

# Android & Innovation

Mark Joselli

[mark.joselli@gmail.com](mailto:mark.joselli@gmail.com)

, ,

Who am I?

# Presentation

- Professor at PUC-PR
- Chief-Research-Officer of Nullpointer
- Researcher in GPGPU, games and mobile
- Developer of mobile Apps for more than 17 years
- pHD and MD in Computer Science



ra desaprovação. As semanas mil metros de Penstrução de uito Federal cia e Tecno- go Cefet. emplada na ograma Na-

transformação econômica que virá com a implementação do Comperj. Todos esses setores dependerão de mão de obra qualificada, que vamos formar no novo instituto federal.

Ainda não há custo definido para a obra, que será bancada integralmente com recursos

viaremos as documentações necessárias.

Ano passado, durante visita de uma comitiva do Congresso Nacional às instalações da Petrobras na Ilha do Fundão, no Rio de Janeiro, um diretor pediu uma indicação para uma vaga técnica na

sil, o do Comperj, e temos que ter mão de obra capaz de atender à demanda do setor. Niterói é uma cidade polo e deve ter esse papel reafirmado — afirma o deputado federal Chico D'Angelo (PT), que negociou com Fernando Haddad, ex-ministro da Educa-

ção de mão de obra qualificada. Além disso, logística e construção civil devem também ser implantados — diz o presidente da Comissão de Educação da Câmara dos Vereadores, Vitor Junior (PT), responsável pela organização da grupo que discutirá os cursos oferecidos. ■

Pedro Teixeira

# Incubadoras são o ensaio para ação da primeira empresa

de ajuda empreendedores a ingressarem no mercado de trabalho

Schmitt  
globo.com.br

uma boa ideia para criar um negócio, mas não têm dinheiro ou um espaço para trabalhar.

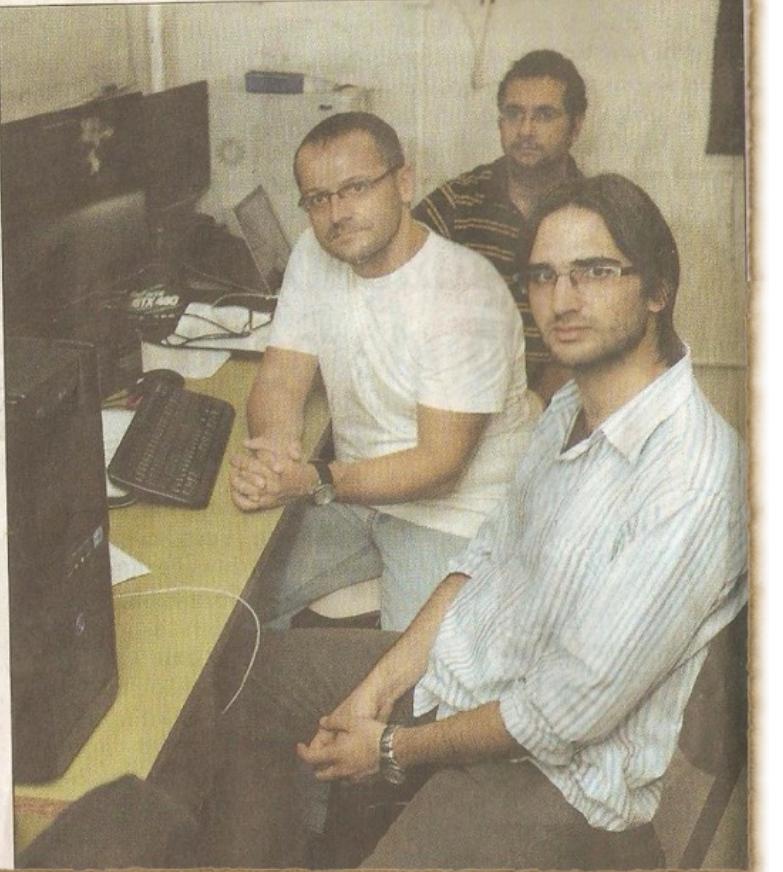
Marcelo Zamith, de 35 anos, Mark Joselli, de 30, e José Ricardo da Silva Junior, de 31, conheciam-se no doutorado em Computação. Desde 2008, o trio pesquisa Tecnologia de Computação em Alta Performance para identificar a topografia de poços de petróleo. O estudo rendeu frutos e, em 2009, eles foram contratados pela Petrobras.

— Aplicamos placas gráficas

óleo. Um processo que chegava a levar três dias passou a ser feito em horas — conta Zamith.

O projeto de pré-incubação precede a criação de uma empresa na estrutura da universidade. O coordenador acadêmico da Incubadora da UFF, Sérgio Mecena, explica que os empreendedores aproveitam a estrutura da instituição para consolidar seu modelo de negócio.

— Eles recebem todo o apoio necessário para que possam sobreviver no mercado. Passam a ter assessoria contábil, jurídica, marketing e



- Newspaper of my first startup.



# MobileTv

I was part of the team that developed the first TV for mobile of Latin America



XXVII SIBGRAPI CONFERENCE ON GRAPHICS, PATTERNS AND IMAGES

## CERTIFICATE

We certify that Mark Joselli (PUC-PR), Esteban Clua (UFF) were awarded with the second place in the Workshop of Theses and Dissertations (Ph.D. category) at SIBGRAPI 2014 - XXVII Conference on Graphics, Patterns and Images, held in Rio de Janeiro, Brazil, from August 27th to 30th. 2014, with the work entitled Grid: A New Data Structure for the Neighbourhood Gathering Problem on GPUs.

Rio de Janeiro, August 30th, 2014

A handwritten signature in black ink.

Moacyr Silva  
Conference Chair

A handwritten signature in black ink.

Asla Medeiros e Sá  
Conference General Chair

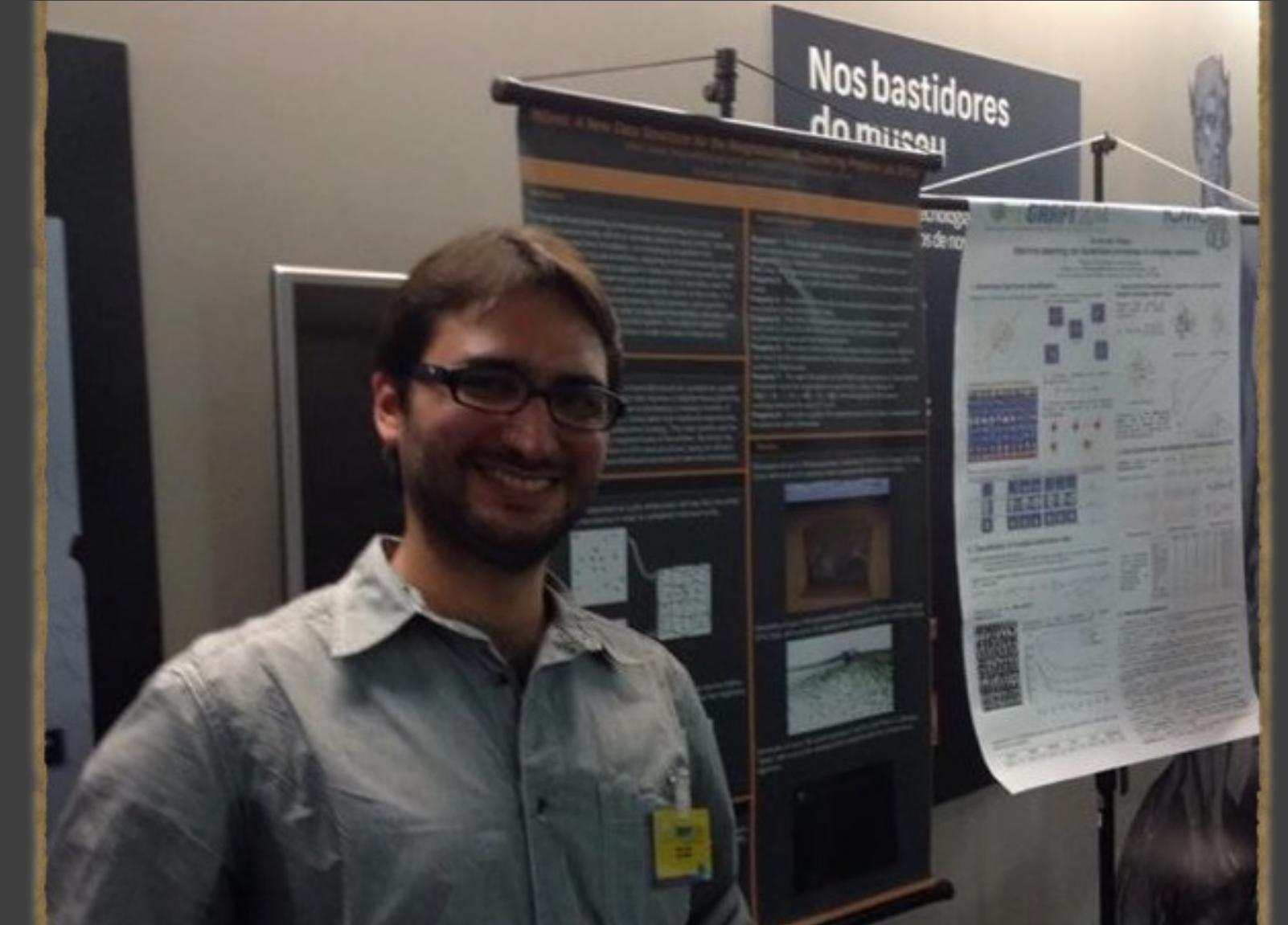
A handwritten signature in black ink.

Paulo Cezar Carvalho  
Conference Chair

Organization:



Promotion:



# Got the Best pHD Thesis in Brazil of 2014



- One of my students received the Apple Design Awards for best game





**SBGames**

Teresina-Pi 2015

**Festival de Jogos**

Melhor Serious Game

**Wyz**

- Another has received best series game for a game that teach deaf children how to read.

And a group of  
students were  
hackaton  
winners



Where do I  
work?

# PUCPR

- Pontifical Catholic University of Paraná
- Located in Curitiba in the State of Paraná
- More than 31,000 students
- Five academic units:
  - the Center for Biological and Health Sciences,
  - the Center for Exact Sciences and Technology,
  - the Center for Juridical and Social Sciences,
  - the Center for Humanities and Theology,
  - and the Business School.



# PUCPR

- PUCPR offers graduation, MBA, Master and pHDs courses in different fields;
  - 63 graduation courses;
  - 175 pos graduation courses
  - and more than 2,000 R&D projects with more than 100 patents
- PUCPR has a central biblioteca, laboratories equipped with computers, projectors
- Focus on Teaching, Research, Innovation and Internationalization



PUCPR  
GRUPO MARISTA

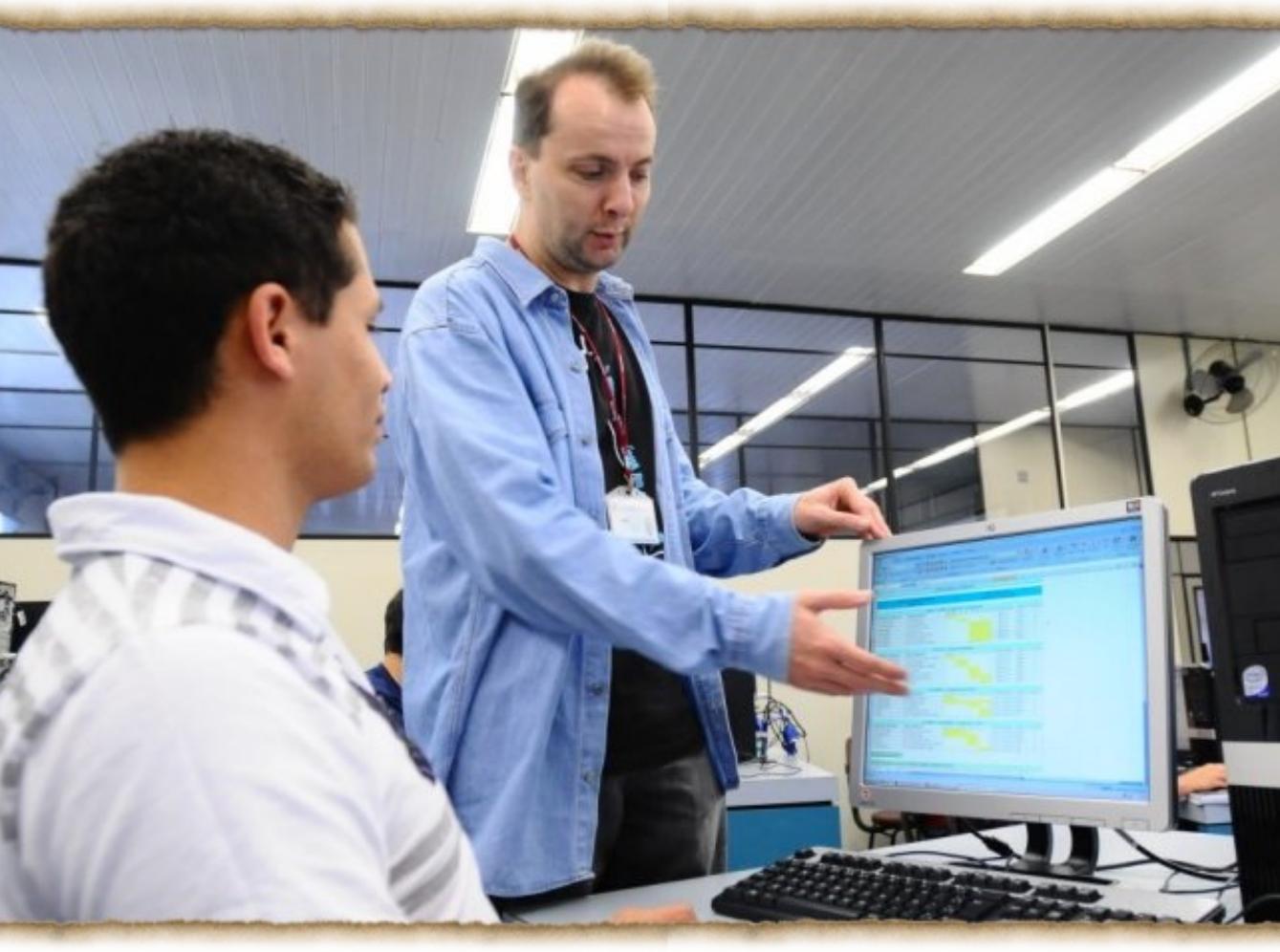
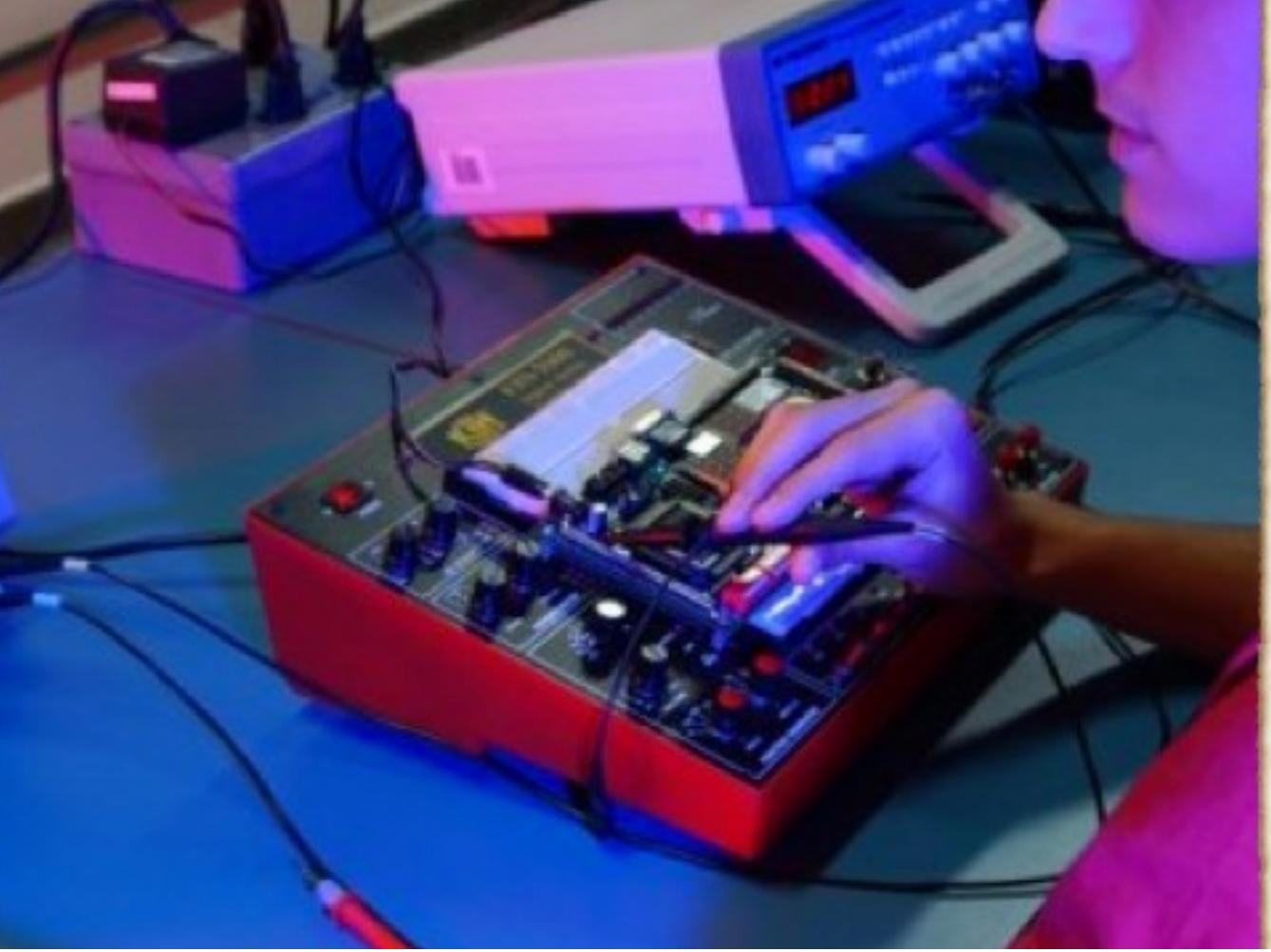
NOKIA

# Equipment Room

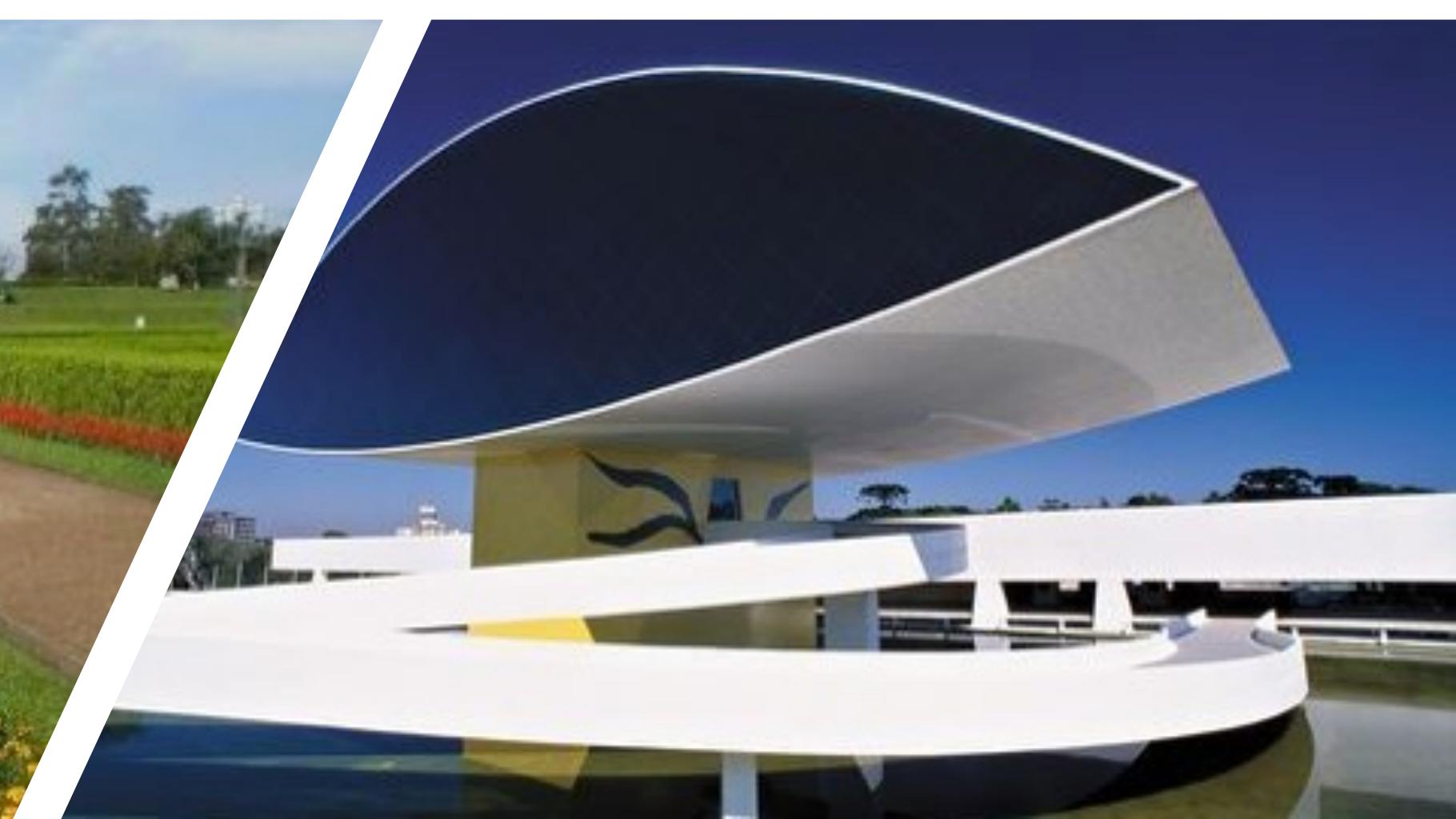


MIC CWB



















What do I teach?

# Games/Mobile Development

- I teach on the Graduation Program and Postgraduation Program
- Subject:
  - Programming
  - Mobile Development
  - Computer Graphics
  - Game Development
  - Server/Cloud Development
  - Databases
  - Blockchain development

## AirPlay

Wirelessly send what's on your iOS device or computer to this display using AirPlay. To learn more, go to [apple.com/airplay](http://apple.com/airplay).

- 1 Network Configuration  
Connect To Wi-Fi Network
- 2 Choose This Apple TV  
`br.epoa.aud.aptv1`

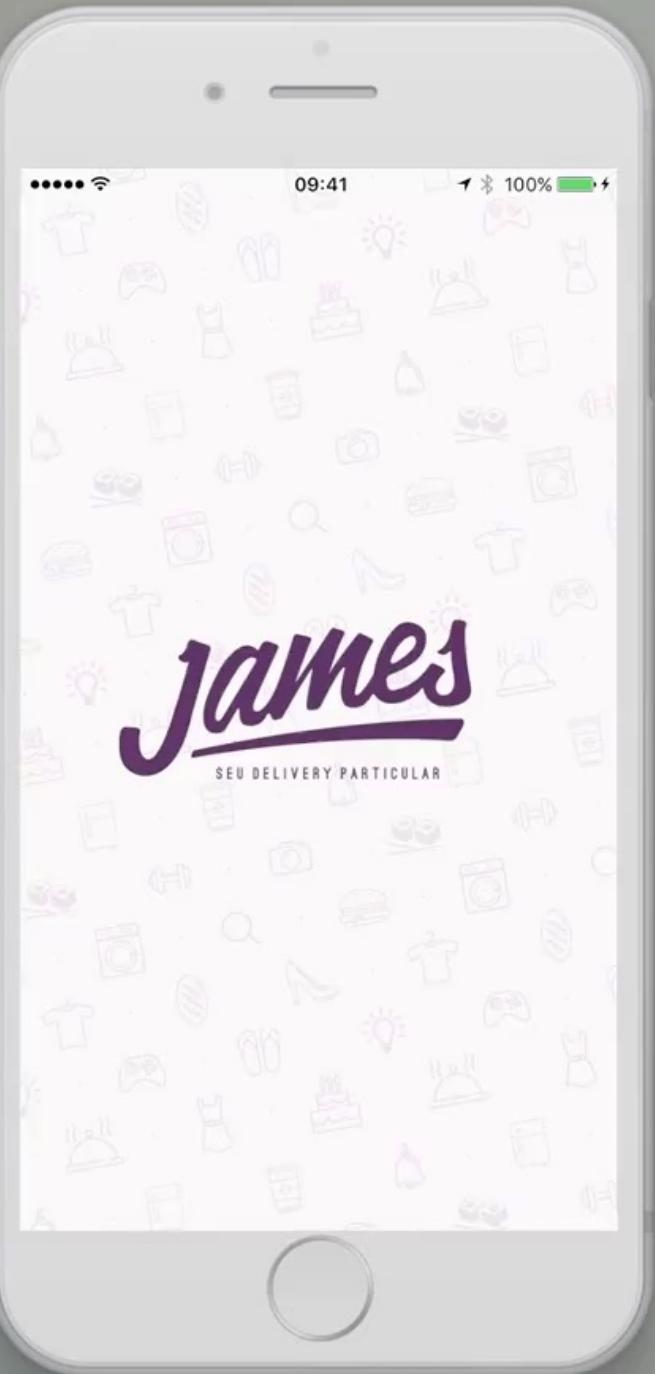


# Apple Developer Academy

- A 2 year program with concentration on the development of apps for iOS
- They develop an app and also a startup

# James Delivery

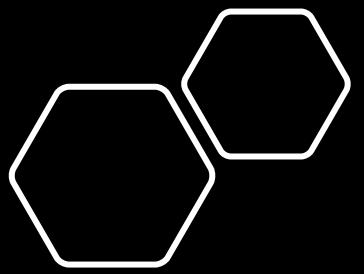
startup that deliveries  
convenience to your home





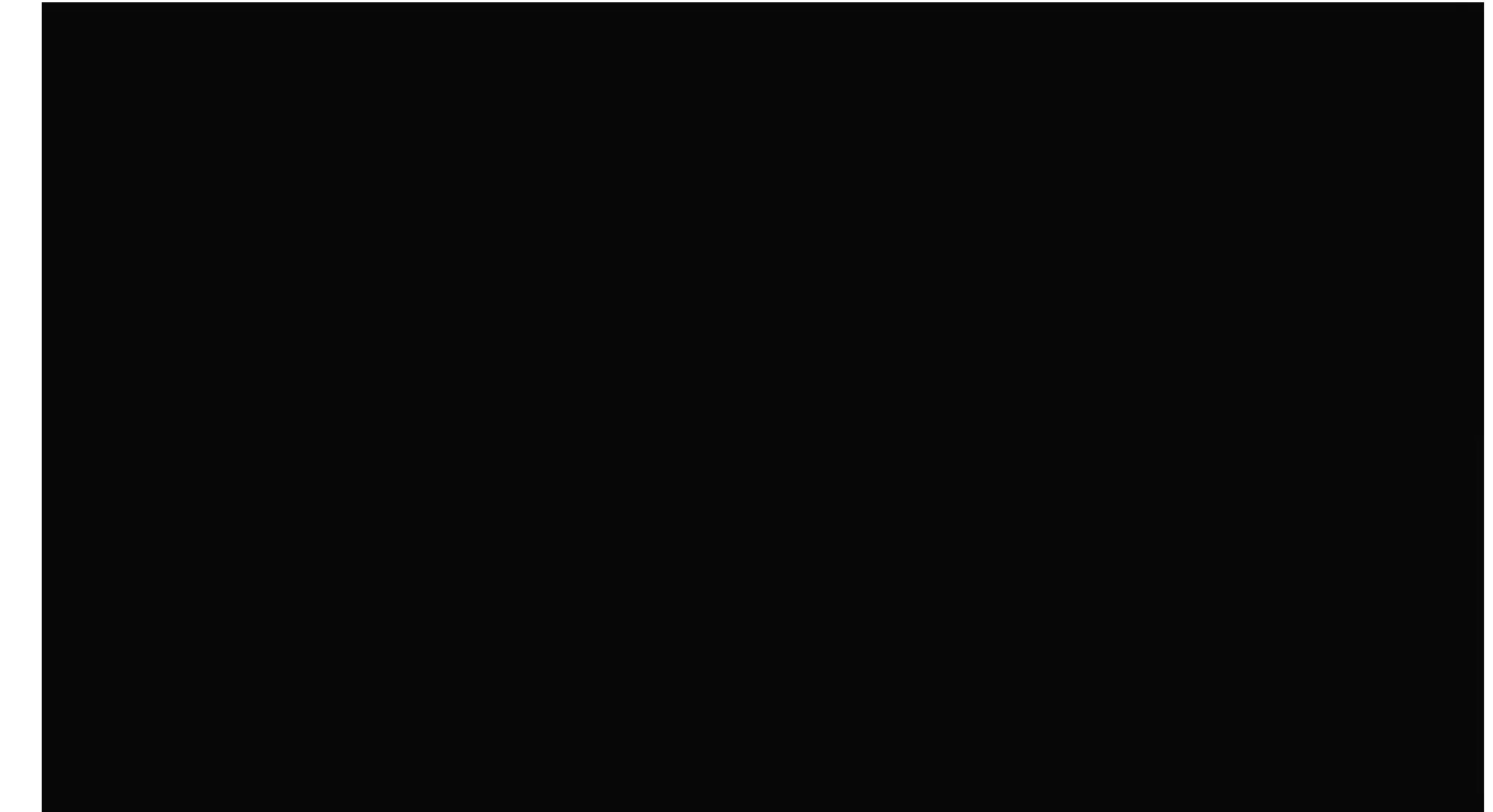
# Super pads

Create and Play top songs



# Jump-o

Minimalist game



# Vector Race

- Autorama game
- [https://www.youtube.com/watch?v=bz5Bndb7Fb4&ab\\_channel=RafaelForbeck](https://www.youtube.com/watch?v=bz5Bndb7Fb4&ab_channel=RafaelForbeck)



# Eternal

Social network that help plan a  
marriage party



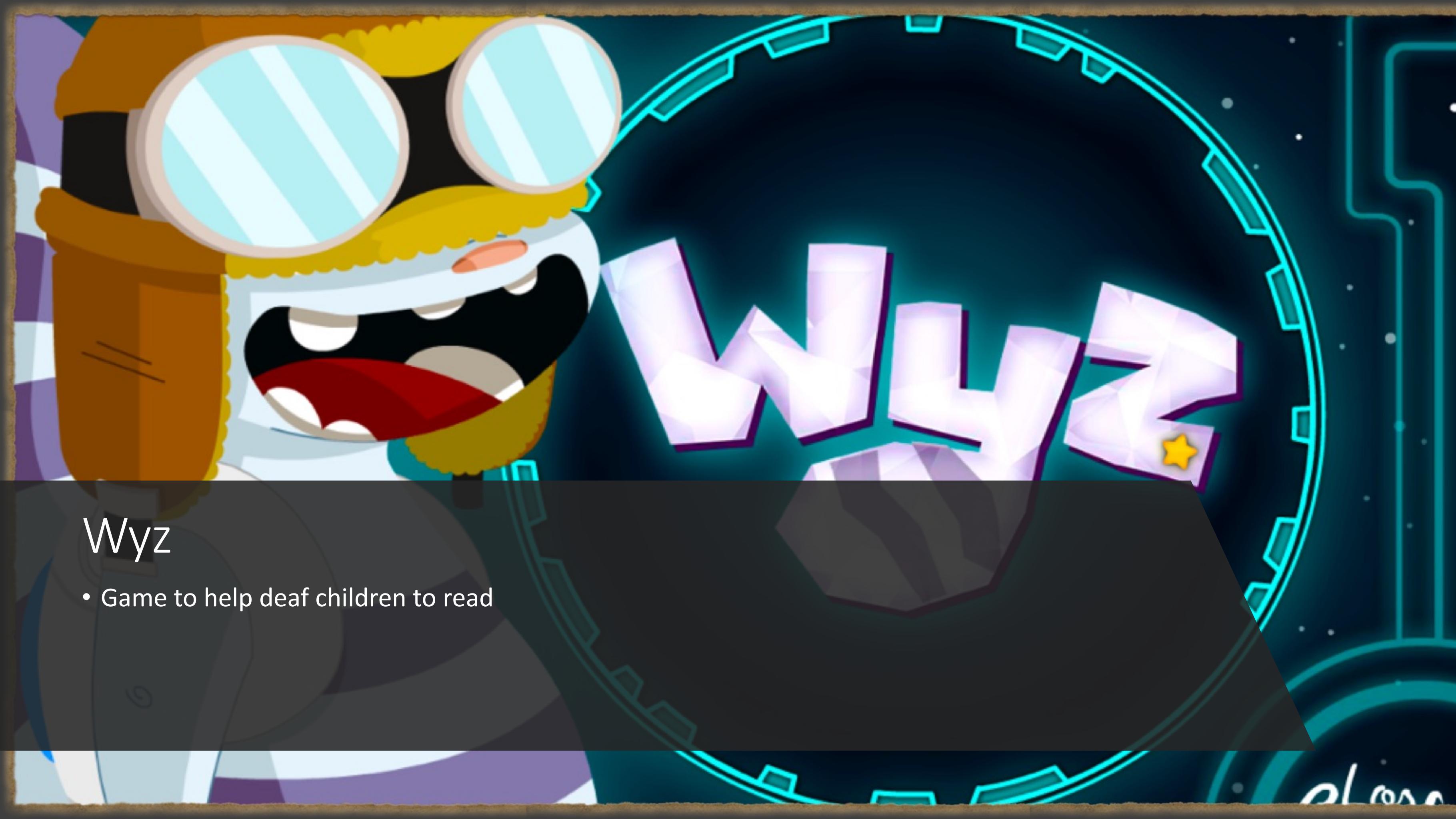
eternal

A rede social do seu Casamento



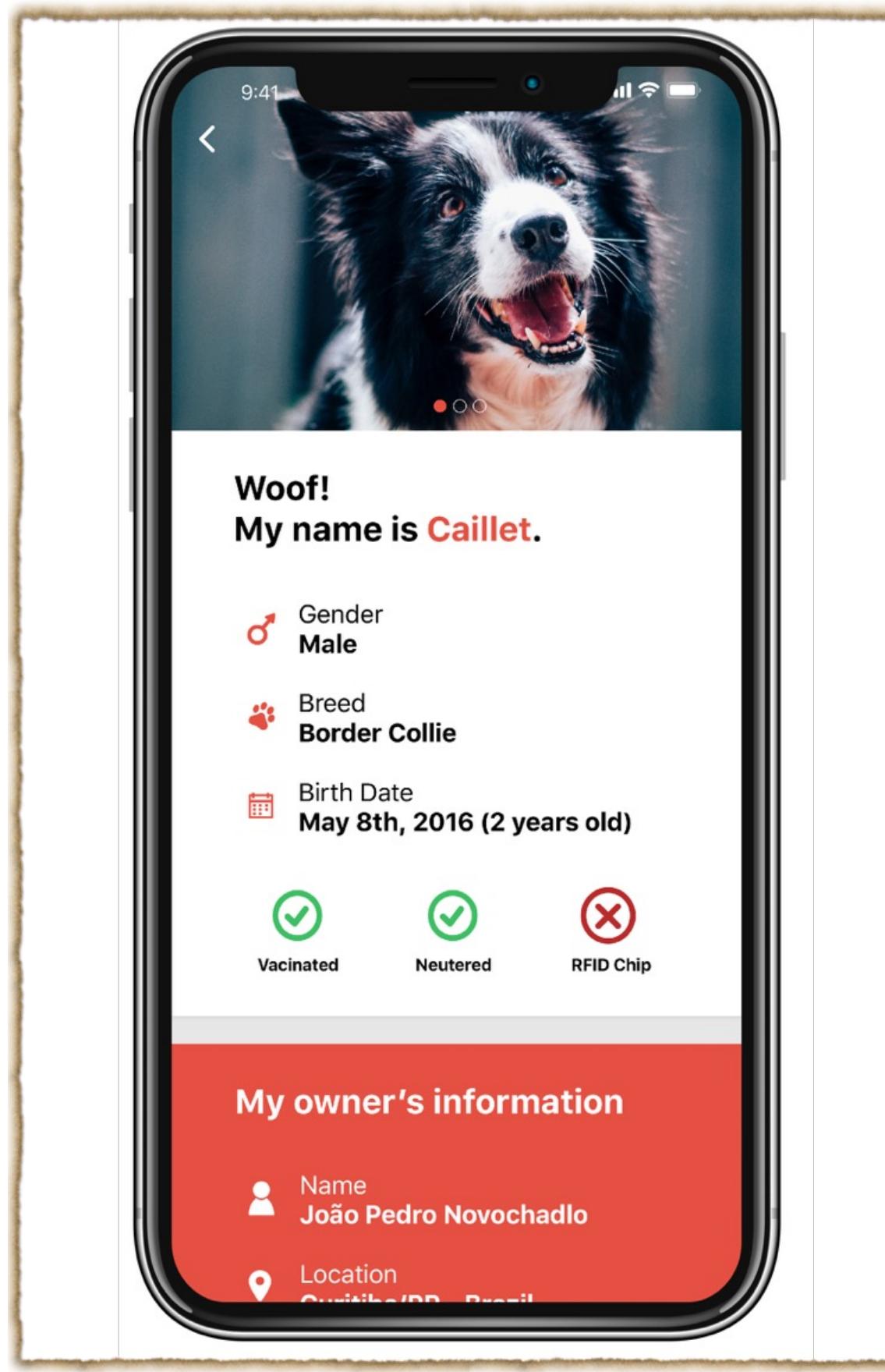
Acesse com o Facebook

Entrar



# Wyz

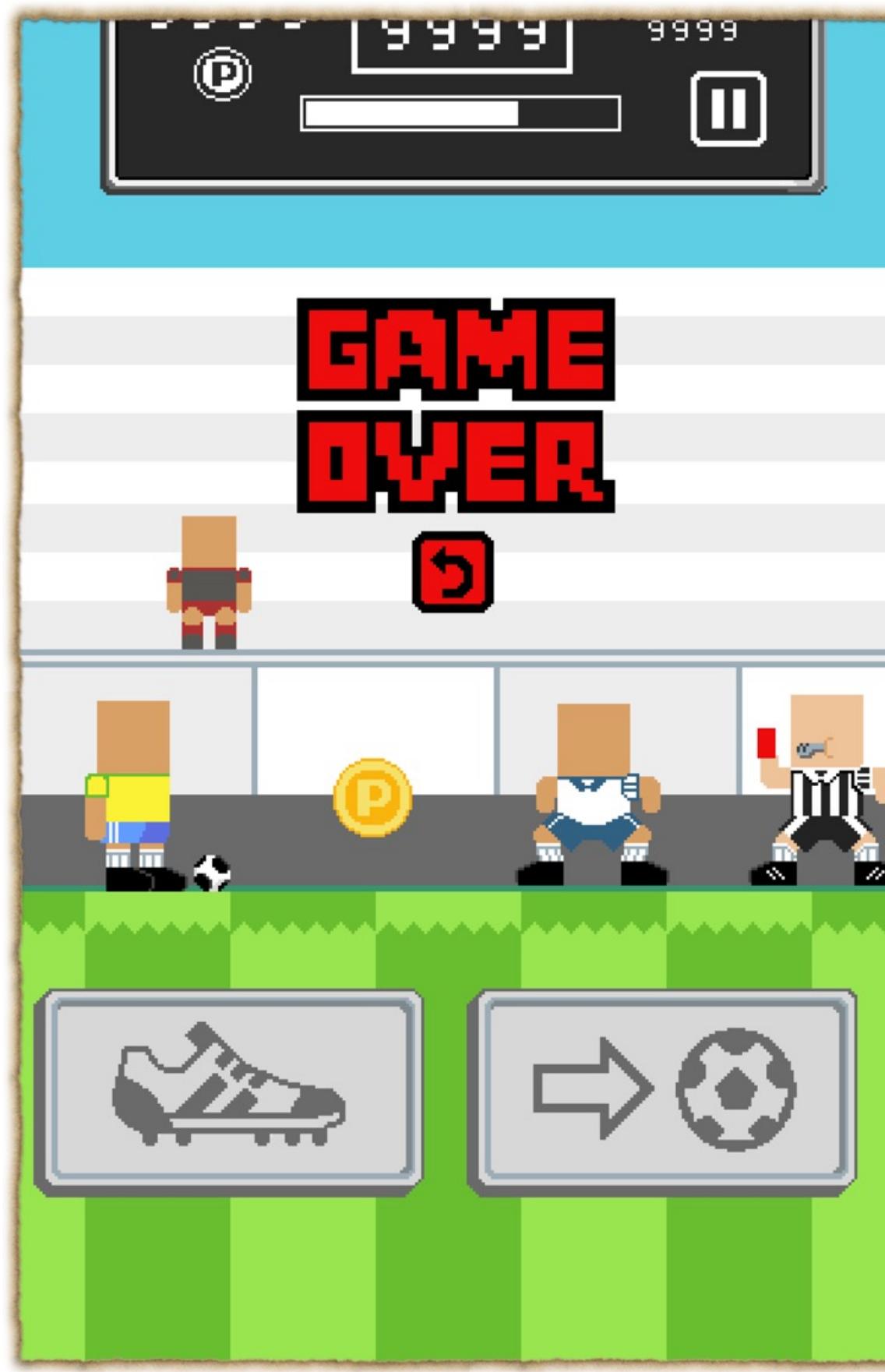
- Game to help deaf children to read



# Kryptags

---

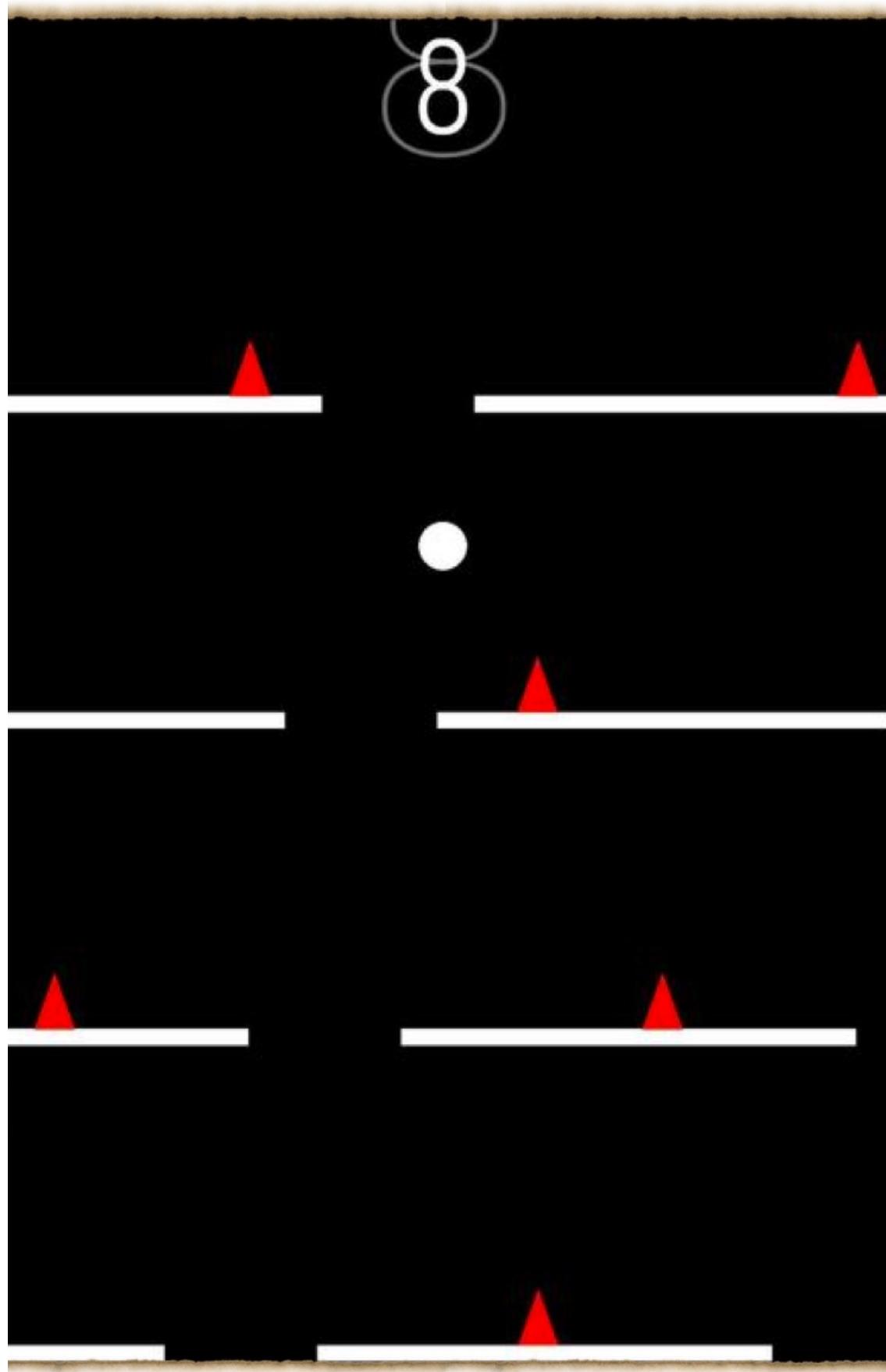
App with nfc technology to track pets



# Soccer Runner

---

Hyper casual game



# Linear Jump

---

Hyper casual game

# Bottle Stack

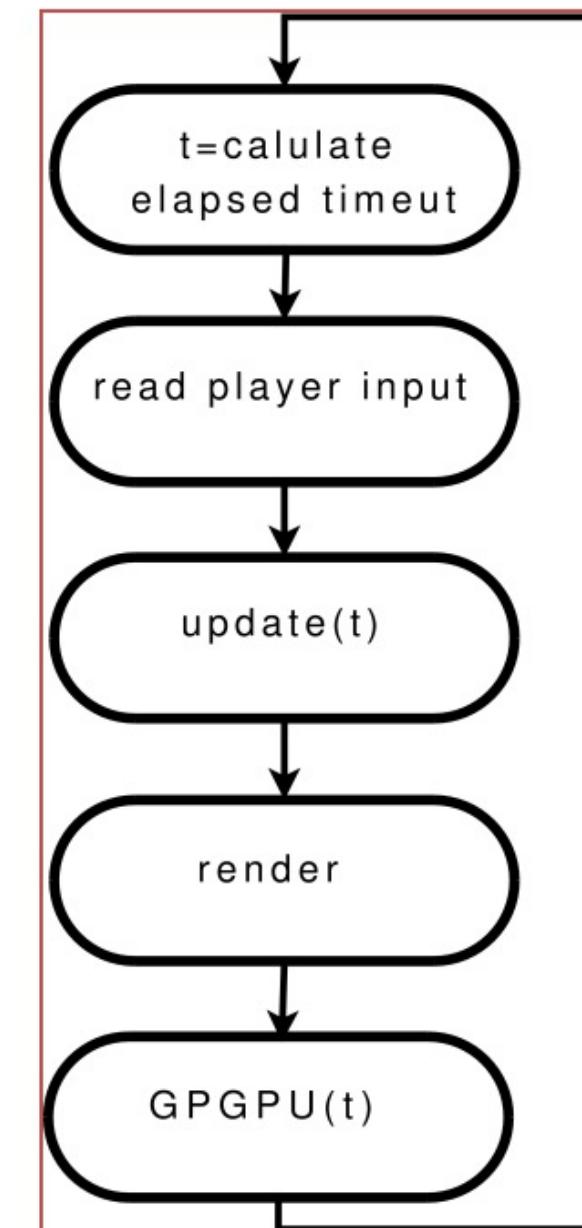
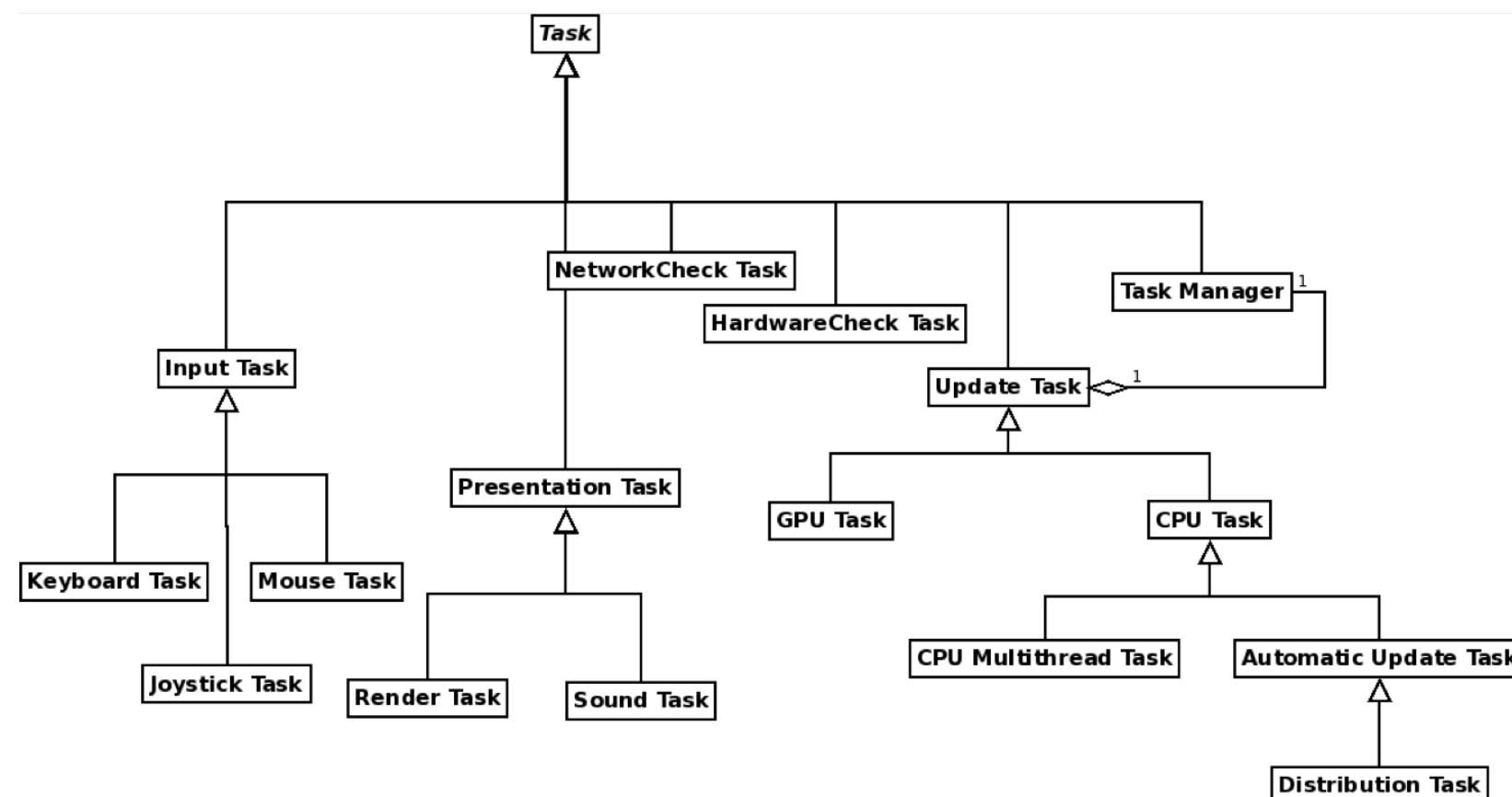


What do I  
research?

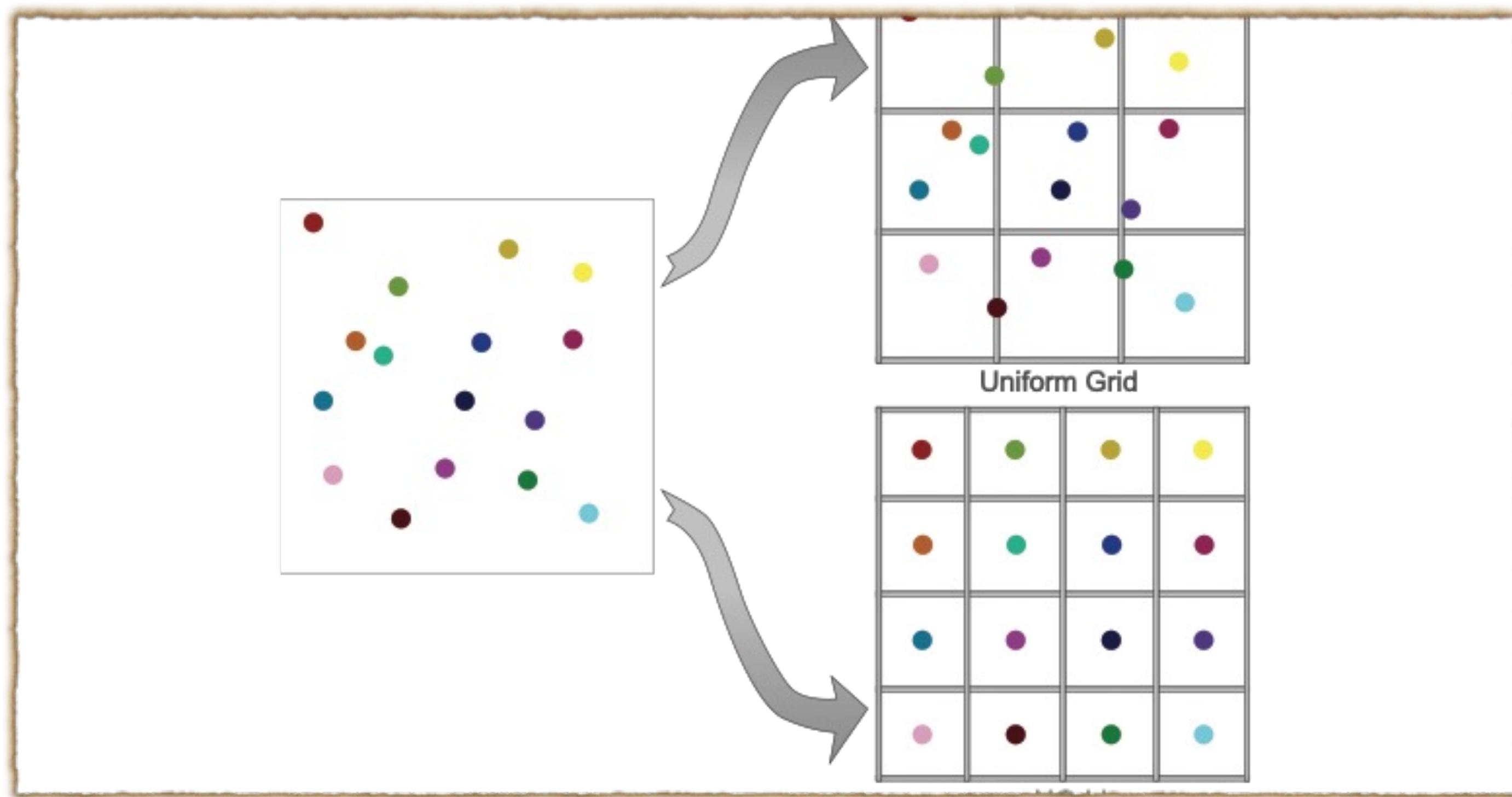


# New Game Architectures

- ◆ How to develop new architectures and framework in games to get the best of the hardware.







# Data Structures

Created a new Data Structure for games and interactive applications.



Points: 202

FPS: 100

# GPU Wars

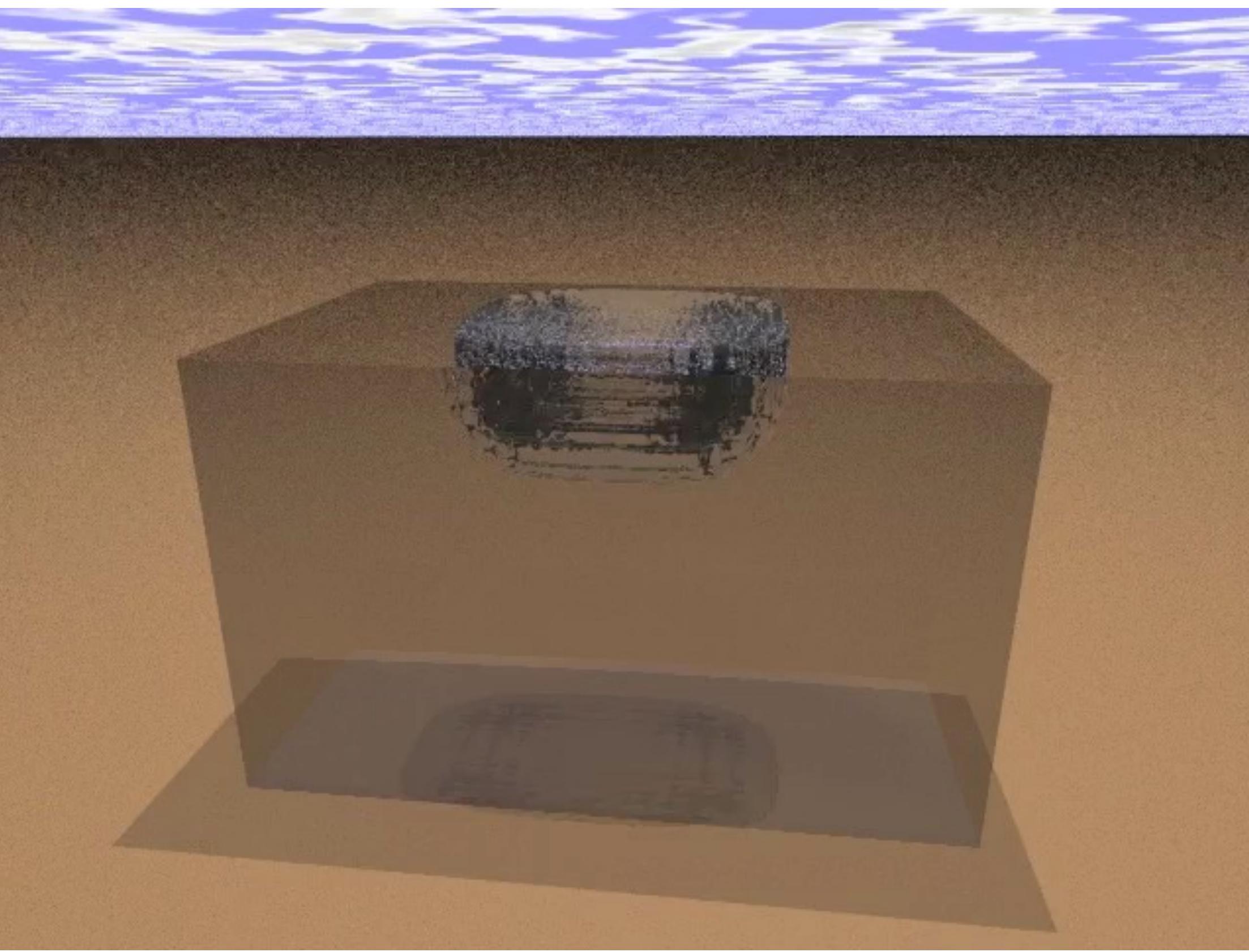




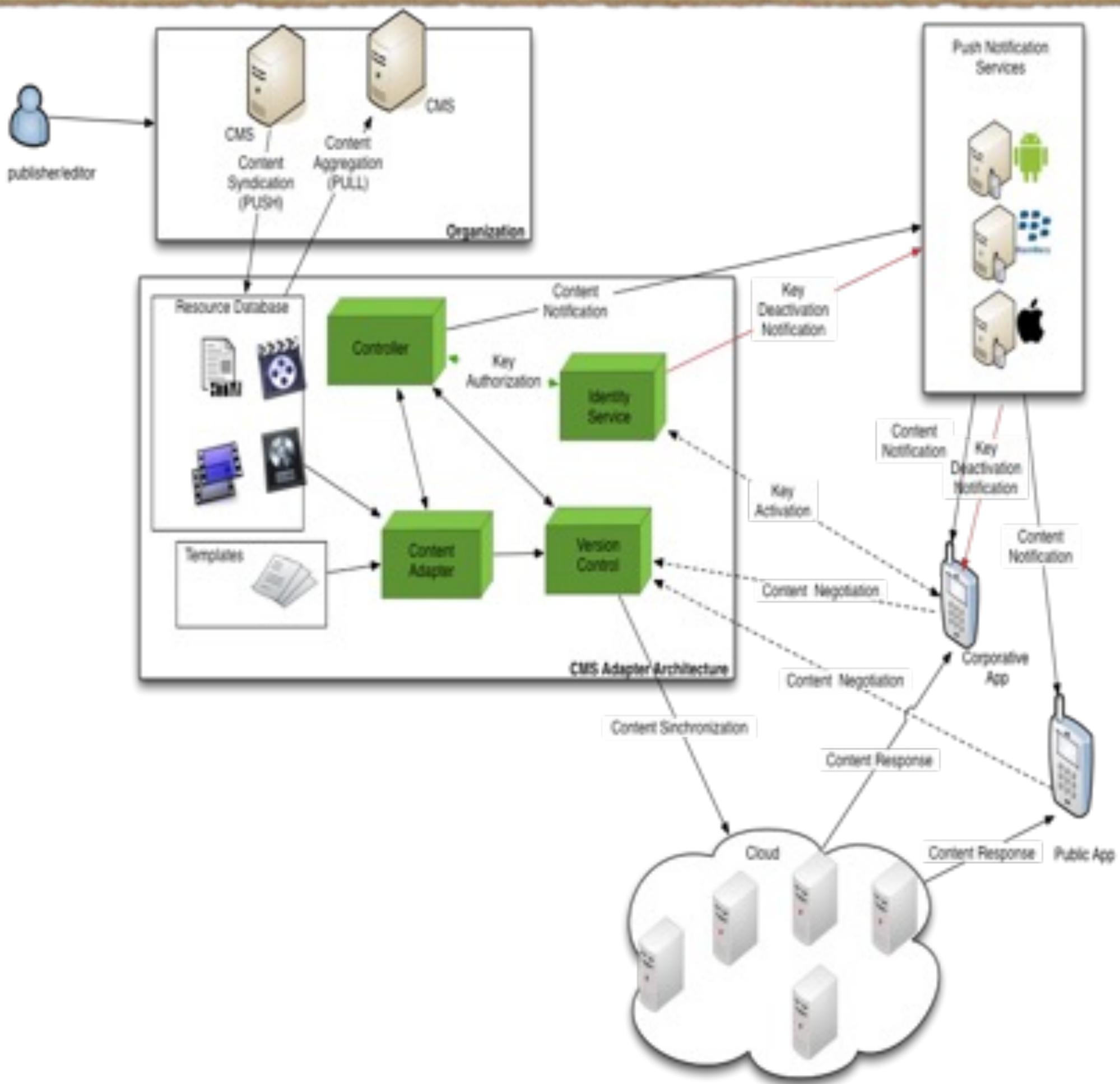
RsBalls

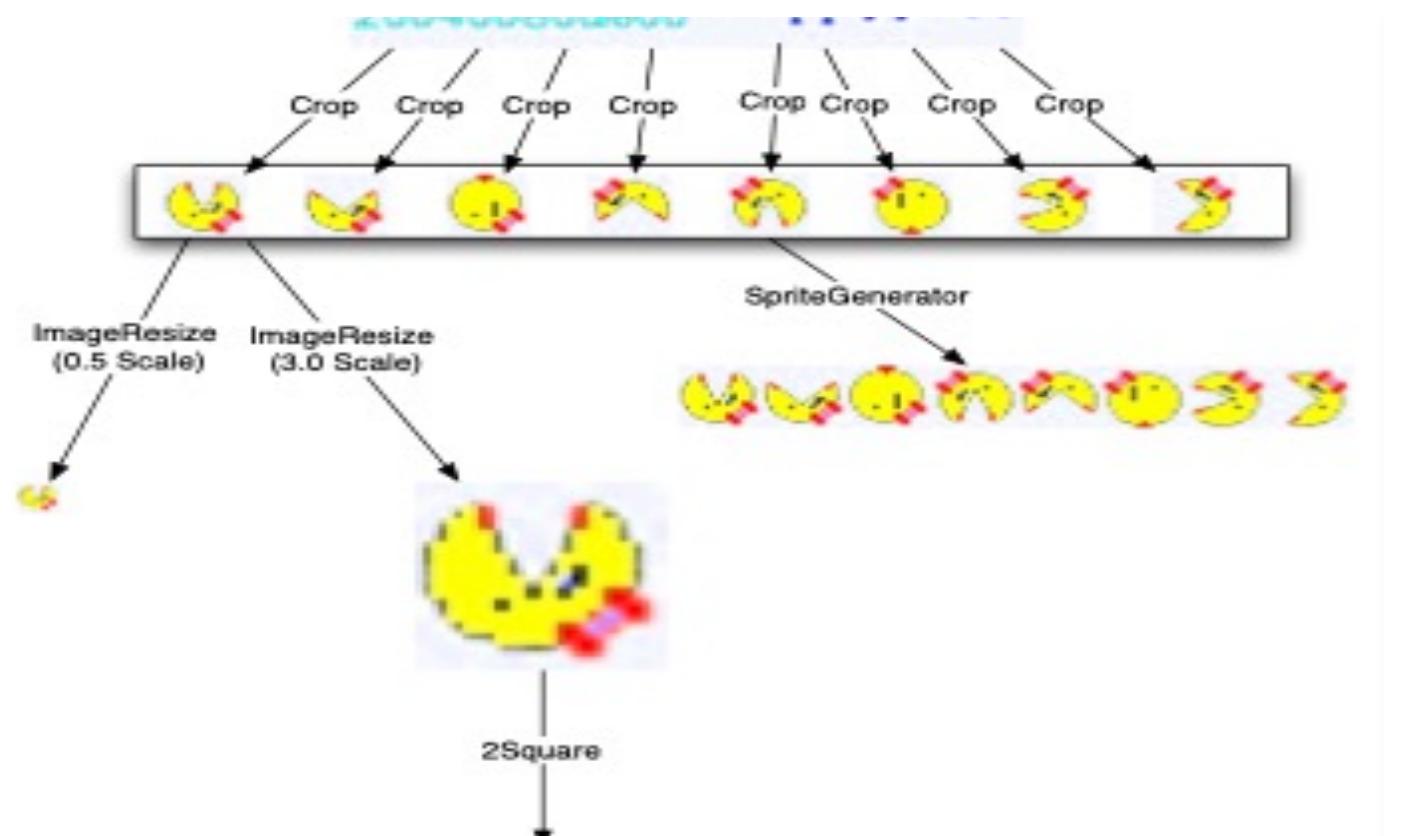
particles1024

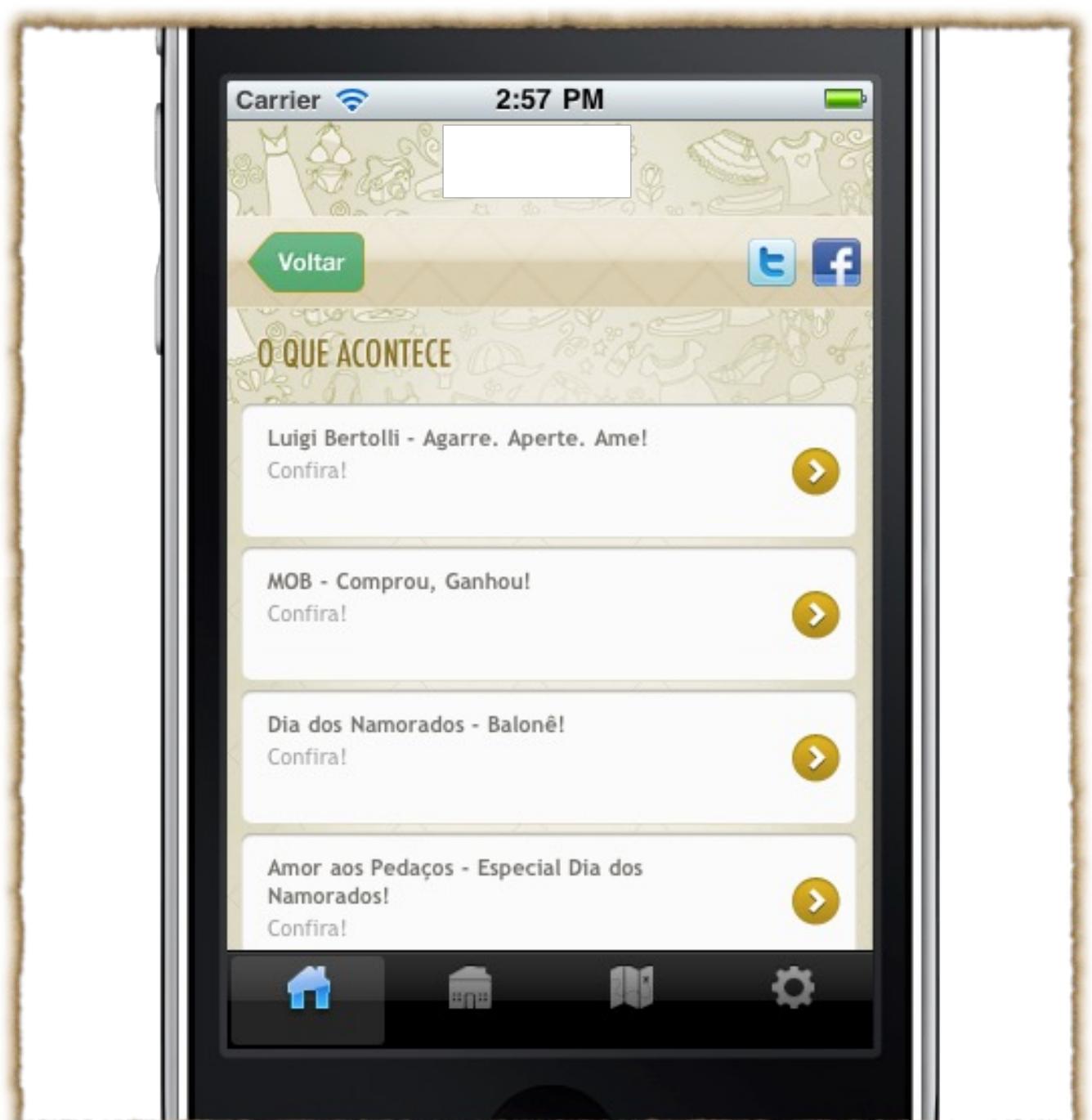


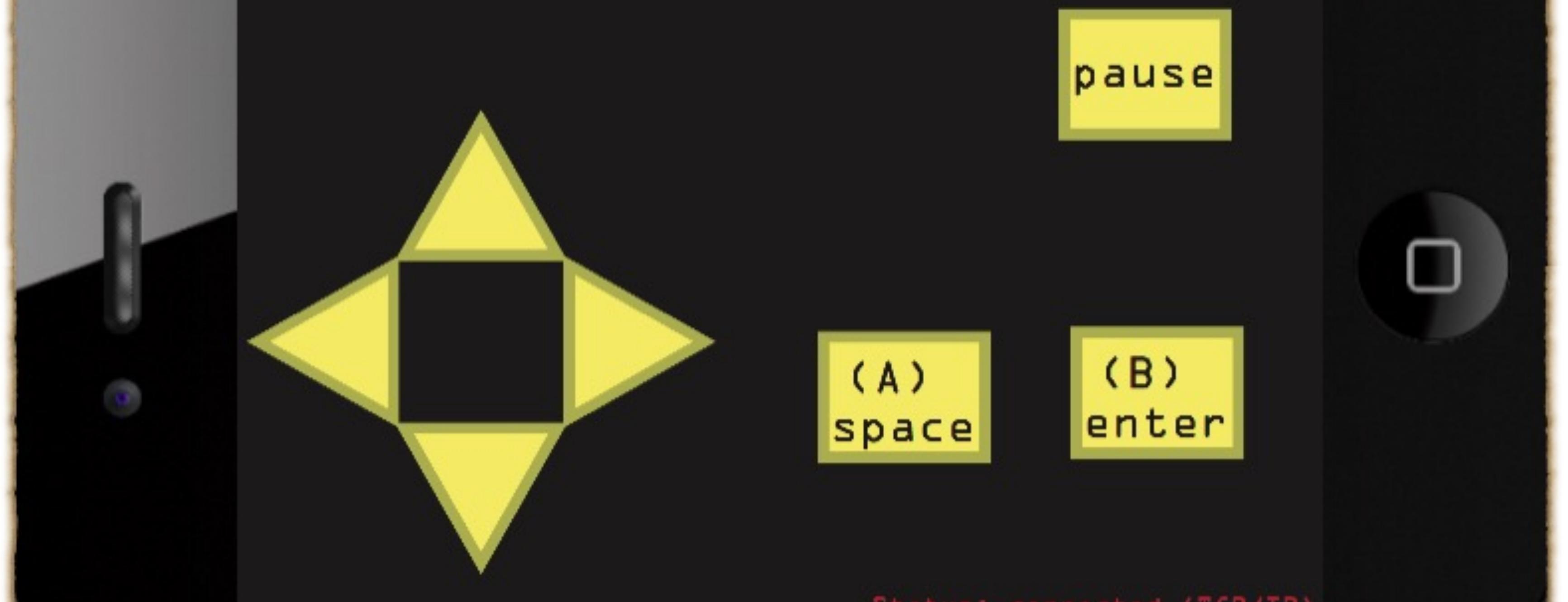


# Cloud Architecture for mobile Resources









# Adapt Control

Have a custom controller  
that adapts to the user  
input.



# Neurofeedback games

Use the brainwaves as a input for games.

# Jecripe

A game to teach children with Down syndrome.





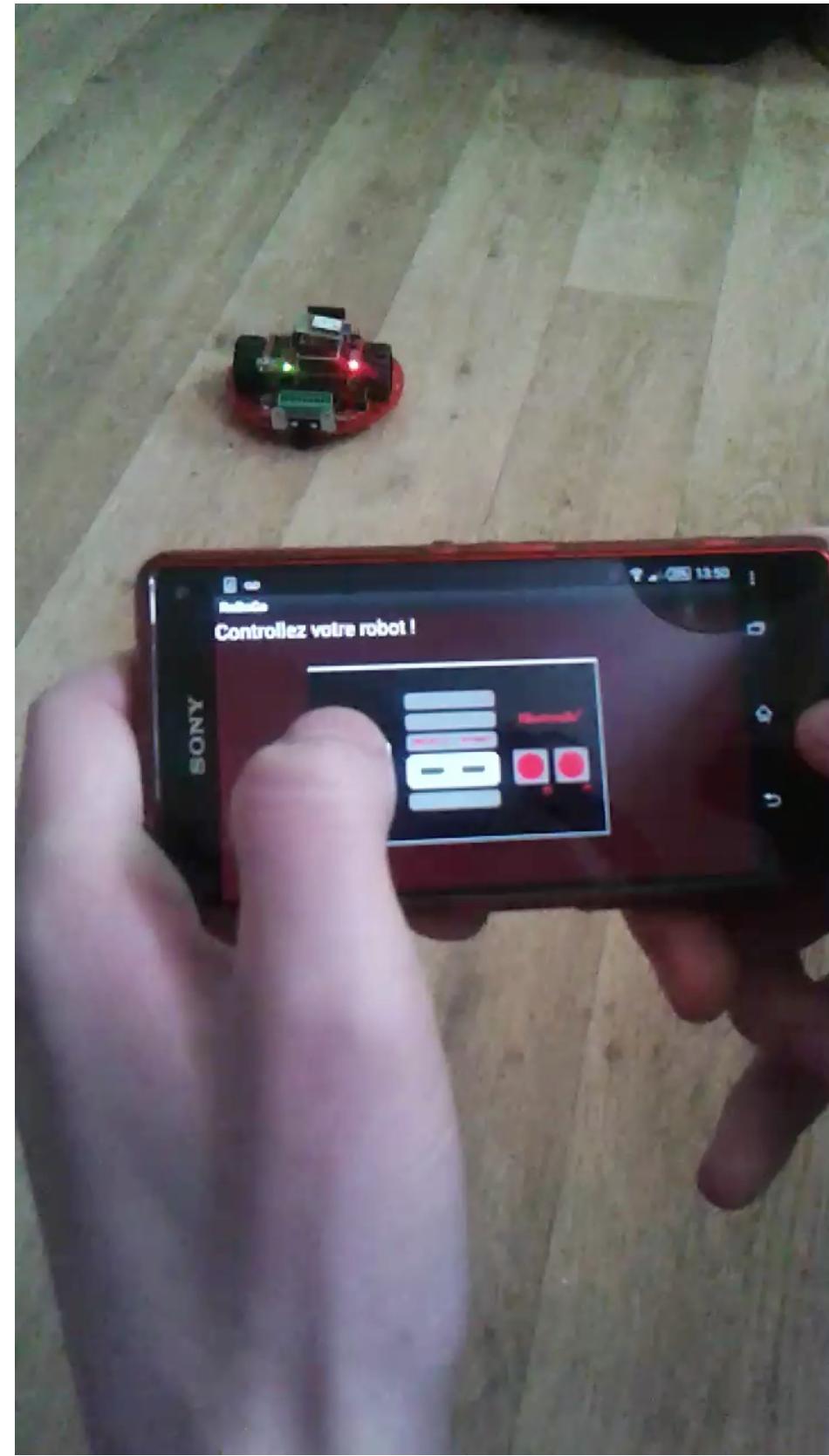
# Carnaval Machine

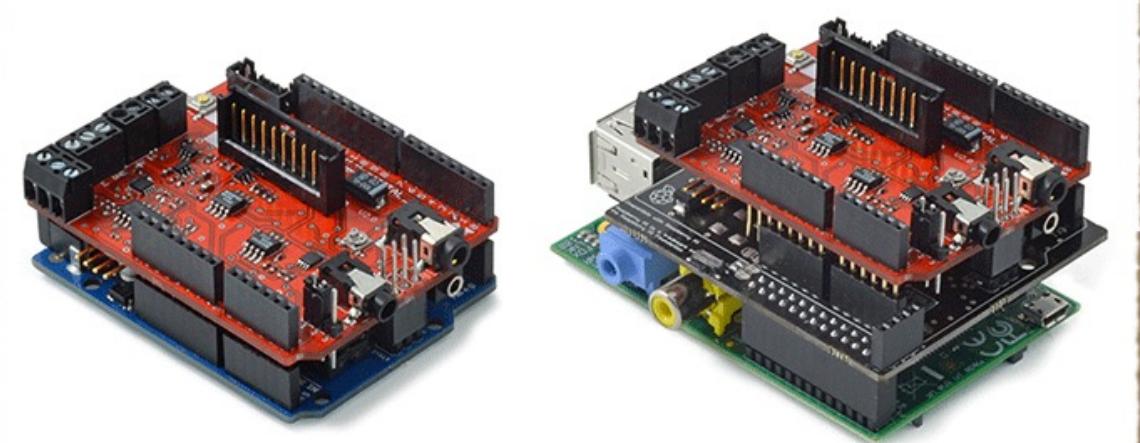
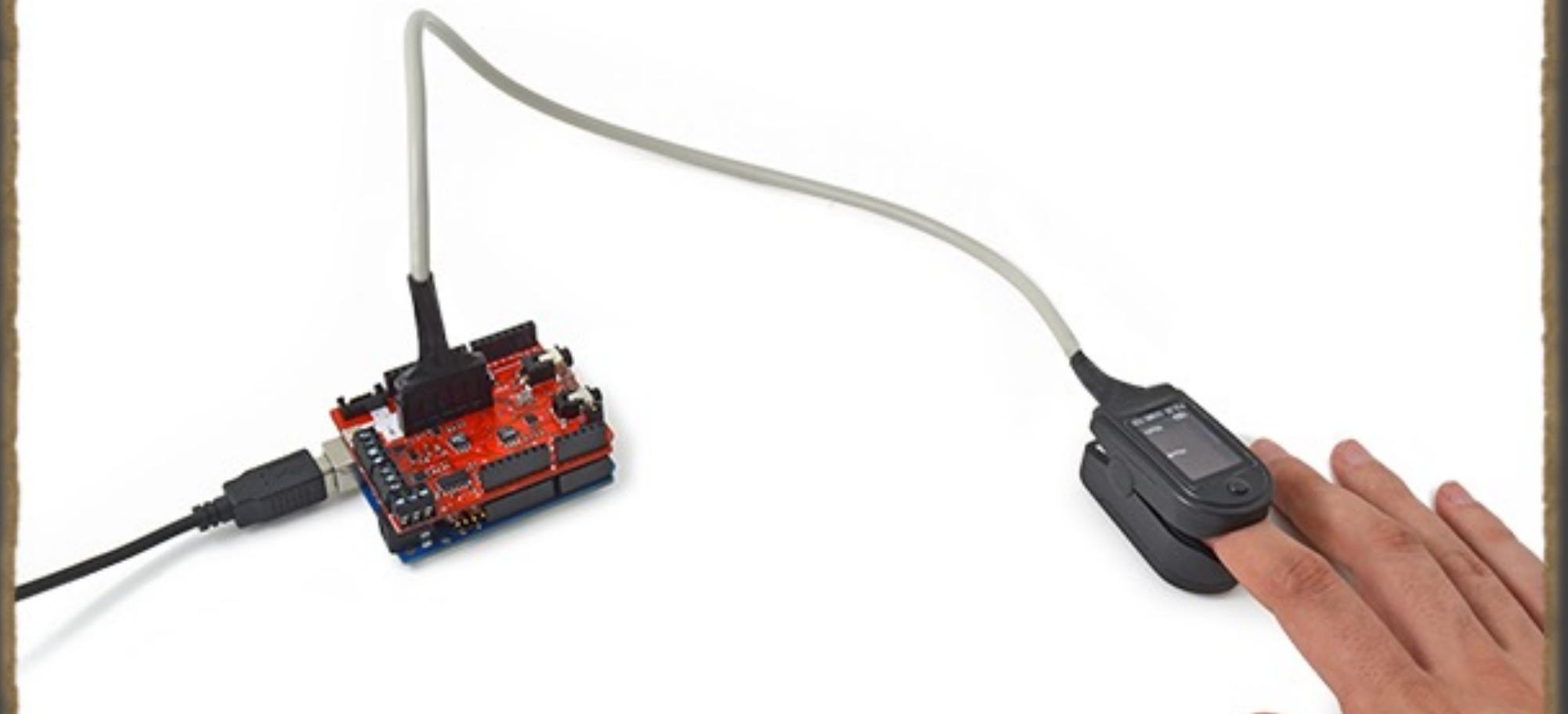
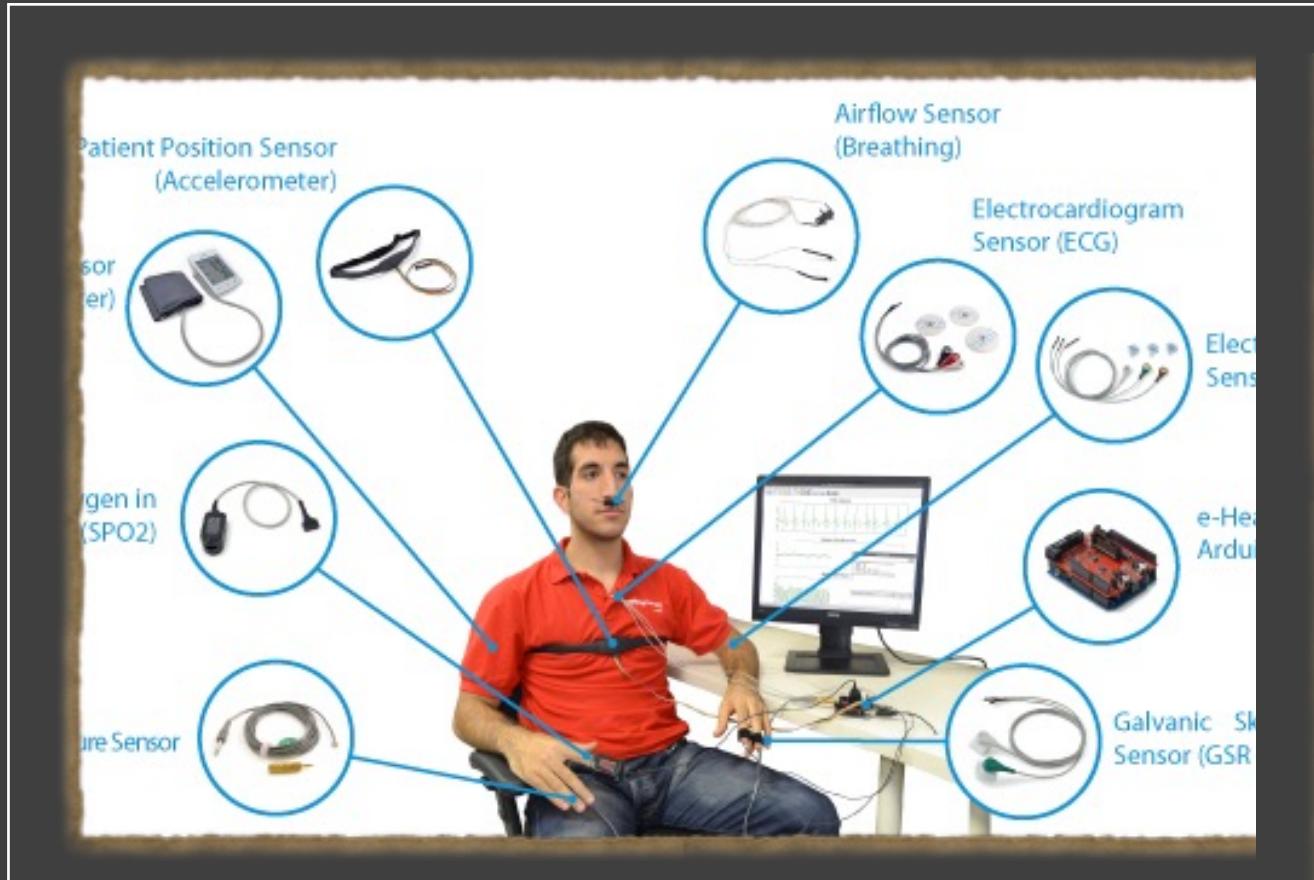
A game to present to the world the culture and world of the Carnaval.

What do I teach in  
ESIGELEC?

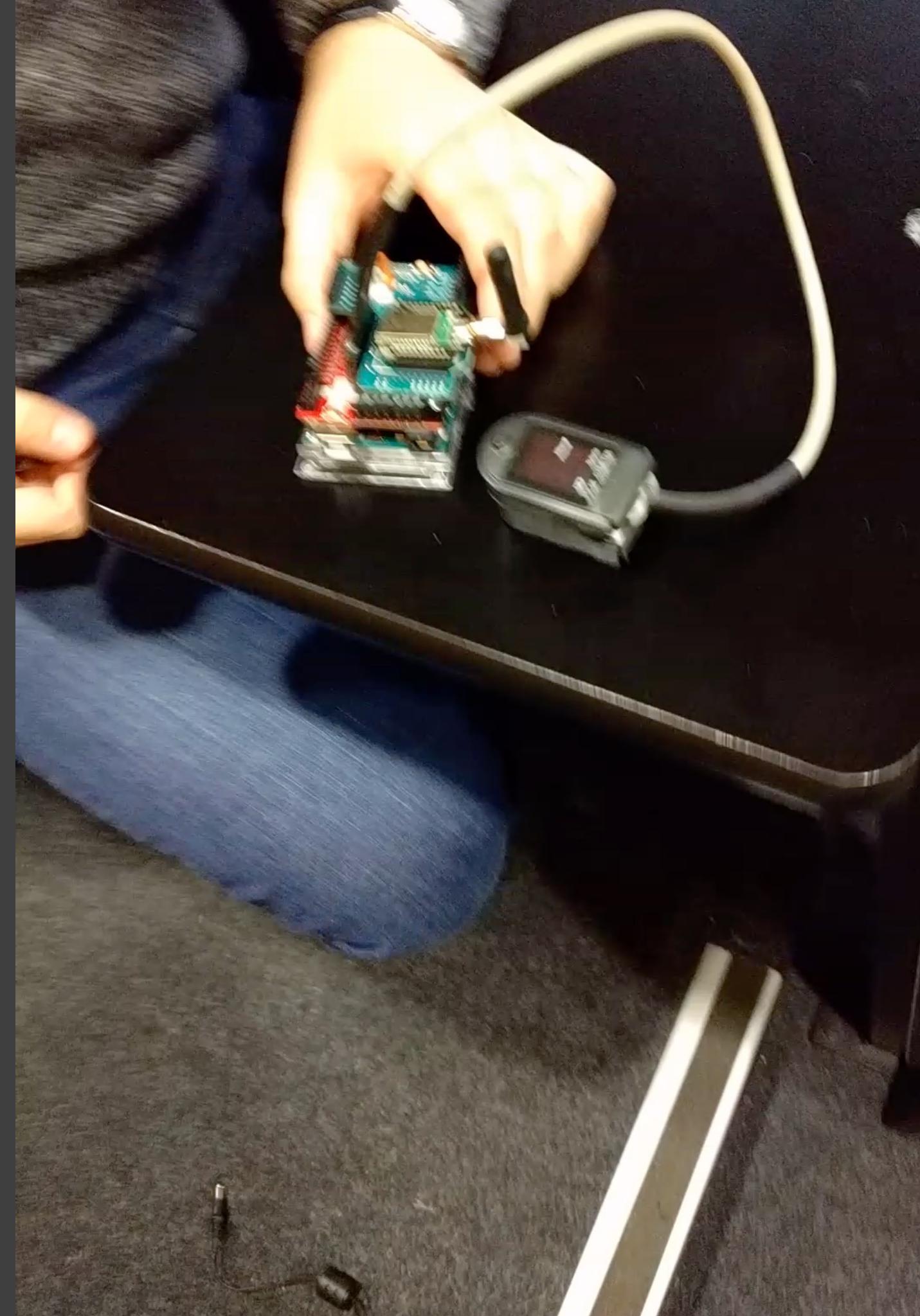
# Android

- I teach mobile development using Android;
- The goal is that after the course the student is able to develop Apps;
- I teach in three courses:
  - Android and Innovation - where the students build an App to control a robot
  - Android for Health Care and Well-being - where students build an health App using extra sensors;
  - App development for Master SEE





# Project with Oximeter





Who are  
you?

---

State your name,

---

where you were born

---

and your academic/professional  
formation

---

Agenda (Can  
be modified  
during the  
course)

---

07/02: Introduction to Android

---

08/02: Basic UI: Buttons, Text...

---

10/02: Activities and Intents

---

14/02: RecyclerView;

---

15/02: Bluetooth and Final Project

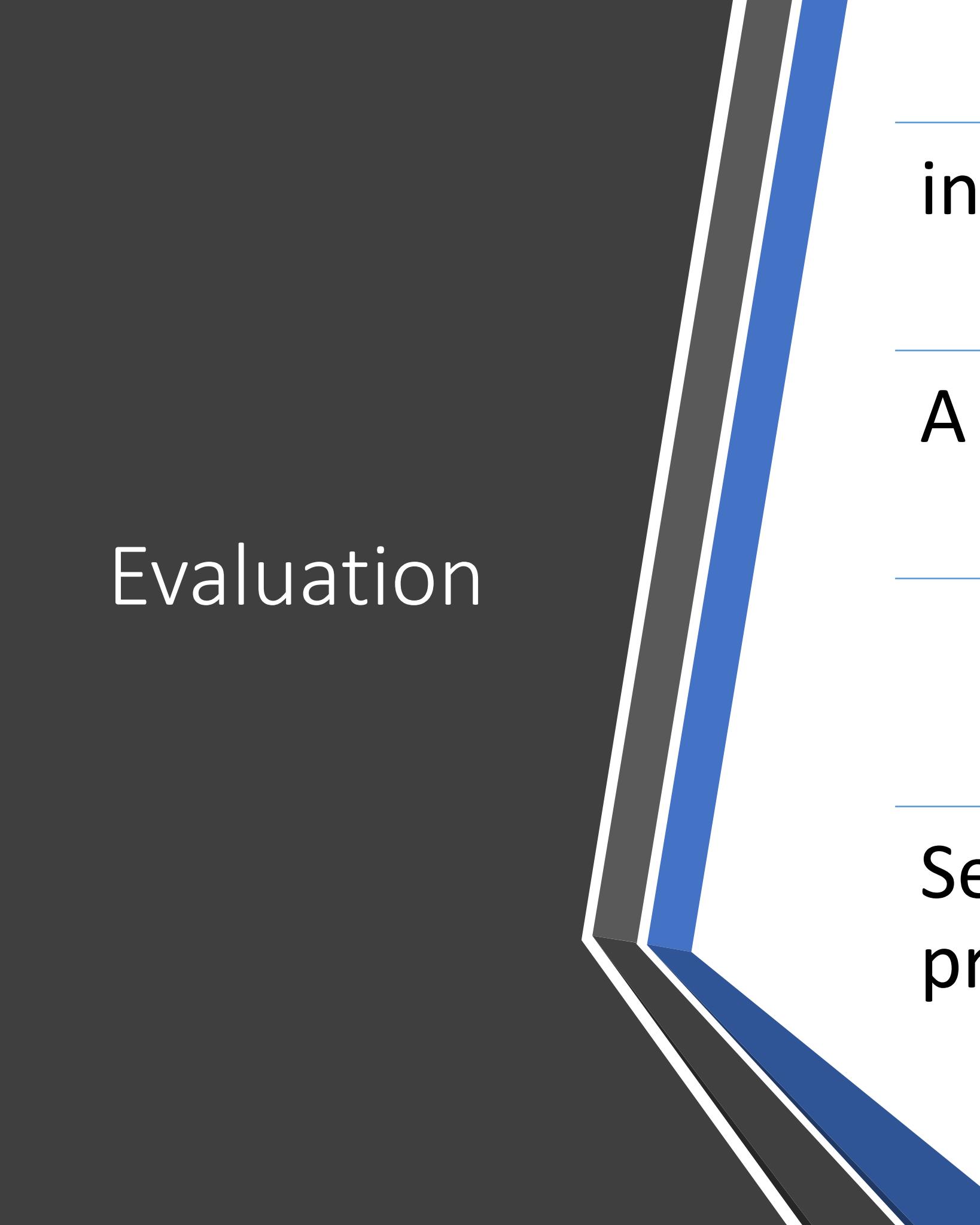
Objective of  
the Course

---

installing Android  
development  
environment

---

creating interface and  
debug it



Evaluation

---

in-class exercises

---

A final project

---

Send me the zip/report with the  
project



Todays  
Objective

---

Prototyping;

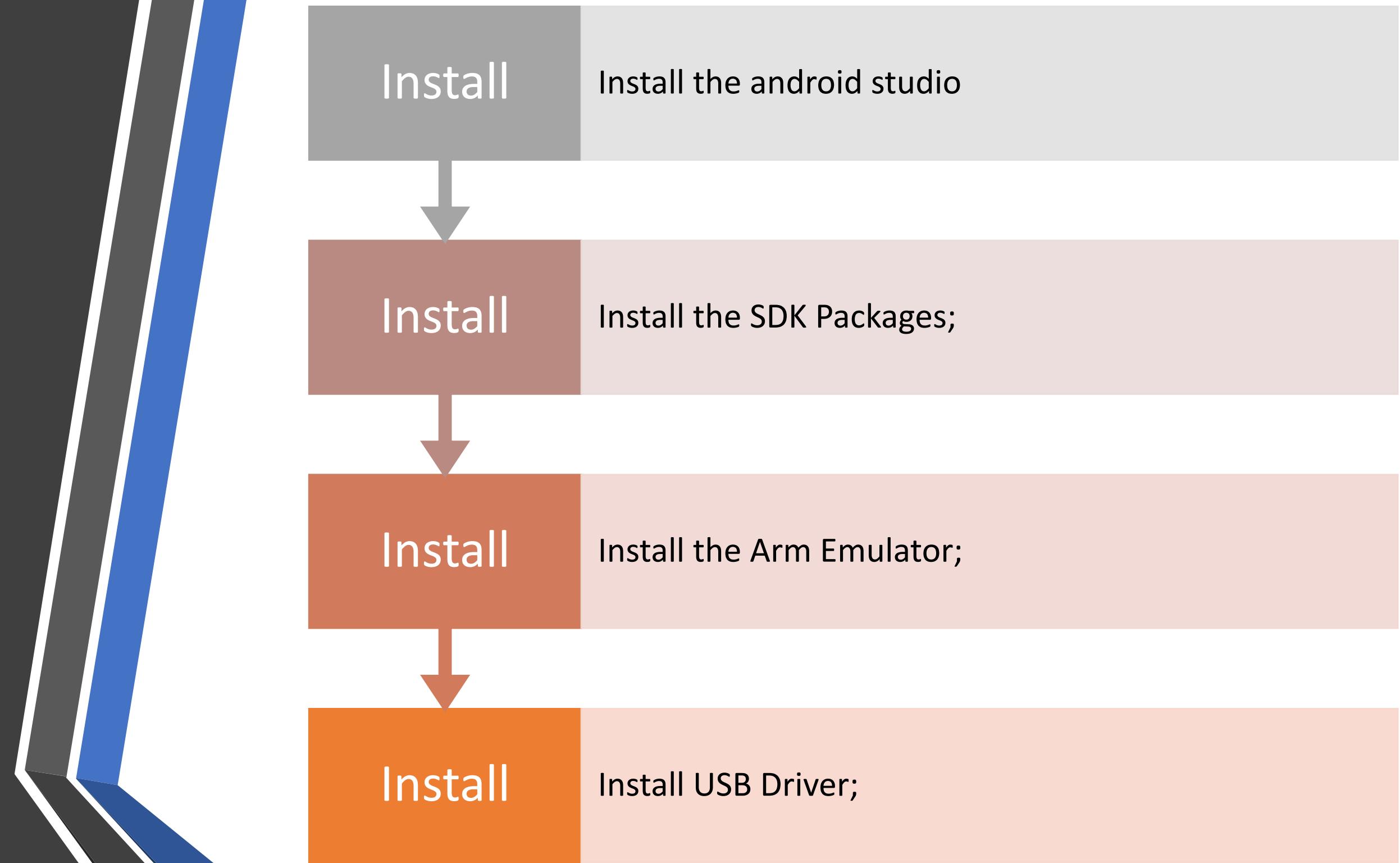
---

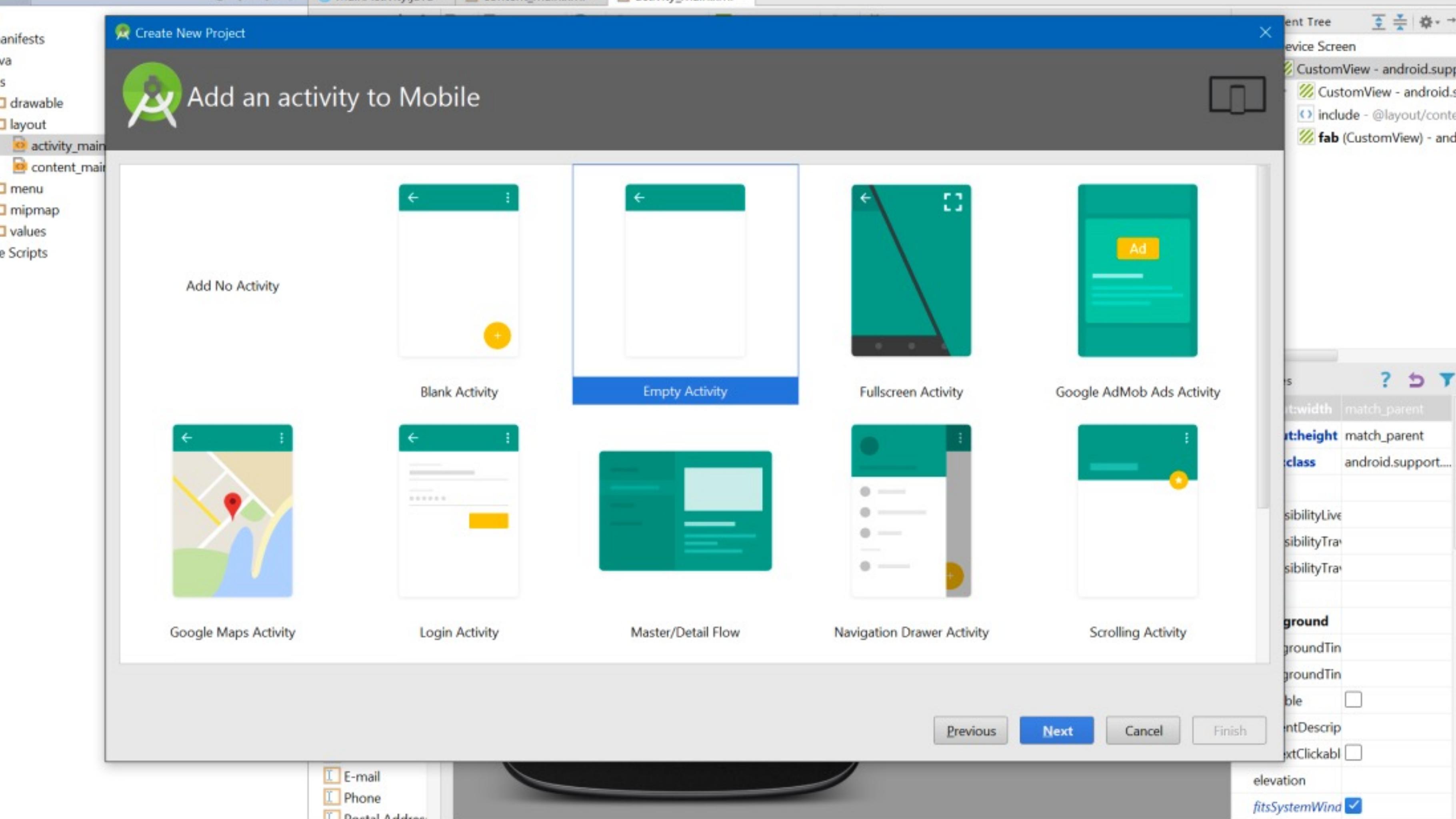
First contact with  
android;

---

Review of technologies;

# Install Android



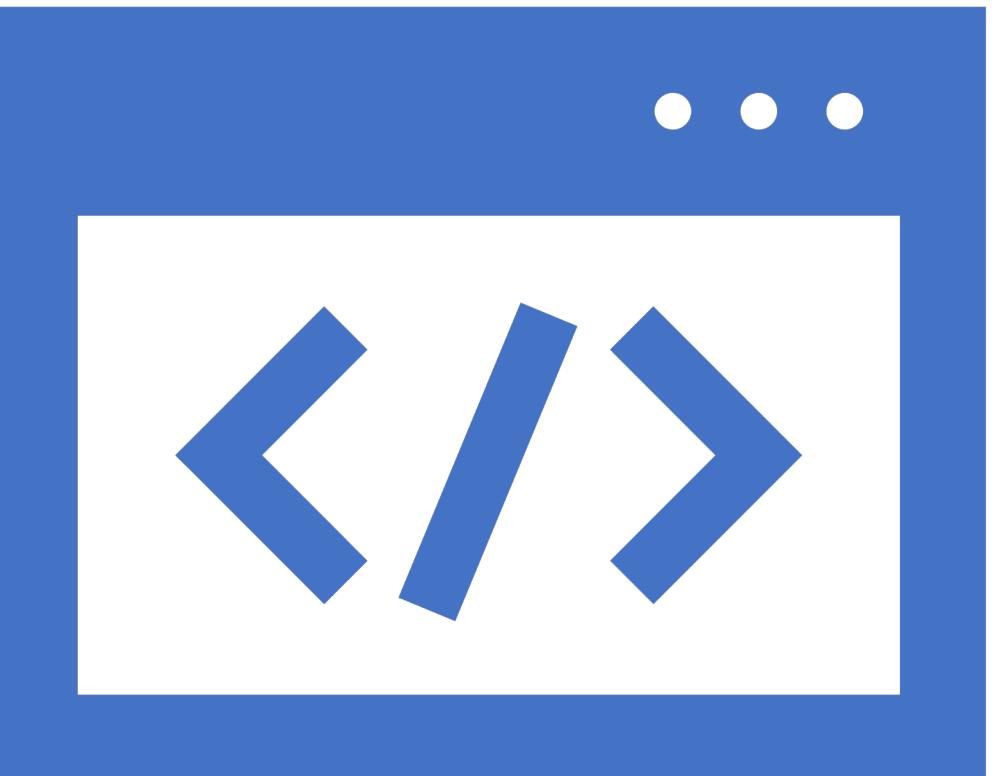


# Android Development

- Need the knowledge of two technologies:
  - XML: for layout, definitions and configurations;
  - Java/Kotlin: for the behavior.

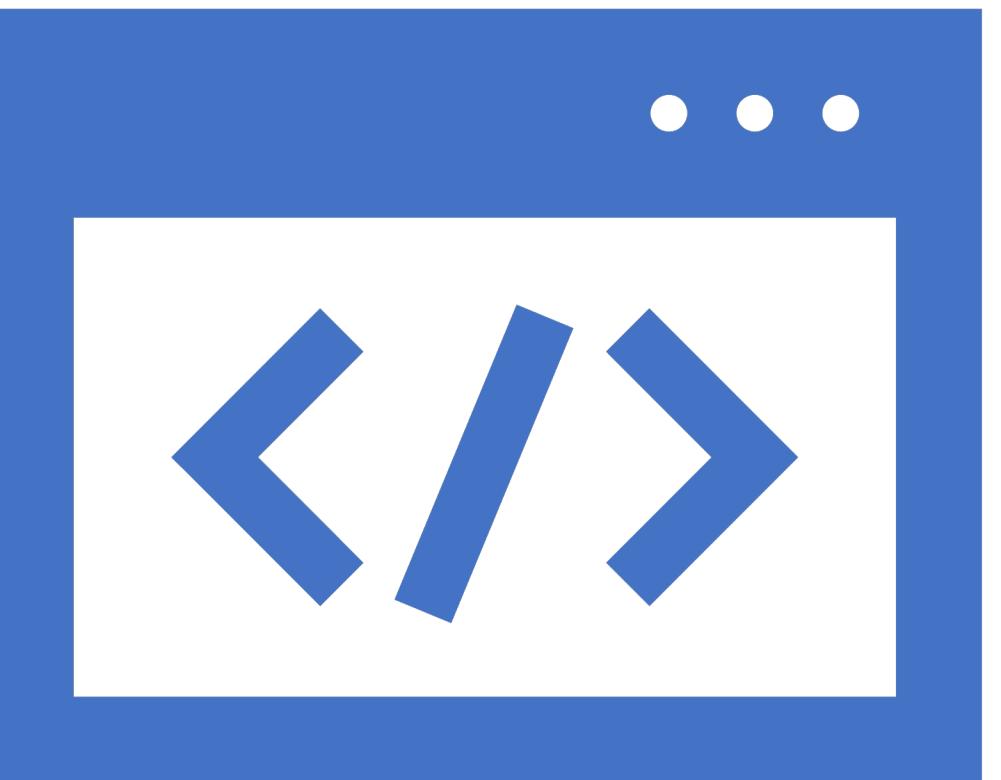
# XML

- Used to define some of the resources
  - Layouts (UI)
  - Strings
- Manifest file
- Preferred way of creating UIs
  - Separates the description of the layout from any actual code that controls it
  - Can easily take a UI from one platform to another



# XML

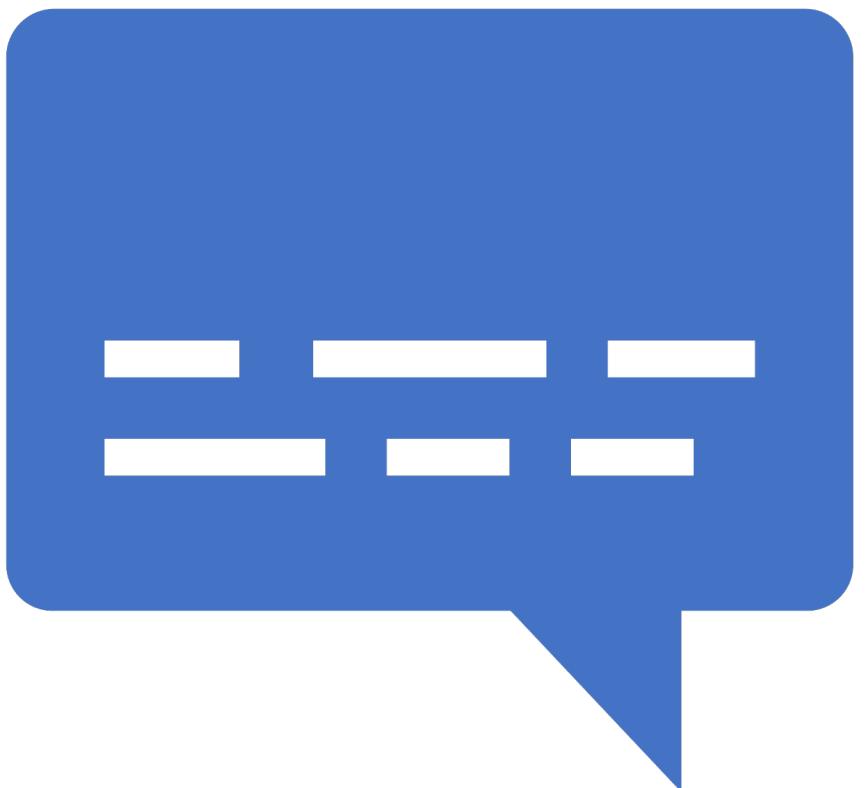
- XML is a meta markup language for text documents / textual data;
- XML allows to define languages ("applications") to represent text documents / textual data



# XML

```
<article>
<author>Gerhard Weikum</author>
  <title>The Web in 10 Years</title>
</article>
```

- Easy to understand for human users
- Very expressive (semantics along with the data)
- Well structured, easy to read and write from programs



# Advantages of XML

- Truly Portable Data
- Easily readable by human users
- Very expressive (semantics near data)
- Very flexible and customizable (no finite tag set)
- Easy to use from programs (libs available)
- Easy to convert into other representations (XML transformation languages)
- Many additional standards and tools
- Widely used and supported

# A Simple XML Document

```
<article>
  <author>Gerhard Weikum</author>
  <title>The Web in Ten Years</title>
  <text>
    <abstract>In order to evolve...</abstract>
    <section number="1" title="Introduction">
      The <index>Web</index> provides the universal...
    </section>
  </text>
</article>
```

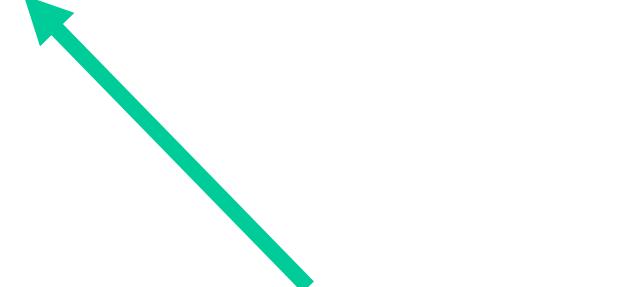
## A Simple XML Document

```
<article>
  <author>Gerhard Weikum</author>
  <title>The Web in Ten Years</title>
  <text>
    <abstract>In order to
evolve...</abstract>
    <section number="1" title="Introduction">
      The <index>Web</index> provides the
universal...
    </section>
  </text>
</article>
```

tags

# A Simple XML Document

```
<article>
  <author>Gerhard Weikum</author>
  <title>The Web in Ten Years</title>
  <text>
    <abstract>In order to evolve...</abstract>
    <section number="1" title="Introduction">
      The <index>Web</index> provides the universal...
    </section>
  </text>
</article>
```



Element

# A Simple XML Document

Start Tag

```
<article>
  <author>Gerhard Weikum</author>
  <title>The Web in Ten Years</title>
  <text>
    <abstract>In order to evolve...</abstract>
    <section number="1" title="Introduction">
      The <index>Web</index> provides the universal...
    </section>
  </text>
</article>
```

End Tag

Element

# A Simple XML Document

Start Tag

```
<article>
  <author>Gerhard Weikum</author>
  <title>The Web in Ten Years</title>
  <text>
    <abstract>In order to evolve...</abstract>
    <section number="1" title="Introduction">
      The <index>Web</index> provides the universal...
    </section>
  </text>
</article>
```

End Tag

Element

Content of the  
Element  
(Subelements  
and/or Text)

# A Simple XML Document

Start Tag

```
<article>
  <author>Gerhard Weikum</author>
  <title>The Web in Ten Years</title>
  <text>
    <abstract>In order to evolve...</abstract>
    <section number="1" title="Introduction">
      The <index>web</index> provides the universal...
    </section>
  </text>
</article>
```

Attributes with  
name and value

End Tag

Element

Content of the  
Element  
(Subelements  
and/or Text)

# Elements in XML Documents

- (Freely definable) **tags**: **article**, **title**, **author**
  - with start tag: **<article>** etc.
  - and end tag: **</article>** etc.
- **Elements**: **<article>** ... **</article>**
- Elements have a **name (article)** and a **content (...)**
- Elements may be nested.
- Elements may be empty: **<this\_is\_empty/>**  
**<br/>**
- Each XML document has exactly one root element and forms a tree.

# Elements vs. Attributes

- Elements may have **attributes** (in the start tag) that have a **name** and a **value**, e.g. `<section number="1">`.
- What is the difference between elements and attributes?
- Only one attribute with a given name per element (but an arbitrary number of subelements)
- Attributes have no structure, simply strings (while elements can have subelements)
- Example: `<person born="1912-06-23" died="1954-06-07">Alan Turing</person>`

# A Simple XML Document

```
<article>
  <author>Gerhard Weikum</author>
  <title>The Web in Ten Years</title>
  <text>
    <abstract>In order to evolve...</abstract>
    <section number="1" title="Introduction">
      The <index>Web</index> provides the universal...
    </section>
  </text>
</article>
```



<https://www.youtube.com/watch?v=c8VF3nb8Z4M>

# Mobile world

- Mobile Market
- Android x iOS



Moto Q

BlackBerry

Palm Treo

Nokia E62



Works like magic

No stylus

Far more accurate

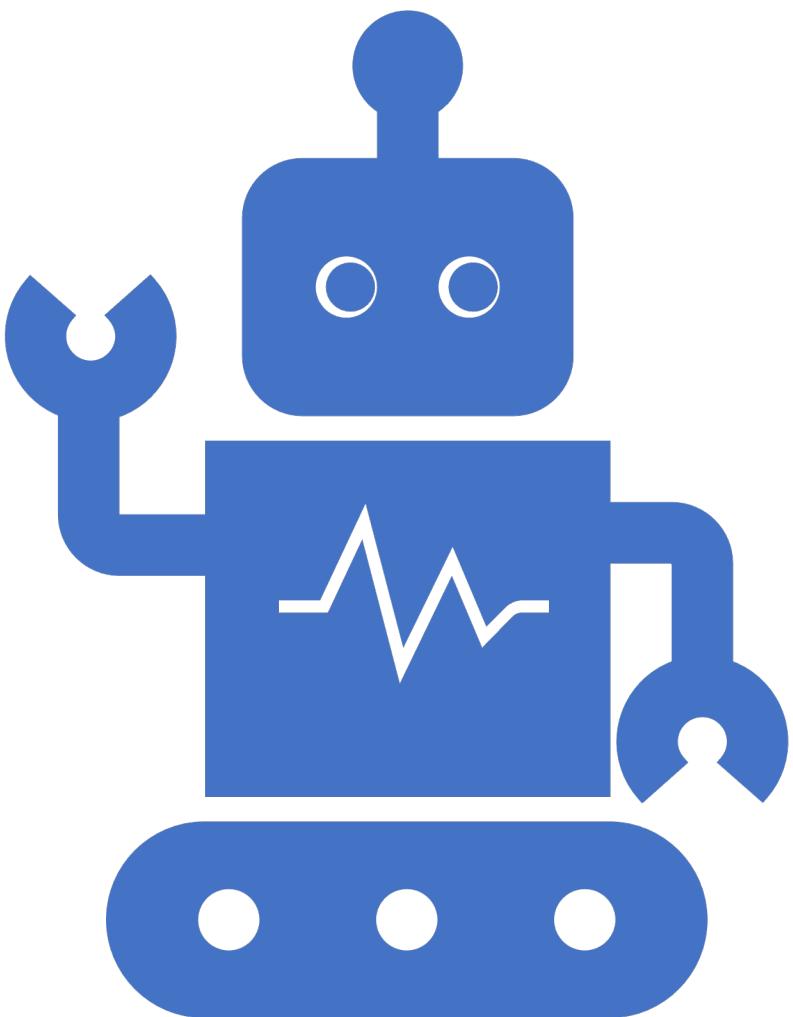
Ignores unintended touches

Multi-finger gestures

Patented !

# Introduction to Android

- “Android is a software stack for mobile devices that includes an operating system, middleware and key applications.”
- “The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language.”
- Stated goal: "accelerate innovation in mobile and offer consumers a richer, less expensive, and better mobile experience."





*Our goal is not just a single device. Our vision is a mobile platform that runs on many many different devices.*

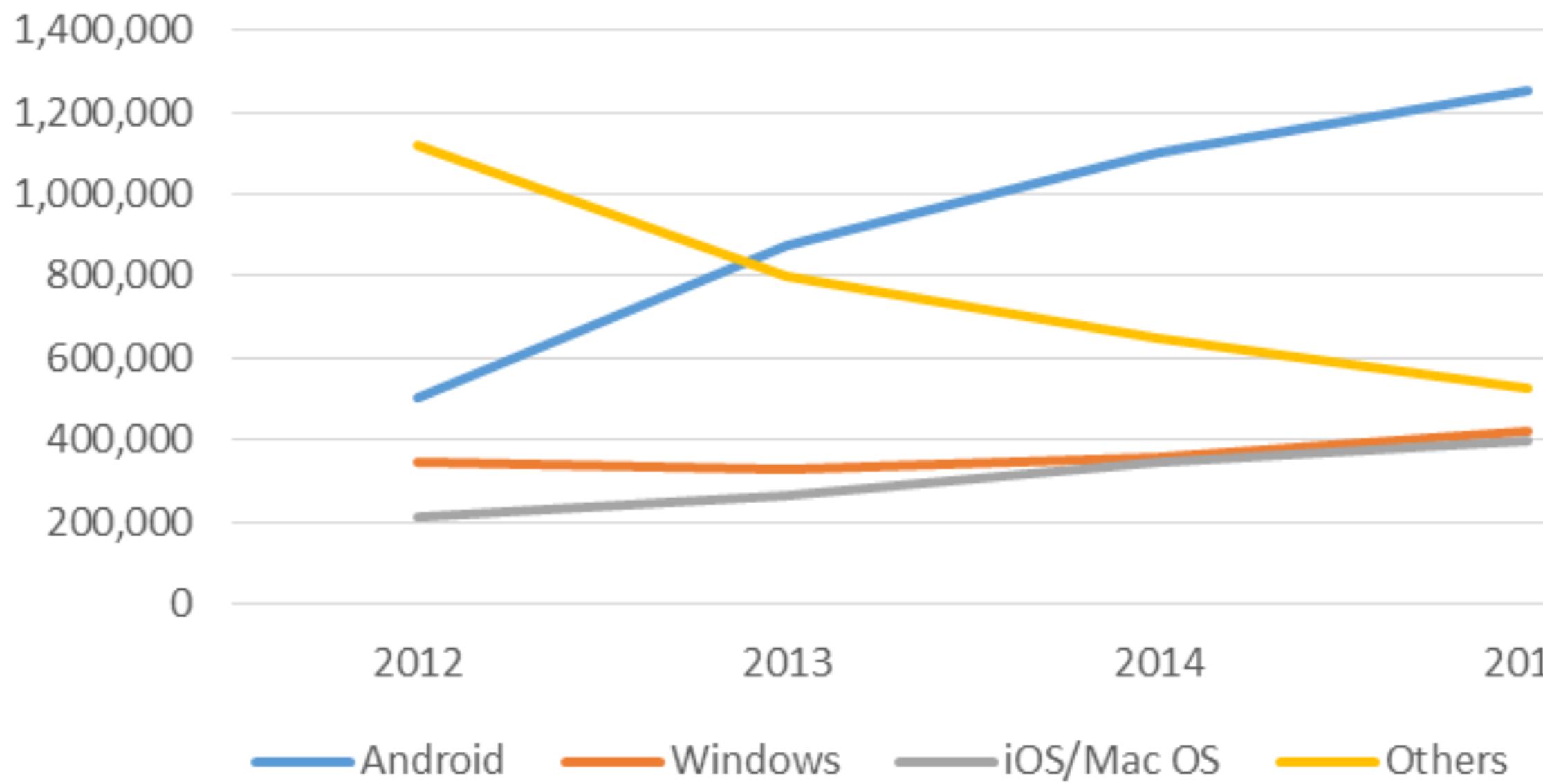
– Eric Schmidt

Vision (2011)

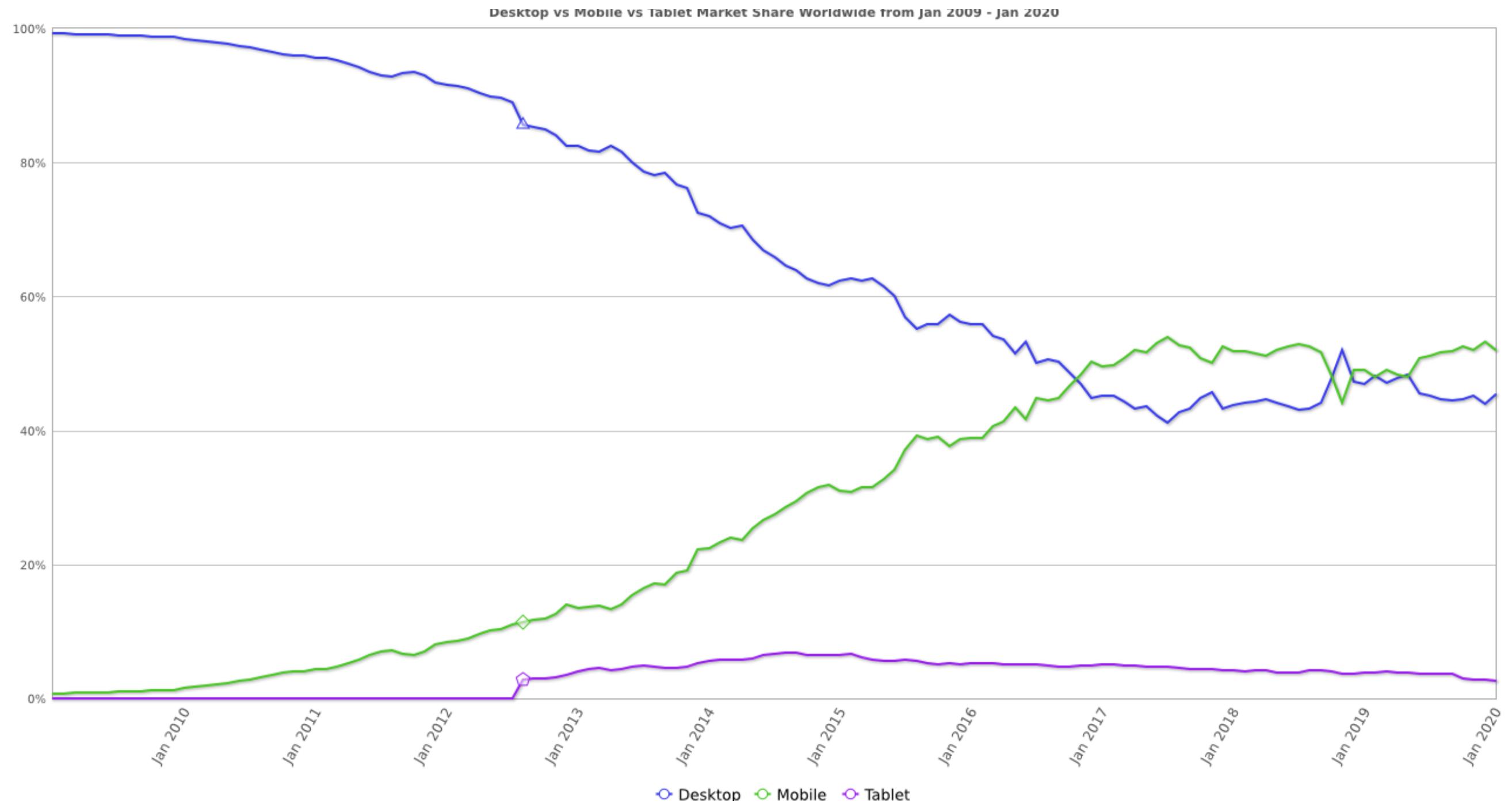
# Top Five Smartphone Operating Systems, Worldwide Shipments, and Market Share, 2014Q2 (Units in Millions)

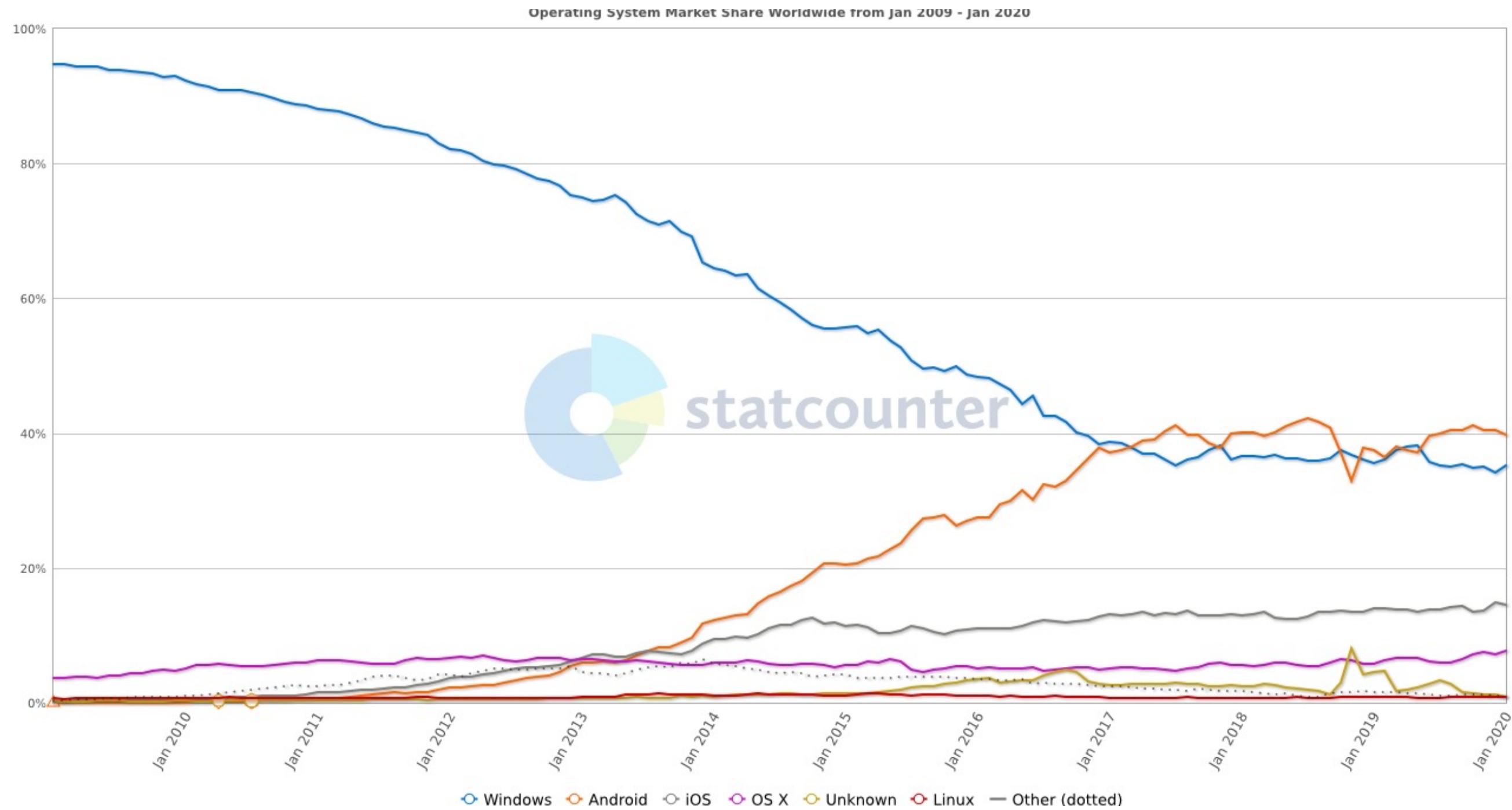
Operating System	2Q14 Shipment Volume	2Q14 Market Share	2Q13 Shipment Volume	2Q13 Market Share	2Q14/2Q13 Growth
Android	255.3	84.7%	191.5	79.6%	33.3%
iOS	35.2	11.7%	31.2	13.0%	12.7%
Windows	7.4	2.5%	8.2	3.4%	-9.4%
BlackBerry	1.5	0.5%	6.7	2.8%	-78.0%
Others	1.9	0.6%	2.9	1.2%	-32.2%
Total	301.3	100%	240.5	100%	25.3%

## Worldwide Device Shipments by Operating System (Thousands of Units)



Android vs.

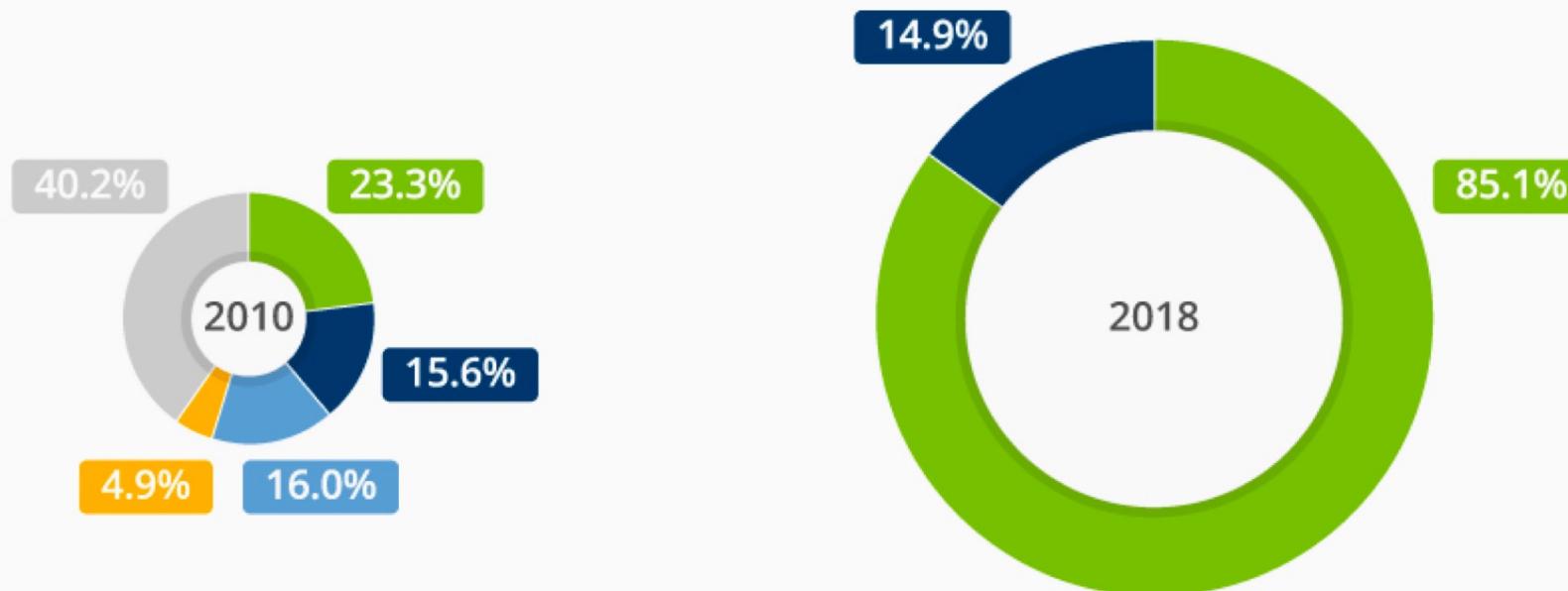




## The Smartphone Duopoly

Worldwide smartphone market share by operating system (based on unit shipments)

● Android   ● iOS   ● BlackBerry   ● Windows Phone   ● Others



Total sales

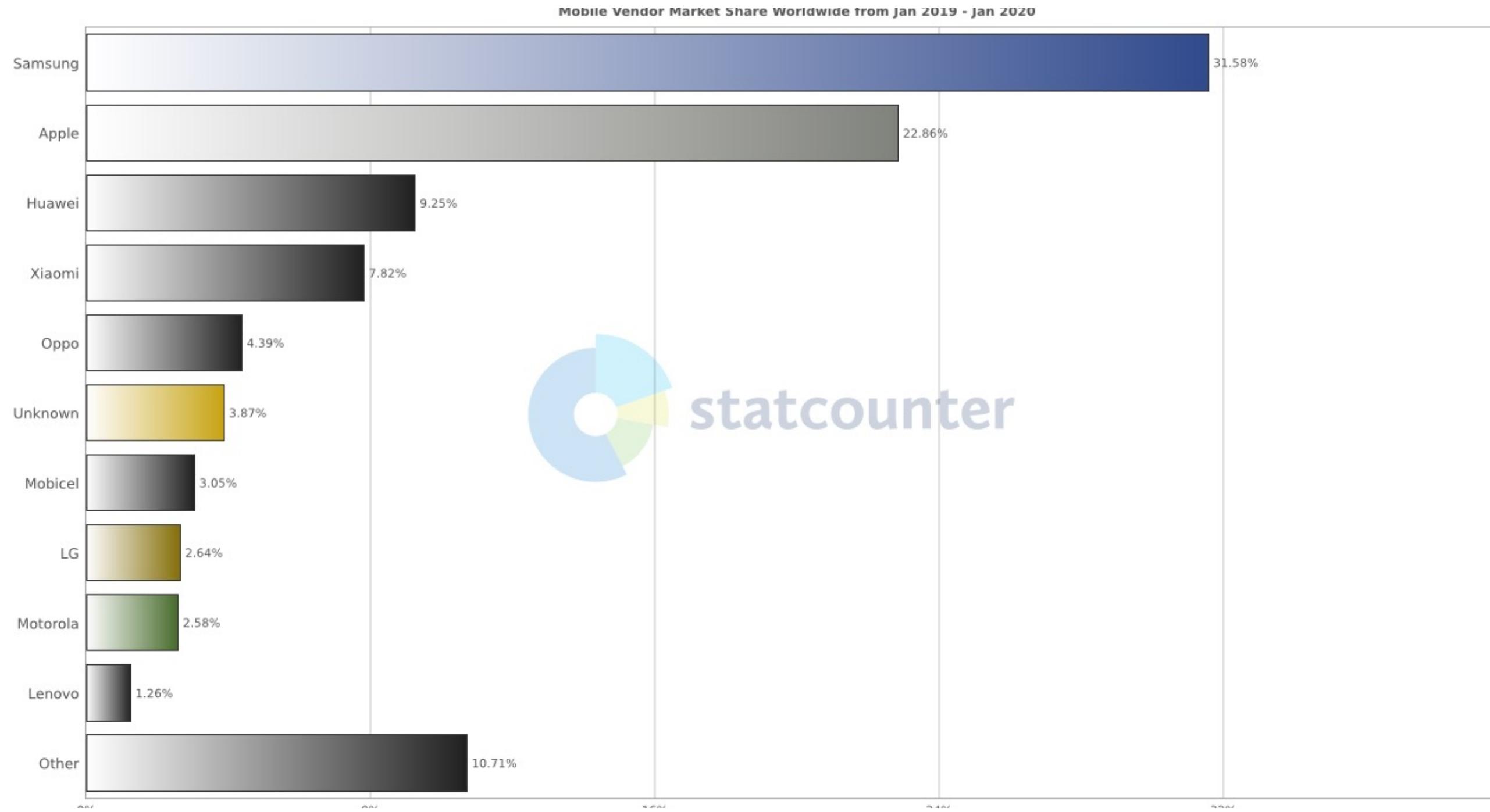
305m

1,405m

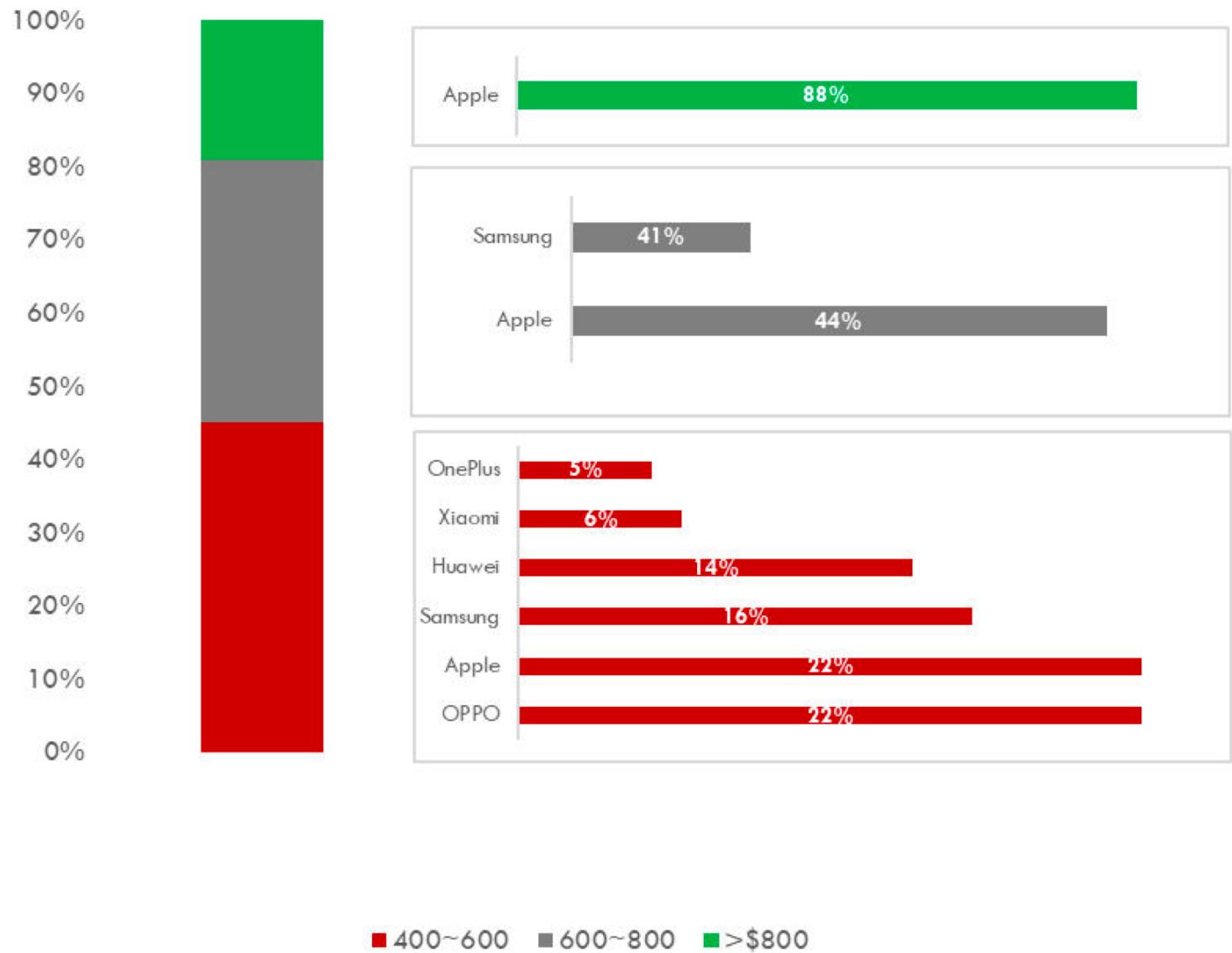


@StatistaCharts Source: IDC

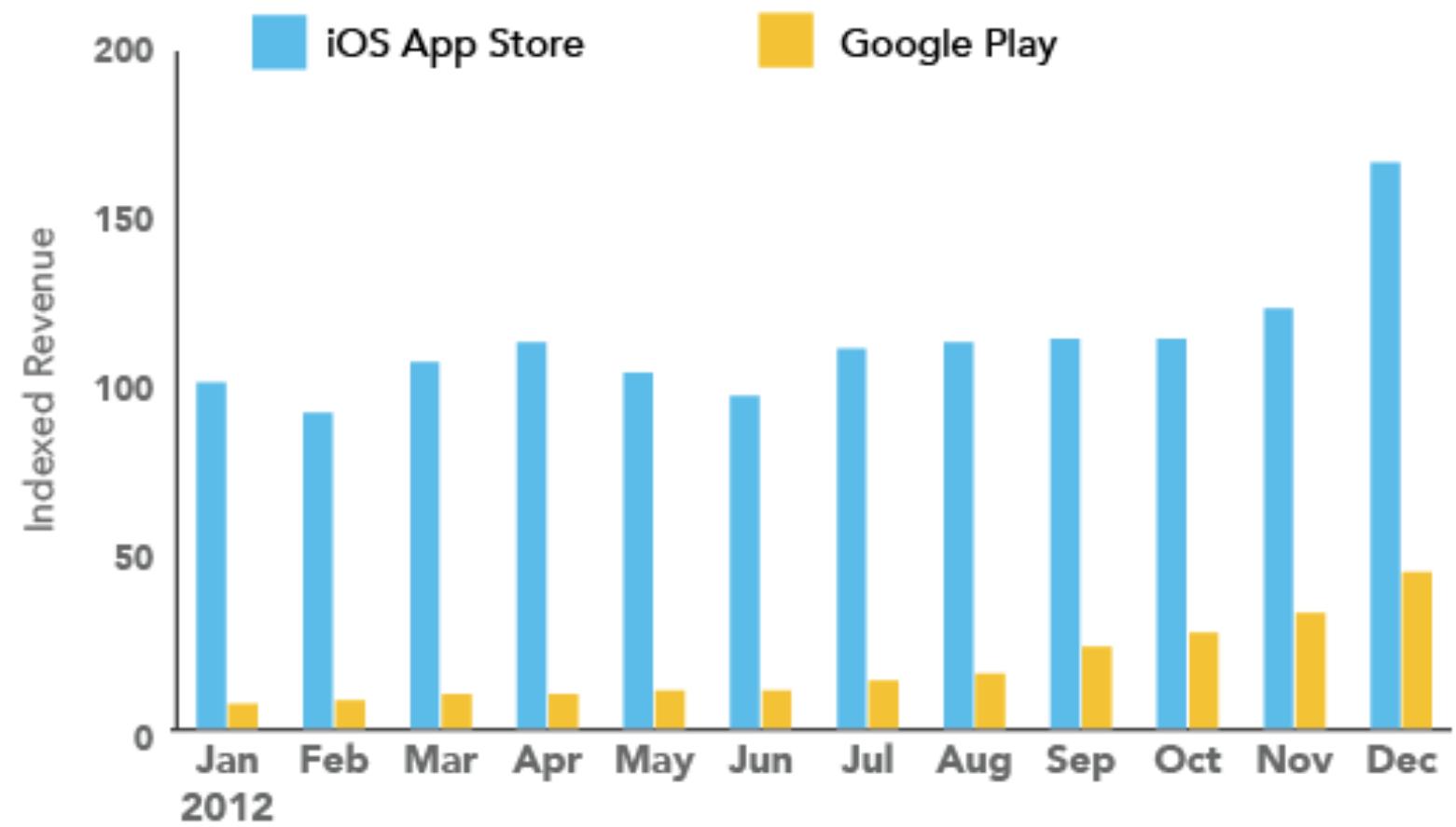
statista



### Premium Smartphone Segment Price Tier Split and OEM Share



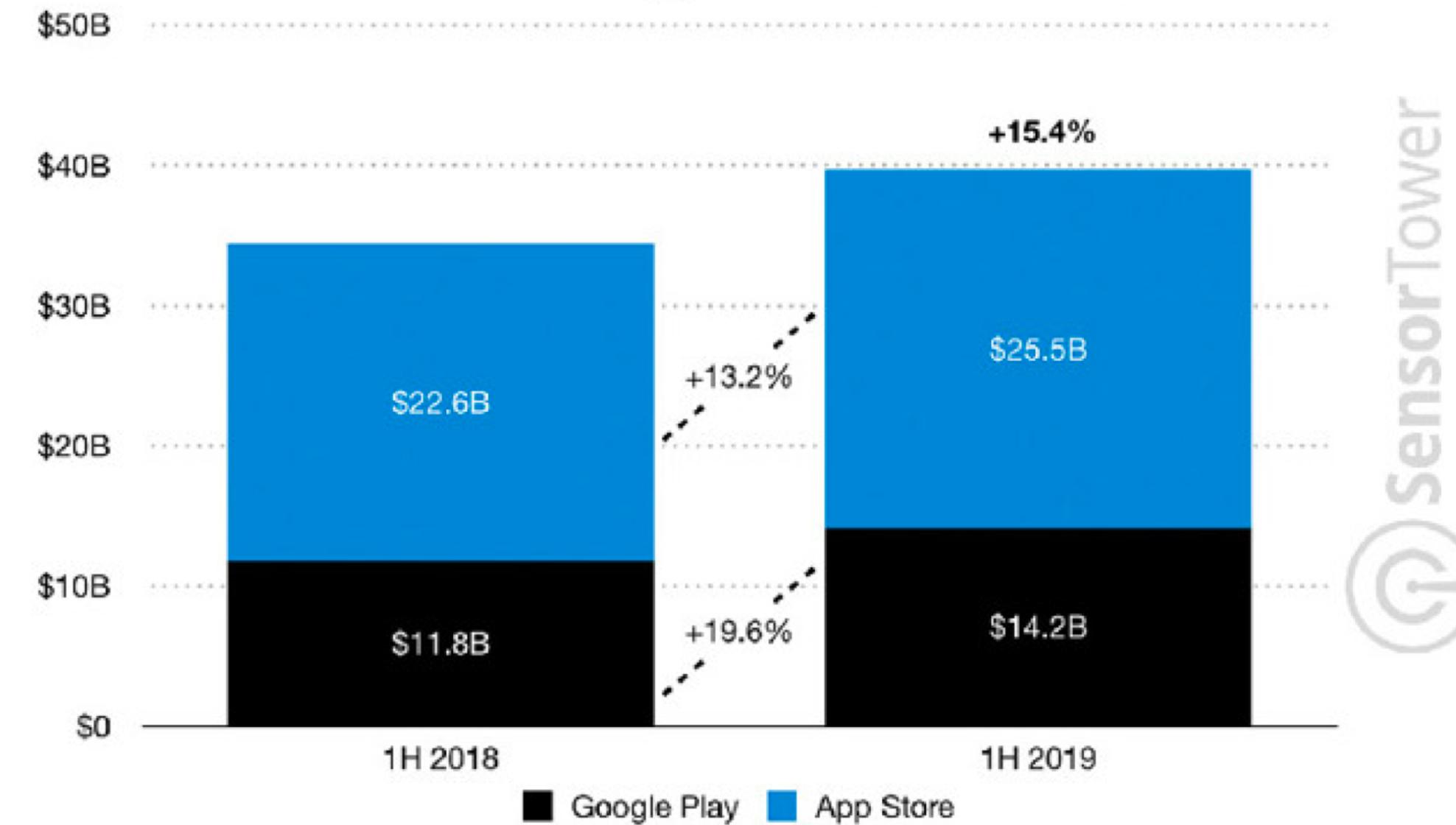
## iOS App Store vs Google Play Revenue



App Annie

SOURCE: App Annie Intelligence  
iOS App Store January 2012 Revenue Index set to 100

## Worldwide Gross App Revenue - First Half 2019



SensorTower



SensorTower Data That Drives App Growth

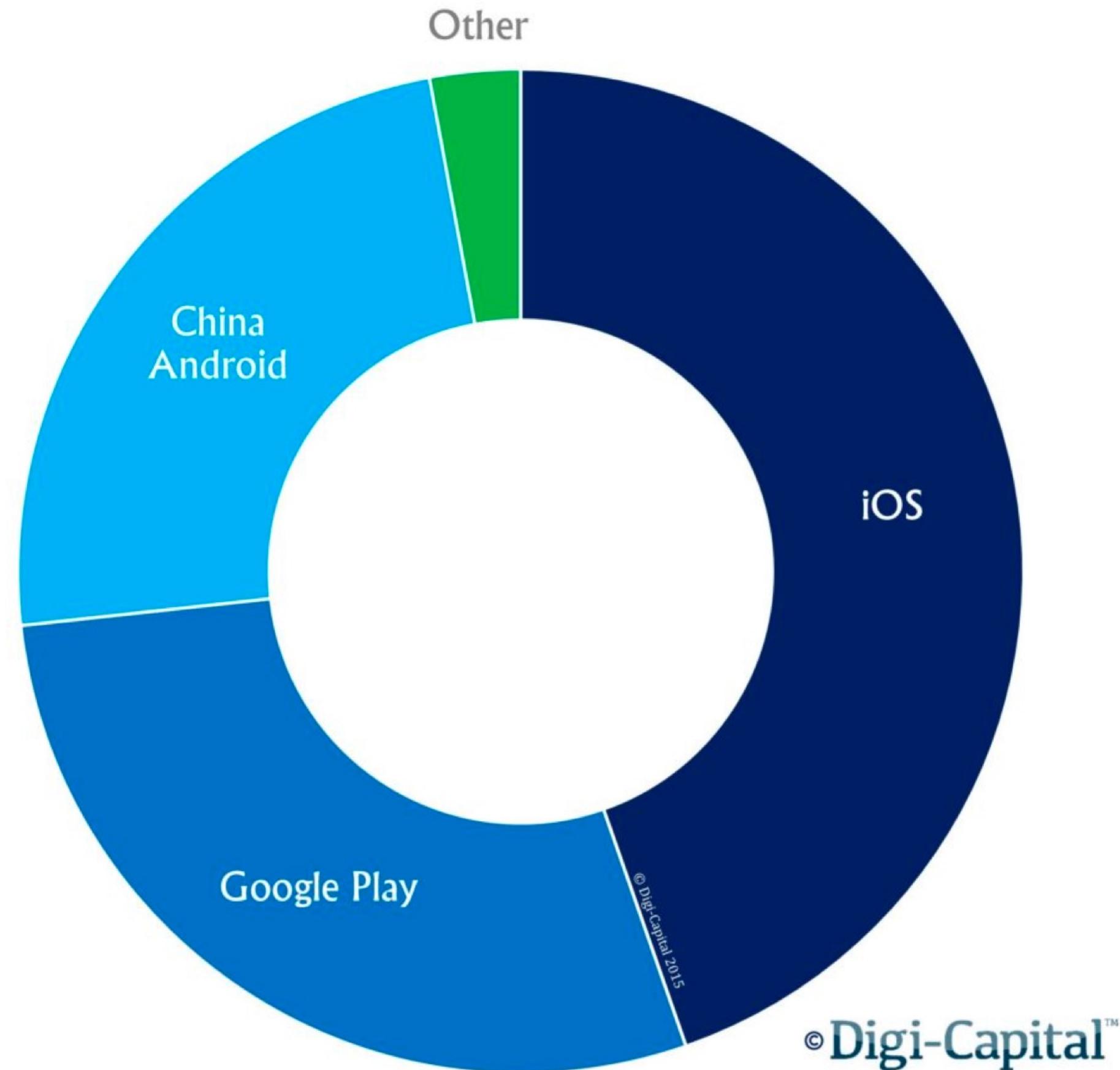
[sensortower.com](https://sensortower.com)

## Worldwide App Downloads and Revenue by Store

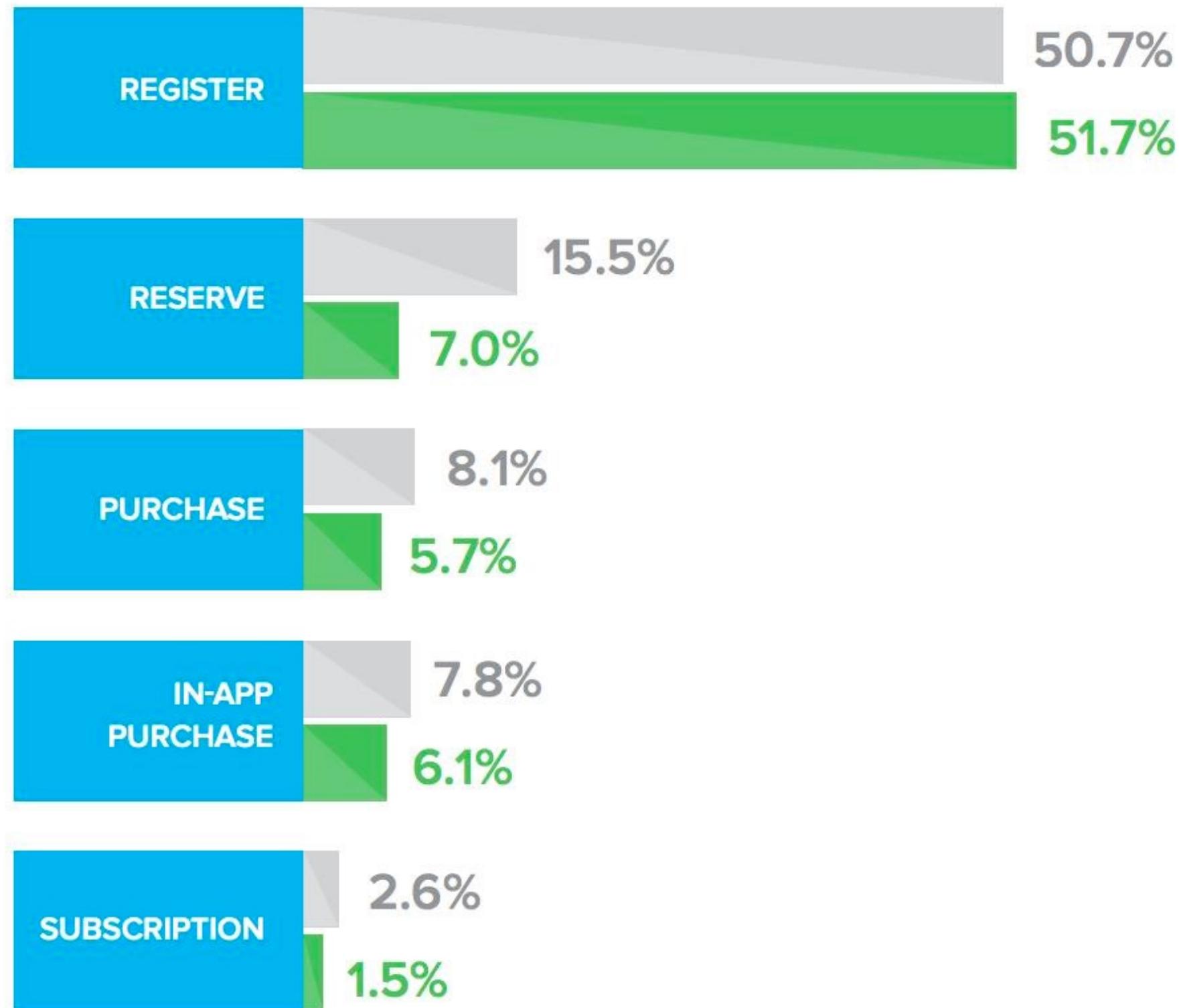


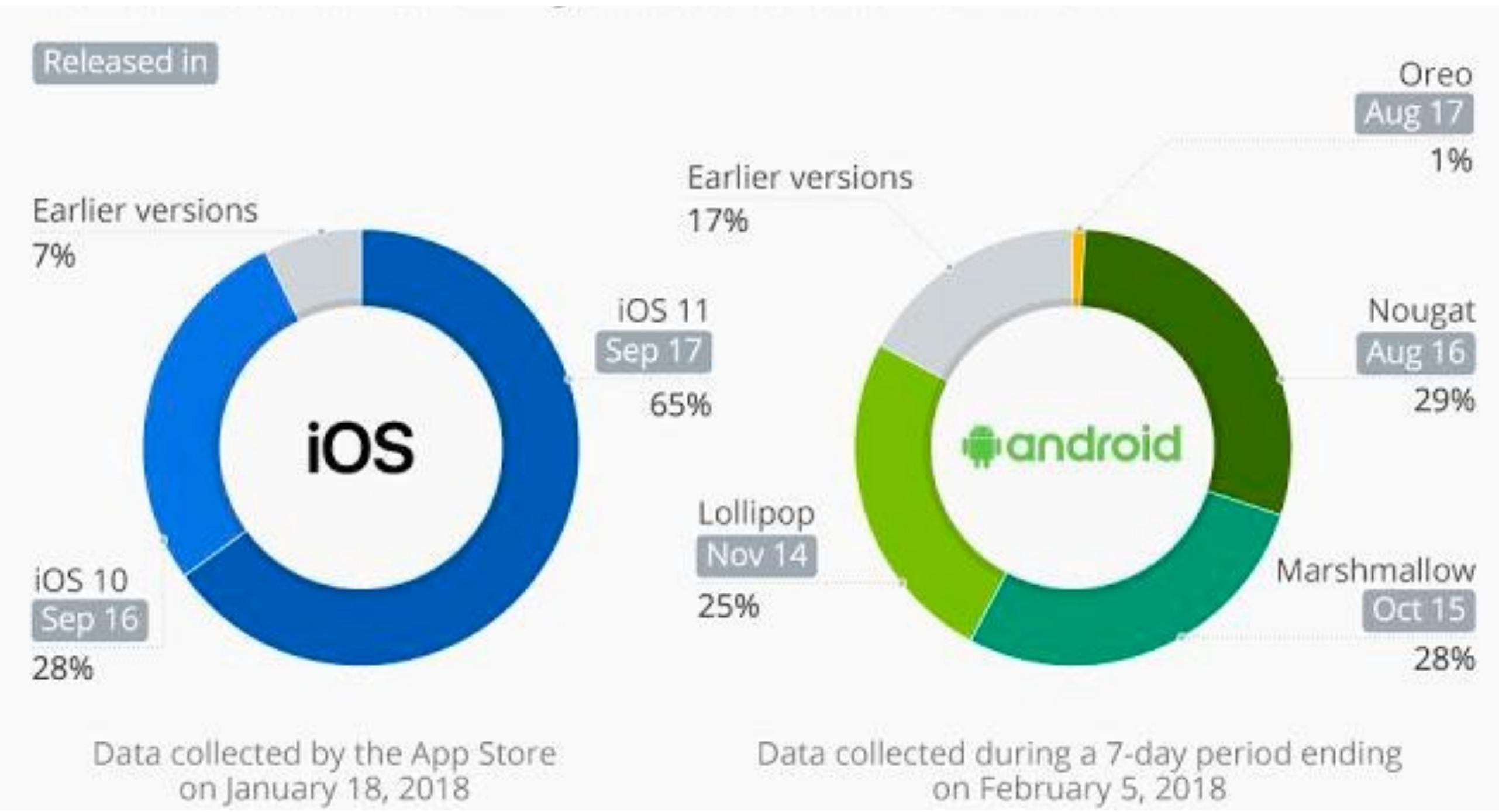
Compared to Q1 2016, the downloads gap remained the same, but iOS extended its lead over Google Play in revenue by 10 percentage points.

# Global app stores revenue value share 2014



POST-INSTALL ACTIVITY ENGAGEMENT RATES





## Android: Pros and Cons

- Many different Android devices, more being developed all the time;
- Backed by Google, one of the world's biggest and most powerful IT companies;
- Google is deliberately “disruptive”;
- Free development environment for low cost of entry;
- Free OS for hardware developers;



# Android: Pros and Cons

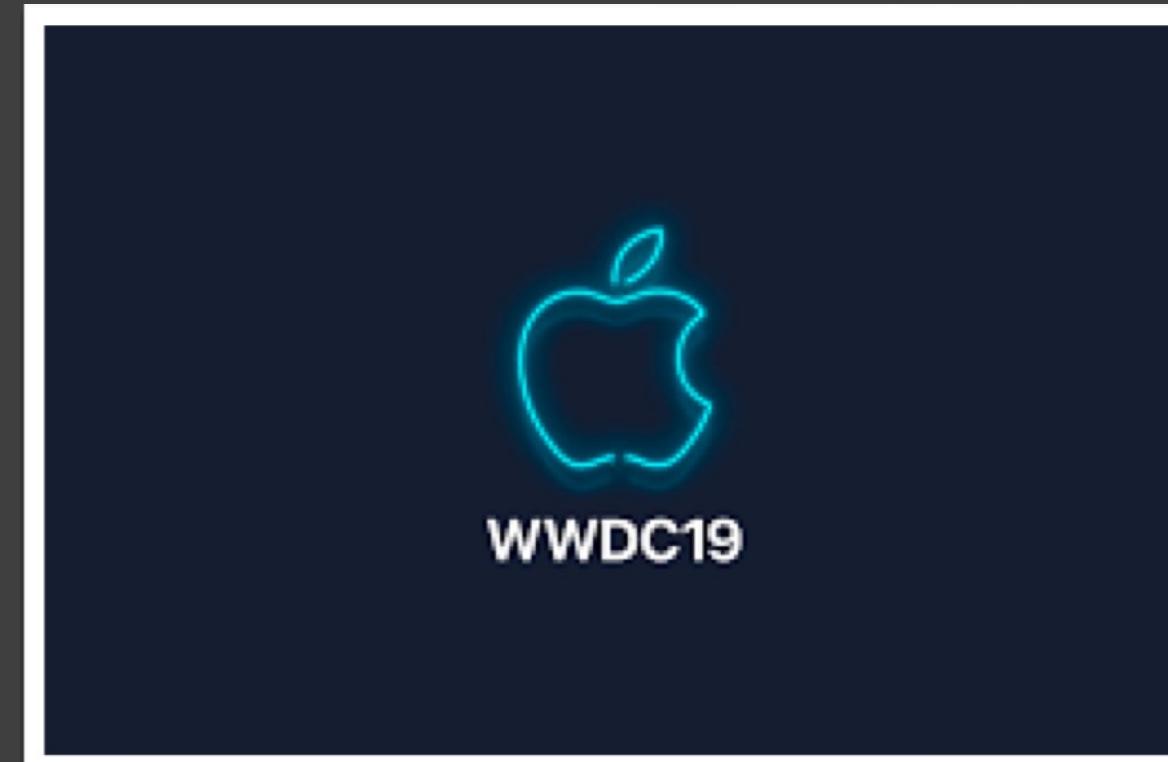
- Although Android can be used on many types of devices, they are not always supported by Google;
- Devices must support quite a rich mix of capabilities in order to be certified as Android compatible;
- Only “compatible” devices have access\* to Google Play (the Android Market);

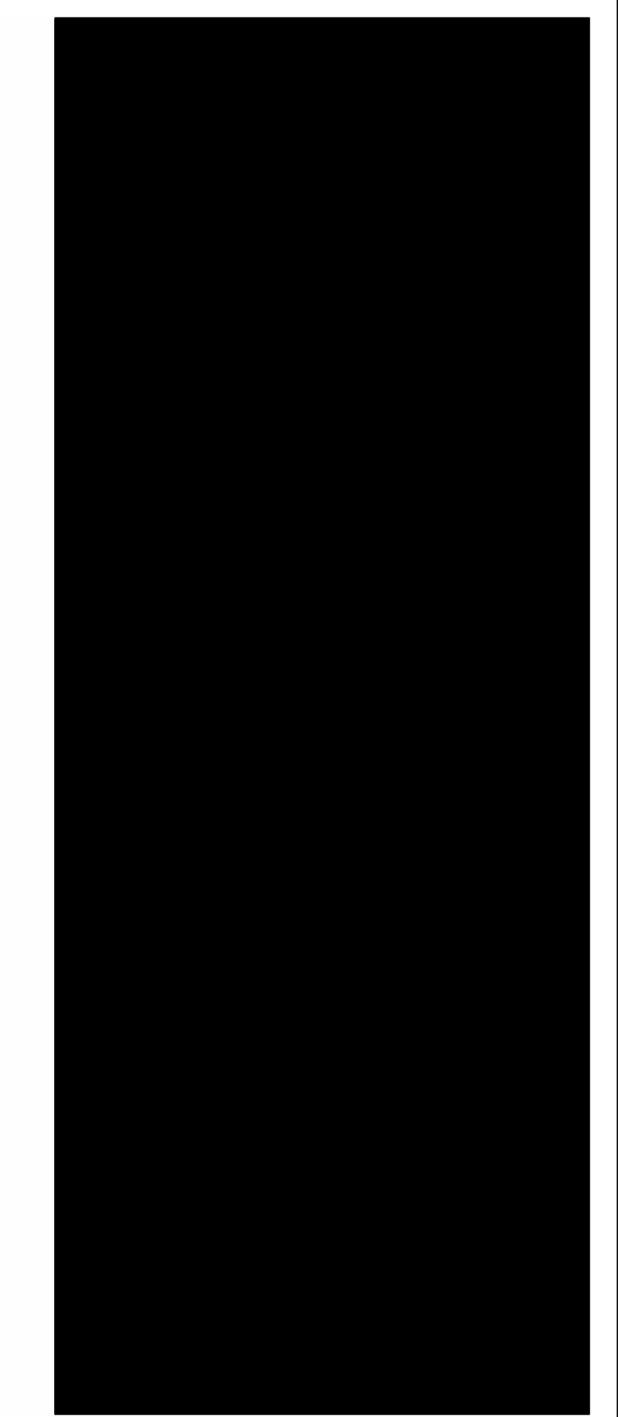
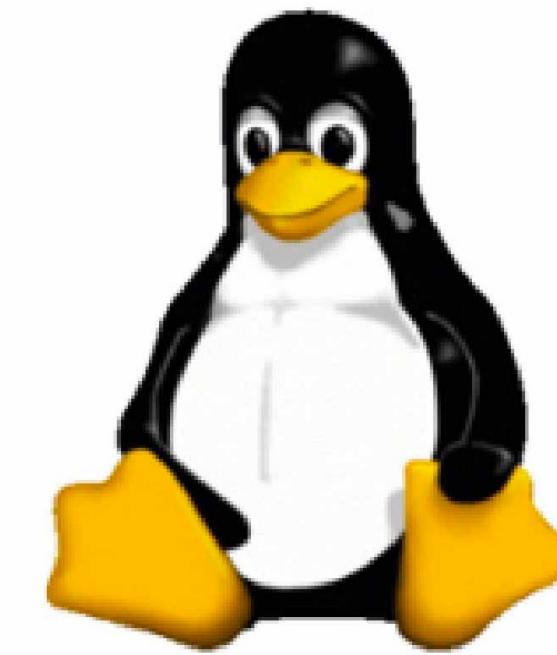
# Android: Why develop?

- Google Play Apps is open to all applications
  - No screening except for illegal or malware content
  - No controls on applications which compete with Google
  - Android explicitly allows new components to replace old ones, even at the OS level
- The downside is that some apps are very poor quality, check user feedback scores
- But Google is implementing a review process for publication on the store.

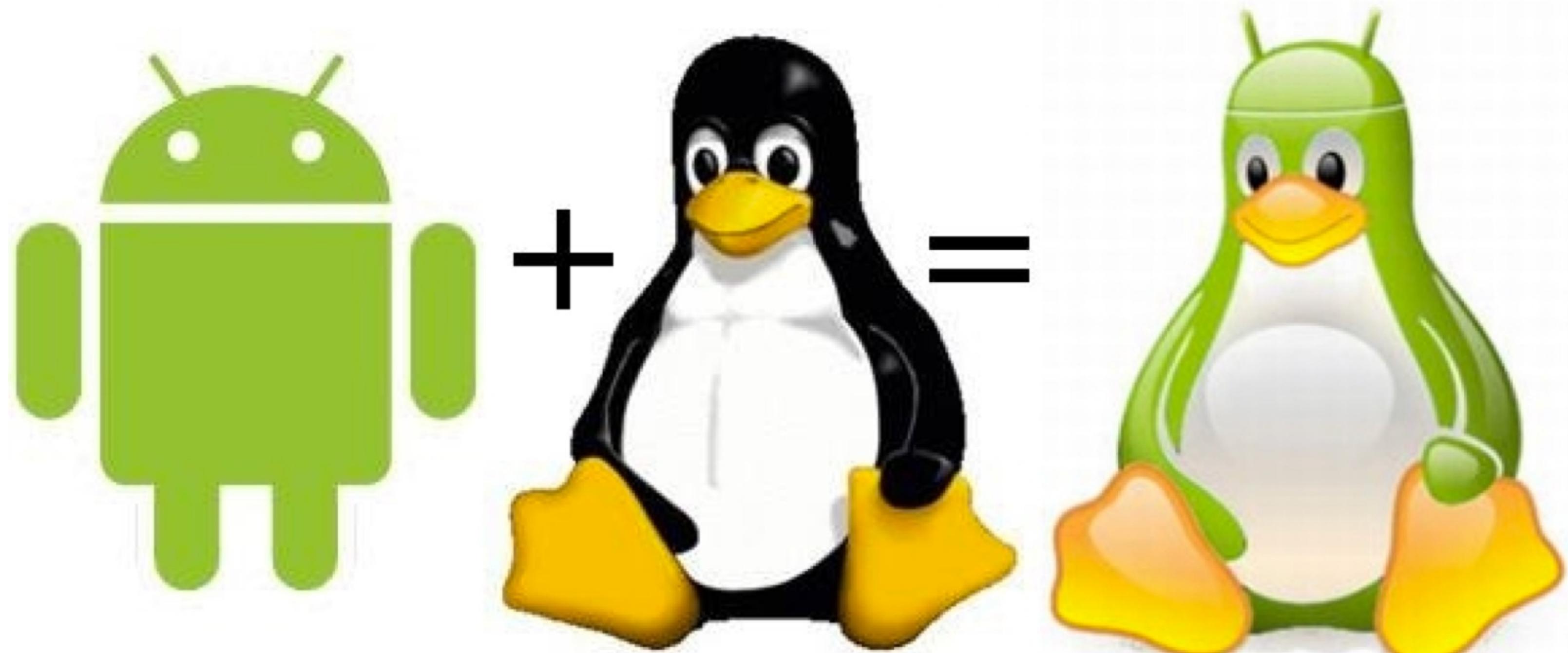
## Android: Success

- Android is tightly regulated by Google at the hardware level
- But Android is an open system for developers
- The success of Android has surprised many
- Much of the success may be down to:
  - Apple's iPhone, opening a new market sector
  - Apple and its over-controlling nature and expensive price
  - Microsoft's inactivity and ball-dropping
  - Google's aggressive development





Architectures



# Android: Programming Model

- Android is built on:
  - Linux kernel
  - The Dalvik Runtime (Java SE compatible) or the Android runtime (ART) on Lollipop
  - The Android APIs
  - A minimum-spec hardware platform
- Android software is:
  - Multi-threaded
  - Interruptible
  - Written in standard Java/Kotlin

# Pre-requisites for development

- Need a java JDK (Java SDK (7):  
[www.oracle.com/technetwork/java/javase/downloads/index.html](http://www.oracle.com/technetwork/java/javase/downloads/index.html) )
  - Contains all the java commands, compiler, and more
- Need the Android SDK
  - Unique java functionality for mobile apps
- Android Studio  
([developer.android.com/sdk/installing/studio.html](http://developer.android.com/sdk/installing/studio.html))
  - Ide for development



Android Garden

## ANDROID VERSIONS LIST: A COMPLETE HISTORY & FEATURES



Cupcake  
1.5



Donut  
1.6



Eclair  
2.0/2.1



Froyo  
2.2



Gingerbread  
2.3



Honeycomb  
3.0/3.1



Ice Cream Sandwich  
4.0



Jelly Bean  
4.1/4.2/4.3



KitKat  
4.4



Lollipop  
5.0



Marshmallow  
6.0



Nougat  
7.0



Oreo  
8.0



Pie  
9.0

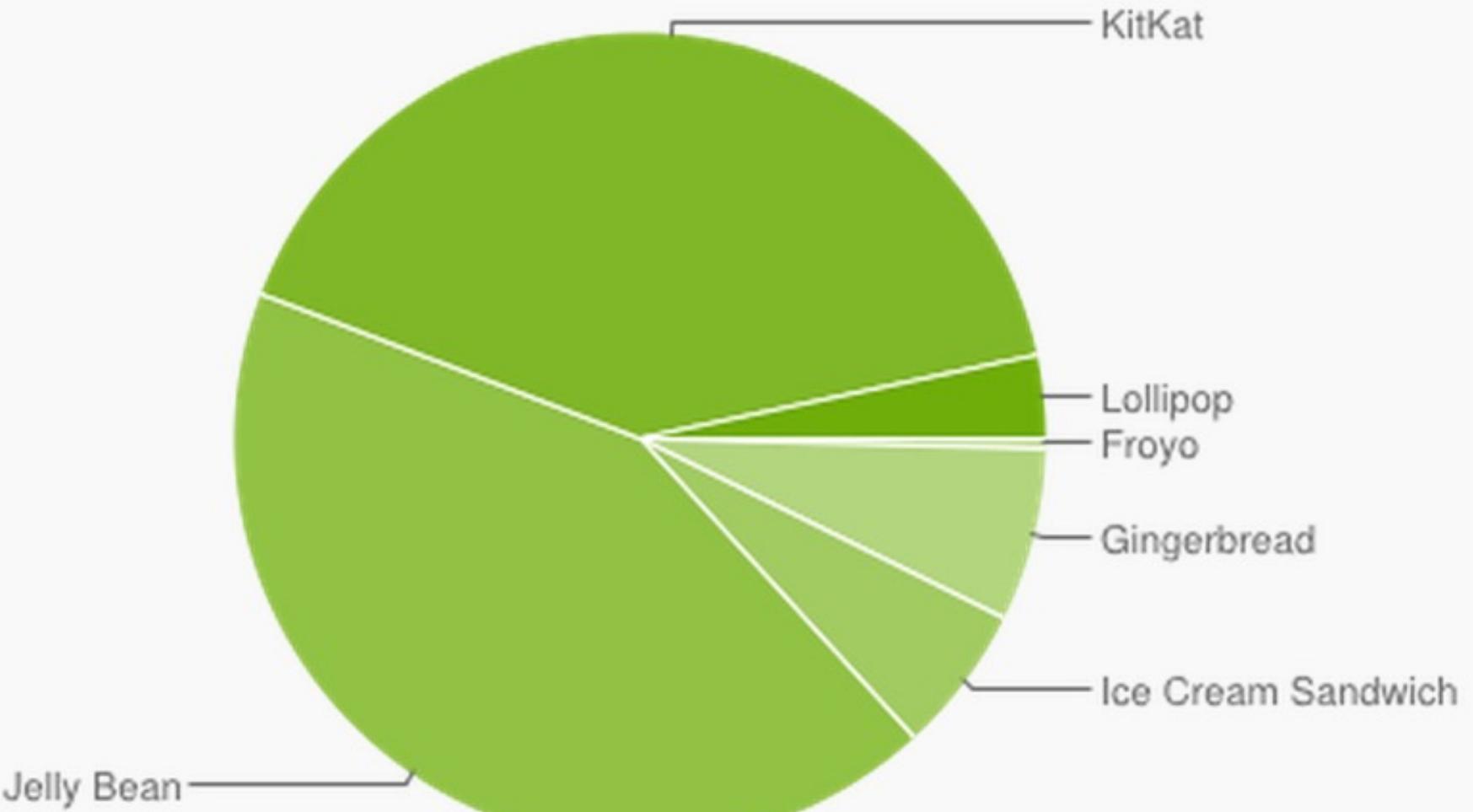


10



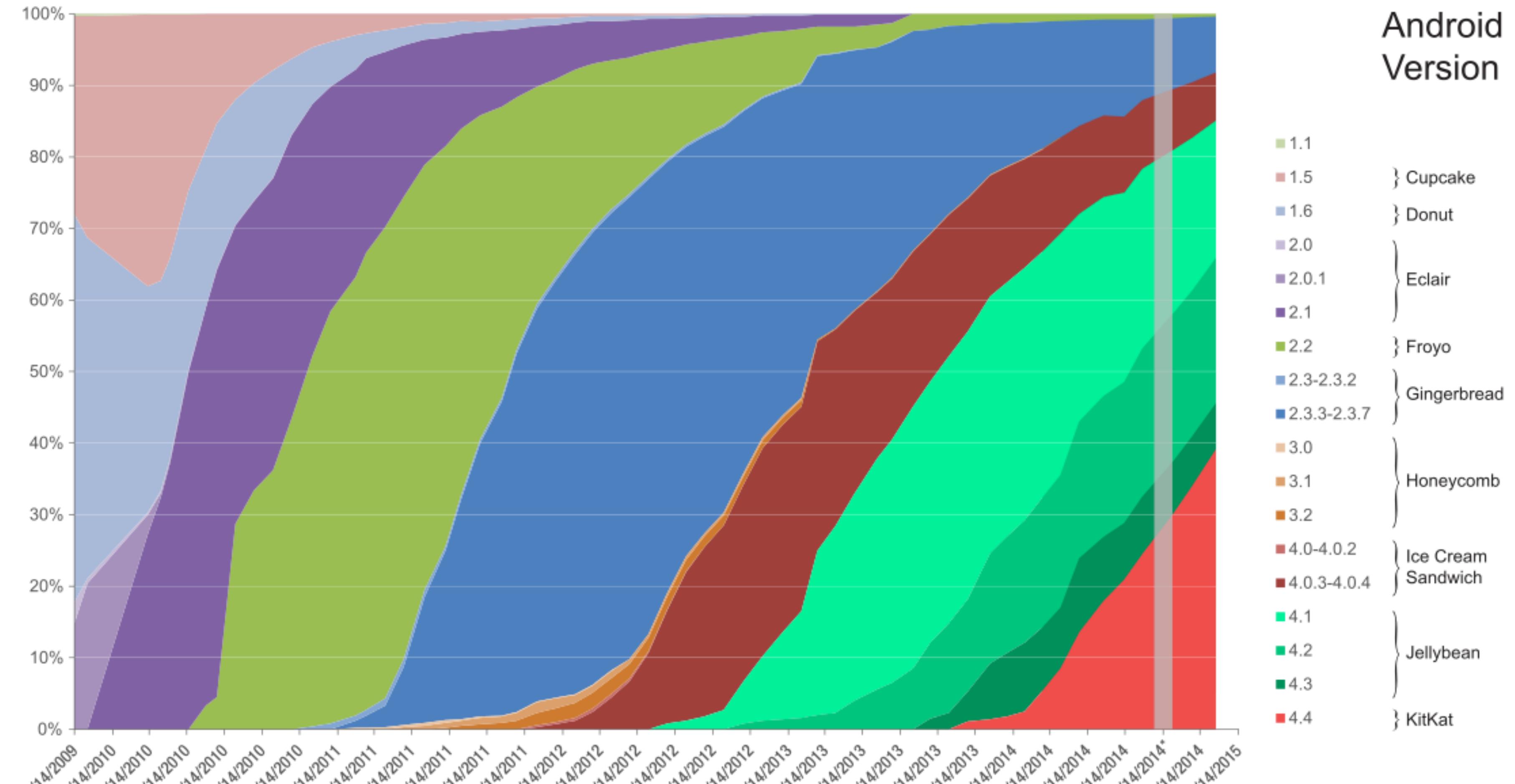
android

Version	Codename	API	Distribution
2.2	Froyo	8	0.4%
2.3.3 - 2.3.7	Gingerbread	10	6.9%
4.0.3 - 4.0.4	Ice Cream Sandwich	15	5.9%
4.1.x	Jelly Bean	16	17.3%
4.2.x		17	19.4%
4.3		18	5.9%
4.4	KitKat	19	40.9%
5.0	Lollipop	21	3.3%



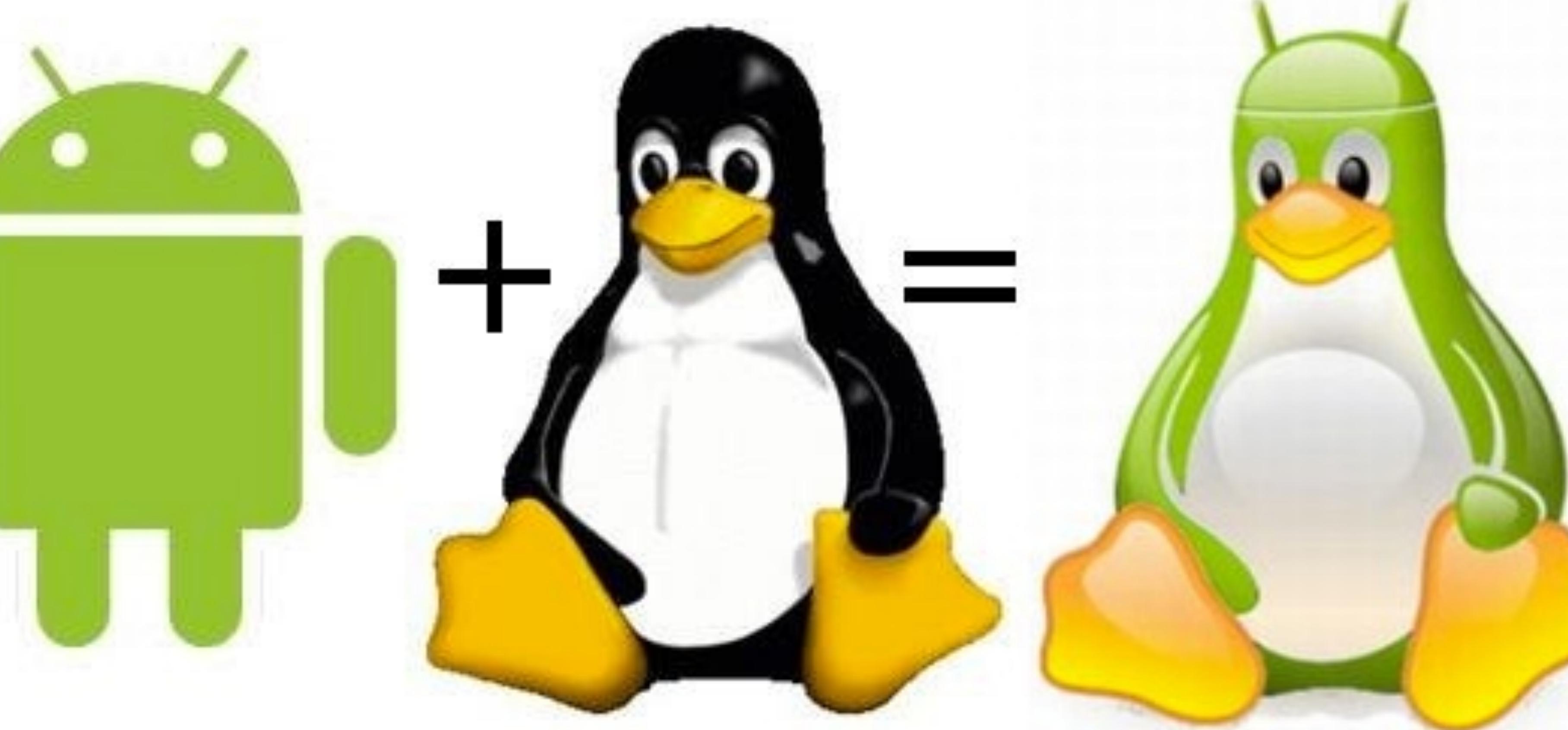
*Data collected during a 7-day period ending on March 2, 2015.  
Any versions with less than 0.1% distribution are not shown.*

Using the compatibility (support) libraries, you can develop in 5.0 and min-build-

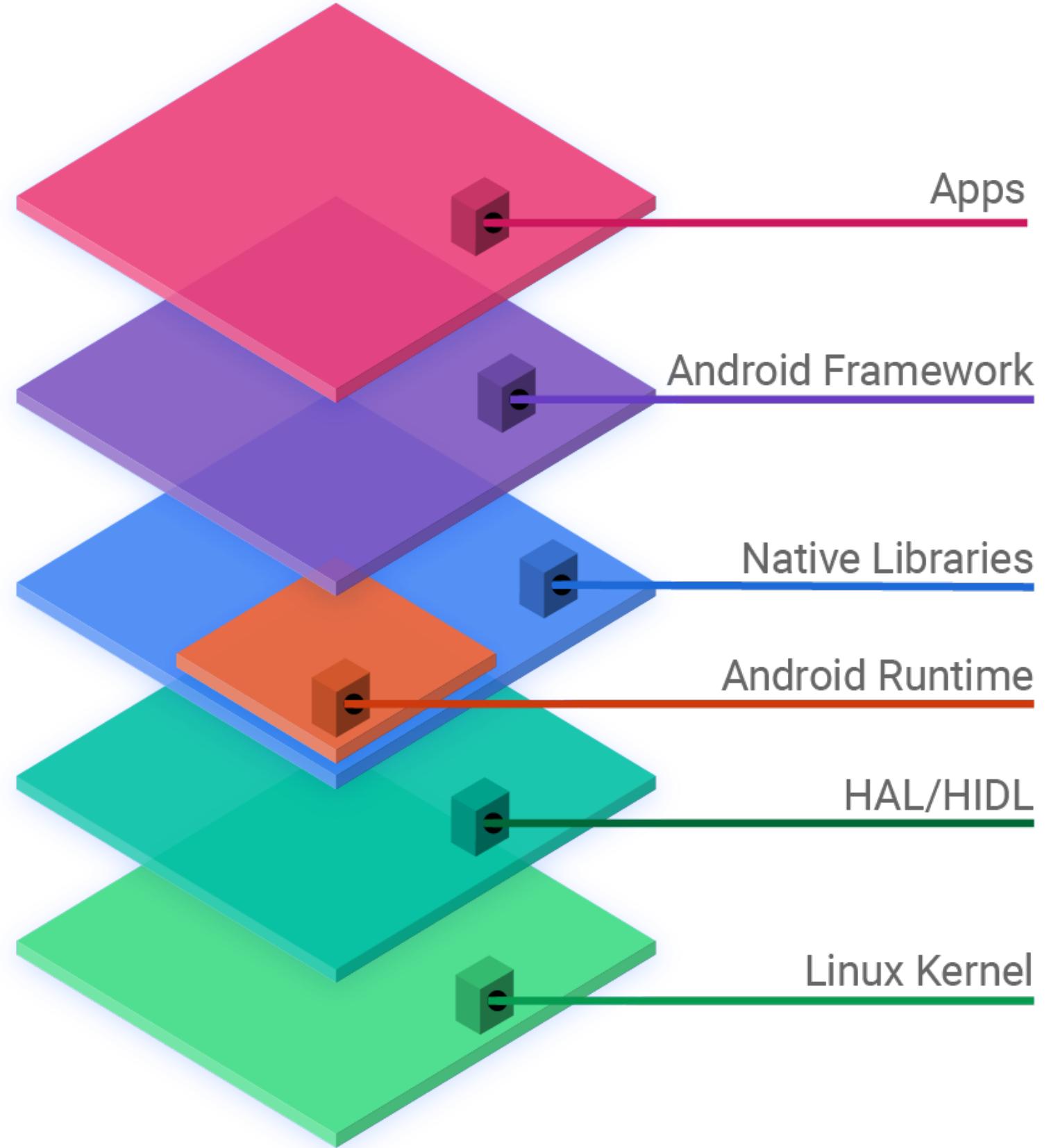


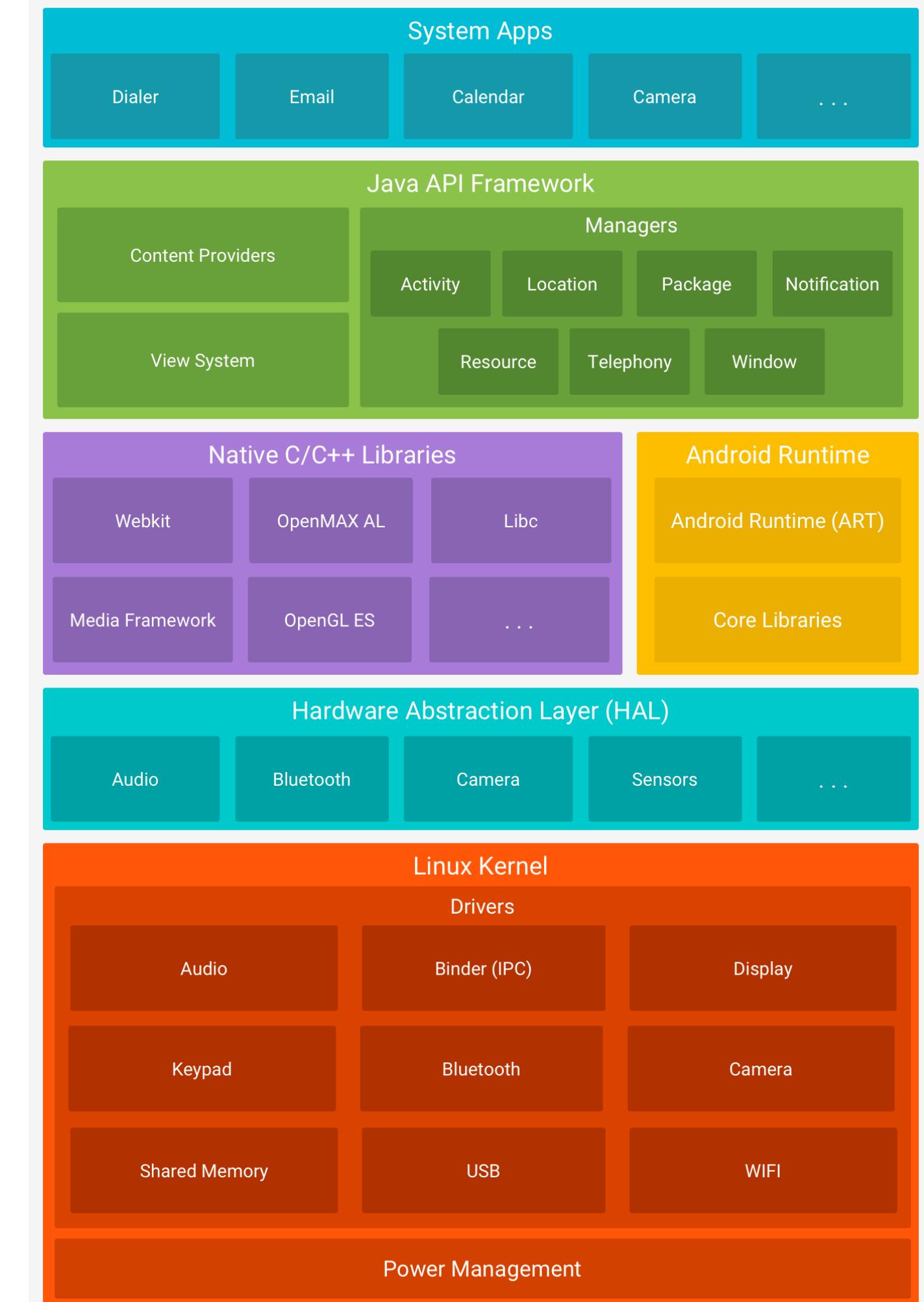
# Code/Version/API map

Code name	Version	API level
Lollipop	5.1	API level 22
Lollipop	5.0	API level 21
KitKat	4.4 - 4.4.4	API level 19
Jelly Bean	4.3.x	API level 18
Jelly Bean	4.2.x	API level 17
Jelly Bean	4.1.x	API level 16
Ice Cream Sandwich	4.0.3 - 4.0.4	API level 15, NDK 8
Ice Cream Sandwich	4.0.1 - 4.0.2	API level 14, NDK 7
Honeycomb	3.2.x	API level 13
Honeycomb	3.1	API level 12, NDK 6
Honeycomb	3.0	API level 11
Gingerbread	2.3.3 - 2.3.7	API level 10
Gingerbread	2.3 - 2.3.2	API level 9, NDK 5
Froyo	2.2.x	API level 8, NDK 4
Eclair	2.1	API level 7, NDK 3
Eclair	2.0.1	API level 6
Eclair	2.0	API level 5
Donut	1.6	API level 4, NDK 2
Cupcake	1.5	API level 3, NDK 1
(no code name)	1.1	API level 2
(no code name)	1.0	API level 1



# Android Architecture

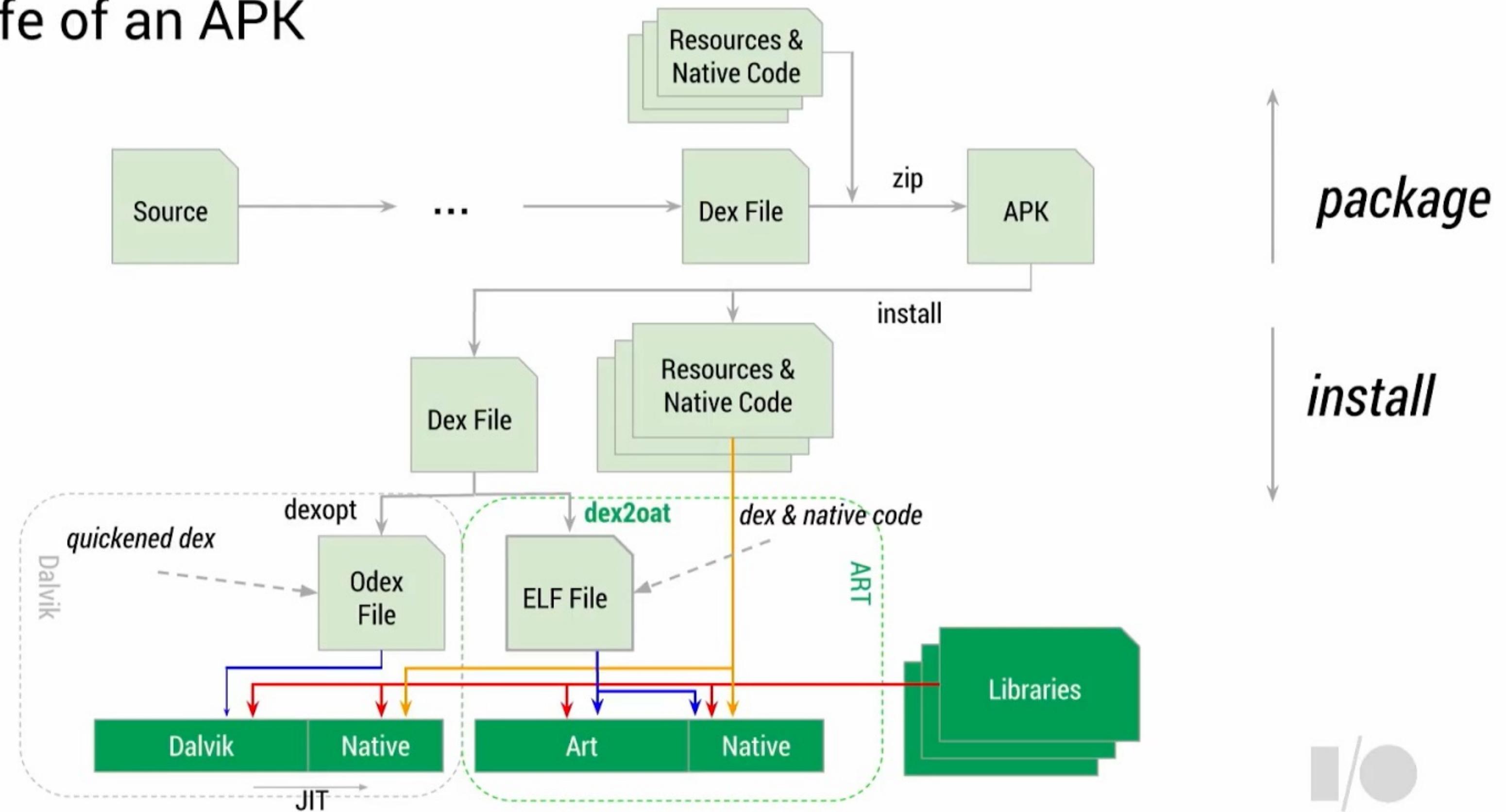




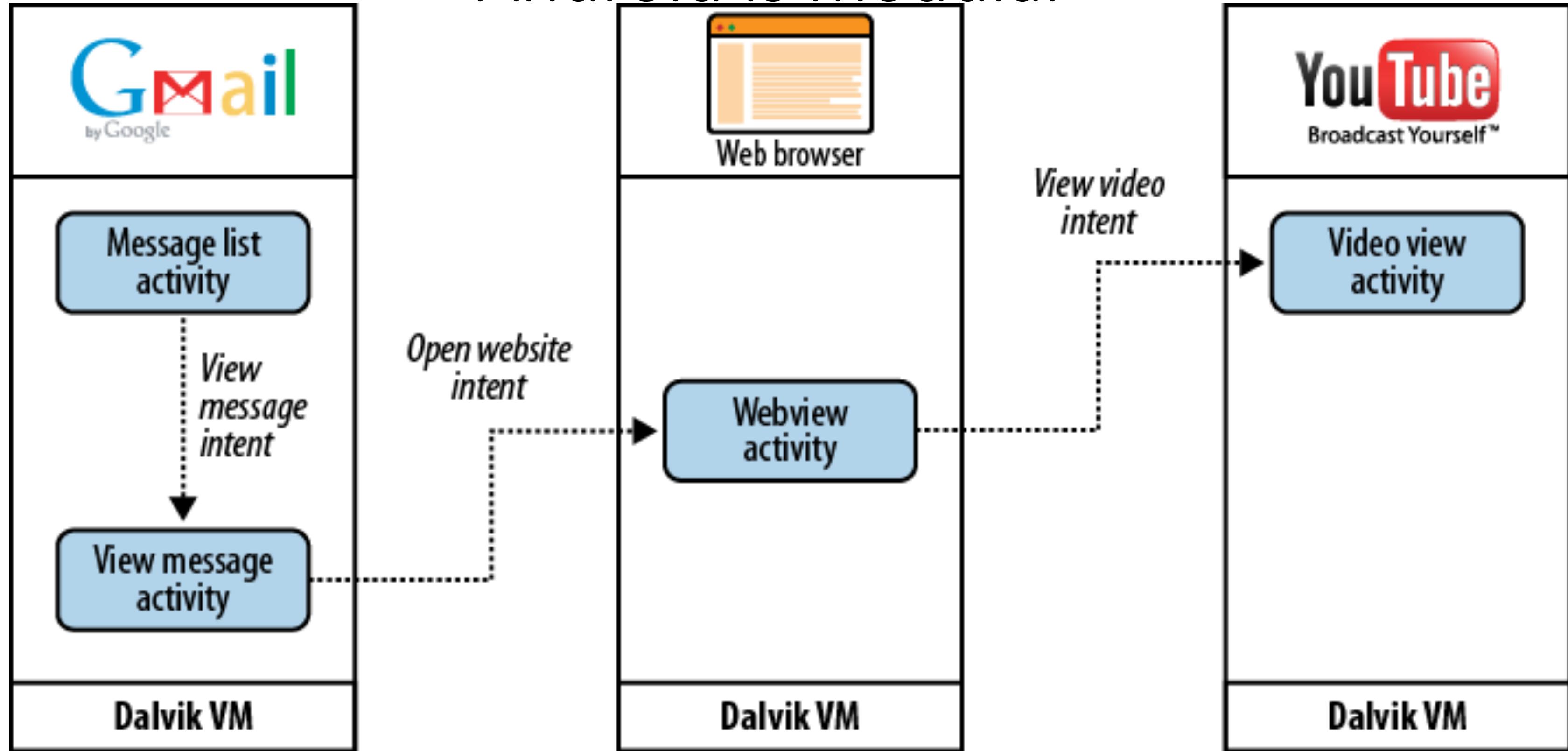
# Architecture

- Android consists of a kernel based on the Linux kernel,
  - with middleware, libraries and APIs written in C
  - and application software running on an application framework which includes Java-compatible libraries based on Apache Harmony.
- Android uses the Dalvik virtual machine with just-in-time compilation to run compiled Java code or the ART android runtime.

# The life of an APK



# Android is modular



# Application Components



## Activity

Present a visual user interface for one focused endeavor the user can undertake

Example: a list of menu items users can choose from



## Services

Run in the background for an indefinite period of time

Example: music on background, calculate and provide the result to activities that need it



## Broadcast Receivers

Receive and react to broadcast announcements

Example: battery low, announcements that the time zone has changed



## Content Providers

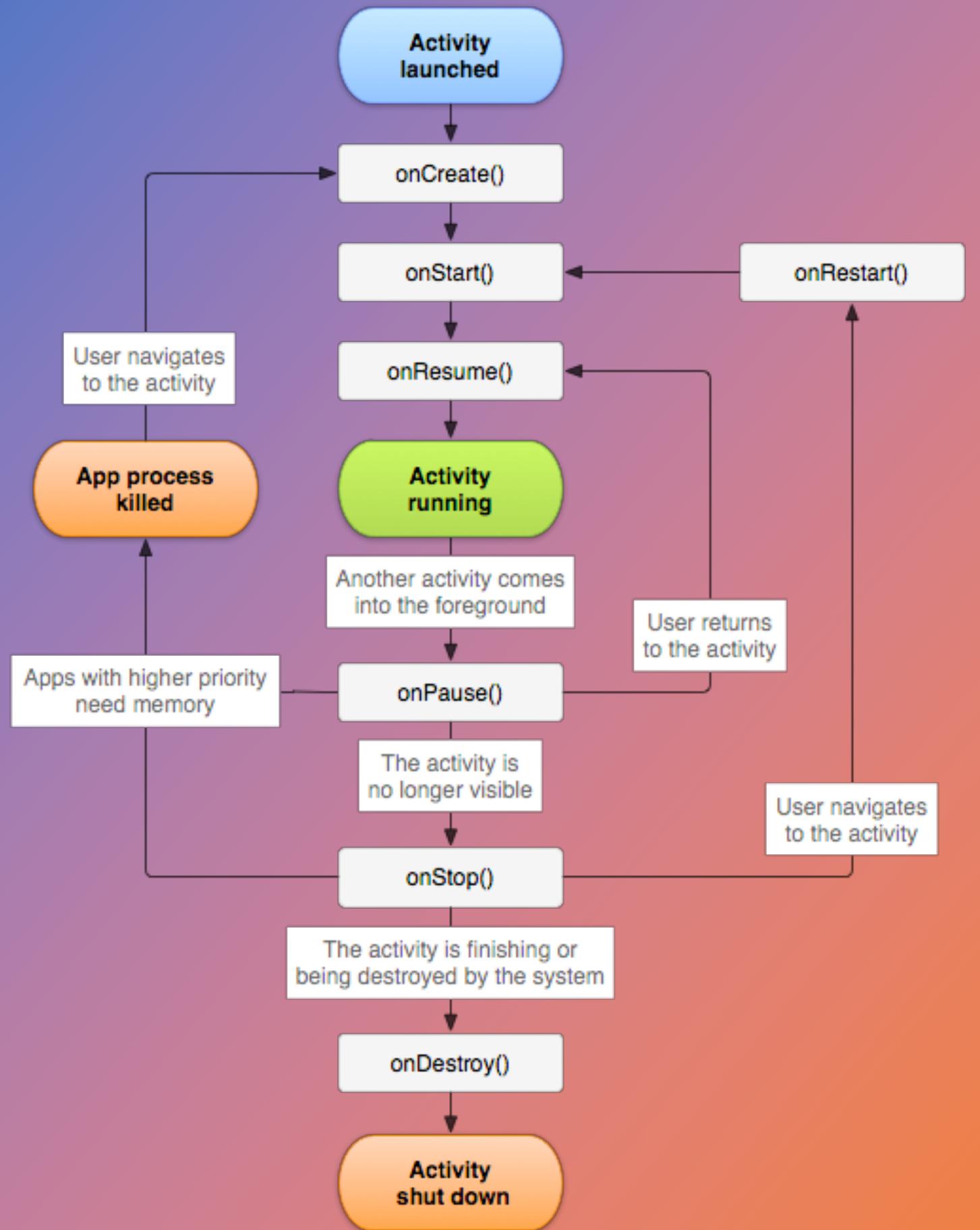
Store and retrieve data and make it accessible to all applications

Example: Android ships with a number of content providers for common data types (e.g., audio, video, images, personal contact information, etc.)



## Intents

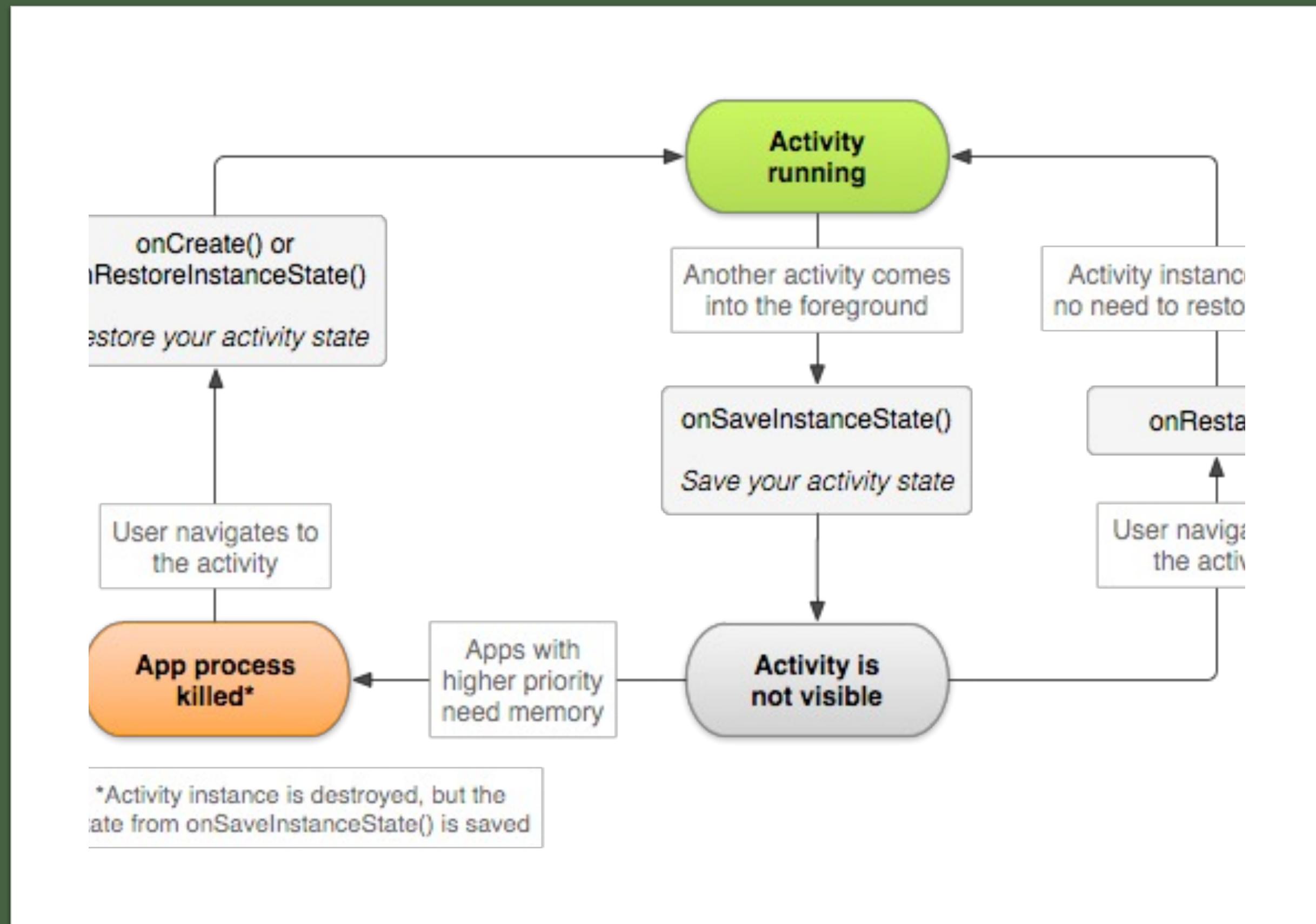
Hold the content of a message  
Example: convey a request for an activity to present an image to the user or let the user edit some text



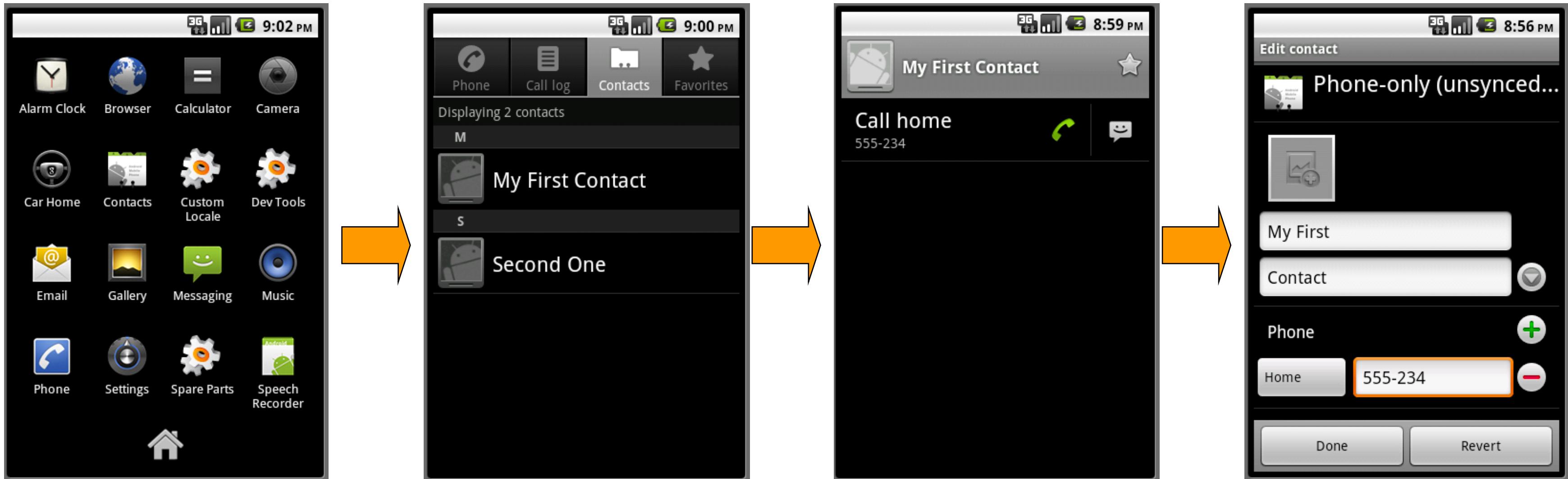
# Activity

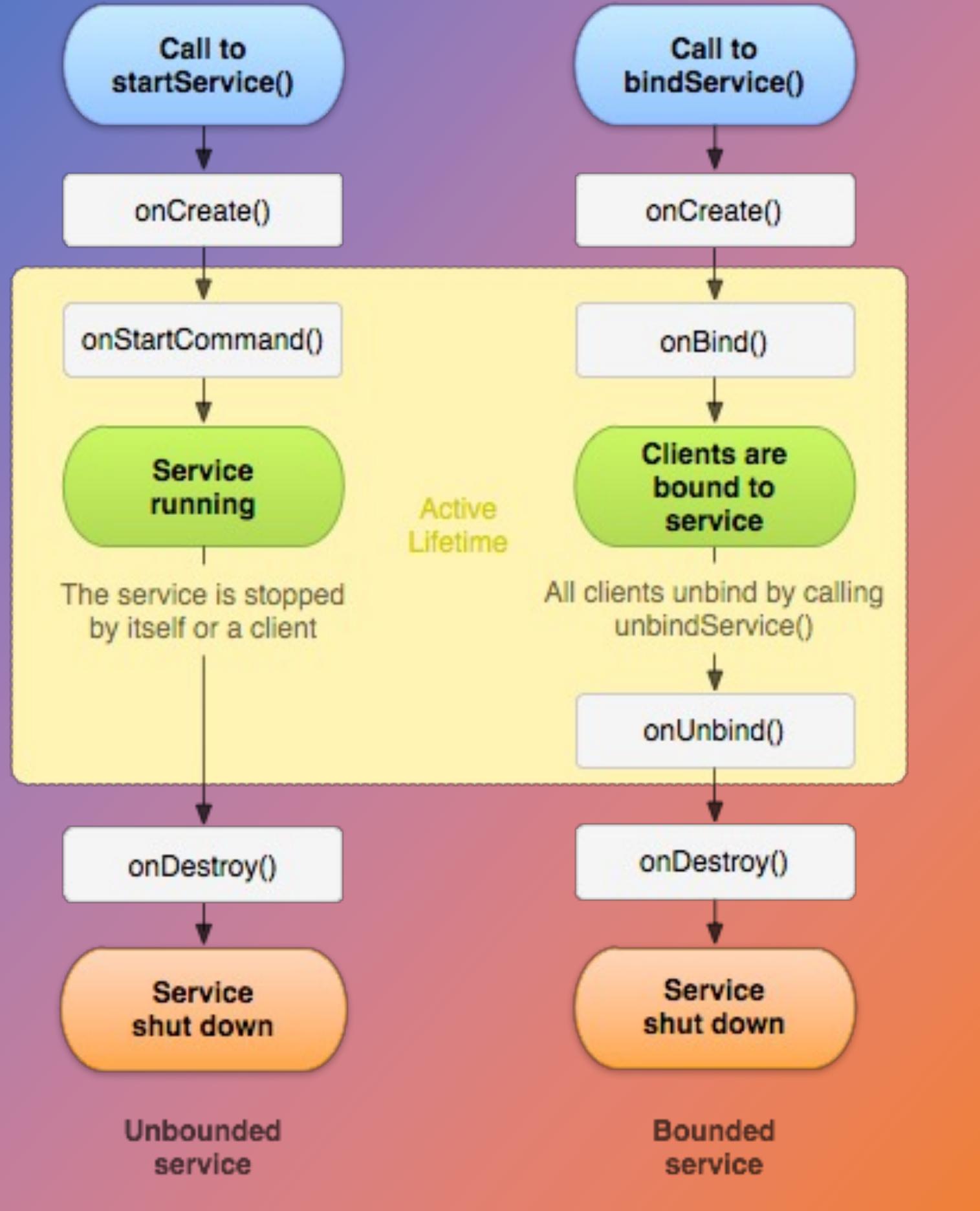
- System upcalls component as its state changes due to user actions.
- If another activity is started, the activity is paused.
- If a paused activity is not visible to the user, it is stopped.
- A stopped activity may be destroyed.
- And its app process may be killed.

## Saving/restoring activity state



# Activities start each other





# Service

- Services advertise one or more binder endpoints.
- Clients choose to bind/unbind (or unbind when stopped).
- A service with no bound clients may be shut down.

# Service

