2110521 Software Architecture

# **Assignment 3:** MVC, MVP and MVVM Architectural Pattern

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## Objective:

1. To understand the concept of patterns for achieving the separation of concerns in software design
2. To understand the concept of Model-View-Controller pattern
3. To understand the concept of Model-View-Presenter pattern
4. To understand the concept of Model-View-ViewModel pattern

## Requirement:

1. Python 3.7 or greater
2. wxPython for UI development (<https://www.wxpython.org/>)
3. RxPY for reactive programming (<https://rxpy.readthedocs.io/en/latest/index.html>)

P.S. The program in this assignment is designed to run on Windows, macOS and Linux.

## How to submit:

1. Create your new group repository in the class organization with all of your source code
2. Answer each question in this document
3. Submit the document with your answers and your repository link in myCourseVille

## Before we start:

When developing software, usually, the presentation layers (GUI/CLI/etc.) and business logic layers are included. There are many ways to communicate between these layers. The easiest way for a presentation layer is to access business logic directly. Alternatively, you can introduce another layer between these layers which may be better for separation of concerns design principle.

Q1: What is separation of concerns?

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| --- |
| เราต้อง concern เรื่องการ code แต่ละส่วนควรทำงานแยกกัน เช่น layer view ก้ควรมีแค่ code ที่ทำงานแค่ view ของโปรแกรม ส่วน controller ก็ควรจะทำงานเพียงแค่ในส่วนของ controller โดยแต่ละอันจะเรียกผ่าน function หรือ interface ของกันและกัน |

Q2: Do you think that we should access the business logic layers directly from presentation layers? Why?

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| ไม่ได้ เพราะไม่มีตัวช่วยในการคุมการแสดง presentation layer ถ้าเกิด business logic เปลี่ยนก็จะทำให้ข้อมูลใน persentation layer เปลี่ยนไปเลย ดังนั้นเราควรเติมตัว controller เพิ่มช่วยในการควบคุม การทำงานของ presentation |

Now, we will setup the development environment for this assignment

1. Install wxPython

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| --- |
| # if you are using Windows of macOS  $ pip install -U wxPython  # if you are using Linux  # Method 1: build from source  $ pip install -U wxPython  # Method 2: Find binary suited for your distro  # For example with Ubuntu 16.04  $ pip install -U -f <https://extras.wxpython.org/wxPython4/extras/linux/gtk3/ubuntu-16.04> wxPython  # Method 3: Find the package in your distro repository |

1. Install RxPY

|  |
| --- |
| $ pip install rx |

P.S. In some OS, “pip” command is pointed to the pip for Python 2. Anyway, we used Python 3 here so please make sure to use the correct “pip” command since it might be “pip3” in some environment such as macOS.

Next, clone the provided git repository

|  |
| --- |
| # Change directory to your desired directory  [your directory] $: git clone https://github.com/2110521-2563-1-Software-Architecture/Assignment-3-MVC-MVP-MVVM.git |

## MVC: Model-View-Controller

Firstly, we start with MVC pattern. In this pattern, three components are presented including Model, View and Controller. The model includes all of your business logic, the view includes all of your program presentations and the controllers are places where your views interact with the models. Note that the implementation of MVC has many variants in addition to the way used in this assignment.

View

Controller

Model

Figure: The MVC pattern and the interaction between each layer

We will create the simple note taking application as shown below

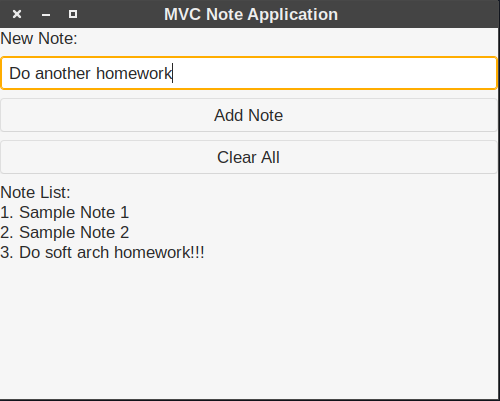


Figure: The simple MVC Note Application which we are going to create

Change directory to the “mvc” folder

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| --- |
| # From assignment root  $ cd mvc |

You will see these structure

mvc

├── main.py

└── mvc

├── controllers

│ ├── \_\_init\_\_.py

│ └── main\_controller.py

├── \_\_init\_\_.py

├── models

│ ├── entities

│ │ ├── \_\_init.py

│ │ └── note.py

│ ├── \_\_init\_\_.py

│ └── repositories

│ ├── \_\_init\_\_.py

│ └── note\_repository.py

└── views

├── base\_view.py

├── \_\_init\_\_.py

└── main\_view.py

What we already implemented for you is all the presentation parts and business logic parts, the objective task is to implement the controller and connect the views and models through the controller.

To run the application

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| --- |
| $ python main.py |

Also make sure that the “python” command pointed to Python 3. If it pointed to Python 2, use the command “python3” instead.

Open main\_controller.py and implement all missing methods.

**Hint:** Use an object of type NoteRepository to interact with the business logic.

Q3: How did you make the controller work?

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| เติมโค้ดส่วนนี้เข้าไปเพื่อให้ครบ layer |

Next, we will connect our views to the controller. Open main\_view.py and implement all missing methods.

**Hint:** Use an object of type MainController which you implemented in the previous step.

Q4: How did you make the view work?

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|  |

Q5: What is the role of the controller here? Explain it breifly.

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| ทำหน้าที่ในการ control model ต่างๆ ที่ถูกเรียกใช้ใน layer ของ controller จัดการเรื่อง model ต่างๆ |

Q6: What are the advantages of MVC pattern?

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| ข้อดีของ model mvc คือเมื่อเราแยก layer เป็น 3 ชั้นแล้วทำให้การทำงานในแต่ละชั้น dependency ต่อกันเมื่อแก้ไข logic หรือ view ในชั้นใดชั้นหนึ่งก็จะไม่กระทบกับชั้นอื่นๆ เมื่อไม่กระทบก็ทำให้ระบบดูง่ายไม่ซับซ้อนส่งผลให้การแก้ไขส่วนต่างๆ เป็นไปได้ง่าย แต่ข้อเสียของระบบนี้คือเมื่อมีโค้ดมากขึ้นวุ่นวายขึ้นก็จะ maintain ได้ยากขึ้นไปอีก เพราะ code จะไปเพิ่มแค่ในตัวของ controller เยอะๆเท่านั้น และตัวของ controller ยึดติดกับส่วนของ view มากเกินไป |

Q7: Put the screenshot of the MVC Note Application displaying your members’ name in each note.

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|  |

## MVP: Model-View-Presenter

Now, we will look into another pattern called “MVP” which is considered as a variant of MVC pattern. In the MVC pattern, the view needs to update itself when the data changes which may not be convenient in a complex application. Instead, we will replace the controller with the presenter and change the way they communicate to each other. In MVP pattern, the presenter will be the object which updates the view instead of the view itself.

View

Presenter

Model

Contract (interface)

Figure: The MVP pattern and the interaction between each layer

According to the figure, notice that the view and presenter don’t directly communicate to each other but through an interface (We use simple class here for this assignment since Python doesn’t have the interface).

Q8: In your opinion, why does an interface need to be introduced between the view and the presenter?

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| เพื่อทำการลด Dependency ระหว่าง Object และทำ Polymorphism |

Change directory to the “mvp” folder

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| --- |
| # From assignment root  $ cd mvp |

You will see these structure

mvp

├── main.py

└── mvp

├── contracts

│ ├── \_\_init\_\_.py

│ └── main\_contract.py

├── \_\_init\_\_.py

├── models

│ ├── entities

│ │ ├── \_\_init.py

│ │ └── note.py

│ ├── \_\_init\_\_.py

│ └── repositories

│ ├── \_\_init\_\_.py

│ └── note\_repository.py

├── presenters

│ ├── base\_presenter.py

│ ├── \_\_init\_\_.py

│ └── main\_presenter.py

└── views

├── base\_view.py

├── \_\_init\_\_.py

└── main\_view.py

We will start by implementing the contract. Open the file main\_contract.py

Our view needs to be updated by the presenter, to achieve this, the view needs an update method exposed through its interface.

Add these methods to the MainContract.View class

|  |
| --- |
| def update\_view(self, items: List[Note]):  pass |

In the same way, the presenter is also accessed by the view therefore we also need to provide required methods in the MainContract.Presenter class

Add these methods to the MainContract.Presenter class

|  |
| --- |
| def add\_note(self, note: str):  pass  def get\_all\_notes(self):  pass  def clear\_all(self):  pass |

Notice that both MainContract.View and MainContract.Presenter were extended from their corresponding base class.

Next, we will move to the presenter. Open main\_presenter.py, you will see the MainPresenter which is the implementation of MainContract.Presenter.

The MainPresenter should implement all of the required methods stated in its interface. You will need to write these methods to interact with the business logic.

**Hint:** The view also passed in the constructor with type MainContract.View. That’s the way the presenter updates the view. Also, don’t forget to update the view when the data changed.

Q9: What is the role of the presenter?

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| --- |
| Presenter จะทำหน้าที่รับ Event ที่ได้มาจาก View ได้แก่ Add Note, Get All Note และ Clear Note แล้วอัพเดท View และ Model |

Q10: What is the main difference between the method in the MainController of the previous section and the method which you just implemented in the MainPresenter?

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| --- |
| MainController เป็นแค่ Interface ที่เอาไว้บอกว่า Presenter จะมีฟังก์ชันใดที่ต้อง Implement บ้าง ส่วน Method ใน MainPresenter จะเป็น Method ที่ Implement จาก Interface เรียบร้อยแล้ว และจะใช้เป็นสื่อกลางในการอัพเดท View และ Model |

The next part is to implement the view so that it can interact with the presenter. If you look at the base\_view.py, you will notice the set\_presenter method which is called by the BasePresenter constructor. This way both view and presenter are now seeing each other.

Open the file main\_view.py and implement all missing method implementation.

**Hint:** Your code only needs to interact with the presenter. Also don’t update the view inside the view and let the presenter do that.

Q11: How did you interact with the presenter? Do you think it makes the implementation of view harder or easier? Why?

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| --- |
| View มีปฏิสัมพันธ์กับ Presenter โดยการที่ View จะไปเรียกให้ Presenter ทำฟังก์ชันต่างๆแล้วมาอัพเดต View โดย View จะไม่อัพเดตตัวเอง |

Q12: Put the screenshot of the MVP Note Application displaying your members’ name in each note.

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| --- |
|  |

Q13: What are pros and cons of MVP pattern compared to MVC pattern?

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| --- |
| เทียบกับ MVC แล้ว MVP จะแบ่งแยก Model กับ View ได้อย่างชัดเจนมากกว่า แต่ข้อเสียเมื่อเทียบกับ MVC คือ จำนวนโค้ดที่เขียนจะมีมากกว่า เพราะต้องเขียนรองรับทุกการกระทำที่เกิดจาก View และยังต้องเขียน Code รองรับการกระทำที่เกิดขึ้นเพื่อส่งข้อมูลกลับไปแสดงยัง View อีกรอบด้วย |

Q14: With MVP pattern, do you think that your application is more testable? Why?

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| --- |
| Testable มากขึ้น เพราะมี Dependencies ที่เป็น Abstract |

## MVVM: Model-View-ViewModel

Next, we will look into the MVVM pattern. In this pattern, we incorporate the reactive programming paradigm in which we make the view update itself automatically when the data change. This can be achieved by letting the views to act as observers while the view model serves the observable stream needed for the UI.

In this assignment we use RxPY, the ReactiveX library for Python, to do reactive programming. You can investigate the RxPY documentation at <https://rxpy.readthedocs.io/en/latest/> and ReactiveX at <http://reactivex.io/>.

Q15: What is reactive programming?

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| --- |
| It is a programming paradigm concerned with data streams and the propagation of change. |

Q16: What is the observer pattern?

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| --- |
| The observer pattern is a software design pattern in which an object, called the subject, maintains a list of its dependents, called observers, and notifies them automatically of any state changes, usually by calling one of their methods. |

In this pattern, the controller is replaced by the view model. The view model serves the observable stream. The view owns the view model as a field and then subscribes to it so that the view knows when to update itself.

One advantage is that the view model is totally decoupled from the view which also means that you can use it with other views without changing the content in the view model.

View

ViewModel

Model

Figure: The MVVM pattern and the interaction between each layer

According to the figure, notice that the arrow from ViewModel to View is a dashed line. This is because the view doesn't interact with the view but the view just observes the change in view model.

Q17: Do you think that the view model should know which view object is owning it? Why?

|  |
| --- |
| Not necessary, as the view is the only component required to acknowledge data change |

Change directory to the “mvvm” folder

|  |
| --- |
| # From assignment root  $ cd mvvm |

You will see these structure

mvvm

├── main.py

└── mvvm

├── \_\_init\_\_.py

├── models

│ ├── entities

│ │ ├── \_\_init.py

│ │ └── note.py

│ ├── \_\_init\_\_.py

│ └── repositories

│ ├── \_\_init\_\_.py

│ └── note\_repository.py

├── view\_models

│ ├── \_\_init\_\_.py

│ └── main\_view\_model.py

└── views

├── base\_view.py

├── \_\_init\_\_.py

└── main\_view.py

Now, open main\_view\_model.py and implement all the missing things.

**Hint:** Look at <https://rxpy.readthedocs.io/en/latest/reference_subject.html>.

Q18: How do you create the observable stream (the behavior subject in this assignment)?

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| Using BehaviorSubject, which can reference the value in real time and observed by the observer. |

Q19: How do you emit the new data (notes in this assignment) to the behavior subject?

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| --- |
| self.note\_behavior\_subject.on\_next(self.note\_repository.get\_all\_notes()) |

Q20: What is the role of the view model?

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Q21: What are the main differences between the presenter and the view model?

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| The presenter must update itself, while the viewmodel doesn’t. |

Q22: In terms of testability, what do you think is easier to test between Presenter and ViewModel? Why?

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| --- |
| ViewModel, as reference is not necessary. |

Next, we will move into the view implementation. Open main\_view.py and implement all the missing things.

**Hint 1:** The view will update itself by subscribing to the observable stream in the view model.

**Hint 2:** You will be mostly interacting with the view model.

Q23: How did you interact with the view model?

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|  |

Q24: Put the screenshot of the MVVM Note Application displaying your members’ name in each note.

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| --- |
| Graphical user interface, text, application, email  Description automatically generated |

Q25: What are pros and cons of MVVM pattern compared to MVC pattern?

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Q26: According to MVC, MVP and MVVM pattern, what pattern would you prefer for your application? Why?

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|  |