

# NAPROCK 4th International Programming Contest

## - Competition Section -

### “Count the Dice”

## 1. Introduction

Given a heap of dice, players should count the number of dice early and exactly by using the computers and the electronic devices like digital cameras. Image analysis is a technology composed of various complicated tasks such as finding, identifying and counting objects by image processing techniques. Such a technology has been applied to many areas, for example, manufacturing, medical cares, and observation of natural phenomena or natural objects. Computers can be utilized in order to realize our convenient life, and to solve the difficult and complicated problems. You, students have skills, and computers as well. Here are a huge number of dice. So, let's count the dice!

## 2. Terminology

### (a) *Die (pl. Dice)*

- *Die* is a cube shaped object to be counted.
- Each of six faces shows the different numbers from 1 to 6. Number "1" is represented by a red dot. Other numbers are represented by black dots.
- There are the following 3 different sizes of dice:
  - Small: 6mm edges each / 0.3g weight,
  - Medium: 10mm edges each / 1.3g weight,
  - Large: 16mm edges each / 5.6g weight.

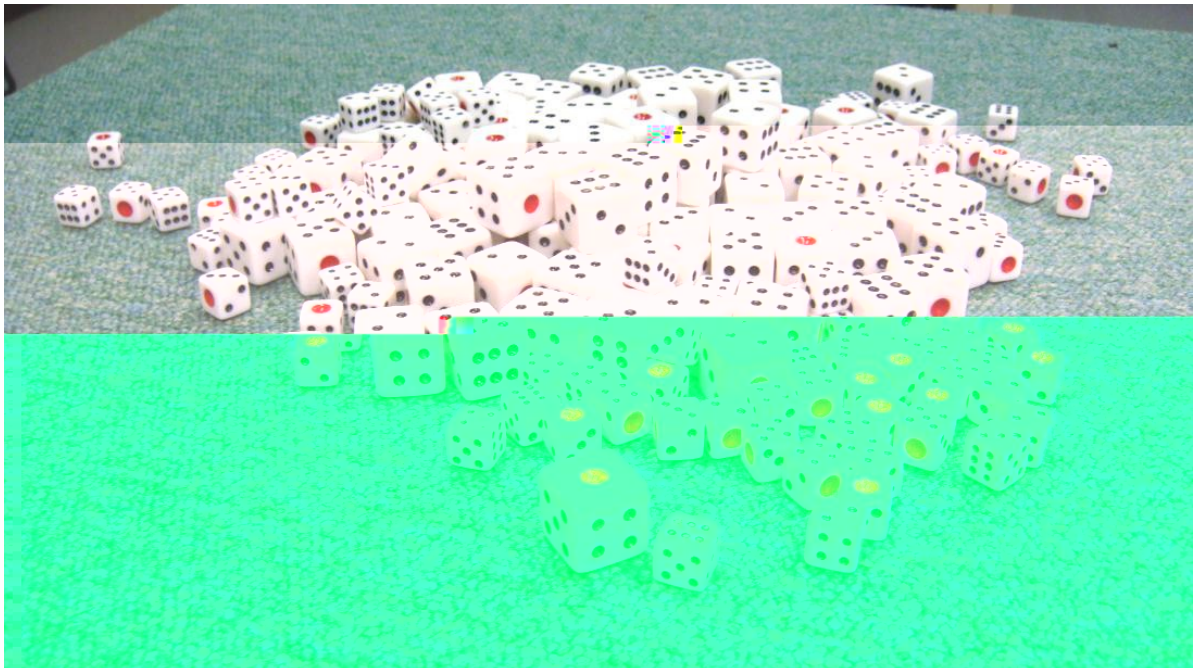


Figure 1: An example of the given dice.

(b) *Booth*

- A *booth* is assigned to each team on stage. The players can analyze the number of dice by computers based on their field researches.
- There is a PC for submitting the answer in each booth.

(c) *Field*

- *Field* is the area where the players can research the given dice.
- There are 2 fields ( Field A and Field O ) on stage. Each of fields have a round table in its center.
- A heap of dice are given on each table.
- There are *Research Areas* and a *No-Entry Zone* in each field.

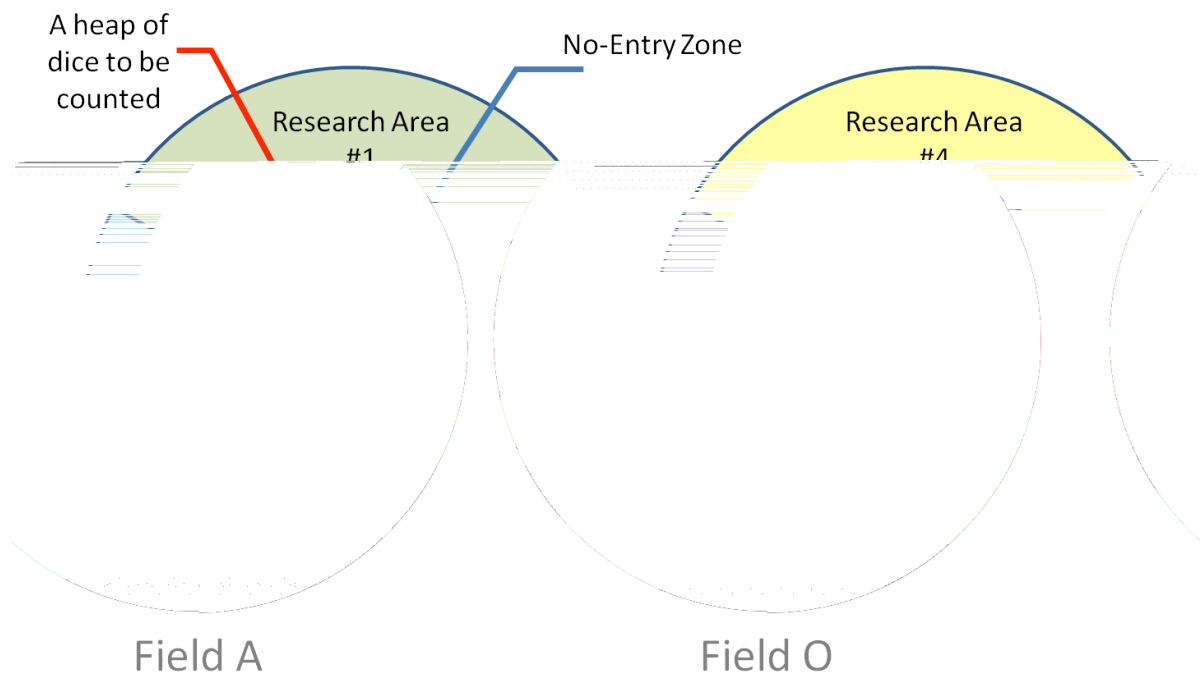


Figure 2: Fields (looked from above).

(d) *Research Area*

- *Research area* is an area where the players can research the dice by using devices such as digital cameras.
- The area within 1.5m-2.0m from the center of the table is *No-Entry Zone* where the players cannot enter. No-entry zone is also valid vertically. In other words, it is also prohibited that any part of the players' bodies and devices enter in the air just right above the no-entry zone.
- There are 3 research areas outside the No-Entry Zone shown in Fig. 2.
- The height of each research area is given as 2m. It implies that any part of the players' bodies and devices should not exceed the height of 2m in each of reserach areas.
- Only 2 players can enter the research area at the same time.
- The height and the diameter of the round table are 70cm and 90cm, respectively.
- The table has a small fence of 3cm high at its edge in order to refrain from falling down of dice.
- Field A can be observed only from the research areas 1, 2, 3, while Field O can be observed only from the area 4, 5, 6.
- The players cannot move to other research areas within the given *research time*. It is possible to go back and forth between the research area and the booth assinged to the team.

(e) *Spurious Object*

- *Spurious object* is the object which should not be counted.
- There are many spurious objects as well as dice on the table.
- Spurious objects never hide each die completely. Dices can hide spurious objects and other dice completely.
- Spurious objects could have any patterns on their surfaces and even have mirror surfaces.

(f) *Research*

- The players can *research* the field only from the research area.
- The players should finish the research within a given *research time*.
- It is prohibited for the players to use any lights, infrared rays and any other objects which can give any effects to other teams.

#### **4. Procedure of a Game**

- (1) 6 teams can play in a single game at most.
- (2) 2 different problems, that is, one problem for a field, will be given in each game.
- (3) First, 2 problems are given, that is, a heap of dice is given in each of 2 fields.
- (4) Once the problems are given, each team starts to research the dice. A research should be done from one of the research area within 1 minute research time. After finishing the researches from all of the 6 research areas, each team starts to analyze the number of dice.
- (5) Within the analysis time, each team should solve the problem based on the research results, and submit the answer by using the PC given by the organizer. The answer can be submitted even in the research time (before the analysis time begins.).
- (6) After each team's answer is submitted, it will be shown on the screen.
- (7) The results are totaled up, and the ranking will be determined.

#### **5. Way to Submit the Answer**

- A PC for submitting the answer is given by the organizer in each booth.
- A software designed for submitting the answer is installed in this PC.
- Each team should submit the answer by using this PC.
- Each team should submit 6 different numbers, that is, the number of dices of each size (small, medium and large) in all of the 2 fields.

#### **6. Determination of the Rankings**

- The winner is determined according to the following order of priority:
  - (1) The error in the number of dice is calculated as an absolute value of the difference between the correct number and the answer. The errors for each size of the dice are summed up for each of the 2 fields. Such a total error for a field is less than other teams' ones.
  - (2) The error in the total number of dice per a field is less than other team's ones.
  - (3) The error in the total number of all dice in 2 fields is less than other teams's ones.
  - (4) The answers are submitted earlier than other teams' ones.
  - (5) If the winner cannot be determined by (1), (2), (3) nor (4), a toss could be executed.

#### **7. Miscellaneous**

- Only 2 portable computers can be used in the competition at most. Any programmable devices should be seen as computers. Other portable devices can be used in the booth unless those devices do not exceed the size of the booth.
- Any devices used outside of the booth should not be connected to any other devices (including power outlets) in the booth by cables.
- The PC for submitting the answer is given in the booth by the organizer.
- Each team can use 2 electric power outlets which cover around 150 [W] as a whole. The power outlets are given by the organizer.
- Any players in the team can communicate one another during the competition, but it is

actions or any actions against the rules are found, the corresponding team would be disqualified. The disqualified team should be at the lowest rank.

- If any problems occur at the competition system prepared by the organizer, such that it turns out to be impossible to send the answers through the network, each team's answer would be provided offline. In this case, the rules about the time to submit the answer would be changed.
- If the organizer has any other troubles during the game, an alternative problem would be provided and the game would be restarted.
- Any players, their computer screens and their desks are possibly recorded by the video camera and shown on the screen during the competition. It includes the data on the screen, key manipulations, notepad on the desk, etc. The screen of the PC given by the organizer will not be recorded and projected.
- The judges possibly visit each desk and watch the players, their computer screens and their desks during the competition. It includes the data on the screen, key manipulations, notepad on the desk and