Dart

Developing Dart Editor
Eclipse Day at Googleplex 2013

Dan Rubel
Eric Clayberg

Overview

- Dart Project
- Dart Language
- Developing in Dart
- Developing Dart Editor
- Questions

Dart Project

http://www.dartlang.org

Dart

Web Apps

- The web is everywhere
- Developing small apps is easy
- No installation required
- Supports incremental development
- Open platform

... but we need to innovate

- Productivity
- Scalability
- Speed

http://www.dartlang.org

Dart

Why?

What is wrong with JavaScript?

- Lack of structure
- Very difficult to find dependencies
- All numbers are floats
- Monkey patching
- Keep on truckin' mentality
- Libraries are files you concatenate

... which makes it ...

- Difficult to optimize performance
- Difficult to maintain large code bases
- Difficult to assert correctness

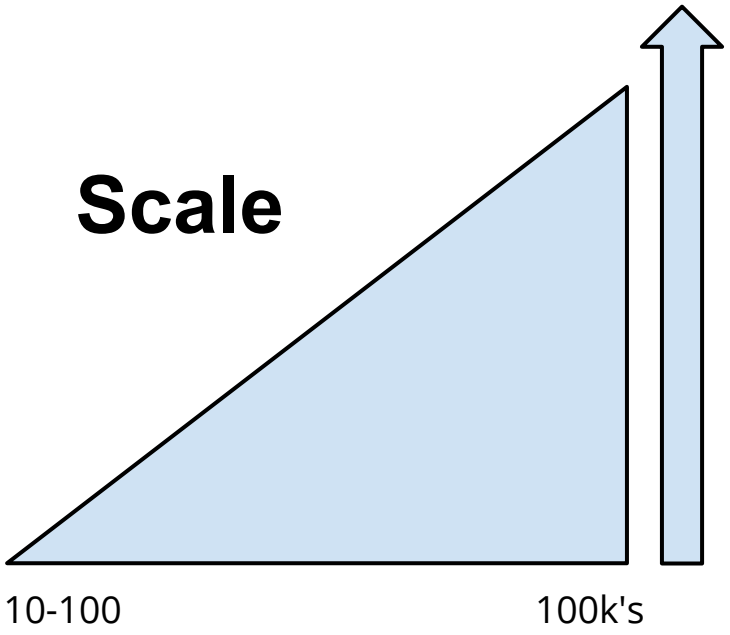
Goal

“Dart helps developers from all platforms build complex, high performance client apps for the modern web.”

VM Speed

x2 → **x?**

Scale

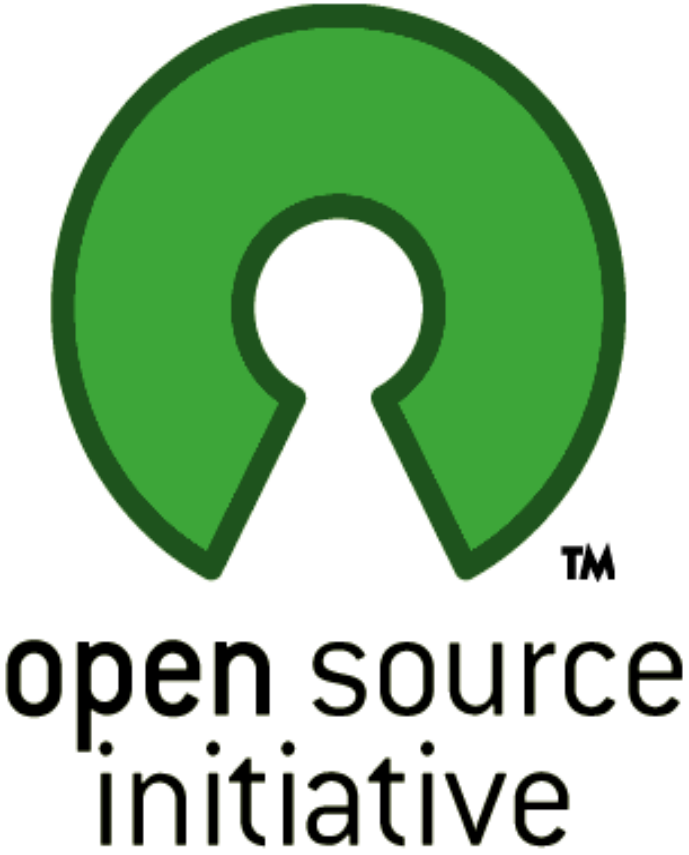


Dart

What is Dart?

Dart is open source

- BSD-style license
- dart.googlecode.com
- GitHub mirror
- Contributing guide
- NEW ECMA Standard (TC52)
- NEW Production ready (1.0)



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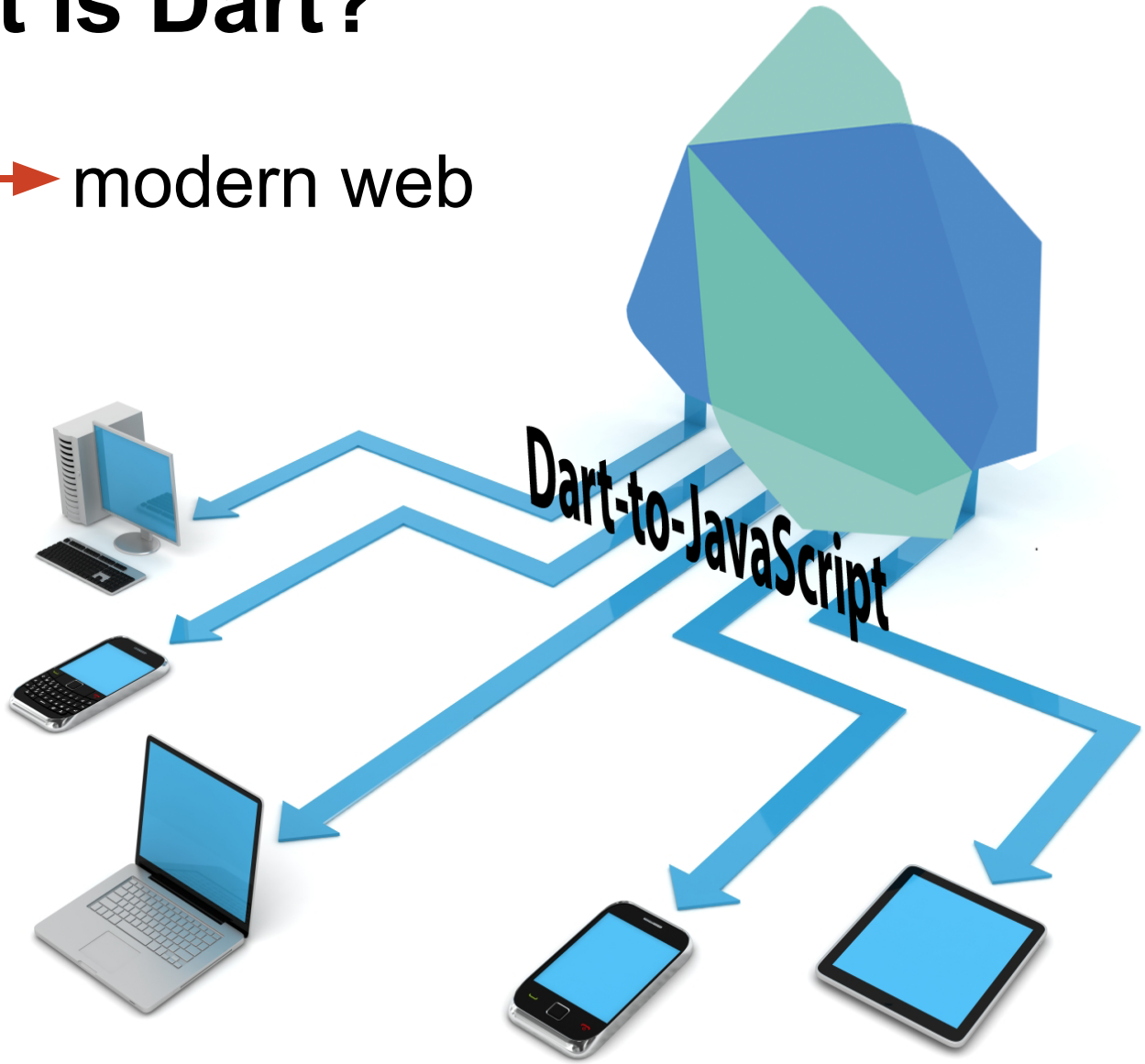
What is Dart?

Dart → modern web



Dart

What is Dart?

- Rich client apps
- Server apps
- Offline-capable
- 60fps
- ECMAScript 5+
- HTML5

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What is Dart?

Language

Libraries (core, math, html, isolate, io, json, uri, utf, crypto, polymer, angular...)

Editor

Virtual machine

Compiler to JavaScript

Browser integration

Package manager

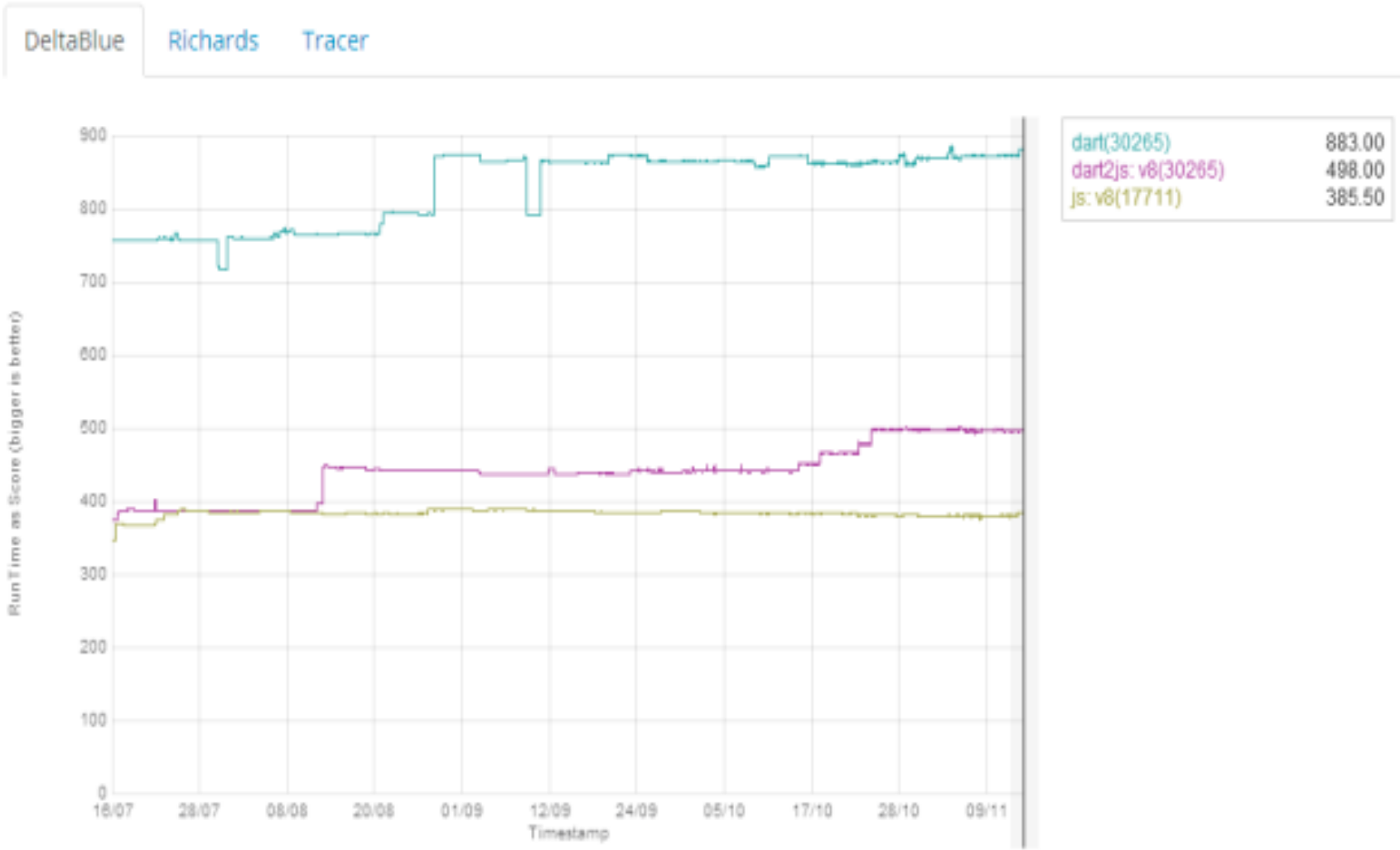
Web Components (Polymer & Angular)

Community

"Batteries Included"

http://www.dartlang.org

Performance - x2 now



Dart Language

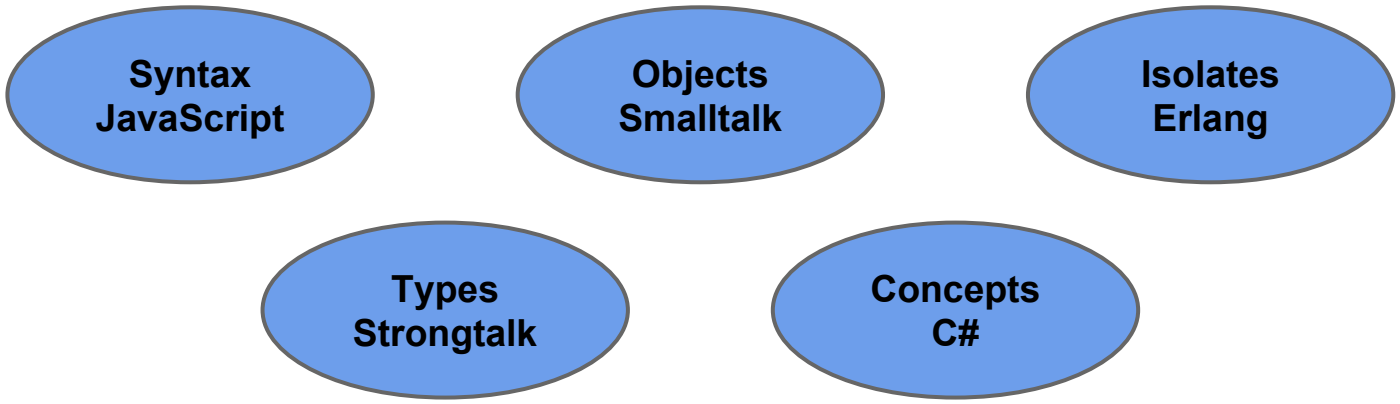
http://www.dartlang.org

Dart

Language Goals

- Unsurprising simple and familiar
- Class-based single inheritance (w/ mixins)
- Proper lexical scoping
- Single-threaded with isolates
- Optional static types

Dart =



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Dart

Optional Static Types

Static types ...

- Communicate developer intent
- Used by tools to assert program correctness
- Not used at runtime unless specified

You can mix typed and untyped code ...

```
var p = new Point(2, 3);
int x = 4;
print (p + new Point(x, 5));
```

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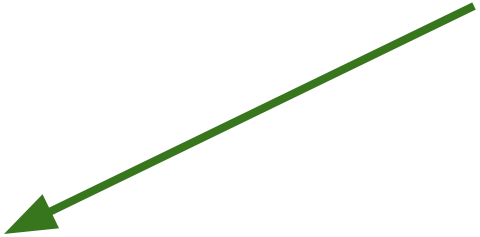
Implicit Interfaces

```
class Printer {
  void print(String message) {
    // print the message
  }
}
```

Mock for testing



```
class MockPrinter implements Printer {
  void print(String message) {
    // validate method was called
  }
}
```

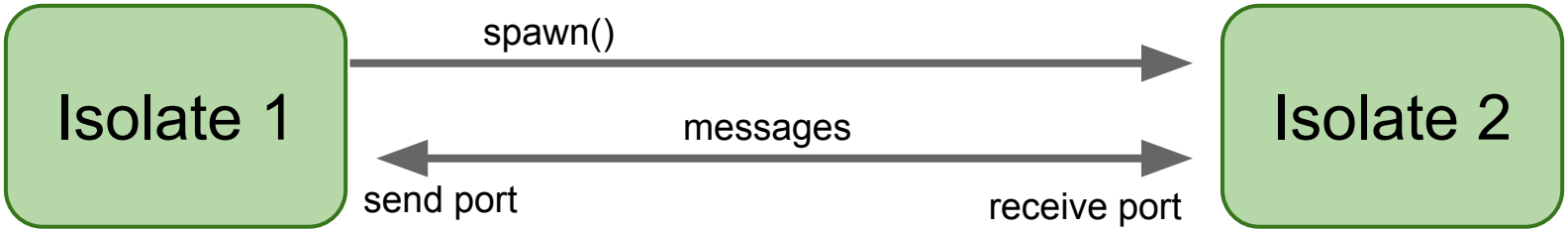
Mixins

```
class PrettyPrinter extends ASTTool with Counter
{
 ...
}

class Counter {
      int count = 0;
      int get increment => ++count;
      int get decrement => --count;
}
```

Isolates

- Inspired by Erlang
- Lightweight units of execution
  - Each isolate conceptually a process
  - Nothing shared
  - All communication via message passing
- Support concurrent execution



Futures

Use Futures to perform asynchronous operations.

```
import 'dart:io';
void main() {
  new File('some.txt').readAsString().then((content) => print(content));
  print('main complete');
}
```

Output:

```
main complete
contents of file
```

Developing in  Dart

http://www.dartlang.org

Hello World

```
import 'dart:html';

void main() {
  new Hello().welcome("World");
}

class Hello {
  void welcome(String name) {
    var message = "Hello $name";
    document.querySelector('#status')
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Libraries

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Functions

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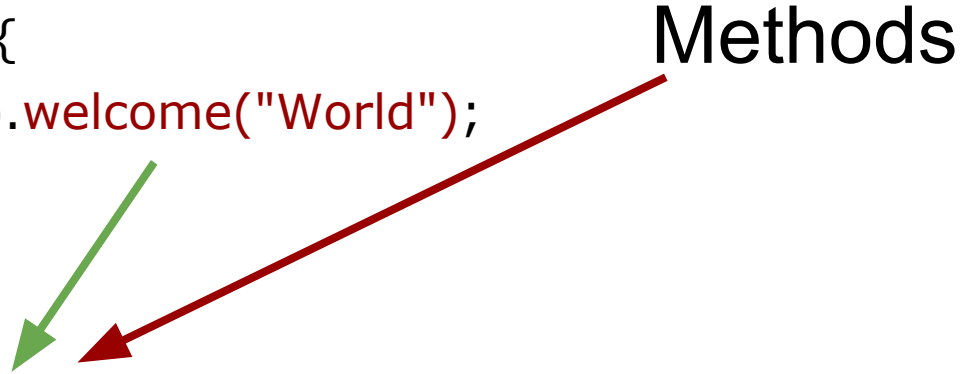

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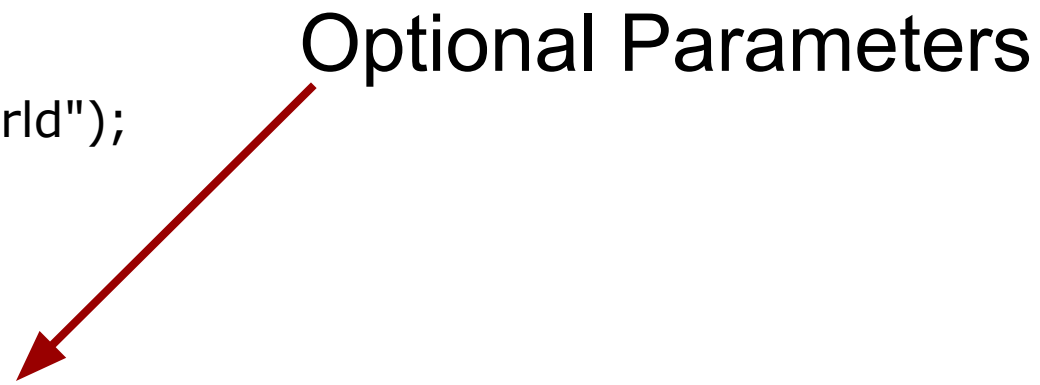

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class Hello {
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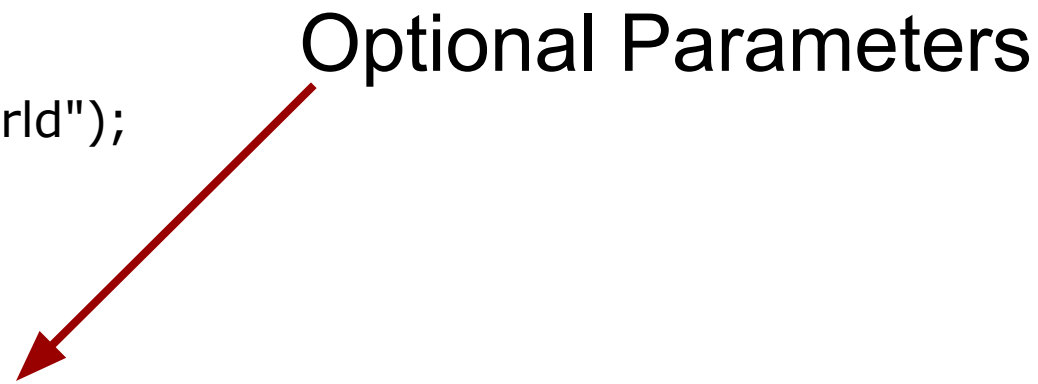

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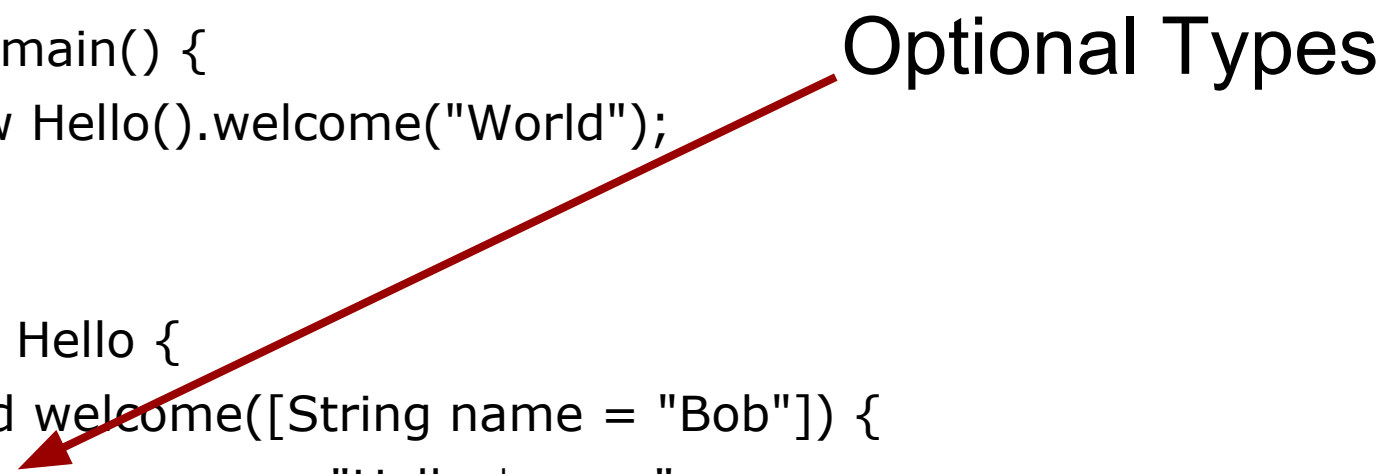

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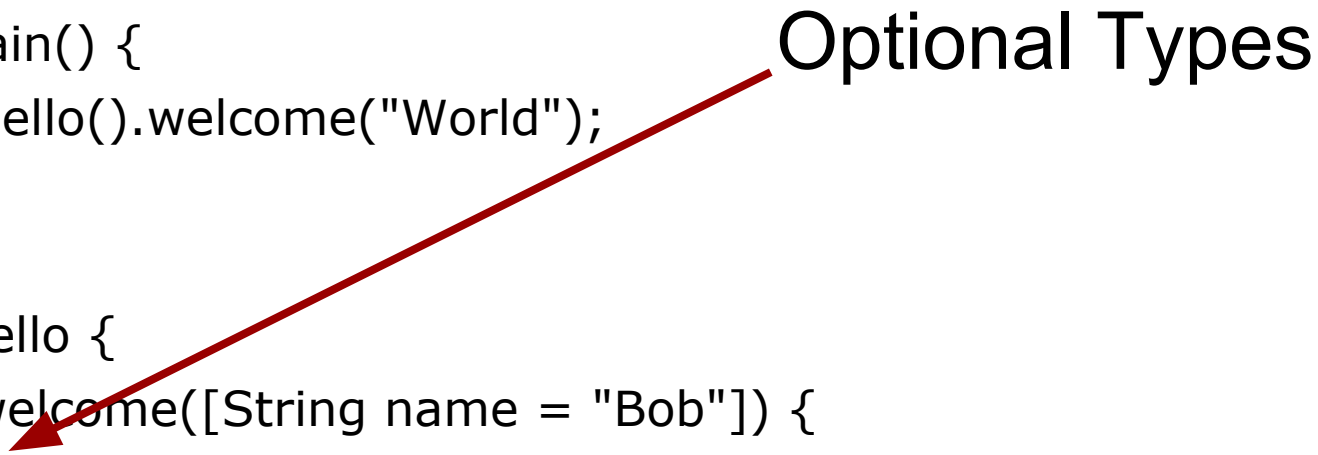

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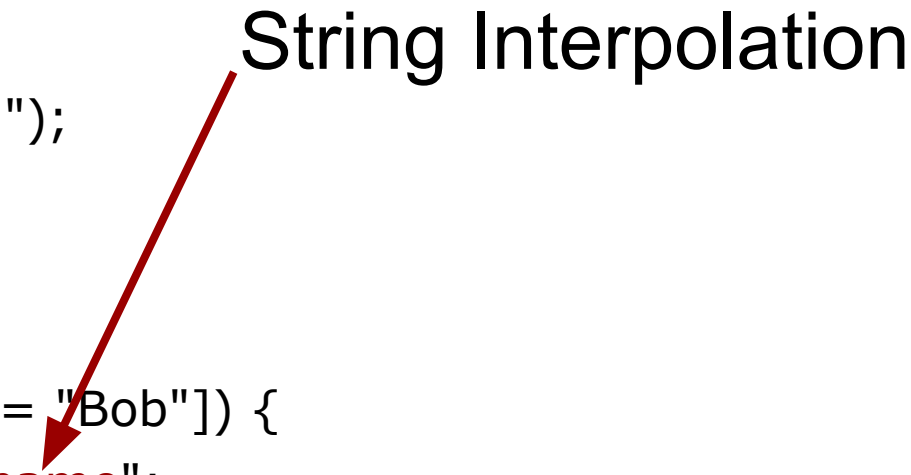

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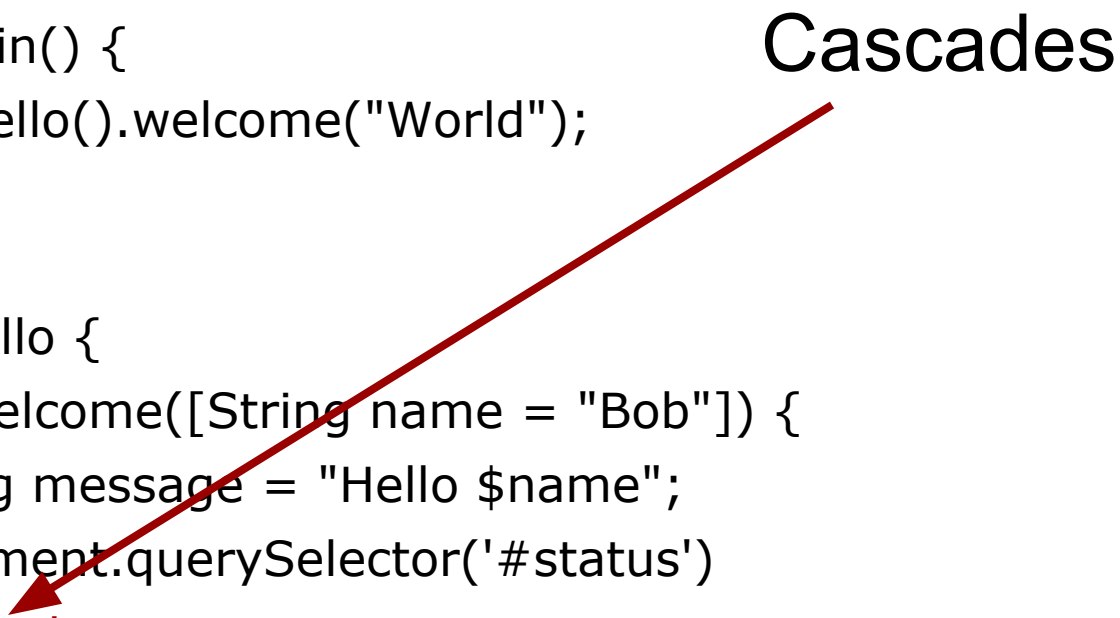

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```
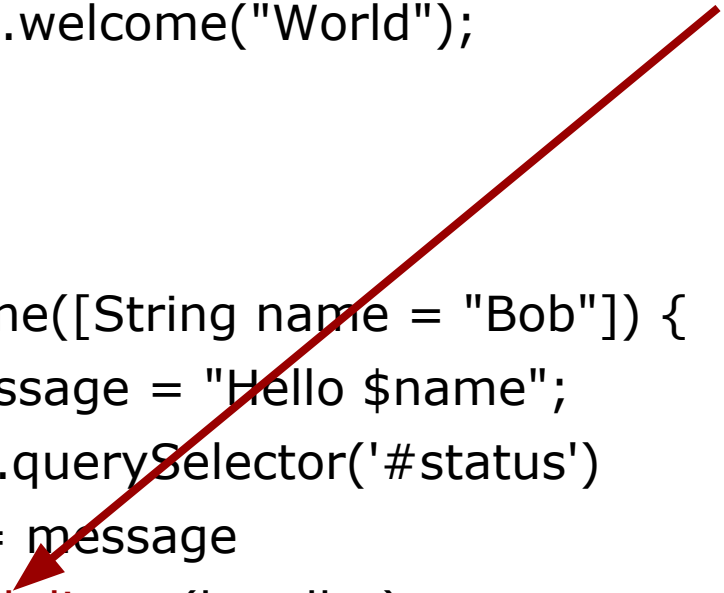

Simple DOM API



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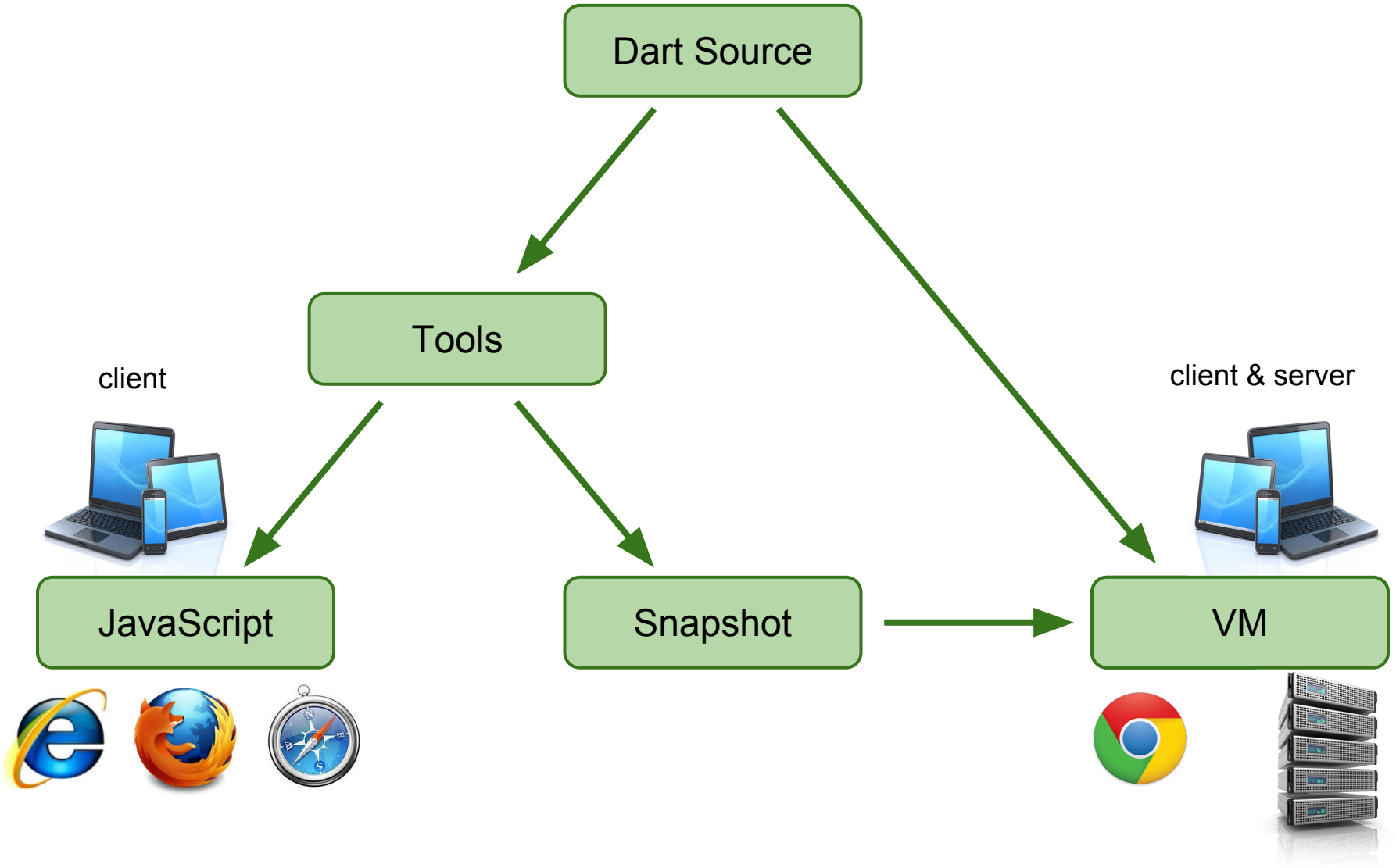
Dart

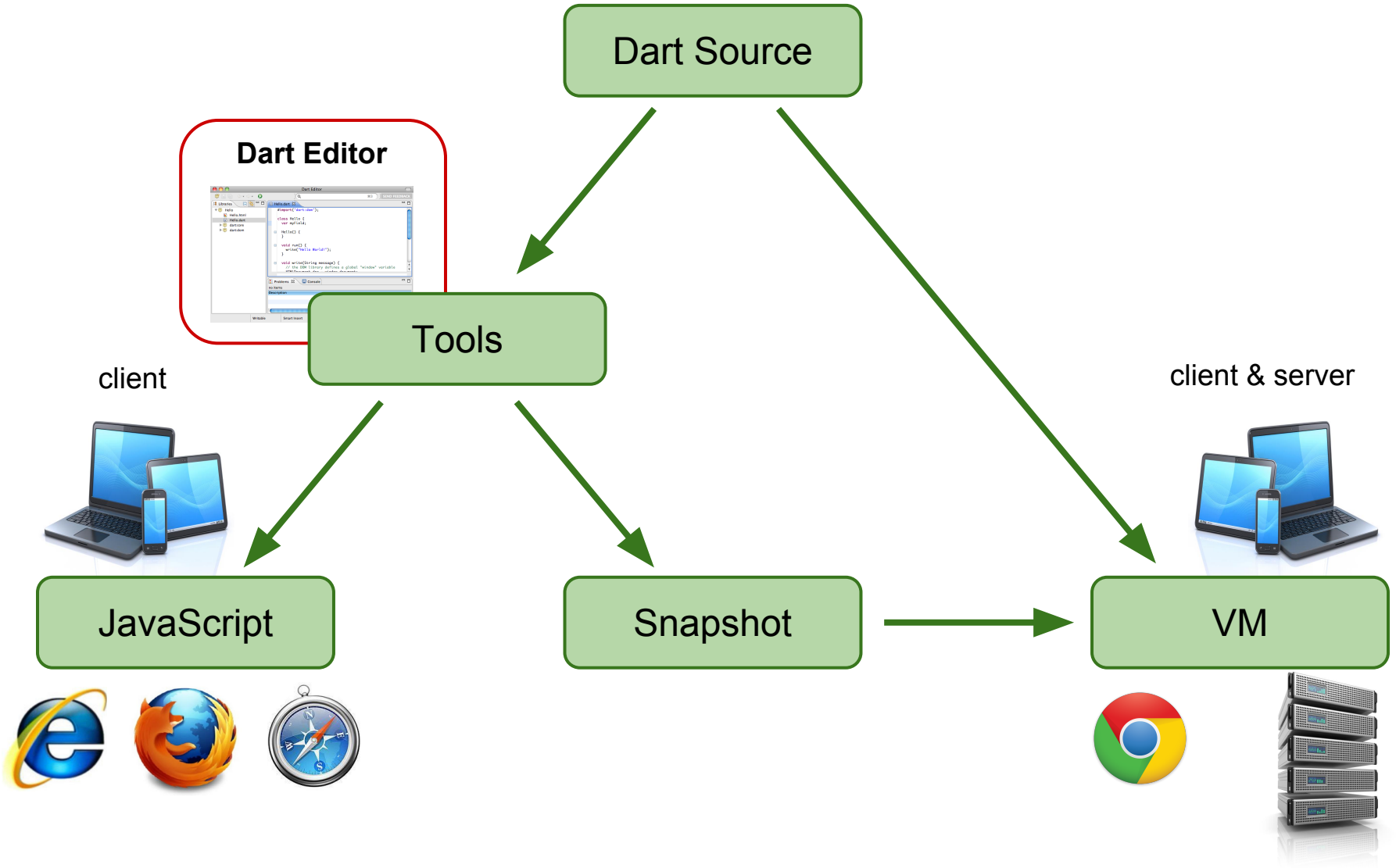
Pub

- Package manager for Dart
- Helps with Dart code reuse and bundling
- Handles versioning and dependency management
- Available at http://pub.dartlang.org/

Tools


Dart Source
Tools
client
client & server
JavaScript
Snapshot
VM

Tools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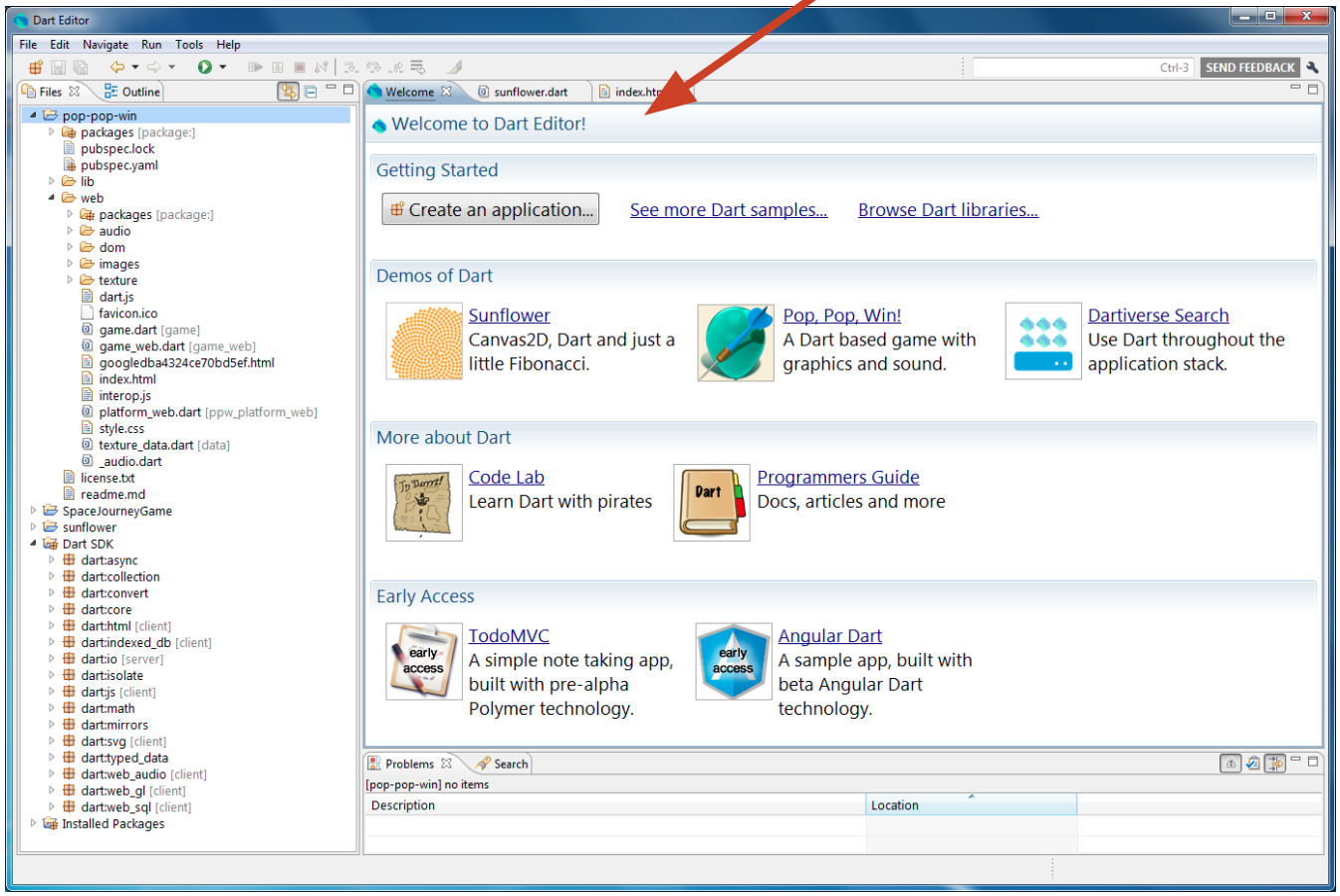
Dart Editor

Welcome Page



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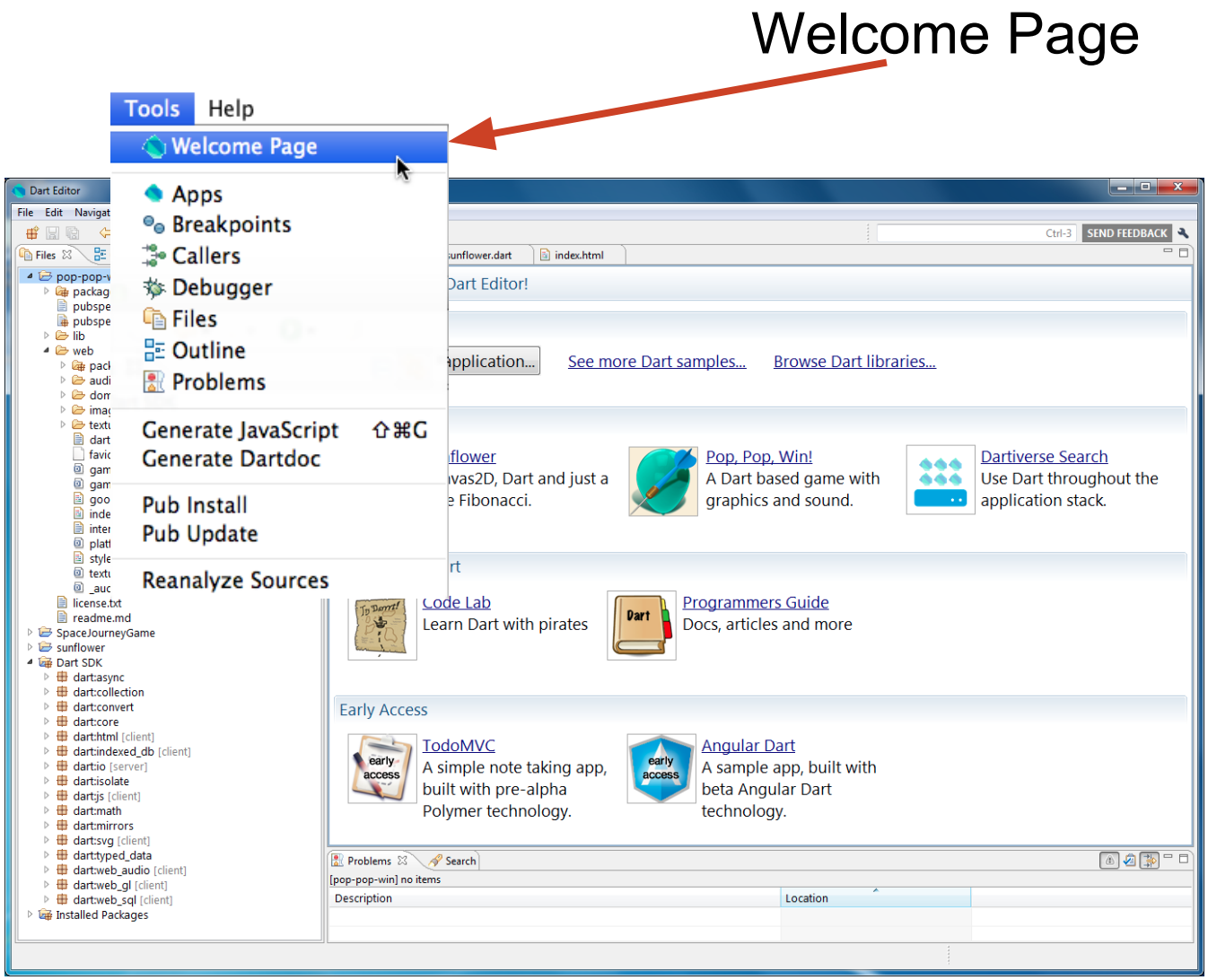
Welcome Page
Tools
Help
Welcome Page
Apps
Breakpoints
Callers
Debugger
Files
Outline
Problems
Generate JavaScript ⇧⌘G
Generate Dartdoc
Pub Install
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Reanalyze Sources
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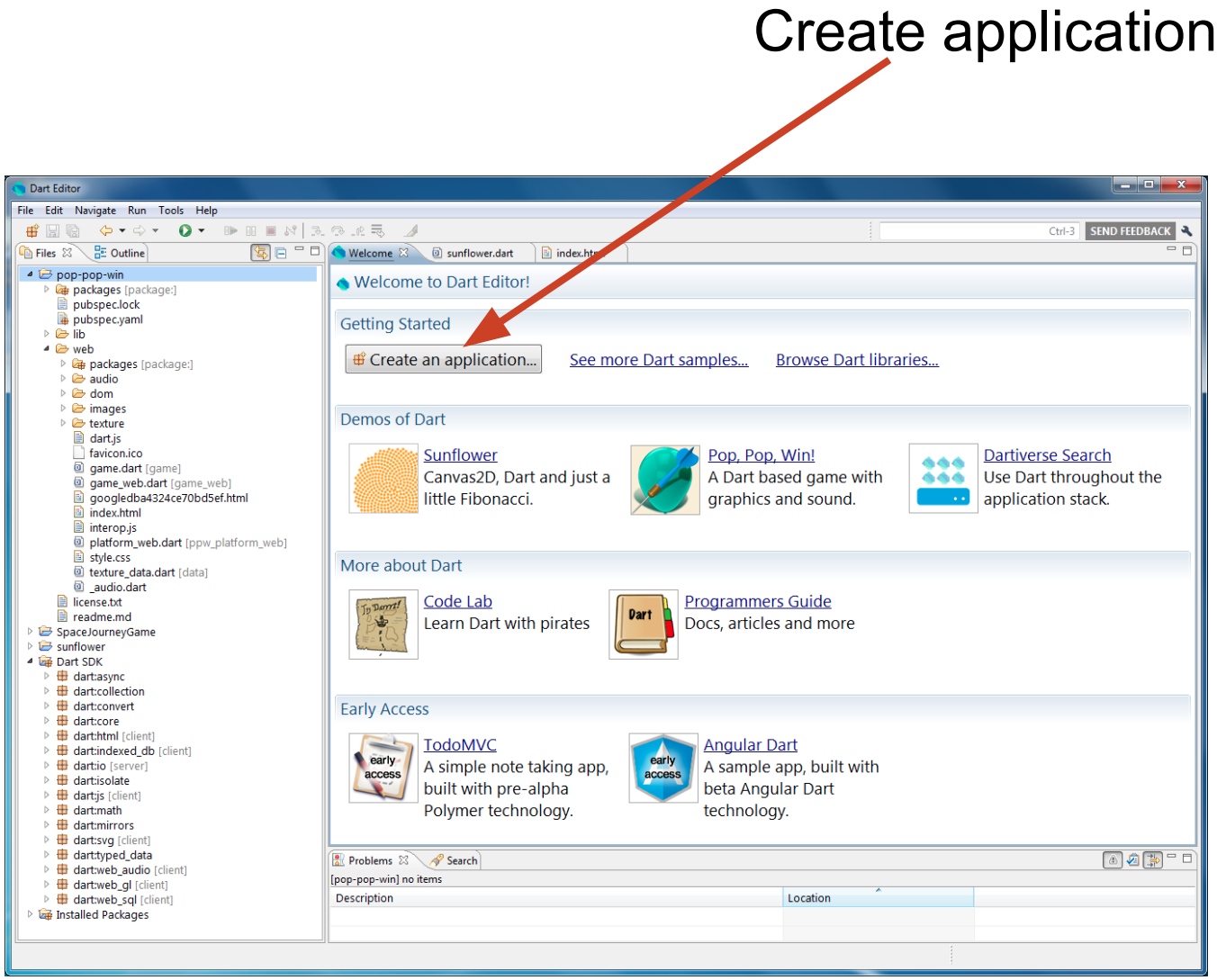
Create application
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File Edit Navigate Run Tools Help
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Welcome sunflower.dart index.html
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Description
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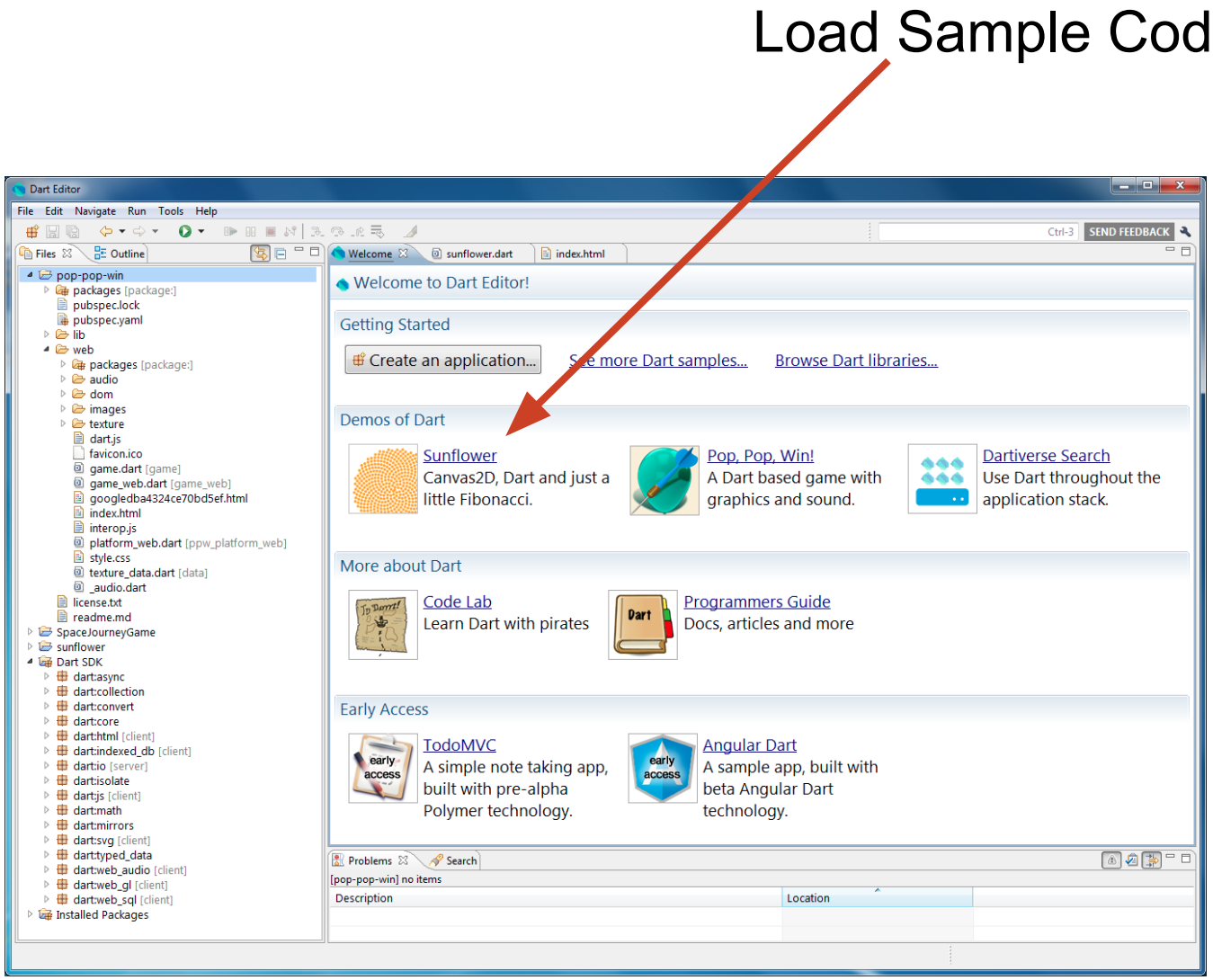
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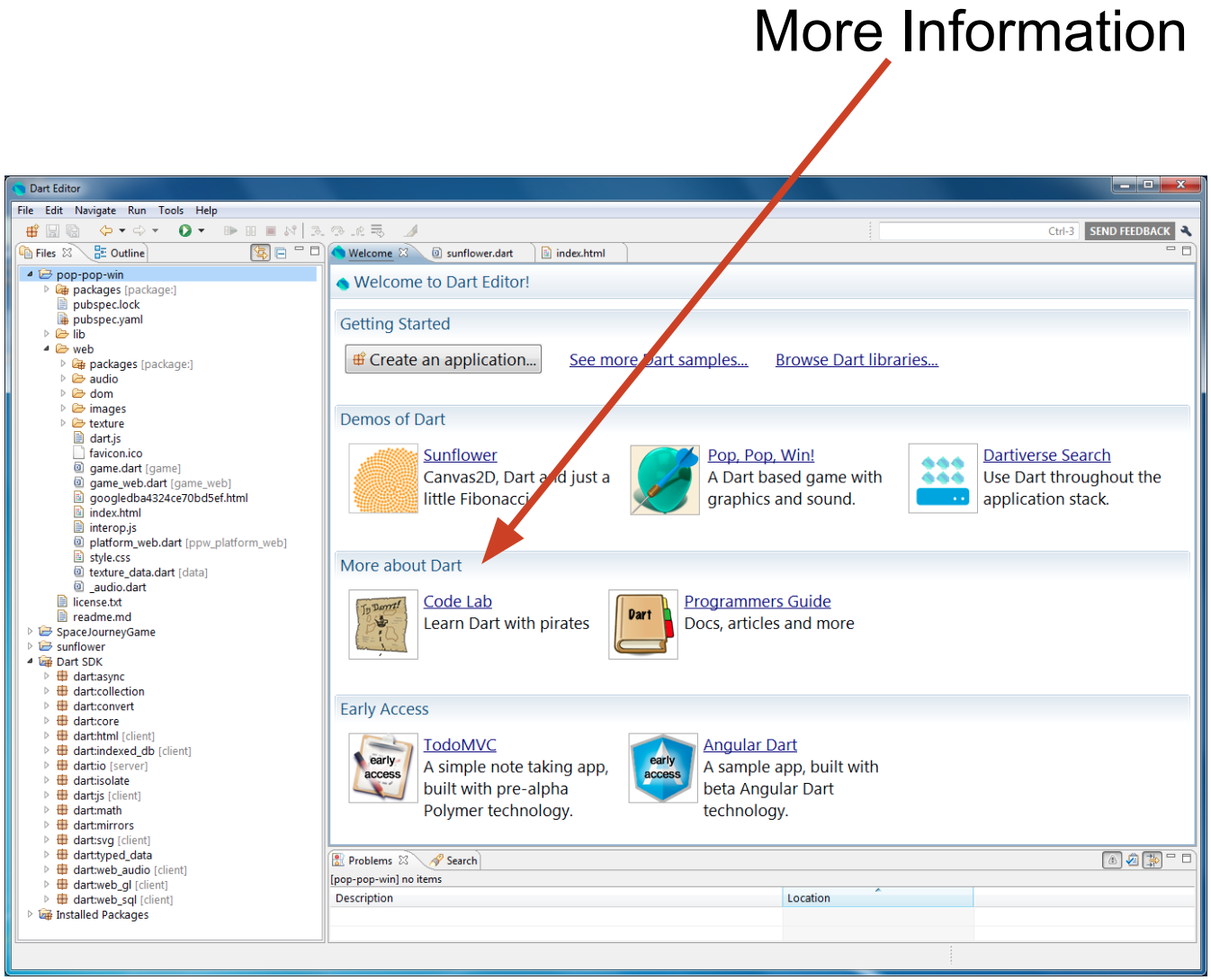
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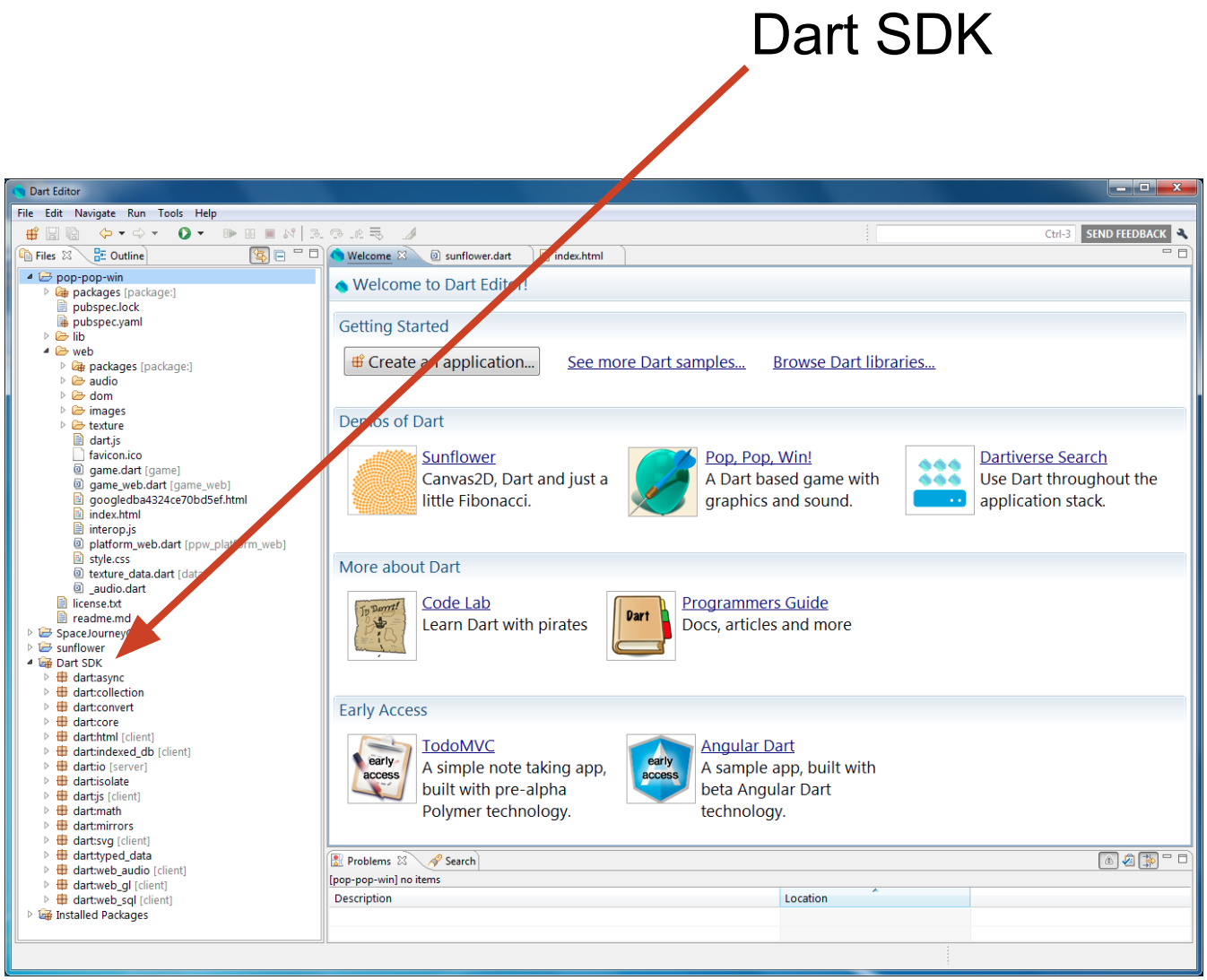
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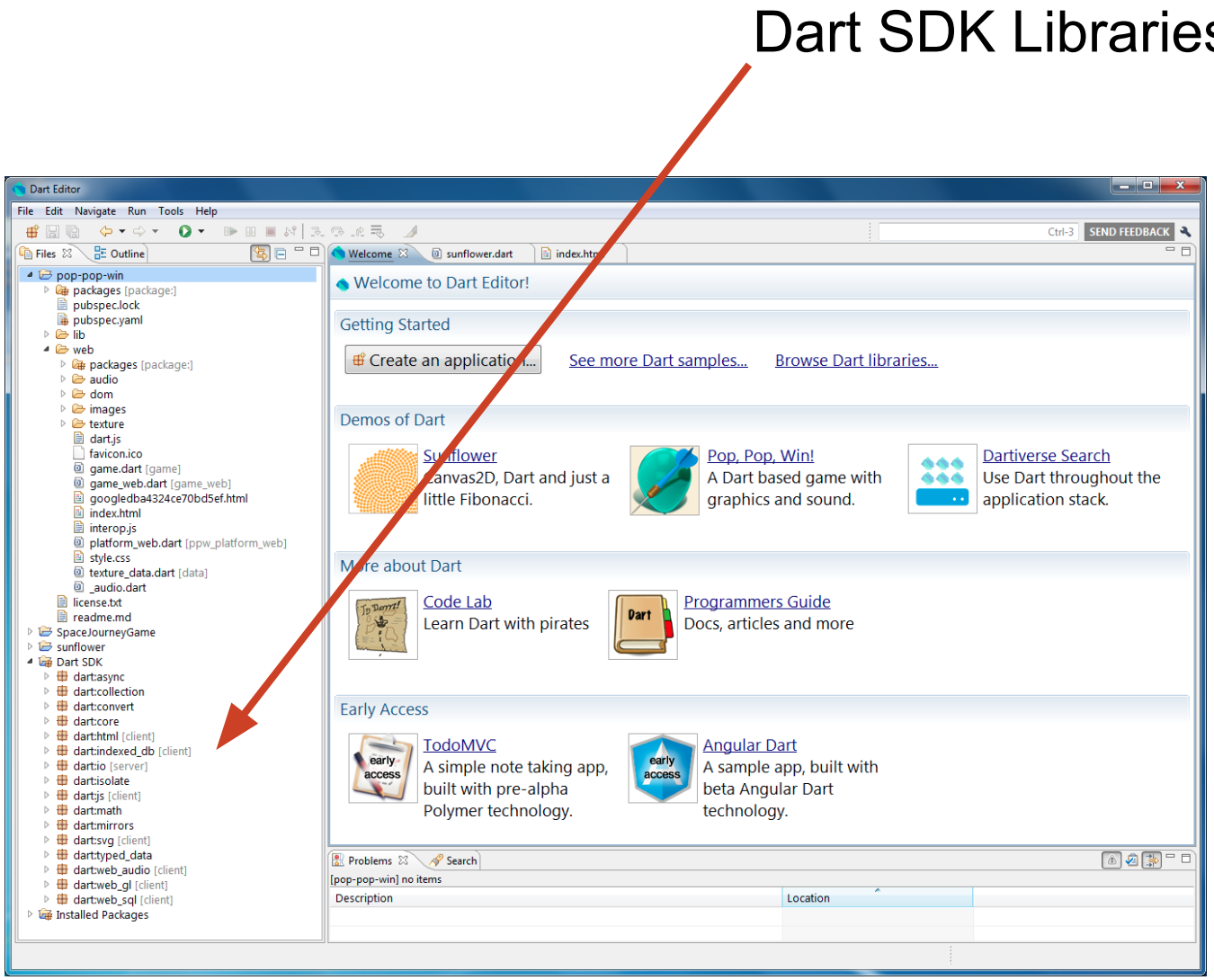
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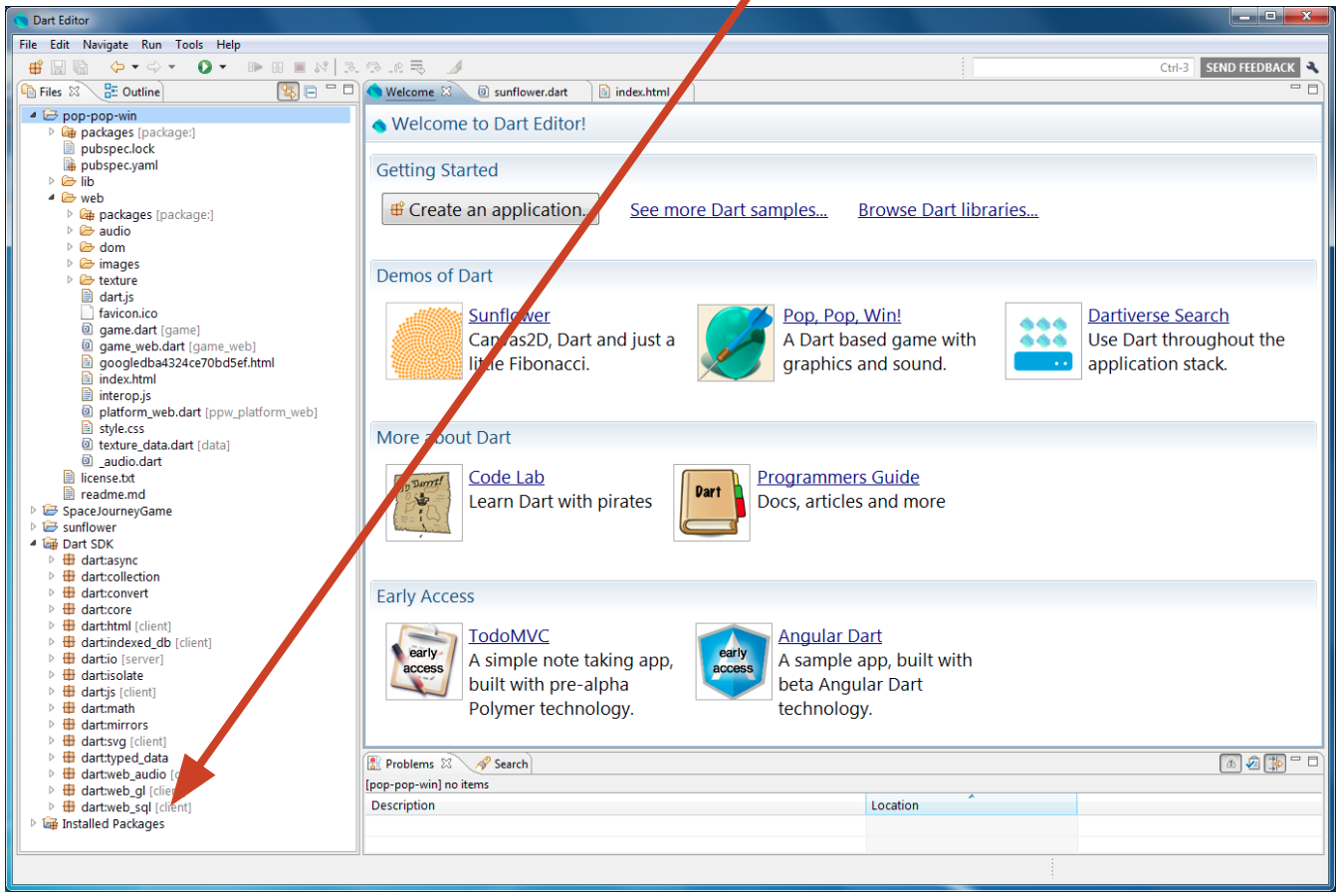
index.html
pop-pop-win
packages [package:]
pubspec.lock
pubspec.yaml
lib
web
packages [package:]
audio
dom
images
texture
dart.js
favicon.ico
game.dart [game]
game_web.dart [game_web]
googledba4324ce70bd5ef.html
index.html
interop.js
platform_web.dart [ppw_platform_web]
style.css
texture_data.dart [data]
_audio.dart
license.txt
readme.md
SpaceJourneyGame
sunflower
Dart SDK
dart:async
dart:collection
dart:convert
dart:core
dart:html [client]
dart:indexed_db [client]
dart:io [server]
dart:isolate
dart:js [client]
dart:math
dart:mirrors
dart:svg [client]
dart:typed_data
dart:web_audio [client]
dart:web_gl [client]
dart:web_sql [client]
Installed Packages
Welcome to Dart Editor!
Getting Started
Create an application...
See more Dart samples...
Browse Dart libraries...
Demos of Dart
Sunflower
Canvas2D, Dart and just a little Fibonacci.
Pop, Pop, Win!
A Dart based game with graphics and sound.
Dartiverse Search
Use Dart throughout the application stack.
More about Dart
Code Lab
Learn Dart with pirates
Programmers Guide
Docs, articles and more
Early Access
TodoMVC
A simple note taking app, built with pre-alpha Polymer technology.
Angular Dart
A sample app, built with beta Angular Dart technology.
Problems
Search
[pop-pop-win] no items
Description
Location

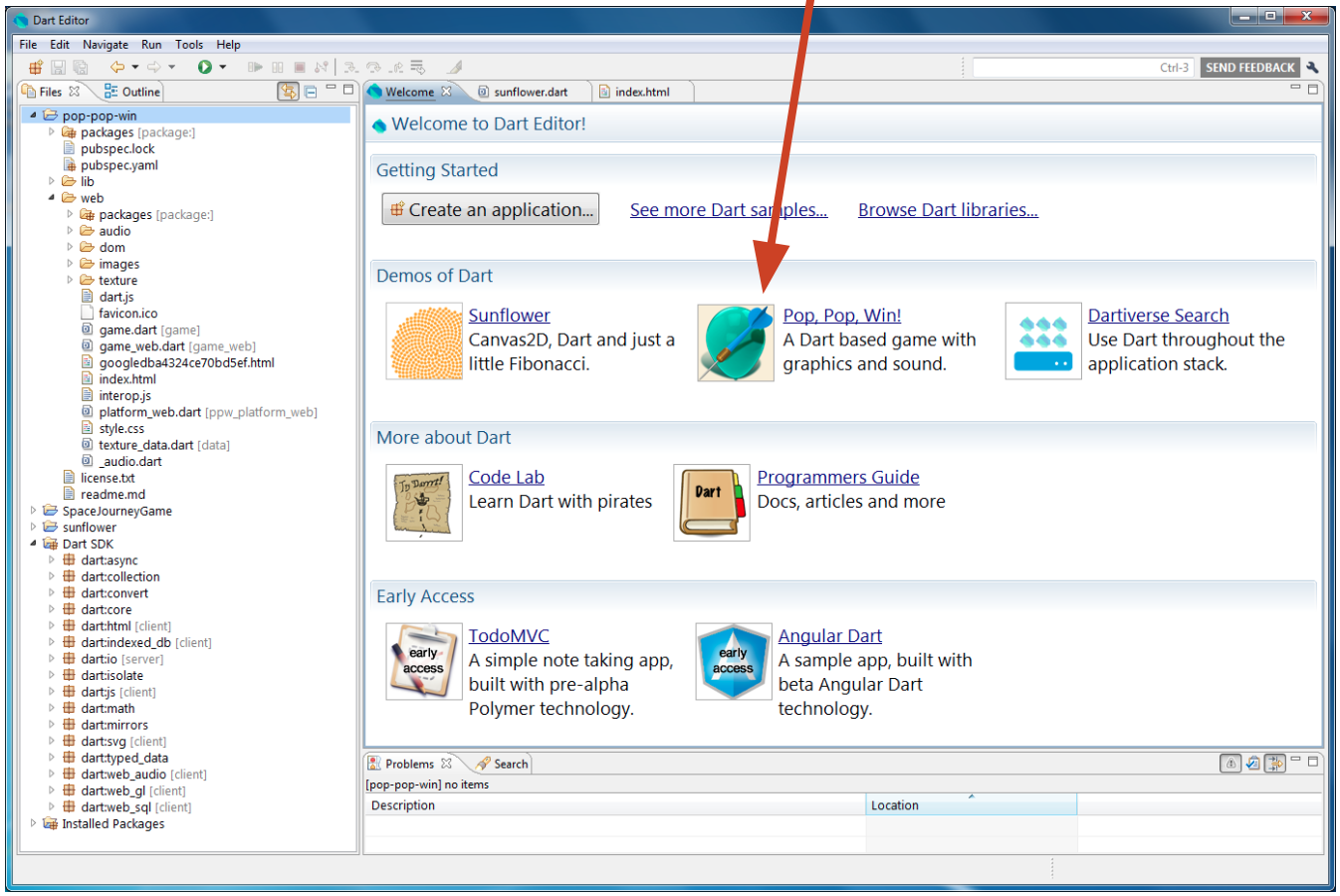
Dart Editor

Installed Pub Packages



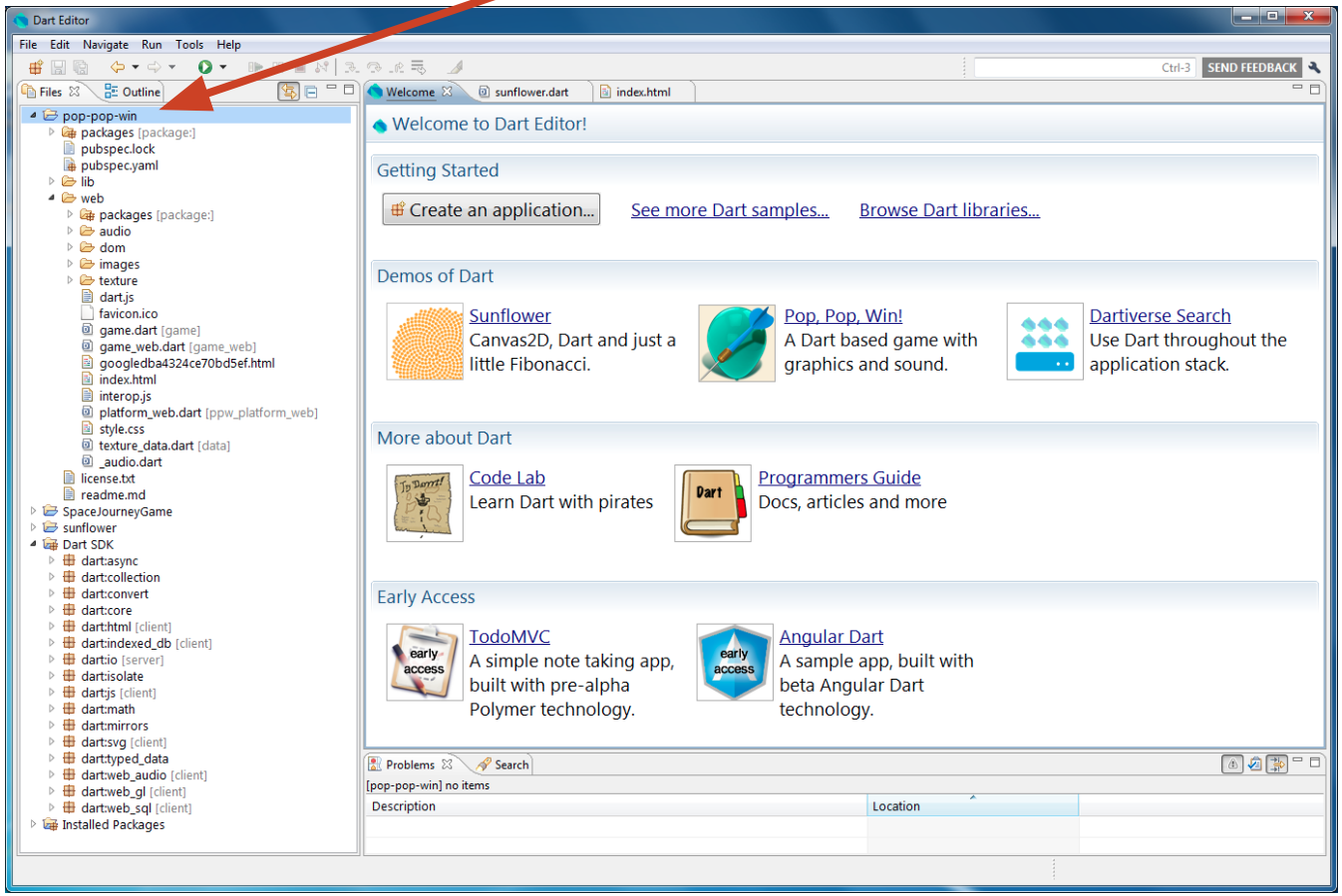
Dart Editor

Load Pop Pop Win Sample



Dart Editor

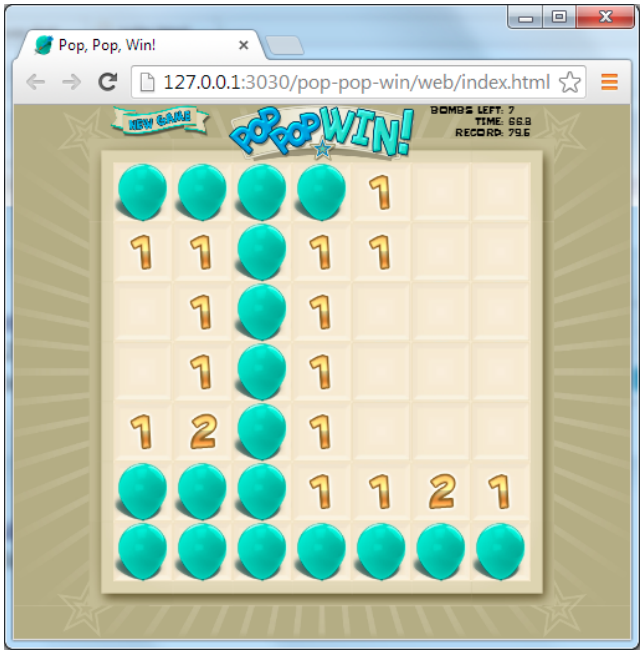
Pop Pop Win Sample



Sample

Pop Pop Win

- Dartium
- JavaScript
- Debugging

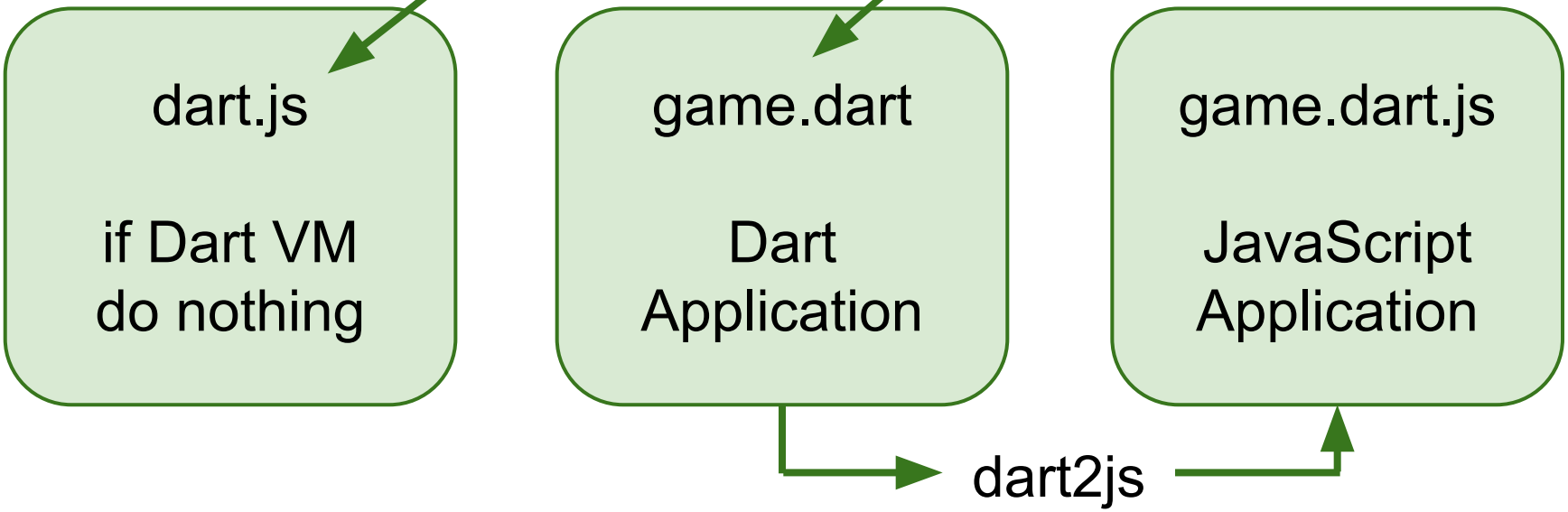


Source → dart2js

HTML + Dart

Dartium

```
<html>
  <body>
    <script type="application/dart" src="game.dart"/>
    <script type=".../dart.js"/>
```



HTML + Dart

Others

```
<html>
  <body>
    <script type="application/dart" src="game.dart.js"/>
    <script type=".../dart.js"/>
```

dart.js

if no Dart VM
rewrite DOM

game.dart

Dart
Application

game.dart.js

JavaScript
Application

dart2js

dart2js

Converts Dart source to JavaScript

- Targets ES5+ (modern browsers)
- Tree shaking and dead code elimination
- Written in Dart

In progress:

- Smaller JavaScript output
- Performance improvements

Pub - package manager

Declaration

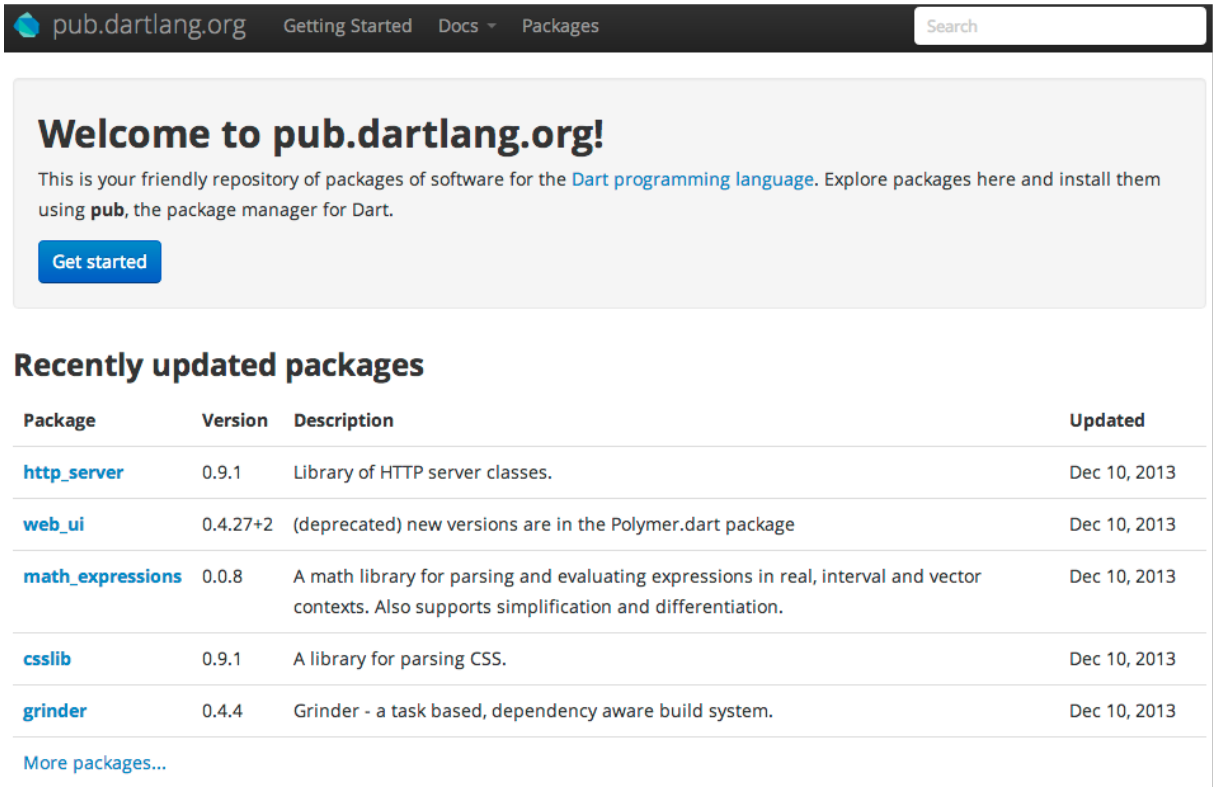
- pubspec.yaml defines the package

Operations

- pub get installs dependencies
- pub upgrade upgrade to latest

See packages on **http://pub.dartlang.org**

Pub - site

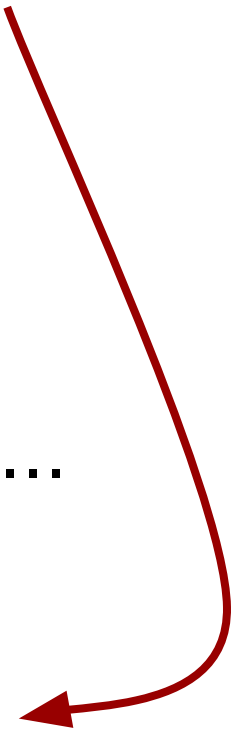


Fun facts: 500+ packages, 1.5 Million LOC,

top 20 packages have been downloaded 700K+ times

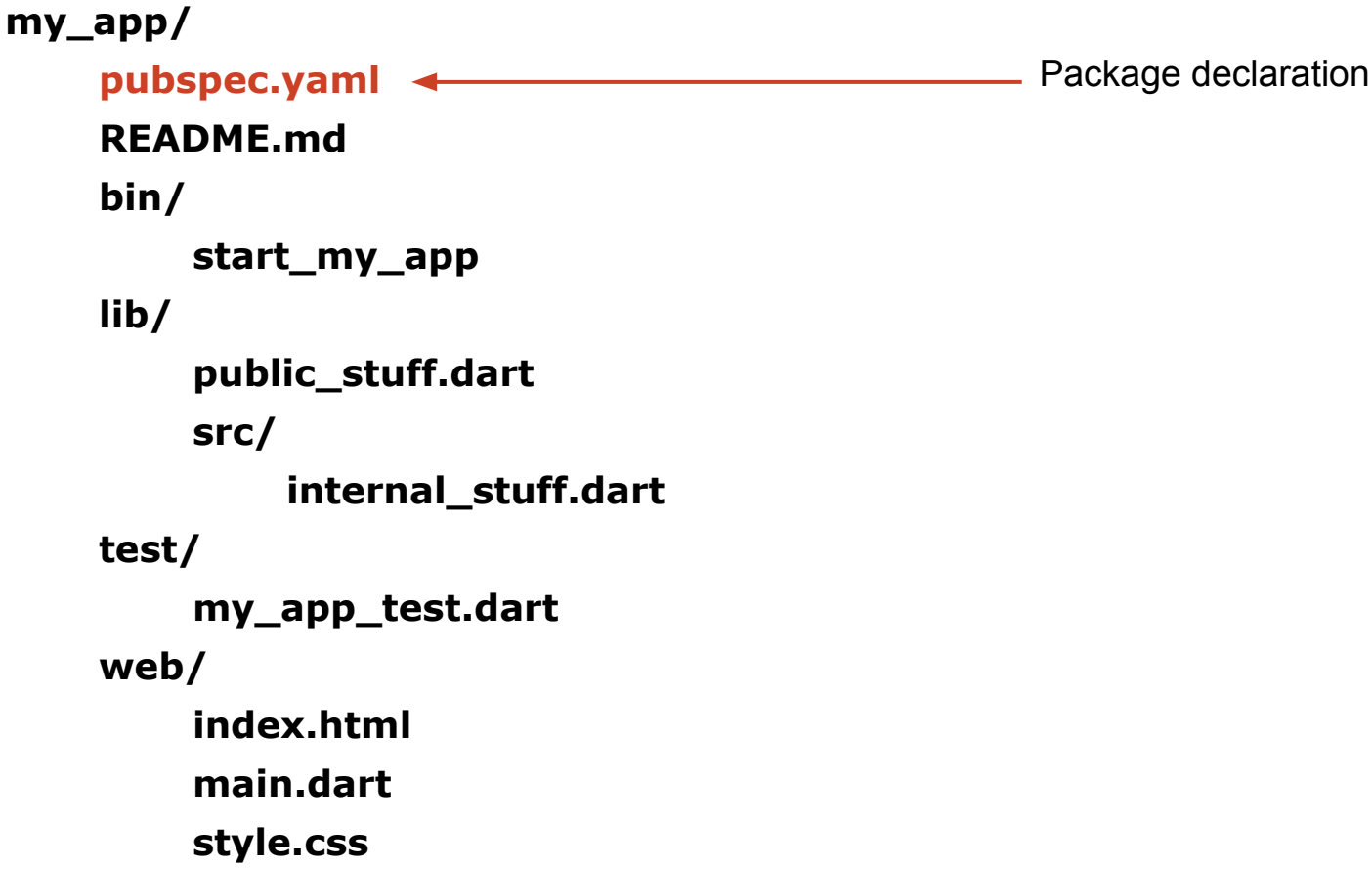
Pub - pubspec.yaml

Semantic Versioning
http://semver.org/

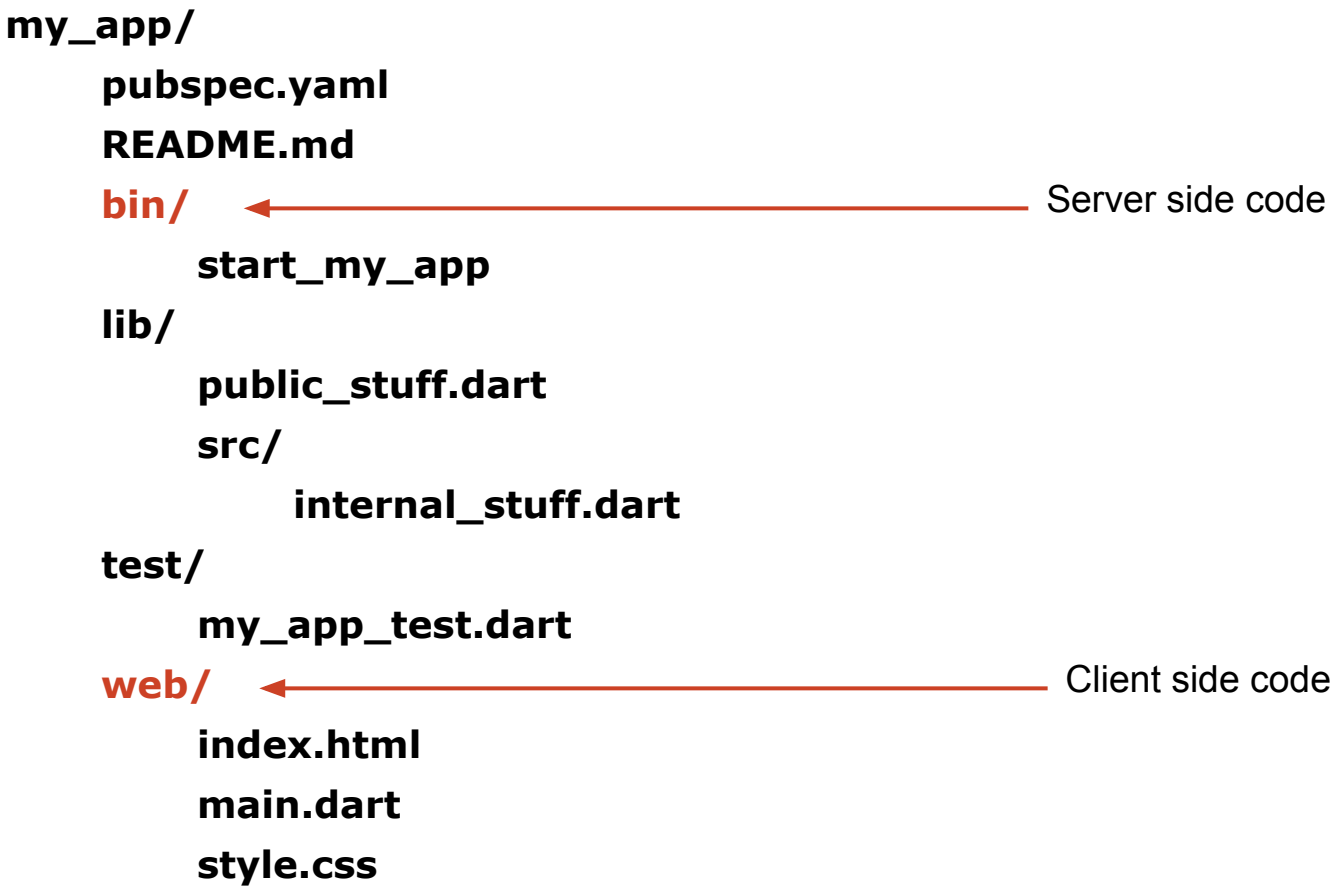


```
name:         my_app
description:  some application
version:      1.2.7
author:       Bob <bob@smith.org>
homepage:     http://www.smith.org/...
dependencies:
    one_package: any
    another_package: "1.2.1-dev4.0"
    my_package: ">=0.2.8+4 <0.2.9"
```

Pub - layout


my_app/
pubspec.yaml
README.md
bin/
start_my_app
lib/
public_stuff.dart
src/
internal_stuff.dart
test/
my_app_test.dart
web/
index.html
main.dart
style.css
Package declaration

Pub - layout


my_app/
pubspec.yaml
README.md
bin/
Server side code
start_my_app
lib/
public_stuff.dart
src/
internal_stuff.dart
test/
my_app_test.dart
web/
Client side code
index.html
main.dart
style.css

Pub - layout

```
my_app/
    pubspec.yaml
    README.md
    bin/
        start_my_app
    lib/                                  <-- Public code
        public_stuff.dart
        src/                              <-- Internal code
            internal_stuff.dart
    test/
        my_app_test.dart
    web/
        index.html
        main.dart
        style.css
```

Pub - layout

```
my_app/
    pubspec.yaml
    README.md
    bin/
        start_my_app
    lib/
        public_stuff.dart
        src/
            internal_stuff.dart
    test/
        my_app_test.dart
    web/
        index.html
        main.dart
        style.css
```

Developing Dart Editor

http://www.dartlang.org

Dart Editor - Users

- Web programmers of varying backgrounds
  - Many languages - HTML, JS, Python, Java
  - Wide range of programming experience
- Primarily **not** Eclipse users
- Dart Plugin available for Eclipse users

Dart Editor - Goals

- Easy on-ramp to learn Dart
- Simplified UI

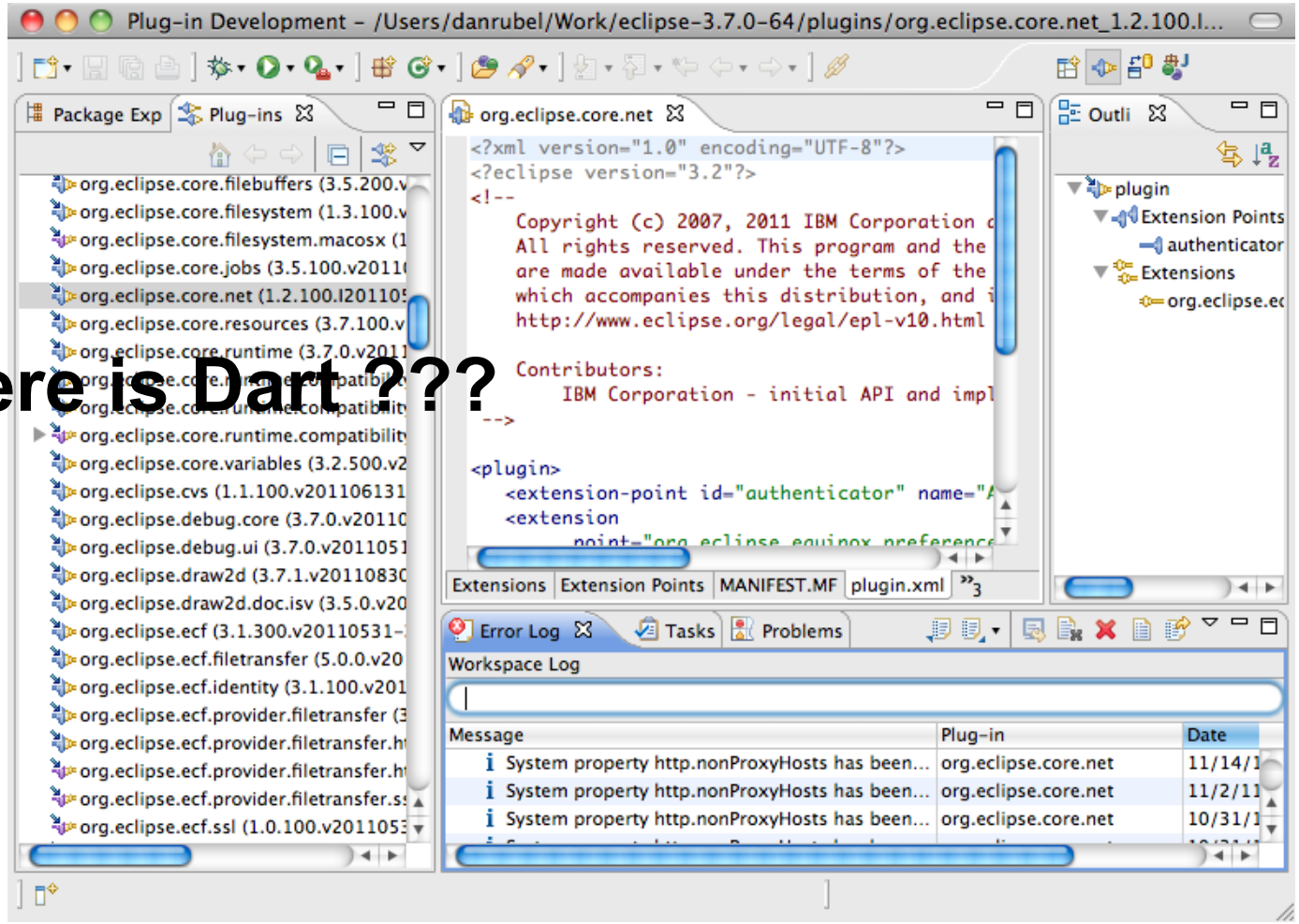
but also...

- Power tools
  - refactoring
  - quick fixes/assists
  - code completion
  - semantic search
  - debugging/inspecting
  - ...and more

http://www.dartlang.org

Dart Editor - Before

Where is Dart ???

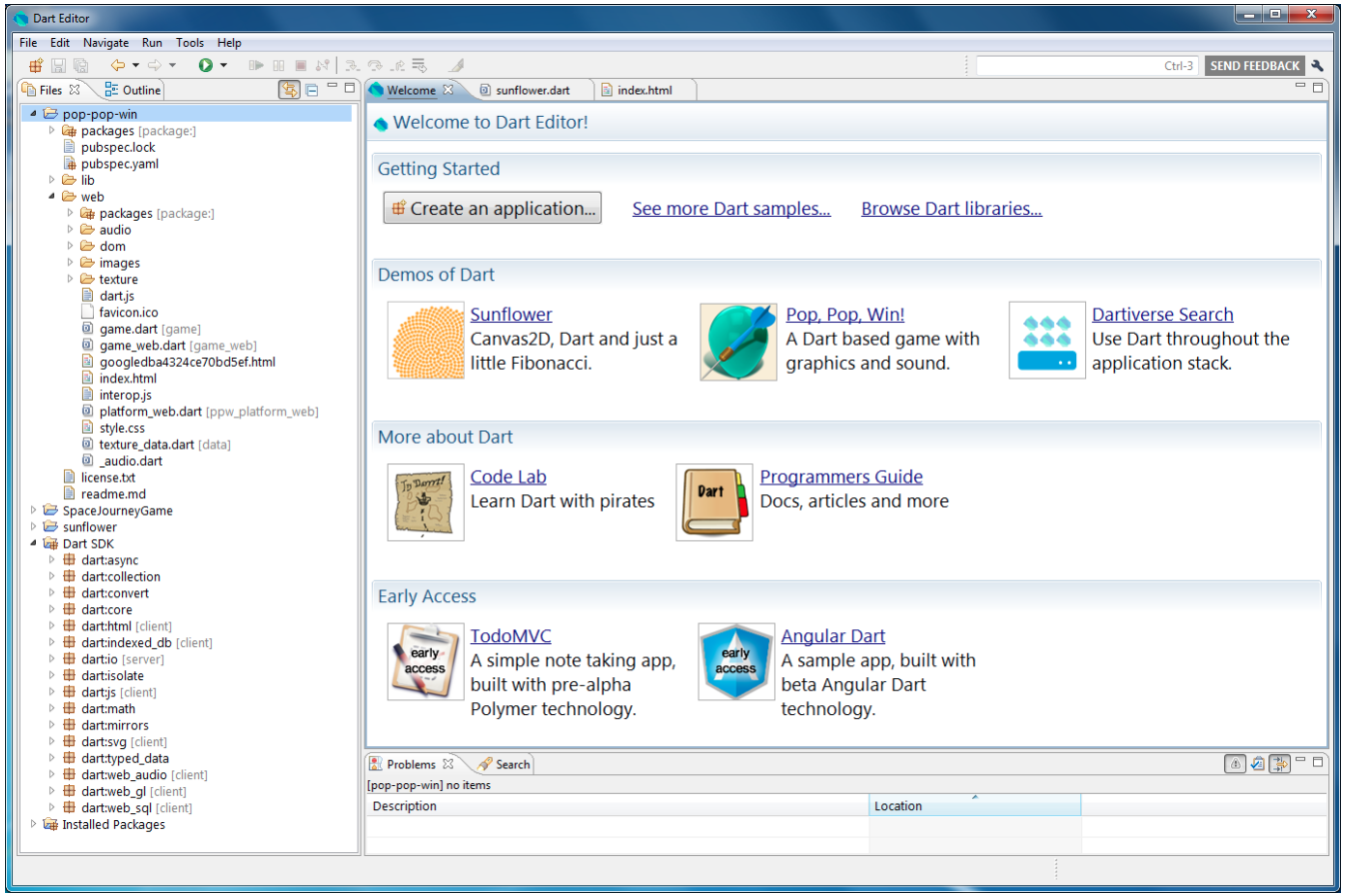


Dart Editor - Strategy

- Narrow the scope
  - Focus on doing a few things well
  - No Eclipse Team support

- Minimalist UI
  - Make it easy to understand
  - Reduce decision making

Dart Editor - Now



Simple and Clean UI

Dart

How?

- Single perspective
- Remove unnecessary plugins
- Redefine entire menu bar
- Use "activities" to suppress UI elements
- Key binding schema

Dart

Start-up Performance

- Remove unused plugins
  - Modify plugins to remove dependencies
- Defer work until after UI appears
  - Early startup extension point
  - Display.asyncExec(...)
- Optimize load order
  - Record class load order
  - Reorder classes in plugin jar files

Application Performance

- Profile and optimize the code
  - Identify hotspots with VM profiler
  - Rewrite or eliminate slow code
- Defer work to background tasks

Dart

Performance-critical Areas

- Navigation
- Code completion
- Errors, warnings, and hints

Solutions:

- Background indexing
- Keep analysis results in memory
- Incremental analysis - ongoing work

Metrics

First RCP build	Current build
70+ MB	54 MB
200+ plugins	110 plugins
25s startup	**9s** startup

Standalone vs. Plugin issues

Same code base but not exactly the same

1) Move **.project** files to new location

- modified the FileSystemResourceManager

2) Wanted slightly different **code completion behavior**

- modified CompletionProposalPopup

3) **Back button** default if refactoring has errors

- modified RefactoringStatusDialog

Standalone vs. Plugin issues

Standalone

- Unique experience
- Specialized HTML editing
- Omnibox search

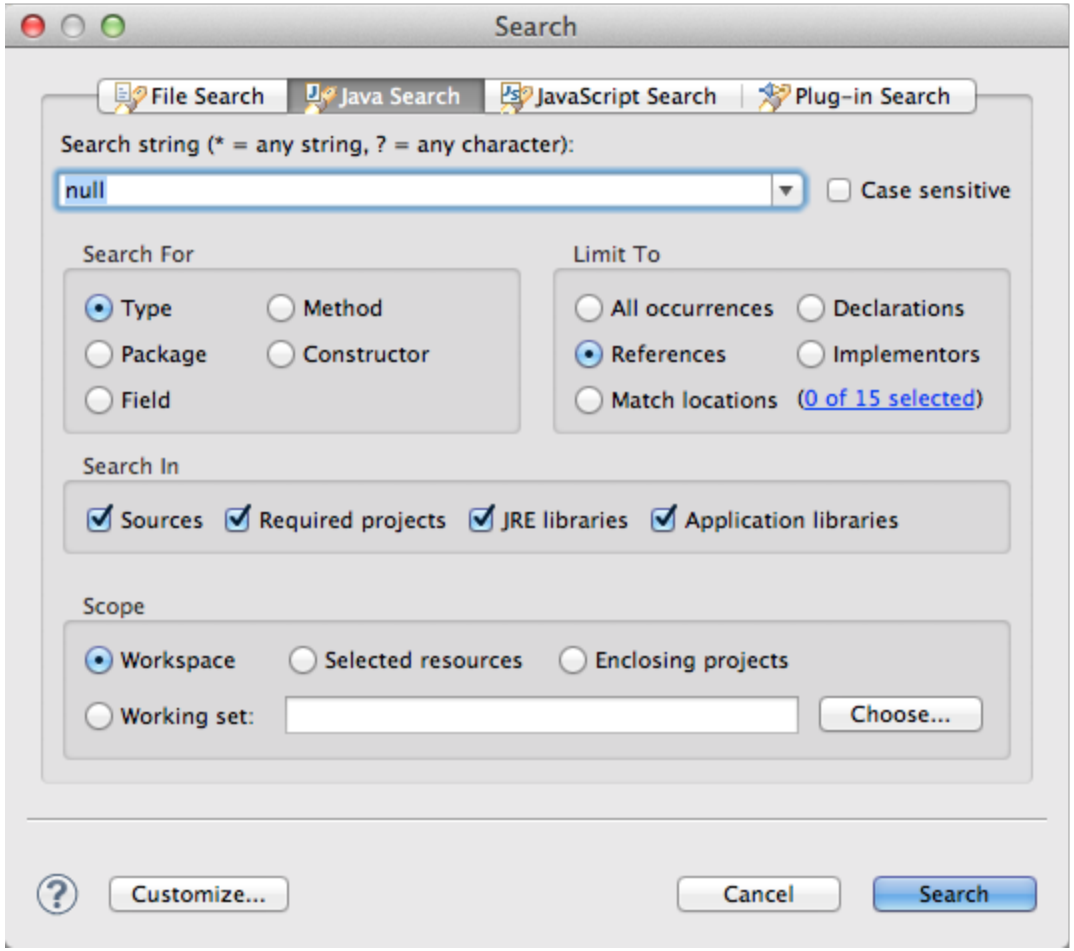
Plugins

- Integrated feel
- Eclipse HTML editing
- Eclipse search

Decision to use WTP

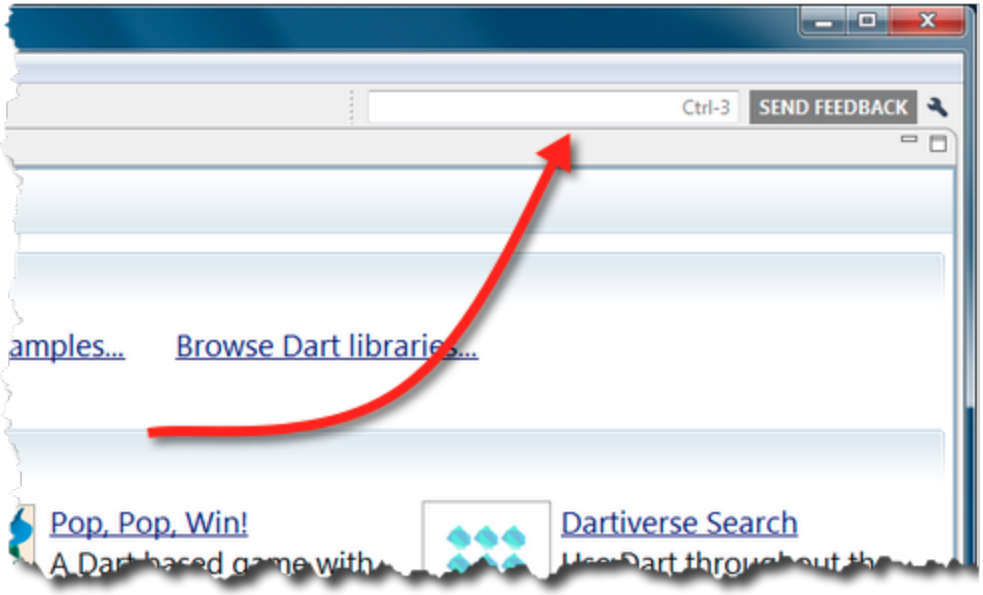
- Dart programs ⇒ .dart, .html and .css files
  - HTML & CSS editing needed
- Initially rolled our own light-weight version
  - Too many missing features and other problems
- Reluctantly decided to include (partial) WTP
  - Worried about size and unnecessary features
  - Stripped it down to remove unneeded pieces

Eclipse Search



http://www.dartlang.org

Omnibox experience



Wanted a simple way to find almost anything

http://www.dartlang.org

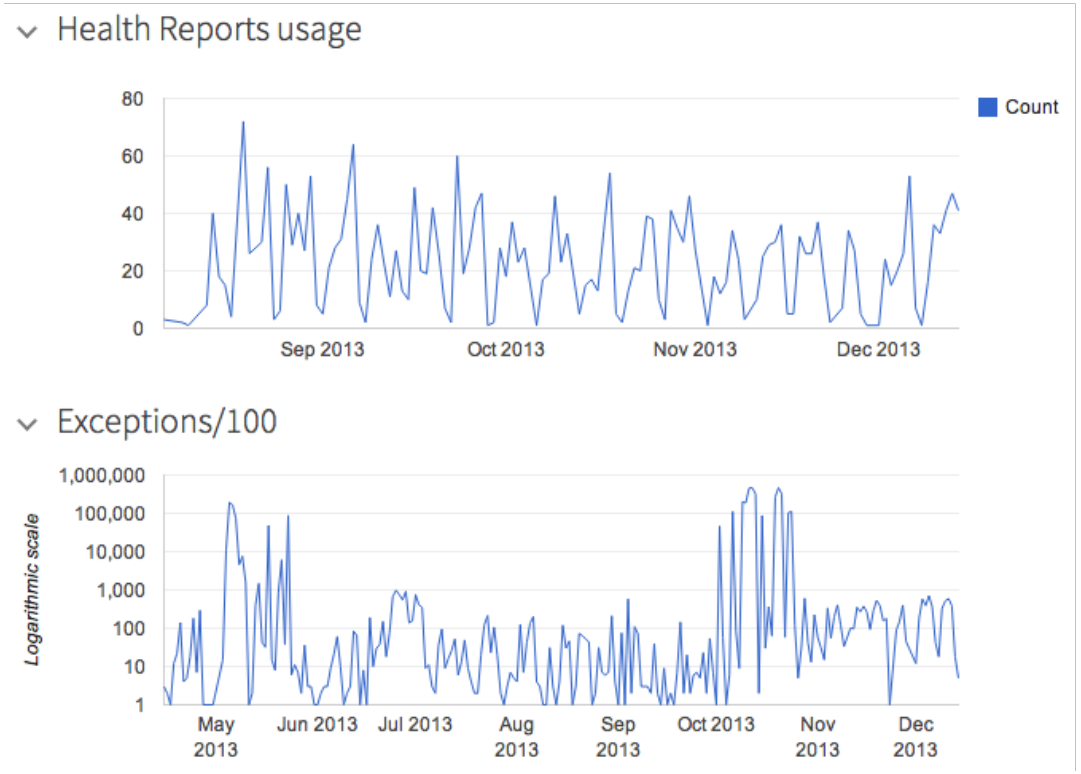
Dart

Instrumentation

- Performance and error data
  - Timing for each task
  - Recurring exceptions
  - Limited to internal Google-only due to privacy
- UI Watchdog
  - Periodically check that the UI thread is responsive
  - Report periods when UI is blocked and by what

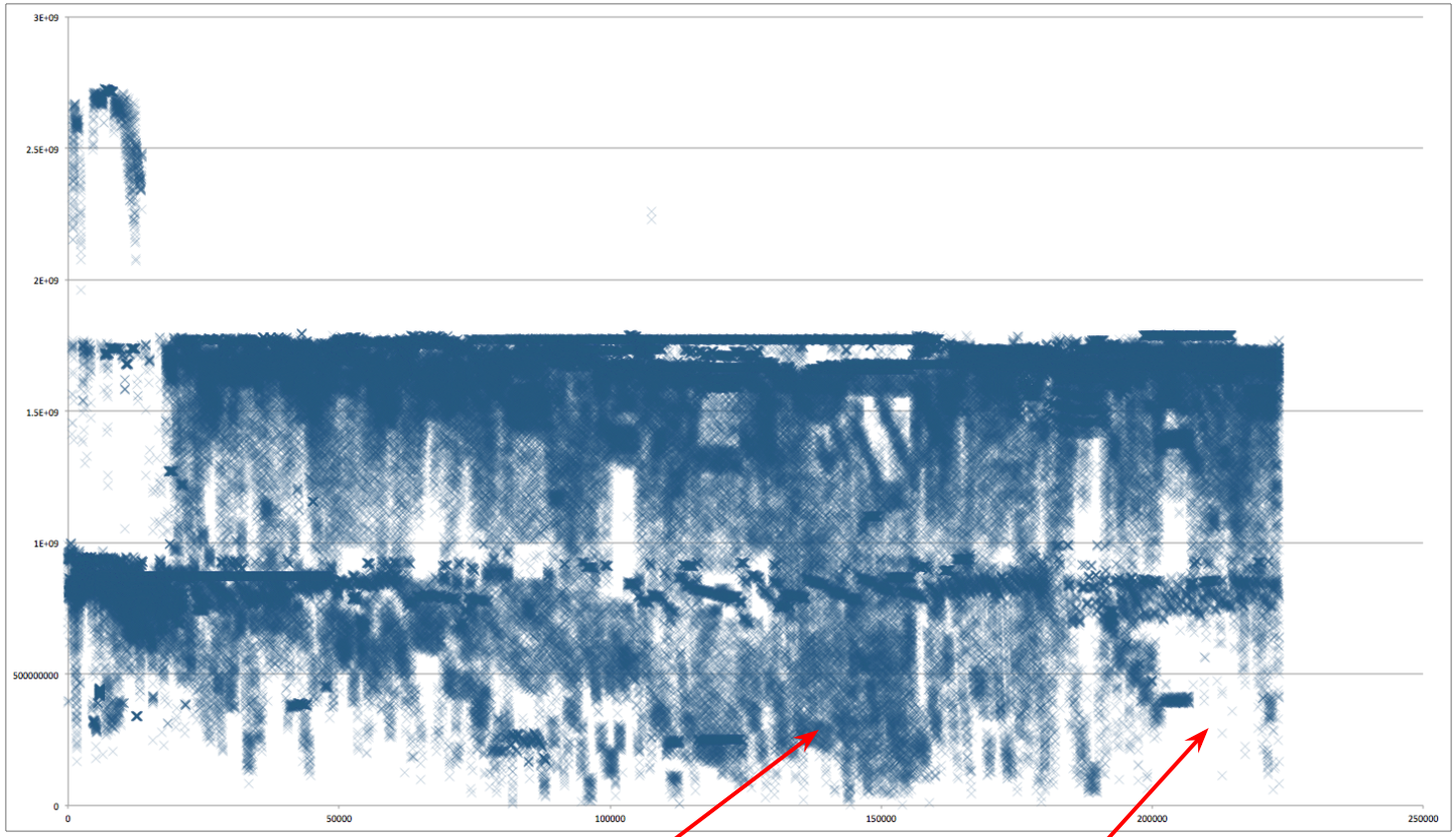
Instrumentation Results

- Exceptions
- Memory usage
- Version uptake
- Usage patterns
- Overall “health”



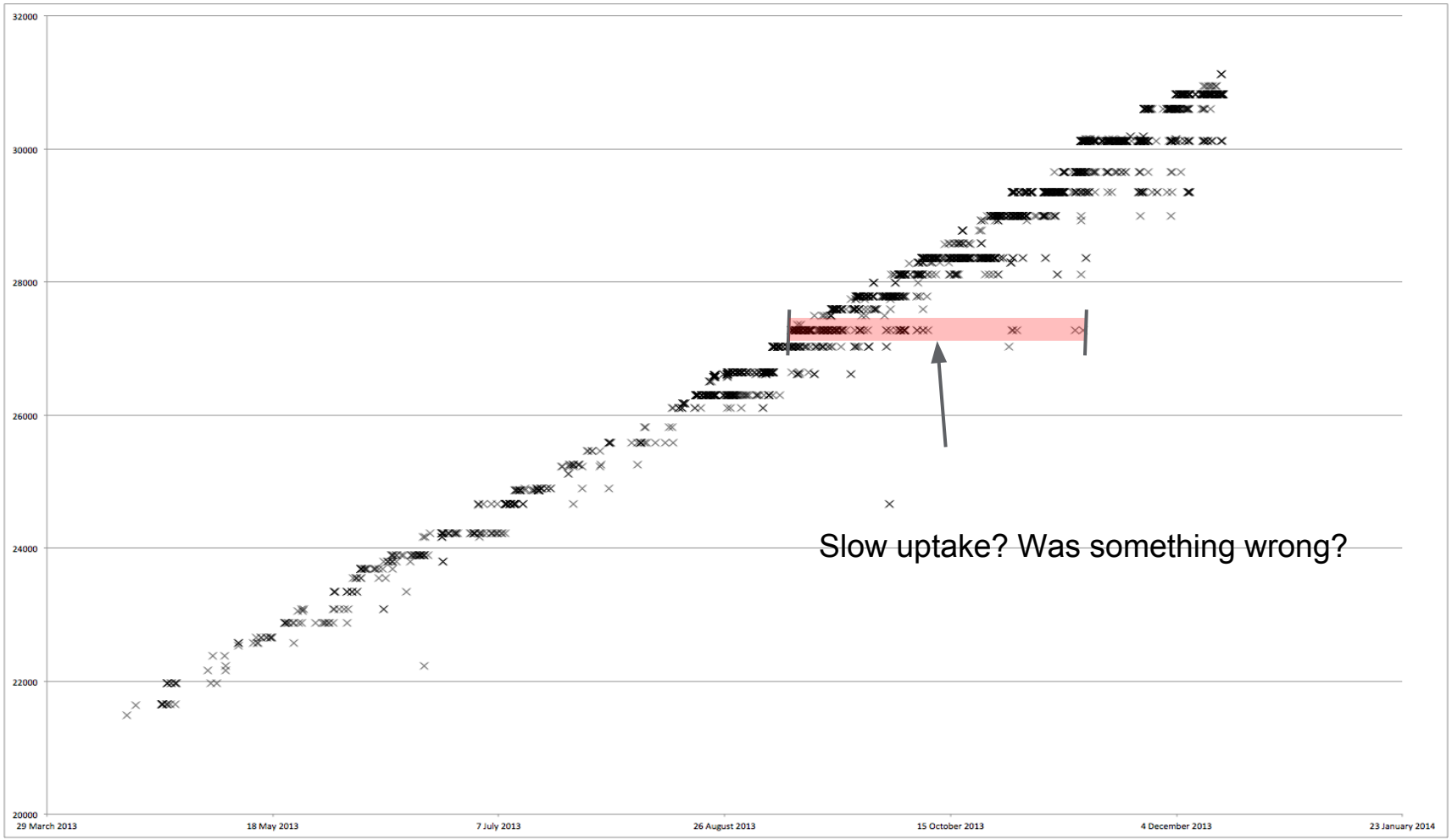
http://www.dartlang.org

Instrumentation - Memory Usage



http://www.dartlang.org

Instrumentation - Version Tracking



Subsystems

Eclipse Specific

- file navigation and code editing
- debugging experience
- UI for code completion, quick fixes, refactoring, ...
- pub integration
- background analysis

Pure Java (thus portable to Dart)

- analysis engine
- code completion
- quick fixes
- refactorings
- suggestions
- indexer

java2dart translator

Pure Dart

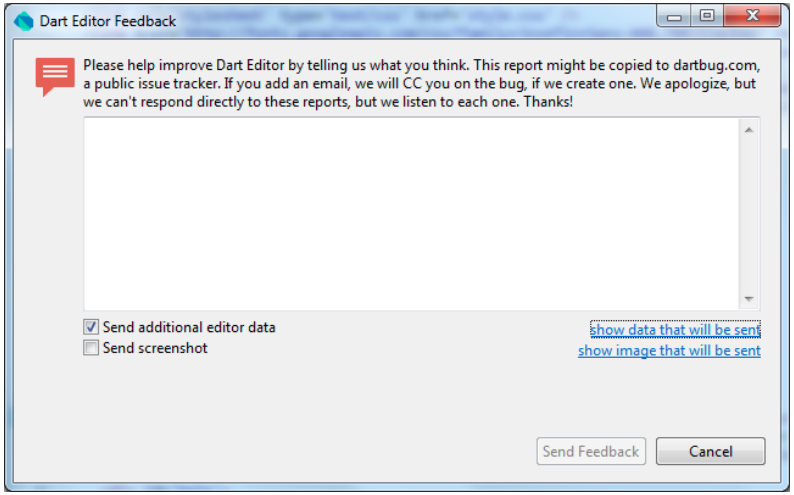
- formatter, cmd line analysis

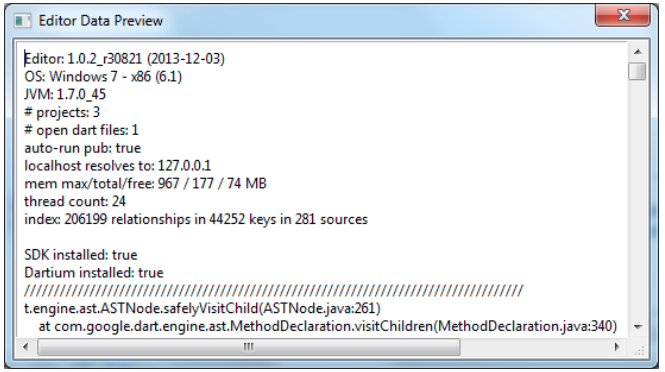
Testing

- Unit tests
- Integration tests
- Functional tests
- Continuous test execution

Feedback & Privacy

- Needed to collect high quality feedback
  - Description, OS info, memory info, screenshot
- Always opt-in and anonymous





http://www.dartlang.org

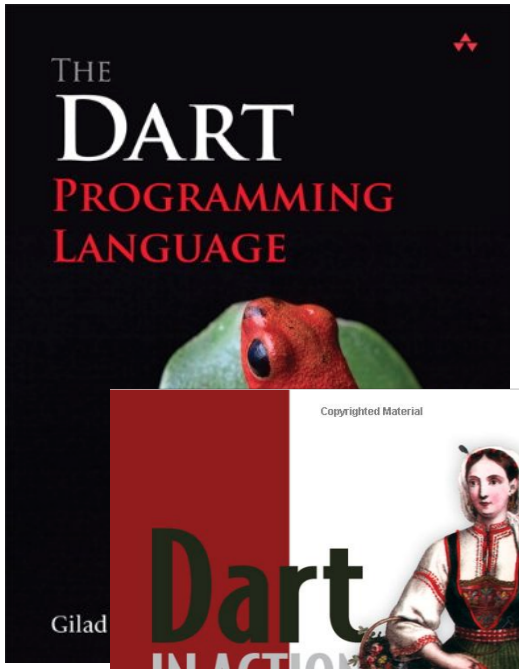
Dart

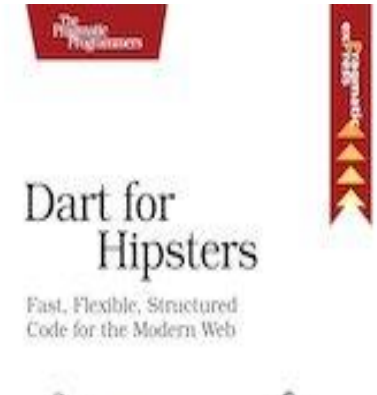
Why Eclipse 3.x and not 4.x?

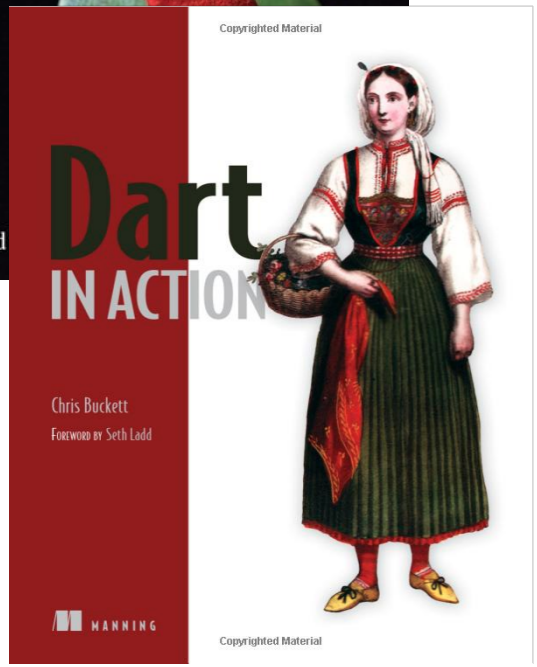
- Eclipse 3.x much faster when we started
- Not really an issue now, but costs to switch
  - Inertia
  - Time to move code
  - Time to retest everything
  - Time to update automated UI tests

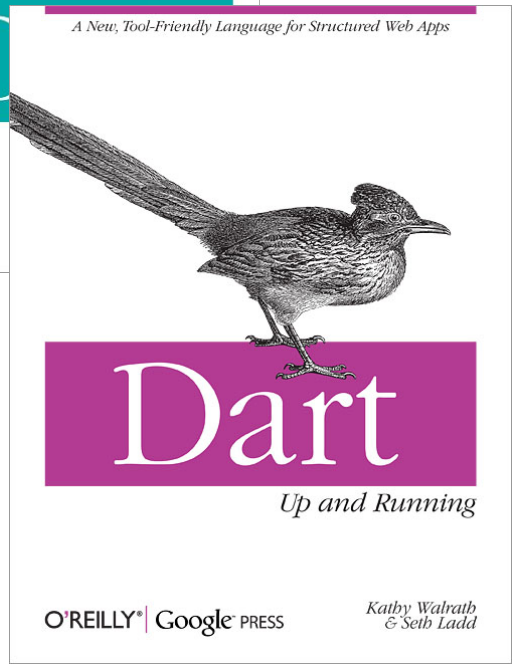
Books

https://www.dartlang.org/books/









Questions?

More information....

https://**dartlang.org**

Introduction, language spec, articles

Download Dart Editor

https://**code.google.com/p/dart/**

Source code to editor, compiler, and virtual machine

See the wiki for instructions

Dart

Community

- G+: **google.com/+dartlang**
- Mailing list: **misc@dartlang.org**
- Stack Overflow: **Tag dart**
- Twitter: **@dart_lang**
- Hashtag: **#dartlang**
- Blogs: **http://dartosphere.org**
- IRC: **#dart**