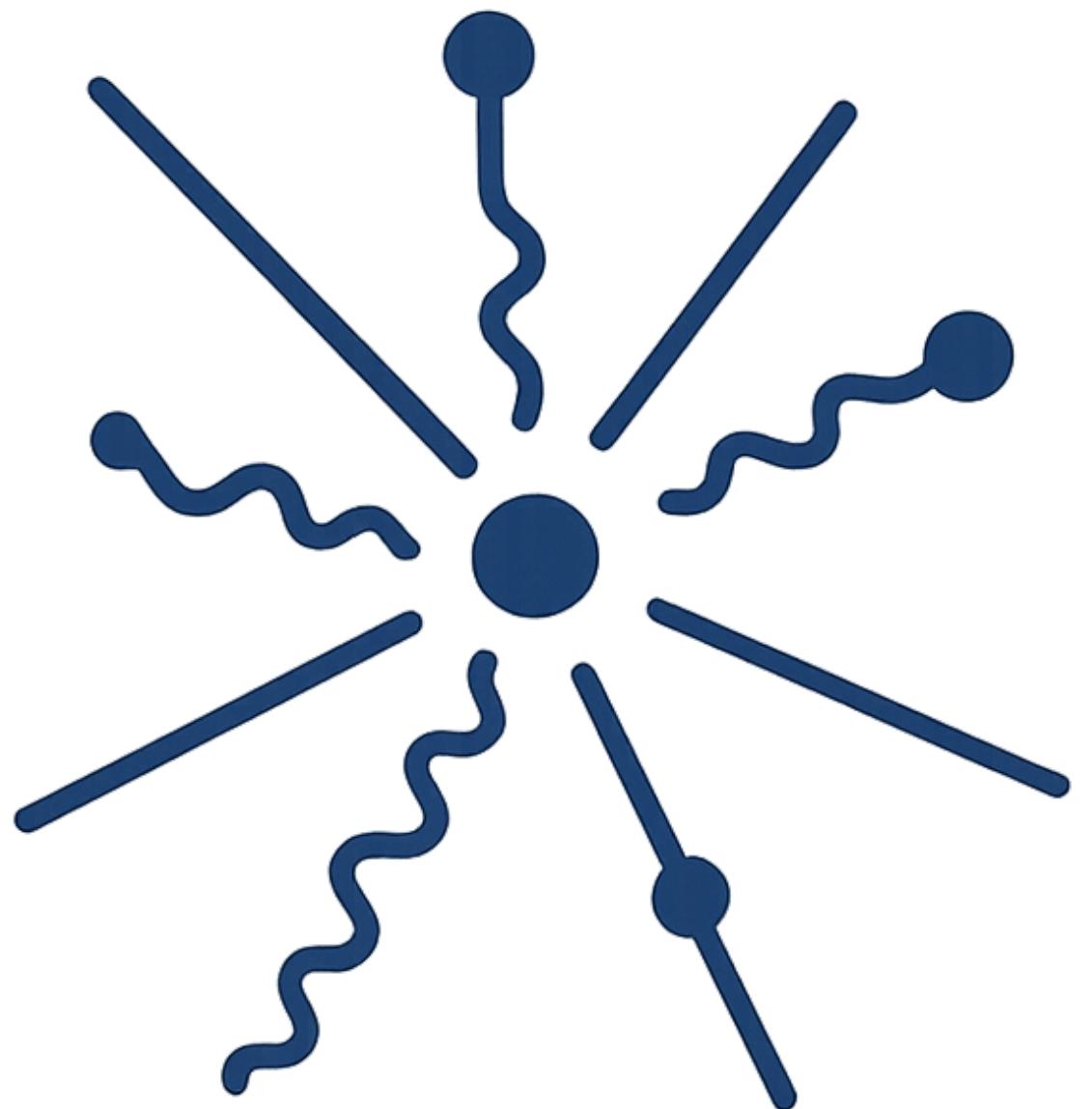
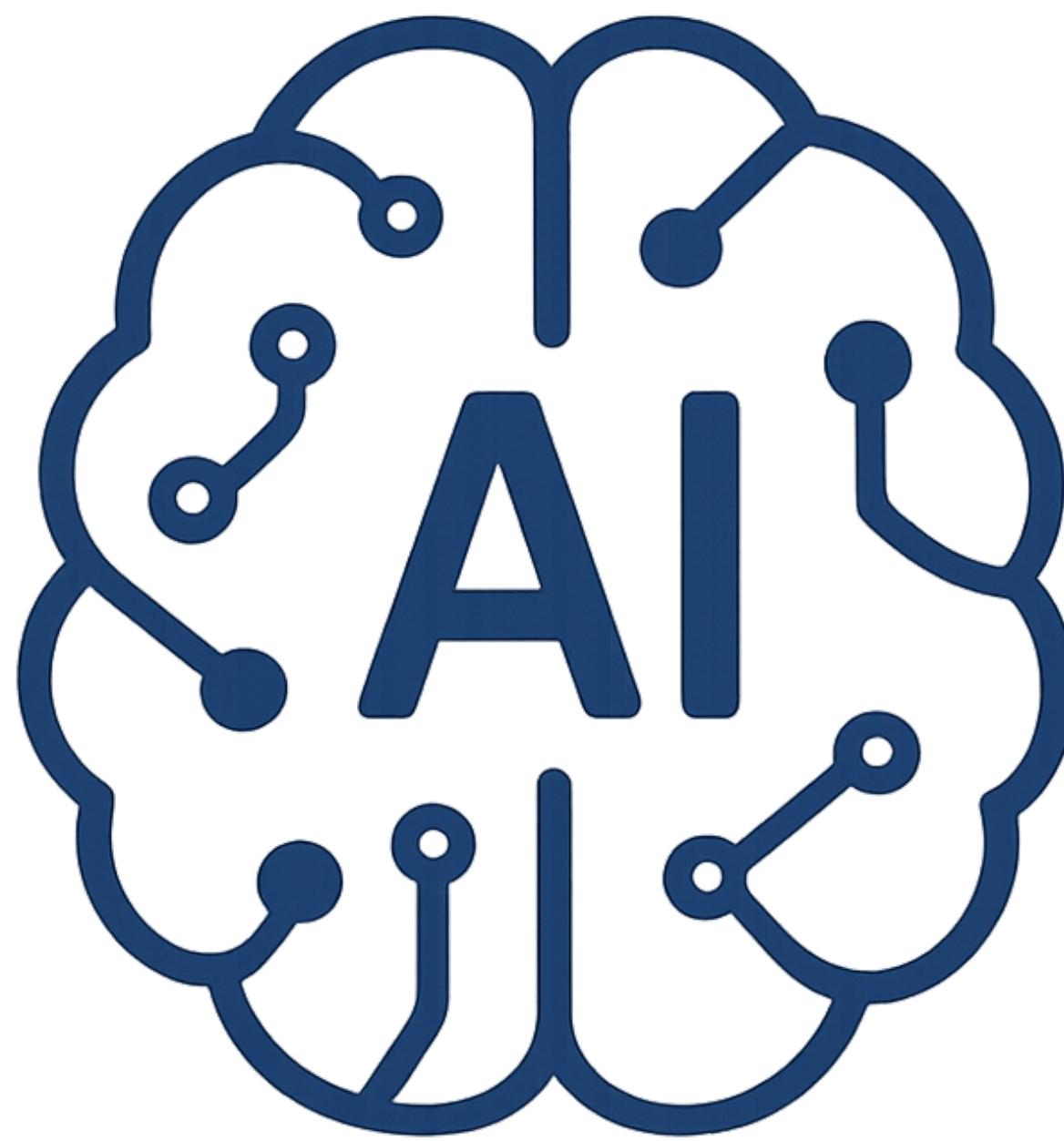
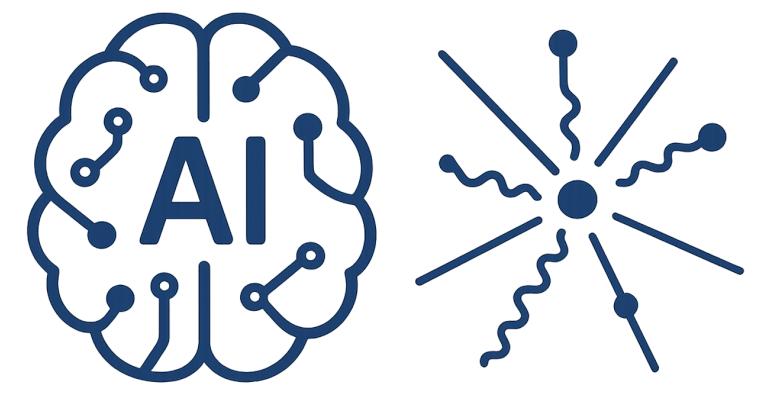


Introduction to

AI-Driven HEP

S. A. Fard - School of Physics (IPM)



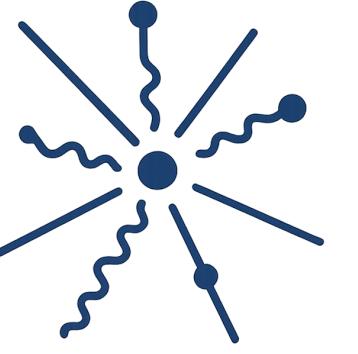
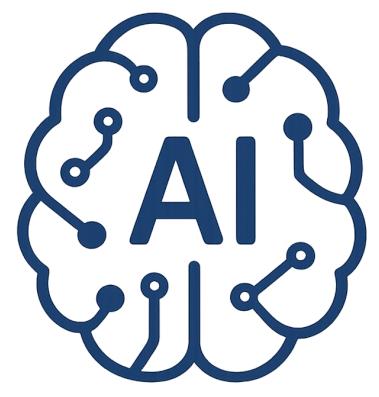


AI-Driven HEP 2

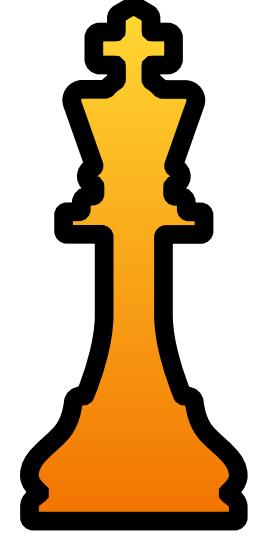


Session 2

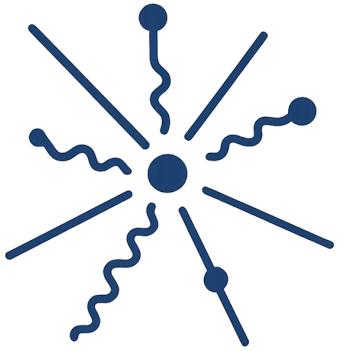
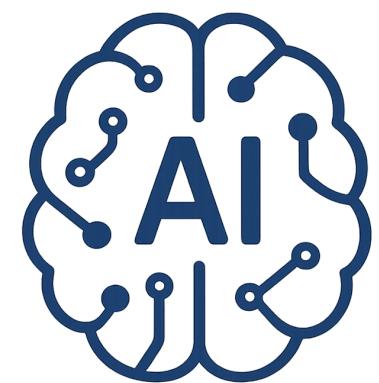
Toward The Summit



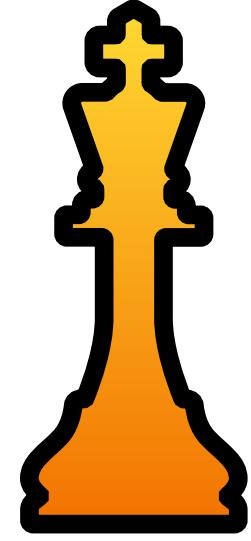
AI-Driven HEP 2



Lets play chess

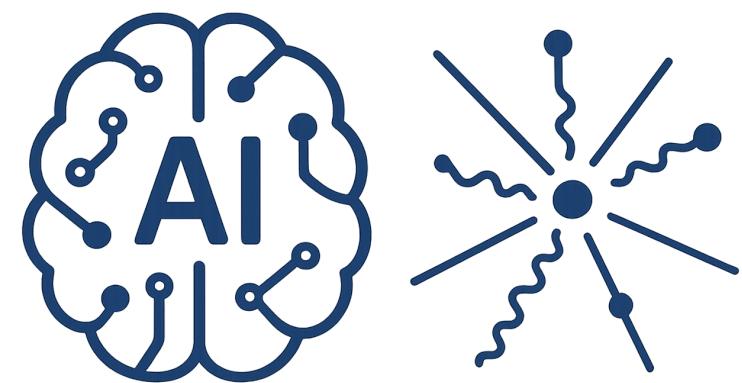


AI-Driven HEP 2

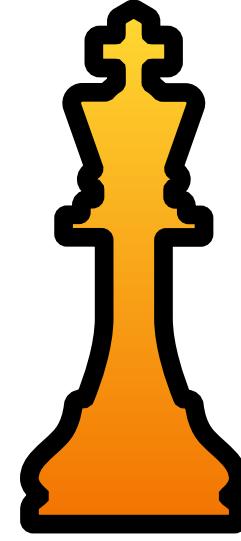


Lets play chess

Find the simplest architecture a machine playing chess ?



AI-Driven HEP 2

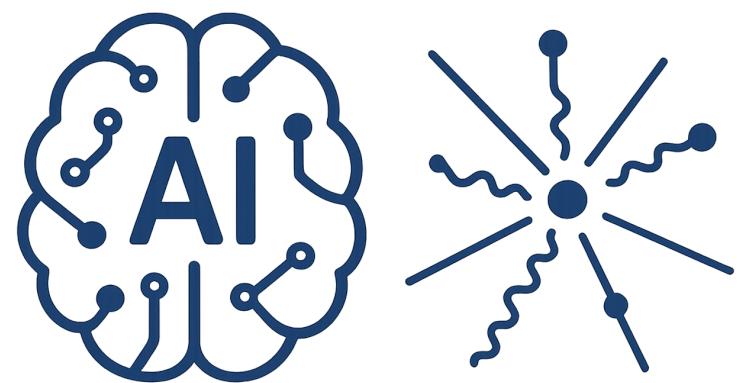


Lets play chess

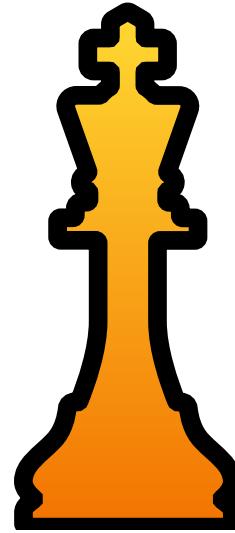
Find the simplest architecture a machine playing chess ?

Brute-force

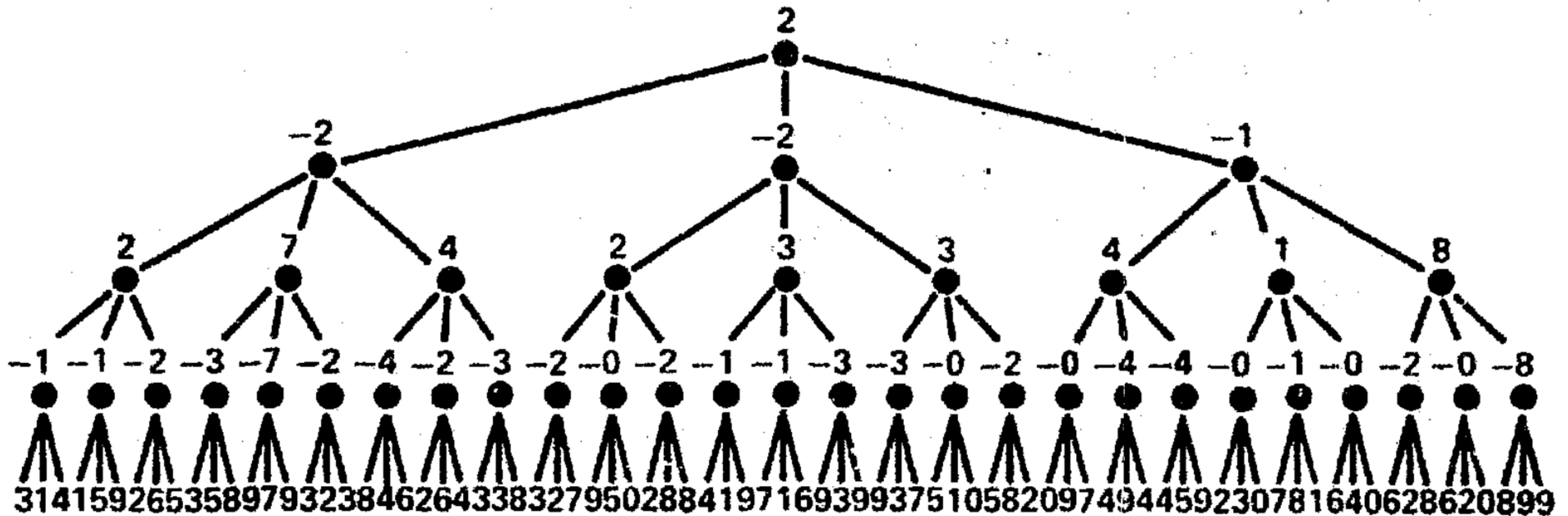
MiniMax optimisation

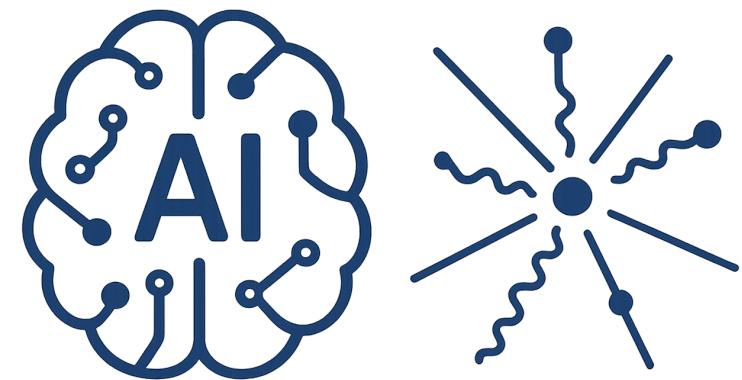


AI-Driven HEP 2

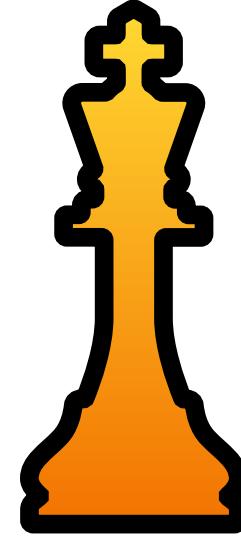


Lets play chess





AI-Driven HEP 2



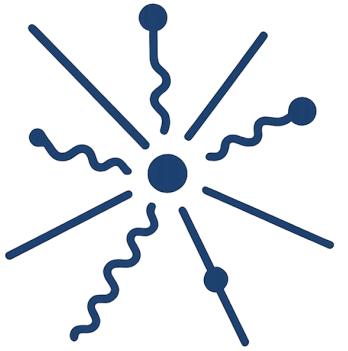
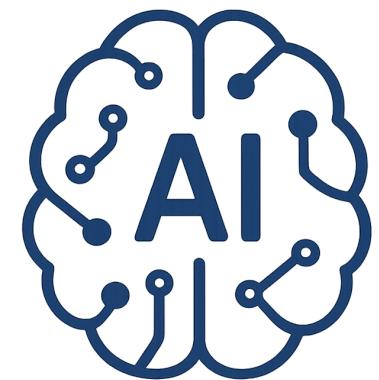
Lets play chess

Find the simplest architecture a machine playing chess ?

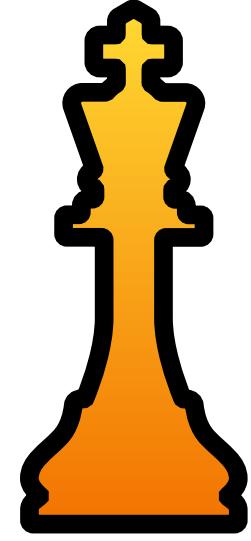
Brute-force

MiniMax optimisation

Number of possible positions to predict 5 move ahed ?



AI-Driven HEP 2



Lets play chess

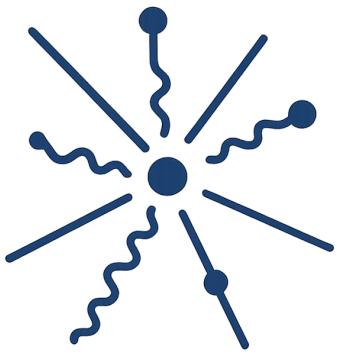
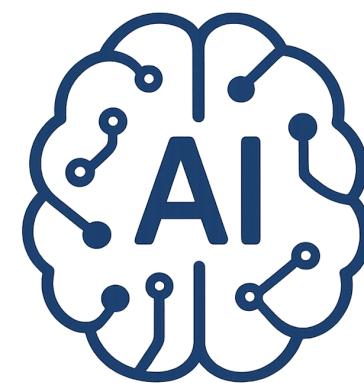
Find the simplest architecture a machine playing chess ?

Brute-force

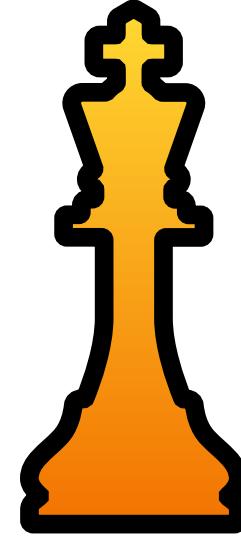
MiniMax optimisation

Number of possible positions to predict 5 move ahed ?

Order of $\sim 30^{10} \sim 10^{14}$



AI-Driven HEP 2



Lets play chess

Find the simplest architecture a machine playing chess ?

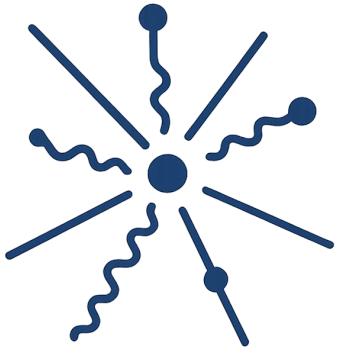
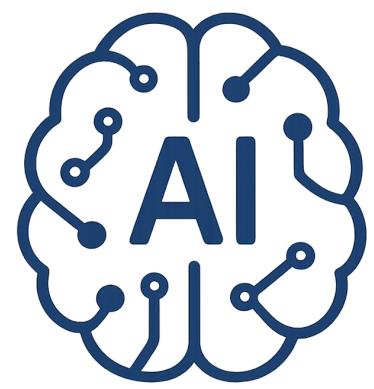
Brute-force

MiniMax optimisation

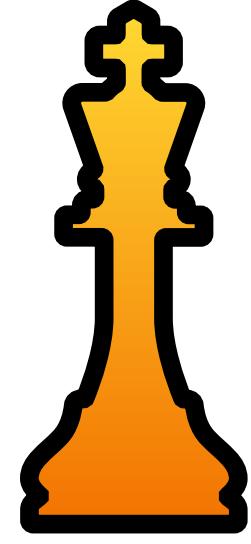
Number of possible positions to predict 5 move ahed ?

Order of $\sim 30^{10} \sim 10^{14}$

made it as simple as possible, but not simplest

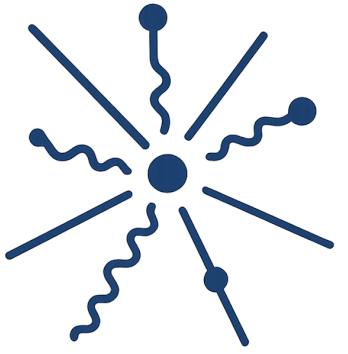
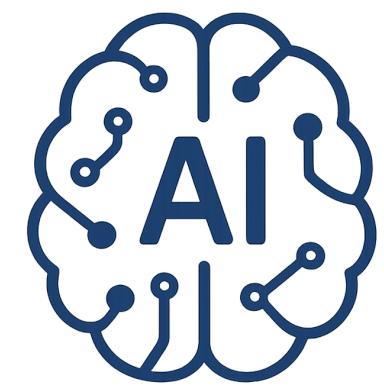


AI-Driven HEP 2

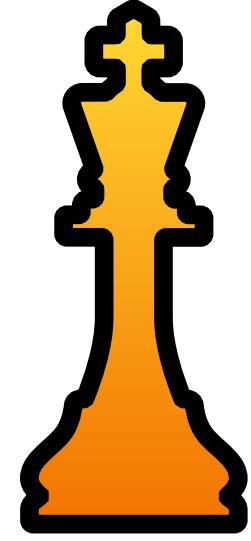


Lets play chess

One step forward make architecture more complex?



AI-Driven HEP 2

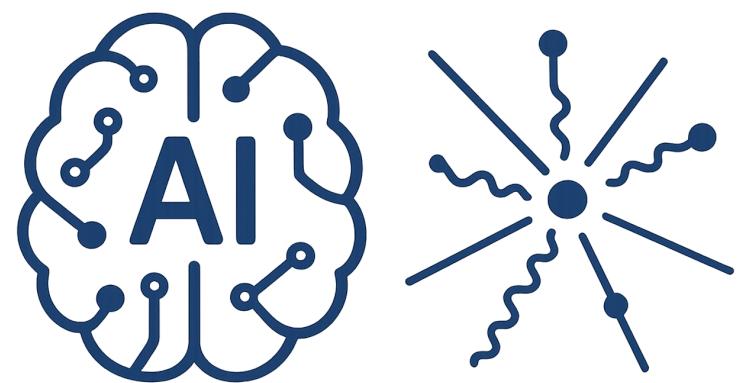


Lets play chess

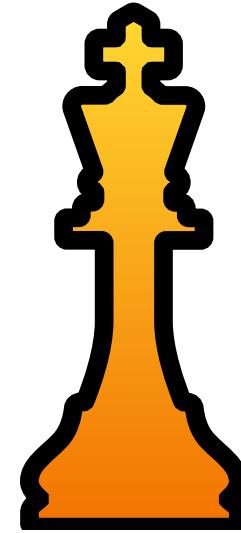
One step forward make architecture more complex?

Alpha-beta pruning :

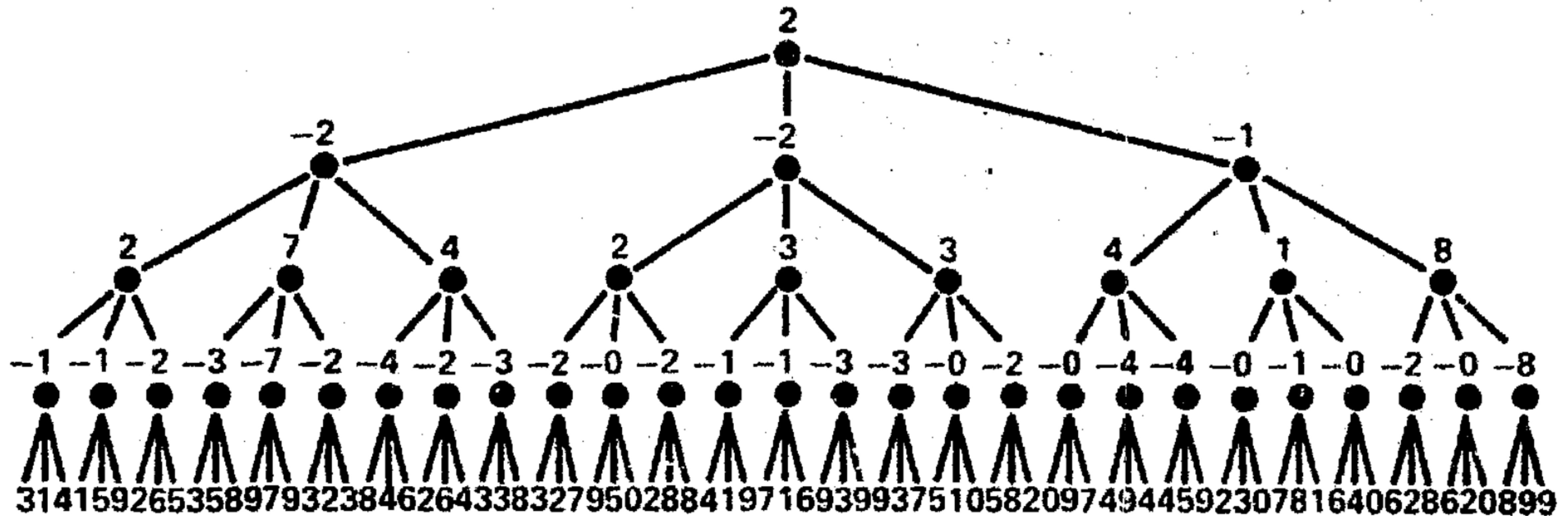
cuts off branches that cannot possibly affect the final decision

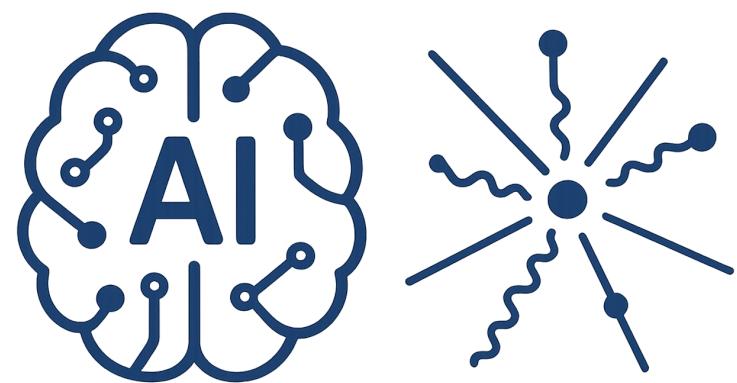


AI-Driven HEP 2

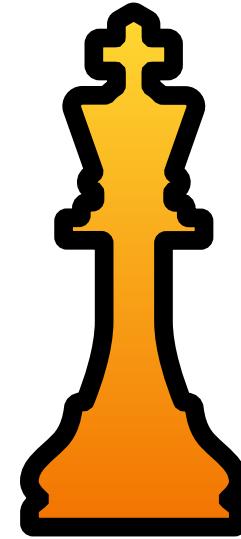


Lets play chess



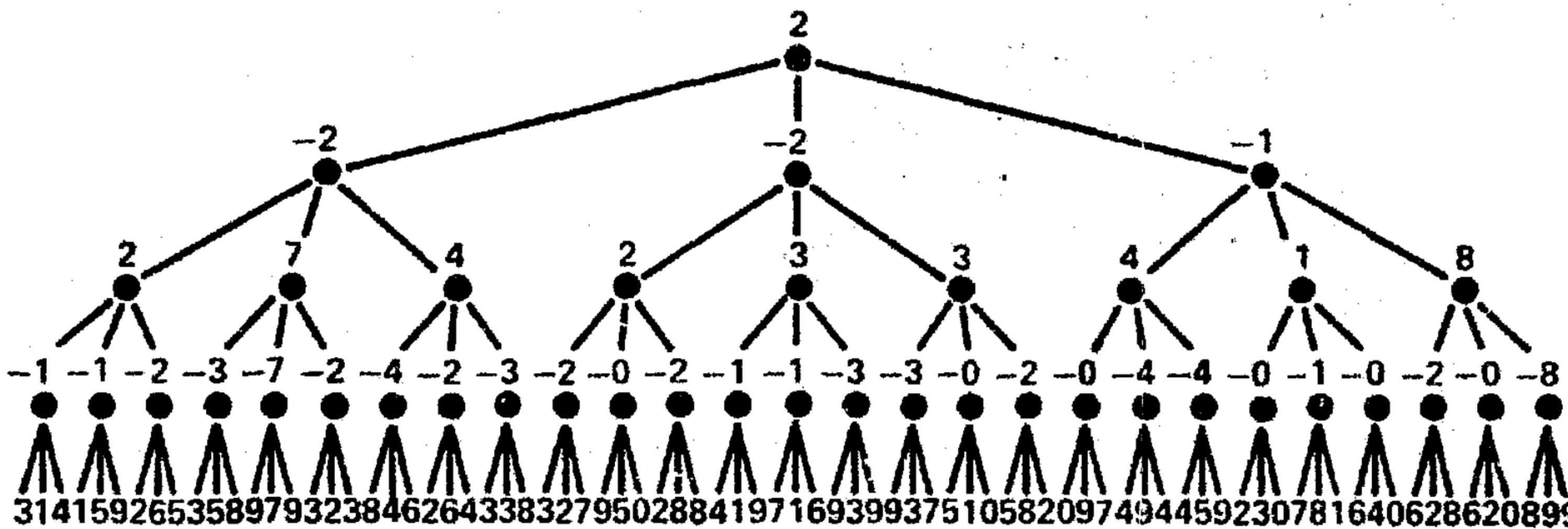


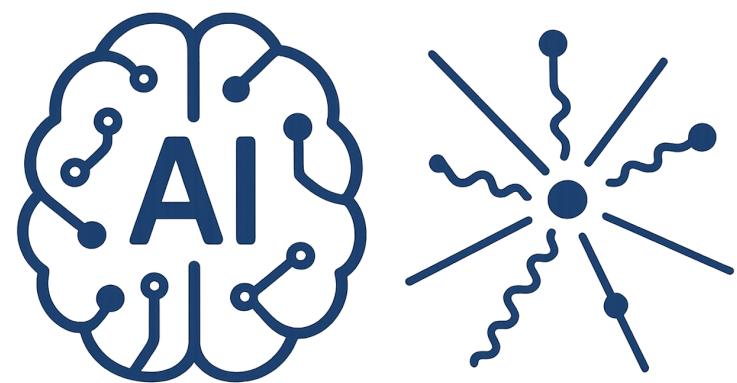
AI-Driven HEP 2



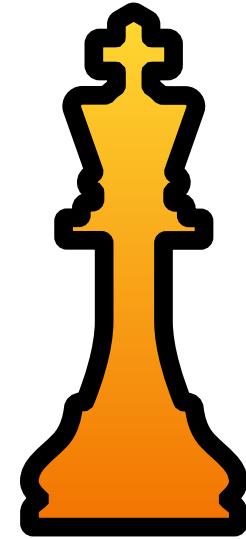
Lets play chess

Order of $\sim 10^7$





AI-Driven HEP 2

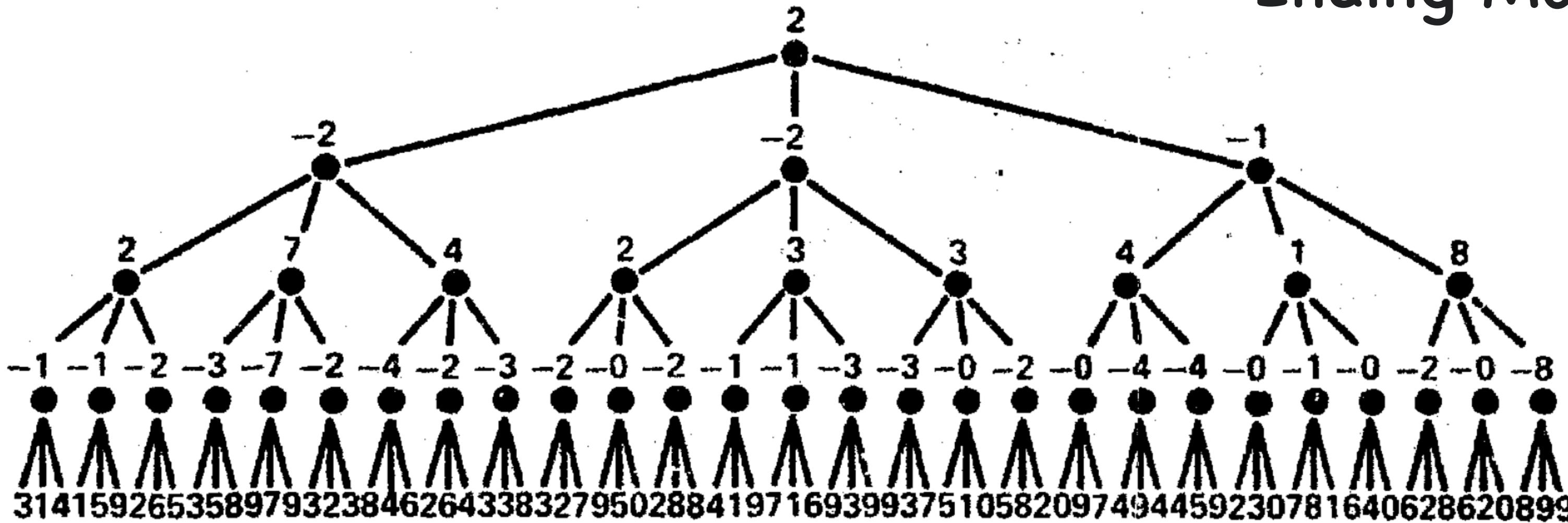


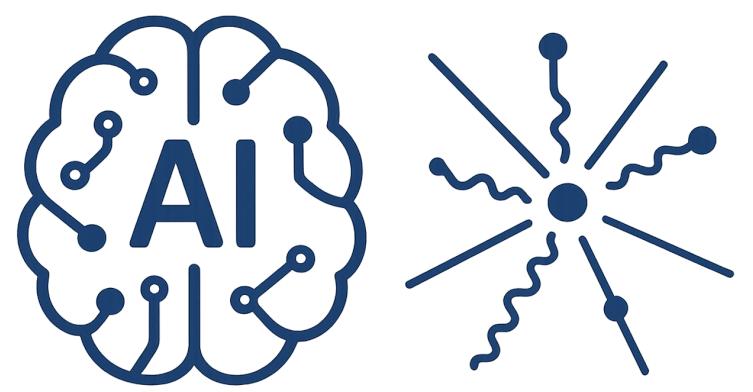
Lets play chess

Order of $\sim 10^7$

Opening tips

Ending Moves





AI-Driven HEP 2

1990



Deep Blue computing power

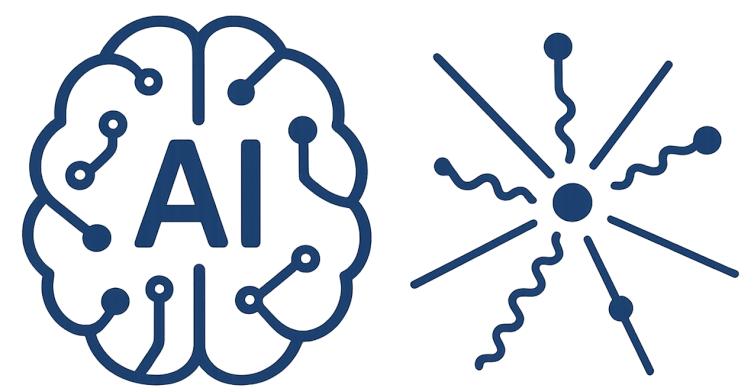
32

200

million

processors

chess positions evaluated per second



AI-Driven HEP 2

1990



Deep Blue computing power

32

**200
million**

processors

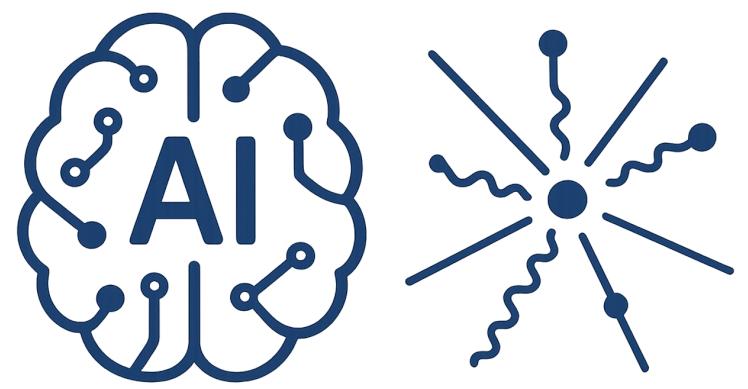
chess positions evaluated per second

$\sim 10^6$ \$

2020



$\sim 10^3$ \$



AI-Driven HEP 2

1990



Deep Blue computing power

32

200
million

processors

chess positions evaluated per second

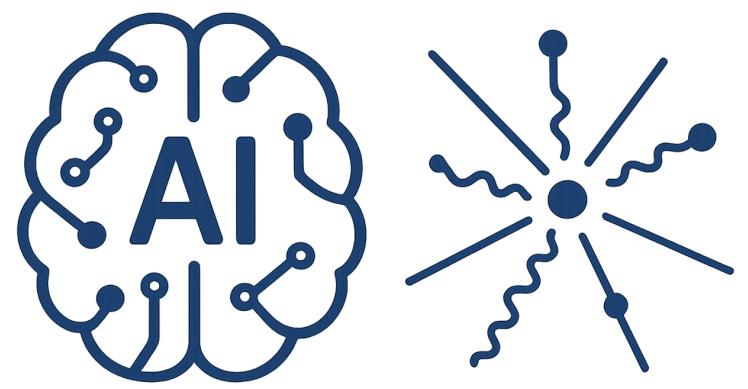
$\sim 10^6$ \$

2020



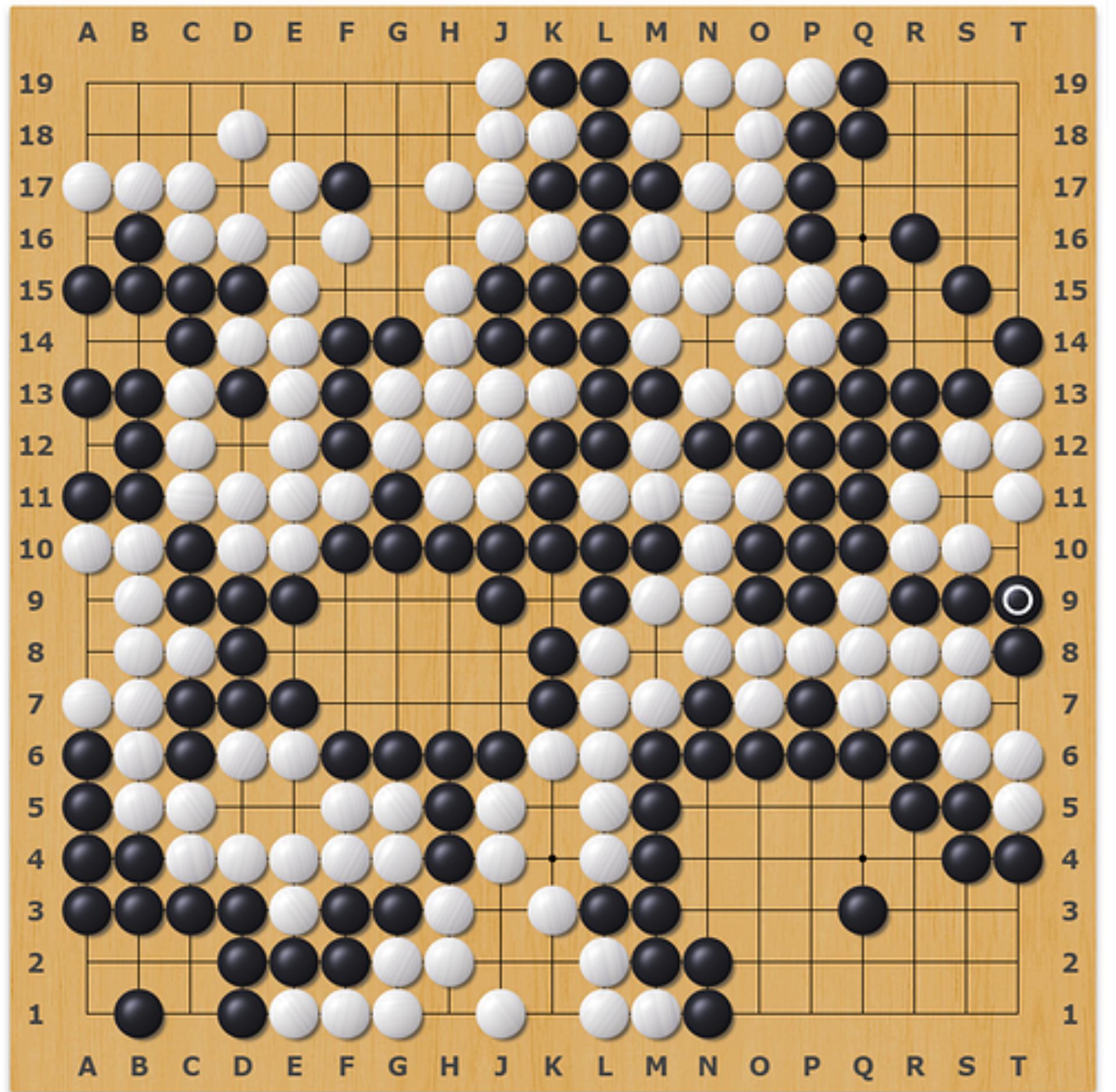
$\sim 10^3$ \$

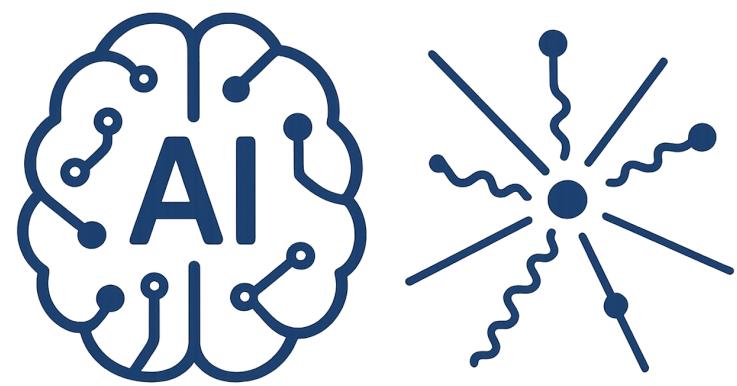
Exe 2-1: Estimate GPU cost in near future



AI-Driven HEP 2

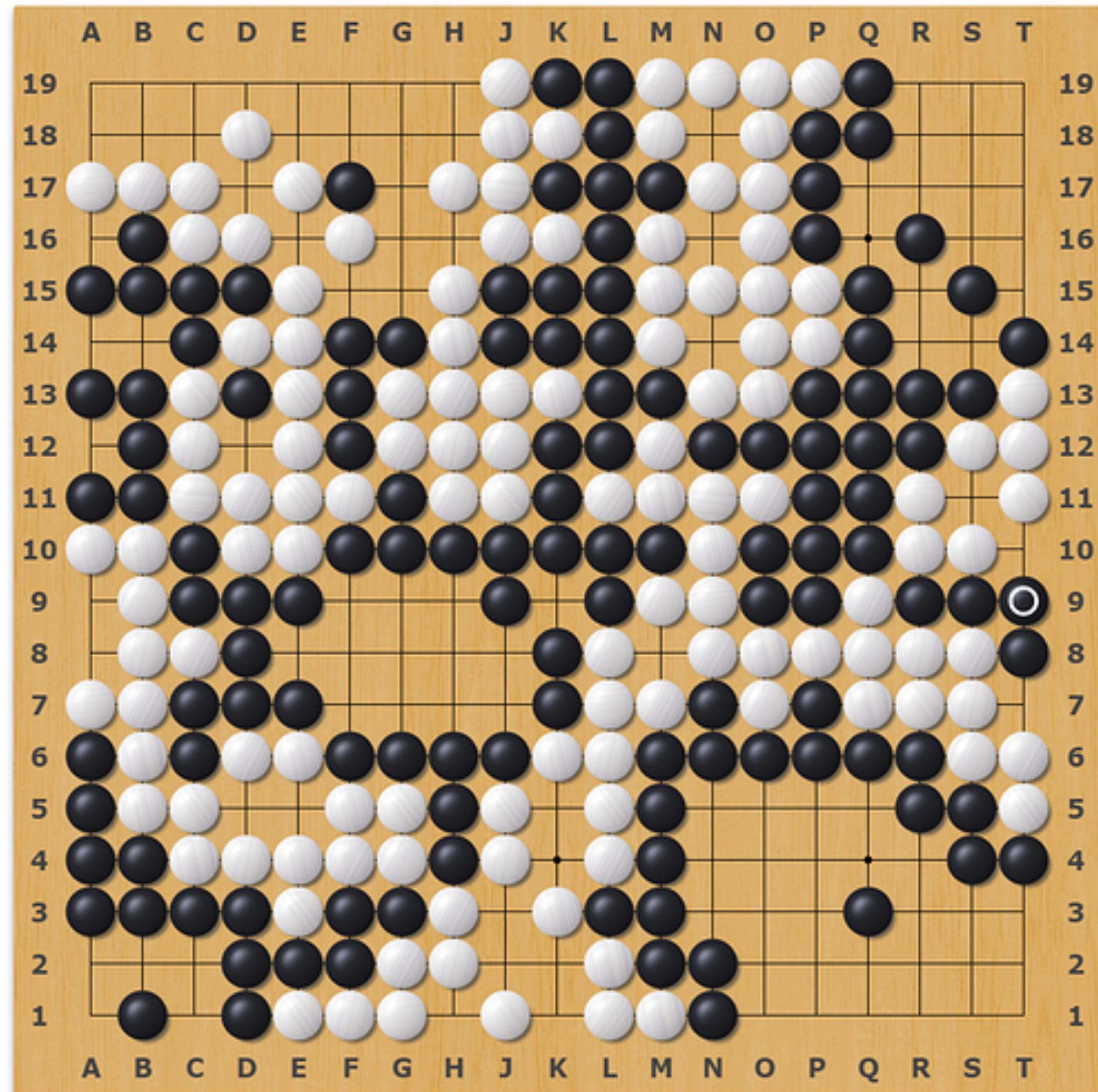
Apply similar procedure playing Go!



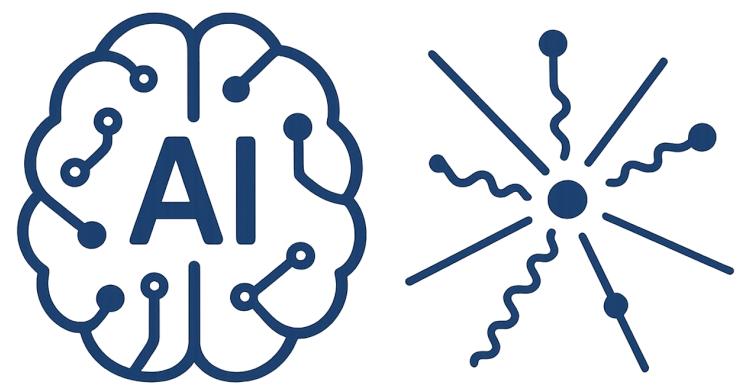


AI-Driven HEP 2

Apply similar procedure playing Go!

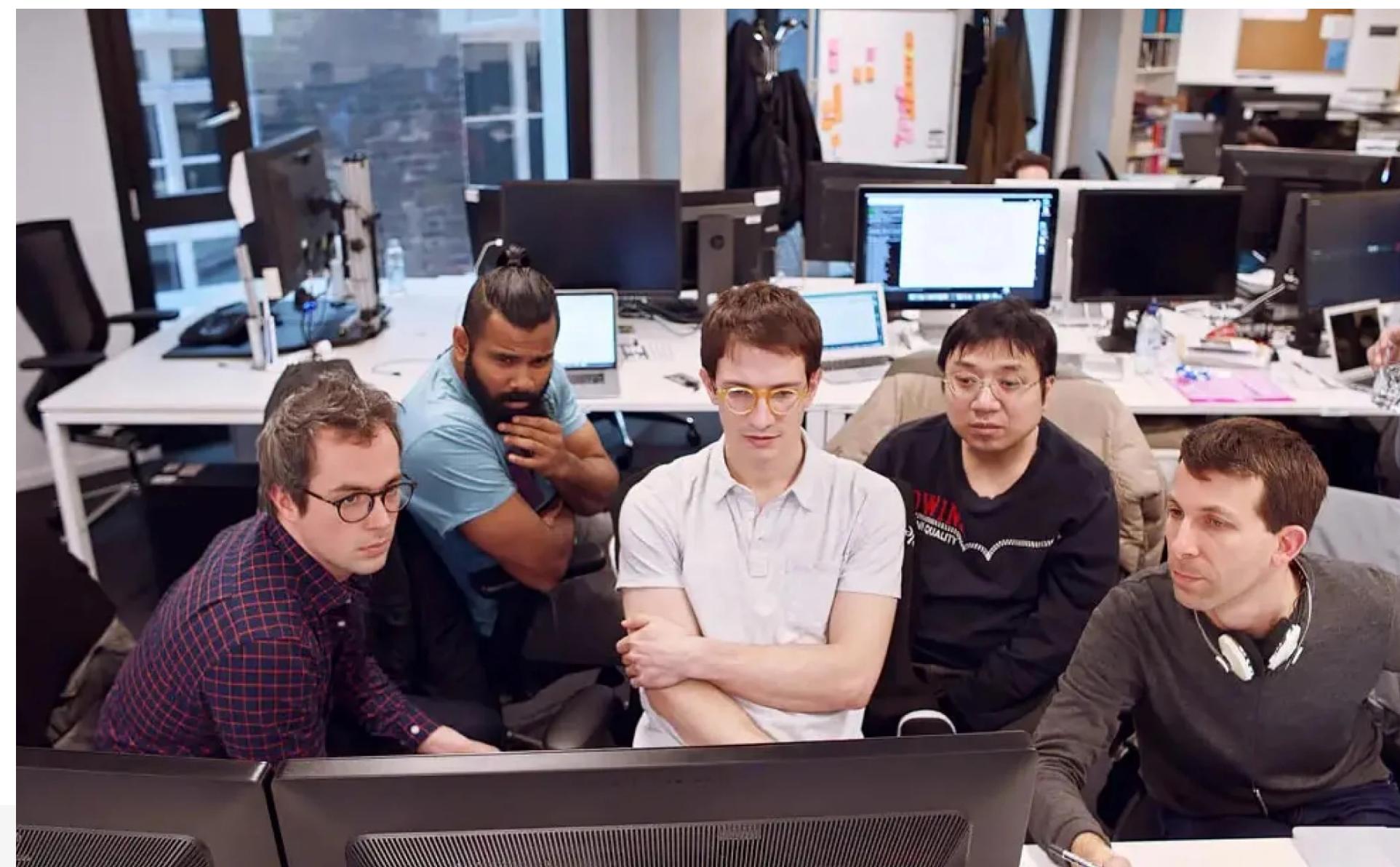
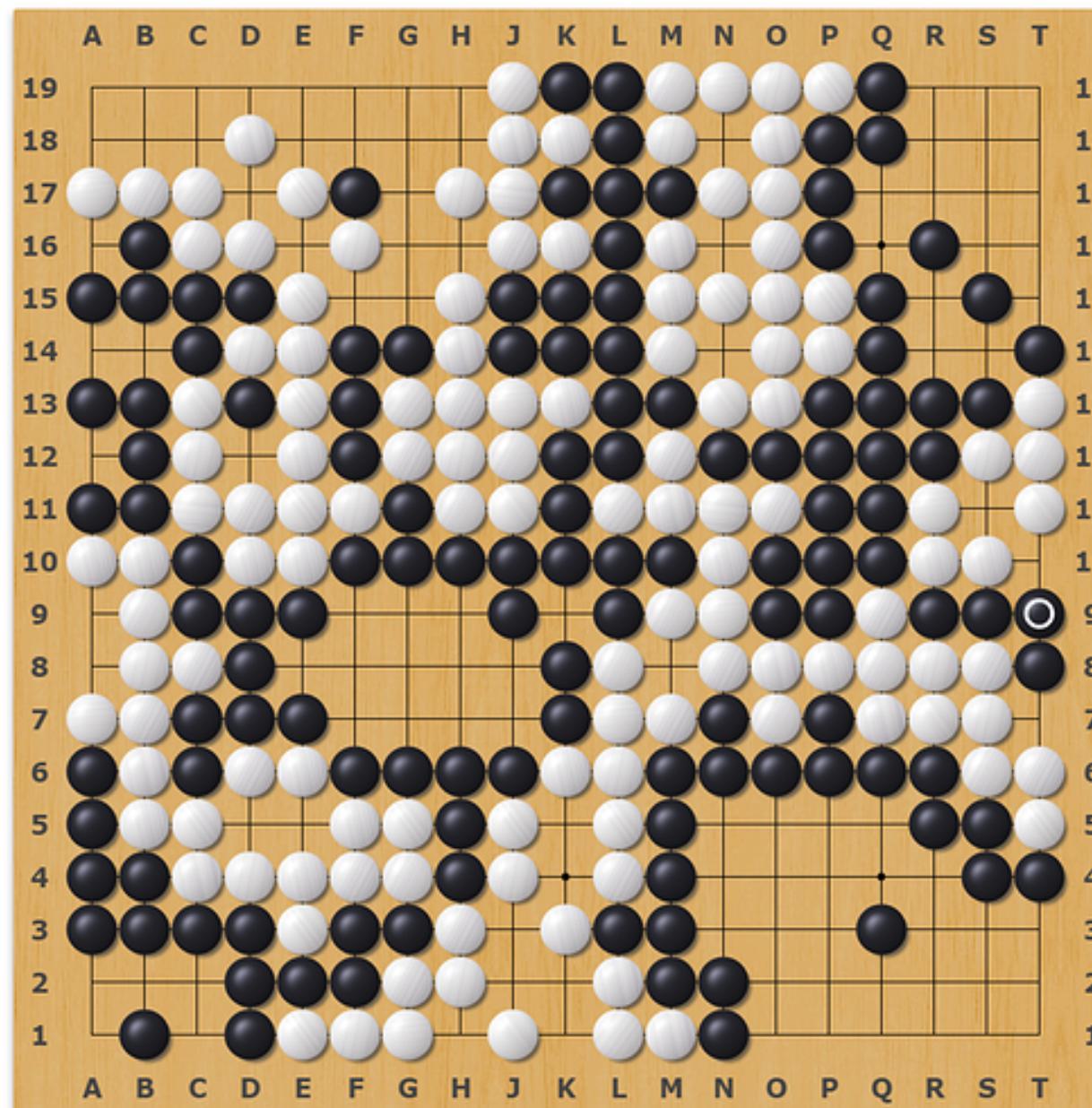


Order of $\sim 200^{10} \sim 10^{23}$



AI-Driven HEP 2

Apply similar procedure playing Go!



TITLE

Mastering the game of Go with deep neural networks and tree search

D Silver, A Huang, CJ Maddison, A Guez, L Sifre, G Van Den Driessche, ...
nature 529 (7587), 484-489

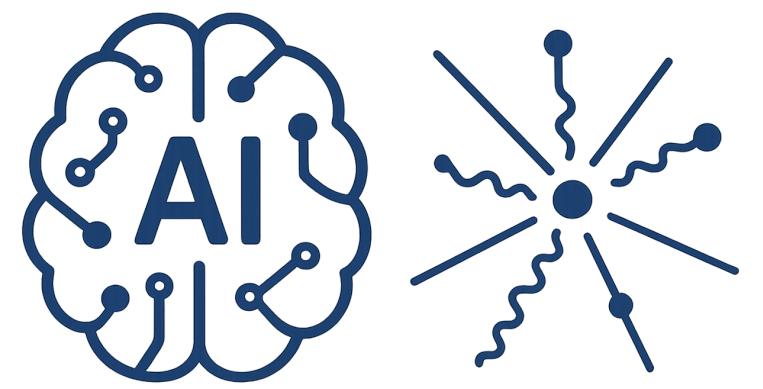
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<https://deepmind.google/research/projects/alphago/>

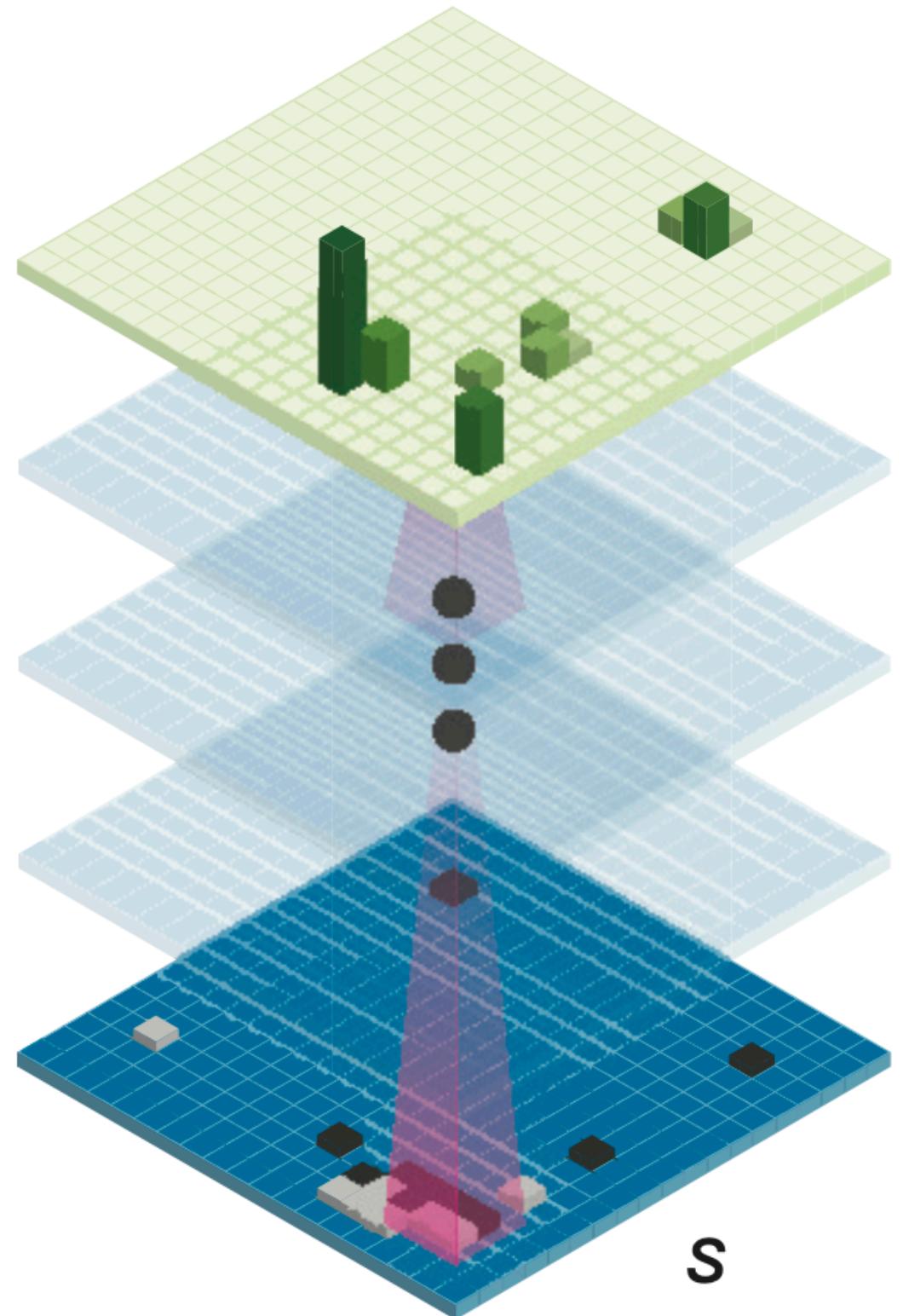


AI-Driven HEP 2

The probability of moves a at position s : $p_\sigma(a | s)$

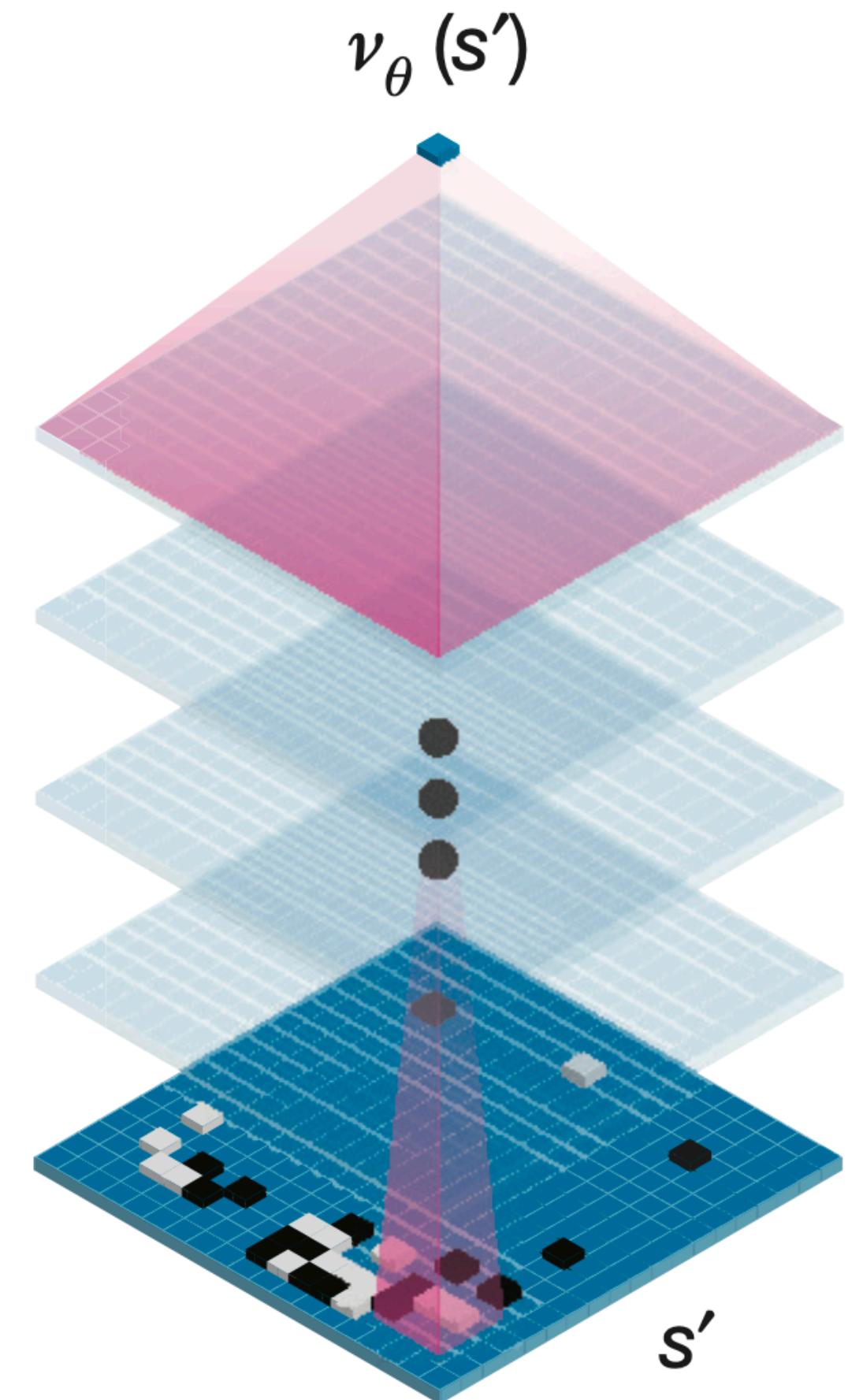
Policy network

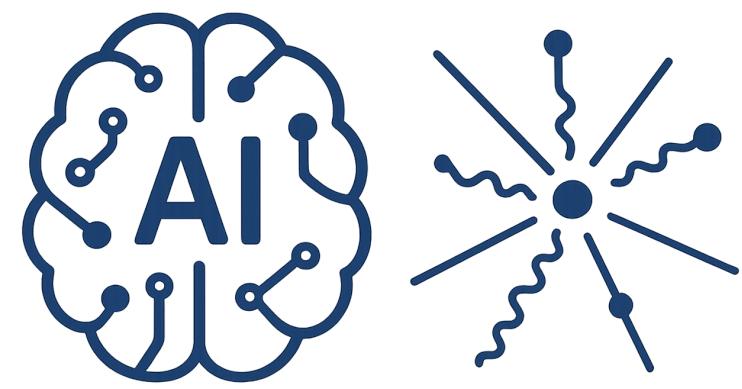
$$p_{\sigma/\rho}(a|s)$$



Value network

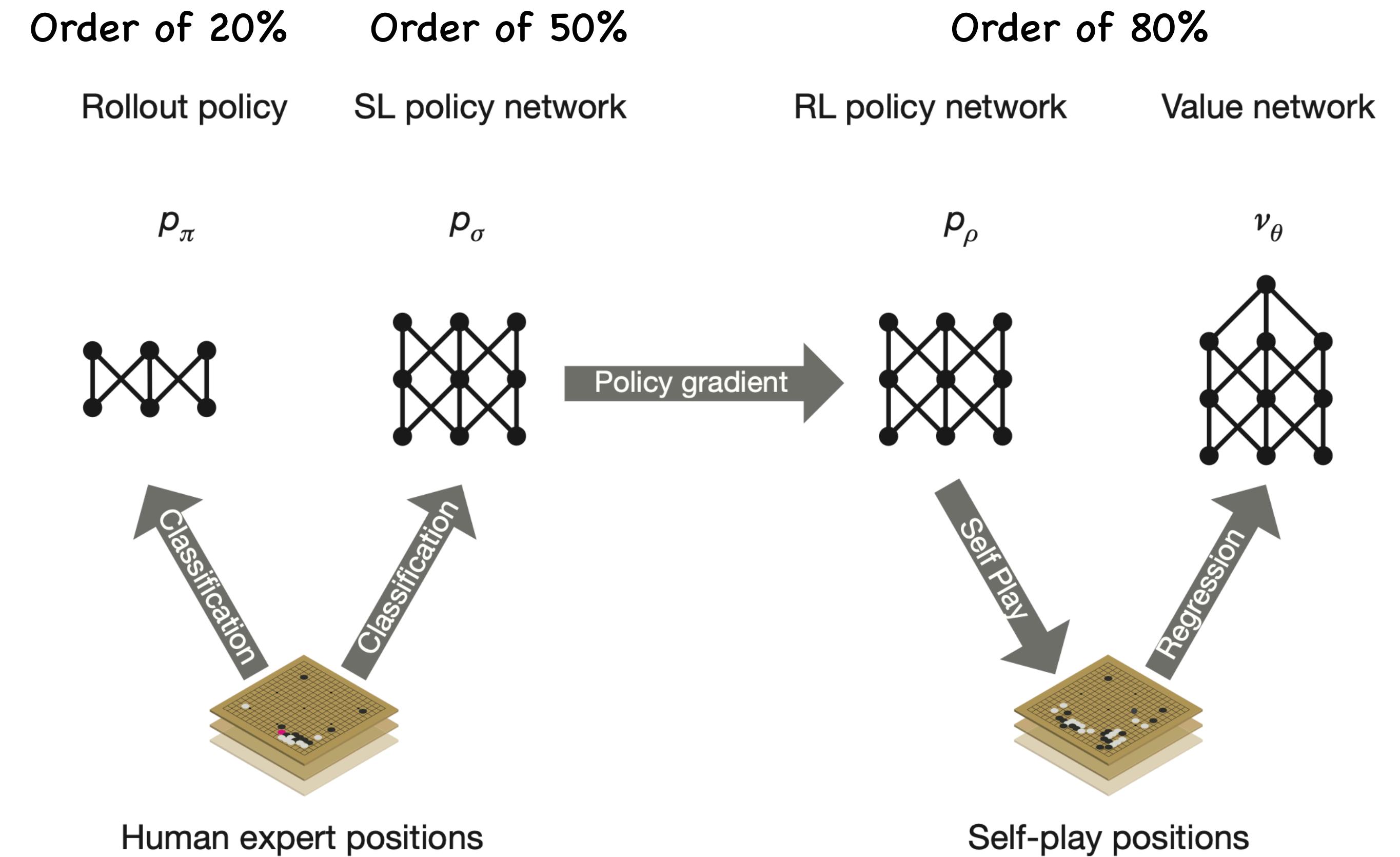
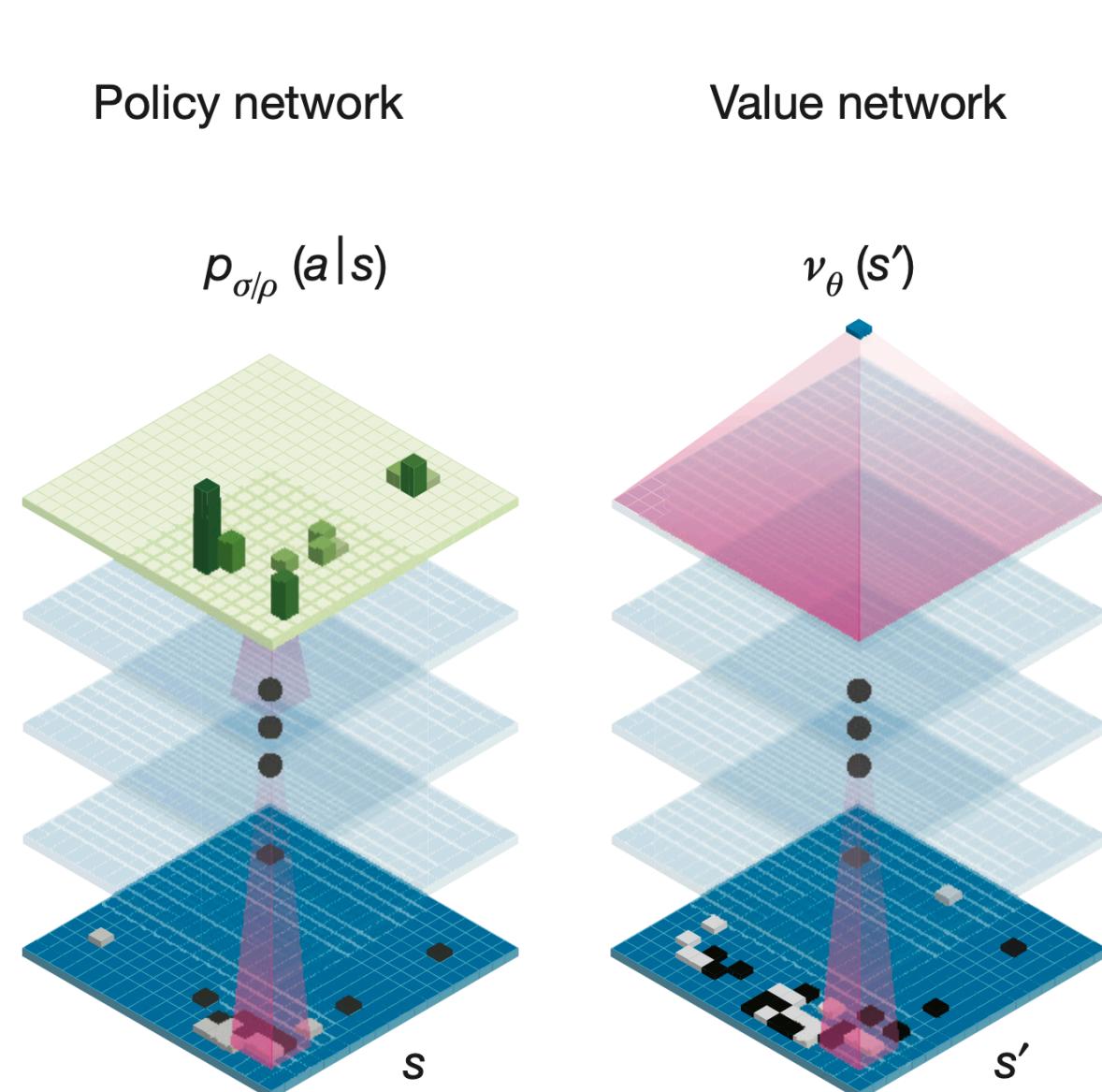
$$\nu_\theta(s')$$

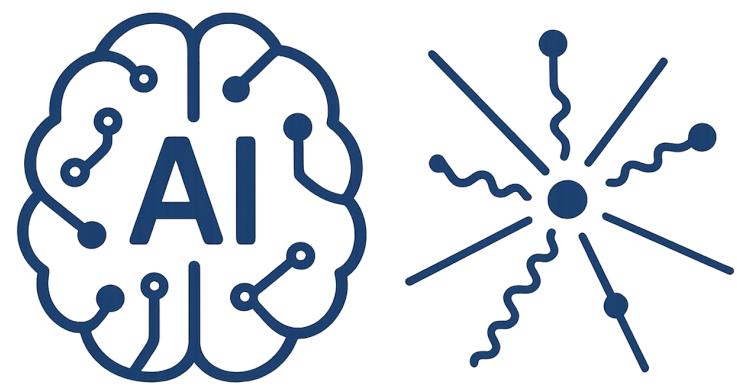




AI-Driven HEP 2

Exe 2-2: Implement the MCTS via a simple python code



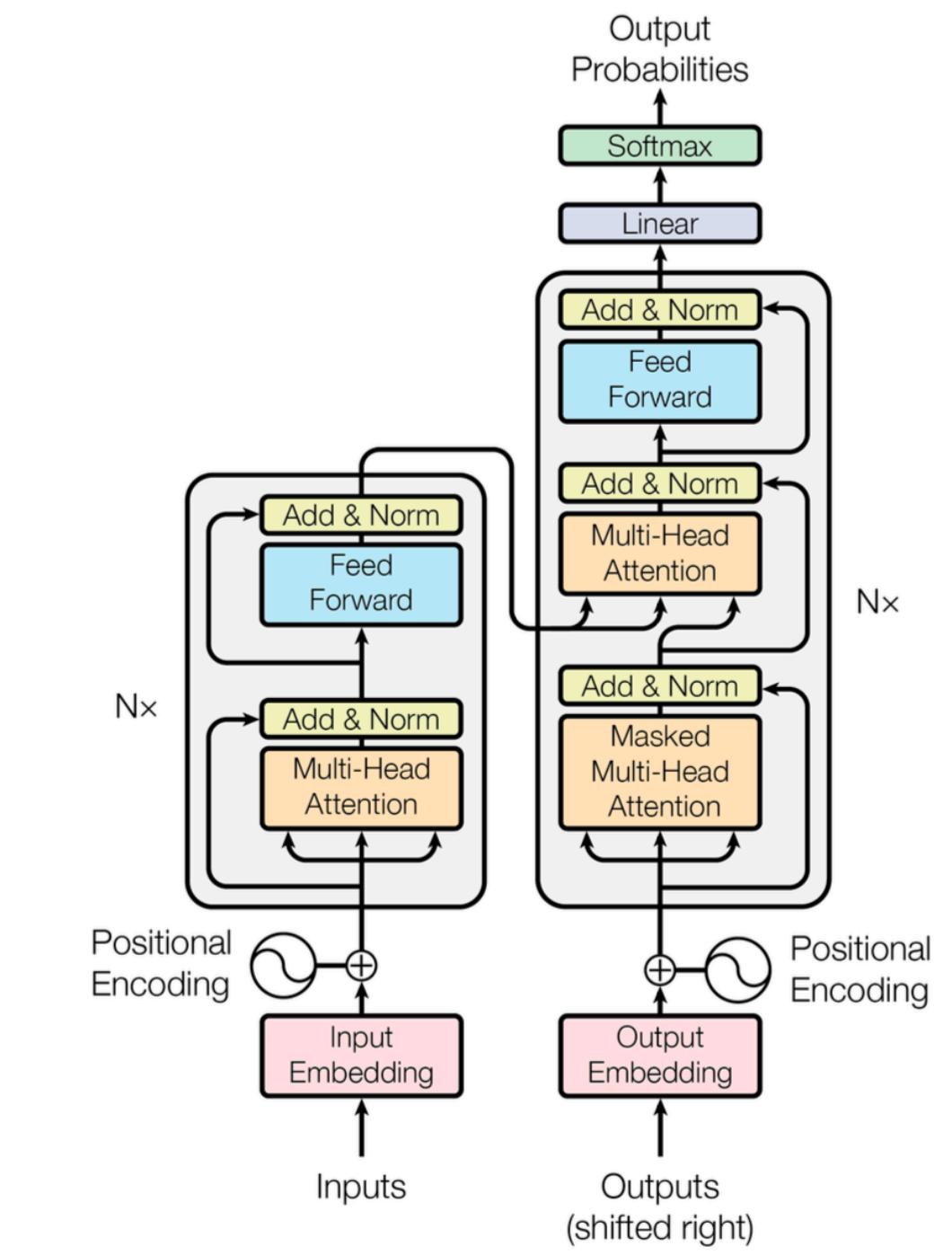


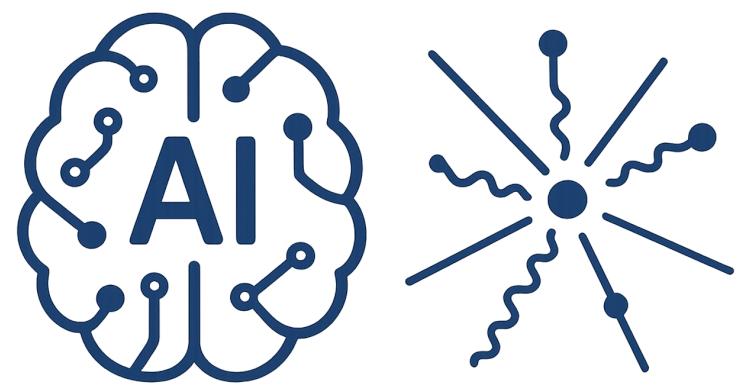
AI-Driven HEP 2

Core idea of AI

make machine behave like human

Rule based
Data based





AI-Driven HEP 2

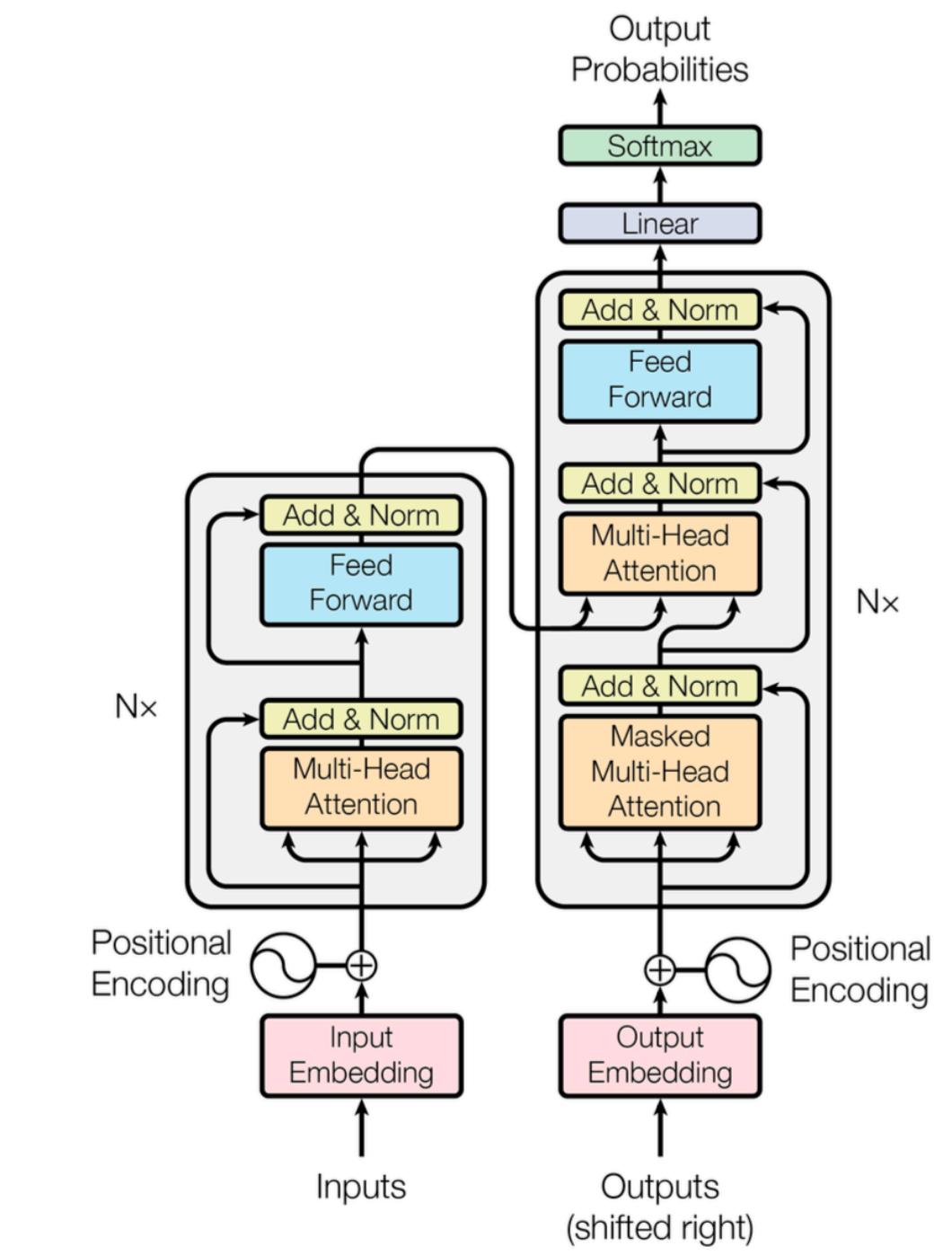
Core idea of AI

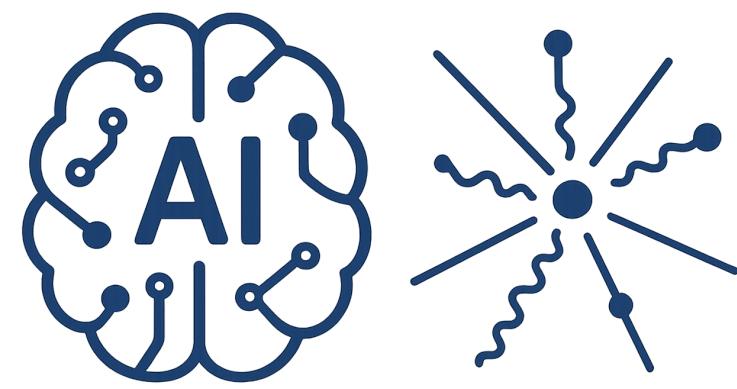
make machine behave like human

Another words

solving tasks that require
intelligence, sometimes beyond
human style

Rule based
Data based





AI-Driven HEP 2

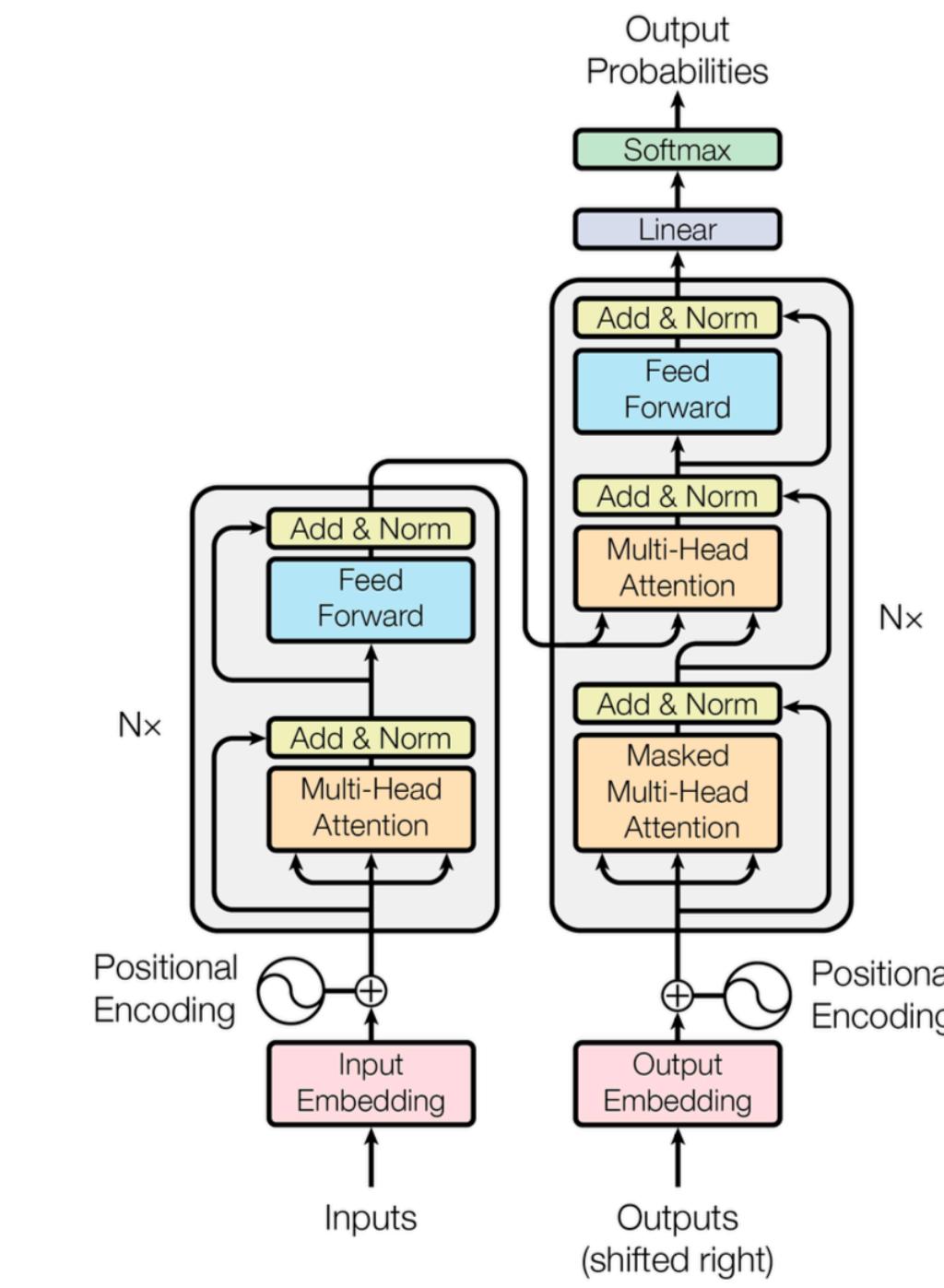
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Science advanced by inventing new experimental techniques to
building theories from data

AI advanced by inventing new learning algorithms to extract
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