App Inventor for Android

Hui Chen, Kostadin Dameski , and David Walter

Dept. of Math & Computer Science

Virginia State University, Virginia, 23806

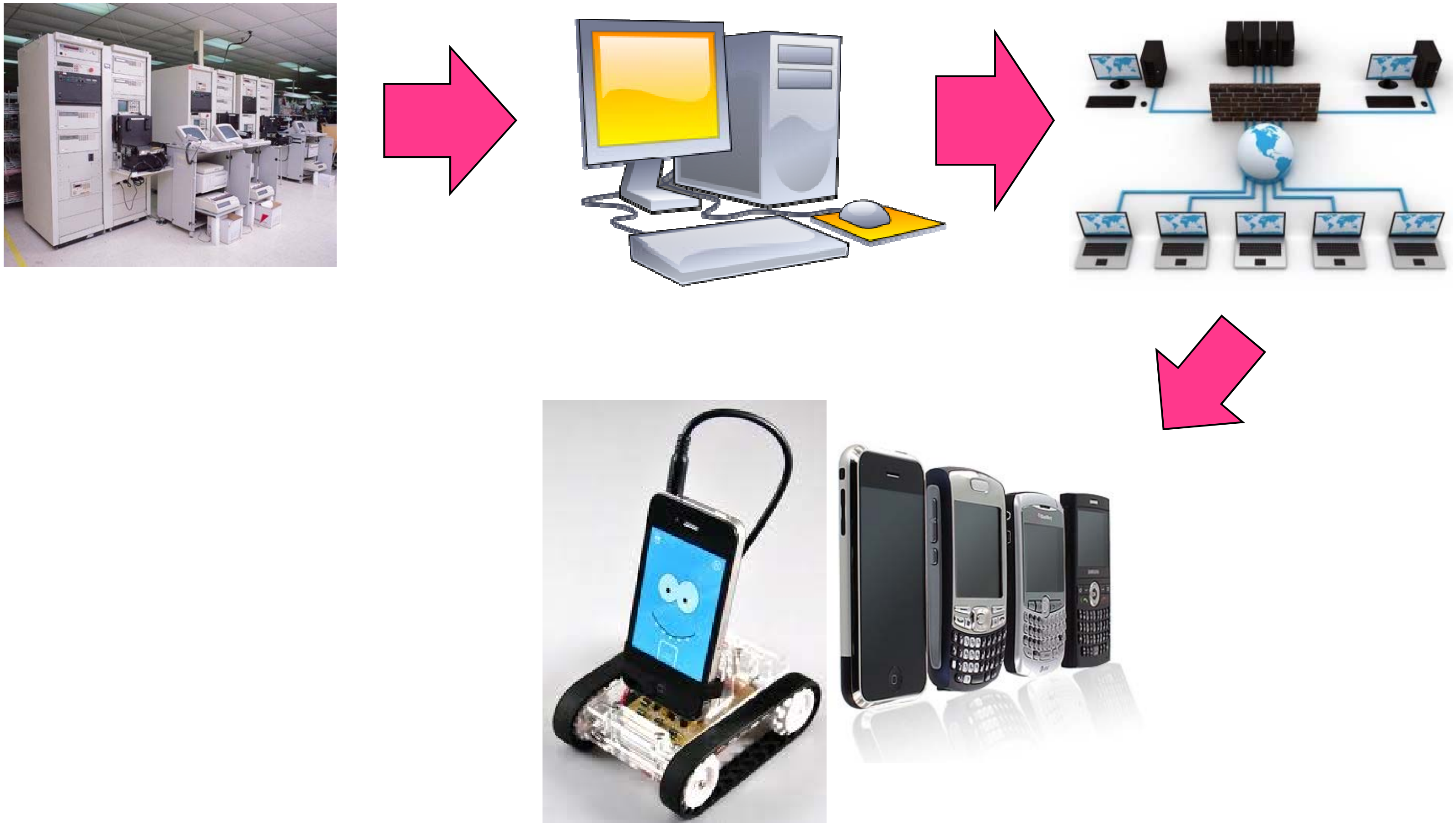
Outline

- Background
- A simple app
- Sensors and sensors-driven applications
  - Location sensor (GPS)
  - Accelerometer
- The take-home
  - Can instruct your own students to prepare working systems for "App" development
  - Can explain App Inventor environment
  - Can develop simple apps

Lesson Website

- http://sysnetgrp.net/academy/cs4hs

Evolving of Computing



PCs and Mobile Devices

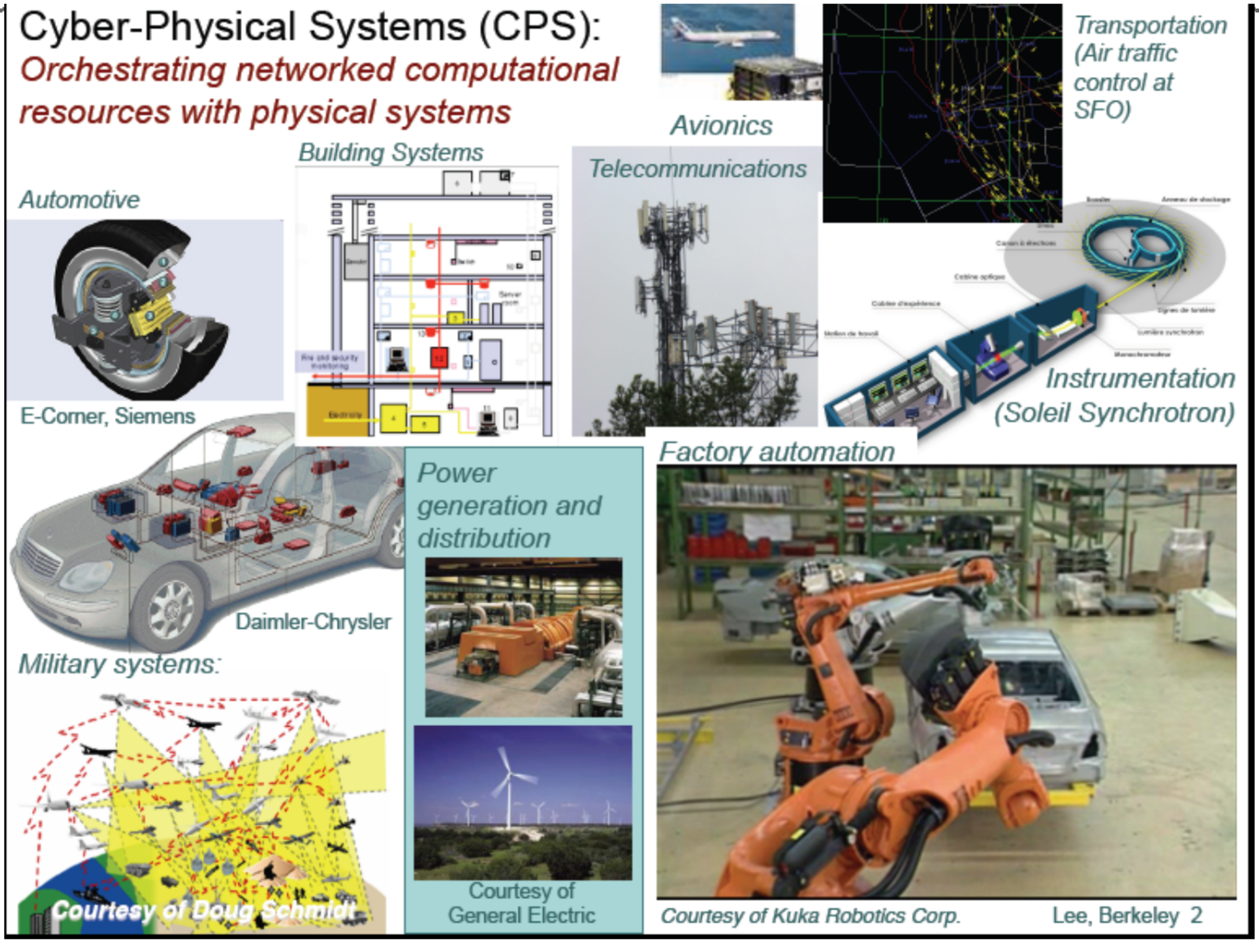
- Big & heavy
- Many peripheral devices and drivers
- Complex support software of many vendors
- Designed for stationary use or limited mobility

- Small & portable
- Sensors in a single case
- One single platform
- Designed for mobility

Smart Phones and Tablets

- New “Instrument’’ for Teaching and Learning
  - Sensors
    - Camera, Accelerometers, GPS, Light, Gyroscope, microphones …
  - Networking
    - 3G, 4G; WiFi; Bluetooth
  - Peripheral devices
    - Android Accessory Development Kit
    - Various vendors and suppliers: e.g., Arduino
- Skills and knowledge can be applied in many applications

Exciting Applications



Cyber-Physical Systems (CPS): *Orchestrating networked computational resources with physical systems*

Avionics

Transportation (Air traffic control at SFO)

Building Systems

Telecommunications

Automotive

E-Corner, Siemens

Daimler-Chrysler

Instrumentation (Soleil Synchrotron)

Factory automation

Power generation and distribution

Military systems:

Courtesy of Doug Schmidt

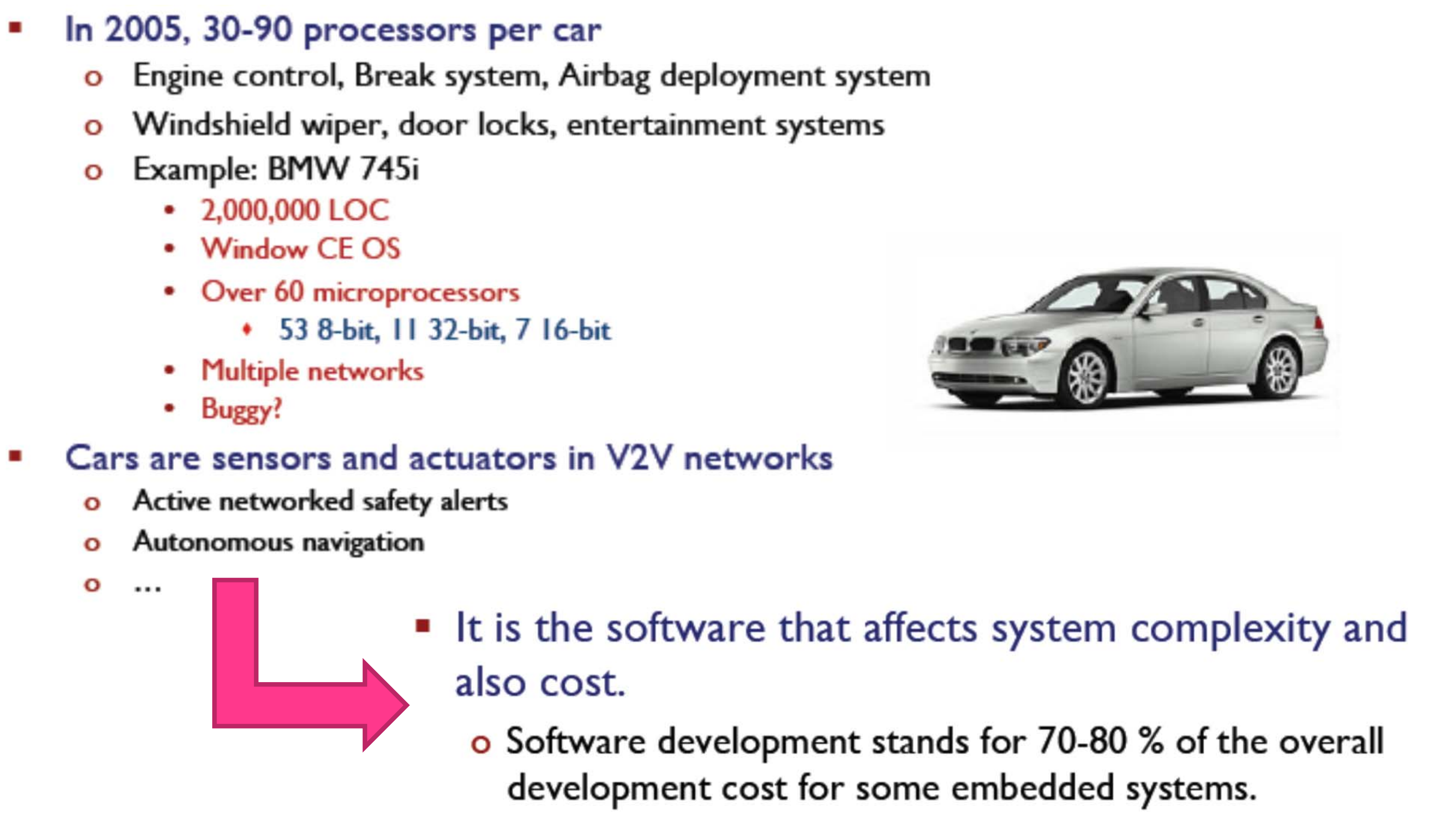
Courtesy of General Electric

Courtesy of Kuka Robotics Corp.

Lee, Berkeley 2

In *Edward A. Lee. Time for High-Confidence Cyber-Physical Systems, Talk or presentation, 20, March, 2012; Invited Plenary Talk, Perfomance Metrics for Intelligent Systems (PerMIS-12) Workshop, University of Maryland.*

Increasing Software Complexity in CPS



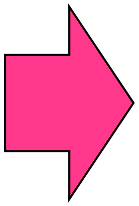
- In 2005, 30-90 processors per car
  - Engine control, Break system, Airbag deployment system
  - Windshield wiper, door locks, entertainment systems
  - Example: BMW 745i
    - 2,000,000 LOC
    - Window CE OS
    - Over 60 microprocessors
      - 53 8-bit, 11 32-bit, 7 16-bit
    - Multiple networks
    - Buggy?
- Cars are sensors and actuators in V2V networks
  - Active networked safety alerts
  - Autonomous navigation
  - …

- It is the software that affects system complexity and also cost.
  - Software development stands for 70-80 % of the overall development cost for some embedded systems.

In *Insup Lee, CIS 480, Spring 2009, http://www.seas.upenn.edu/~lee/09cis480/lec-CPS.pdf*

Opportunity of Android Devices

- Why Android?
  - Open source, can develop on multiple platforms, differentiated cost
- Topics can be explored using Android devices
  - Problem solving
  - UI design
  - Sensor-driven apps
  - Computer vision
  - Robotics ……



Help develop mental model for learning

- Abstraction
- Logic
- Subject matter

- Learn App Inventor for Android **today**

Lesson Plan

- Introduction to Android and App Inventor
- Install the App Inventor Setup
- The “Hello Purr” App
  - Develop and run the App
    - Use emulator
    - Use an Android device
- Sensor-driven applications
  - Location sensor
  - Accelerometer

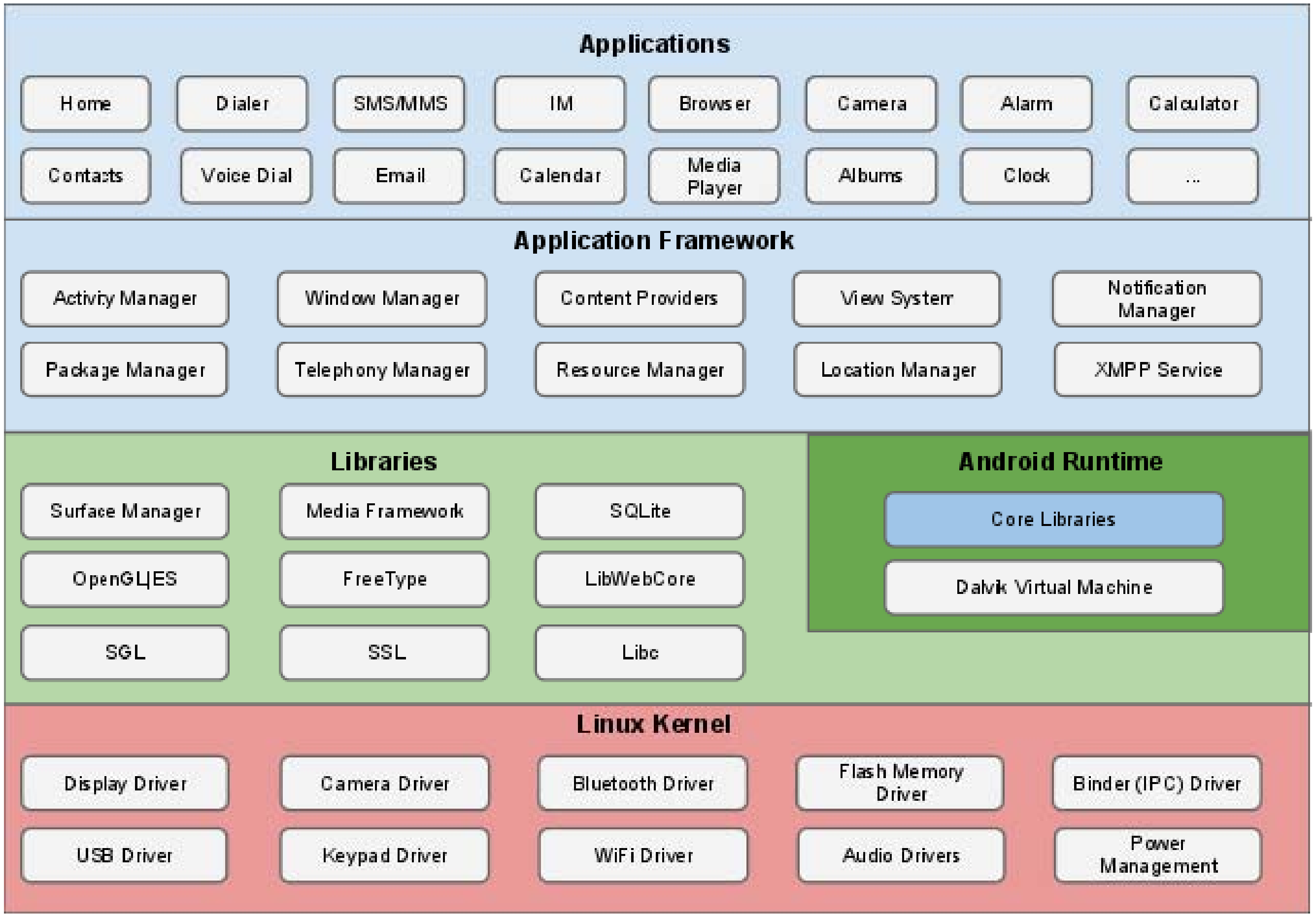
Android

- An open source software stack
  - Updated and maintained by Google and the Open Handset Alliance
  - Source code: http://source.android.com

Android Layers

- Linux kernel
- Standard libraries: Apache HTTP, OpenGL ES, Open SSL, SAX, WebKit, SQLite, libc, FreeType …
- Android framework: Activity Manager, Search Manager, Notification Manager, Media Player, Widow Manager, …
- Android apps and service
  - Executed by the Dalvik virtual machine, a Java virtual machine
  - Android does supports native C/C++ applications

Android Software Stack



Applications

Home, Dialer, SMS/MMS, IM, Browser, Camera, Alarm, Calculator

Contacts, Voice Dial, Email, Calendar, Media Player, Albums, Clock, ...

Application Framework

Activity Manager, Window Manager, Content Providers, View System, Notification Manager

Package Manager, Telephony Manager, Resource Manager, Location Manager, XMPP Service

Libraries

Surface Manager, Media Framework, SQLite

OpenGL|ES, FreeType, LibWebCore

SGL, SSL, Libc

Android Runtime

Core Libraries

Dalvik Virtual Machine

Linux Kernel

Display Driver, Camera Driver, Bluetooth Driver, Flash Memory Driver, Binder (IPC) Driver

USB Driver, Keypad Driver, WiFi Driver, Audio Drivers, Power Management

From: https://source.android.com/tech/security/

Android Applications Packaging

- Packaged and distributed in .apk file
  - APK = Android Package
  - A zip file with a distinct file structure
  - Contains
    - The Android Manifest file
    - A resource bundle (sounds, graphics, etc)
    - The Dalvik classes

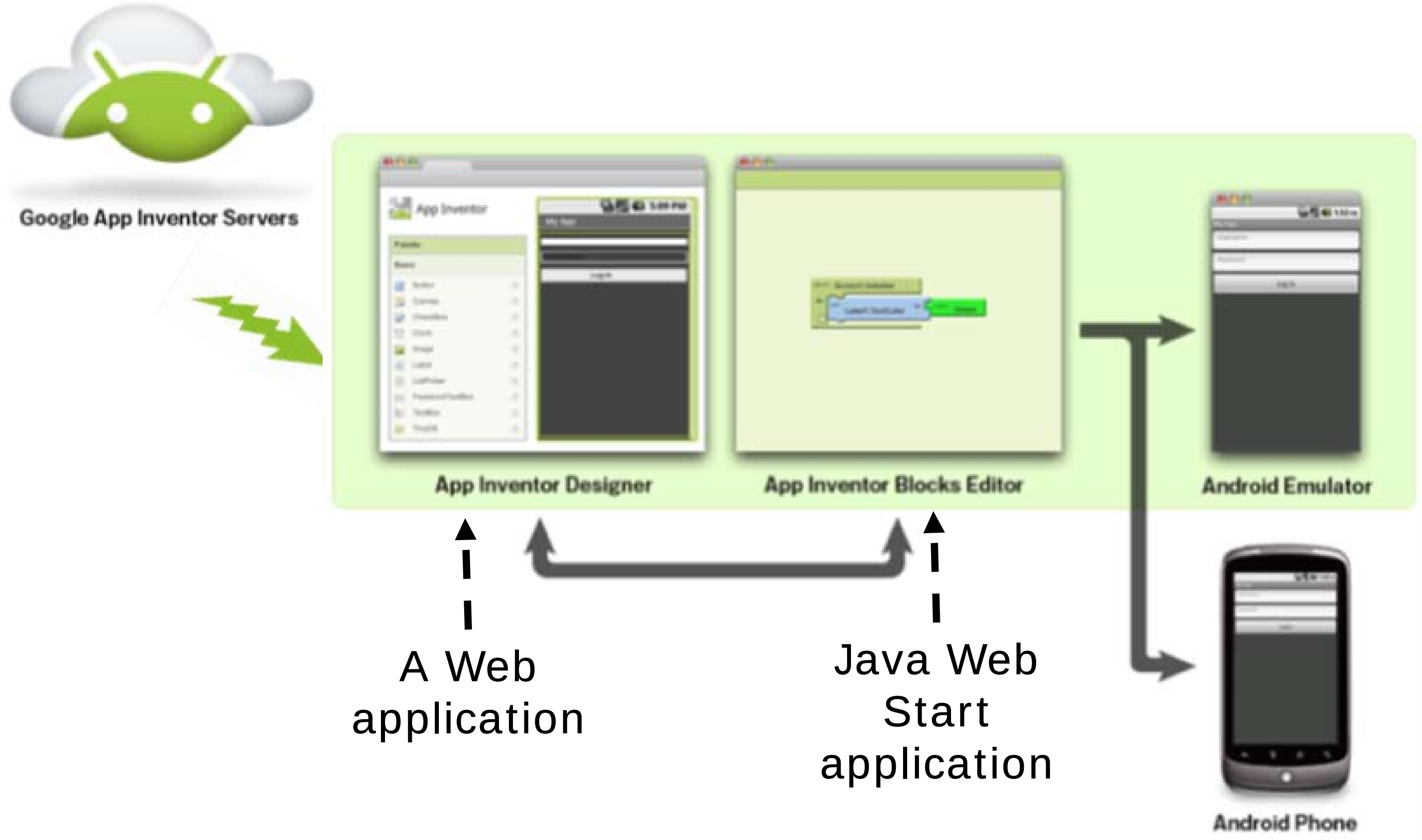
Learn to Develop Android Applications

- Large development environment
  - Java programming language
  - Android SDK and Development Tools
  - Eclipse
  - ……
- Through large software stack
  - Various library, services, and APIs
- **Not trivial** even for experienced developer

Make it More Accessible …

- *App Inventor for Android (or App Inventor)*
  - *Initially developed by Google*
  - *MIT picked it up*
  - *Visual programming (similar to Scratch): creating applications by “drag & drop” visual objects*
- Sofia Framework
  - Stephens H. Edwards, Virginia Tech
  - http://sofia.cs.vt.edu/sigcse2013/
  - Designed for Computer Science CS1/CS2 courses

App Inventor



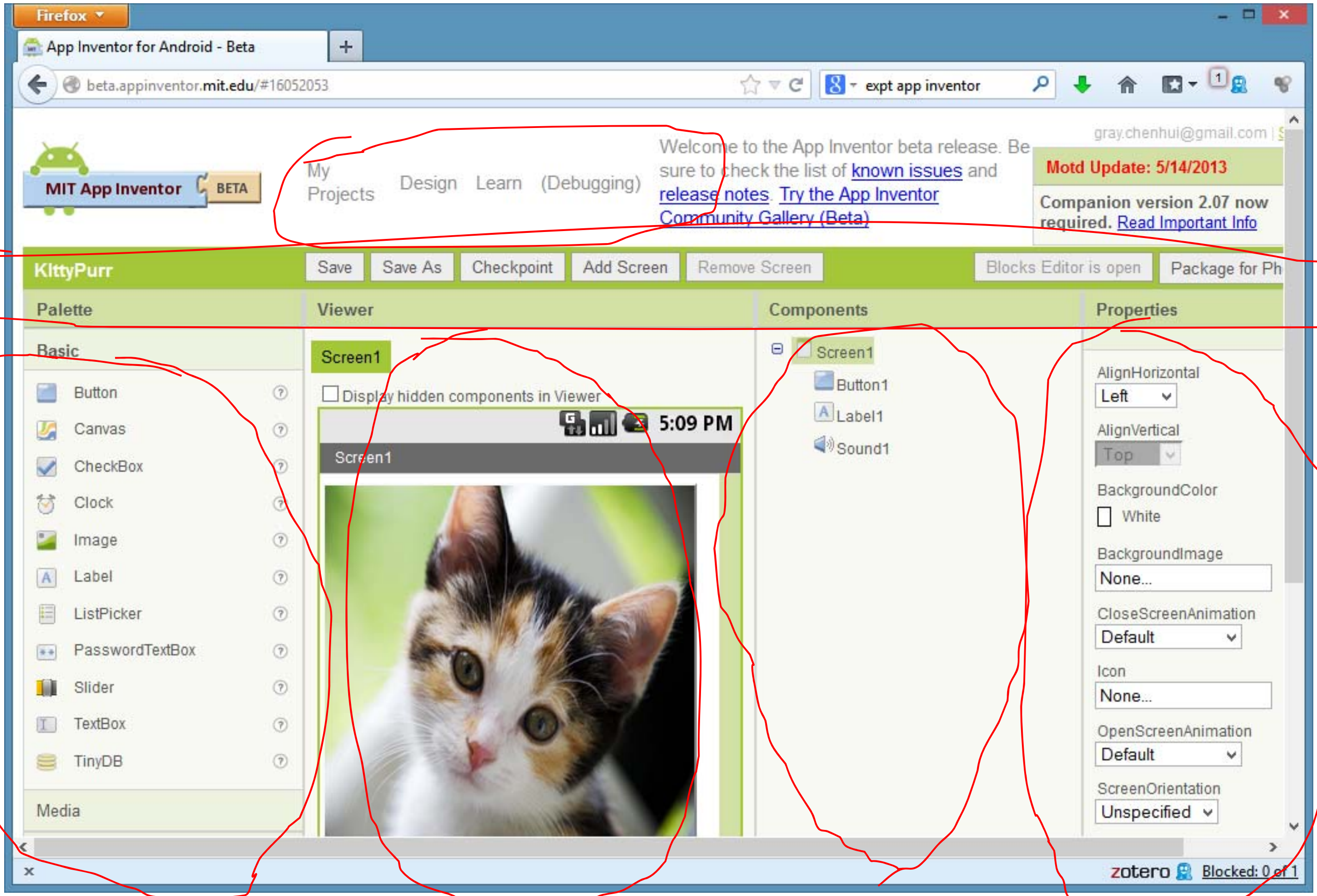
A Web application

Java Web Start application

App Inventor

- The *App Inventor Designer*
  - Select Components and design User Interface
- The *App Inventor Block Editor*
  - Assemble program blocks that specify how the components should behave.
  - Assemble programs visually, fitting pieces together like pieces of a puzzle.
- The *App Inventor Setup*
  - *Install on local computer to support the above*
    - *Emulation, connect to devices, …*

App Inventor Designer



Welcome to the App Inventor beta release. Be sure to check the list of known issues and release notes. Try the App Inventor Community Gallery (Beta)

Motd Update: 5/14/2013

Companion version 2.07 now required. Read Important Info

☐ Display hidden components in Viewer

AlignHorizontal: Left

AlignVertical: Top

BackgroundColor: ☐ White

BackgroundImage: None...

CloseScreenAnimation: Default

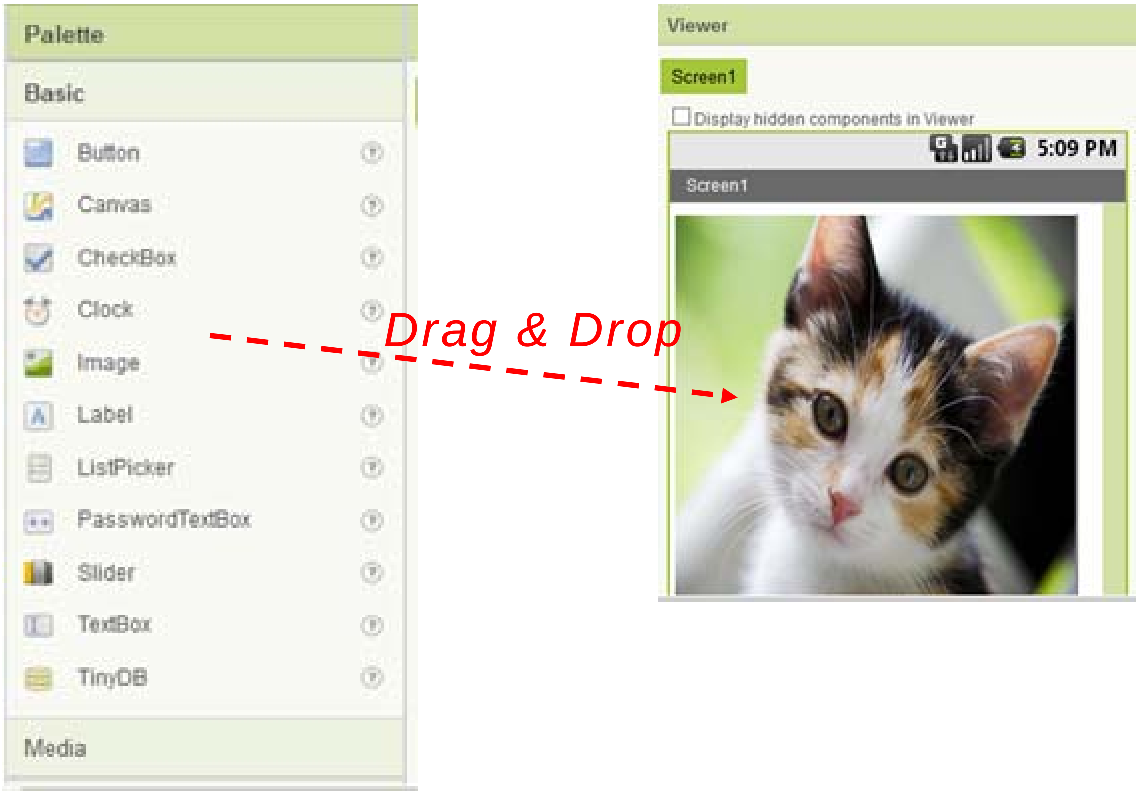
Icon: None...

OpenScreenAnimation: Default

ScreenOrientation: Unspecified

App Inventor Designer

- Select the components for your app.



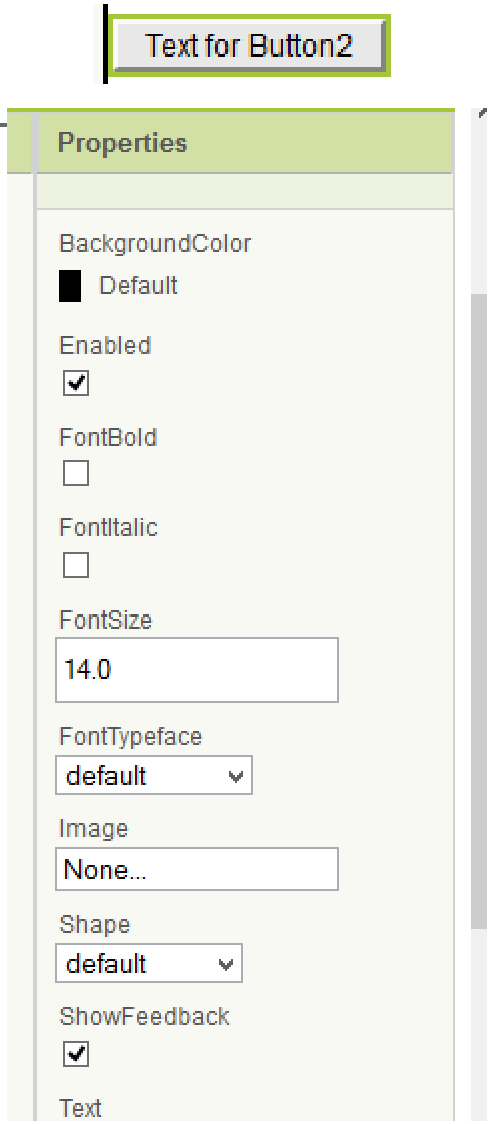
Drag & Drop

Components

- A reusable software module
  - Methods
    - Behavior of the component
  - Events
    - An action or occurrence detected and may be handled by the program
  - Properties
    - Attributes of the component
    - Some may be read-only

The Button Component

- http://appinventor.mit.edu/explore/content/basic.html#Button



Text for Button2

Properties

BackgroundColor
■ Default

Enabled
☑

FontBold
☐

FontItalic
☐

FontSize
14.0

FontTypeface
default

Image
None...

Shape
default

ShowFeedback
☑

Text

The Label Component

- http://appinventor.mit.edu/explore/content/basic.html#Label

The TextBox Component

- http://appinventor.mit.edu/explore/content/basic.html#TextBox

Components

- Basic components
- Media components
- Animation components
- Social components
- Sensor components
- Screen Arrangement components
- LEGO® MINDSTORMS® components
- Other components
- Not ready for prime time components

App Inventor Blocks Editor

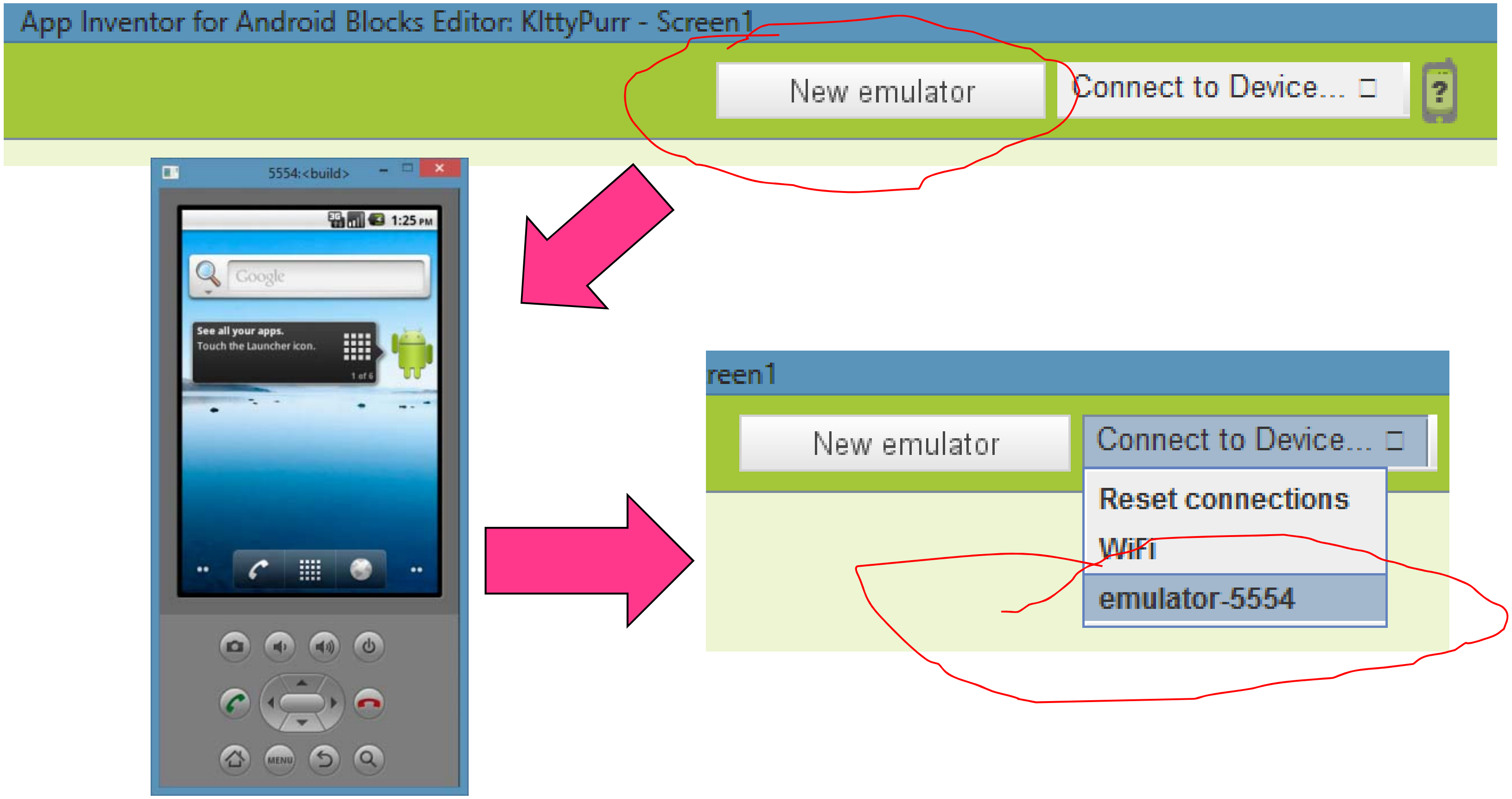
- Use App Inventor Blocks Editor
- Visual programming
  - Assemble “blocks”
  - Control behavior and logic flow
  - Event-driven programming

Blocks

- Event Handlers
- Commands and Expressions
- Control Flow
- Arranging Components on the Screen
- Manipulating Component State
- http://appinventor.mit.edu/explore/understanding-blocks.html

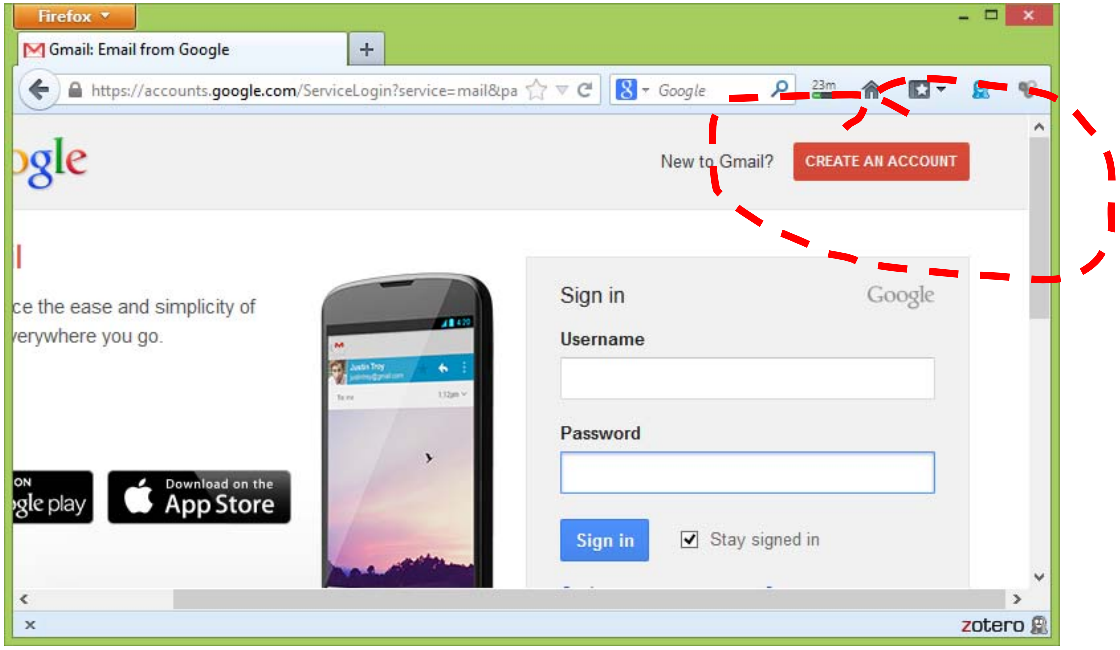
Don’t Have an Android Device: Emulator

- Run on both Android Emulator and Android devices



Google Account

- App Inventor requires a Google Account
- If you don’t have one yet, sign it up now!
  - http://gmail.com or *use provided ones*



https://accounts.google.com/ServiceLogin?service=mail&pa

ce the ease and simplicity of
verywhere you go.

Username

Password

☑ Stay signed in

Install App Inventor Setup

- Step 1: Install or verify Java is installed
- Step 2: Install App Inventor Setup
  - If your network slow, download a “local” copy at the workshop website
- Install without administrative privilege → user specific
- For all users: install with administrative privilege

Let’s begin!

Develop “Hello Purr” App

- Hello Purr
  - *“HelloPurr is a simple app that you can build in a very short time. You create a button that has a picture of a cat on it, and then program the button so that when it is clicked a ‘meow’ sound plays.”*
- Step 1: develop “Hello Purr” App with Emulator
  - Everyone develops the app
- Step 2: deploy the app to an Android device

Follow Tutorial or Follow Me

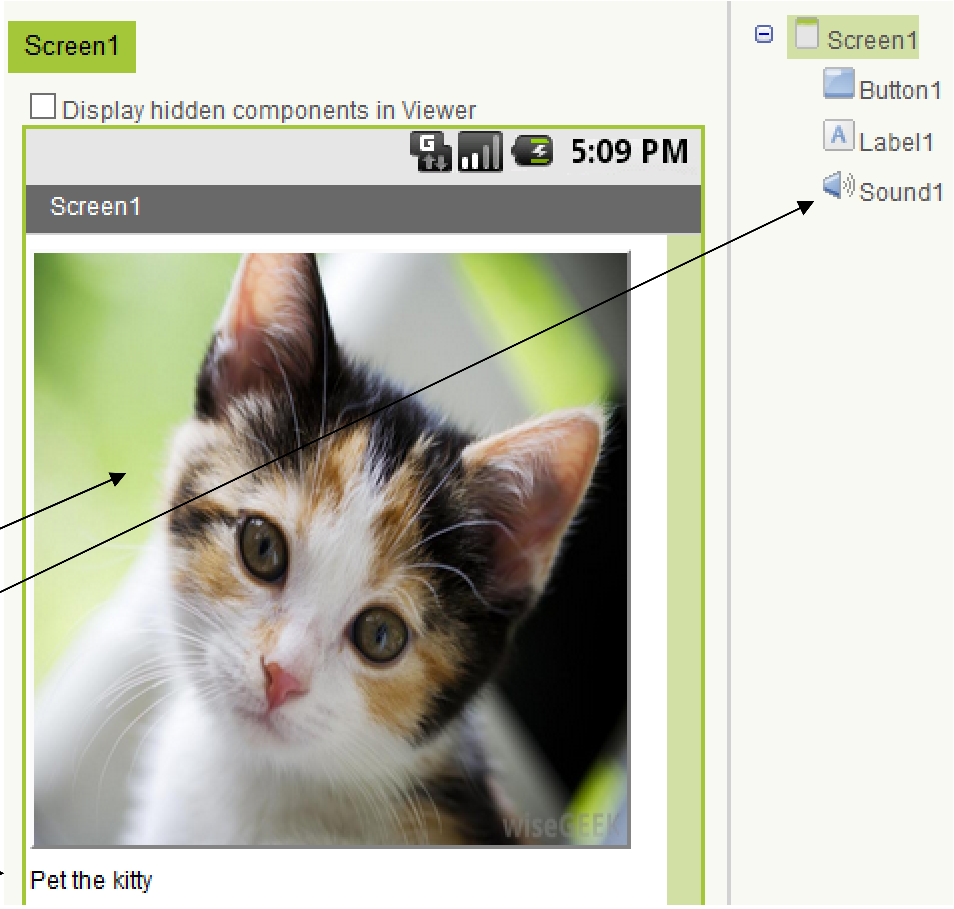
- Tutorial
  - http://appinventor.mit.edu/explore/content/hellopurr.html
- Steps
  - Download media files
  - Design user interface
  - Program application behavior (handle events)

Download Media Files

- Download two media files
  - Links are placed at http://sysnetgrp.net/academy/cs4hs/cs4hs-resources
  - Make sure to do:
    - **Right-click on the mouse, then "Save target as"** (or "Save link as" depending on the browser you are using)
    - **Note** the location (folder) you saved the files
- Kitty picture: kitty.png (Right-click and Save)
  - http://appinventor.mit.edu/explore/sites/all/files/helloPurr/kitty.png
- Meow sound: meow.mp3 (Right-click and Save)
  - http://appinventor.mit.edu/explore/sites/all/files/helloPurr/meow.mp3

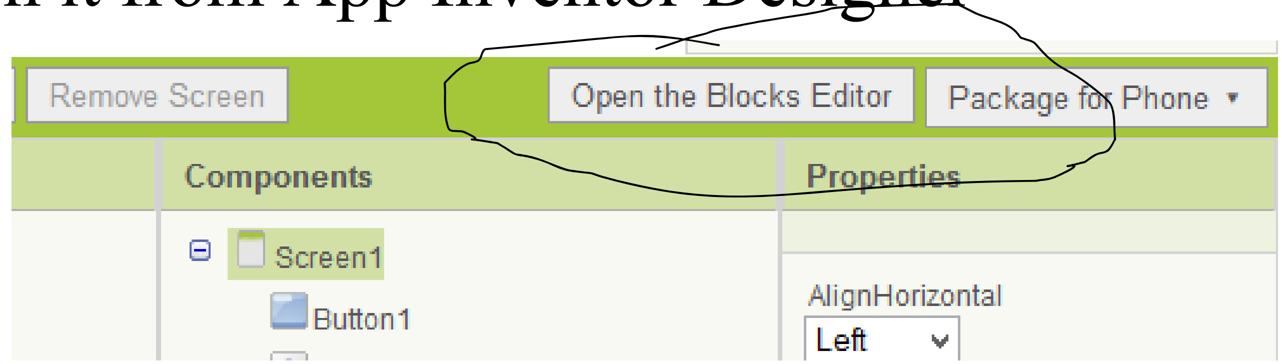
Design User Interface

- Use the App Inventor Designer
- Go to
  - http://beta.appinventor.mit.edu
- Select and arrange components
  - A Button
  - A Sound
  - A Label



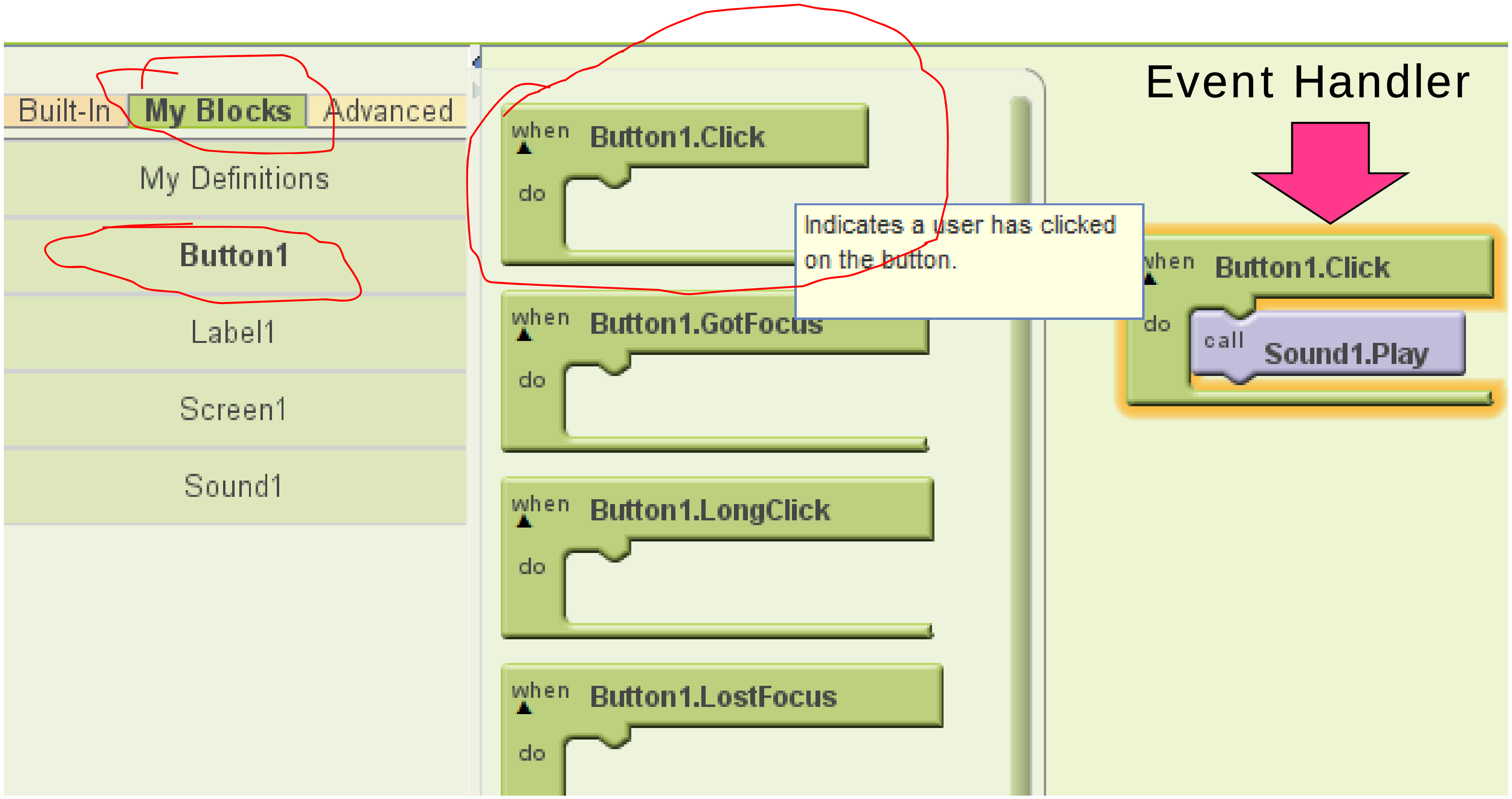
Program Behavior

- Use App Inventor Blocks Editor
- Open it from App Inventor Designer



  - It may take a while!
  - Do not click “Cancel”!
  - Do click “Run”!
  - Leave it open, no need to close!

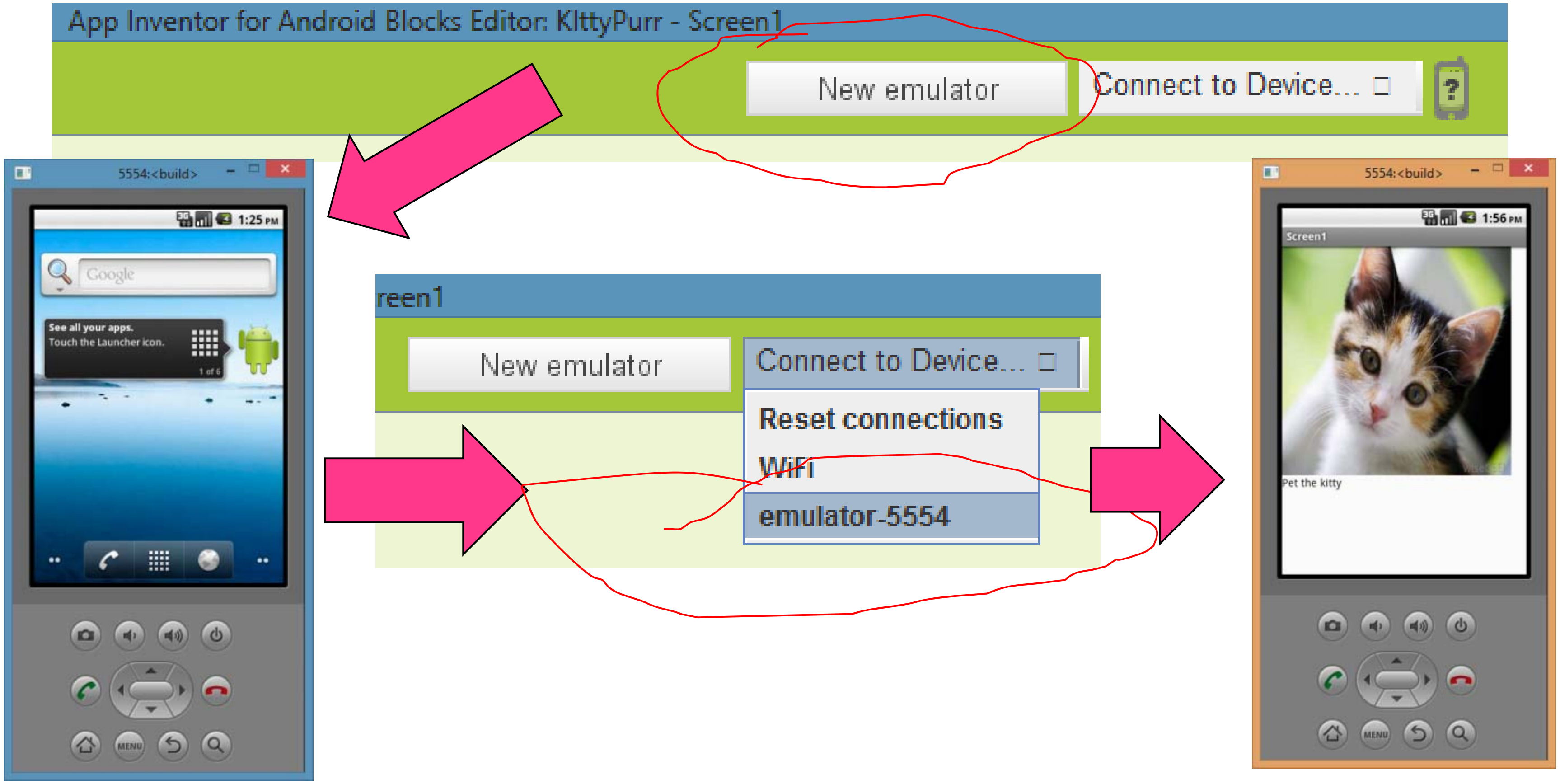
Add Blocks



Indicates a user has clicked on the button.

Ready to Run the App

- Use emulator: it also takes time, be patient



How About Real Android Device?

- The instructors provide an Android Tablet to each participant
- Now, it is the time …

Work with Real Android Device

- Install driver software
  - Typically available from the device's technical support website
- Configure the device for development

Driver Software

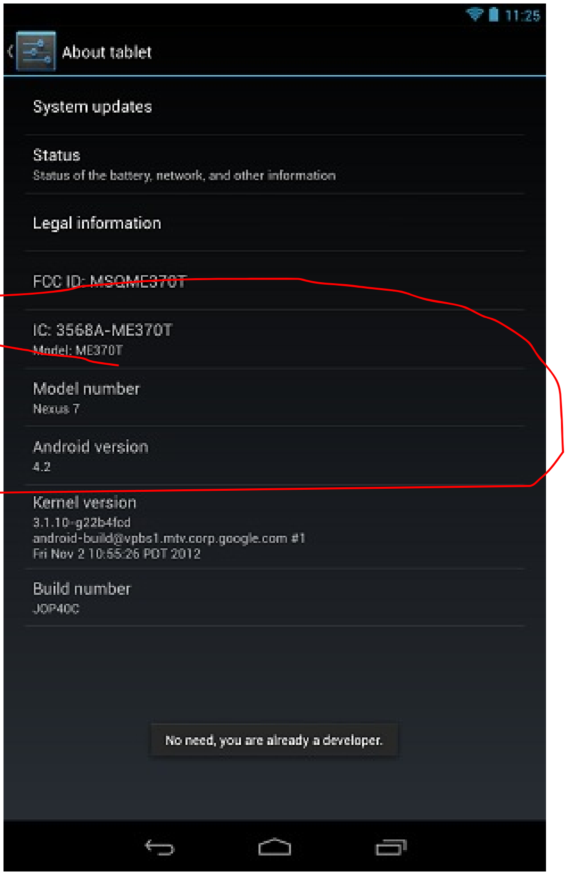
- How to?
  - Identity the device's model
  - Locate the device's driver software
  - Download and install

Identify Device’s Model and Maker

- A device can be marked using different names by different service providers.
- Need to find the phone’s model and maker

Identify Device: Simple Method

- The “Setting” App and then “About …”



11:25

About tablet

System updates

Status
Status of the battery, network, and other information

Legal information

FCC ID: MSQME370T

IC: 3568A-ME370T
Model: ME370T

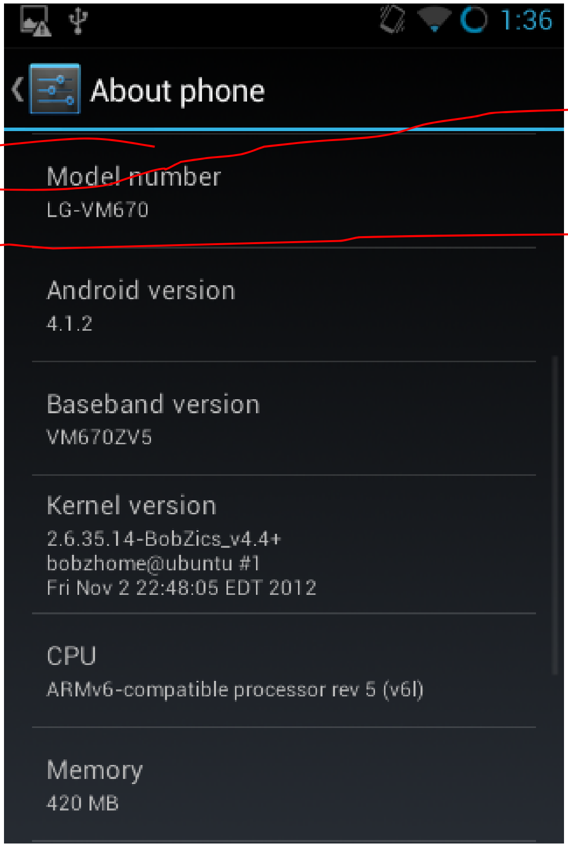
Model number
Nexus 7

Android version
4.2

Kernel version
3.1.10-g22b4fcd
android-build@vpbs1.mtv.corp.google.com #1
Fri Nov 2 10:55:26 PDT 2012

Build number
JOP40C

No need, you are already a developer.



1:36

About phone

Model number
LG-VM670

Android version
4.1.2

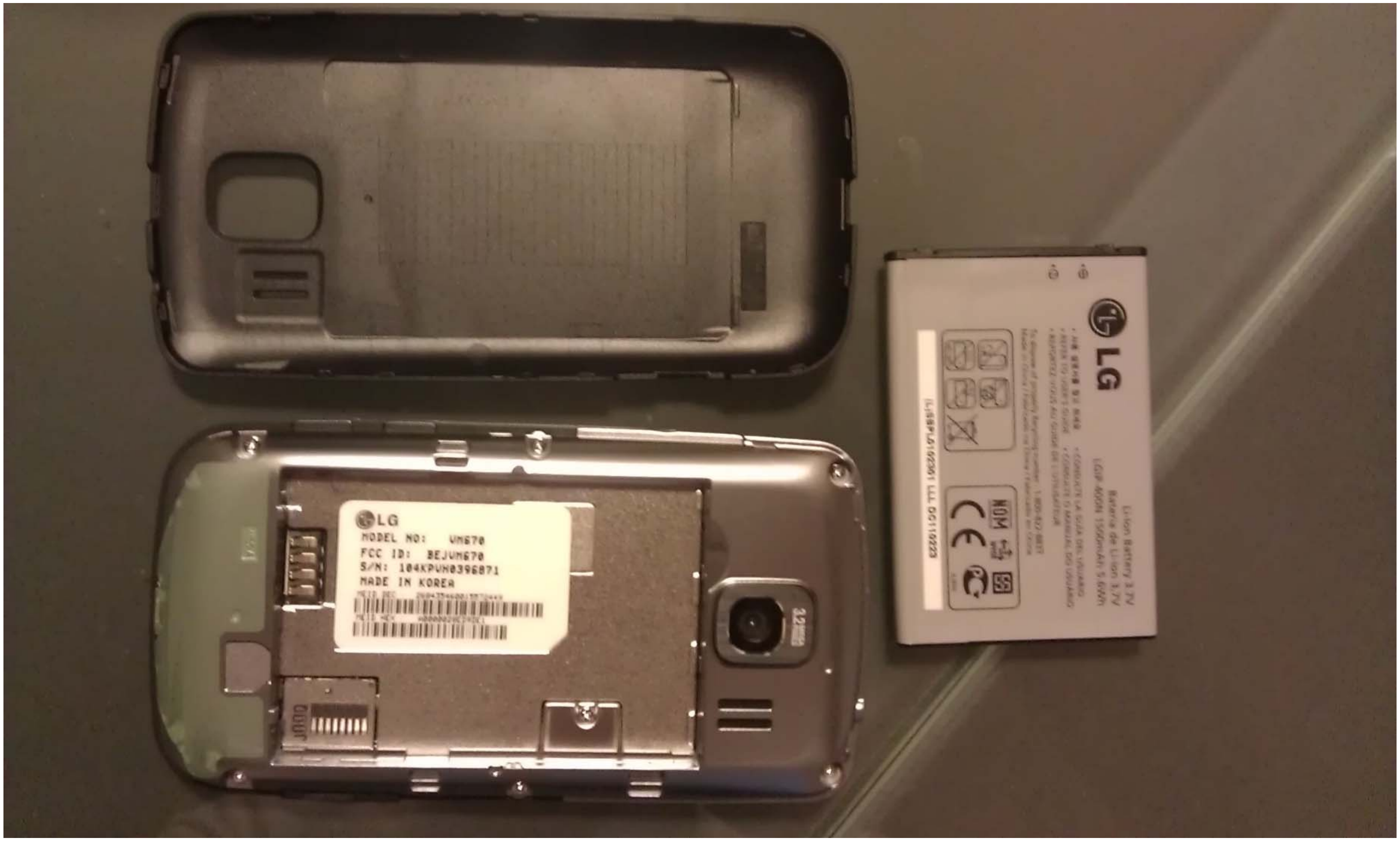
Baseband version
VM670ZV5

Kernel version
2.6.35.14-BobZics_v4.4+
bobzhome@ubuntu #1
Fri Nov 2 22:48:05 EDT 2012

CPU
ARMv6-compatible processor rev 5 (v6l)

Memory
420 MB

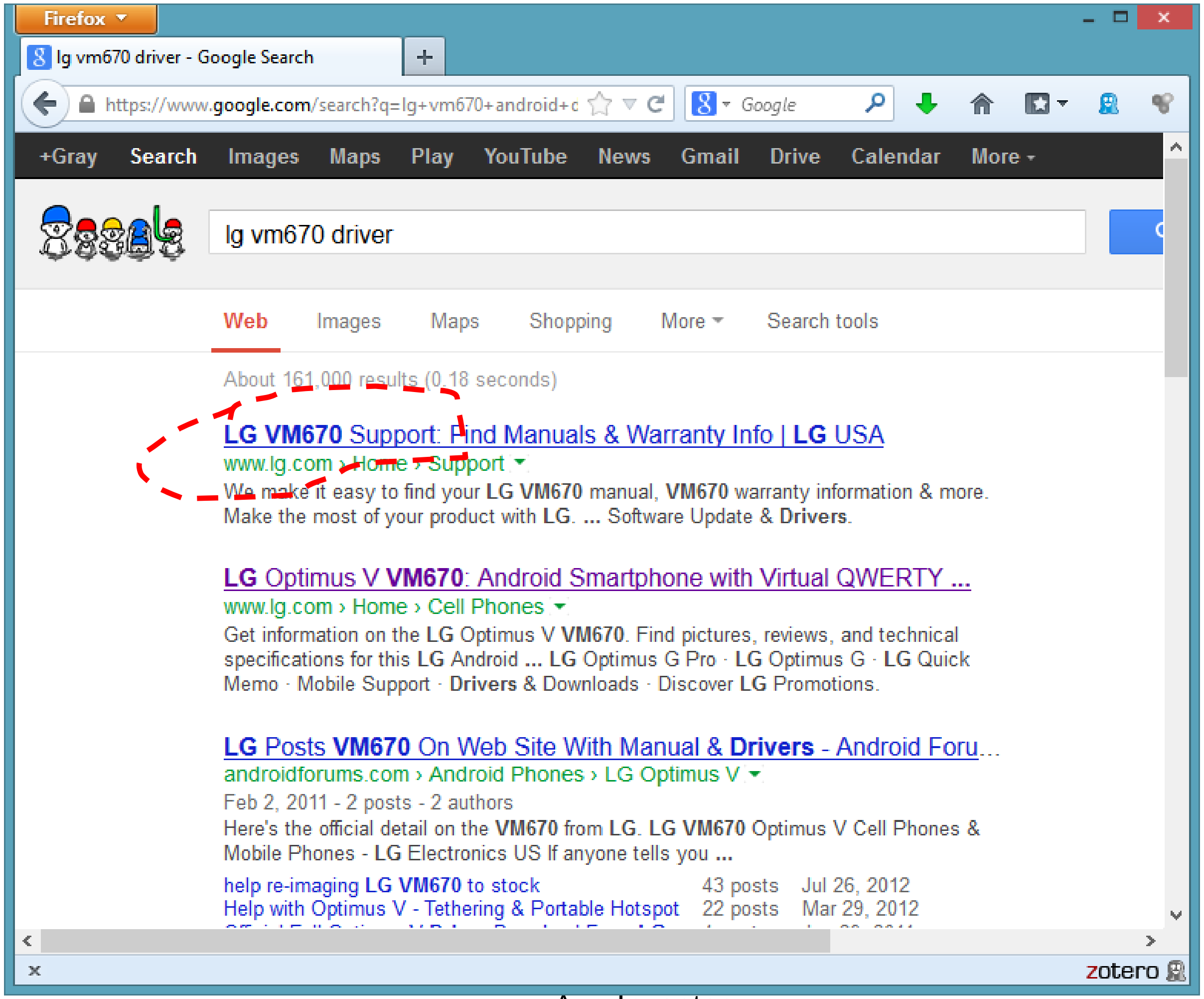
Identify Device: Simpler Method



Driver Software

- Example: LG VM670
  - Google “LG VM670 support”
  - Locate the page belonging to the maker
- Example: Nexus 7
  - Google “Nexus 7 support”
  - Locate the page belonging to the maker

Google Result for LG VM670



lg vm670 driver

About 161,000 results (0.18 seconds)

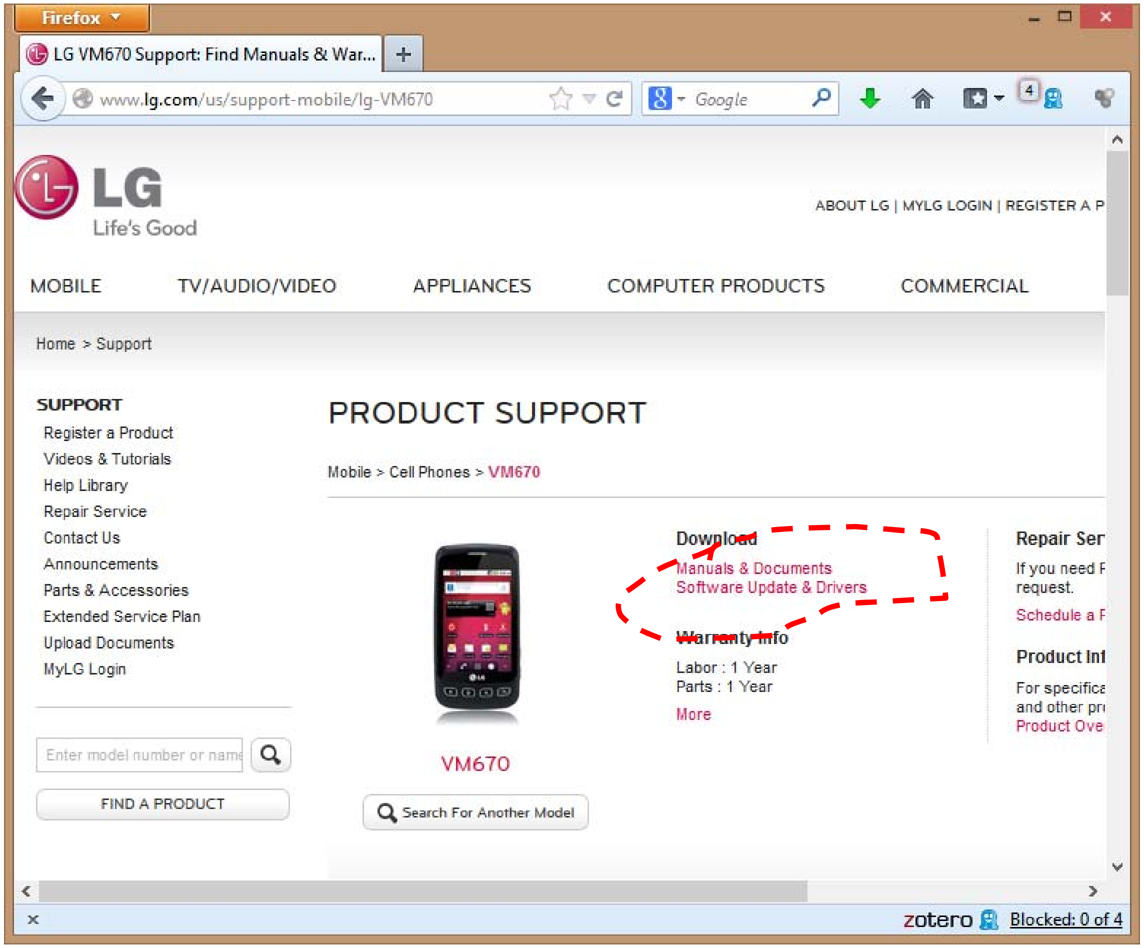
LG VM670 Support: Find Manuals & Warranty Info | LG USA
www.lg.com › Home › Support
We make it easy to find your LG VM670 manual, VM670 warranty information & more. Make the most of your product with LG. ... Software Update & Drivers.

LG Optimus V VM670: Android Smartphone with Virtual QWERTY ...
www.lg.com › Home › Cell Phones
Get information on the LG Optimus V VM670. Find pictures, reviews, and technical specifications for this LG Android ... LG Optimus G Pro · LG Optimus G · LG Quick Memo · Mobile Support · Drivers & Downloads · Discover LG Promotions.

LG Posts VM670 On Web Site With Manual & Drivers - Android Foru...
androidforums.com › Android Phones › LG Optimus V
Feb 2, 2011 - 2 posts - 2 authors
Here's the official detail on the VM670 from LG. LG VM670 Optimus V Cell Phones & Mobile Phones - LG Electronics US If anyone tells you ...

help re-imaging LG VM670 to stock	43 posts	Jul 26, 2012
Help with Optimus V - Tethering & Portable Hotspot	22 posts	Mar 29, 2012

LG VM670 Support Page



Firefox

LG VM670 Support: Find Manuals & War...

www.lg.com/us/support-mobile/lg-VM670

Google

LG Life's Good

ABOUT LG | MYLG LOGIN | REGISTER A P

MOBILE TV/AUDIO/VIDEO APPLIANCES COMPUTER PRODUCTS COMMERCIAL

Home > Support

SUPPORT

- Register a Product
- Videos & Tutorials
- Help Library
- Repair Service
- Contact Us
- Announcements
- Parts & Accessories
- Extended Service Plan
- Upload Documents
- MyLG Login

Enter model number or name

FIND A PRODUCT

PRODUCT SUPPORT

Mobile > Cell Phones > VM670

VM670

Search For Another Model

Download

Manuals & Documents

Software Update & Drivers

Warranty Info

Labor : 1 Year

Parts : 1 Year

More

Repair Ser

If you need r

request.

Schedule a F

Product Inf

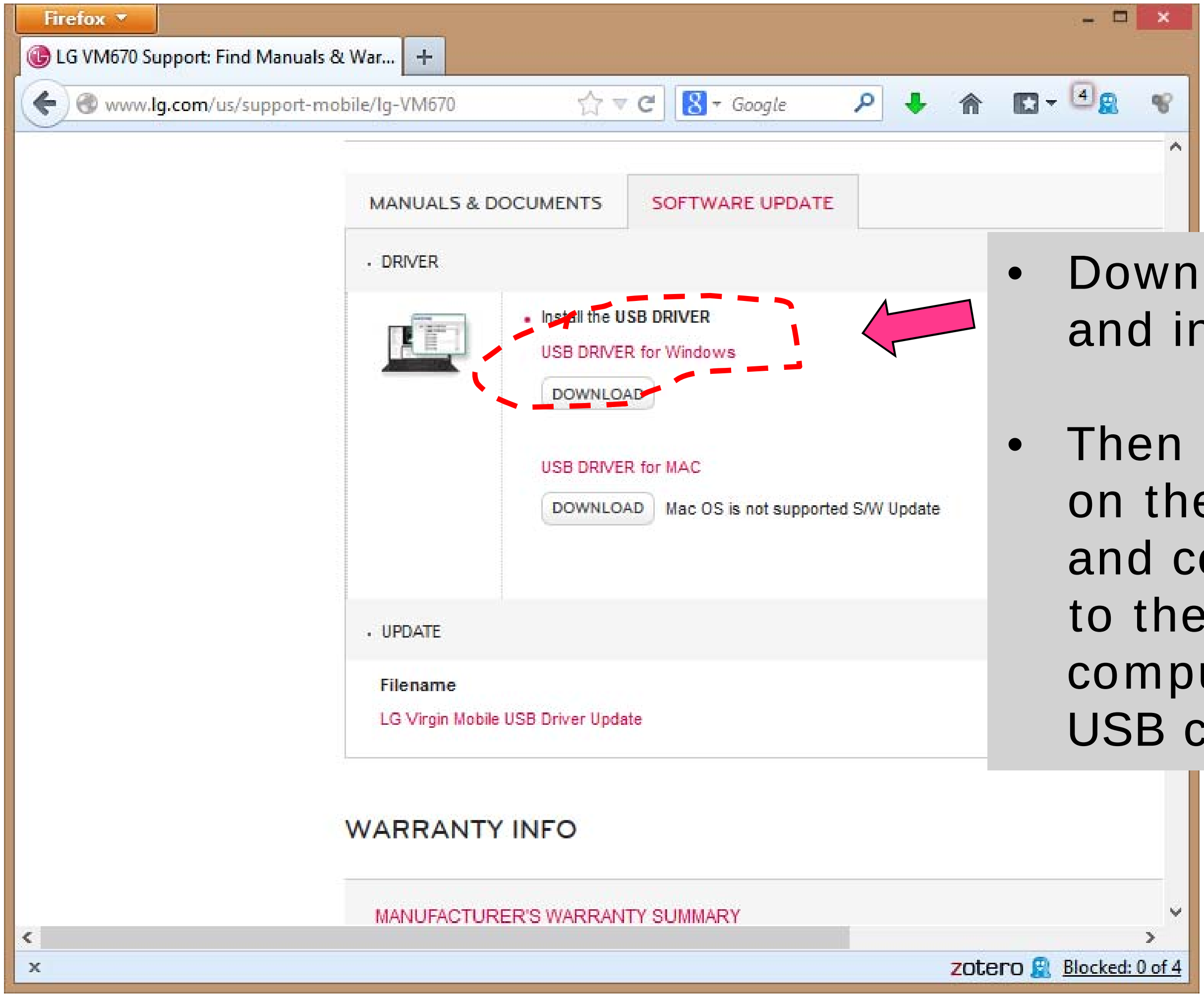
For specifica

and other pr

Product Ove

zotero Blocked: 0 of 4

LG VM670 Driver Software



LG VM670 Support: Find Manuals & War...

www.lg.com/us/support-mobile/lg-VM670

MANUALS & DOCUMENTS | SOFTWARE UPDATE

- DRIVER

Install the USB DRIVER

USB DRIVER for Windows

DOWNLOAD

USB DRIVER for MAC

DOWNLOAD Mac OS is not supported S/W Update

- UPDATE

Filename

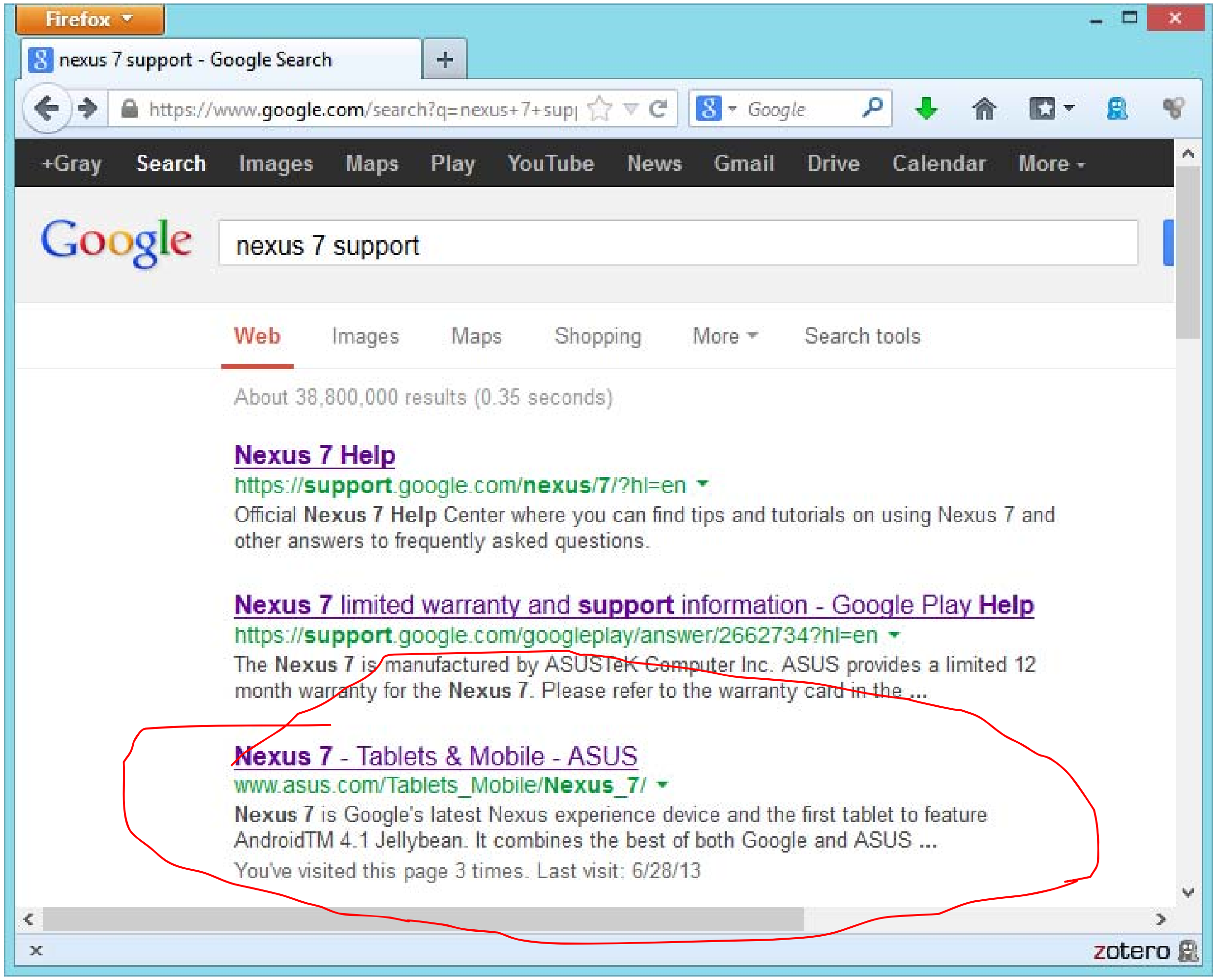
LG Virgin Mobile USB Driver Update

WARRANTY INFO

MANUFACTURER'S WARRANTY SUMMARY

- Download and install
- Then power on the phone and connect to the computer via USB cable

Google Result for Nexus 7



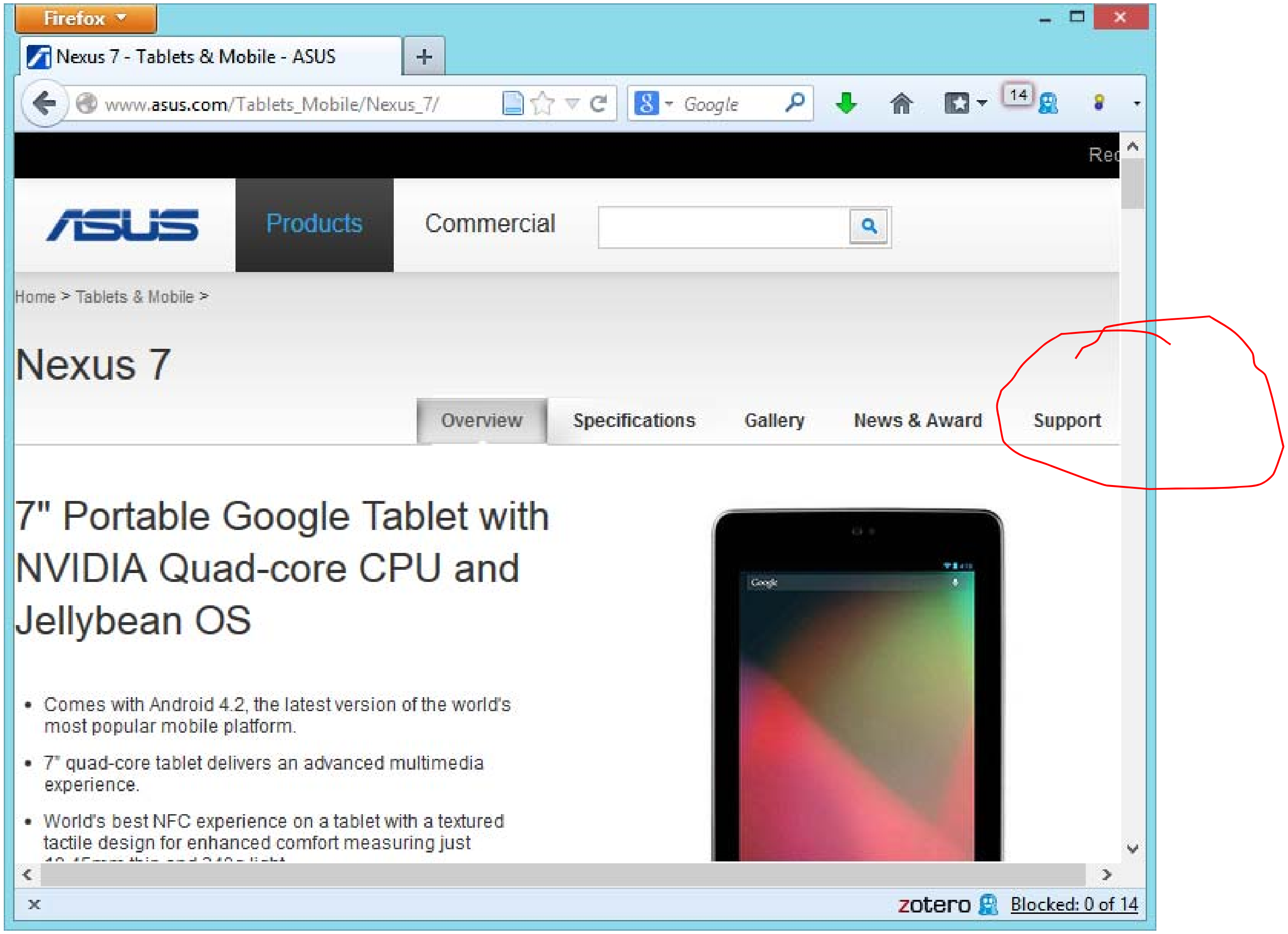
About 38,800,000 results (0.35 seconds)

Nexus 7 Help
https://support.google.com/nexus/7/?hl=en
Official Nexus 7 Help Center where you can find tips and tutorials on using Nexus 7 and other answers to frequently asked questions.

Nexus 7 limited warranty and support information - Google Play Help
https://support.google.com/googleplay/answer/2662734?hl=en
The Nexus 7 is manufactured by ASUSTeK Computer Inc. ASUS provides a limited 12 month warranty for the Nexus 7. Please refer to the warranty card in the ...

Nexus 7 - Tablets & Mobile - ASUS
www.asus.com/Tablets_Mobile/Nexus_7/
Nexus 7 is Google's latest Nexus experience device and the first tablet to feature AndroidTM 4.1 Jellybean. It combines the best of both Google and ASUS ...
You've visited this page 3 times. Last visit: 6/28/13

Locate “Support Page”

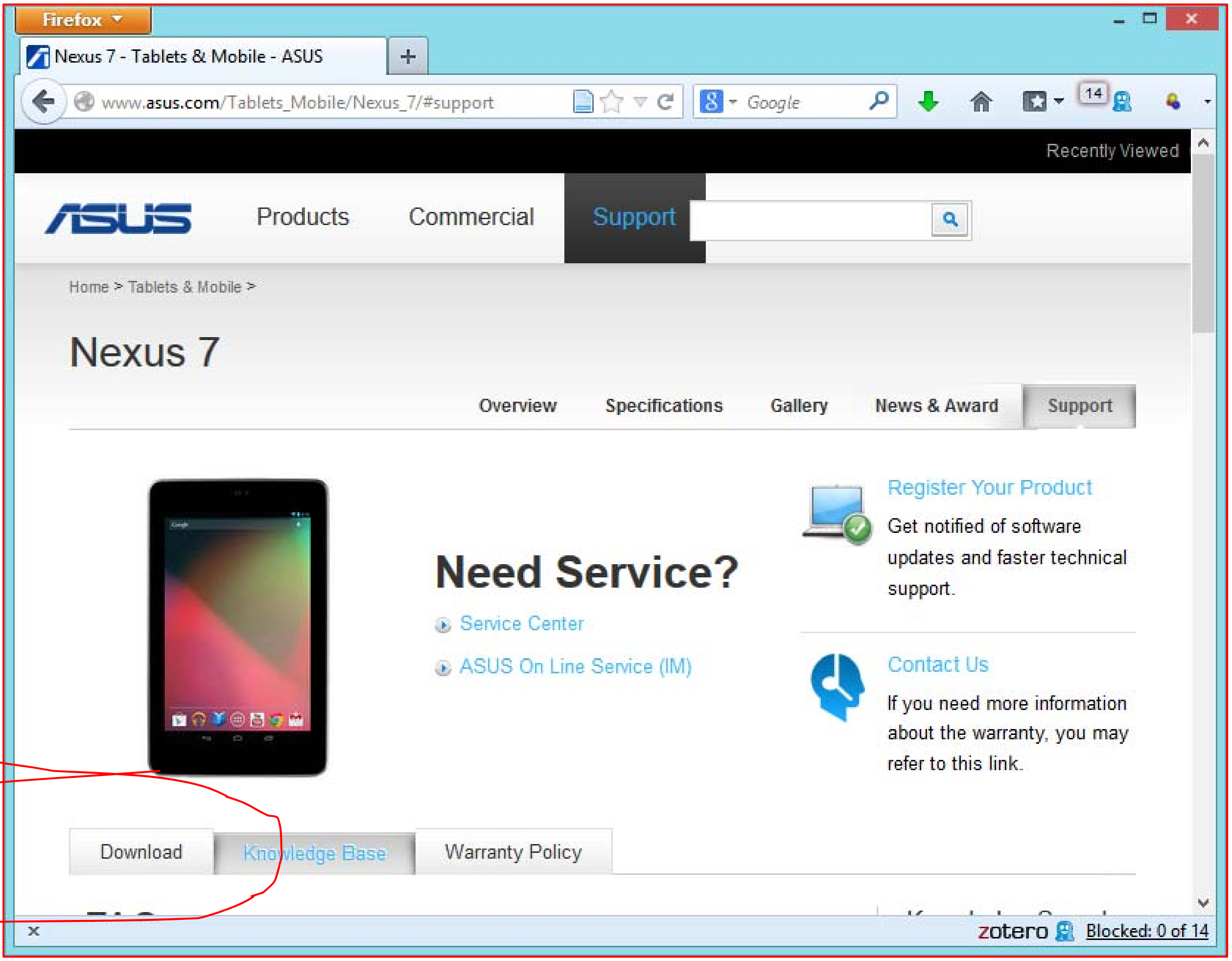


Nexus 7

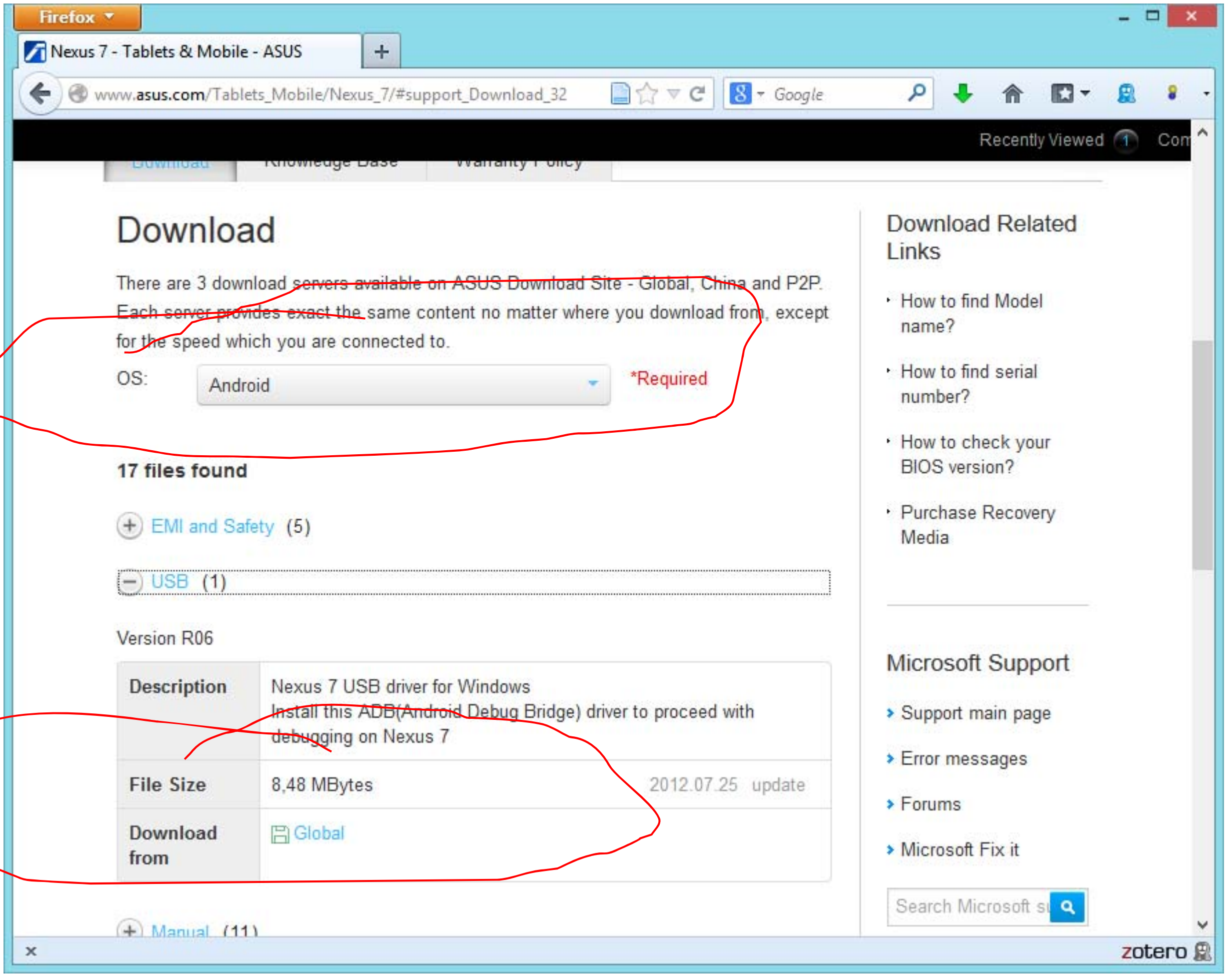
7" Portable Google Tablet with NVIDIA Quad-core CPU and Jellybean OS

- Comes with Android 4.2, the latest version of the world's most popular mobile platform.
- 7" quad-core tablet delivers an advanced multimedia experience.
- World's best NFC experience on a tablet with a textured tactile design for enhanced comfort measuring just

Locate “Download”


Firefox
Nexus 7 - Tablets & Mobile - ASUS
www.asus.com/Tablets_Mobile/Nexus_7/#support
Google
14
Recently Viewed
ASUS
Products
Commercial
Support
Home > Tablets & Mobile >
Nexus 7
Overview
Specifications
Gallery
News & Award
Support
Need Service?
Service Center
ASUS On Line Service (IM)
Register Your Product
Get notified of software updates and faster technical support.
Contact Us
If you need more information about the warranty, you may refer to this link.
Download
Knowledge Base
Warranty Policy
zotero
Blocked: 0 of 14

Locate the “Driver”



Firefox
Nexus 7 - Tablets & Mobile - ASUS
www.asus.com/Tablets_Mobile/Nexus_7/#support_Download_32
Google
Recently Viewed
Download
Knowledge Base
Warranty Policy

Download

There are 3 download servers available on ASUS Download Site - Global, China and P2P. Each server provides exact the same content no matter where you download from, except for the speed which you are connected to.

OS: Android *Required

17 files found

+ EMI and Safety (5)

− USB (1)

Version R06

Description	Nexus 7 USB driver for Windows Install this ADB(Android Debug Bridge) driver to proceed with debugging on Nexus 7
File Size	8,48 MBytes 2012.07.25 update
Download from	Global

+ Manual (11)

Configuration on Device

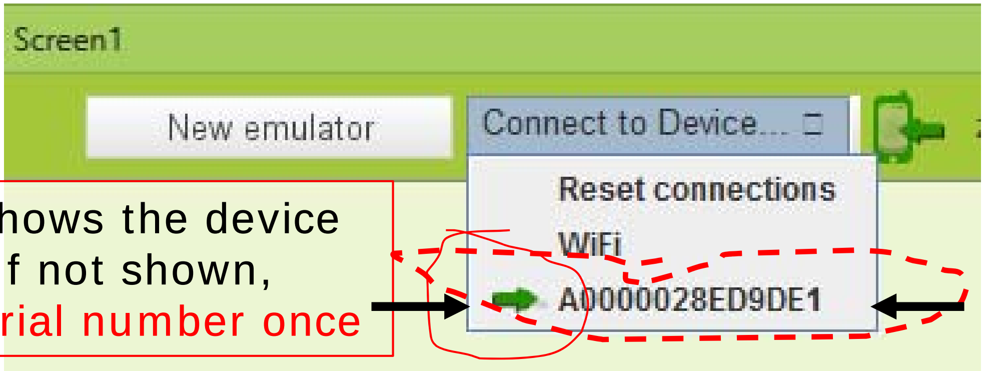
- Old versions of Android
  - LG VM670 (Android 2.2.1)
    - Allow phone to install apps from *Unknown Sources*
      - Settings → Applications → Check *Unknown Sources*
    - Allow *USB Debugging*
      - Settings → Applications → Development → Check *USB Debugging*
- New versions of Android
  - Nexus 7
    - Allow device to install apps from *Unknown Sources*
      - Settings → Security → Check "Unknown sources" (may also uncheck "Verify apps")
    - Allow *USB Debugging*
      - Settings → About … → Tap "Build number" 7 times; then Settings → Developer options → Check "USB debugging"

More Detailed Description …

- http://sysnetgrp.net/academy/cs4hs/cs4hs-resources/nexus-7

Download App to Device (1)

- Launch the *App Inventor Designer*
  - http://beta.appinventor.mit.edu
  - Open the App project
- Make sure the device is connected
- Open the *App Inventor Blocks Editor*. Make sure the connected device is shown

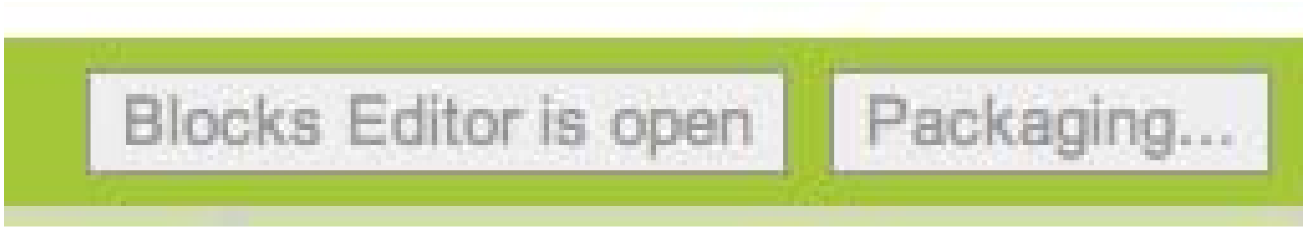


Green arrow shows the device is connected. If not shown, click on the serial number once

Serial No of the device

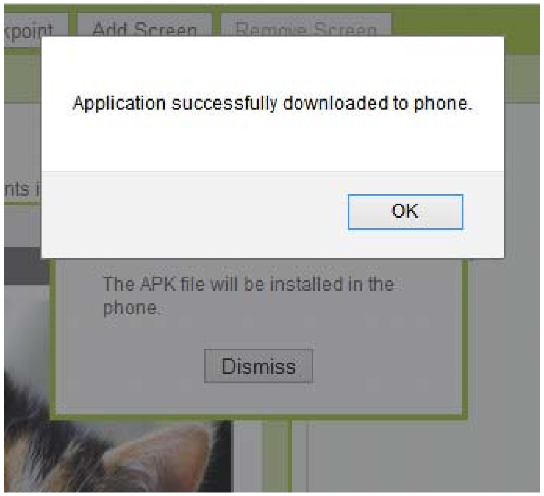
Download App to Device (2)

- Go back to the Designer and click the "Package for Phone" button, then "Download to Connected Phone".
- The button should turn gray and say "Packaging." It takes about 3 to 5 minutes to complete the packaging process. Do not disconnect your device or touch the USB cable during this time.

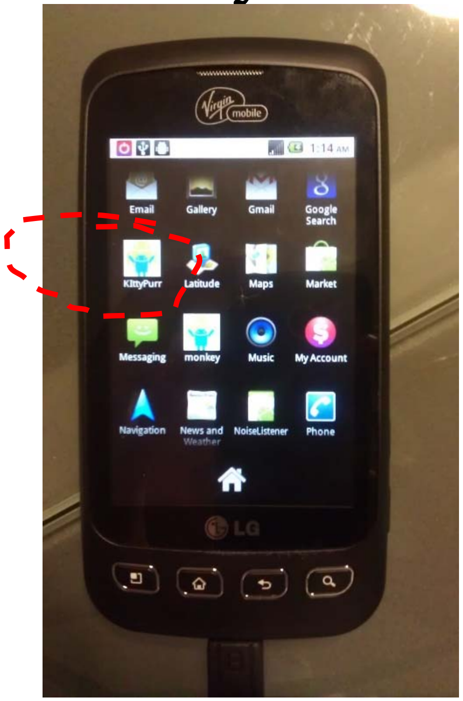


Download App to Device (3)

- After the packaging is completed, a pop-up notification indicates the app is downloaded.
- The app with an Android icon stored in the same place as all the other apps you have on your device.


Application successfully downloaded to phone.

The APK file will be installed in the phone.



Run App on Device

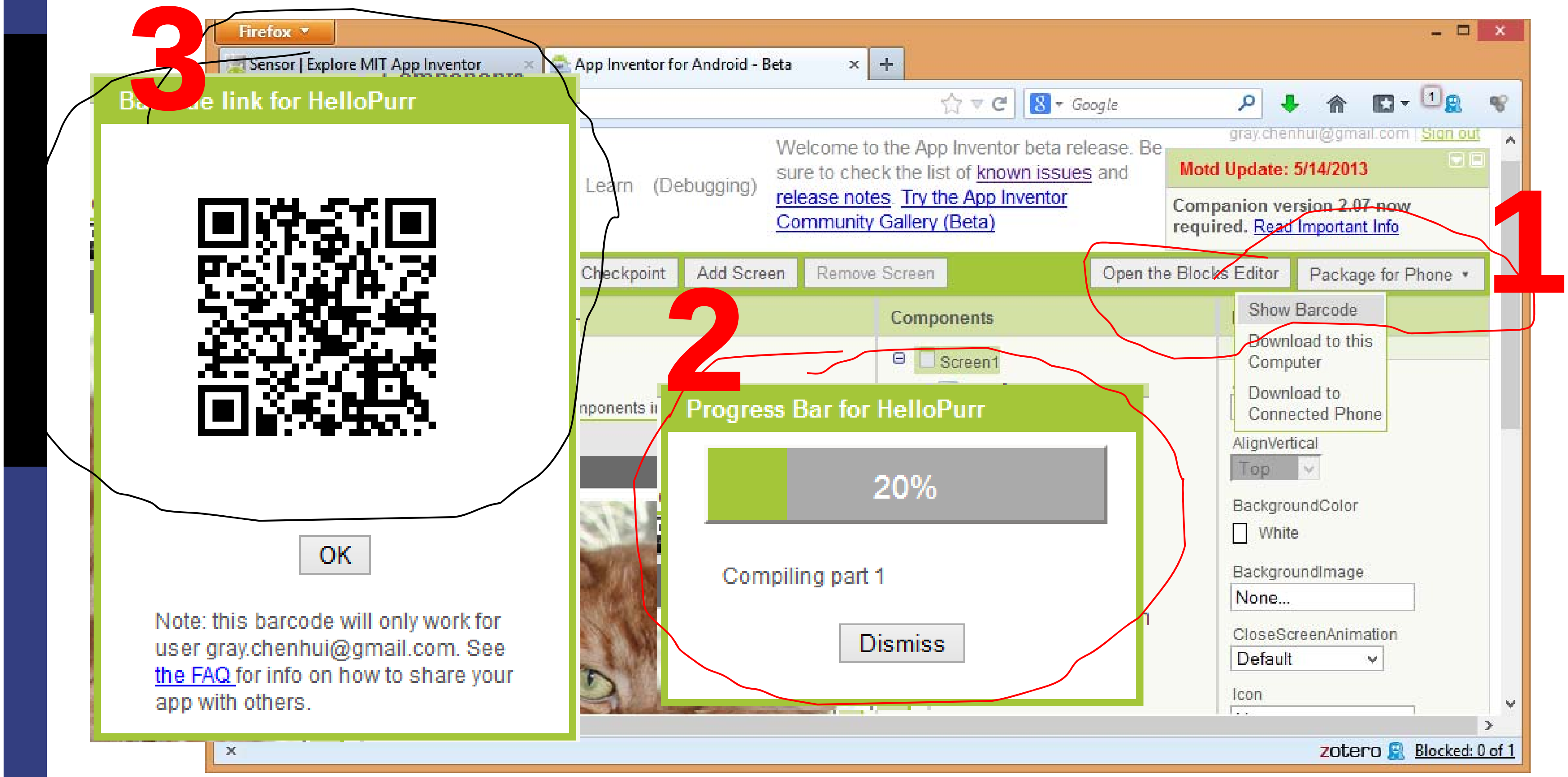
- Tap the app and see what happens!
- The Kitty Purr app
  - Does it meow?
  - Does the device vibrate?

App Inventor Specific Method: MIT AICompanion

- Install App Inventor Apps without installing device driver
  - Require data network connectivity
  - Require the MIT AICompanion App
- Download and install the MIT AICompanion App
  - Tag on Google Play Store on the device
  - Search MIT AICompanion
  - Select the App and Tap on “Download and Install”

Install App Inventor Apps using MIT AICompanion: QR Code

- Show the QR code of the App



Welcome to the App Inventor beta release. Be sure to check the list of known issues and release notes. Try the App Inventor Community Gallery (Beta)

Motd Update: 5/14/2013

Companion version 2.07 now required. Read Important Info

Progress Bar for HelloPurr

20%

Compiling part 1

Dismiss

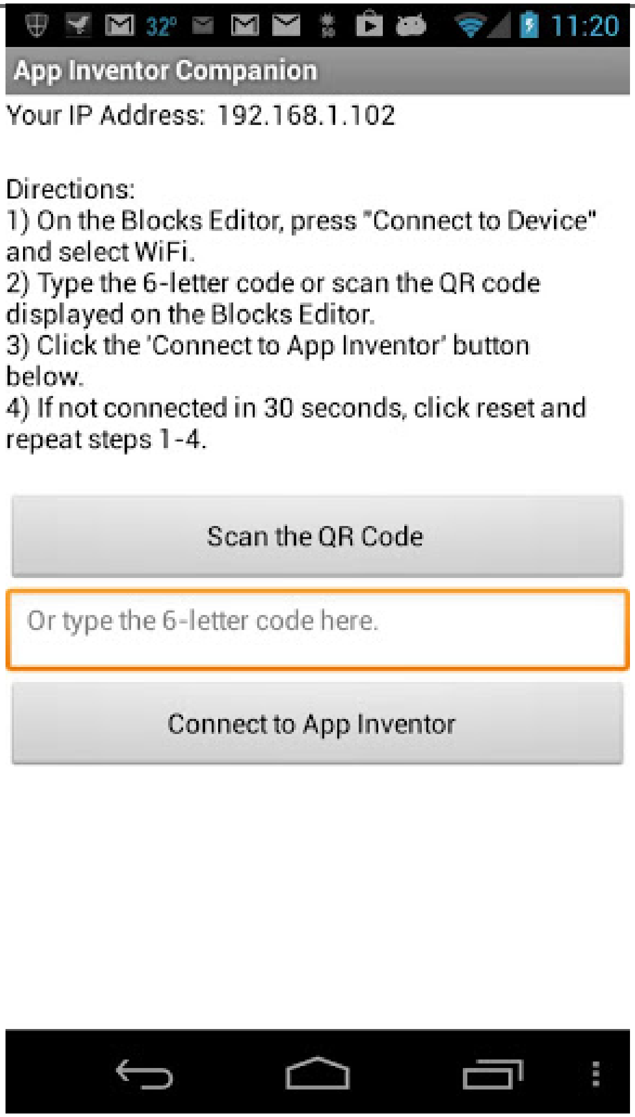
Barcode link for HelloPurr

OK

Note: this barcode will only work for user gray.chenhui@gmail.com. See the FAQ for info on how to share your app with others.

Install App Inventor Apps using MIT AICompanion: Install App

- Run the MIT AICompanion App on the device
- Scan the QR Code using the MIT AICompanion App
- Alternatively enter 6-letter code from the Blocks Editor (see next slide)

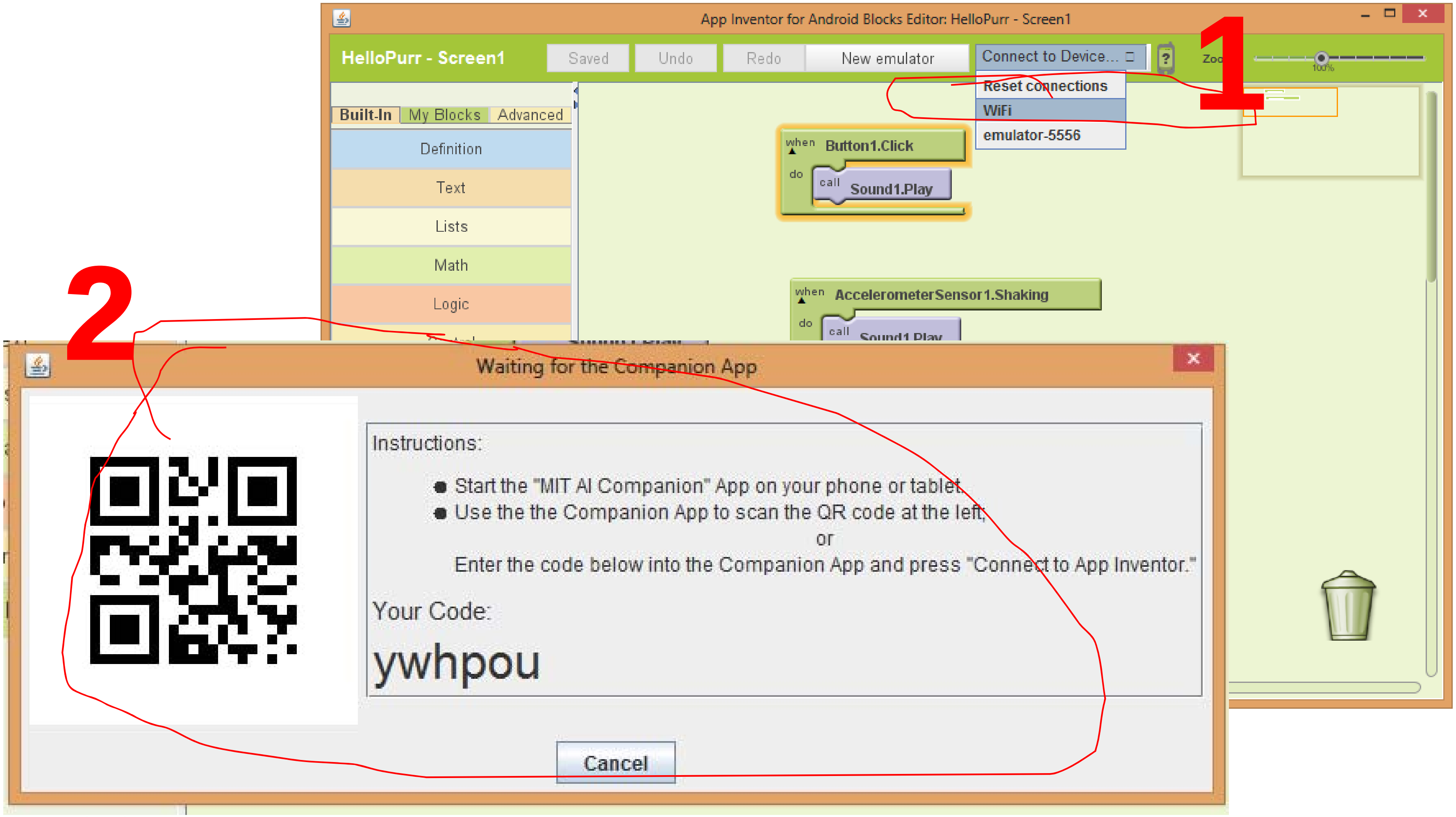


App Inventor Companion

Your IP Address: 192.168.1.102

Directions:
1) On the Blocks Editor, press "Connect to Device" and select WiFi.
2) Type the 6-letter code or scan the QR code displayed on the Blocks Editor.
3) Click the 'Connect to App Inventor' button below.
4) If not connected in 30 seconds, click reset and repeat steps 1-4.

Install App Inventor Apps using MIT AICompanion: Install App



Instructions:

- Start the "MIT AI Companion" App on your phone or tablet
- Use the the Companion App to scan the QR code at the left,

or

Enter the code below into the Companion App and press "Connect to App Inventor."

Your Code:

ywhpou

Sensor-Driven Applications

- Smart phones and tablets have many sensors
  - Location sensor (GPS or network)
  - Accelerometer
  - Orientation sensor and gyroscope
  - Proximity sensor (light sensor)
  - Camera sensor
  - Acoustic sensor (microphone)
  - ……

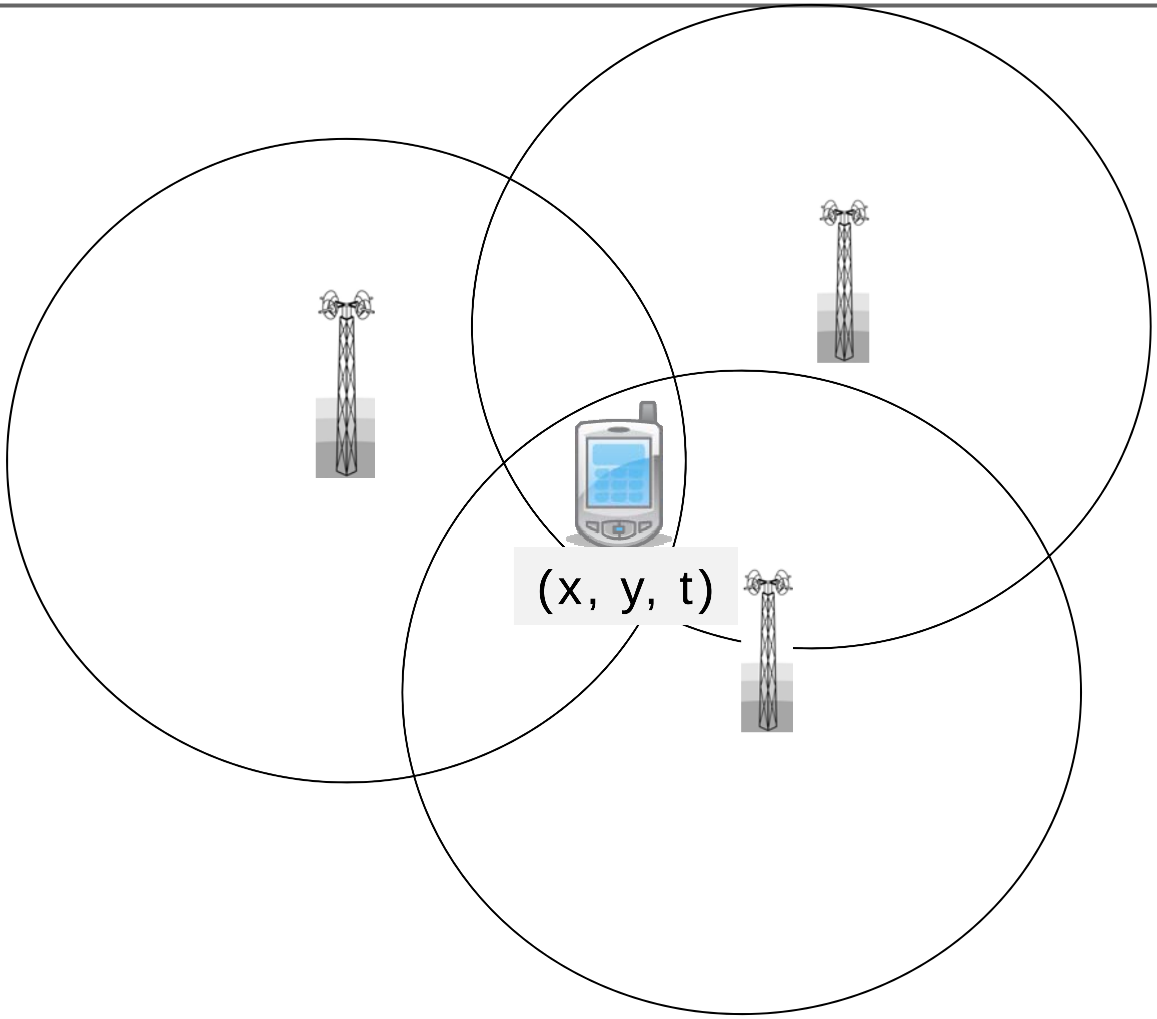
Sensor Data

- Characteristics
  - Continuously streams of data
  - Vary with time
  - Noisy and sometimes can be erroneous
- How to store, process, and use the data is new to many
  - Filtering
  - Statistical processing
  - ……

Location Sensor

- Common “providers”
  - Wireless networks
    - Using triangulation of multiple base stations
  - Global Positioning Systems
    - e.g., the U.S. Global Positioning Systems (GPS)
    - Using triangulation of 4+ satellites on Median Earth Orbit (~20,200km)

Base Station Triangulation



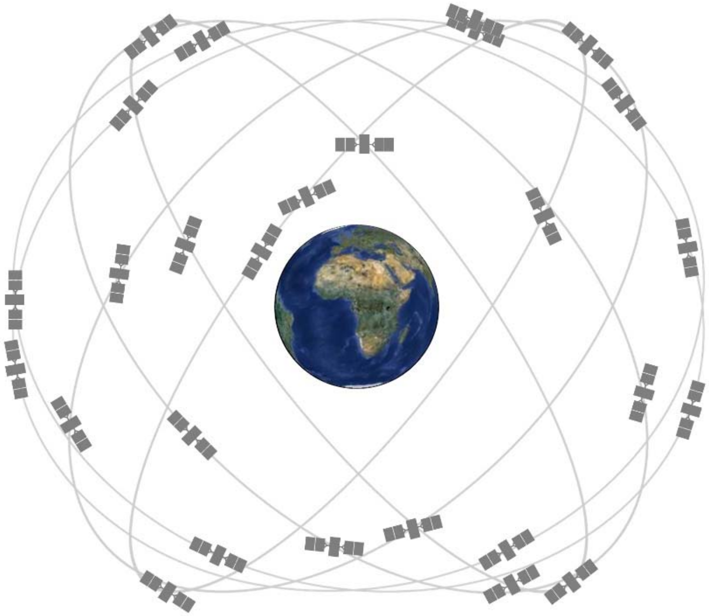
The U.S. Global Positioning System

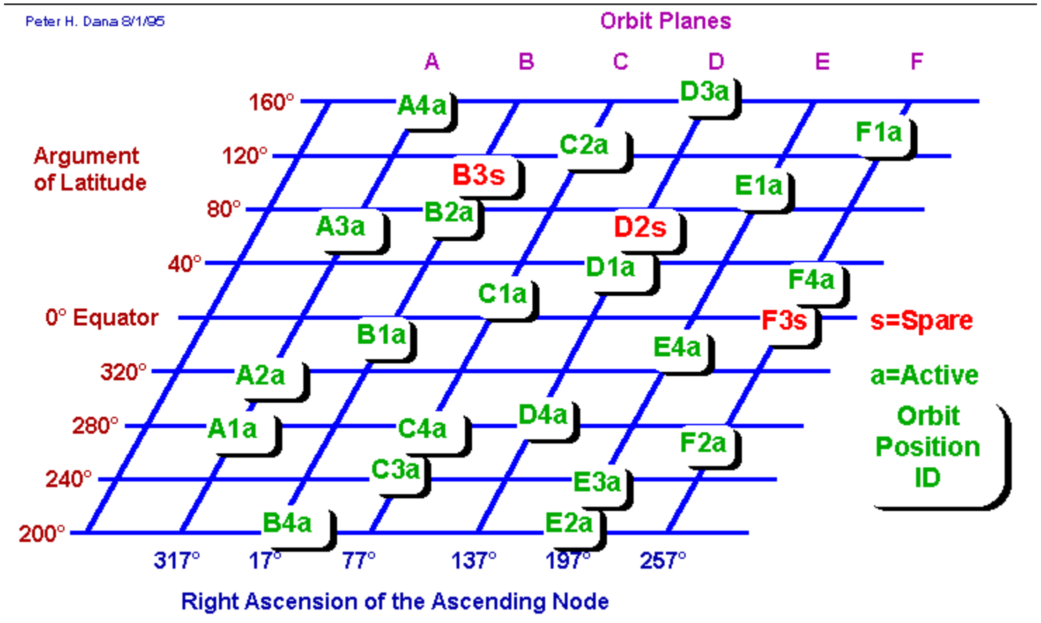
- Maintained and operated by the U.S. Air Force
- Minimum 24 satellites in Medium Earth Orbit (20,200 km)
- Since June 2011, Air Force flies 27 satellites using “Expandable 24” configuration

A United Launch Alliance Atlas V rocket successfully launched the fourth Global Positioning System IIF-4 satellite for the U.S. Air Force at 5:38 p.m. EDT, May 15, 2013, from Space Launch Complex-41, Cape Canaveral Air Force Station, Fla. (Courtesy photo/ULA)

GPS Orbital Planes

- Minimum 24 satellites in 6 equally spaced orbital planes (55° inclination). Minimum 4 each plane.

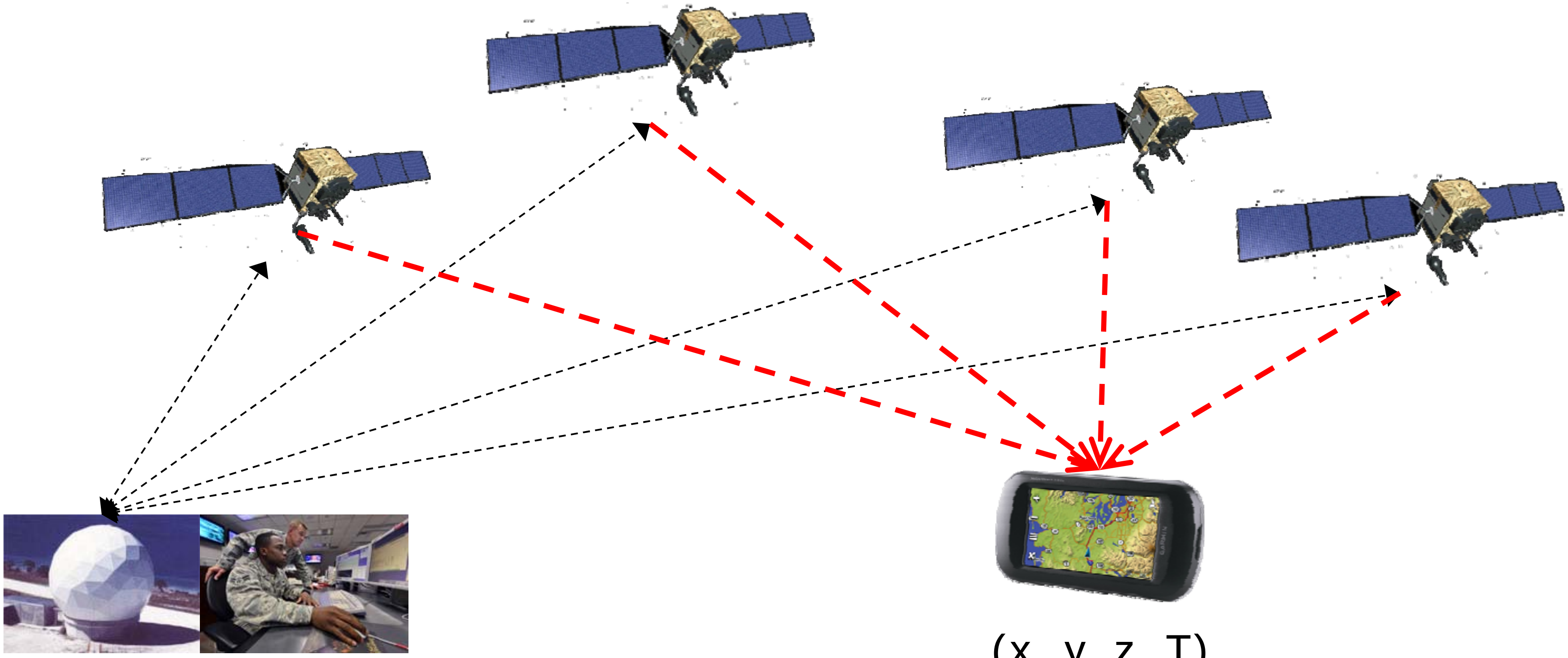




Simplified Representation of Nominal GPS Constellation

Source: http://www.gps.gov/systems/gps/space Source: http://www.colorado.edu/geography/gcraft/notes/gps

GPS Localization

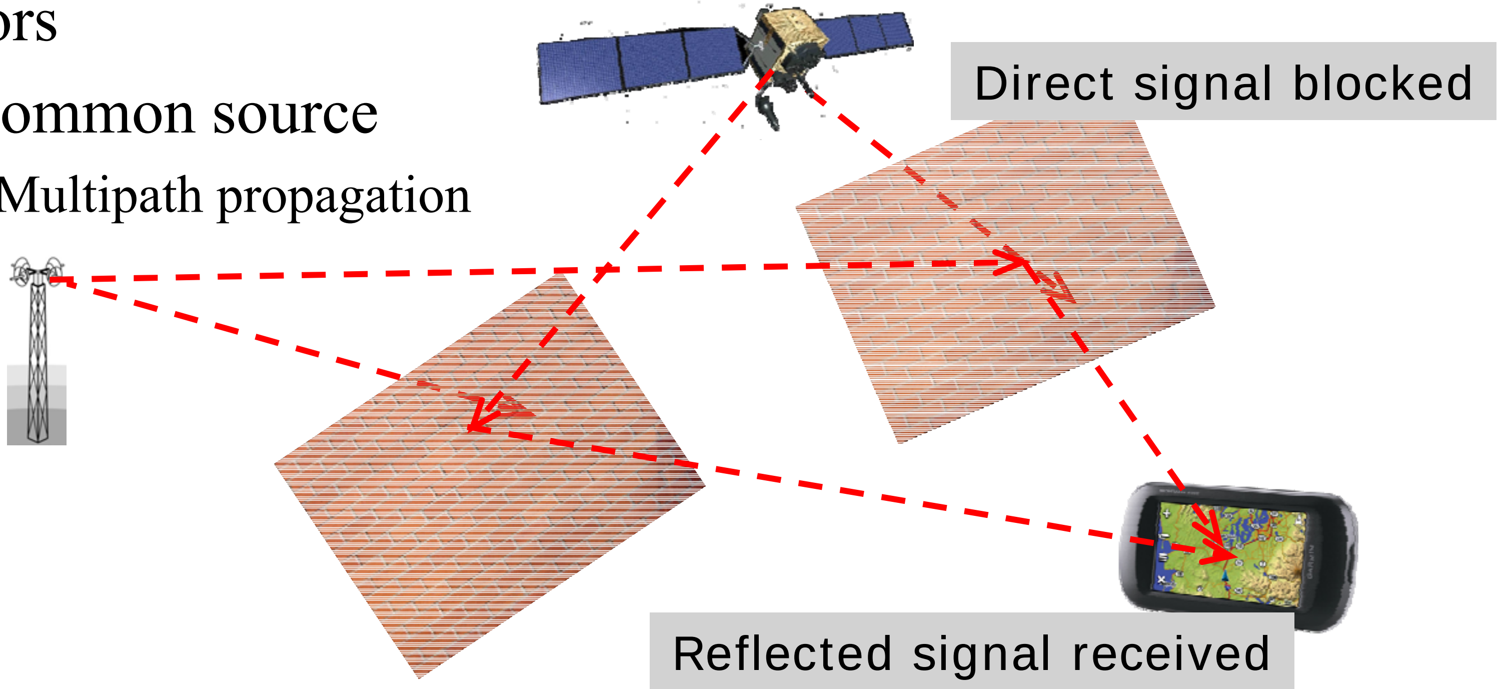


Control Segment

(x, y, z, T)

Source Localization Error

- Both wireless network base station triangulation and GPS rely on radio signals
  - Each has some unique factors contributing to localization errors
  - A common source
    - Multipath propagation



Direct signal blocked

Reflected signal received

App Inventor Location Sensor

- http://appinventor.mit.edu/explore/content/sensors.html#LocationSensor
- Properties
  - Latitude, Longitude, Altitude, and Accuracy
  - CurrentAddress
    - Only available when you have data network connectivity.
    - Accuracy depends on determined location and backend database
  - DistanceInterval and TimeInterval
    - The condition that a location update will be sent.
  - HasAltitude, HasAccuracy, HasLatitudeLongitude …
- Methods and events

App Inventor Location Sensor: Events

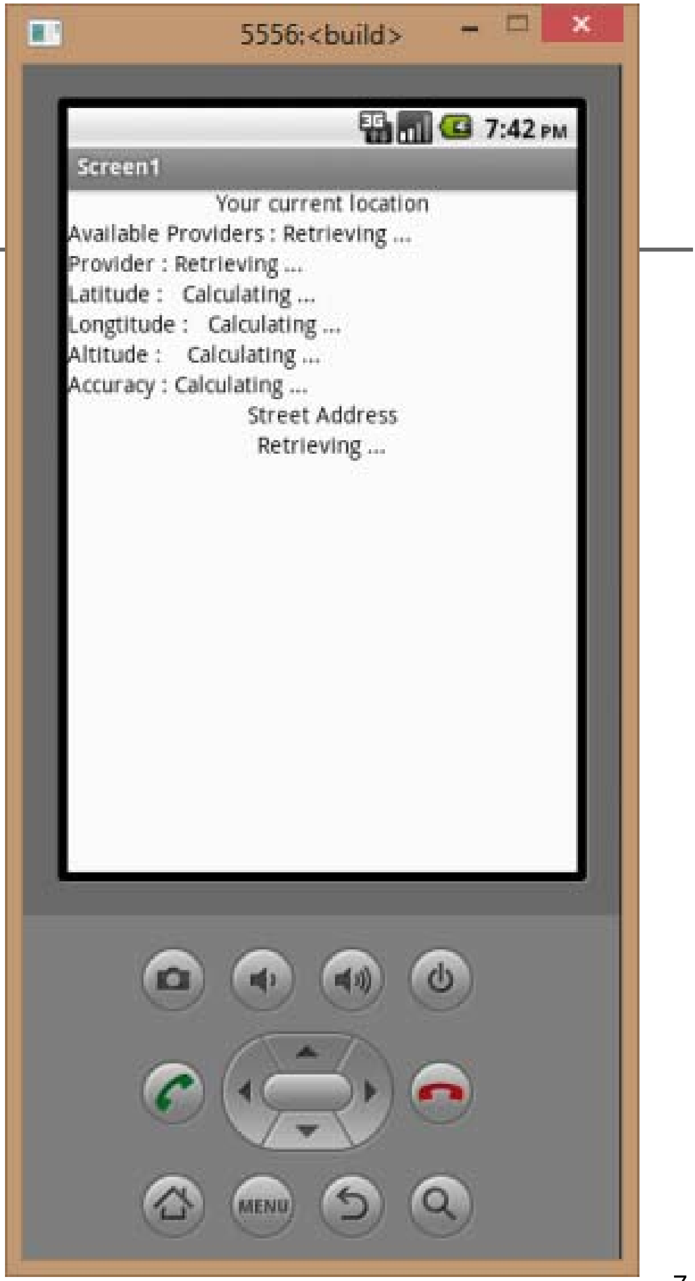
- Events
  - LocationChanged(number latitude, number longitude, number altitude)
    - Called when the Android device reports a new location.
    - Frequency controlled by TimeInterval and DistanceInterval and actual location changes
    - Location update drains energy (battery): do not use a small TimeInterval or DistanceInterval unnecessarily
  - StatusChanged(text provider, text status)
    - Called when the status of the service provider changes.

App Inventor Location Sensor: Methods

- Methods
  - number LatitudeFromAddress(text locationName)
    - Determines the latitude of the given address.
  - number LongitudeFromAddress(text locationName)
    - Determines the longitude of the given address.
  - Must have data network connectivity to return a meaningful result

Location Sensor

- App: where am I?
  - Display current location and more
- Download the app from
  - http://sysnetgrp.net/academy/cs4hs/cs4hs-resources
- Upload to your account



5556:<build>

7:42 PM

Screen1

Your current location

Available Providers : Retrieving ...

Provider : Retrieving ...

Latitude : Calculating ...

Longtitude : Calculating ...

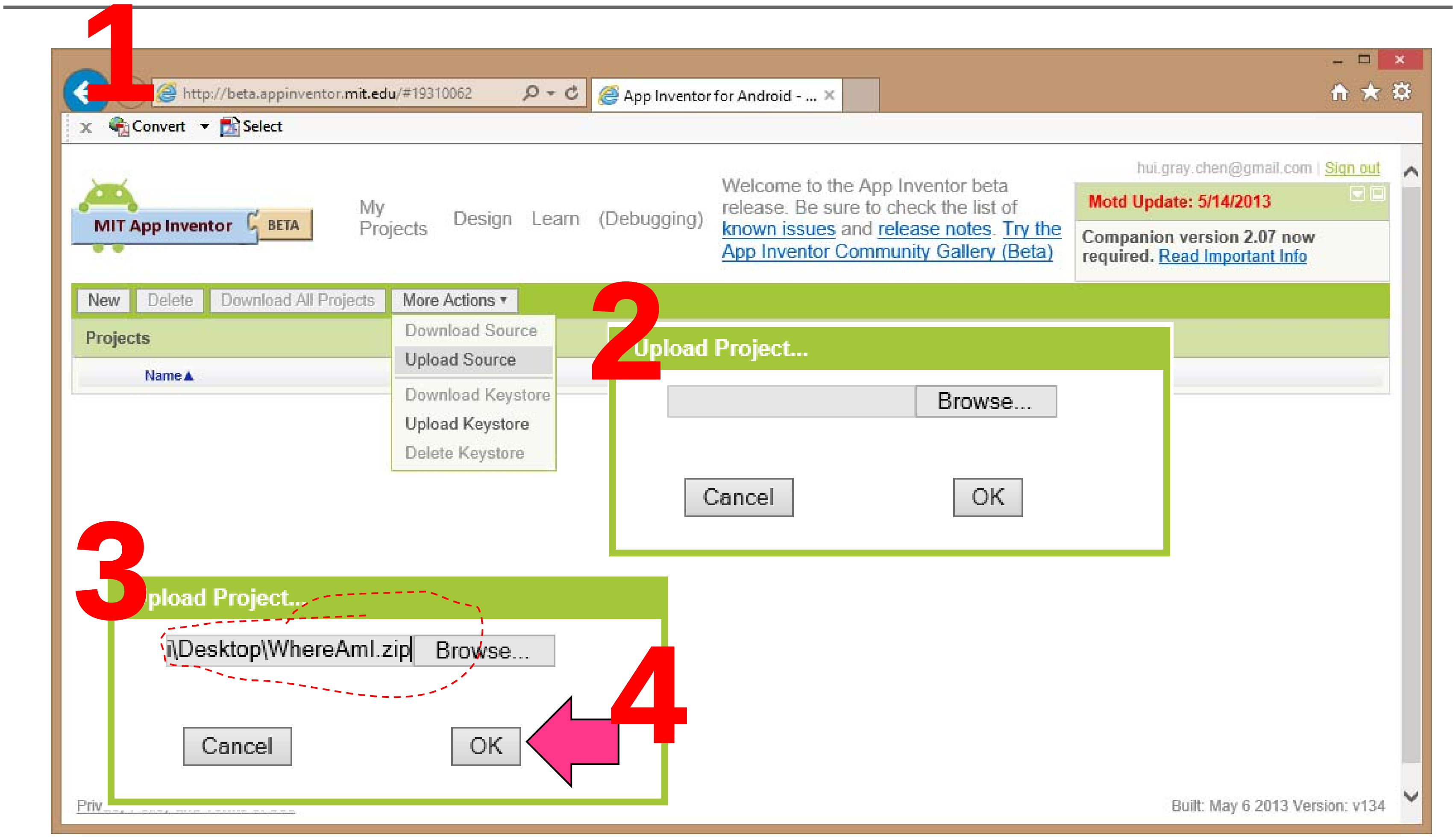
Altitude : Calculating ...

Accuracy : Calculating ...

Street Address

Retrieving ...

Upload the App Inventor Project



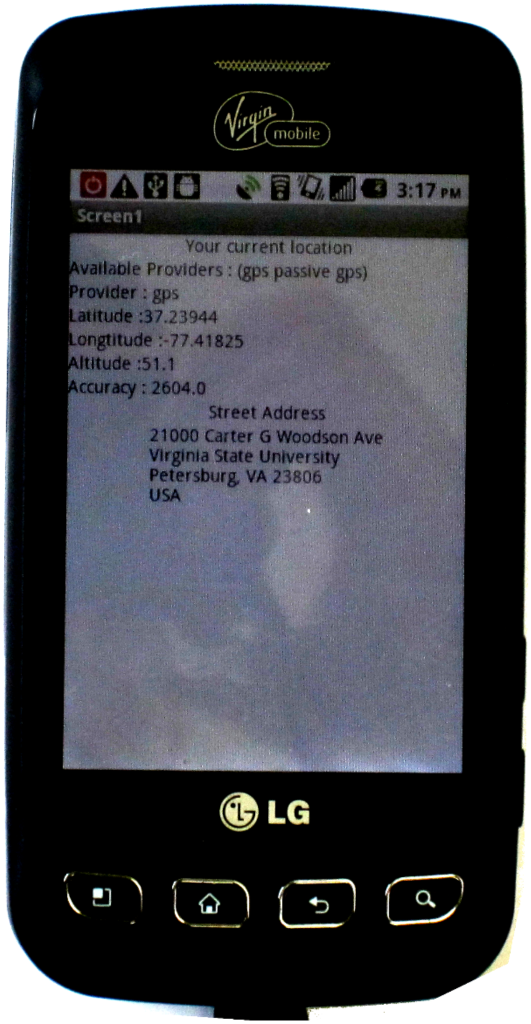
Welcome to the App Inventor beta release. Be sure to check the list of known issues and release notes. Try the App Inventor Community Gallery (Beta)

Motd Update: 5/14/2013

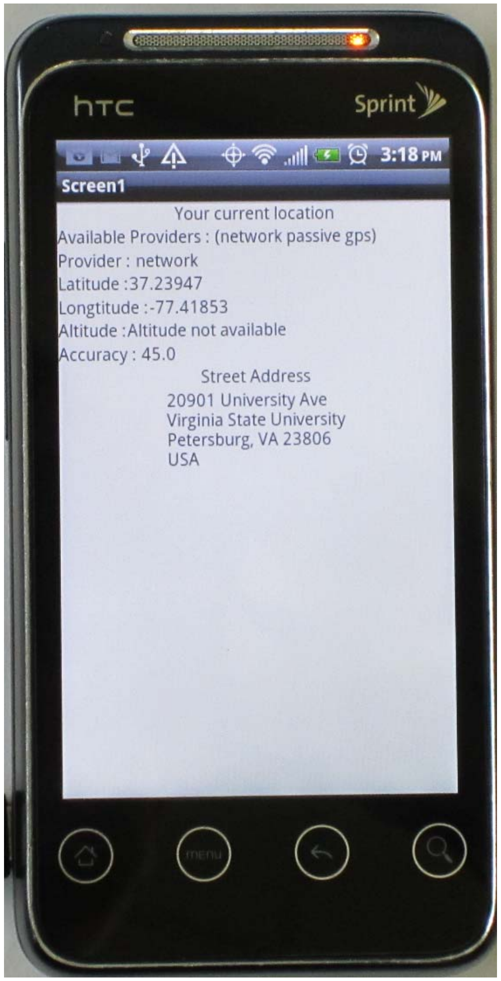
Companion version 2.07 now required. Read Important Info

n\Desktop\WhereAmI.zip

Compare Different Location Providers



```
Screen1
Your current location
Available Providers : (gps passive gps)
Provider : gps
Latitude :37.23944
Longtitude :-77.41825
Altitude :51.1
Accuracy : 2604.0
Street Address
21000 Carter G Woodson Ave
Virginia State University
Petersburg, VA 23806
USA
```

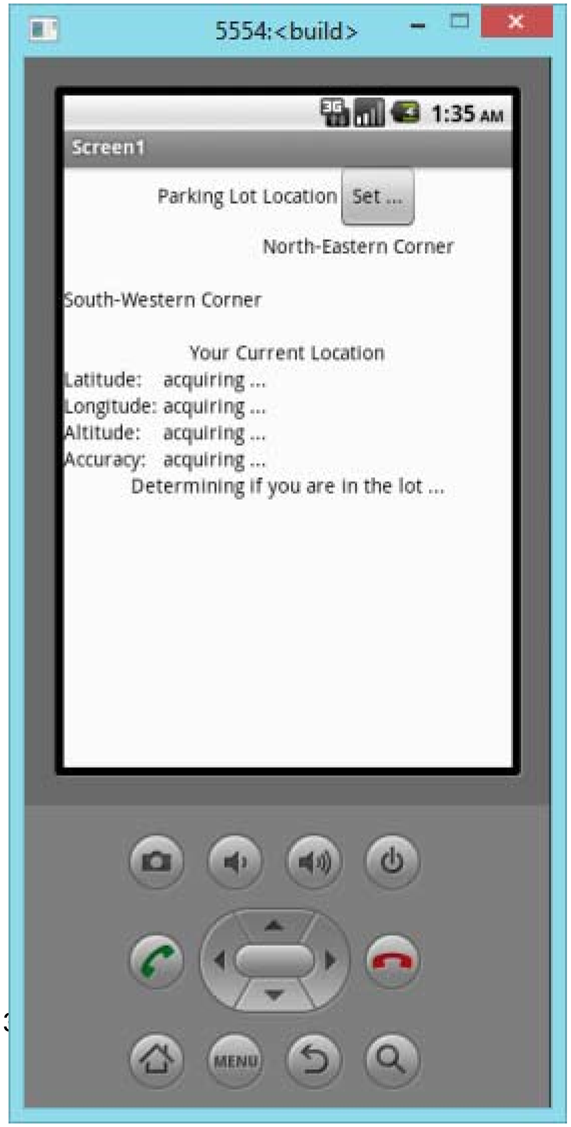


```
Screen1
Your current location
Available Providers : (network passive gps)
Provider : network
Latitude :37.23947
Longtitude :-77.41853
Altitude :Altitude not available
Accuracy : 45.0
Street Address
20901 University Ave
Virginia State University
Petersburg, VA 23806
USA
```

Exercise 1

- Am I in the parking lot?
  - Assume the parking lot is of rectangular shape and whose borders are parallel to either latitude lines or longitude lines
  - The location of the north-eastern and south-western corners are given (in latitude and longitude) in four textboxes.
  - Use Location Sensor to determine whether your device is in the parking lot.
    - Yes. Display: I am in the parking lot.
    - No. Display: I am not in the parking lot.

Exercise 1: Sample Solution



Screen1

Parking Lot Location Set ...

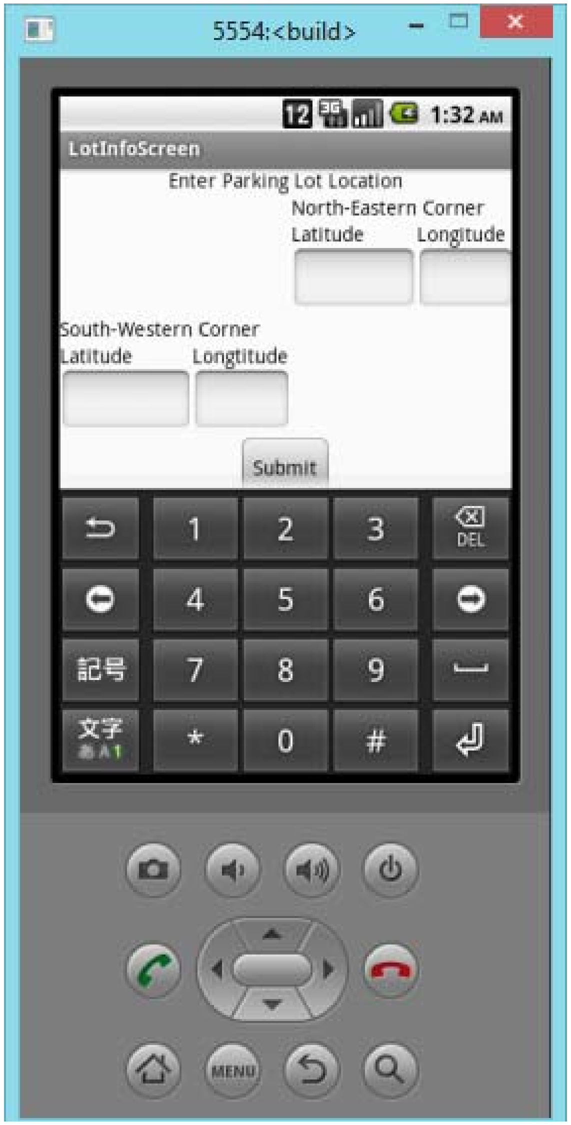
North-Eastern Corner

South-Western Corner

Your Current Location

Latitude: acquiring ...
Longitude: acquiring ...
Altitude: acquiring ...
Accuracy: acquiring ...

Determining if you are in the lot ...



LotInfoScreen

Enter Parking Lot Location

North-Eastern Corner

Latitude Longitude

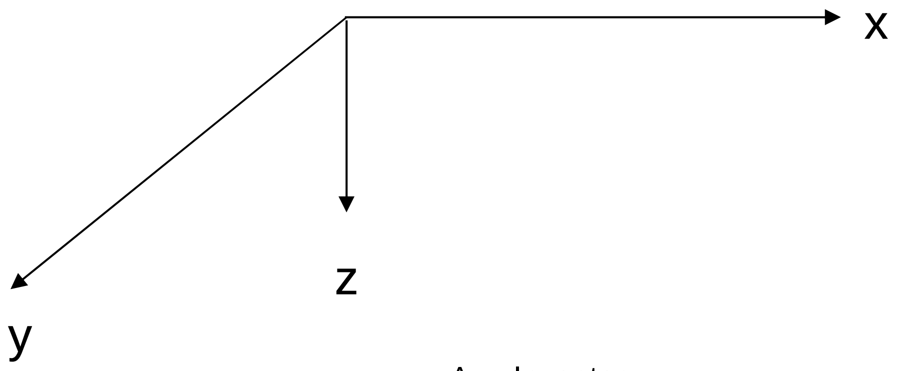
South-Western Corner

Latitude Longtitude

Submit

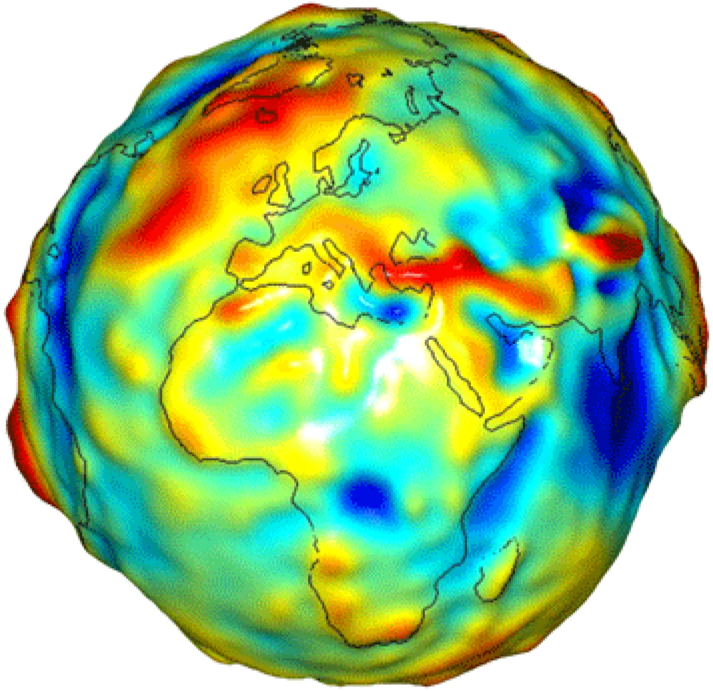
Accelerometer

- Acceleration
  - rate at which the velocity changes over time
  - Acceleration is a vector (has direction) as velocity does
- Measure acceleration of the device on 3-dimensions
- Dimension: m^2/s (meter squared per second)
- The gravity of Earth is acceleration



The Gravity of Earth

- Not homogenous
- ~9.8 m^2/s



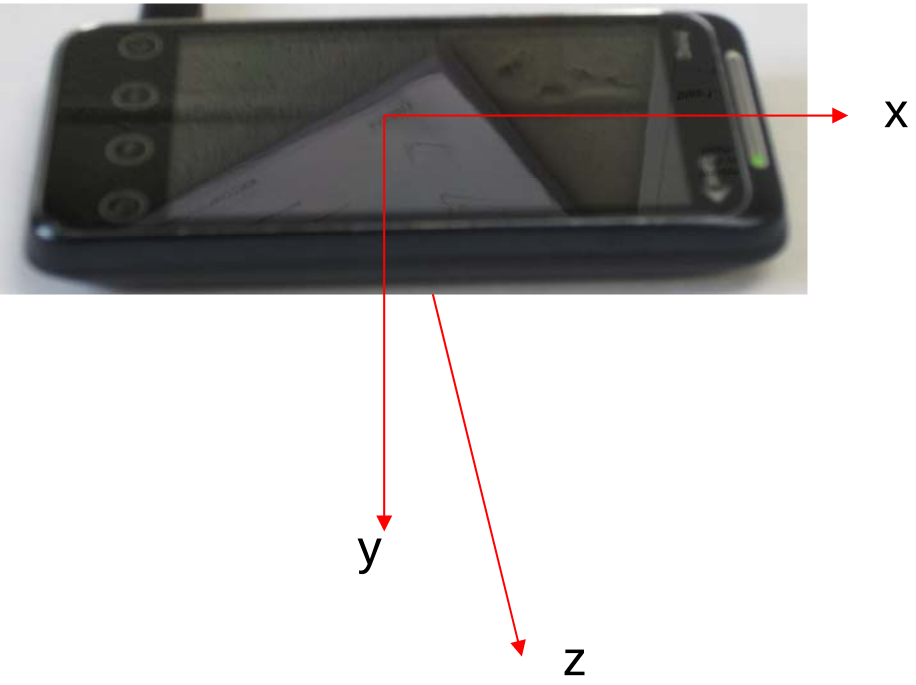
Source: http://cires.colorado.edu/science/divisions/ses/foci/gravityFromSpace.html

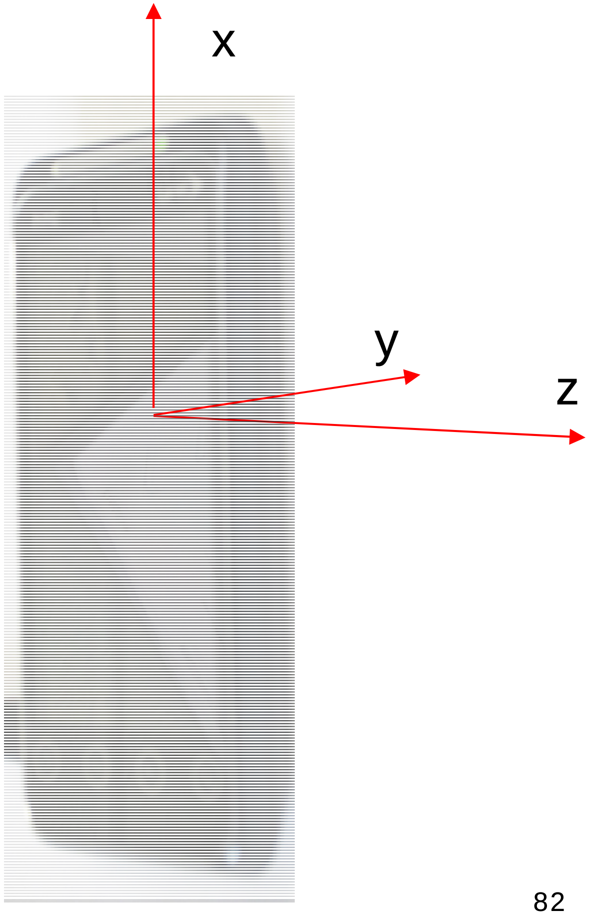
App Inventor Accelerometer Sensor

- Produces
  - XAccel, YAccel, and ZAccel

Which Directions are X, Y, and Z?

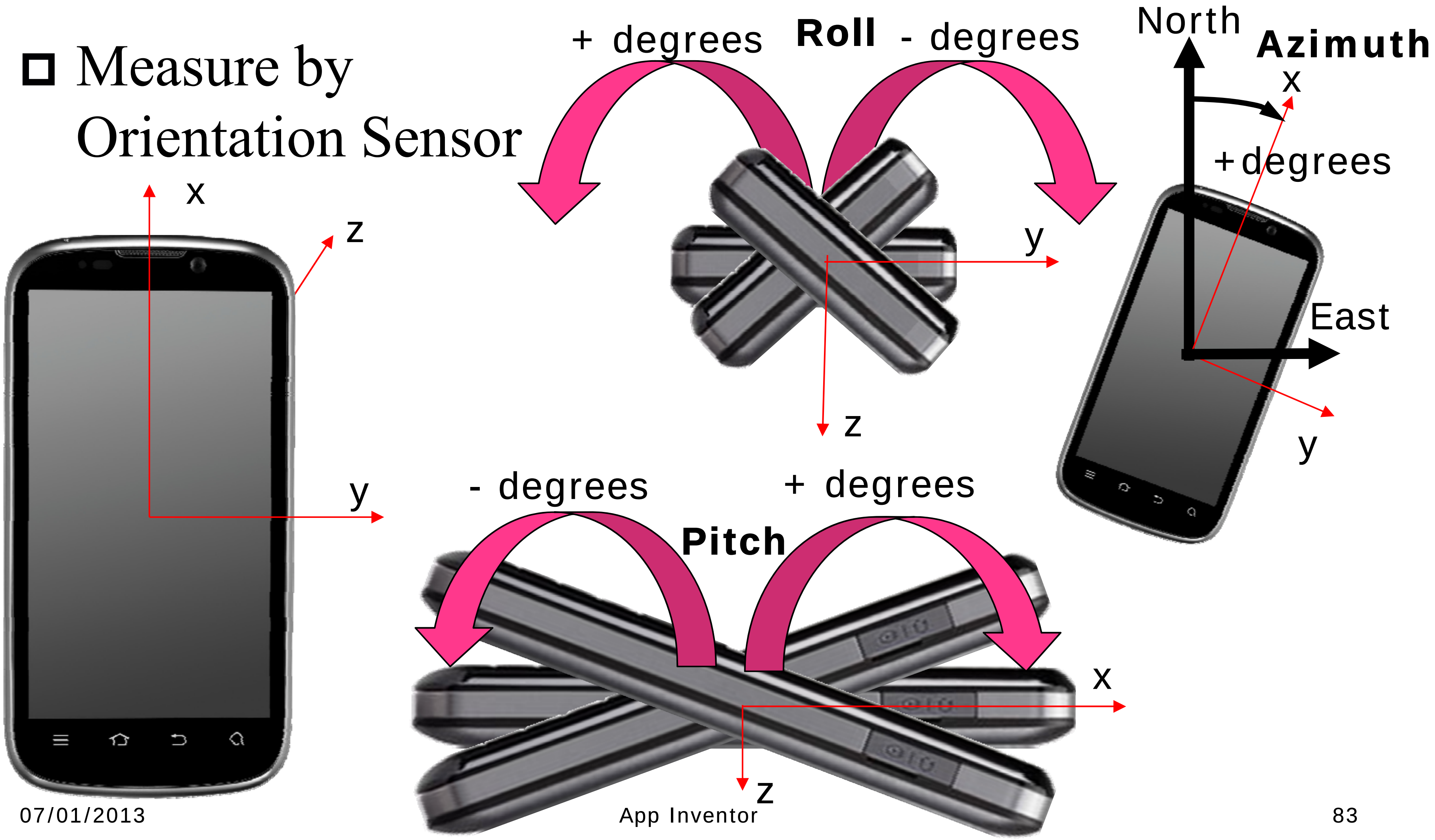
- Configuration depends on vendor design
  - Typically two designs





Your Device can Pitch, Roll, and Rotate

- Measure by Orientation Sensor

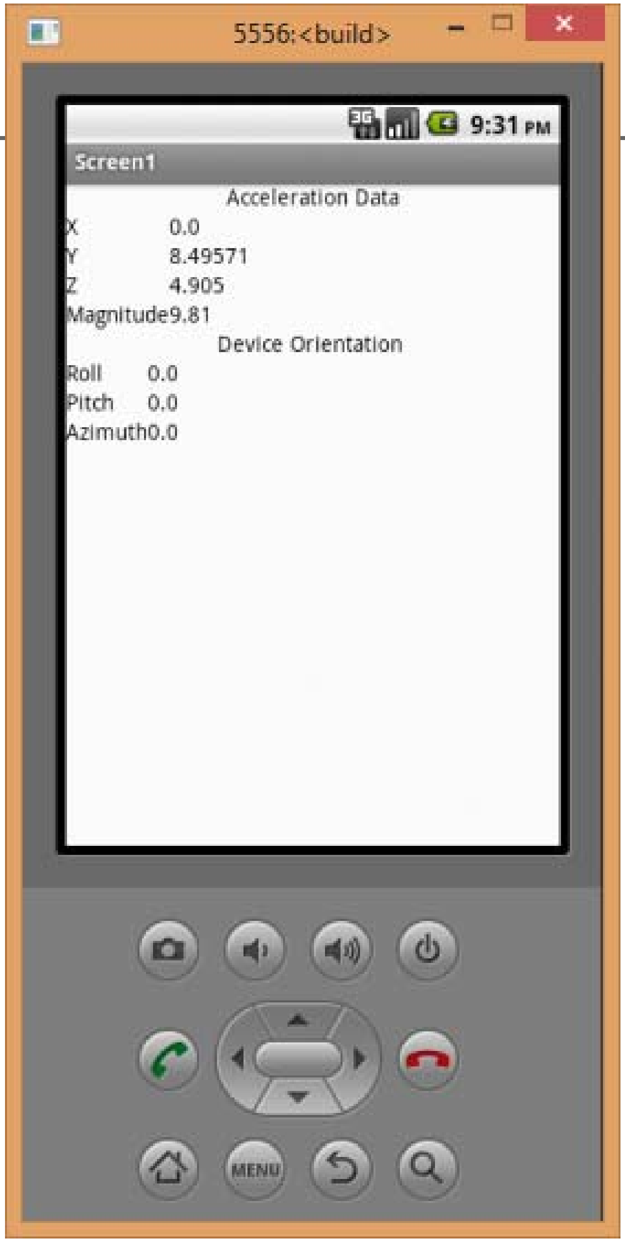


App Inventor Accelerometer Sensor

- Produces
  - XAccel, YAccel, and ZAccel
- Sensor (a physical component) is mounted on the device in a fixed position
- When the device rolls, pitches, and changes its azimuth, the 3 axis of the sensor also changes.
- Even if the device as a whole (treated as a "point") maintains the same acceleration, the acceleration readings can alter.

Observe the Acceleration Data App

- The Acceleration Data App
  - Download from
  - http://sysnetgrp.net/academy/cs4hs/cs4hs-resources
  - Upload the App



Screen1

Acceleration Data

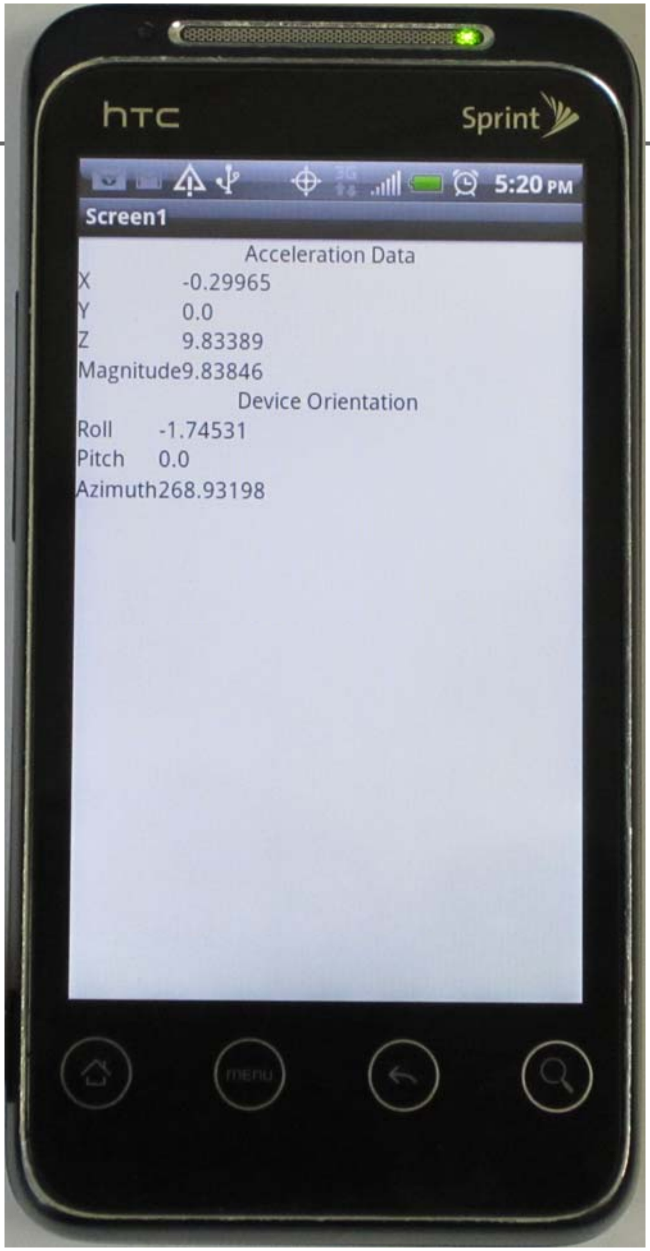
```
X         0.0
Y         8.49571
Z         4.905
Magnitude9.81
```

Device Orientation

```
Roll     0.0
Pitch    0.0
Azimuth0.0
```

Observe the Acceleration Data App

- Set the device again the top of the desk to reduce any change of any movement
- Alter the device's orientation
- What do you observe?
  - The gravity is always present!



```
Screen1
            Acceleration Data
X           -0.29965
Y           0.0
Z           9.83389
Magnitude9.83846
            Device Orientation
Roll      -1.74531
Pitch     0.0
Azimuth268.93198
```

Participatory Sensing using Mobile Devices

- Determine individual or community's habits or behavior
  - Healthy life style
    - How much excise does an individual do?
    - What does the individual's diet constitute of?
  - Senior citizen care
    - Fall detection
  - …..
- Example
  - Human activity classification using accelerometer data
    - Where an individual is still, walking, or running?

Human Activity Classification: Still-Walk-Run

- Can we use a mobile device's accelerometer data to determine if the user is still, walking, or running?
- If we can, we can probably introspect the individual's life style correlating with other data (such as diet).
- The method, if successful, potentially can be applied to solve many other problems.
  - Essentially by contributing to determine what a user is doing
- Let's examine accelerometer data!

Human Activity Classification App

- This app is incomplete
- But is designed to examine accelerometer data
- Download it from
- http://sysnetgrp.net/academy/cs4hs/cs4hs-resources
- Upload the project

Experiment

- Collecting data for 15 seconds using the App
  - Standing still for 5 seconds
  - Walking for 5 seconds, and
  - Running for 5 seconds
- Graph and observe the data
- What's your observation?

Classification Algorithm (1)

- A simple attempt
  - Use standard deviation of the accelerometer data over a moving window of a given length

$$\overline{A_{w(s,e)}} = \frac{\sum_{i=s}^{e} A(i)}{e - \mathrm{s} + 1} \qquad s_{w(s,e)} = \sqrt{\frac{\sum_{i=s}^{e} \left(A(i) - \overline{A_{w(s,e)}}\right)^2}{e - s}}$$

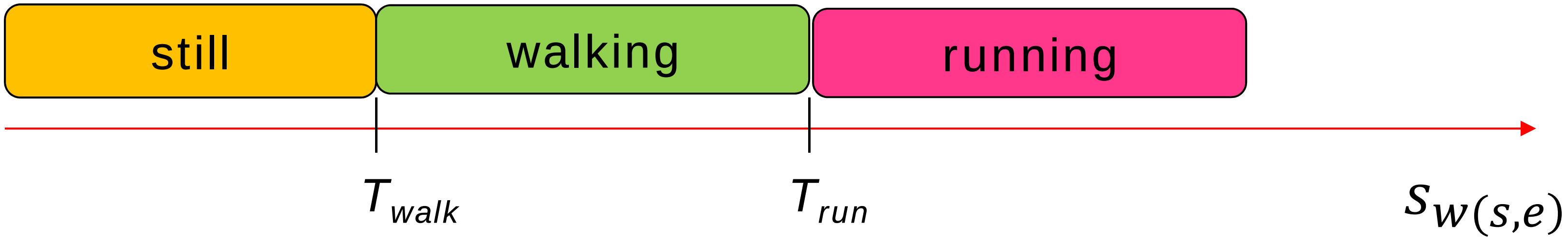
where *A(i)* is the magnitude of the acceleration data, *w(s, e)* is the window with starting time *s* and ending time at *e*, and

$$A(i) = \sqrt{A_x(i)^2 + A_y(i)^2 + A_z(i)^2}$$

where A_x, A_y, and A_z are accelerometer readings in directions x, y, and z respectively.

Classification Algorithm (2)

- Based on your observation
  - Pick two three thresholds, T_{walk} and T_{run}
- Then,
  - If $s_{w(s,e)} < Twa_{lk}$, the user is still;
  - otherwise, if $T_{walk} \leq s_{w(s,e)} < Tru_{n}$, the user is walking
  - otherwise, the user is running



Exercise 2

- Implement the classification algorithm by revising the uploaded the “Human Activity Classification” project
  - Use the screen “ClassficationUsingSTD”
  - Revise the “ClassificationButton.Click” event handler

Sample Solution

1. Retrieve the maximum tag from the TinyDB using tag "Counter"
2. Let the "Counter" value to the "end" value of a window
3. Choose a "start" value for the window. The "start" value must be less than the "end" value.
4. Compute mean of the magnitudes within the window
5. Compute standard deviation (let it be "std") of the magnitudes within the window
6. If std $\leq T_{walk}$, you are still; else if $T_{walk} \leq$ std $< T_{run}$, you are walking; else you are running

App Inventor: What We Know?

- App Inventor for Android is a good tool
  - Introduce learners to problem solving strategy (such as divide-and-conquer)
  - Introduce learners to programming mobile devices
  - Help learners to develop computing abstractions
    - Components
    - Variables, procedures, control structures
  - Avoid learners' dealing with syntax of programming languages
  - Avoid learners' dealing with complex development environment and platforms

App Inventor: What Needs to Improve?

These arguments may be invalidated as App Inventor continue to evolve

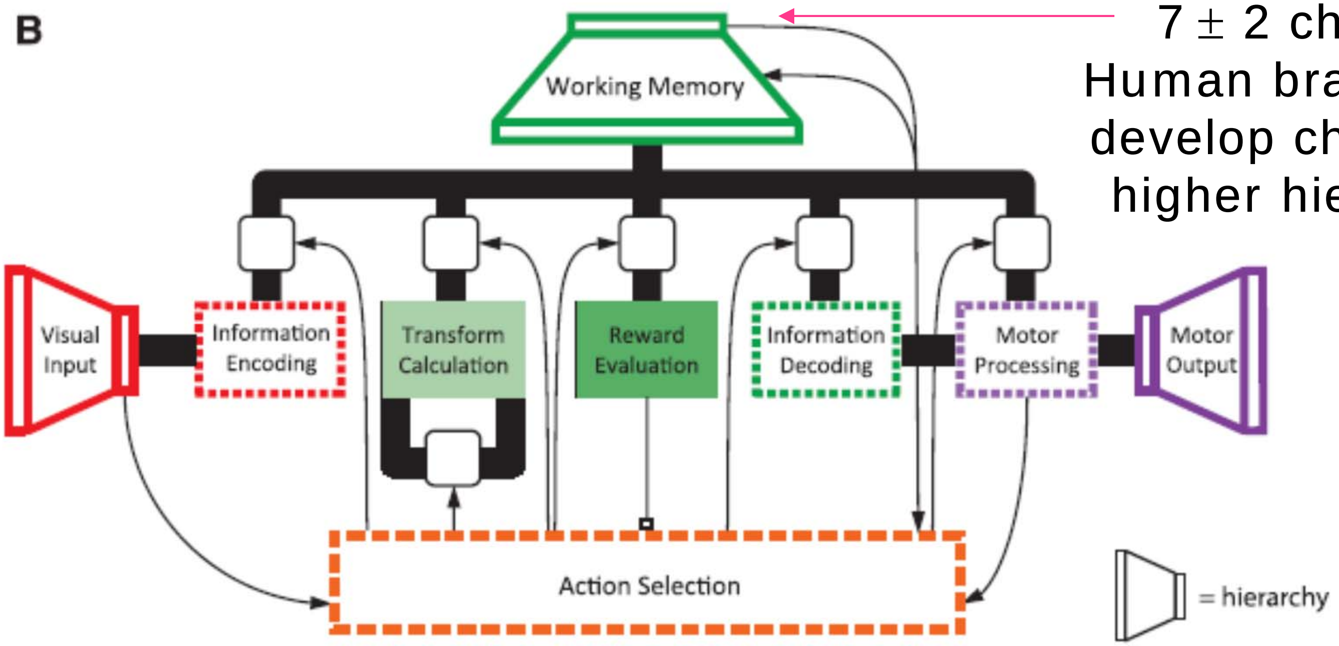
- Variable
  - Only support global variable (with the scope of a screen)
  - Desired: Need application-scope variables and procedure-scope variables
- Procedure
  - Visible within the scope of a screen
  - Inconvenient to return more than one values to caller
  - Desired: Need application-scope procedures and support to return more than one values
- Editing
  - Cannot copy blocks between screens
- Emulations
  - Does not support multiple-screen apps
- Robustness of the tool needs improvement

App Inventor: Fundamental Deficiency

Presenter’s personal observation and still need scientific evidence

- App Inventor is not suitable for small project and difficult for projects of moderate size.
- Hypothesis
  - Visual programming is effective in shortening learning curve to develop small projects;
  - However, visual programming is fundamentally limited in help learners develop large projects
- Fundamentally constrained by how human brain works.

Computational Model of Human Brain

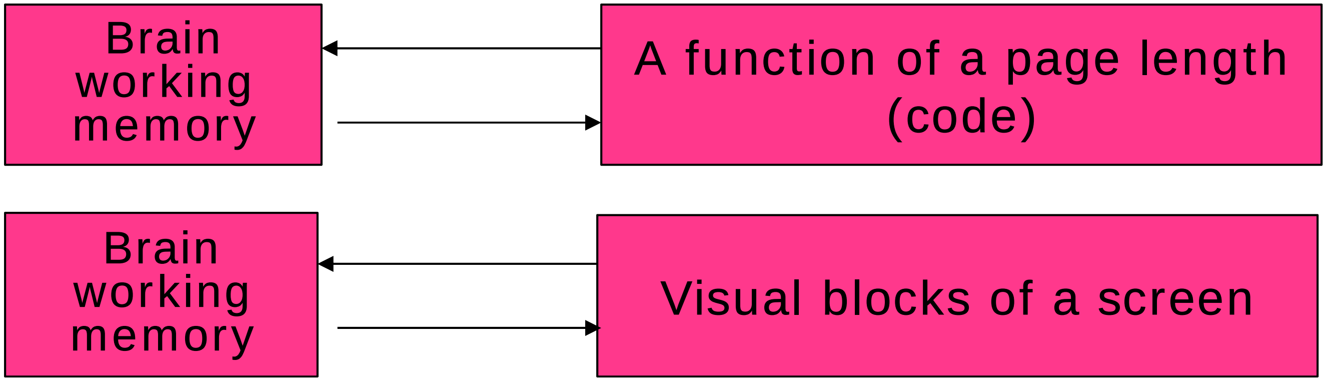


7 ± 2 chunks
Human brain must develop chunks of higher hierarchy

Eliasmith, C., Stewart, T., Choo, X., Bekolay, T., DeWolf, T., Tang, Y., & Rasmussen, D. (2012). A Large-Scale Model of the Functioning Brain Science, 338 (6111), 1202–1205 DOI: 10.1126/science.1225266

Memory and Abstraction

- Visual blocks competes limited screen size that serve as an external working memory
- Observation: a good coding practice is
  - To write a function within a length of a page



Visible, quick retrieval from brain

However, visual blocks has less information (low information density), require more screen space, thus hinder information retrieval and storage, eventually information encoding & decoding

Is There Any Alternative?

- A trade-off between “traditional coding” and “visual programming”
  - Shortened learning curve for beginners
  - Allow develop abstractions quickly using large projects
- Sofia and Java Programming with Android
  - Drs. Kostadin Damevski and David Walter will take the lead.

Conclusion

- Introduction to App Inventor for Android
  - Opportunities in learning and teaching
- Sensor-driven applications
  - Understand location, orientation, and accelerometer sensors
  - Use the sensor to develop simple applications