

## 고급 프로그래밍 강좌를 위한 "게임 인공지능 경진대회 포털"의 교육적 사용

### Educational Use of "Game AI Competition Portal" for Advanced Programming Courses

Sehar Shahzad Farooq<sup>o</sup> Kyung-Joong Kim\*

[Sehar146@gmail.com](mailto:Sehar146@gmail.com), [kimkj@sejong.ac.kr](mailto:kimkj@sejong.ac.kr)

Department of Computer Science and Engineering, Sejong University, South Korea

#### Abstract

It is not surprising that competitions have been important tools to promote research and education in challenging problems. Recently, there have been a lot of game AI (Artificial Intelligence) competitions for video games, real-time strategy games and first person shooting games. The purpose of the game AI competitions is to build a program to play games automatically without human intervention. Because materials for competitions (rules, manuals, software, samples and so on) have been open to the public, it is promising to use them for education. Educators can adopt them for their courses' project by focusing only on the AI issues. It has been known that game AI competitions have been a good benchmarking tool and it enable students compare their works with state-of-the arts. However, it's not easy to get basic information on the game AI competitions if the instructor is not familiar with the competitions. In this paper, we propose to use Game AI competition portal (<http://cilab.sejong.ac.kr/gc>) with the history, results, AI techniques, source code, recent and future competitions and links for several game AI competition for education purposes.

#### Introduction

Recently, there have been a lot of game AI competitions in the world ranging from board games (Othello and Go) to complex real-world games (car racing, StarCraft, unreal tournament, and so on). The purpose of the Game AI Competitions is to build a program to play games automatically. However, it is not trivial to start the game AI competition for beginners because the contents are designed for experts. It is necessary to provide meta-level portal of the game AI competitions with easy introduction and step-by-step guidelines.

Usually, it requires much effort to design programming projects for advanced computer science courses. Educators should define problems (sometimes, open-ended) to be solved by students. If the problem set is invented by the educator for the first time, it is not easy to compare student's works with current state-of-the art. In addition to that, the introduction of multimedia and games (may be interesting to students) mean extra skills to edit/modify the programs for the course projects.

We have introduced the use of game AI competitions for education [1] with companion game AI competition portals<sup>1</sup>. Useful information on several famous game AI competitions has been posted in this portal. It includes the history of previous competitions, rules, results, winning strategies, source codes and educational materials. This game AI competition portal

can be a good starting point for those who have interested in game AI competitions.

#### Game AI Competitions

Games have been widely used as a test bed for artificial intelligence and computational intelligence research. It gives researchers concrete goals and ways to evaluate the goodness of their approach. In the game AI competitions, organizers define concrete goals and operational rules of the competition, and provide with free software, API, example controllers, and documents. The task of each participant is to develop their own AI controller for the game and submit it to organizer when it is ready. This approach is quite successful and efficient because each research team can skip the development of the details of goals, rules, platforms and comparisons with other methods. The organizers run the competition in the conference day and determine the winner of the competition.

For several years, game AI competitions have been important parts of several conferences and journals. Several researchers invested their invaluable time and effort on the competition by organizing the events, managing websites, making competition software and documents. It resulted in several international conference and journal papers related to the competitions and media appearance through major magazines and YouTube. It has opened several new research areas: Learning from human behaviors, Turing test for game AI, Procedural contents generation, and User Satisfaction Modeling. The competition evolved

<sup>1</sup> <http://cilab.sejong.ac.kr/gc>

\* Corresponding Author

every year by introducing new types of competitions and the number of competitions and participants has grown annually [2]. Table 1 shows the famous game AI competitions held in collaboration with international conferences for last three years.

Table 1 List of game AI competitions in last three years

Year	Conference	Car Racing	Unreal Tournament	Super Mario	Angry Bird	StarCraft	Ms. Pac-Man	Physical TSP
2011	CEC		O					
	WCCI			O			O	
	GECCO	O						
	AIIDE					O		
	CIG	O	O	O		O	O	
	SSCAI					O		
2012	Evo*	O						
	WCCI		O	O			O	O
	AIIDE					O		
	SSCAI					O		
	CIG	O	O	O		O	O	O
	GECCO	O						
	AJCAI					O		
Evo*	O							
2013	AIIDE					O		
	SSCAI					O		
	CIG					O		O
	GECCO	O						
	IJCAI					O		

The AI competition software has great potential for the development of new computational intelligence research and education. The game AI competition is relatively new field and there are enough rooms for further research and development. These competitions have been used earlier for teaching purposes. Based on the experience of education with the competition software; it is a promising tool to use them to bridge research and education.

**Game AI Competition Portal**

There are different game AI competitions with their own websites which provide the latest updates about the game, define concrete goals and operational rules of the competitions, provide basic software, API's, example controllers and documents. However it is not an easy task to keep updated with all the websites. Game AI competition portal acts as an information aggregator for past and recent competitions. As a result, you can access the distributed resources related to the game AI competitions.

It is useful for beginners to start their own entry. Usually, the information from the competition websites is insufficient for a new participant to build its own controller (when the competition is started, it is assumed that the participant has a potential to cope up with basic information). It requires step by step

information of installing the software, updating patches, overwriting the directories and building the platform.

In order to attract the students in this field, game AI competition portal is introduced providing with all the details required for the novice users to start its own controller generation and participate in the game AI competitions.

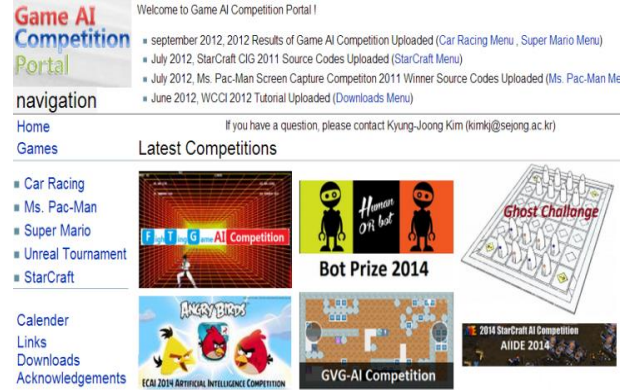


Figure 1 an overview of game AI competition portal

**Motivation on the use of Game AI Competition in Education**

A lot courses opened in the computer science department in different institutes used game AI competitions for the student's semester project. (Game AI in 2012 by Mark Riedl at Georgia Tech<sup>2</sup>, Modern AI for Games in 2012 by Julian Togelius at IT university of Copenhagen<sup>3</sup>, Agents AI & Games in 2011, by Saturnino Luz, at Trinity College Dublin<sup>4</sup> and so on).

Students are asked to make a program for the game AI competition as a semester project. In this way, students learn about the game as well as the state of the art techniques. The novel approach can be tested easily on the competition benchmark so it is not a burden for the teachers/lecturers. It can motivate the students to submit their controllers to game AI competitions in different competition related conferences and can also publish their work. Therefore, there are several benefits of the game AI competitions for researchers and teachers.

- 1) If you decide to start game AI research and education, it is necessary to build game platforms but it is not a trivial task. In the game AI competition, you just need to use the game software and API provided by organizers. It speeds up the research by focusing only on the AI part of the game.
- 2) Like UCI benchmark dataset, game AI competition can be a good benchmark tool to compare with other works. It provides transparent, fair and reusable way of benchmarking algorithms.

<sup>2</sup><https://research.cc.gatech.edu/inc/cs-4731-spring-2012>

<sup>3</sup><https://blog.itu.dk/MAIG-E2012>

<sup>4</sup><https://www.scss.tcd.ie/~luzs/t/cs7032/>

- 3) It allows an easy way to get into the research fields for researchers from the other fields as the competitions are open to public.
- 4) There is continuing interest and efforts on teaching computational intelligence (neural network, evolutionary computation, fuzzy systems, and so on) to undergraduate and graduate students, the game AI competition are suitable for course projects as an application of computational intelligence.
- 5) There are several conferences and journals related to the competitions and you can find good opportunity to publish articles. For example, IEEE CIG has a special track for “competition papers.”

**Game AI Competition Portal Survey**

In order to understand the importance and usefulness of the Game AI Competition Portal, we conducted an online survey to get the feedback. The subjects chosen were the undergraduate, graduate and doctoral students of department of computer science and engineering, Sejong University, South Korea.

The purpose of the online survey was to introduce the Game AI Competition Portal to students and get the feedback about its significance. A total of 11 subjects participated in the survey. Among them, two were doctoral students (experts in competitions), three were graduate students (intermediate level of familiarity) and six were undergraduate students (beginner or novice). Table 2 shows the statistics of the survey.

Graduate and doctoral students showed their familiarity with game AI competitions. They agreed that the portal explains everything they expect and with the help of this portal, they can be able to participate in the next competitions. However they disagree that the portal information is not up to date and many new competitions need to add in the game AI competition portal. Undergraduate students who have no idea of game AI competitions have shown more interest towards the historical background of the competition,

information of how to develop their controller and procedure of participation in the game AI competition.

**Conclusion and Future Works**

Game AI competitions have great potential to be widely used by new CI researchers and teachers in education. Although there are several introductory materials and surveys on the topics of game and intelligence, there is no article devoted to game AI competitions. Hence this game AI competition portal can be a good starting point for those who have interested in game AI competitions.

However it is necessary to construct a game AI competition portal web site as a hub of several competitions. It is interesting to organize local game AI competitions together with the international events. Game AI competition portal needs a regular update about latest activities related to game AI competitions.

In future, this game AI competition portal can be connected to several international conferences and journals that organize competitions and publish special session papers. Furthermore, special courses/training sessions based on game AI competitions can be offered to different institutes and organizations.

**Acknowledgement**

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**References**

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Table 2 Questions and responses of game AI competition portal survey

No.	Question	Response		
		Yes %	No %	Other %
1	Are you familiar with Game AI Competition?	50	50	
2	Are the contents of Game AI Competition portal helpful?	91	9	
3	Does Game AI Competition portal explain everything you want?	60	30	10
4	This portal is in English language. Are you satisfied with it?	57	43	
5	Does the video link give clear understanding of Game AI Competitions?	64	18	18
6	With the help of portal, can you participate in any Game AI Competition?	64	36	
7	Do you think the information in Game AI Competition Portal is latest?	67	22	11
8	Can you download the resources available at Game AI Competition Portal?	78	22	
9	Did you understand the purpose of Game AI Competition Portal?	100	0	