3-Hirn System: The First Results in Shogi

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Abstract

Humans and computers with their different aspects of strength can be a nice combination in making a good decision. In order to combine the strength of humans and computers, "Multiple Choice System" was introduced. 3-Hirn is one of the example of Multiple Choice System, where two different computer programs (or humans) make one proposal for solving a given problems and a human boss has the final choice amongst them. The experiments of 3-Hirn in shogi have shown that the strength is considerably improved. In addition, the 3-Hirn systems with two human advisors have defeated the players that are stronger than two advisors. Besides a game world, 3-Hirn concept can be practical in various fields.

Keyword: Multiple Choice System, 3-Hirn, Chess, Shogi

1 Introduction

"3-Hirn", which is introduced by Prof. Dr. Ingo Althofer is a system that consists of two different computer programs and a human boss (or controller) to make the final decision.

The definition of this system is, two different computer programs are asked to make their proposals each for solving a given problem. Then, the human boss has the final choice among the proposals of these two computer programs. If both programs propose the same solution, it has to be executed. The human boss is not

allowed to outvote the programs. The boss selects one of two proposals in the case where they are different.

In 3-Hirn, the human is only the referee in the case where the proposals are different. Human boss is always in a choice situation.

In this paper, we tell a story of success in Chess with 3-Hirn in Section 2. In Section 3, we described the experiment of 3-Hirn in Shogi. And the last Section we conclude a short discussion.

2   The 3-Hirn in Chess

The 3-Hirn system has been explored in domain of Chess since 1985. The 3-Hirn teams played against other persons or chess computer programs. Table 1 shows the performance of several 3-Hirn teams with changing computers and programs.

In all of these teams, the controller's Elo rating is between 1950 and 1850.

Year	Strength of the computer programs	Strength of 3-Hirn
1985	1500	1700
1987	1800	2100
1989	2050	2250
1992/93	2250	2500
1995	2350	2540
1996*	2350	2550
1997*	2550	2750

Table 1: The result of 3-Hirn in Chess

*"Double-Fritz with Boss" had used. In "Double-Fritz with Boss", Fritz was used in 2 best mode. In this mode Fritz does not only compute its best move but also its second proposal.

** "List 3-Hirn" had used. In "List 3-Hirn", two different chess programs compute their k best

From the experiment, we can learned that the total strength of 3-Hirn team is,

Strength of the program + 200 Elo points improvement
± 50   points Elo deviation

From the conclusion above, we understand that the strengths of human and computers were well-combined in 3-Hirn.Table 2 shows us the strengths of combination humans and computers in 3-Hirn.

Aspect/ Entity	Tactics	Memory	Long-range Planning	Learning	Psychology
Program	Strong	Strong	Weak	Weak	??
Human	Weak	Weak	Strong	Strong	??
3-Hirn	Strong	Strong	Strong	Strong	Strong

Table 2: Strengths of 3-Hirn

From the table above we knows that computer is strong in tactical power and memory. In the other hand human is strong in long-range planning and learning. The question marks "??" in the psychology column indicate that human is more or less able to aware the opponent, which are not well understood by the computer. These combinations supplement very well.

3   The 3-Hirn in Shogi

Besides Chess, there are several other brain games that can proved the usefulness of multiple choice systems.

Shogi   is   another   instructive   testbed   to   which   the multiple-choice systems can be usefully applicable. In Shogi, playing strength is measured in dan (master) and kyu (lower) grades for amateurs.

The same as 3-Hirn in Chess, 3-Hirn in Shogi also consists of

two different Shogi computers and one human player. Each computer decides a move in position on the board. They are run in an infinite mode and compute and compute. The controller inspects their display all the time. Then, the human boss chooses one of the proposals by the two computers. The human is not allowed to overrule the computers.

3.1   Experiments

The 3-Hirn in Shogi experiment is towards three groups: professional player, standard player and the beginner.

The experiment is implemented in a match, which the 3-Hirn team is consists of two advisors and one human boss. The team will have a match between the opponent (human). In each experiment we assume that the boss select the proposal randomly.

This time we had arranged the 3-Hirn in Shogi experiment in two kinds of experiment: Experiment 1 and Experiment 2.

In Experiment 1, we used the present condition of 3-Hirn, which comprise one human boss and two computer programs as the advisors. But the advisor of the 3-Hirn systems is not absolutely necessary a computer. To answer this criticism, in Experiment 2, we had a new condition of 3-Hirn, which comprise one human boss and two humans as the advisors.

3.1.1   Experimental Results

The following table shows us the results of Experiment 1 in which the 3-Hirn advisors are computers.   The used programs are Todai Shogi, Gekisashi, AI Shogi and Kanazawa Shogi. The game record of a two-piece handicap match between 3-Hirn (Todai+Kanazawa with human boss (1700?)) as handicap taker vs. human (2600) as handicap giver is shown in Appendix.

| Date | Rating | | | | Result |
	Boss (Human)	Advisor1 (Computer)	Advisor2 (Computer)	Opponent	
3 July	0	Todai	Gekisashi	1500	Win
27 July	1700?	Todai	AI	1800?	Win
* 27 July	1700?	Todai	Kanazawa	2600	Win
** 10 October	0	Todai	Gekisashi	1700	Win
** 10 October	700	Todai	Gekisashi	1805	Win

Table 3: Result of Experiment 1

* Game with two-piece handicap to Opponent
** These two matches were played in Shogi Club 24 via the Internet.
Besides of these two matches, there were other four experiments in Shogi Club 24 that did not finish because of the time limits.

The results of Experiment 2 when the advisors are humans are shown in Table 4. The experiments that use computer as the advisor are too complicated. That is one of reason why we changed the condition. Moreover, it is quite interesting to examine the correlation between a human boss and human advisors.

| Date | Rating | | | | Result |
	Boss (Human)	Advisor1 (Human)	Advisor2 (Human)	Opponent	
1 October	2100	800	200	1500	Win
4 October	2100	1600	1500	1893	Win

Table4: Result of Experiment 2

3.1.2 Conclusions

From the Experiment 1, we can say that the lower bound of the strength of a man-machine team is not dependent on the strength of a human boss. Conversely, the result of Experiment 2 presents that the strength of a man-machine team is dependent on the strength of a human boss.

In Experiment 1(when advisor is a computer), the rating of each advisor is higher than opponent. If the opponent has a match between each of the advisor alone, a probability to win is very small. In this experiment, although the human boss selects the proposal randomly, the man-machine team still has the possibility to win.

In Experiment 2 (when advisor is a human), the rating of each advisor is lower than opponent. It is very hard to win a game if each of the advisors have a match with the opponent alone. But in the experiment that had been held on October 1 and October 4, we can make a conclusion that there is a relation between the strength of a human boss and the strength of 3-Hirn team.

When we change the advisors from computers to humans, we get a new table (Table 5) to shows us the strength of combination human boss and human advisors. Although both of the advisor's tactics and memory are not strong, this is not giving any effect to the 3-Hirn team.

Aspect/ Entity	Tactics	Memory	Long-range Planning	Learning	Psychology
Human1	Weak	Weak	Strong	Strong	??
Human2	Weak	Weak	Strong	Strong	??
3-Hirn	Strong	Strong	Strong	Strong	Strong

Table 5: Strengths of 3-Hirn with human advisors

Here we had known the result when we change the advisors from computers to humans. Then we need another condition such as the human boss is forbidden to know which advisor makes his/her proposal.

The experiment that had been held on October 1 and October 4 were using this condition. In these two experiments, the human boss doesn't know whose advisor proposal he choose. But the human boss still can make a planning and choose which one is the best proposal. From this we know that the higher the human boss rating, the possibility of 3-Hirn team to win a match is high.

In Experiment 1, the condition of the two matches that had been held on October 10 is different with the matches that had been held on October 1 and October 4. Besides the advisor condition is different, each human boss of these two matches knows whose proposal he choose. Most of the human boss choices are from the stronger advisor proposal. This also gives an effect to the match.

Even though the 3-Hirn system is most perfect, we have to face that 3-Hirn system has a problem with time management. The 3-Hirn system need time to think which is not usual in a common match.

4 Discussions

1. Besides of the points that we explain above, there is some other more question that we still not find the answer.
   It listed as below:
   - One of the 3-hirn system concept is boss cannot outvote the programs but what happened if the boss has his/her idea
   - The result if 2 advisors become N advisors.

2. Multiple choice system may be useful in other application not only in a world of game. For example;
   - Optical pattern recognition
   - Vehicle routing, traffic control, organization of air flights and railway planning
   - Stock market, financial
   - Computer-assisted analysis in Medicine
     (for instance cardio-diagnosis with the help of automatic electro-cardiogram analyzers)
   - Computer-assisted theorem proving in mathematics and in other more fields.

5 References

1. I. Althofer and R.G.Snatzake, Playing game with Multiple Choice Systems, 3rd International Conference on Computers and Games 2002, Edmonton, 2002.to appear in LNCS, Springer.

2. I. Althofer, 3-Hirn ··· New Ways in Go with Computer, 10 August 2000.

3. I. Althofer, The 3-Hirn Setting and its Variants in Chess

Appendix: Game record of a two-piece handicap match between 3-Hirn (Todai+Kanazawa with human boss (1700?)) as handicap taker vs. human (2600) as handicap giver

△6二銀	▲7六歩	△7二金	▲4八銀	△3二金	▲5六歩
△5二玉	▲6八玉	△9四歩	▲9六歩	△7四歩	▲7八玉
△7三銀	▲6八銀	△6四歩	▲6六歩	△8四銀	▲7七銀
△6三金	▲5八金右	△7五歩	▲同 歩	△同 銀	▲6七金
△8四銀	▲7九角	△7五歩	▲5五歩	△4二銀	▲8八玉
△8五銀	▲5七銀	△7四銀	▲7八金	△8四銀	▲5六銀
△4四歩	▲2六歩	△4三銀	▲2五歩	△5四歩	▲2四歩
△同 歩	▲5四歩	△同 金	▲5五歩	△5三金	▲2四角
△2三歩	▲6八角	△8五歩	▲8六歩	△同 歩	▲8二歩
△7三桂	▲8一歩成	△8七歩成	▲同 玉	△7六歩	▲同 玉
△7五歩	▲8七玉	△6五歩	▲9一と	△6六歩	▲同 銀
△6五歩	▲5七銀	△6四金	▲7二歩	△6二玉	▲2二歩
△同 金	▲8二歩	△7二玉	▲8一歩成	△6三玉	▲9二と
△5四歩	▲4六銀	△4五歩	▲同銀左	△5五歩	▲4四香
△5四銀	▲4二香成	△8六歩	▲8八玉	△8五銀	▲8二と寄
△6六歩	▲同 金	△6五銀	▲5五金	△6六歩	▲8三と
△8七歩成	▲同 金	△6七歩成	▲7三と	△同 玉	▲7七桂打
△7六銀右	▲6五桂	△同 金	▲同 金	△同 銀	▲5五銀
△6八と	▲6四金	△7二玉	▲7三歩	△8一玉	▲8三銀
△8二金	▲7二歩成	△同 金	▲同銀成	△同 玉	▲7四歩
△7九角	▲9八玉	△8四銀	▲7三歩成	△同 銀	▲6三金打
△8三玉	▲7三金寄	△9三玉	▲6五金	△8二歩	▲8四銀

まで 132 手で下手の勝ち