AutSoft

Android app architecture powered by Jetpack & Kotlin

HWSW mobile! 2018

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Coroutines

Coroutines

- Language level support for asynchronous, suspendable computations
- Essentially lightweight threads
  - We can start them for almost free
- Allows clients to write code in a traditional, sequential style that they're used to
  - Unlike callbacks, Rx, and other solutions which require an entirely new coding style

```
interface CallbackUserApi {
    @FunctionalInterface
    interface Callback<T> {
        void onResult(T result);
    }

    void getUsers(Callback<List<User>> callback);
}


api.getUsers(new CallbackUserApi.Callback<List<User>>() {
    @Override
    public void onResult(List<User> result) {
        for (User user : result) {
            System.out.println(user.getName());
        }
    }
});
```

```
interface CallbackUserApi {
    @FunctionalInterface
    interface Callback<T> {
        void onResult(T result);
    }

    void getUsers(Callback<List<User>> callback);
}


api.getUsers { users ->
    for (user in users) {
        println(user.name)
    }
}
```

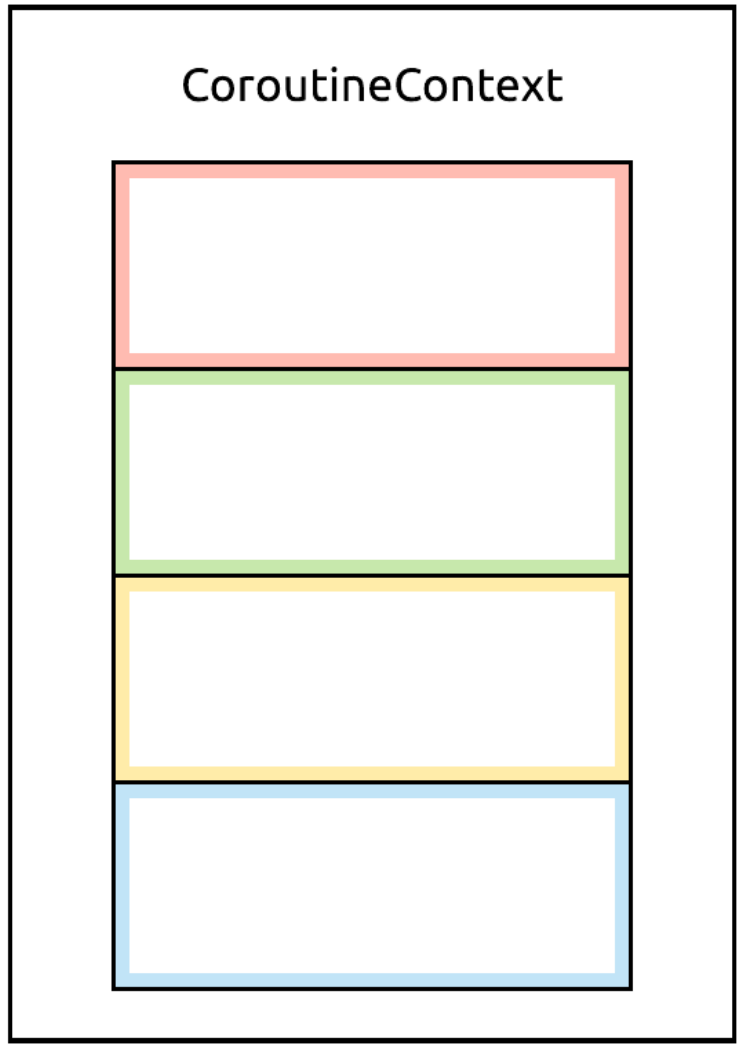
```
interface BlockingUserApi {
    fun getUsers(): List<User>
}
```

```
Thread {
    val users = api.getUsers()
    for (user in users) {
        println(user.name)
    }
}.start()
```

```
launch {
    val users = api.getUsers()
    for (user in users) {
        println(user.name)
    }
}
```

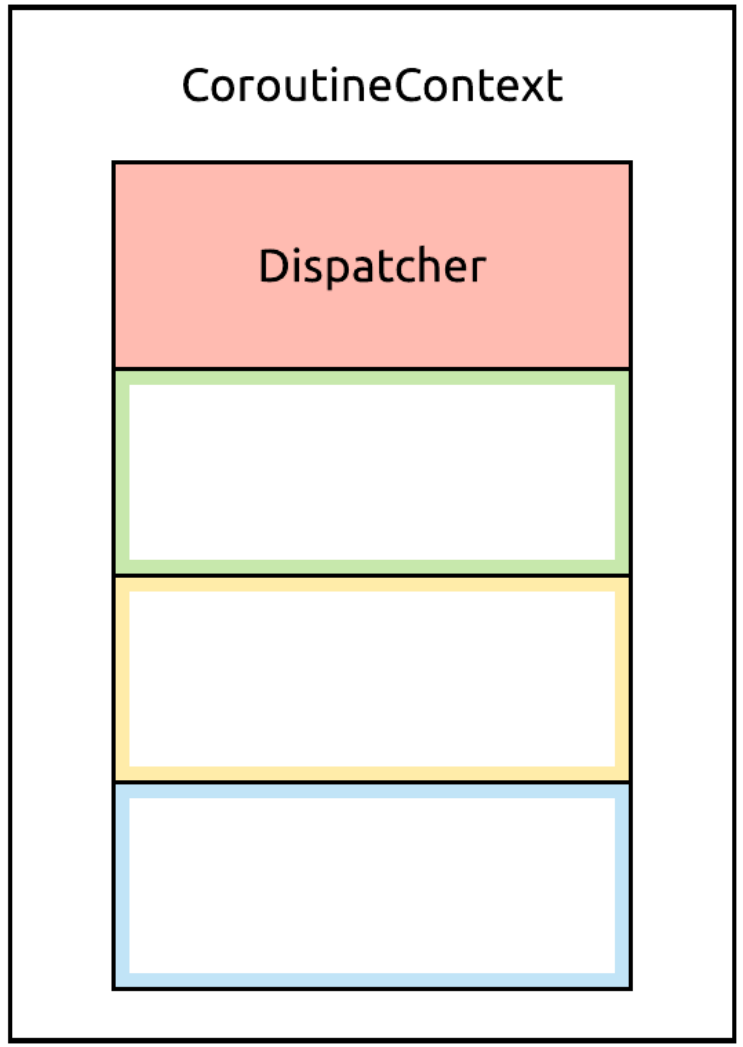
CoroutineContext

- A collection of *elements* that describe *how* the coroutine will be executed
  - Threading
  - Cancellation
  - Error handling
  - Name



Dispatcher

- The most commonly used context element
- Describes what thread the coroutine will run on
  - A single thread, for example the main thread on Android
  - A threadpool containing multiple threads, any of which may be used for the coroutine



Contexts object

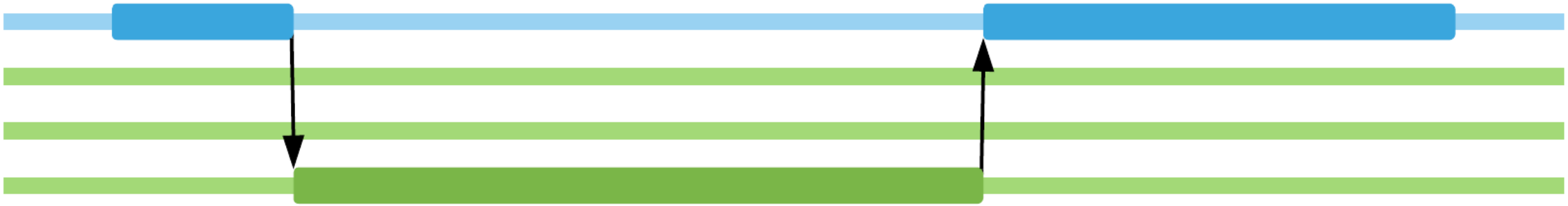
- Our own solution to group the various `CoroutineContexts` and `Dispatchers` in our app
  - Some are built-in `Dispatchers`
  - Some are custom threads and thread pools

```
object Contexts {

    val UI = Dispatchers.Main
    val IO = Executors.newFixedThreadPool(3).asCoroutineDispatcher()

}
```

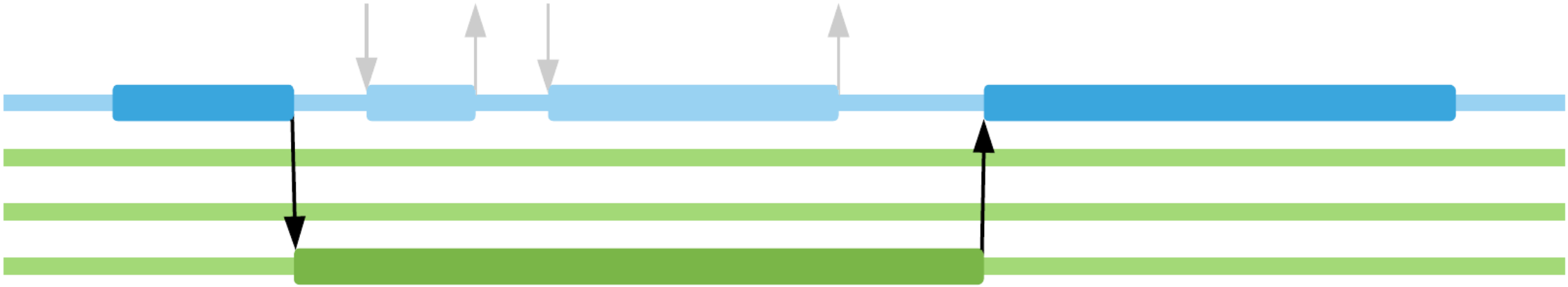
```
launch(Contexts.IO) {
    val users = api.getUsers()
    for (user in users) {
        println(user.name)
    }
}
```

```
launch(Contexts.IO) {
    val users = api.getUsers()

    withContext(Contexts.UI) {
        for (user in users) {
            println(user.name)
        }
    }
}
```

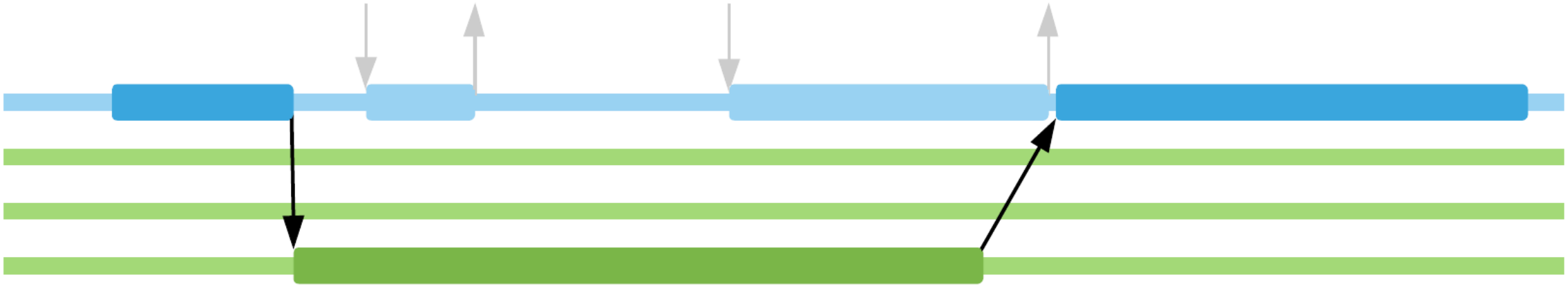
```
launch(Contexts.UI) {
    val users = withContext(Contexts.IO) {
        api.getUsers()
    }

    for (user in users) {
        println(user.name)
    }
}
```



```
launch(Contexts.UI) {
    val users = withContext(Contexts.IO) {
        api.getUsers()
    }

    for (user in users) {
        println(user.name)
    }
}
```

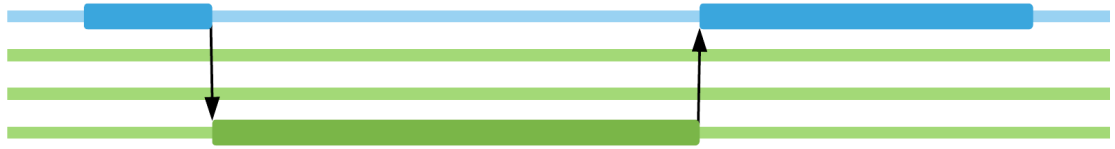


```
launch(Contexts.UI) {
    val users = withContext(Contexts.IO) {
        api.getUsers()
    }

    for (user in users) {
        println(user.name)
    }
}
```



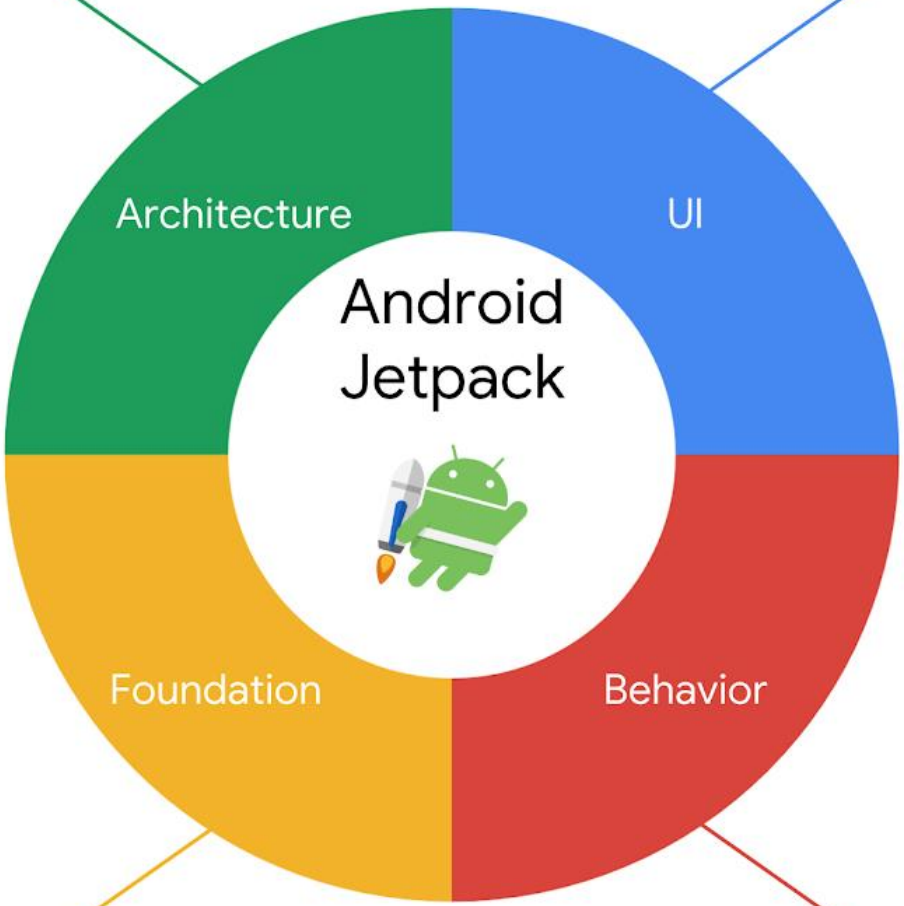
```
class CoroutineUserApi(private val blockingApi: BlockingUserApi) {

    suspend fun getUsers() = withContext(Contexts.IO) {
        blockingApi.getUsers()
    }

}
```

```
launch(Contexts.UI) {
    val users = api.getUsers()
    for (user in users) {
        println(user.name)
    }
}
```



```
class CoroutineUserApi(private val blockingApi: BlockingUserApi) {

    suspend fun getUsers() = withContext(Contexts.IO) {
        blockingApi.getUsers()
    }

}


launch(Contexts.UI) {
    val users = api.getUsers()
    for (user in users) {
        println(user.name)
    }
}
```

Jetpack!



- Data Binding
- Lifecycles
- LiveData
- Navigation *new!*
- Paging *new!*
- Room
- ViewModel
- WorkManager *new!*

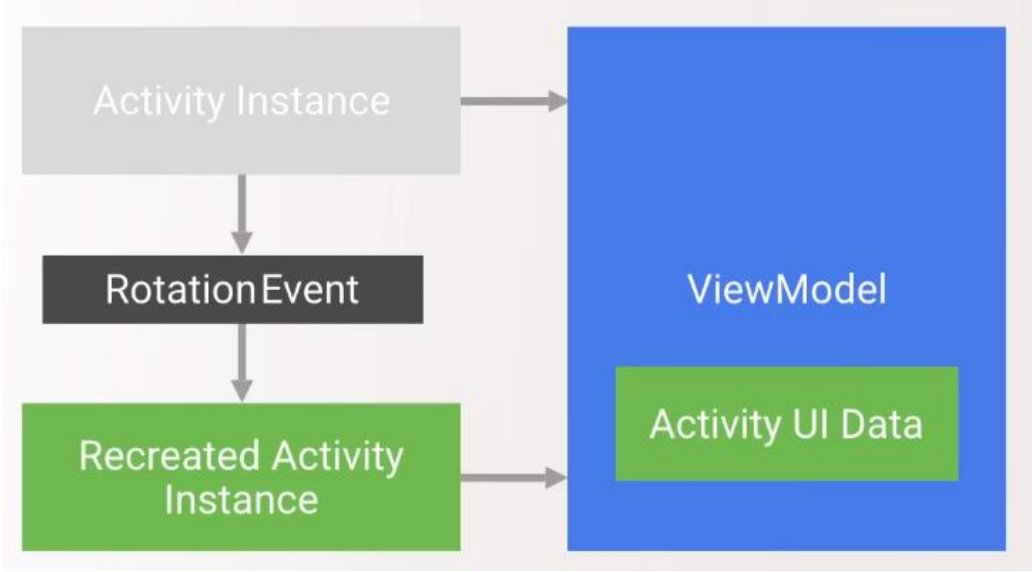
- AppCompat
- Android KTX *new!*
- Multidex
- Test

- Animation & Transitions
- Auto, TV & Wear
- Emoji
- Fragment
- Layout
- Palette

- Download Manager
- Media & Playback
- Permissions
- Notifications
- Sharing
- *new!* Slices

ViewModel

- A component to store UI related state in a lifecycle-conscious manner
  - Should store all UI related state instead of the `Activity`
  - Survives configuration changes, `Activity`/`Fragment` recreation



ViewModel

```
class UserViewModel : ViewModel() {
    val user = User(name ="Sally", age = 25)
}

class UserActivity : AppCompatActivity() {
    override fun onCreate(savedInstanceState: Bundle?) {
        super.onCreate(savedInstanceState)
        val userViewModel = ViewModelProviders.of(this)
                                    .get(UserViewModel::class.java)
    }
}
```

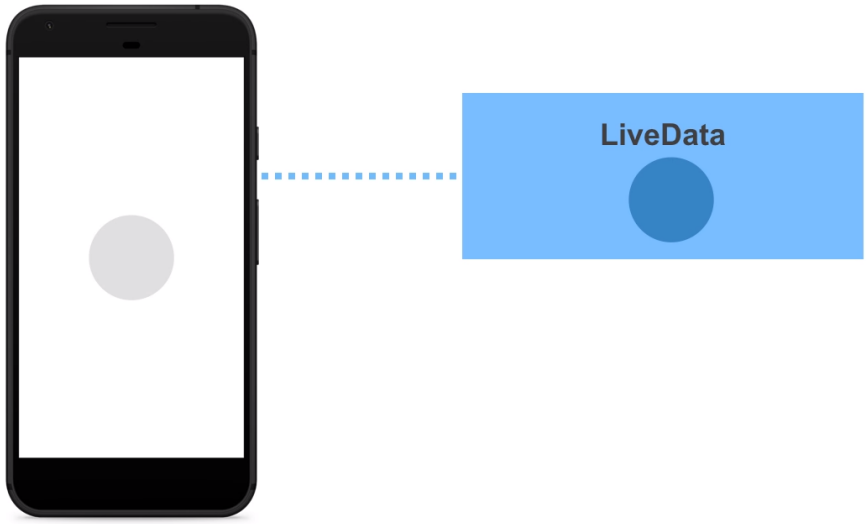
Tips for ViewModel usage

- *Never* hold a reference to a UI element or Activity
  - ViewModels have a longer lifespan, this would be a memory leak
- They don't replace `savedInstanceState` entirely
  - ViewModel: may store any type of data in properties, easy to access from Activities
    - Use it to store all data necessary to populate the UI
  - `savedInstanceState`: survives configuration changes, and even application death on low memory, but stores little data
    - Use it to store the minimal required data to load data into a ViewModel (e.g. an ID)

```kotlin
class UserViewModel : ViewModel(private val context: Context) {
    val user = UserRepository(context).getUser()
}


class UserViewModelFactory(private val context: Context)
     : ViewModelProvider.Factory {

    override fun <T : ViewModel?> create(modelClass: Class<T>): T {
        return UserViewModel(context) as T
    }
}


val factory = UserViewModelFactory(applicationContext)
val viewModel = ViewModelProviders.of(this, factory)
                                  .get(UserViewModel::class.java)
```

LiveData

- Lifecycle aware, observable data holder
- Observable:
  - Wraps a single value, and implements the *observer pattern*, notifying any observers when the value it contains changes



LiveData

- Typically used in a ViewModel
  - Observe data in the ViewModel without referencing the Activity

```
class UserViewModel : ViewModel() {
    val user: LiveData<User> = ...
}

class UserActivity : AppCompatActivity() {
    override fun onCreate(savedInstanceState: Bundle?) {
        super.onCreate(savedInstanceState)
        val userViewModel = ViewModelProviders.of(this).get(UserViewModel::class.java)
        userViewModel.user.observe(this, Observer { user ->
            // show user on UI
        })
    }
}
```

LiveData

- Lifecycle aware
  - Only notifies “active” observers
    - Background Activities don’t get updates
    - When they become active again, they receive only the latest value
  - Observation is automatically cancelled when the `LifecycleOwner`’s lifecycle comes to an end
    - No way to forget, no memory leaks, simple API

```
userViewModel.user.observe(this, Observer { user ->
    // show user on UI
})
```

LiveData

- Instantiation:

```
val user: MutableLiveData<User> = MutableLiveData<User>()
```

- Setting the value from the UI thread:

```
user.setValue(User("Ann", 34))
user.value = User("Jim", 41)
```

- Setting the value from a background thread:

```
user.postValue(User("Zoe", 22))
```

ViewModel & LiveData

- ViewModels usually use backing properties for `LiveData`
  - A private `MutableLiveData` that stores the actual `LiveData` instance holding a value
  - A publicly observable, read-only `LiveData` property that's set to the same instance

```
class UserViewModel : ViewModel() {
    private val _user = MutableLiveData<User>()
    val user: LiveData<User> = _user

    fun initUser() {
        _user.value = User("Michael", 54)
    }
}
```

Cancellation, jobs, parenting, and scope

Cancellation

- Coroutines like we've seen them before will continue running until they throw an exception or complete
- We need a way to cancel them when we no longer need their results
  - `launch` returns a `Job` instance that lets us do this

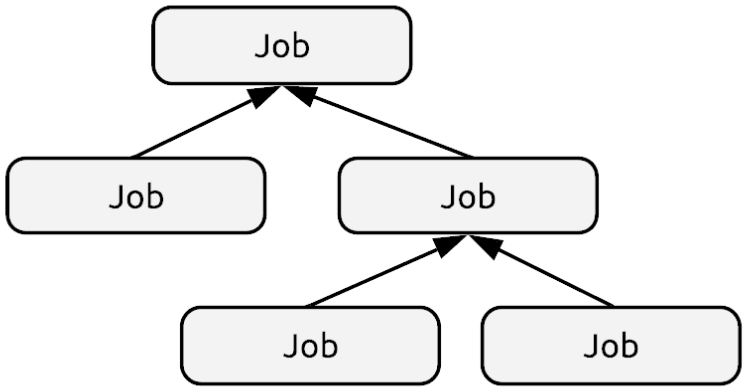
```
val job: Job = launch(Contexts.UI) {
    ...
}

job.cancel()
```

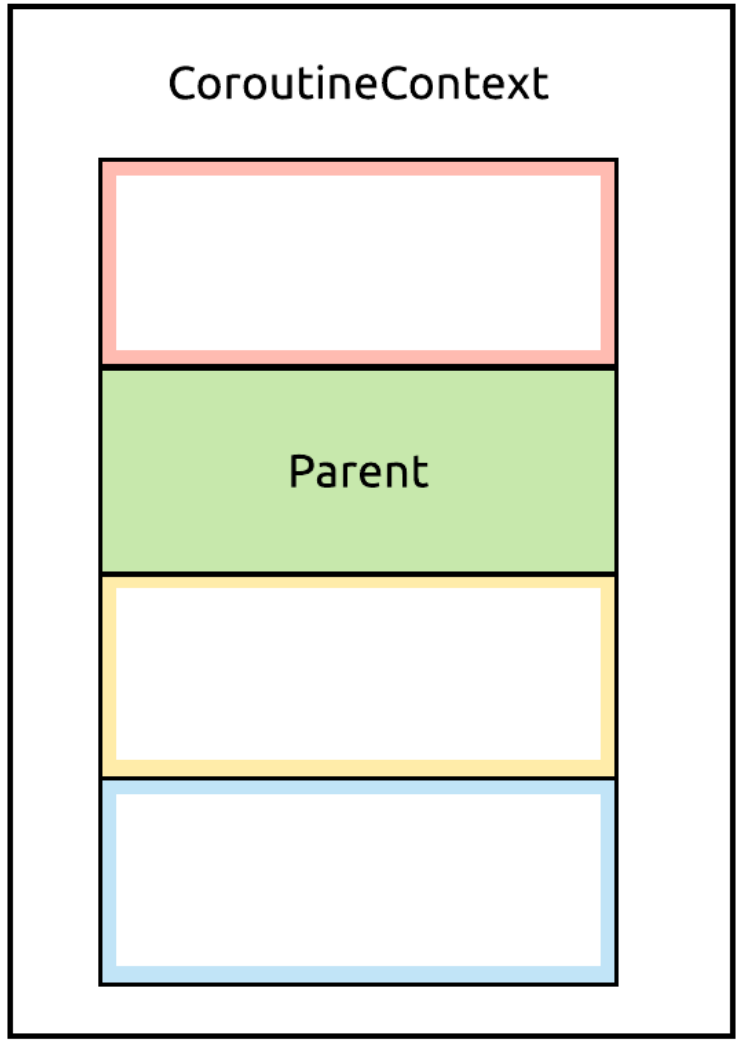
Cancellation

- Where should we launch coroutines?
  - If we launch it in an `Activity`, we'll have to cancel them and start new ones on every rotation, which is wasteful
  - We can start them in our `ViewModels` instead!
    - They'll survive until the screen is active
- How do we manage them?
  - We could put the `Jobs` of every coroutine we launch in a `List`, and cancel all of them when the `ViewModel` is cleared one by one
  - There is, however, a better way

Parent

- The *second* most commonly used context element
- Organizes coroutines in a tree structure
  - If a parent is cancelled, all of its children are cancelled as well



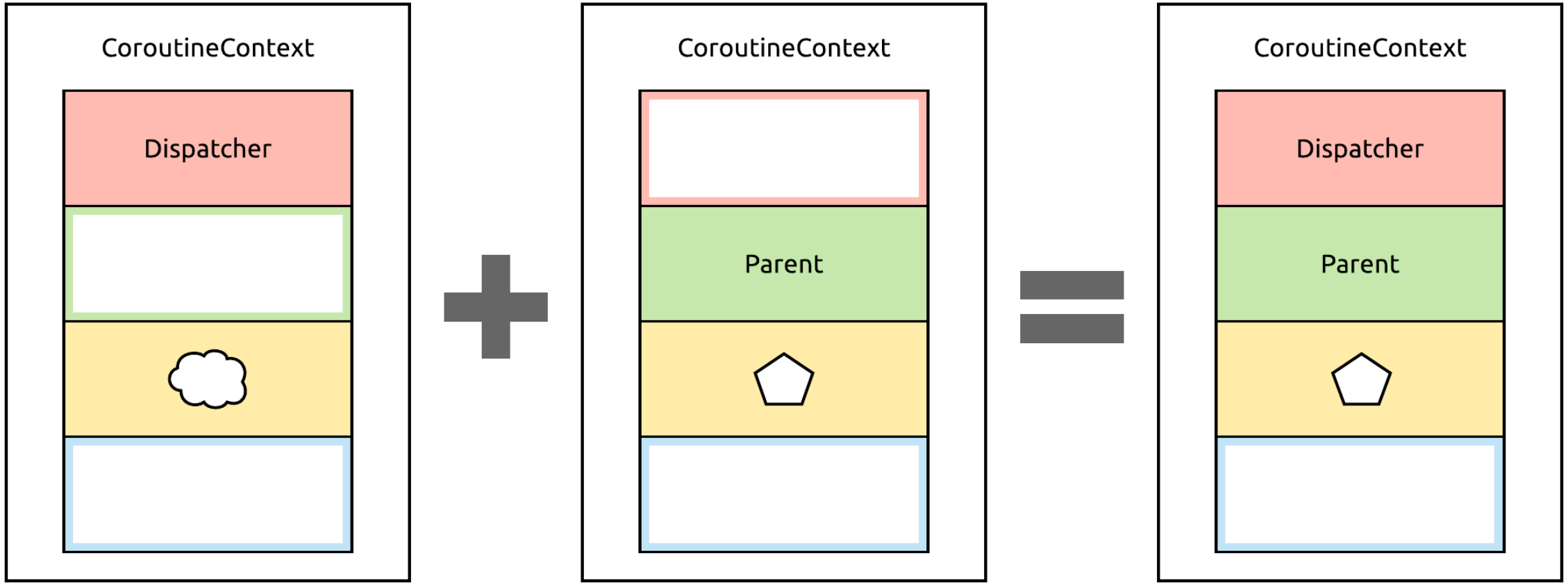


Parent

- A single “empty” parent for all coroutine in a `ViewModel`
  - This lets us cancel them with a single call, in a safe manner

```
class UserViewModel : ViewModel() {

    private val parentJob = Job()

    fun getUserProfile() {
        launch(parentJob) {
            // fetch profile from somewhere
        }
    }

    override fun onCleared() {
        parentJob.cancel()
    }
}
```

Combining CoroutineContexts



Combined contexts

- Using the + operator, we can create a context that defines both the coroutine's parent and `Dispatcher`

```
class UserViewModel : ViewModel() {

    private val parentJob = Job()

    fun getUserProfile() {
        launch(Contexts.UI + parentJob) {
            // fetch profile from somewhere
        }
    }

    override fun onCleared() {
        parentJob.cancel()
    }
}
```

CoroutineScope

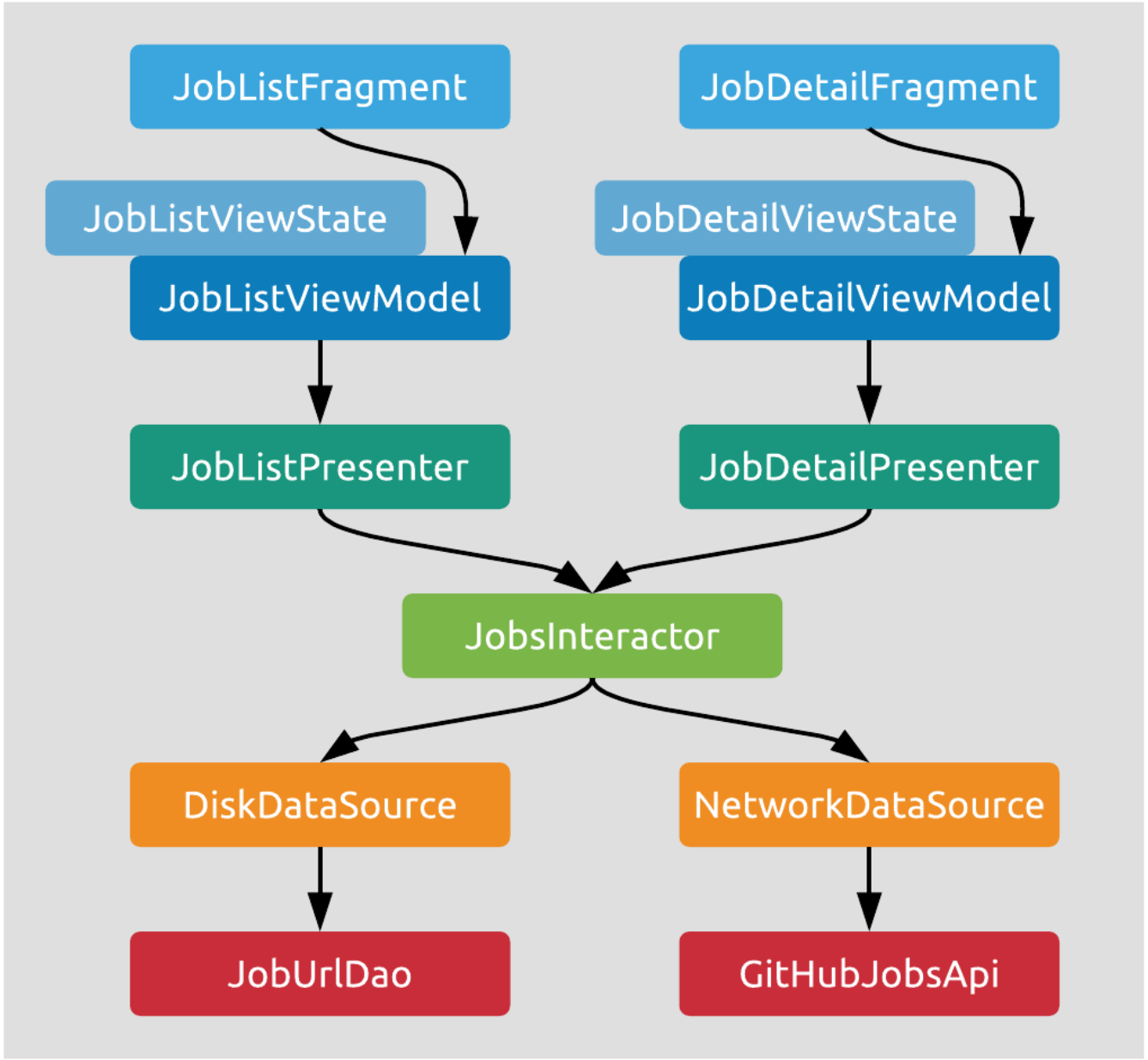
- An interface that defines a common context for all coroutines launched within its scope

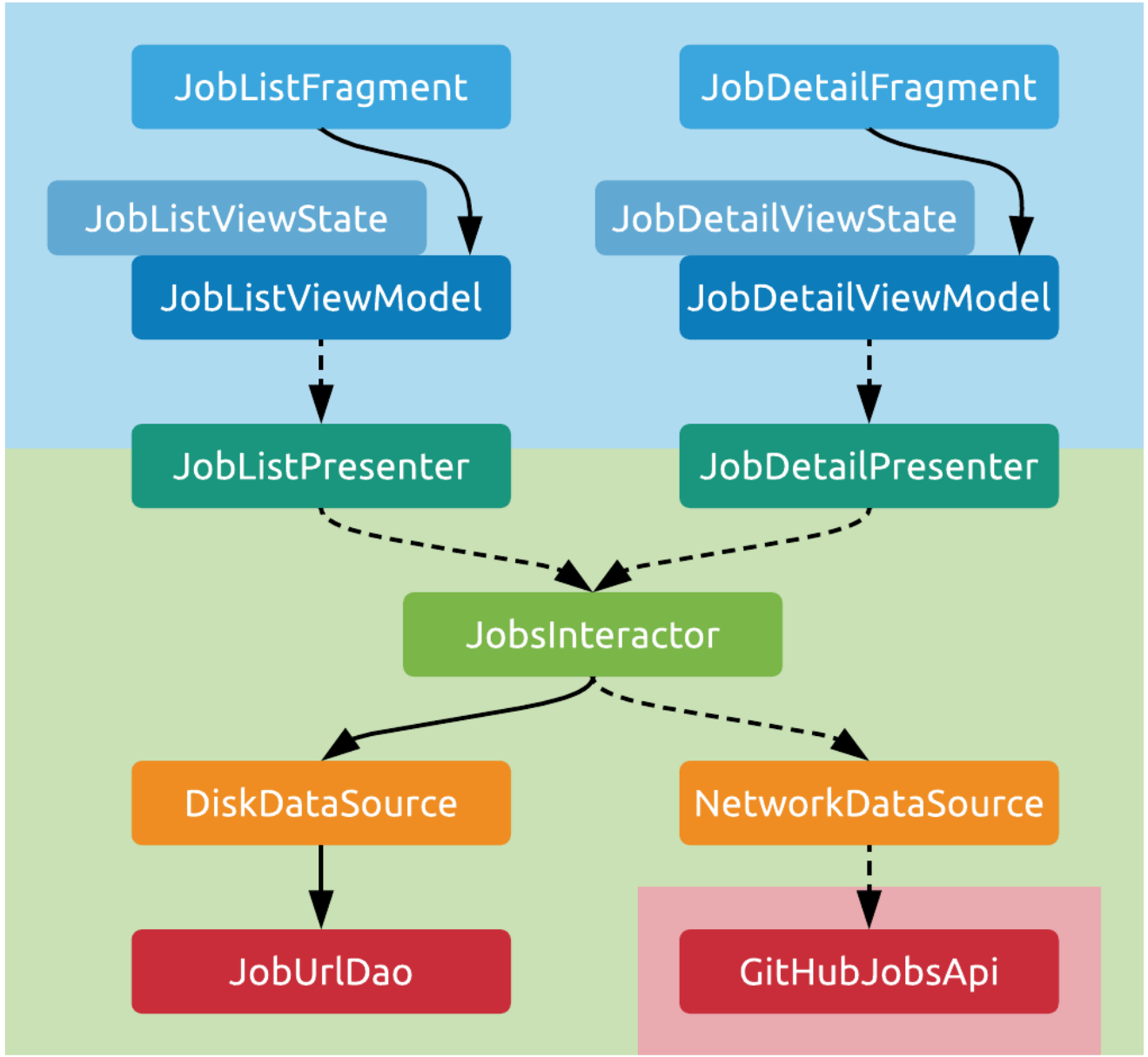
```
class UserViewModel : ViewModel(), CoroutineScope {
    private val parentJob = Job()
    override val coroutineContext: CoroutineContext = Contexts.UI + parentJob

    fun getUserProfile() {
        launch {
            // fetch profile from somewhere
        }
    }

    override fun onCleared() { parentJob.cancel() }
}
```

Architecture

Main goals

- Clear separation of responsibilities
  - Well defined coordination of components
- Easy to use threading
  - Offload work to background threads trivially
- Safe state handling
  - Always maintain a consistent state
  - Handle configuration changes and process death gracefully
- Fragment-based navigation in a single Activity
  - With argument passing


JobListFragment
JobDetailFragment
JobListViewState
JobDetailViewState
JobListViewModel
JobDetailViewModel
JobListPresenter
JobDetailPresenter
JobsInteractor
DiskDataSource
NetworkDataSource
JobUrlDao
GitHubJobsApi


JobListFragment
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JobListViewState
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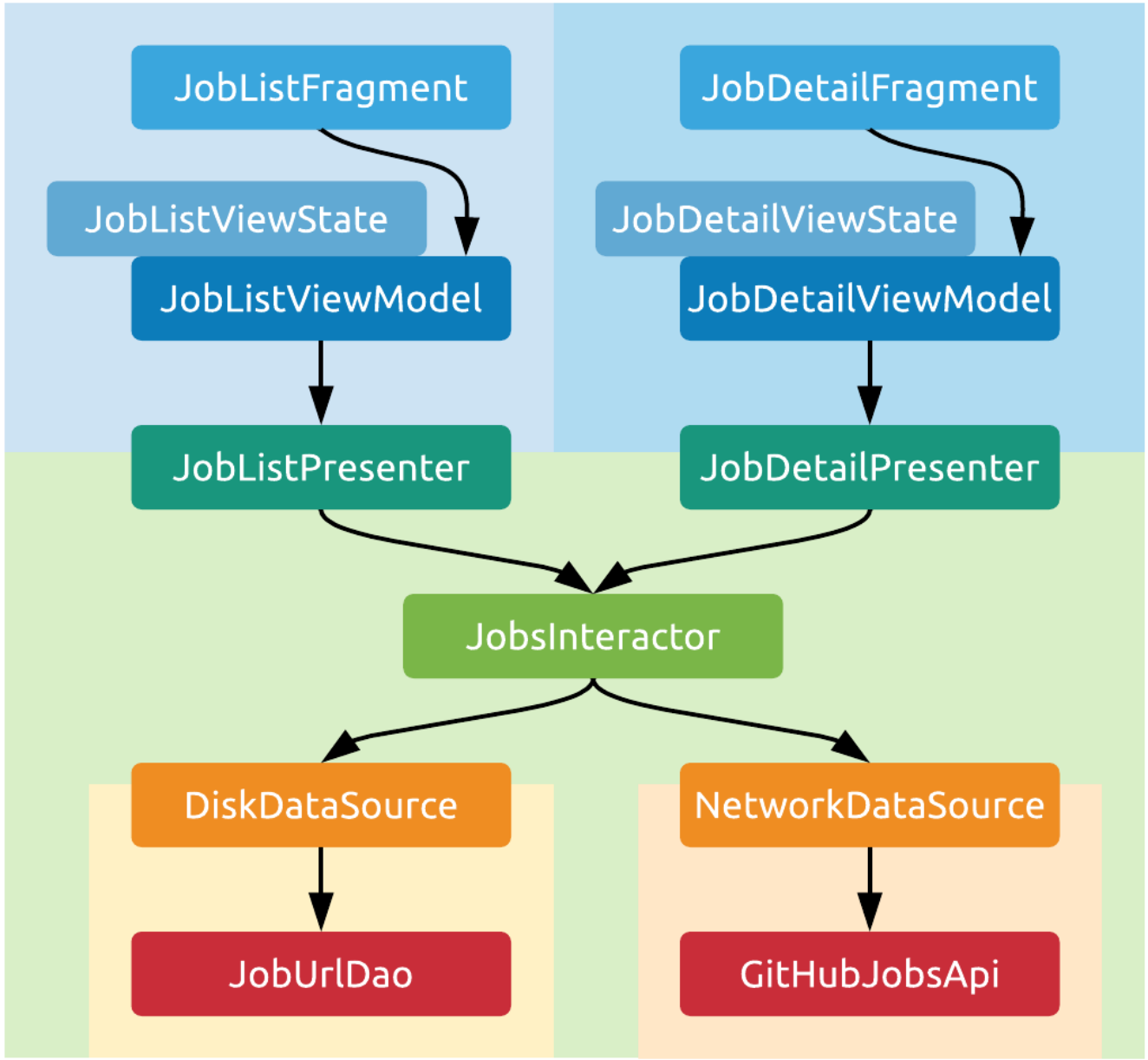
JobUrlDao
GitHubJobsApi
Android UI thread
IO thread(pool)
OkHttp threadpool
Blocking calls
Suspending calls



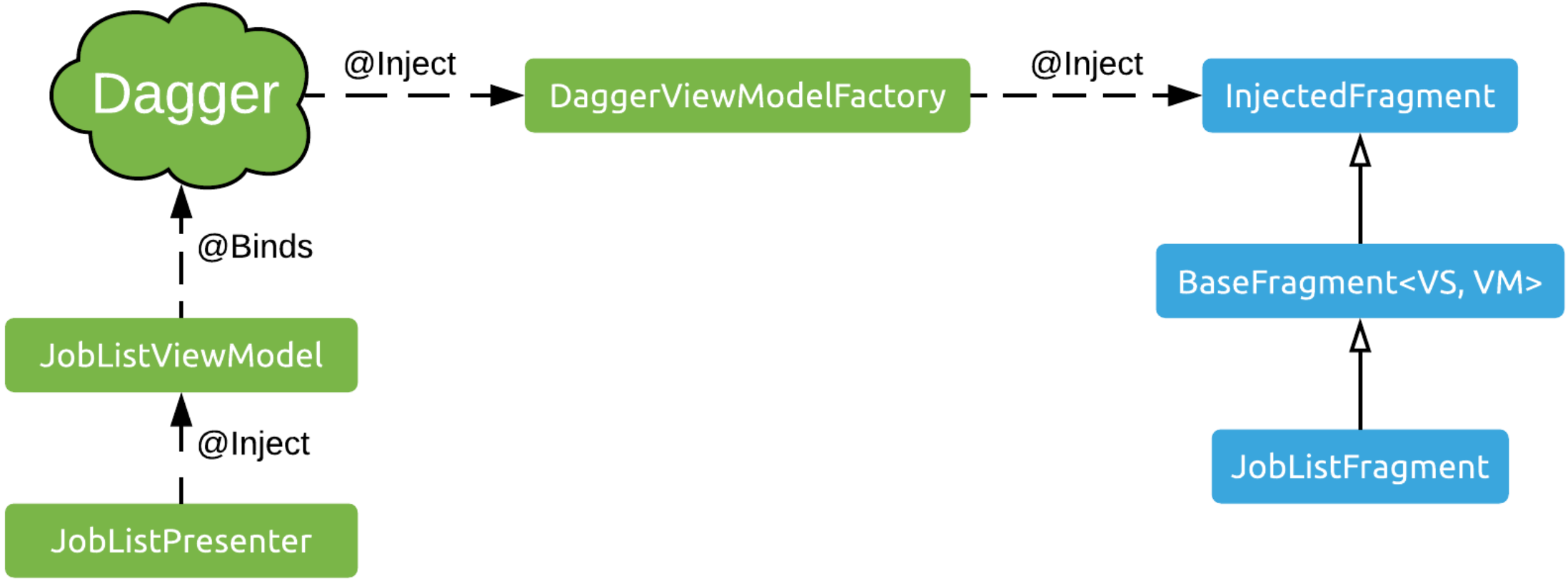
Presentation models

Domain models

DB models

Network models

DaggerViewModelFactory



Thank you for your time!

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