Marc Brehmer

Developing a clean architecture-inspired React application with MVVM

Frontend

code.talks

About me

- Software Engineer since 2013
- @Spaceteams
- Technology agnostics - No boundaries or biases
- Staying ahead of the game - It’s Spacetime

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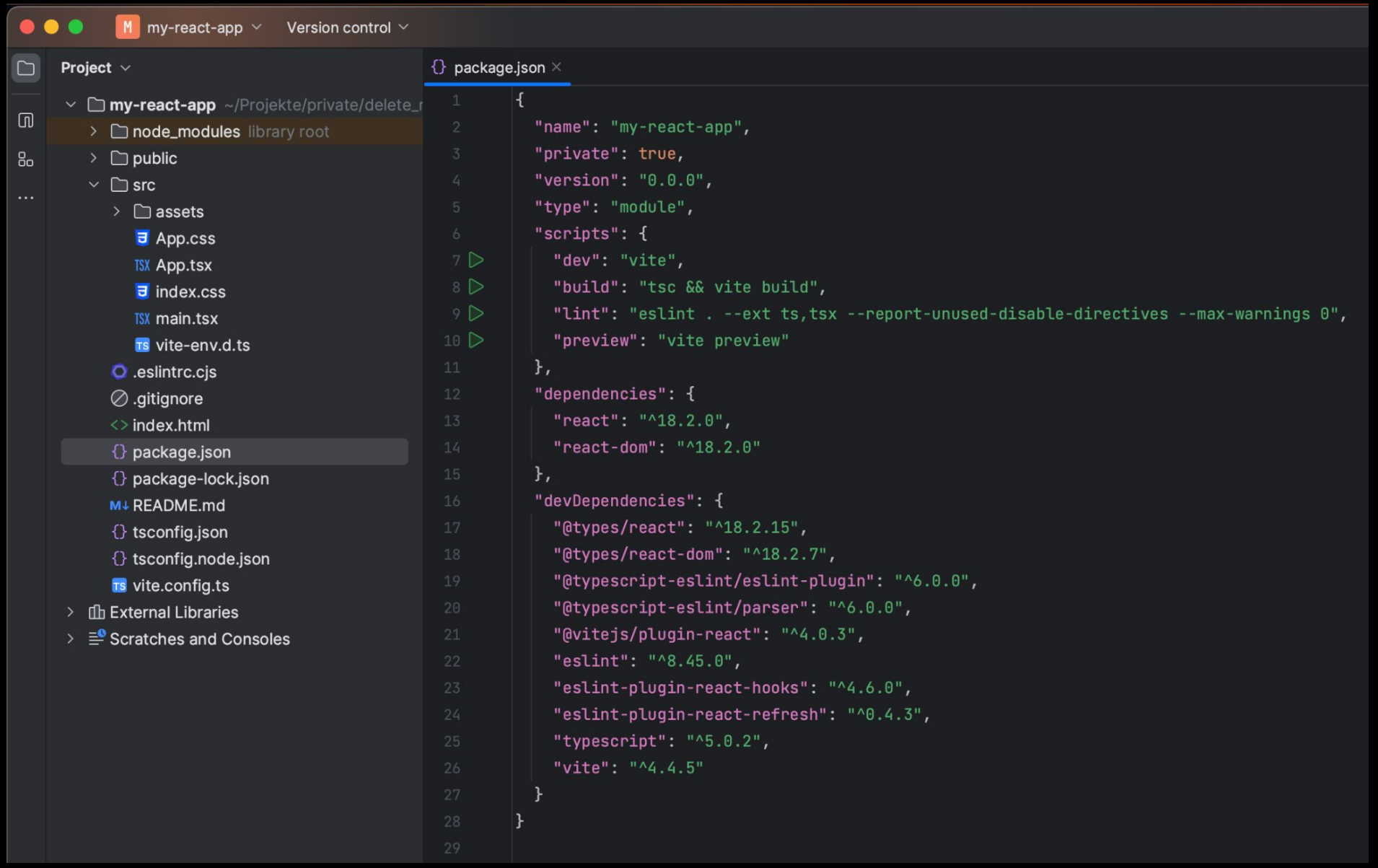
Setting up a React app


my-react-app
Version control
Project
my-react-app ~/Projekte/private/delete_r
node_modules library root
public
src
assets
App.css
App.tsx
index.css
main.tsx
vite-env.d.ts
.eslintrc.cjs
.gitignore
index.html
package.json
package-lock.json
README.md
tsconfig.json
tsconfig.node.json
vite.config.ts
External Libraries
Scratches and Consoles
package.json
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"typescript": "^5.0.2",
"vite": "^4.4.5"
}
}

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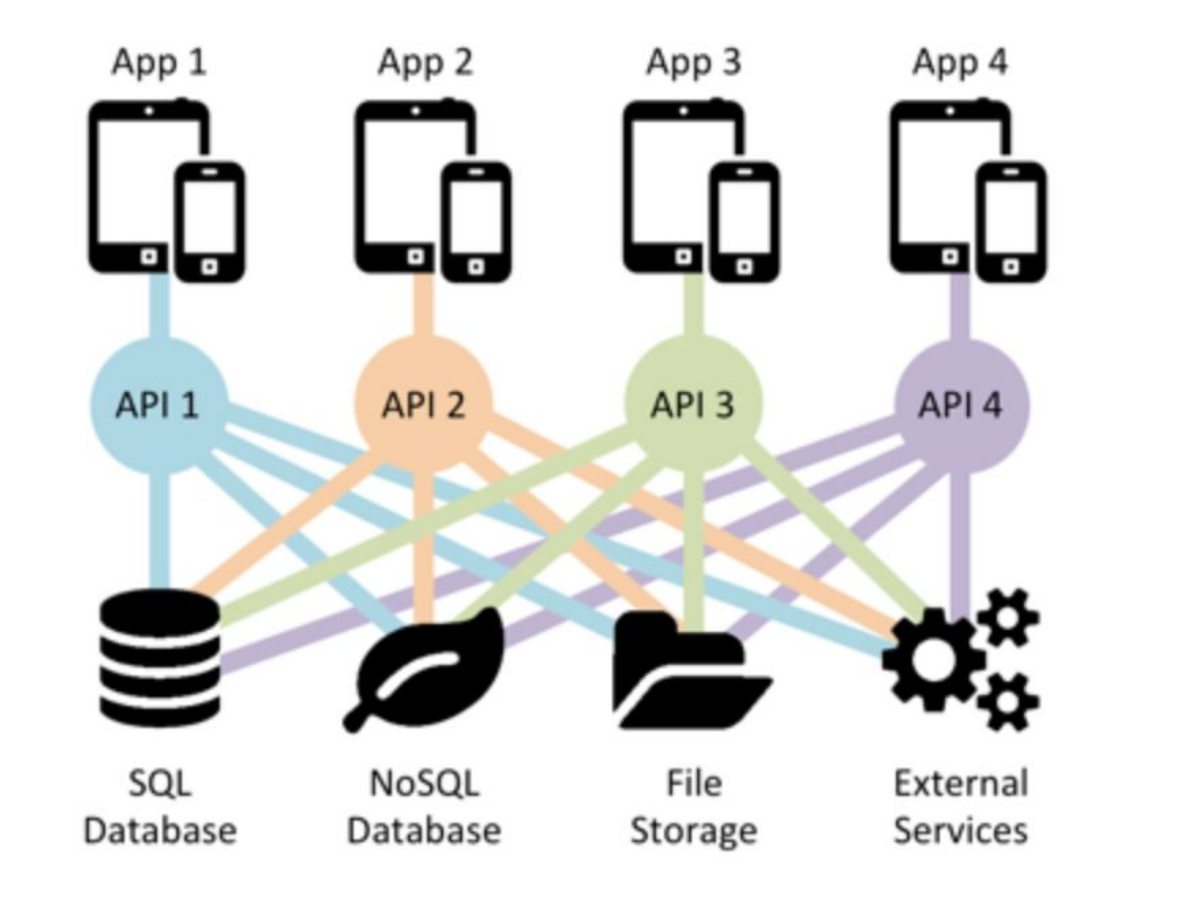
Issues incoming...

Code Duplication

Source: Mr. Hugo Weaving in “The Matrix Reloaded”, 2003. Photograph by Warner Bros./Photofest

Tight Coupling

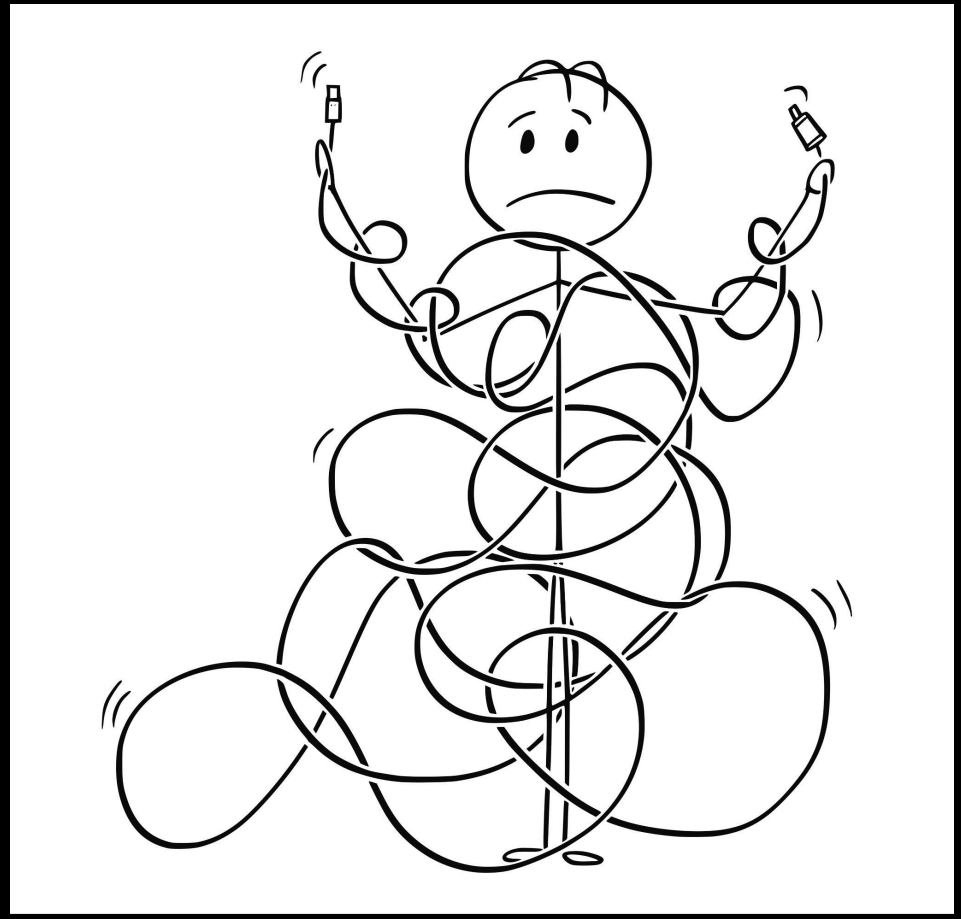


Source: [Jason Gilmore - What is Loose Coupling in REST APIs?]

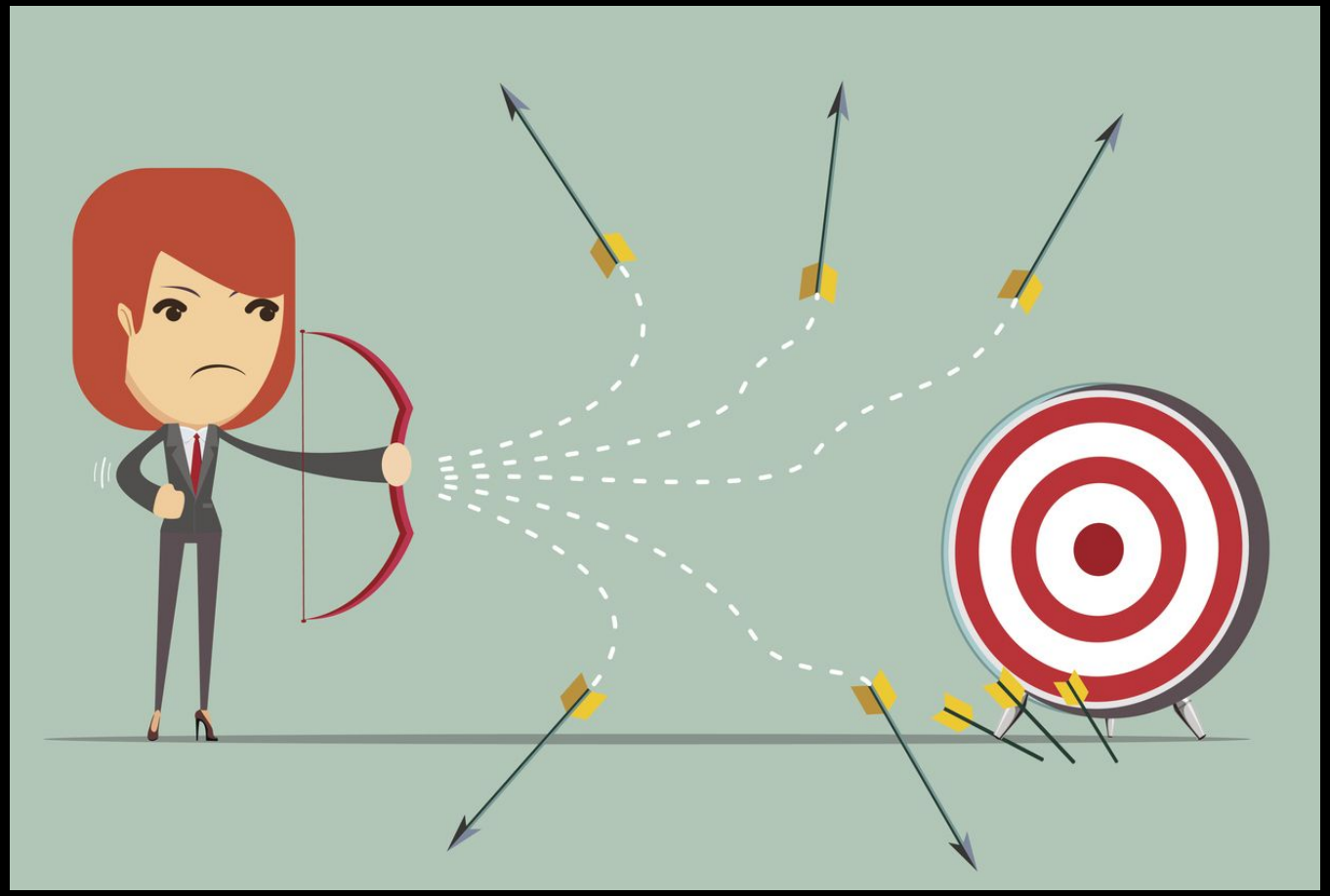
Scalability Challenges

Source: [Aran Davies - How to Scale a Software Product?]

Testing Complexity

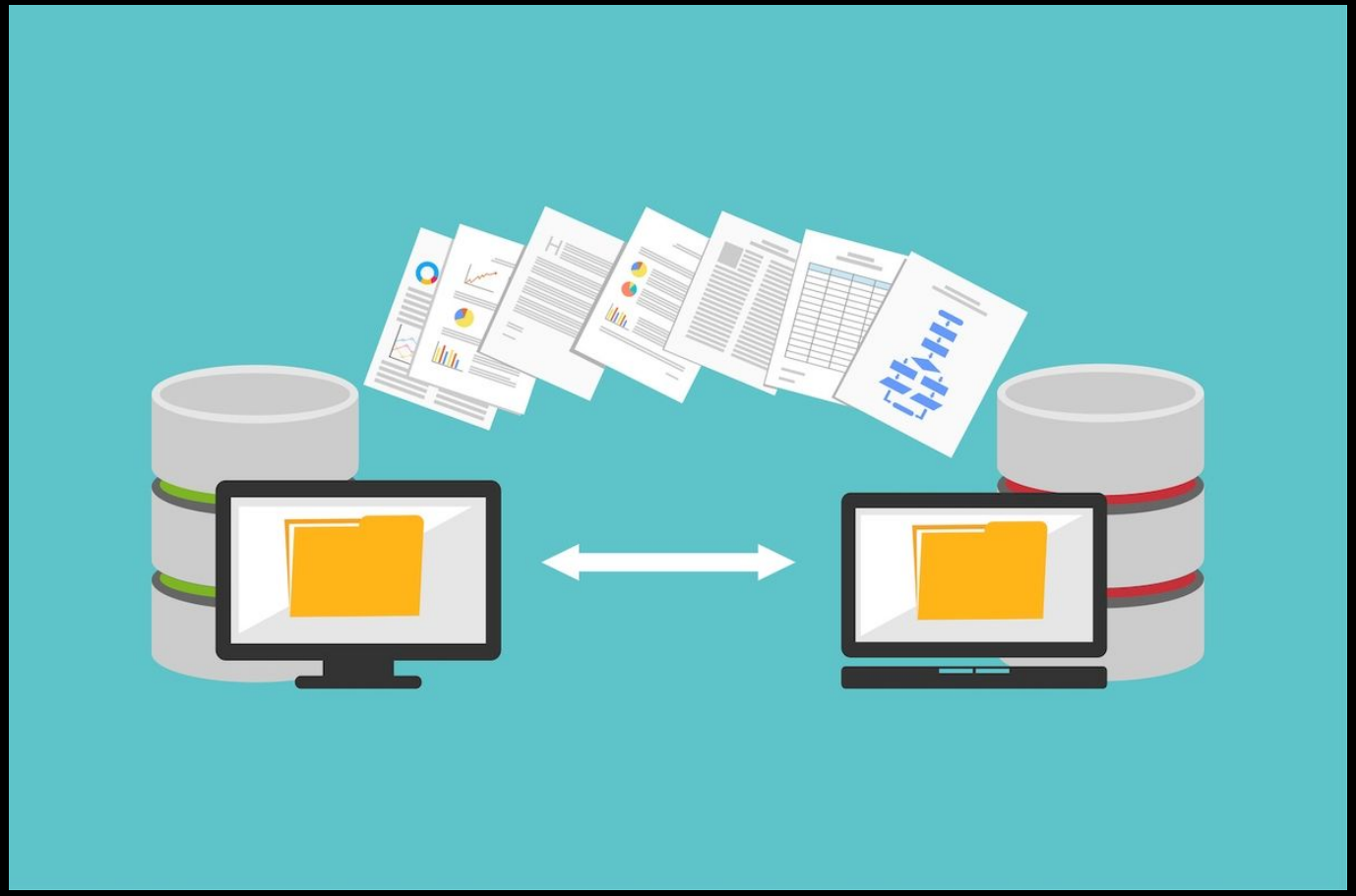


Inconsistencies



Source: [Jenna Gourlay - The 3 Secrets For Consistency... From the Consistently Inconsistent]

Difficulty in Migration

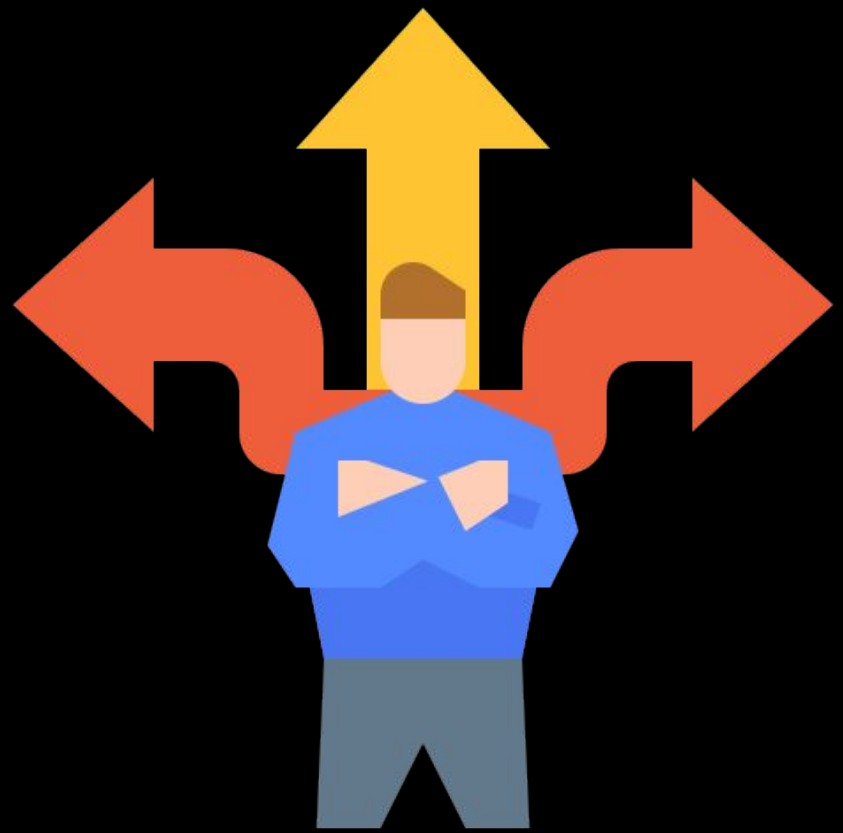


Source: Ali Azhar - What is data migration?

Reduced Maintainability

Source: Nina Perez - 3 types of Maintenance and How to go from Reactive to Predictive with IoT Technology

Lack of Flexibility



Source: Kavya Garg - Flexibility

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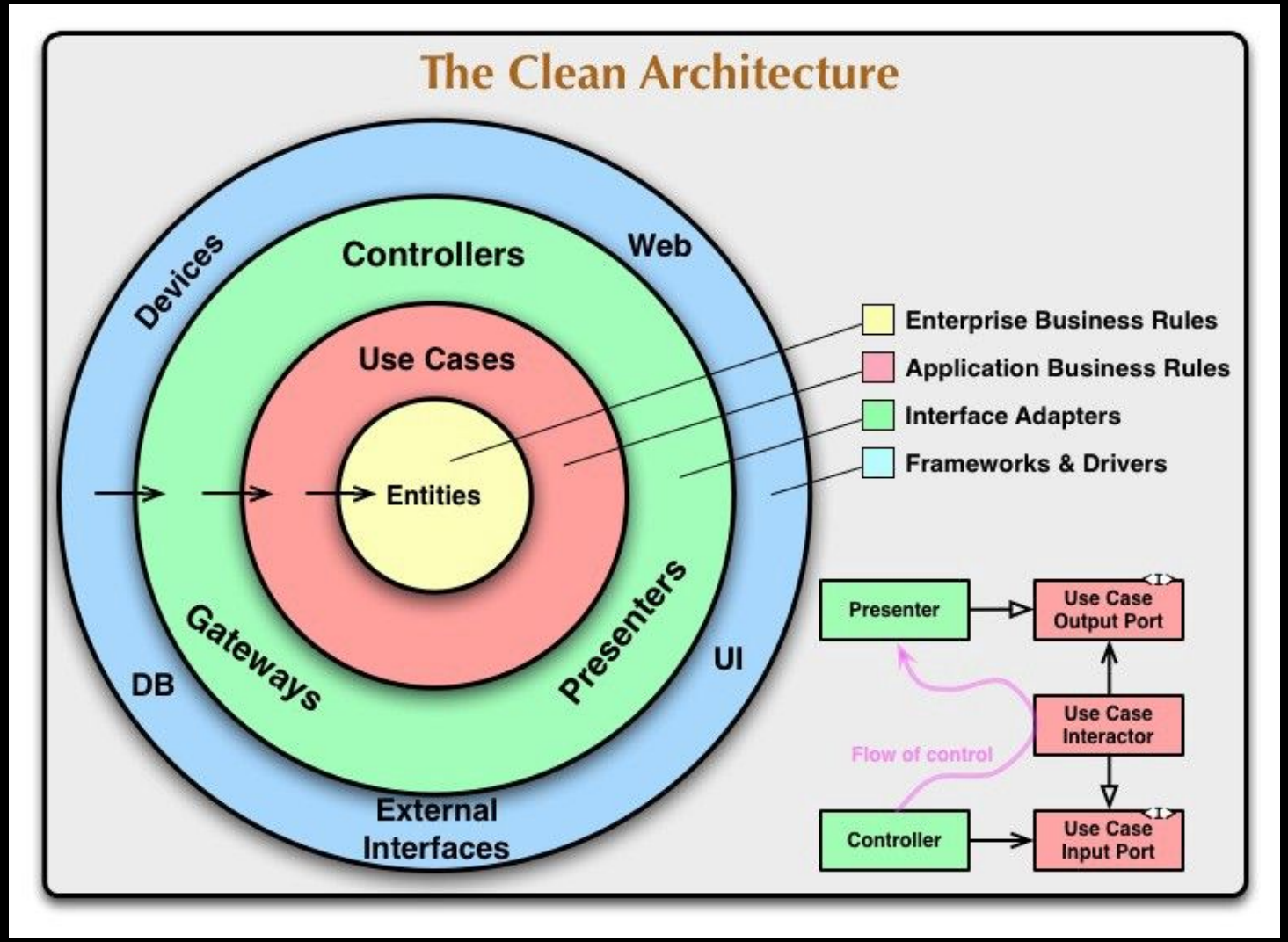
Clean Architecture

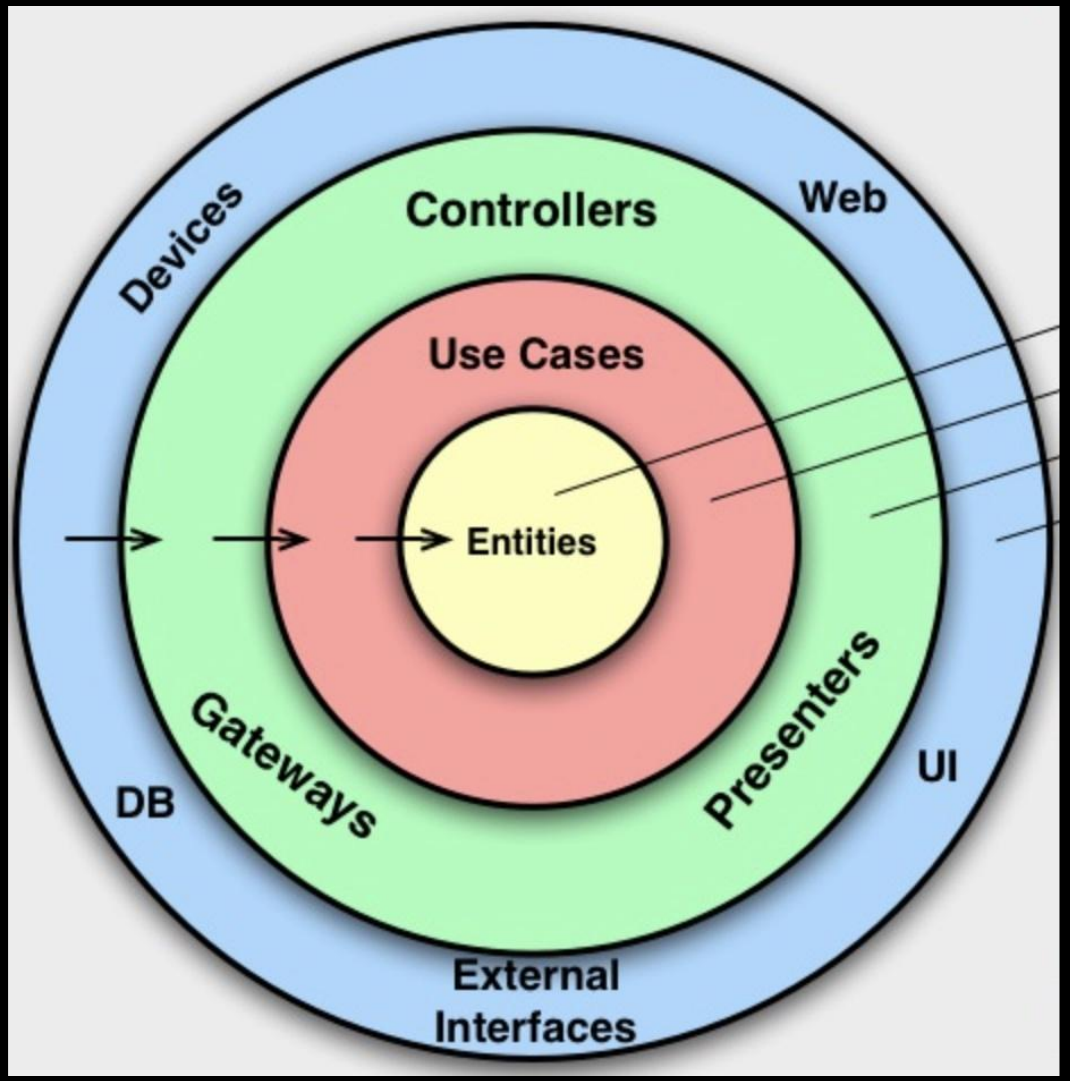


Source: [Robert C. Martin (Uncle Bob) - The Clean Code Blog]

Entities

Enterprise Business Rules

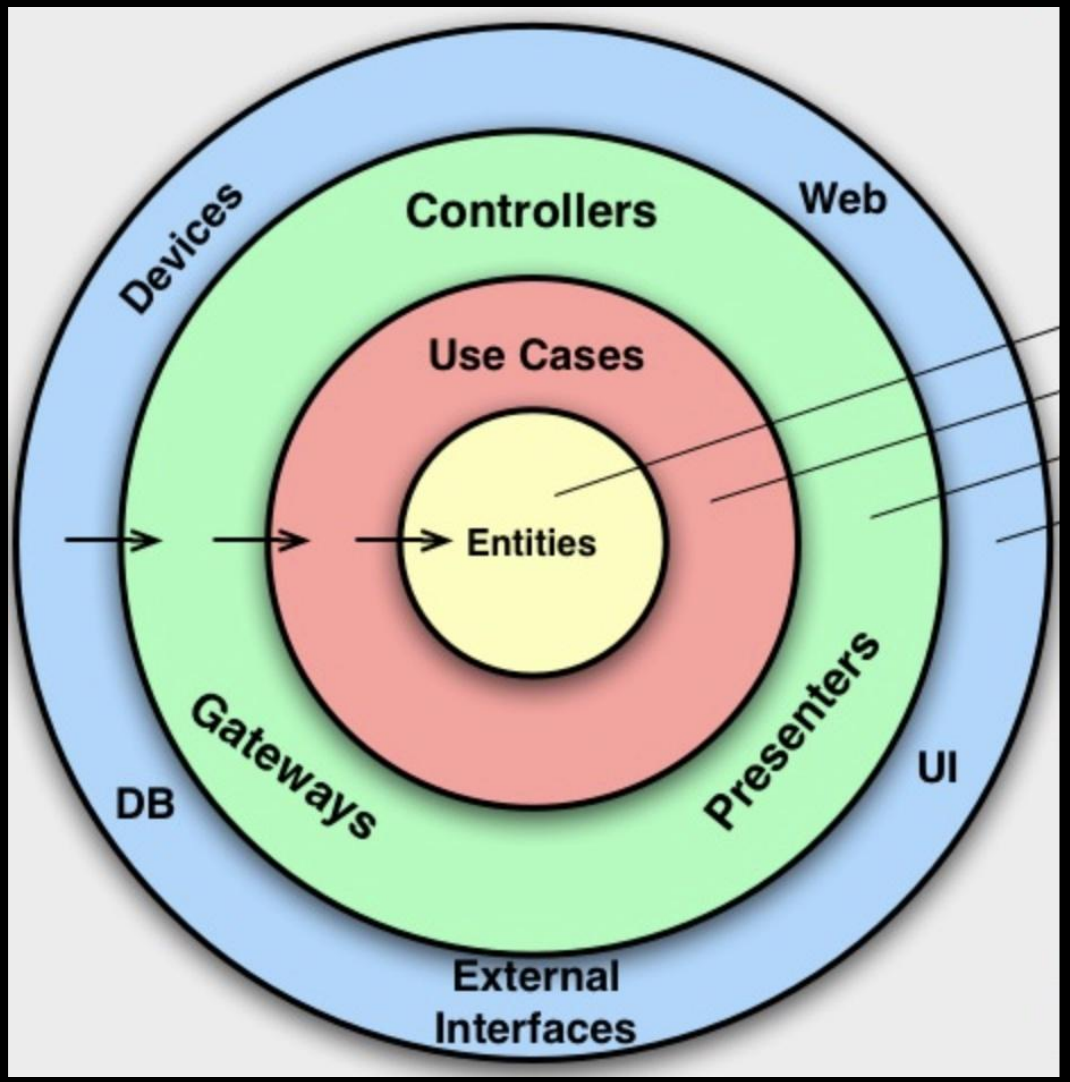
- Represent domain objects
- Contains business rules & business data
- Separated from every other concern in the application



Use Cases

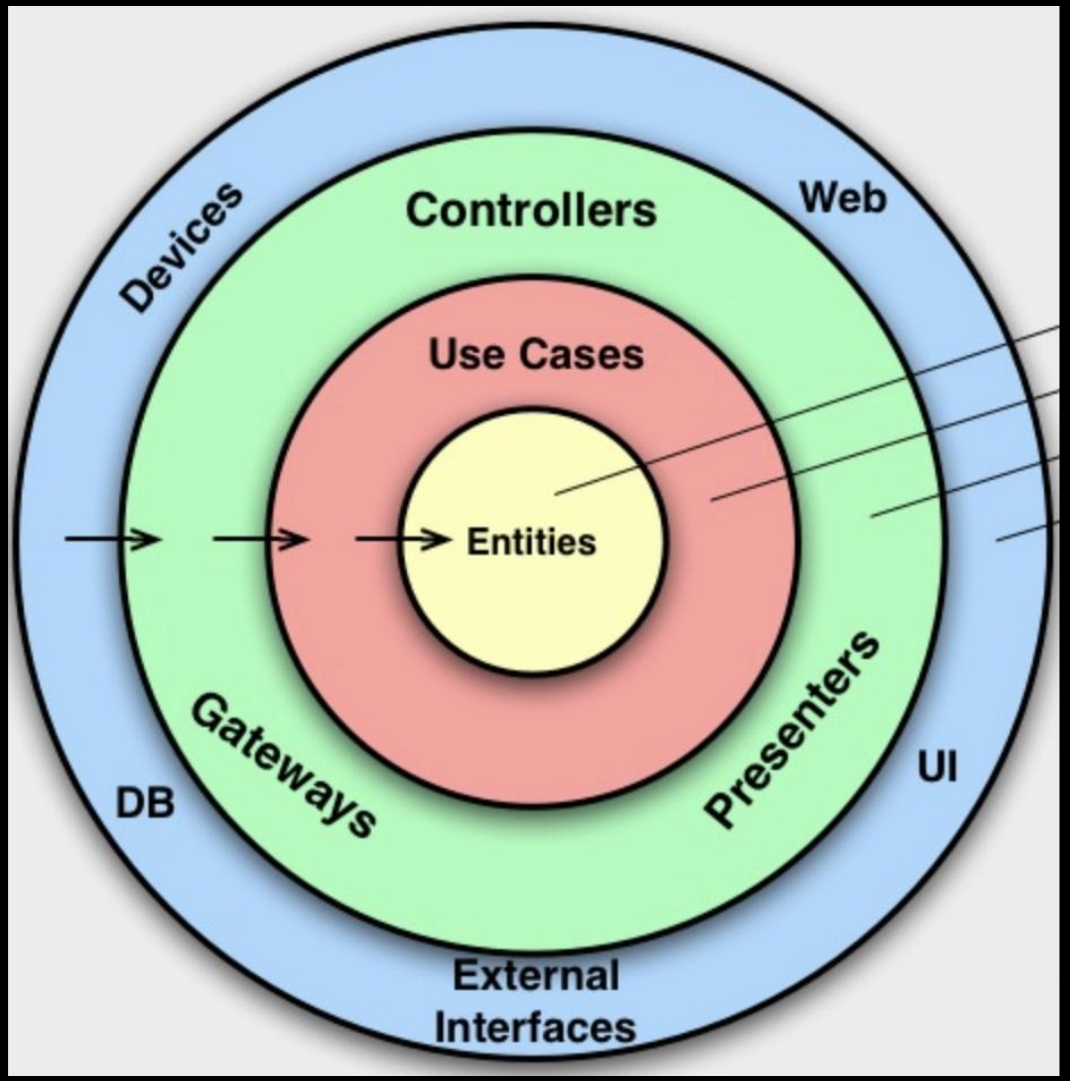
Application Business Rules

- Represent business actions
- Pure business logic



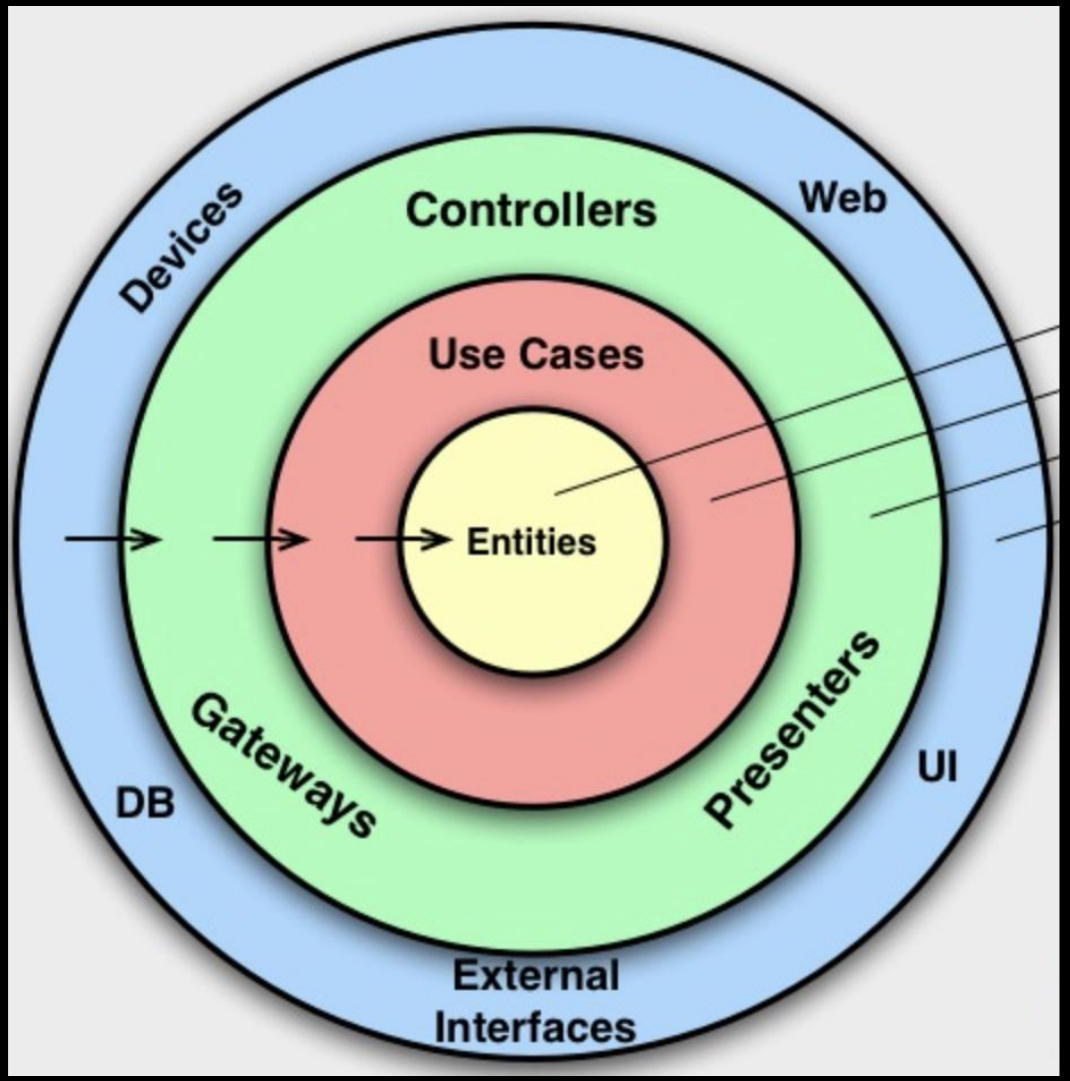
Interface Adapters

- Converts data from data layer to use case / entity layer & vice versa
- Implement the interfaces defined by the use case
- Trigger use cases
- Presenters, views & controllers all belong here



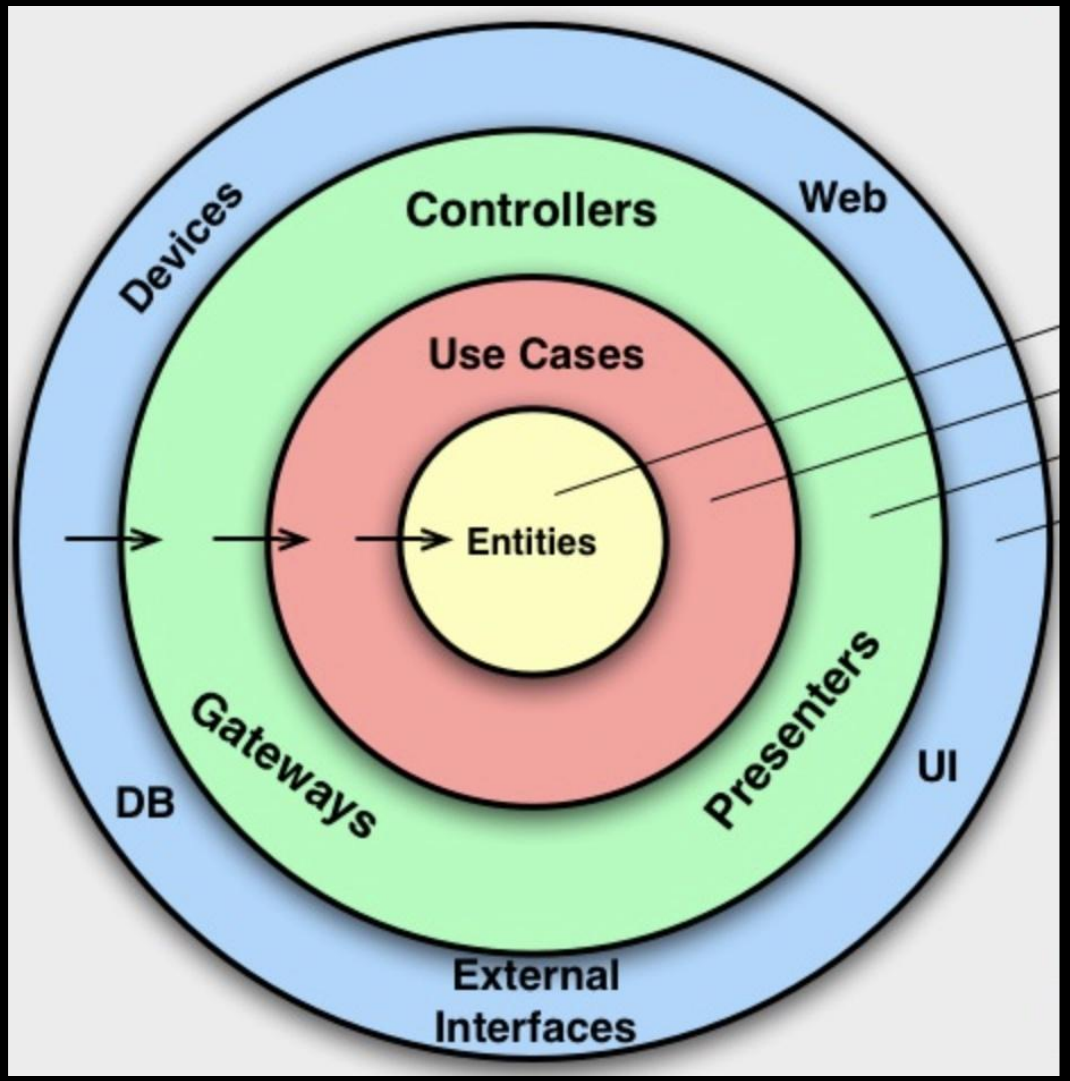
Frameworks & Drivers

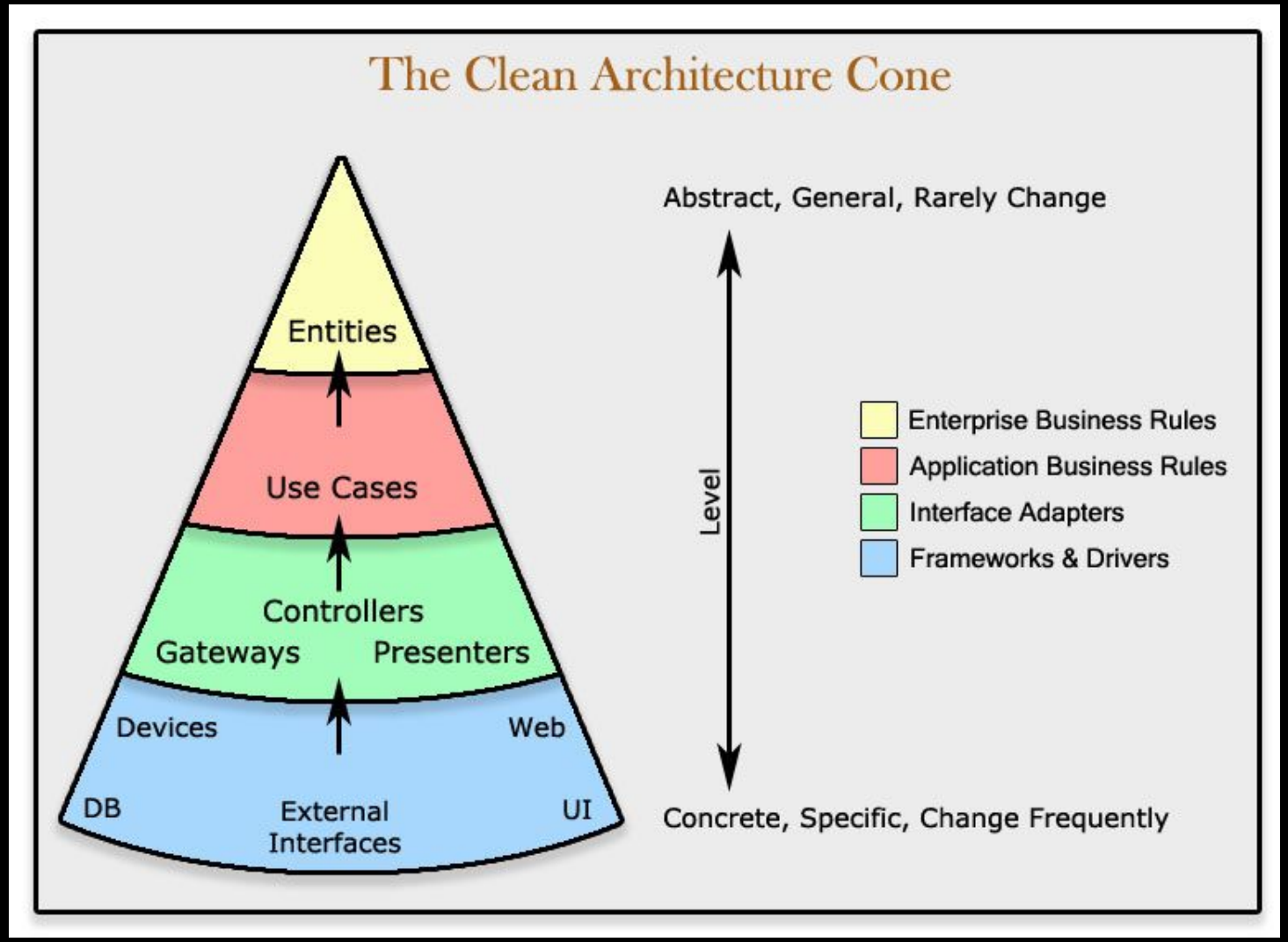
- Glue code that hooks up the various layers
- Composed of frameworks & tools
  - e.g., DB, Web Framework, etc.
- Isolates all details, like infrastructure, etc.
  - Can do little harm to the application
  - Makes it easy to replace



Crossing Boundaries

- Flow of control from the outside to the inside
- Dependency Inversion Principle:
  - Higher level components know nothing of the lower level components
  - Example
    - Use case needs to call a presenter
    - Use case calls an interface
    - Implementation of interface is provided by the interface adapter layer





Source: [Michael Outlaw - Clean Architecture – Make Your Architecture Scream]

How does this solve our issues?

CA's answer to issues

- Tight Coupling
  - CA promotes separation of concerns
  - Clear boundaries between different layers
  - Decoupling of components & modules by using interfaces & dependency injection
- Scalability Challenges
  - CA emphasizes modularity & organization
  - Isolating new features within specific layers or modules
- Testing Complexity
  - Components are independent & testable in isolation

CA's answer to issues

- Code Duplication
  - Creation of reusable components & services
- Inconsistencies
  - CA emphasizes consistent patterns & design principles throughout the app
- Difficulty in Migration
  - Modularity allows to encapsulate data access & other external dependencies
  - Switching components: Focus on updating specific layers or interfaces,
    - Minimizes the impact on the rest of the app

CA’s answer to issues

- Reduced Maintainability
  - Separation of concerns & modular design make maintenance easier
  - Updates & fixes within specific layers without affecting the entire app
- Lack of Flexibility
  - CA encourages loose coupling & abstraction
  - This makes replacing components or technologies easier when needed

Let's apply it with...

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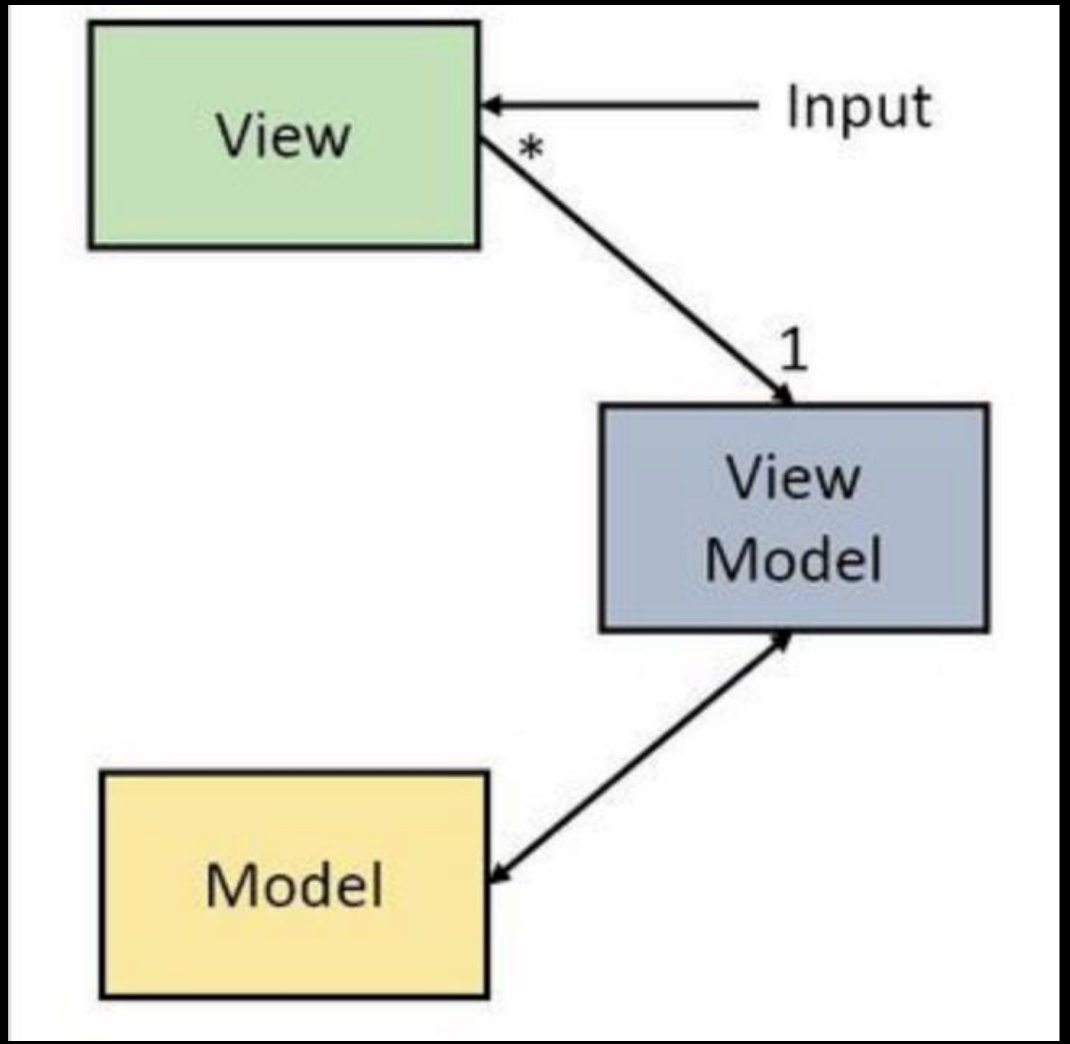
MVVM

MV* - Patterns

- Goal of the MV* - Patterns:
  - Separation of Concerns
  - Maintainability
  - Reusability
  - Testability

MVVM

- Model
  - Represents the app's data & business logic
- View
  - Displays data from the ViewModel in UI
  - Sends user input back to the ViewModel
- ViewModel (VM)
  - Exposes data from the Model to the View
  - Handles user interactions & processes them into actions on the Model



Source: T. Drilling & S. Augsten - Durchblick im JavaScript-Ökosystem

Why do we use MVVM?

- Separation of Concerns
  - Enforces separation between UI (View), presentation logic (VM), & underlying data (Model)
- Layers of Abstraction
  - VM acts as layer that abstracts the View from the Model,
    - VM keeps UI concerns separate from business logic
- Testability & Isolation
  - VM can be tested in isolation without needing the actual UI components

Why do we use MVVM?

- Business Logic
  - VM centralizes presentation logic & business rules
  - Use cases remain distinct components
  - VM coordinates use case execution as needed
  - This maintains a separation of concerns & modularity

- Data Flow
  - VM prepares & updates data for the View
    - Aligns with principles of CA by maintaining controlled flow of data from VM to View

Why do we use MVVM?

- Dependency Injection
  - VM can receive services & repositories via dependency injection
    - Enables VM to interact with external data sources & services without being tightly coupled to them
    - Helps to achieve the Dependency Inversion Principle within the context of CA

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A clean architecture-inspired app

Example: TODO app

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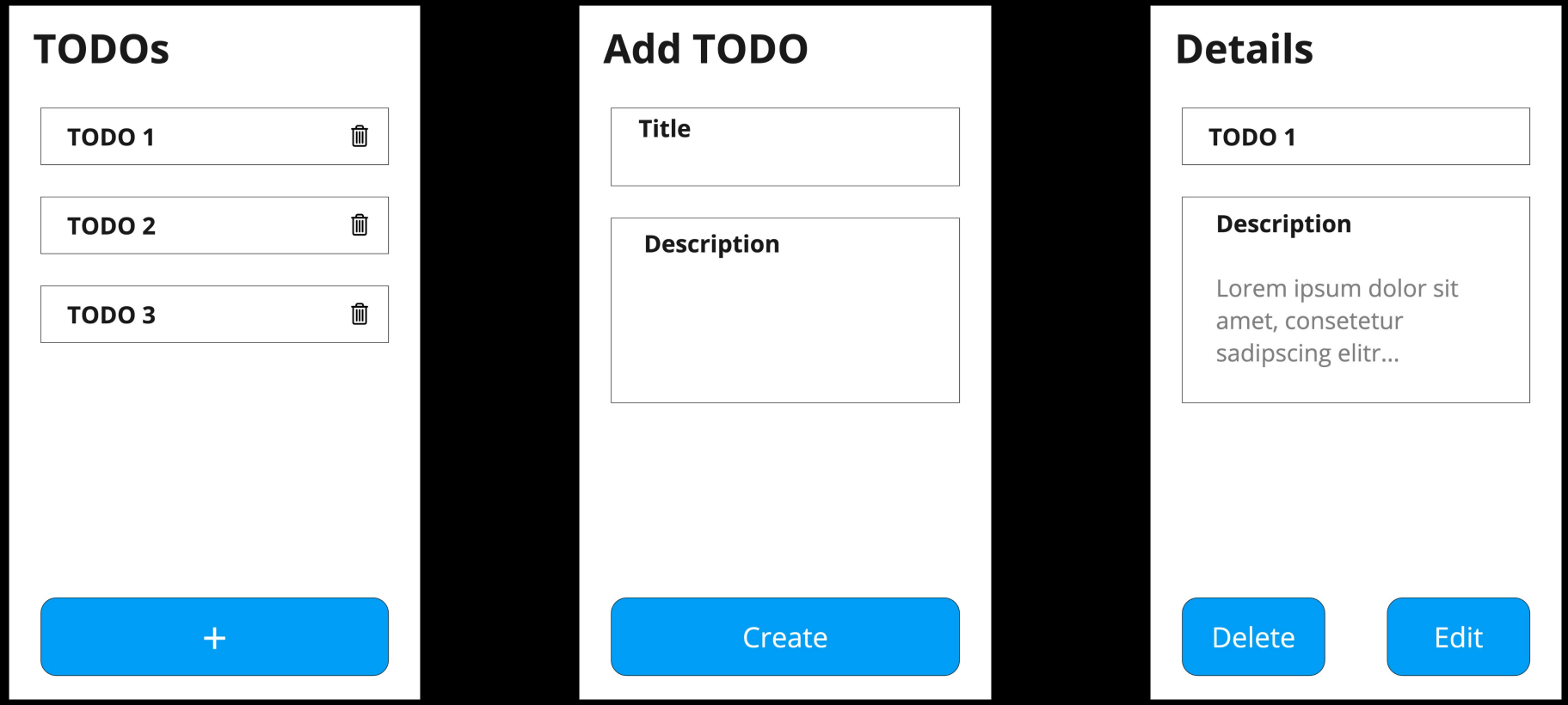
Example: TODO app

Features

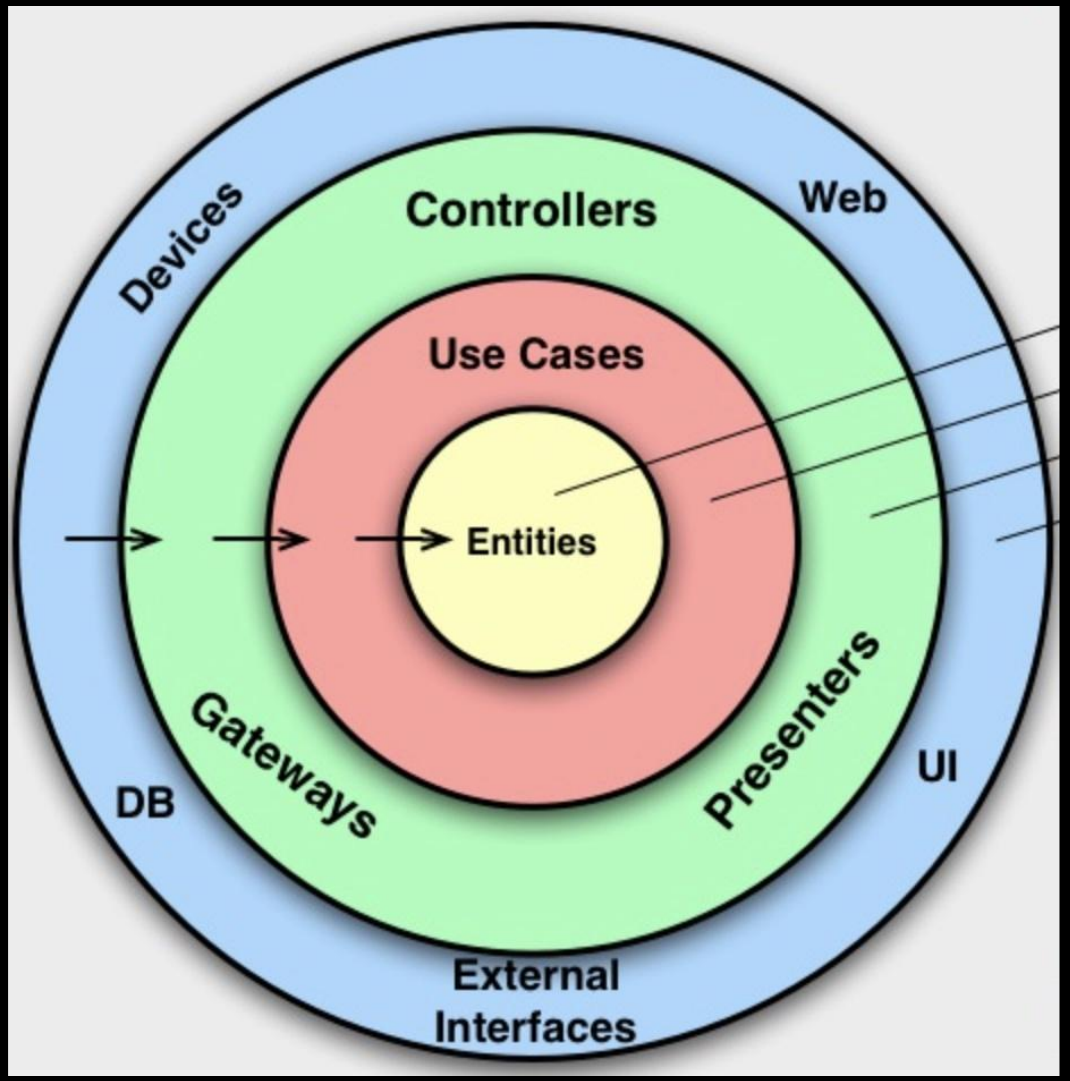
- List Todos
- Create a Todo
- Delete an existing Todo
- Update an existing Todo

UI


TODOs
TODO 1
TODO 2
TODO 3
+
Add TODO
Title
Description
Create
Details
TODO 1
Description
Lorem ipsum dolor sit amet, consetetur sadipscing elitr...
Delete
Edit

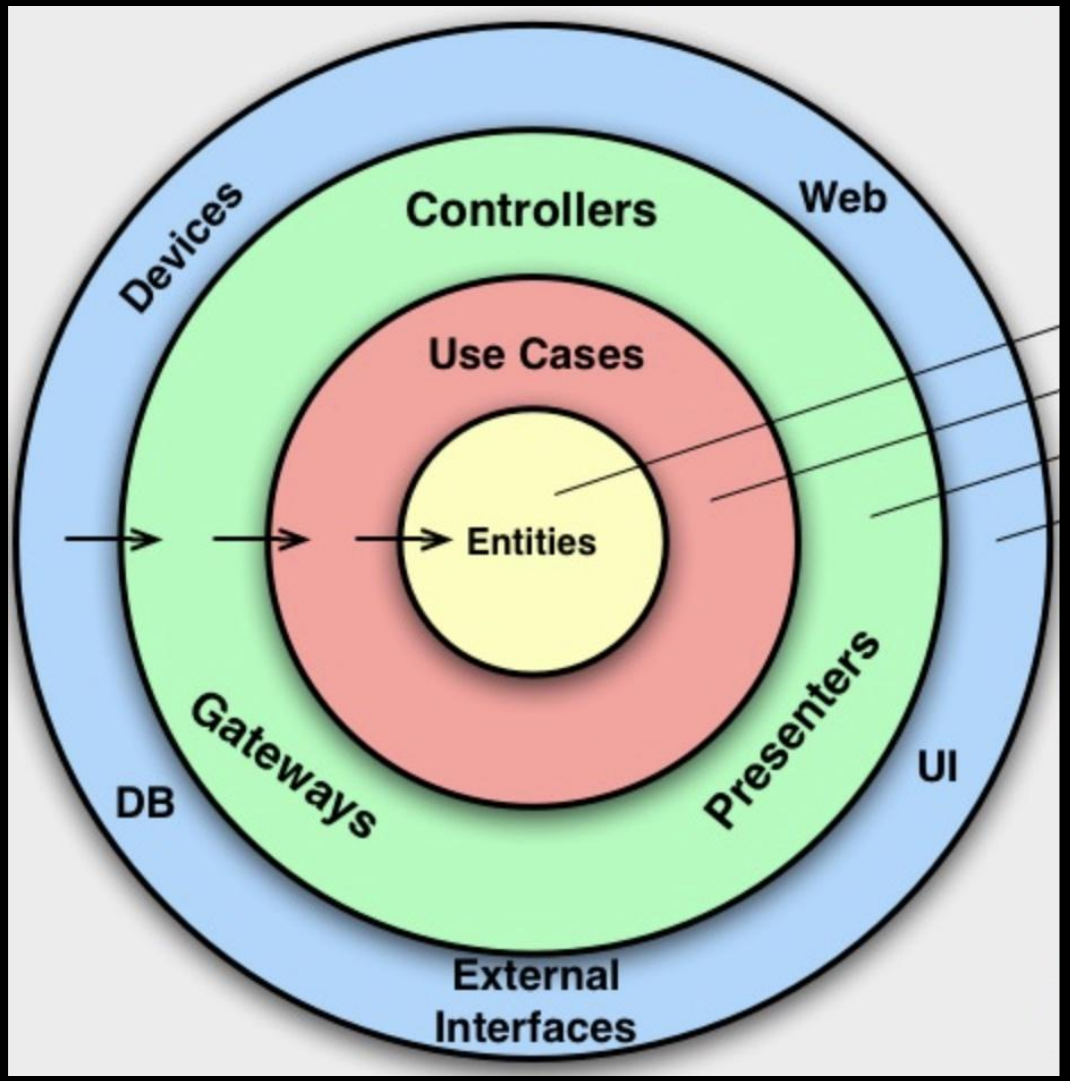
What layer?

- Entities:
  - Todo
- Use Cases:
  - Get Todos
  - Get Todo
  - Create Todo
  - Update Todo
  - Delete Todo

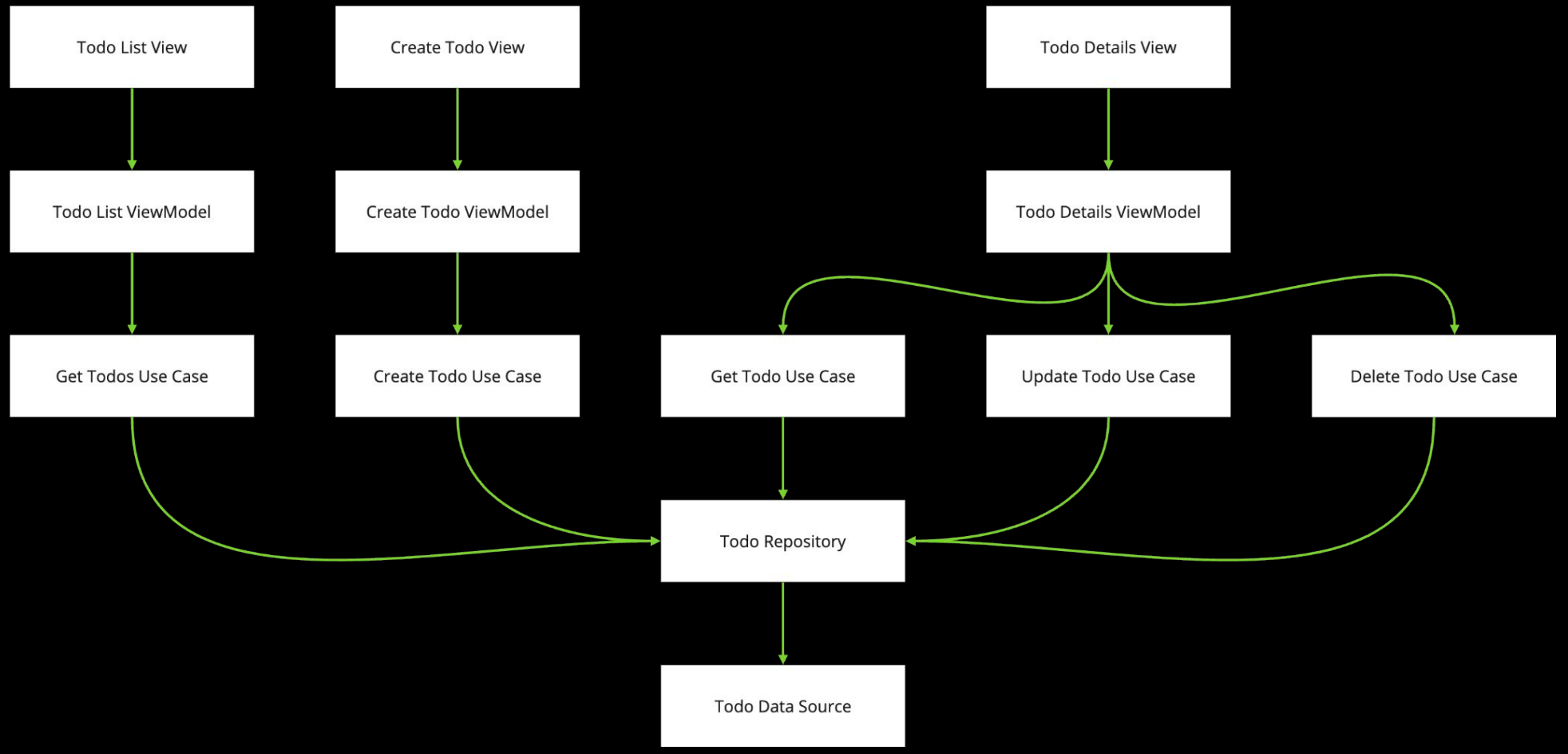


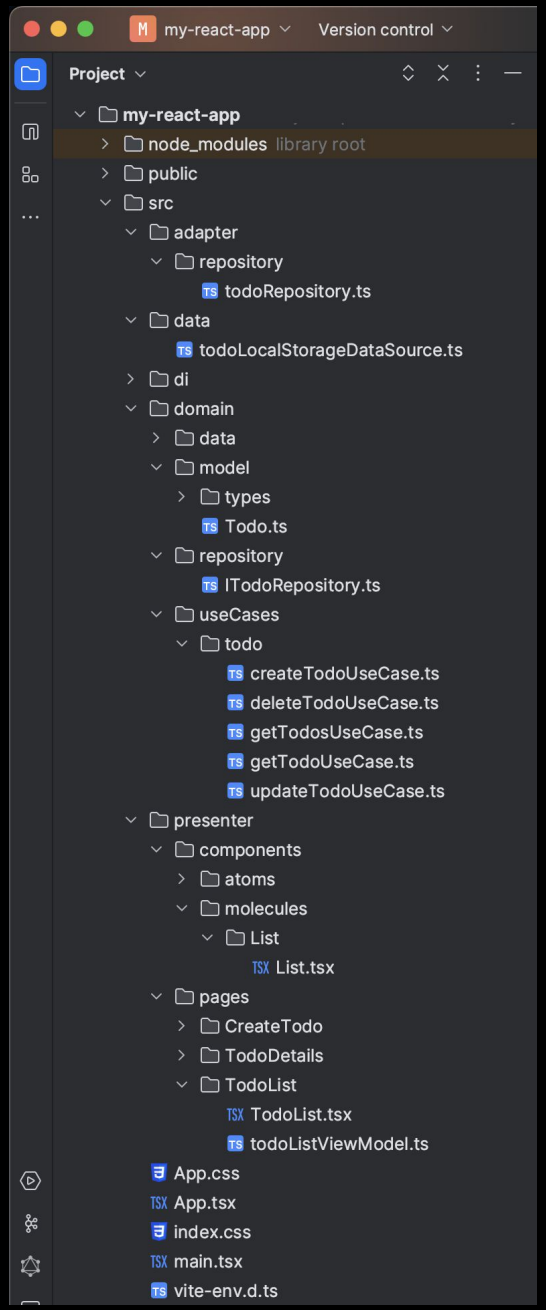
What layer?

- Interface Adapters:
  - Presenters
    - Todo List View & VM
    - Create Todo View & VM
    - Todo Details View & VM
  - Todo Repository
- Frameworks & Drivers:
  - Todo DB / Store



Application Flow




my-react-app
Version control
Project
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src
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data
model
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repository
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deleteTodoUseCase.ts
getTodosUseCase.ts
getTodoUseCase.ts
updateTodoUseCase.ts
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atoms
molecules
List
List.tsx
pages
CreateTodo
TodoDetails
TodoList
TodoList.tsx
todoListViewModel.ts
App.css
App.tsx
index.css
main.tsx
vite-env.d.ts

View

```
export const TodoList: FC = () => {
    const navigate : NavigateFunction  = useNavigate()

    const {todos, deleteItem} = DI.resolve( name: "todoListViewModel")

    return <div style={{display: "flex", flexDirection: "column", rowGap: "1rem"}}>
        <Header title="TODOs"/>
        <List
            items={todos}
            onItemClick={todo : Todo  => navigate( to: `/todo/detail/${todo.id}`)}
            onItemDelete={todo : Todo  => deleteItem(todo.id)}
        />
        <Button label={"+"} onClick={() => navigate( to: "/todo/create")}/>
    </div>
}
```

Dependency Injection

```
import {asFunction, asValue, createContainer} from "awilix";

const container : AwilixContainer<any>  = createContainer();

container.register( nameAndRegistrationPair: {
    todoRepository: asFunction(todoRepository),
    todoDataSource: asValue(TodoLocalStorageDataSource),
    todoListViewModel: asFunction(todoListViewModel),
    createTodoViewModel: asFunction(createTodoViewModel),
    todoDetailsViewModel: asFunction(todoDetailsViewModel),
    getTodosUseCase: asFunction(getTodosUseCase),
    deleteTodoUseCase: asFunction(deleteTodoUseCase),
    createTodoUseCase: asFunction(createTodoUseCase),
    getTodoUseCase: asFunction(getTodoUseCase),
    updateTodoUseCase: asFunction(updateTodoUseCase),
})

5+ usages
export const DI : AwilixContainer<any>  = container
```

ViewModel

```
export const todoListViewModel = ({getTodosUseCase, deleteTodoUseCase}: Dependencies) : {deleteTodo: (id: Id) => Promise<void>, todos: ...}  => {
    const [todos : Todo[] , setTodos : React.Dispatch<React.SetStateA... ] = useState<Todo[]>( initialState: []);

    1 usage
    const getTodos = async () : Promise<void>  => {
        const result : Todo[]  = await getTodosUseCase.execute()
        setTodos(result)
    }

    no usages
    const deleteTodo = async (id: Id) : Promise<void>  => {
        await deleteTodoUseCase.execute(id)
        setTodos(todos.filter(todo : Todo  => todo.id !== id))
    }

    1 usage
    const sortById = (prevTodo: Todo, todo: Todo) : number  => prevTodo.id < todo.id ? -1 : prevTodo.id > todo.id ? 1 : 0

    useEffect( effect: () : void  => {
        void getTodos()
    }, deps: [])

    return {todos: todos.sort(sortById), deleteTodo}
}
```

Use Cases

```
export const getTodosUseCase = ({todoRepository}: Dependencies): UseCase<Todo[]> => ({
    execute: () => todoRepository.get()
})
```

```
export const deleteTodoUseCase = ({todoRepository}: Dependencies): UseCaseWithParams<void, Id> => ({
    execute: (id: Id) => todoRepository.delete(id)
})
```

Repository

```
export const todoRepository = ({todoDataSource}: Dependencies): ITodoRepository => {
    1 usage
    const get = () => todoDataSource.getAll()

    1 usage
    const getById = (id: Id) => todoDataSource.getOne(id)

    1 usage
    const create = (title: string, description: string) =>
        todoDataSource.createOne( todo: {title, description})

    1 usage
    const update = (id: Id, title: string, description: string) =>
        todoDataSource.updateOne( todo: {id, title, description})

    1 usage
    const deleteTodo = (id: Id) => todoDataSource.deleteOne(id)

    return {get, getById, create, update, delete: deleteTodo}
}
```

Data Source

```
const COLLECTION_NAME: string = "todos"

5+ usages
export const getAll = (): Promise<Todo[]> => {
    try {
        const result : string | null  = localStorage.getItem(COLLECTION_NAME)
        return result !== null ? JSON.parse(result) : []
    } catch (error) {
        return Promise.reject(error)
    }
}

1 usage
export const deleteOne = async (id: Id): Promise<void> => {
    const todos : Todo[]  = (await getAll()).filter(({id: todoId : string }) : boolean  => todoId !== id)

    localStorage.setItem(COLLECTION_NAME, JSON.stringify(todos))
}
```

Thanks!

Any questions?

https://spaceteams.de