate circular circumference

$$S = \pi r^2$$

- 2) to have circular area

$$C = 2\pi r$$

3. Interview: Problem 2

3.1 Session of Question and Answer

- 1) Do you need to deal with numbers frequently?
 - Answer 1: Yes
 - Answer 2: Sure
- 2) How often do you use a calculator?
 - Answer 1: Very often, but just some very easy calculation
 - Answer 2: Sure...unless I must use my head
- 3) When and where do you use it?
 - Answer 1: Actually, mostly I could satisfy my needs by heart work, but I choose to use calculator finally.
 - Answer 2: Everywhere, all the time.
- 4) Do you have any personal preference for using a calculator?
 - Answer 1: Yes, I like using a calculator with everything big for mutual interaction. I think that would be much more handy.
 - Answer 2: I am OK with most designs for today's calculators.
- 5) If there is calculator, what kind of appearance would you like, say, the operators, keys, the button, the screen etc.?
 - Answer 1: I hope it could be as big as my pocket, the buttons are no need to big but large screen. The operators no need to be very rich as I just need it to do some simple calculation like sum, subtraction, mod or multiplication.
 - Answer 2: not too big, easy to take, big screen with simple and clear buttons. For operators, four arithmetic operation is enough for me.
- 6) what do you think is the most necessary function with PI involved in this device?
 - Answer 1: as I mentioned previously, circumference and area are often used, so I hope it has one-button circumference or area calculation function.
 - Answer 2: to calculate circle area which is highly desired for me.

- 7) When you use the function, what other parameters do you think you are going to use?
- Answer 1: input radius or diameter, get circumference and area
 - Answer 2: it is better to be able to record a group of parameter or numbers, so I can just find them in machine memory but no need to recall in head.
- 8) If the function is created, do you think what is the best way for you to use it conveniently?
- Answer 1: One-button calculations!
 - Answer 2: Speech control perhaps...I don't want to type numbers all the time.

3.2 Analysis

This interview gives an overview of the expectation of two potential users for a calculator with a special number. The interview was conducted with one domain professional and one common user.

Firstly, calculators are still broadly used, even for today with rapid development of technology, general-purpose calculators still have a very wide range of users.

Second, in addition to the desire for a more portable and easy-to-use design, it is also desirable to incorporate new technologies such as speech recognition.

Third, for special numbers, users are not satisfied with the function only to obtain the value itself, but hope to extract the calculation results related to other most used function employing a specific special number. For example, when the value of the PI is obtained, one button can also be used to obtain values of the circumference length and the circle area with PI.

4. User Personas: Problem 3

4.1 Definition

Persona gives meaningful archetypes which we can use to assess our design development against. Personas are actually fictional characters, which we create based upon our research in order to represent the different user types that might use our service, product, site, or brand in a similar way. Creating personas will help us to understand our users' needs, experiences, behaviors and goals.

Constructing personas will help us ask the right questions and answer those questions in line with the users we are designing for. Creating personas can help we step out of ourselves. It can help us to recognize that different people have different needs and expectations, and it can also help us to identify with the user we're designing for. Personas make the design task at hand less complex, they guide our idea processes, and they can help we to achieve the goal of creating a good user experience for our target user group.

As opposed to designing products, services, and solutions based upon the preferences of the design team, it has become standard practice within many human centered design disciplines to collate research and personify certain trends and patterns in the data as personas. Hence, personas do not describe real people, but we compose our personas based on real data collected from multiple individuals. Personas add the human touch to what would largely remain cold facts in our research. When we create persona profiles of typical or atypical (extreme) users, it will help we to understand patterns in our research, which synthesizes the types of people we seek to design for. Personas are also known as model characters or composite characters.

4.2 Information

I have interviews with two representative users. One is a professional expert whose name is Leon Gannt, the other, Mr. David Huang, is an ordinary user. Their persona information are shown as follows.



Name: Mr. Leon Gannt

Email: gannt.leon@acet.com

Gender: Male

Age: 42

Profession: CTO

Skill level: Expert

User story: Leon graduated as bachelors in Computer Science, Working as a Software Developer. His Work Experience (Programming) as a Software Developer is more than 15 years. He is responsible for design and maintain email system with StrongMail. He developed Java code for improving profiles matching engine with Solr serve. He also implemented Java code for normalization the whole world city for matel system. Then, he developed code for converting no regional profiles to the normal profiles with location information and developed and Maintain process in the background with Python, sh and Crontab.

Wishes:

1. Leon hope to build and organize Dev team and Research team working on the customer project in the public space via the monitoring system which is powered by cutting-edge computer vision technology Massive, efficient and inexpensive video processing solution with smart edge computation component

Motivation:

1. He wants to use technology to change the world and bring better user experience

Pain Points:

1. Leon needs rich of programming experience in OOP. He wants well understand of software architecture and design patterns He wants to completely mast Test Driven Development (TDD) and Test Automation.



Name: Mr. David Huang

Email: david.huang@lstd.com

Gender: Male

Age: 23

Profession: Accountant

Skill level: Junior

User story: David examines financial statements to be sure that they are accurate and comply with laws and regulations. He Computes taxes owed, prepare tax returns, and ensure that taxes are paid properly and on time inspect account books and accounting systems for efficiency and use of accepted accounting procedures. He also organize and maintain financial records. Meanwhile he suggests ways to reduce costs, enhance revenues, and improve profits.

Wishes:

1. David wants to earn professional recognition, especially as Certified Public Accountants (CPAs), has the best prospects. He also wants to gain a master's degree in accounting or a master's degree in business with a concentration in accounting also may have an advantage. project in the public space via the monitoring system which is powered by cutting-edge computer vision technology Massive, efficient and inexpensive video processing solution with smart edge computation component

Motivation:

1. David wants to know better about scientific calculation tool

Pain Points:

1. David need to develop an interest in the Persuading and Organizing interest areas, according to the Holland Code framework. He needs to work on persuading interest area indicates a focus on influencing, motivating, and selling to other people, and work on the organizing interest area indicates a focus on working with information and processes to keep things arranged in orderly systems.

5. Problem Domain: Problem 4

5.1 Domain Diagram

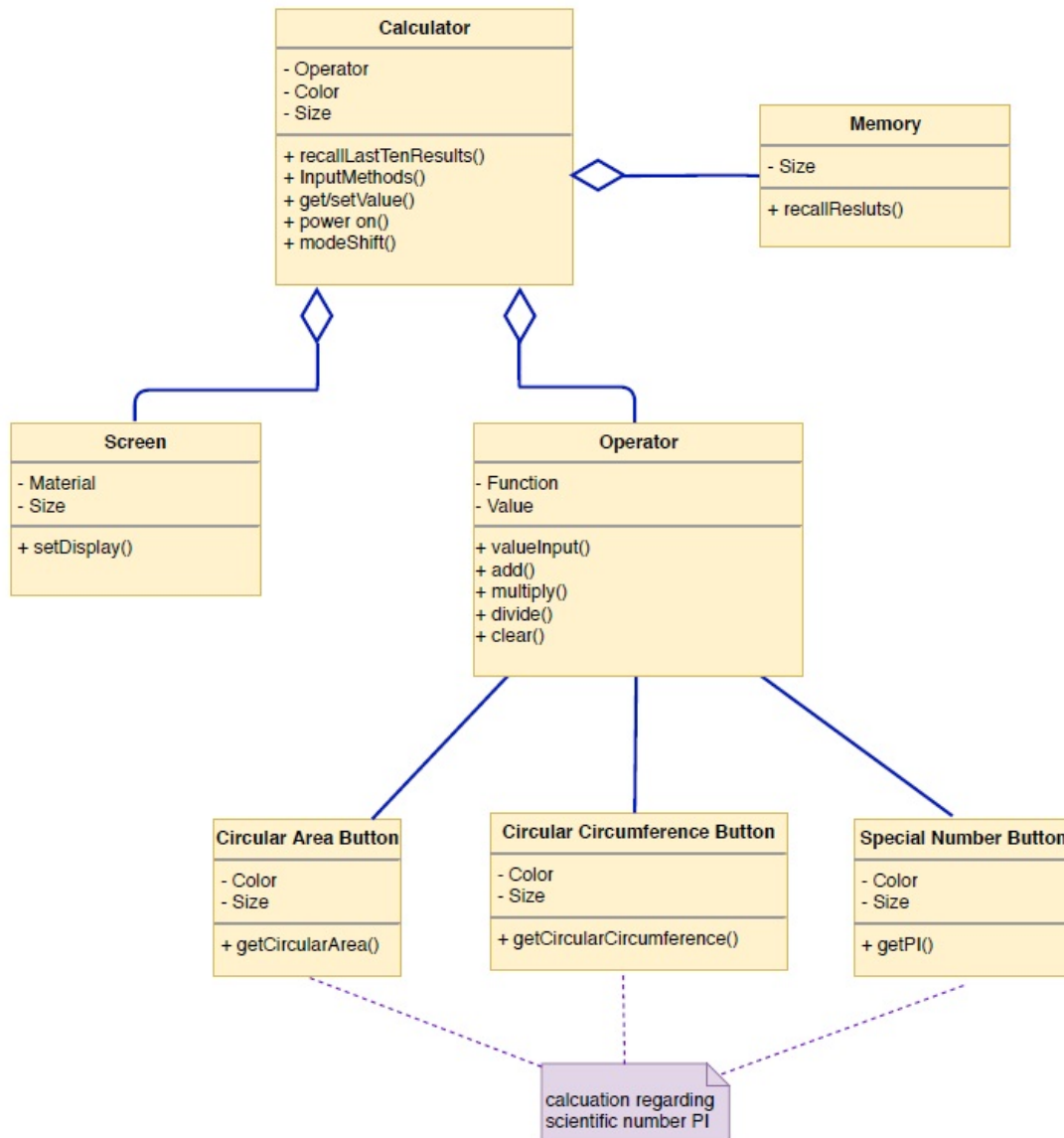


Figure 5.1: Domain Model

5.2 Concept Relationship

1) Concepts:

calculator, screen, operator, memory, special number button, circular area button, circular circumference button

2) Relationship:

screen ———-<> calculator (aggregate relationship)

operator ———-<> calculator (aggregate relationship)

memory ———-<> calculator (aggregate relationship)

special number button ——— operator (association relationship)

circular area button ——— operator (association relationship)

circular circumference button ——— operator (association relationship)

6. Use Case Analysis : Problem 5

6.1 Use Cases List

- 1) Calculate regular number: user switch on calculator, the regular number calculation mode starts by default.
- 2) Input regular number: user types intended number and operators
- 3) Recall last 10 results: user recollects historical 10 calculation results
- 4) Calculate special number: the special number calculation mode starts by default.
- 5) Get PI: user gets approximate number of PI directly
- 6) Calculate circular area: user gets approximate circular area result regarding input radius using PI
- 7) Calculate circular circumference: user gets approximate circular circumference regarding input radius using PI
- 8) Input radius value: user type numerical value of radius for a targeted circular

6.2 Use Cases Diagram Description

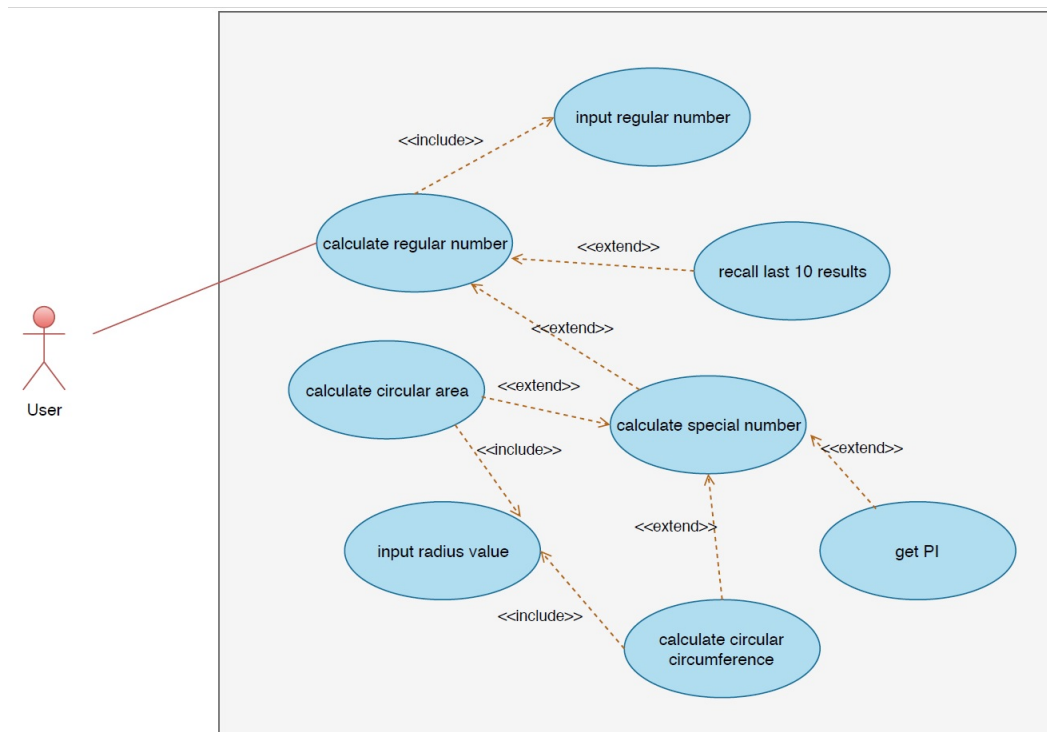


Figure 6.1: Use Case Diagram

Use-Case Name:	Calculate regular number		
Created By:	ZAN WANG	Last Updated By:	ZAN WANG
Date Created:	2019/7/5	Date Last Updated:	2019/7/18
Actors:	Calculator User		
Description:	Calculator user switch on calculator, calculator enter regular number calculation mode and waiting for user's input		
Preconditions:	<ul style="list-style-type: none"> Calculator users have basic operation knowledge about pocket calculator Calculator are available Calculator is functioning properly 		
Post-conditions:	Calculator user is able to input under regular number calculation mode		
Normal Flow:	Switching on calculator by pressing start button Cursor shines on screen waiting for input from user		
Alternative Flow:	No Alternative Flows		

Use-Case Name:	Input regular number		
Created By:	ZAN WANG	Last Updated By:	ZAN WANG
Date Created:	2019/7/5	Date Last Updated:	2019/7/18
Actors:	Calculator User		
Description:	Calculator user input regular number for intended calculation		
Preconditions:	<ul style="list-style-type: none"> Calculator enters regular number calculation mode already Buttons on calculator work properly 		
Post-conditions:	Calculator user receives correct result		
Normal Flow:	Calculator user inputs numbers and operators for his calculation Calculator screen shows exact numbers and operators entered by user Calculator user presses "=" button to receive calculation result Result is shown on calculator screen		
Alternative Flow:	No Alternative Flows		

Use-Case Name:	Recall last 10 results		
Created By:	ZAN WANG	Last Updated By:	ZAN WANG
Date Created:	2019/7/5	Date Last Updated:	2019/7/18
Actors:	Calculator User		
Description:	Calculator user wants to see the last 10 results calculated previously		
Preconditions:	<ul style="list-style-type: none"> Calculator did at least 10 calculations ready Buttery power is sufficient 		
Post-conditions:	Calculator user receives 10 results stored in memory card		
Normal Flow:	Calculator user presses "RC" button aiming call back 10 historical results Calculator screen shows 10 historical results split by comma		
Alternative Flow:	No Alternative Flows		

Use-Case Name:	Recall last 10 results		
Created By:	ZAN WANG	Last Updated By:	ZAN WANG
Date Created:	2019/7/5	Date Last Updated:	2019/7/18
Actors:	Calculator User		
Description:	Calculator user wants to see the last 10 results calculated previously		
Preconditions:	<ul style="list-style-type: none"> ▪ Calculator did at least 10 calculations ready ▪ Buttery power is sufficient 		
Post-conditions:	Calculator user receives 10 results stored in memory card		
Normal Flow:	Calculator user presses "RC" button aiming call back 10 historical results Calculator screen shows 10 historical results split by comma		
Alternative Flow:	No Alternative Flows		

Use-Case Name:	Calculate special number		
Created By:	ZAN WANG	Last Updated By:	ZAN WANG
Date Created:	2019/7/5	Date Last Updated:	2019/7/18
Actors:	Calculator User		
Description:	Calculator user wants to shift to special number calculation mode to receive the value of special number or calculation regarding the special value		
Preconditions:	<ul style="list-style-type: none"> ▪ Calculator users have basic operation knowledge about pocket calculator ▪ Calculator are available ▪ Calculator is functioning properly ▪ The special number calculation is regarding PI 		
Post-conditions:	Calculator user is able to receive the PI number or results regarding PI calculation		
Normal Flow:	Switching on calculator by pressing start button Cursor shines on screen waiting for input from user Calculator user press "shift" button		
Alternative Flow:	No Alternative Flows		

Use-Case Name:	Get PI		
Created By:	ZAN WANG	Last Updated By:	ZAN WANG
Date Created:	2019/7/5	Date Last Updated:	2019/7/18
Actors:	Calculator User		
Description:	Calculator user wants to receive the value of special number (PI)		
Preconditions:	Calculator enters special number calculation status		
Post-conditions:	Calculator user received the PI number		
Normal Flow:	Switching on calculator by pressing start button Cursor shines on screen waiting for input from user Calculator user press "shift" button Calculator user press "PI" button		
Alternative Flow:	No Alternative Flows		

Use-Case Name:	Calculate circular area		
Created By:	ZAN WANG	Last Updated By:	ZAN WANG
Date Created:	2019/7/5	Date Last Updated:	2019/7/18
Actors:	Calculator User		
Description:	Calculator user wants to get the value of circular area		
Preconditions:	Calculator enters special number calculation status, then input circular radius		
Post-conditions:	Calculator user received the value of circular area		
Normal Flow:	Switching on calculator by pressing start button Cursor shines on screen waiting for input from user Calculator user press "shift" button Calculator user type number to radius Calculator user press "area" button		
Alternative Flow:	No Alternative Flows		

Use-Case Name:	Calculate circular circumference		
Created By:	ZAN WANG	Last Updated By:	ZAN WANG
Date Created:	2019/7/5	Date Last Updated:	2019/7/18
Actors:	Calculator User		
Description:	Calculator user wants to receive the value of circular circumference		
Preconditions:	Calculator enters special number calculation status, then input circular radius		
Post-conditions:	Calculator user received the value of circular circumference		
Normal Flow:	Switching on calculator by pressing start button Cursor shines on screen waiting for input from user Calculator user press "shift" button Calculator user type number to radius Calculator user press "ccf" button		
Alternative Flow:	No Alternative Flows		

Use-Case Name:	Input radius value		
Created By:	ZAN WANG	Last Updated By:	ZAN WANG
Date Created:	2019/7/5	Date Last Updated:	2019/7/18
Actors:	Calculator User		
Description:	Calculator user wants to enter circular radius to calculate circular area or circular area		
Preconditions:	Calculator already switched to special number calculation status		
Post-conditions:	Circular radius was received by the calculator		
Normal Flow:	Switching on calculator by pressing start button Calculator user press "shift" button Calculator user input number to radius Calculator user press "ccp" or "area" button to get result regarding the radius		
Alternative Flow:	No Alternative Flows		

Use-Case Name:	Recall last 10 results		
Created By:	ZAN WANG	Last Updated By:	ZAN WANG
Date Created:	2019/7/5	Date Last Updated:	2019/7/18
Actors:	Calculator User		
Description:	Calculator user wants to see the last 10 results calculated previously		
Preconditions:	<ul style="list-style-type: none"> ▪ Calculator did at least 10 calculations ready ▪ Battery power is sufficient 		
Post-conditions:	Calculator user receives 10 results stored in memory card		
Normal Flow:	Calculator user presses "RC" button aiming call back 10 historical results Calculator screen shows 10 historical results split by comma		
Alternative Flow:	No Alternative Flows		

6.3 Sequence Diagram for Main Use Cases

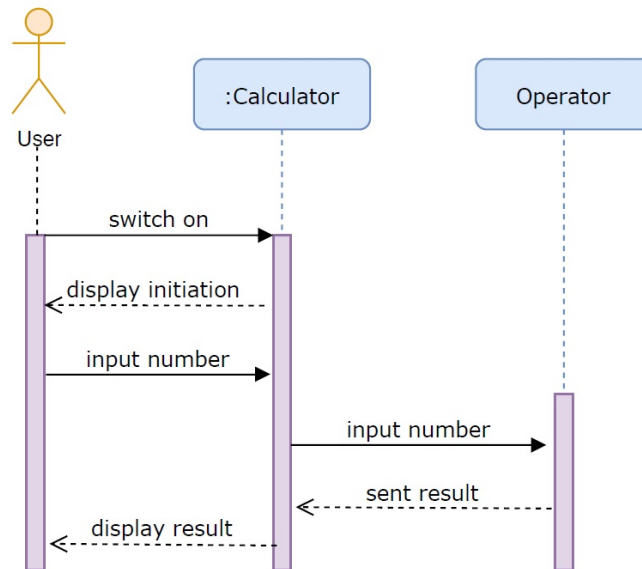


Figure 6.2: Input Regular Number

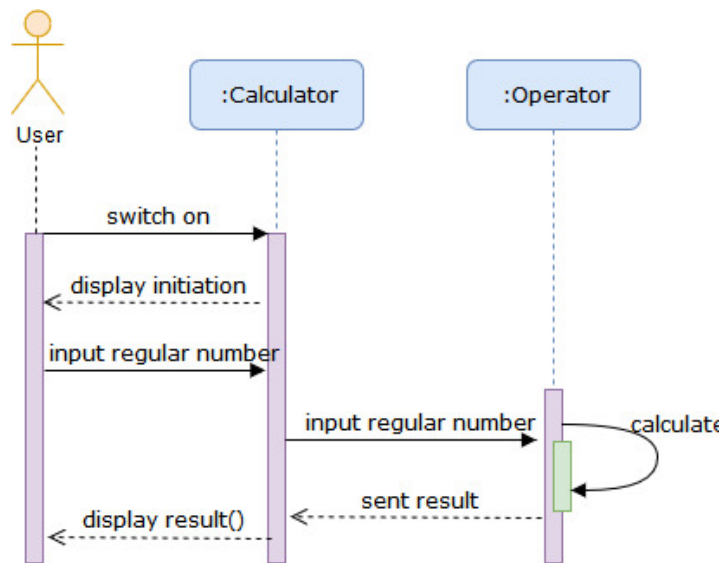


Figure 6.3: Calculate Regular Number

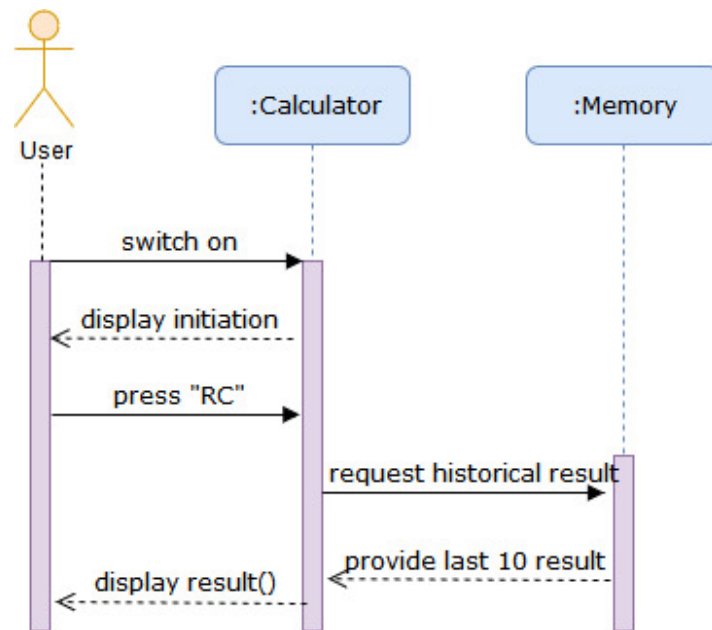


Figure 6.4: Recollect Historical Result

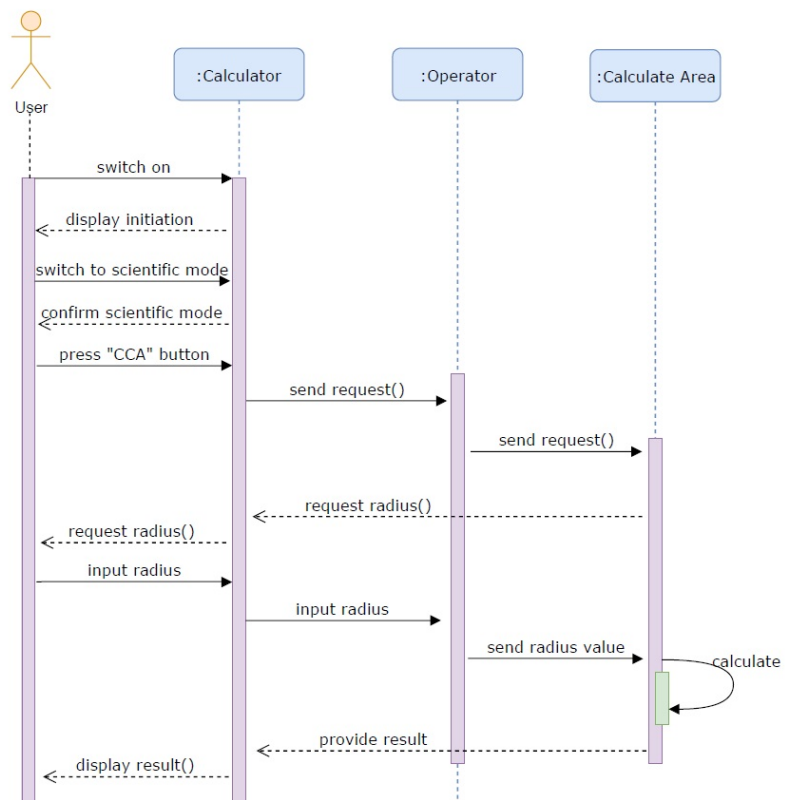


Figure 6.5: Calculate Circular Area

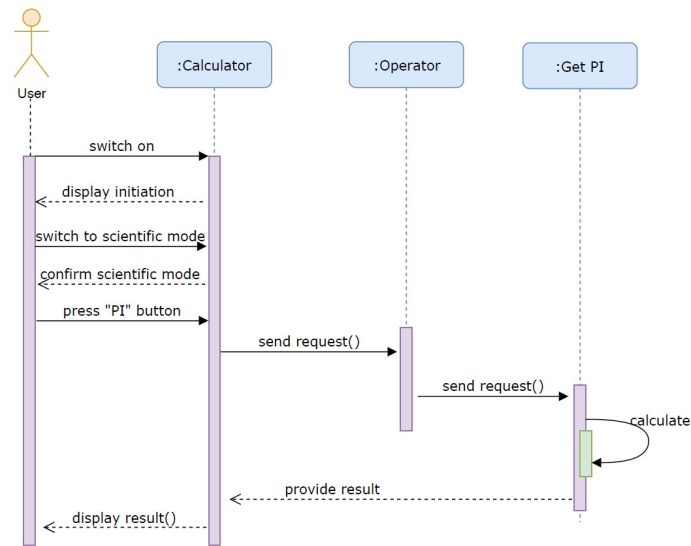


Figure 6.6: Calculate PI

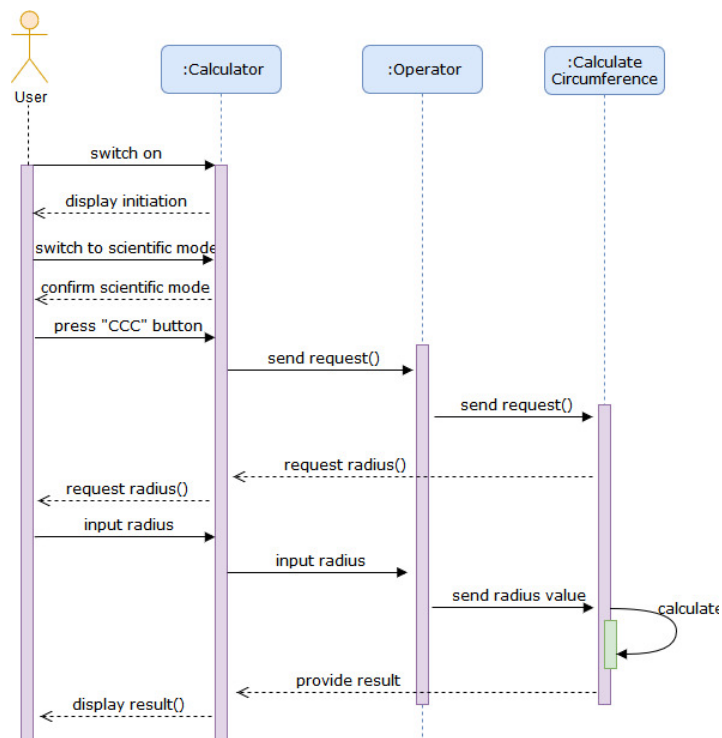


Figure 6.7: Calculate Circular Circumference

6.4 Activity Diagram

Activity Diagrams describe how activities are coordinated to provide a calculation results which can be at different levels of abstraction. Typically, user needs to switch on the calculator first, then the user could choose to trace the last 10 results, calculate regular number, or calculate special scientific number (PI). If user want to have scientific number, then functions related to this scientific number could be applied. Taking PI as an example, addition to get the PI value, user also can know circular area and circular circumference after inputting exact radius value for intended circular.

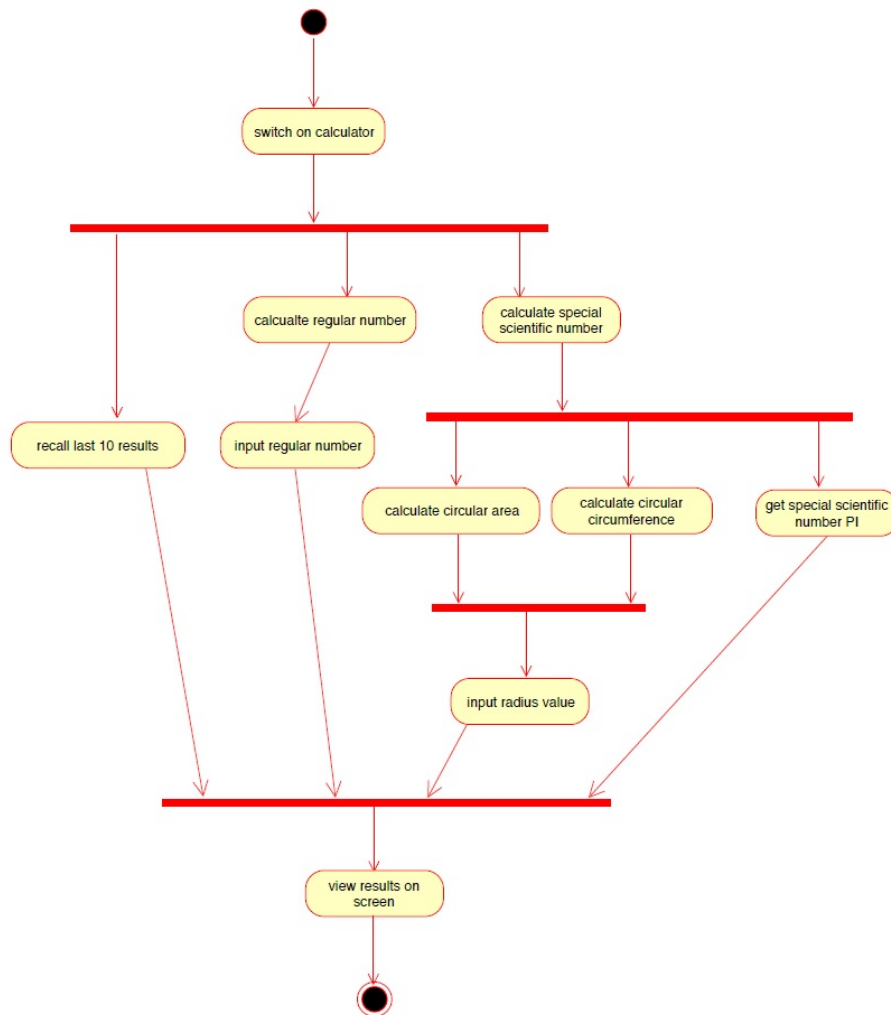


Figure 6.8: Activity Diagram