'LOSING MOVE'

which a grandmaster, chosen at random, will make one or the other of the two plausible moves with probability one-half. Assume that in all other positions he will choose the correct move with probability one. Then we might expect to find only a half-dozen or so positions for each player in a game that are problematic in this strict sense. We can now apply the abstract model to characterize problematic positions as W*, W', 'plus', and so on. We can characterize moves that change the game from D to L', say, as 'losing moves' or 'weak moves.'

Number of coins remaining	Number of heads minus number of tails										
	10	8	6	4	2	0	-2	-4	-6	-8	-10
10	-	-	-	-	-	.172	-	-	-	-	-
8	-	-	-	-	.363	.144	.035	-	-	-	-
6	-	-	-	.657	.344	.110	.016	0	-	-	-
4	-	-	.938	.688	.313	.063	0	0	0	-	-
2	-	1.000	1.000	.750	.250	0	0	0	0	0	-
0	1.000	1.000	1.000	1.000	0	0	0	0	0	0	0

Table 1: Probability of Win by Player 1
(calculated as a problem of gamblers' ruin, given number of coins (plays) remaining and net excess of heads)
$N = 5, \; k = 2$

The theory of gamblers' ruin can be used to throw further light on the meaning of these terms. Each move in a problematic position corresponds to a toss of an (unbiased) coin. V is the number of heads minus the number of tails. **Table 1** shows the probabilities of a win by the first player as a function of the number of problematic positions remaining in the game and the current value of V, where a win requires an excess of two heads. The numbers in this table are not entirely unrealistic as a description of grandmaster chess. It could be made more realistic by taking account of the initial advantage the first player is thought to have. For chess between strong players, $V(0)=1$, $k=1$ might be realistic.

The model can readily be extended to take account of differences in skill between the players. Positions will be problematic for the weaker player that are not for the stronger player. Consider all the positions that are problematic for the weaker player (regardless of who is on move). A subset of these will be problematic for the stronger player; on the remainder, if he is on move he will make the correct choice. This representation is equivalent to a gamblers' ruin problem in which the stronger player starts out with a positive score equal to the difference in numbers of choice points that are problematic for the two players. It can be seen that only a small positive score is needed virtually to guarantee victory to the stronger player.

Conclusion

From a game-theoretic standpoint, chess is a trivial game of perfect information. For purposes of psychological or artificial intelligence theory, we must take into account the fallibility of the players (men or computers) as information processing systems. One way to do this is to distinguish between "obvious" and "problematic" moves, and to take account of the probability that a correct choice will be made in a problematic situation. A formalization of this problem shows that it can be viewed as a problem of gamblers' ruin. A further elaboration of these ideas can be found in another paper.⊗

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BOOKS

Robotics
John F. Young
Halsted Press, John Wiley & Sons, Inc., N.Y., 1973
reviewed by Steve Coles - SRI

Author of books on "Cybernetics" and "Cybernetic Engineering", John Young is a lecturer at the University Aston, Birmingham, England. His text on robotics is heavily oriented toward the British work with special emphasis on industrial applications. It is marred by unsubstantiated claims regarding the market for household, domestic robots and the speed with which humanoid robots (androids) will be upon us. Its complete lack of photographs and numerous other minor flaws leads me to recommend that it can be safely ignored by the AI community.

Artificial Intelligence
Marvin Minsky and Seymour Papert
(MIT)
1974 Condon Lectures (Paperback Publication)
Oregon University Eugene, Oregon

1. Vision and Description: Reasoning by Analogy;
   Children's Use of Descriptions.

2. Appearance and Illusion: Sensation, Perception, and Cognition;
   Parts and Wholes.

3. Analysis of Visual Scenes: Program for Finding Bodies in Scenes.

4. Description and Learning: Learning or "Keeping Track";
   An Example of Learning: Piaget's Conservation Experiments;
   Learning;
   Learning Without Description: "Incremental Adaptation";
   Trial and Error; Learning by Building Descriptions;
   Learning by Being Taught; Analogy, Again;
   Grouping and Induction.

5. Knowledge and Generality:
   Uniform Procedures vs. Heuristic Knowledge;
   Successive Approximations and Plans.

⊗ Simon, Herbert A. "The Psychological Concept of 'Losing move' in a Game of Perfect Informaton", **Proceedings of the National Academy of Sciences.**