2018 Starcraft AI Competition

Report and Results

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MEMORIAL
UNIVERSITY

BWAPI


BLIZZARD
ENTERTAINMENT


Facebook
AI Research


DeepMind

Tournament Results

www.StarcraftAICompetition.com

“Results / Files”

Tournament Format

- Full Game – Starcraft Broodwar
  - Fog of War Enabled
- Round Robin Format
  - 1v1 Games
  - Bots ranked by final win percentage

Game Rules

- 60 minute game time-limit
  - Tie break with in-game score
- No cheating or in-game glitches
  - Disqualified if cheating found
- Bots penalized for slow computations
  - Game loss if bot goes over computation limit
- File I/O - Learning

Why Not Starcraft 2?

Stacraft 2 EULA Violations:

- In whole or in part, copy or reproduce (except as provided herein),translate, reverse engineer, derive source code from, modify, disassemble, decompile, or create derivative works based on the Game;
- Use cheats, automation software (bots), hacks, or any other unauthorized third-party software designed to modify the Game experience, including without limitation, mods that violate the terms of this License Agreement or the Terms of Use;
- Use any unauthorized third-party software that intercepts, "mines", or otherwise collects information from or through the Game or the Service, including without limitation any software that reads areas of RAM used by the Game to store information; provided, however, that Blizzard may, at its sole and absolute discretion, allow the use of certain third party user interfaces;
- Modify or cause to be modified any files that are a part of the Game in any way not expressly authorized by Blizzard;

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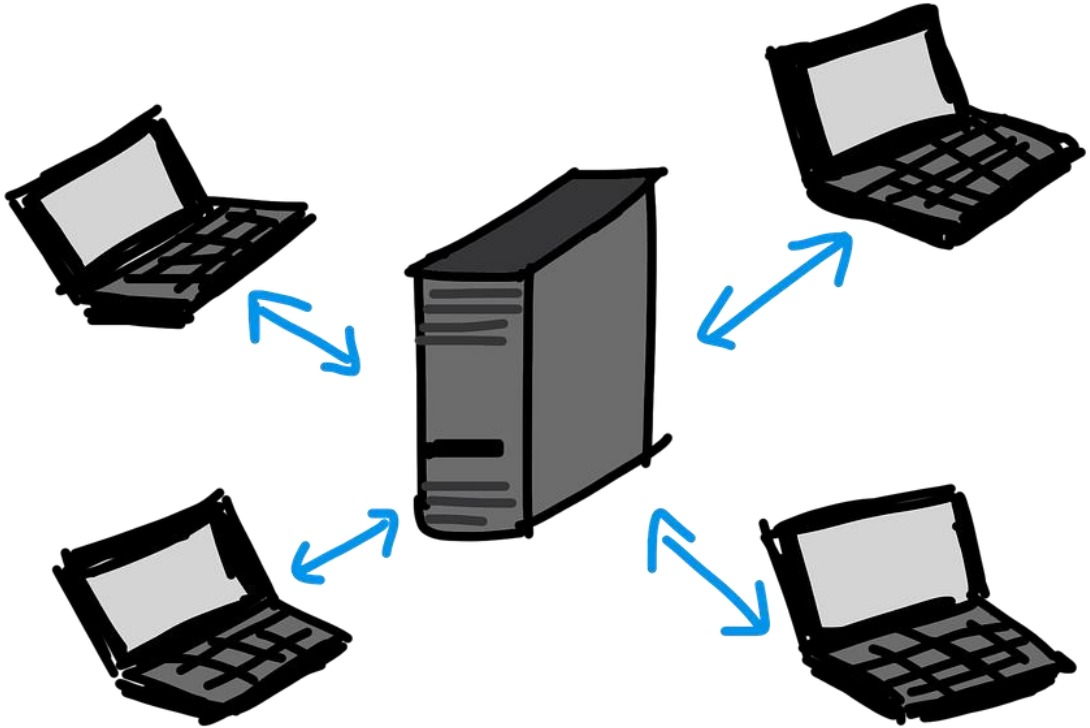
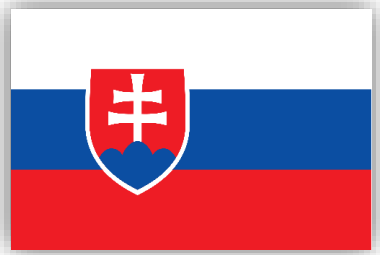
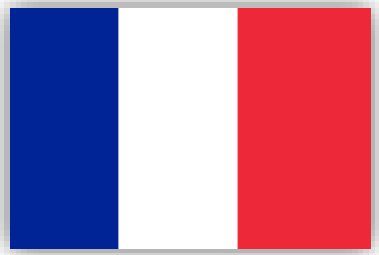
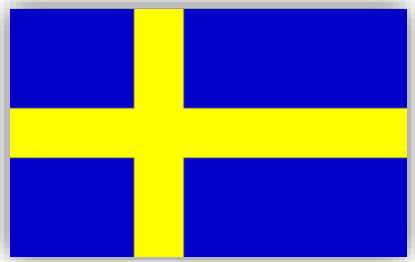
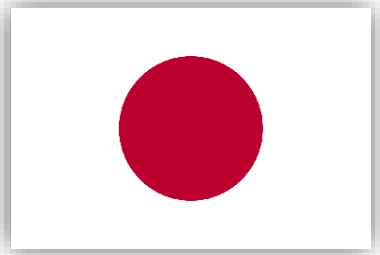
Why Not StarCraft 2?

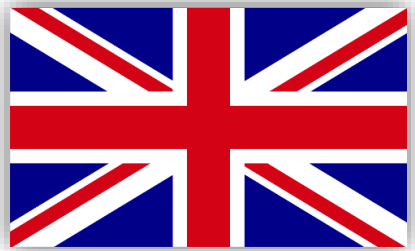


	Bot Name	Author Name	Affiliation	Race	BWAPI	Type	Status
1	BlueBlueSky	Pengfei Hou	Independent	Protoss	4.1.2	dll	2018 Registered
2	CDBot	Seevan Yang	Independent	Zerg	4.1.2	dll	2018 Registered
3	CherryPi	Gabriel Synnaeve + Team	Facebook AI Research	Zerg	4.2.0	proxy	2018 Registered
4	CSE	Wei Guo	Independent	Protoss	4.1.2	dll	2018 Registered
5	CUNYBot	Bryan Weber	CSI-CUNY	Zerg	4.2.0	dll	2018 Registered
6	DaQin	Lion Gis	Independent	Protoss	4.1.2	dll	2018 Registered
7	Ecgberht	Francisco Javier Sacido	Univ. Carlos III Madrid	Terran	4.2.0	Java	2018 Registered
8	Hellbot	James Hellman	Falmouth University	Protoss	3.7.4	client	2018 Registered
9	KillAll	Zhentao Tang	Independent	Zerg	4.1.2	dll	2018 Registered
10	ISAMind	Fang Gao	Independent	Protoss	4.1.2	dll	2018 Registered
11	LastOrder	Sijia Xu	Bilibili	Zerg	4.2.0	dll+proxy	2018 Registered
12	Locutus	Bruce Nielsen	Independent	Protoss	4.1.2	dll	2018 Registered
13	McRave	Christian McCrave	Independent	Protoss	4.2.0	dll	2018 Registered
14	MetaBot	Anderson Tavares	UFMG	Protoss	3.7.4	dll	2018 Registered
15	Microwave	Micky Holdorf	Independent	Zerg	4.1.2	dll	2018 Registered
16	SAIDA	Changhyeon Bae	Samsung SDS	Terran	4.1.2	dll	2018 Registered
17	Steamhammer	Jay Scott	Independent	Zerg	4.1.2	dll	2018 Registered
18	Tyr	Simon Prins	Independent	Protoss	4.1.2	Java	2018 Registered
19	WillyT	Nico Klausner	Independent	Terran	4.2.0	dll	2018 Registered
20	AILien	Alexander Stumpp	Independent	Zerg	4.2.0	dll	2017 Returning
21	Aiur	Florian Richoux	Université de Nantes	Protoss	3.7.4	dll	2017 Returning
22	Arrakhammer	Anthony Van	Stanford University	Zerg	4.1.2	dll	2017 Returning
23	Iron	Igor Dimitrijevic	Independent	Terran	4.1.2	dll	2017 Returning
24	LetaBot	Martin Rooijackers	University Maastricht	Terran	3.7.4	dll	2017 Returning
25	UAlbertaBot	David Churchill	Memorial University	Random	4.2.0	dll	2017 Returning
26	Ximp	Tomas Vajda	Independent	Protoss	3.7.4	dll	2017 Returning
27	ZZZKBot	Chris Coxe	Independent	Zerg	4.2.0	dll	2017 Returning







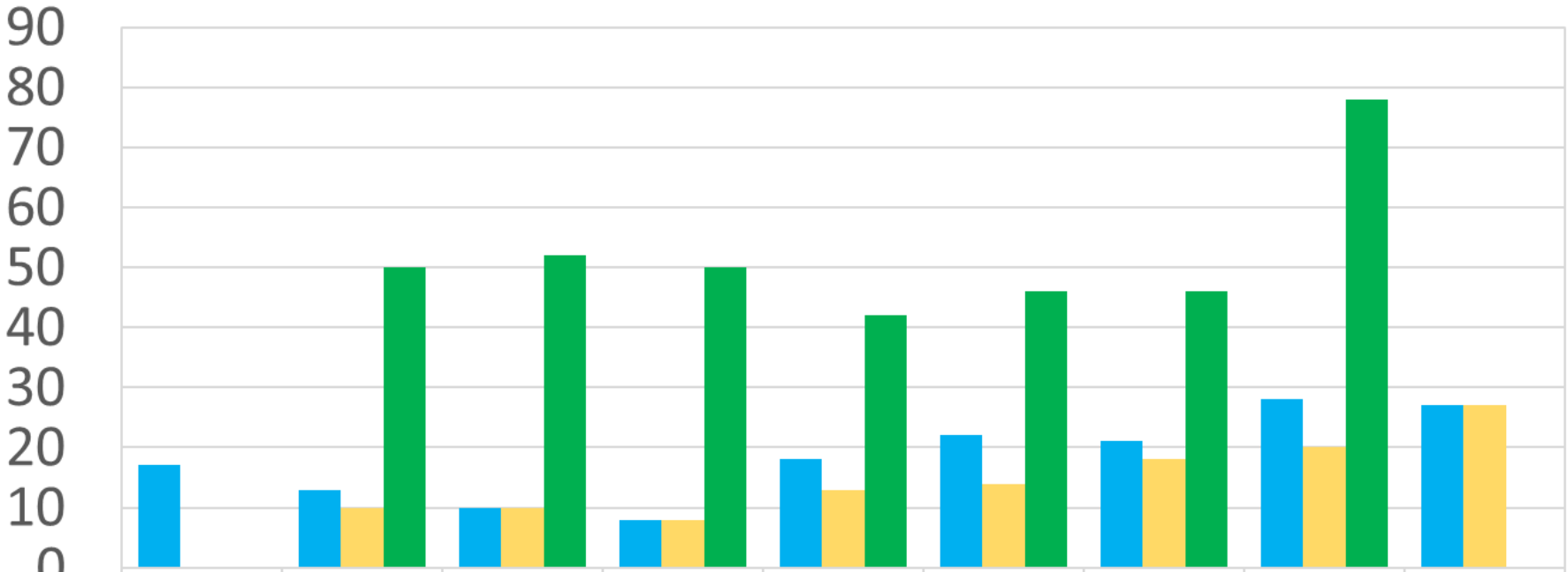
2018 New Features

- GPU computation support
  - Tag bots as requiring GPU, and they run only on machines that have GPU support
  - Only used by CherryPi (facebook) bot
- More detailed crash reporting
- More detailed analysis of results
- Results format changed slightly (JSON)

Tournament Statistics

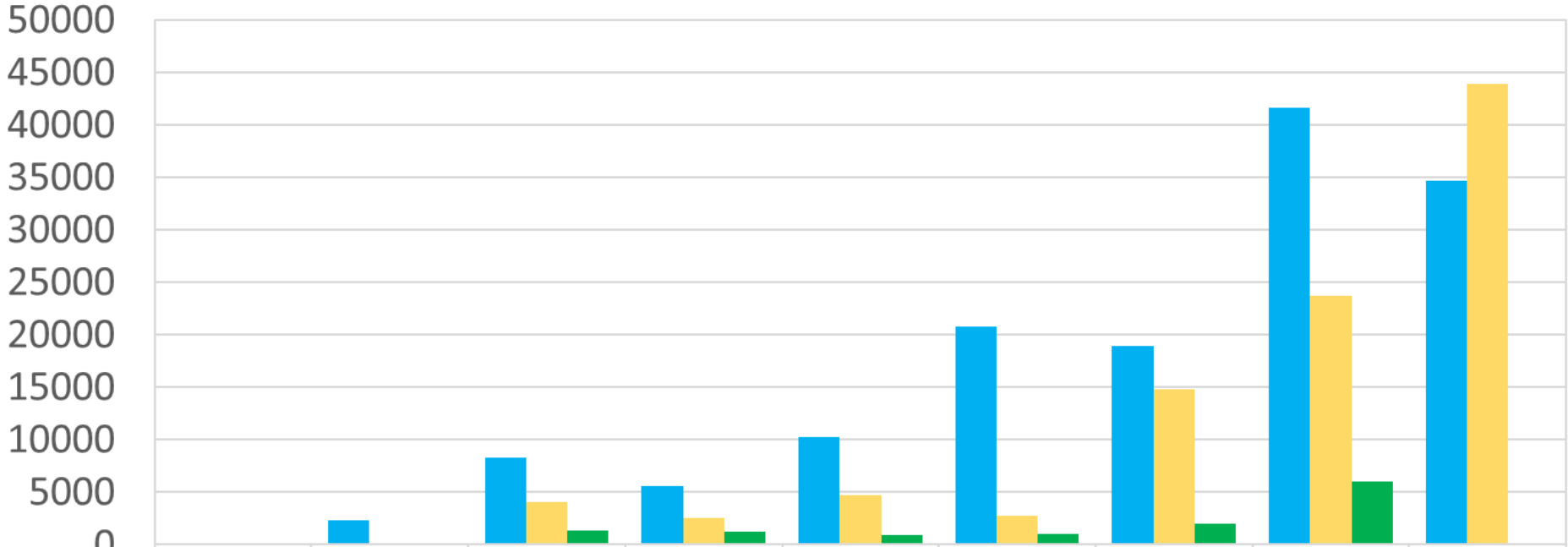
- Played on 12 virtual/real machines
- Tournament ran for ~2 weeks
- 34694 games played in total
- ~2600 games per bot
- 100 games per bot pairing
- 10 games per pairing per map

Starcraft AI Competitions - Total Entrants



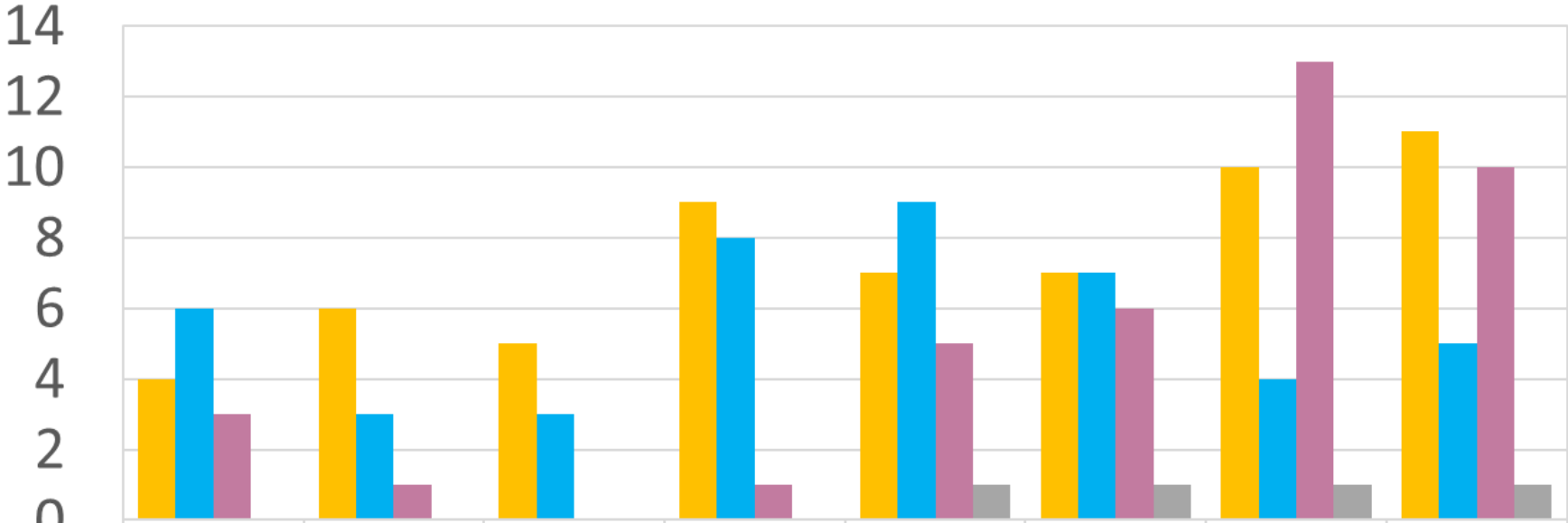
	2010	2011	2012	2013	2014	2015	2016	2017	2018
AIIDE	17	13	10	8	18	22	21	28	27
CIG		10	10	8	13	14	18	20	27
SSCAIT		50	52	50	42	46	46	78	

Starcraft AI Competitions - Total Games Played



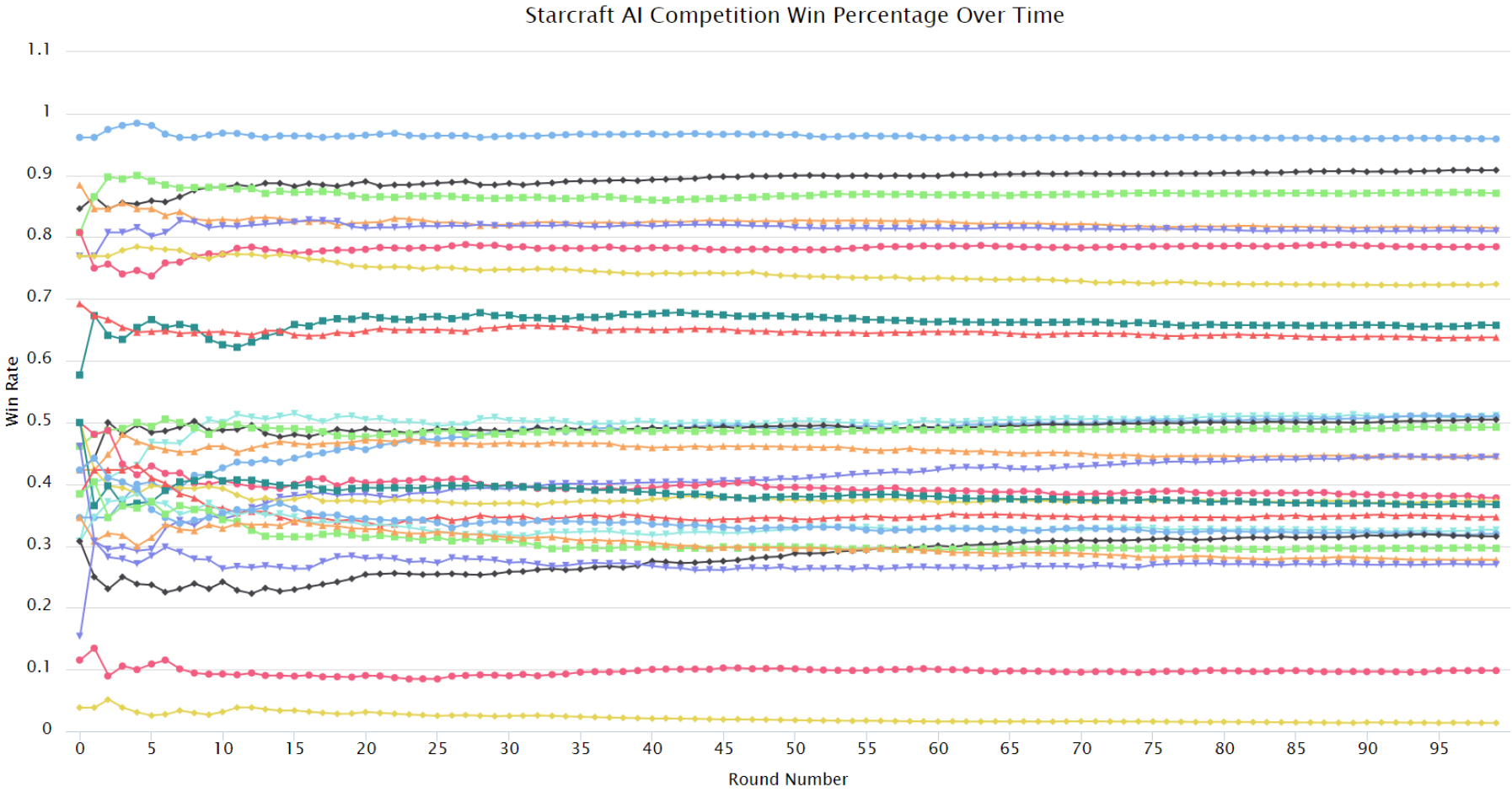
	2010	2011	2012	2013	2014	2015	2016	2017	2018
AIIDE	70	2340	8279	5579	10251	20788	18882	41580	34694
CIG		40	4050	2500	4680	2730	14787	23750	43875
SSCAIT		100	1326	1190	861	1035	1980	6006	

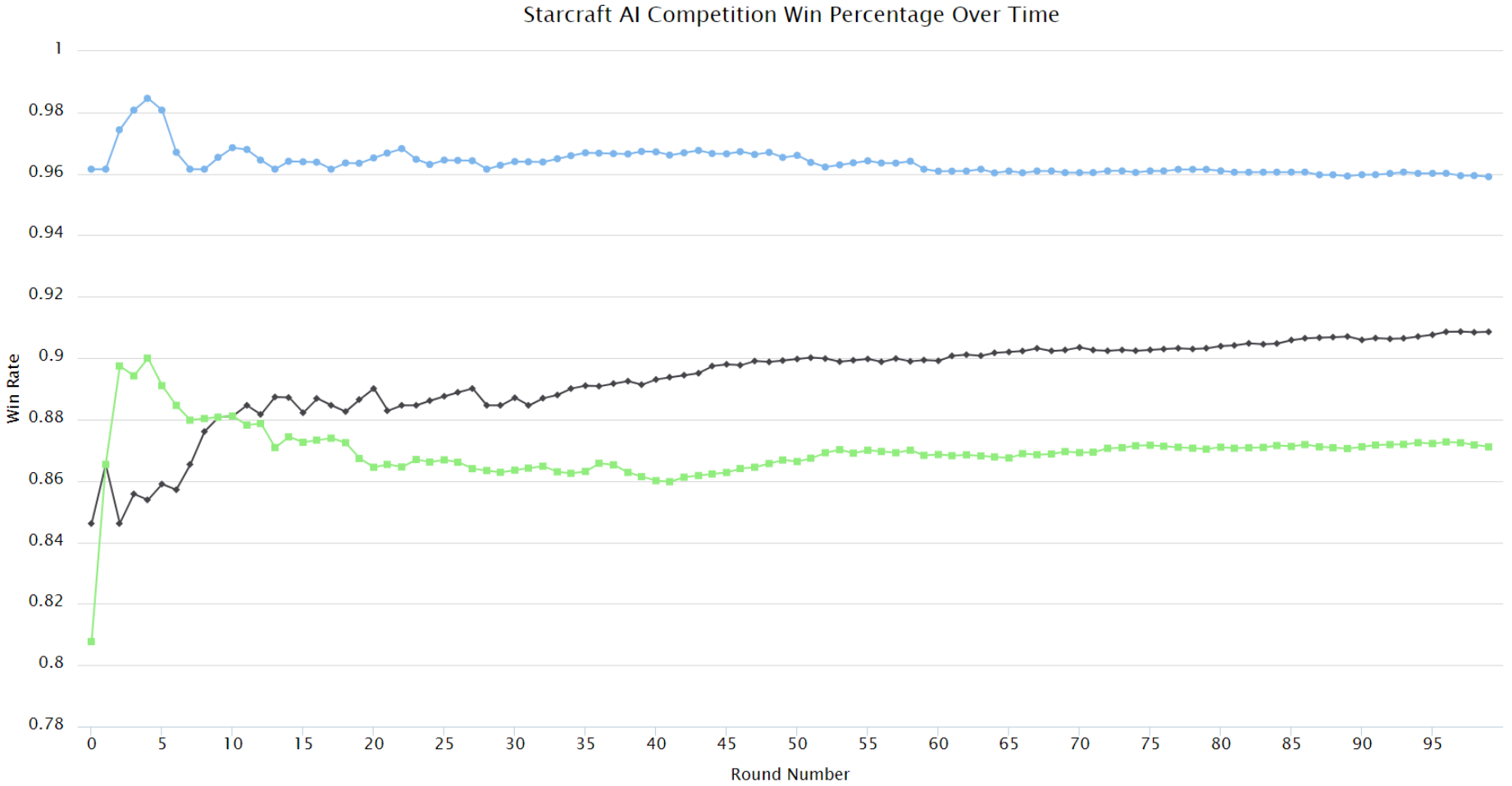
AIIDE Starcraft AI Competition - Race Distribution



	2011	2012	2013	2014	2015	2016	2017	2018
Protoss	4	6	5	9	7	7	10	11
Terran	6	3	3	8	9	7	4	5
Zerg	3	1	0	1	5	6	13	10
Random	0	0	0	0	1	1	1	1

RESULTS


Starcraft AI Competition Win Percentage Over Time
Win Rate
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95
Round Number


Starcraft AI Competition Win Percentage Over Time
Win Rate
1
0.98
0.96
0.94
0.92
0.9
0.88
0.86
0.84
0.82
0.8
0.78
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
Round Number

Rock, Paper, Scissors?

- A beats B, B beats C, C beats A
- Can happen with different strategies
  - Rush beats Expand
  - Expand beats Defend
  - Defend beats Rush
- 2017 Competition:
  - 1 > 2 > 10 > 6 > 3 > 5 > 8 > 9 > 4 > 7 > 1

No RPS in 2018

-	083/100	093/100	097/100	096/100	089/100	095/100
017/100	-	072/100	086/100	089/100	096/100	100/100
007/100	028/100	-	066/100	068/100	078/100	084/100
003/100	014/100	034/100	-	061/100	066/100	092/100
004/100	011/100	032/100	039/100	-	056/100	076/100
011/100	004/100	022/100	034/100	044/100	-	063/100
005/100	000/100	016/100	008/100	024/100	037/100	-

	Bot	Win %	Games	Win	2015
1st					
2nd					
3rd					
4th					
5th					

	Bot	Win %	Games	Win	2015
1st					
2nd					
3rd					
4th					
5th	Locutus	81.01	2586	2095	-

	Bot	Win %	Games	Win	2015
1st					
2nd					
3rd					
4th	BlueBlueSky	81.48	2586	2107	-
5th	Locutus	81.01	2586	2095	-

	Bot	Win %	Games	Win	2015
1st					
2nd					
3rd	CSE	87.11	2591	2257	-
4th	BlueBlueSky	81.48	2586	2107	-
5th	Locutus	81.01	2586	2095	-

CSE

- Protoss Bot
- Nationality: China
- Authors: Junge Zhang, Wei Guo, Qiyue Yin, Dong Zhan, Qiwei Wang, Yihui Hu, Shengqi Shen, Kaiqi Huang
- No Official Affiliation
- Competed as ‘cpac’ bot last year

CSE

- Based on the bot “Locutus”
- 6 weeks of improvements to their code
- Mainly based on hard-coded rules, with a little bit of machine learning
- “We use a multilayer perception network and several rules to predict units to train when the build order queue is empty.”

	Bot	Win %	Games	Win	2015
1st					
2nd	CherryPi	90.86	2592	2355	6th
3rd	CSE	87.11	2591	2257	-
4th	BlueBlueSky	81.48	2586	2107	-
5th	Locutus	81.01	2586	2095	-

CherryPi

- Zerg Bot
- Facebook AI Research (NY, USA)
- Authors: Jonas Gehring, Vegard Mella, Daniel Gant, Zeming Lin, Da Ju, Danielle Rothermel, Nicolas Carion, Nicolas Usunier, Gabriel Synnaeve

CherryPi

- “CherryPi has 8-13 strategies per matchup. It selects one at the start of the game based on history against the current opponent, using a bandit model with time-decaying weights on previous games. Using a pre-trained model, and given the current state of the game, it estimates the expected likelihood of winning (“value”) with each of the available strategies, and under certain conditions will switch to the strategy with the highest value. This can produce “mixed” strategies by switching back and forth.”

CherryPi AI Techniques

- Search: “We use region-level pathfinding to send units around map obstacles, and threat-aware pathfinding to kite and navigate units out of combat.”
- Offline ML: A ConvNet model that places buildings based on human data from https://arxiv.org/abs/1708.02139
Also: “An LSTM model for high level strategy selection”
- Offline RL: “Yes”
- Online Learning: “Yes” (uses file IO) “
- Map Analysis: Uses BWEM Library (Brood War Easy Map)
- Analyzed matchups against bots from previous competitions in offline training stage

CherryPi Strengths

- Efficient macro-management: Optimized harvester distribution, automatic tuning of mineral:gas ratio, building Drones in unsaturated bases, and a build queue that automatically expedites build items wherever possible eg. by inserting Hatcheries or Overlords as needed.
- Strategy selection: Having a diverse set of openers and the ability to intelligently switch between them
- Army positioning: Pre-positioning armies to achieve maximum surface area in combat; using threat-aware pathfinding to evacuate armies smoothly with minimized losses
- Basic unit control: Distributing targets so units don't collide; controlling Hydralisks between shots

	Bot	Win %	Games	Win	2015
1st	SAIDA	95.91	2590	2484	-
2nd	CherryPi	90.86	2592	2355	6th
3rd	CSE	87.11	2591	2257	-
4th	BlueBlueSky	81.48	2586	2107	-
5th	Locutus	81.01	2586	2095	-

SAIDA

- Terran Bot
- Affiliation: Samsung, South Korea
- Authors: Changhyeon Bae(Leader), Iljoo Yoon, Daehun Jun, Junseung Lee, Hyunjin Choi, Hyunjae Lee, Yonghyun Jeong, Uk Jo
- Also consulted with some South Korean Starcraft Progamers about the bot
- https://github.com/TeamSAIDA/SAIDA

SAIDA

- Based on source code of UAlbertaBot
- “SAIDA basically plays the mechanic terran in all games. it starts with a stable defence-first strategy and after mid stage of game, it seeks the best rush timing and win the game with a powerful one-shot attack.”
- “We think that the mechanic terran can cope with the most opponent's strategies and has the least weakness. That's why we chose this one.”

SAIDA AI Techniques

- Uses UAlbertaBot's existing techniques
- "We made the CNN & Encorder-Decode that has learned progamers replays to decide when to fight. (Not in submitted version of AIIDE because of some performance issue)"
- "We studied the multi-agent reinforcement learning in micro unit control in several mini-games of Starcraft. (Not in submitted version)"

SAIDA AI Techniques

- No hard-coded map information
- No online file IO / opponent learning
- “We use a finite-state machine to control units and buildings. Every units and buildings has a specific state in every situation. And we use several search algorithm to find enemy base or place to build on. “

SAIDA

- Q: Have you tested your bot against humans? If so, how did it go?
- A: Yes we did several times and beat amateurs. When we tested against progamer, we couldn't win but saw the possibilities that it is not that long way to beat the progamer.

Conclusions

- Bot strength much higher this year than previous years (previous high 89% wins)
- Two major companies competing
  - Samsung 1st Place, Facebook 2nd Place
  - Samsung has Korean Progamers
  - Facebook has many top 3 bot authors
  - Can amateurs ever win again?

Thank You!

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www.StarCraftAICompetition.com