# **ECE 1778: Creative Applications for Mobile Devices**



Lecture 4 October 7, 2016





### **Today**

- 1. Logistics Plan, Assignments
  - Description of Assignment P3/S3
  - Proposal
- 2. Block Diagrams + Living in Apps
- 3. Notes on Group Work
  - Working in Groups
- 4. A Note on the Android Life cycle
- 5. External Gadgets you may want to use
- TeamChooser
  - Lessons from an App development experience
- 7. Informal Topic Discussions



# Logistics



### **Assignments**

- S2 and P2 were due yesterday
  - Any comments/questions?
- S3 and P3 are posted on course website
  - But are **not due** for 2 weeks,
  - To give you time to work on your proposal/plans, due next week.
- S1 and P1 have been graded



### **Assignments P3 and S3**

S3 Part 2 Due next Friday Oct 14 S3 Part 3 and P3 Due Thursday Oct 20

Please Note: All Assignments are Posted Online Here:

http://www.eecg.utoronto.ca/~jayar/ece1778/assignments.html



#### Mobile App Backends, Images, and Location

#### Learning how

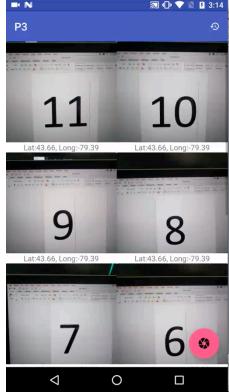
- to setup a backend server that holds a database, files, and does authentication
- to determine out where the phone is, geographically (GPS)
- Using the camera to capture images

#### 1. Read the relevant parts of

- Firebase (Google's database) documentation
- Android: Murphy & Android Development site
- iOS: Mark, Nutting, LaMarche & Olsson (Objective-C/Swift)



- Application takes pictures using camera
  - Record the location, using GPS/location services where each picture was taken
- Display gallery of all pictures taken, with thumbnails
  - Also display location latitude and longitude





A fair bit of functionality including (see assignment for all):

- All new pictures (and their location) should be uploaded to the backend server and stored as a file; their information should be stored in the database
- When the user clicks on the thumbnail, you should display the picture taken at that location.
- The list should be maintained over separate invocations of the app (i.e. stored in a file)



- Any pre-existing picture that was in the photo directory should also be uploaded to the server
  - This won't have location information to store.
- it should be possible to delete a picture, which would remove the corresponding image in the file system.
- Read Assignment for Full Details
- Online video demo:
  - https://www.dropbox.com/s/iq8dyij3mf5env3/ ece1778\_p3\_demo.mp4?dl=0
- Due in 2 weeks,
  - October 20th, 6pm, penalty for being late



### **Assignment S3 – for Specialists**

- Recall: one goal of course is to give experience in reaching across disciplines
- Aside: we anticipate that Specialists will be teaching Programmers the language of their discipline, and the basic concepts
  - Please, programmers, ask questions get jargon explained
  - AND vice-verse
- Assignment S3 is an attempt to bring Specialists a little into the world of computer engineering/science
  - To give you practice talking to each other



#### **Basic Idea of S3**

- Specialist: Choose from one of 5 technical areas listed
  - that you are not already familiar with,
  - and that your programming partners are familiar with:
- 1. Fast Searching
- 2. Databases
- 3. Digital Signal Processing
- 4. Optimization
- 5. Internet Communication



#### **Then**

#### Part 1

- Spend an hour with your partners, learning about this area, and take notes.
- Don't use any other sources of information

#### Part 2

- Write up those notes & submit Friday October 14, 6pm
- 500 words + pictures
- Explain in your own words



#### Then – Part 3

- Pursue a deeper understanding of the topic, via Internet
- Write another 500 words, due Thursday October 20<sup>th</sup>, 6pm
  - Do a better job of describing the topic; add some nuance & more understanding
- Offer some additional commentary on your view of this learning process
  - how it went
  - how much you learned from Part 2 vs. Part 3,
  - what would have made it better



# **Project**



### **Project Stages 16f**

- **1.** Forming Groups
  - Must be formed now
- 2. Project Approval-in-Principle
  - Should be wrapping up
- 3. Project Proposal/Plan
  - Document Due October 13<sup>th</sup>
- 4. Proposal & Plan Presentations
  - October 20 & 21
  - NOTE EXTRA LECTURE Thursday Oct 20, 6-8pm, SF 1101
- 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



### Proposal/Plan Due October 13 @ 6pm

- 1. Reprise Goal, make more precise
  - What & Why
- 2. Rough design of what the user sees
  - Mock-ups of screens
  - https://moqups.com
    - From Specialist Assignment 2
    - Any drawing package will do
- 3. Block Diagram overview of planned code
  - The large (5 or so) pieces of they system
    - With short prose description of each
  - Should be linked to the screens
  - In moment will discuss creation of block diagrams



### Plan, continued

- 4. Statement of Risks/Issues
  - What roadblocks/issues/challenges do you foresee?
  - software-wise, logic-wise, hardware-wise, ethics-wise, scope
- 5. What do you need to learn that you don't know
  - all members
- 6. Important: Specialists
  - Submit a separate essay on how App relates to field of Specialist, and how the Specialist will contribute to project
  - Want clear thought about the activities of the Specialist
  - 500 words
- Document must have these sections; will lose marks if missing



#### **Plan Document**

- Plan document length: 1500 words max
  - Not including 500 word Specialist essay (item #6)
  - Should include pictures
  - Include word count, penalty for overage.
- Seeking clarity, not quantity of words
  - 'Omit needless words'
- Submit to Portal, under "Specialist Assignments" look for Proposal-Plan (if external specialist, then prog submits)
  - Worth 10% of grade
  - including in-class presentation done following week
- Due Thursday October 13<sup>th</sup> at 6pm



### A Note on Block Diagrams

And the creative process



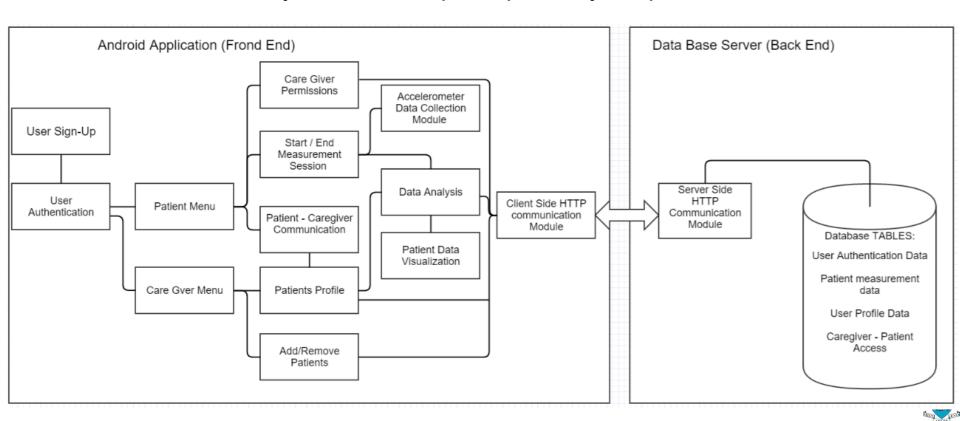
### **Block Diagrams**

- In Proposal you're asked to give a block diagram of your planned software
  - In past, many have not understood this
- A Block diagram describes the major pieces of the project's functions (typically 5)
- Is the first step in the standard divide & conquer approach
- Draw blocks, give each block a name
  - Name gives a sense of what it does
  - Provide several sentences that give more detail of function of each block



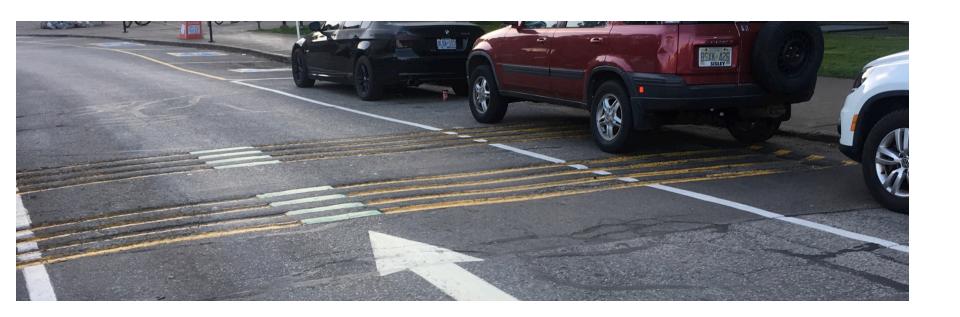
### **Block Diagrams**

- Lines between blocks show how each block communicates with others
- May need to break blocks themselves down
  - In a hierarchy, in a subsequent part of your plan document



### Let's Work Through An Example

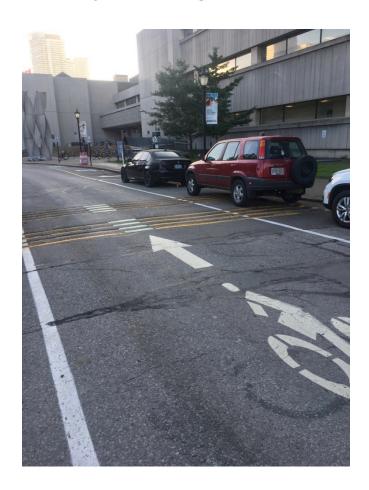
- Problem: Speed Bumps on King's College Circle were very poorly designed
  - Hitting the yellow part almost throws bike rider off bike!





### So, Fill in Middle for Smooth Bike Cross

- This forces the cyclist into the middle of the road
- Into the path of any trailing car!

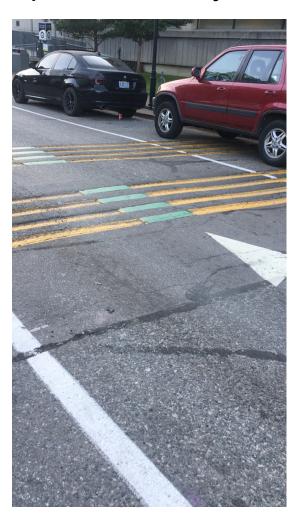




### That's Dumb, But Even Worse

■ The speed bumps don't really seem to affect cars at all!

Watch:





### App Goal:

- Measure Speed Bumps Effectiveness in Car
  - i.e. how noticeable is the bump?
  - Does the bump get worse with higher speed of a car?
- How could you do this with a phone?



### Let's Make the Block Diagram

What are the main components?



### Let's Figure out How to Enhance it

Think about the context, what could we do to make this more useful/functional/helpful?



### **Last Year Project: How Bumpy**

Measurement of Two Different Cars over bumps







# **Project/Groups**



# **Group Names:**

Group #	Approval in Principle	Project Name	Specialist
	V	37 - 37 - 4	•
1	Yes	YouVote	Hugo de Grandpre
2	Yes	Correctly	Venis Nasr
3	In Review		Kingba Lawson-Jack
4	Yes	Trip Story (Adventure)	Saher Samnani
5	Pending		Katzman-Group
6	Yes	Ups and Downs	Daniyal Liaqat
7	In Review		Daniel Ramnath
8	Yes	HIIT It!	Dana Swarbrick
9	In Review		Gorett Reis
10	In Review		Jiawei (Grace) Du
11	In Review		Arya Ghadimi
12		(30)	Alheli Pimienta



### A Note on Group Interaction



### **Group Interaction**

- Now that groups are formed, it is very important for you to meet regularly and coordinate your activities
- Each of you will need to be assigned tasks, and make commitments to do those tasks at a particular deadline
- The expectations that each group member has of the others must be made clear
  - I suggest that these be written down, and recorded on website
  - Most teams now use github for storing software and tracking issues
  - The major goals, not small stuff



### Difficulties Can and Do Happen

- Most of the difficulties that have occurred in this course have been because expectations were not made clear
- Sometimes, group members consistently failed to live up to commitments.
- If this happens, please report it to me as soon as it is something that you cannot handle with internal discussion & resolution
  - We will help you resolve it
- Disagreements are part of all human relationships
  - One distinguishes oneself by how well you deal with them



### What is a good way to communicate?

- Your favourite messaging app
  - Kik, FB Messenger, WeChat....
- Piazza
- Email
- Skype/Google Hangouts



### That's About What Could Go Wrong

- What about doing things to make it go right?
  - See above about basic organization
- What is a good way to create a successful group?
  - Get to know each other find out goals and interests
  - Break Bread' have some meals together breakfast lunch or dinner.
  - Practice the notion of listening and giving everyone's ideas a fair hearing.



### **Class Participation & Peer Review**



### **Class Presentations**

- A key part of what happens in this course is the contribution you make to other's projects
- You will do many presentations in this class
  - Indeed, one side-effect of this project course is some real practice in giving high-quality, concise & clear communication
  - Most presentations will be 5 minutes in length
  - Must be geared so that most people in the class will understand



### **Peer Review**

- Want everyone to come, listen & provide useful input
- Expectation that you'll listen and provide thoughtful feedback and suggestions to other's presentations

### In Addition

- For each of Proposal, Spiral 1, and Spiral 2 you'll be asked to provide a peer review for one other groups; these will be graded
- Means you'll need to be here for every lecture, not just when you're presenting.



# **Peer Review for Proposal**

Will be asked to answer questions such as:

- 1. In your own words, what was the goal of the project?
- 2. What parts of the proposal did you understand, and what parts could be more clear?
- 3. What was the best thing about the proposal?
- 4. What one thing could be improved the most?



# **External Gadgets**



# **Texas Instruments Sensor Tag 2**

- Requires Android 4.3 or above.
- Bluetooth Connection
- Sensors:
  - 9 axis
  - Magnet sensor
  - Light
  - Ambient temperature
  - IR temperature
  - Humidity
  - Air pressure
  - Two Buttons, two lights, quiet buzzer!
- I now have several of these





### **Node Sensor**

- A single 'platform' with many different attachable sensors
- Connected by Bluetooth LE (need Android 4.3/iphone)
- See: <a href="http://variableinc.com/products/">http://variableinc.com/products/</a>
- I have one with these attachments
  - IR temperature
  - Paint Colour
  - 9-axis: Accelerometer, Gyro,
     Magnetometer
  - Climate sensor (Clima)





A Sensor for Every Application



# Other Node Sensors End-Units for Purchase



#### **THERMOCOUPLE**

Thermocouple can measure surface temperature temperatures in liquids, semi-solids-foods, and meats, for quality control, and temperature monitoring.

\$75

click here to buy or learn more



#### OXA

With a NODE OXA gas module installed your smart device becomes a super sensor. Each OXA gas module detects one of the following gases: CO, NO, NO2, Cl2, SO2, and H2S.

\$149

click here to buy or learn more



#### CO2

NODE + CO2 is a sensor module for the NODE+ bluetooth sensor platform. The CO2 module measures the Carbon Dioxide level of the air around the sensor.

\$149

click here to buy or learn more



#### **BARCODE**

We're proud to announce new NODE+Barcode sensor module! NODE+Barcode can scan any item, keeping track of your inventory, pricing and availability.

\$99

click here to buy or learn more

### Or, build your own:



1/0

\$25

The i/o Module allows users to connect different sensors, lights, and buttons, to access the POWER of NODE in their own projects.



# **Muse Head Band**

- Measures 'brain activity' through measurement of electro-magnetic waves brain produces
- Have 2 of these





# **Button TrackR**

- Note where things are, where they were lost!
  - https://www.youtube.com/watch?v=0Ep8XHtsq8A
- Have 1 of these, could get more.



**TrackR** 



# Other External Devices I have

- Fitbit Flex (activity monitor)
  - Can only get low-rate data processed from web server
- Wahoo Tickr (2) heart rate monitor strap (bluetooth connected)
  - Direct live heart rate
- 1 Tobii Eye Tracker (could be Android connectable)
  - Real-time eye location on screen
  - Somewhat large for a phone









# Other Sensors/Gadgets?

- If you find one that will enable your project, you can request to have it purchased
  - I try to collect these for this course and research
  - No guarantee, depends on cost & function, but ask if you see something interesting!



# **Small Programming Note: The Android Life Cycle**



# **Android Application Life Cycle**

- Recall: Activities are screens that the user sees, and associated process
- Android manages these Activities as a stack.
- When a new activity is started, it is placed on the top of the stack and becomes the running activity



- The previous activity always remains below it in the stack,
  - and will not come to the foreground again until the new activity exits.



# Important to Pay Attention to 'LifeCycle'

- To ensure app behaves well in several ways, including:
- Does not crash if the user receives a phone call or switches to another app
- 2. Does not consume valuable system resources when the user is not actively using your app
- 3. Does not lose the user's progress if they leave your app and return to it at a later time
- 4. Does not crash or lose the user's progress when the screen rotates between landscape and portrait orientation.



# An Activity Can Be in 1 of 4 'States'

### State 1: Active/Running

- Activity in the foreground of the screen (at the top of the stack)
- Has 'focus', meaning user interactions go to it.

### State 2: Paused

- activity has lost focus but is still visible
- a new smaller or transparent activity has focus on top of the activity)
- A paused activity is completely alive (it maintains all state and member information and remains attached to the window manager), but can be killed by the system in extreme low memory situations.



# **Activity States 3 and 4**

### **State 3: Stopped**

- activity is completely obscured by another activity
- retains all state and member information
- no longer visible to the user so its window is hidden
- it will often be killed by the system when memory is needed elsewhere.

### **State 4: Destroyed**

- If an activity is paused or stopped, the system can drop the activity from memory by either asking it to finish, or simply killing its process.
- When displayed again to the user, it must be completely restarted and restored to its previous state.



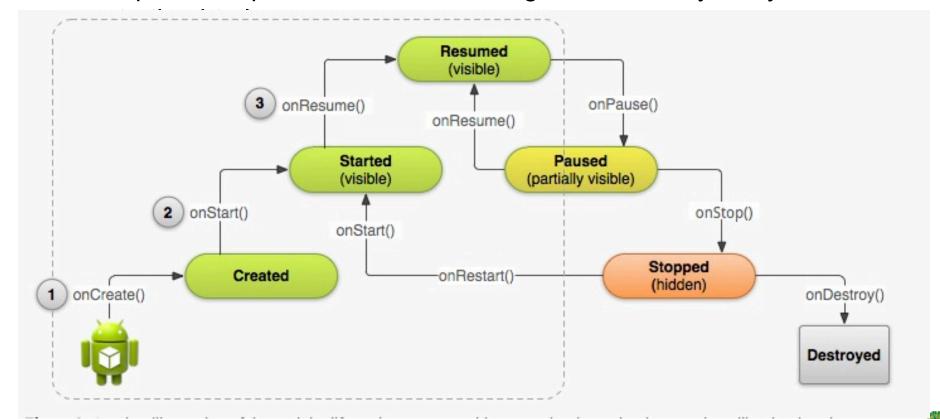
# **Android Talking to Your App**

The Android operating system asks (or tells) your app to go into those different states by invoking methods associated with your Activity



# Methods Called By Android to Change States

- Diagram shows states and methods called to change state
  - Colours: the states
  - http://developer.android.com/training/basics/activity-lifecycle/



# **Three Key States**

Activity can be in 1 of 3 states for long period of time:

### Resumed

 In this state, the activity is in the foreground and the user can interact with it. (Also sometimes referred to as the "running" state.)

### 2. Paused

In this state, the activity is partially obscured by another activity—
the other activity that's in the foreground is semi-transparent or
doesn't cover the entire screen. The paused activity does not
receive user input and cannot execute any code.

### 3. Stopped

In this state, the activity is completely hidden and not visible to the user; it is considered to be in the background. While stopped, the activity instance and all its state information such as member variables is retained, but it cannot execute any code.



# **State Management**

- The other states (Created and Started) are transient and the system quickly moves from them to the next state by calling the next lifecycle callback method. That is, after the system calls onCreate(), it quickly calls onStart(), which is quickly followed by onResume().
- Depending on the complexity of your activity, you probably don't need to implement all the lifecycle methods.
- However, it's important that you understand each one and implement those that ensure your app behaves the way users expect.



### References

1. The Android Documentation:

https://developer.android.com/training/basics/activity-lifecycle/starting.html

- Murphy, Busy Coder's Android, Chapter "Activities and their Lifecycles" (Page 316)
- Once your project gets going, it is really important to read through this and understand it
  - Previous years' students pointed out that this was the key thing they had not understood in Android, that caused the most problems



# The Key 'LifeCycle' Methods

### OnCreate()

Familiar with already – brings the activity to life

### OnPause()

- Another Activity has gained the 'focus'
- Should stop any background threads, release large resources (such as a camera)
- No guarantee that OnDestroy() will be called, so best to save all state here

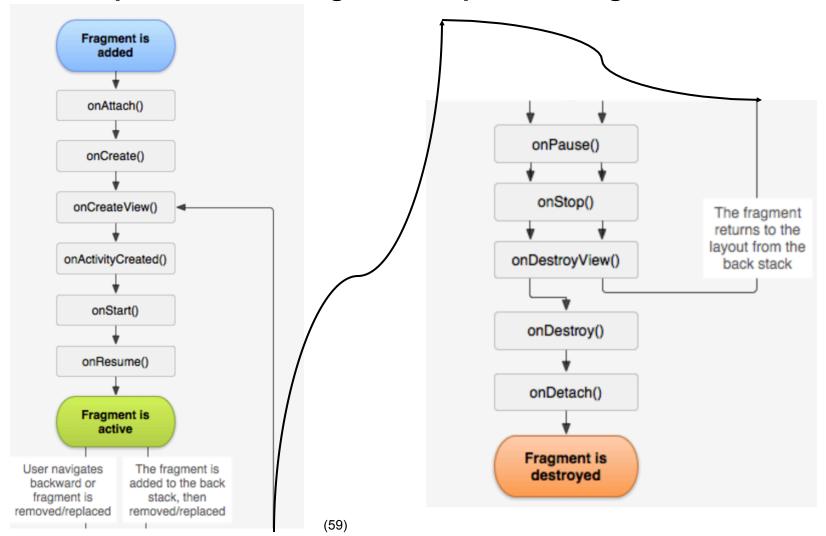
### OnResume()

- Called as activity starts, or is restarted from a pause
- Can recall state from file, refresh the User Interface see example



# **Fragments Behave Similarly**

http://developer.android.com/guide/components/fragments.html





# My App: TeamChooser

Solving a Problem in Pick-up Team Sports



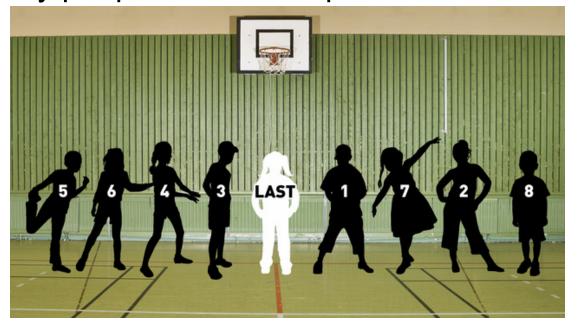
# Kids Who Play Want Games to be Fair!





### So Do Adults!

- When playing friendly games there is a need to choose who is on which team
- A common method is to have team captains, and they alternate choosing people, in a very public way
- How many people have been picked first? ©
- How many people have been picked last? ⊗





# I've Been Playing Hockey for Many Years

- A friendly game, but still have problem choosing teams:
- Classic Canadian method:
  - Put players' sticks into middle
  - One person randomly throws sticks to either side!
  - Random outcome!
- I once chose teams for a few years in friendly game
  - People complained a lot!





# Play in Two Different Friendly Games

- Wednesday Game: terrible chooser (Agar)
  - People always complaining
  - Games often lopsided, much distaste
  - no-one else took over, though (didn't want the hassle?)



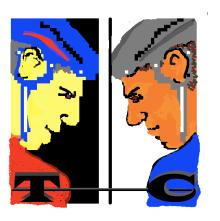
- Sunday Game: excellent chooser (Paul)
  - Paul had a natural ability to pick great teams!
  - Even when teams didn't look right, many more times than not, the game was fair
  - Became known as the 'algorithm'





# The Solution: TeamChooser

- Wouldn't it be great if an App made the teams?
  - No one to yell at
  - Possibly give better teams
- Who needs this?
- Every pick-up hockey, soccer, basketball game around!



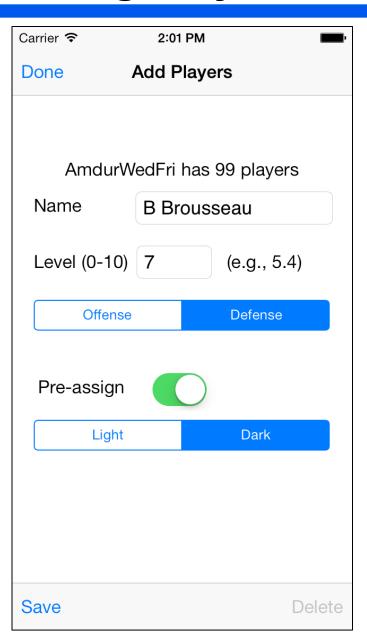


# **TeamChooser: How It Works**

- Enter every player in advance of game day
  - Player's name
  - Preferred position (offence or defense)
  - A rating, from 1-10, as to how effective player is
    - Rating is the trickiest part
- On game day select all players present
- Push 'Make Teams'
  - And voila, two evenly matched teams

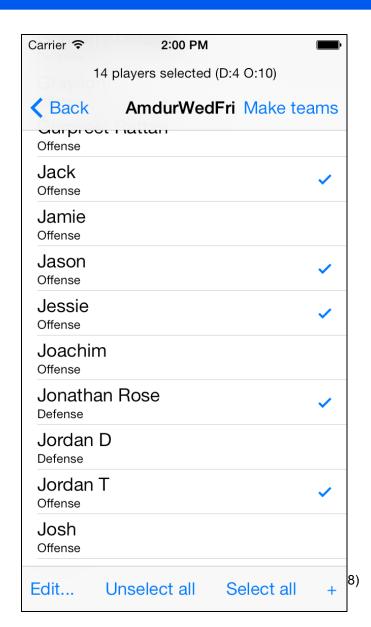


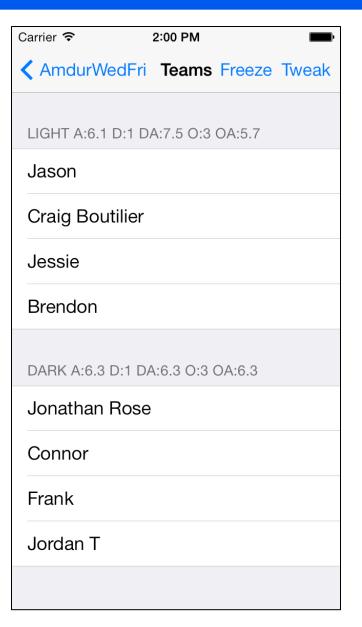
# **Do Demo! Entering Players**





# **Selecting Present & Making Teams**







# **Recent Game**

### Dark Team

### **Light Team**

DARK 5.6 D:5.0 O:5.7 COUNT: 6

LIGHT 5.6 D:5.4 O:5.7 COUNT: 7



**Gurpreet Rattan** 



# **Final Score in that Game**

A Victory for Team Chooser!





# Team Selection Method ('Algorithm')

Step 1: Sort Players in Order of Rating, Highest to Lowest

**Step 2: Alternate Team Assigned Going Down List** 

Team A 6 Team B 5 4 4 3 2 1

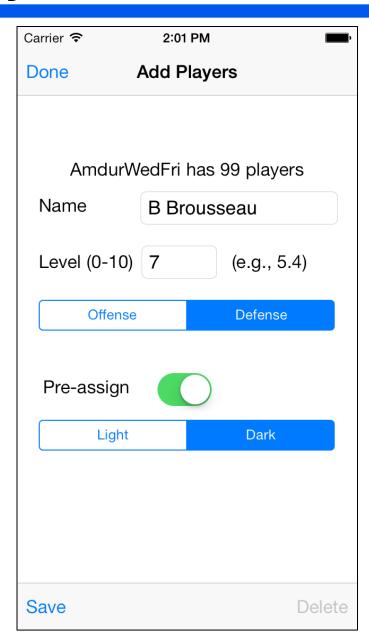


### **Team Selection Method**

- Gets more complicated when add features!
  - Balance offense and defensive player count
  - Pre-assigns
  - Balance quality of offense and defense
- Many discussions from CS and ECE Professors over algorithms in hockey game!

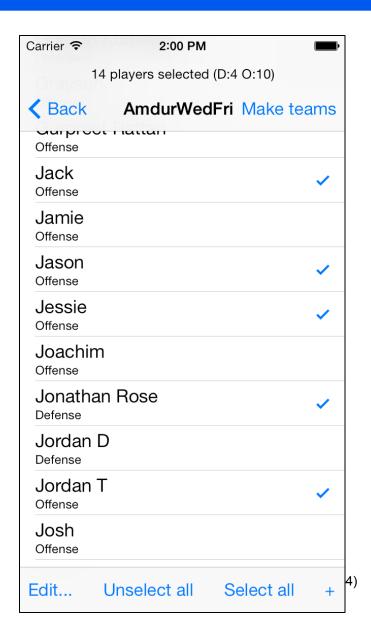


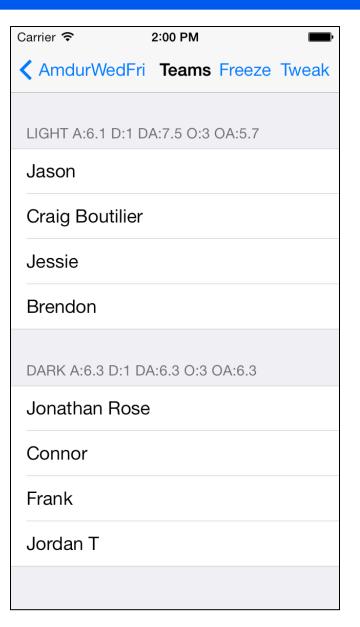
# **Entering Players**





# **Selecting Present & Making Teams**





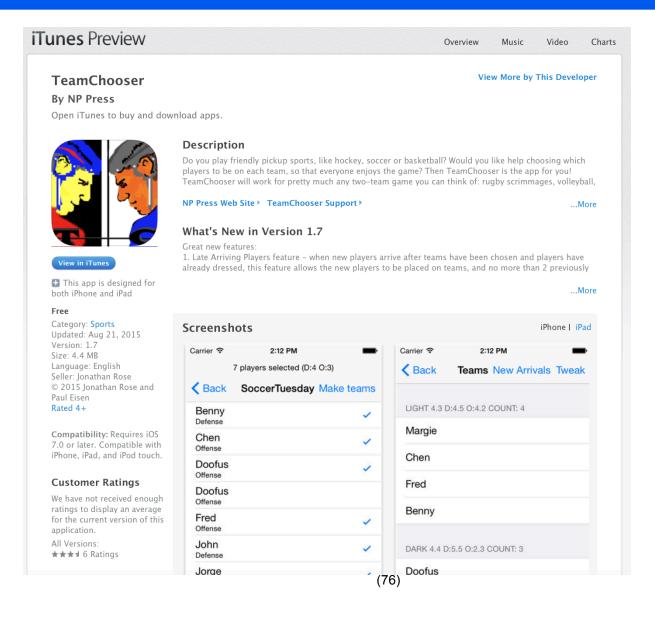


#### Does it Work?

- Yes!
- I've been using it with friends in roughly 500 hockey games and it has often done a good job.
  - We've tweaked it's algorithms here and there
  - Added some features
  - Occasionally very unbalanced games, bad luck?



# On iPhone App Store Since May 2010



- Free!
- 2330 Downloads
- Mostly in US/ Canada, but a few in UK, Ireland, Japan, Norway, Romania, Portugal, Australia, Denmark, **Finland**



#### **Lesson Learned**

- From last time: Ratings of players, key part of engine, must be kept secret!
- Can add password to App so no-one can grab phone and look at their ratings or anyone else's





# Sad Outcome: Agar

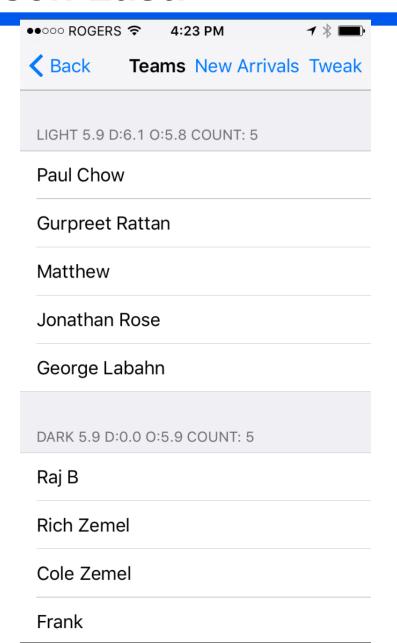
- The day after the first use of TeamChooser on Wednesday
  - Recall very poor chooser Agar
  - Folks joked and called it the iGar.
- Agar never played again on Wednesday!
  - Still plays hockey, but not with team he played with for decades





### Feature: No-One Chosen Last!

- The order that people are listed (and spoken out loud by user) is randomized
- There is no way to infer rating





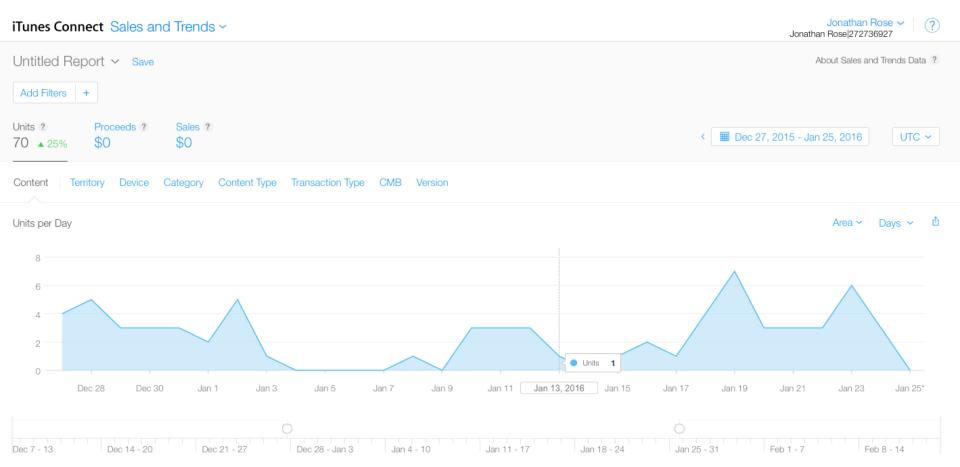
### Improvements Needed

- Really needs a backing website
  - To support a business model of advertising, promotions related to sports
- Much discussion about using results of games to determine better ratings
  - Rating players is the most difficult part of using
  - Have an undergraduate group working on this, this year.
- Don't really have time to support
  - Did, this year, work on improved algorithms
  - Added Late Arrival Feature (good!)
  - Not sure new algorithm gives better result



## **Downloads Over the Last 30 Days**

Is delightful to see people using!





# Is Anyone Using it Who Bought It?

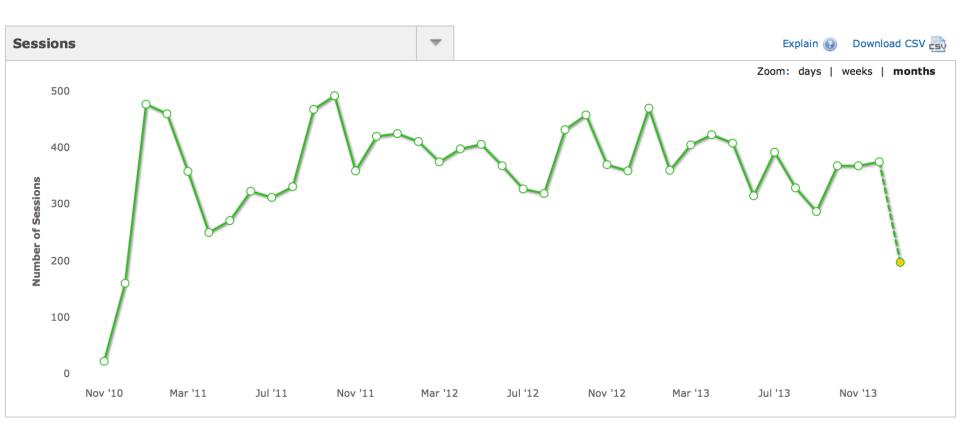
- Instrumented Using Flurry.com
  - Analytics for iPhone, Blackberry and Android
  - Very easy to insert into any app

#### Reports:

- # of users sessions, amount of time spent on app
- Specific pages/events, as you wish from each user
- Location of user, if already use GPS (no other ID).
- Anything I wish to report!
- Flurry also gives guess as to age & gender of users!

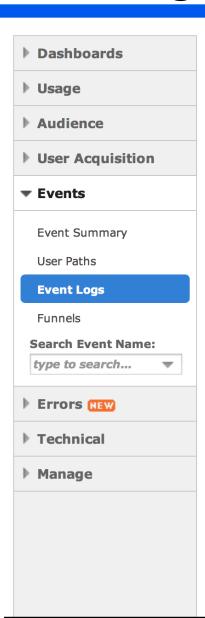


# **Sample Flurry Reports**





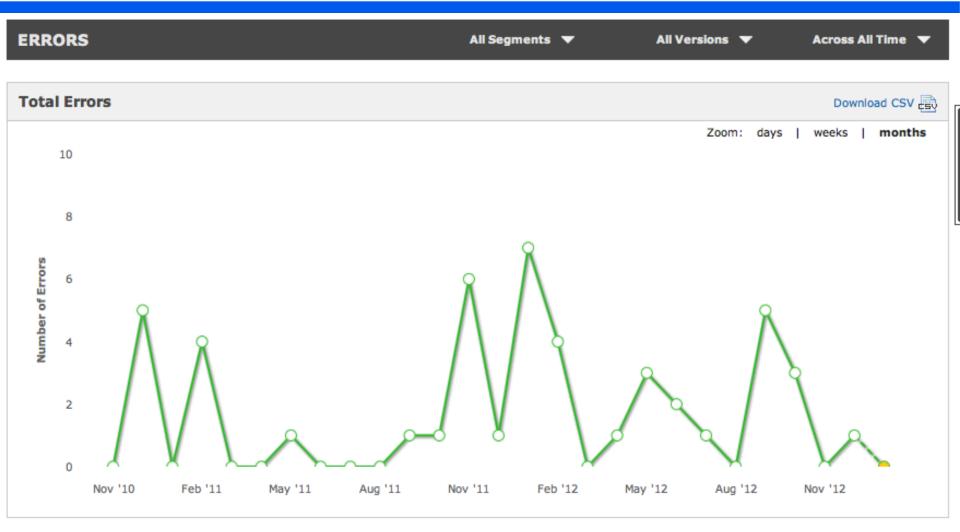
# **Event Logs**



obal Event Logs					
		Page 1			
Session Time	Version	Details			
01/19/14 21:02:57 EST	1.6 (iPhone)	Apple iPhone 4s			
1) Teams Made					
01/19/14 12:27:20 EST	1.6 (iPhone)	Apple iPad 2			
1) Adding Players Mode					
2) New Player Add	ed				
01/19/14 12:24:27 EST	1.6 (iPhone)	Apple iPad 2			
1) Teams Made					
01/18/14 15:54:27 EST	1.6 (iPhone)	Apple iPad 2			
1) Teams Made					
01/18/14 15:54:11 EST	1.6 (iPhone)	Apple iPad 2			
1) Teams Made					
01/17/14 16:03:22 EST	1.6 (iPhone)	Apple iPhone 4 (GSM)			
1) Teams Made					
2) Teams Made					
01/17/14 15:58:44 EST	1.6 (iPhone)	Apple iPhone 4 (GSM)			
1) Adding Players	Mode				
2) New Player Added					
3) Teams Made					
01/16/14 16:14:47 EST	1.6 (iPhone)	Apple iPhone 5 (CDMA)			
1) Teams Made		·			

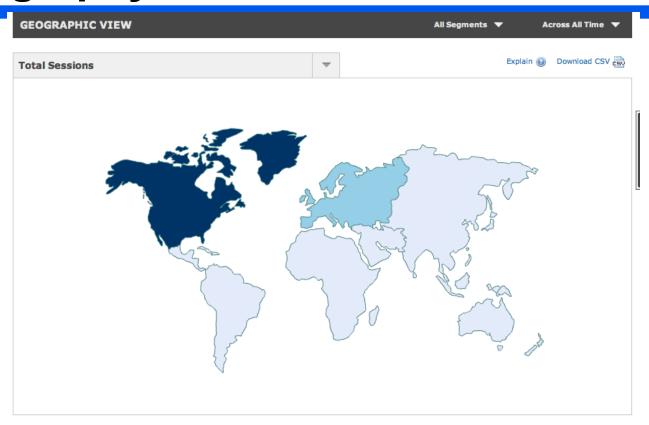


# **Errors (uncaught exceptions)**





# Geography

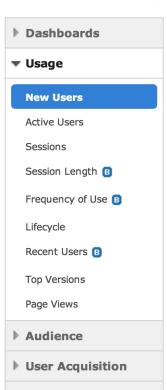


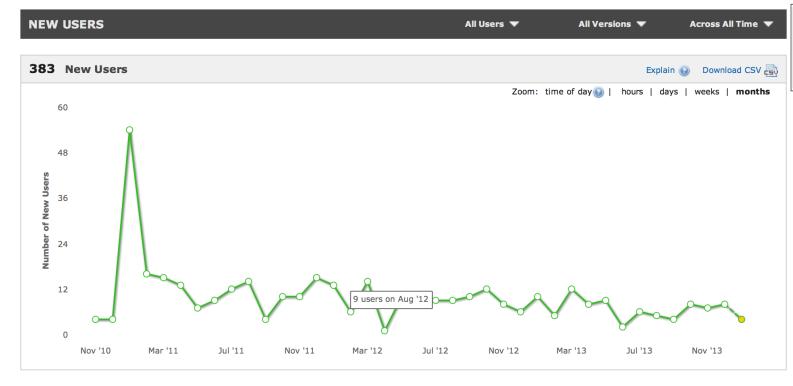
etailed View					Explain 😡	Download CSV
Region	Sessions	•	% of Sessions			
North America	7,238			76.0%		
Europe	2,184		22.9%			
South America	42		0.4%			
Oceania	26		0.3%			
Africa	26		0.3%			
Asia	7		<0.1%			
Middle East	1		<0.1%			
Central America	1		<0.1%			



#### **New Users**

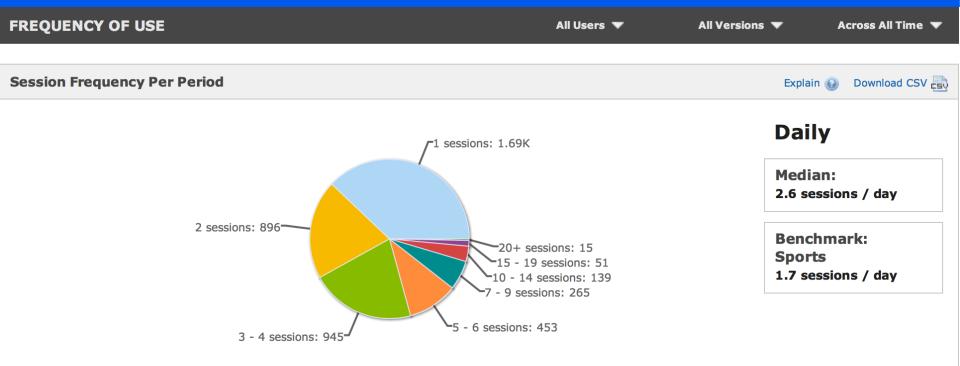
All Applications > ( TeamChooser > Analytics

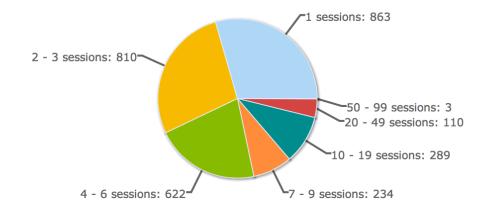






# Frequency of Use





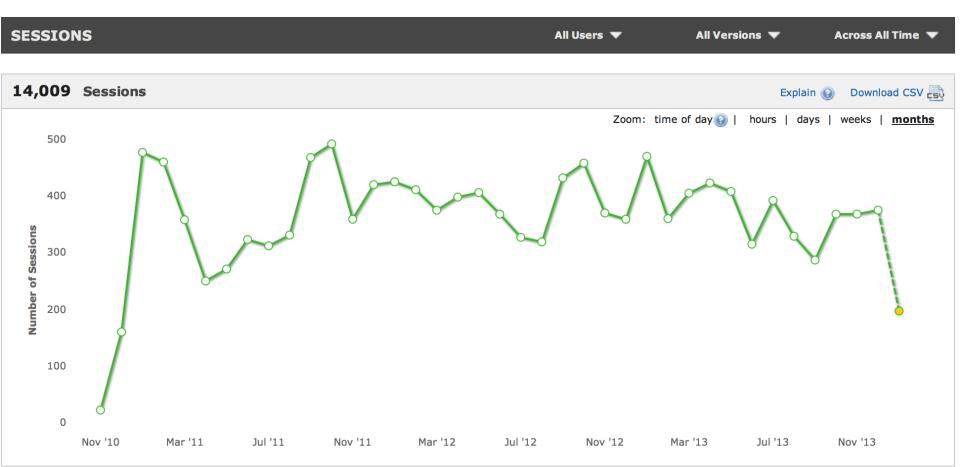
#### Weekly

Median:

3.5 sessions / week

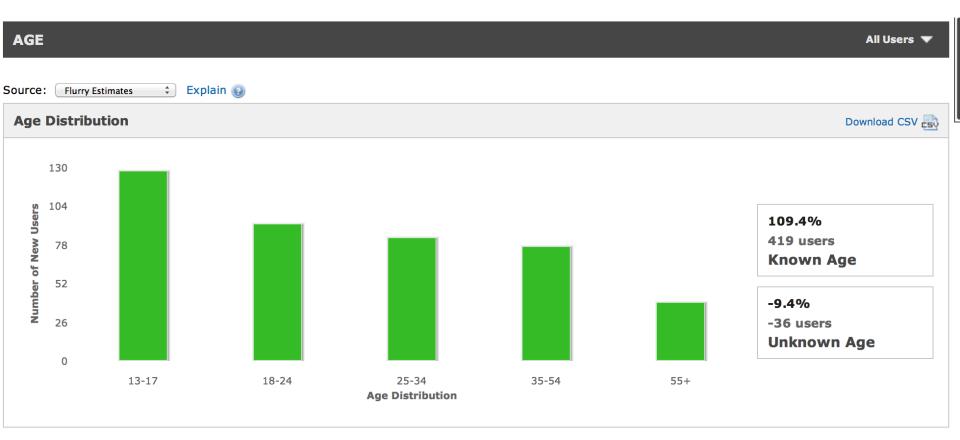
Benchmark: Sports 1.9 sessions / week

### **Sessions**



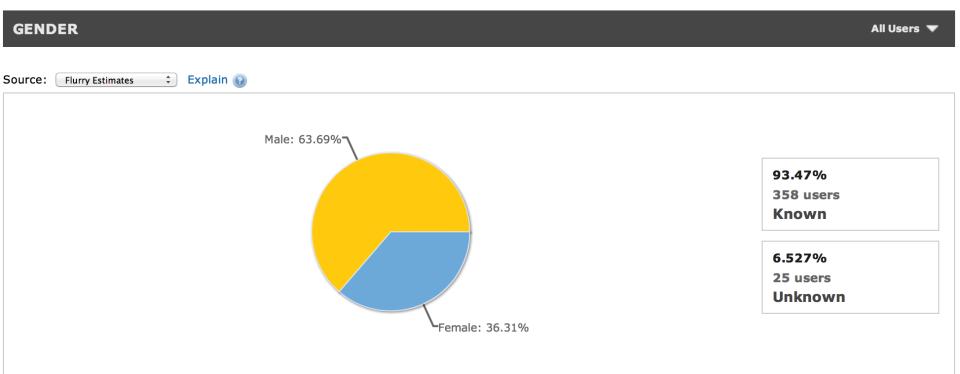


# Age Estimates!



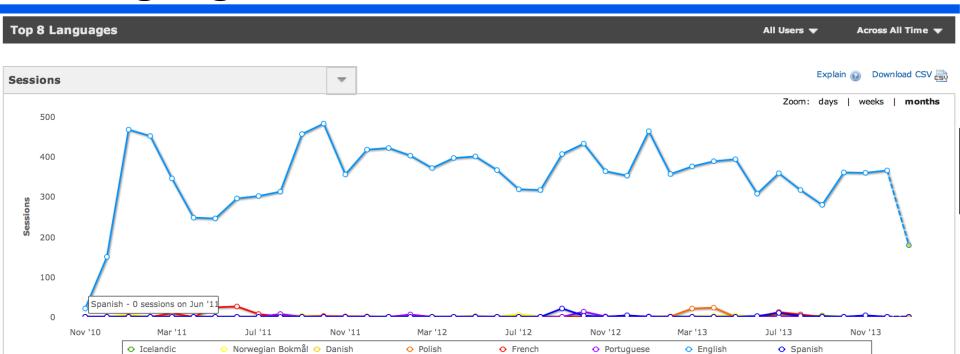


### **Gender Guess!**





# Languages



D	Detailed View								
	Language	Sessions ▼	% of Sessions						
	English	13,621	98.2%						
	French	90	0.6%						
	Polish	50	0.4%						
	Spanish	46	0.3%						
	Norwegian Bokmål	30	0.2%						
	Portuguese	29	0.2%						
	Danish	4	<0.1%						

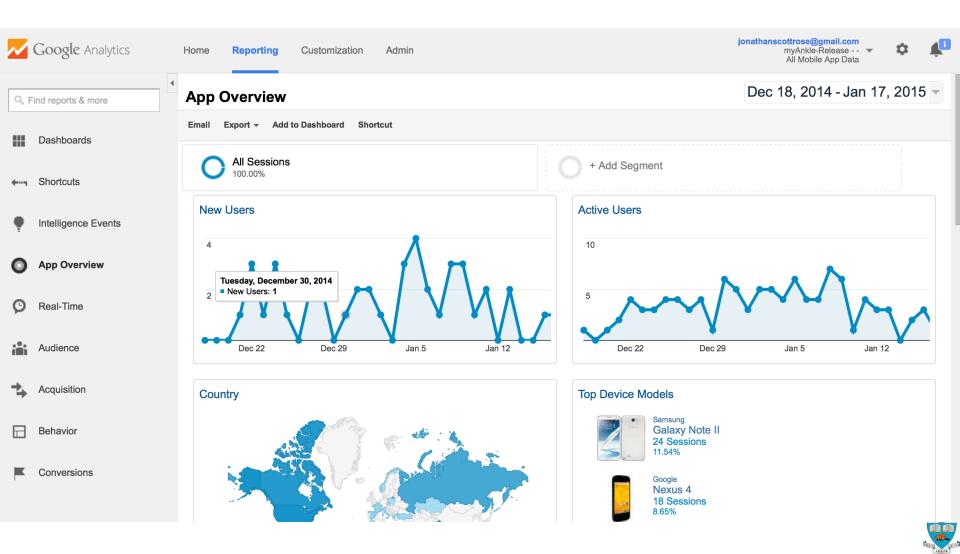


### **Lots More**

See www.flurry.com



# Google Analytics is Similar – MyAnkle



# **Topic Discussion Time**





# **Group Names:**

Group #	Approval in Principle	Project Name	
			Specialist
1	Yes	YouVote	Hugo de Grandpre
2	Yes	Correctly	Venis Nasr
3	In Review		Kingba Lawson-Jack
4	Yes	Trip Story	Saher Samnani
		(Adventure)	
5	Pending		Katzman-Group
6	Yes	Ups and Downs	Daniyal Liaqat
7	In Review		Daniel Ramnath
8	Yes	HIIT It!	Dana Swarbrick
9	In Review		Gorett Reis
10	In Review		Jiawei (Grace) Du
11	In Review		Arya Ghadimi
12		(96)	Alheli Pimienta

