Is ML just search?

2025 May 24

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Bangpypers + PyData Bangalore meetup
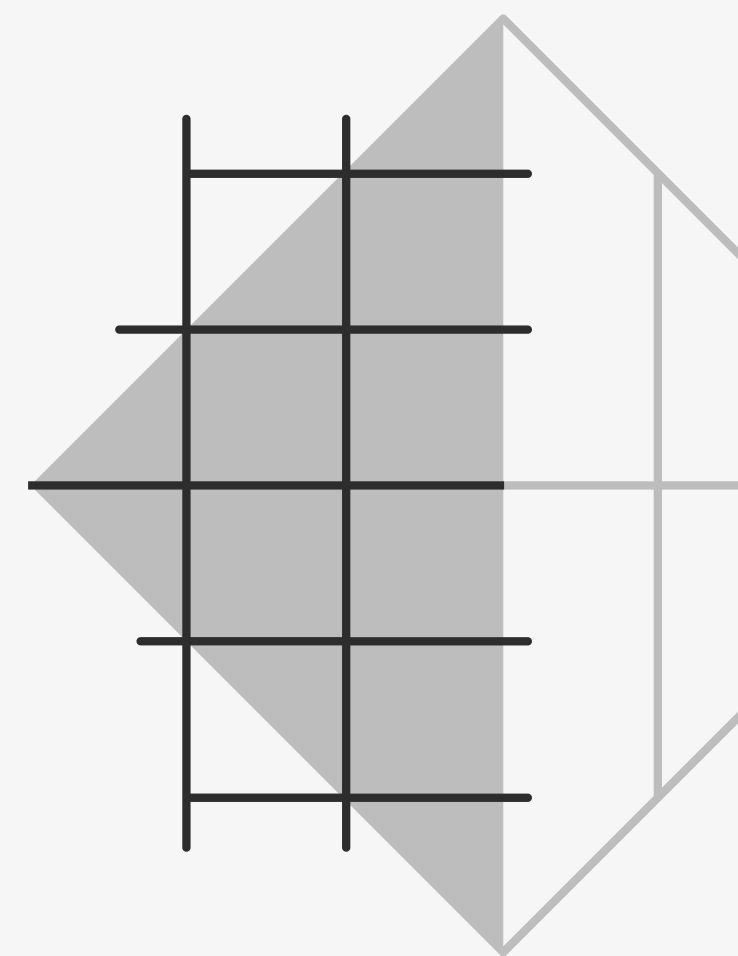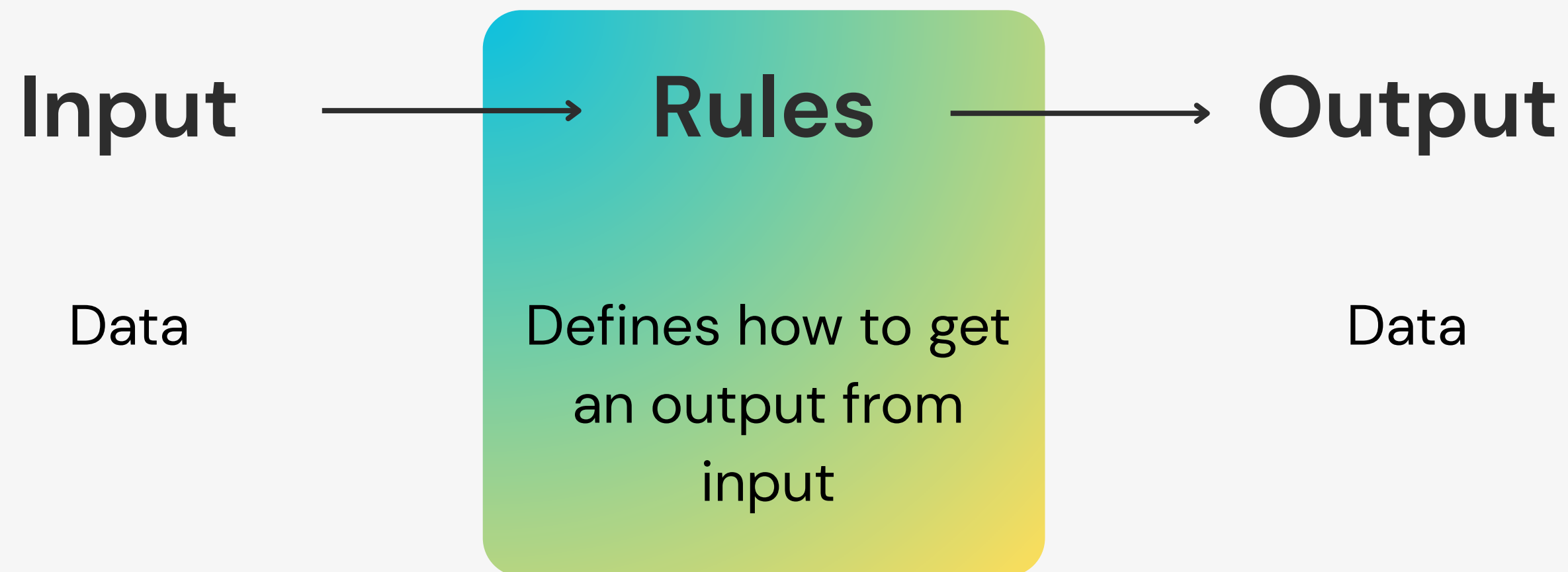
Overview

Where do you use ML in your daily life?

- How did you find out about the event?
- Did you use Gmaps to get here?
- LLMs – ChatGPT, Claude, Gemini etc

Let's define a 'problem'

Input → Rules → **Output**

Data

Rules

Defines how to get an output from input

Data

Two types of problems

Rule & Input given

The most common type of problem. You are given rules, and an input, you're expected to use these rules to get the output.

examples :- Leetcode, most programming assignments in college.

Input & Output given

Lets flip the definition around. what if we could learn a rule from given data, in order to predict future outputs from only the input?

You get to be creative, and guess the rule.

Example

What is the rule being used here –

Input a	Input b	Output y
5	7	2
129	-8	-137
32	41	9
?		

How about here?

Input a	Input b	Input c	Output y
5	7	4	8
12	-8	14	17
9	21	-24	30
32	4	3	?

y = (1)b +(-1)a + 0

y = ?

Search

Search for the best set of numbers (parameters) to get the relationship between the input and the output.

A

B

C

Bias

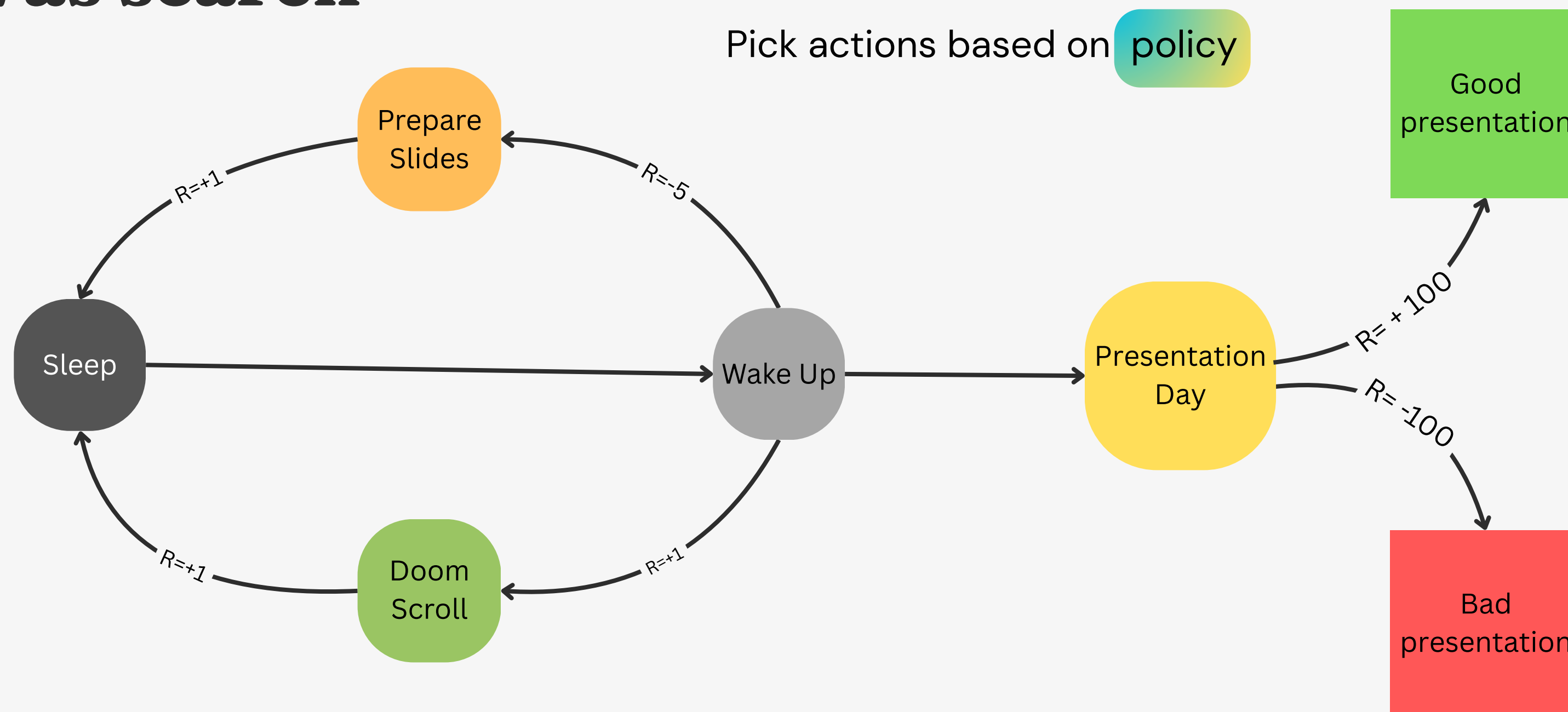W_a

W_b

W_c
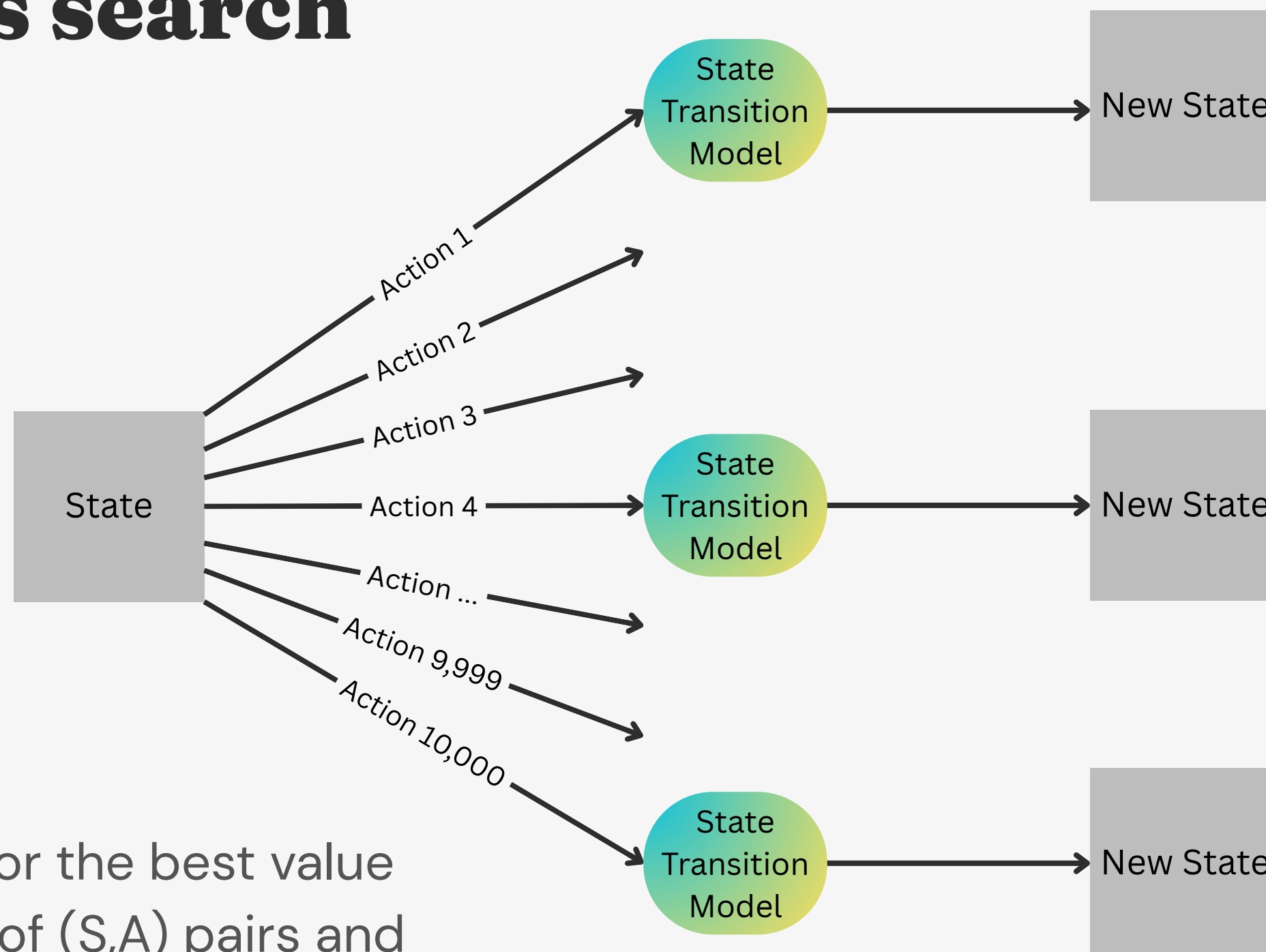
fn(
W_a*a +
W_b*b +
W_c*c +
bias
)

Y
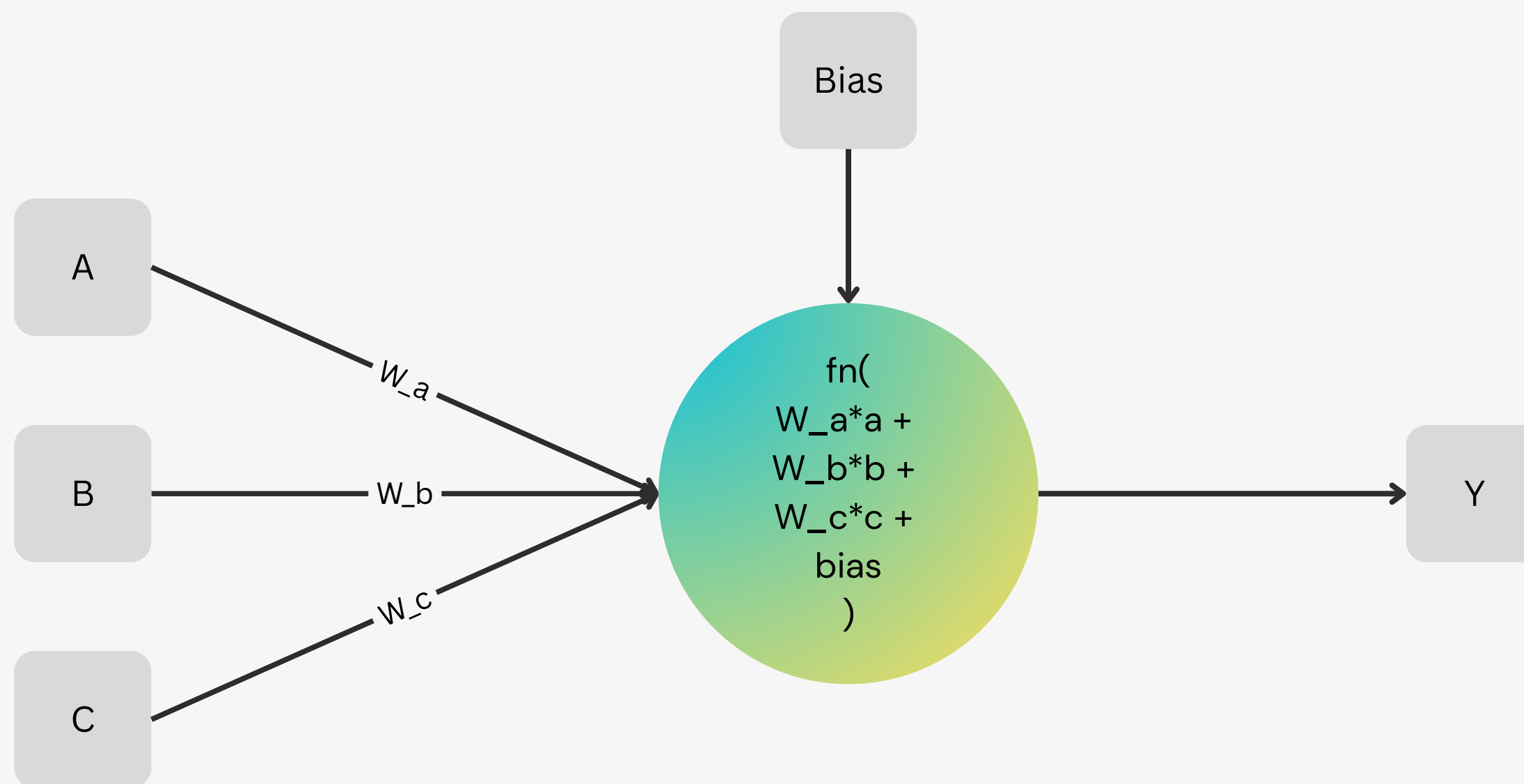
Jupyter Notebook Time!

Jupyter Notebook   TensorBoard

RL as search

Pick actions based on policy

Search - What is the best set of state-action values for optimal performance

RL as search

State

Action 1
Action 2
Action 3
Action 4
Action ...
Action 9,999
Action 10,000

State Transition Model → New State

State Transition Model → New State

State Transition Model → New State

Parameter search for the best transition model, similar what we saw in the jupyter notebook.

Search for the best value for each of (S,A) pairs and use this to form a policy.

LLMs as search

source: *Attention is all you need paper*

Here is how AI translation works.

Words → word vectors → contextually rich word vectors → . . . → probability of the next word being w_i

Okay that's a super complicated diagram!

LLMs as search

Output
Probabilities

Softmax

Rules:
Search for the best
set of numbers to
convert the input to
the output

Inputs   Outputs
(shifted right)
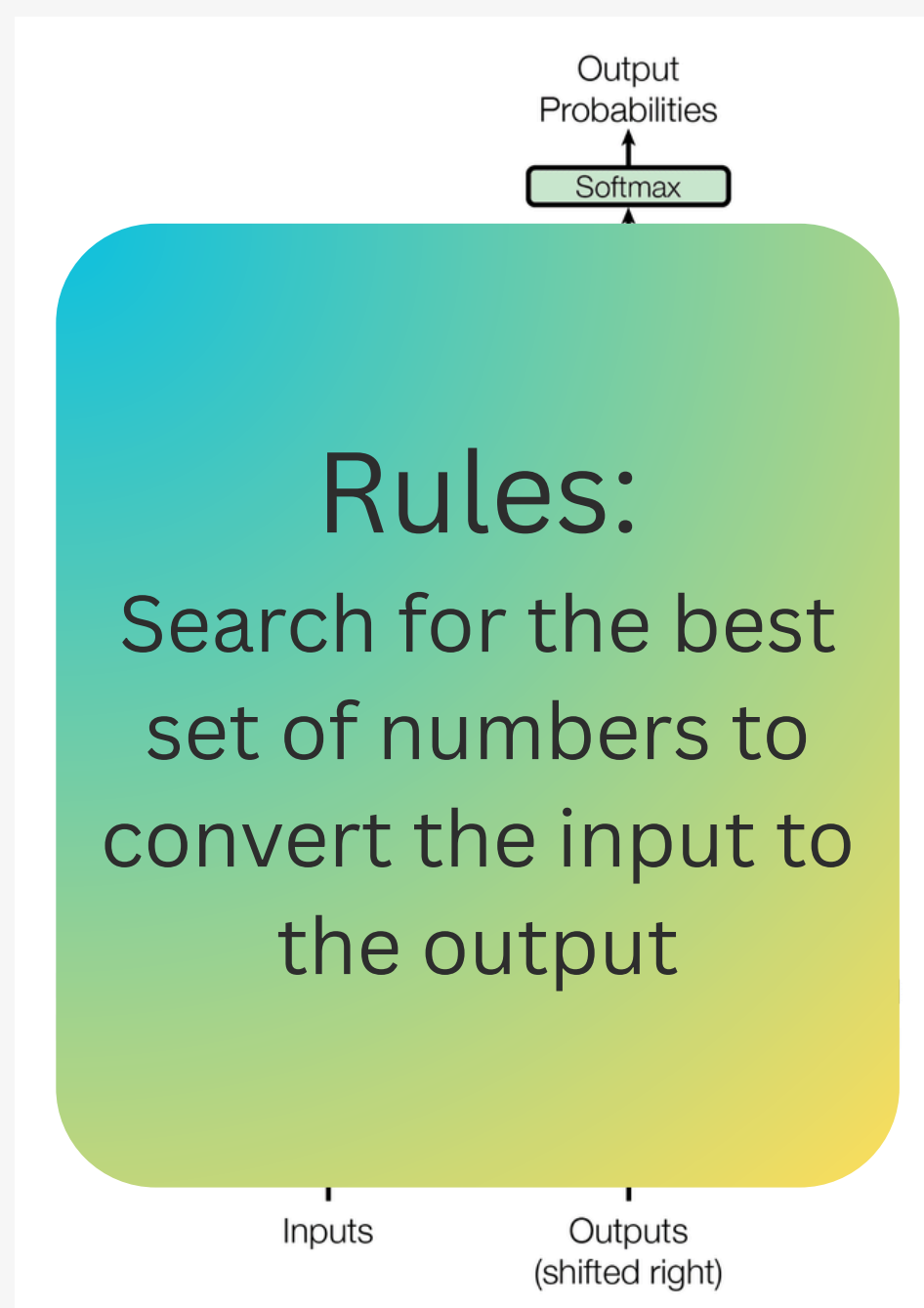
source: Attention is all you need paper

But isn't this still just the search for the right parameters, such that an input sentence generates the correct set of outputs?

ChatGPT uses only the right side (decoder) to iteratively search for the best next word in the sequence.
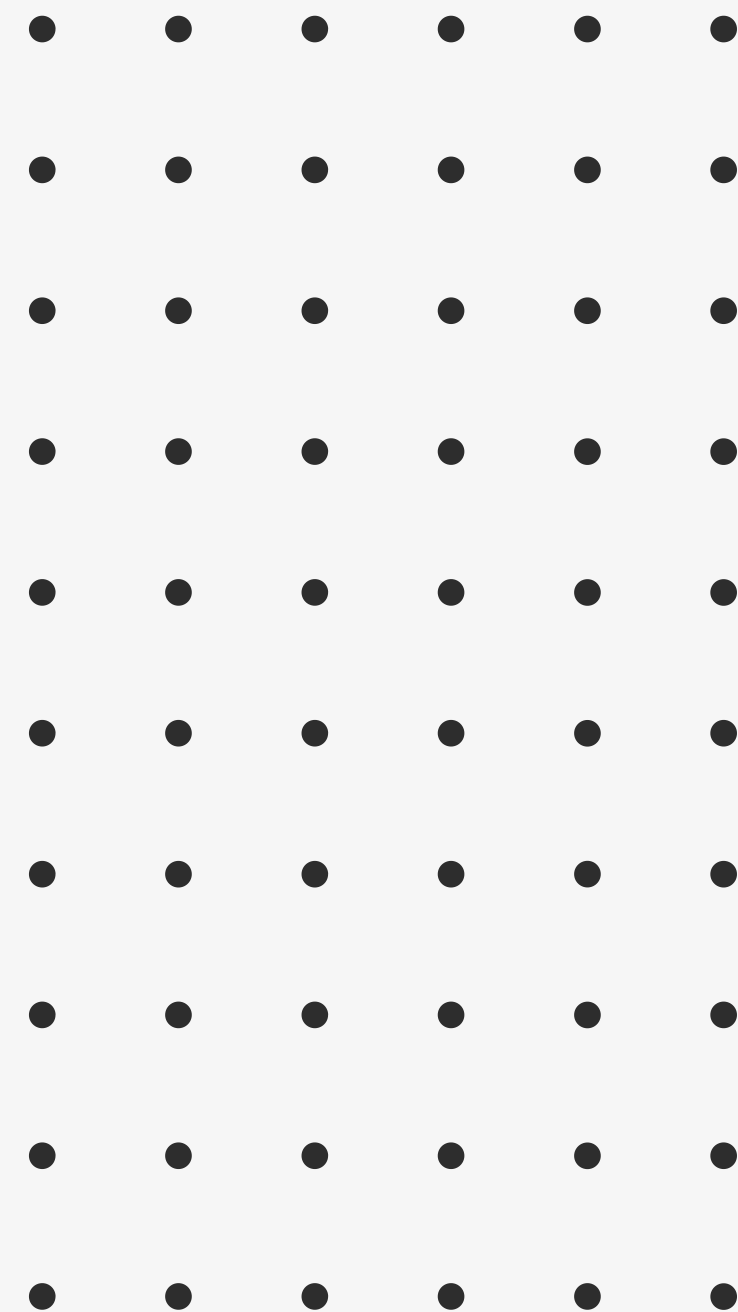
Thank you :)

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Resources

- https://www.youtube.com/@statquest
- https://davidstarsilver.wordpress.com/teaching/
- https://www.3blue1brown.com/
- https://web.stanford.edu/class/psych209/Readings/SuttonBartoIPRLBook2ndEd.pdf
- https://www.coursera.org/specializations/machine-learning-introduction