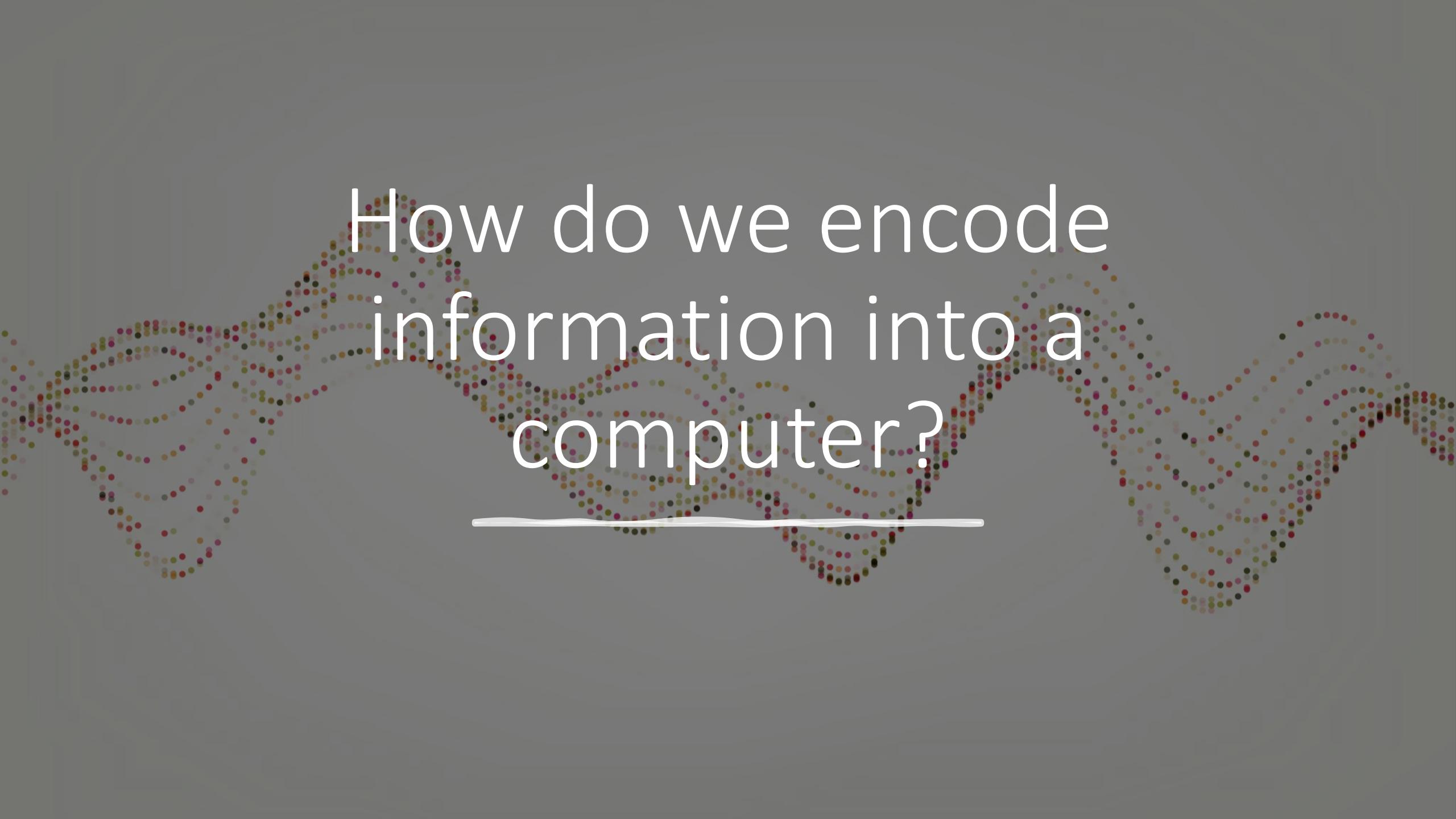


Software 2.0, Abstraction and Gödel's Incompleteness Theorems

Nate

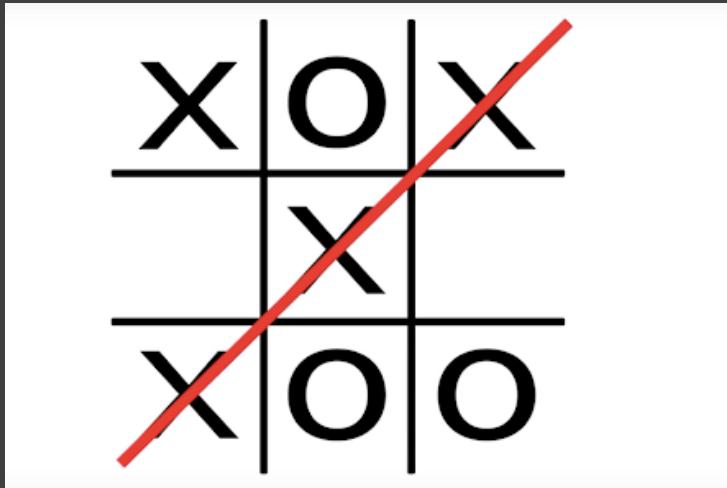
natitaw.com



How do we encode
information into a
computer?

A Simple Case – Tic-Tac Toe

- *Define Game Boundary*
- *Define Rules*
- *Respond via Executing a Search Algorithm*



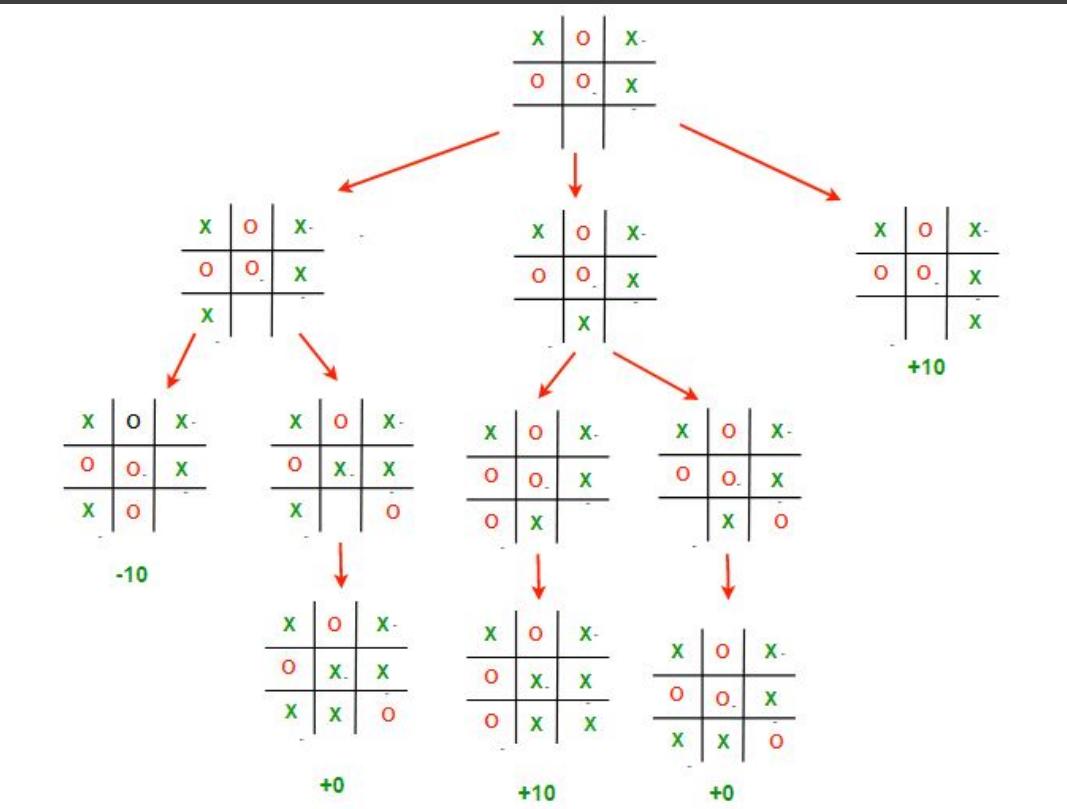
```
1  def game():
2
3      turn = 'X'
4      count = 0
5
6      for i in range(10):
7          printBoard(theBoard)
8          print("It's your turn," + turn + ".Move to which place?")
9
10         move = input()
11
12         if theBoard[move] == ' ':
13             theBoard[move] = turn
14             count += 1
15         else:
16             print("That place is already filled.\nMove to which place?")
17             continue
```

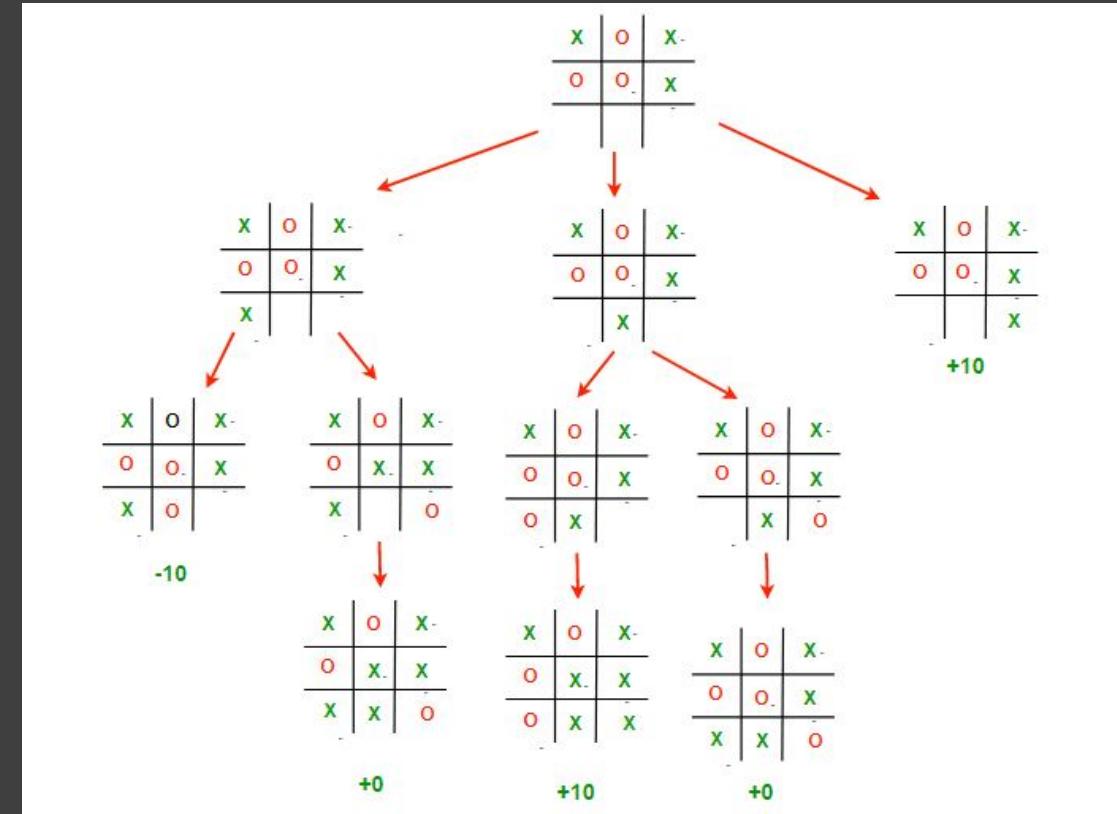
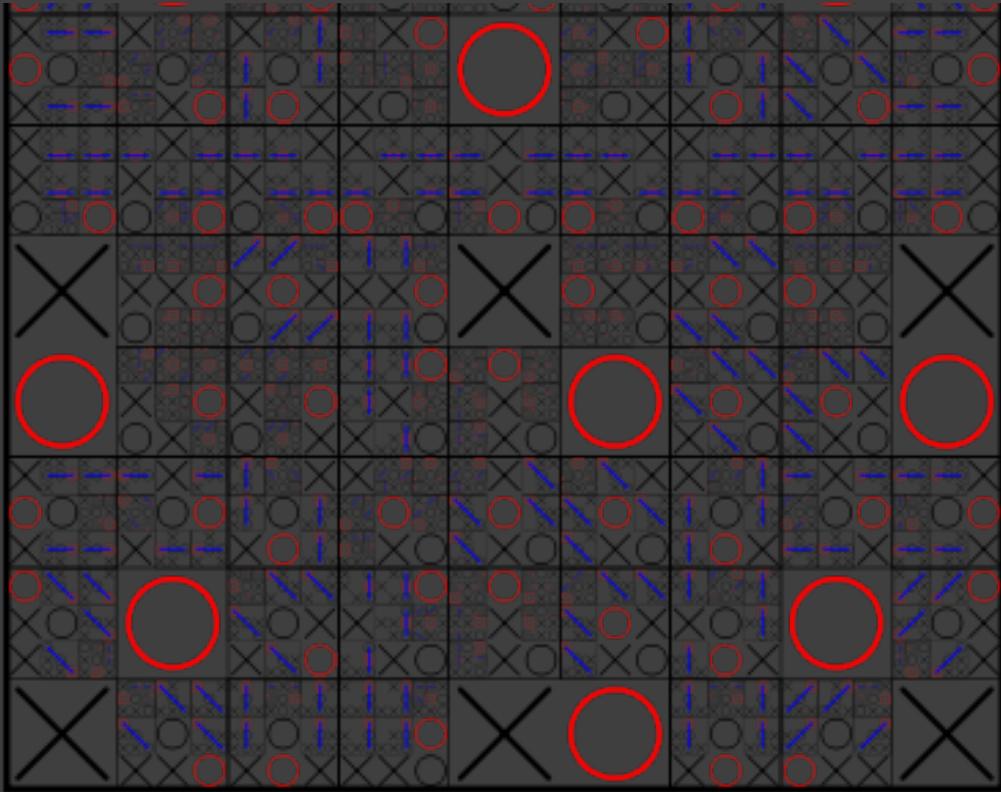
A Simple Case – Tic-Tac Toe

```
4     printBoard(theBoard)
5
6     print("\nGame Over.\n")
7     print(" **** " +turn + " won. ****")
8     break
9
10    elif theBoard['4'] == theBoard['5'] == theBoard['6'] != ' ':
11        printBoard(theBoard)
12        print("\nGame Over.\n")
13        print(" **** " +turn + " won. ****")
14        break
15
16    elif theBoard['1'] == theBoard['2'] == theBoard['3'] != ' ':
17        printBoard(theBoard)
18        print("\nGame Over.\n")
19        print(" **** " +turn + " won. ****")
20        break
21
22    elif theBoard['1'] == theBoard['4'] == theBoard['7'] != ' ':
23        printBoard(theBoard)
24        print("\nGame Over.\n")
25        print(" **** " +turn + " won. ****")
26        break
27
28    elif theBoard['2'] == theBoard['5'] == theBoard['8'] != ' ':
```

Force Compute

$$3^9 = 19,683$$





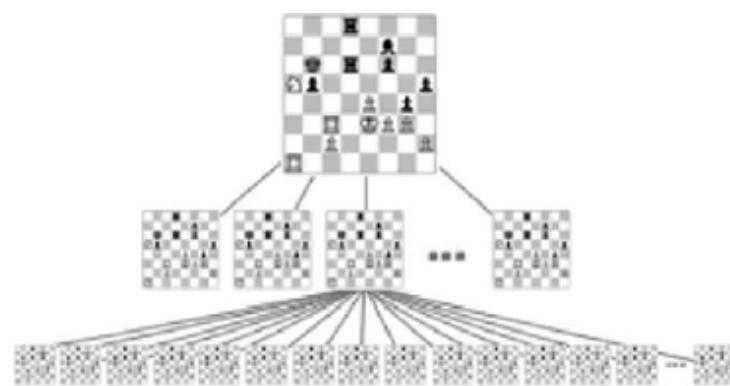
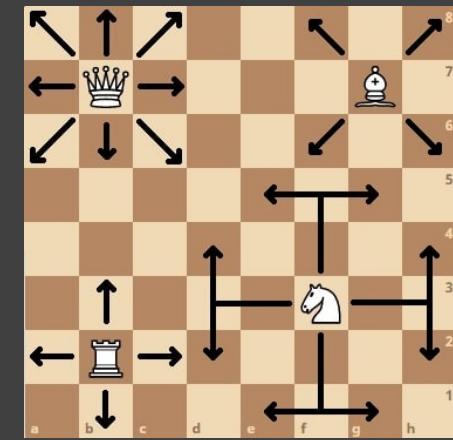
Software 1.0

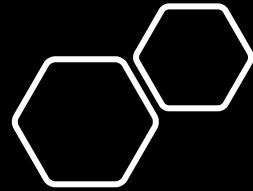


Tic-Tac Toe

Slight Complication -- Chess

- *Define Rules*
- *Execute a Search Algorithm*





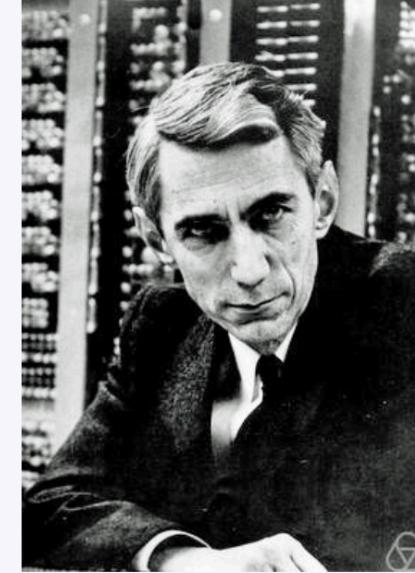
Game-Tree Complexity of Chess

Possible States of Chess

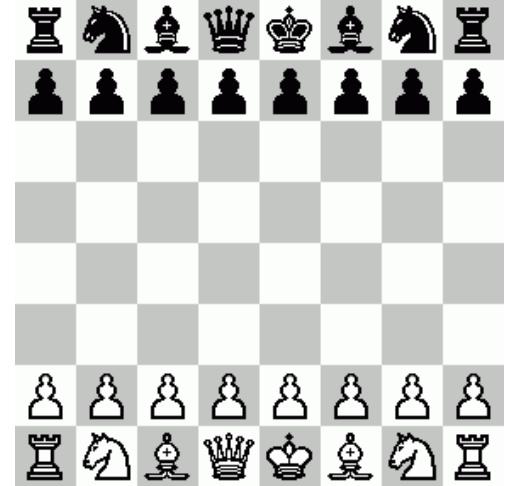
$$\lim_{n \rightarrow 40} B = 10^{120}$$

$$\lim_{n \rightarrow \infty} B = 10^{10^{50}}$$

Claude Shannon



Born April 30, 1916
[Petoskey, Michigan](#), U.S.
Died February 24, 2001 (aged 84)
[Medford, Massachusetts](#), U.S.
Nationality American
Alma mater [University of Michigan](#) (A.B.
B.S.E.E.)
[MIT](#)



Philosophical Magazine, Ser.7, Vol. 41, No. 314 - March 1950.

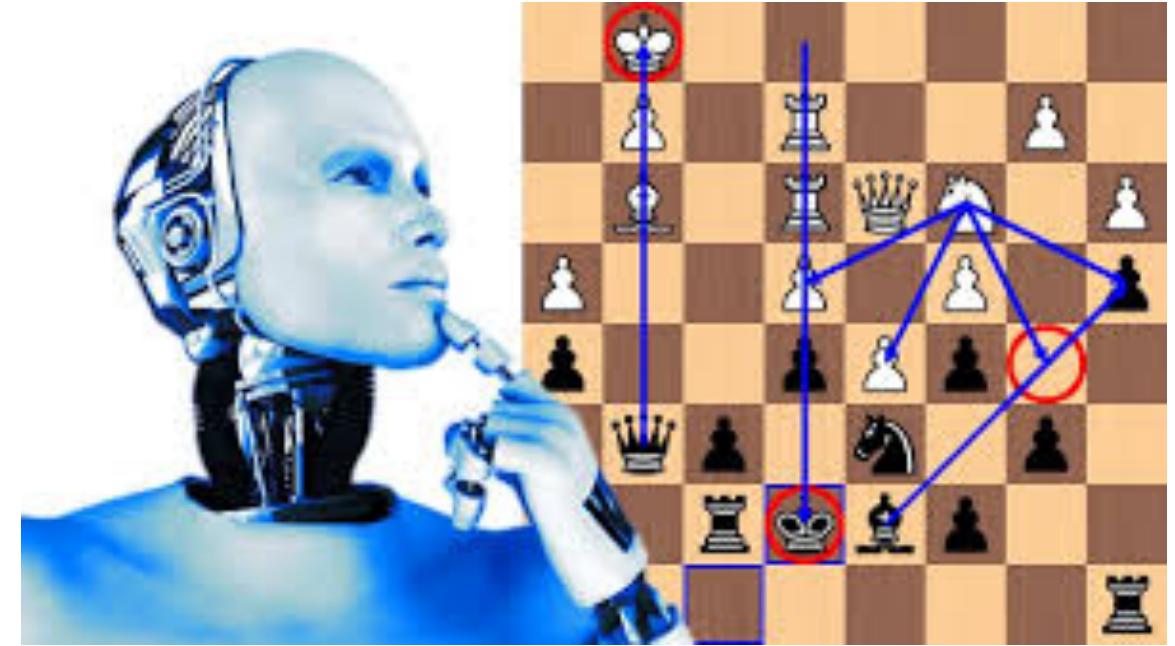
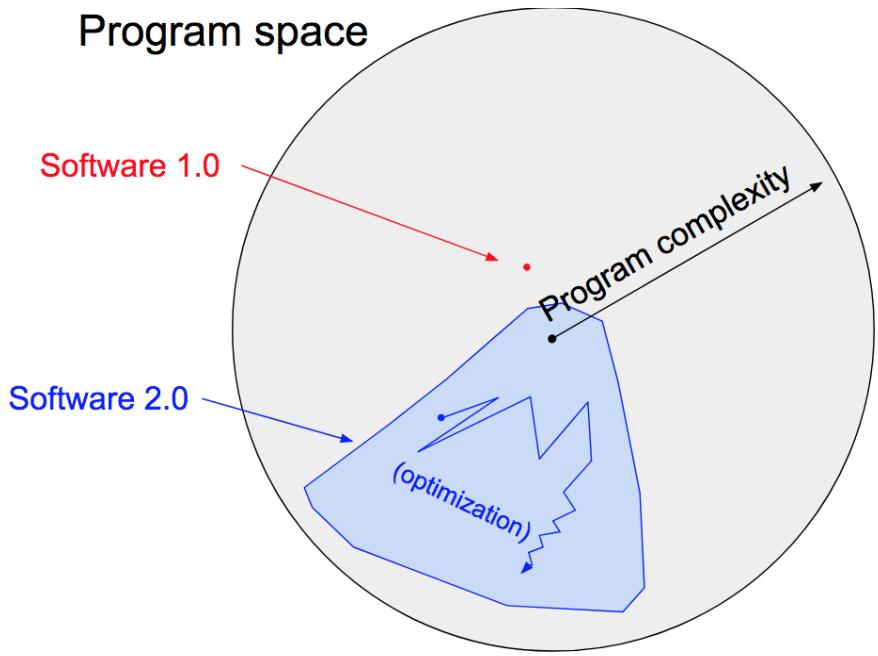
XXII. Programming a Computer for Playing Chess¹
By CLAUDE E. SHANNON

Bell Telephone Laboratories, Inc., Murray Hill, N.J.²
[Received November 8, 1949]

$$\text{EXPTIME} = \bigcup_{k \in \mathbb{N}} \text{DTIME}\left(2^{n^k}\right)$$



Enter Software 2.0



What is Software 2.0?

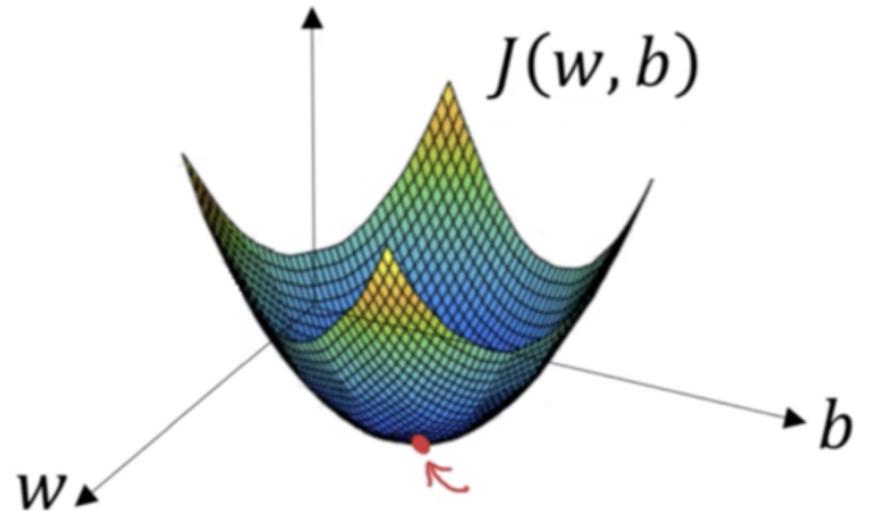
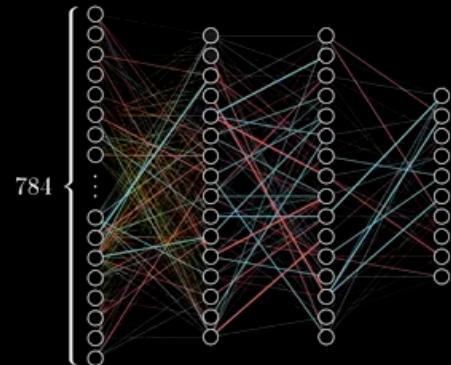
Modern Artificial Intelligence

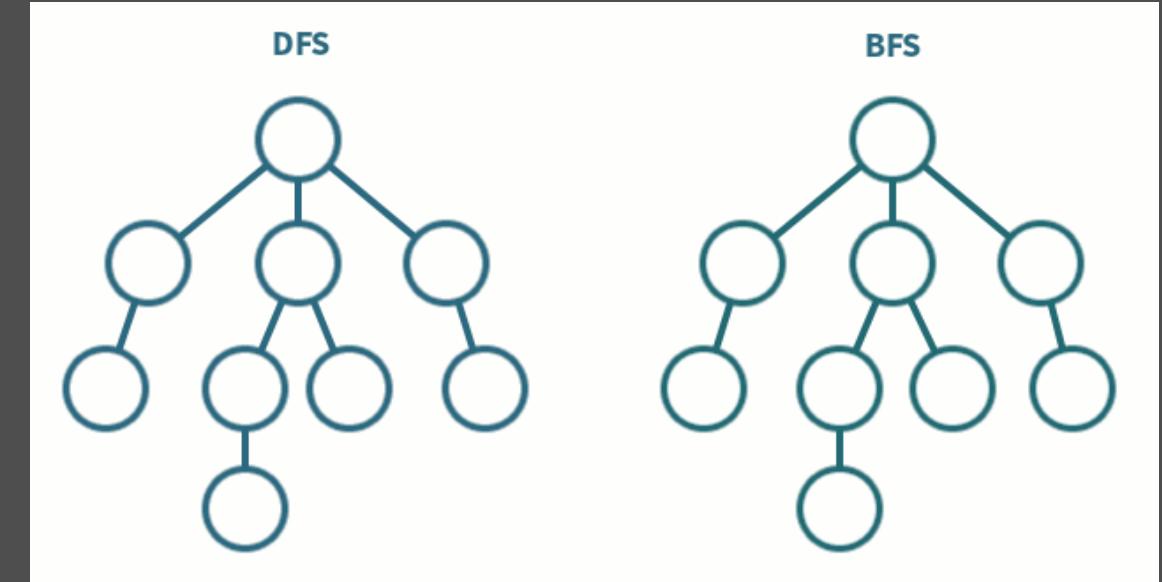
- *Define Space/Time Boundary*
- *Execute Training Cycles*
- *Extract Rules from Data*

$$\int_{\mathbb{R}^n} |f(x) - F_{\mathcal{A}}(x)| \, dx < \epsilon$$

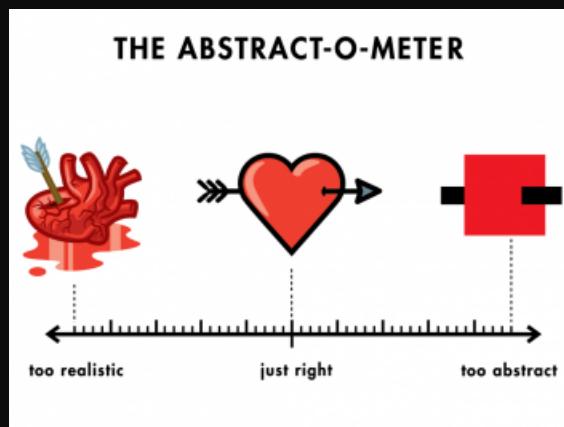
Training in
progress...

 → 5





20 Years Later, Humans Still No Match For Computers On The Chessboard



Abstraction

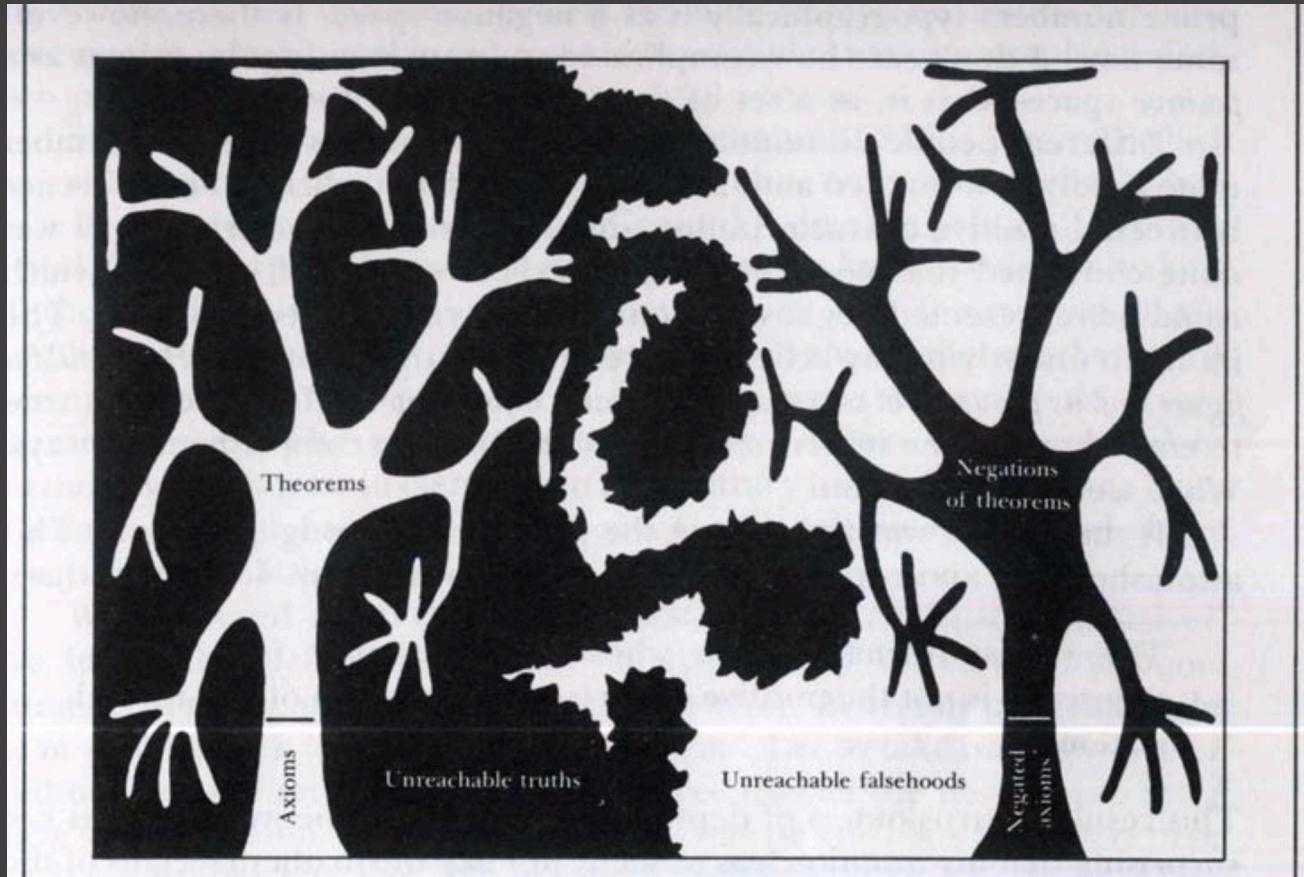
When you go on a higher-level abstraction, you can fit in more things in your head. You can think more.

— Christ Lantner (Creator of the LLVM)

The Paradigm Shift

In the past, your source code is your code. In the future, your source code is your data.

The Incompleteness Theorems

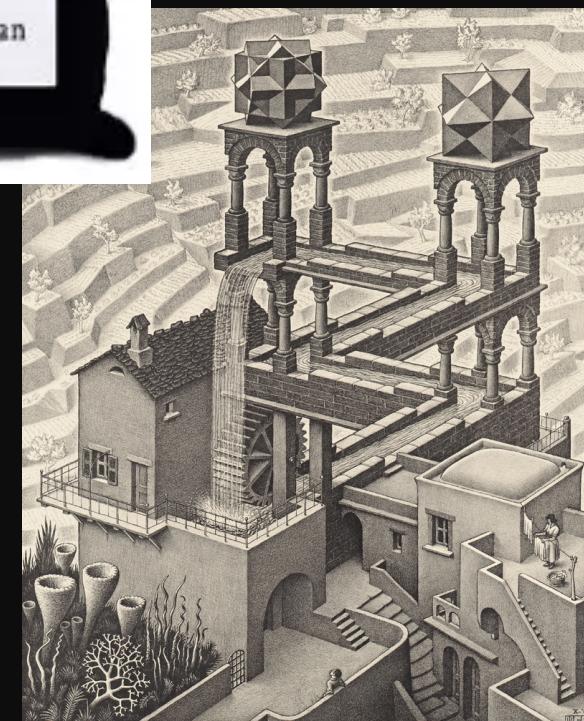


- Axioms: the basics of formal systems
 - Win/Lose States
 - Rules defining valid moves
 - Listable axioms without internal contradiction
-
1. Some statements are true but cannot be proved
 2. A system of axioms will not be able to show the systems consistency



A Hint to the Next
Paradigm -> *The*
Strange Loop

"This statement is false"



J.S. Bach - Das Musikalische Opfer (*The Musical Offering*)

Johann Sebastian Bach
Canon perpetuus
super
Thema Regium
from
The Musical Offering

How do we find the next paradigm?

Quantum computing
Non-duality

