Mobile App Development for Research

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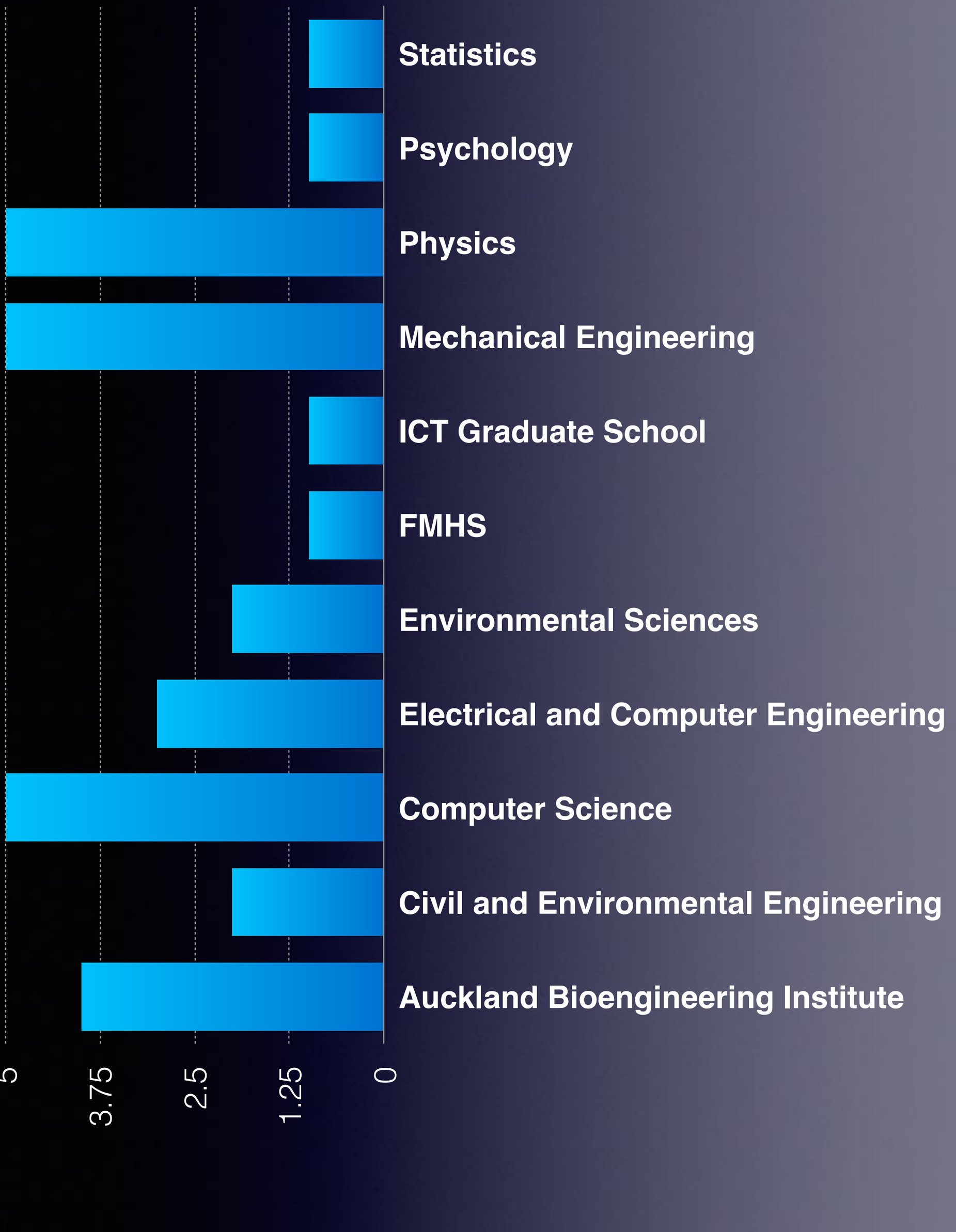
Statistics
Psychology
Physics
Mechanical Engineering
ICT Graduate School
FMHS
Environmental Sciences
Electrical and Computer Engineering
Computer Science
Civil and Environmental Engineering
Auckland Bioengineering Institute
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3.75
2.5
1.25
0

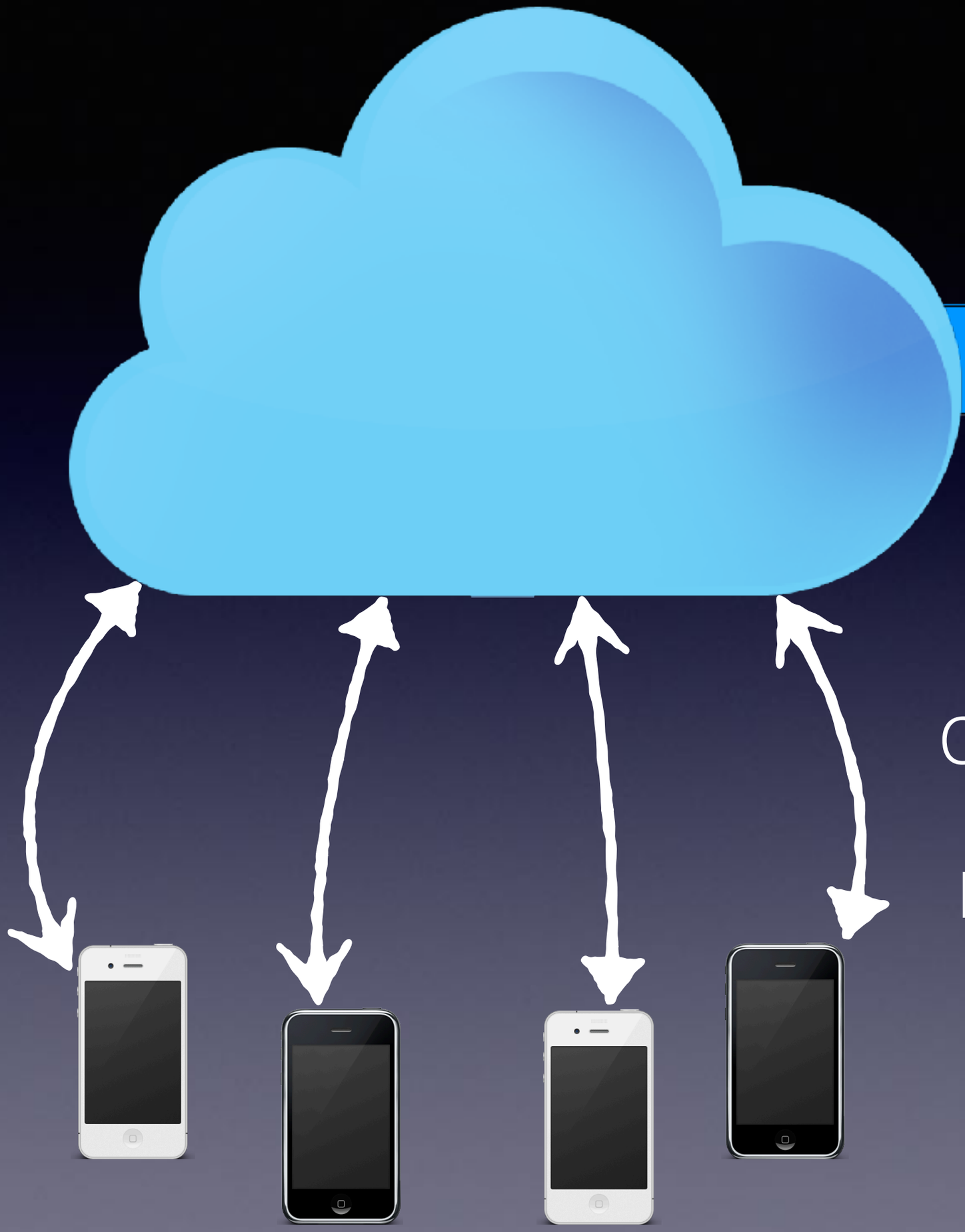

中关村在线
zol.com.cn


股城网


NO CELL PHONES
CELL PHONES
WALK IN THIS LANE

How can we utilise smartphone apps in our research?

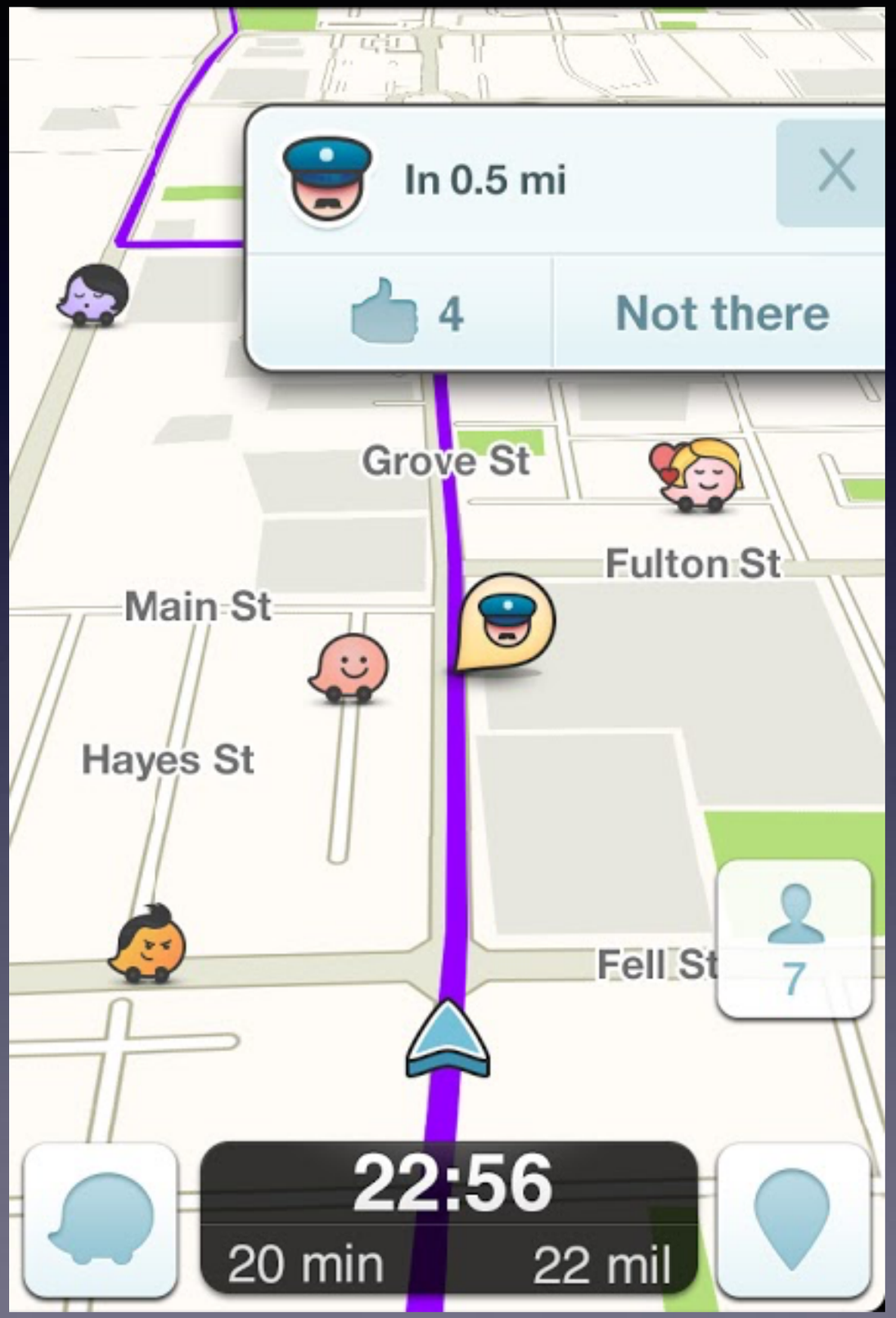
data



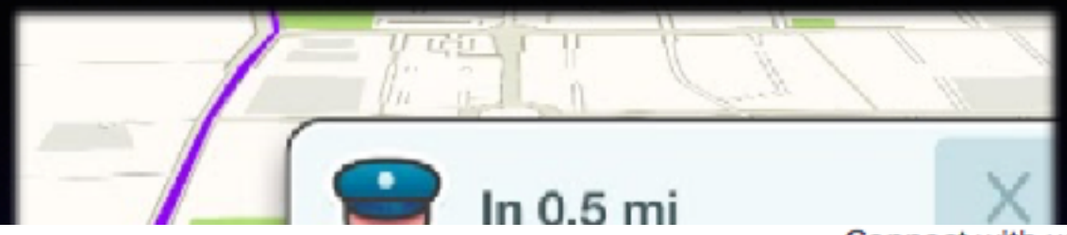
Context Identification
Emerging News
Cellular Coverage Map
Geo Tagging
Realtime Photostream
Pollution Monitoring
Traffic Info Collection
.....

Traffic Info Collection

waze by Google



Traffic Info Collection



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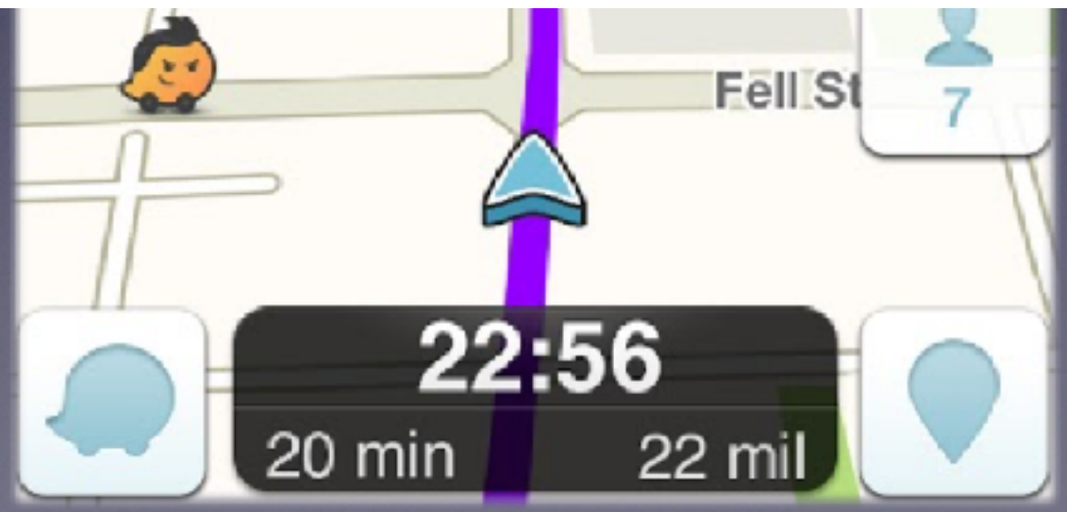
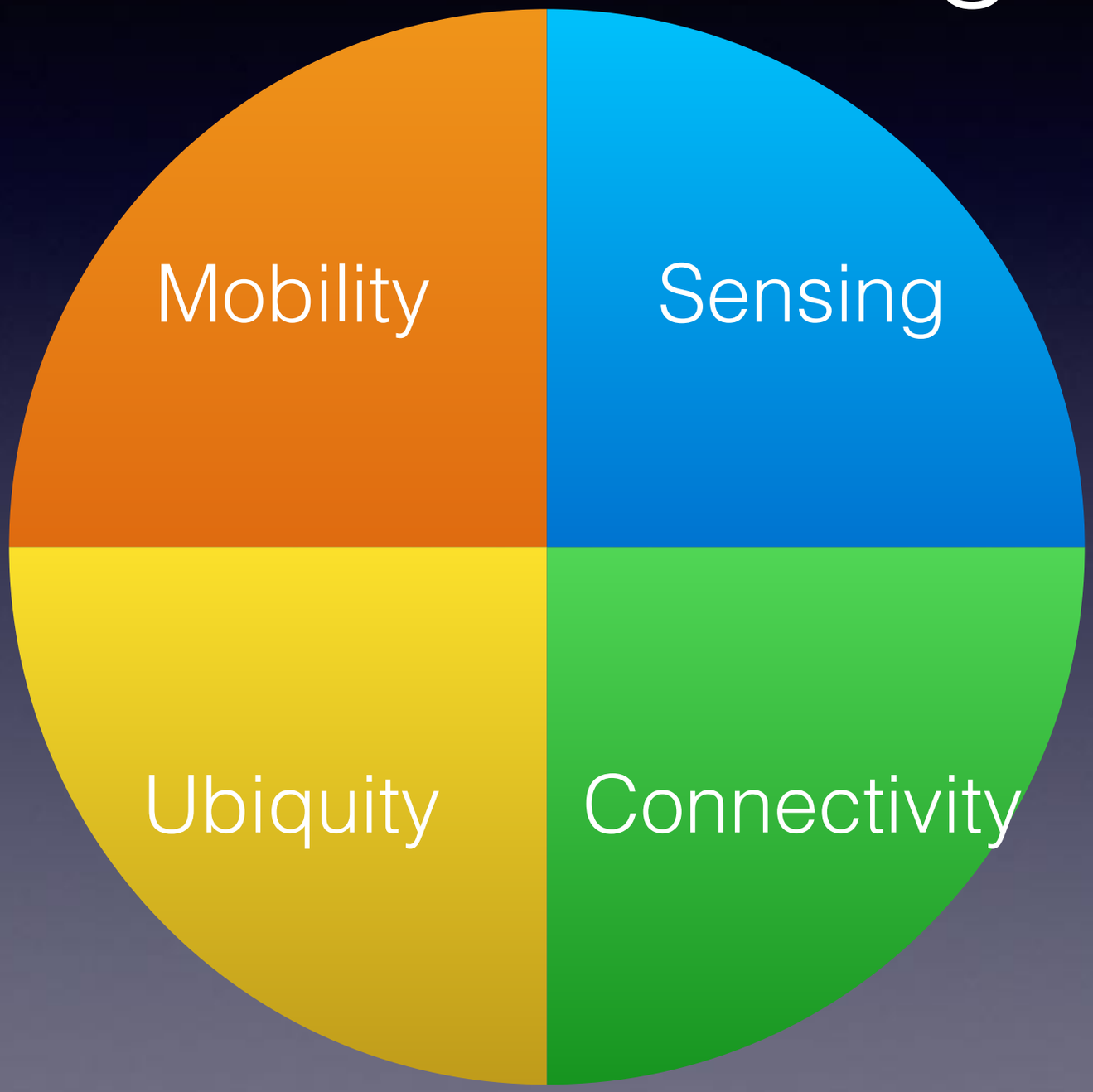


Smartphone based Crowdsourcing



Full Syllabus on MOOC

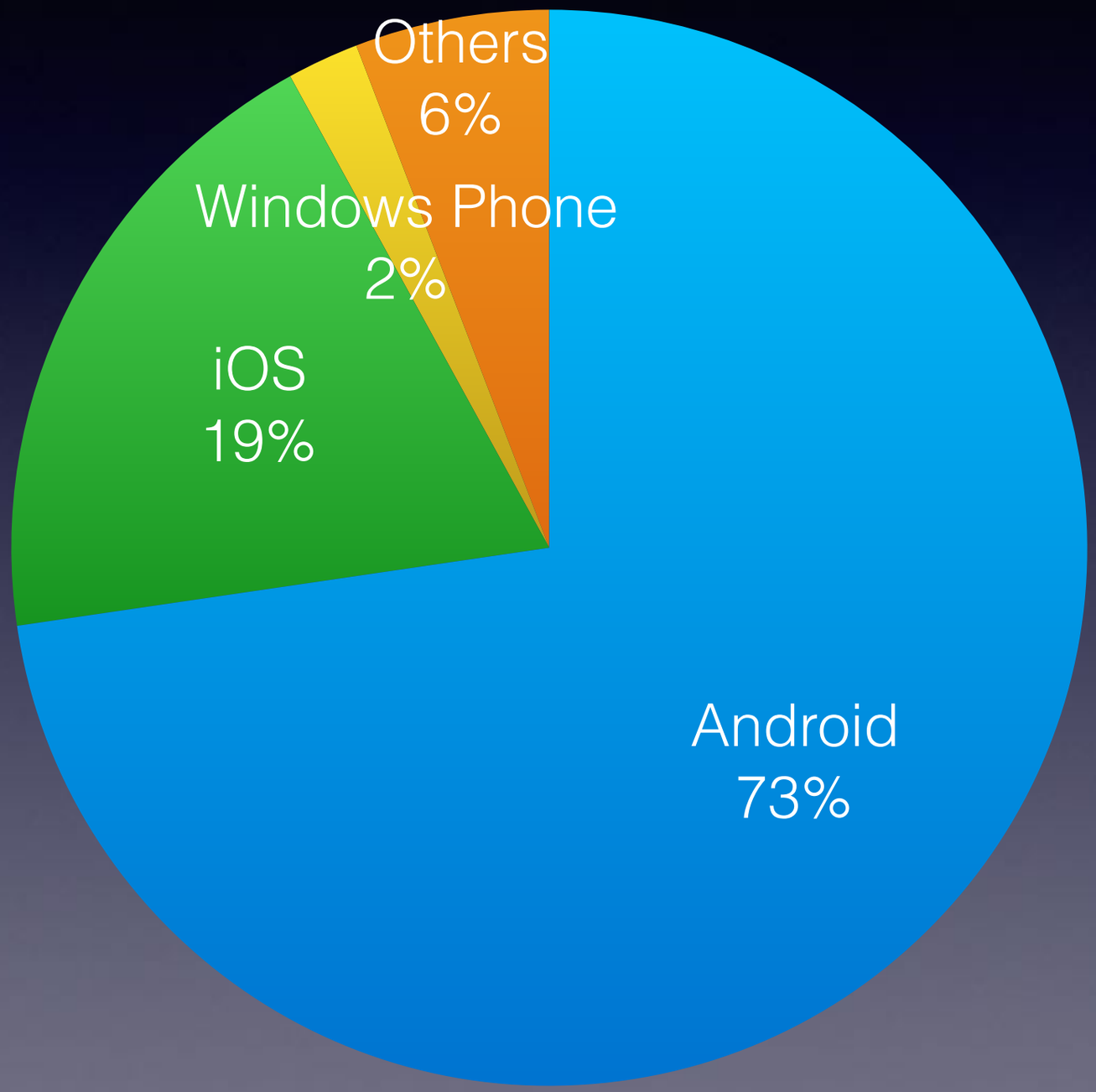
Android and iOS courses on **Udacity**

Outline

Part 1: Fundamentals

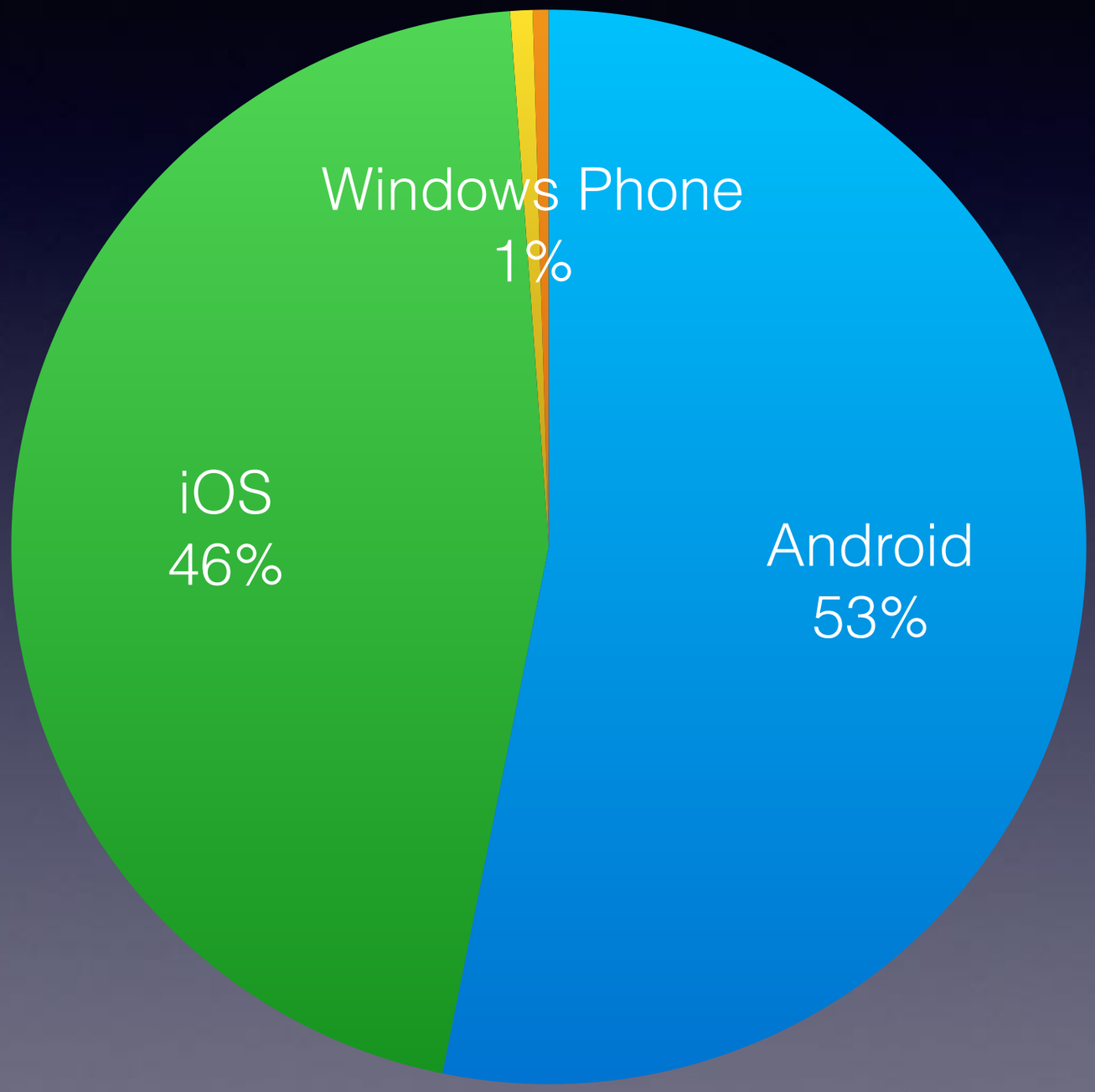
Part 2: Sensors

Market Share — Worldwide



Source : statcounter, May 2017

Market Share — NZ



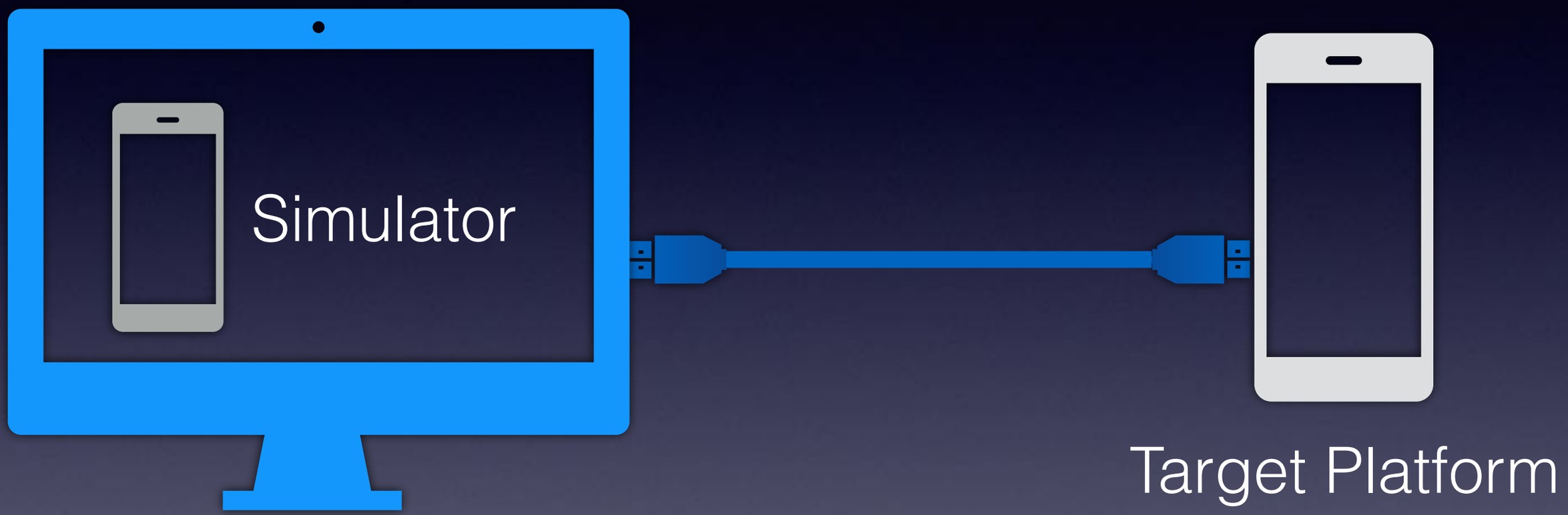
Source : statcounter, May 2017

Mobile App Development
Key Features

1. Cross Platform Development

2. Energy Efficiency

Cross Platform Development



Dev Platform

Target Platform	Programming Language	IDE	Host Platform
Android	Java, Kotlin (SDK) C++ (NDK)	Android Studio	Windows / macOS / Linux
iOS	Objective C / Swift	XCode	macOS

Dev Platform (Unofficial)

	Programming Language	IDE	Target Platform
Xamarin	C#	Visual Studio	Android, iOS, Windows Phone Native
phonegap / cordova	HTML5 / JS / CSS	Any Text Editor	Browser + Extension

Demo: Hello World

Apps

=

View (UI)

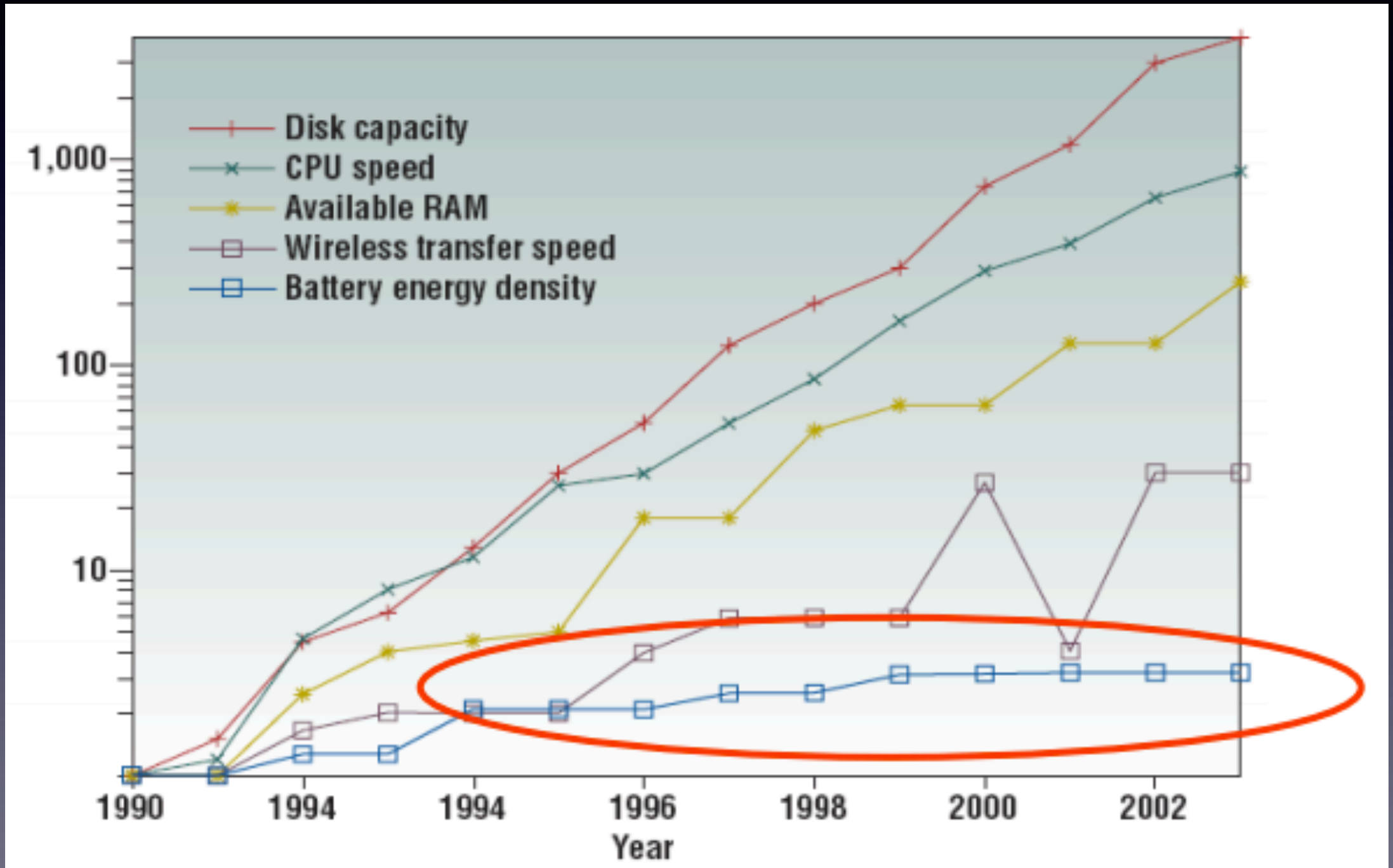
+

Model (Code)

+

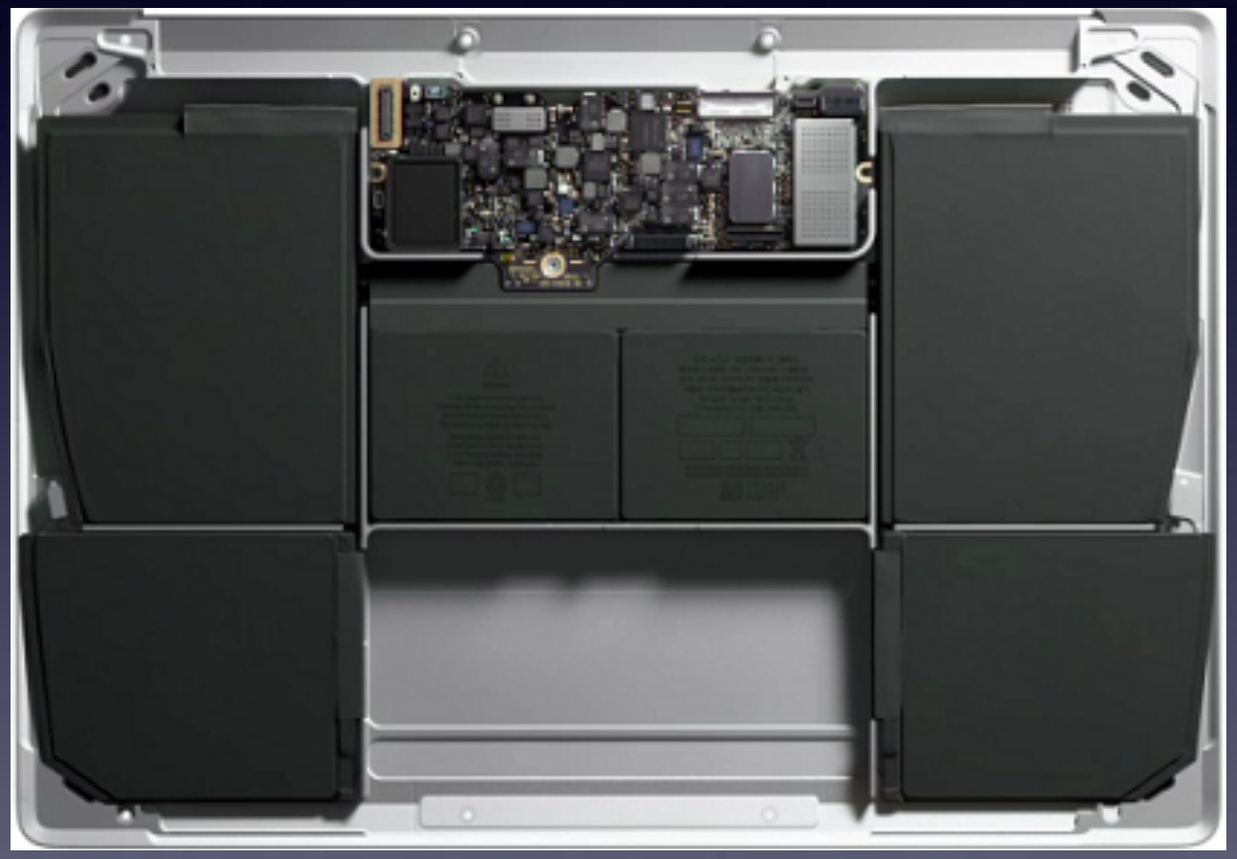
Controller (Glue)

Energy Efficiency



Mobile Computing Improvement – Paradiso, *et al.* Pervasive Computing, IEEE, 2005.

Energy Efficiency



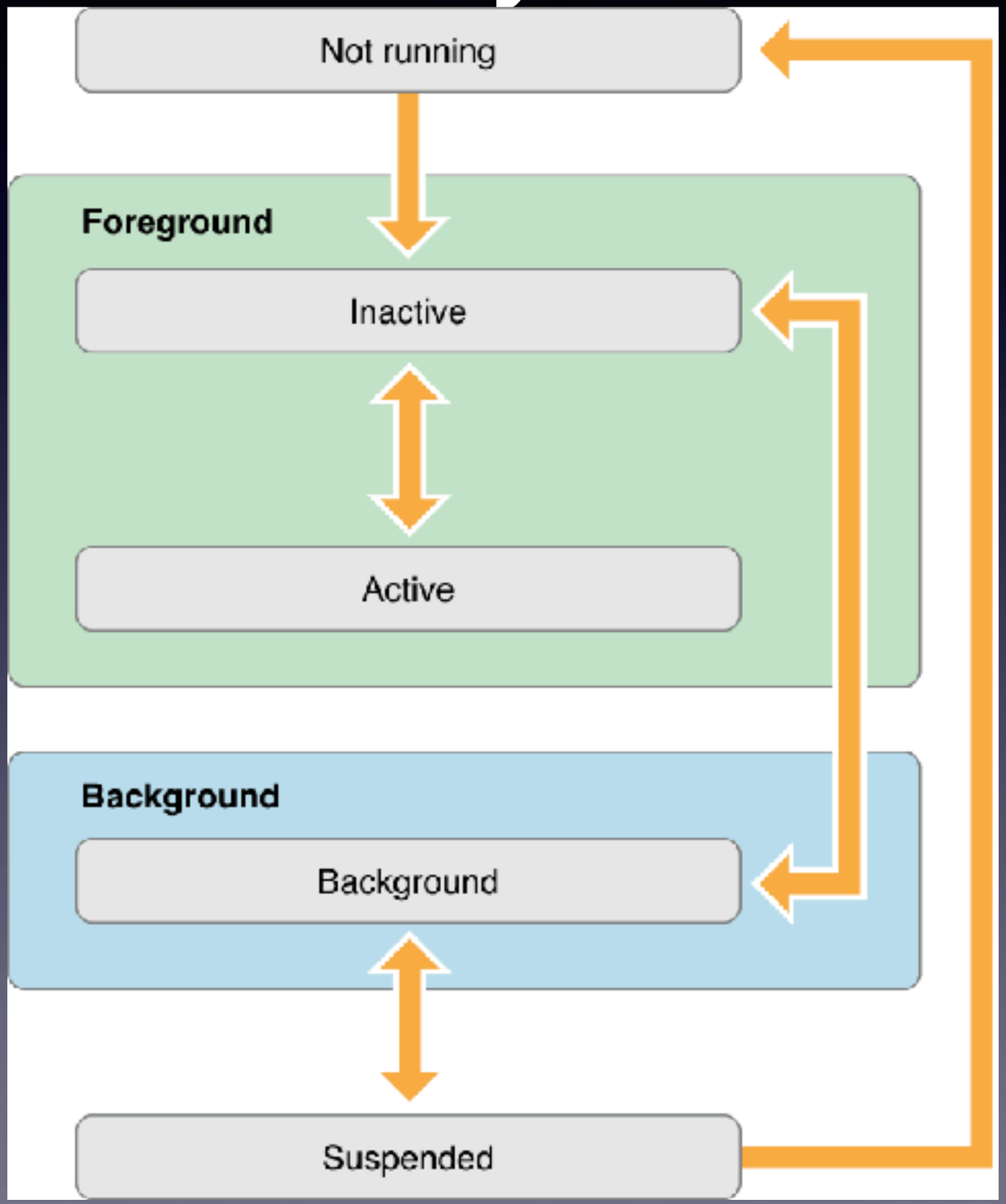
MacBook

iPhone 7 Plus

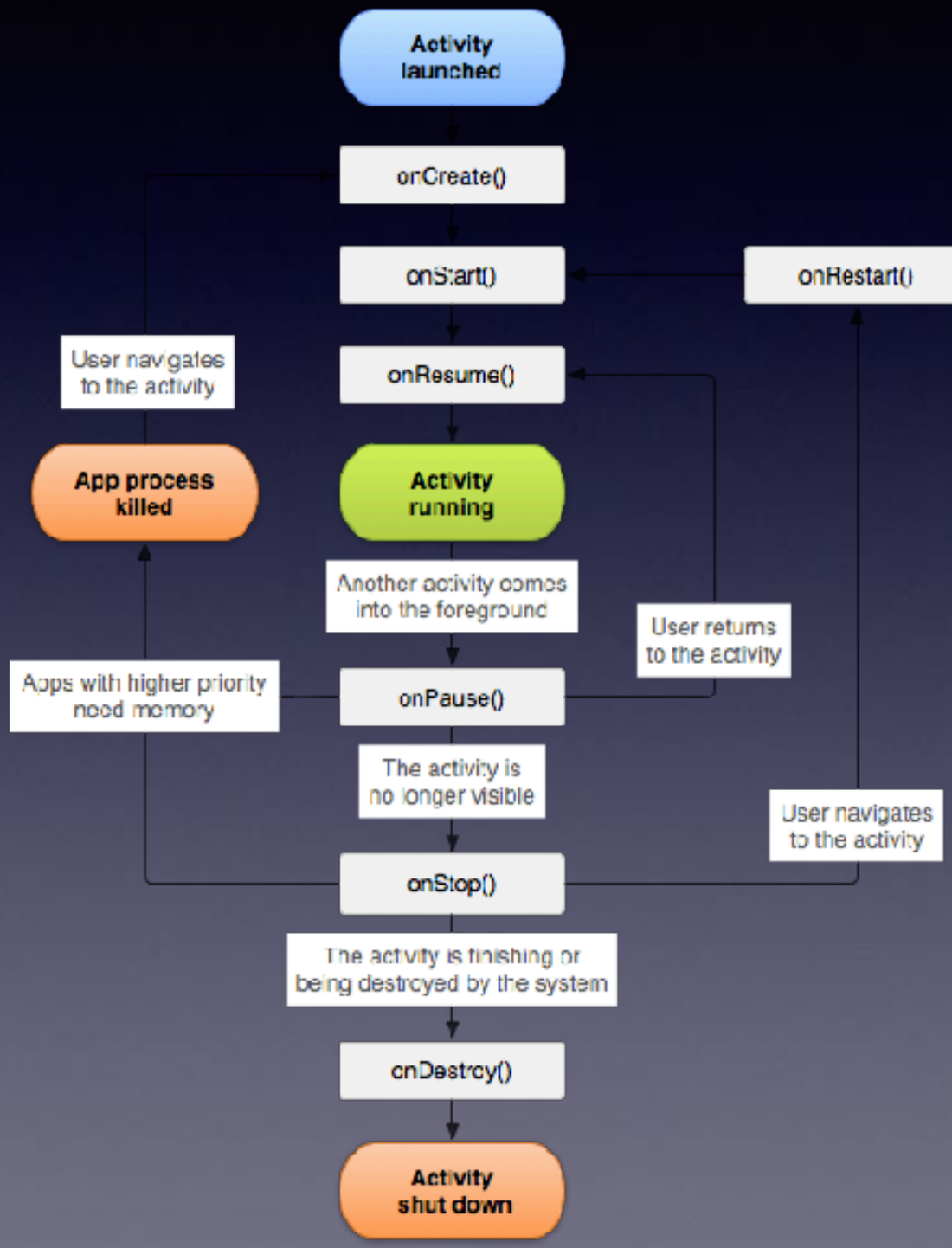
Energy Efficiency in App

- **Active**: respond to hardware events:
  - Low battery warning
  - Power connected / disconnected
- **Passive**: repsond to operating system events:
  - Switch between foreground and background
  - Suspend / Resume

App Life Cycle — iOS



App Life Cycle — Android



BG Execution — Guideline

iOS

Guideline

Android

Guideline

Demo: App Life Cycle

App Distribution

	Android	iOS
Store	Google Play Store	App Store
Price	$25 one time	$99 / year
Review Process	Loose	Strict
Time to market	Fast	Slow

Follow the checklist: iOS Android

App Distribution — Unofficial

	Android	iOS
Direct Install	Turn off unidentified developer option	Jailbreak
Source code Distribution	Install Android SDK	Install Xcode

Part 1 Summary

Test on Real Devices

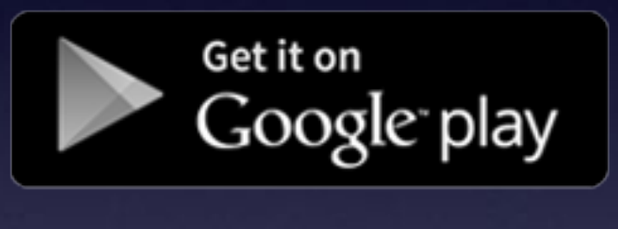
Battery Life Matters

Part 2: Sensors

Sensors

- Sensors have changed the phone industry.
- One of the key feature of smartphone.
- Enabling technology for:
  - Augmented reality
  - Innovative HCI
  - Context-aware applications
  - ……

Learning Sensor Data



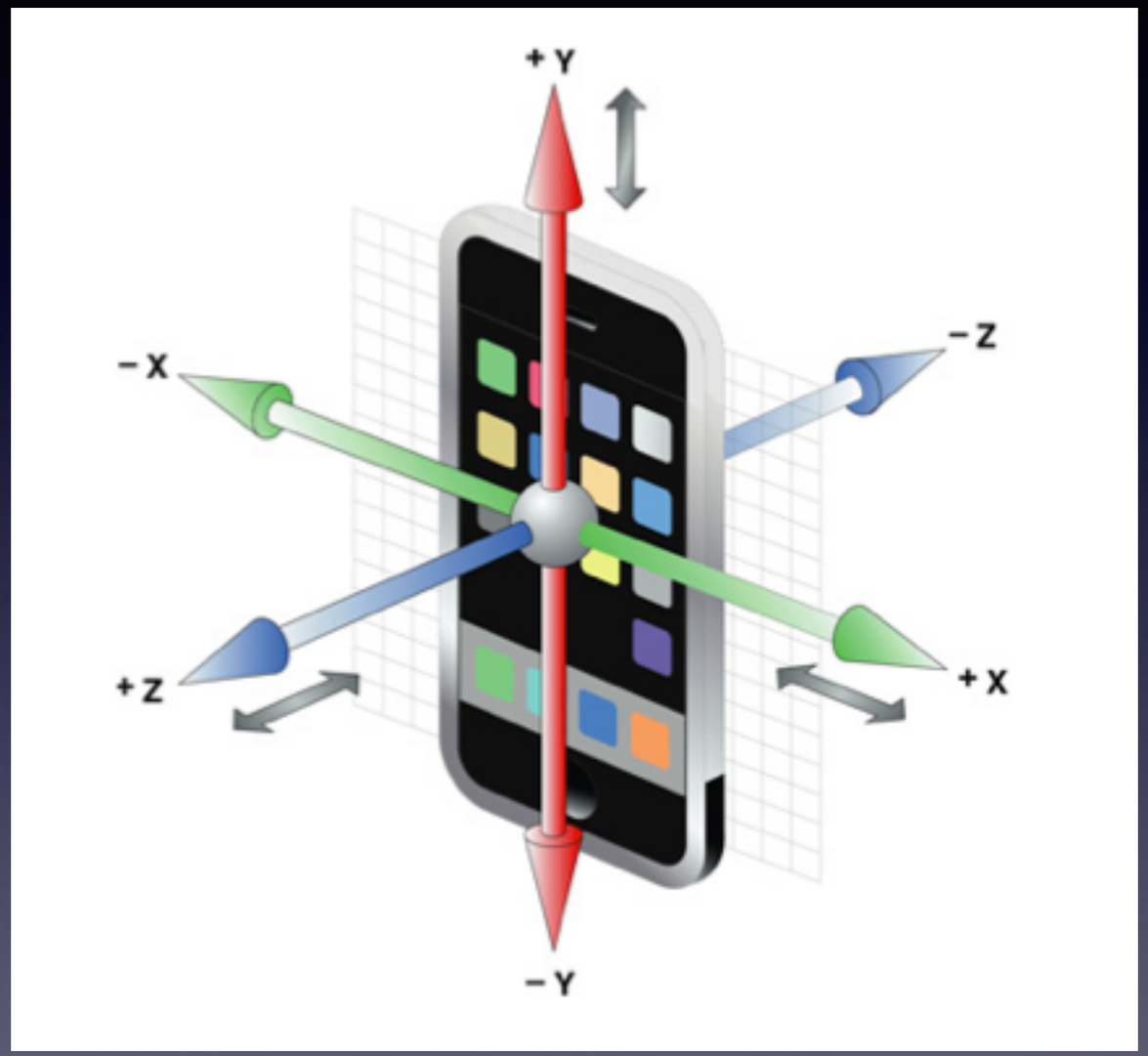
Sensors Multitool

SensorKinetics

Accelerometer

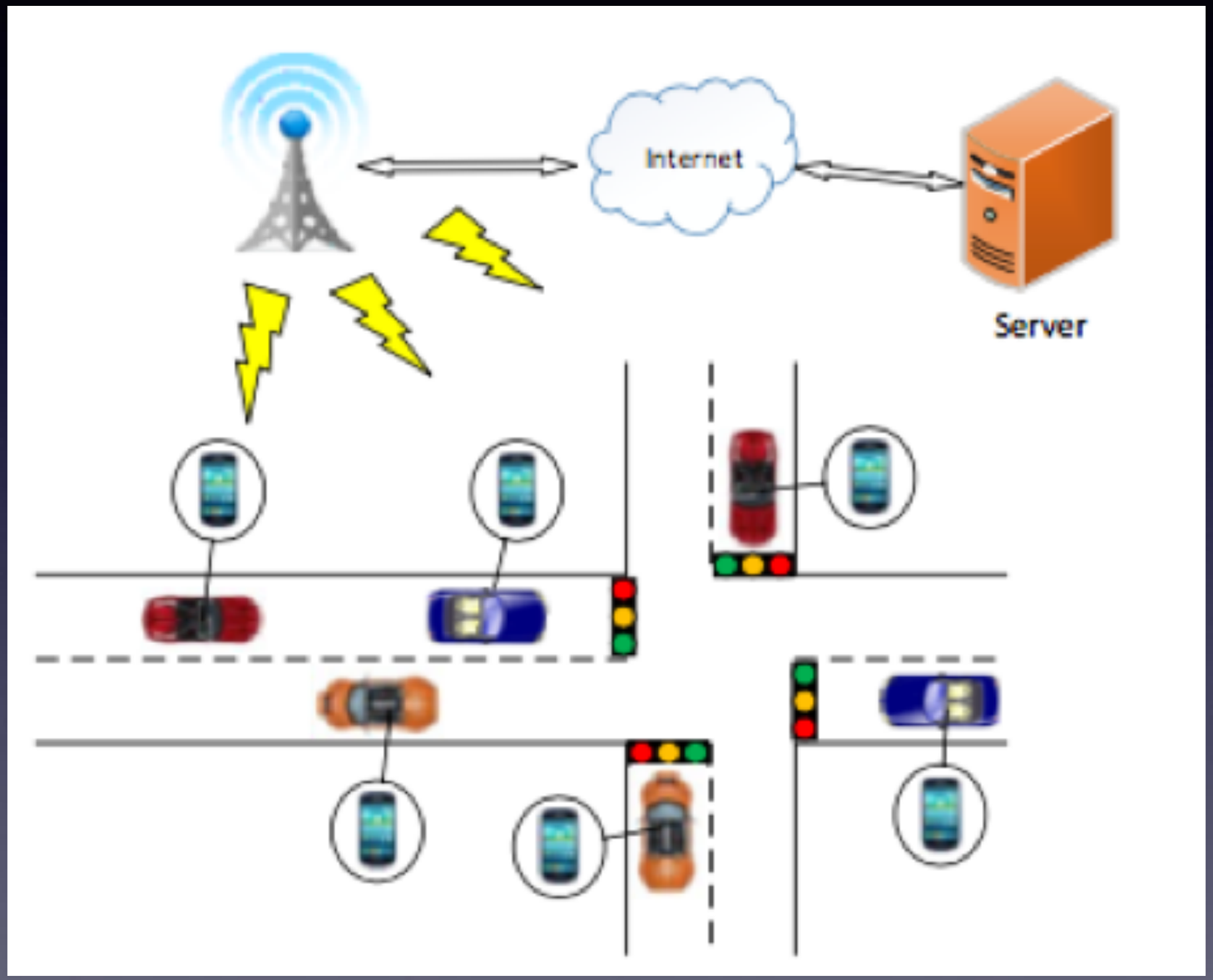
- Measures proper acceleration (acceleration it experiences relative to freefall), felt by people or objects
- Units: m/s^2 or g
- Most smartphone accelerometers trade large value range for high precision, iPhone range: ±2g, precision 0.018g
- Sample Applications:
  - Screen rotation
  - Free fall detection
  - Phone tap detection
  - Human behaviour detection

Axis



Phone frame <—> Earth frame

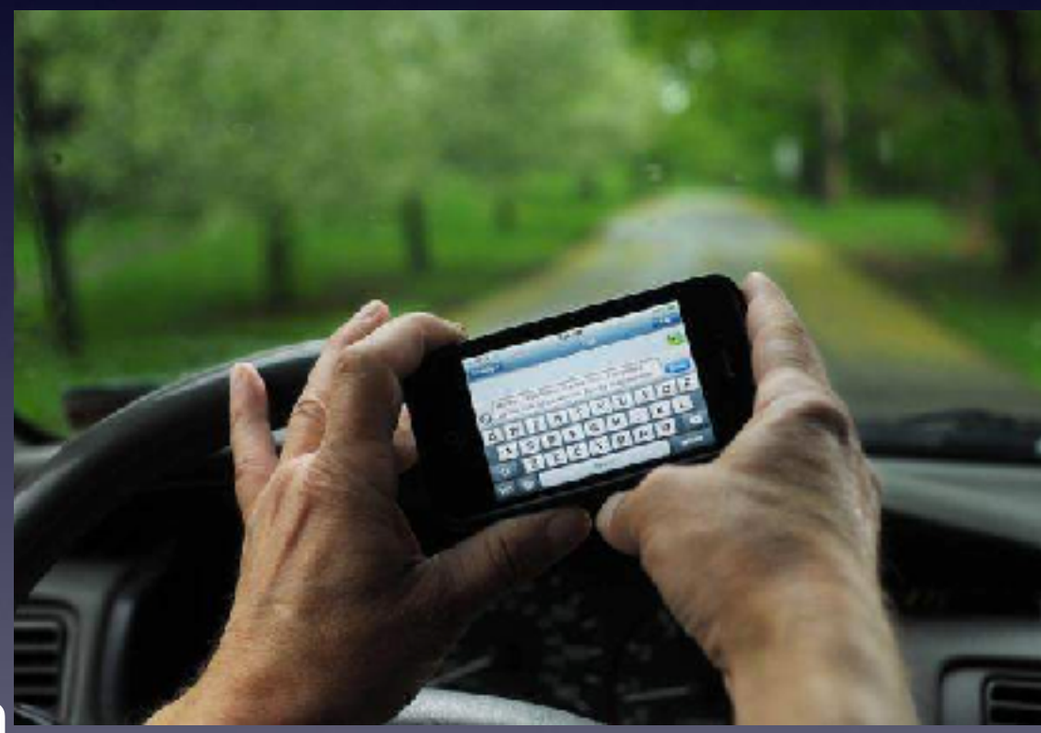
iTip: traffic signal prediction



Junhao Zheng, Zongjian He, et al. iTrip: Traffic Signal Prediction using Smartphone based Community Sensing. The 17th International IEEE Conference on Intelligent Transportation Systems (ITSC 2014)

iLoc

- Fine-grained in-vehicle positioning can improve many vehicular applications
  - Accuracy
  - User experience
- Examples:
  - Drowsiness detection
  - Driver distraction reduction
  - Automatic profile switching

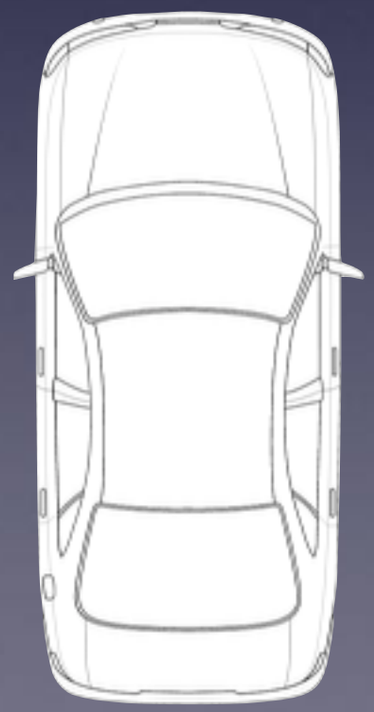


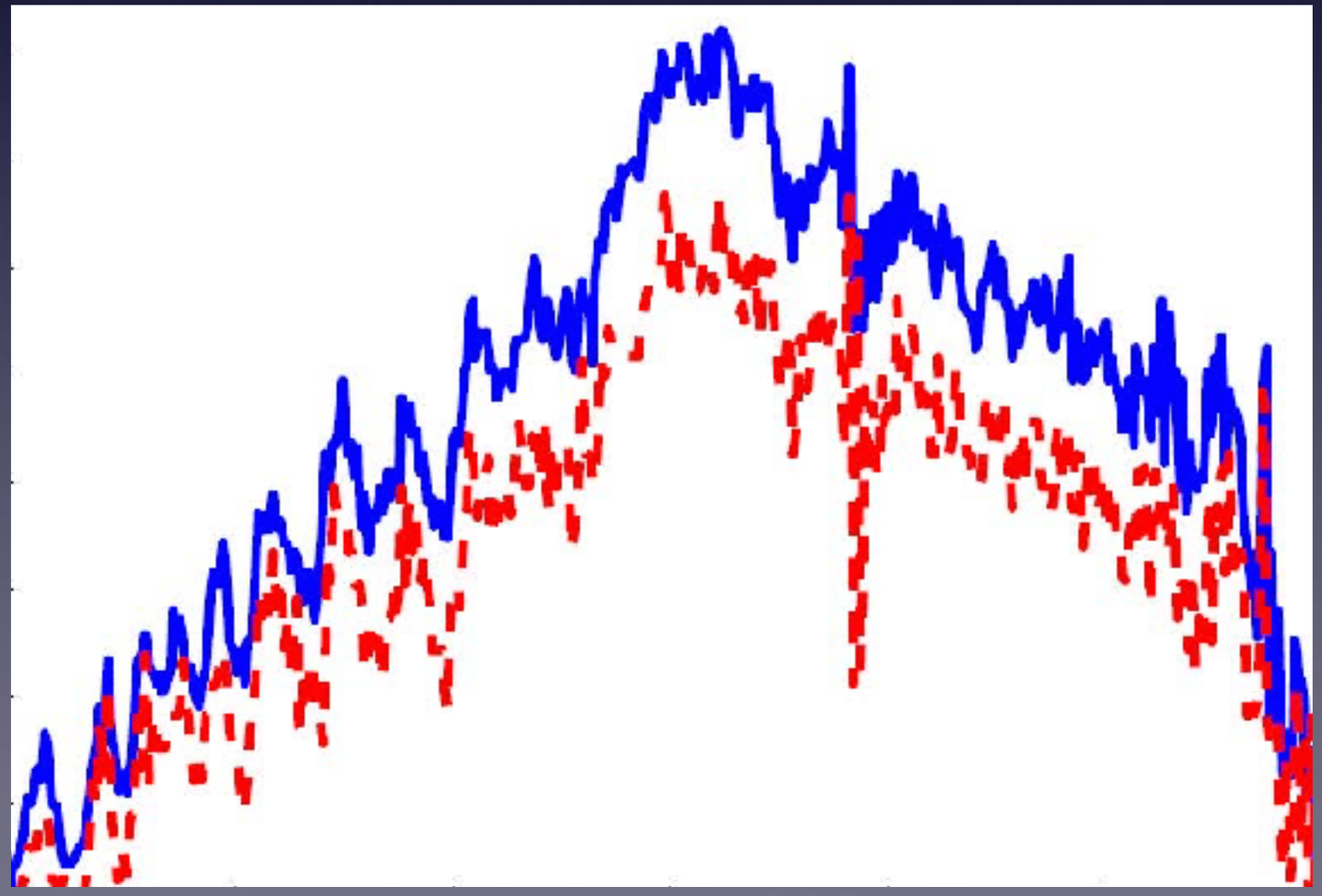
Zongjian He, Jiannong Cao, et al. Who Sits Where? Infrastructure-Free In-Vehicle Cooperative Positioning via Smartphones. Sensors. 2014

How

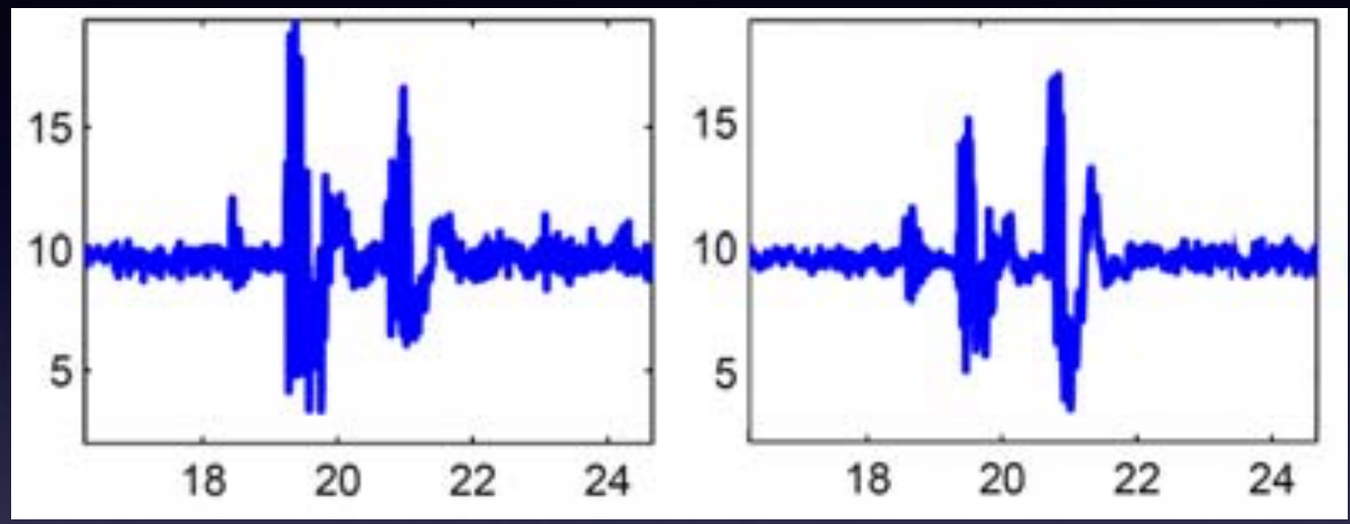
$a_c = \omega^2 r$

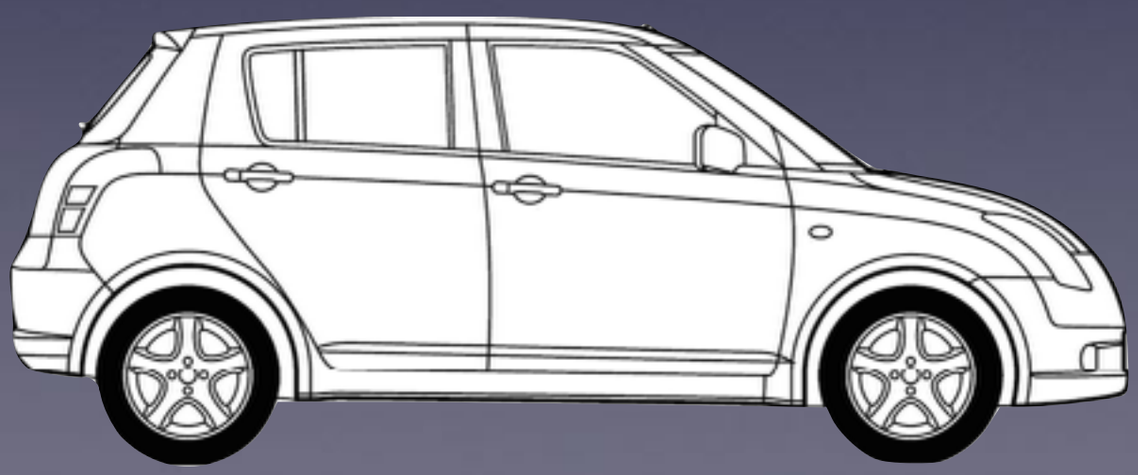
Left / Right Identification





Front / Back Identification





Gyroscope

- Detects the **changes** in the orientation
- Unit: rad / s
- Orientation can be computed from the angular rate that is detected by the gyroscope
- Sample apps:
  - AR games
  - Rotation detection

Texting & Driving Detection

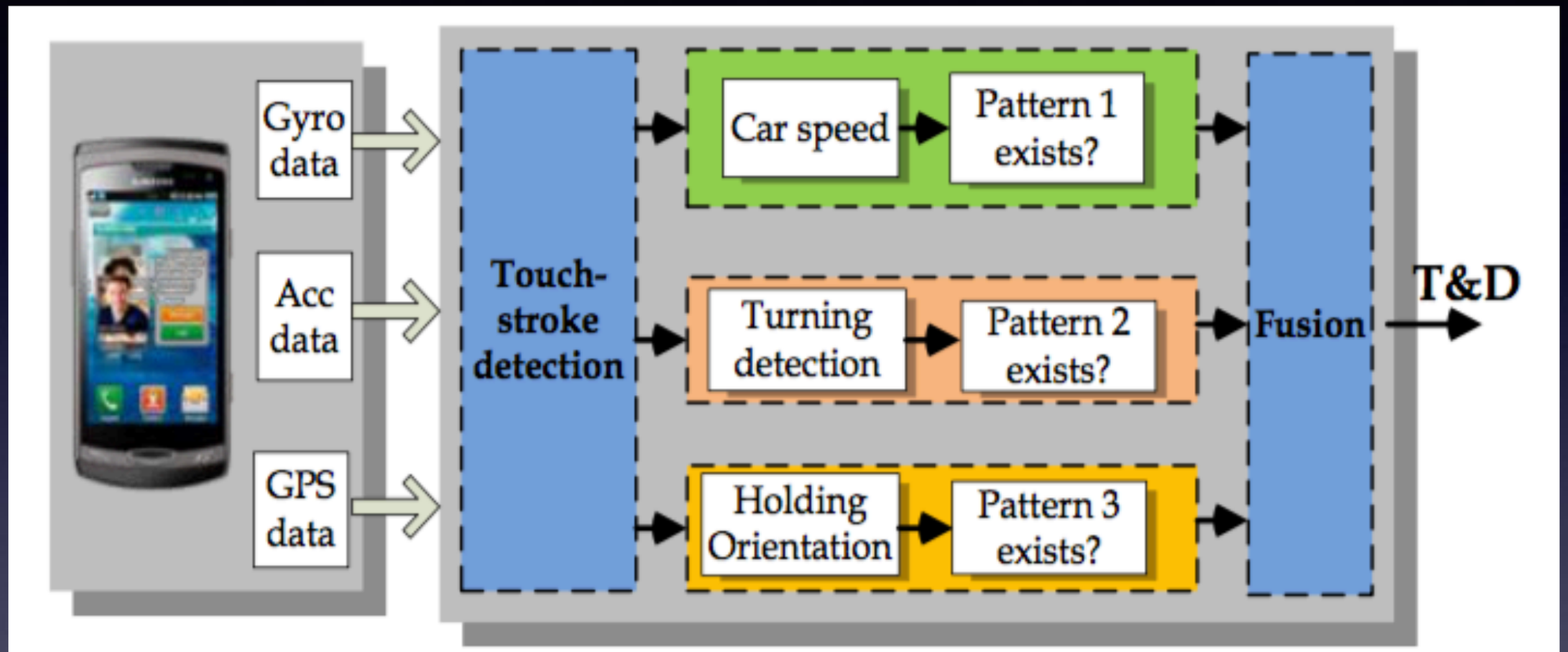
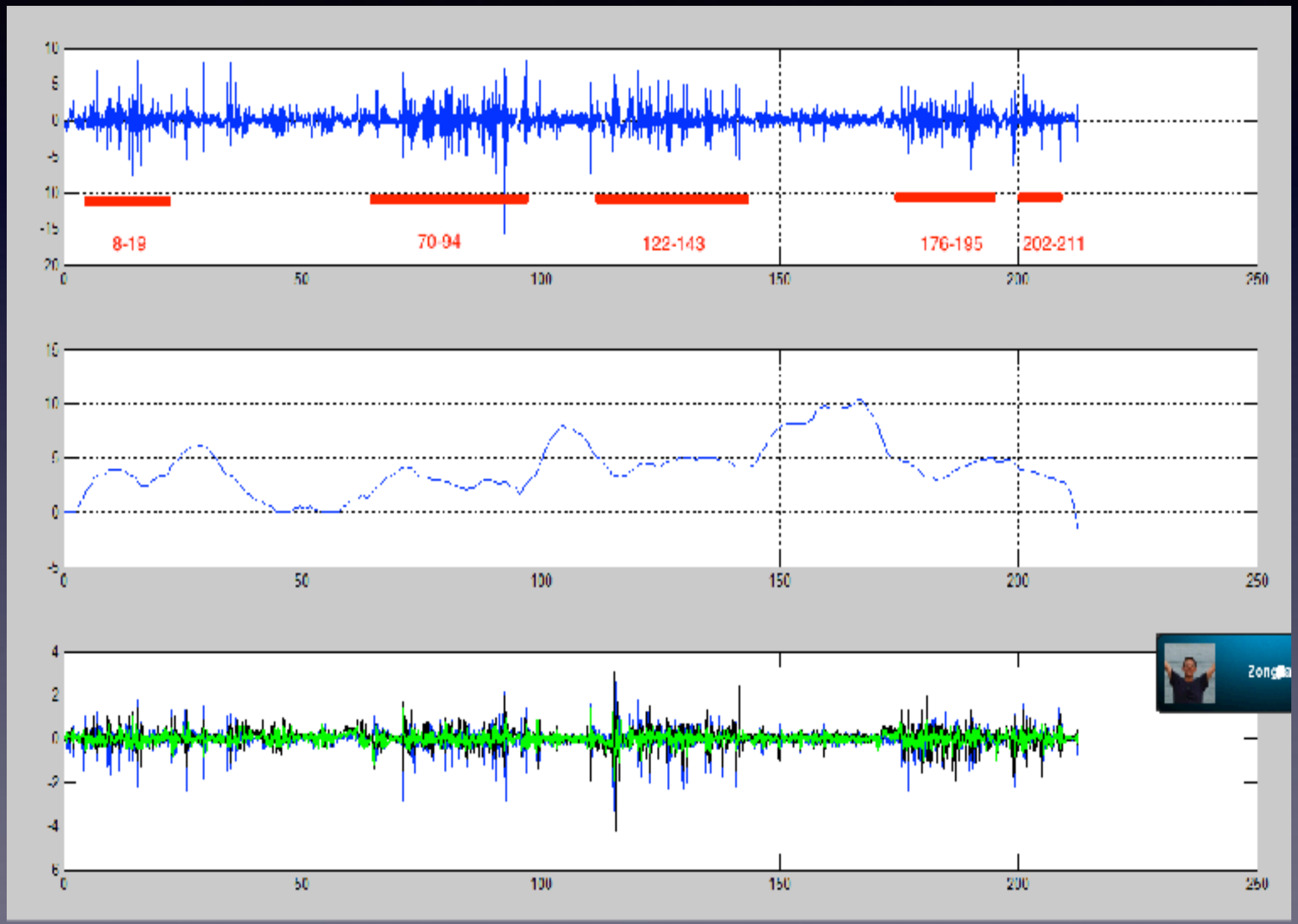


Fig. 1: The logic flow of the T&D system

Xuefeng Liu, Jiannong Cao, Shaojie Tang, Zongjian He, Jiaqi Wen. Drive Now, Text Later: Nonintrusive Texting-while-Driving Detection using Smartphones. IEEE Transactions on Mobile Computing.

Gyroscope --> keystroke



Magnetometer

- Measures the strength of **earth's magnetic field**
- Strength is expressed in tesla [T]

- iPhone magnetometer range: ±2mT

- Sample Apps:
  - Compass
  - Frame trans: phone frame -> earth frame.

Proximity

- Detect how close between the phone and the body.
- Precision: boolean or length.
- Sample Apps:
  - Disable touch during phone call. (Introduced in first generation of iPhone)

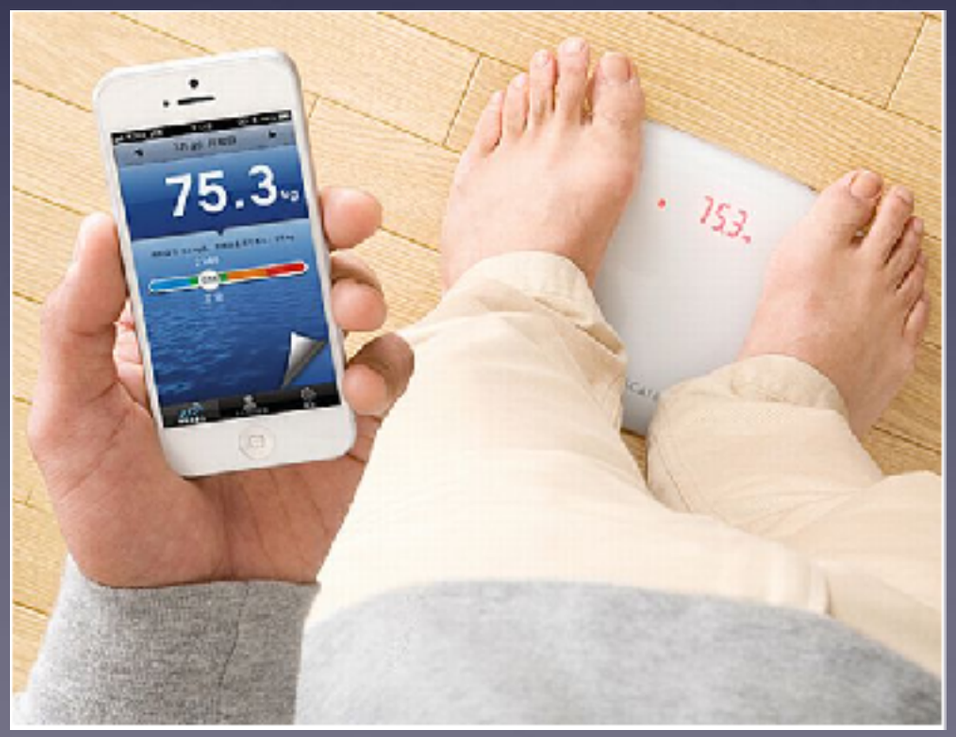
Luxmeter

- A.k.a. : Ambient light sensor
- Detect the light of the strength
- Sample Applications:
  - Screen auto brightness

barometer

- Measures atmospheric pressure
- Unit: hPa
- Sample applications:
  - Calculate altitude
  - Floors climbed

External Sensors



Are we missing something?

- Camera
- Microphone
- Wireless networks
- .....

Camera

- Image Capture & Processing
- MIT researchers measure your pulse, detect heart abnormalities with smartphone camera
- Measuring heart rate with a smartphone camera
- App Store: Instant Heart Rate: Heart Rate & Pulse Monitor

GPS

+ Accuracy
- Power
- Speed
- Indoors

- Accuracy
+ Power
+ Speed
- Wilderness

Location services

Cellular Tower

+/- Accuracy
+/- Power
+/- Speed
+/- Urban areas

WiFi

Wireless Networks

- RSSI: Received Signal Strength Indicator
- Indoor Localisation
- Respiration Monitoring
    - Contactless Respiration Monitoring Via Off-the-Shelf WiFi Devices
- Activity & Gesture Recognition
    - The telepathic phone: Frictionless activity recognition from WiFi-RSSI

Other Sensors

- Temperature
  - Crowdsourcing urban air temperatures from smartphone battery temperatures.
- Microphone
  - Ear-phone: an end-to-end participatory urban noise mapping system

Demo: Sensors

References

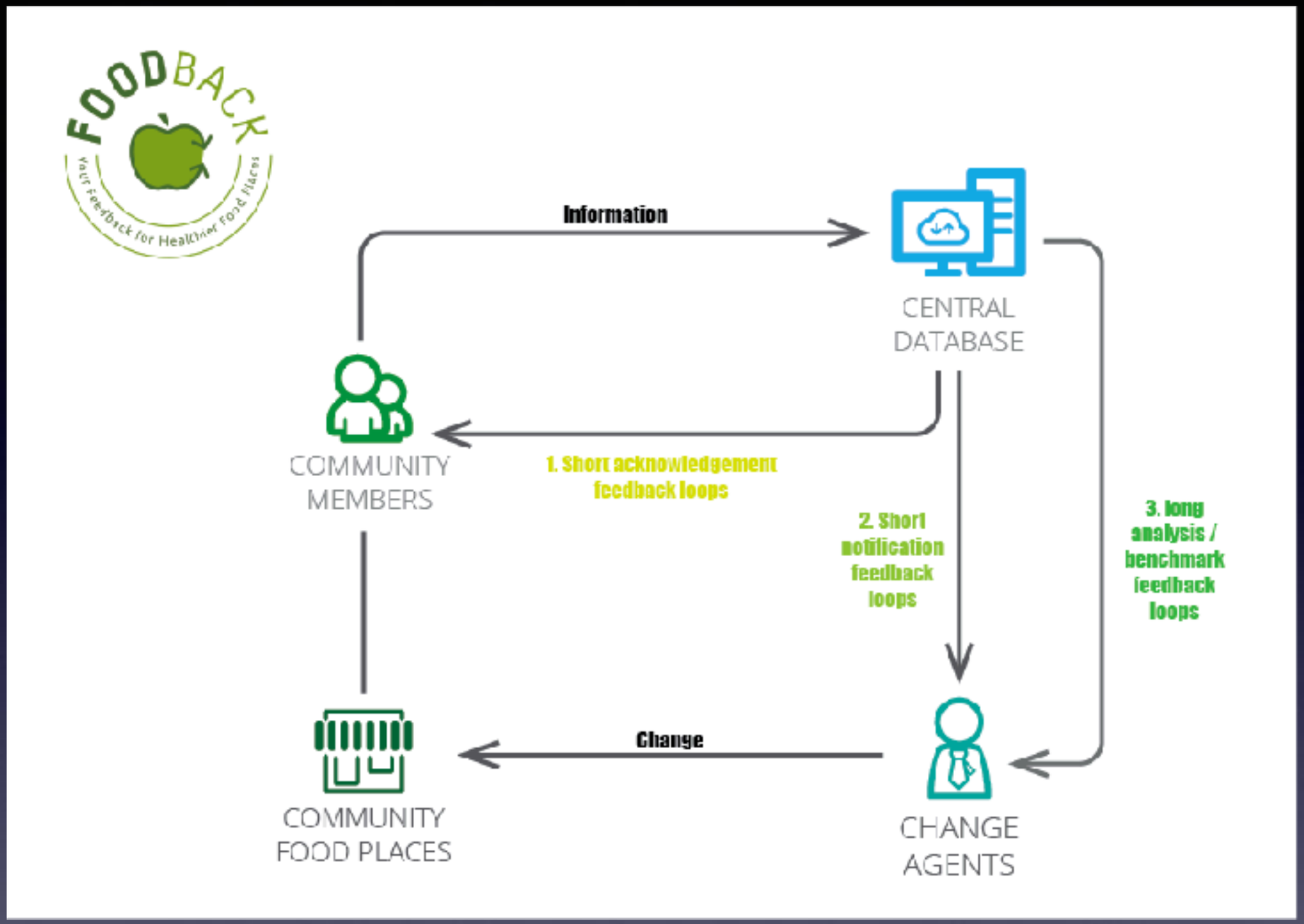
- Android and iOS courses on Udacity
- Android Developer Website
- iOS Developer Website

Thank you !

Download source code + slides

https://github.com/cszhe/app4r/

Case Study



Website: http://www.foodback.org.nz/

Introduction: https://youtu.be/-4gUui0DWLA