MVWTF: Demystifying Architecture Patterns

Adam McNeilly - @AdamMc331

You May Have Heard These Buzzwords:

- MVC
- MVP
- MVVM
- MVI
- MVU??

Why Are There So Many?

What's The Difference?

Which One Should I Use?

Which One Should I Use?

Why Do We Need Architecture Patterns?

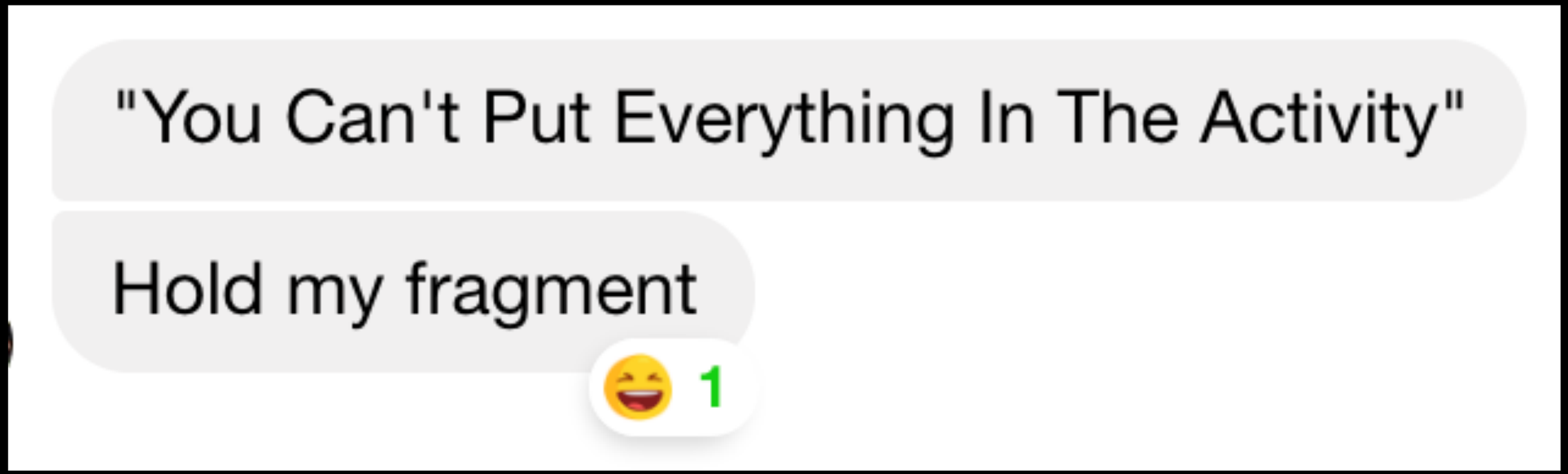
More Buzzwords!

- Maintainability
- Extensibility
- Robust
- Testable

Let's Start With One Simple Truth

You Can't Put Everything In The Activity

Or Your Fragment[1]



[1] Thanks Mauricio for proofreading

Why Not?

- Not readable
- Difficult to add new code
- Difficult to change existing code
- Can't write Junit tests for this

We Need To Break Up Our Code

Let's Explore Some Options

Model-View-Controller

- One of the earliest architecture patterns
- Introduced in the 1970s as a way to organize code
- Divides application to three parts

Model

- This is your data source
- Database, remote server, etc
- It does not care about the view

View

- This is the visual representation of information
- Does not care where this data came from
- Only responsible for displaying data
- If your view has a conditional, consider refactoring

Controller

- Handles user inputs
- Validates if necessary
- Passes input to model
- Passes model response to view

The Model & View Components Are The Same For All Patterns

Chet Haase
@chethaase

Improv game for software geeks:
Describe the architecture for "Model-View [random word from audience]"
Winner gets applause.
Loser has to implement theirs.

From a conversation with @objcode

3:49 PM · Jul 8, 2019 · Twitter Web Client

25 Retweets **86** Likes



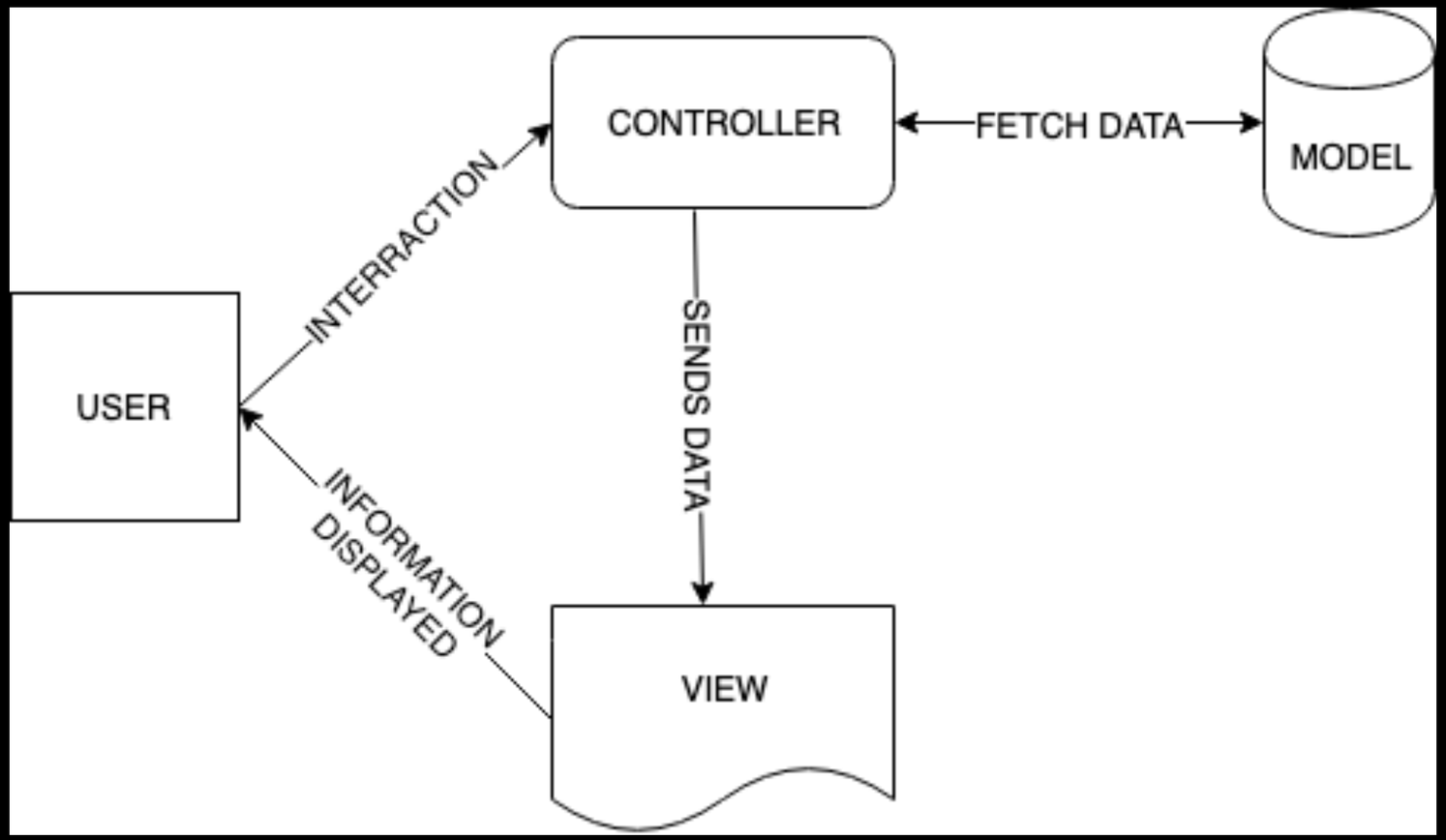

Model-View-WhateverTheFYouWant

Why Do We Have So Many Options For This Third Component?

Short Answer: State Management

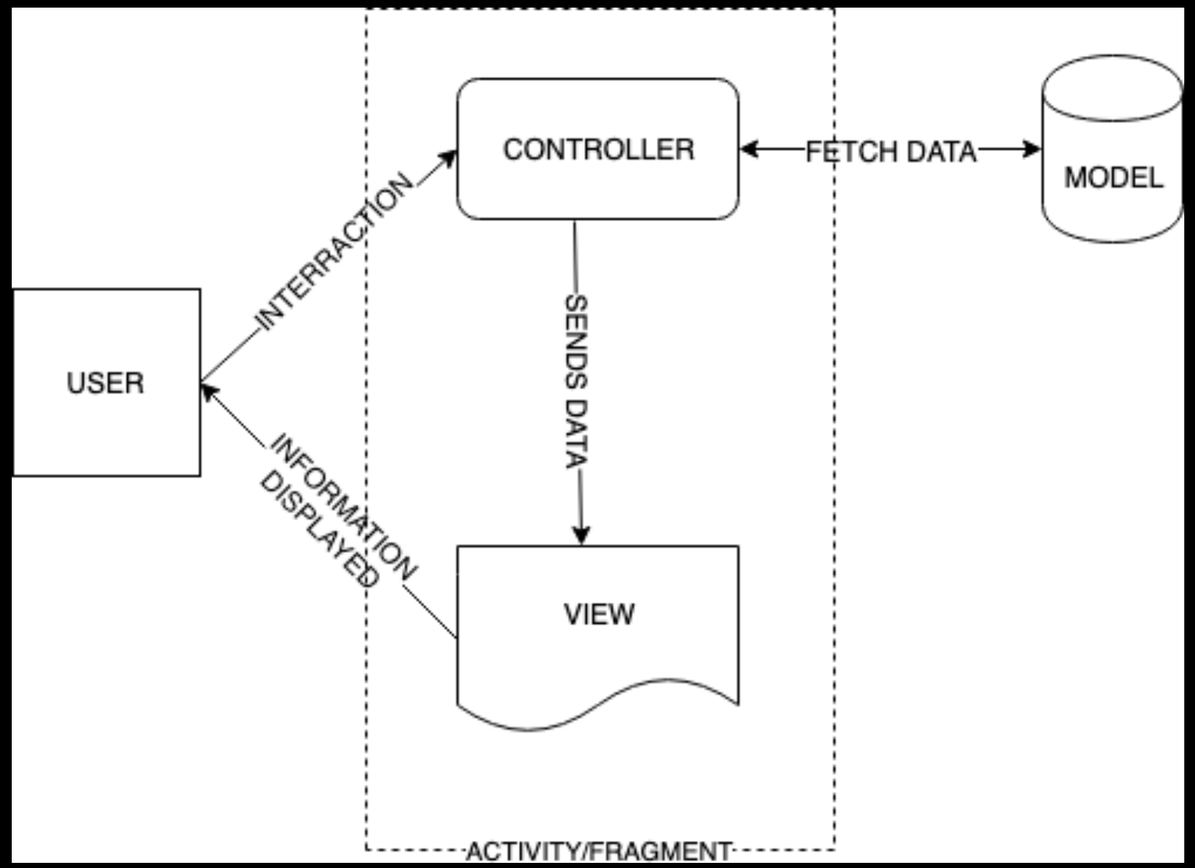
Long Answer: Let's Break Them Down

Model-View-Controller



Why Don't We Use This For Android?

Why Don't We Use This For Android?



Why Don't We Use This For Android?

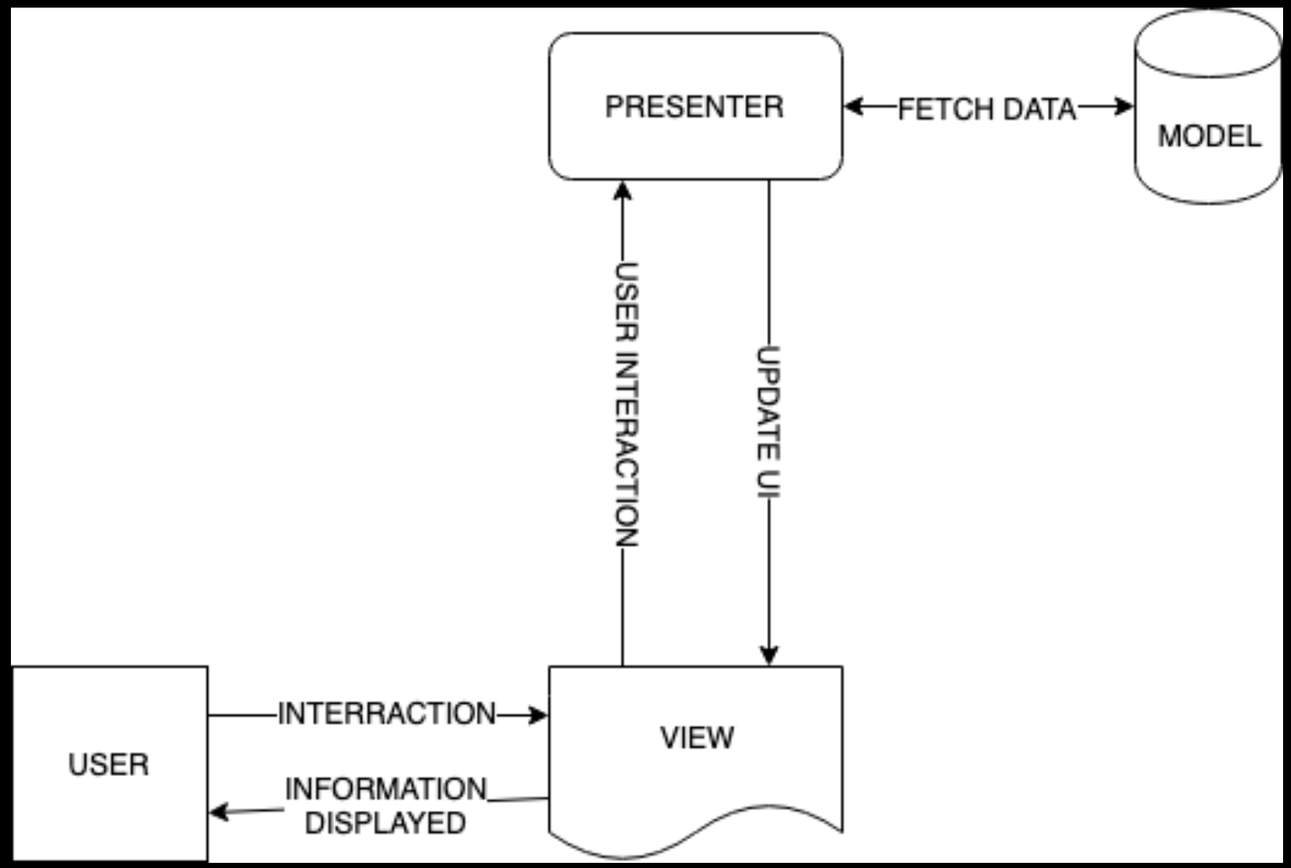
- We can't write Junit tests for an Activity
  - We can't unit test our UI logic
- We don't really have a separation of concerns here

Model-View-Presenter

Model-View-Presenter

- Similar to the last pattern
- Moves our presentation logic out of the Activity class

Model-View-Presenter



Why Is This Better?

- UI logic is outside of the Activity, and now supports Junit tests
- Our concerns are separated again

MVP Implementation

Contract Class

```
class TaskListContract {

    interface View {
        fun showTasks(tasks: List<Task>)
    }

    interface Presenter {
        fun viewCreated()
        fun viewDestroyed()
    }

    interface Model {
        fun getTasks(): List<Task>
    }
}
```

Contract Class

```
class TaskListContract {

    interface View {
        fun showTasks(tasks: List<Task>)
    }

    interface Presenter {
        fun viewCreated()
        fun viewDestroyed()
    }

    interface Model {
        fun getTasks(): List<Task>
    }
}
```

Model

```
class InMemoryTaskService : TaskListContract.Model {
    override fun getTasks(): List<Task> {
        return listOf(
                Task("Sample task 1"),
                Task("Sample task 2")
        )
    }
}
```

View

```
class TaskListActivity : AppCompatActivity(), TaskListContract.View {
    private val taskAdapter = TaskAdapter()
    private val presenter = TaskListPresenter(this, TaskRepository())

    override fun onCreate(savedInstanceState: Bundle?) {
        super.onCreate(savedInstanceState)
        // ...

        presenter.viewCreated()
    }

    override fun onDestroy() {
        presenter.viewDestroyed()
        super.onDestroy()
    }

    override fun showTasks(tasks: List<Task>) {
        taskAdapter.tasks = tasks
    }
}
```

View

```
class TaskListActivity : AppCompatActivity(), TaskListContract.View {
    private val taskAdapter = TaskAdapter()
    private val presenter = TaskListPresenter(this, TaskRepository())

    override fun onCreate(savedInstanceState: Bundle?) {
        super.onCreate(savedInstanceState)
        // ...

        presenter.viewCreated()
    }

    override fun onDestroy() {
        presenter.viewDestroyed()
        super.onDestroy()
    }

    override fun showTasks(tasks: List<Task>) {
        taskAdapter.tasks = tasks
    }
}
```

Presenter

```
class TaskListPresenter(
        private var view: TaskListContract.View?,
        private val model: TaskListContract.Model
) : TaskListContract.Presenter {

    override fun viewCreated() {
        val tasks = model.getTasks()
        view?.showTasks(tasks)
    }

    override fun viewDestroyed() {
        view = null
    }
}
```

Presenter

```
class TaskListPresenter(
        private var view: TaskListContract.View?,
        private val model: TaskListContract.Model
) : TaskListContract.Presenter {

    override fun viewCreated() {
        val tasks = model.getTasks()
        view?.showTasks(tasks)
    }

    override fun viewDestroyed() {
        view = null
    }
}
```

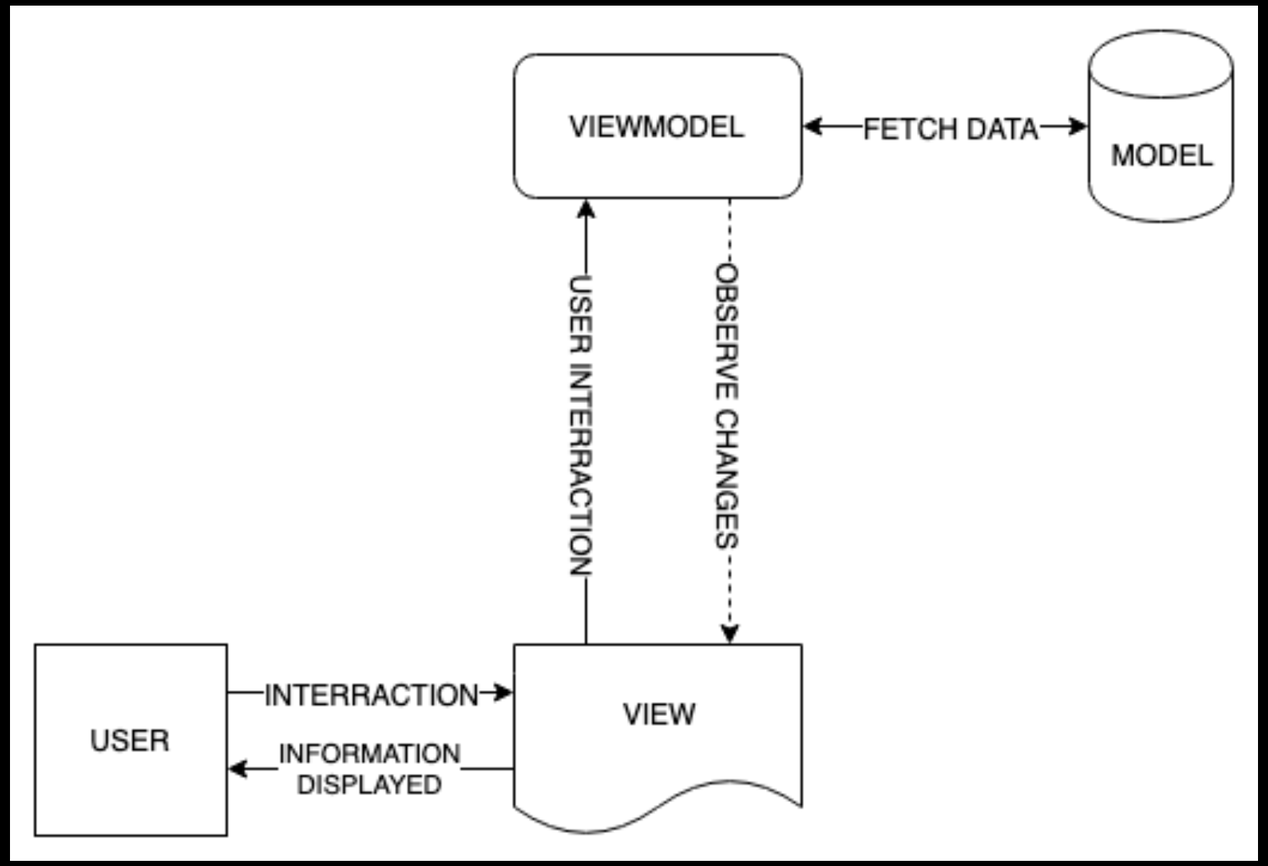
Is That Enough?

- View does nothing but display data
- Data fetching is all handled by model
- Presentation of data is handled by presenter
- Everything is separated, everything is testable
- If you think this is good enough, use it!

What's Different About MVVM?

The Presenter Doesn't Need To Care About The View

Model-View-ViewModel



MVVM Implementation

Model Doesn't Change (much)

```
interface TaskRepository {
    fun getTasks(): List<Task>
}

class InMemoryTaskService : TaskRepository {

    override fun getTasks(): List<Task> {
        return listOf(...)
    }
}
```

ViewModel

```
class TaskListViewModel(
        private val repository: TaskRepository
) {
    private val tasks = MutableLiveData<List<Task>>()
    fun getTasks(): LiveData<List<Task>> = tasks

    init {
        fetchTasks()
    }

    private fun fetchTasks() {
        tasks.value = repository.getTasks()
    }
}
```

ViewModel

```
class TaskListViewModel(
        private val repository: TaskRepository
) {
    private val tasks = MutableLiveData<List<Task>>()
    fun getTasks(): LiveData<List<Task>> = tasks

    init {
        fetchTasks()
    }

    private fun fetchTasks() {
        tasks.value = repository.getTasks()
    }
}
```

ViewModel

```
class TaskListViewModel(
        private val repository: TaskRepository
) {
    private val tasks = MutableLiveData<List<Task>>()
    fun getTasks(): LiveData<List<Task>> = tasks

    init {
        fetchTasks()
    }

    private fun fetchTasks() {
        tasks.value = repository.getTasks()
    }
}
```

View

```
class TaskListActivity : AppCompatActivity() {
    private val adapter = TaskAdapter()
    private val viewModel = TaskListviewModel(repository = InMemoryTaskService())

    override fun onCreate(savedInstanceState: Bundle?) {
        super.onCreate(savedInstanceState)
        // ...

        subscribeToViewModel()
    }

    private fun subscribeToViewModel() {
        viewModel.getTasks().observe(this, Observer { tasks ->
            adapter.tasks = tasks
        })
    }
}
```

View

```
class TaskListActivity : AppCompatActivity() {
    private val adapter = TaskAdapter()
    private val viewModel = TaskListviewModel(repository = InMemoryTaskService())

    override fun onCreate(savedInstanceState: Bundle?) {
        super.onCreate(savedInstanceState)
        // ...

        subscribeToViewModel()
    }

    private fun subscribeToViewModel() {
        viewModel.getTasks().observe(this, Observer { tasks ->
            adapter.tasks = tasks
        })
    }
}
```

This Is Pretty Close To MVP, With One New Benefit

Since ViewModel Doesn't Reference View, We Can Leverage Android ViewModel To Outlast Config Changes

Handle Rotation In MVP

1. Update your presenter to save/restore state
2. Modify the view to call appropriate save/restore methods

Handle Rotation In MVP

```
class TaskListContract {
    interface Presenter {
        // New:
        fun getState(): Bundle
        fun restoreState(bundle: Bundle?)
    }
}
```

Handle Rotation In MVP

```
class TaskListActivity : AppCompatActivity(), TaskListContract.View {
    override fun onCreate(savedInstanceState: Bundle?) {
        // ...
        presenter.restoreState(savedInstanceState)
    }

    override fun onSaveInstanceState(outState: Bundle) {
        outState.putAll(presenter.getState())
        super.onSaveInstanceState(outState)
    }
}
```

Handle Rotation In MVVM

1. Have ViewModel class extend the Android ViewModel class
2. Update Activity to use ViewModelProviders
3. Since Android's ViewModel outlasts config changes, no need to save/restore state, just re-subscribe

Handle Rotation In MVVM

```
class TaskListViewModel(
        private val repository: TaskRepository
) : ViewModel() {
    // ...
}
```

Handle Rotation In MVVM

```
class TaskListActivity : AppCompatActivity() {
    private lateinit var viewModel: TaskListViewModel

    override fun onCreate(savedInstanceState: Bundle?) {
        super.onCreate(savedInstanceState)
        // ...

        setupViewModel()
    }

    private fun setupViewModel() {
        viewModel = ViewModelProviders.of(this, viewModelFactory).get(TaskListViewModel::class.java)

        viewModel.getTasks().observe(this, Observer { tasks ->
            taskAdapter.tasks = tasks
        })
    }
}
```

Is That Enough?

- View does nothing but display data
- Data fetching is all handled by model
- ViewModel handles all UI logic
- We can easily save state across config changes
- Everything is separated, everything is testable
- If you think this is good enough, use it!

Where Does MVVM Fall Short?

Let's Consider A More Complicated State

Let's Consider A More Complicated State

```
sealed class TaskListState {
    object Loading : TaskListState()
    data class Loaded(val tasks: List<Task>) : TaskListState()
    data class Error(val error: Throwable?) : TaskListState()
}
```

Let's Consider A More Complicated State

```
class TaskListViewModel(private val repository: TaskRepository) : ViewModel() {

    init {
        showLoading()
        try {
            fetchTasks()
        } catch (e: Exception) {
            showError()
        }
    }

    // ...
}
```

Let's Consider A More Complicated State

```
class TaskListViewModel(private val repository: TaskRepository) : ViewModel() {
    // ...

    private fun showLoading() {
        state.value = TaskListState.Loading
    }

    private fun fetchTasks() {
        val tasks = repository.getItems()
        state.value = TaskListState.Loaded(tasks)
    }

    private fun showError() {
        state.value = TaskListState.Error(Throwable("Unable to fetch tasks."))
    }
}
```

What Are The Risks Of These Methods?

```
private fun showLoading() {
    state.value = TaskListState.Loading
}

private fun fetchTasks() {
    val tasks = repository.getItems()
    state.value = TaskListState.Loaded(tasks)
}

private fun showError() {
    state.value = TaskListState.Error(Throwable("Unable to fetch tasks."))
}
```

What Are The Risks Of These Methods?

- Any methods in the class can call them
- We can't guarantee they're associated with a specific action or intent
- We have multiple methods manipulating our state that we have to ensure don't conflict with each other

How Can We Mitigate This Risk?

- Have one single source of truth for our state
- Do this through a single pipeline where every action causes a specific change in the state
- This makes state changes predictable, and therefore highly testable as well

Model-View-Intent

Model-View-Intent

- Unlike the previous patterns, "Intent" isn't used to reference a specific kind of component, but rather the *intention* of doing something that we want to capture in our state.

The First Goal Is To Make Our State Changes Predictable

We Achieve This With A Reducer

```
abstract class Reducer {
    abstract fun reduce(action: Action, state: State): State
}
```

Clearly Defined Inputs And Outputs

```
class TaskListReducer : Reducer<TaskListState>() {

    override fun reduce(action: Action, state: TaskListState): TaskListState {
        return when (action) {
            is TaskListAction.TasksLoading -> TaskListState.Loading()
            is TaskListAction.TasksLoaded -> TaskListState.Loaded(action.tasks)
            is TaskListAction.TasksErrored -> TaskListState.Error()
            else -> state
        }
    }
}
```

We Also Want A Single Source Of Truth

We Create A State Container Called A Store

- Contains our state and exposes it for anyone to observe
- Contains our reducer instance
- Dispatches actions into that reducer to modify the state

Store Implementation

```
class BaseStore<S : State>(
    initialState: S,
    private val reducer: Reducer<S>
) {
    private var stateListener: ((S) -> Unit)? = null

    private var currentState: S = initialState
        set(value) {
            field = value
            stateListener?.invoke(value)
        }

    fun dispatch(action: Action) {
        currentState = reducer.reduce(action, currentState)
    }

    fun subscribe(stateListener: ((S) -> Unit)?) {
        this.stateListener = stateListener
    }
}
```

Store Implementation

```
class BaseStore<S : State>(
    initialState: S,
    private val reducer: Reducer<S>
) {
    private var stateListener: ((S) -> Unit)? = null

    private var currentState: S = initialState
        set(value) {
            field = value
            stateListener?.invoke(value)
        }

    fun dispatch(action: Action) {
        currentState = reducer.reduce(action, currentState)
    }

    fun subscribe(stateListener: ((S) -> Unit)?) {
        this.stateListener = stateListener
    }
}
```

Store Implementation

```
class BaseStore<S : State>(
    initialState: S,
    private val reducer: Reducer<S>
) {
    private var stateListener: ((S) -> Unit)? = null

    private var currentState: S = initialState
        set(value) {
            field = value
            stateListener?.invoke(value)
        }

    fun dispatch(action: Action) {
        currentState = reducer.reduce(action, currentState)
    }

    fun subscribe(stateListener: ((S) -> Unit)?) {
        this.stateListener = stateListener
    }
}
```

Store Implementation

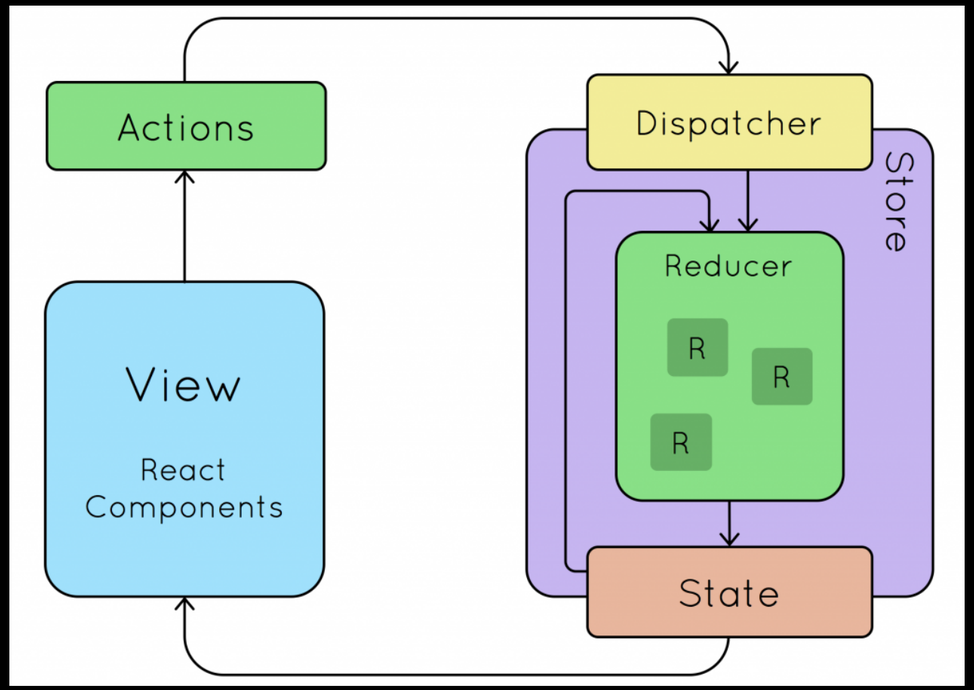
```
class BaseStore<S : State>(
    initialState: S,
    private val reducer: Reducer<S>
) {
    private var stateListener: ((S) -> Unit)? = null

    private var currentState: S = initialState
        set(value) {
            field = value
            stateListener?.invoke(value)
        }

    fun dispatch(action: Action) {
        currentState = reducer.reduce(action, currentState)
    }

    fun subscribe(stateListener: ((S) -> Unit)?) {
        this.stateListener = stateListener
    }
}
```

Redux Diagram[2]



[2] https://www.esri.com/arcgis-blog/products/3d-gis/3d-gis/react-redux-building-modern-web-apps-with-the-arcgis-js-api/

Hook This Up To Our ViewModel/Presenter

```
class TaskListViewModel(private val repository: TaskRepository) : ViewModel() {
    private val store: BaseStore<TaskListState> = BaseStore(
        TaskListState.Loading(),
        TaskListReducer()
    )

    // ...

    private fun fetchTasks() {
        store.dispatch(TaskListAction.TasksLoading)

        try {
            val tasks = repository.getTasks()
            store.dispatch(TaskListAction.TasksLoaded(tasks))
        } catch (e: Throwable) {
            store.dispatch(TaskListAction.TasksErrored(e))
        }
    }
}
```

Hook This Up To Our ViewModel/Presenter

```
class TaskListViewModel(private val repository: TaskRepository) : ViewModel() {
    private val store: BaseStore<TaskListState> = BaseStore(
        TaskListState.Loading(),
        TaskListReducer()
    )

    // ...

    private fun fetchTasks() {
        store.dispatch(TaskListAction.TasksLoading)

        try {
            val tasks = repository.getTasks()
            store.dispatch(TaskListAction.TasksLoaded(tasks))
        } catch (e: Throwable) {
            store.dispatch(TaskListAction.TasksErrored(e))
        }
    }
}
```

Hook This Up To Our ViewModel/Presenter

```
class TaskListViewModel(private val repository: TaskRepository) : ViewModel() {
    private val store: BaseStore<TaskListState> = BaseStore(
        TaskListState.Loading(),
        TaskListReducer()
    )

    // ...

    private fun fetchTasks() {
        store.dispatch(TaskListAction.TasksLoading)

        try {
            val tasks = repository.getTasks()
            store.dispatch(TaskListAction.TasksLoaded(tasks))
        } catch (e: Throwable) {
            store.dispatch(TaskListAction.TasksErrored(e))
        }
    }
}
```

Is That Enough?

- View does nothing but display data
- Data fetching is all handled by model
- ViewModel handles UI logic
- We can easily save state across config changes
- Everything is separated, everything is testable
- State management is clear and predictable
- If you think this is good enough, use it!

Is MVI The Best We Can Do?

- State management is pretty solid
- But, we have 22 letters that weren't covered yet

What Should I Take Away From This?

Model-View-Presenter

- Separated concerns and allows us to unit test all of our code
- Good for quick prototyping
- Good for blog post samples because of its readability
- Can handle config changes but requires a little more work
- State management is unpredictable

Model-View-ViewModel

- Separated concerns and allows us to unit test all of our code
- Even better for quick prototyping
  - No contract class boilerplate
- Good for blog post samples because of its readability[3]
- Can handle config changes easily if we use Android's architecture components
- State management is unpredictable

---

[3] Depending on how you expose information

Model-View-Intent

- Can work with presenter or viewmodel
  - Separated concerns, testability come with this
- Not good for quick prototyping
- Can be confusing if used for sample apps due to unfamiliarity
- Can handle config changes based on whether we used a presenter or a viewmodel
- State management is clear and predictable

General Suggestions

- MVP can get you up and running quickly, but due to the boilerplate and config changes work I wouldn't recommend it.
- MVVM is what I'd recommend the most. It allows for separation of concerns and unit test support without a major learning curve.
- If your app handles complex user flows or states, MVI can give you more support for state management.

What's Most Important

- Be consistent

Thank you!

https://github.com/adammc331/mvwtf