

# Al in chess

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### Introduction

- Al and techniques
  - DeepBlue
  - Stockfish
  - AlphaZero



### What is chess?

Chess is a recreational and competitive board game played between two players.

It is played on a square chessboard with 64 squares arranged in an eight-by-eight grid.

It has 6 different pieces that move different.

The goal is to checkmate the opponent's king.





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### Can we not just store all the perfect moves?

Well it's not that simple...

# **Chess complexity**

- Size of complete search tree
  - Chess: 10<sup>123</sup>
  - Go: 10<sup>360</sup>
- Atoms in human body: 10<sup>27</sup>
- Atoms in Earth:  $10^{49}$
- Atoms in Milky Way: 10<sup>68</sup>
- Atoms in Universe: 10<sup>78</sup>



So, one of the goals of early computer scientists was to create a chess-playing machine.



1946: Alan Turing began first investigations.



 1951: The University of Manchester developed a program for the Ferranti Mark 1 computer that solved predefined problems.





### And in 1997 we finally did it!

Deep Blue became the first computer to beat the reigning World Champion in a match when it defeated Garry Kasparov





### So how does Deep Blue work?



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# DeepBlue

- Made by IBM in the 90's.
- 30 IBM Power2 processors of 120 MHz.
- 480 coprocessors specially made for this machine.
- It could calculate 100 million positions per second.
- Uses 4 techniques.



## Tree Search





## The Evaluation Function





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# Heuristics/Optimizations





# Stockfish

- 512 CPU threads in multiprocessor systems.
- 32 TB cache of previously seen positions.
- Developed in C++
- Same techniques as DeepBlue
- Neural network as an evaluation function
- 70 million positions per second



# Alpha Zero

- Developed in 2017 by DeepMind
- Reinforced learning techniques and Deep Neural Networks
- Monte Carlo search tree

## **Monte Carlo**





# Alpha Zero

- 80.000 positions per second
- 80 layers and hundreds of thousands of neurons
- Generates games for training
- 64 TPUs for training and 4 TPUs for playing





### Conclusión

