

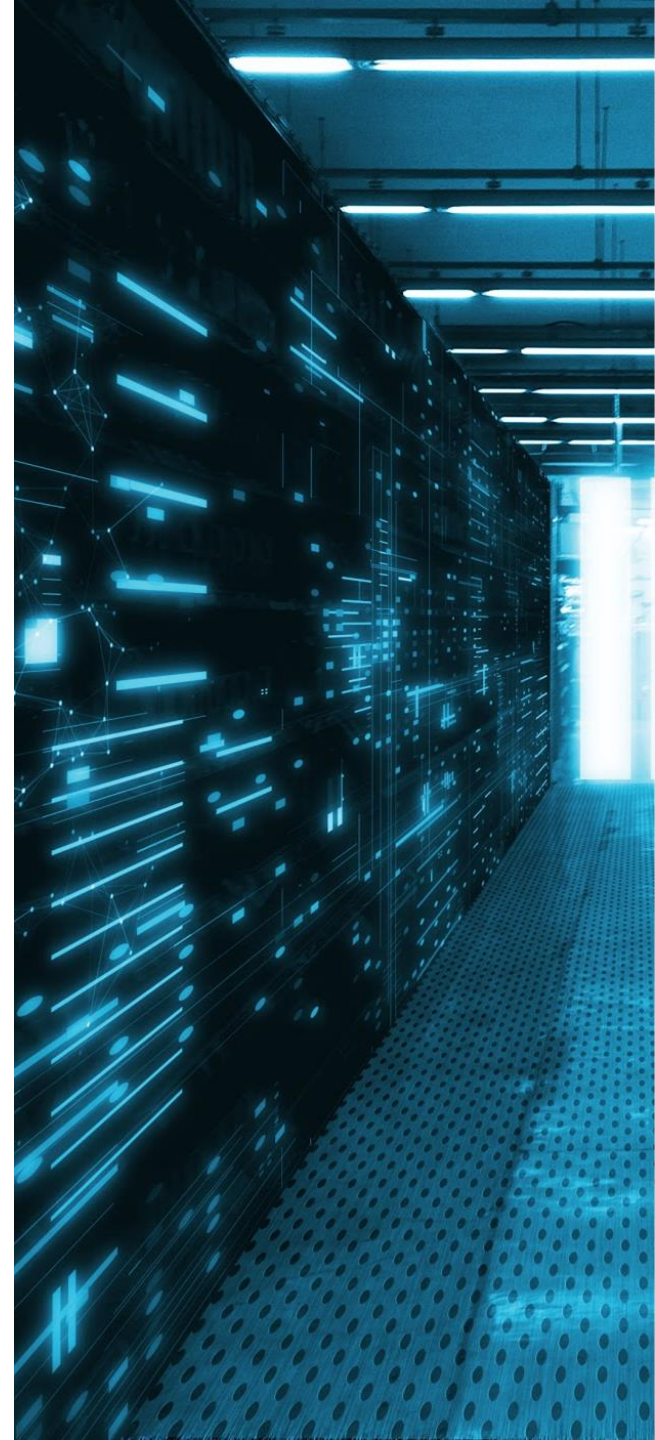


IEEE BigData 2021 Cup: Predicting Victories in Video Games

Andrzej Janusz, Maciej Świechowski, Rafał Tyl

AGENDA

- Tactical Troops: Anthracite Shift
 - The game
 - Tactical Troops Analytics portal
 - The Fogs of War project
- The new challenge at KnowledgePit.ml
 - The scope and research aims
 - What have we learned so far?
 - Our plans for the following months



Tactical Troops: Anthracite Shift



Tactical Troops: Anthracite Shift - general information



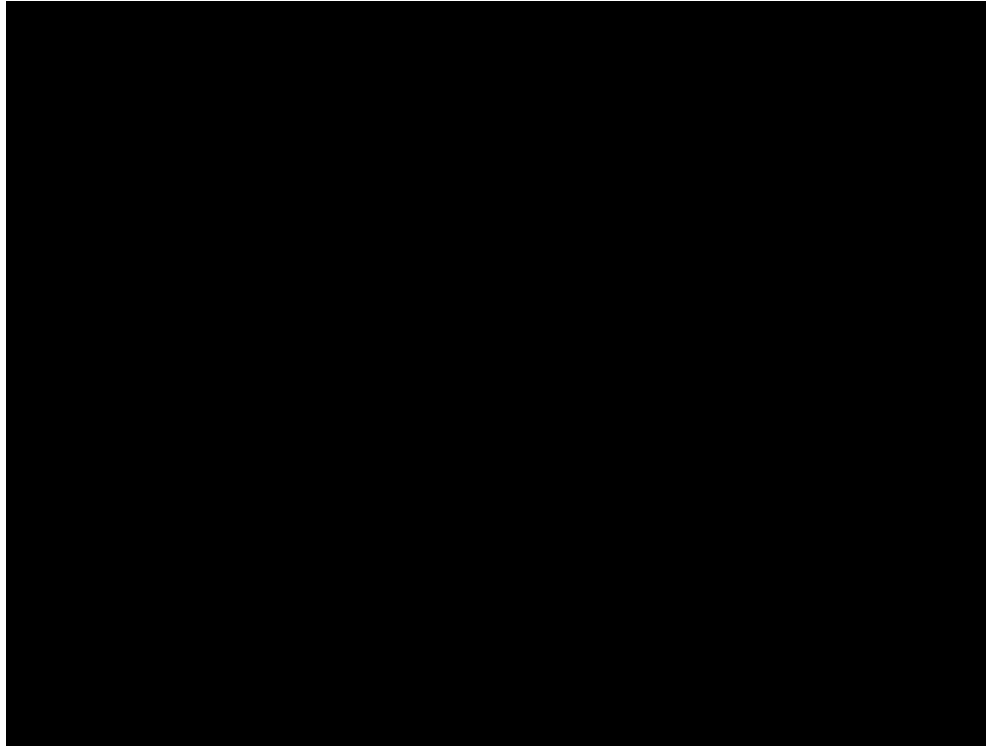
1. Features:

- a. Turn-based, tactical game
- b. Gridless, physics-based gameplay
- c. Teleportation
- d. Singleplayer, 30 hours of gameplay
- e. Multiplayer, 24 different maps
- f. Rich selection of tools of destruction: 34 weapons, 7 gadget types
- g. Advanced, diverse opponent AI

1. Official website: <https://tacticaltroops.net/>
2. Twitter QED Games Team: <https://twitter.com/QEDGamesTeam>
3. Steam: https://store.steampowered.com/app/1266890/Tactical_Troops_Anthracite_Shift/
4. Youtube - Devastator mode explained: <https://www.youtube.com/watch?v=r7CIG9sVLgo>
5. Youtube - Domination mode explained: https://www.youtube.com/watch?v=WY6_nnG3Dug



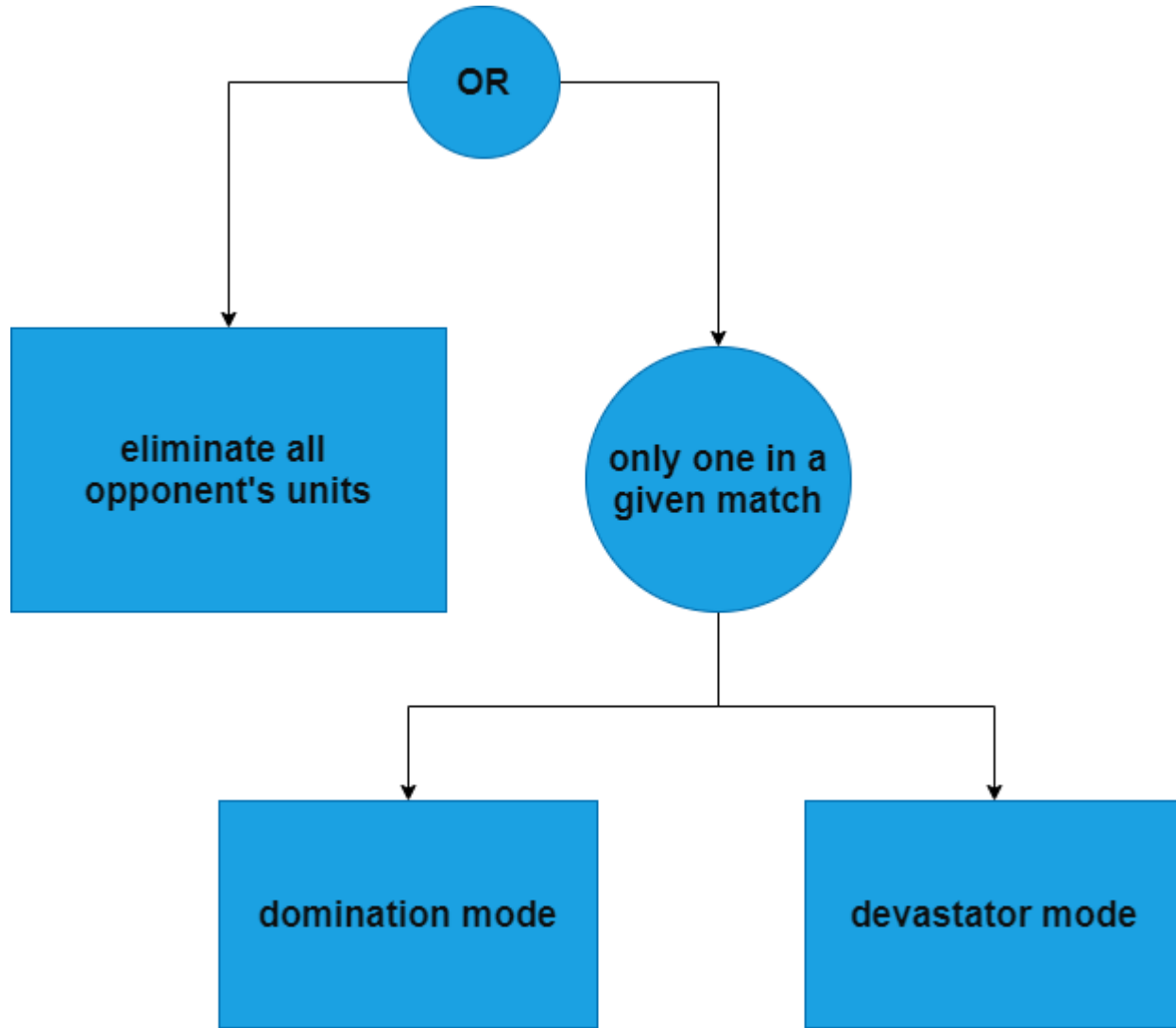
Gridless, physics-based gameplay with destructible environment



- Turn-based
- Movement, combat and all environment interactions are based on 2D physics
- Many obstacles can be pushed around and serve many different purposes, like building temporary covers



The goal of the game (multi-player)



Domination game mode



In this game mode, the goal is to secure two out of three control points and hold them for two full rounds



Devastator game mode



In this game mode, the goal is to destroy all generators belonging to your enemy



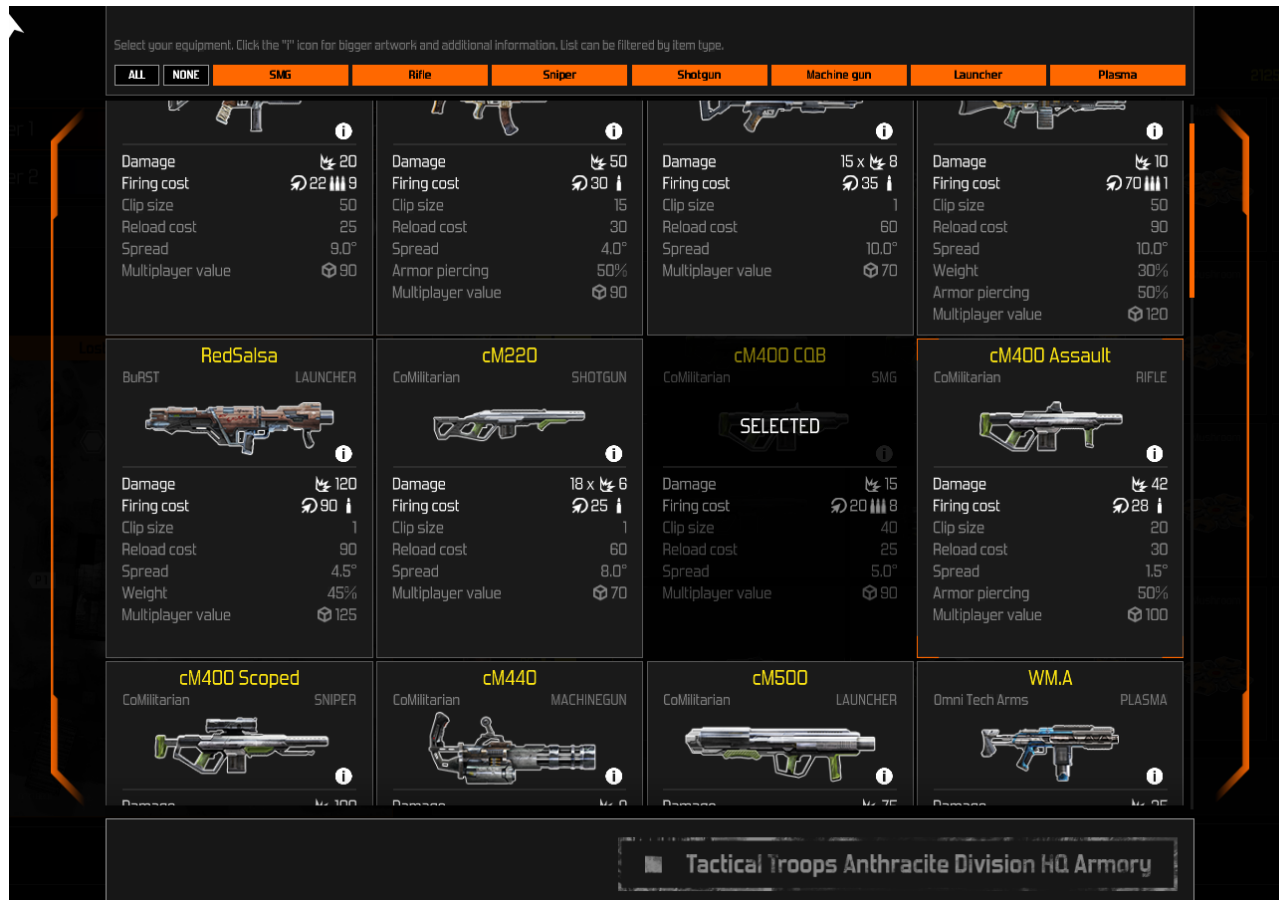
Teleportation



- Units, grenades, bullets and crates can be teleported
- There's a special weapon class (plasma weapons) that bypasses the teleportation mechanic
- Teleportation makes map navigation and target selection much more complicated



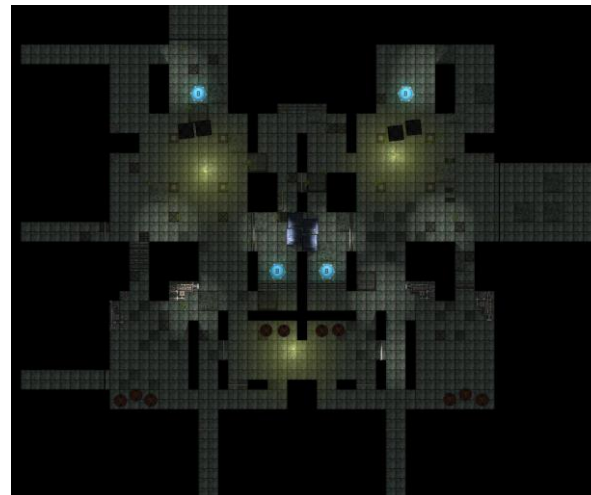
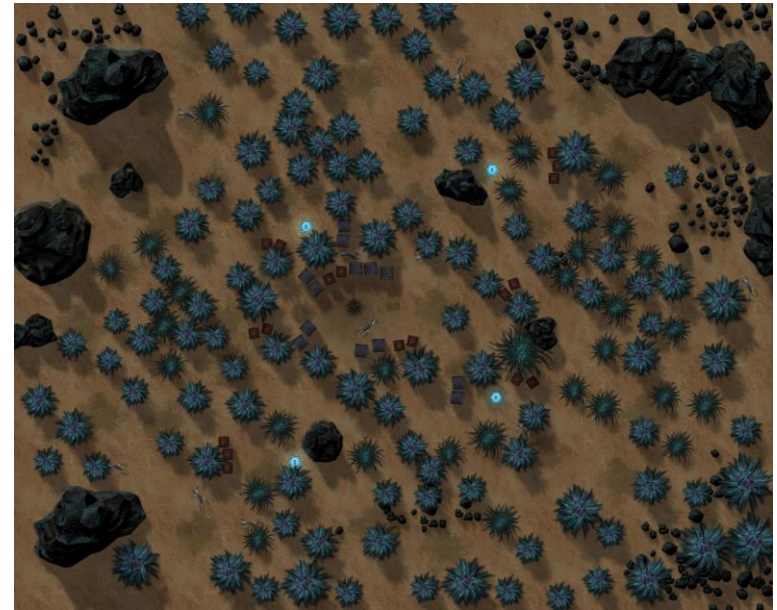
Rich equipment selection



- Weapon types: SMG, machine guns, rifles, plasma rifles, sniper rifles, rocket launchers
- Gadget types: grenades, shields, mortars, stimulants, mines



Many diverse map types



Bots in Tactical Troops

Strategy:

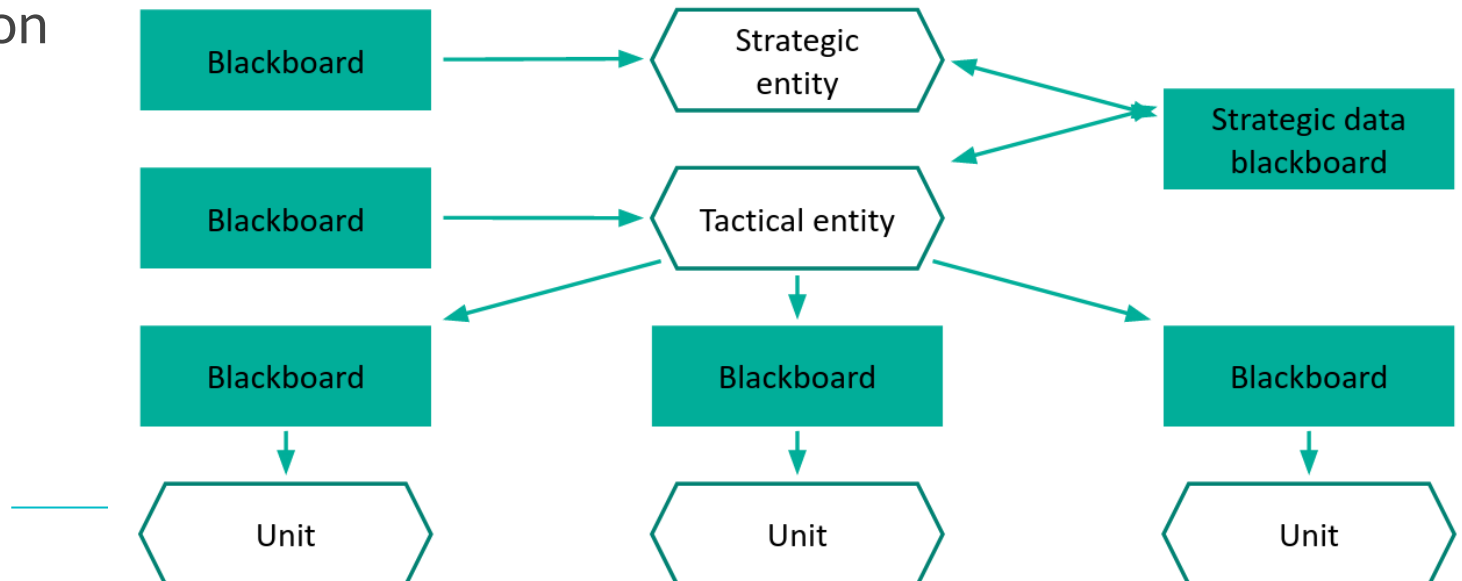
- balancing victory conditions
- general goals assignment to units
- forming “ad-hoc” attack squads

Heuristics:

- possible movement paths
- choosing the right weapon

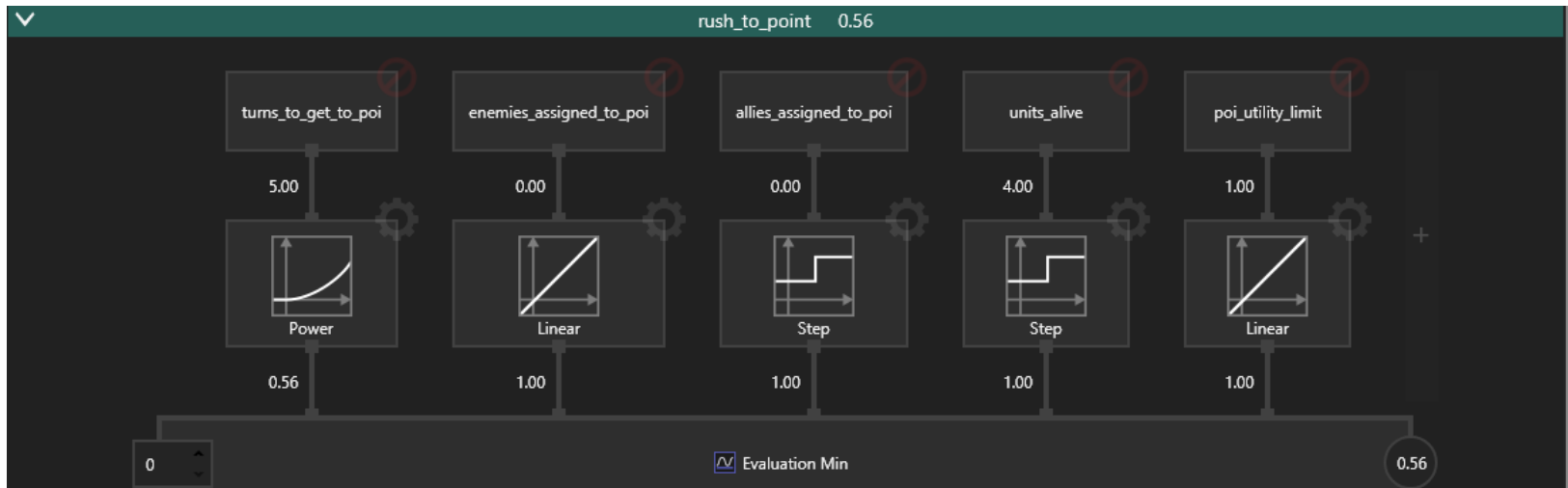
Tactics:

- choosing actions (*e.g. attack vs throw vs movement*)
- movement paths
- coordination

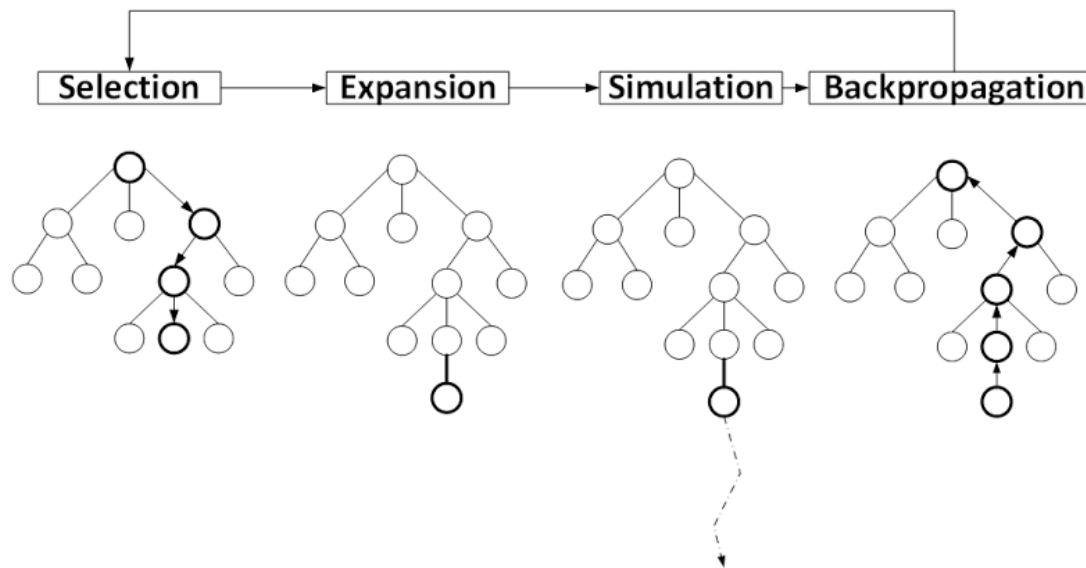


Bots in Tactical Troops

- Hierarchical combination of Utility AI and Monte Carlo Tree Search



Run continuously in the allotted time



Tactical Troops Analytics

DASHBOARD PLAYER GAME INFO ANALYSIS FORUM MAIN SITE LOG IN

MOST POPULAR MAP

Some Tapas Palmas
Map #23

44 024
Games played on

2	SeconTopMap	42 166
3	Anothermap	36 950
4	NotTheFirstmap	28 584
5	AndTheFifthMap	27 980

MOST POPULAR WEAPON

CoMilitarian cm400 Scope
Sniper

24 k
Used

2	SeconTopWeapon	24 101
3	AnotherWeapon	22 465
4	NotTheFirstWeapon	22 464
5	AndTheFifthWeapon	19 407

ANALYSE LATEST MATCH!

[GO TO ANALYSIS](#)

2	SeconMatch
3	AnotherWeapon
4	NotTheFirstWeapon
5	AndTheFifthWeapon

TOP PLAYERS

	Avatar	Name	Games played	Score
1		HotChocolate15	426	2401
2		Fiona234	450	2206
3		PCMRdude	369	2185

MOST POPULAR LOADOUTS

	Support	Assault	Heavy	Scout
	Weapons		Gadgets	
1				
	Ey-Key 47	B-Splitter	Thunder.A	Carmen.B

Users of Tactical Troops Analytics (TTA)

- Part of Sensei R&D project
- Analytics for games
- Tactical Troops is one of proof-of-concepts
- One of many facets of AI/ML in games



Players

To hone their skills



E-sport coaches

To train players and teams



Game developers

To acquire data on players

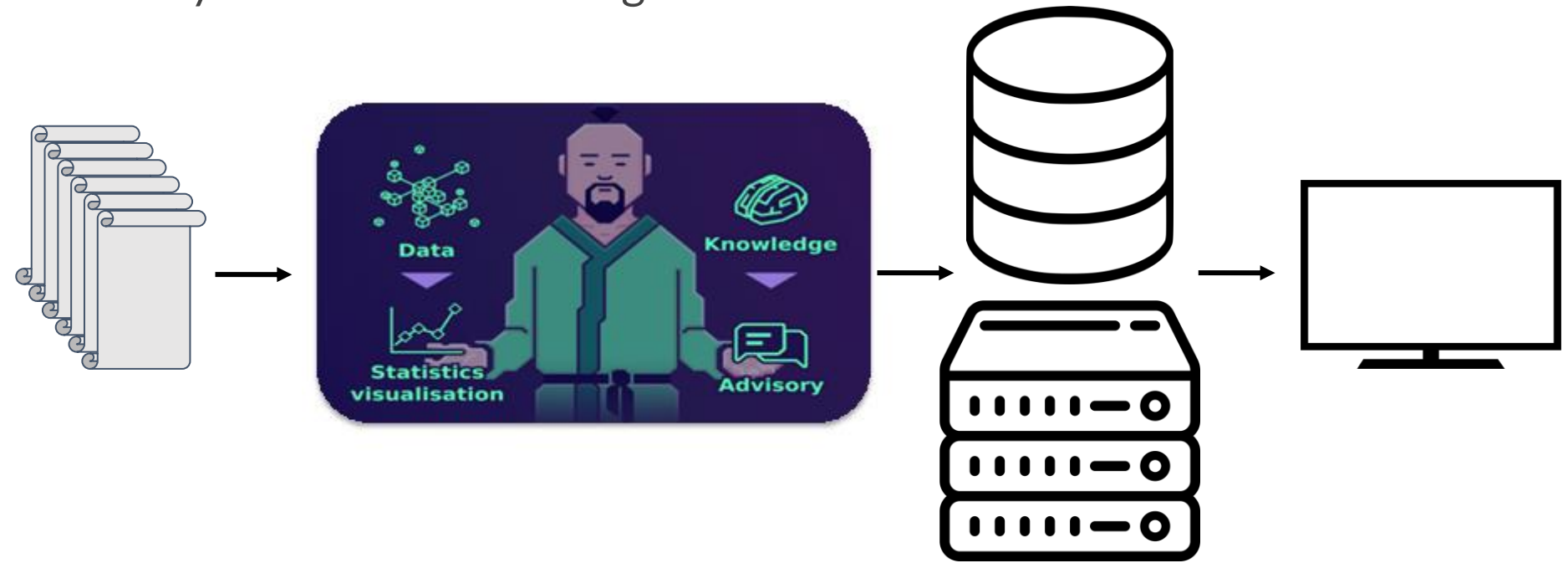
+ commentators

+ QA and testing



Logs as the main source of data

- Incremental logs directly from the game
- “Logs are the food”
- Analysis outside from the game



Feature example 1: win chances

Goal: predict chances for the win $\rightarrow [0,1]$ based on starting parameters

Method: neural networks, embeddings

The screenshot displays a game lobby interface titled "Analysis - Winrate". It features a "SELECT MAP" section with a grid of 24 map thumbnails labeled Map01 through Map24. Below the map selection, the interface shows player information for two players: "PLAYER 1" (Rafaka Zabijaka, 2 kills, 1065 score) and "PLAYER 2" (So Drama, 22 kills, 1000 score). The game mode is set to "Domination". The player classes are: Player 1 (Assault, Scout, Assault, Heavy) and Player 2 (Support, Scout, Assault, Heavy). At the bottom, a progress bar indicates a "63% chance of Player 1 to win".



Feature example 2: loadout recommender / completer

Goal: predict strong and fun loadout for the player (with constraints)

Method: XGBoost; a special way of training

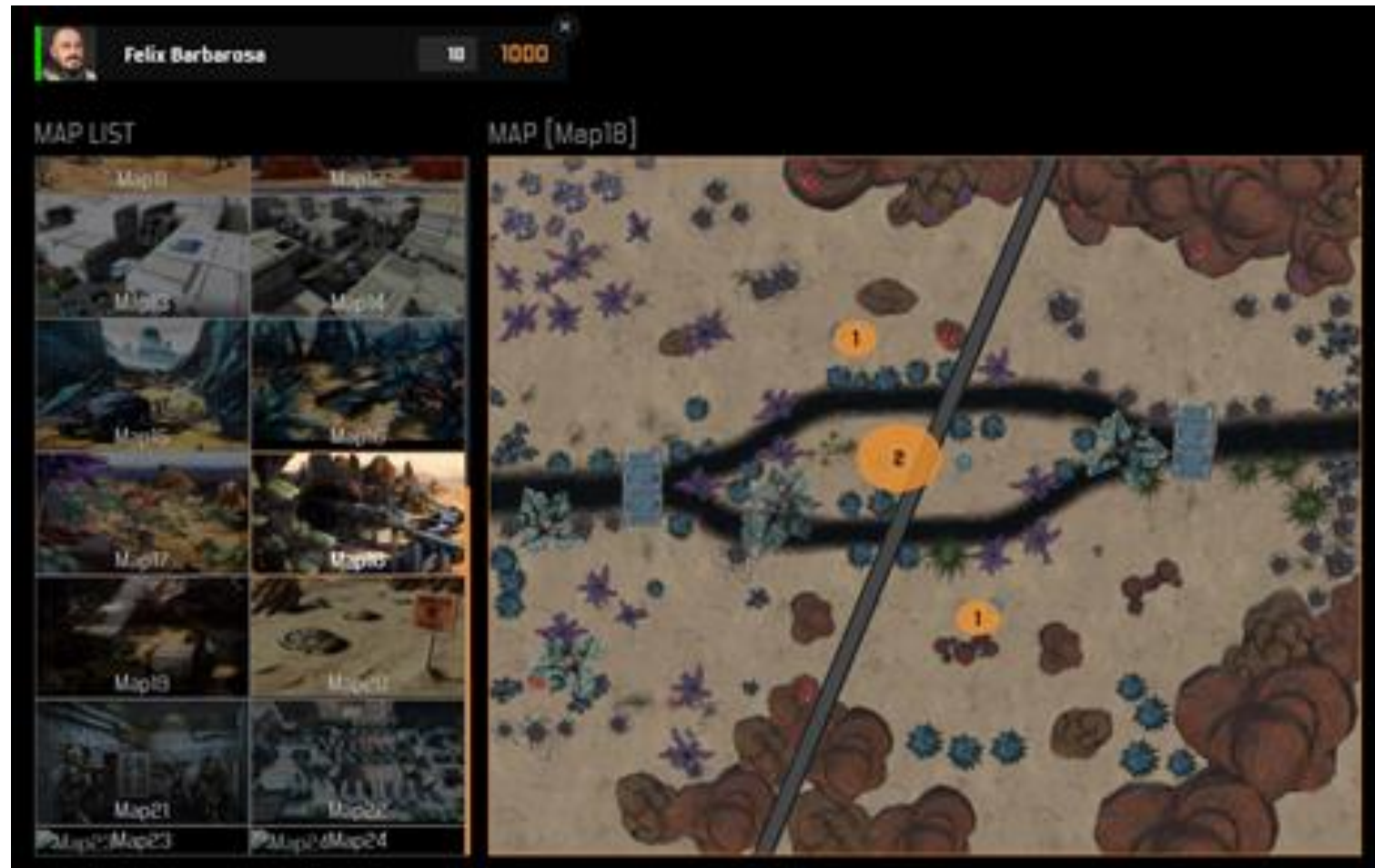
The screenshot displays a game's loadout recommender interface. At the top, a 'SELECT MAP' section shows a grid of 24 map thumbnails, labeled Map01 through Map24. Below this, the 'UNITS' and 'EQUIPMENT' sections are visible. The 'UNITS' section has three slots, each with a unit icon and a name: Scout, Heavy, and Support. The 'EQUIPMENT' section has a grid of slots, with the first slot containing a 'cM100 Assault' weapon. To the right of the equipment grid are two columns of buttons: 'Recommend Next' and 'Recommend All'. At the bottom left, there are two large buttons: 'Recommend Next' and 'Recommend All'.



Feature example 3: formations analysis

Goal: observe how players group their units; which go together; centers

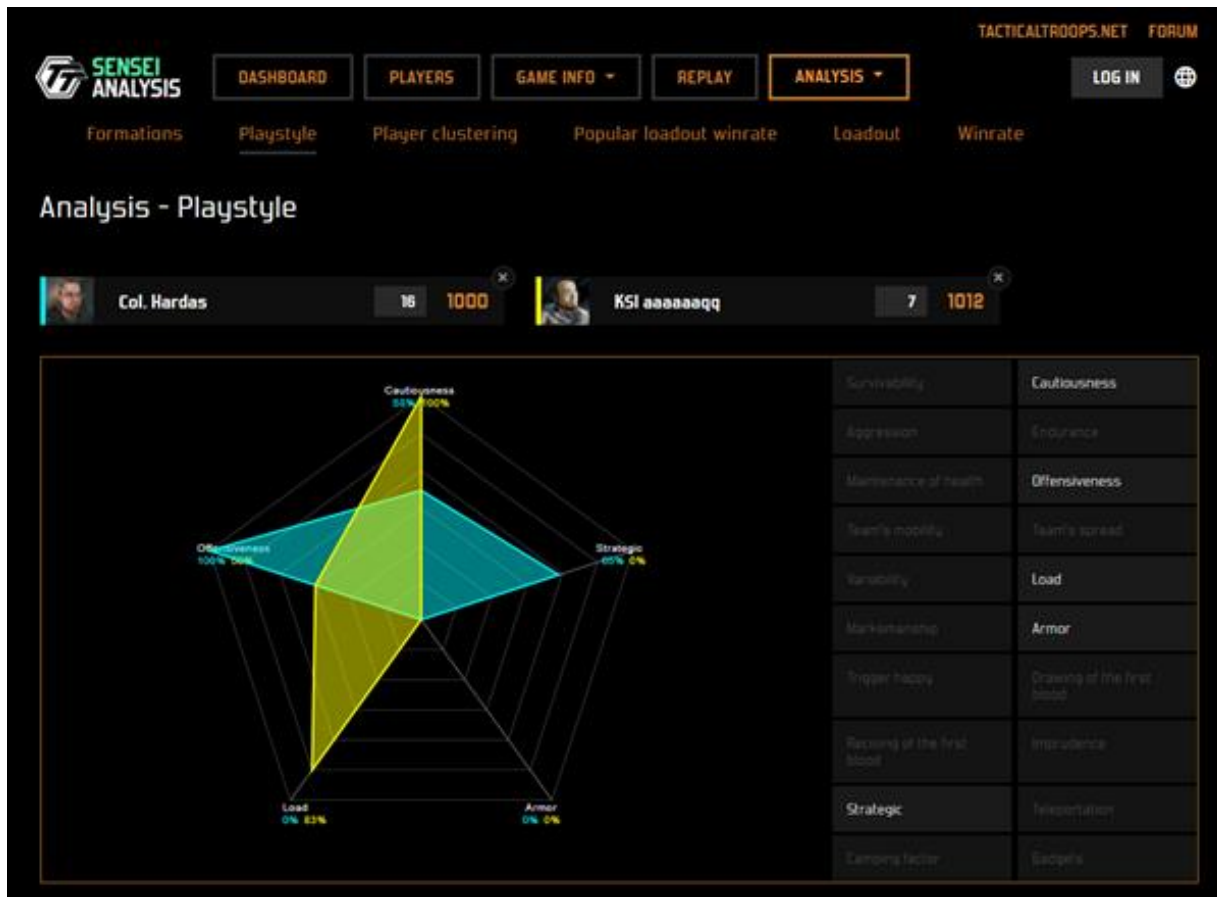
Method: DBSCAN + cluster analysis + heuristics



Feature example 4: playstyle & players clustering

Goal: individual player characteristic, comparing players

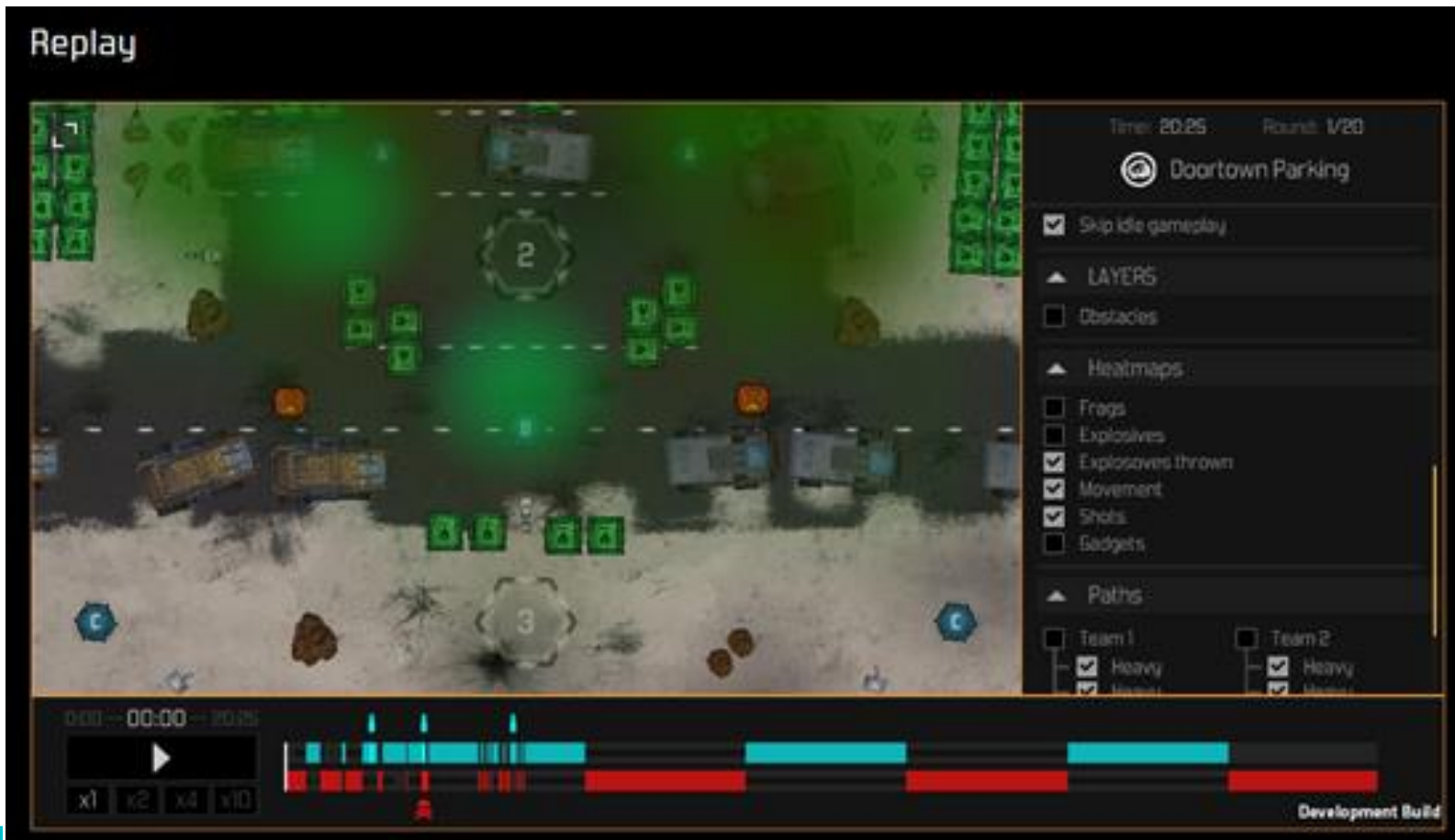
Method: mRMR, feature selection, smooth normalization, GUI widgets



Feature example 5: heatmaps

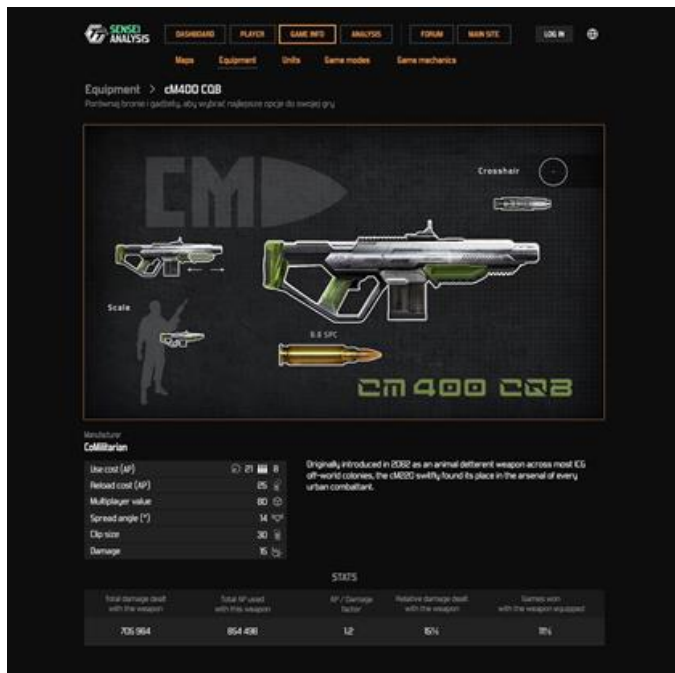
Goal: show “where” and “how much” something happens on a map

Method: heatmaps



Feature example 6: direct statistics

- Player efficiency & ranking
- Weapon efficiency
- Popular choices
- Basic game information



Selected other aspects

- Data processing pipeline
- Motivation for players e.g. forum with gamification
- Motivation for data scientists
- Taxonomy of players
- Other games analyzed: Clash Royale



Fogs of War project summary

1. Part 1: game AI agents dealing with uncertainty and partial information
 - a. Deducing missing information from current beliefs of AI agents: logical and probabilistic reasoning
 - a. Making decisions based on incomplete or uncertain data: modified implementations of Utility AI, Monte Carlo Tree Search and other techniques
 - a. Cooperation and group belief formation
 - a. Explaining game AI behavior in a way understandable to humans (developers and players)
1. Part 2: Automated Turing test - an ML model for discerning human players from AI bots, based on game logs and additional data



THE NEW CHALLENGE AT



Our competitions related to video games (so far)

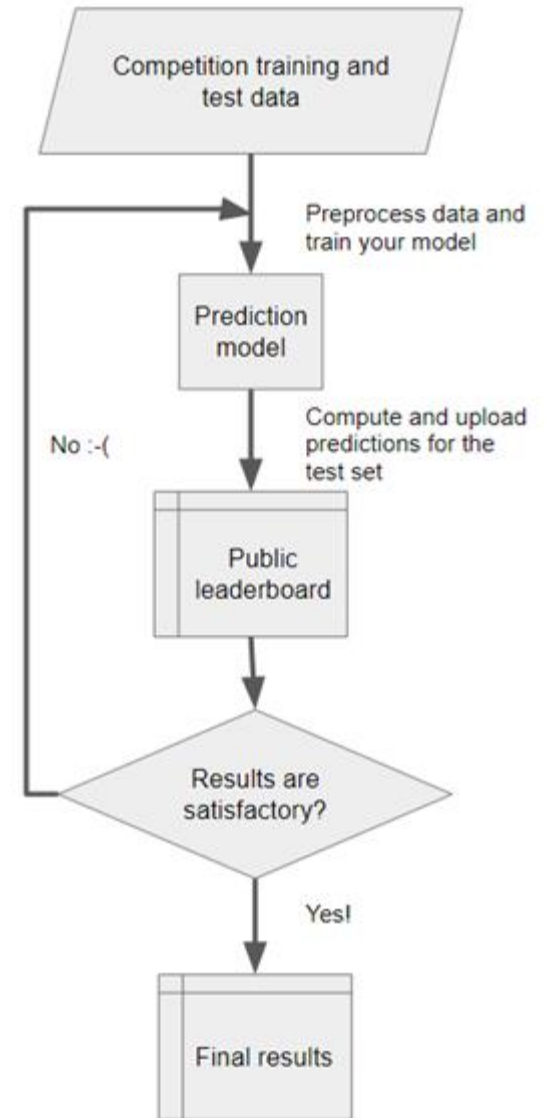
- [Clash Royale Challenge: How to Select Training Decks for Win-rate Prediction](#)
- [AAIA'18 Data Mining Challenge: Predicting Win-rates of Hearthstone Decks](#)
- [AAIA'17 Data Mining Challenge: Helping AI to Play Hearthstone](#)
- All of the above competitions were organized in association with the FedCSIS conference series.
- Data sets are available on request.



HOW DOES IT WORK?

A typical competition schema

1. The available data set is divided into the training and test parts.
2. Target values (e.g. labels) for the test set are hidden from participants – they have to be predicted.
3. Participants submit solutions which are assessed on a sample from the test set.
4. Participants select their most reliable models and write short reports.
5. The final solutions are evaluated on the remaining test data.



IEEE BigData 2021 Cup: Predicting Victories in Video Games



- Competition page: <https://knowledgepit.ml/predicting-victories-in-video-games/>
- April 30, 2021: start of the competition, datasets became available,
- August 31, 2021: deadline for submitting the solutions,
- September 5, 2021: reports due, end of the competition,
- Awards sponsored by QED Software:
 - 1750 USD cash prize pool for the top 3 teams
 - 3x costs of IEEE BigData 2021 registrations
 - publication opportunity for authors of interesting solutions



Multimodal data representations

The three main data representation types available for participants:

- Truncated game logs
- Flattened log format
- Tabular (aggregated) format

Additional data about units, gadgets, and maps is available as metadata in separate files.

The main challenge:

how to utilize multimodal data views to facilitate the prediction of winners at a given time point in a game?



Truncated logs

- Full game logs truncated at the decision time - allow to reproduce the course of the game.
- 7.5GB + 3.8GB of data.
- Separate JSON file for each game.
- Logs contain each taken action and unit status change.



Flattened logs

- Additional 1.5GB training + 0.8GB test data.
- JSON files whose names correspond to game ids
- Detailed description of the situation on a map (including positions of each troop, etc.).
- Detailed description of JSONs is available in competition files.



Tabular data

- 38,658 training games + 20,000 test instances.
- Id column allows joining data from other representations.
- A mixture of 197 numeric and symbolic features.
- Simple characteristics of each troop on the map.
- Additional information on units and weapons in meta-data files.

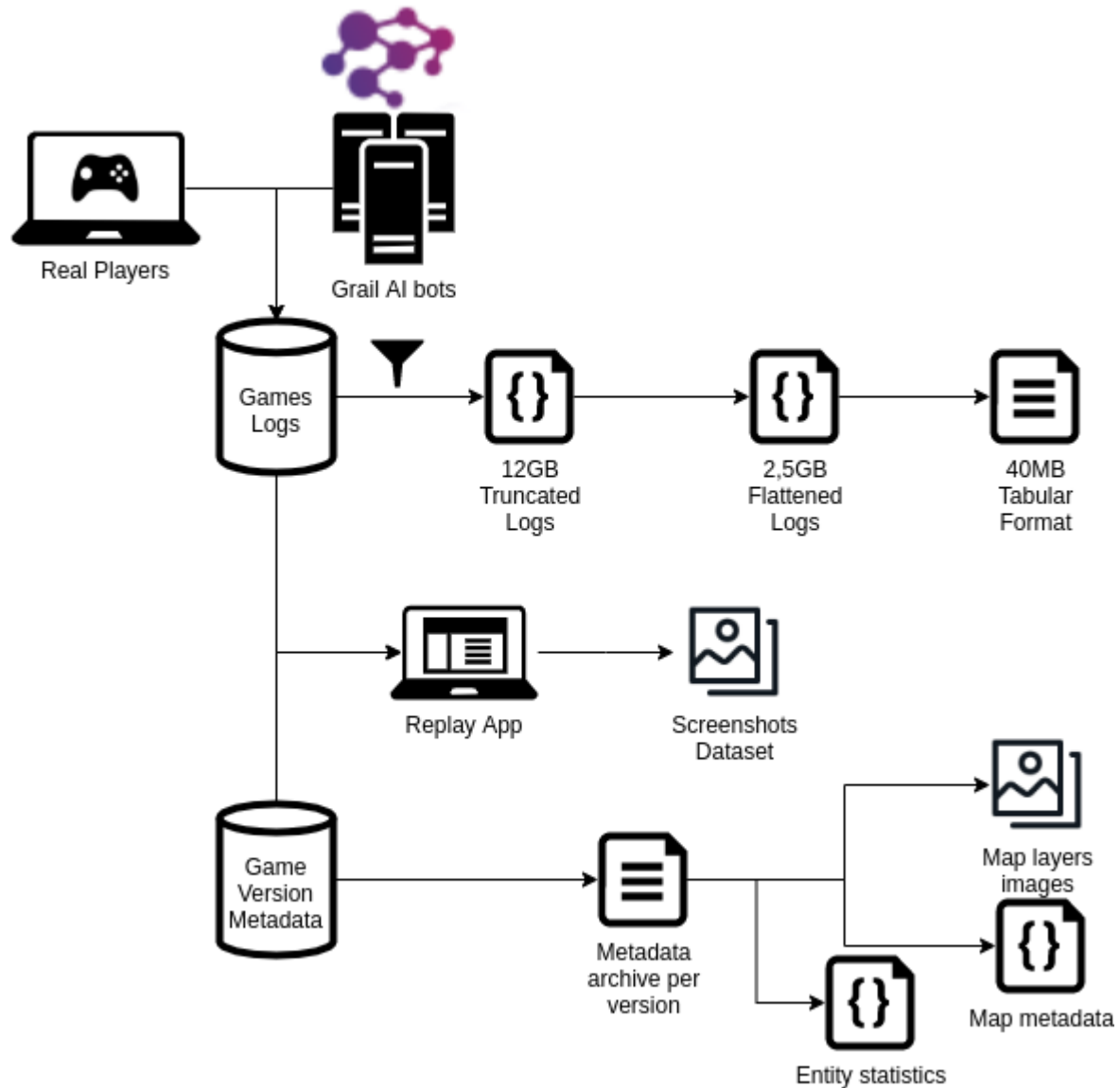
id	winner	version	map_name	mode	t	turn_no	to_move	teams.0.0.unit_type	teams.0.0.dead
<int>	<int>	<chr>	<chr>	<chr>	<dbl>	<int>	<int>	<chr>	<int>
10001	1	0.9.2	Map05	Devastator	213.65486	12	0	unt03	1
10002	1	0.9.2	Map15	Devastator	226.89012	13	1	unt03	0
10004	1	0.9.2	Map01	Devastator	218.87694	10	0	unt03	1
10008	1	0.10.1	Map13	Domination	146.65840	6	0	unt03	1
10009	1	0.10.1	Map16	Domination	164.80205	6	0	unt03	0
10012	1	0.9.2	Map16	Domination	150.92955	8	0	unt03	1
10013	0	0.9.2	Map19	Devastator	181.75165	9	1	unt01	0
10014	1	0.9.2	Map09	Devastator	386.31970	18	0	unt03	1
10015	1	0.10.1	Map14	Domination	144.48239	5	1	unt02	0
10017	0	0.10.1	Map12	Domination	240.43335	21	1	unt03	0

1-10 of 38,658 rows | 1-10 of 198 columns

Previous 2 3 4 5 6 ... 100 Next

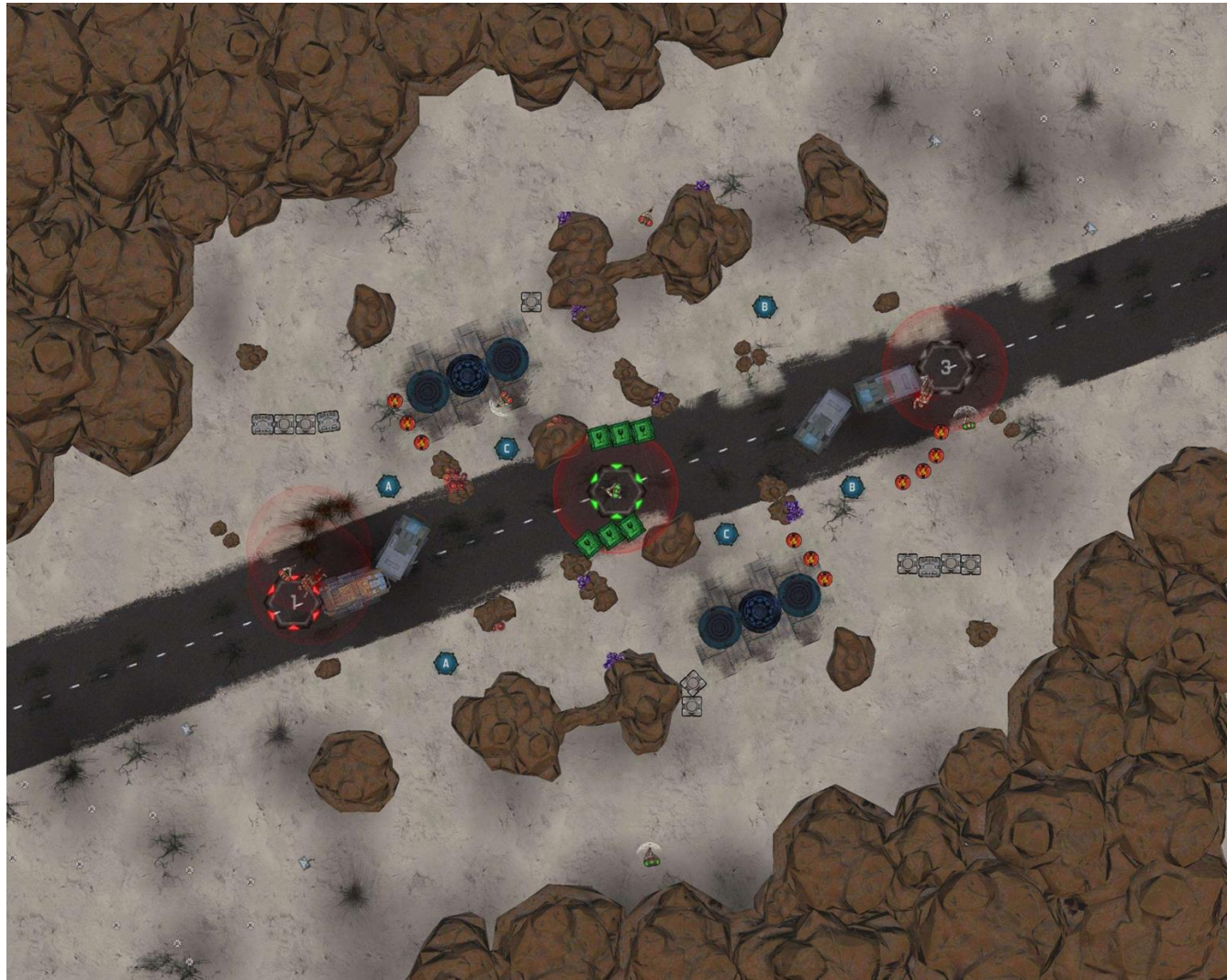


Data acquisition process



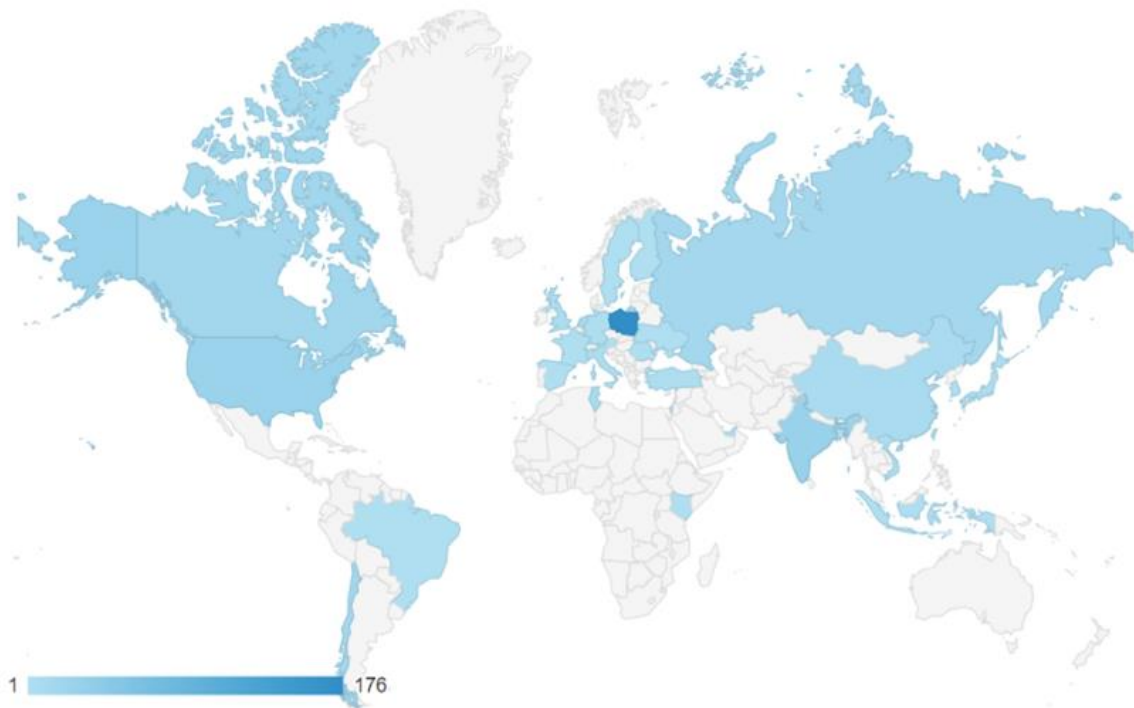
Auxiliary data representation

- We will release one more dataset - game screens
- Each screen will show the situation on a map at the prediction time
- We are considering adding additional screens from preceding game turns - is it worth it?
- planned release date: May 31



Participation so far...

- 61 registered teams
- enrolled participants from 15 countries
- 260 submitted solutions
- we expect those numbers to grow :-)
- currently, the best Leaderboard result is 0.8854 (AUC)



Country	Users	Users
	354 % of Total: 64.84% (546)	354 % of Total: 64.84% (546)
1. Poland	176	49.44%
2. India	28	7.87%
3. United States	26	7.30%
4. Canada	18	5.06%
5. Chile	15	4.21%
6. Russia	15	4.21%
7. China	9	2.53%
8. Tunisia	8	2.25%
9. United Arab Emirates	6	1.69%
10. Singapore	6	1.69%



Baseline model - XGBoost

- Uses only the tabular representation.
- Standardized and mean-filled numerical features.
- One-hots of categorical features with a few distinct values (<10 distinct categories)
- Ordinal-encodes the remaining symbolic features.
- XGBoost hyper-parameter search
- 0.8733 preliminary score
- Most important feature: HP (obviously)



Summary

- The main goal is to create efficient models for predicting game outcomes in Tactical Troops: Anthracite Shift
 - results can be deployed in the Tactical Troops Analytics portal empowered by the SENSEI system
 - trained models can be used to improve AI bots
- The big question is whether the multimodal representations of data can help in the construction of better models
- The competition is attracting attention from around the world but we still hope for more :-)







Thank you for your attention!

Andrzej Janusz

andrzej.janusz@qed.pl

Maciej Świechowski

maciej.swiechowski@qed.pl

Rafał Tyl

rafal.tyl@qed.pl

