

FIRST.2024 CHAMPIONSHIP

PRESENTED BY

BAE SYSTEMS

FIRST. IN **SHOW.**
PRESENTED BY Qualcomm

Scouting – More Than Alliance Selection

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Mark Maciejewski

FIRST.2024
CHAMPIONSHIP

PRESENTED BY **BAE SYSTEMS**

195

CYBERKNIGHTS

DESIGN
BUILD
COMPETE
REPEAT

FIRST.2024
CHAMPIONSHIP

PRESENTED BY **BAE SYSTEMS**

Overview

- Roles – Scouting team in general & individual student roles
- Components of the scouting system & software stack
- Take aways

High-level Role – Kickoff

Six “Alliance” Groups

Read Rules
& Answer
Questions

Rules
Presentation
& Discussion

Mock
Matches

Small Group
Discussions

Full Team Discussion

Robot Business Requirements

High-level Role – Pre-season

Drive Team

- define preferred paths
- define strategies to avoid & play defense
- define match strategies
- ensure driver practice encompasses breadth of situations

Programming

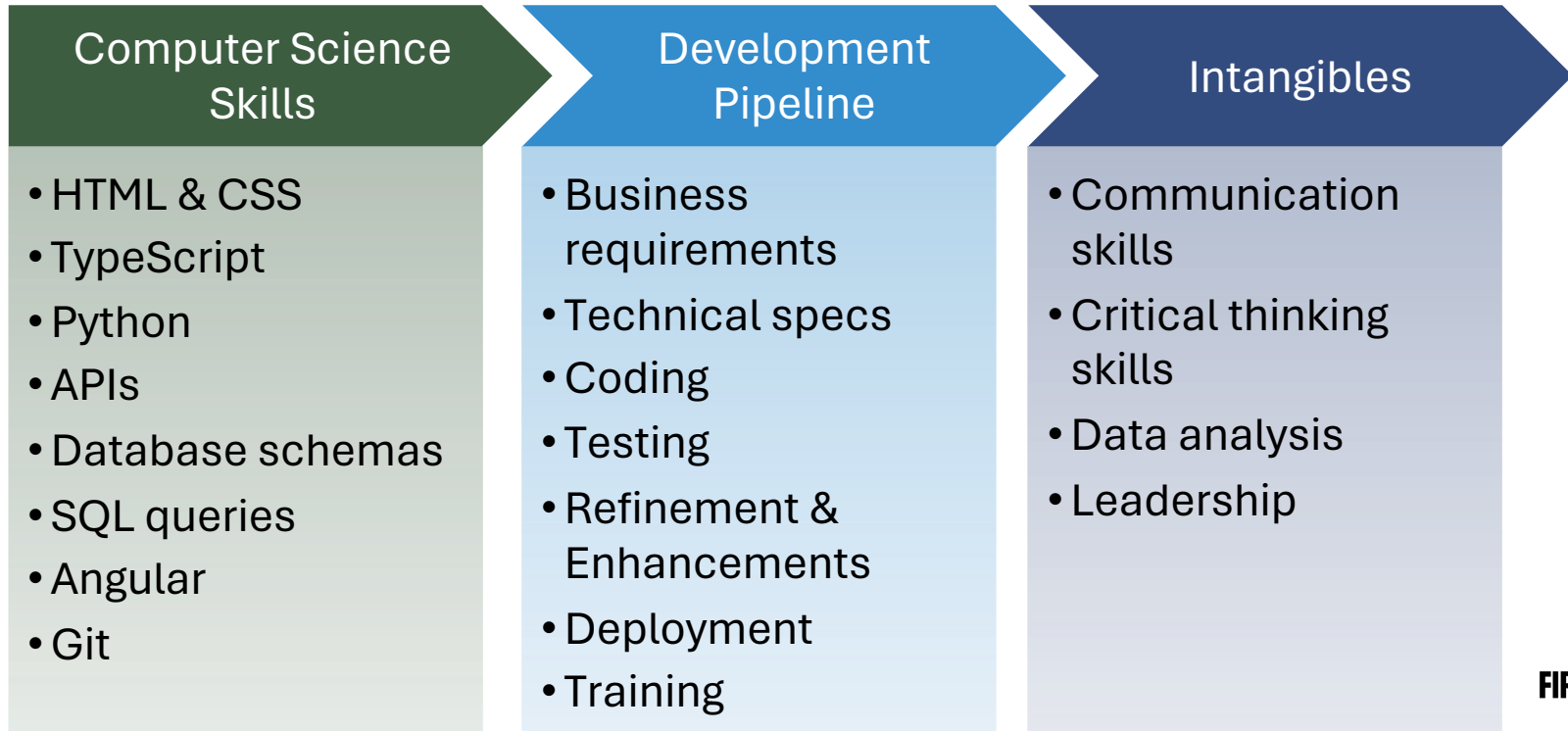
- define autos
- define “alternative” strategies & capabilities
 - *e.g. direct from source intake as a backup to ground intake*
- define “extra” features
 - *e.g. shuttle shots*

High-level Role – Match Day

Scouting Team

- pit scouting
- quantitative scouting – level 1
- qualitative scouting – level 2
- match strategies
 - missed opportunity for many teams
- alliance selection

Ultimate Role – *teach students*



Student Roles

1. Level 1

2. Level 2
3. Match Strategist
4. Alliance Selector
5. Coordinator

- one scouter per team
- quantitative data
- all team members scout with few exceptions
- data shared with community

Student Roles

1. Level 1

2. Level 2

3. Match Strategist

4. Alliance Selector

5. Coordinator

- six dedicated scouters
- responsible for 1/6th of the teams
- pit scout
- watch their robots in as many matches as possible
- qualitative comments that tell more than quantitative data - reports

Student Roles

1. Level 1

2. Level 2

3. Match Strategist

4. Alliance Selector

5. Coordinator

- analyzes level 1 and level 2 data ahead of match
- develops comprehensive plan for match
- predicts likely outcomes
- refines strategy with drive coach
- finalizes strategy with alliance

Student Roles

1. Level 1
2. Level 2
3. Match Strategist
- 4. Alliance Selector**
5. Coordinator

- works with level 2 scouters
- formulates pick lists
- watches most matches
- formulates strategy for alliance selection
- leads the “midnight meeting” with level 2 scouters and mentors

Student Roles

1. Level 1
2. Level 2
3. Match Strategist
4. Alliance Selector

5. Coordinator

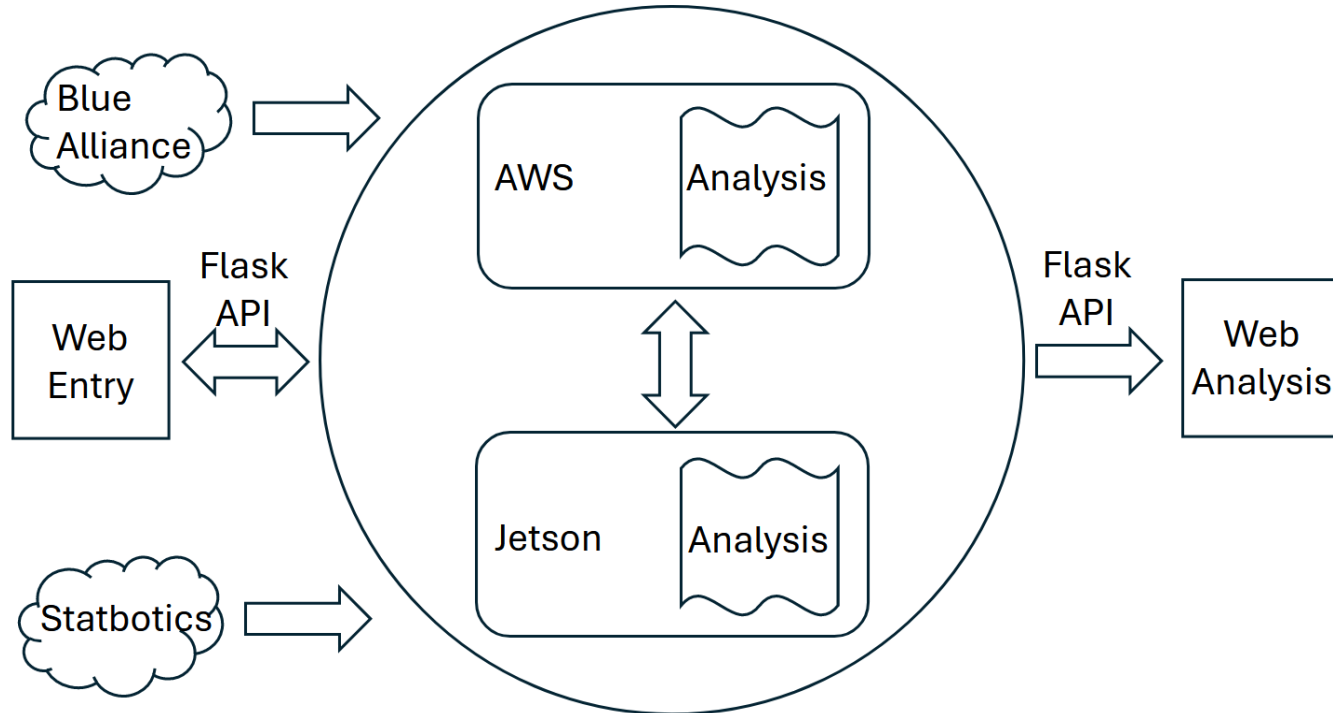
- sets scouting schedule
- makes sure scouters are present ahead of their matches
- helps fix technical issues
- provides guidance to level 1 scouters

Components / Software Stack - Outline

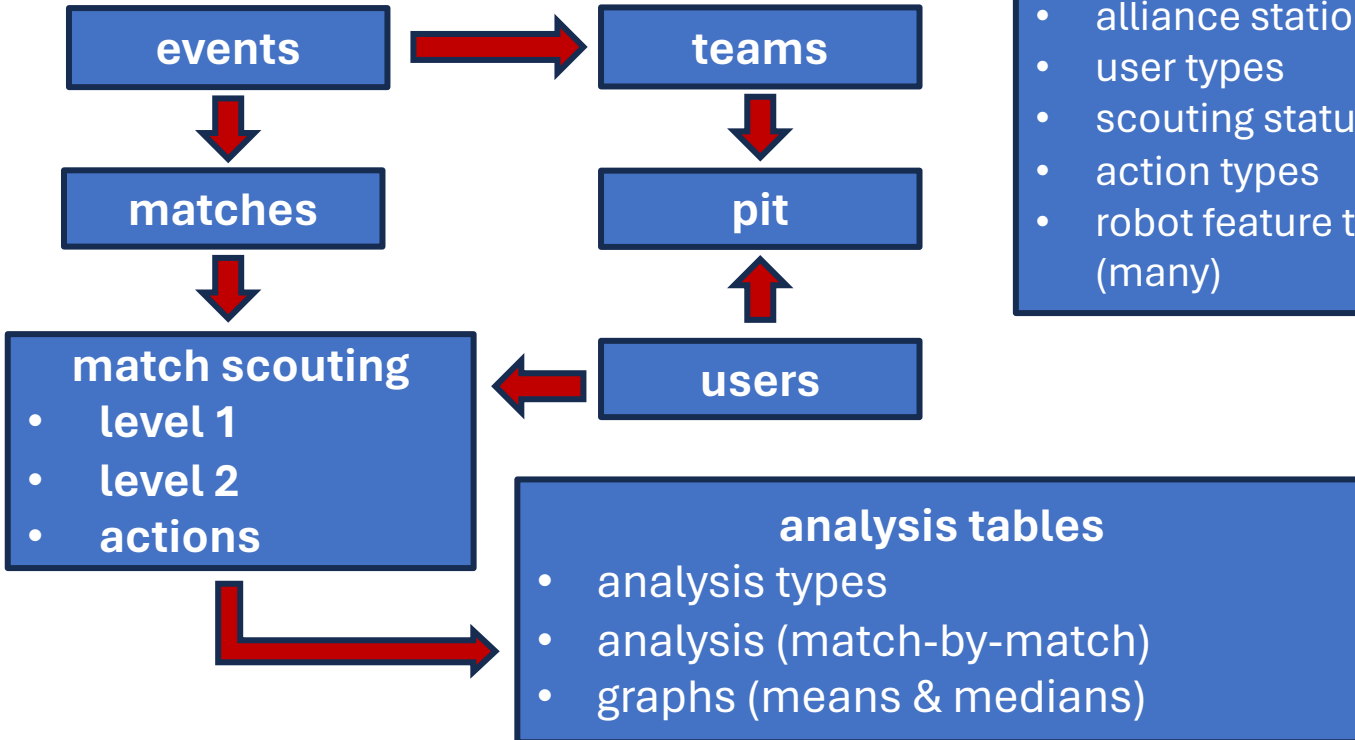
- Relational Database – MariaDB, SQL
- Web Data Entry – Angular, HTML, CSS, TypeScript
- Setup & Analysis Scripts – Python 3, SQL
- Web API endpoints – Python Flask, SQL
- Web Analysis – Angular, HTML, CSS, TypeScript

Same software stack used in industry

Components



Database Schema



“reference” tables

- alliance stations
- user types
- scouting status
- action types
- robot feature types (many)

“BA” tables

- teams
- schedule
- OPRs
- ranks

“list” tables

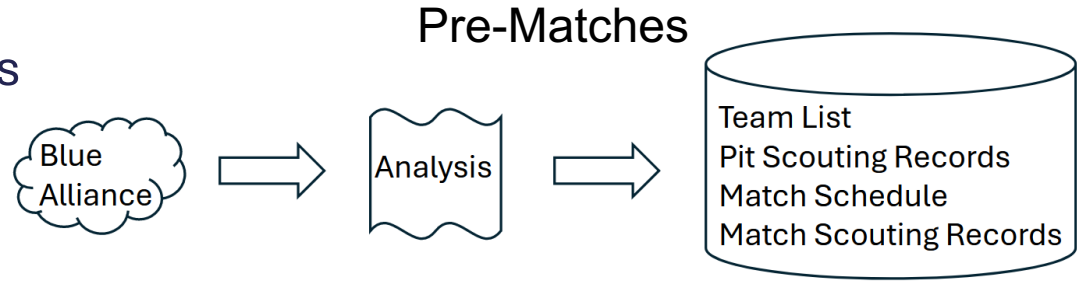
- pick lists
- watch lists

Database Benefits

- data integrity
- easy interaction with Python
- powerful queries
- interfaces easily with web-apps
- usability - data model stable
- dynamic website
- tools for backups and data syncing

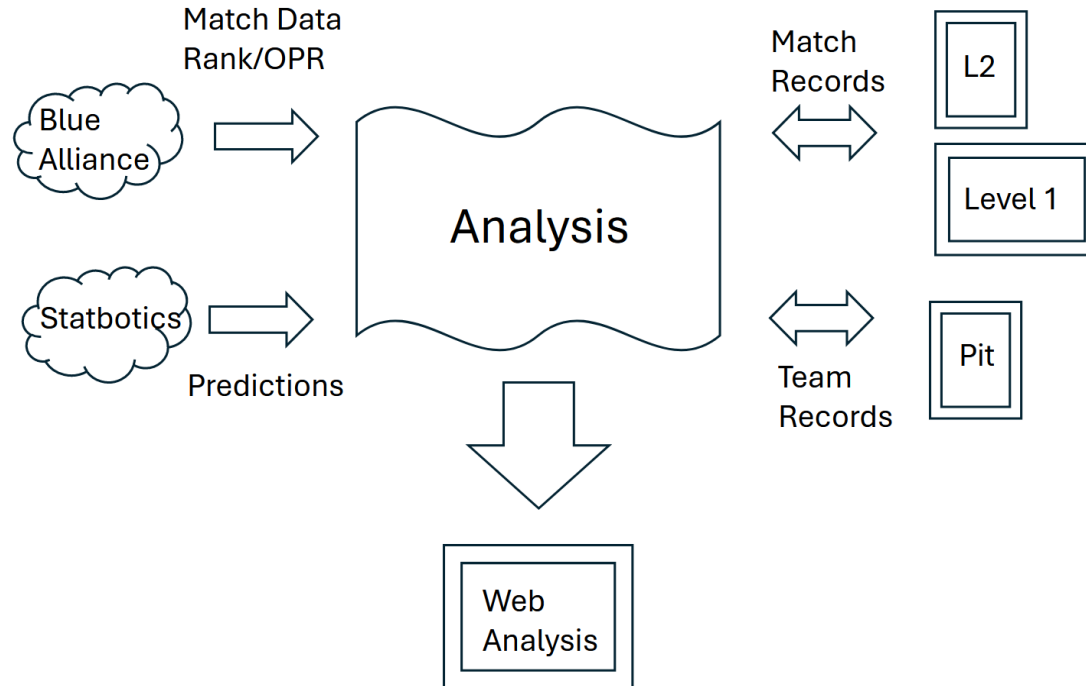
Analysis & Productivity Scripts

- Blue Alliance – retrieve events, teams, event teams, schedule, match data, OPRs, ranks
- Auto build database records
 - match records
 - pit records
 - match scouting records
- Statbotics – score predictor
- helper tools (e.g., sync tables)



No changes, or only minor, between seasons

Data Flow – During Match



Analysis Module – Analysis Types

GOAL – For a given team harvest data from match scouting records, processes them with various analysis types, and write two new database tables (*CEanalysis*) which the web analysis application utilizes for easy display of robot snapshots, match reports, and alliance selection tables

Analysis types may be the exact data collected (e.g., *teleSpeaker*), or they may perform additional manipulations (e.g., *totalNotes*)

Analysis Module – Analysis Types

Schema (48 columns)

eventID
 team
 analysisType
 M1V
 M1D
 M1F
 ...
 M12V,D,F
 S1V,D,F
 S2V,D,F
 S3V,D,F

code

M = match
 # = team match number
 S = summary (S1-mean, S2-median, S3-rank)
 V = value (float)
 D = display (string)
 F = format (color code)

color codes

white & gray = neutral
 blue > green > yellow > red > black

Analysis Module – Analysis Types

Analysis Type = 4

S3 (Rank) = 90

AutoSpkr (scored attempted)															
Team	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	A	M	R
6328	4 4	7 7	5 5	5 6	4 7	4 6	3 4	4 6	5 5	6 6	6 6	5 5	4.8	5.0	90

M1D (Display) = 4|4
M1V (Value) = 4
M1F (Format) = 4

M4D = 5|6
M4V = 5
M4F = 5

S1 (Mean) = 4.8

S2 (Median) = 5.0

Analysis Module – Analysis Types

Graphs

- Extract data from *CEanalysis* table and write new table for easy graphing (*CEanalysisGraphs*)
- Has three rows per analysis type; Mean, Median, and a Format (color code) based on Rank

Analysis Module – additional tools

- insert BA match data
- auto path images
- shooting heat maps
- robot pictures
- score predictor
- defense analyzer

Scratching the surface of Python tools for data analysis

Analysis Module – Benefits

- modular – code broken into small files
- novice to advanced students
- allows web analysis to need few changes year2year
- allows flexibility to create a new analysis type by using combinations of data
- easy formatting for robot snapshots, match reports, alliance selection, and graphing

Web Data Entry

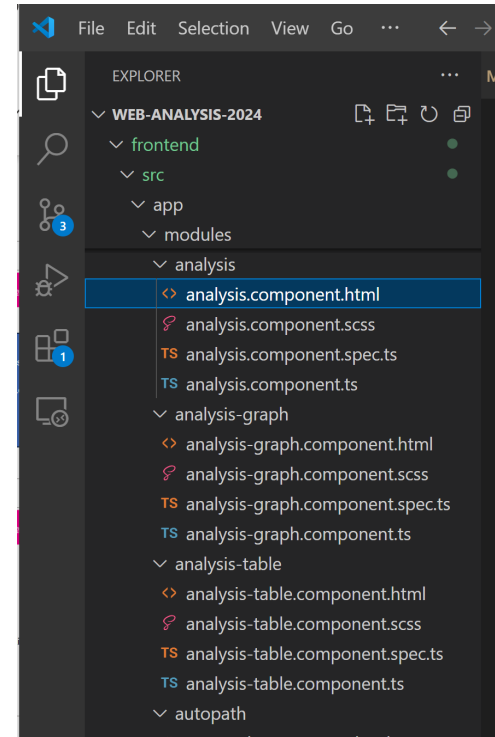
- Angular Framework interfacing with Flask API
- Hosted on AWS and Jetson
- Data stored in browser Local Storage
- Editing ensures all required fields are entered before moving on to next page

Angular Framework

- Component
 - HTML
 - SCSS
 - Typescript

- Service

- Project is built and deployed to web server



Web Data Entry

Level 1

Level 2

Pit Scouting

Comments

Admin

- Quantitative Data
- Data entered in tablets connected to Jetson (or AWS)
- PreGame, Auto, TeleOp, End Game, Post Game and Eval Sections
- Focus on Quality over Quantity
- Available for teams to download

Web Data Entry

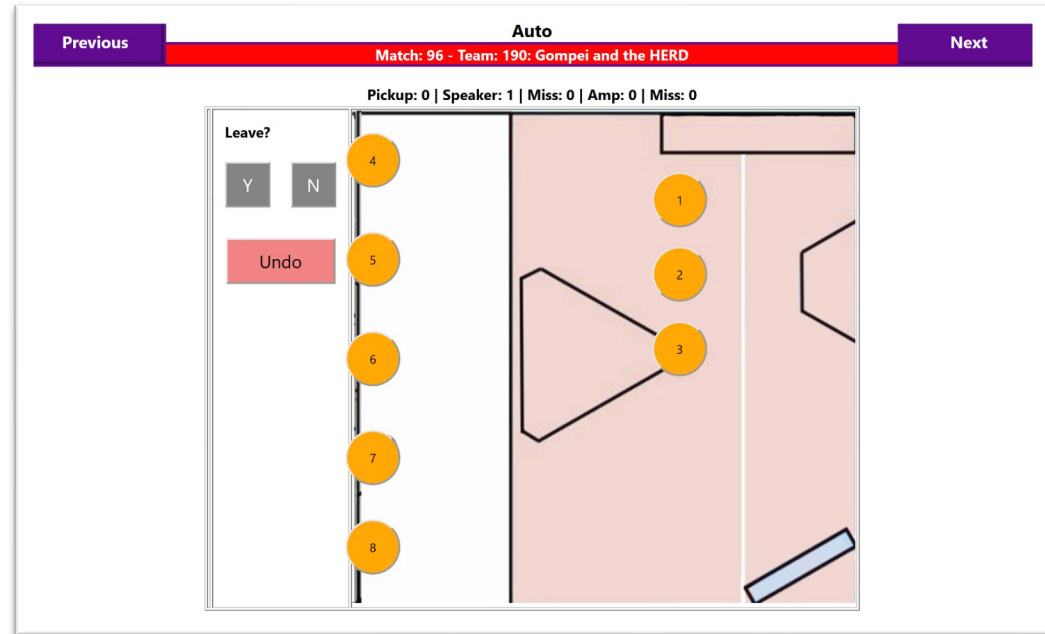
Level 1

Level 2

Pit Scouting

Comments

Admin



Web Data Entry

Level 1

Level 2

Pit Scouting

Comments

Admin

Previous Tele Next

Match: 96 - Team: 190: Gompei and the HERD

Pickup: 0 | Drop: 0 | Speaker: 0 | Miss: 0 | Amp: 0 | Miss: 0 | Trap: 0 | Miss: 0 | Shuttle: 0 | S-Shuttle: 0

Pickup

Source

Center

Wing

Undo

Web Data Entry

Level 1

Level 2

Pit Scouting

Comments

Admin

Previous

End Game

Match: 96 - Team: 190: Gompei and the HERD
Next

<p>Climb Time</p> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-bottom: 5px;">20</div> <table style="width: 100%; text-align: center; border-collapse: collapse;"> <tr> <td style="width: 33%; padding: 5px;">7</td> <td style="width: 33%; padding: 5px;">8</td> <td style="width: 33%; padding: 5px;">9</td> </tr> <tr> <td style="padding: 5px;">4</td> <td style="padding: 5px;">5</td> <td style="padding: 5px;">6</td> </tr> <tr> <td style="padding: 5px;">1</td> <td style="padding: 5px;">2</td> <td style="padding: 5px;">3</td> </tr> <tr> <td style="padding: 5px;"></td> <td style="padding: 5px;">0</td> <td style="padding: 5px; background-color: red; color: white;"><</td> </tr> <tr> <td colspan="3" style="padding: 5px; text-align: center;">N/A</td> </tr> </table>	7	8	9	4	5	6	1	2	3		0	<	N/A			<p>Climb Status</p> <div style="margin-bottom: 5px;">Spotlight</div> <div style="margin-bottom: 5px;">Successful</div> <div style="margin-bottom: 5px;">Failed, but Parked</div> <div style="margin-bottom: 5px;">Failed</div> <div style="margin-bottom: 5px;">Parked</div> <div>No Attempt</div>	<p>Trap During End Game?</p> <div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> Yes No Miss </div> <p>Harmonies?</p> <div style="display: flex; justify-content: space-around; margin-bottom: 5px;"> 0 1 2 </div>
7	8	9															
4	5	6															
1	2	3															
	0	<															
N/A																	

Web Data Entry

Level 1

Level 2

Pit Scouting

Comments

Admin

- Qualitative Data
- Data entered in phone/laptops connected to AWS
- Teams assigned to scouter in database and highlighted in schedule
- Match Comments, Ranking, and Summary sections

Web Data Entry

Level 1

Level 2

Pit Scouting

Comments

Admin

Level 2 Scouting

Scouter Name: Jonathan Pillsbury ▾

Summary

All ▾ Next Score On

#	Time	Red Alliance			Blue Alliance		
1		1100	509	839	8410	7913	2
2		173	2713	1350	558	8709	4
3		2067	4473	88	1768	2423	2
4		190	238	8544	1699	5422	1
5		2648	3464	467	9729	1474	1
6		4909	5112	4905	5687	177	6
7		9710	4311	2877	8013	1922	1
8		8085	1119	230	6346	138	1
9		4176	2168	2079	8410	88	1
10		558	2423	509	2648	1100	5
11		1350	6328	9729	8544	3464	7913
12		1757	4905	1699	4909	2713	467
13		2877	8709	8085	238	4473	195
14		8013	9710	2067	1119	138	5112
15		1474	1922	177	1991	230	173
16		839	5687	4311	6346	1768	190

Robot Ranking

Team Name	Rank
176	▾
177	▾
195	▾
1699	▾
1768	▾
2713	▾
5687	▾
6328	▾

Web Data Entry

Level 1

Level 2

Pit Scouting

Comments

Admin

- Robot Specification Data
- Data entered in phone connected to AWS
- Physical Characteristics, Components, Mechanical/Electrical Eval, Robot Photo upload sections

Web Data Entry

Level 1

Level 2

Pit Scouting

Comments

Admin

Pit Scouting
177 - Bobcat Robotics

Dimensions

Length in

Width in

Height in

Weight lbs

Pit Scouting
195 - CyberKnights

General Info

Drive Base:

Drive Motor:

Build Type:

Shooter Types:

Ground Intakes:

Slider Intake? Y N

Climb Brake Mode? Y N

Pit Scouting
195 - CyberKnights

Rating

Build Quality

Build Comments

Electrical Quality

Electrical Comments

Web Data Entry

Level 1

Level 2

Pit Scouting

Comments

Admin

- Crowd Sourced Comments
- Comments entered on phone by students/mentors/parents
- Can enter new comment or respond to, like, or dislike on existing comment
- “If you see something, post something!”

Web Data Entry

Level 1

Level 2

Pit Scouting

Comments

Admin

Add Comment for Team:

2713 - Played impressive defense and really kept us from lob shooting in match 66 - Ellen Serenson

Respond 1 1

8709 - Watch opponents source when playing against 8709. They like to intake directly from source, but sometimes miss, leaving notes behind. - John Hryb

Respond 2 0

Add Comment for Team:

Web Data Entry

Level 1

Level 2

Pit Scouting

Comments

Admin

- Sets Alliance Station for Tablet
- Allows user to clear stored records
- Can be used to resend or delete a specific saved record for Level1, Level 2, and Pit Scouting

Web Data Entry – Benefits

- Web Applications easy to deploy changes
- Angular framework allows multiple students to work on application concurrently
- Data backed up on tablets/phones
- Dynamic Content controlled from database
- Access controlled through secure log in
- Can be used to back-scout a future event

Flask API

- Python and SQL
- Hosted on AWS and Jetson using uWSGI and Nginx
- Provides data in json format

Flask API - Benefits

- Provides a single interface for both Web Sites
- Establishes a connection with the database to run embedded SQL statements
- Allows for upload of images to server
- Web Sites can run entirely in browser
- Code is easily maintained

Web Analysis

- Angular Framework interfacing with Flask API
- Plotly used for web graphics
- Hosted on AWS and Jetson
- Data stored in browser Local Storage
- Site Includes:
 - Schedule
 - Robot Snapshot
 - Match Report
 - Team Picker

Web Analysis – Schedule

Partners

#	Time	Red Alliance			Blue Alliance		
1	1100	509	839	8410	7913	2079	
2	173	2713	1350	558	8709	4176	
3	2067	4473	88	1768	2423	2168	
4	190	238	8544	1699	5422	176	
5	2648	3464	467	9729	1474	195	
6	4909	5112	4905	5687	177	6328	
7	9710	4311	2877	8013	1922	1757	
8	8085	1119	230	6346	138	1991	
9	4176	2168	2079	8410	88	176	
10	558	2423	509	2648	1100	5422	
11	1350	6328	9729	8544	3464	7913	
12	1757	4905	1699	4909	2713	467	
13	2877	8709	8085	238	4473	195	
14	8013	9710	2067	1119	138	5112	
15	1474	1922	177	1991	230	173	
16	839	5687	4311	6346	1768	190	
17	6328	5422	2713	88	1350	2648	
18	8085	4473	3464	176	4905	509	
19	138	9729	558	1757	2168	1119	
20	173	238	8410	9710	1699	230	
21	5687	8013	195	1991	4311	5112	
22	839	190	177	1100	8544	2877	
23	1768	2079	4909	7913	2067	4176	
24	2423	1922	8709	1474	6346	467	
25	88	6328	238	4473	138	1757	
26	4311	230	8013	176	3464	5687	
27	1100	8410	2168	5112	2648	2713	

Watch List

#	Time	Red Alliance			Blue Alliance		
1	1100	509	839	8410	7913	2079	
2	173	2713	1350	558	8709	4176	
3	2067	4473	88	1768	2423	2168	
4	190	238	8544	1699	5422	176	
5	2648	3464	467	9729	1474	195	
6	4909	5112	4905	5687	177	6328	
7	9710	4311	2877	8013	1922	1757	
8	8085	1119	230	6346	138	1991	
9	4176	2168	2079	8410	88	176	
10	558	2423	509	2648	1100	5422	
11	1350	6328	9729	8544	3464	7913	
12	1757	4905	1699	4909	2713	467	
13	2877	8709	8085	238	4473	195	
14	8013	9710	2067	1119	138	5112	
15	1474	1922	177	1991	230	173	
16	839	5687	4311	6346	1768	190	
17	6328	5422	2713	88	1350	2648	
18	8085	4473	3464	176	4905	509	
19	138	9729	558	1757	2168	1119	
20	173	238	8410	9710	1699	230	
21	5687	8013	195	1991	4311	5112	

Team Schedule

#	Time	Red Alliance			Blue Alliance		
5	2648	3464	467	9729	1474	195	
13	2877	8709	8085	238	4473	195	
21	5687	8013	195	1991	4311	5112	
28	195	509	8544	4905	4176	1350	
39	177	176	4909	558	195	2067	
45	138	2877	5687	195	2713	2423	
56	195	2168	467	509	9710	1768	
61	4176	195	9710	5422	6346	839	
66	2713	2079	558	195	8085	839	
75	176	195	6328	173	509	1757	
87	230	9729	5422	2079	5112	195	
96	6346	8410	3464	3464	195	195	

Web Analysis – Robot Snapshot

B013 - Boston Lions (Boston, Massachusetts, USA)

Type	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	A	M	R
StartPos															
AutoScore	7	2	11	11	12	12	17	17	17	17	7	12	12.2	12.6	76
AutoSpkr	111	111	111	212	213	315	315	313	313	111	213		2.0	2.8	74
AutoAmp	0/0	0/0	0/0	1/1	0/0	0/0	0/0	0/0	0/0	0/0	0/0		0.1	0.8	30
AutoNotes	1	0											2.1	2.8	75

Type	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	A	M	R
TotalScore	34	29	35	29	27	28	37	33	30	29	34	35	32.8	30.5	90
TotalSpkr	518	414	515	415	414	414	414	517	515	414	415	518	4.6	4.5	75
TotalAmp	414	414	515	414	213	311	212	313	515	414	414	111	3.2	4.8	75
It-a-Trap	111	111	111	111	111	111	111	515	010	111	213	111	1.3	1.8	90
TotalNotes	111	111	111	111	111	111	111	111	111	111	111	111	10.1	10.0	90
TotalPkg	11111	111	11111	111	11111	11111	11111	11111	11111	11111	11111	11111	10.4	11.1	90
TotalShuffle	010	010	010	010	1100	010	010	1100	010	010	010	010	0.3	0.8	90
StagePla	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	90
ClimbTime	20	3	5	14	14	2	15	5	3	20	21	3	11.4	11.4	95
AutoSpkr%	100	0	100	100	100	87	100	100	100	100	100	87	86.2	100.0	50

Type	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	A	M	R
TotalScore	49	31	31	41	35	42	31	31	31	41	41	31	32.4	49.5	90
TotalSpkr	5	2	5	5	5	5	5	5	5	5	5	5	4.6	4.5	90
TotalAmp	4	4	4	4	4	4	4	4	4	4	4	4	3.3	4.8	90
TotalNotes	12	11	12	12	11	11	11	11	11	11	11	11	11.2	11.0	90

Type	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	A	M	R
SubStrike	N	N	N	N	N	N	N	N	N	N	N	N	0.0	0.0	
BreakDown	N	N	N	N	N	N	N	N	N	N	N	N	0.1	0.0	
UnderStage	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	1.0	1.0	
GrpPick	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	1.0	1.0	
LevelOffTop	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	0.9	1.0	
ShutNote	N	N	N	N	N	N	N	N	N	N	N	N	0.1	0.0	
PlayDef	N	N	N	N	N	N	N	N	N	N	N	N	0.0	0.0	
WinDef	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	0.2	0.0	

Type	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	A	M	R
valSummary	3.5	2	3.7	3.4	3.4	3.3	3.3	3.3	3.2	3.1	3.1	3.9	3.8	3.8	76
SpeedEval	3	3	4	3	3	3	3	3	3	3	3	3	3.1	4.0	
ManufEval	3	3	3	3	3	3	3	3	3	3	3	3	3.8	4.0	
IntakeEval	3	3	3	3	3	3	3	3	3	3	3	3	3.6	4.0	
OpenerEval	3	3	3	3	3	3	3	3	3	3	3	3	3.2	3.0	
AmpEval	3	3	3	3	3	3	3	3	3	3	3	3	3.4	3.0	
InfusedEval	5	5	5	4	4	5	3	5	5	5	4	5	4.4	5.0	
ClimbEval	4	4	4	4	4	5	3	5	4	4	3	5	4.2	4.0	

Picture

25 in. x 25 in. x 18

Graphic Pit Data Graphs Level 1 Level 2 Comm A.Path

FIRST.IN SHOW. PRESENTED BY Qualcomm

Web Analysis – Robot Snapshot

Graphic Pit Data Graphs Level 1 Level 2 Comm A.Paths

Scouting Status **Complete**

Scouted by: Aidan

Type of Drive: Swerve

Type of Motors: Kraken X50

Type of Build: Custom Build

Type of Shooter: 1W Two Sides

Build Quality: 5

Electrical Quality: 4

Robot Durability:

Length: 25 in.

Width: 25 in.

Height: 18 in.

Weight: 110 lbs.

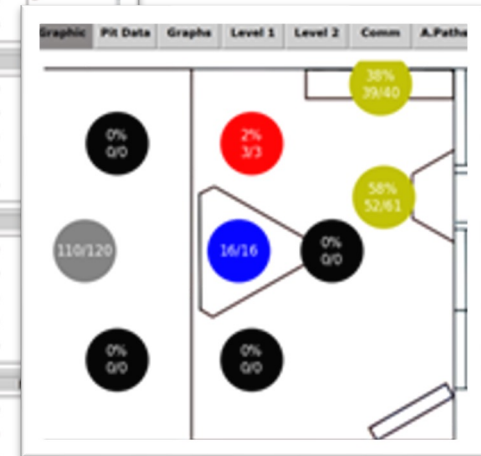
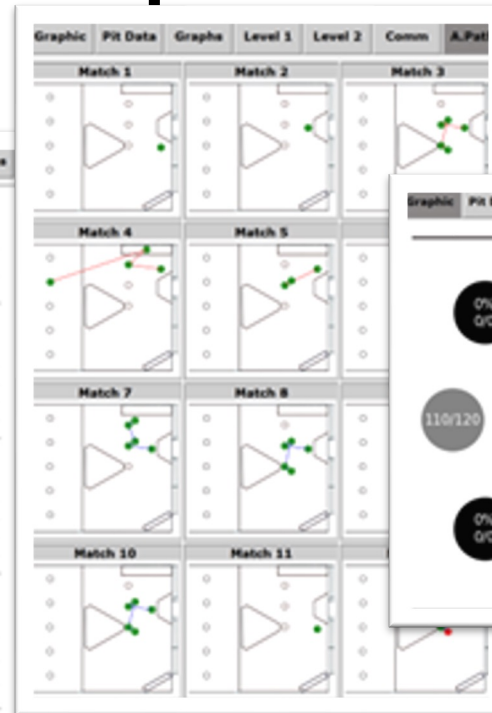
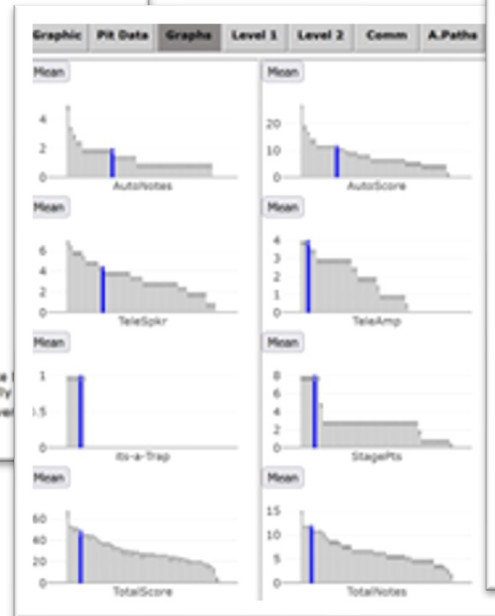
Brake Mode:

Ground Intake: Over Bumper

Slider Intake: 1

Build Comments: Looks really really good. Has oib intake and the drive base is put together really

Electrical Comments: Can't tell if they have rainbows, but even if it's tied down



Web Analysis – Team Picker

The screenshot displays a 'Team Picker' web application interface. On the left, there is a 'Team Selection' panel with a list of 24 teams, each with a 'Final' and 'Pick' column. The main area contains two data tables: 'TotalScore ()' and 'TotalNotes ()'. Each table has columns for quarters (Q1-Q6), a 'Dns' column, and a 'Total' column. The data is color-coded, with green indicating positive performance and red indicating negative performance. A 'Team Sort' menu is visible on the left, and a 'Comp Dns' button is at the bottom left.

Team	Q1	Q2	Q3	Q4	Q5	Q6	Dns	Total
5328	15	17	15	14	14	15		102
1768	18	14	17	17	17	17		106
4809	16	15	15	14	15	15		100
1923	13	15	15	14	15	15		102
1099	18	18	15	14	15	15		105
176	17	15	15	14	15	15		100
1377	16	15	15	14	15	15		100
2067	19	17	16	16	16	16		111
1699	14	14	15	14	15	15		103
5687	19	15	15	14	15	15		103
8085	15	14	15	14	15	15		104
2079	15	15	15	14	15	15		104
2168	18	16	16	16	16	16		108
2713	24	19	18	18	18	18		121
236	25	18	18	18	18	18		125
195	26	20	18	18	18	18		128
88	13	17	17	16	16	16		102
467	19	18	15	14	14	14		104
190	14	12	11	11	11	11		82
558	12	16	11	11	11	11		82
2648	8	10	10	10	10	10		68
1119	28	20	18	18	18	18		130
8709	30	25	20	20	20	20		145
1130	36	27	20	20	20	20		163
5422	28	16	16	16	16	16		128
1390	16	16	16	16	16	16		104
538	15	14	14	14	14	14		100
8544	18	18	15	15	15	15		108
2877	16	16	14	14	14	14		102
4473	27	24	20	20	20	20		141
4905	22	14	14	14	14	14		110
6344	24	10	10	10	10	10		94
173	30	28	18	18	18	18		132
4311	17	13	13	13	13	13		86
839	23	16	16	16	16	16		113
4174	35	26	18	18	18	18		153
509	36	27	18	18	18	18		159
2423	24	16	16	16	16	16		112
3464	27	11	11	11	11	11		103
1474	21	9	9	9	9	9		78

Web Analysis – Benefits

- Visualizations that are easy to read and evaluate
- Valuable tool when working with alliance partners
- Easy to navigate between pages
- Supports viewing of prior events (including back-scouted events)
- **Schedule** guides scouters on the teams to watch during an event
- **Robot Snapshot** displays a clear view of a robots capabilities
- **Match Report** provides insight on alliances strengths and weaknesses
- **Team Picker** ensures we have all the data we need to build an alliance

Take Aways

- You don't need a complex system like ours to do what we do
- Any technology you use is an opportunity to teach students
- Use what you can from Available API (ex: Blue Alliance / Statbotics.io / Google Docs)
- Create match records ahead of time to limit data entry errors
- Analyze your data and display in easy to read graphics
- Use your data for More than Alliance Selection! (Match Reports, Robot Snapshot) Dynamic Content controlled from database.

Code



<https://gitlab.team195.com/cyberknights/scouting>