ECE 1778:
Creative Applications for Mobile Devices

Instructor: Jonathan Rose

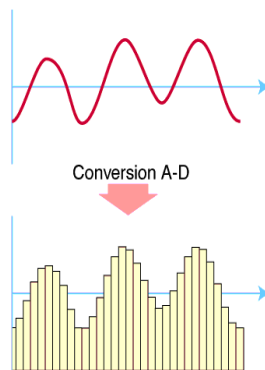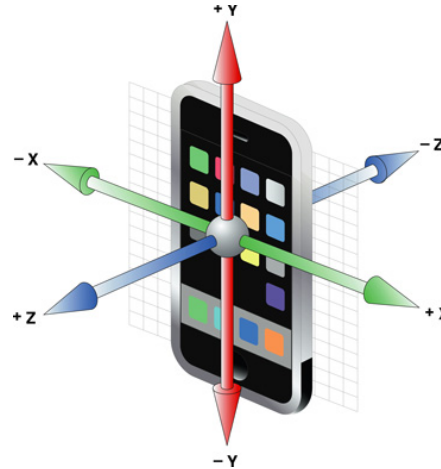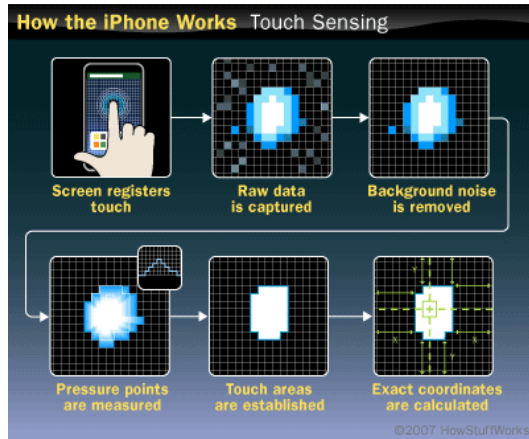Department of Electrical & Computer Engineering

Welcome!

- Recent advances in technology have given us a new creative canvas: **mobile devices**

- They are revolutionary
  - despite prior existence of both computers and cell phones

Revolutionary Sensors & Output

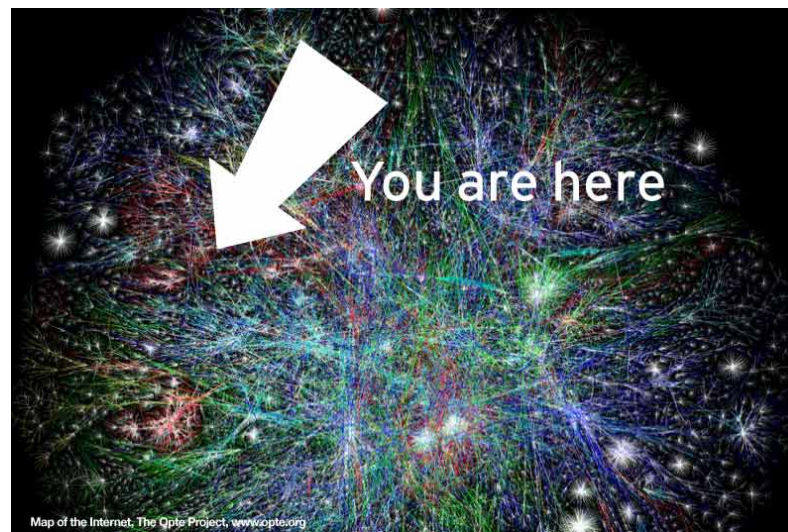# Why Revolutionary?

All in one device:

- Sensor inputs
- Output methods
- Easily Portable

- Powerful Computer
- Networked

You are here

Map of the Internet, The Opte Project, www.opte.org

Engineer: Many *Axes* of Invention Possible

- Each capability is an axis

- Each kind of software capability is also an axis

- Each axis multiplies what is possible with the others!
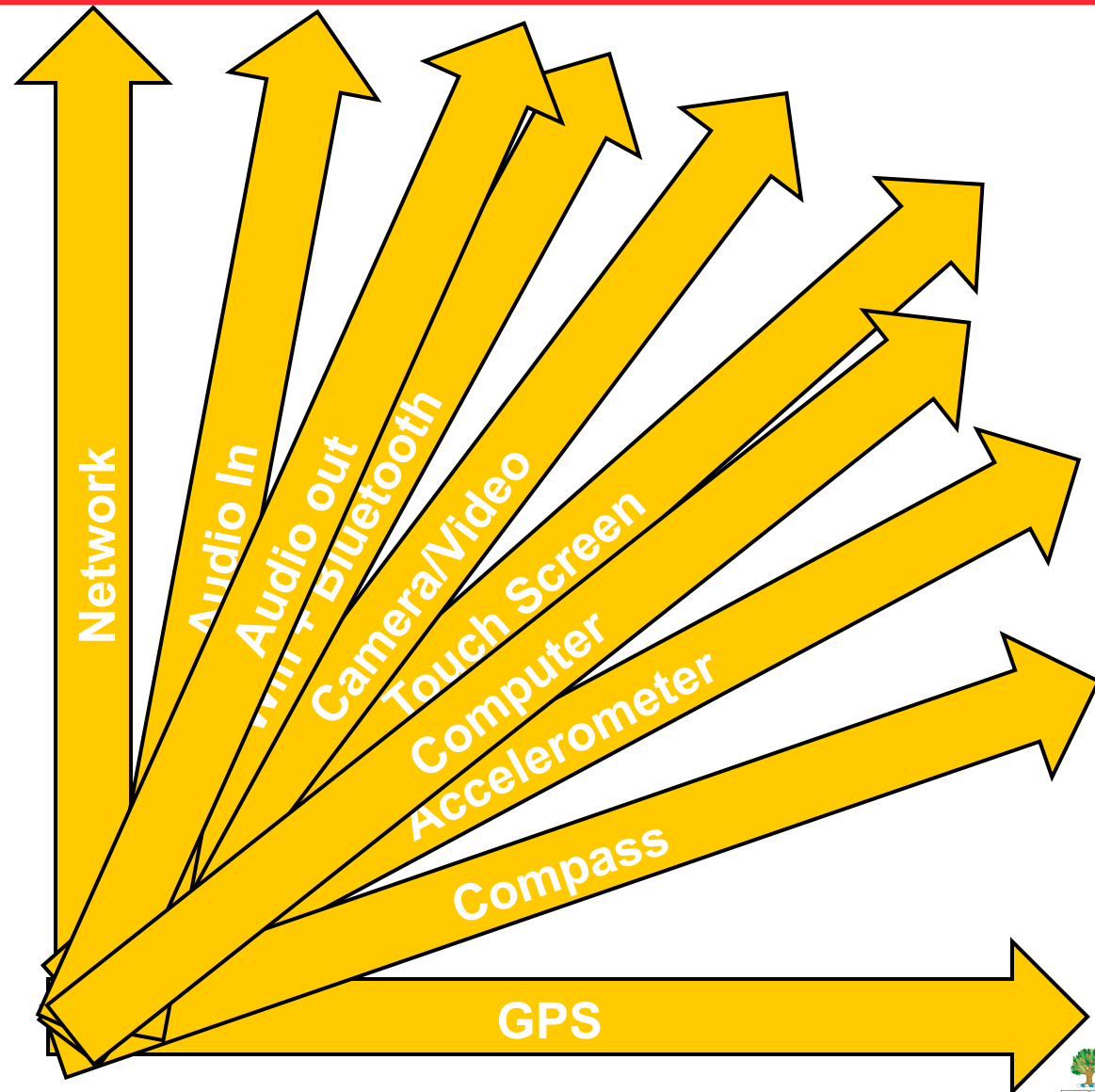
Consider: Ocarina Musical Instrument

■ A case study in inventiveness

– Using a novel combination of capabilities

– "Blow" into microphone; multi-touch touch screen; speaker

Ocarina

Synthesized ocarina

dynamically generated, parametrically controlled ocarina model; options: digital delay, reverb

multitouch (1-4 points) for pressing up to 4 finger holes
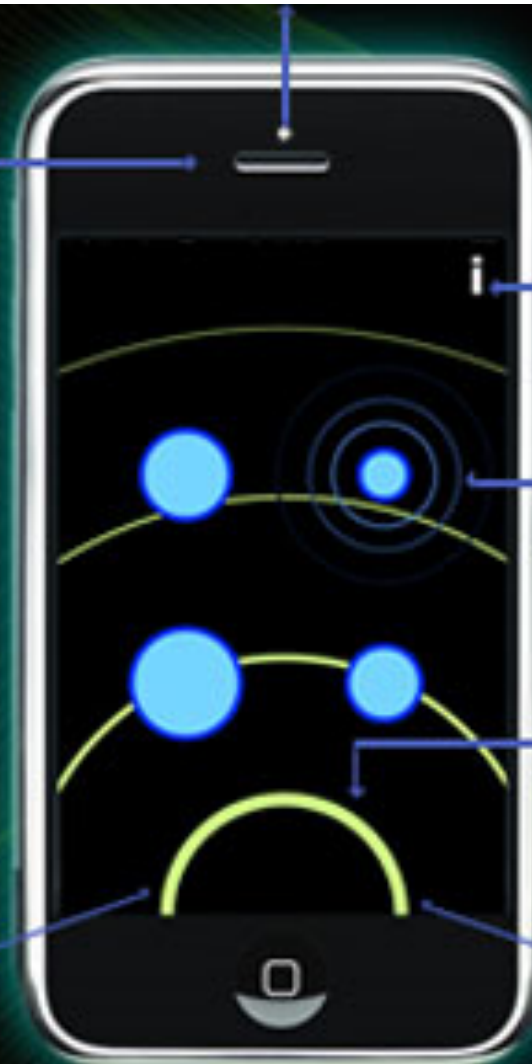
Real-time map display

(see map display)

Visual Feedback 1

as finger presses down

Visual feedback 2

con-centric rings radiate from the bottom as user blows

Accelerometer

controls vibrato (left/right)

controls timbre (front/back)

Microphone

plays the instrument

OCARINA

Ocarina: The Really Neat Part

- **World map**
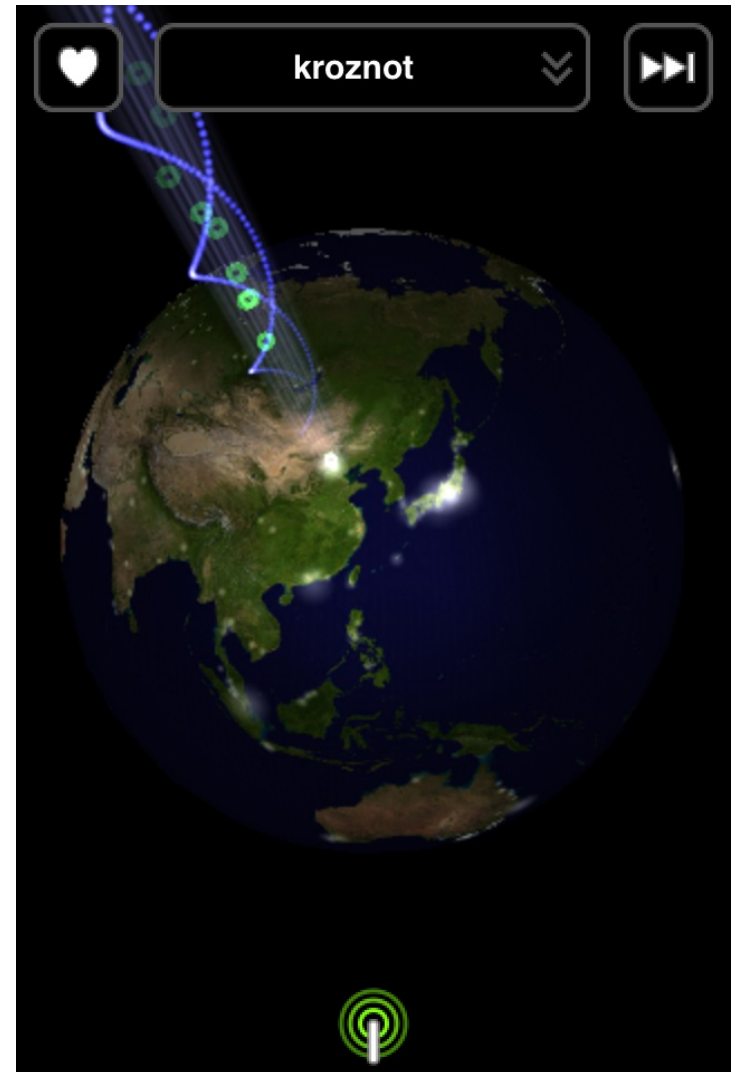 - uses GPS to locate users
  - White dots on globe show users
- **Ocarina records the sound everyone plays *by default***
  - Dot 'plays' music from randomly chosen Ocarina player, anywhere in the world!
  - Nice graphic too;
  - Moving
- **Top 20 iphone app of all time, according to Smule**

Axes are Different Kinds of Paint Brushes

Painting & Programming

- We can create new things with mobile devices, more easily than ever before.

- But not so easily that everyone can do it
  - need ability to program

- The point of this course is to bring together people from different disciplines, including programmers, to be able to create new things on this remarkable canvas.

The Revolution Began July 2008

■ With the advent of the Apple iPhone App Store
  – & associated development tools
■ Today:

While There are Many Apps Out There …

TOTAL APPLICATIONS/PUBLISHERS ACTIVE IN GOOGLE ANDROID MARKET

400K

Free   Paid   Publishers

DISTIMO
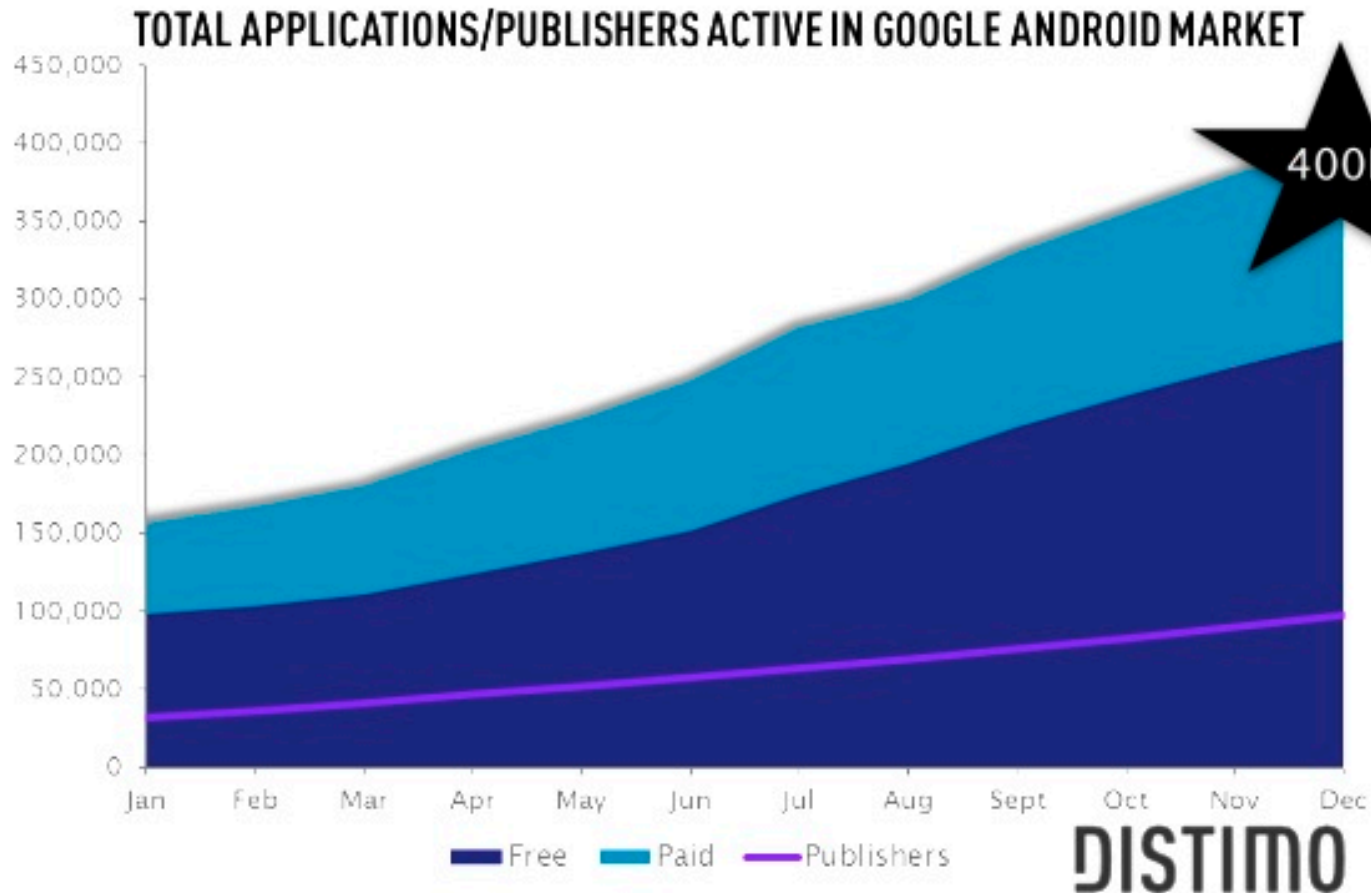
■ I think these have only scratched the surface

Many New Ideas are Possible

- **In research, human interaction and business**
  - As people get used to using them for ever more functionality
  - As phone hardware capabilities grow (better sensors, faster processors)
  - As connected websites/servers provide more capability

Course Goals & Outcomes

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
   - <u>That is of sufficient technical depth</u>

2. Make a creative inter-disciplinary environment
   - Interaction between programming & non-programming disciplines
   - Interactions between many disciplines

3. Teach literacy in mobile programming & potential
   - Gain engineering project experience with hard deliverables

This is an Experimental Course

- Open to students from *all* disciplines

- Multi-disciplinary project-based course

- Second time taught,

  - we've made several changes from last year

- I welcome suggestions for improvement

  - Will continue to adjust as we go along this year

- It will be quite a bit of work

- **Key**:

  - to reach across the boundaries of disciplines

  - learn the language of the 'other' discipline

Two Kinds of Students/Paths in Course

1. **'Programmer'**

   – Engineering, Computer Science and other **graduate** students with good programming backgrounds

   – Undergraduates with permission of instructor

Two Kinds of Students/Paths

2. **'Apper'**

– Graduate Students from other Disciplines

– With some computer literacy

– A desire to create new app, in art, science, engineering

– <u>YOU BRING EXPERTISE IN THAT DISCIPLINE</u>

– e.g. from last year: <u>**Wound Care**</u>:

• Robert Fraser was a registered Nurse

– e.g. <u>**Brain Ex**</u>

• Rowa Karkoli was in Rehabilitation Sciences/IBBME

Programmer or Apper?

- All ECE and Computer Science students will be considered programmers and must make a strong case to be otherwise

- 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

Declaration (non-binding)

Raise Your Hand if you Think you are a Programmer

Raise Your Hand if you Think you are an Apper

Sign Up Sheet

- Name
- Student Number
- Department
- Degree
- Taking Course for credit
  - Yes/Maybe
  - Audit: cannot without special permission; can't do project as an auditor
- Programmer/Apper self designation
  - Can check both
- Phone Type: (Need some of you to have own phones!)

Learning/Outcomes

- **Knowledge & Experience**
  - **Programmer:** How to program in a mobile environment
  - **Apper:** Capabilities of mobile devices & basic technical understanding & how it can be applied to your discipline
- **How to Work across disciplines**
  - Inter-disciplinary creativity
- **Project Experience**
  - With tangible deliverables
- **Clear, Concise Presentation Experience/Feedback**
- **Advance of research capability through use of mobile dev**

Instructor Bio: Jonathan Rose

- **Professor in Electrical & Computer Eng since 1989**
  - Bachelor's, Master's & PhD from here, last in 1986
  - Post-Doc at Stanford 86-89
- **Research Field: Field-Programmable Gate Arrays**
  - 'soft' hardware that can be programmed to become any circuit
  - includes architecture, circuit design, software, algorithms, apps
- **Entrepreneur:**
  - Co-founder of Right Track CAD Corp in 1998
  - Senior Software Engineering Director of Altera 2000-2003
  - Run the Engineering Entrepreneurship Seminar Series
- **Administration:**
  - Dept. Chair of ECE 2004-2009;
  - Director of Engineering Business Minor
- **F.IEEE, F.ACM, F.CAE, FA NAE, Sr Flw Massey College**

Why I'm Teaching this Course

- Aside from my research field, I have always felt that mobile devices would one day take a central role to human progress

- I've always been 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 last year
  - M.A.Sc. Candidate (soon to PhD) in ECE
  - M.A.Sc. thesis: accelerating computer vision for smartphones using FPGA hardware
  - braiden.brousseau@utoronto.ca

- **Daniel DiMatteo**
  - M.A.Sc. Candidate, ECE
  - daniel.dimatteo@utoronto.ca
  - Experienced Android Developer

The Project

The Project Group

- **Done in Groups of 3**
  - 2 Programmers
  - 1 Apper

- **Need enough programmers : appers to make this work**
  - otherwise will have to restrict enrolment

- **OK to have groups of programmers-only, if extra, but only if no Appers left**

Rules on Project App

1. <u>Subject Must be in the **discipline of the Apper**</u>
    –   an idea to support research
    –   or something useful/worthwhile/interesting within the discipline
    –   should leverage expertise that discipline
    –   Message to those who want to be programmer+appers: wait
        •   Should first hear ideas
        •   I will (mostly) enforce pure Apper-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

e.g.: Measure the Fraction of Conversation

- Listen to a conversation, and measure the fraction of the conversation that each participant takes up!

- Daniel DiMatteo's (course TA) undergraduate thesis
  - Known as 'Diarization'
  - Using open source software

- Could be used to measure 'turn taking' behaviours in different cultures in Anthropology
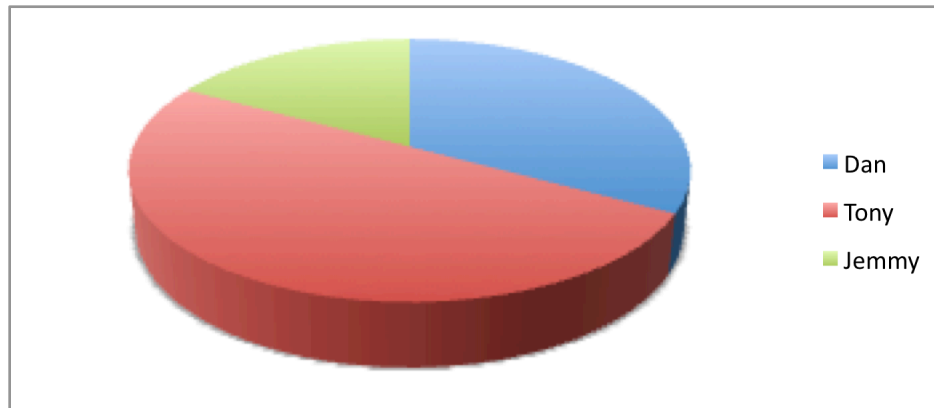
Stages of Project

1. **Forming Groups**
   - Within 2 weeks; special get together Wed Jan 18 @6:30pm
2. **One-Page Proposal**
   - Due January 31st; Must receive approval to proceed
3. **Project Plan**
   - Due Feb 7th
4. **Proposal & Plan Presentations**
   - Weeks of February 14 and 28 [No class in Reading Week]
5. **Spiral 2 & Spiral 4 Presentations**
   - 2: March 6/13   4: March 20/27
6. **Final Presentations**
   - Weeks of April 3 & 10
7. **Final Report Due April 12th**

Course Material

Course Website:

- **http://www.eecg.utoronto.ca/~jayar/ece1778/**
    - Has link to videos & reports from most of last year's proejcts

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

- Piazza Discussion Board (blackboard board is terrible):
    - http://piazza.com/class#winter2012/ece1778/0

Course Material

- **Lectures**
  - Basic phone capabilities
  - Thinking/discussion about how to use capabilities in project
  - Programming concepts and some details
  - Project basics
  - Case Studies of interesting/inspiring apps
  - Two Visitors planned:
    1. A music composition app development
    2. A new sensor from a startup
  - <u>Mostly</u> presentations from class – proposal, progress, final
- **4 Weekly Assignments in first 5 weeks**
  - Programmers: learning basic SDK and programming
  - Appers: case studies; learning design software; learning technology

(33)

Mobile Platform - Android

■ We will focus on, and I will teach to, Google's Android

- – Widely available, works on all major operating systems (Windows, Mac, Linux)

- – Many phones available

- – Is successful

- – **Con**: Eclipse environment not very clean;

- – Programming Language: **Java**

Alternative, if you have a 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
  - **Con:** Must have a Mac computer

- Assignments are set up to be for Android, though, but are easily ported to iPhone

Physical Phones

- **Have some phones donated to help with assignments and projects**
  - I may purchase a few more
  - good, also, if you have one yourself
- **It is much better (and sometimes necessary) to have an actual phone to develop on**
- **Can use the emulator; OK on android; good on iphone**
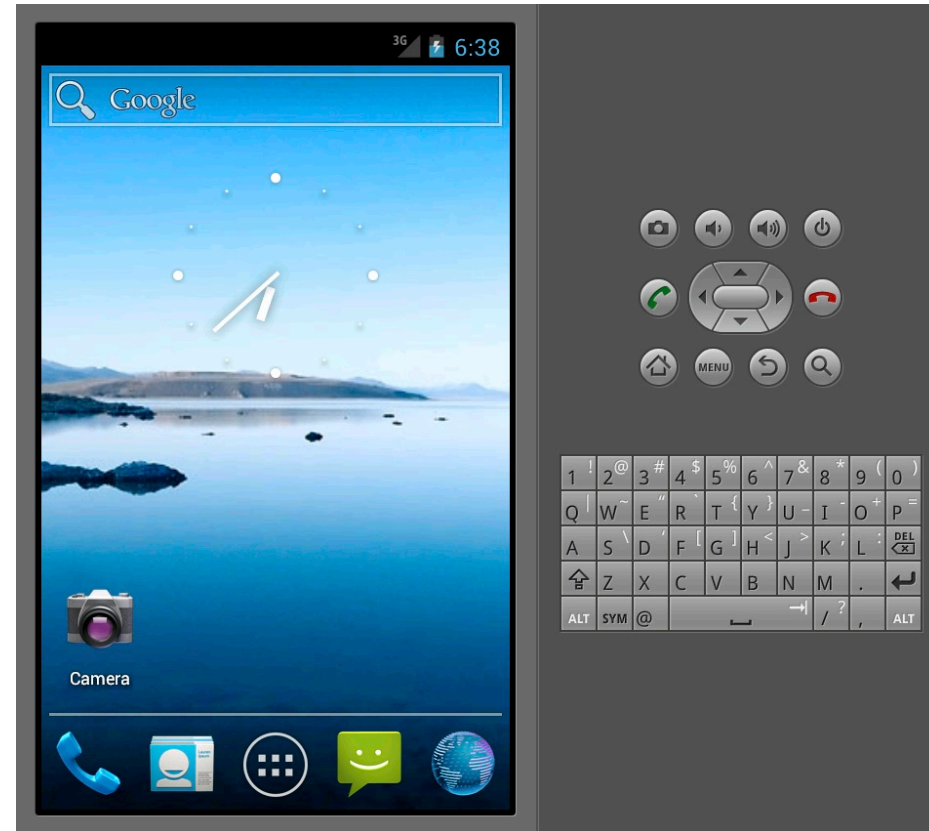
Textbooks for Programmers & Appers:

<u>Android</u>

By Mark Murphy:

1. The Busy Coder's Guide to Android Development
2. The Busy Coder's Guide to Advanced Android Development
3. The Busy Coder's Guide to Android Tutorials
   - $40 buys all current versions, and a year's subscription to the updates, that come out with each new version of Android
   - Free for students for 4 months; I'll request licenses today
   - Although this is largely for programmers, I suggest that Appers read through the first 9 chapters as well.

Textbook for Programmers:

iPhone

Beginning iOS 5 Development, Apress

– by David Mark, Jack Nutting and Jeff LaMarche,

See: http://www.apress.com/9781430236054

$40 for printed book

$28 for e-book.

Assignments!

Due January 16 & 23

Assignment P1 for Programmers

- **Acquire textbook**
- **Need some basic Java knowledge**
  - Get a Java book, or use pointers to wikibook on page xx of text
  - http://en.wikibooks.org/wiki/Java_Programming/Language_Fundamentals
- Download Android Environment or access ECE computers
- Do "Hello World" tutorial
  - Make it work on an emulator
- Read Chapters 1 through 9 of text, do small coding exercises
- Write simple android application
- Due Monday January 23, 6pm; late penalty
- Posted under Assignments on Course Website & Portal

Assignment A1 for Appers

1. Write 250 words that describe your field to a lay person.
2. Find 5 apps in your field and describe each in 100 words
3. Choose the best of those 5 and do deeper case study:
   - Get it, use it, described it. 1000 words max
   - Mark penalty for too many words

■ Part 1 due next week, before class

■ Part 2 due Monday January 23, 6pm; late penalty

■ Posted under Assignments on Course Website & Portal

Other Assignments

Date Assigned	Assignment	Due
January 24	P2/A2	January 31
February 7	P3/A3	February 14
February 14	P4/A4	February 28

Grading

- Assignments: **20%**
  - 4 assignments

- Project: **80%**
  - Proposal   10%
  - Plan (incl presentation)   10%
  - Spiral 2 Presentation   10%
  - Spiral 4 Presentation   10%
  - Presentation/Demo   10%
  - Final Report   30%

Commercialization & Intellectual Property

Commercialization

- If your group wishes to create an app for sale, feel free to do so

- If not, consider giving away if useful

Commercialization & Intellectual Property

- **University of Toronto Intellectual Property Rules apply**
  - Work done here at UofT nominally
    - Requires disclosure & extraction of Universities' rights in exchange for fraction of licensing revenue
  - However, these rules aren't well set-up for apps/app store
  - However, if more than person contributes – group partner, your research supervisor, then their rights must be respected

- **Note: the scope of course project is broader than those apps that are commercializable**
  - Apps can be motivated by research goals

Warning on 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'
- – Don't get caught up in the IP side

Introductions

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.

- We will use the remainder of this lecture and some of the next to have you introduce yourself

- Also: will hold extra meeting: **Wednesday January 18 at 6:30pm** in SF B560 to spend time forming groups

- So, please introduce yourself …

Introduce Yourself

1. Name
2. Taking Course for Credit – yes, no, maybe
3. What discipline you work in & degree sought
4. What your thesis topic is (if doing thesis)
5. If you work, where & what you do.
6. Why you're taking this course
7. What kind of phone you're carrying
8. Apper: What idea you have for an app
9. Programmer: What you're interested in doing app on.