Smart Stadium VIP Team

Final Presentation

November 30, 2023

Order of Presentation

- SensorNets
- Apps Team
- Machine Learning
- Market Research + Commercialization

SensorNets

Greg, Kate, Alex, Archie,
Jack, Brianna, Adnan

Overview - Progress Made

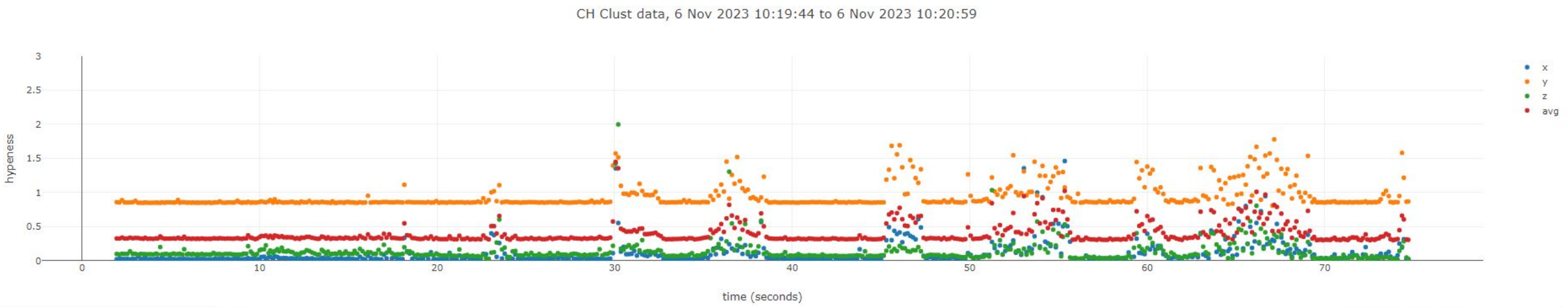
1. Created a data visualization tool

2. Evaluated the viability of the CC3235S/SF MCU evaluation boards

3. Outlined the program flow of the new CC3235 SensorMote program

Data Visualization

- Took advantage of the movement of data storage to the cloud from last semester to build a live visualization tool
- To boost efficiency, includes temporal clustering, merging adjacent data points together
- Adjustable settings for hypeness/acceleration, time range, time cluster amount



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CC3235 - Power Management

- Completed and works just as expected from the TI example documentation
- We needed to use this example to figure out how to configure the device in various low power uses cases, for the purposes of current/power consumption measurements.
- We were able to configure the example to prompt for time input in seconds to put the device to sleep for the amount of seconds inputted.
- The current measurements during this hibernation and wakeup periods were found to be:
  - In hibernate: 0.003-0.008 microamps
  - Wakes up from hibernation: 3 –11 milliamps

CC3235 - SNTP and Local Time

- Tested the Local Time example for NTP use
  - Works to return GMT time from a default server list

- Searched through the source files, figured out how to specify a server list
  - Requires some refactoring to work in SensorMote code

- Began looking at integration into the SensorMote code

CC3235 - OTA Updates

```
#define CLOUD_OTA_SUPPORT                (1) // HTTP client - Download content from a (remote) file server
#define LOCAL_OTA_SUPPORT                (0) // HTTP server - Upload from HTTP client (a mobile device connects on the local network)
#define INTERNAL_UPDATE_SUPPORT          (0) // File System - load content from a local (tar) file
```

- Completed the TI Wifi OTA example
- Intended to apply to OTA updates with sensors
- Network Privacy: not an issue anymore
  - We were able to use a token to access a GitHub test repository when we tested on a local WiFi network
- Created a local Git server on the ClusterHead and tested functionality by cloning and adding files on local machine
- Local Git servers cannot generate user access tokens, so we cannot access the server and retrieving files from the CC boards
- Only Cloud OTA supports user access tokens, based on the TI example
- **To Do:** Reach out to TI for Local OTA support + possible workarounds

CC3235 - Analog-to-Digital Converters

- Tested initial outputs on the CC3235S device using a single thread
- Added 2 more channels for further testing
- Tested the voltage values being received from the CC3235S using a breadboard to ensure that the program was outputting the expected values
- The voltage value from the first thread was 0 microvolt since it was connected to GND on the CC3235S and for the second thread, I used a value of 5 volts and received a value of 1467000 microvolt since the CC3235S device is only capable of measuring values in between 0-1.4V

Moving Ahead:

- I will add a loop for sampling the results using a timer. This would help in automating the process and receive data measured in regular intervals.

Goals for Next Semester

- Continue integrating features into the new SensorMote program.
- Build and test a circuit to connect the new devices to our accelerometer.
- Continue power testing with multiple new devices.
- Audio boosterpack testing (newly acquired).

Fanplay (Apps) Team

Ayman Ismail, Mit Patel, Kathryn Metheny, Nyshad Williams, Sacchit Mittal, Rahul Rajesh, James Ryzhkov, Mina Um, Srikar Narayan, Ananya Garg

Purpose/Overview

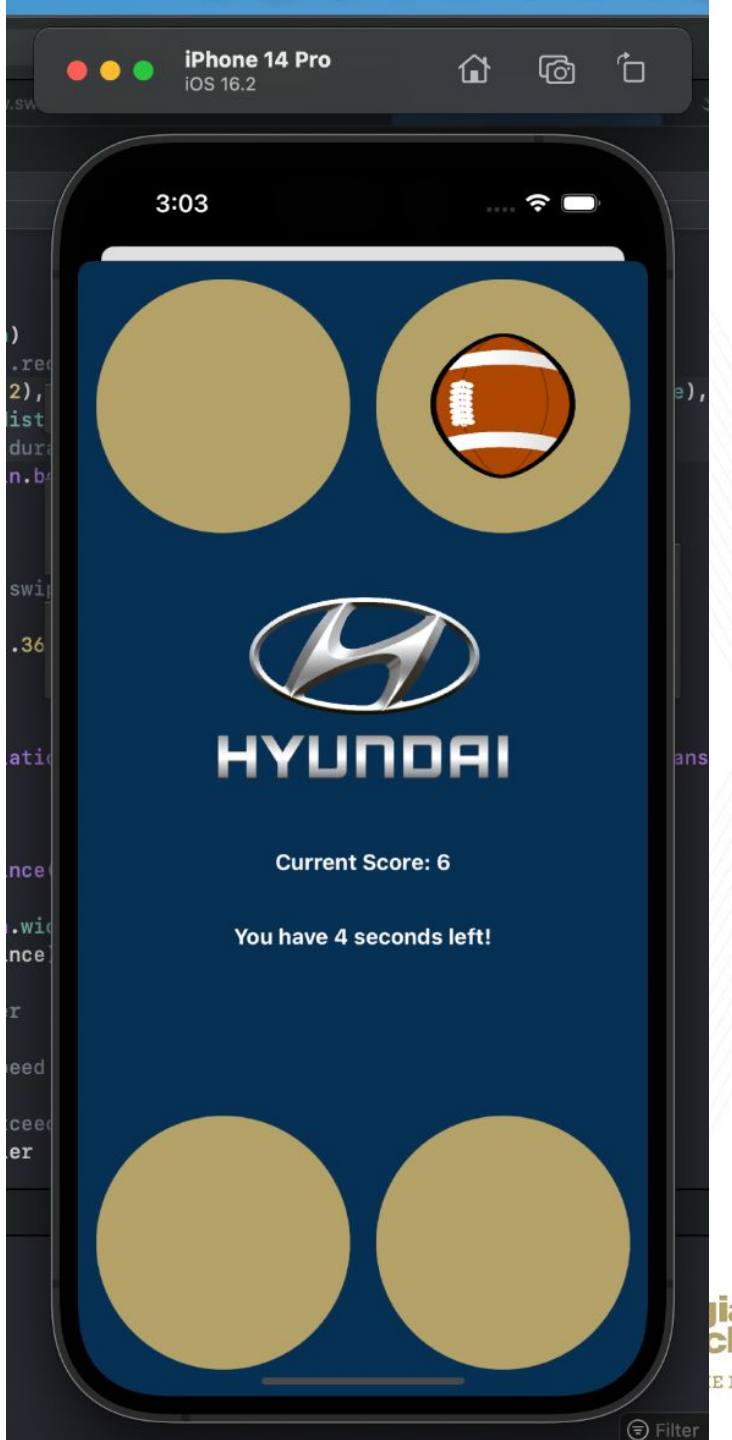
- To create an app that makes use of the phone's and stadium's sensors to improves the engagement of football fans at Bobby Dodd
- Technologies:
  - Swift: For the frontend of the iOS app
  - MySQL DB: To store various data such as user information, scores, and questions for the Trivia Game
  - Laravel/Spring Boot API: To allow communication between the app and the SQL database
- Mini games: TapDrive, Prediction, Field Goal Frenzy, Trivia

TapDrive

Tasks Completed:

- Resolved bug preventing game score to reset between games
- Utilized POST and GET requests to send game scores to backend databases
- Implemented a new GT colorscheme to better fit our audience
- Added a monetization method into the game for GT Athletics' interest

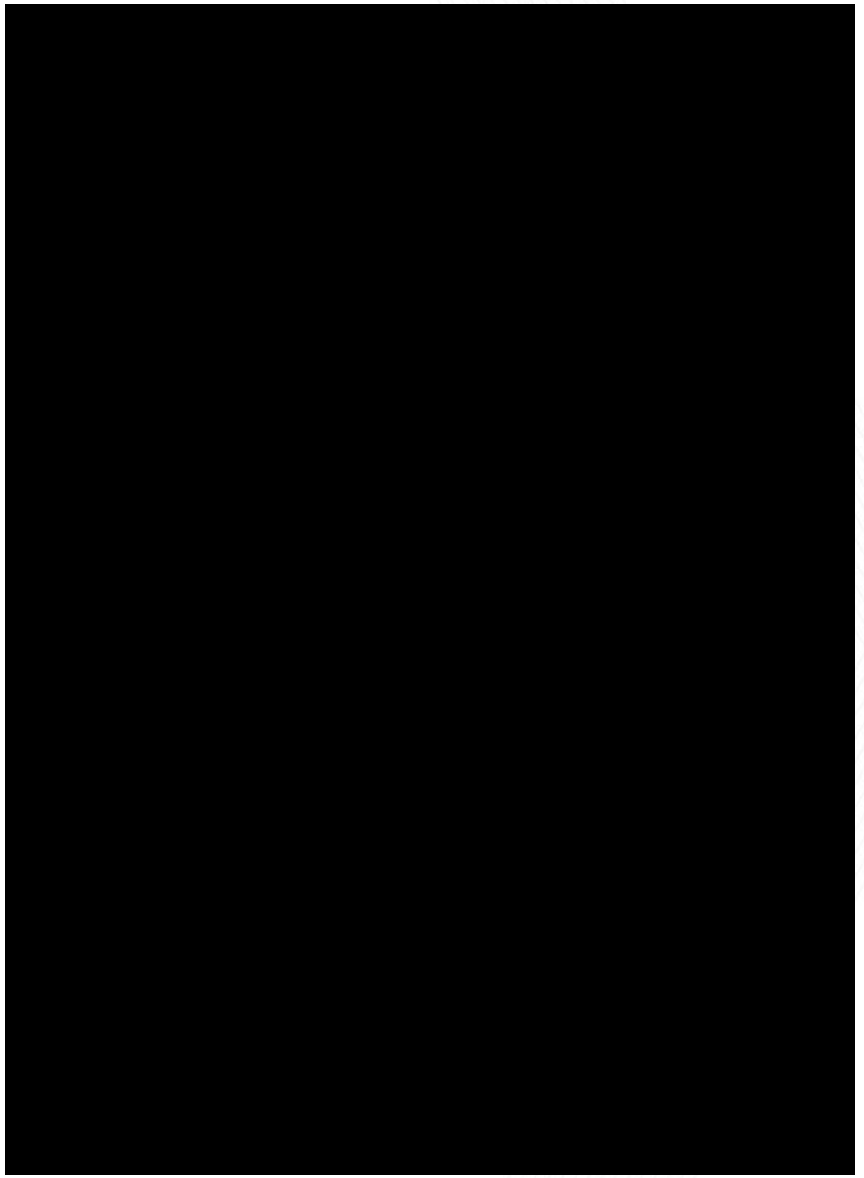

2:16
My Profile
TapDrive
Prediction Game
Field Goal Frenzy
Trivia
Leaderboard


iPhone 14 Pro
iOS 16.2
3:03
HYUNDAI
Current Score: 6
You have 4 seconds left!

FanIQ

Tasks Completed:

- Question Bank Expanded
- Questions Randomized (Every game is different)
- Implemented a proper ending screen to display score
- Backend route to access questions refactored (Backend)
- Resolved various bugs regarding score and resetting game



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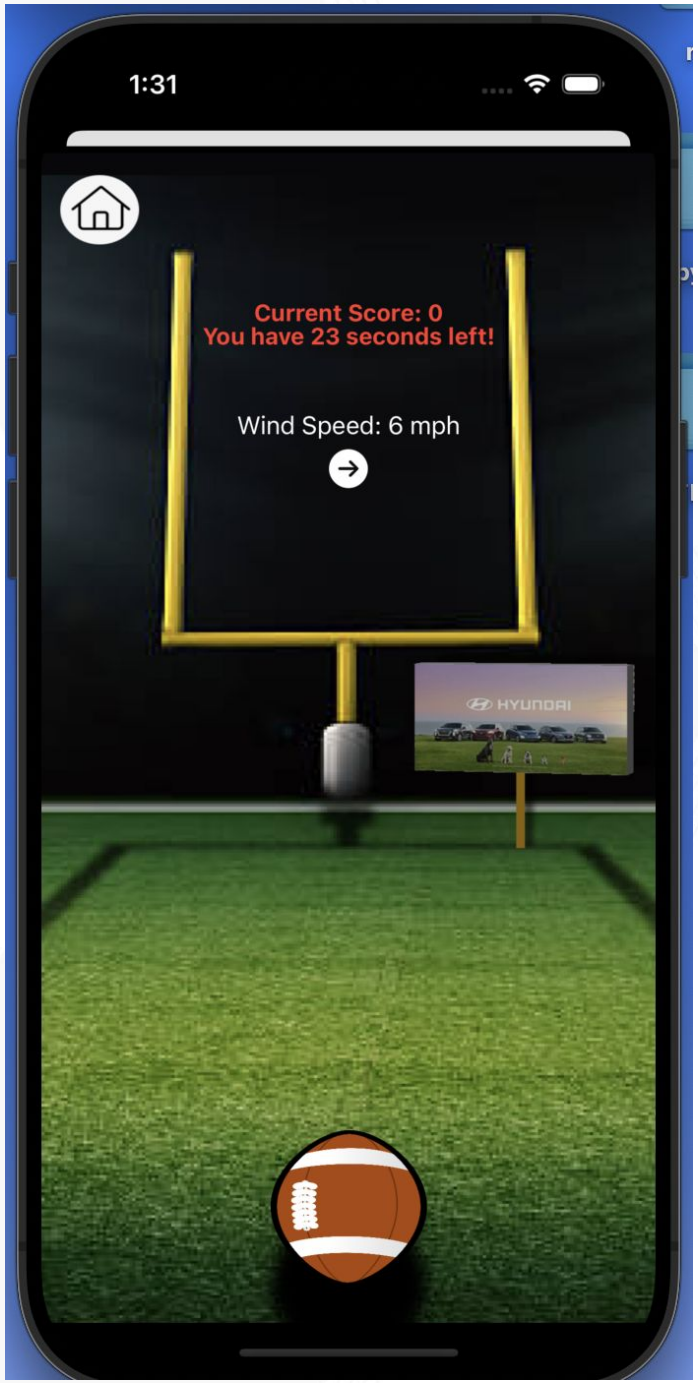
Field Goal Frenzy

Tasks Completed:

- Added wind speed and directions to the game along with a visual arrow to represent it
- Made ball reactive to the wind physics of the game
- Reduced the difficulty of swiping the ball by increasing swipe gesture multipliers
- Resolved bug preventing game score to reset between games
- Added a monetization method into the game for GT Athletics' interest



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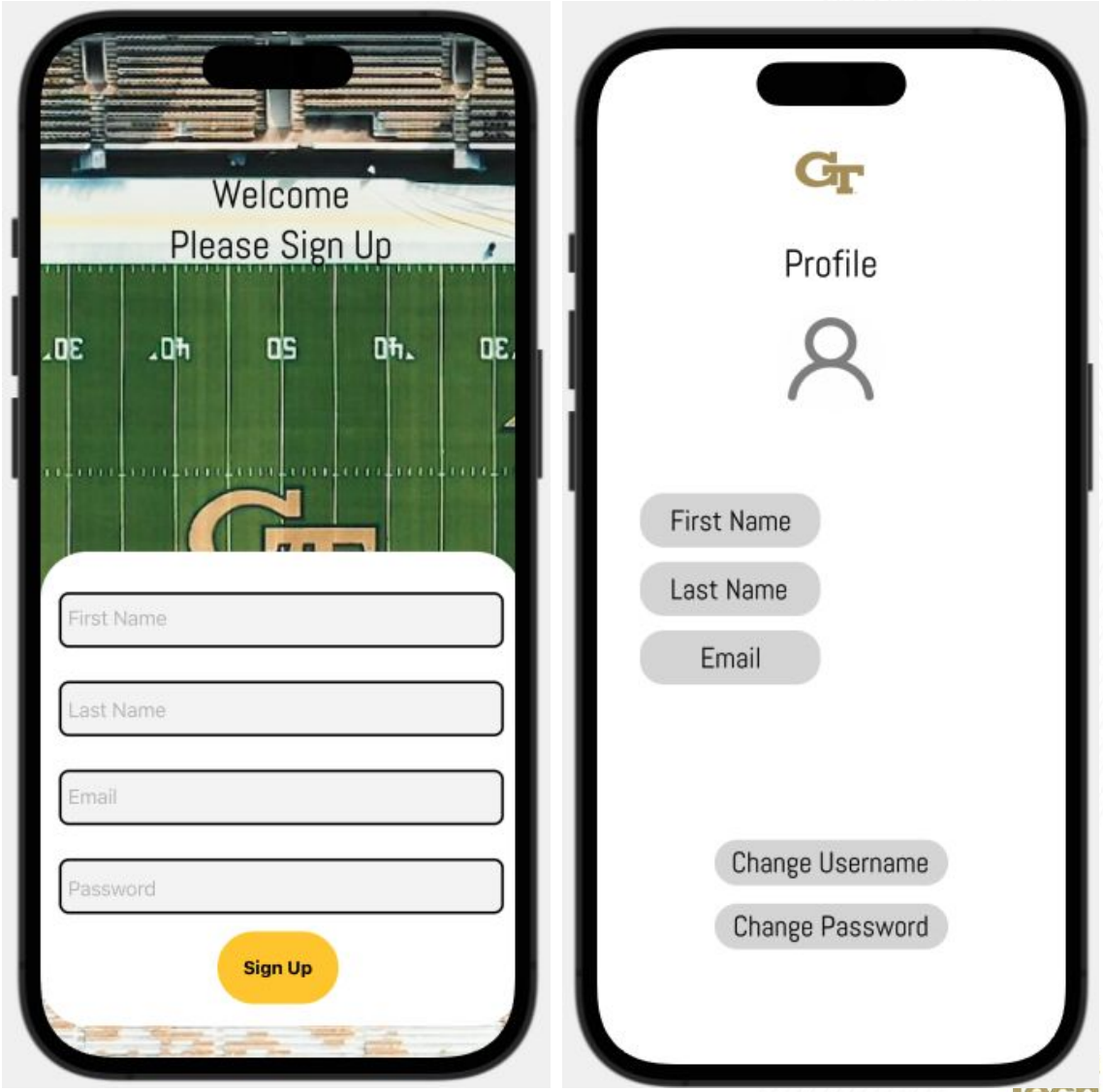
SignUp / User Profile Screen

- New users can create accounts to login to the app
- Added User Profile Page where users info is displayed
  - Also can change their username/password



Fanplay Website Updates

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about

Our team, partners, and
open positions

Fanplay was created by the Apps Sub-Team of the SmartStadium VIP team at Georgia Tech. This team, a subset of the eStadium project, specializes in the design and deployment of smartphone apps to enhance game day experiences. The Fanplay app is dedicated to providing fans in the stadium with an interactive experience.

Play fun games with fellow fans

Use our stadium network technology

See your live ranking during the game

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Some of our partners

Georgia Tech

VIP Program

Texas Instruments

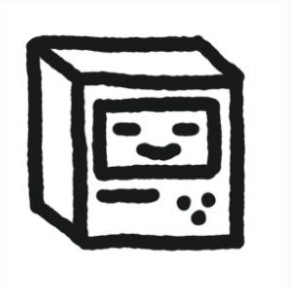
Say Hi to our team

Ayman Ismail

Team lead

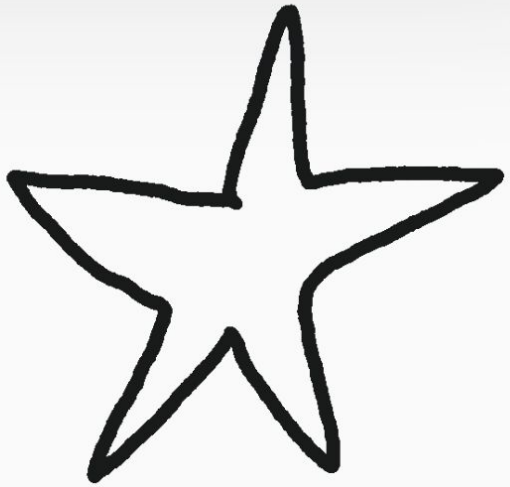
James Ryzhkov

Assitant Team lead



Sacchit Mittal

Senior Developer



Opportunities at FanPlay

Work in Atlanta

Junior Requirement

Practical Growth

Work-Life Balance

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Backend Progress

- Laravel REST API migrated over to Spring boot
- Spring Security implementation in progress
- All leaderboard routes have been rewritten in Spring boot
- Created a new route that returns every question in the FanIQ table rather than just the first 3
- Code refactored so that each game has its own controller and repository class rather having a separate class for each controller method.

Old Backend onboarding progress

2. Setting up the project

- Add PHP and Composer to your PATH.
  - (Mac) If you installed PHP and Composer, with Homebrew, you shouldn't have to worry about this...
  - (Windows)
    - Type "environemnt" into the Windows search bar and open "Edit the system environement variables". In system properties, open the advanced tab and click "Environment Variables".
    - You will see a top panel for user environment varibales and a bottom one for system variables. Scroll through the bottom panel and look for the variable named "Path".
    - Click this variable and click the edit button. Add `C:\xampp\php` to a new line at the bottom. Click OK and click OK again to close the environmemt variables.
  - (All) (Optional) To check if PHP and Composer are in the PATH, open Terminal (Mac), Command Prompt/PowerShell (Win) or Git Bash and run `php -v` and `composer -v`
  - You should see the version numbers for both programs and PHP should be 8.x.
- Clone the testAPI repo from this link. You will need to be a member of the eStadium organization on our public Github to access the repo. Contact your team lead if you are not.
  - (Windows) Clone the repo into `C:/xampp/htdocs`
  - (Mac) Clone the repo into `/Applications/MAMP/htdocs`
- Open Terminal (Mac), Command Prompt/PowerShell (Windows), or Git Bash and navigate to wherever you cloned the API repository.
- Run `composer install`.
- Copy everything in the .env.example file and paste it into a new file named .env. Add .env to the .gitignore in your local repository if it isn't there already.
  - (Mac) Use VS Code or whatever text editor you have. Don't use TextEdit as it may not save in the format you need.
  - (Mac) In the .env file, set DB_PORT=8889. This is to match a setting in MAMP.
- Change the document root to be `/public`
  - (Mac) In MAMP, open preferences -> server -> Document Root -> choose -> navigate to `testapi/public` -> choose this folder
  - (Windows) In Xampp, to the right of Apache, click Config and open httpd.conf. Ctrl+F "Document". You should see a line that says DocumentRoot and one that says <Directory. Change the location in DocumentRoot to `"C:/xampp/htdocs/public"`.
  - (Windows) If you wish to run the API from another location, you can change the <Directory and DocumentRoot lines to wherever you clone/move the repo. The DocumentRoot must still be the public directory inside the repo. (NOTE for Jamal: Need to put this at the beginning).
- Run the application.
  - (Windows) Open up Xampp and click start next to Apache.
    - Open a browser and go to http://localhost
  - (Mac) Open up MAMP and start it.
    - Open a browser and go to http://localhost:8888/
- (All)
- If you see the "Welcome to Stadium-IoPT at Georgia Tech" screen, you installed the application correctly.
- If you see a screen that says "Laravel", you're on the right track but something is not configured right.

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3. Setting up your local database

- In .env, set both DB_DATABASE and DB_USERNAME to iotdb.
- Set DB_PASSWORD to any password you like.
- Open PHPMyAdmin
    - (Windows) Open http://localhost/phpmyadmin
    - (Mac) Open http://localhost:8888/phpmyadmin5
- Go to User Accounts
- Click "Add a user account"
    - Set the username to iotdb
    - Click the dropdown next to Host Name and choose Local. This should automatically populate the text box next to it with localhost.
    - Enter the SAME password that you have in the .env file
    - Under "Database for user account" check "Create database with the same name....."
    - Next to "Global priviliges", check the box that says "check all". All of the boxes under Data, Structure, and Administraiton should be checked.
    - Under SSL, select "require none".
    - Click Go at the bottom. This will create your user and database.
- Run `php artisan migrate` in a terminal application wherever you cloned the API.
    - When you run that command, you should see a bunch of tables created.
- Run `php artisan passport:install` in the repository directory. You should see "Personal access client created successfully" and "Personal grant client created successfully".
    - Under "Personal access client", take note of the "Client ID" and set the value OAUTH_PERSONAL_ACCESS_CLIENT_ID to this value.
    - Also take note of the "Client secret" value under "Personal access client" and set OAUTH_PERSONAL_ACCESS_CLIENT_SECRET to this value.
    - Do the same with the two values under "Personal grant client". There are two values in the .env that correspond to these.
- ^^^ You may get a message saying something like "Encryption Keys already exist use the force command...". If you get this, just rerun the command with the --force flag.

- Import the data from the Production DB into your local database.
    - Download this SQL file.
    - In PHPMyAdmin, click on Import on the toolbar at the top of the page.
    - Select the SQl file you downloaded.
    - Uncheck "Enable foreign key checks" near the bottom.
    - Click Go

Spring Boot Onboarding Process

FanPlay

To use the REST API:

- Install IntelliJ
- Download the Spring Boot Assistant plugin in IntelliJ
- Hit the play button in `FanPlayApplication.java`
- The API is now running, use Insomnia or Postman to test the different routes

Ananya’s updates

- Progress so far
  - Refactored backend to ensure all routes for each game are contained in one Spring controller/repository
    - Ex. FieldGoalController has getAllScores, getTopFGMatches, and all other FG-related routes
  - Created routes for REST API using Spring Boot for Laravel to Spring backend migration for top touchdowns and field goals

Future Goals

- Polish the wind mechanics for FieldGoal Frenzy
- Expand FanIQ’s question bank
- Add more topics to FanIQ
- Add live scores for the football games to the app
- Implement token authorization for the Spring API
- Deploy the Spring boot application to AWS
- Implement login/registration routes to the Spring API (Need token authentication for this)
- Implement Hypemeter to the FanPlay app

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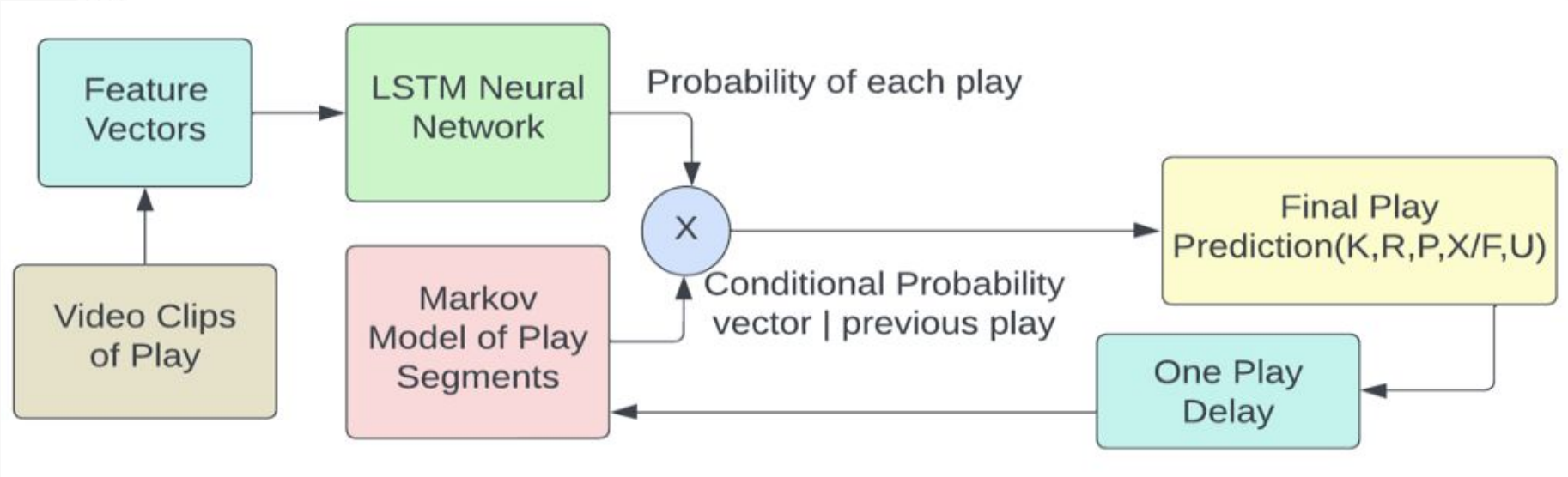
Machine Learning

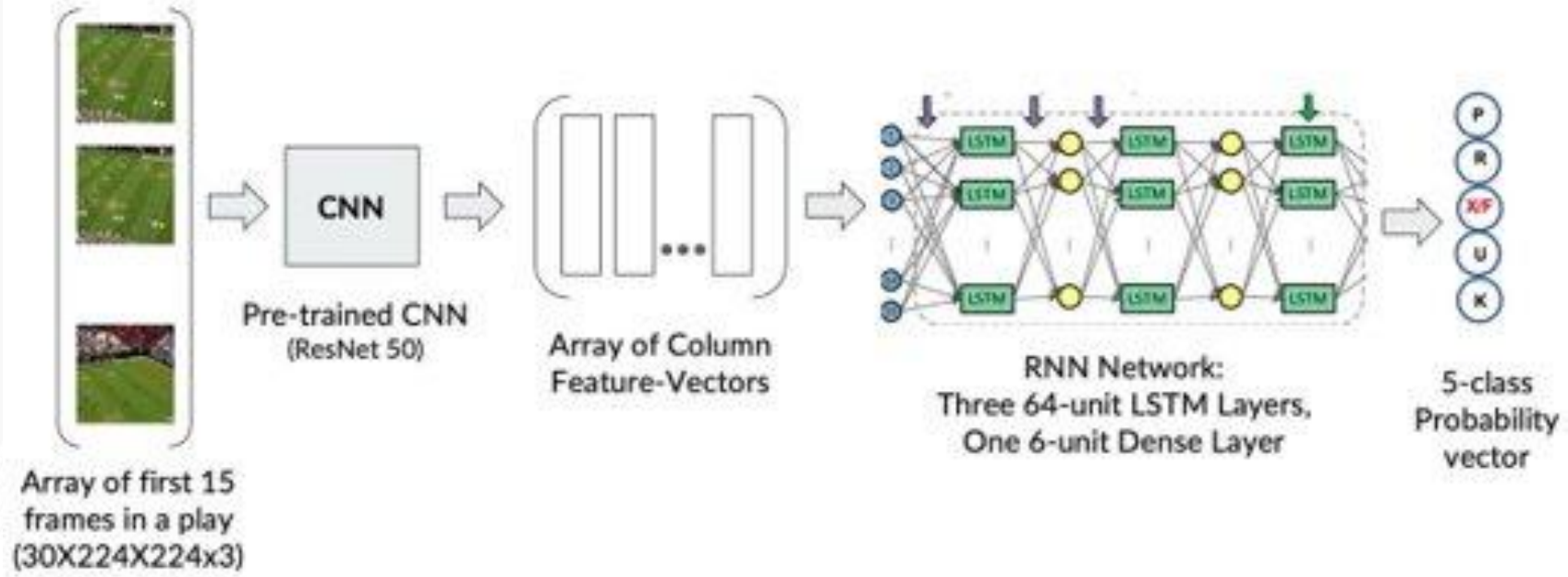
Andrew, Amit, Deepa, Pedro, Pranav, Ryan,
Saahil, Rushil, Yash, Henry, Shail, Andrew, Nick

Purpose/Overview

- Over 80,000 existing GT football plays in dataset with annotations
  - We are considering ~800 in our local sampling
    - 80% (640 plays) in training set and 20% (160 plays) in test set
- Developing a model to classify clips of football plays
  - Rushing (R), Pass (P), Kickoff (K), Punt (U), Field Goal and Extra Point (X/F)
- Potential use cases:
  - Scouting/Analysis for football coaching staff
  - Instantaneous updates on sports platforms
  - Decrease the need for complete manual human verification

Model Structure





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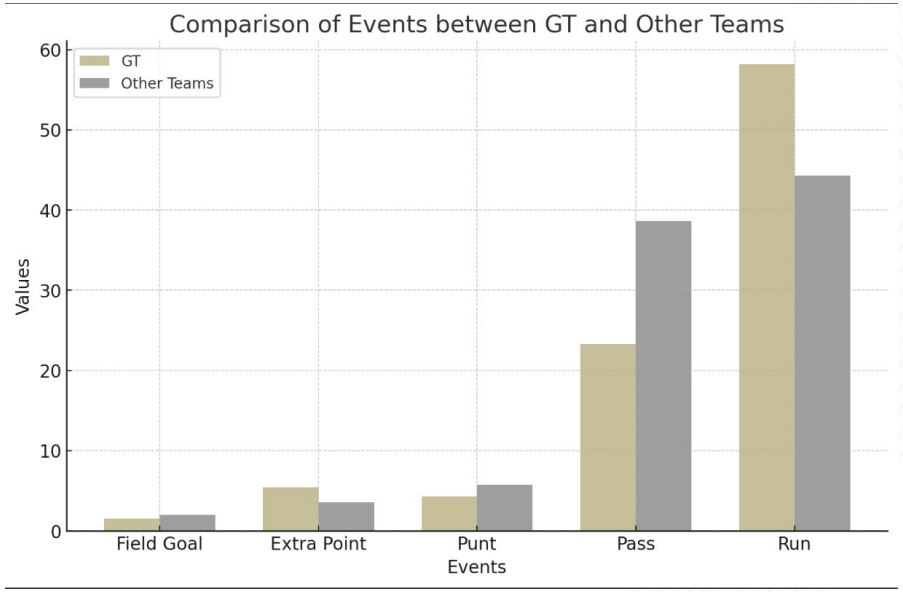
Cleaning and Preprocessing New Play Data

- Preprocessing additional stats play data from other CFB teams
- Get them into same format as allplays.csv
- Added context (down, distance, who has ball)
- Issues
  - multiple plays occurring concurrently
- Added about 485,000 new plays
  - before: 56,000 existing plays from GT
- Ran Markov Chain on data (2021-2023)
- Markov chain performed worse than GT
- Next steps:
  - more clarity on how data was scraped
  - additional years



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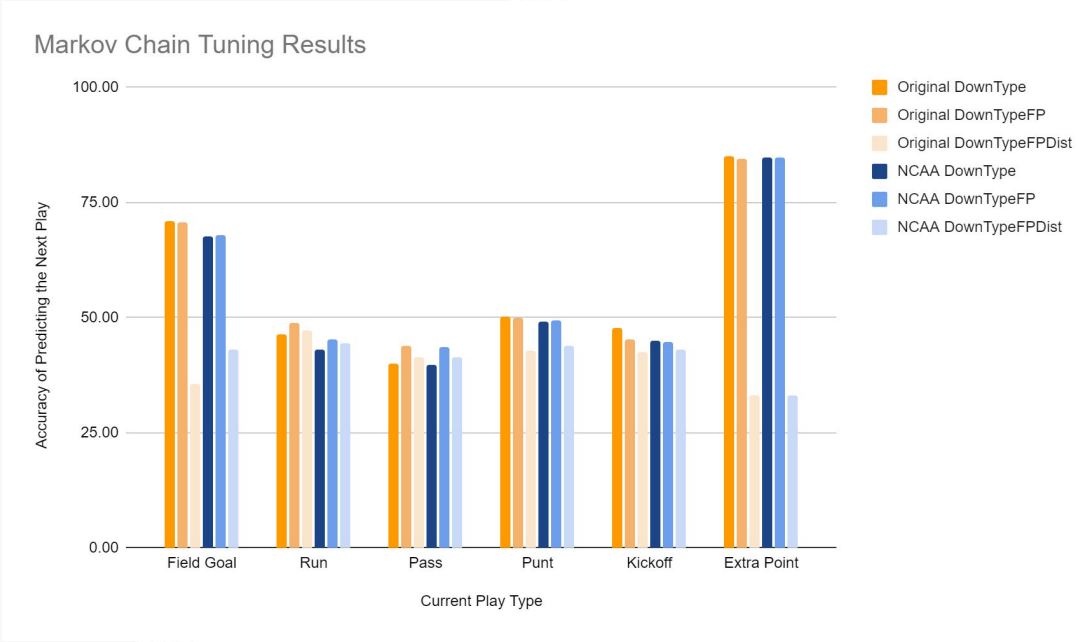
Markov Models

$Down$	1	2	3	4	$Total$
1	0.403	0.597	0.000	0.000	1
2	0.375	0.005	0.619	0.000	1
3	0.454	0.000	0.003	0.543	1
4	1.000	0.000	0.000	0.000	1

- Developed six main models
  - 3 for GT & 3 for NCAA data
    - DownType
    - DownTypeFP
    - DownTypeFPDist
- Comparing the models performance based on specific play types



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Investigating Misclassified Plays

- Look for trends and Patterns in Misclassified Plays
- Found that the model struggled with classifying Option plays.
- Noticed that plays were being input incorrectly to the model (ie. Model sees a run play, identifies it as a run play, but the “correct” classification was input to the model as a pass)
- Found problem was in the joining of our play and video csvs - PlayIDs aren't lining up correctly.
- Adjusted our code to join by game, down, and play text instead of ID.

- Wrote a paper outlining subteam's work and prediction accuracies
  - Deadline Dec 1st (tomorrow)
- Detailing the model conflation approach and how utilizing markov chain with a computer vision model maximizes play prediction
- We have achieved the highest recorded accuracy in the field
- Made changes according to feedback from last semester's PIMRC paper submission

Goals Moving Forward

- Finalize research paper and submit by tomorrow
- Continue finding other NCAA play data to train Markov Model
- Find play videos from other schools (with annotations) to increase training/test set size
- Fix alignment issue between videos/annotations
  - Recently discovered, can increase accuracy by 5-15%
- Incorporate Object Detection algorithms for more difficult plays
  - Laterals, short passes, turnovers, etc.

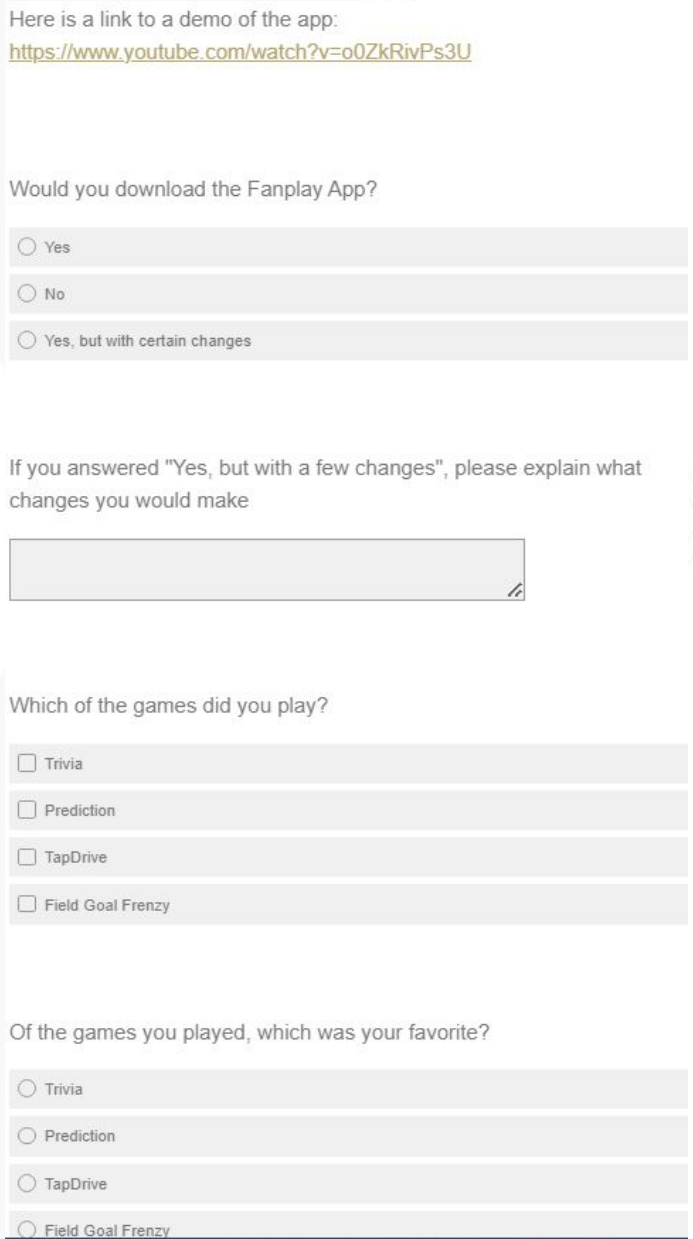
Market Research and Commercialization

Ryan Kelly, Laura Barros, Greg Lanier

This Semester's Goals

- Finish IRB
- Get GT Athletics Approval
- Transition Documents
- Prepare for future commercialization

IRB



- Everyone currently involved has up to date certifications
- The survey itself is approved by IRB
- GT Athletics is the only barrier to this being given out

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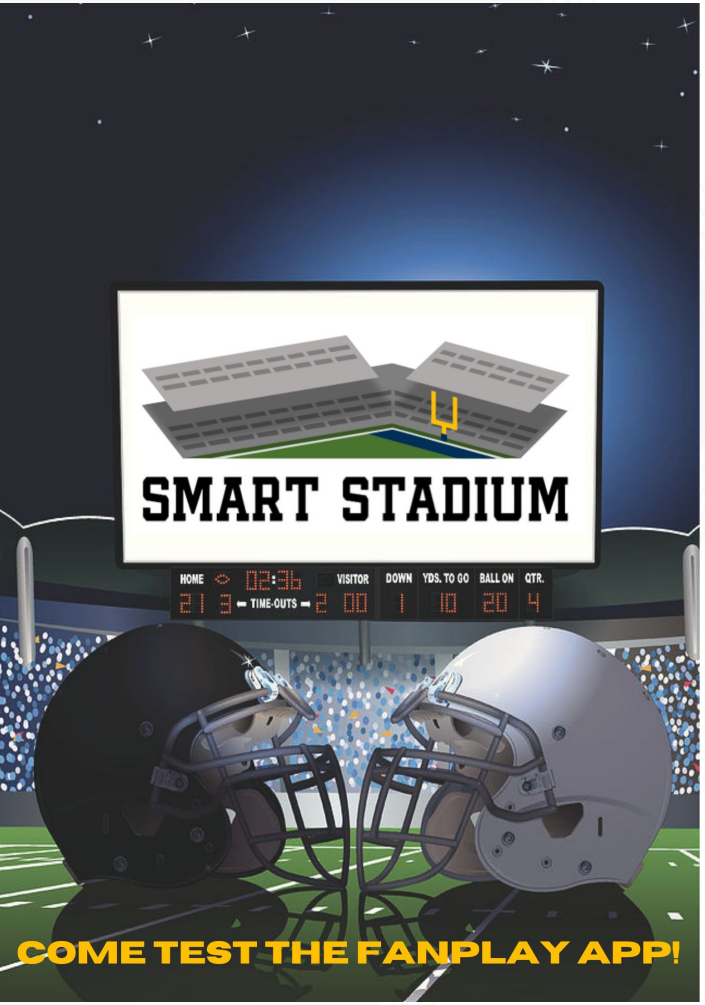
Marketing Materials



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I-Corps

- Run by the National Science Foundation
- 4 cohorts per year (January, April, August, November)
- $50,000 in grants primarily for travel
- 7 Week program in which a minimum of 100 Customer Discovery interviews are to be done + 1.5-3 hrs of Curriculum per week
- 3 required roles
  - Entrepreneurs to do the interviews (1 to 2 people, typically Grad students)
  - Technical Lead (1 to 2 people, often PI or a post-doc)
  - Industry Mentor (we do not have one and would need to find one)

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Goals for Next Semester

- IRB Survey Given out at a Basketball or Baseball game
- Decide if we want to do April I-Corp
  - If so, gain more info into the process to apply and participate
- Determine feasibility and market for advertisements on FanPlay App

Thank You
:)

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