Rethinking Dependency Injection
Producer-Consumer Linking at the Bytecode Level

Junyu Yue

Mobile Infrastructure @ TikTok

TikTok

Agenda

1. Challenges of Hilt
2. TikTok DI Solution
3. Open Source & Future Plans

TikTok

Challenges of Hilt in TikTok

Build Time Impact

10% of TikTok compilation duration

TikTok

Multiple Rounds Annotation Processing

TikTok

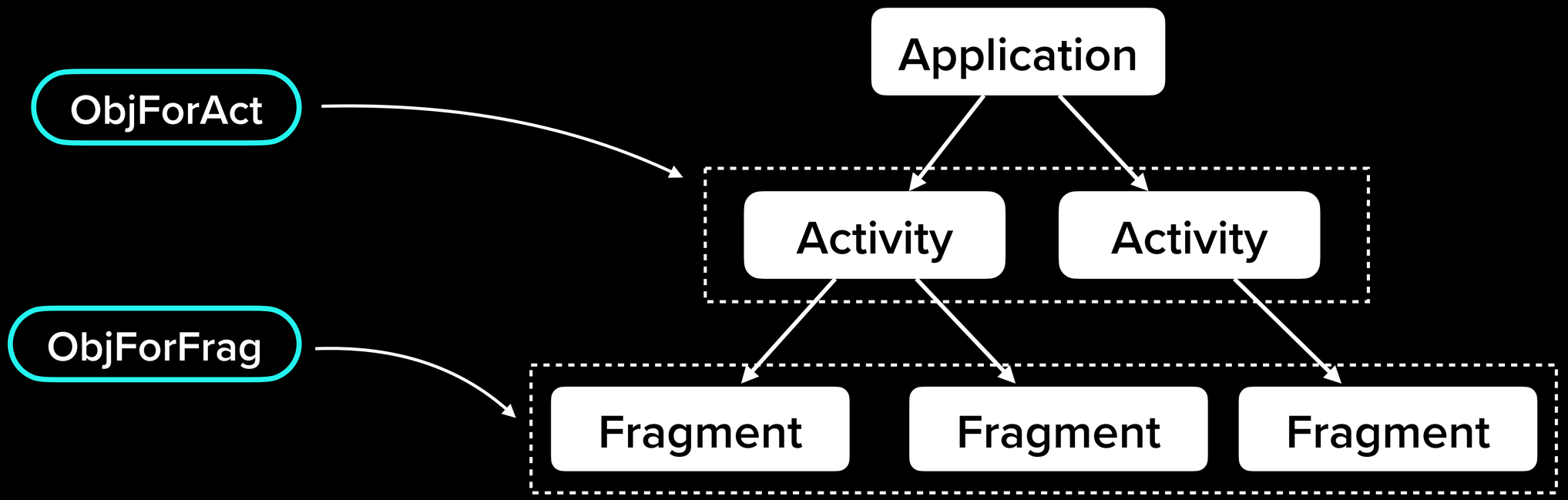
Multiple Rounds Annotation Processing

TikTok

Multiple Rounds Annotation Processing

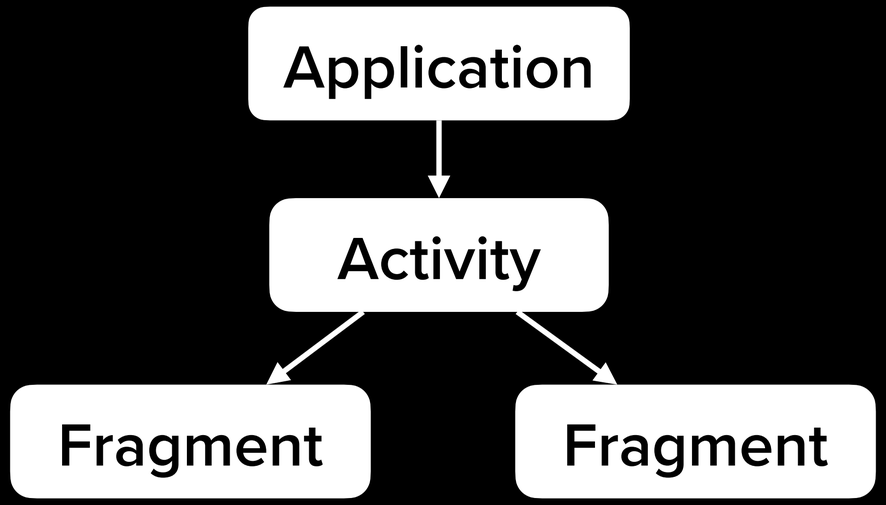
TikTok

Hilt Standardized Hierarchy



TikTok

TikTok Hierarchy



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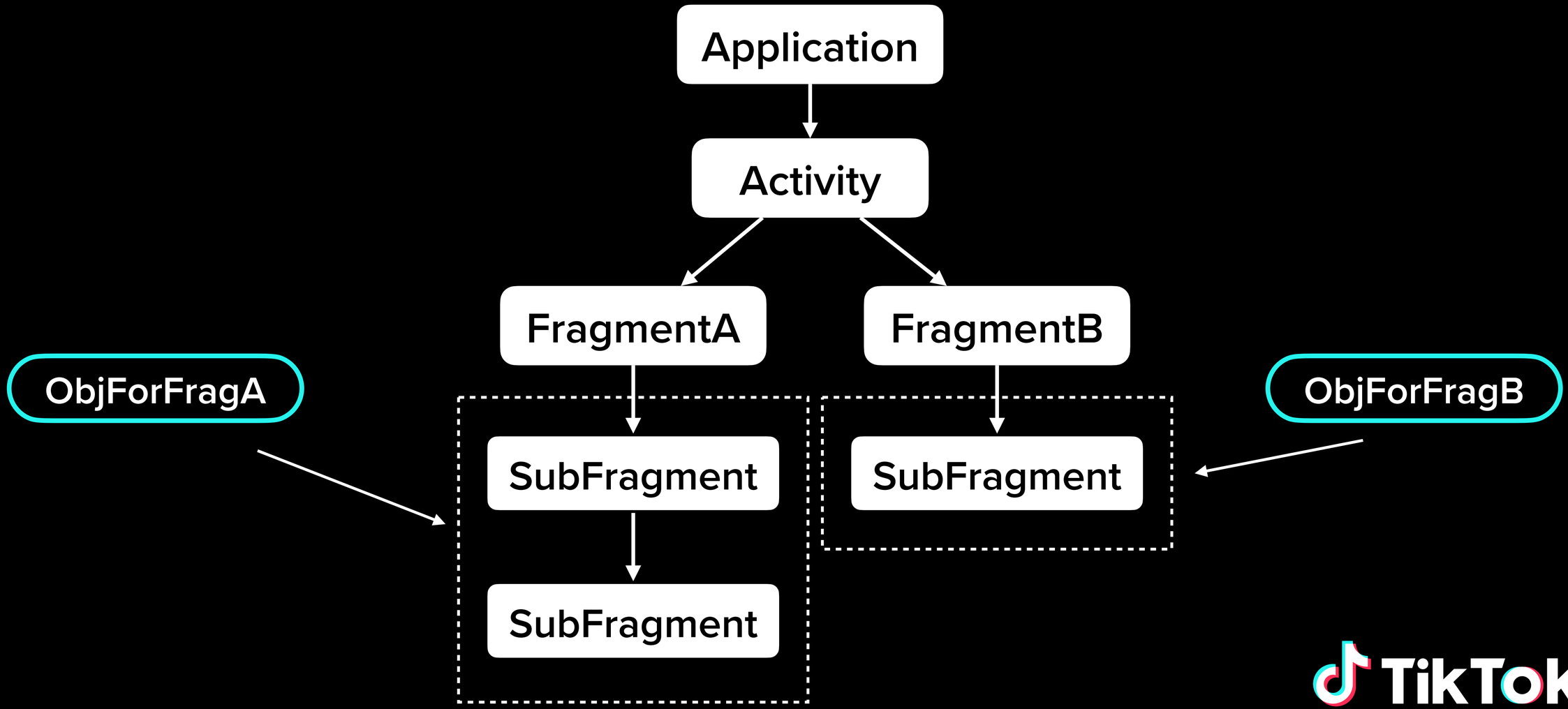
TikTok Hierarchy



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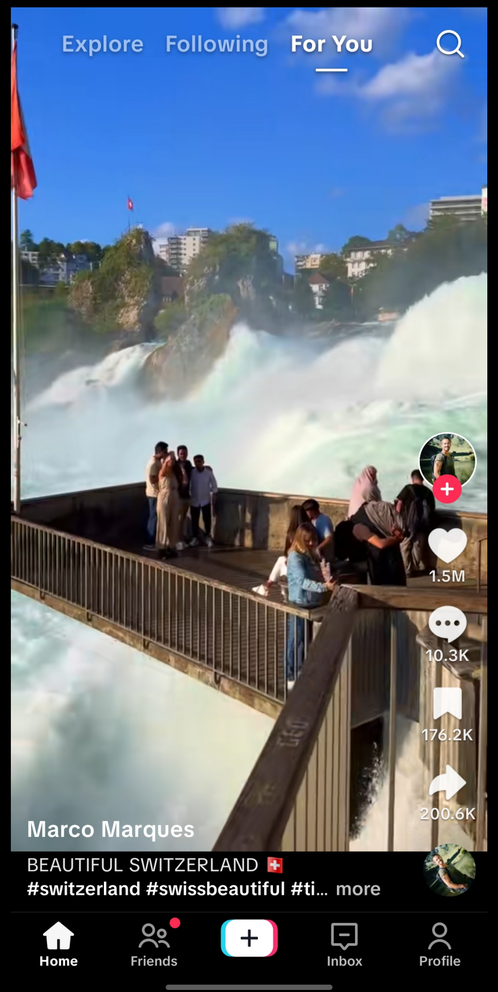
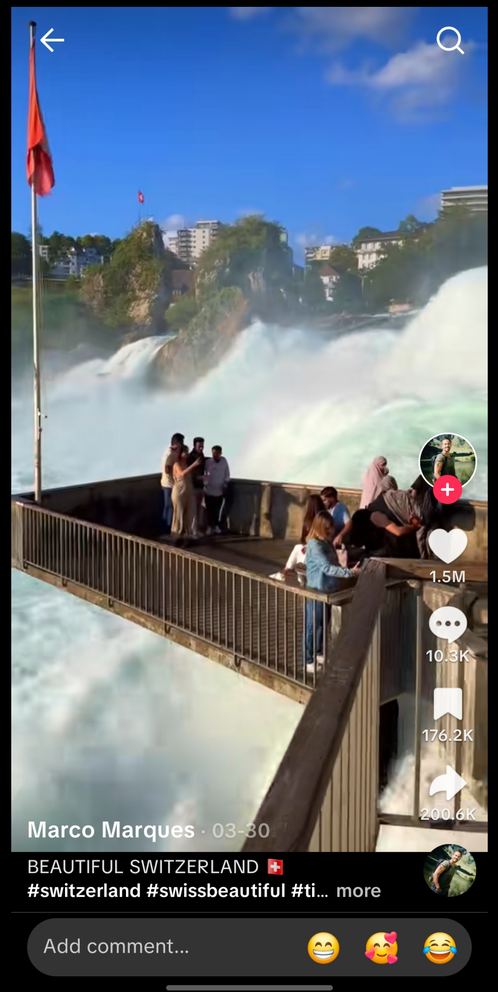
FeedFragment



DetailFragment



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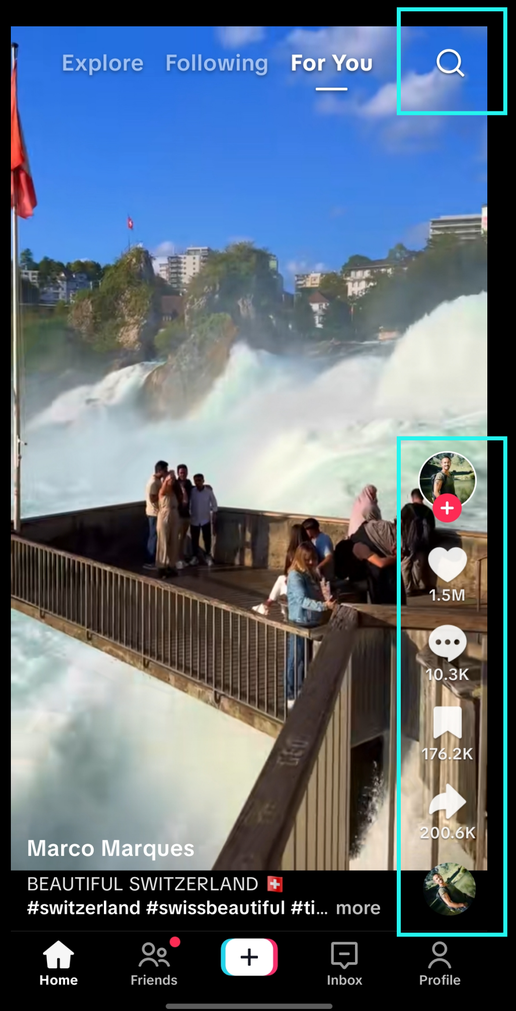
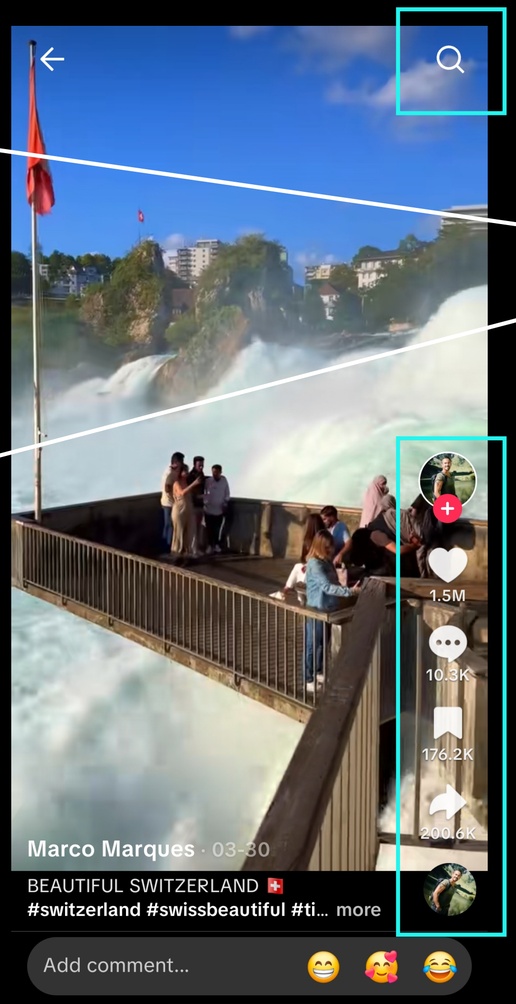
FeedFragment

DetailFragment





Same

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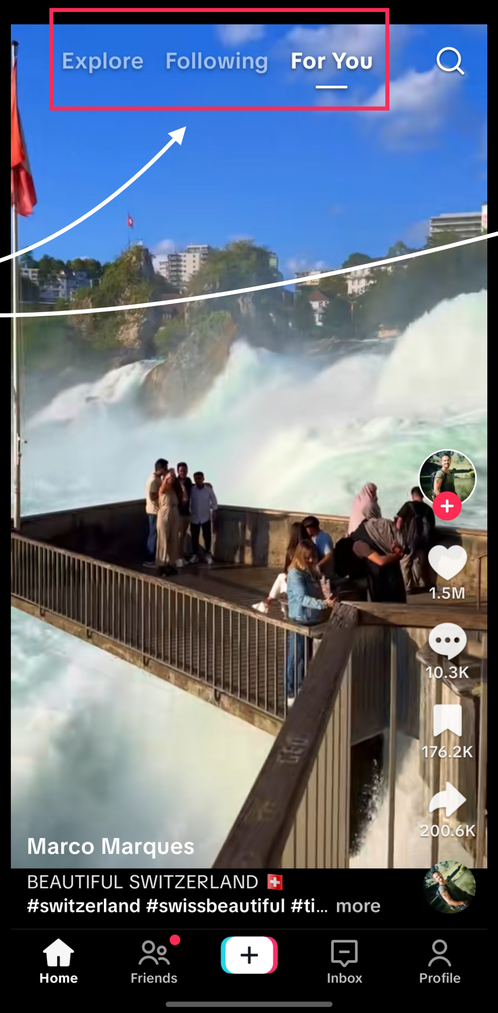
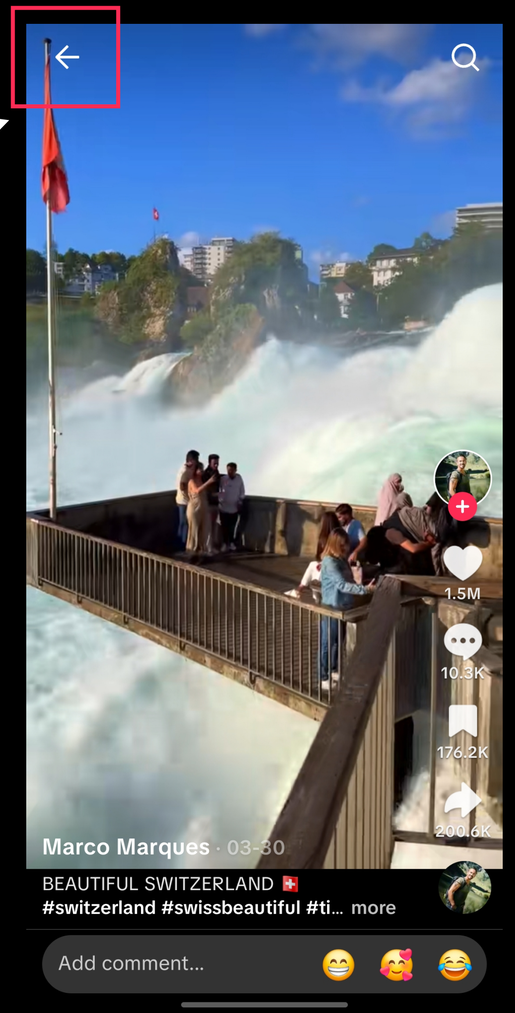
FeedFragment

DetailFragment

Different





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Runtime Loading Overhead

388K ANR per month

Top 3 in TikTok

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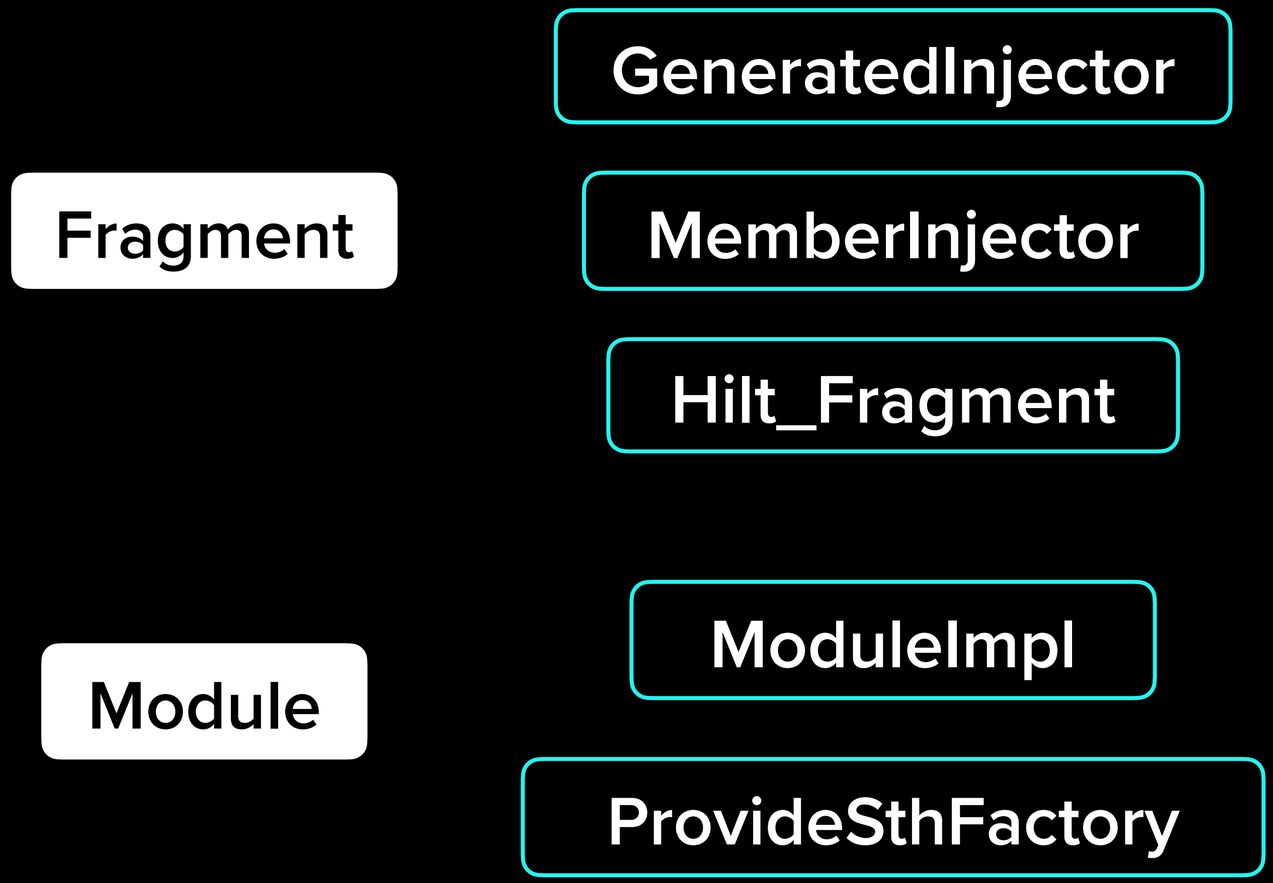
Package Size



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What’s the Ideal DI Pattern?

Fast

Fast compile-time & Fast runtime

Flexible

Flexible component hierarchy

Safe

Verify dependency errors
at compile stage

Minimized

Minimal code generated

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What is the basis of DI?

What is the basis of DI?

Producer

Consumer

TikTok

What is the basis of DI?

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TikTok DI Solution

 Knit

Knit

```
@Provides
class UserRepository

class UserService {
    val repository: UserRepository by di
}
```

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TikTok

Knit

```
@Provides
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class UserService {
   val repository: UserRepository by di
}
```

After Knit Transform

```
class UserRepository

class UserService {
   val repository: UserRepository get() {
      return UserRepository()
   }
}
```

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Knit

```
@Provides
class UserRepository

class UserService {
   val repository: UserRepository by di
}
```

After Knit Transform

```
class UserRepository

class UserService {
  val repository: UserRepository get() {
    var localRepo = this._repository
    if (localRepo != null) return localRepo
    synchronized(this) {
      localRepo = this._repository
      if (localRepo != null) return localRepo
      localRepo = UserRepository()
      _repository = localRepo
      return localRepo
    }
  }
}
```

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Knit

```
class UserRepository

class UserService {
  val repository: UserRepository get() {
    var localRepo = this._repository
    if (localRepo != null) return localRepo
    synchronized(this) {
      localRepo = this._repository
      if (localRepo != null) return localRepo
      localRepo = UserRepository()
      _repository = localRepo
      return localRepo
    }
  }
}
```

```
.method public final
getRepository()Lknit/demo/UserRepository;
   aload 0 # "this"
   getfield knit/demo/UserService _repository
   astore 1 # val localRepo = this._repository
   aload 1
   ifnonnull :L4

   aload 0
   monitorenter # synchronized(this)
 :L0
   aload 0
   getfield knit/demo/UserService _repository
   astore 1 # localRepo = this._repository
   aload 1
   ifnonnull :L3
 :L1
   anew knit/demo/UserRepository
   dup
   invokespecial knit/demo/UserRepository <init> ()V
   astore 1 # localRepo = UserRepository()
 :L2
   aload 0
   aload 1
   putfield knit/demo/UserService _repository
 :L3
   aload 0
   monitorexit
 :L4
   aload 1
   areturn
.end method
```

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Knit

```
@Provides
class UserRepository

class UserService {
    val repository: UserRepository by di
}
```

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@Provides with Arguments

```
@Provides
class UserRepository(val userName: String)

class UserService {

    @Provides
    private fun provideName(): String = “bob”

    val repository: UserRepository by di
}
```

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@Provides with Arguments

```
@Provides
class UserRepository(val userName: String)

class UserService {

    @Provides
    private fun provideName(): String = “bob”

    val repository: UserRepository by di
                    -> UserRepository(provideName())
}
```

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Provided by Parent Component

Provided by Parent Component

```
class MainActivityComponent(
    @Provides val userRepository: UserRepository
)

class ProfileComponent(
    @Component val main: MainActivityComponent
) {
    val userRepository: UserRepository by di
}
```

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Provided by Parent Component

```
class MainActivityComponent(
    @Provides val userRepository: UserRepository
)

class ProfileComponent(
    @Component val main: MainActivityComponent
) {
    val userRepository: UserRepository by di
                        -> main.userRepository
}
```

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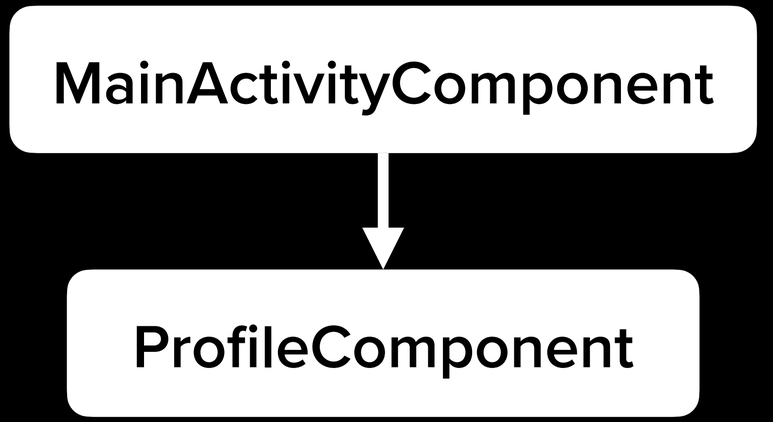
Provided by Parent Component

```
class MainActivityComponent(
    @Provides val userRepository: UserRepository
)

class ProfileComponent(
    @Component val main: MainActivityComponent
) {
    val userRepository: UserRepository by di
                        -> main.userRepository
}
```



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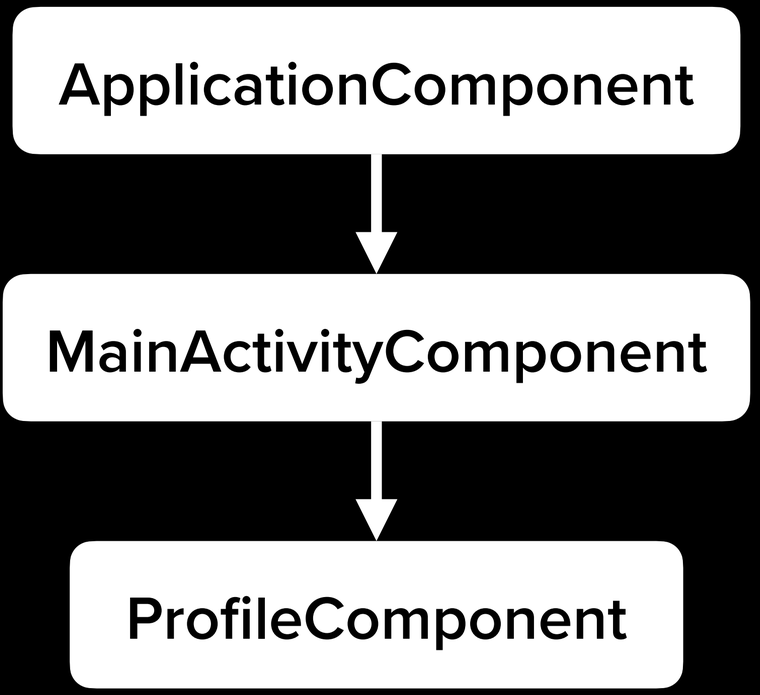
🧬 Provided by Parent Component

```
class ApplicationComponent(
    @Provides val application: Application,
)

class MainActivityComponent(
    @Component val appComponent: ApplicationComponent,
    @Provides val userRepository: UserRepository,
)

class ProfileComponent(
    @Component val main: MainActivityComponent,
) {
    val application: Application by di
    val userRepository: UserRepository by di
}
```



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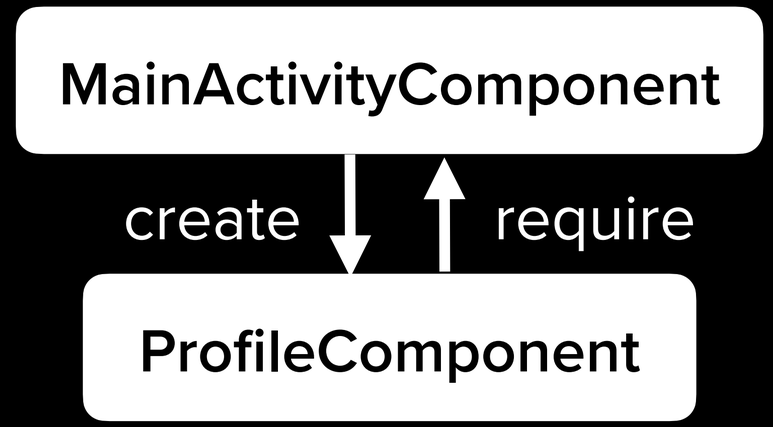
🧬 Provided by Parent Component

```
class MainActivityComponent(
    @Provides val userRepository: UserRepository
) {
    val profile = ProfileComponent(this)
}

class ProfileComponent(
    @Component val main: MainActivityComponent
) {
    val userRepository: UserRepository by di
}
```



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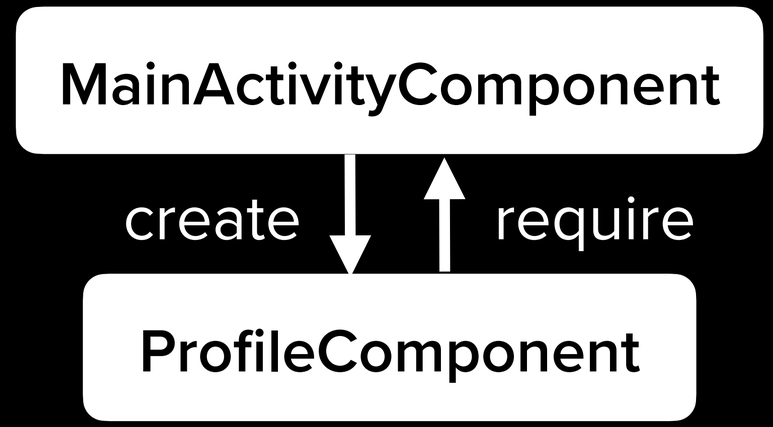
Provided by Parent Component

```
// main module
class MainActivityComponent(
    @Provides val userRepository: UserRepository
) {
    val profile = ProfileComponent(this)
}

// profile module
class ProfileComponent(
    @Component val main: MainActivityComponent
) {
    val userRepository: UserRepository by di
}
```



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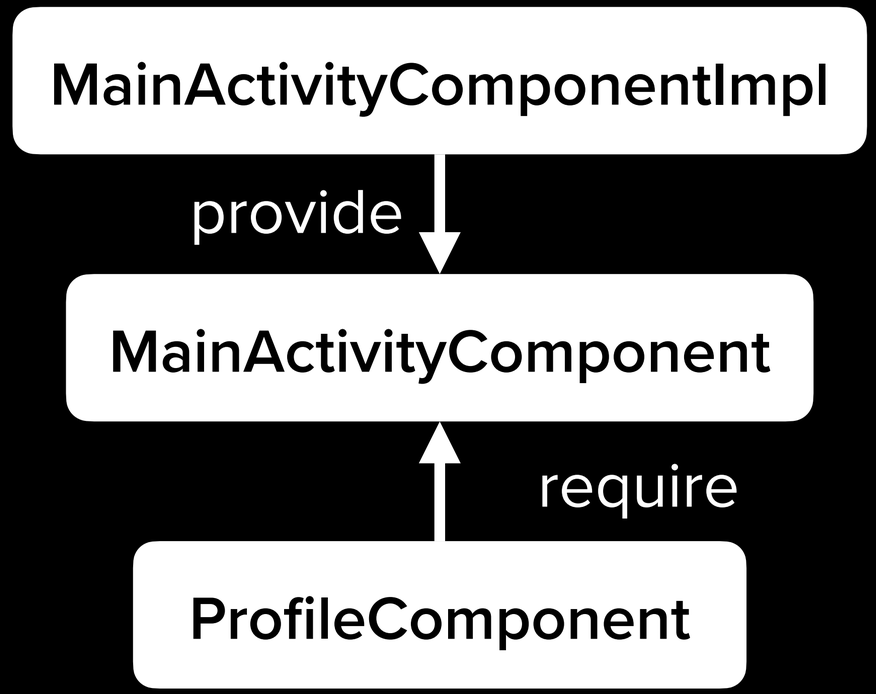
Interface Injection

Interface Injection

```
// main-api module
interface MainActivityComponent {
    @get:Provides
    val userRepository: UserRepository
}

// main-impl module
@Provides(MainActivityComponent::class)
class MainActivityComponentImpl(
    override val userRepository: UserRepository
) : MainActivityComponent

// profile module
class ProfileComponent(
    @Component val main: MainActivityComponent
) {
    val userRepository: UserRepository by di
}
```



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More Features

More Features

- Multi-bindings
- Singleton
- ViewModel Injection
- Factory / Lazy / Loadable

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🧬 More Features

- Multi-bindings
- Singleton
- ViewModel Injection
- Factory / Lazy / Loadable

```
@Provides(Repo::class)
class RemoteRepo: Repo

@Provides(Repo::class)
class LocalRepo: Repo

val repos: List<Repo> by di
```

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More Features

- Multi-bindings
- Singleton
- ViewModel Injection
- Factory / Lazy / Loadable

```
var i: Int = 1

@Provides
@Singleton
fun provideInt(): Int = i++

val a: Int by di // 1
val b: Int by di // 1
```

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🧬 More Features

- Multi-bindings
- Singleton
- ViewModel Injection
- Factory / Lazy / Loadable

```
class FooViewModel
    @KnitViewModel constructor()
: ViewModel()

@Component
class MyFragment : Fragment() {
    val fooVM: FooViewModel
        by knitViewModel()
}
```

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More Features

- Multi-bindings
- Singleton
- ViewModel Injection
- Factory / Lazy / Loadable

```
@Provides
class Foo

val factory: Factory<Foo> by di
val lazy: Lazy<Foo> by di
val loadable: Loadable<Foo> by di
```

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More Features

- Multi-bindings
- Singleton
- ViewModel Injection
- Factory / Lazy / Loadable

```
@Provides
class Foo

val factory: () -> Foo by di
val lazy: kotlin.Lazy<Foo> by di
val loadable: Loadable<Foo> by di
```

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Benefits After Using Knit

Benefits After Using Knit

Build time reduced by 10%

ANR reduced 388K per month

Package size reduced 1M

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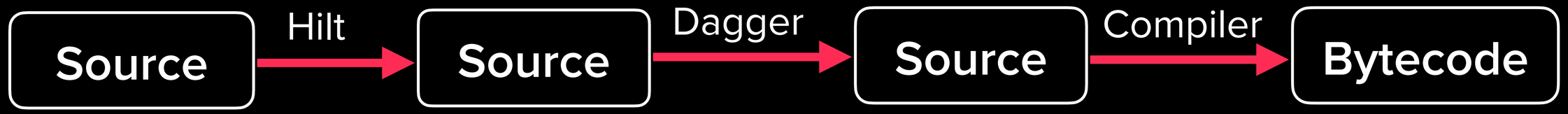
Compare with Hilt

Compare with Hilt



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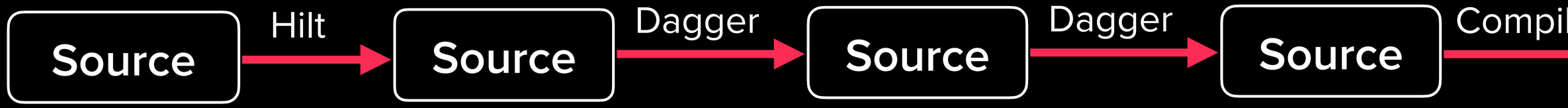
Compare with Hilt



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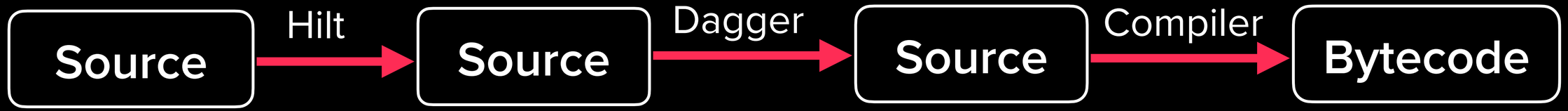
Compare with Hilt



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Smaller Package

Smaller Package

Fragment

Hilt

Module

TikTok

Smaller Package

Hilt

Fragment

Module

GeneratedInjector

MemberInjector

Hilt_Fragment

ModuleImpl

ProvideSthFactory

TikTok

Smaller Package

Fragment

Knit

Component

TikTok

Smaller Package

Knit

Fragment

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Runtime Performance

Runtime Performance

Everything Lazily by Default

Limitations

Limitations

- Kotlin only
- Not compatible with JSR330 @Inject
- No sources generated

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Future Plans

Future Plans

- Inject functions

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Future Plans

- Inject functions

```
@Provides
fun provideFooByKey(key: String): Foo = Foo(key)

class Container {
    val fooFactory: (String) -> Foo by di
}
```

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Future Plans

- Kotlin Multiplatform support

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Future Plans

- Inlay hint in IDE

```
class Parent {
    @Provides
    val bar: Bar = ...
}

class Foo {
    @Component
    val parent: Parent = Parent()

    val bar: Bar by di = parent.bar
}
```

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Open Source

Open Source

github.com/tiktok/knit