Dependency injection made easy with Dagger2

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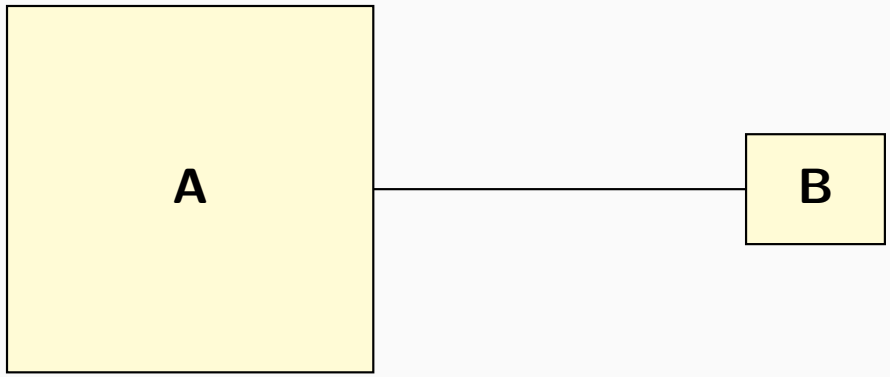
Agenda

1. Dependency injection principles
2. Dagger2
3. Dagger2 Android
4. Alternative patterns

Dependency injection principles

What is a dependency?



```
/** Class A (the client) */
class A {
    // ....
    fun doSomething() {
        b.log("text")
    }
}

/** Class B (dependency/service) */
class B {
    fun log(text : String) {
    }
}
```

```
// Option 1 - static methods

class A {
    fun doSomething() {
        B.log("text") // <- static method
    }
}

class B {
    companion object {
        fun log(text: String) {
        }
    }
}
```

Examples:

- Helper classes
- Utils classes
- Manager classes, etc. . .

Drawbacks:

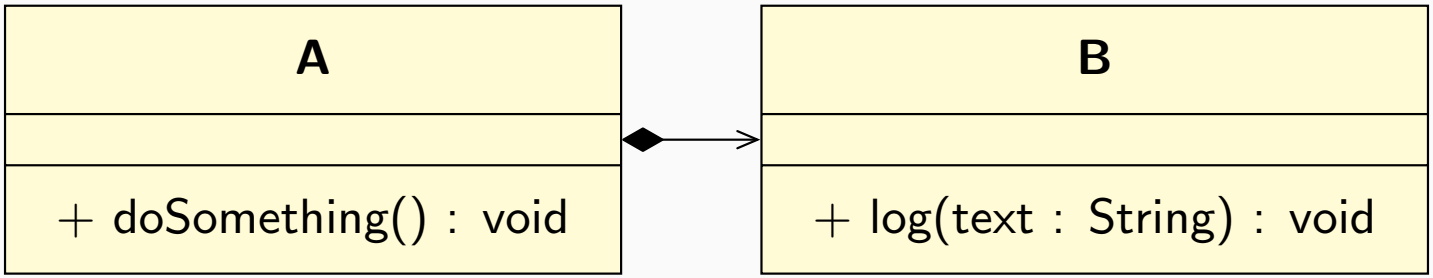
- A not testable in isolation (integration test of A & B)
- A *strongly coupled* to B (hardcoded dependency, no way to override/replace it)
- Lack of encapsulation (backdoor)
- *Hidden* dependency

More Examples:

- `Application.getStaticContext()`
- in order to move one class to a different module, you have to move “hundreds“ of classes. . .

```
// Option 2 - singletons

class A {
    fun doSomething() {
        B.log("text") // <- singleton
    }
}

object B {
    fun log(text: String) {
    }
}
```

```
// Option 3 - composition

class A {
    private val b : B = B() // <-- instantiate

    fun doSomething() {
        b.log("text")
    }
}

class B {
    fun log(text: String) {
    }
}
```



The *life* of the child is completely controlled by the parent.

Example:

- Custom views or adapters instantiating objects
- `Date date = new Date()` (imagine test today date)

Drawbacks:

- A is in charge of instantiating B (additional responsibility)
- A can't be tested in isolation (integratin test of A and B together)
- A is strongly coupled to B (can't replace B rom outside and/or in testing)

```
// Externalise the dependency

class A(private val b : B) {
    fun doSomething() {
        b.log("text")
    }
}

class B {
    fun log(text: String) {
    }
}
//
val b : B = B()
val a : A = A(b) // <-- plug b
```

We can do even better. . .

```
class A(private val b : B) {
    fun doSomething() {
        b.log("text")
    }
}

interface B {
    fun log(text: String);
}

class AmazingB : B {
    override fun log(text : String) {
    }
}
//
val b : B = AmazingB()
val a : A = A(b)
```

Now we have:

- Full decoupling
- A loosely coupled to B (A knows anything about B but the contract)
- Inversion of control[1]: it's no longer responsibility of A to get its own dependencies

[1] Not yet actually... We miss an ingredient

There is a problem:

```
class C {
    fun qhdouwh() {
        val b = AmazingB() // <-- not good
        val a = A(b) // <-- not good
        a.doSOmething()
    }
}
```

We want (recursively)

```
class C(private a : A) { // A being now an interface
    fun qhdouwh() {
        a.doSOmething()
    }
}
```

Antipattern: we want...

```
class MainActivity : AppCompatActivity() {

    lateinit var presenter : Presenter

    override fun onCreate(bundle: Bundle?) {
        super.onCreate(savedInstanceState)
        setContentView(R.layout.activity_main)
        presenter.doSomething()
    }
}
```

...instead we get

```
class MainActivity : AppCompatActivity() {

    lateinit var presenter : Presenter

    override fun onCreate(bundle: Bundle?) {
        super.onCreate(savedInstanceState)
        setContentView(R.layout.activity_main)
        val okHttp : OkHttp = /*...*/
        val gson : Gson = GsonBuilder = /*...*/
        val retrofit : Retrofit = /*...*/
        val repository : Repository = /*...*/
        val usecase : UseCase = /*...*/
        val presenter : Presenter = /*...*/
        presenter.doSomething()

    }
}
```

Question

If

- A is not in charge of getting B
- C should not be in charge of instantiating A and B

who is in charge?

In software engineering, dependency injection is a technique whereby one object supplies the dependencies of another object. A dependency is an object that can be used (a service). An injection is the passing of a dependency to a dependent object (a client) that would use it. The service is made part of the client's state. Passing the service to the client, rather than allowing a client to build or find the service, is the fundamental requirement of the pattern.

It directly contrasts with the service locator pattern, which allows clients to know about the system they use to find dependencies.

Source: `https://en.wikipedia.org/wiki/Dependency_injection`

Ingredients:[2]

modules : it containes recipies (methods) to instantiate the dependencies

injector/component : wiring and feed the target with the dependencies it needs

- Often, the injector is also responsible of instantiating the client itself. Sometimes this is not possible (e. g., Android)
- Modules are pluggable in the injector

[2]Preparing the ground for dagger terminology, but here we are not using dagger yet

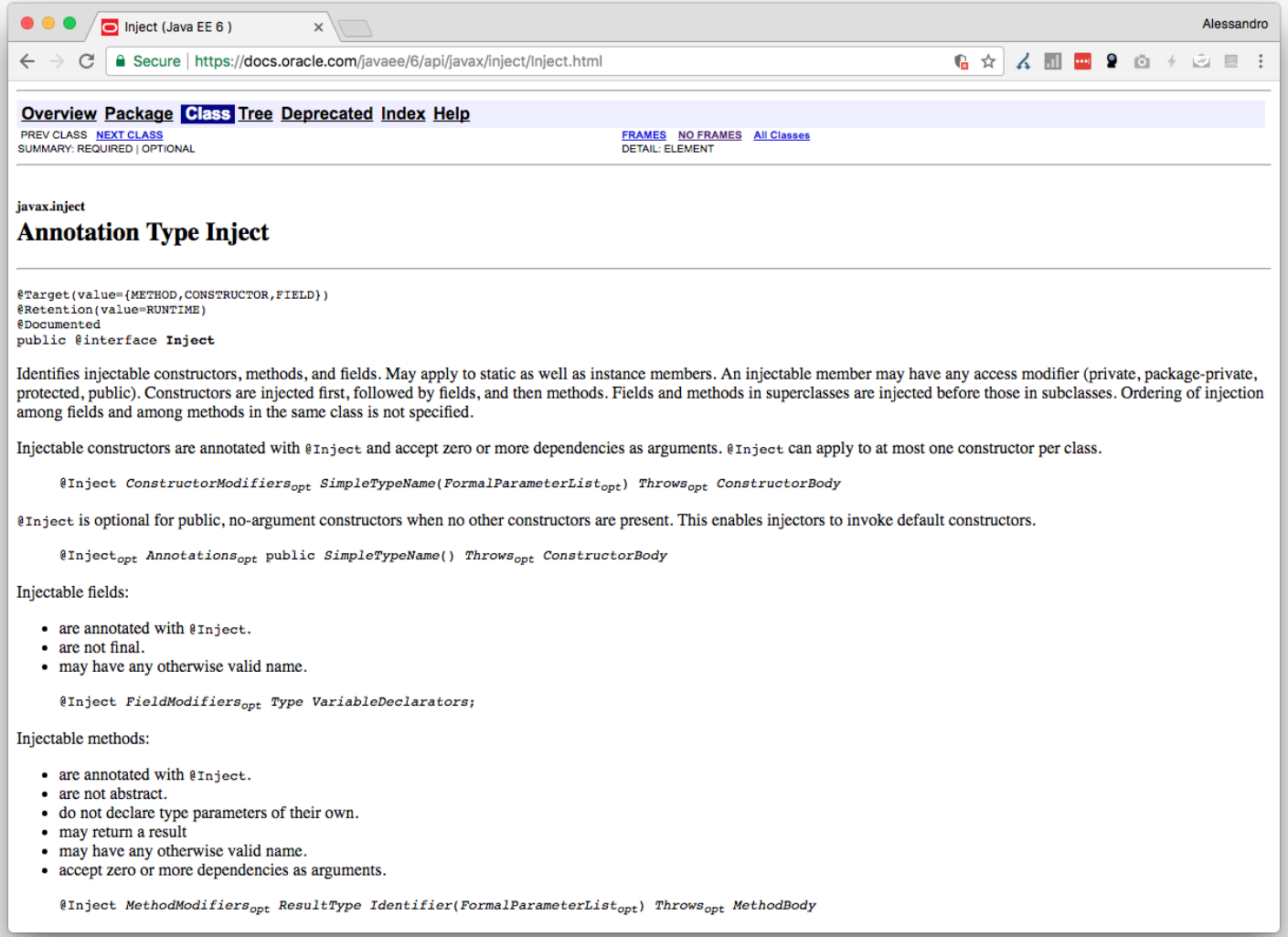
Injector

- ensures inversion of control (i. e., *duality*):
  - You reverse the control of the object dependencies from the object to the one who is calling the object
- restores single responsibility principle

```
// injector  (wiring things up)
interface Component {
    fun inject(activity : MainActivity)
}

// provides the dependencies
class Module {
    fun providePresenter(): Presenter {

    }
}
```

```
class MainActivity : AppCompatActivity() {

    @Inject
    lateinit var presenter : Presenter

    override fun onCreate(bundle: Bundle?) {
        val injector = InjectorImplementation();
        injector.inject(this);
        super.onCreate(savedInstanceState)
        setContentView(R.layout.activity_main)
        presenter.doSomething()
    }
}
```

Activity accepts the dependencies from an injector. It is no longer responsible for creating the dependecies needed, or to delegate instantiation to another object



https://docs.oracle.com/javaee/6/api/javax/inject/Inject.html

```
// provides the dependencies
class Module {
    fun providePresenter(): Presenter {
        val okHttp : OkHttp = ...
        val gson : Gson = GsonBuilder = ...
        val retrofit : Retrofit = ...
        val repository : Repository = /*...*/
        val usecase : UseCase = /*...*/
        return Presenter(usecase)
    }
}
```

We can be more granular:

```
class Module {
  fun providesOkHttp() : OkHttp = /*..*/
  fun providesGson() : Gson = /*..*/
  fun providesRetrofit(gson:Gson, okHttp : OkHttp)
       : Retrofit = /*..*/
  fun providesRepository(retrofit : Retrofit)
       : Repository = /*..*/
  fun providesUseCase(repository:Repository)
       : UseCase = /*..*/

  fun providePresenter(useCase: UseCase)
       : Presenter = PresenterImpl(usecase)
}
```

- modules provide a flexible, pluggable, *declarative* definition on how to instantiate dependencies in the modules
- we have just to implement the interface for the injector that builds the necessary dependencies and plug them into the target (wiring)

The end. . . (really?)

inconveniences

- Boilerplate in implementing the injector
- Combinatorial explosion when chaining mutual dependencies

Dependency injection frameworks help to *automatic organise* the graph of dependencies.

Common DI frameworks for the Java platform:

- Pivotal's Spring Core Container (autowiring)
- Google's Guava
- Square's Dagger1
- Google's Dagger2

Two strategies (common in java):

- Reflection (runtime)
- JSR-269 Annotation processing (compile time)

Pros/cons. . .

Dagger2

Dagger2 is

- fully static
- compile-time
- annotation processing based
- Java/Android
- dependency injection framework
- for organising dependencies into a *directed acyclic graph* (DAGger)

```
// Gradle module file
implementation group: 'com.google.dagger', \
        name: 'dagger', \
        version: '2.14.1'
implementation group: 'com.google.dagger', \ // <--
     name: 'dagger-compiler',
     version: '2.14.1'
```

Check https://mvnrepository.com/artifact/com.google.dagger/dagger/

```
@Module
class NetworkModule {
  @Provides
  fun providesOkHttp() : OkHttp = /*..*/

  @Provides
  fun providesGson() : Gson = /*..*/

  @Provides
  fun providesRetrofit(gson:Gson, okHttp : OkHttp)
       : Retrofit = /*..*/
}
```

```
@Module
class RetrofitModule {

    companion object {
        private val BASE_URL = "http://content.guardianapis.com"
    }

    @Singleton
    @Provides
    fun providesRetrofit(okHttpClient: OkHttpClient, gson : Gson) =
            Retrofit.Builder()
                    .baseUrl(BASE_URL)
                    .client(okHttpClient)
                    .addConverterFactory(GsonConverterFactory.create(gson))
                    .addCallAdapterFactory(RxJava2CallAdapterFactory.create())
                    .build()

    @Provides
    fun providesGuardianService(retrofit: Retrofit) = retrofit.create(GuardianService::class.java)

}
```

```
@Component(modules = arrayOf(
        ModuleA::class,
        ModuleB::class,
        ModuleC::class
))
interface ApplicationComponent {

        fun inject(activity : MainActivity)
}
```

```
val applicationComponent =
    DaggerApplicationComponent.builder() // <--
      .moduleA(ModuleA())
      .moduleB(ModuleB())
      .moduleC(ModuleC())
      .build()
```

Some dependencies are application-wise (e. g., network or DB). They will be provided through a component rooted at the application level:

```
class MyApplication : Application() {
  lateinit var component: ApplicationComponent
  override fun onCreate() {
    super.onCreate()
    applicationComponent
      = DaggerApplicationComponent.builder()
          .moduleA(ModuleA(this))
          .moduleB(ModuleB())
          .moduleC(MOduleC())
          .build()
    }
}
```

Strategy:

- Avoid relying only on application level components; scope your dependencies (e. g., have other components rooted at activity/fragment classes)
- Subcomponents allow to have visibility on higher-component dependencies (e. g., a presenter can see netwok request dependencies)
- Scopes are defined by where the component is rooted (annotations can help identify scoping issues)
- Scopers are not related to android
- the purpose of scope annotations is to point Dagger provide either scoped or unscoped objects. But its our responsibility to “scope”.
- Dependencies are instantiated on-demand if/when needed

```
@MyActivityScope
@Component(modules = arrayOf(ModuleD::class))
interface MyActivityComponent {
    fun inject(activity: MyActivity)
}

@Scope
@Retention(AnnotationRetention.RUNTIME)
annotation class MyActivityScope
```

Warning!

Module *D* will not have access to dependencies defined in modules *A*, *B* and *C* for application component, because this is a new independent component

```
val myActivityComponent =
    DaggerMyActivityComponent.builder() // <--
      .moduleA(ModuleD())
      .build()
```

```
class MyActivity : Activity() {
  lateinit var component: MyActivityComponent
  override fun onCreate() {
    super.onCreate()
    component
      = DaggerMyActivityComponent.builder()
        .moduleA(ModuleD(this))
        .build()
    }
}
```

Subcomponents:

```
@MyActivityScope
@SubComponent(modules = arrayOf(ModuleD::class))
interface MyActivityComponent {
    fun inject(activity: MyActivity)
}

@Scope
@Retention(AnnotationRetention.RUNTIME)
annotation class MyActivityScope
```

Warning!

This time, Module *D* will have access to dependencies defined in modules *A*, *B* and *C* for application component, because this is a subcomponent

```
@Component(modules = arrayOf(
    ModuleA::class,
    ModuleB::class,
    ModuleC::class
))
interface ApplicationComponent {

  fun plus(moduleD : ModuleD) : MyActivityComponent
  fun inject(activity : MainActivity)
}
```

```
class MyActivity : Activity() {
  lateinit var component: MyActivityComponent
  override fun onCreate() {
    super.onCreate()
    val applicationComponent = /* .... */
    component  = applicationComponent
         .plus(ModuleD(this))
    }
}
```

Spoiler!

This way, MyActivity knows it's injector! Violation of DI in a strict sense.

With dagger we can replace (at compilation time) the implementation of some interfaces with

- debug-only variants of the dependencies (e. g., with logs), keeping the app code exactly the same as per production app
- mocked dependencies for java testing (and testing the exact code of the app)
- mocked dependencies for instrumented testing (e. g., unit test of the view mocking the presenter)
- Easily replace or enhanced (via decorator pattern) the dependencies without impacting changing any other area of the code (as long as the contract of the interface is the same)

Things to keep in mind:

- if there is an error (e. g., missing dependency) you are not able to build the project (no unexpected issues at runtime), most of the time the error message is informative
- Dagger provides no help for dynamic dependency injection at runtime
- Dagger increases compilation time (generation of new java files occurs at compilation time)
- If not used carefully, it might instantiate lot of stuff at starting time, leading to slower startup times of the app[3]

[3] the same can happen manually of course, but sometimes it's easier if dependecies are just handled by dagger2

Dagger2 Android

```
implementation group: 'com.google.dagger', \
               name: 'dagger-android', \
               version: '2.14.1'

kapt group: 'com.google.dagger', \
     name: 'dagger-android-processor',  \
     version: '2.14.1'
```

```
class MyActivity : AppCompatActivity() {

    @Inject
    lateinit var presenter: Presenter

    override fun onCreate(bundle: Bundle?) {
        AndroidInjection.inject(this) // <-- AMAZING
        super.onCreate(savedInstanceState)
        setContentView(R.layout.activity_login)
    }
}
```

Less amazing stuff here...

```
@Module
abstract class ActivityBuilder {
    @ContributesAndroidInjector(modules = arrayOf(Modu
    internal abstract fun bind(): MyActivity
}
```

```
@Component.Builder
    interface Builder {

        @BindsInstance
        fun application(application: Application): Bu

        fun build(): ApplicationComponent

    }
```

```
open class MyApplication : Application(),
                HasActivityInjector {

    @Inject
    lateinit var dispatcher: DispatchingAndroidInjecto

    override fun onCreate() {
        super.onCreate()
        DaggerApplicationComponent.builder()
                .application(this)
                .build()
                .inject(this)
    }
    override fun activityInjector(): AndroidInjector<
        return activityDispatchingAndroidInjector
    }
}
```

Alternative patterns

- Cake pattern
- Reader monad
- Implicits (Scala)

Questions?