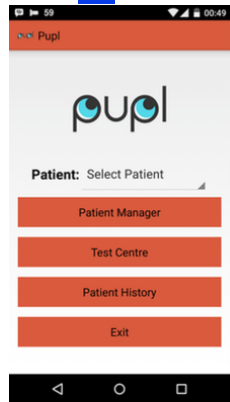
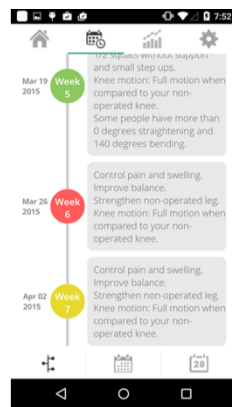


Creative Applications for Mobile Devices

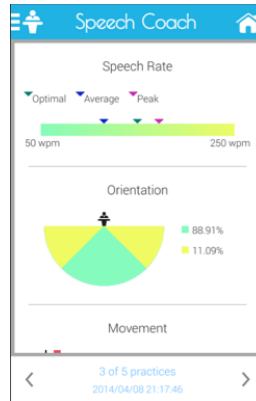
PUPL



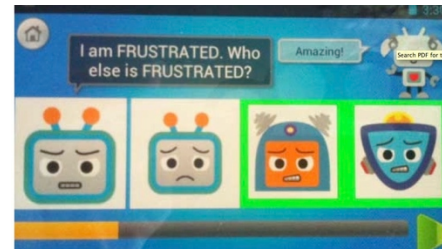
MyACL



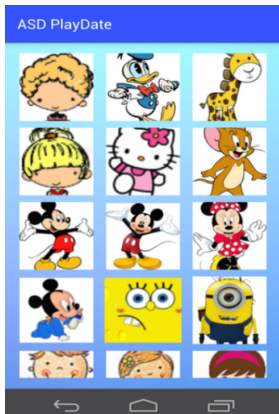
Speech Coach



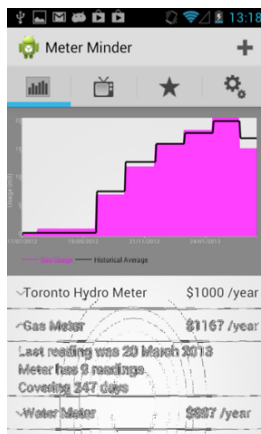
EYEDentify



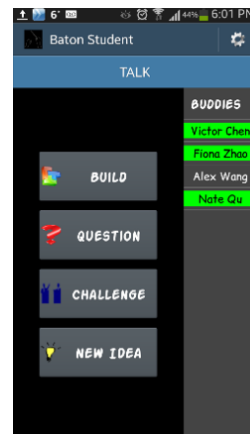
Mobile Stage



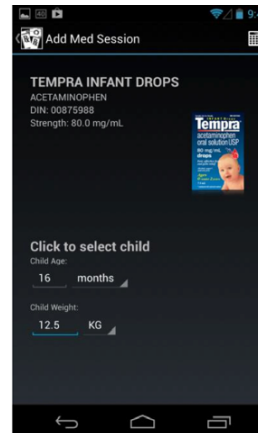
ASD Playdate



Meter Minder



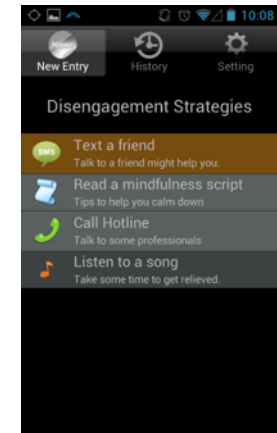
Baton⁽¹⁾



Snap N Dose



Practice Cactus



Mindful Me



ECE 1778:

Creative Applications for Mobile Devices

Instructor: Jonathan Rose

Department of Electrical & Computer Engineering



Welcome!

- Advances in Mobile, Internet and Wearable technology have changed the landscape of many human endeavors
- Which kind of mobile device do you carry?
- Do you have some kind of wearable?



iPhone?



Android?



Purpose of this Course

To bring together people from different disciplines
to prototype novel and useful mobile applications

To Create and Engineer Interesting Things
and
Learn alot in the Process



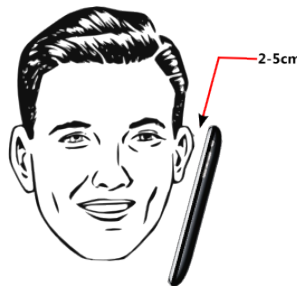
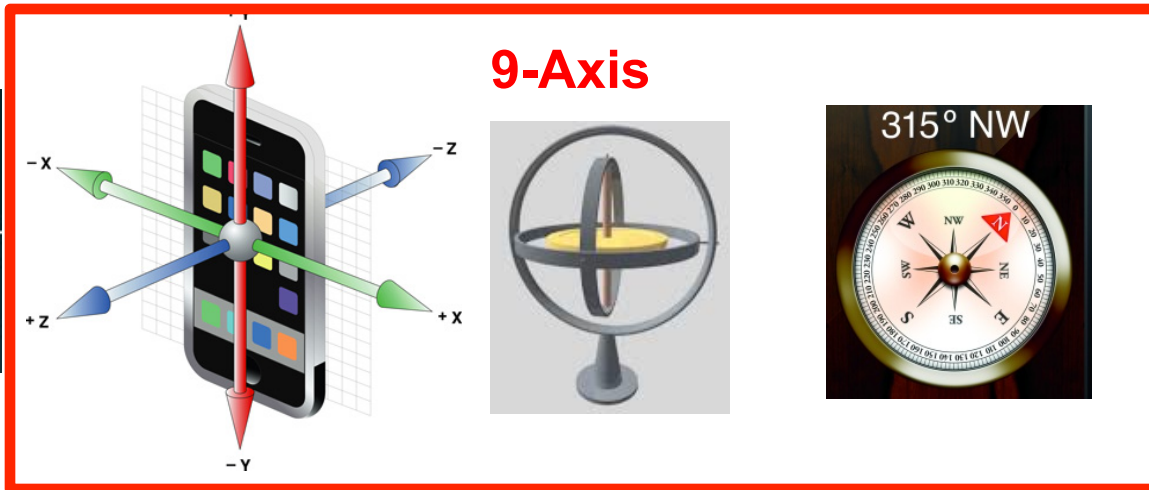
Mobile Devices are Incredibly Capable

Because they contain in one portable package:

- A powerful computer you can carry in your pocket
- Connected to the Internet
 - More knowledge & compute power
- Can **sense** its environment in many ways
- Can **speak** to its environment in several ways
- Can also make phone calls



Many Capabilities in Mobile Device



(6)



Bluetooth®



And in Connected/Wearables



A Sensor for Every Application



TrackR



Activity Trackers/
Health Monitors

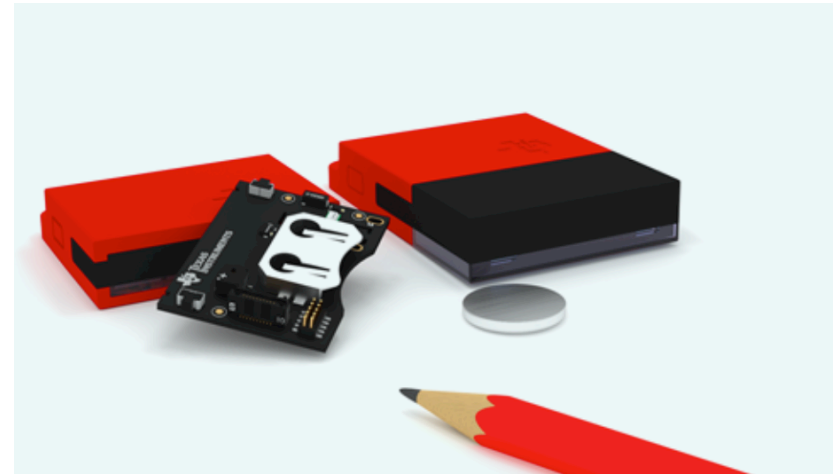


Instrumented
Clothing

Check This Out: \$29 Wireless Sensor

■ Texas Instrument's 'Sensor Tag'

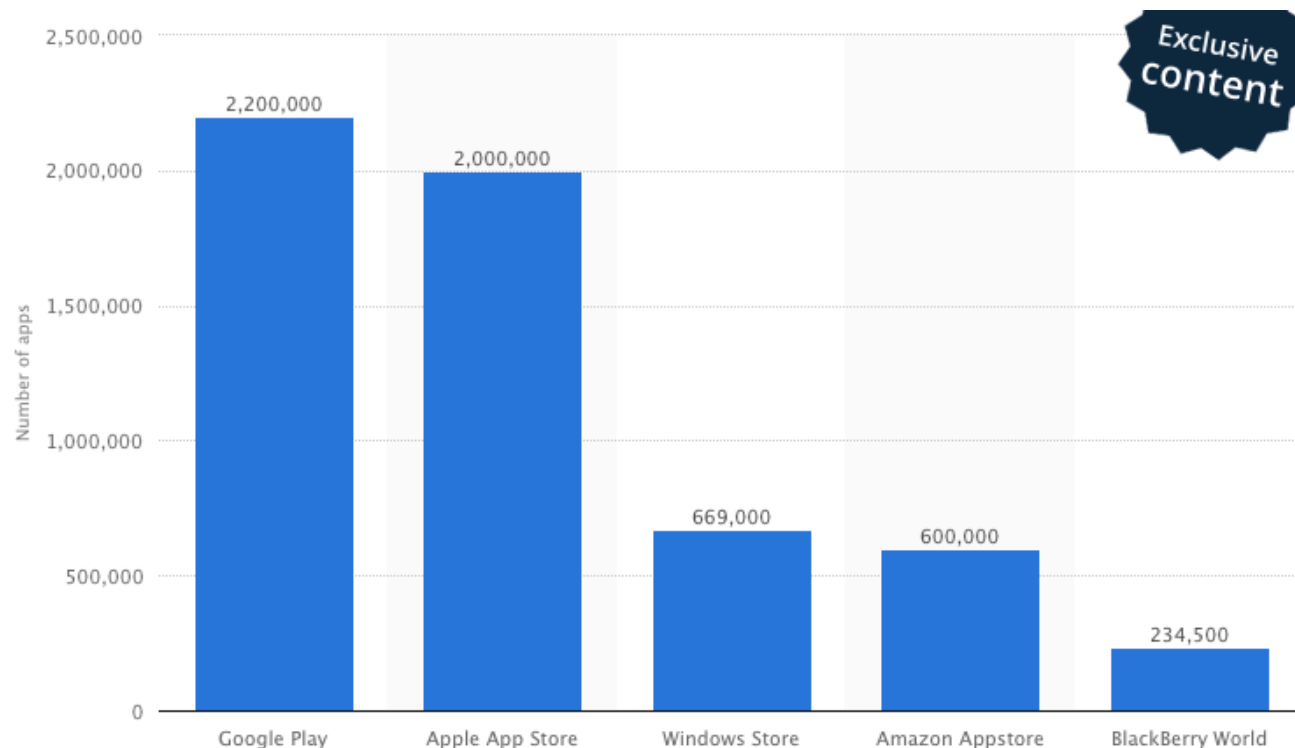
- **Cost:** \$USD 29
- **Bluetooth Connection**
- **Sensors:**
 - 9 axis
 - Magnet sensor
 - Light
 - Ambient temperature
 - IR temperature
 - Humidity
 - Air pressure
 - Two Buttons, two lights, quiet buzzer!



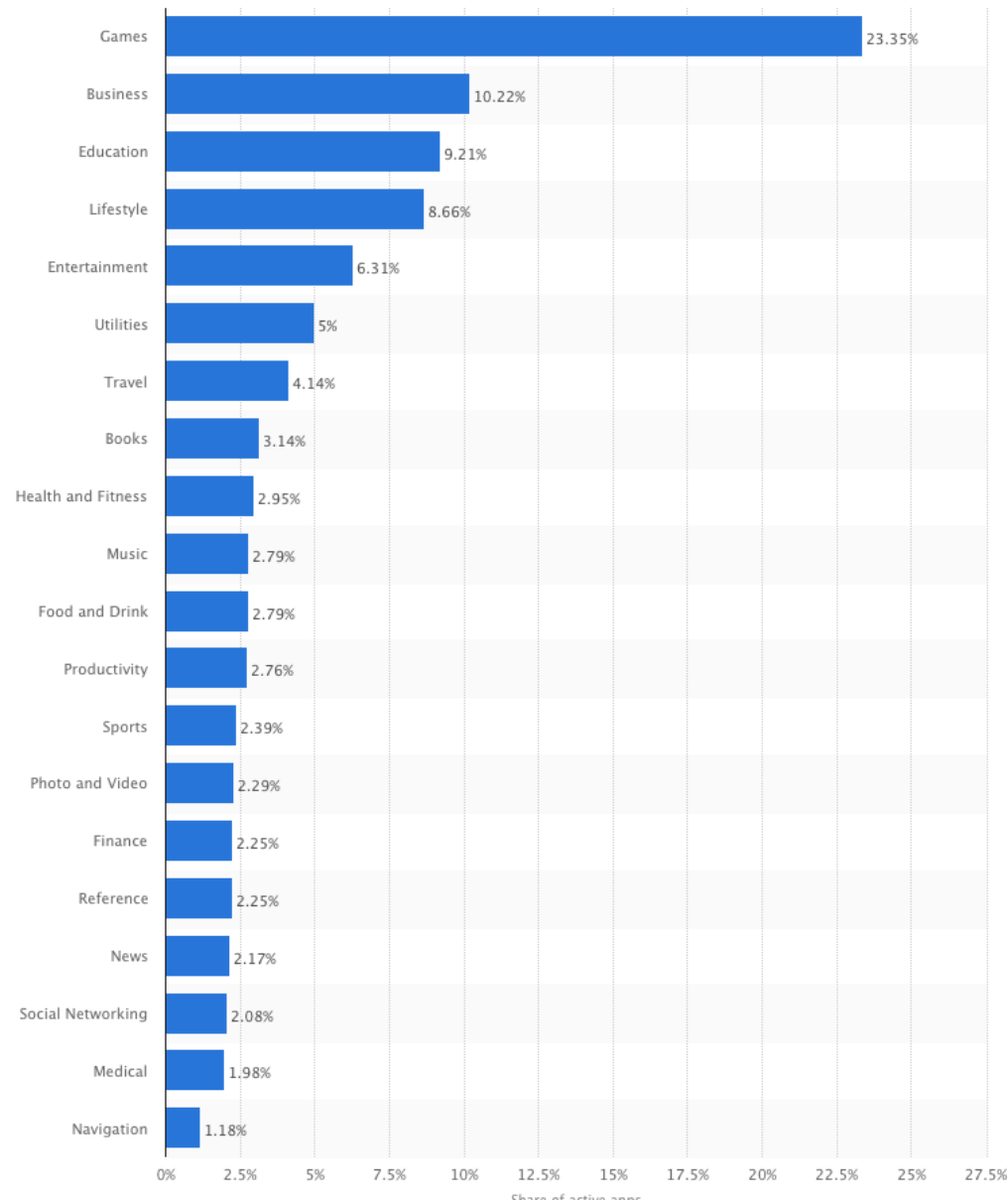
■ Demo

Given Rise to Thousands of Great Ideas

- Perhaps one of the greatest surges of creativity in human history has occurred in the past 7 years
- 2M Apps in Apple App Store
- 2.2 M Apps in Google Play Store



In Many Areas



There are Many More Great Ideas to Come

1. We are still not used to what is possible when all these elements are brought together
 - **We** are evolving
2. Regular progress in technology
 - Fierce competition: Apple, Samsung, Google, Huawei ...
 - Economics of large-scale market
3. Not Enough Expertise has been Combined with Tech
 - Experts + software & hardware folks
 - That is the purpose of this course!



A Few Example Projects

From previous years in this course

MyWalk

Measuring and Correcting Step-Time *Asymmetry*

Specialist: Justin Chee

Programmers: Tuck-Voon How

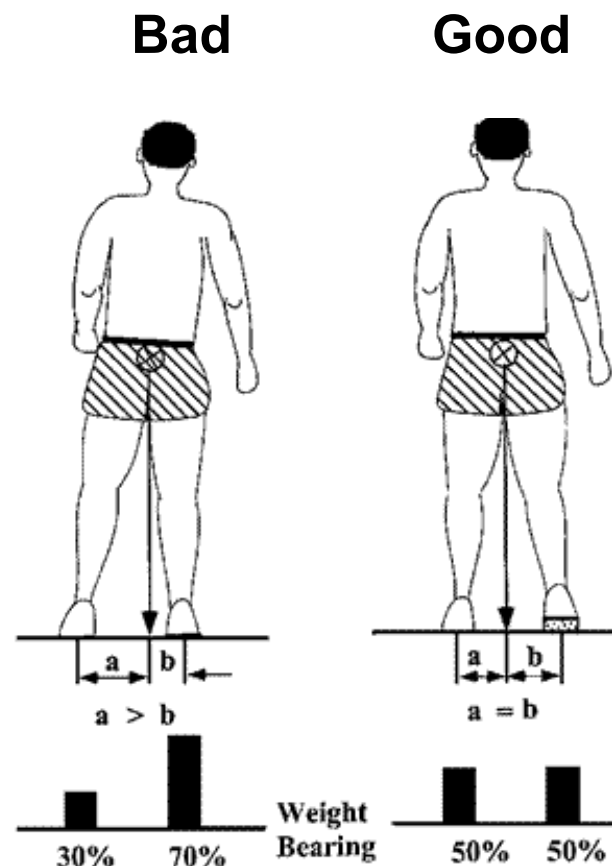
Eric Wan

April 2012



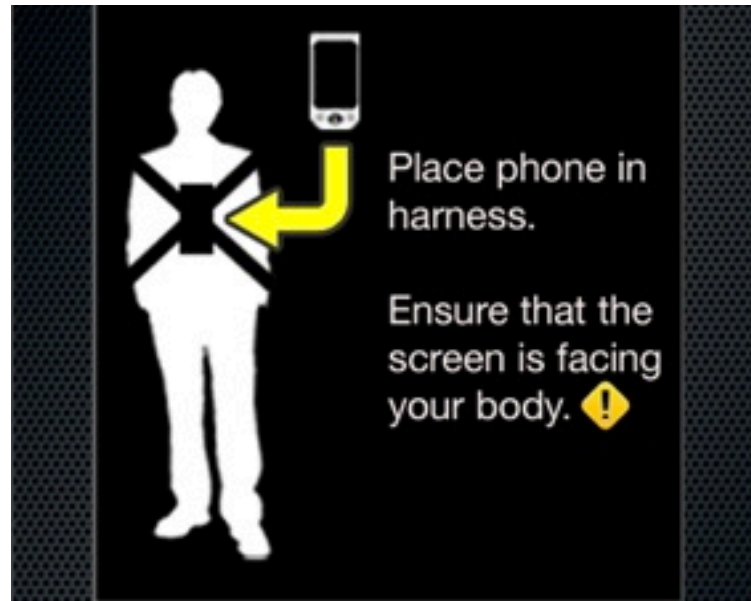
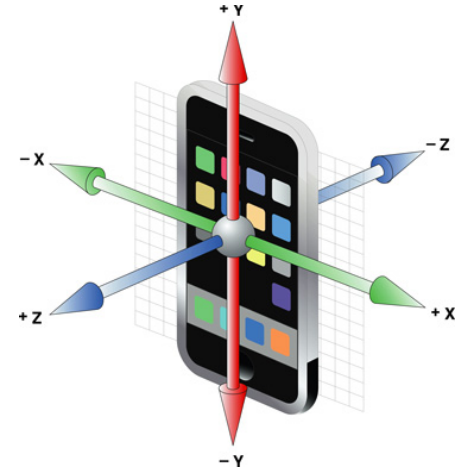
Walking Unevenly is Bad For You

- Asymmetric walking is caused by a stroke or other injury
- Has bad effects that worsen over time:
 - increased joint degeneration
 - Pain
- Can **measure** by measuring amount of **time** spent on each footfall



Measuring Step-Time Asymmetry

- MyWalk measures the amount of time spent on each foot using the **Accelerometer** in phone
- Phone is strapped to chest






My Walk

- Measures step-time asymmetry using **accelerometer**

$$\text{Step Time Asymmetry} = \left(\frac{\text{Time spent on one foot (s)}}{\text{Time spent on other foot (s)}} \right) \times 100$$

Table of Symmetry Value Meanings

Rating	Score	Meaning	Corresponding Populations
 GOOD	> 91%	Symmetrical Gait	Able-bodied adults (Normative)
 MODERATE	80-89%	Mild Asymmetry	Stroke patients (3 years post-stroke)
 POOR	< 80%	Severe Asymmetry	Stroke patients (6 years post-stroke)

Corrective Action

- Helps person correct it by providing timing 'beeps'



Flip the Script

Learning Second Language with a Dual Language Book



Specialist: Sameen Ahmad

Programmers: Yuxin Cheng

Maosen Wang

April 2016

Flip the Script: Goal & Motivation

‘Flip the Script’ is a dual language storybook app. Children can read and engage in a story while making connections between English and their mother tongue. Features include:

- a) translation highlight**
- b) dialogue and questions**
- c) read-aloud**
- d) record your own**



MyAlly

Helping At-Risk Teens



Specialist: Sharon To
Programmers: Mario Badr
Ilona Wong

April 2014

(20)

MyAlly

- Targeted at Troubled Adolescents
 - Borderline Personality Disorder
 - With Suicidal Tendencies
- Uses 'Dialectical Behaviour Therapy'
 - A cousin of 'Cognitive' Behaviour Therapy
- Four modules/approaches:
 1. Mindfulness
 2. Distress Tolerance
 3. Emotion Regulation
 4. Interpersonal Effectiveness

Exercises to Help Stress

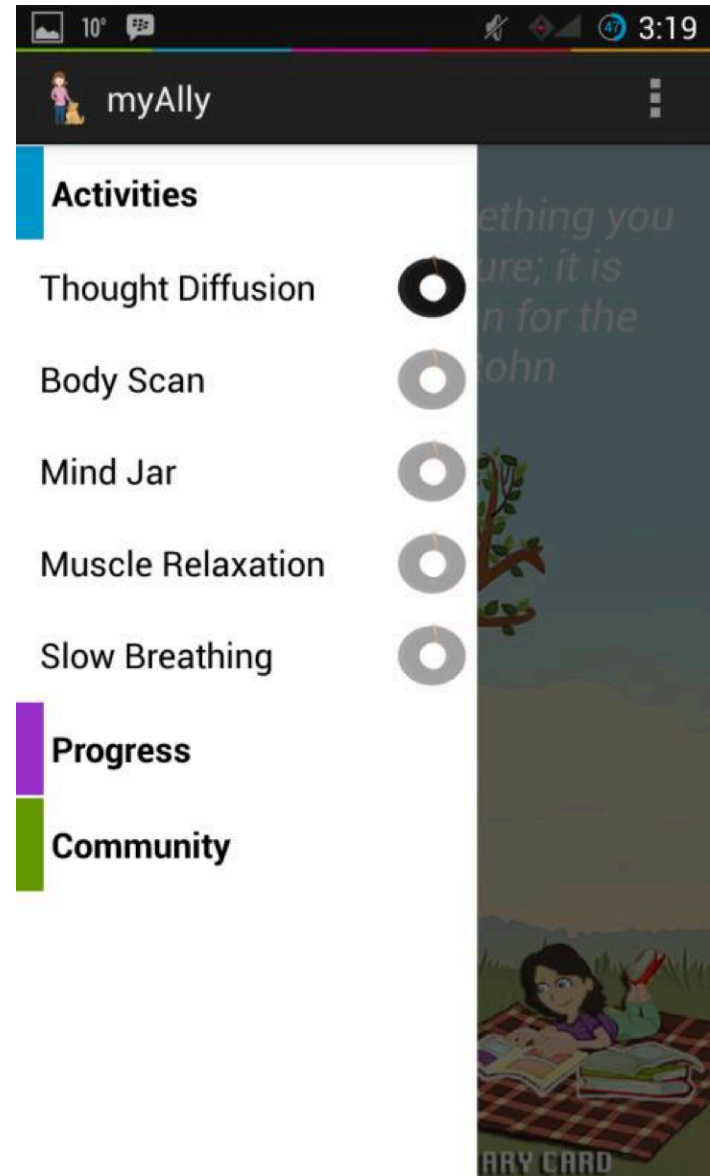
1. Balloon Breathing
2. Muscle Relaxation
3. Mind Jar
4. Thought Diffusion
5. Diary Card
6. World Community



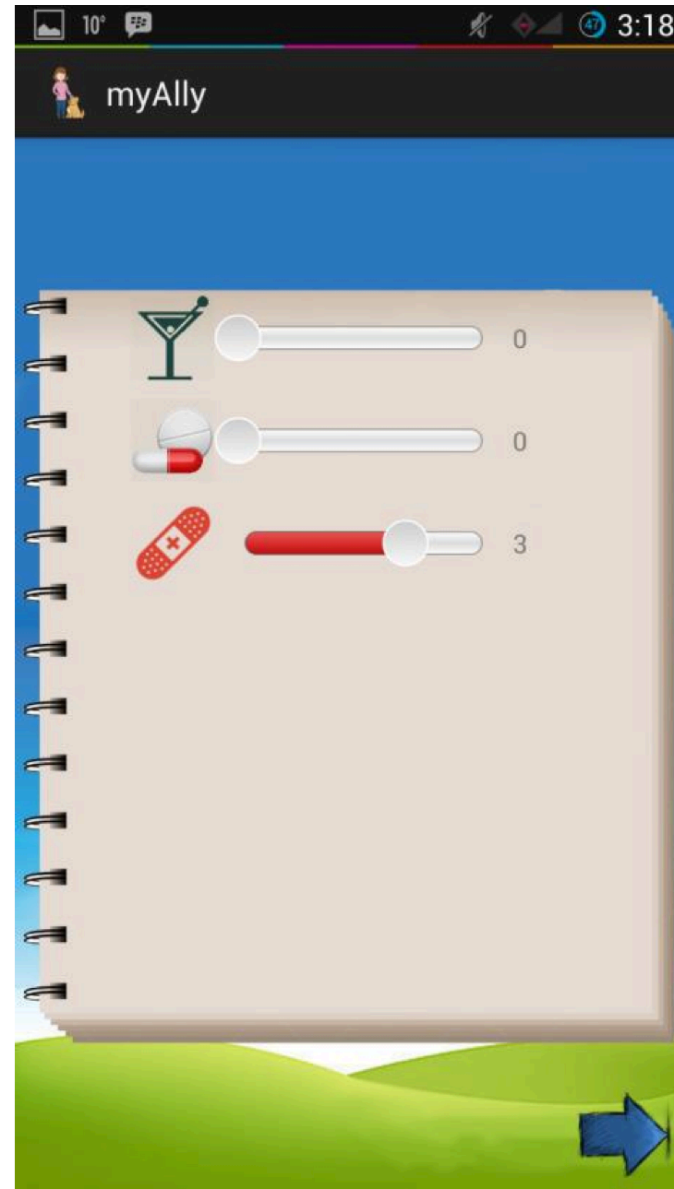
Main Screens



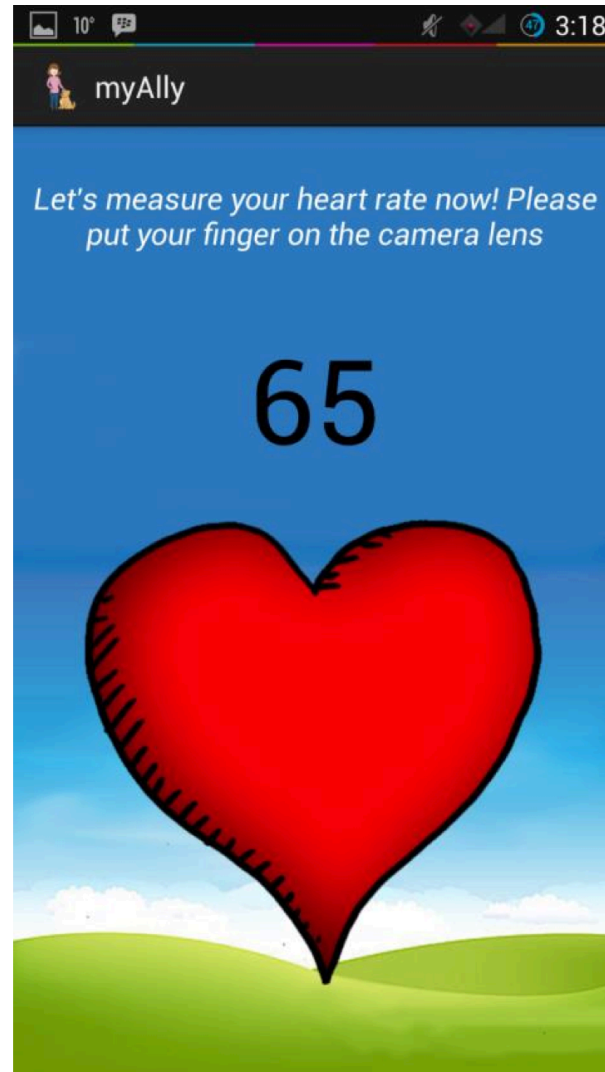
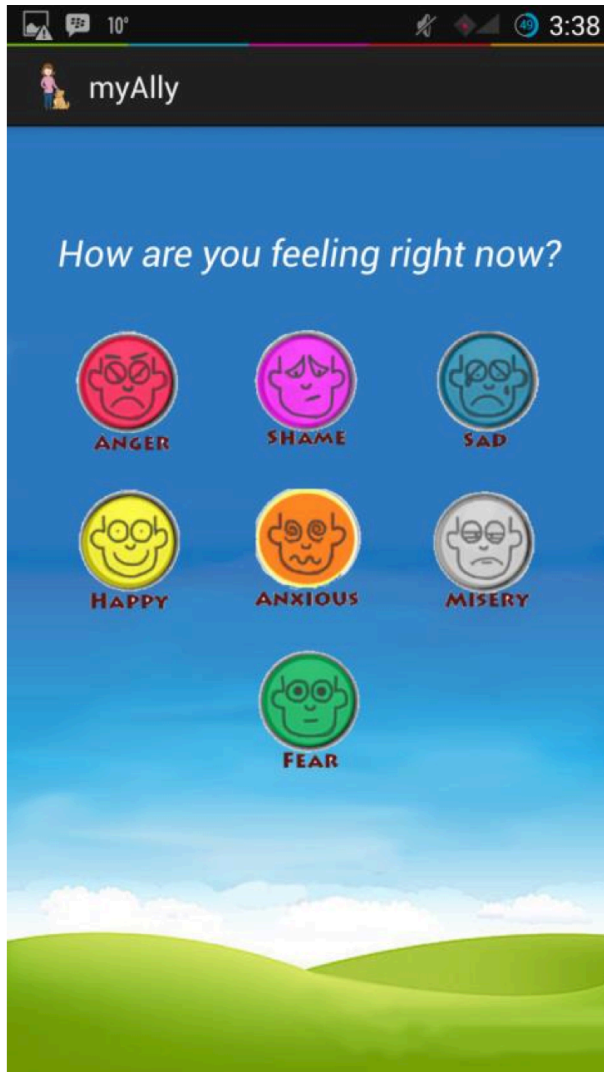
23)



Emotion Characterization

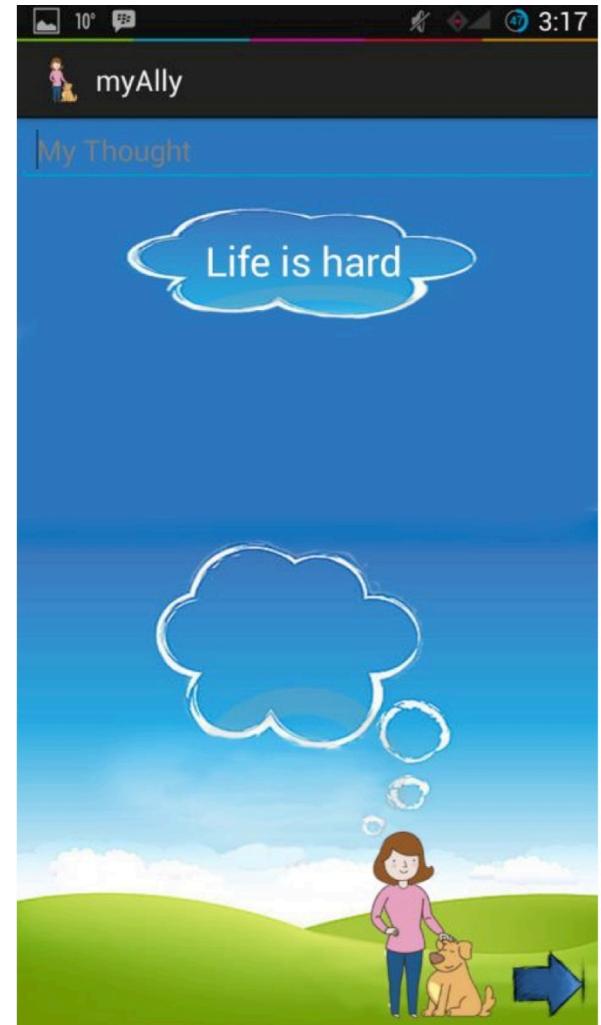


Emotion & Heart Rate Measurement



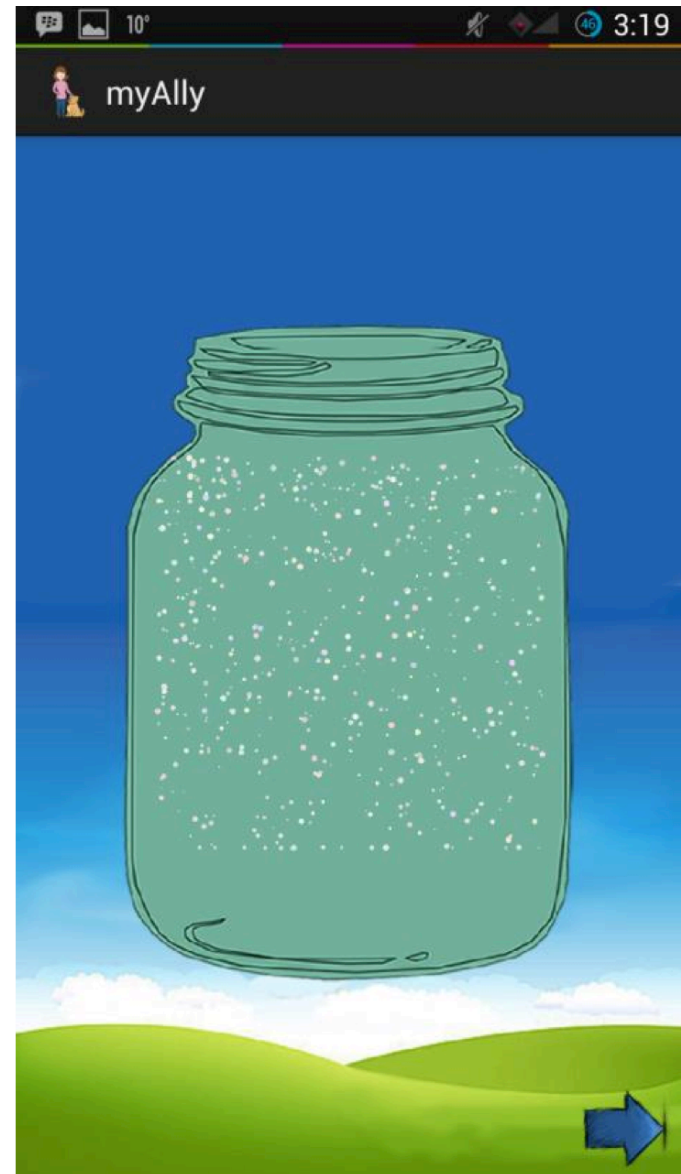
Thought Diffusion Exercise

- Push unwanted thoughts away



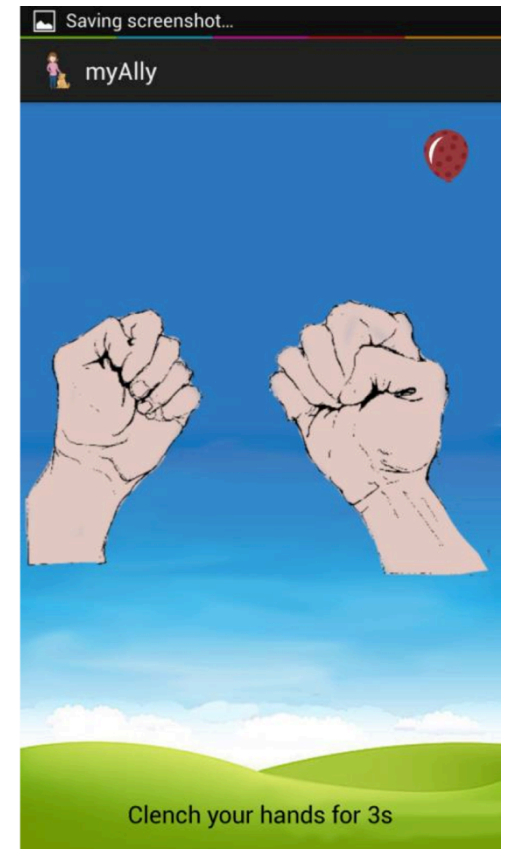
Mind Jar Exercise

- Allow thoughts to settle



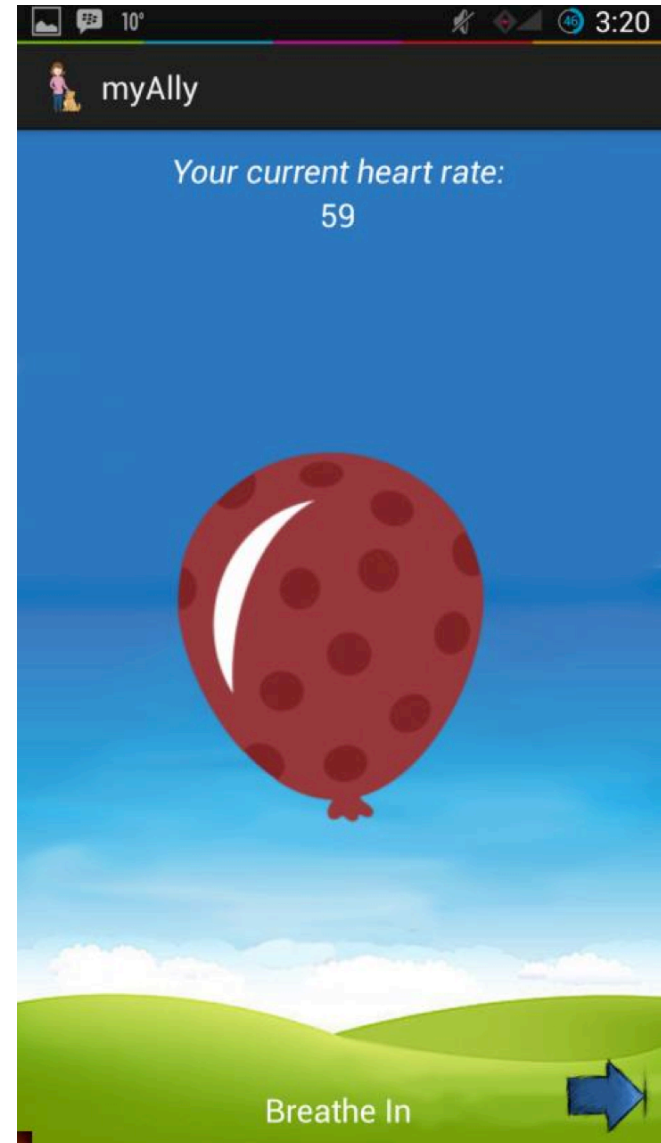
Muscle Relaxation Exercise

- Identify parts of body with mind
- Clench and relax



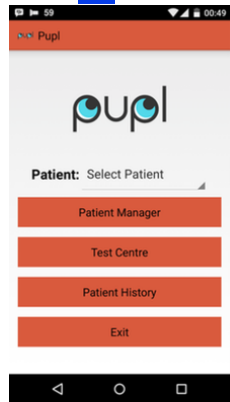
Breathing Exercise

- Balloon animates inflation/deflation to pace breathing to

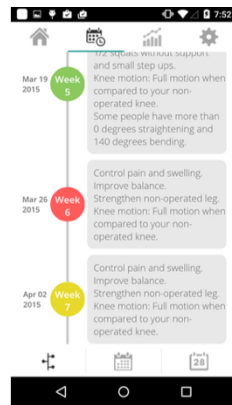


Other Sample Apps from Prior Years

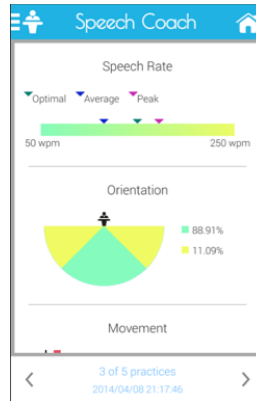
PUPL



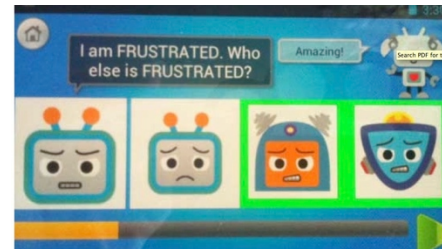
MyACL



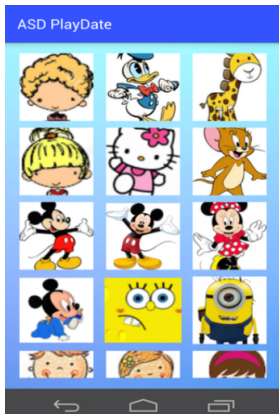
Speech Coach



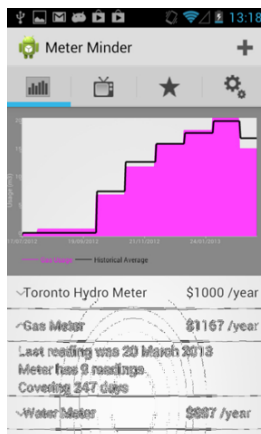
EYEDentify



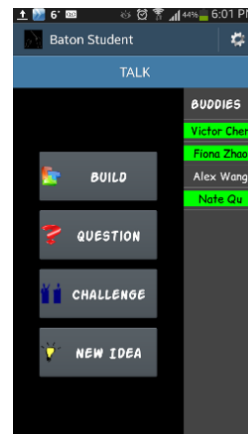
Mobile Stage



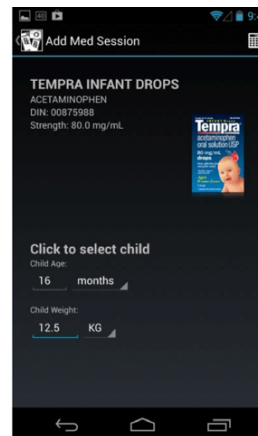
ASD Playdate



Meter Minder



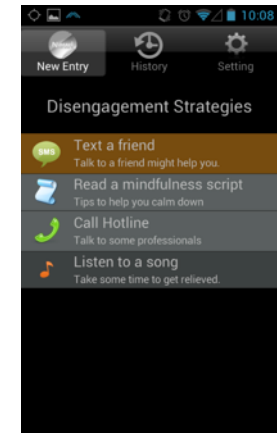
Baton⁽³⁰⁾



Snap N Dose



Practice Cactus



Mindful Me



Course Structure

Goals of Course

1. Create an interesting & novel mobile application
 - In a group project
 - That enhances/enables research in a specific field
 - **Or** that enhances a specific field in a new way
 - That is of sufficient technical depth
2. Participate in a creative inter-disciplinary environment
 - Interaction between software & other disciplines
 - Interactions between many disciplines
3. Teach literacy in mobile programming & potential
 - Gain engineering project experience with hard deliverables

Two Kinds of Students in Course

1. 'Programmer'

- Engineering, Computer Science or other **graduate** students with **good** programming backgrounds
- 'Graduate-level' Programmers:
- Have undertaken **significant** programming projects in past – 1000+ lines of code
- Courses: well beyond introductory programming
- Including several of: Operating Systems, Software-based Data Structures and Algorithms, Graphics and significant software final year Capstone Design Project
- In assignment P1, Part I, you will describe software background
- **Why?** Our past experience in this course has shown that insufficient software background makes course impossible.



Two Kinds of Students

2. 'Specialist'

- Graduate Students from every discipline or external specialist
- With some computer literacy
- A desire to create new app, in art, science, engineering
- YOU BRING EXPERTISE IN THAT DISCIPLINE



Example Specialists from the Past

- 6 years ago: Wound Care
 - Robert Fraser was a registered Nurse, M.N. candidate
- 4 years ago: Mozart's Ear
 - Andrea Stewart, M.A. candidate in faculty of Music
- 3 years ago: Baton
 - Zack Teitel, High School Teacher, M.Ed. Candidate at OISE
- Last Year: ASD Playdate
 - Ian Roth, Speech Pathologist, Toronto Western Hospital



This Course is a Bargain/Agreement

- Between group of 2 programmers and 1 Specialist
 - Programmers bring skill and willingness
 - Specialist brings expertise and efforts
- Together you will arrive at an exciting project!



Programmer or Specialist?

- All ECE and Computer Science students should be considered Programmers
- You can separately make a case that you wish to drive the application, but should still take the **programmer** path through the course



Which Kind of Student are You?

Specialist or Programmer?

Declaration (non-binding)

Raise Your Hand if you Think you are a Specialist

Raise Your Hand if you Think you are a Programmer



Sign Up Sheets – Circulating

- Name
- Student Number
- Department/Field
- **Degree**
- Taking Course for credit
 - Yes or Maybe
 - Cannot audit without very special permission
- Full time or Part Time
- Programmer/Specialist self designation
 - Can check both
- Phone Type: What kind of smartphone do you have?
 - Android/iPhone ... Blackberry/Windows ...



Course Learnings & Outcomes

- Knowledge & Experience
 - **Programmer:** How to program in a mobile environment
 - **Specialist:** Capabilities of mobile devices & basic technical understanding & how it can be applied to your discipline
- How to work across disciplines
 - **Key:** to reach across the boundaries of disciplines, learn the language of the 'other' discipline
- Project Experience
 - Dealing with tangible deliverables and hard deadlines
- **Clear, Concise Presentation Experience**
- Advance of Research Capability

Instructor Bio: Jonathan Rose

- Professor in Electrical & Computer Eng since 1989
 - Bach, Master's & PhD from UofT, Post-Doc at Stanford
- Research: Health-Oriented Mobile Apps
 - Recently switched into this area, because of this course!
 - Previously: Field-Programmable Gate Arrays (FPGAs)
- Entrepreneurial/Business Experience:
 - Co-founder of Right Track CAD Corp in 1998
 - Senior Software Engineering Director of Altera 2000-2003
 - Run the Engineering Hatchery Entrepreneurship Seminar
- Administration:
 - ECE Dept. Chair of ECE 2004-2009;
 - Director of Eng Biz Minor; Chair Eng Entrepreneurship **Hatchery**
- F.IEEE, F.ACM, F.CAE, FA NAE, FRSC, Sr Fellow Massey College



Why I Began Teaching this Course

- Have always felt that mobile devices would one day take a central role in human progress
- Am thrilled with possibilities of small, portable, highly integrated computers
- That time is now upon us; let's make interesting things happen!



Teaching Assistants

■ Braiden Brousseau

- TA'd course for last 6 years
- Ph.D. Candidate in ECE
- Thesis: Eye Tracking in Mobile Devices & Application
- braiden.brousseau@utoronto.ca

■ Daniel Di Matteo

- TA'd course for 2 years
- Ph.D. Candidate in ECE
- Thesis: Diagnosis of Social Anxiety using Mobile Technology
- dandm@ece.utoronto.ca



The Project

The Project Group

- Done in Groups of 3
 - 2 Programmers
 - 1 Specialist
- OK to have groups of programmers-only, only if extra, but only if no Specialists available
- New last year: **External Specialists**

External Specialists

- Are Post-docs, Psychiatrists, Speech Pathologists and Professors, Journalists, Lawyers
 - Who I have personally vetted
 - Who have agreed to commit the time necessary to guide the team as a specialist (and participate in presentations)



Rules on Project App

1. Subject **Must be in the discipline of the Specialist**
 - an idea to support research
 - **or** something useful/worthwhile/interesting within the discipline
 - should leverage Specialist's expertise
 - to those who want to be both programmer & specialist: **wait**
 - Should first hear ideas
 - I will (mostly) enforce pure specialist-driven projects
2. Must have sufficient technical depth
 - Will be an approval step in process to ensure this
3. *Should* be a new idea
 - Can be variant of existing app if enough different
4. Must be approved
 - By me



Project Stages

1. Forming Groups

- Pair up Programmers, then together find Specialist
- Form group in 3 weeks; extra meet Tuesday Sept 27 @6:30pm

2. Project Approval-in-Principle

- via email; due October 7th

3. Project Proposal/Plan

- Document Due October 14th

4. Proposal & Plan Presentations

- October 20 & 21
- **NOTE EXTRA LECTURE Thursday Oct 20, 6-8pm, SF1101**

5. Spiral 2 & Spiral 4 Presentations

- 2: November 4/11 4: November 18/25

6. Final Presentations

- Weeks of December 2/9

7. Final Report Due December 14th

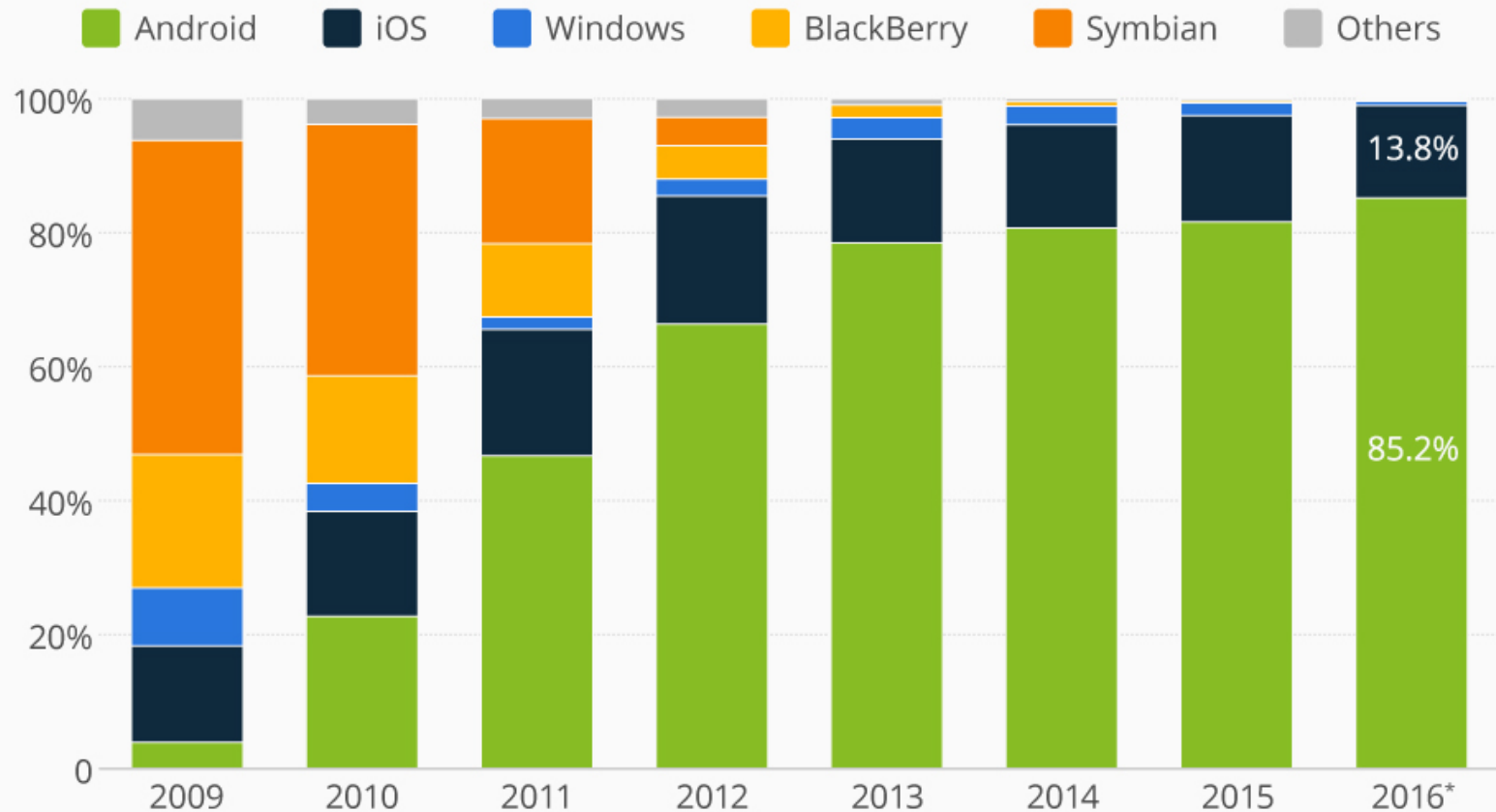


Which Platform – Android or iOS?

On the One Hand

The Smartphone Platform War Is Over

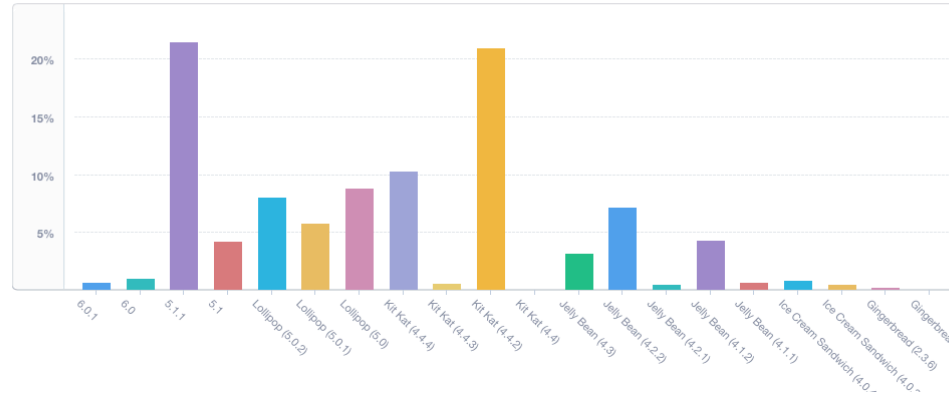
Worldwide smartphone operating system market share (based on unit sales)



On the Other, Fragmentation vs. Adoption

Android OS versions

Nov 29th, 2015 – Dec 29th, 2015 **DONE**



**Android
Fragmentation**

iOS 9 adoption

Sep 1, 2015 - Dec 29, 2015 **Hour Day**



**iOS 9
Adoption**



Sam Vafae https://mixpanel.com/trends/#report/android_frag

https://mixpanel.com/trends/#report/ios_9

Like · Reply · 1 · December 7 at 5:27pm

**Former ECE Student
who works at Apple**



Other Relevant Facebook Comments



Bijan Vaez As a qualitative measure across our millions of users - we look at the graph mentioned in this article, then look at our own usage stats and realize we still have 60%+ iOS users on our platform. Our end users are general consumers from high school students to 60 year old surgeons. Our surveys indicate that most of the people who have an android do it because it's the defacto cheap standard and all they want to do is text, phone and maybe now & then check Facebook. From our surveys they do not install apps, have no idea what the google play store even is or what 'apps' do 😊 quite interesting.

Unlike · Reply · 👍 3 · December 7 at 5:48pm

Primary Mobile Platform: Android

- We will focus on the Android System because:
 - Widely available & can develop on all major operating systems (Windows, Mac, Linux)
 - Many phones available, some donated for class
 - Is successful

- Using Android Studio environment
 - Previous big 'con' against Android was Eclipse environment
 - Programming Language: **Java**



Alternative, If You Have Mac & iPhone

- If you wish to do assignments & project on iPhone, that is allowed, but talk to me first
 - **Pro:** Better development environment
 - **Con:** less common language: Objective C
 - Even less common new one: Swift
 - **Con:** Must have a Mac computer
- Assignments are set up for **both** Android and iPhone
- **Important: your project partners must agree**
- Other kinds of phone operating systems?
 - Not sensible at this point. ☹



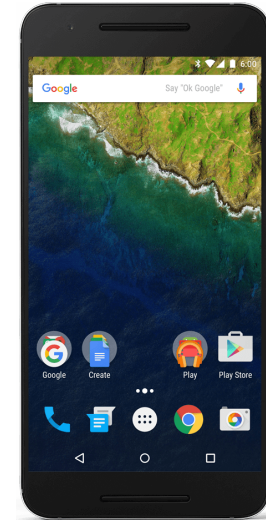
Physical Phones

- Have some older phones donated and some new phones donated
 - good, also, if you have one yourself
- It is much better (and sometimes necessary) to develop on actual phone
- Can use the emulator;
 - Getting better on android;
 - Good on iphone

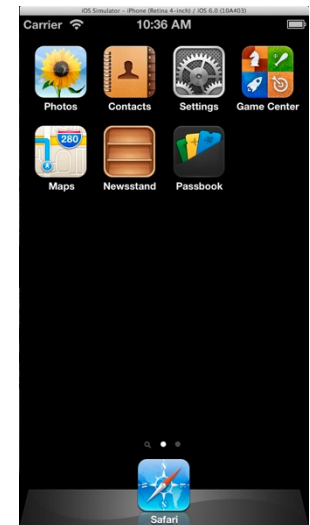


Nexus 6P

Ascend P6



Android Emulator iPhone Emulator



Textbooks for Programmers & Specialist:

Android

By Mark Murphy:

1. The Busy Coder's Guide to Android Development v7.6

- <http://commonsware.com>
- Murphy gives free 4 months licenses for students
 - Ask TA Braiden Brousseau for License key by email
- \$40 buys all current versions, and a year's subscription to the updates, that come out with each new version of Android
- Specialists may wish to browse too
- Have found that the Android development website is good or better for some things:

<https://developer.android.com/studio/intro/index.html>



iOS Textbook for Programmers:

Two Choices, depending on language

1. Objective-C

- **Beginning iOS 7 Development, Apress**
- by David Mark, Jack Nutting, Jeff LaMarche, Fredrik Olsson
- <http://www.apress.com/9781430260226>
- \$USD 35, \$17.50 for e-book

2. Swift

- **Beginning iPhone Development with Swift 2, Exploring the iOS 9 SDK**
- By Mark, Topley, Nutting, Olsson, and LaMarche
- <http://www.apress.com/9781484217535>
- \$USD 32, \$16 for e-book



Course Material

Three Course Websites:


- <http://www.eecg.utoronto.ca/~jayar/ece1778/>
 - Has link to videos & reports from previous years' projects
 - Assignments will be placed here
 - Lectures posted here

- UofT Blackboard Portal for basic stuff
 - Grades
 - Announcements
 - Handing in Assignments

- **Piazza** website for interaction & upload
 - See announcement on Portal that tells you how to access

Course Material

■ Lectures

- Basic phone capabilities
- Thinking/discussion about how to use capabilities in project
- Programming concepts, **but not much** 
- Project basics; block diagrams
- Case Studies of interesting/inspiring apps
- Visitor planned:
 - Design for User Experience Lecture

■ Mostly presentations from class

- proposal, progress x2, final

■ Assignments ...

■ Meetings with your Project Partners!

Assignments!

Part 1: Due next week: **Thursday** September 22, 6pm

Part 2: Due in 2 weeks: **Thursday** September 29, 6pm



Programmer Assignment P1

Prog Assign Part 1: Describe Yourself

1. In Writing

- Give your background – what undergraduate & graduate program you've taken/are in
- List the programming courses you've taken
- List the major programming projects you've undertaken (& size)
- Give the names of all company(s) you've worked for as professional/programmer (either as co-op, summer, or full time)
- I reserve the right check that your capability is at the right level

2. In a video, no more than 2 minutes;

- Describe the projects and work you listed above
- Indicate what areas of projects you'd like to work in



Prog Assign Part 1: Describe Yourself

- Upload both on **Piazza**
 - the website we'll use to interact
- Purpose
 - for **Specialist** to get to know you;
 - for us to check that your background is sufficient
- Part I is due Thursday, September 22nd, at 6pm
 - However, do it right away, so people can get to know you!
 - Late penalty



Assignment P1, Part 2

- Acquire textbook – Android or iPhone
 - **Android: Need some basic Java knowledge**
 - Get a Java book
 - http://en.wikibooks.org/wiki/Java_Programming/Language_Fundamentals
 - Download Android Environment
 - Do “Hello World” tutorial; make it work on an emulator
 - Walk through initial Android Websites; read/skim Text
 - Write simple android application
 - Part 2 due Thursday September 29th, 6pm; late penalty
 - Assignment posted under Assignments in Course Website
- <http://www.eecg.utoronto.ca/~jayar/ece1778/assignments.html>



Specialist Assignment S1

Specialist Assign Part 1: Describe Yourself

1. In writing

- Write 250 words that describe your field to a lay person
- Give your background – what undergraduate & graduate program you've taken/are currently in
- Describe what the focus of your degree/research is (e.g. 'my thesis topic is ...', or 'I'm taking courses in..')
- Brief history of work, if any

2. In a video, no more than 2 minutes;

- Name your field, give quick description of it
- Describe other things you might bring to the project – skills, access to a lab for measurements, job experience & what you're interested in working on
- A rough idea of what you're thinking about as an App



Specialist Assign Part 1: Describe Yourself

- Upload both on **Piazza**
 - the website we'll use to interact
- Purpose
 - for Programmers to get to know you;
 - for us to establish your field of expertise
- Part I is due Thursday September 22nd, at 6pm
 - However, do it right away, so people can get to know you!
 - Late penalty



Assignment S1 for Specialists, Part 2

1. Find 5 apps in your field and describe each in 100 words
 2. Choose the best of those 5 and do deeper case study:
 - Obtain app, use it, describe it. 1000 words max
 - Mark penalty for too many words
-
- Part 1 due Thursday September 22 6pm; late penalty
 - Part 2 due Thursday September 29 6pm; late penalty
 - Available on Course Website
<http://www.eecg.utoronto.ca/~jayar/ece1778/assignments.html>
 - Hand in on Blackboard Portal



Other Assignments

Date Assigned	Assignment	Due
September 30	P2/S2	October 6
October 7	P3/S3	October 20
October 21	P4/S4	November 3



Grading

■ Assignments: **20%**

- 4 in total

■ Project: **80%**

- Proposal/Plan (incl presentation) 10%
- Spiral 2 Presentation 10%
- Spiral 4 Presentation 10%
- Final Presentation/Demo 10%
- Final Report 20%
- Individual Contribution 15% [included in group report]
- Peer Review 5%

New This Year: Peer Review

- Each individual student will be asked to provide feedback to other groups on each of **three** presentations
 - Proposal
 - Spiral 2
 - Spiral 4
- You will be assigned to 1 group each period
- Asked to provide specific, useful feedback to that group's presentation
- Your feedback/commentary will be graded for quality
- Has side effect that you must attend all classes, not just the one that you'll be presenting in.



A Note to ECE M.Eng Students

- Raise your hand if you are in ECE and the M.Eng (professional master's) program
 - How many are full time/part time
- Currently, ECE does not limit the number of courses you can take.
- However, other students are not allowed to take more than 3 courses in a term.
- You should not take this course if plan to take more than three courses per term. It is too much work.
- If you are part-time (presumably with a full-time job?) then you should not take more than this one course.
 - I suggest that all prospective project partners ask each other what their course load is;



Commercialization & Intellectual Property



Commercialization

- If group wishes to commercialize App, feel free to do so
- If not, consider giving away if useful
 - In previous years, people have given away source code for others to use/view
- Note: scope of project is *broader* than those apps that are commercializable
 - Apps can be motivated by research & not-for-profit goals



Commercialization & Intellectual Property

- University of Toronto Intellectual Property Rules:
- Work that makes significant use of UofT resources
 - Requires disclosure & extraction of Universities' rights in exchange for fraction of licensing revenue, or some other deal
 - These rules aren't well set-up for apps/app store
- In my view, **nothing** in this regular course work makes significant use of UofT resources
- If other people make contributions – supervisors, or UofT employees, then UofT rules will apply
- Law of the land does apply – all inventors have rights

Warning about Intellectual Property

- In my experience, all talk of IP tends to make people think about keeping secrets; that's bad
 - Most ideas live and grow well in 'the light'
 - This is true for startups as well
 - Advice: don't get too caught up in worrying about IP



Project Step 1: Getting To Know Potential Partners



Why

- The key part of this course is the project
- You need to get to know each other, to explore who might work well together
- Assignment 1 asks you to write & speak about yourself
- Also: we will hold an extra course meeting explicitly for the purpose of forming groups:

Date: Tuesday September 27 at 6:30pm

Location: GB 405

(Galbraith Building, 35 St. George Street)

- We will use the remainder of this lecture for introductions

Suggestion for Team-Forming

- Programmers first 'pair-up' with compatible partner
 - Do this by mid-next week
- Then seek mutually agreeable Specialist & project
 - Needed the week after
- When contemplating projects, feel free to communicate with us (myself and all TAs) for fast feedback



Please Introduce Yourself

1. Name
2. Discipline you work in & degree sought
3. Taking Course for Credit – yes or maybe?
4. Part time or full time student?
5. What your thesis topic is (if doing thesis)?
6. If you work, where & what you do?
7. Why you're taking this course?
8. What kind of phone you're carrying?
9. **Specialist:** What idea, if any yet, you have for an app
10. **Programmer:** What areas are you interested in?

