Contest Rule of 2019 WER Brick Robot Contest

“Artificial Intelligence”

1 Theme Introduction

Robot is a comprehensive product of contemporary technologies, and robotics should also keep pace with the times. The theme of the 2019 WER brick robot contest is "artificial intelligence", which is highly integrated with development of the modern world.

In 1956, American computer scientist John McCarthy organized the Dartmouth Conference, at which the term ‘Artificial Intelligence’ was first adopted.

In 1986, First driverless car, a Mercedes-Benz van equipped with cameras and sensors, built at Bundeswehr University in Munich under the direction of Ernst Dickmanns, drives up to 55 mph on empty streets.

In 1997, IBM’s Deep Blue defeated became the first computer to beat a reigning world chess champion, Garry Kasparov.

In 2006, Geoffrey Hinton publishes “Learning Multiple Layers of Representation,” summarizing the ideas that have led to “multilayer neural networks that contain top-down connections and training them to generate sensory data rather than to classify it,” i.e., the new approaches to deep learning.

In March-2016, Google DeepMind's AlphaGo defeats Go champion Lee Sedol.

In 2017, AlphaGo’s Upgraded version “Master” defeated Ke Jie, the number one Go player in China, with 3:0 in the three-part match.

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Human beings are constantly studying the nature and drawing wisdom from it. However, the most complex research object in nature is the human beings themselves.

Artificial intelligence refers to an artificial intelligence system built using computer technology and biological knowledge. It is a science that realizes the imitation or research of human behavior. Artificial intelligence is a simulation of the information processing process of human consciousness and thinking. It is not human intelligence, but it can think like a human being, and may even exceed human intelligence. The research content of artificial intelligence includes: search methods, machine learning and knowledge acquisition, automation, etc., which is the development trend of future technology.

Artificial intelligence was born in the middle of the 20th century and has been booming in the near future. It has achieved rapid development in problem solving, deductive logic and machine automatic proof theory and etc., and

set off a wave of research and simulation of human thinking. It is believed that in the near future, human-created machines can become artists, musicians, engineers and waiters.

Due to the complexity of human intelligence and the limitations of computer hardware and software, the development path of artificial intelligence is rugged and has fallen into a trough for several times. Until recently, with the rapid development of computer technology, artificial intelligence has entered a new development period. Some new technologies, new ideas and new methods have been integrated into the field of artificial intelligence, giving it a strong momentum of rapid development. The well-known technologies in the field of artificial intelligence include computer vision (image processing), language understanding and communication (speech recognition), robotics, machine learning, etc.

As a good scientific research, demonstration, display and application platform for artificial intelligence, robots can fully embody the power and versatility of artificial intelligence. All kinds of dialogue robots, all kinds of service robots, and industrial robots that operate autonomously on the assembly line, as well as the current unmanned vehicles - they are the result of artificial intelligence. Artificial intelligence involves many fields and has broad application prospects.

In 2017, the State Council of China issued the “New Generation Artificial Intelligence Development Plan”, which marked the official rise of artificial intelligence as China’s national strategy.

In 2019 WER Brick Robot Contest (4+3), the participants should work like software engineers, algorithm scientists, robot engineers, etc., to create robots and write code so that the robots can complete the competition tasks autonomously.

2 Contest venue and surrounding

2.1 Venue

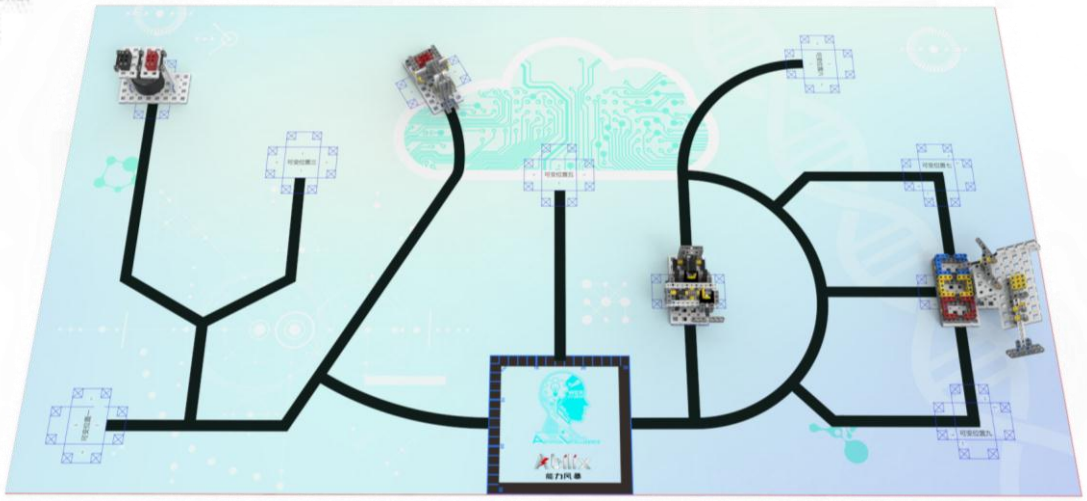

Figure 1: Arena Map

The dimension of the arena map (made of PU or PVC) is 220cm(Length) x 120cm(Width). End of the black line (2cm-3cm in width) marks a position of a task model (model zone). The position and direction of models are variable. There is a base (30cm x 30cm) in the arena to which the robot can go back and leave in multiple times.

2.2 Surrounding

The contest surroundings are categorized into cold-light source, low-level lighting and magnetic interference-free. Due to the various uncertainties, for example: the surface of the arena is bumpy or zigzag, the lighting condition is variable, etc, the contestants need to come up with countermeasures when designing their robots.

3 Task and Score

There are 7 tasks for each round, including preset and additional tasks. 4 preset tasks will be drawn on the arena in terms of difficult, medium and basic levels; 3 additional tasks will be made public only before the contest.

Contents of preset tasks are announced in the rule whereas the position and direction of models, which are variable, are published right before the contest. Additional tasks will be made public only before the contest and contestants should refer to venue situation to design robot′ s building and programs.

Following preset tasks simulate some real life scenarios:

3.1 Smart Chip

3.1.1 The smart chip is placed on the model platform as shown in Figure 2.

3.1.2 By pressing the handle, the chip will fall into the target zone and its vertical projection shall not exceed the highlighted red square (as shown in Figure 2, 40 points). Color of the chip is not determined. The color showed below serves only as reference.

Difficulty：★★

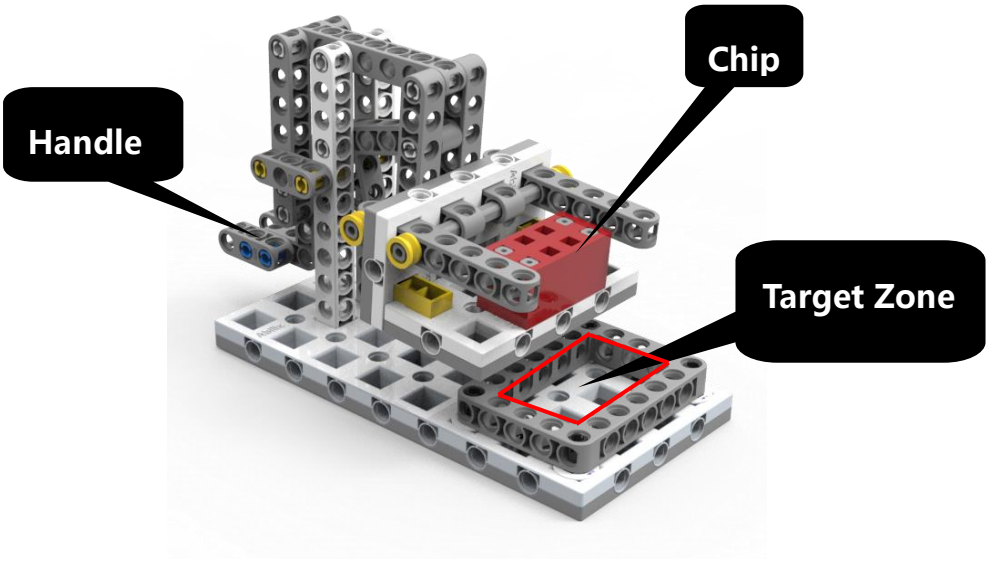

Figure 2 Initial position of the Smart Chip task model

3.2 Acquisition of Samples

3.2.1 Two samples are placed in the middle of the shelves, with one placed in the middle of the right shelf and the other in the left shelf. Their initial position is shown in the Figure 3.

3.2.2 The robot must contact the bob to make the samples completely detach from the shelves (30 points each sample).

3.2.3 The robot needs to bring the samples back to the base (50 points each sample).Color of the sample is not determined. The color showed below serves only as reference.

Difficulty：★★★

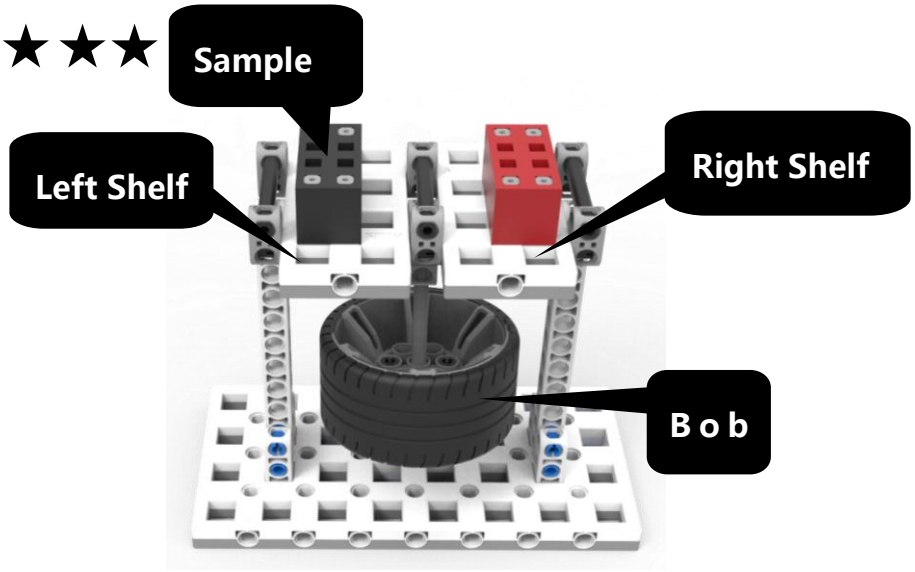

Figure 3 Initial Position of Acquisition of Samples

3.3 Energy Core

3.3.1 The Energy Core is placed at the top of the task model and securely attached to a magnet. The handle is either horizontal or vertical (will be determined right before the contest starts), as shown in Figure 4.

3.3.2 The robot must rotate the handle to get the energy core. The energy core is considered to be acquired as long as its vertical projection doesn't fall into the baseboard.

3.3.3 The robot acquires the energy core (detached from the task model, 50 points). The robot brings it back to base (80 points).

3.3.4 To complete the task, robot must do 3.3.2 first. If taking the energy core directly, there won't be any point.

Difficulty：★★★★

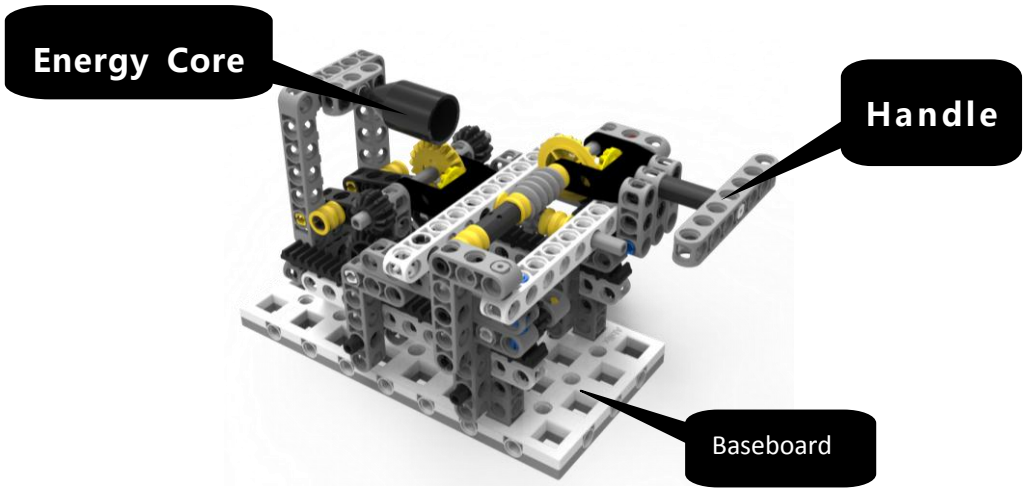

Figure 4 Initial Position of Energy Core

3.4 Intelligent Sorting

3.4.1 The task model of intelligent sorting is placed on the map with 3 baskets marked by 3 different colors. Its initial position is suggested in Figure 5.

3.4.2 The color of the sorting material will be determined before the contest. The robot needs to make the material fall into the basket which matches its color by working with the push bar and sorting bar.

3.4.3 Vertical projection of the sorting material shall not exceed the edge of the basket.

Difficulty：★★★★★

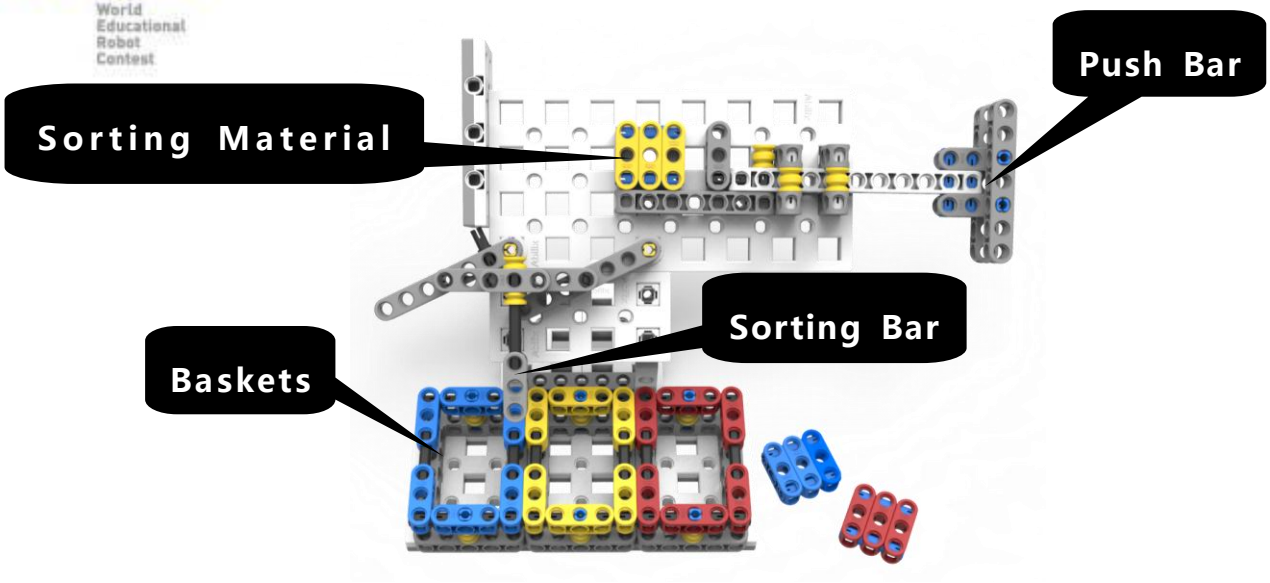

Figure 5 Initial Position of Intelligent Sorting

3.5 Location of Task Model

3.5.1 Location of some task model is fixed, but some may change. In some cases, location and orientation of the task model will change altogether. All uncertainties will be released right before the contest. Once released, there won't be any change.

3.5.2 Location of the Intelligent Sorting can only be at Location 7 or Location 8 and its orientation is fixed. Location of Energy Core is fixed, but its orientation will change. Location and orientation of Smart Chip and Acquisition of Samples shall be changed. Their location can be at Location 1, 2, 3, 4,5,6 or 9.

3.5.3 Location of the additional task models can only be at Location 1, 2, 3, 4, 5, 6 or 9. There will be 3 additional tasks. Model and points of each task will be released right before the contest.

3.5.4 Task models cannot be put at Location 4 and 5 at the same time.

4 Robot

Robot′ s design and building rules and regulations: All robots must be checked before the contest. In order to guarantee the fairness, judge will randomly check contestants′ robots during the contest and require those non-compliant robots to be adjusted in line with the regulations. If the robot still cannot meet the requirement, contestants will be disqualified.

4.1 Dimension: The dimension of robot shall not be larger than 30cm x 30cm x 30cm (Length x Width x Height) before taking off; the structure of robot can automatically extend after leaving the base.

4.2 Controller: The controller shall not be replaced during the single round. Each robot can only use one controller.

4.3 Actuator: Each robot can only use 4 motors in total. (Digital servo motor is forbidden)

4.4 Sensor: The sort and number of sensors used by each robot are unlimited.

4.5 Structure: Robots must apply plastic splicing structure; accessories such as ribbons, screws, rivets, glue or tapes shall not be applied.

4.6 Power: Each robot must have individual battery with a voltage less than 9V, external power supply, boost, step-down or regulated power supply shall not be applied

5 Contest

5.1 Team

5.1.1 Each team consists of 2-3 students (in-school students by June 2019) and one of the members shall be the team leader.

5.1.2 Contestants shall cope with all issues in the contest positively and voluntarily, with self-esteem and self-discipline, respect and kindly interact with teammates, opponents, volunteers, judges and all other people who have contributed greatly to the contest, and put into efforts to develop solid and sound qualities.

5.2 Rules

5.2.1 WER brick educational robot contest (4+3) is categorized into elementary, middle and high school division.

5.2.2 rounds are involved in the contest (no preliminary or semi-final). The time of each round is 180 seconds.

5.2.3 Time will not be extended if the team chooses additional tasks.

5.2.4 After all rounds complete, teams will be ranked by their score in total, which is a sum of their score per each round.

5.2.5 It is of possibility that organizing committee alter the rules in terms of registration and practical situations.

5.3 Procedure

5.3.1 Build robot and program

5.3.1.1 Building and programming can only be conducted in preparation area while debugging can be performed in the arena map.

5.3.1.2 Contestants can enter the preparation area after registration. Judges needs to check the equipment carried by contestants. Built robots can be carried into the preparation area and all equipment must tally with the contest rules and regulations. Contestants are forbidden to carry telecommunication devices not approved by the organizing committee. After all contestants are seated in the preparation area, judges will notify teams of diagrams of model distribution and additional task rules.

5.3.1.3 Contestants should carry portable calculators, repair tools, replacement and spare parts. Contestants are prohibited to surf the internet or download any programs in the preparation area; contestants are also prohibited to shoot the venue by camera or other devices, or contact trainer or parents by any means.

5.3.1.4 There are 2 hours including debugging and sealing. Contestants can make use of the time to revise robot′ s building and program referring to the surroundings.

5.3.1.5 Daily lighting is applied on the arena and contestants can calibrate sensors accordingly, whereas the organizing committee will not guarantee the on-arena lighting is constantly invariable. The lighting may alter in the progress of contest due to flashlight of camera or camcorder, LED light or other unknown lights, contestants should find solutions on their own.

5.3.1.6 Contestants must debug and prepare in order and trainers shall intervene by no means. Teams who disobey the order may be warned or even disqualified. Teams shall put robots in the designated place of the sealing area before the end of the debugging time, afterwards, the arena is in closure.

5.3.2 Preparation before contest time

5.3.2.1 Contestants pick up their own robots and are guided by judges into the contest field. Teams who do not show up in the regulated time will be deemed as waiver.

5.3.2.2 Contestants shall stand near the base after entering the field.

5.3.2.3 Contestants put their robots in the base, of whose parts and shadows must maintain inside the base.

5.3.2.4 The present contestants shall complete the preparation within 2 minutes and give a signal to the judge

after completion.

5.3.3 Start-up

5.3.3.1 After judge confirms the team is ready, he/she will count down from 3 while contestant can use a hand to slowly approach the robot. When hearing the command "Start", contestant can touch the button or give the sensor a signal to start up the robot.

5.3.3.2 If the team starts up the robot before the command "Start" is given, the operation will be regarded as a mistake and the team will be warned or penalized accordingly (being counted as a restart).

5.3.3.3 Once robot starts up, it will only be controlled by the controller's in-built programs. Generally speaking, contestants shall not touch robots. (Restart is exceptional)

5.3.3.4 Contestants shall not deliberately detach components or drop components on the ground, such behaviors with a deliberate intent will be judged a foul. Any unintentionally dropped components shall be cleaned out of the arena instantly by the judge. Robot being scored due to detached components shall be invalid. Detached components indicate at a certain moment there is no connection between robot's built-in components and robot's body.

5.3.3.5 If the carried objects are cast out of the arena accidentally because of robot's rapid speed or program error, the objects shall not be back to the arena.

5.3.4 Restart

5.3.4.1 If dysfunction occurs or certain task is not completed in the progress, contestants can take the robot back to the base to restart and a "Restart" will be recorded; the tasks which are completed before "Restart" will be scored accordingly while the carried object during the dysfunction or task failure becomes invalid and will be kept by judge till the end of the contest. Timing will not be paused during the process.

5.3.4.2 Score: In each round, Restart 0 times, the team gains 40 points; Restart once, the team gains 30 points; Restart twice, the team gains 20 points; Restart 3 times, the team gains 10 points; Restart 4 times or above, the team gains zero.

5.3.4.3 Time to Restart is of no limit in each round, but point-gaining will comply with 5.3.4.2.

5.3.4.4 Timing will not be paused or restarted during Restart period.

5.3.5 Robot can go back to the base autonomously.

5.3.5.1 Robot can go back and forth time and again, which will not be counted as a Restart.

5.3.5.2 The criterion of robot autonomously going back to the base is its vertical shadow lying in the base and contestants can touch robots which are already back to the base.

5.3.5.3 After robot autonomously goes back to the base, contestants can alter or repair robot′ s structure.

5.3.6 End of contest

5.3.6.1 Each round has 180 seconds.

5.3.6.2 After the team accomplishes some tasks, they shall give a signal to judge if they decide to give up in the contest, the judge will stop timing and keep the currently used time for a single round; otherwise, the team has to wait till the end of the contest. (Judge blows a whistle)

5.3.6.3 After judge blows a whistle for the ending of the contest, contestants must power off the robot instantly and leave the robot and all objects on arena untouched.

5.3.6.4 Judge fill in the scoring sheet and tell contestants their scores.

5.3.6.5 Contestants clear up the arena and move their robots back to the preparation area.

6 Score

6.1 Score the team based on their task accomplishment at the end of each round. Details in the 3th section.

6.2 The sequence of accomplishing tasks will not influence the score of a single task.

6.3 Some tasks can only be scored after the model is carried back to the base, meanwhile, the following requirements must be matched: 1. The criterion defining robot autonomously going back to the base; 2. The shadow of robot and that of the model are partially or utterly overlapped, or robot contacts the model.

7 Foul and Disqualification

7.1 The score of the team who does not show up on time will be deducted 10 points for every minute; if the team still does not show up in 2 minutes, they will be disqualified then.

7.2 Judge will give a warning to the team for their 1st mis-start, robot should be back to the base area for a

Restart and timing will be restarted. The 2nd time mis-start will lead to the team′ s disqualification.

7.3 Detaching components intentionally is regarded as a foul. The team may be disqualified depending on the seriousness of the situation.

7.4 If the model is damaged by robot or contestants in the progress, intentionally or not, contestants will be given a warning. The task, no matter completed or not, will not be scored.

7.5 Neither the model nor robot shall be touched out of the base during the process, otherwise, a ″Restart″ will be recorded.

7.6 Contestants who disobey judge′ s directions will be disqualified.

7.7 Contestants will be disqualified if they privately contact trainer or parents without a permission of judge.

8 Rank

Each team will be ranked based on their score in total of all rounds, the higher the score is, the top the ranking will be. If there are teams scored the same, see followings to determine the ranking:

1) The team who used less time for all rounds will be ranked higher;

2) The team who restarts less will be ranked higher;

3) The team who completes more single tasks in all rounds will be ranked higher;

4) The team whose robot is less-weighted will be ranked higher, or the result will be decided by judge.

Appendix Scoring Sheet

WER 2019 brick educational robot contest (4+3) scoring sheet							Round _
No.		Seat		Team		Category	

Tasks		Points	Status	Score
Smart Chip	Smart chip falls into the target zone.	40		
Acquisition of Samples	Samples detach from the task model	30/each		
	Samples enter the base.	50/each		
Energy Core	Energy core detaches from the task model.	50		
	Energy core gets back to the base.	80		
Intelligent Sorting	Sorting Material falls into the color-matching basket.	80		
Additional task	Details to be confirmed	100		
Additional task	Details to be confirmed	100		
Additional task	Details to be confirmed	100		
Autonomous Operation Reward	40-(number of restart)*10. The score should be no less than zero.			
Total Score				
Time for the single round				

Remarks on disqualification:

Judge: _____ **Scorekeeper:** _____

Players: _____

Chief Judge: _____ **Data Entry By:** _____