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Big Modular Java™ with Guice

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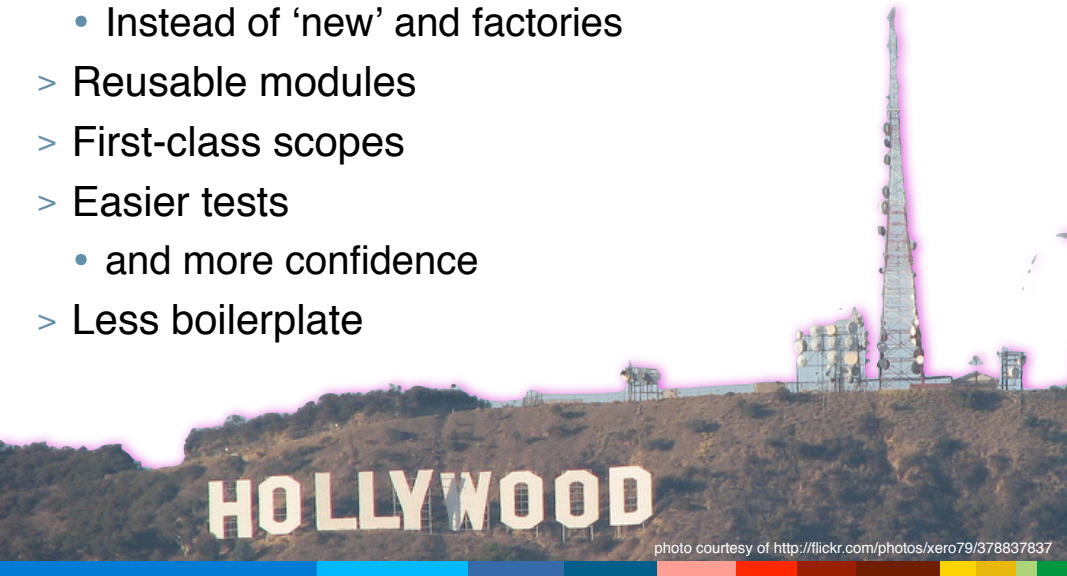
How does my code change with Guice?

- Objects come to you
  - Instead of ‘new’ and factories
- Reusable modules
- First-class scopes
- Easier tests
  - and more confidence
- Less boilerplate



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Overview

- **Example**
  - Ugh, factories aren't fun
- **Using Guice**
  - @Inject is the new **`new`**
- **Leveraging Guice**
  - A tour of extensions and advanced features

Example
tweet tweet

- Setting the stage
- Constructors
- Factories
- Dependency Injection
  - by hand
  - with Guice

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http://flickr.com/photos/jessicafm/62271212

Code you might write
A tweets client

```
public void postButtonClicked() {
  String text = textField.getText();
  if (text.length() > 140) {
    Shortener shortener = new TinyUrlShortener();
    text = shortener.shorten(text);
  }
  if (text.length() <= 140) {
    Tweeter tweeter = new SmsTweeter();
    tweeter.send(text);
    textField.clear();
  }
}
```

Calling Dependencies' **Constructors** Directly

photo courtesy of http://flickr.com/photos/salford_ian/3134250986

Getting dependencies via their constructors

...calling **new** directly doesn't afford testing

```
public void postButtonClicked() {
  String text = textField.getText();
  if (text.length() > 140) {
    Shortener shortener = new TinyUrlShortener();
    text = shortener.shorten(text);
  }
  if (text.length() <= 140) {
    Tweeter tweeter = new SmsTweeter();
    tweeter.send(text);
    textField.clear();
  }
}
```

We post to tinyurl.com and send an SMS for each test! This is neither fast nor reliable.

Getting Dependencies from **Factories**

photo courtesy of http://flickr.com/photos/abulic_monkey/130899453

Getting dependencies from factories

```
public void postButtonClicked() {
  String text = textField.getText();
  if (text.length() > 140) {
    Shortener shortener = ShortenerFactory.get();
    text = shortener.shorten(text);
  }
  if (text.length() <= 140) {
    Tweeter tweeter = TweeterFactory.get();
    tweeter.send(text);
    textField.clear();
  }
}
```

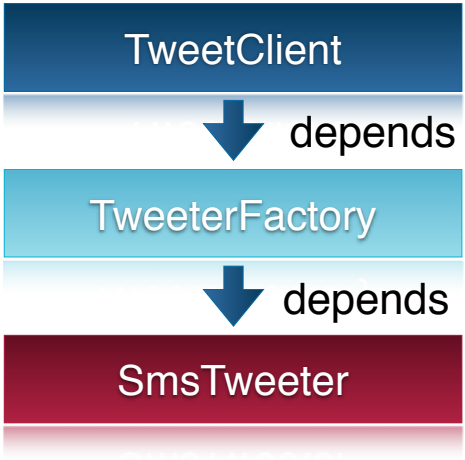
Implementing the factory

all of this boilerplate slows you down. Ugh!

```
public class TweeterFactory {
  private static Tweeter testValue;
  public static Tweeter get() {
    if (testValue != null) {
      return testValue;
    }
    return new SmsTweeter();
  }
  public static void setForTesting(Tweeter tweeter) {
    testValue = tweeter;
  }
}
```

We still have to write a factory for the URL shortener.

Factory dependency graph
the static dependency causes monolithic compiles



Testing with a factory
don't forget to clean up afterwards!

```
public void testSendTweet() {
  MockTweeter tweeter = new MockTweeter();
  TweeterFactory.setForTesting(tweeter);
  try {
    TweetClient tweetClient = new TweetClient();
    tweetClient.getEditor().setText("Hello!");
    tweetClient.postButtonClicked();
    assertEquals("Hello!", tweeter.getSent());
  } finally {
    TweeterFactory.setForTesting(null);
  }
}
```

Dependency Injection (DI) by hand

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Dependency injection by hand
objects come to you

```
public class TweetClient {
  private final Shortener shortener;
  private final Tweeter tweeter;

  public TweetClient(Shortener shortener, Tweeter tweeter) {
    this.shortener = shortener;
    this.tweeter = tweeter;
  }

  public void postButtonClicked() {
    ...
    if (text.length() <= 140) {
      tweeter.send(text);
      textField.clear();
    }
```

Dependency Injection: rather than looking it up, get it passed in.

Testing with dependency injection
no cleanup required

```
public void testSendTweet() {
  MockShortener shortener = new MockShortener();
  MockTweeter tweeter = new MockTweeter();
  TweetClient tweetClient
      = new TweetClient(shortener, tweeter);
  tweetClient.getEditor().setText("Hello!");
  tweetClient.postButtonClicked();
  assertEquals("Hello!", tweeter.getSent());
}
```

Where does the dependency go?

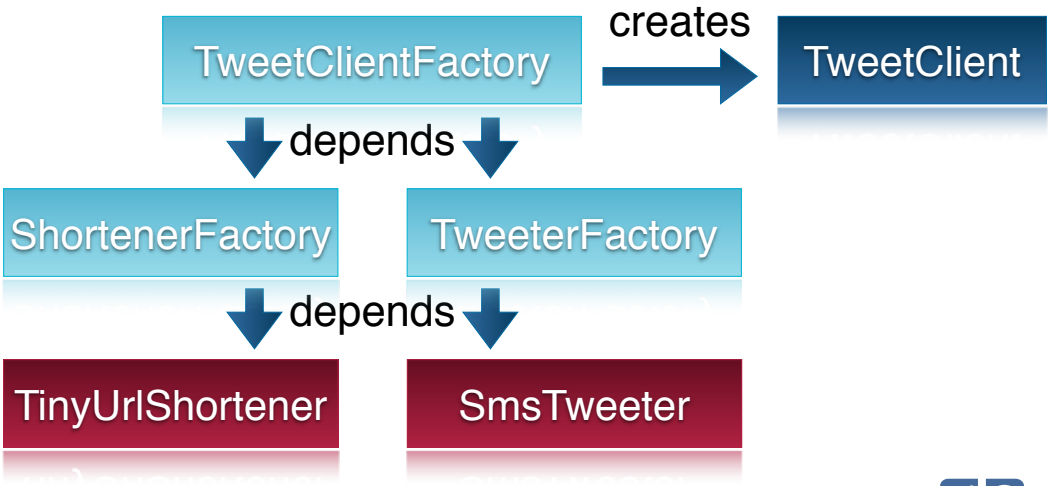
ugh, you still have to write boilerplate code to build stuff

```
public class TweetClientFactory {
  private static TweetClient testValue;

  public static TweetClient get() {
    if (testValue != null) {
      return testValue;
    }

    Shortener shortener = ShortenerFactory.get();
    Tweeter tweeter = TweeterFactory.get();
    return new TweetClient(shortener, tweeter);
  }
```

DI motto:
Push dependencies from the core to the edges

Where does the dependency go?

your application code sheds its heavyweight dependencies



Dependency Injection with **Guice**

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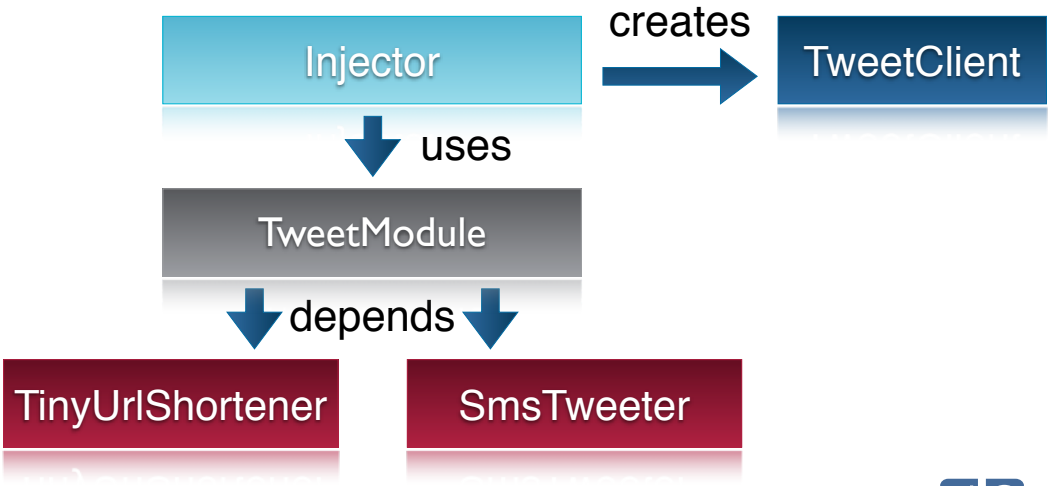
Dependency injection with **Guice**



Configuring the injector using modules

```
import com.google.inject.AbstractModule;

public class TweetModule extends AbstractModule {
  protected void configure() {
    bind(Tweeter.class).to(SmsTweeter.class);
    bind(Shortener.class).to(TinyUrlShortener.class);
  }
}
```

Telling Guice to use your constructor

annotate a constructor with @Inject

```
import com.google.inject.Inject;

public class TweetClient {
  private final Shortener shortener;
  private final Tweeter tweeter;

  @Inject
  public TweetClient(Shortener shortener, Tweeter tweeter) {
    this.shortener = shortener;
    this.tweeter = tweeter;
  }
```

Bootstrapping Guice

```
public static void main(String[] args) {
  Injector injector = Guice.createInjector(new TweetModule());

  TweetClient tweetClient
      = injector.getInstance(TweetClient.class);

  tweetClient.show();
}
```

Using Guice

- Why?
- Bindings
  - Instances
  - Constructors
  - Linked Bindings
  - Provider Methods
- Scopes
- Injections

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Why use a framework?

- Writing boilerplate slows you down
- More up front type checking
- **It makes it easier to write better code**

- Plus...
  - Scopes
  - AOP
  - Tight integration with web, data access APIs, etc.

Guice in a nutshell

- Types have dependencies
  - these are passed in automatically
  - identified with annotations
- Modules define how dependencies are resolved

Bindings

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Bindings
map types to their implementations

```
public class TweetModule extends AbstractModule {
  protected void configure() {
    bind(TweetClient.class);
    bind(Tweeter.class)
        .to(SmsTweeter.class);
    bind(String.class).annotatedWith(Username.class)
        .toInstance("jesse");
  }

  @Provides Shortener provideShortener() {
    return new TinyUrlShortener();
  }
}
```

Binding Annotations
uniquely identify a binding

```
protected void configure() {
  bind(String.class).annotatedWith(Username.class)
      .toInstance("jesse");
  ...
}
```


```
@Inject
public SmsTweeter(@Username String username) {
  this.username = username;
}
```

Defining your own binding annotations

```
@BindingAnnotation
@Retention(RUNTIME)
@Target({FIELD, PARAMETER, METHOD})
public @interface Username {}
```

- This boilerplate defines a binding annotation
- Everything is compile-time checked
  - IDE autocomplete, import, find usages
  - Avoids clumsy string matching

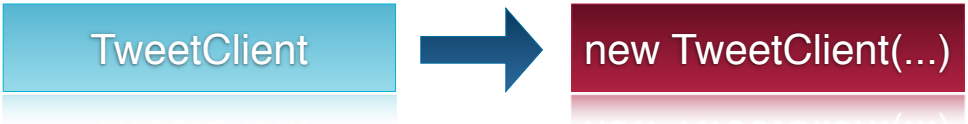
Instance Bindings
always use the same value

```
protected void configure() {
  bind(Integer.class).annotatedWith(Port.class)
      .toInstance(8080);
  ...
}
```

- Best suited for value objects such as a database name, or webserver port

Constructor Bindings
to resolve a type, call its constructor

```
public class TweetModule extends AbstractModule {
  protected void configure() {
    bind(TweetClient.class);
    ...
  }
}
```



- Requires @Inject on the constructor
  - Dependencies are passed in as parameters

Linked Bindings
to resolve a type, use another binding

```
public class TweetModule extends AbstractModule {
  protected void configure() {
    bind(Tweeter.class).to(SmsTweeter.class);
    ...
  }
}
```

- Requires a binding for the target type
  - If none exists, one will be created automatically

Linked Bindings
to resolve a type, use another binding

```
public class TweetModule extends AbstractModule {
  protected void configure() {
    bind(Tweeter.class).to(SmsTweeter.class);
    ...
  }
}
```

- Requires a binding for the target type
  - If none exists, one may be created automatically...

Provider methods
to resolve a type, call this method

```
public class TweetModule extends AbstractModule {
  protected void configure() {...}

  @Provides Shortener provideShortener() {
      return new TinyUrlShortener();
  }
}
```

- Annotate a module method with @Provides
  - The return type is bound
  - Dependencies are passed in as parameters

Using **Scopes**

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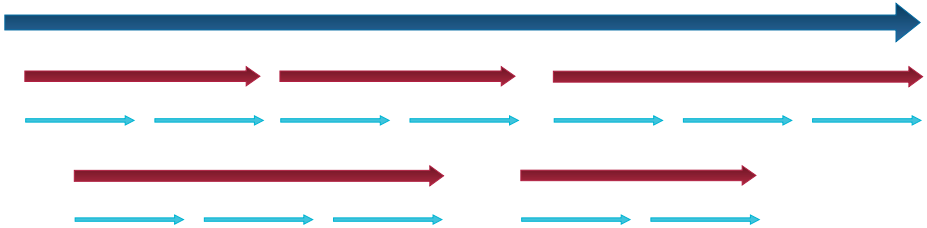
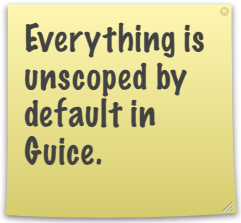
Scopes
manage how many

- Scopes manage how instances are reused
  - because they're **stateful**
  - or **expensive** to construct or lookup
  - or expensive to maintain



Common scopes

- **Unscoped**: one per use
  - create it, use it, and toss it!
  - often the best choice
- **@Singleton**: one per application
  - for heavyweight resources
  - and application state
- **@RequestScoped**: one per web or RPC request
- **@SessionScoped**: one per HTTP session



Applying scopes

the best way is to annotate a class with its scope

```
@Singleton
public class TweetClient {

  ...

  @Inject
  public TweetClient(Shortener shortener, Tweeter tweeter) {
    this.shortener = shortener;
    this.tweeter = tweeter;
  }
```

Applying scopes
you can specify scopes in a module

```
public class TweetModule extends AbstractModule {
  protected void configure() {
    bind(Tweeter.class)
        .to(SmsTweeter.class)
        .in(Singleton.class);
  }

  @Provides @Singleton Shortener provideShortener() {
    return new TinyUrlShortener();
  }
}
```

Defining **Injections**

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Constructor injection

to supply dependencies when creating an object

```
public class TweetClient {
  private final Shortener shortener;
  private final Tweeter tweeter;

  @Inject
  public TweetClient(Shortener shortener, Tweeter tweeter) {
    this.shortener = shortener;
    this.tweeter = tweeter;
  }
```

Method injection

sets dependencies into a new or existing instance

```
public class TweetClient {
  private Shortener shortener;
  private Tweeter tweeter;

  @Inject void setShortener(Shortener shortener) {
    this.shortener = shortener;
  }

  @Inject void setTweeter(Tweeter tweeter) {
    this.tweeter = tweeter;
  }
```

- Plays nice with inheritance

Field injection

sets dependencies into a new or existing instance

```
public class TweetClient {

  @Inject Shortener shortener;
  @Inject Tweeter tweeter;

  public TweetClient() {}
```

> Concise, but difficult to test

Injecting **Providers**

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The Provider interface

```
public interface Provider<T>   {
  T get();
}
```

Injecting a Provider

```
public class TweetClient {
  @Inject Provider<Shortener> shortenerProvider;
  @Inject Tweeter tweeter;

  public void postButtonClicked() {
    String text = textField.getText();
    if (text.length() > 140) {
      Shortener shortener = shortenerProvider.get();
      text = shortener.shorten(text);
    }
    ...
  }
```

Why inject Providers?

- to get **multiple instances**
  - for example, if you need multiple DatabaseConnections
- to **load lazily**
- to **mix scopes**
  - for example, to access request-scoped objects from a singleton-scoped object

Leveraging Guice

- AJAX via GWT
- Servlets and App Engine
- AOP
- Type Literals
- Introspection SPI

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AJAX via GWT
and GIN

- Zero runtime cost: GIN generates JavaScript from modules
- API compatibility with Guice
  - Great for GWT-RPC
  - Test without a browser

```
public class MyWidgetClientModule extends AbstractGinModule {
  protected void configure() {
    bind(MyWidgetMainPanel.class).in(Singleton.class);
    bind(MyRemoteService.class)
        .toProvider(MyRemoteServiceProvider.class);
  }
}
```

Servlets and App Engine

- Configure your servlets programatically
- Use @RequestScoped and @SessionScoped to manage application state safely and easily

```
public class TweetSearchServletModule extends ServletModule {
  protected void configureServlets() {
    serve("/search").with(TweetSearchServlet.class);
  }
}
```

AOP
aspect oriented programming

- You can apply method interceptors to injected objects
  - This is fantastic for cross-cutting concerns like transactions, security, and performance

```
public class DatabaseTweetStorage implements TweetStorage {

  @Transactional
  public void saveTweet(String message) {
    ...
  }
}
```

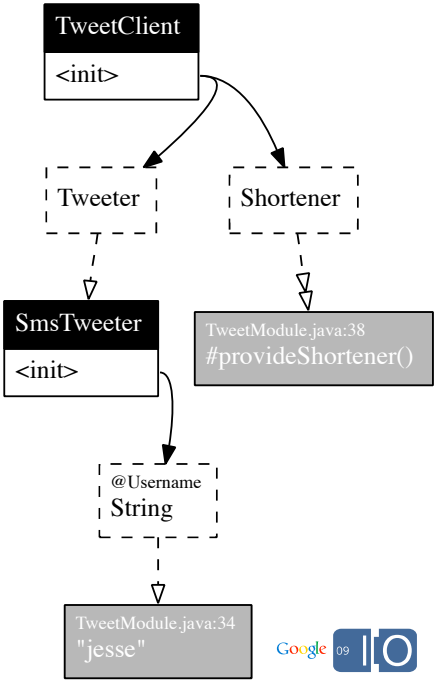
Type Literals

- Like the language it's built on, Guice loves types
  - Set<User> is distinct from Set<Tweet>
- Guice can defeat erasure!

```
@Inject
public SocialView(
    Set<User> followers,
    Set<Tweet> tweets) {
  ...
}
```

Introspection SPI
service provider interface

- Module and injector internals are available via a mirror SPI
  - Inspect, analyze and rewrite bindings
- Guice uses it internally for...
  - createInjector()
  - module overrides
  - graphing

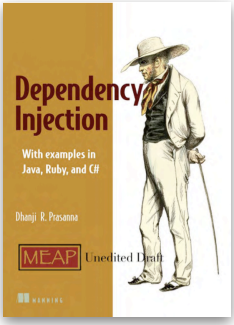


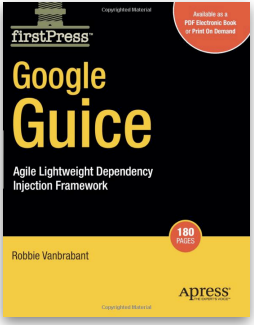
Wrapping up...

- Dependency injection leads to testable and reusable code
- Guice makes dependency injection easy
  - plus it enables scopes
  - and it integrates neatly with the other APIs you use
- It works on both Java™ SE and Java™ EE
  - Plus Android, App Engine and GWT (via GIN)

For more information...

- The Guice website documents usage, extensions, and best practices
  - http://code.google.com/p/google-guice/
- Plus, Dhanji and Robbie's books:





Q & A

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