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Origins of Game Theory

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**Café de la
Régence,
Paris, 19th
Century**



Source: Wikimedia Commons

Chess in the Culture

“In the first decades of the twentieth century, chess enjoyed great visibility in many parts of Continental Europe.... From London to Moscow, the grand masters enjoyed great visibility and prestige, and the game was played in the chess cafés of the capitals, such as the Marienbrücke in Vienna and the famous Café de la Régence in Paris. Against a background of high tournament drama, chessmasters such as [Emanuel] Lasker and Siegbert Tarrasch wrote manuals on strategy, and the influence of the game was felt in many dimensions of scientific and literary culture. Thus psychologists investigated the thought processes required in chess, and mathematicians wondered whether so human an activity could be made amenable to formal treatment. Others speculated philosophically about the relationship of chess to life in general, and the game was a source of inspiration for several writers, including Vladimir Nabokov ... and ... Stefan Zweig.”

-- Von Neumann, *Morgenstern and the Creation of Game Theory*, by Robert Leonard, Cambridge University Press, 2010, p.10

Chess and Life



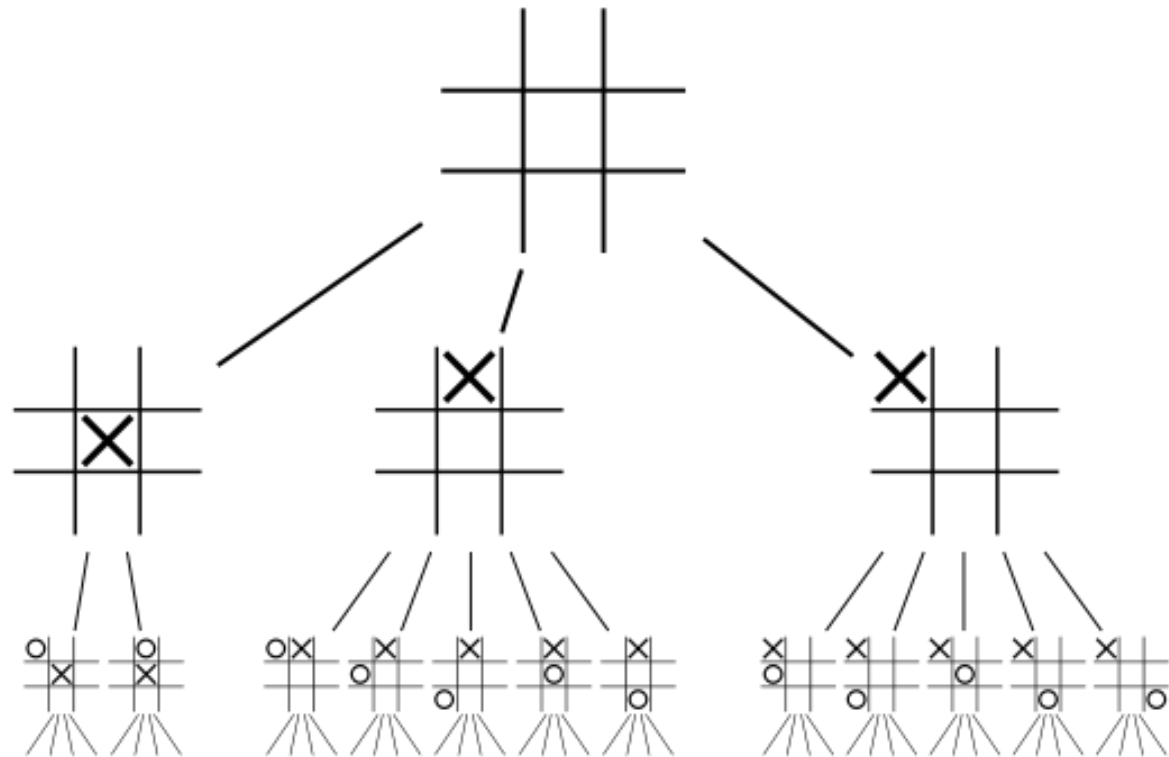
CHESS PLAYER EMANUEL LASKER.

<http://en.wikipedia.org/wiki/File:ELasker.jpg>

“The magnitude of the work that a group of [players] can perform under all varying possible conditions that may present themselves ... is an index of the ... value of that group.”

-- *Struggle*, by Emanuel Lasker, Lasker's Publishing Company, New York, 1907, p.31 (Lasker was World Chess Champion from 1894 to 1921)

The Game Tree for Tic-Tac-Toe



Source: Wikimedia Commons

Question: What would you estimate the number of different 'games' of tic-tac-toe (formally: paths through the tree) to be?

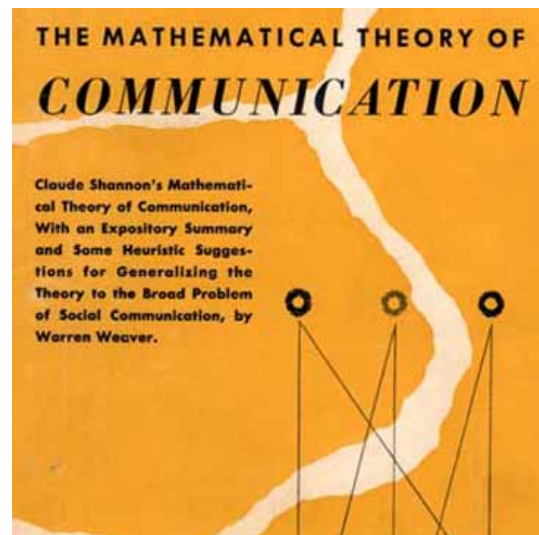
The Game Tree for Chess

Question: What would you estimate the number of different 'games' of chess (formally: paths through the tree) to be?

Hint: The number is greater than the number of elementary particles in the (visible) universe

An estimate can be found in the famous paper "Programming a Computer for Playing Chess," by Claude Shannon (*Philosophical Magazine*, 41, 1950), that initiated the field of computer chess

(Claude Shannon was the founder of information theory)



Source:
<http://museum.mit.edu/nom150/entries/1364>

Von Neumann's 1928 Paper

1. The concept of **strategy**

"[I]t is possible to bring all games ... into a much simpler normal form Each player S_m ($m = 1, 2, \dots, n$) chooses a number $1, 2, \dots, N_m$ without knowing the choices of the others."

2. The **Minimax Theorem**

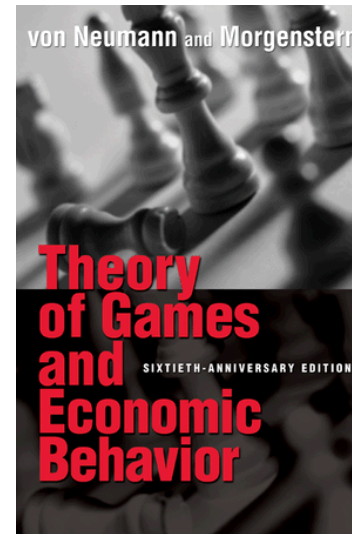
"[H]e is protected against his adversary 'finding him out'"

3. The concept of a **cooperative** game

"[T]he three-person game is essentially different from a game between two persons.... It is [now] a question of which of the three equally possible coalitions $S_1, S_2; S_1, S_3; S_2, S_3$ has been formed. A new element enters, which is entirely foreign to the stereotyped and well-balanced two-person game: struggle."

"Zur Theorie der Gesellschaftsspiele," *Mathematische Annalen*, 100, 1928, 295-320

**Von
Neumann's
and
Morgenstern's
1944 Book**



“The theory of mechanics for 2, 3, 4, ... bodies is well known, and in its general theoretical (as distinguished from its special and computational) form is the foundation of the statistical theory for great numbers. For the social exchange economy --- i.e., for the equivalent ‘games of strategy’ --- the theory of 2, 3, 4, ... participants was heretofore lacking.... A fundamental reopening of this subject is the more desirable because it is neither certain nor probable that a mere increase in the number of participants will always lead in fine to the conditions of free competition.”

Theory of Games and Economic Behavior, by John von Neumann and Oskar Morgenstern, 1944, pp.14-15