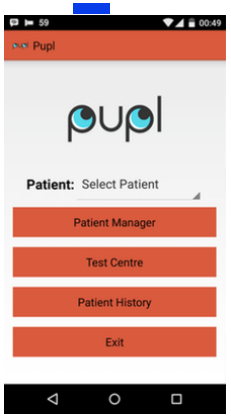
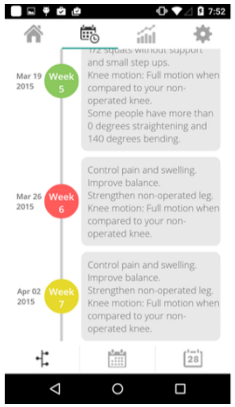
Creative Applications for Mobile Devices

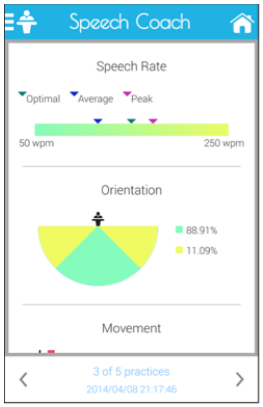
PUPL



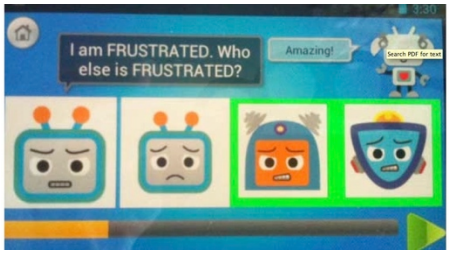
MyACL



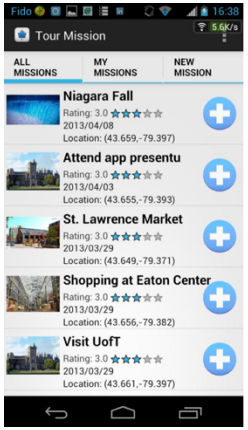
Speech Coach



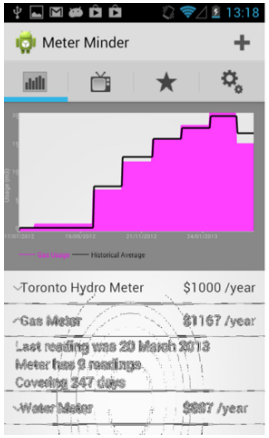
EYEDentify



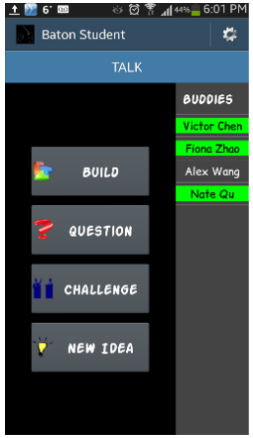
Mobile Stage



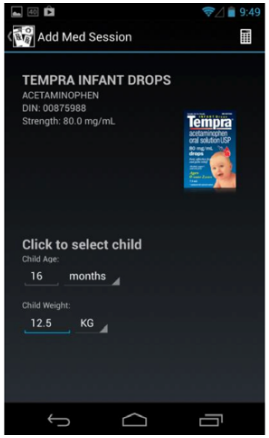
New Canuck



Meter Minder

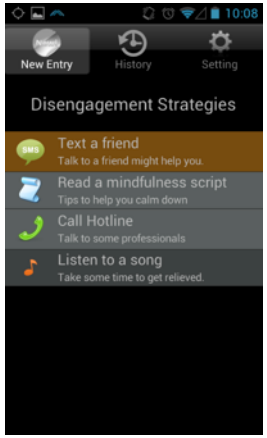


Baton (1)



Snap N Dose

Lunch Time



Mindful Me

ECE 1778:
Creative Applications for Mobile Devices

Instructor: Jonathan Rose

Department of Electrical & Computer Engineering

Welcome!

- Recent advances in Mobile and Wearable technology has 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

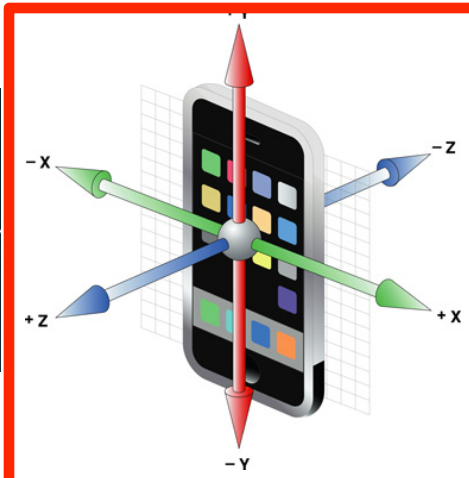
To bring together people from different disciplines to prototype novel and useful mobile applications

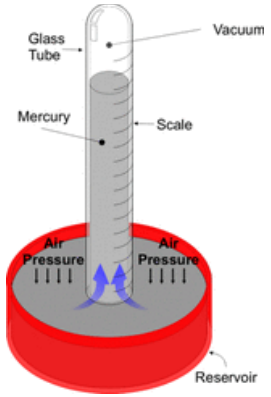
Mobile Devices are Powerful

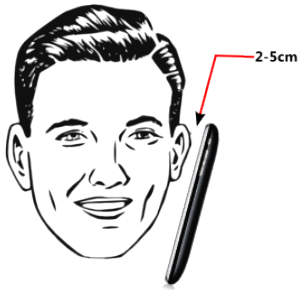
Because they contain in one portable package:

- 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)

And in Connected/Wearables

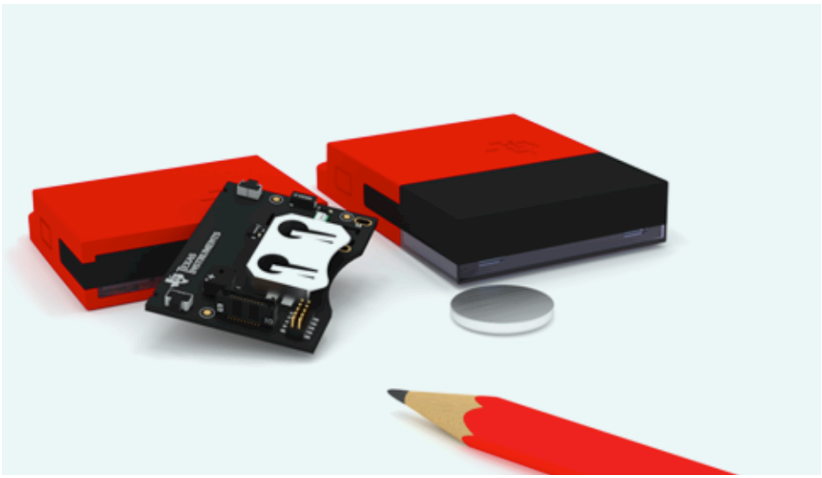
TrackR

Activity Trackers/
Health Monitors

Instrumented
Clothing

Great Example Wireless Device

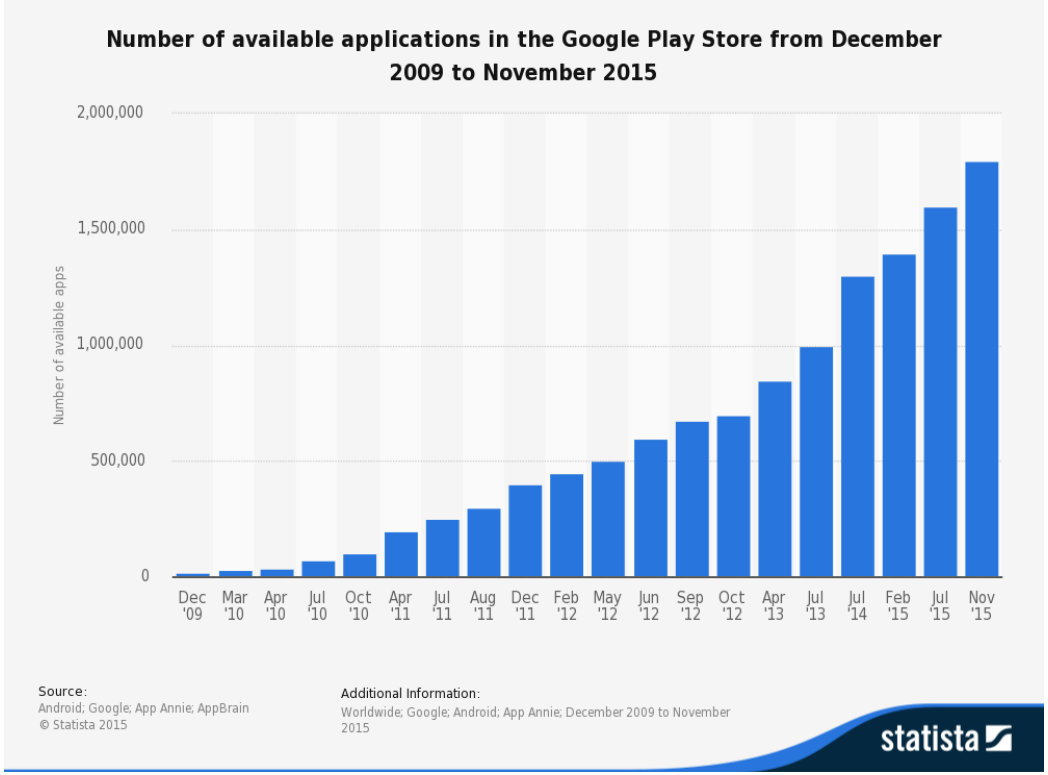
- Texas Instrument's 2nd Gen 'Sensor Tag'
  - **Cost:** $USD 29
  - **Bluetooth Connection**
  - **Sensors:**
    - 9 axis
    - Magnet sensor
    - Light
    - Ambient temperature
    - IR temperature
    - Humidity
    - Air pressure
    - Two Buttons, two lights, quiet buzzer!



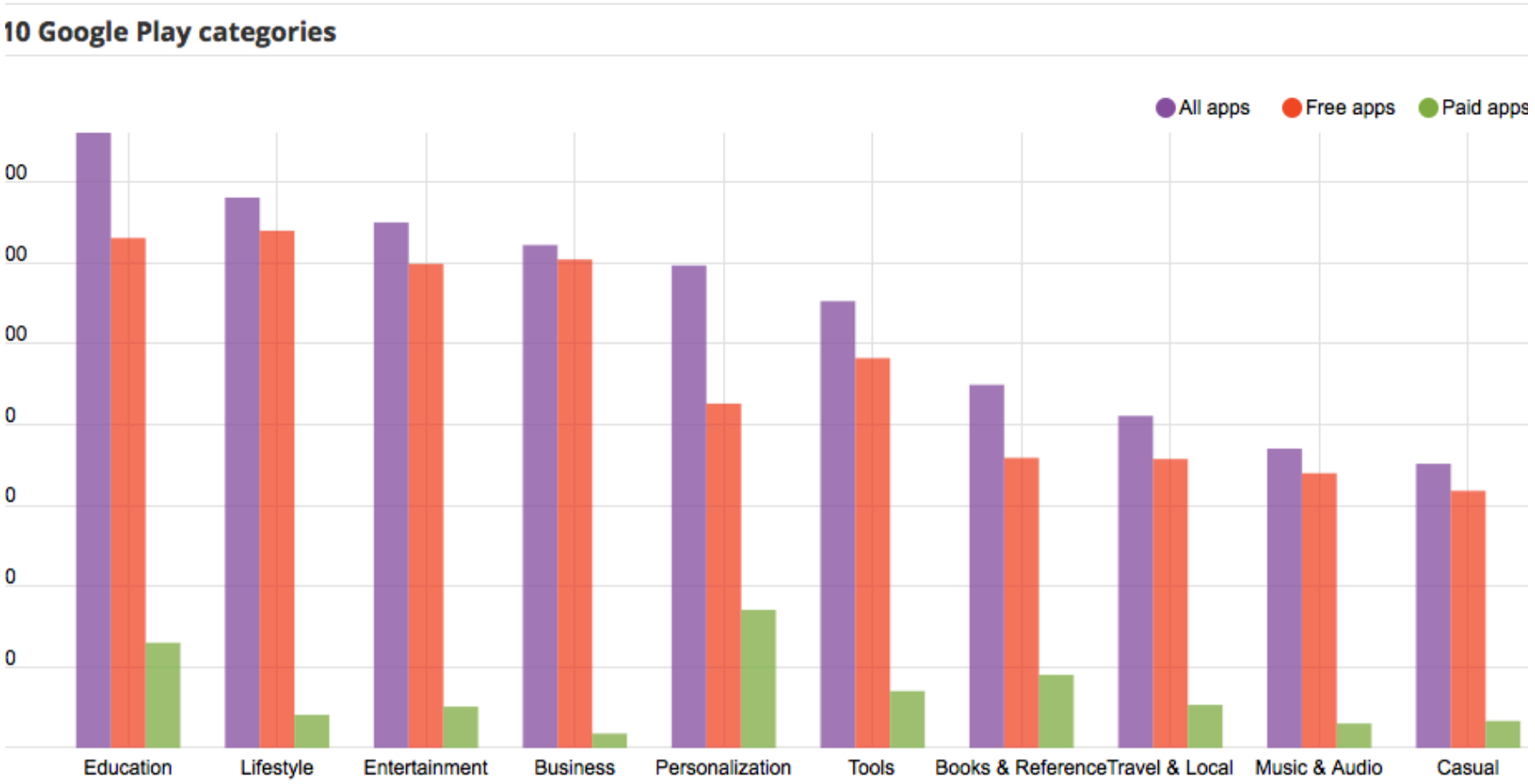
- **Demo**

Given Rise to Thousands of Great Ideas

- Perhaps one of the greatest surges of creativity in human history has occurred in the past 6 years
- 1.5M Apps in Apple App Store
- 1.6M Apps in Google Play Store



In Many Areas



There are Many More Ideas to Come

1. We are still not used to what is possible when all these elements are brought together
   - **We** are evolving

2. Monthly 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

Step-Time Asymmetry

- Is a walking problem
  - individual spends unequal time on each foot while walking
- Affects a wide range of patient populations
  - including stroke victims
- Has bad effects that worsen over time:
  - increased joint degeneration
  - pain
- Studies demonstrate that patients can improve with active feedback…

My Walk

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

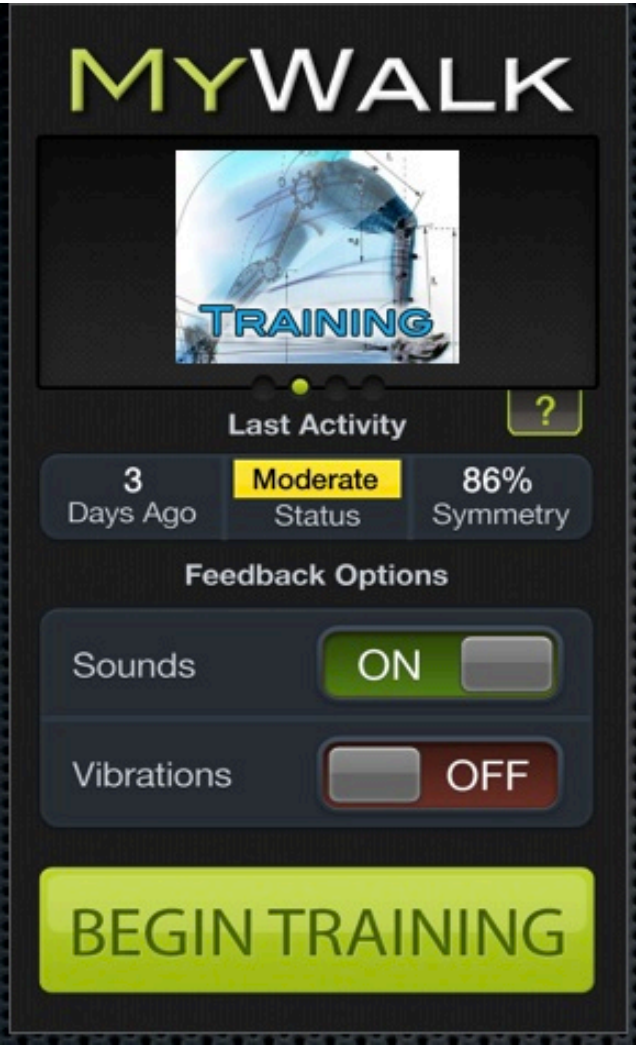
$$\text{Step Time Asymmetry} = \left(\frac{\text{Time spent on one foot (s)}}{\text{Time spent on other foot (s)}} \right) \times 100$$

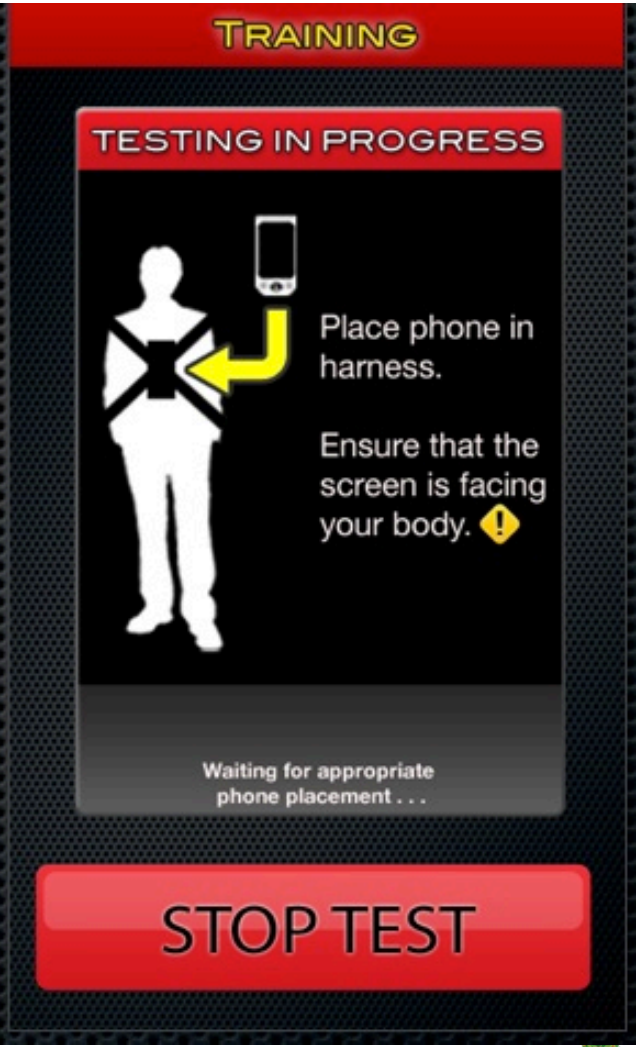
- Helps person correct it by providing timing 'beeps'

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)

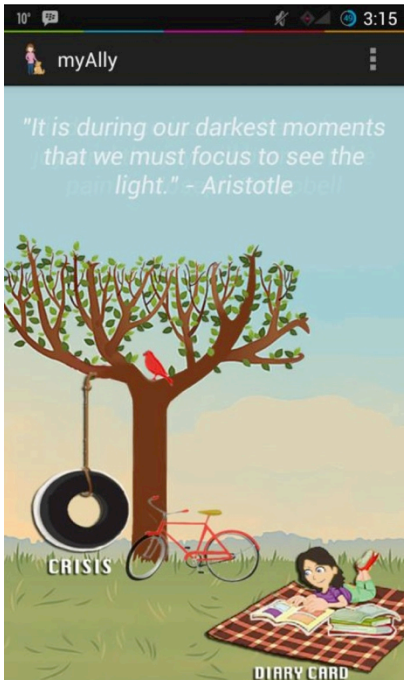
My Walk Screen Shots





MyAlly

Helping At-Risk Teens



Specialist: Sharon To

Programmers: Mario Badr

Ilona Wong

April 2014

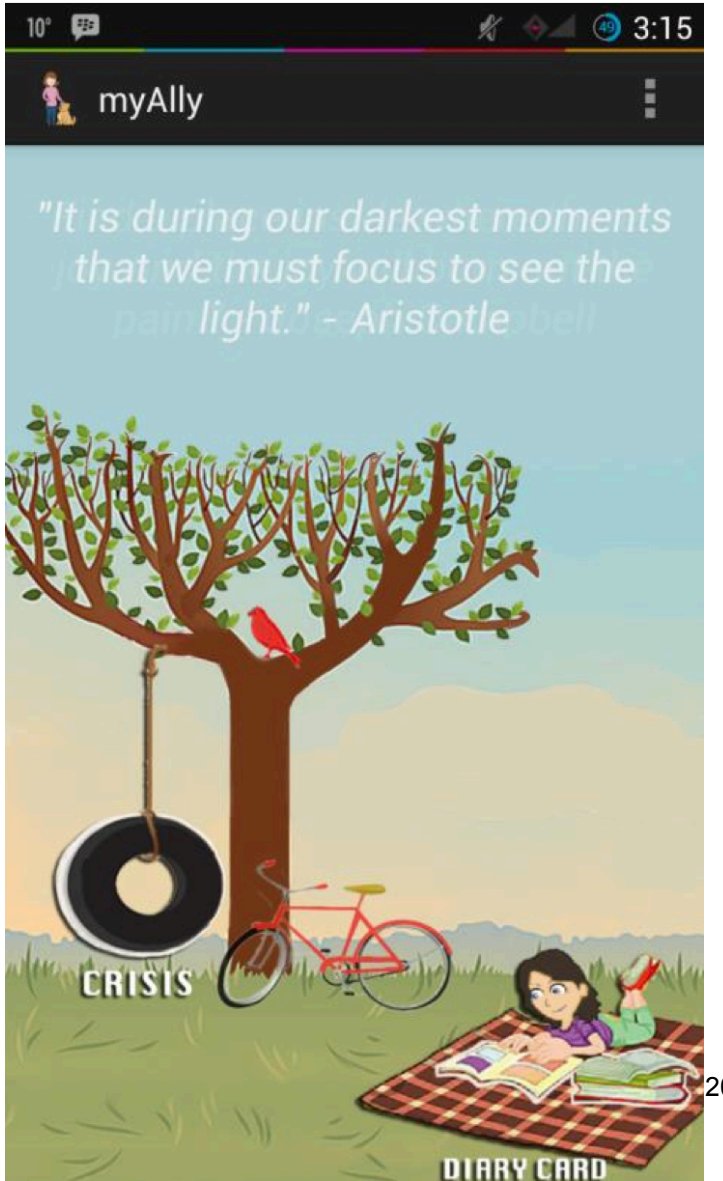
MyAlly

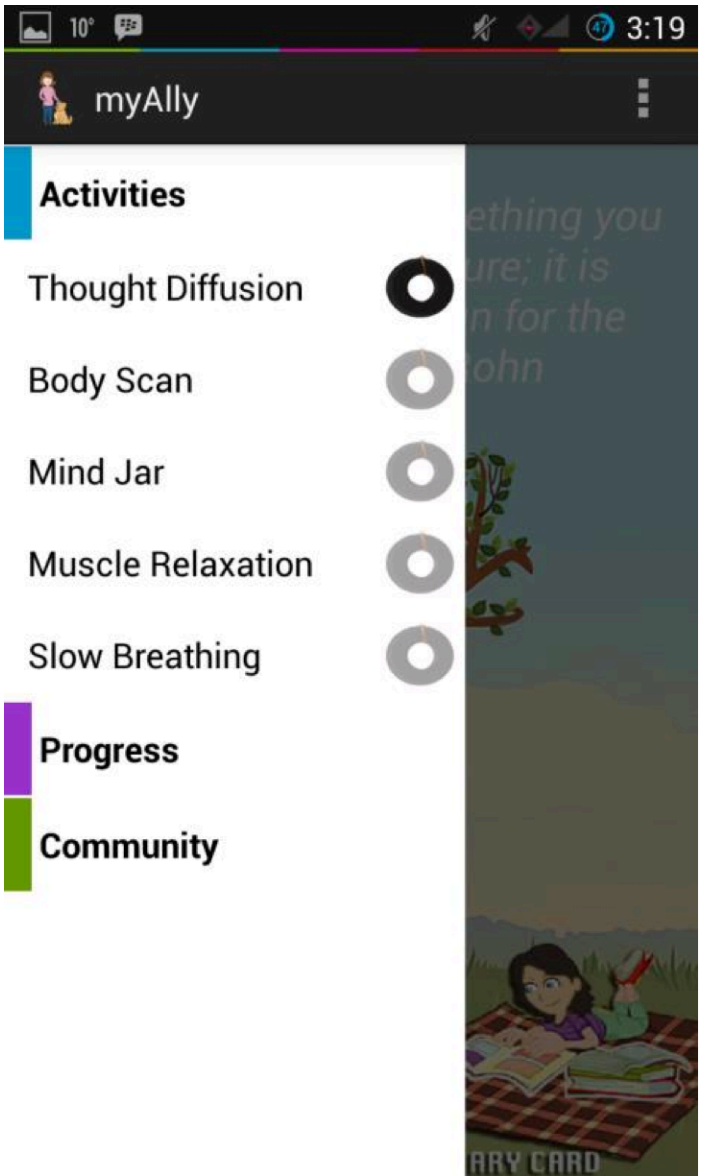
- Targeted at Troubled Adolescents
  - Borderline Personality Disorder
  - With Suicidal Tendencies
- Employed Dialectical Behaviour Therapy
  - Similar to ‘Cognitive’ Behaviour Therapy
- Has four modules/approaches
  1. Mindfulness
  2. Distress Tolerance
  3. Emotion Regulation
  4. Interpersonal Effectiveness

Exercises to Help Stress

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

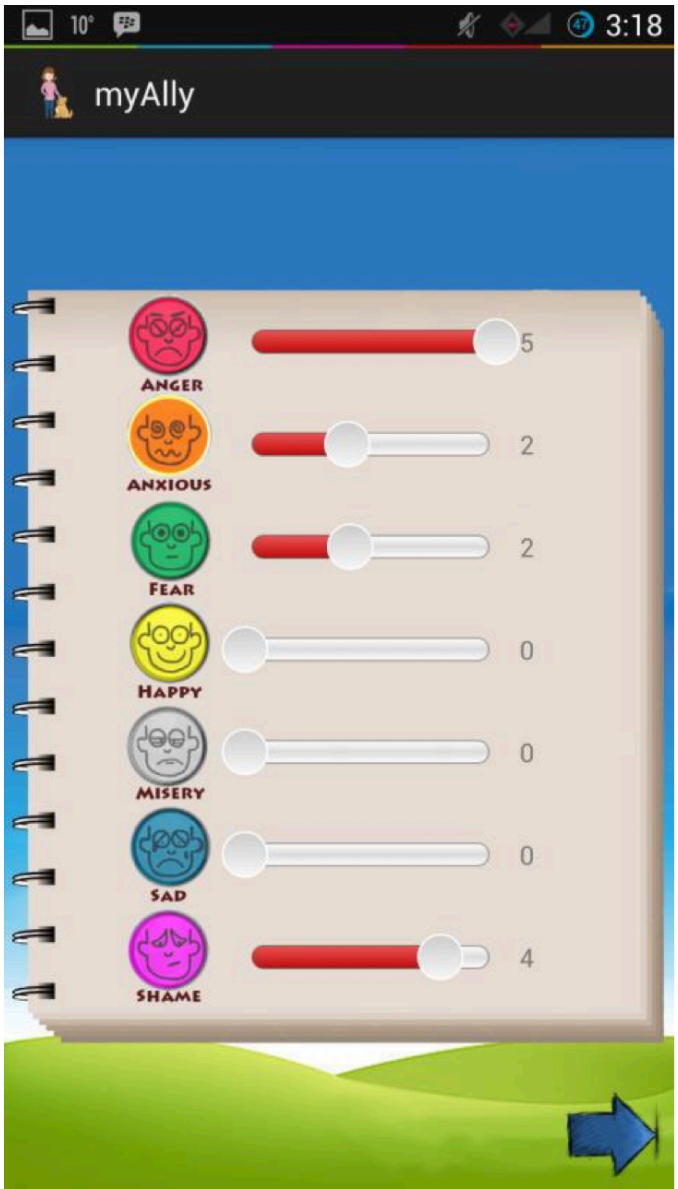
Screen Shots

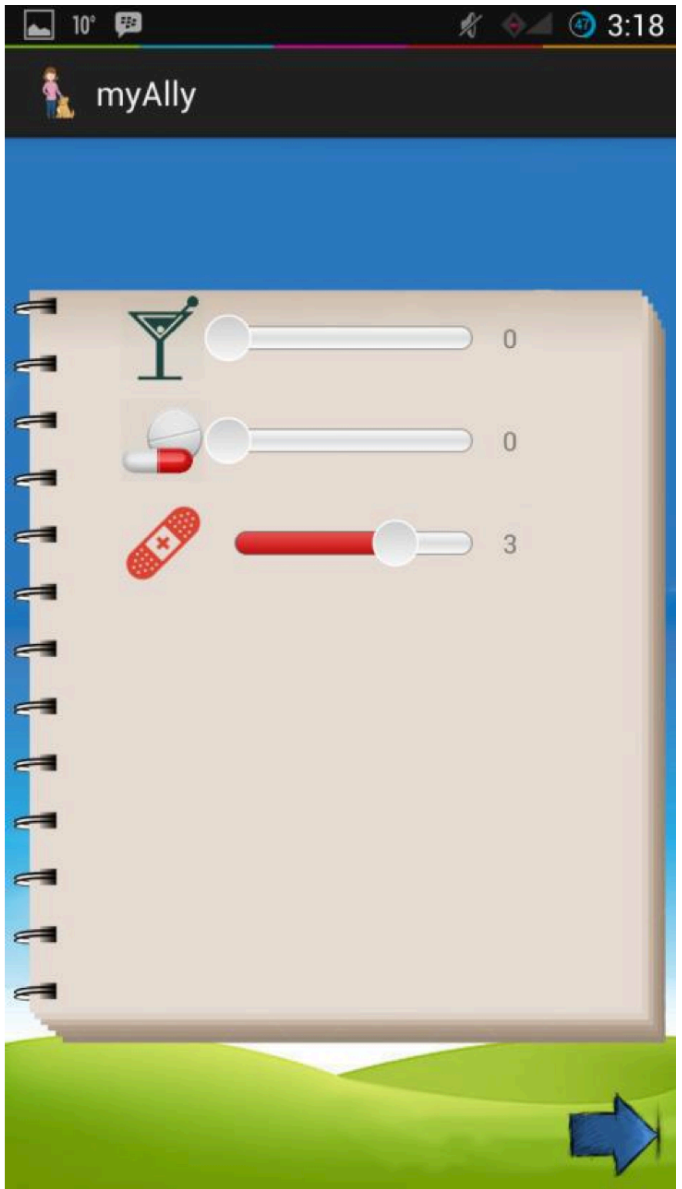




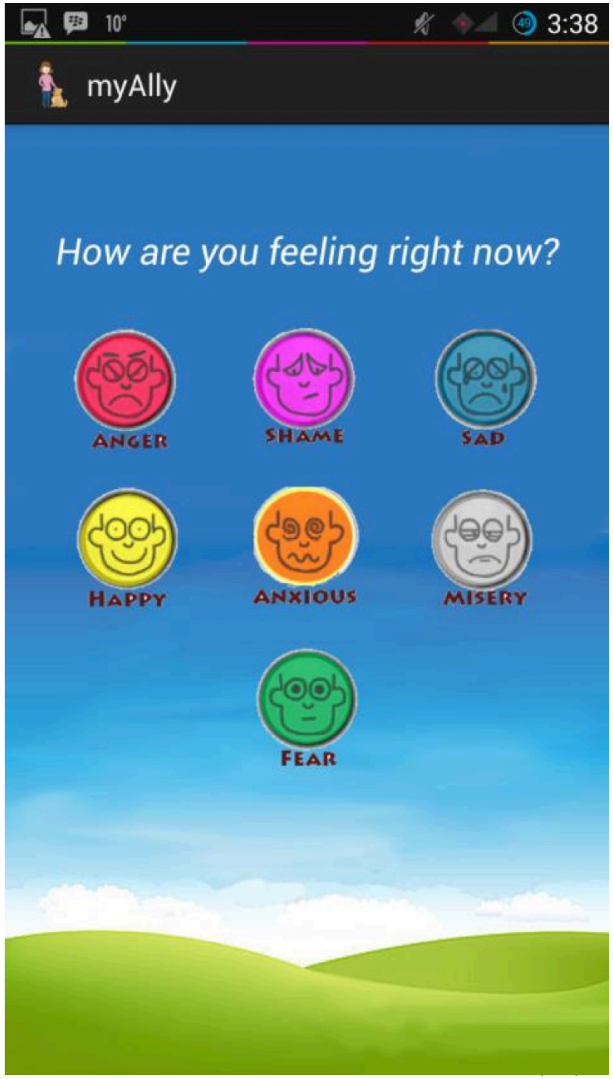
20)

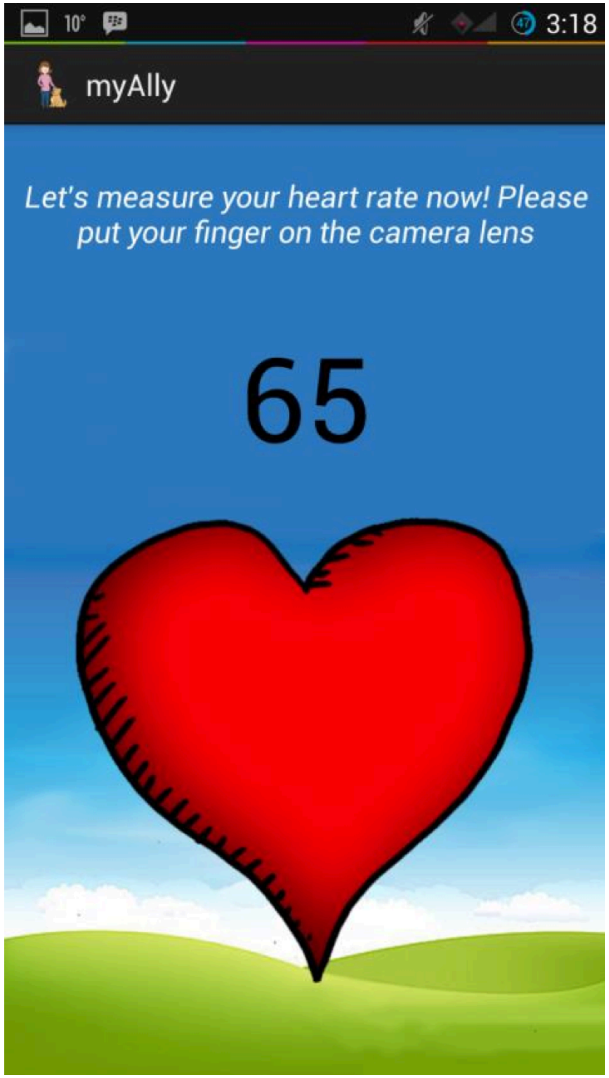
Emotion Characterization





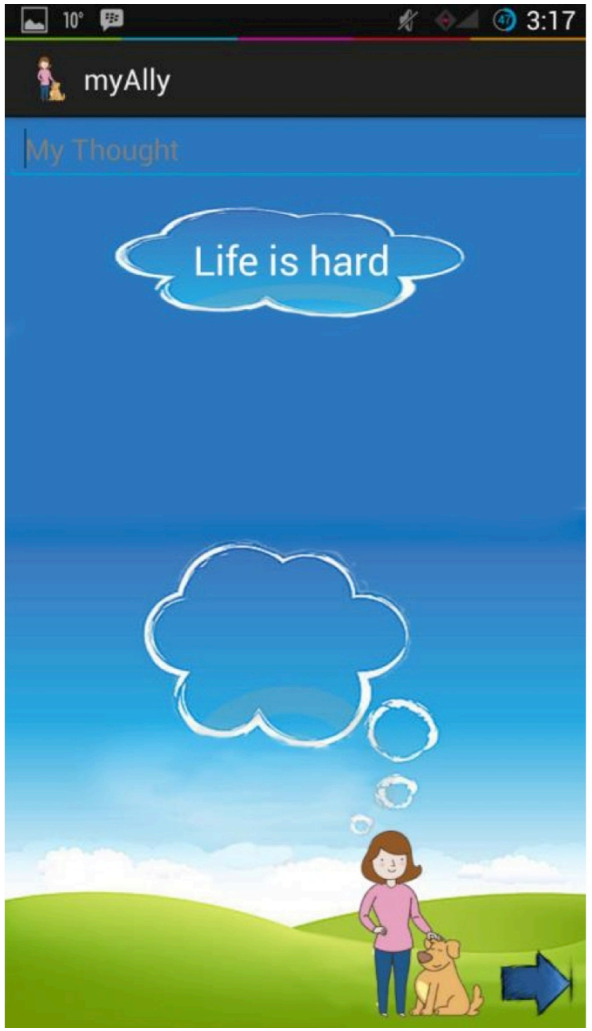
Emotion & Heart Rate Measurement





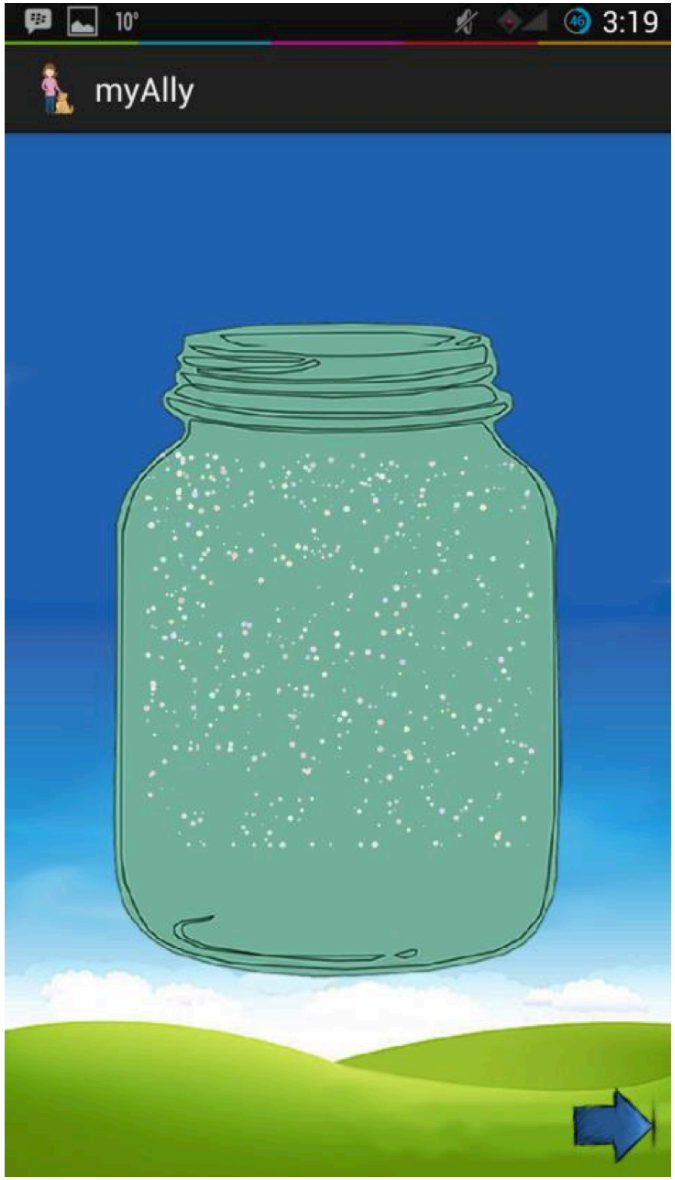
Thought Diffusion Exercise

- Push unwanted thoughts away



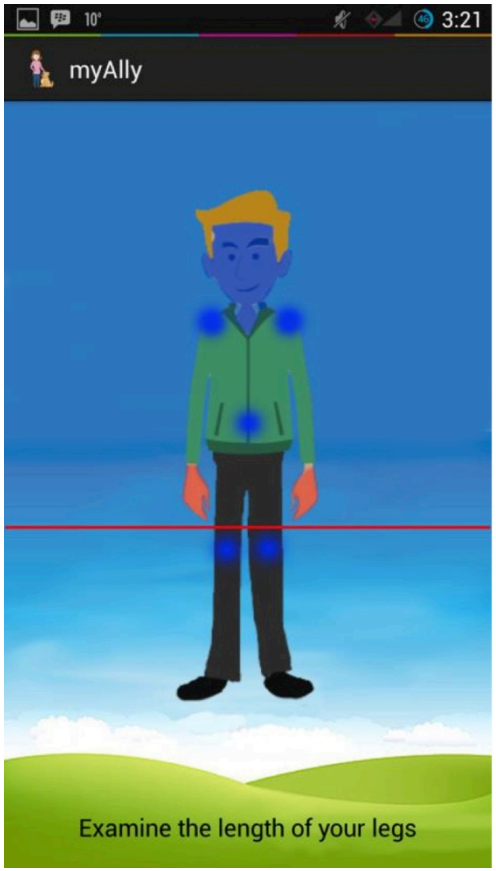
Mind Jar Exercise

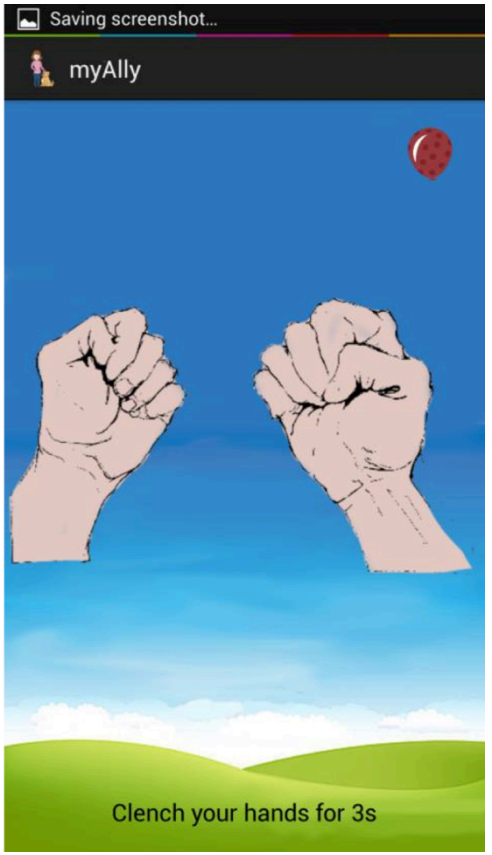
- Allow thoughts to settle



Muscle Relaxation Exercise

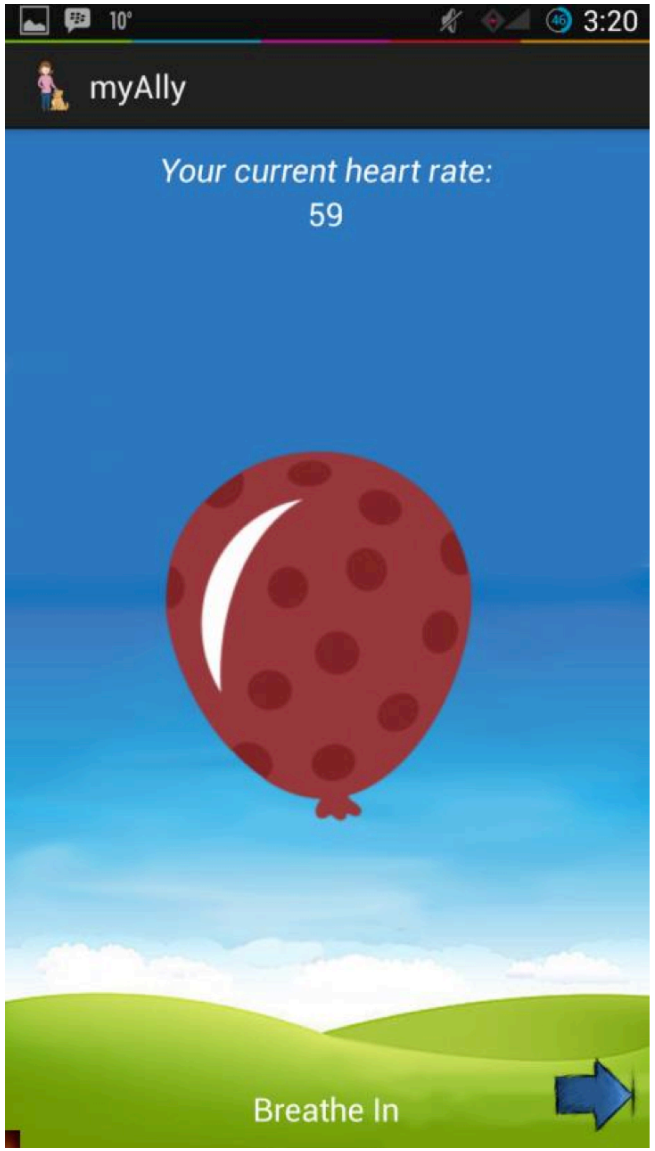
- Identify parts of body with mind
- Clench and relax





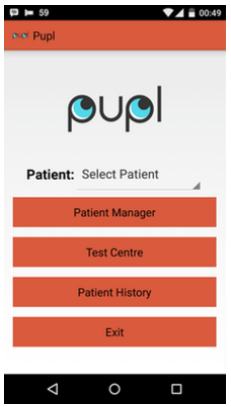
Breathing Exercise

- Balloon animates inflation/deflation to pace breathing to



Other Sample Apps from Prior Years

PUPL



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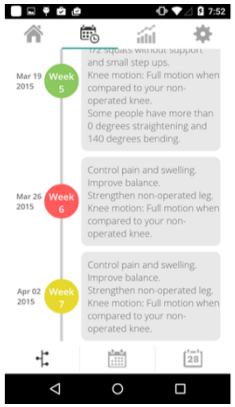

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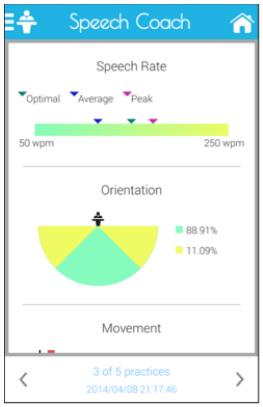

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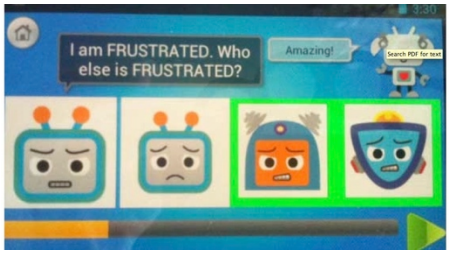
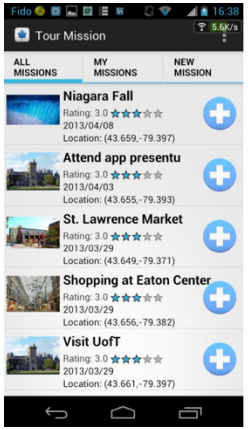
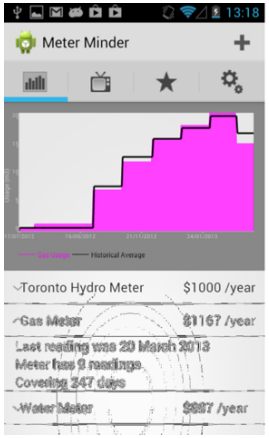


Mobile Stage

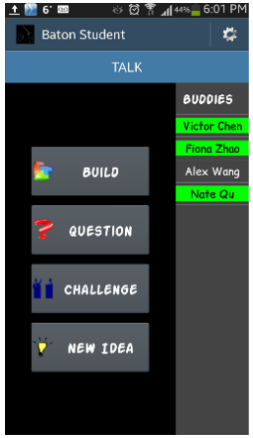
New Canuck



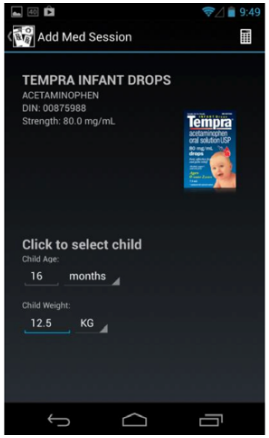
Meter Minder



Baton (27)

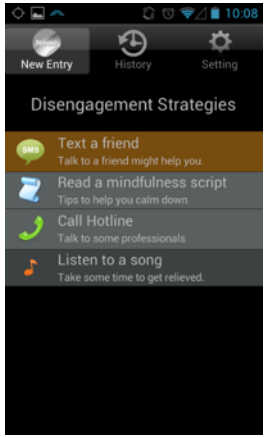


Snap N Dose



Lunch Time

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

Examples:

- 4 years ago: **Wound Care**
  - Robert Fraser was a registered Nurse, M.N. candidate
- 3 years ago: **Mozart's Ear**
  - Andrea Stewart, M.A. candidate in faculty of Music
- 2 years ago: **Baton**
  - Zack Teitel, High School Teacher, M.Ed. Candidate at OISE

The Bargain

- Between group of 2 programmers and 1 Specialist
  - Programmers bring skill and willingness
  - Specialist brings expertise and efforts

- Together you will arrive at an exiciting 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 must still take the **programmer** path through the course
  - Other thoughts on this later

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 Learning's & 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
  - With tangible deliverables
- Clear, Concise Presentation Experience/Feedback
- 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 5 years
  - Ph.D. Candidate in ECE
  - Thesis: Eye Tracking in Mobile Devices & Application
  - braiden.brousseau@utoronto.ca
- Daniel Di Matteo
  - TA'd course in a previous year
  - Ph.D. Candidate in ECE
  - Thesis: Diagnosis of Social Anxiety using Mobile Technology
  - dandm@ece.utoronto.ca
- Keiming Kwong
  - M.A.Sc. Candidate in ECE
  - keiming.kwong@mail.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 this year: **External Specialists**

External Specialists

- Are Post-docs, Psychiatrists, Speech Pathologists and Professors
  - 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

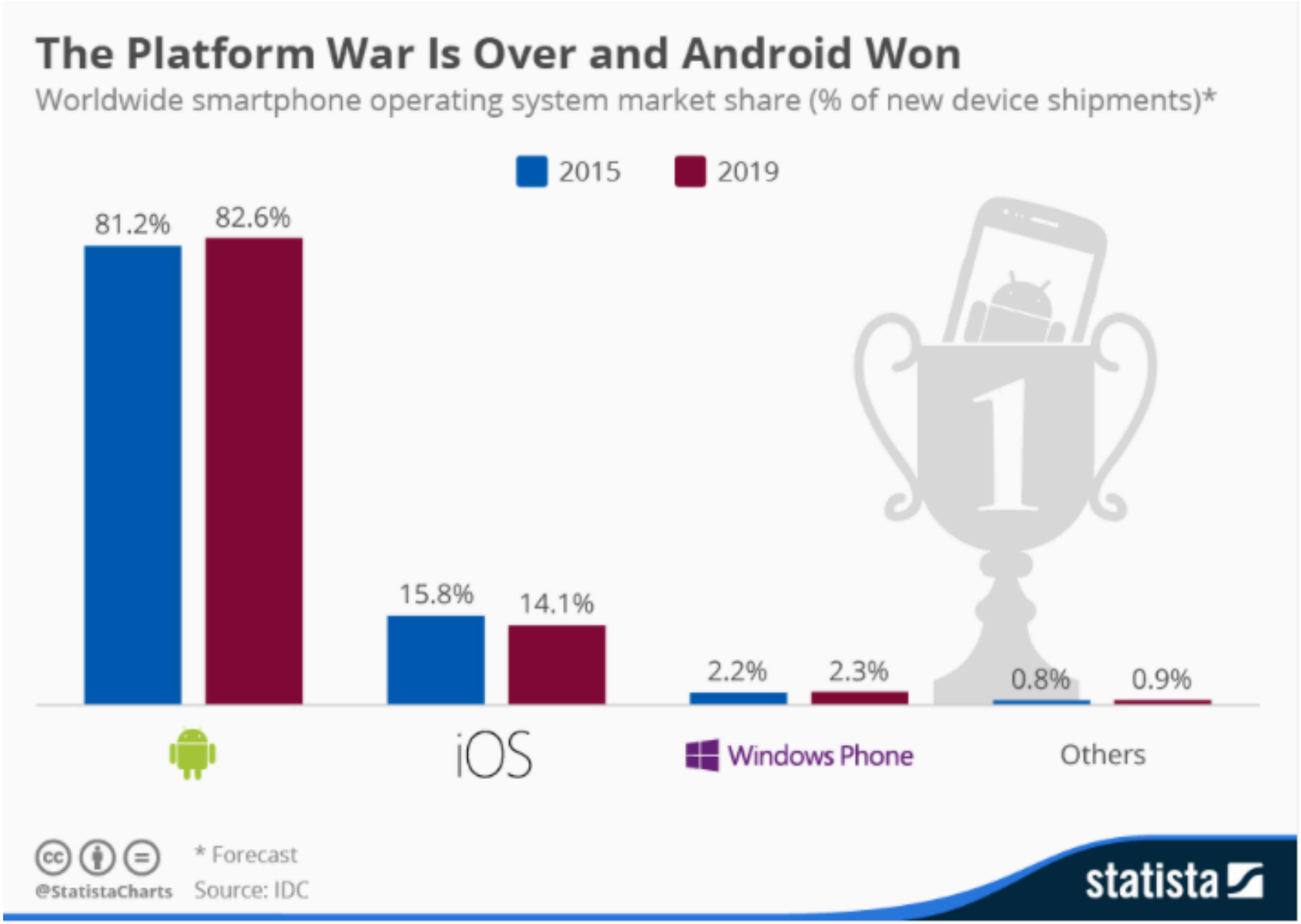
1. Subject **Must be in the discipline of the Specialist**
   - an idea to support research
   - **or** something useful/worthwhile/interesting within the discipline
   - should leverage Specialist's expertise
   - to those who want to be both programmer & specialist: **wait**
     - Should first hear 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

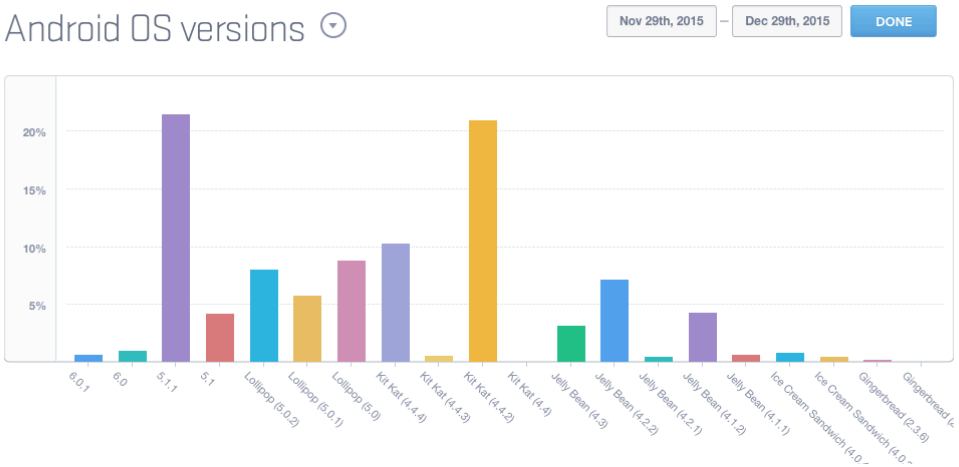
1. **Forming Groups**
   - Pair Programmers, then find Specialist
   - Form group in 3 weeks; extra meet Tuesday Jan19 @6:30pm
2. **Project Approval-in-Principle**
   - via email; due January 26th
3. **Project Proposal/Plan**
   - Document Due Feb 1st
4. **Proposal & Plan Presentations**
   - February 9 & 11
   - **NOTE EXTRA LECTURE Thursday Feb 11, 6-8pm, Loc:TBD**
5. **Spiral 2 & Spiral 4 Presentations**
   - 2: March 1/8 4: March 15/22
6. **Final Presentations**
   - Weeks of March 29/April 5
7. **Final Report Due April 7th**

Which Platform – Android or iOS?

On the One Hand ….

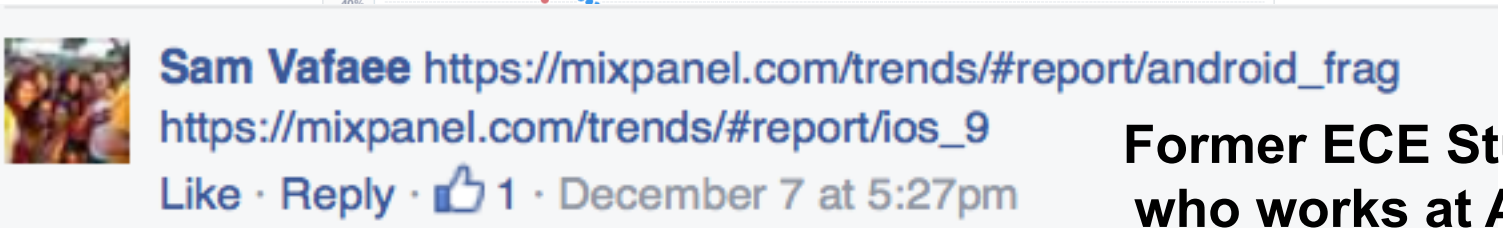


On the Other, Fragmentation vs. Adoption



Android Fragmentation

iOS 9 Adoption



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 newer 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

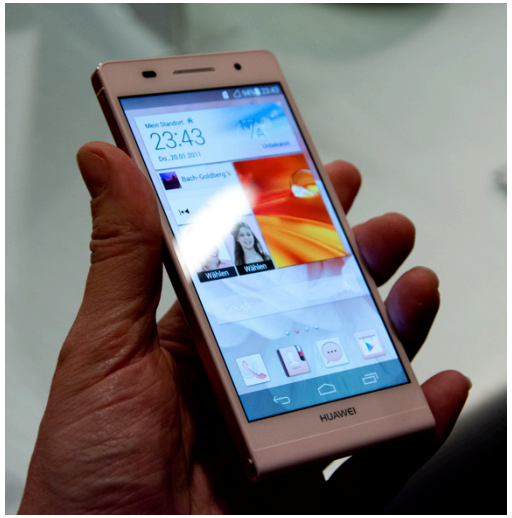
- Assignments are set up for **both** Android and iPhone
- **Important: your project partners must agree**
- Other platforms?
  - Not sensible at this point. ☹

Physical Phones

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

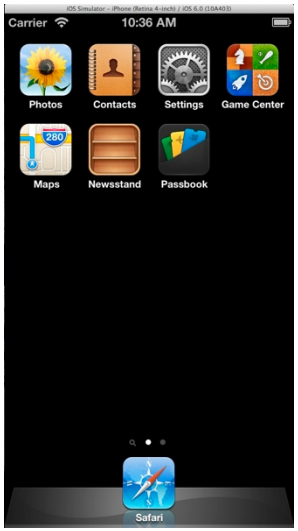
HUAWEI

Ascend P6



Android Emulator

iPhone Emulator



Textbooks for Programmers & Specialist:

Android

By Mark Murphy:

1. The Busy Coder's Guide to Android Development v6.9
   - 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:

     http://developer.android.com/sdk/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
   - Not yet one for iOS 8; may be due to switch to Swift?
   - $USD 30
2. **Swift**
   - **Beginning iOS 9 Programming with Swift**
   - By Simon Ng
   - http://www.appcoda.com/swift/
   - $USD 39

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

- Plus 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 …

Assignments!

Part 1: Due next week: **Monday** January 11, 6pm

Part 2: Due in 2 weeks: **Monday** January 18, 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)
   - We 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

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 Monday January 11th, 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 Monday January 18th, 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 Monday January 11th, 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 Monday January 11 6pm; late penalty
- Part 2 due Monday January 18 6pm; late penalty
- Available on Course Website and Blackboard Portal

  http://www.eecg.utoronto.ca/~jayar/ece1778/assignments.html
- Hand in on Blackboard Portal

Other Assignments

Date Assigned	Assignment	Due
January 19	P2/S2	January 25
January 26	P3/S3	February 8
February 9	P4/S4	February 22

Grading

- Assignments: **20%**
  - 4 in total

- Project: **80%**
  - Proposal/Plan (incl presentation) 10%
  - Spiral 2 Presentation 10%
  - Spiral 4 Presentation 10%
  - Presentation/Demo 10%
  - Final Report 25%
  - Individual Contribution 15% [includes self/group report]

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: Wednesday January 19 at 6:30pm

Location: Galbraith Building Room 221

- 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. What discipline you work in & degree sought
3. Taking Course for Credit – yes, maybe
4. Part time or full time
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 you're interested in doing app on