

NAPROCK International Procon 2011 Competition Section “Restore the World’s Heritage”

1. Introduction

Some of the properties in Kyoto, a Japanese ancient capital, was registered as World’s Cultural Heritage in 1994. For example, famous Kiyomizu-dera Temple and Kinkaku-ji Temple are included in the Heritage list. These properties were constructed on the basis of the Japanese excellent architectural technologies and the artistic policies of garden design. In addition, in Tohoku region destructed by earthquakes and tsunamis last March, there are other important properties which are supposed to be registered as World’s Cultural Heritage list.

Many of these properties throughout Japan have been hugely degraded over time by rains, storms or other disasters. There have been many activities to prevent them from deteriorations and to restore them in detail. These are the reasons why we can visit and watch these ancient properties even now. The concept of Competition Section in this year’s Procon, “Restore the World’s Heritage” is named after these restoration of ancient cultural properties.

At first, a single initial image is presented as "field" as well as many "stamps" are given to players. If the player apply the stamp to the field, the parts of the field that correspond to the stamp are flipped (that is, restored). The goal of the competition is to obtain the final image by applying these stamps to the field correctly. In other words, “field” and “stamps” stand for the cultural property and the restoration tools, respectively. Winner of the competition is the first to restore the final image successfully from the given initial image.

2. Terminology

(a) *Cell*

- A single dot in the image is called as "*cell*".
- The value of each cell is 0 or 1.

(b) *Field*

- A "*field*" consists of many cells aligned horizontally and vertically in a rectangular shape.
- The maximum size of the field is 640 horizontal cells and 480 vertical cells.
- The origin of the field is identified by the coordinate (0,0), and located at the left-top cell of the field.
- Each cell in the rightward and downward position from the origin has horizontally and vertically positive coordinate.
- The size of the field will be assigned for each problem.

(c) *Stamp*

- A "*stamp*" consists of many cells aligned horizontally and vertically in a rectangular shape.
- The maximum size of the stamp is 128 horizontal cells and 128 vertical cells.
- The sizes of the stamps given in a game are basically different one another, but possibly some have the same sizes.
- 128 stamps will be given in a game at most.
- The number of stamps provided in a game will be specified for each problem.

(d) *Restoration*

- It is called “*restoration*” to apply a stamp at a rectangular region in the field.
- Each restoration is counted and accumulated as the number of trials.
- The value of the cell is determined by the exclusive-OR (XOR) operation between the cells of the field and the corresponding cells of the stamp.
- Stamp can be applied at any locations in the field.
- The field can be restored even if a part of the stamp is applied to the edge of the field. In other words, the whole part of a stamp is not necessarily on the field for restoration.
- The location of the restored part in the field is identified by the coordinate of the left-top cell of the applied stamp.
- Figure 1 shows an example of the restoration. In this figure, a stamp is applied to the coordinate (1, -1).

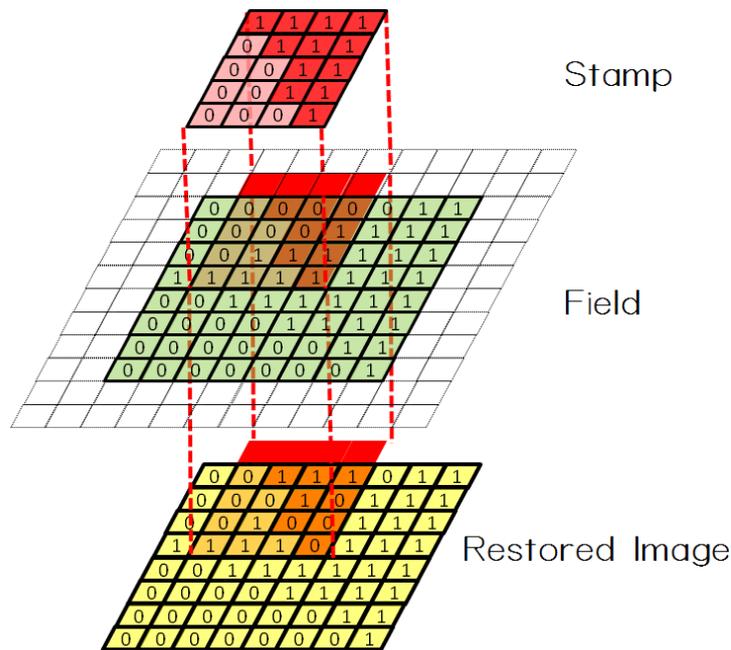


Figure 1: An example of the restoration of the field.

(e) *Problem*

- In each *problem*, an initial image, a final image and a certain number of stamps are provided.
- Figure 2 shows an example of the problems. This problem consists of an initial image, a final image and 3 stamps.
- The initial image is provided as the initial state of the field.
- In each problem, there is always at least a single stamp with the square shape of the length 1 on a side, which has the value of 1 (like stamp 0 in Fig.2).
- All problems are provided as a single file. (Please see **6. Format of Problems.**)

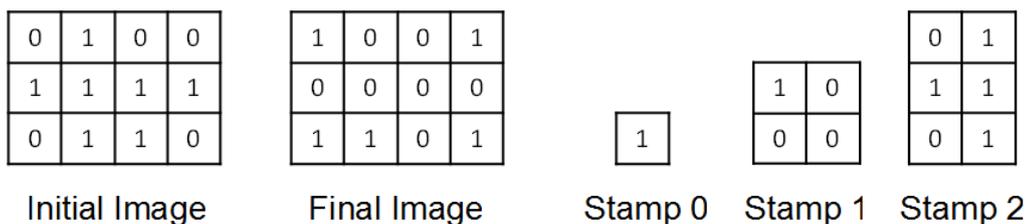


Figure 2: An example of the provided problems.

3. Restricted Time to Solve

- The time to solve the problem is restricted for each problem.
- The time to solve each problem is set as 1 to 10 minutes.
- Players should send their answers to the server before the given time is expired.
- If the time is expired while an answer is being transmitted, the corresponding answer cannot be accepted.
- The time to solve the problem will be announced before the game begins.

4. Procedure of a Game

- (1) 12 teams can play in a single game at most.
- (2) 2 different problems will be given in each game.
- (3) The first problem will be provided online soon after the game begins.
- (4) Each team should solve the provided problem and submit the answer to the server online.
- (5) After each team's answer is submitted, the following information will be shown on the screen:
 - The answer is accepted.
 - Whether the submitted image (that is, the restored image by stamps) is matched to the final image or not.
 - An error message will be shown if the submitted image does not satisfy the predetermined format.
- (6) Each team can submit the answer for a single problem 10 times at most before the given time is expired.
- (7) If a team submitted the answer too many times or sent a too big image file, it would be difficult to proceed the game. In this case, the corresponding team could be disqualified.
- (8) Only the last answer that each team submitted is supposed to be valid.
- (9) The results of the first problem (for example, rankings, the number of applied stamps or submission time) will be shown on the screen soon after the given time is expired.
- (10) An example of the correct procedures to restore the initial image could be also shown on the screen.
- (11) The second problem will be provided online soon after the time given for the first problem is expired
- (12) Each team should solve the second problem in a similar manner as the first one.
- (13) The ranking will be determined after the time given for the second problem is expired.

5. Determination of the Rankings

- The winner is determined according to the following order of priority:
 - (1) The answer is matched to the final image more precisely than others. This implies that there are less cells whose values are not matched to the values of the corresponding cells of the final image than those of other teams' answers.
 - (2) The number of applied stamps is less than those of other teams' answers.
 - (3) The final answer is submitted earlier than other teams's answers.
 - (4) If the winner cannot be determined by (1), (2) nor (3), a toss could be executed.
- The final ranking of the game is determined by the sum of (1), (2) and (3) described above for the given 2 problems.

6. Format of Problems

- Each problem (that is, an initial image, a final image and stamps) is provided as a file described in the following format:

```
Horizontal size of the initial image
Vertical size of the initial image
Bit data of the initial image
.....
Horizontal size of the final image
Vertical size of the final image
Bit data of the final image
.....
Number of stamps
Horizontal size of stamp #0
Vertical size of stamp #0
Bit data of stamp #0
.....
Horizontal size of stamp #1
Vertical size of stamp #1
Bit data of stamp #1
.....
```

- The index of the stamp starts from 0. The data of each stamp is described in the ascending order of these indices.
- The character code of the file should be UTF-8, and the newline character should be CR+LF unless otherwise announced.
- Figure 3 shows an example of the provided file which corresponds to the problem shown in Fig.2.

7. Format of Answers

- The number of applied stamps to restore the image should be written in the first line.
- From the second line, the restoration information should be written in the correct order. Each application of the stamp (that is, each trial to restore the image) should be written in one line.
- One restoration information consists of the following 3 elements : (1) the index of the stamp; (2) X-coordinate of the applied location ; (3) Y-coordinate of the applied location. Each of these elements should be marked off with a single space.
- If the file includes more number of restoration information than the declared number of applied stamps, only the declared number of restoration information is valid.
- If the file includes less number of restoration information than the declared number of applied stamps, the answer is not valid.
- Any answers which are not matched to the predetermined format are not valid.
- The character code of the file should be UTF-8, and the newline character should be CR+LF unless otherwise announced.
- Figure 4 shows an example of the answers. This answer implies that the number of applied stamps is 3, and that at the first turn, stamp #2 is applied to the coordinate (5, 10), then, stamp #0 is applied to (-5, 10), and at the last turn, stamp #1 is applied to (10, 20).

```
4
3
0100
1111
0110
4
3
1001
0000
1100
3
1
1
1
2
2
10
00
2
3
01
11
01
```

Figure 3: An example of the provided file of the problems.

```
3
2 5 10
0 -5 10
1 10 20
```

Figure 4: An example of the answers.

8. Way to Submit the Answer

- Basically, the answers should be submitted by using the software provided from the organizer of Procon.
- The source code of the provided software will be opened to the public. Teams can develop and exploit their own software to submit their answer if required.
- A token is required when each player send the answer. This token identifies each player. The token used in the competition will be provided in advance.

9. Competition Software

- A simple version of the competition system will be provided on Procon website.
- Additional information on the system and software will be also provided on Procon website.

10. Miscellaneous

- Only 2 portable computers can be used in the competition at most. One of them should have a USB port and an ethernet port for 100BASE-TX.
- These computers should be located on the assigned desk.
- Each team can use 2 electric sockets which cover around 150 [W] as a whole.
- A single LAN cable will be provided to connect to the server through the network. If any team would like to connect 2 computers to the network at the same time, they should have certain devices like switching hub by themselves.
- Any players in the team communicate one another during the competition at their desk, but it is prohibited to communicate with anyone in other teams or outside the competition area.
- Any wireless communications between 2 computers are prohibited.
- Any actions interfering the server, judges or other teams are strictly prohibited. If any of such 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, the problem for the game and each team's answer would be provided offline via USB flash memory etc. In this case, the rules about the time and submission limit 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.
- The judges possibly visit each desk and watch the players, their computer screens and their desks during the competition.
- Any data used in the competition and the data submitted by each team will be opened on the web after the competition.

11. Contact Information

- Any technical questions about competition should be asked to Contact Information provided by NAPROCK International Procon:

Prof. Tetsuya KOJIMA, Tokyo National College of Technology (kojt @ tokyo-ct.ac.jp)

12. Important Dates

- **July, 10-17, 2011 : Official entry**
- **August, 31, 2011 : Submission deadline of participants' information**
- **December, 22-23, 2011 : Programming contest**