SamurAI 3x3 2016
Rules and Program Interface

IPSJ Programming Contest Committee

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Abstract

SamurAI 3x3 (Samurai three on three) is a game played by two armies each consisting of three samurai with different weapons, competing for wider territory. Contestants build an AI program that decides the actions of the samurai that plays the games. This document describes the rules of SamurAI 3x3 2016 used in the SamurAI Coding 2016-2017 contest and its input/output specification of AI programs.

1   Game Outline

The game battlefield is mesh-partitioned into 15×15 sections. The objective of the game is to expand their territories; the number of sections they occupy on the battlefield.

1.1   Game Organization

A game is played with two armies. Each army has three samurai, each with different weapons, namely, a spear, swords, or a battleax. A samurai can occupy sections around it, and the shapes of the occupied sections depend on the weapon. Game consists of a series of turns, in which two armies play alternatingly. At one turn, one of three samurai and a sequence of its actions within the cost limit are instructed.

A series of six consecutive turns is called a period. One game consists of 16 periods, or 96 turns. In each of the three turns of an army in one period, all three samurai make actions in one of the turns.

1.2   Actions of Samurai

Each of the samurai are initially at their own home positions. AI programs are given information on the situation of (a part of) the battlefield at their turns, and decide which samurai to act and its actions.

Possible actions include: attacking and occupying surrounding areas, moving around in the battlefield, hiding themselves from enemies eyes, and showing themselves again. Each action

is associated with its cost and actions in one turn can be an arbitrary combination of actions within the given budget.

The battlefield state information a samurai is given is limited to the fields of vision of samurai of the friendly army. About such sections, whether the section has ever been occupied by samurai, and, if so, which samurai occupied it last. For friend samurai, their current position and whether they are showing themselves or not can be known, while enemy samurai can be detected only when they are showing themselves and are within the vision field of a friend samurai. AI programs have to decide the order with such limited information and within the given time limit.

1.3   Scoring

Armies played in a game receive the total of the following points.

Winning points   The army with most total occupied section is the winner. The winning army is awarded winning points of 300. The winning points do not depend on the margin of the victory. If two armies have the same number of total section, both teams receive a half, that is, 150 winning points.

Occupation points   One occupation point is awarded to each individual samurai for every single section it occupies.

2   Representation of the Battlefield and Samurai

2.1   Battlefield Sections and Coordinates

The battlefield of the game is partitioned into a mesh of 15×15 sections. Each section has two-dimensional coordinates (x, y). The coordinate system is left-handed (See Figure 1). The northwest corner has the coordinates $(0, 0)$ and the southeast corner has $(14, 14)$.

(0,0)	(1,0)	(2,0)	(3,0)	(4,0)
(0,1)	(1,1)	(2,1)	(3,1)	(4,1)
(0,2)	(1,2)	(2,2)	(3,2)	(4,2)
(0,3)	(1,3)	(2,3)	(3,3)	(4,3)
(0,4)	(1,4)	(2,4)	(3,4)	(4,4)

Figure 1: Coordinates

2.2   Weapons and Occupation

Samurai can occupy battlefield sections around depending on its weapon. Figure 2 shows the IDs of weapons and the areas of their reach. Green circles in the figure show the positions of samurai and sections painted green can be occupied using the weapons. The figure shows areas when occupation actions are southward. Occupation can also be directed westward, eastward, and northward.

With neither of the weapons, the section where the samurai stands cannot be occupied. Home positions of other samurai cannot be occupied either.

By the occupation action, enemy samurai in the occupied sections, whether or not they show themselves, are injured and require medical treatment. They will show themselves and be brought back to their home positions immediately. For the following 18 turns of treatment, they cannot take any actions.
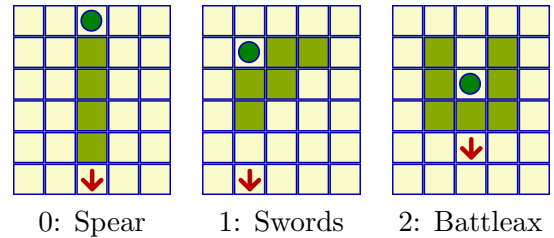

0: Spear   1: Swords   2: Battleax

Figure 2: Weapons and Occupied Areas

2.3   Home Positions

Two armies of three samurai play against each other, making a total of six participating samurai in each game. Each participating samurai is identified by its weapon ID. Samurai are initially in their home position as listed in Table 1.

The home positions are occupied by corresponding samurai before the game starts. They will never be occupied by other samurai throughout the game.

Table 1: Home Positions

Weapon	Coordinates	
	First	Second
0:Spear	(0,0)	(14,14)
1:Swords	(0,7)	(14,7)
2:Battleax	(7,0)	(7,14)

3   AI Programs

3.1   Outline

AI programs are initiated by the game system. On its initiation, an AI program receives the overall information and specification of the game (game information) from the standard input. It then should respond with an acknowledgement to the game system via the standard output, indicating that it is ready. After this initiation phase, the AI program will receive information on the state of the game (turn information) from the standard input on its turn, and the order, a samurai ID and its a sequence of actions to take are to be sent through the standard output.

3.2   Formats of Transferred Data

All the contents are represented in ASCII characters. Numerical values are decimal integers. A minus sign ('-') in front of the number indicates a negative value. Decimal integers are delimited with blanks and newlines. A sharp sign ('#') indicates comments, and whatever follows until the end of the line are considered to be a part of the comment.

3.3   Time Limit

AI programs should respond within the time limit of 100 milliseconds. This is not CPU time, but wall clock time elapsed between when the game system completed sending and it completed receiving the response. Failing to meet the time limit disqualifies the army: All the samurai of the army will show themselves and be sent back to their home positions. They cannot take any actions until the end of the game.

3.4   After Completing a Response

The AI program will be suspended by the game system after completing its response until its next turn.

4   Game Information

Game information tells whether the army is the first player or the second player.

4.1   Play Order

When the army plays first, it is indicated by a 0; otherwise, that is, it plays second, 1.

4.2   Game Information Example

Figure 3 shows an example of game information. The first line is a comment line starting with a '#'. The second line says that the army is the second player in the game.

```
# Game Info
1
```

Figure 3: Game Information

4.3 Acknowledgement Response to the Game Information

Receiving the game information, the AI program should return an integer zero and a newline to acknowledge it. This may include comments and extra spaces, but the total of characters should not exceed 100. The acknowledgement response should be made within the time limit of 100 milliseconds, or else the army will be disqualified.

5 Turn Information

Turn information consists of the following in this order.

1. Turn number

2. Samurai states

3. Battlefield states

Details are discussed below.

5.1 Turn number

Turn number is the sequential number of the turn for which the actions of the samurai should be planned. Turn numbers start with zero and is less than the total number of turns, or, the total number of periods times 6.

5.2 Samurai States

Samurai states are information of six samurai immediately before the turn. Information for one samurai consists of five integers: two for its current position, one for its order status, that is, whether or not an order for the samurai has already been placed in the same period, and one for its showing status, that is, whether or not it shows itself, and, finally, one for the number of treatment turns. The samurai state information is given first for three samurai of the friendly army in the order of their weapon IDs, and then for three in the enemy army in the same order. There are, thus, 30 integers in total.

The current position has two integers x and y, which gives the coordinates (x, y) of the samurai before the turn. Positions of friendly samurai are always found, but those of enemy samurai cannot be found when they are out of the vision of all friendly samurai or they are hiding. For such samurai, their current positions are indicated as two -1.

The order status is 1 if the samurai already has given an order in the same period, and 0 otherwise. This also applies to samurai in injury treatment that cannot take any actions.

For friendly samurai, the showing status is 1 when it is hiding itself and 0 otherwise. For enemies, you cannot tell whether they are hiding or simply out of the vision. The showing status of 1 is given in either case.

When a samurai is in the section occupied by an enemy samurai, it will show itself and be immediately brought back to its home position. During 18 consequent turns of injury treatment, it cannot make any action, but it can receive the status information. The treatment turns is

the number of turns remaining for treatment. It is 0 if the samurai is not during its treatment. This information is provided even if the samurai is out of the vision fields of any of the friendly samurai.

5.3 Battlefield State

Battlefield state gives occupation states of battlefield sections.

The state of a section is given as a single integer. They are given in the ascending order of y and x axes, as $15 \times 15 = 255$ integers. Not all the sections are provided with their state information. Only those in the vicinity of friendly samurai are visible. The sections for which information are provided are those within the Manhattan distance of 5 from the positions of friendly samurai, that are, with a friendly samurai is at (x, y), sections at $(x + d_x, y + d_y)$ for $|d_x| + |d_y| \le 5$ (Figure 4). Even if a samurai is in recovery or is disqualified, it can provide battlefield state information around its position (which is its home position).

Information on each section is encoded as follows.

Figure 4: Field of Vision

0 to 2: This section was last occupied by a friendly samurai with weapon ID 0 to 2.

3 to 5: This section was last occupied by an enemy samurai with weapon ID 0 to 2.

8: Not occupied with any samurai yet.

9: No information is provided as there are no friendly samurai nearby.

5.4 Turn Information Example

An example of turn information is shown in Figure 5.

6 Ordering

An order to a samurai consists of the weapon ID of the samurai followed by a sequence of integers specifying its actions and terminated with an integer 0.

6.1 Actions of Samurai

Samurai can take any of the following 9 actions of 3 categories.

Occupy (1 through 4; cost 4): Occupies neighboring sections. The sections occupied are decided by the weapon used and the direction to apply it. The sections that can be occupied are shown in Figure 3. Directions to apply the weapon is specified as 1 for southward, 2 for eastward, 3 for northward, and 4 for westward. Occupation actions cannot be made while hiding.

Move (5 through 8; cost 2): Moves to one of the adjacent sections. If the samurai is not hiding itself, it cannot move to a sections in which a non-hiding samurai is in. A samurai hiding itself can only move to a friendly territory section. Whether showing or hiding
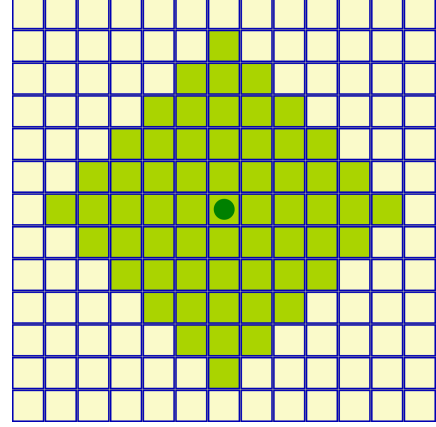
itself, home positions of other samurai cannot be entered. The move direction is specified as 5 for southward, 6 for eastward, 7 for northward, and 8 for westward.

Show/Hide (9; cost 1): Switches its showing state. This can be done more than once in the action sequence of a single order. Hiding is only possible when the samurai is in a friendly territory section. Showing is not possible if there is another non-hiding samurai, either friendly or enemy, in the same section.

The constraints on move and show/hide actions ensures that no two samurai can share the same section when both are showing themselves. On the other hand, more than one hidden samurai can share a section occupied by a friend.

6.2 Order

An Order tells which samurai to take actions and a sequence of actions.

The samurai to take actions is specified by the ID of its weapon. The action sequence is specified by a list of integers meaning the actions described in the previous section, within the cost total of 7, followed by a 0 to indicate the end of the list. An order with only a weapon ID and a 0, for example, means that the specified samurai is ordered to do nothing.

When the specified weapon ID is that of a samurai already ordered in the same period, the order is invalid and no actions are taken. Invalid actions (moving out of the battlefield, moving into an enemy territory while hiding itself, trying to hide itself in an enemy territory, etc.) and all the following actions in the action sequence are ignored, although actions to it are effective. When the total cost of the actions exceeds the given budget, actions up to their total cost of seven are valid, and the rest are ignored. An order of one turn should not exceed one hundred characters, and the army will be disqualified if this is violated.

Samurai in its injury treatment can be ordered, although actions specified will be ignored.

```
# <turn>
14
# Samurai states
0 6 1 0 0
1 14 0 0 0
9 12 0 0 0
-1 -1 1 0 0
-1 -1 0 0 0
-1 -1 1 0 0
# Battle field states
 0 9 9 9 9 9 9 2 9 9 9 9 9 9 9
 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9
 8 8 9 9 9 9 9 9 9 9 9 9 9 9 9
 8 8 8 9 9 9 9 9 9 9 9 9 9 9 9
 8 8 8 8 9 9 9 9 9 9 9 9 9 9 9
 8 0 0 0 0 9 9 9 9 9 9 9 9 9 9
 0 8 8 8 8 8 9 9 9 9 9 9 9 9 9
 1 8 8 8 8 9 9 9 9 8 9 9 9 9 4
 0 8 8 8 9 9 9 9 8 8 3 9 9 9 9
 0 8 8 9 9 9 9 8 8 8 8 8 9 9 9
 8 8 8 9 9 9 8 8 8 8 8 8 8 9 9
 8 8 8 8 9 8 8 8 2 8 2 8 8 8 9
 1 1 8 8 8 8 8 8 2 2 2 8 8 8 8
 1 1 1 8 8 8 8 8 2 2 2 8 8 8 9
 8 1 1 1 8 8 8 5 2 2 2 8 8 9 3
```

Figure 5: Turn Information

6.3 Order Example

An example of an order is given in Figure 6. This order tells three actions to the samurai with swords (1), southward occupation (1), move eastwards (9), and then switch show/hide (9), in this order, followed by a 0 to indicate the end. The sum of the action costs is seven in this case.

```
# Order
1 1 6 9 0
```

Figure 6: Order Example

7 Miscellaneous

- In the acknowledgement response to the game information or the orders, any content following the terminating 0, including comments, will not be processed. The unprocessed

contents will show up as the output of the AI program in its next turn, so it might cause the program to act unpredictably.

- AI programs will be terminated by the game system. Therefore, the AI programs are not required to process its own termination.

- The game has many aspects common with the SamurAI 3x3 game used in the SamurAI Coding 2015-2016 contest. Major differences are the following.

  - A single program controls all three samurai in an army.
  - The samurai to take actions is specified in an order.
  - Parameters such as the battlefield size, the total number of turns, and the number of turns for injury treatment are fixed.
  - Actions to switch between show/hide status are merged.