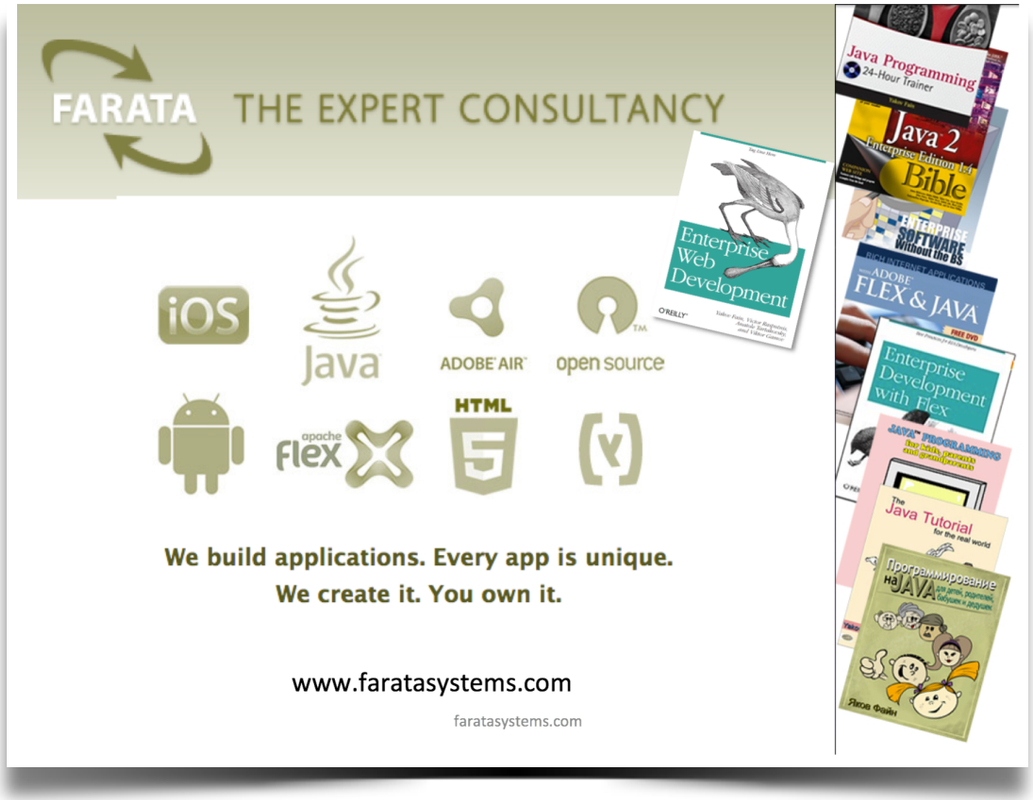
Dart for Java Developers

Yakov Fain, Farata Systems

Farata Systems and SuranceBay



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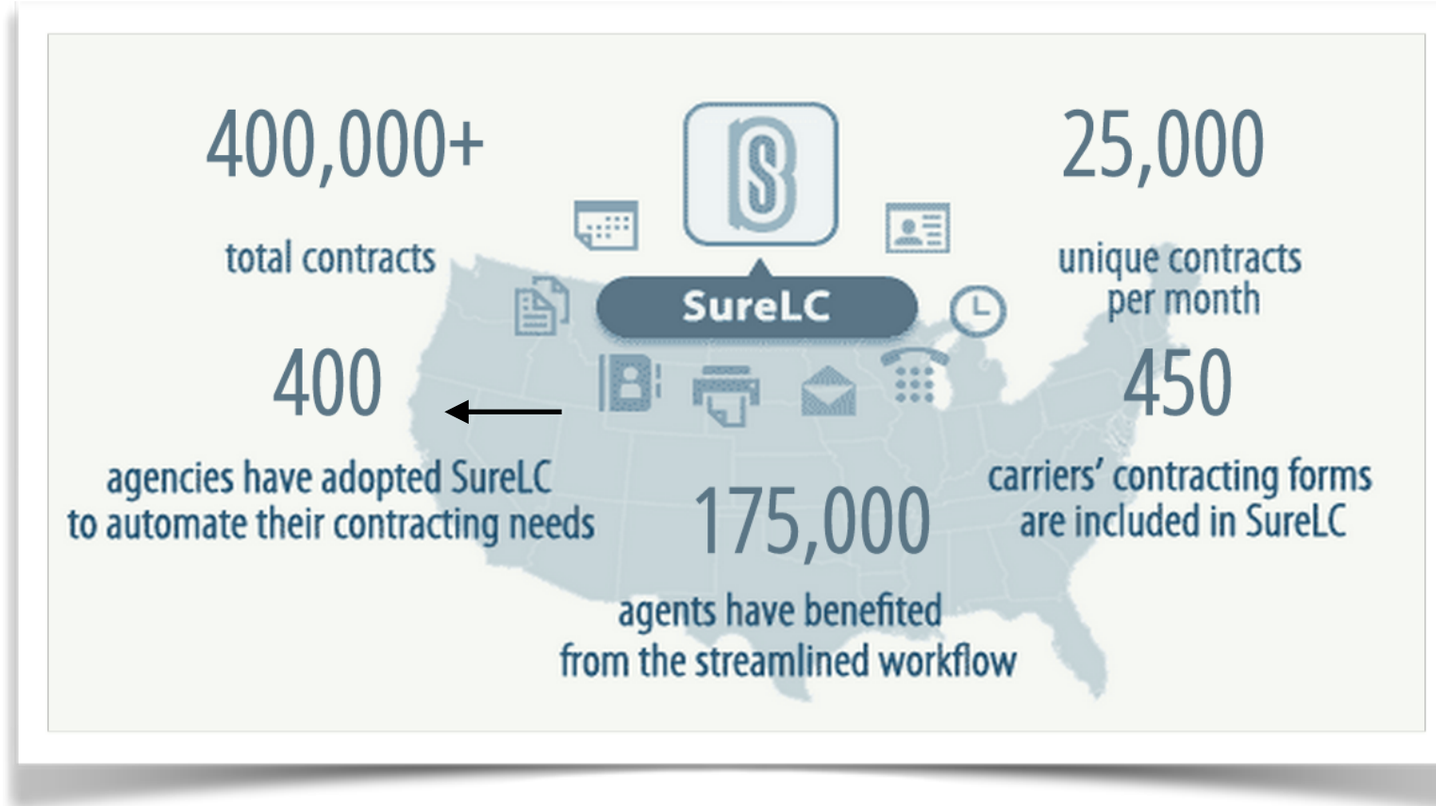

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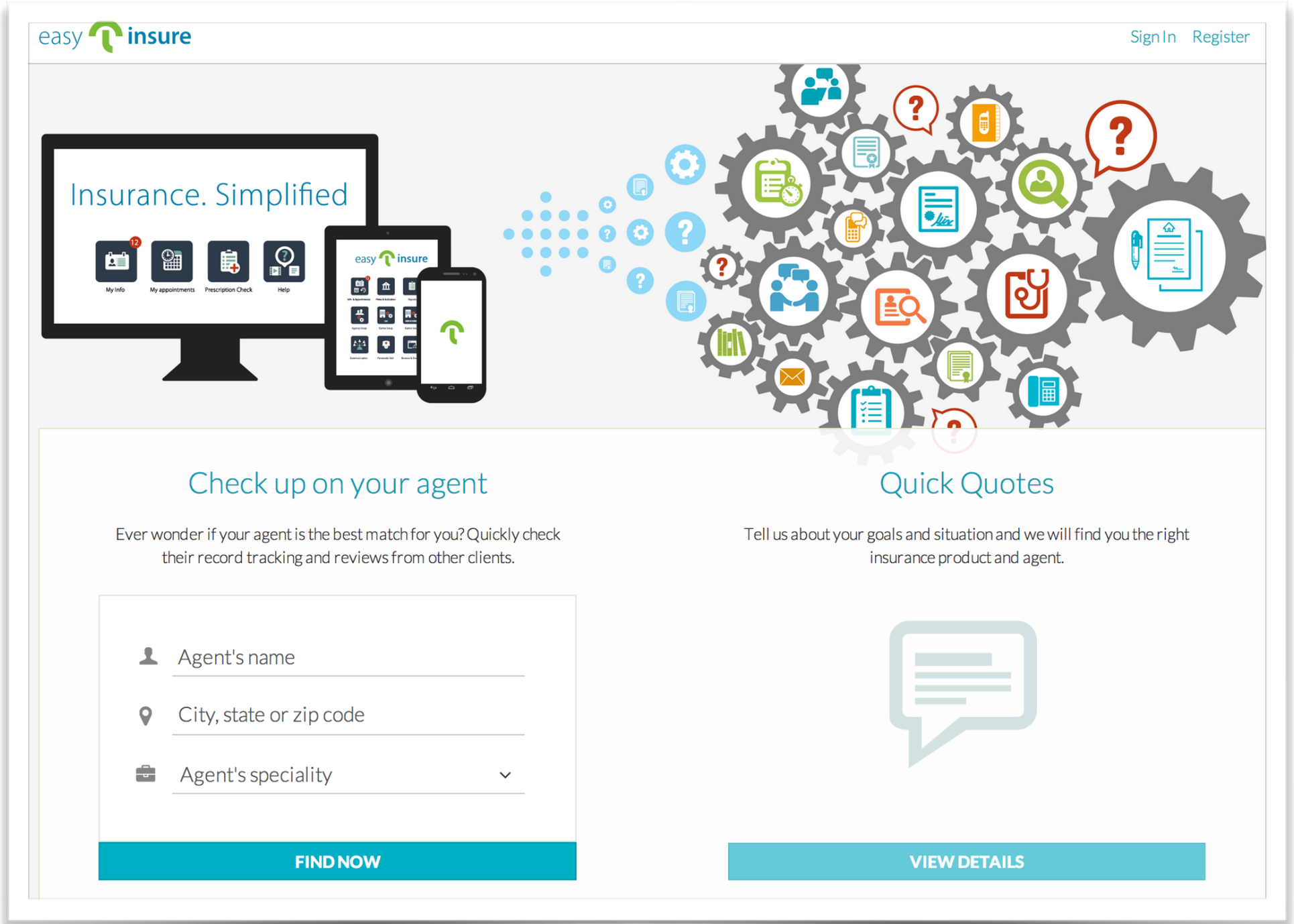
Our First Dart App: Easy Insure



http://easy.insure

Why Learn Google Dart

- Dart is a productive way to develop future JavaScript apps today
- Comes with a complete set of dev tools
- Will help you to ease into the EcmaScript 6 developement in 2016

Dart: Java Simplified

- Program with classes and/or with functions
- You can, but don’t have to declare variable types.
- Any class is an interface
- No data access qualifiers
- Single-threaded but supports concurrency
- No checked exceptions
- No autoboxing/unboxing
- IDEs: Dart Editor, IntelliJ IDEA, WebStorm, Eclipse Sublime Text…
- Write in Dart and run either in Dart VM or as JavaScript on any browser

Why Developing with Dart VM ?

- Developing in Dart is more productive than in JavaScript. A static code analyser shows errors as you type.
- Instanteneous feedback from the VM - no bytecode is generated for running in Dart VM.
- During development there’s no need to transpile code to JS as in GWT.
- Your program can run standalone in Dart VM.
- Production deployment is done in JavaScript.

The Dart App Entry Point

A single entry point to any Dart app is a function `main()`:

```
main() {
  print('Hello world!');
}
```

The Dart App Entry Point

A single entry point to any Dart app is a function main():

```
main() {
  print('Hello world!');
}
```

Or with command-line arguments:

```
import 'package:args/args.dart';

main(List<String> args) {

  final parser = new ArgParser();
  argResults = parser.parse(args);

  List<String> someArgs = argResults.rest;

  print(‘Got the argument ${someArgs[0]}');

}
```

Checked Mode

```
main() {
  print('Adding numbers: ${add (2,3)}');
  print('Adding strings: ${add ("Hello ","World")}');
}

add (num a, num b){

  return a+b;
}
```

bin — bash — 80×24

```
Yakov:bin yfain11$ dart checked_mode.dart
Adding numbers: 5
Adding strings: Hello World
Yakov:bin yfain11$
Yakov:bin yfain11$
Yakov:bin yfain11$
Yakov:bin yfain11$
Yakov:bin yfain11$ dart --checked checked_mode.dart
Adding numbers: 5
Unhandled exception:
type 'String' is not a subtype of type 'num' of 'a'.
#0      add (file:///Users/yfain11/Documents/Farata/Training/courseware/Dart/tra
ining/src/DartForJavaDevs/HelloWorldConsole/bin/checked_mode.dart:7:10)
#1      main (file:///Users/yfain11/Documents/Farata/Training/courseware/Dart/tr
aining/src/DartForJavaDevs/HelloWorldConsole/bin/checked_mode.dart:4:32)
#2      _startIsolate (dart:isolate-patch/isolate_patch.dart:239)
#3      _startMainIsolate.<anonymous closure> (dart:isolate-patch/isolate_patch.
dart:192)
#4      _RawReceivePortImpl._handleMessage (dart:isolate-patch/isolate_patch.dar
t:130)
```

Importing Packages

- SDK comes with libraries whose names start with `dart`:

```
import 'dart:math';
```

- You can add packages in the directory *packages* of your project are app dependencies. Imports start with `package`:

```
import 'package:args/args.dart';
```

Dart Libraries

- dart:core
- dart:async
- dart:math
- dart:io
- dart:html
- dart:mirrors
- dart:convert

Package Dependencies

- Dart package manager is called **pub**
- Dependencies are specified in the file **pubspec.yaml**.
- Package versions are locked in the file **pubspec.lock**.

pubspec.yaml

```yaml
name: stock_quote_console
version: 0.0.1
description: A stock quote app
environment:
  sdk: '>=1.0.0 <2.0.0'
dependencies:
  args: any
dev_dependencies:
  unittest: any
```

The central repo pub.dartlang.org has 1000+ packages

Selected pub commands

- **pub get** - retrieves packages (dependencies)
- **pub upgrade** - upgrades packages and regenerates pubspec.lock
- **pub serve** - starts dev http server
- **pub run** - runs Dart scripts using dependencies from pubspec.yaml
- **pub build** - generates and copies assets into the build dir
- **pub global** - run Dart packages installed anywhere on the computer, pub.dartlang.org, or GitHub

Demo

Functions-only app

Using pub to get dependencies

Command-line arguments

IDEA module: StockQuoteConsole

Dart Classes

- Name class files in small letters with _ as a word separator
- Constructors support short syntax for variable initializations
- No keywords for public, protected, private.
- If a var name start with _ it's private on a library level
- No method overloading
- Getters and setters are specified with `get` and `set` keywords

Class Stock

private vars

constructor

lazy getter

setter

```
class Stock {
  String _symbol;
  double _price;

  Stock (this._symbol);

  double get price => _price==null?
                                _price=getFromYahoo():_price;

  set price(double value){
    _price = value;
  }

  String get symbol => _symbol;

  set symbol(String value){
        // some other processing may go here
       _symbol = value;
  }
}
```

Class Stock

private vars

constructor

lazy getter

setter

```
class Stock {
  String _symbol;
  double _price;

  Stock (this._symbol);

  double get price => _price==null?
                                _price=getFromYahoo():_price;

  set price(double value){
    _price = value;
  }

  String get symbol => _symbol;

  set symbol(String value){
       _symbol = value;
  }
}
```

```
Stock stock = new Stock("IBM");

var price = stock.price;
```

Constructors

```
class Customer {

  int _id;
  String name;

  Customer(this._id, this.name);

  Customer.taxExempt(int id, String name){
    // Do something lowering taxes
  }

  Customer.optName(this._id, {this.name});


  factory Customer.mafia(int id, String name){
    if (name == "Don Carleone")
        return new Customer.taxExempt(id, name);
    else
      return new Customer(id, name);
  }
}
```

short form

named

optional param

factory

Cascade Operator ..

- Avoid repeating the object name
- You can use method cascades **..** on any object.
- Every **..** refers to the original object, not to the result of the previous method.

```
querySelector('#abutton') // Get an object
  ..text = 'Confirm'      // Use its members
  ..classes.add('important')
  ..onClick.listen((e) => window.alert('Confirmed!'));
```

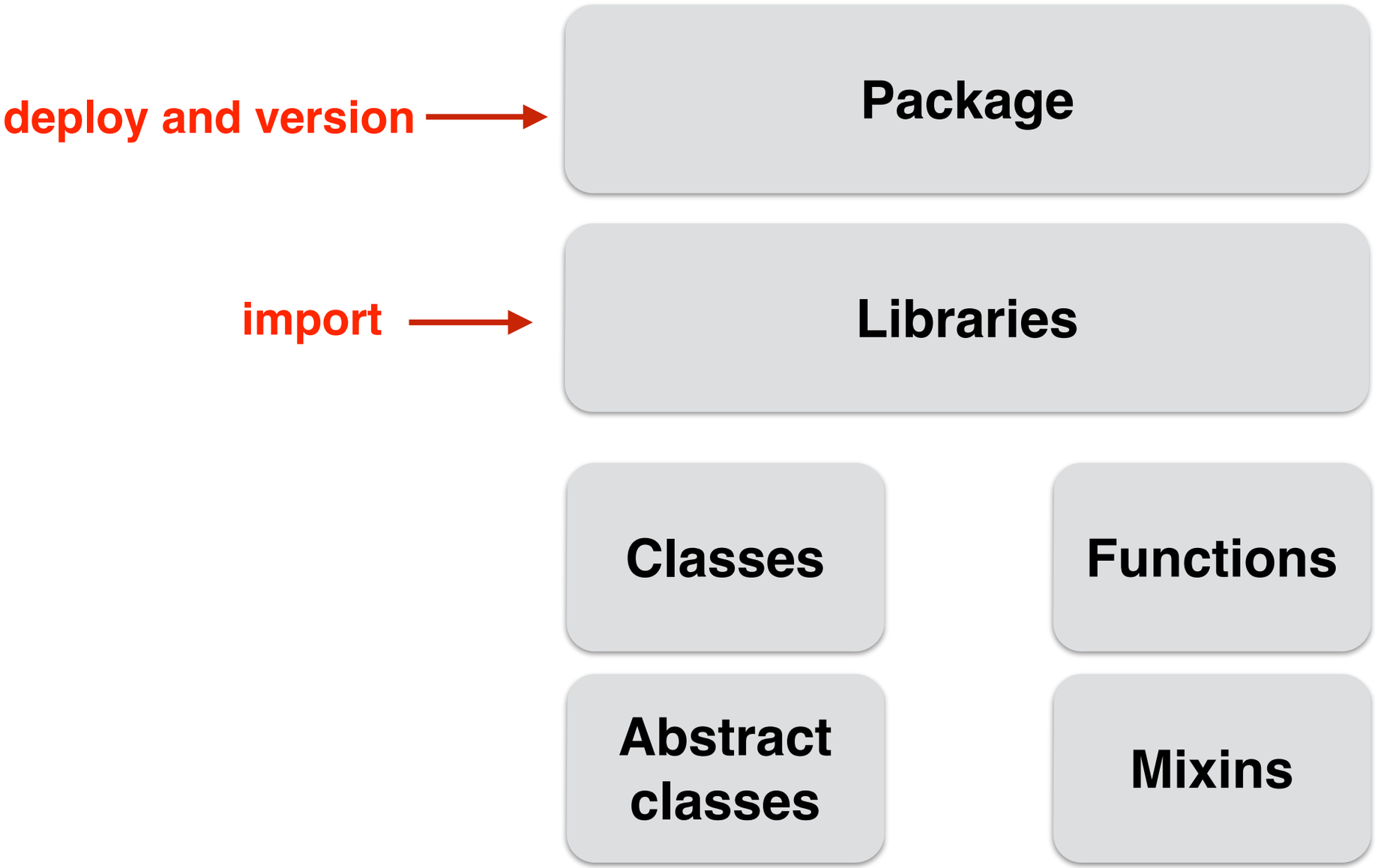
Exceptions

- All exceptions are unchecked
- You can throw any objects:

```
throw "Something happened";
```

```
try {
  // Do stuff here
} on NoSuchMethodError catch (e) {
    print('Error: ${e.stackTrace}');
} on RangeError catch (e) {
    print('Error: ${e.stackTrace}');
} on TypeError catch (e) {
    print('Error: ${e.stackTrace}');
} catch (e) {
    print('$e');
}
```

Code Structure



Libraries

Combine classes and top-level functions into libraries.

```
library stock_quote;

import 'dart:math';
import 'dart:io';
import 'package:args/args.dart';

part "stock.dart";
part "stock_quote_generator.dart";

main(List<String> args) {
…
}
```

```
part of stock_quote;

class Stock {
   …
}
```

```
part of stock_quote;

class StockQuoteGenerator {

 …
}
```

Demo

- Classes
- Getters
- Setters
- Libraries

IDEA module: StockQuoteClassesConsole

Mixins

- Mixin is a class with functionality that can be added to another class using the `with` keyword
- You can add multiple mixins to the class declaration

```
class Bond extends Security with TradeReporter{

}
```

Java 8 interfaces are not mixins. They can’t have state.

Mixin Sample

```
class Security{

  String name;

  Security(this.name);

}
```

```
class Stock extends Security{

  String symbol;
  double previousClosingPrice;

  Stock(String name): super(name);

}
```

```
class Bond extends Security
          →   with TradeReporter{

  double faceValue;
  DateTime maturityDate;

  Bond(String name): super(name);

}
```

Mixin Sample

```
class Security{

  String name;

  Security(this.name);

}
```

```
class Stock extends Security{

  String symbol;
  double previousClosingPrice;

  Stock(String name): super(name);

}
```

```
class Bond extends Security
          →   with TradeReporter{

  double faceValue;
  DateTime maturityDate;

  Bond(String name): super(name);

}
```

```
class TradeReporter{

   String whereToReport;

   reportMuniBondTrade(name){
     print('Trade for municipal bond $name has been reported to $whereToReport');
   }

   reportCorpBondTrade(name){
     print('Trade for corporate bond $name has been reported to $whereToReport');
   }
}
```

A Mixin Sample

```
class Security{

  String name;

  Security(this.name);

}
```

```
class Stock extends Security{

  String symbol;
  double previousClosingPrice;

  Stock(String name): super(name);

}
```

```
class Bond extends Security
            with TradeReporter{

 double faceValue;
 DateTime maturityDate;

 Bond(String name): super(name);

}
```

```
class TradeReporter{

   String whereToReport;

   reportMuniBondTrade(name){
     print('Trade for municipal bond $name has been reported to $whereToReport');
   }

   reportCorpBondTrade(name){
     print('Trade for corporate bond $name has been reported to $whereToReport');
   }
}
```

```
Bond bond = new Bond('Metropolitan Transportation');
bond.whereToReport = "SEC";      // from mixin
bond.reportMuniBondTrade('Metropolitan Transportation'); // from mixin
```

Demo

Mixins

IDEA module: TradingMixins

Web Apps Development

```
<!DOCTYPE html>

<html>
<head>
    <title>My Web App</title>
</head>

<body>

  Your HTML content goes here

  <script type="application/dart" src="main.dart"></script>

  <script data-pub-inline src="packages/browser/dart.js"></script>

</body>
</html>
```

For development with Dartium

Web Apps Deployment

```html
<!DOCTYPE html>

<html>
<head>
    <title>My Web App</title>
</head>

<body>

   Your HTML content goes here

  <script src="main.dart.js"></script>

</body>
</html>
```

For deployment, manually precompile you code with dart2js

or add a transformer to pubspec.yaml

```yaml
dependencies:
  browser: any
  dart_to_js_script_rewriter: any
transformers:
  - dart_to_js_script_rewriter
```

Running Dart Web App

1. **From a command line:**

   Run **pub serve** and refresh the Web page

2. **From IDEA:**

   Right-click on your index.html file and run it in any Web browser

Running Web app with pub serve

Running pub serve

Visiting localhost:8080 in Dartium

Visiting localhost:8080 in Chrome

StockQuoteSimpleWeb — dart — 80×29

```
Yakov:StockQuoteSimpleWeb yfain11$ pub serve
Loading source assets...
Serving stock_quote_simple_web web on http://localhost:8080
Build completed successfully
      GET / → stock_quote_simple_web|web/index.html
      GET /main.dart → stock_quote_simple_web|web/main.dart
      GET /packages/browser/dart.js → browser|lib/dart.js
      GET /styles/main.css → stock_quote_simple_web|web/styles/main.css
      GET /packages/stock_quote_simple_web/stock.dart → stock_quote_simple_web|l
ib/stock.dart
      GET /packages/stock_quote_simple_web/stock_quote_generator.dart → stock_qu
ote_simple_web|lib/stock_quote_generator.dart
      GET /favicon.ico → Could not find asset stock_quote_simple_web|web/favicon
.ico.
      GET / → stock_quote_simple_web|web/index.html
      GET /packages/browser/dart.js → browser|lib/dart.js
      GET /styles/main.css → stock_quote_simple_web|web/styles/main.css
[Info from Dart2JS]:
Compiling stock_quote_simple_web|web/main.dart...
[Info from Dart2JS]:
Took 0:00:05.553774 to compile stock_quote_simple_web|web/main.dart.
Build completed successfully
      GET /main.dart.js → stock_quote_simple_web|web/main.dart.js
      GET /main.dart.js.map → stock_quote_simple_web|web/main.dart.js.map
      GET / → stock_quote_simple_web|web/index.html
      GET /styles/main.css → stock_quote_simple_web|web/styles/main.css
      GET /packages/browser/dart.js → browser|lib/dart.js
      GET /main.dart.js → stock_quote_simple_web|web/main.dart.js
      GET /main.dart.js.map → stock_quote_simple_web|web/main.dart.js.map
```

Working with DOM in a Browser

```
<body>
  Enter Symbol: :
  <input id="#enteredSymbol" type="text">


<script type="application/dart" src="main.dart"></script>
<script data-pub-inline src="packages/browser/dart.js"></script>
</body>
```

```
import 'dart:html';


void main() {

  InputElement enteredSymbol = querySelector("#enteredSymbol");

}
```

Event Handling

```
Element myHtmlElement = querySelector(“#myElementID");

myHtmlElement.onChange.listen(myEventHandler);
```

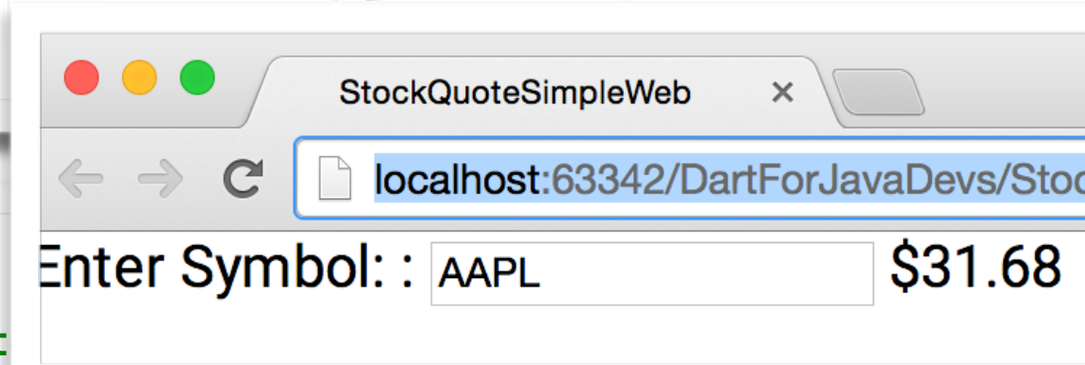
```
void myEventHandler(Event e){
   // Handle event here
}
```

A Simple Stock Quote Web App

```
<body>
  Enter Symbol: :
  <input id="enteredSymbol" type="text" placeholder="AAPL, IBM, or MSFT">

  <span id="priceQuote"></span>

<script type="application/dart" src="main.dart"></script>
<script data-pub-inline src="packages/browser/dart.js"></script>
</body>
```




```
import 'dart:html';
import 'package:stock_quote_simple_web/stock.dart';
import 'package:stock_quote_simple_web/stock_quote_generat

StockQuoteGenerator generator = new StockQuoteGenerator();

InputElement enteredSymbol;
SpanElement priceQuote;

void main() {

  enteredSymbol = querySelector("#enteredSymbol");
  priceQuote = querySelector('#priceQuote');

  enteredSymbol.onChange.listen(showPrice);
}

void showPrice(Event e){
  Stock stock = generator.getQuote(enteredSymbol.value);
  priceQuote.text = "\$${stock.price.toStringAsFixed(2)}";
}
```

DOM search

Event listener

Event handler

Demo

Web app

Working with DOM

Event Handling

pubspec.yaml

```yaml
name: stock_quote_simple_web
version: 0.0.1
description: >
  An absolute bare-bones web app.
environment:
  sdk: '>=1.0.0 <2.0.0'
dependencies:
  browser: any
transformers:
- $dart2js:
    commandLineOptions: [--minify, --show-package-warnings]
```

IDEA module: StockQuoteSimpleWeb

Debugging Dart Web App

- In Chromium:

  - Open Chrome Development Tools, enable JavaScript sourcemaps

  - Set breakpoints, refresh.

- In IntelliJ IDEA:

  - Install the **extension** JetBrains IDE Support in Chromium.

  - Set the breakpoint in IDEA in Dart code and run your HTML file in the debug mode.

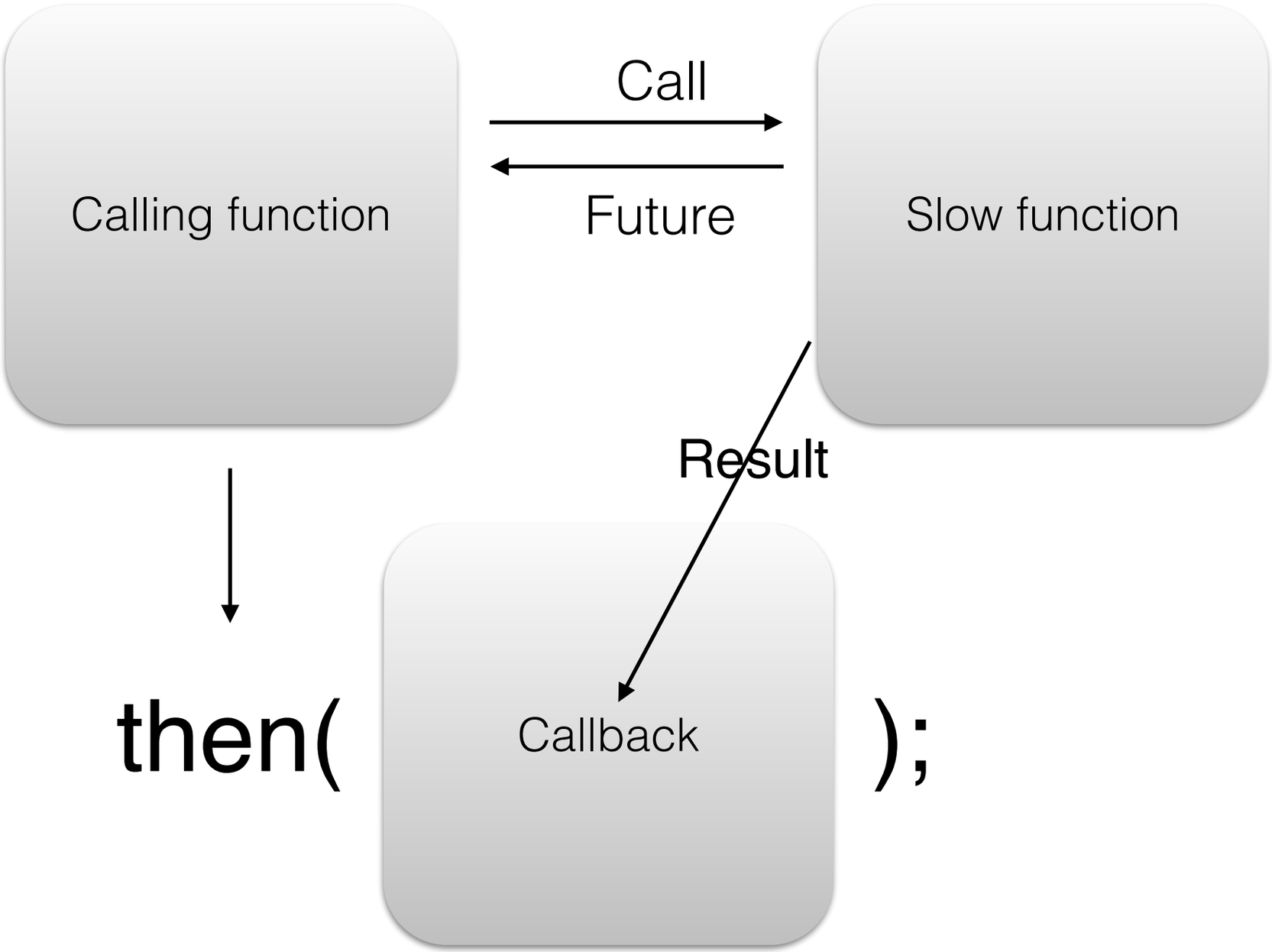
Async Programming

- Use `Future` objects
- Use `async` and `await` keywords

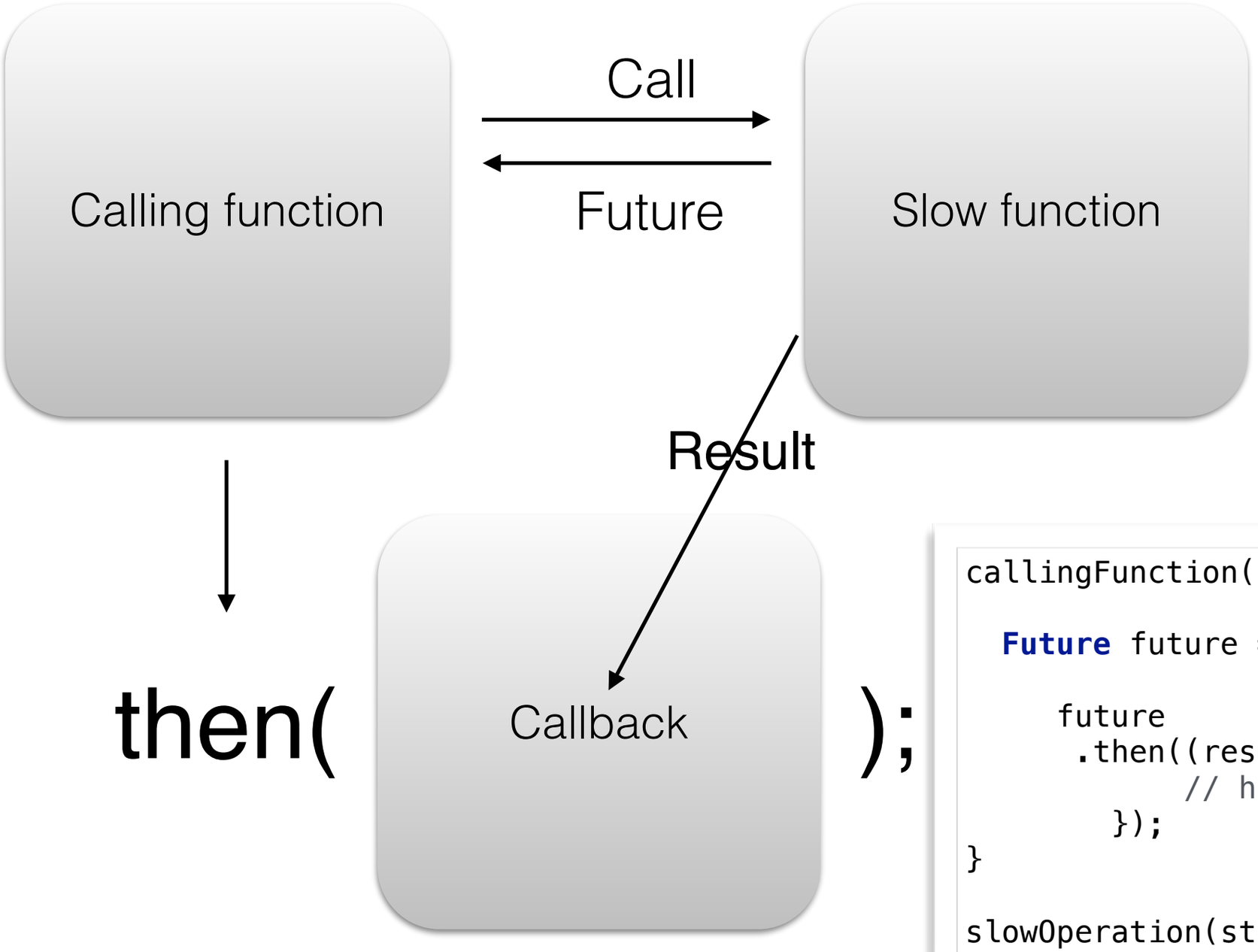
`Future`, `async`, and `await` are for asynchronous execution.

For parallel execution use isolates.

Async Processing: Futures



Async Processing: Futures




```
callingFunction(){

  Future future = slowOperation("IBM");

     future
      .then((result){
            // handle result here
        });
}

slowOperation(stockSymbol){

 return new Future.delayed(
   const Duration(seconds: 10), () {
    return "$stockSymbol is a great investment!";
  });
}
```

Error Handling in Future Objects

- A `Future` represents a deferred result of a function call.
- Register callbacks for success and errors:

```
doStuff()
    .then(callbackForSuccess)
    .catchError(callBackForError);
```

```
void callbackForSuccess() {
  //...
}

void callbackForError(Error error){
  // ...
}
```

Demo

Web app

Asyncronous processing using Future

IDEA module: StockQuoteFuture

Asynchronous Processing with async and await

- A function with `async` modifier immediately returns a `Future`
- The code after `await` will wait for the result
- You can have several sequential operations with `await`
- The code flow is easier to read comparing to callbacks, e.g. you can place all `awaits` in the `try/catch` block if need be.

```
callingFunction() async{

  var result = await slowOperation(arg);

   // the code will be suspended until
   // the result is returned

   // Handle the result here
}

slowOperation(stockSymbol){

 return new Future.delayed(
   const Duration(seconds: 10), () {
    return "$stockSymbol is a great investment!";
  });
}
```

Demo

Asyncronous processing using async and await

IDEA module: StockQuoteAsyncAwait

AJAX:HttpRequest

The `HttpRequest` class from dart:html is used for AJAX operations from a Web browser:

```
var path = 'myData.json';

HttpRequest.getString(path)
    .then((data) {
        // do something with data
    })
    .catchError((Error error) {
          print(error.toString());
    });
```

The package http.dart can be used on both the client and server.

Demo

AJAX and JSON

IDEA module: StockQuoteWebJSON

Concurrency with Isolates

- Isolates are units of secure execution
- The code can only access classes/values located in the same isolate
- Each isolate has its own heap - no shared memory
- The code in separate isolates can execute in parallel
- Isolates can communicate by sending each other messages via **send** and **receive** ports

Isolates: Standalone vs Web Browser

Standalone Apps

- run isolates in parallel using available CPU cores

- isolates can be created by invoking `spawn()` or `spawnUri()`

Web Browser Apps

- run isolates in Dart VM or as JavaScript Web workers

- isolates can be created by invoking `spawnUri()`

Isolates: Standalone vs Web Browser

Standalone Apps

- run isolates in parallel using available CPU cores

- isolates can be created by invoking `spawn()` or `spawnUri()`

Web Browser Apps

- run isolates in Dart VM or as JavaScript Web workers

- isolates can be created by invoking `spawnUri()`

Use `spawnUri()` to dynamically load code

Demo

Parallel execution with isolates

Using multiple CPU cores

IDEA modules: IsolatesConsole and IsolatesWeb

Demo

1. Reading a large JSON file with HttpRequest - GUI doesn’t freeze

2. Running a long Dart loop with async - GUI freezes

3. Running a long Dart loop in isolate - GUI doesn’t freeze

IDEA module: FrozenAsyncOrIsolate

Dart-WebSocket-Java

Dart client's getting data pushed by the GlassFish server:

```
main() {

  var output = querySelector('#output');

  WebSocket ws = new WebSocket(
                 'ws://localhost:8080/GlassfishWebsocketDart_war_exploded/clock');

  ws.onOpen.listen((event){

    output.text = "Connected";

  });

  ws.onMessage.listen((event){

    output.text = event.data;

  });

}
```

Java EE WebSocket Endpoint

```java
@ServerEndpoint("/clock")
public class WebSocketClock {

    static ScheduledExecutorService timer =
            Executors.newSingleThreadScheduledExecutor();

    private static Set<Session> allSessions;

    DateTimeFormatter timeFormatter =
            DateTimeFormatter.ofPattern("HH:mm:ss");
    @OnOpen
    public void showTime(Session session){
        allSessions = session.getOpenSessions();

        // start the scheduler on the very first connection
        // to call sendTimeToAll every second
        if (allSessions.size()==1){
            timer.scheduleAtFixedRate(
                    () -> sendTimeToAll(session),0,1,TimeUnit.SECONDS);
        }
    }

    private void sendTimeToAll(Session session){
        allSessions = session.getOpenSessions();
        for (Session sess: allSessions){
            try{
                sess.getBasicRemote().sendText("Local time: " +
                        LocalTime.now().format(timeFormatter));
            } catch (IOException ioe) {
                System.out.println(ioe.getMessage());
            }
        }
    }
}
```

Demo

Pushing data from a Java EE server to the Dart client using WebSocket protocol

The detailed description of this demo is here: http://bit.ly/1DeulKX

IDEA module: GlassfishWebSocketDart

Dart Tools

1. **IDEs:** Dart Editor, and plugins for all major IDEs

2. **dart2js** is a Dart-to-JavaScript transpiler and a tree-shaker

3. **pub** is a dependency management, development server and build tool.

4. **gulp** is a task manager. It's an analog of Grunt or Gradle.

5. **Dartium** is a Web Browser for developers.

6. **Dump-Info Visualizer** allows to inspect the generated JavaScript.

7. **Observatory** is Dart profiler.

8. **AngularDart** is a port of AngularJS framework.

Links

- Code samples from this demo: https://github.com/Farata/dart
- Dart Style Guide https://www.dartlang.org/articles/style-guide
- Dart API docs: https://api.dartlang.org
- Try Dart: https://dartpad.dartlang.org
- Hands-on labs: darlang.org/codelabs
- List of languages that compile to JS: http://bit.ly/1FGHtPT
- NYC Dart meetup: http://www.meetup.com/Dart-Users-Group

More Links

- Our Dart/Java app: https://easy.insure
- Farata Systems: faratasystems.com
- Twitter: @yfain
- email: yfain@faratasystems.com
- Personal blog: yakovfain.com
- The book Java for Kids: http://yfain.github.io/Java4Kids/