

HISTORY OF GAME THEORY

PROBABILITY

- The history of game theory is closely related to that of probability.
- The theory of probability developed because of gambling.
- Dice date back to at least 5,000 years ago.
- The dice below were found at Shahr-e Sukhteh (translated to Burnt City) in southeastern Iran in a backgammon set.



PROBABILITY (CONT.)

- The foundations of mathematical probability can be traced back to 1654. Prominent gambler Antoine Gombaud was considering the following two lotteries. He could not figure out why he was winning on the first lottery and losing on the second one.

- Roll a single die four times. What are the odds of getting a six?

Each roll has a single chance out of six, so four rolls should give us a four out of six chance to roll a six.

- Now, roll two dice twenty-four times. What are the odds of getting a double six?

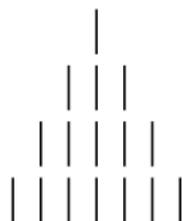
Each toss of the dice has a one out of thirty-six chance to roll a double six. Roll twenty-four times, and your odds of getting a double six should be twenty-four out of thirty-six, which reduces to four out of six.

PROBABILITY (CONT.)

- Those two outcomes are equally likely, Gombaud thought, and so he set games based on those odds. After he lost a huge amount of money, it occurred to him that he might have made a mistake.
- Gombaud posed this question to Blaise Pascal and Pierre de Fermat.
- They clarified the problem by simply calculating the odds of not rolling a six or a double six.
 - Bet 1: A six will happen at least once out of four rolls of one die.
 - Bet 2: Two sixes will happen at least once out of 24 rolls of two dice.

EARLY GAMES

- Some games of chance are: craps, roulette.
- Some games of strategy are: baccarat, bridge, chess.
- Consider the following game called Nim.
 - The game starts with several rows of objects.
 - On each turn, a player must remove at least one object, and may remove any number of objects provided they all come from the same row.
 - Whoever takes the last object loses.



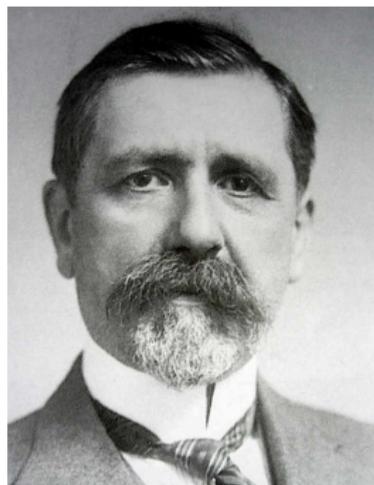
(For the winning strategy, see
<https://www.youtube.com/watch?v=niMjxNtiu8>.)

EARLY APPROACHES

- Early approaches involved trying to find a winning strategy.
 - Bouton dealt with Nim in 1901.
 - Zermelo dealt with chess in 1913.
 - Nash dealt with Hex in 1952.

STRATEGIC INDEPENDENCE

- Emil Borel wrote a series of papers between 1921 and 1927 where he set out to investigate whether it is possible to determine a method of play that is better than all others. This method of play is a code that determines for every possible circumstance exactly what the person should do.



JON VON NEUMANN

- Jon von Neumann was a Hungarian mathematician.
- By 26, he had already published 32 papers.
- He has been credited with founding game theory based on a paper he wrote in 1928.
- In 1944, he wrote, alongside Oskar Morgenstern, the seminal book *Theory of Games and Economic Behavior*.
- Jon von Neumann developed the first electronic computer while working on the Manhattan Project.



JOHN FORBES NASH JR.

- John Nash started as a mathematics graduate student at Princeton in 1948.
- He submitted a paper to the Proceedings of the National Academy of Sciences in 1949, where he proved that an equilibrium exists in every game.
- Jon von Neumann's remark was: That's trivial you know. That's just a fixed-point theorem ...



EXTENDING NASH

- Nash's dissertation elaborated on ideas about *non-cooperative* game theory.
- Once Nash's program became well accepted, the general concept needed to be modified for specific cases.
- Nash's formulation gave social scientists a general formal theory that can be used to analyze any situation.

NOBEL PRIZE WINNERS

- John Nash won the Nobel prize in 1994 alongside Reinhard Selten and John Harsanyi.
- The Nobel laureates that researched game theory are the following.

