Frameworks & Play

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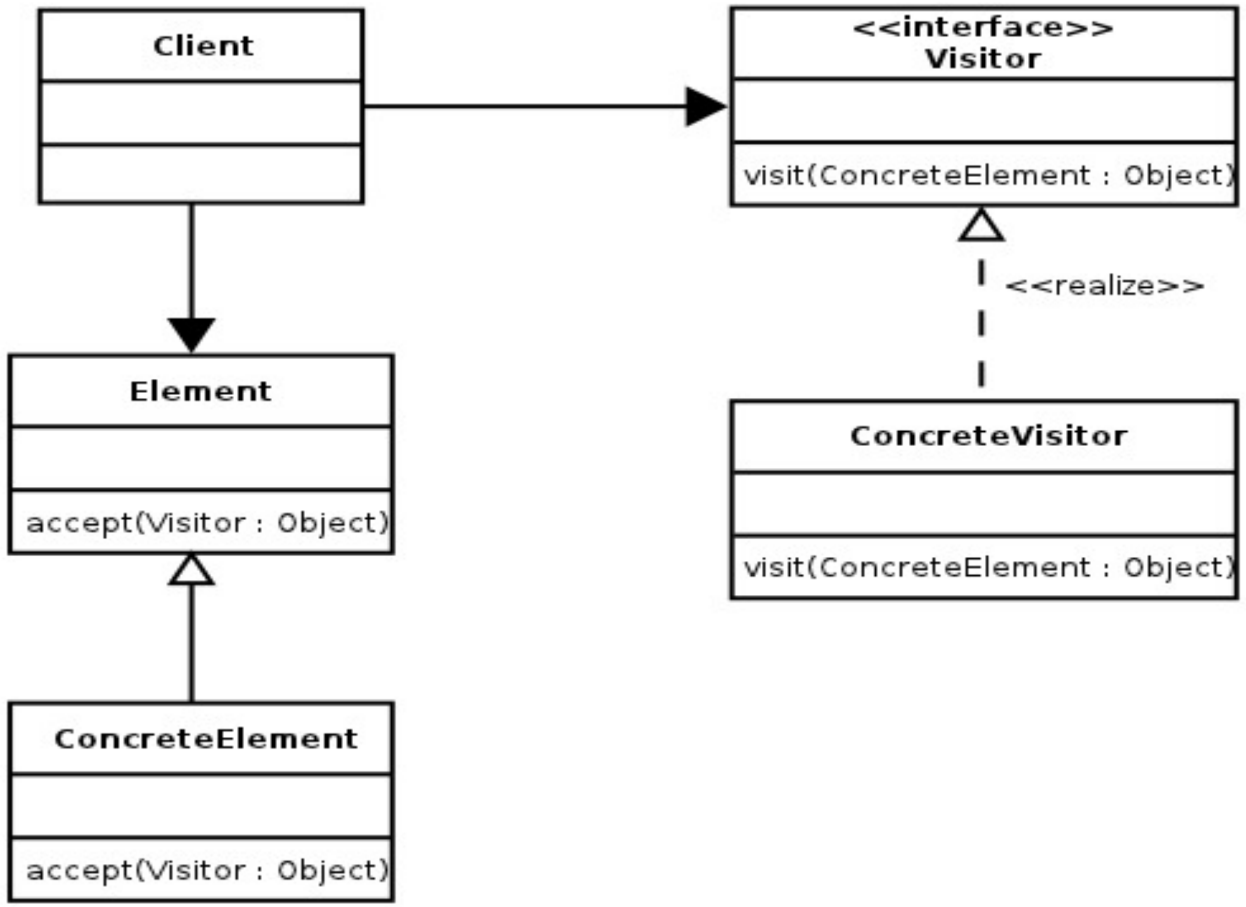
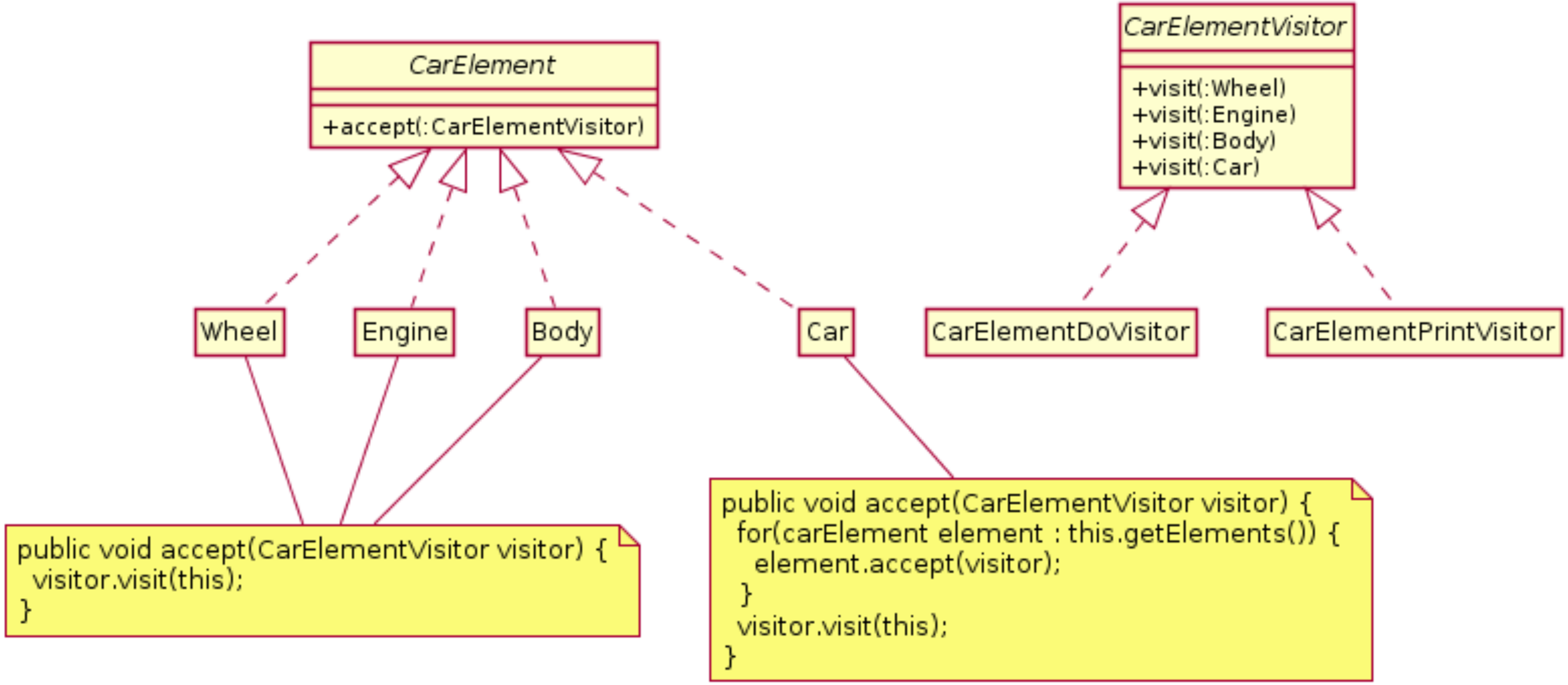
Visitor Design Pattern

- **Problem**: Many distinct and unrelated operations need to be performed on node objects in a heterogeneous aggregate structure. You want to avoid “polluting” the node classes with these operations. And, you don’t want to have to query the type of each node and cast the pointer to the correct type before performing the desired operation.
- **Solution**: Represent an operation to be performed on the elements of an object structure. Visitor lets you define a new operation without changing the classes of the elements on which it operates.



Visitor Example



```
public void accept(CarElementVisitor visitor) {
  visitor.visit(this);
}
```

```
public void accept(CarElementVisitor visitor) {
  for(carElement element : this.getElements()) {
    element.accept(visitor);
  }
  visitor.visit(this);
}
```

Software creation is re-using

- The majority of programming activities has been done before:
  - Creation of a responsive website
  - Taking care of internet payments
  - Access control to certain parts of a website
  - A link between a website and stock maintenance systems
  - A link between stock maintenance and packet delivery providers
  - Etc..
  - And not only for webshops.

- Naturally, it is stupid and time-consuming to create all of this yourself→
  - Libraries

- But:
  - The great quest for fitting libraries
  - Don't work well together
  - Low level knowledge still needed
- So:
  - Frameworks

Frameworks

A software framework is a *universal, reusable* software environment that provides *particular functionality* as part of a larger software platform to facilitate development of software *applications, products and solutions*

Software frameworks work on top of general purpose languages

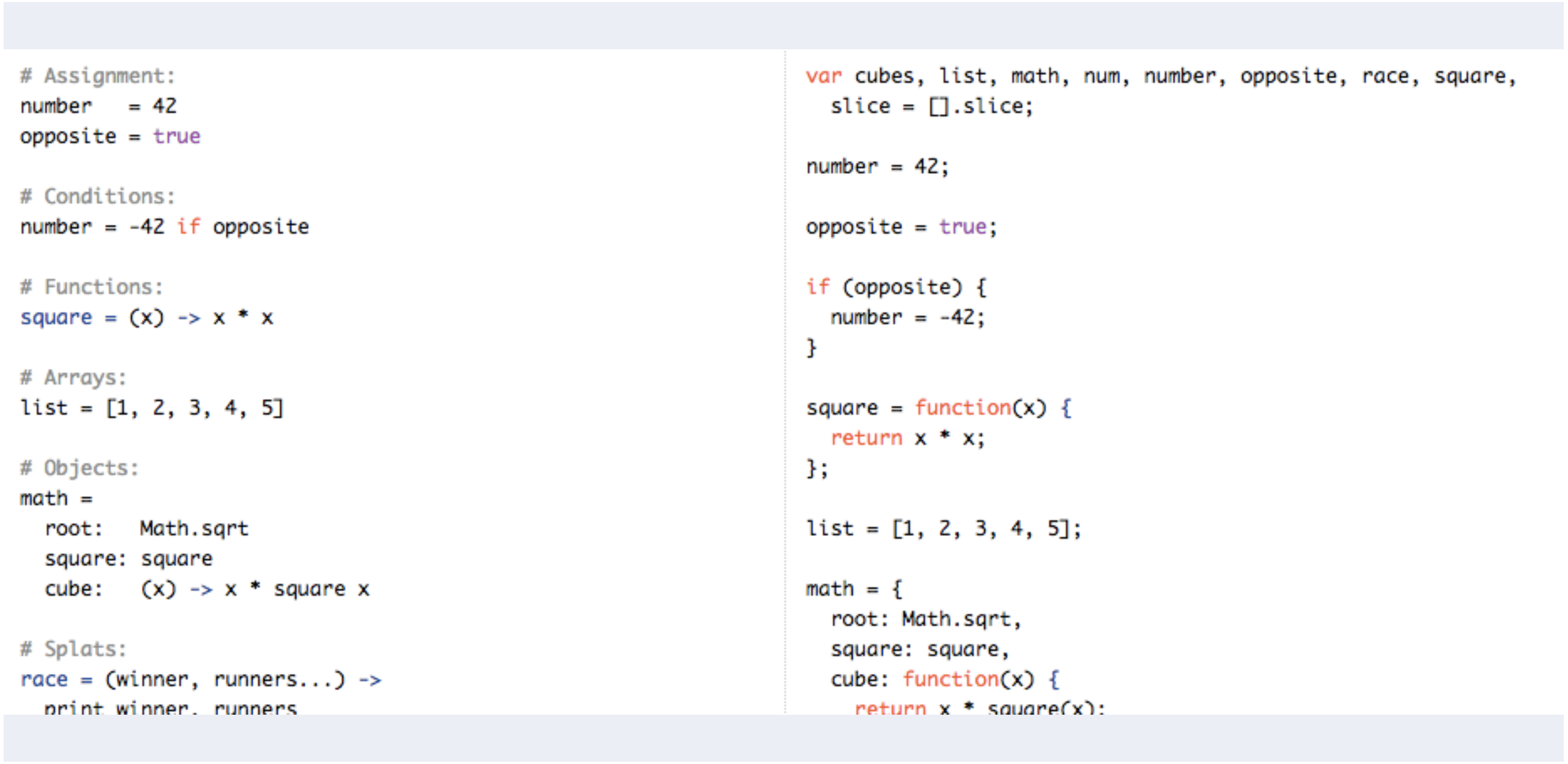
Framework properties

- Frameworks:
  - Usually introduce new, (domain specific) language components to the underlying language
  - Therefore sometimes come with compilers
  - Usually consist of several separate but integrated libaries…
  - …That can often be selected for use or not
  - Sometimes come with support programs
  - Sometimes provide customized IDE’s or IDE plugins
  - Usually run on top of other frameworks or external libraries
  - Are often open source
  - Can be domain specific (eg.: webshop) or generic (eg.:responsive website)
  - Have a learning curve…
  - But make life easier afterwards

Framework principles

- Inversion of control
  - In a framework, unlike in libraries or normal user applications, the overall program's flow of control is not dictated by the caller, but by the framework.
- Default behavior
  - A framework has a default behavior. This default behavior must be some useful behavior
- Extensibility
  - A framework can be extended by the user usually by selective overriding or specialized by user code to provide specific functionality.
- Non-modifiability
  - The framework code, in general, is not supposed to be modified (open-closed principle)

Framework example: Coffeescript



```
# Assignment:
number   = 42
opposite = true

# Conditions:
number = -42 if opposite

# Functions:
square = (x) -> x * x

# Arrays:
list = [1, 2, 3, 4, 5]

# Objects:
math =
  root:   Math.sqrt
  square: square
  cube:   (x) -> x * square x

# Splats:
race = (winner, runners...) ->
  print winner, runners
```

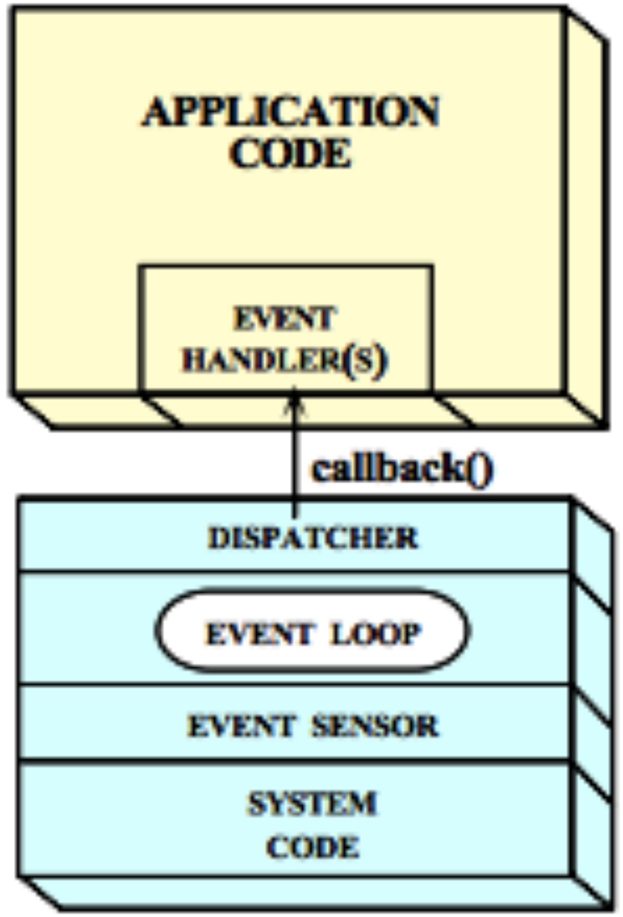
```
var cubes, list, math, num, number, opposite, race, square,
  slice = [].slice;

number = 42;

opposite = true;

if (opposite) {
  number = -42;
}

square = function(x) {
  return x * x;
};

list = [1, 2, 3, 4, 5];

math = {
  root: Math.sqrt,
  square: square,
  cube: function(x) {
    return x * square(x);
```

Frameworks drawbacks

- Learning curve can be quite steep
- Constant need for extra compilation steps
  - If not regulated in an IDE
- Bloated code
- Incomprehensive / inefficient code
- Dependency on frameworks update and backwards compatibility
- (im)possibility of using a framework on hosted machines

Framework: inner workings

- Many frameworks utilize an eventloop
  - Scanning for events
  - Handling those events
  - Dispatching or relegating events to the ‘add-on’ client-code
- Event-handling is done through callbacks. (reactive programming)



Reactive programming

- Since the flow of control doesn't reside in ‘our’ piece of code we have to *react* to events occurring within the framework
  - We don’t have to check events ourselves or support an extra event-loop
  - This is called reactive programming or asynchronous programming
  - It is achieved through callback functions that utilize function pointers (javascript Jquery example)

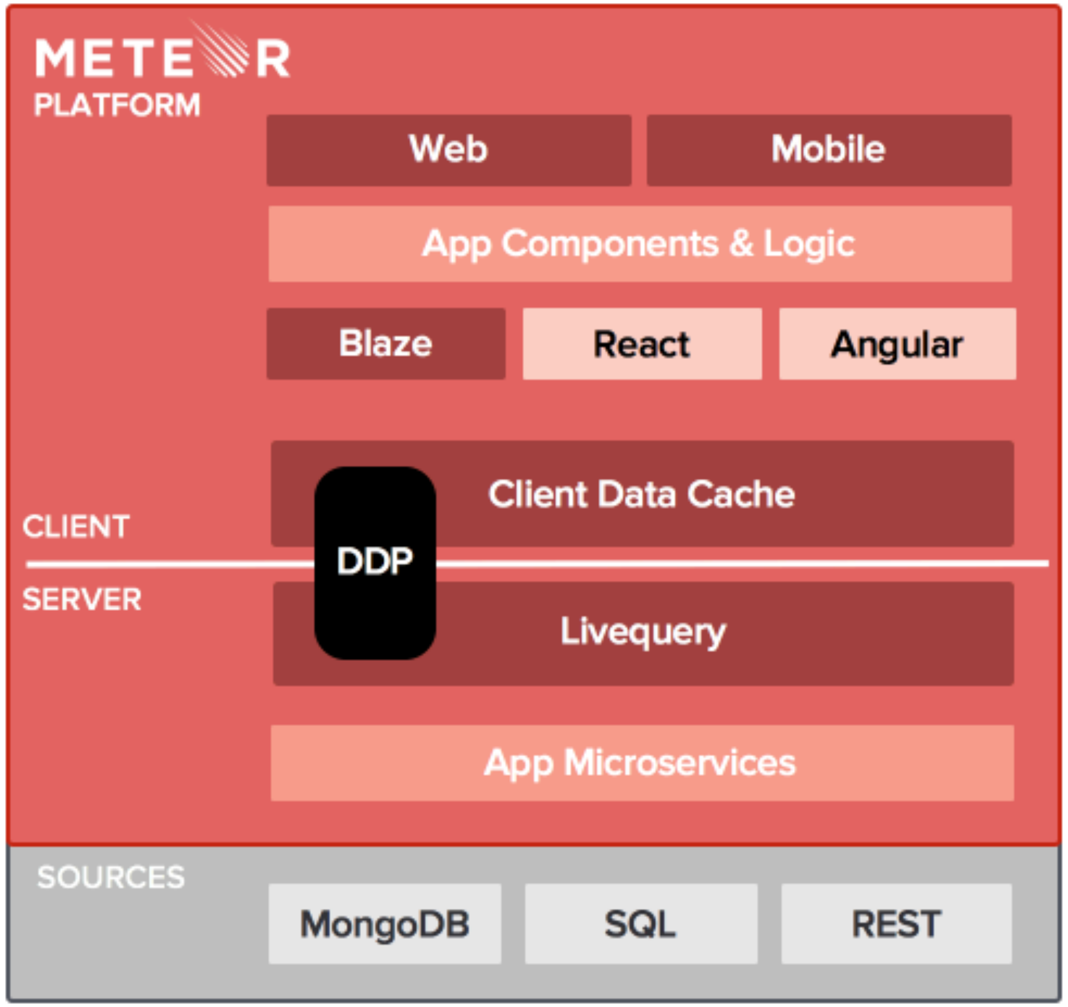
```
$("#btn_1").click(function() {
        alert("Btn 1 Clicked");
});
```

```
$func = function() {
        alert("Btn 1 Clicked");
}
$("#btn_1").click($func);
```

In the function click, a function pointer is expected. The parameter is stored and later called if an event ‘click’ is to be dispatched

Example framework: Meteor

- A framework consisting of frameworks is sometimes called a *platform*
- How the platform is structered is called its *stack*



Node.JS
Bootstrap
Mini-Mongo
Handlebars
…

Iron router
…

Mandatory Frameworks

- Sometimes the usage of certain frameworks is mandatory (or highly recommended / encouraged)
  - .NET framework
  - Cocoa Framework
  - Android framework
  - ...

Laboratory assignment

- Create an Android app (iOS?) that shares GPS locations of friends and displays them on a map
  - Use Play framework for server side programming
  - Suggestion: use SQLite for database handling
  - Design your own data interface
  - Create an app in Android (Android framework) or iOS? (Cocoa framework)

Play Framework

- Gebruik Java (of Scala) for all server side scripting
- Easy routing
- MVC Pattern
  - Seperation of Model (data), controller (programs) , view (interface)

https://www.youtube.com/watch?v=bLrmnjPQsZc

GET or PUT

- GET
  - Usually used for getting webpages from server
  - Parameters can be passed: ?name=tim&job=teacher
  - Parameters are not hidden
  - Parameters are easily appended
  - Within the server we can ‘decide’ to store data as well
- POST
  - Usually used for writing data to server
  - Paramaters are passed in original HTTP packet
  - Parameters are hidden
  - Parameters are not so easily appended
  - Within the server we can ‘decide’ to send data back as well (usually done)

Next up…

- Start with assignment 4
  - Explore the Play framework
  - Get it to work
  - Explore the usage of SQLite within Play
  - Get simple queries to work
- After the workshop:
  - Design the interface between the App and the server: what information is exchanged? How is it structured?

Android

- What is Android?
- Dalvik virtual machine
- Android SDK
- Anatomy of an Android application
- Excercises

What is Android ?

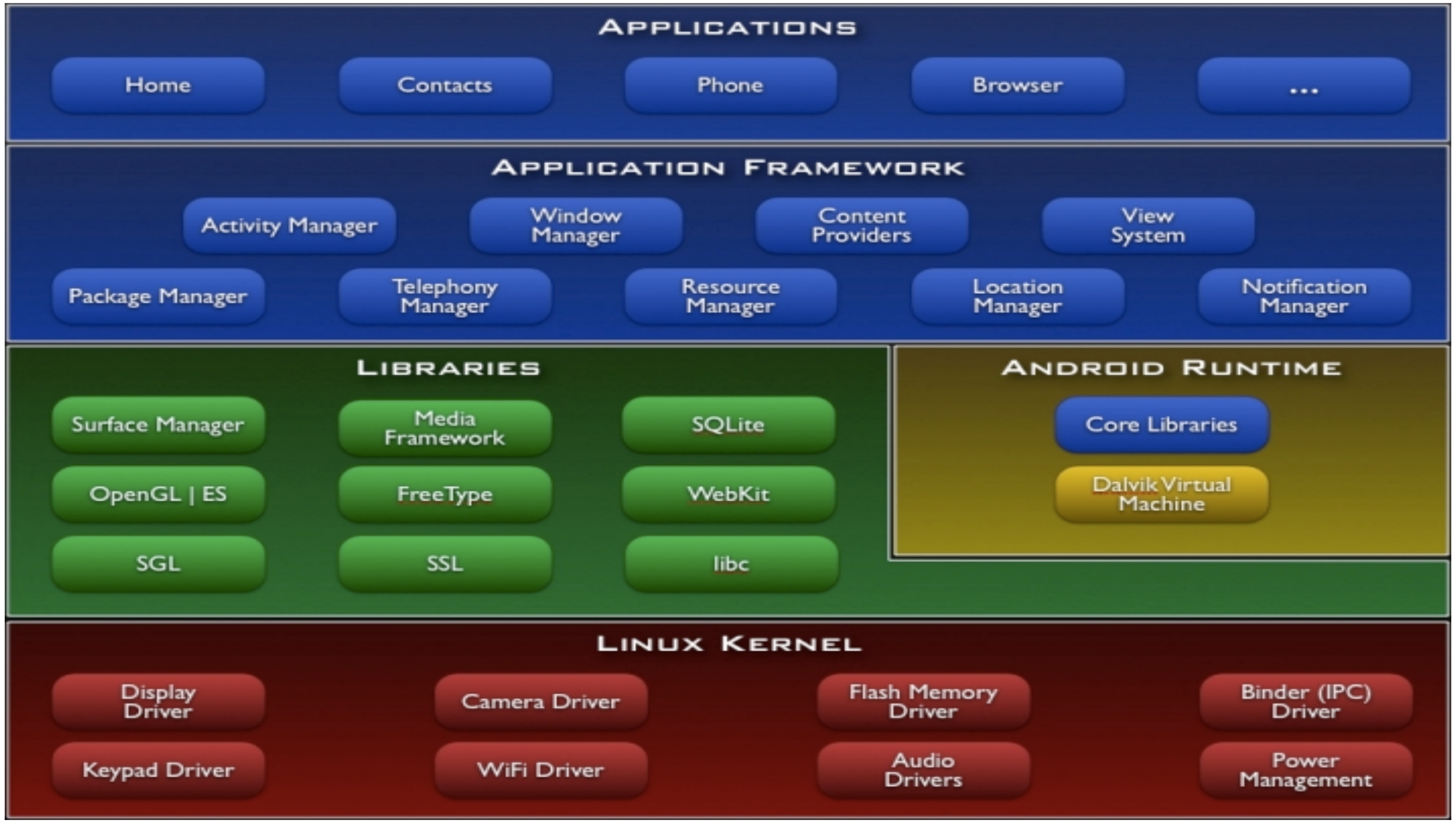
- Android is a mobile operating system that is based on a modified version of Linux.
- It was originally developed by a company with the same name (android, Inc.).
- Google purchased this company in 2005 and took over its development work and development team.
- Since then Android has become the most popular mobile operating system.
- Android is an open and free mobile operating system.
- As a result it can be used on different mobile devices of different vendors.

What is Android (2)

- Android is based on a Linux 2.6 kernel.
- It thus includes basic operating system capabilities such as memory management and process management.
- Some enhancements are made in order to let the operating system function optimally on a mobile device.
- On top of the adjusted kernel runs a Dalvik virtual machine.
- As a result Java programs can be run on android devices.

Architecture of Android

- As with most other operating systems Android can be roughly divided into layers:



- Notice the position of the Dalvik virtual machine:

Dalvik virtual machine

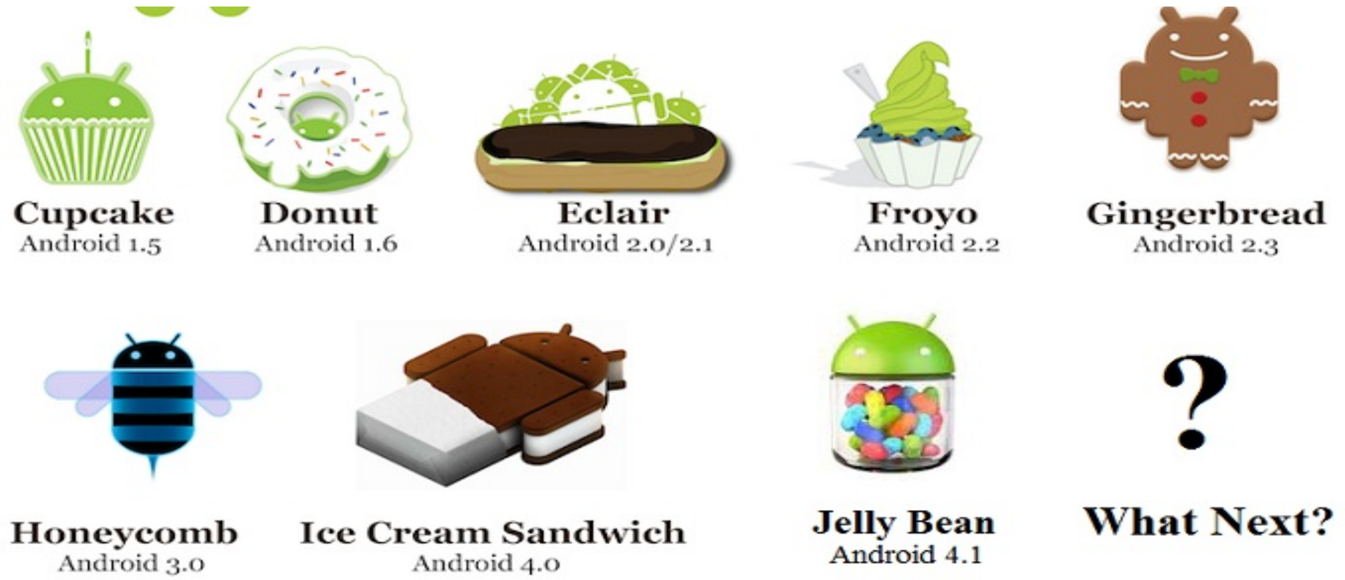
- Written by one person, Dan Bornstein
- Dalvik is a small village in Iceland where ancestors of Bornstein lived.

- To run the Java code, it is first compiled to special byte code that can be interpreted by the Dalvik virtual machine.

- Dalvik is optimized for the android platform. It can execute byte code faster and with less power consumption, because it contains some hardware dependent optimizations.
- Third party (some preinstalled) applications are also interpreted by the Dalvik virtual machine.

Android versions

- There have been quite a number of android releases. As a result there are a lot of different versions. For example:



(date of figure: July 2012)

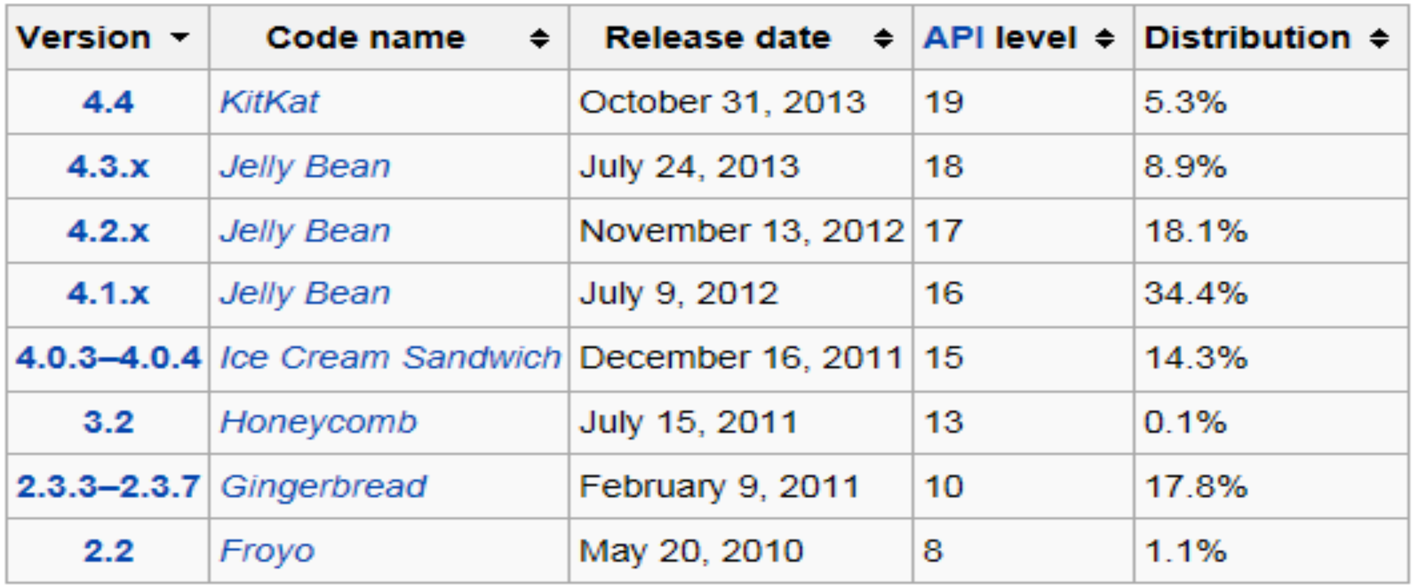
- Each new version contains bug fixes and new functionality, but more importantly also support for new devices such as tablets.

API's

- Third-party programs need to interact with the android operating system.
- Solution: Use API's (Application Programmers Interface) which are provided by the Android operating system. These are just methods from classes or objects which you can call from your Java program.
- In every android release these API's change because of new functionalities and improvements.
- Consequence: Every android release has a different set of API's
- You need to account for this when developing software!

API Levels

- To distinguish the different sets of API's each set is given a number. This is called an API level.
- Often each new Android version has got changes in the API, so the API level is increased.
- Overview of some different API levels:



Version	Code name	Release date	API level	Distribution
4.4	*KitKat*	October 31, 2013	19	5.3%
4.3.x	*Jelly Bean*	July 24, 2013	18	8.9%
4.2.x	*Jelly Bean*	November 13, 2012	17	18.1%
4.1.x	*Jelly Bean*	July 9, 2012	16	34.4%
4.0.3–4.0.4	*Ice Cream Sandwich*	December 16, 2011	15	14.3%
3.2	*Honeycomb*	July 15, 2011	13	0.1%
2.3.3–2.3.7	*Gingerbread*	February 9, 2011	10	17.8%
2.2	*Froyo*	May 20, 2010	8	1.1%

Android SDK

- In order for you to make android Java applications you need to use the android SDK.
- The SDK includes for example:
  - Software for compiling Dalvik virtual machine byte code
  - Method and class signatures of the API's.
  - Emulators for simulating your android programs

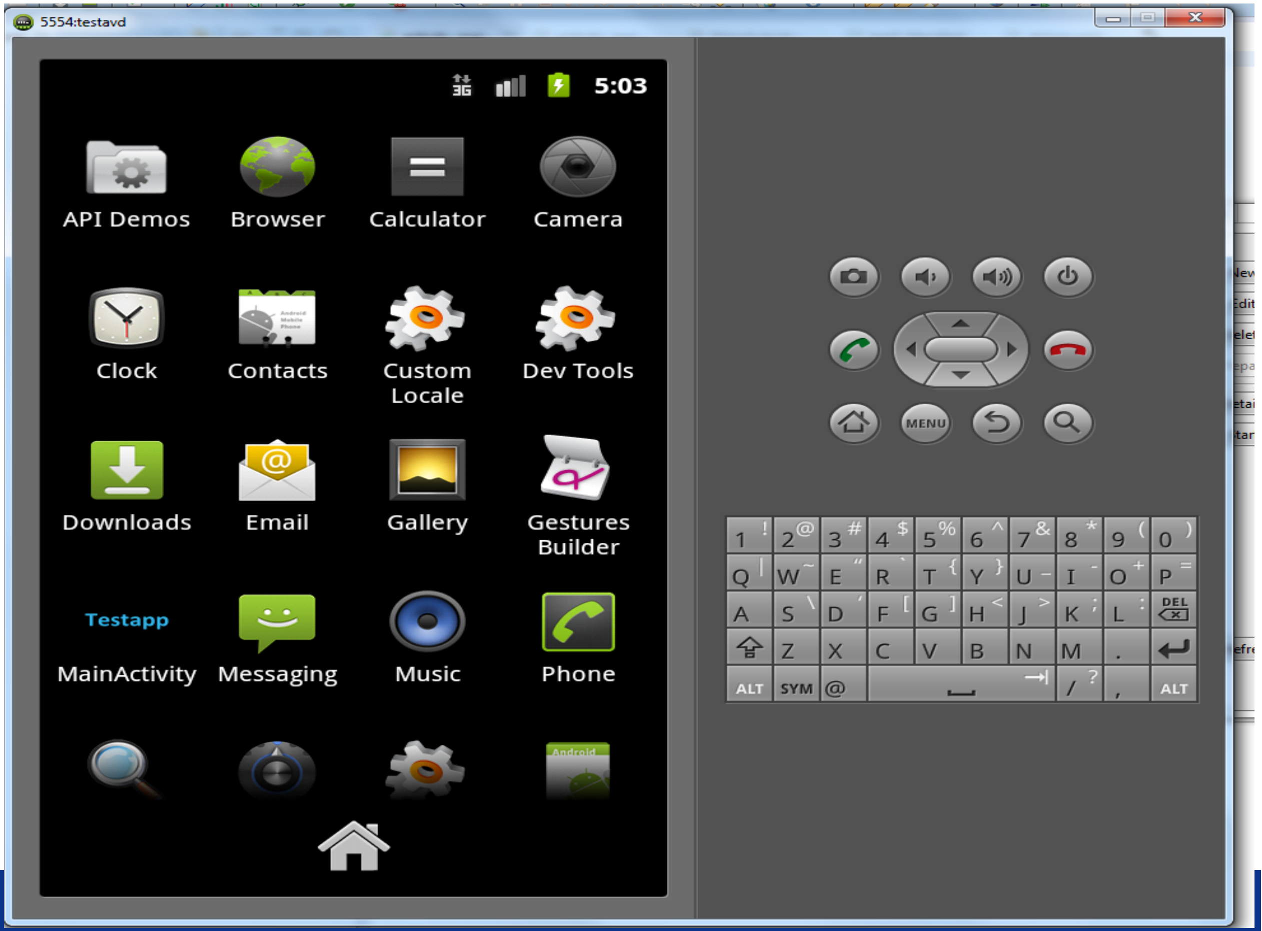
- The SDK can be integrated into a number of IDE’s

AVD (1)

- An Android Virtual Device (AVD) can be created once the SDK is installed
- An AVD is a simulation (actually emulation) of a real device and android operating system.
- You can use an AVD to test your own applications on different android versions and hardware.
- Your application may behave different on various devices due to the large number of android versions (API levels) and different hardware.
- It is therefore a wise idea to test your application on different android versions and hardware. An AVD allows you to do so.

AVD (2)

- The most important options for your AVD are:
  - Android version (this means also the API level)
  - Device RAM size
  - Resolution and size of the screen of the device
  - Existence and type of other hardware such as a camera, accelerometer keyboard etc.
- Options that are perhaps less important:
  - SD-card size



Anatomy of an android application

- The most important parts of an android application project are:
  - *src* : contains Java source files
  - *gen*: contains compiler generated files such as R.java
  - *res:* contains all the resources using your application. This includes for example images and layouts.
  - *bin*: this folder contains the generated .apk file. An apk file is the executable file which can be run by an android device. (comparable with a jar file)
  - *Androidmanifest.xml* : This is a file where important settings for your application are defined.

Androidmanifest.xml (1)

- Androidmanifest.xml is an XML file where important settings for your application are defined.
- It is mostly generated by the Android SDK.
- It contains detailed information about the application such as:
  - The permissions the application needs to run. You can notice the effects of this when you are installing an application and you need to allow the application to use for example the camera.
  - Which screens (activities) are in the application and which one to start with.
  - Application name and icons

Androidmanifest.xml (2)

- Example of an Androidmanifest.xml file

-This means that this application needs API level 13.
-Android versions which only support API levels lower than 13
 will not be able to run this application.

```
<?xml version="1.0" encoding="utf-8"?
<manifest xmlns:android="http://scher
  package="net.learn2develop.HelloWo
  android:versionCode="1"
  android:versionName="1.0" >

  <uses-sdk android:minSdkVersion="13" />

  <application
    android:icon="@drawable/ic_launcher"
    android:label="@string/app_name" >
    <activity
      android:label="@string/app_name"
      android:name=".HelloWorldActivity" >
      <intent-filter >
          <action android:name="andr

          <category android:name="ar
      </intent-filter>
    </activity>
  </application>

</manifest>
```

-The file res/values/strings.xml contains constants
 which have values.
-*@string* is actually a reference to this particular
 XML file and *app_name* is the name of the constant
 within the XML file.
-These kind of constructions are often used in android Java
 applications!

A simple activity

- A piece of Java code which will present a layout with for example buttons and labels is as follows:

```
public class HelloWorldActivity extends Activity {
    @Override
    public void onCreate(Bundle savedInsta      te) {
        super.onC  eate(savedInstanceState
        setConte   iew(R.layou
    }
}
```

The Activity class is inherited, because we are creating a screen of our own and we want to use all the standard properties of the Activity class.

For now it is enough to assume that the *onCreate* method is called by the android OS when the activity (your program) must be started.

R.java

- The statement which will show the buttons, labels etc. is:

```
setContentView(R.layout.main);
```

- R (R.java) is a class which is automatically generated and contains constants with memory addresses.
- These addresses are ultimately used by *setContentView* to build the user interface with buttons and labels.
- How is R composed? It is generated by interpreting all the XML files of the project, so that Java code (which you can write) can reach the values that are originally in these files.
- *main* is a constant in R which contains an address. On this address all the information regarding the layout is stored.
- The data on this address is generated from an XML file.

Layout in XML

- The layout of an activity is thus defined in an XML file (in res/layout)
- Example of an XML file defining the layout:

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="fill_parent"
    android:layout_height="fill_parent"
    android:orientation="vertical" >
    <TextView
        android:layout_width="fill_parent"
        android:layout_height="wrap_content"
        android:text="@string/hello" />
    <TextView
        android:layout_width="fill_parent"
        android:layout_height="wrap_content"
        android:text="This is my first Android Application.
    <Button
        android:layout_width="fill_parent"
        android:layout_height="wrap_content"
        android:text="And this is a clickable button!" />
</LinearLayout>
```

This is a GUI container which contains our components. (can be compared with a Jpanel in Java)

Defines a label with some text

The width of the component is adjusted to the width of the component where it is put in

Defines a button

- Why would the layout be defined in XML and not straight in Java code?

Building the GUI

- GUI components (such as text lines and buttons) can easily be created by introducing the corresponding XML tag in the GUI XML file.
- With properties of the XML tag you can adjust the component. (for example the width or color)
- There are of course other GUI components (such as radio buttons, spinners, progress bars etc.) which can also be shown by using the corresponding tag.
- All these components are shown and explained at: http://developer.android.com/guide/topics/ui/index.html
- Use this to see what a component does and what kind of properties it has.

Activities

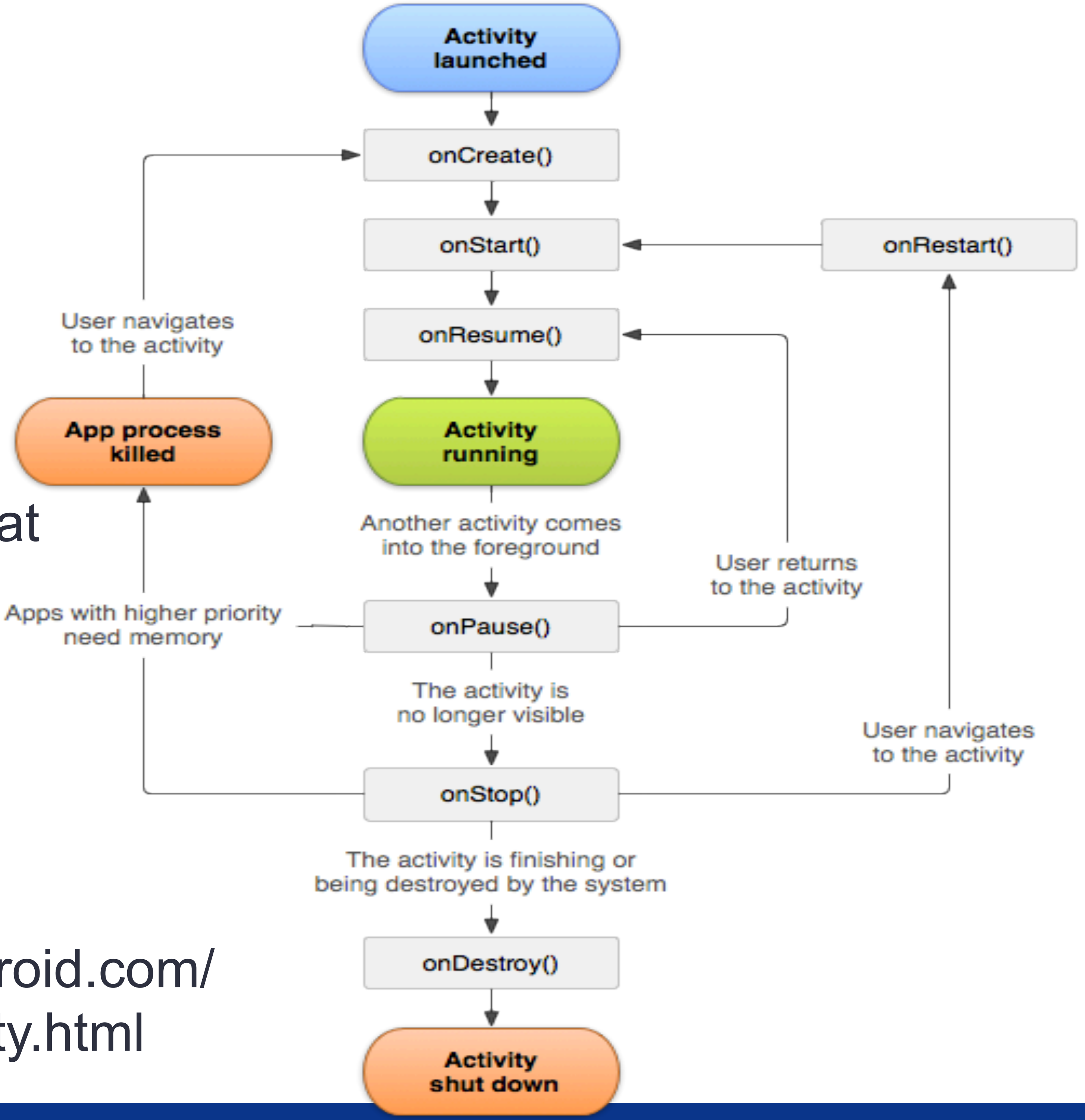
- Every activity you have in your application must be declared in the AndroidManifest.xml.
- The reasons for this will be clear later on.

```
<application
  ......
    <activity
     android:label="@string/app_name"
     android:name=".Activity101Activity" >
        <intent-filter >
            <action android:name="android.intent.action.MAIN" />
            <category android:name=
              "android.intent.category.LAUNCHER" />
        </intent-filter>
    </activity>
</application>
```

This line will cause the android operating system to start with this activity.

Activity lifecycle (1)

- An activity has got various stages it goes through.
- Shown are the various stages and the corresponding methods that are called in a stage.


Activity launched
onCreate()
onStart()
onRestart()
User navigates to the activity
onResume()
App process killed
Activity running
Another activity comes into the foreground
User returns to the activity
Apps with higher priority need memory
onPause()
The activity is no longer visible
User navigates to the activity
onStop()
The activity is finishing or being destroyed by the system
onDestroy()
Activity shut down

Source: http://developer.android.com/reference/android/app/Activity.html

Activity lifecycle (2)

- From the previous image the following guidelines for the use of the different methods can be derived:
  - *onCreate():* Use this method to create and instantiate the objects you will be using in your application.
  - *onResume()*: Use this one to start any services or code that needs to run while your activity is in the foreground.
  - *onPause()*: Use this one to stop any services or code that does not need to run when your activity is not in the foreground.
  - *onDestroy()*: This method can be used to free up resources before your activity is destroyed.
- Note that you don't have any control on when these methods are called! This is all determined
  by the framework