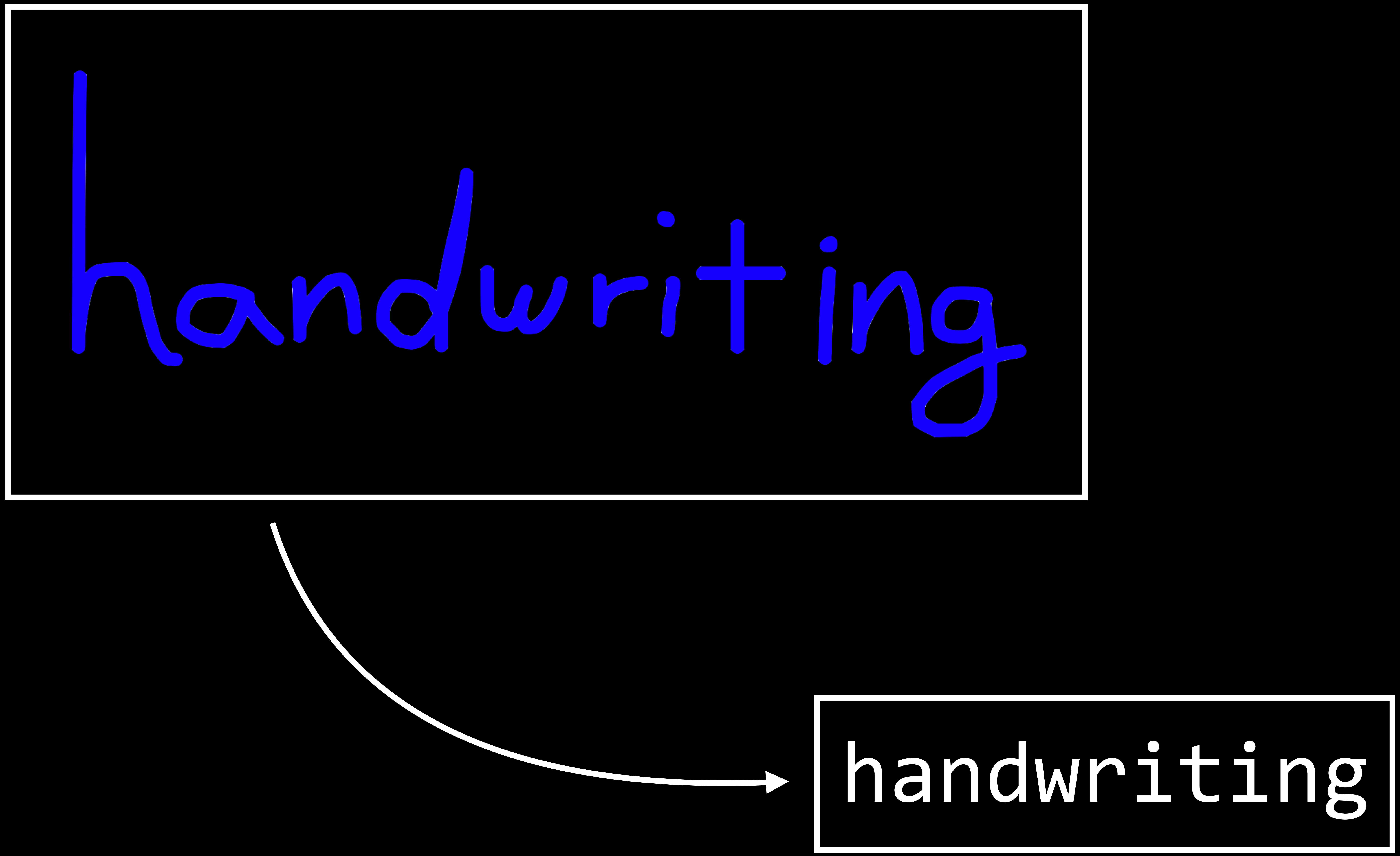
# Artificial Intelligence

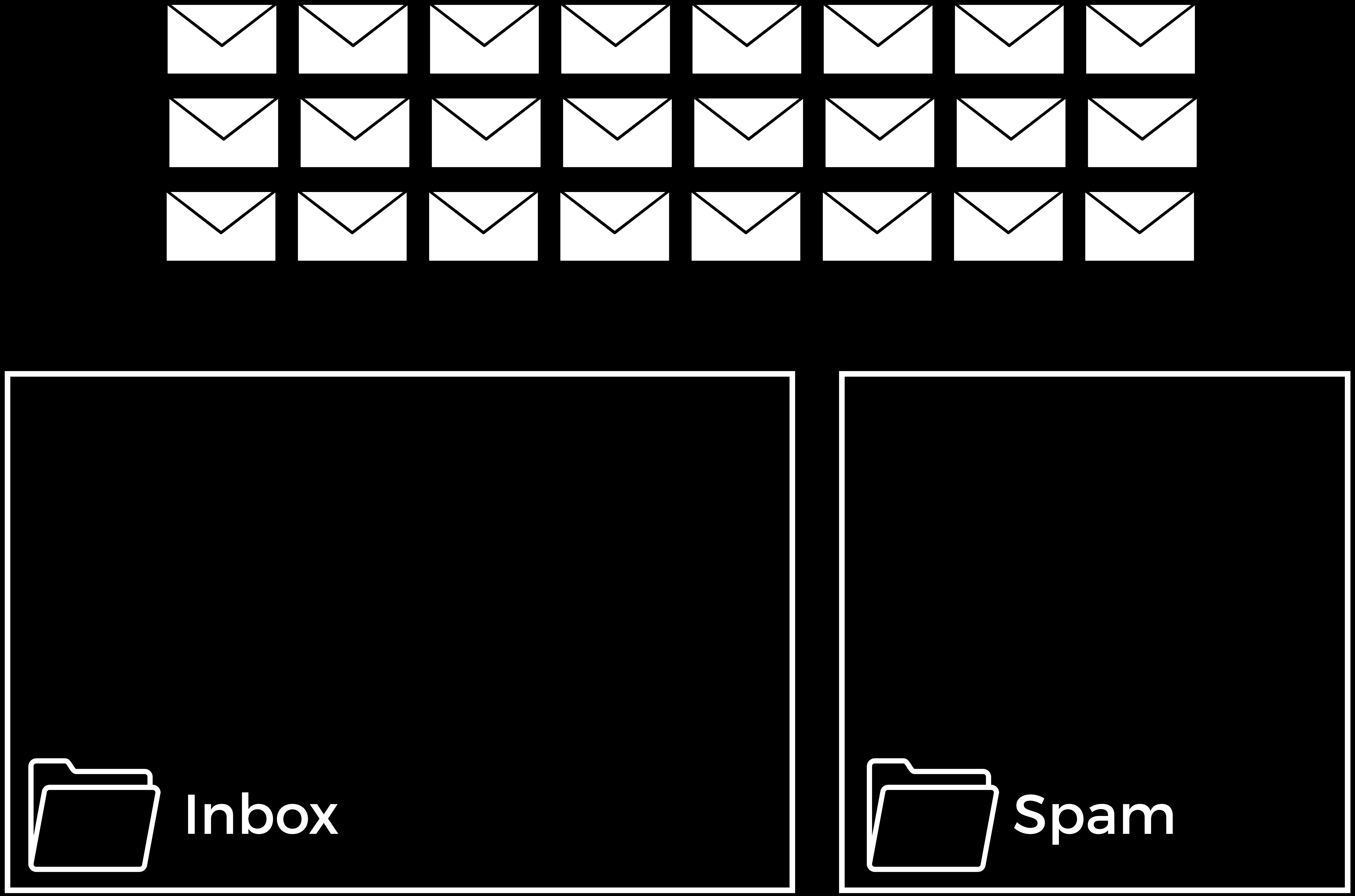
|   |   |   |
|---|---|---|
|   | O | X |
| O | X | X |
| O |   | X |



handwriting

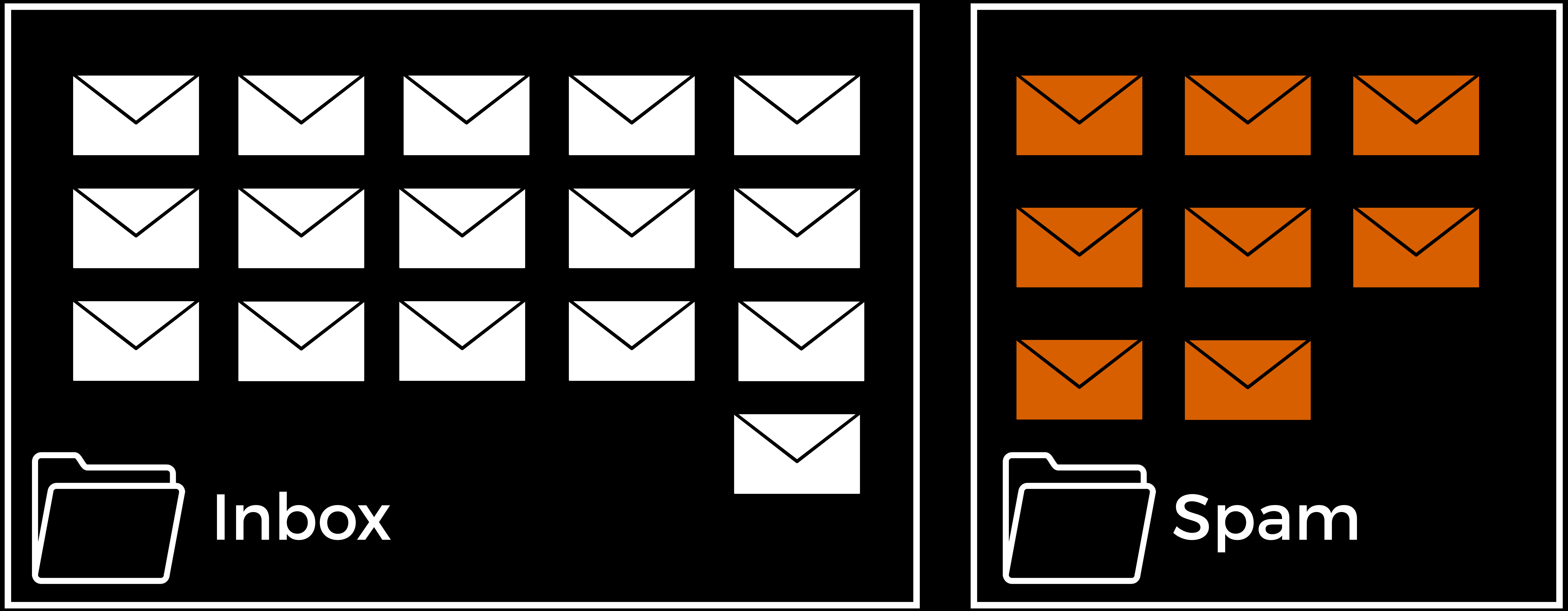
Inbox

Spam



Inbox

Spam



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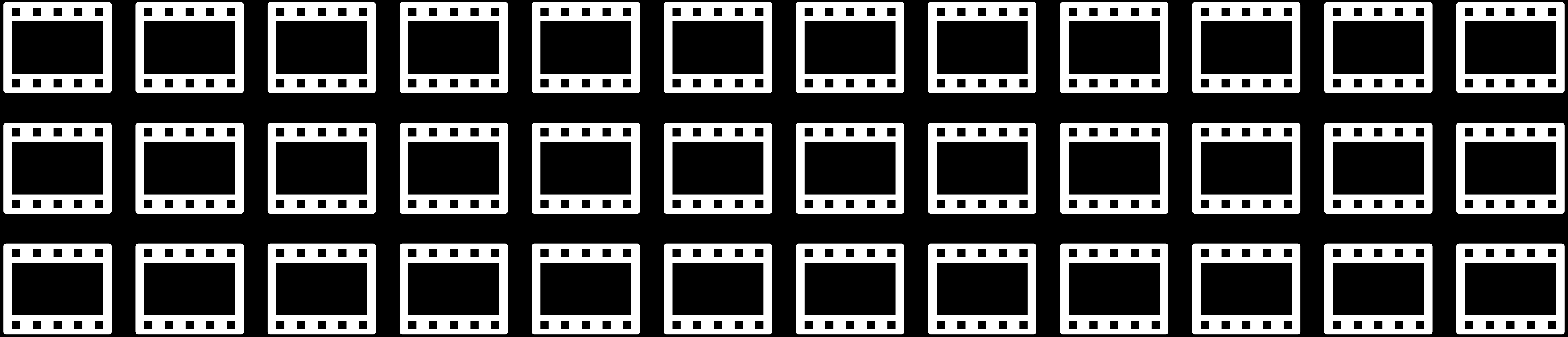
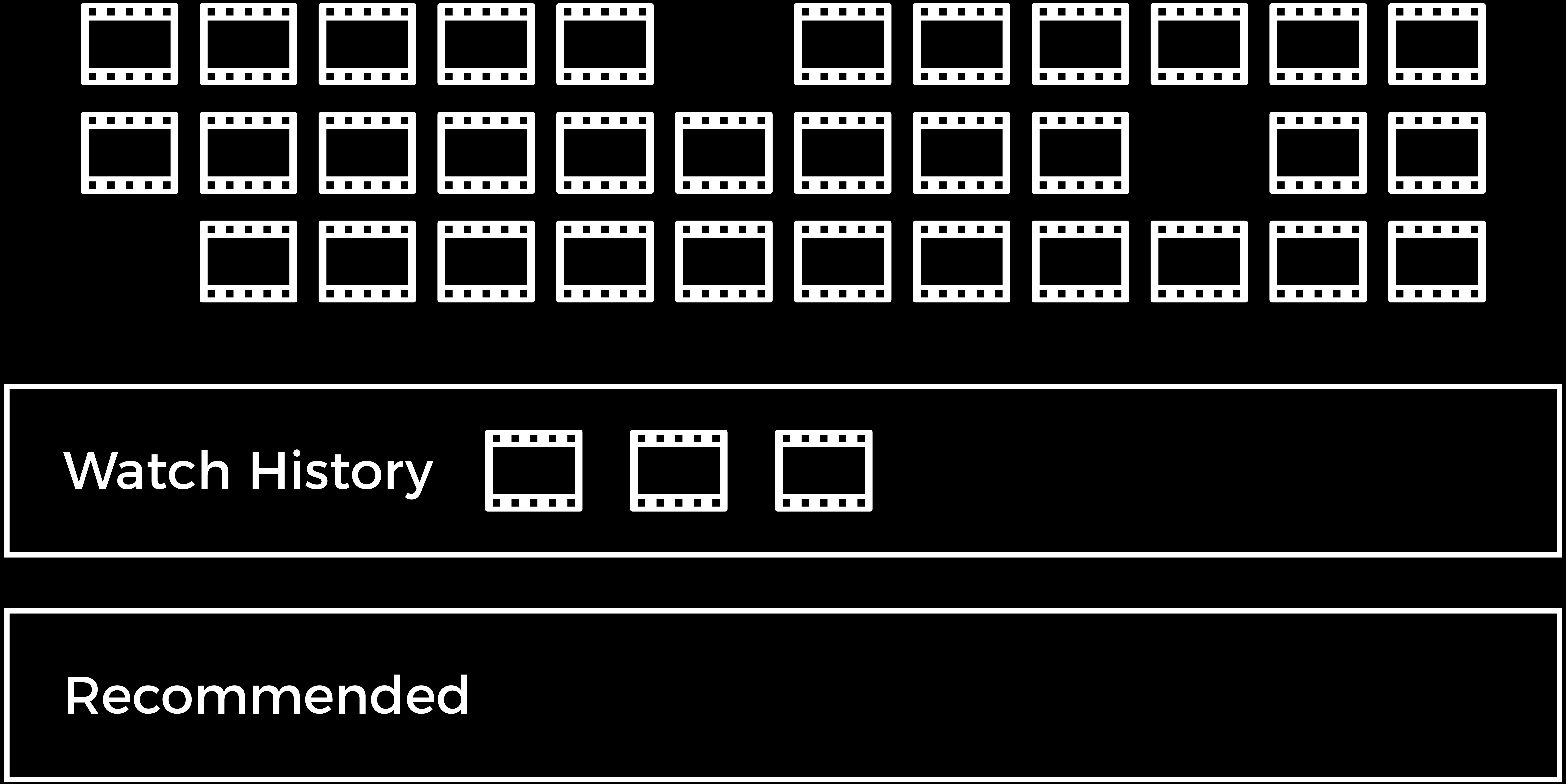
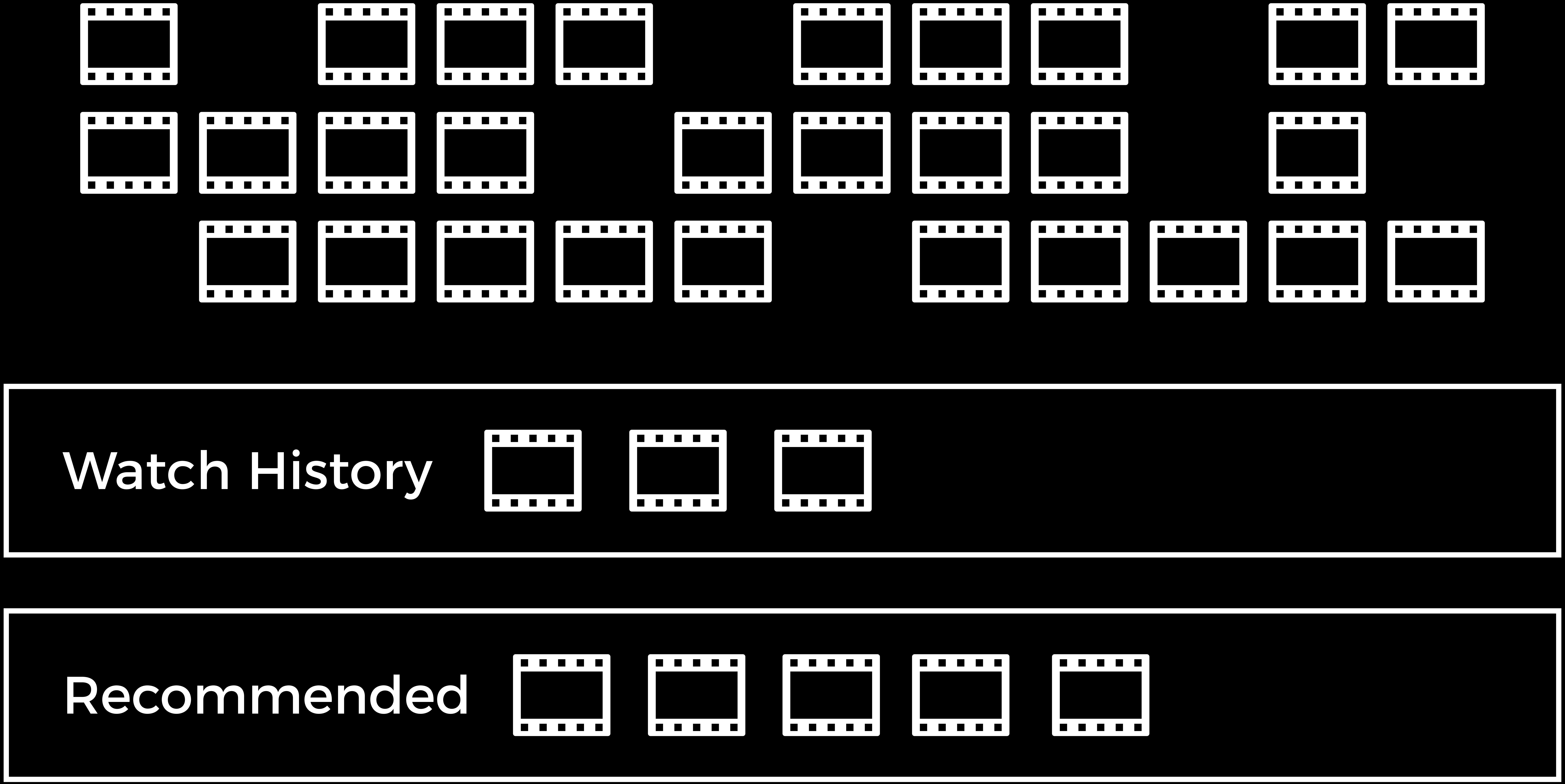


Watch History



Watch History

Recommended

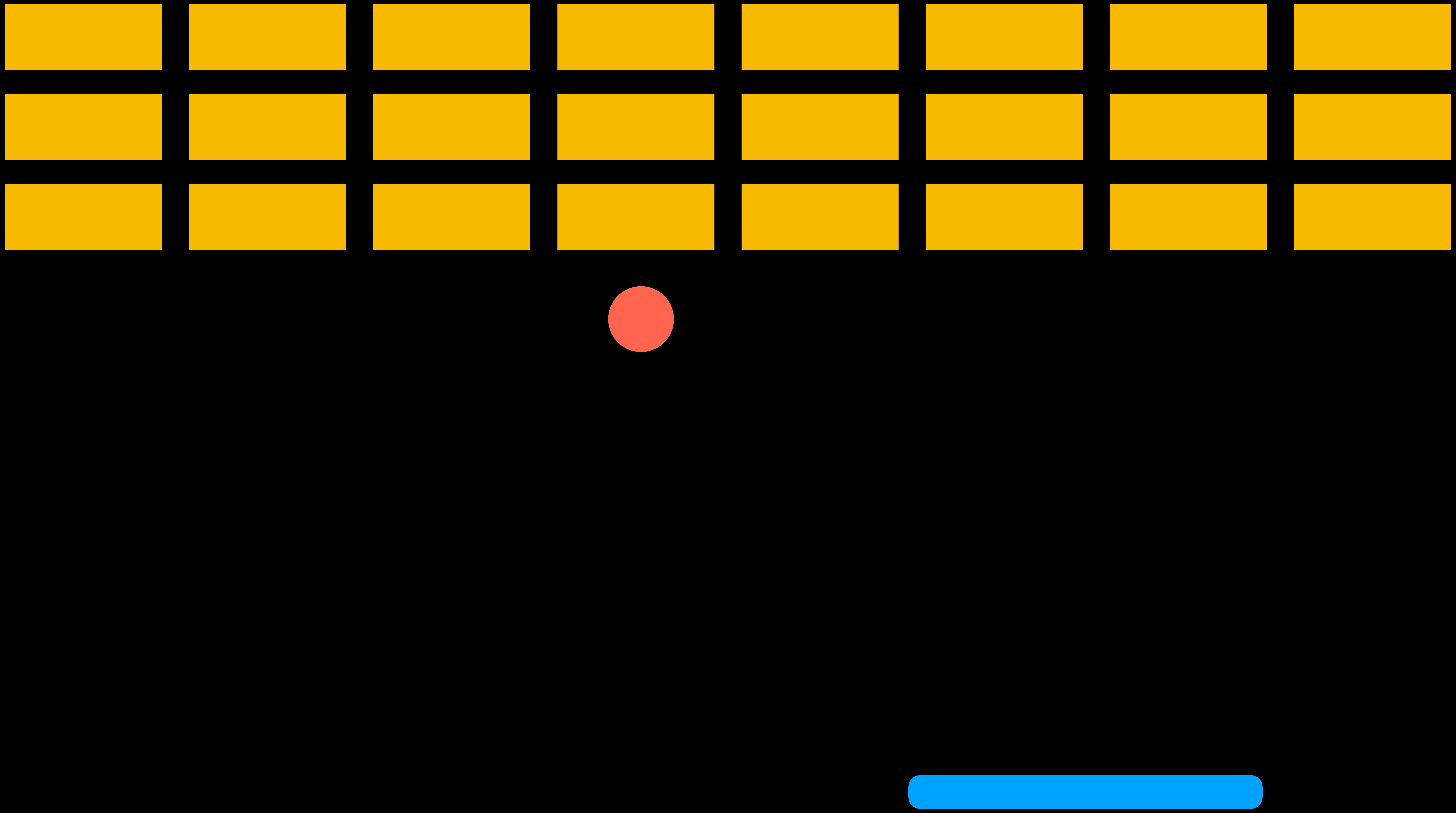


Watch History

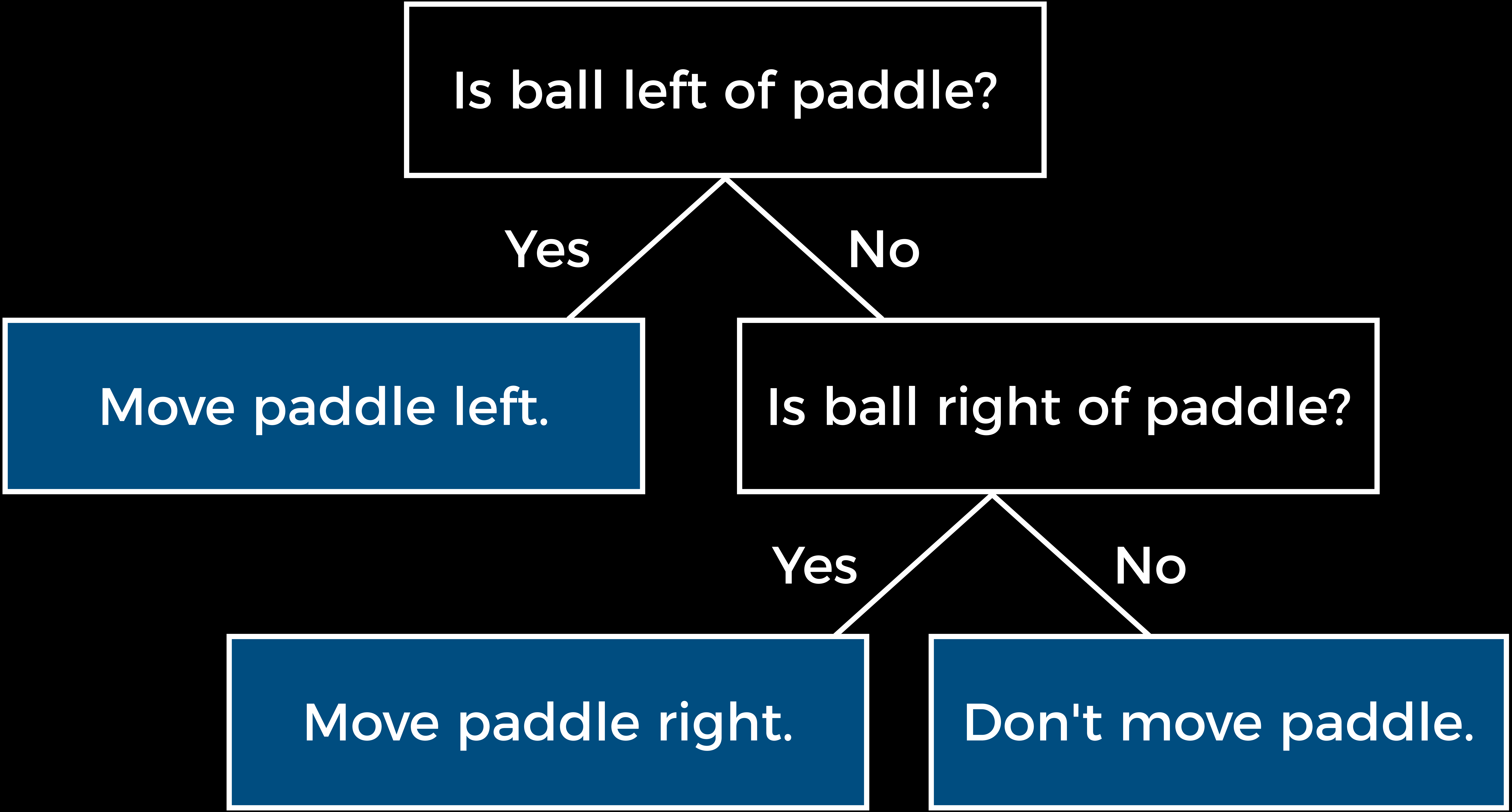
Recommended

# Artificial Intelligence

# Decision-Making



# Decision Trees



Is ball left of paddle?

Yes

Move paddle left.

No

Is ball right of paddle?

Yes

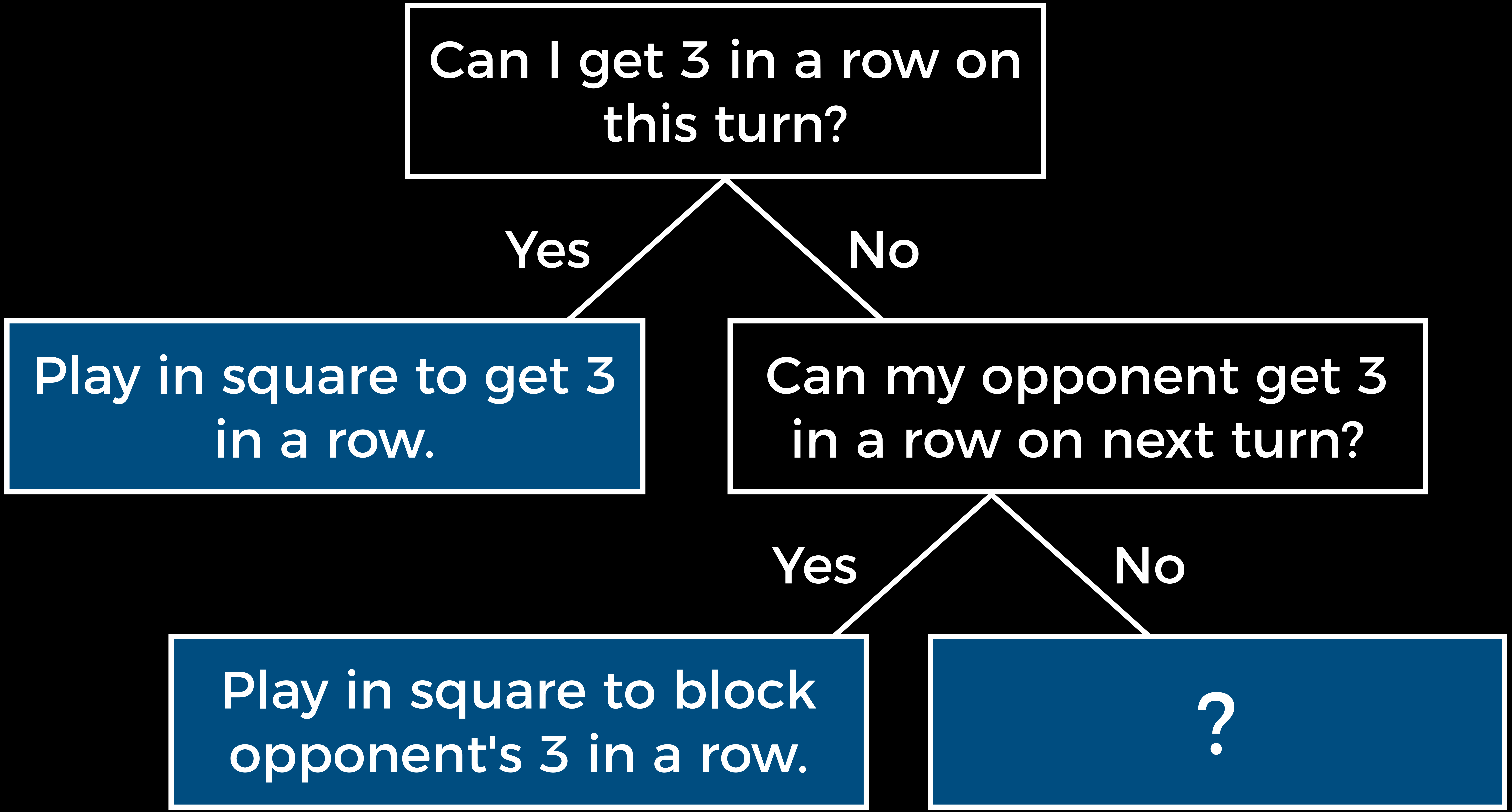
Move paddle right.

No

Don't move paddle.

```
while game is ongoing:
    if ball left of paddle:
        move paddle left
    else if ball right of paddle:
        move paddle right
    else:
        don't move paddle
```

| | | |
|---|---|---|
| | | O |
| | X | |
| X | | O |



Can I get 3 in a row on this turn?

Yes

No

Play in square to get 3 in a row.

Can my opponent get 3 in a row on next turn?

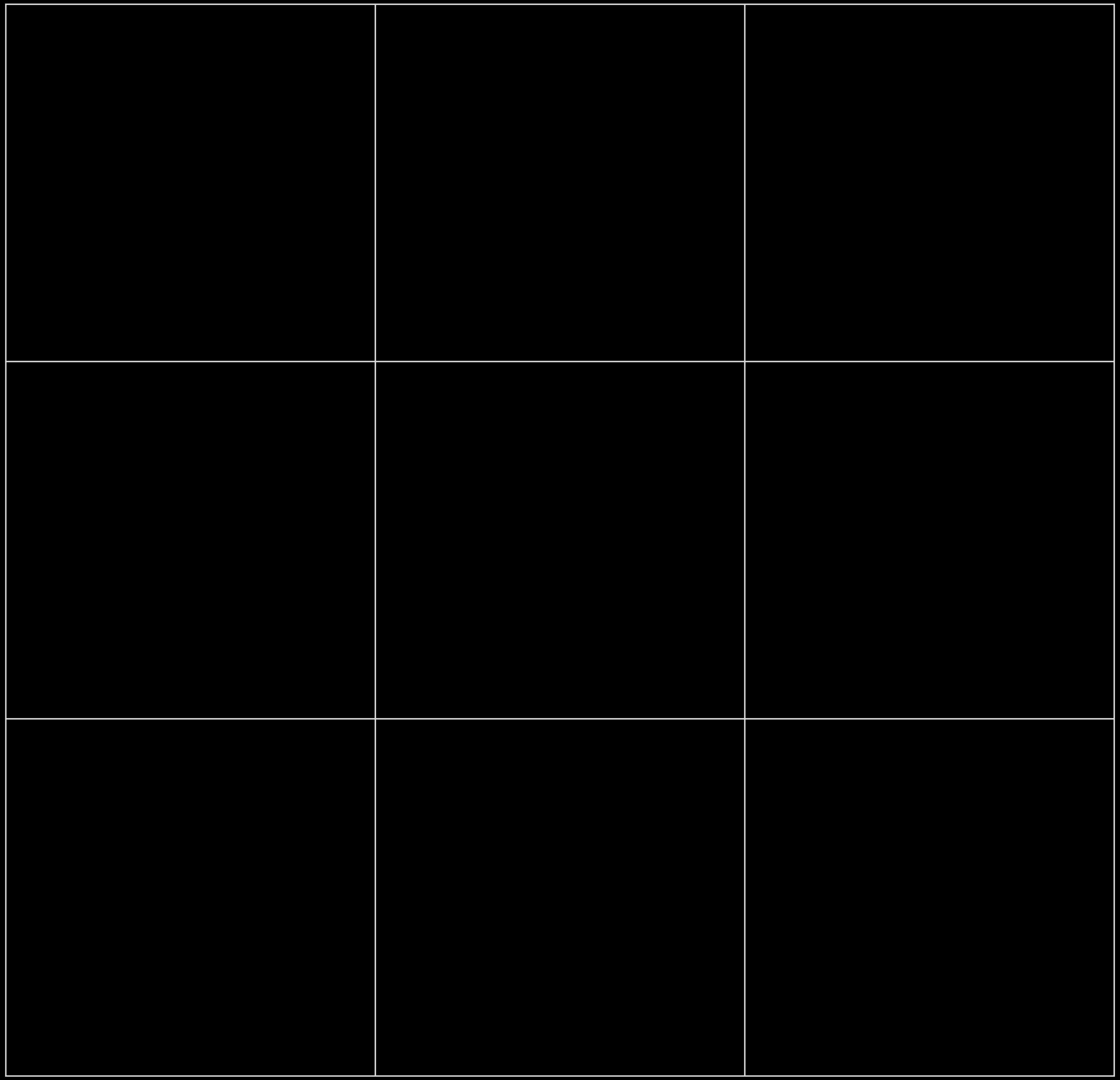
Yes

No

Play in square to block opponent's 3 in a row.

?

# Optimal Decision-Making



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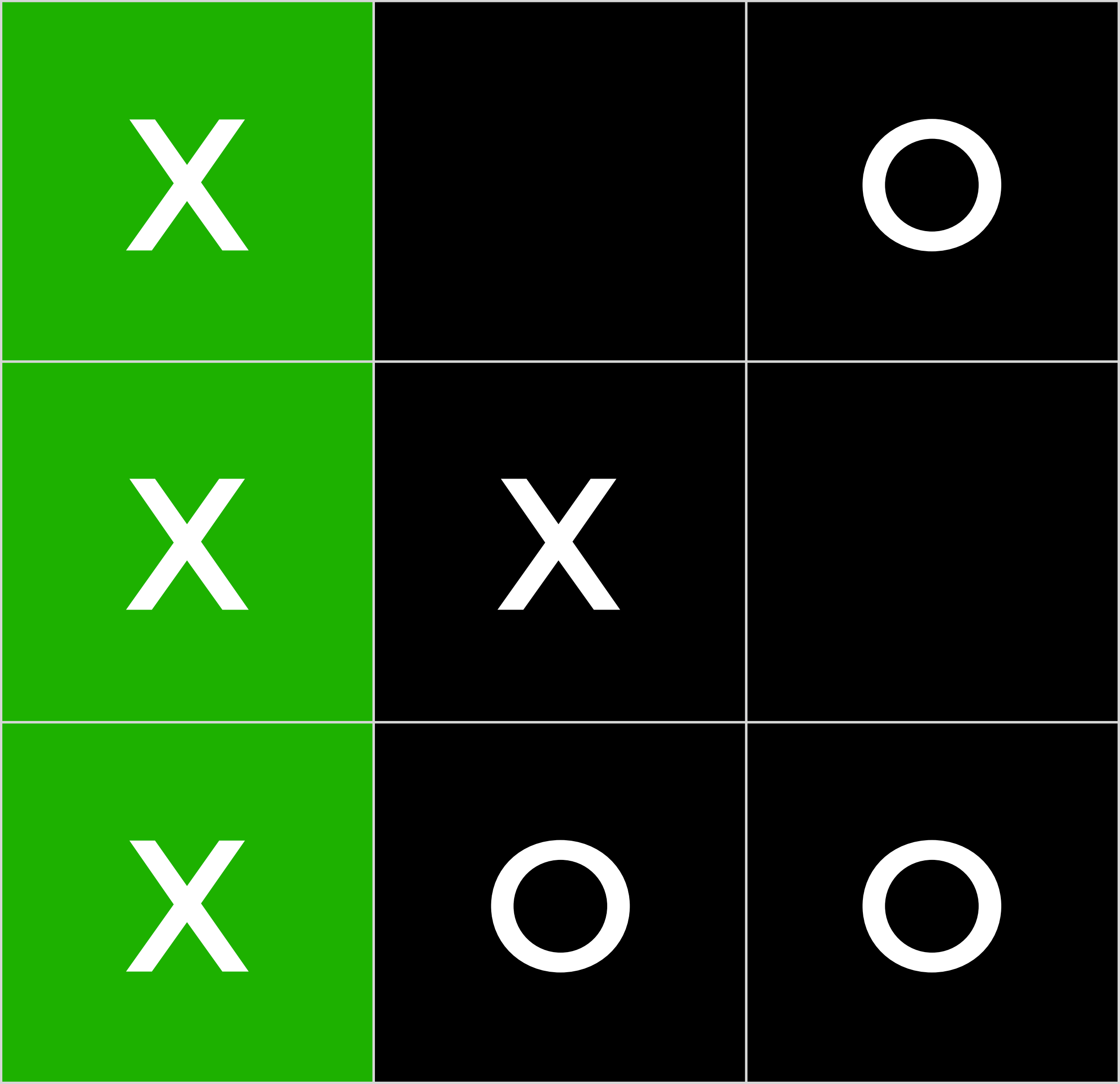
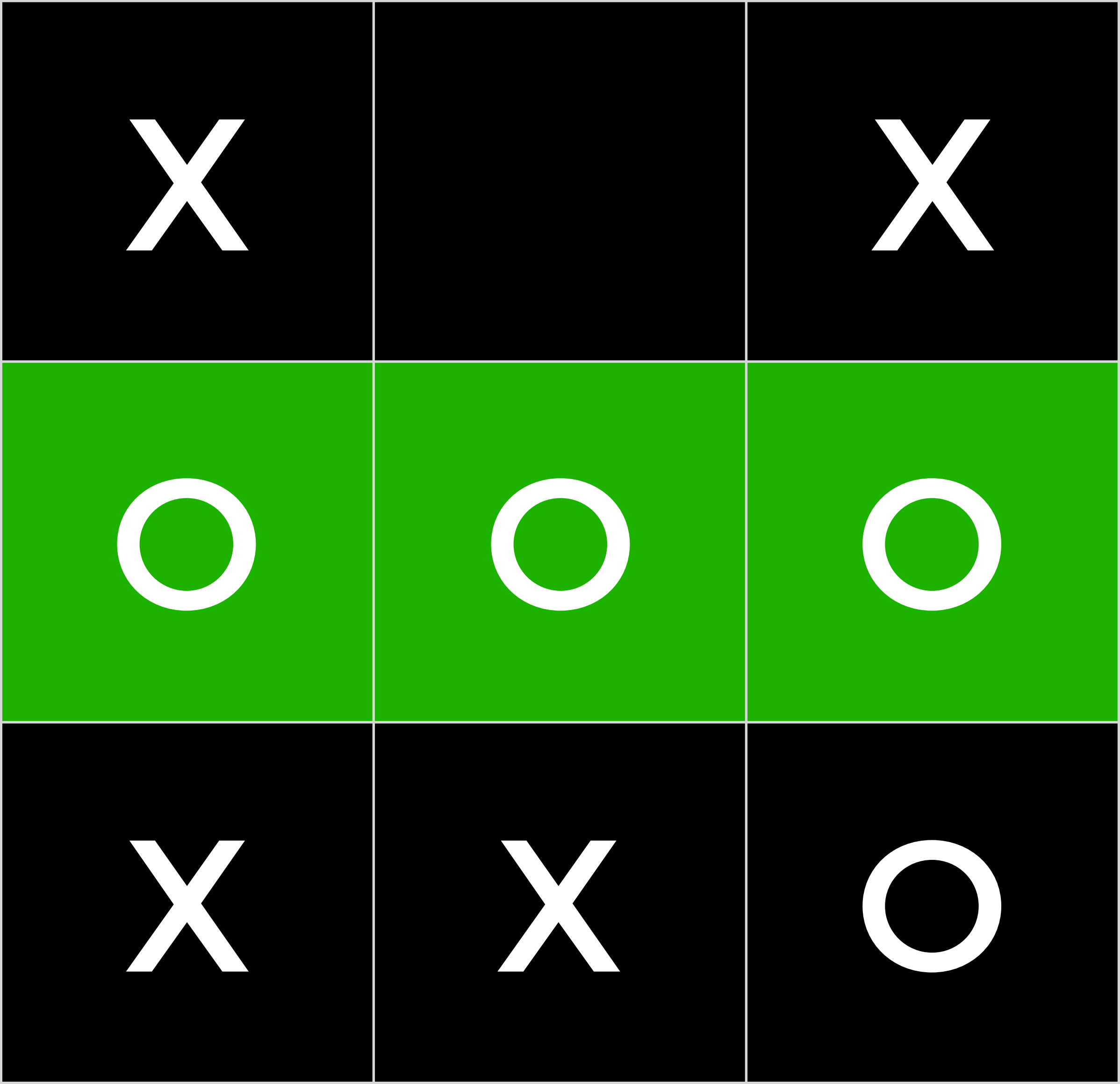
X wants to maximize score.
O wants to minimize score.

1



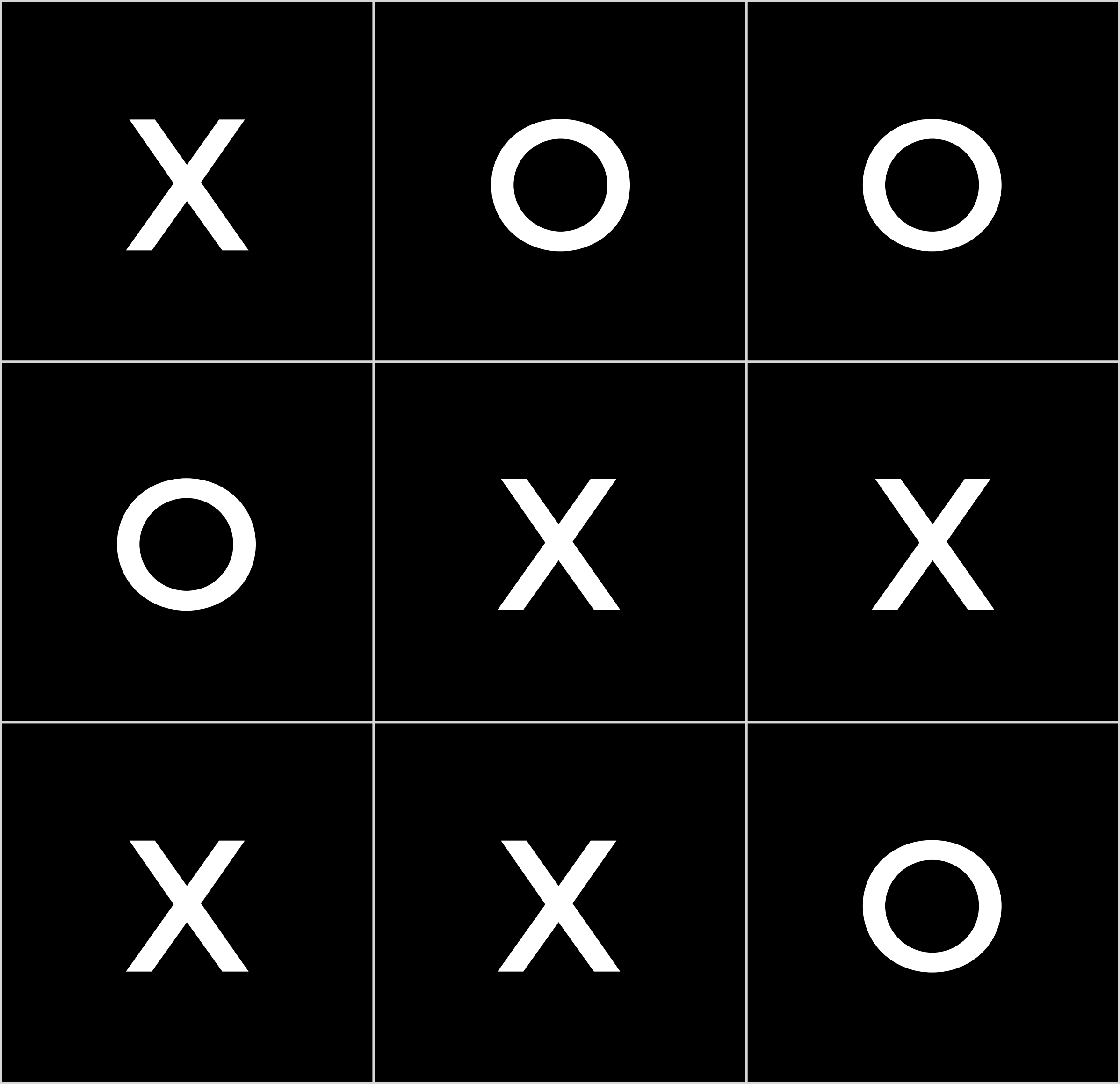
| | | |
|---|---|---|
| X | | O |
| X | X | |
| X | O | O |

-1



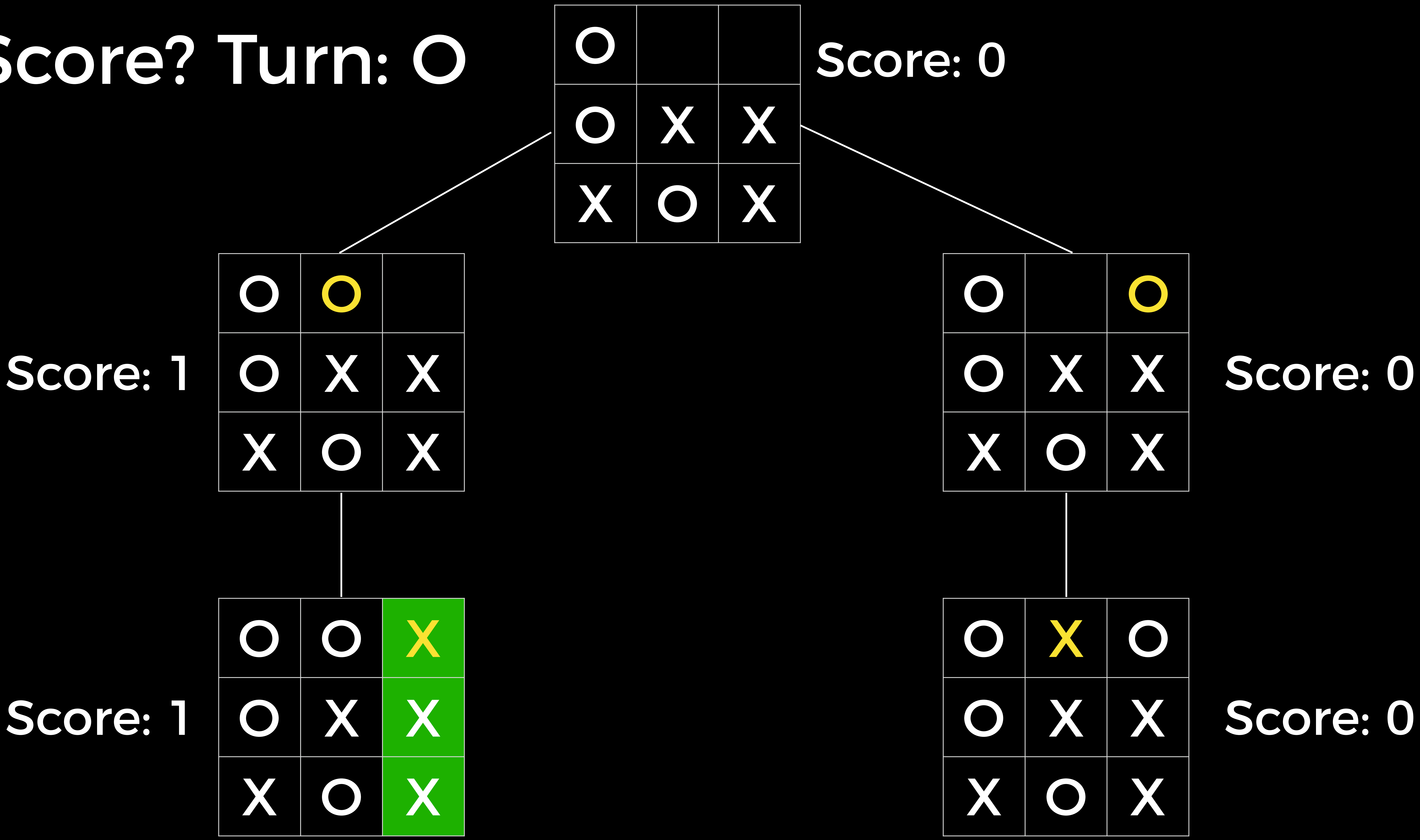
| | | |
|---|---|---|
| X | | X |
| O | O | O |
| X | X | O |

0



| | | |
|---|---|---|
| X | O | O |
| O | X | X |
| X | X | O |

# Score? Turn: O



Score: 0

|   |   |   |
|---|---|---|
| O |   |   |
| O | X | X |
| X | O | X |

Score: 1

|   |   |   |
|---|---|---|
| O | O |   |
| O | X | X |
| X | O | X |

Score: 0

|   |   |   |
|---|---|---|
| O |   | O |
| O | X | X |
| X | O | X |

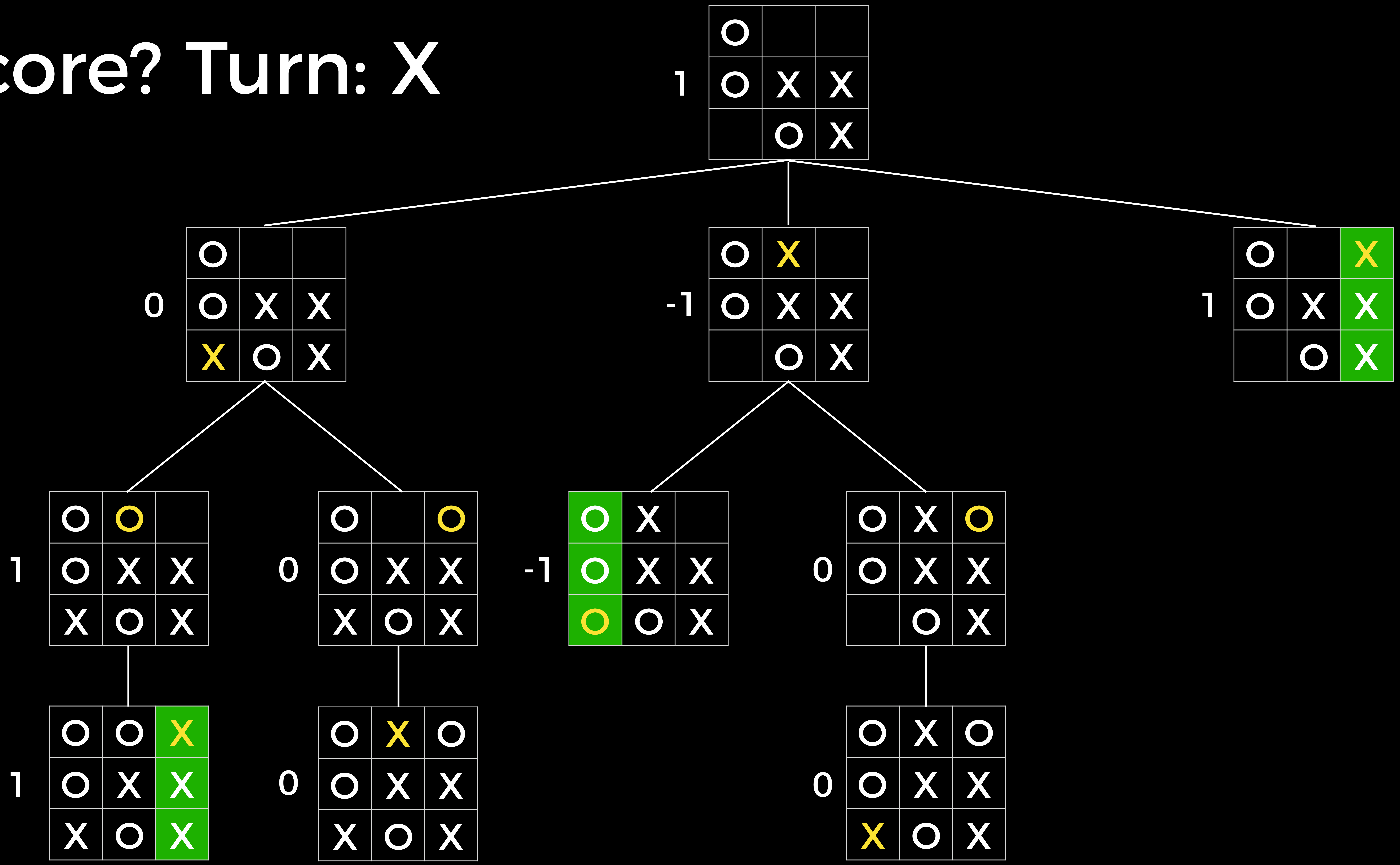
Score: 1

|   |   |   |
|---|---|---|
| O | O | X |
| O | X | X |
| X | O | X |

Score: 0

|   |   |   |
|---|---|---|
| O | X | O |
| O | X | X |
| X | O | X |

# Score? Turn: X

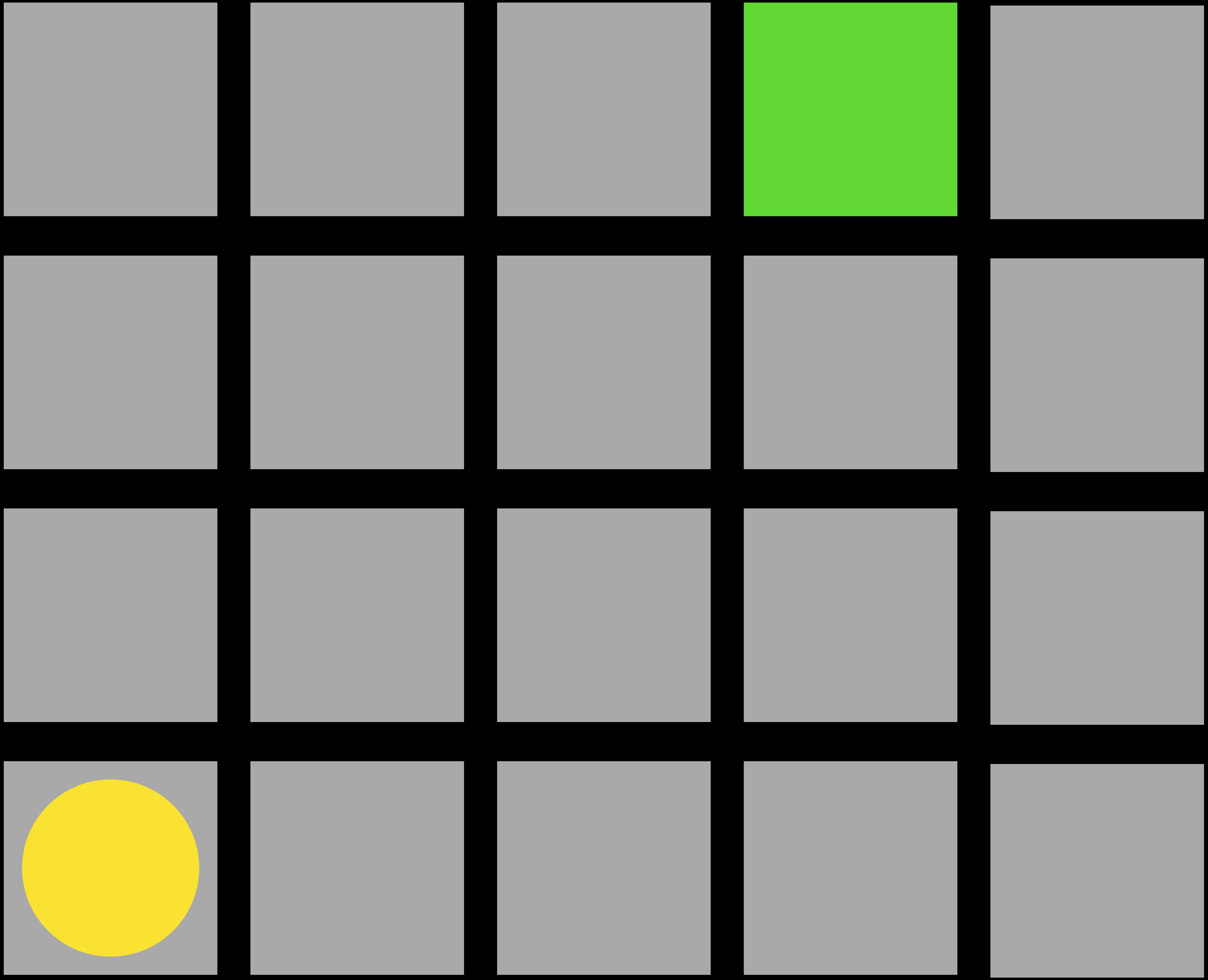

1
O
O X X
O X
0
O
O X X
X O X
-1
O X
O X X
O X
1
O X
O X X
O X
1
O O
O X X
X O X
0
O O
O X X
X O X
-1
O X
O X X
O O X
0
O X O
O X X
O X
1
O O X
O X X
X O X
0
O X O
O X X
X O X
0
O X O
O X X
X O X

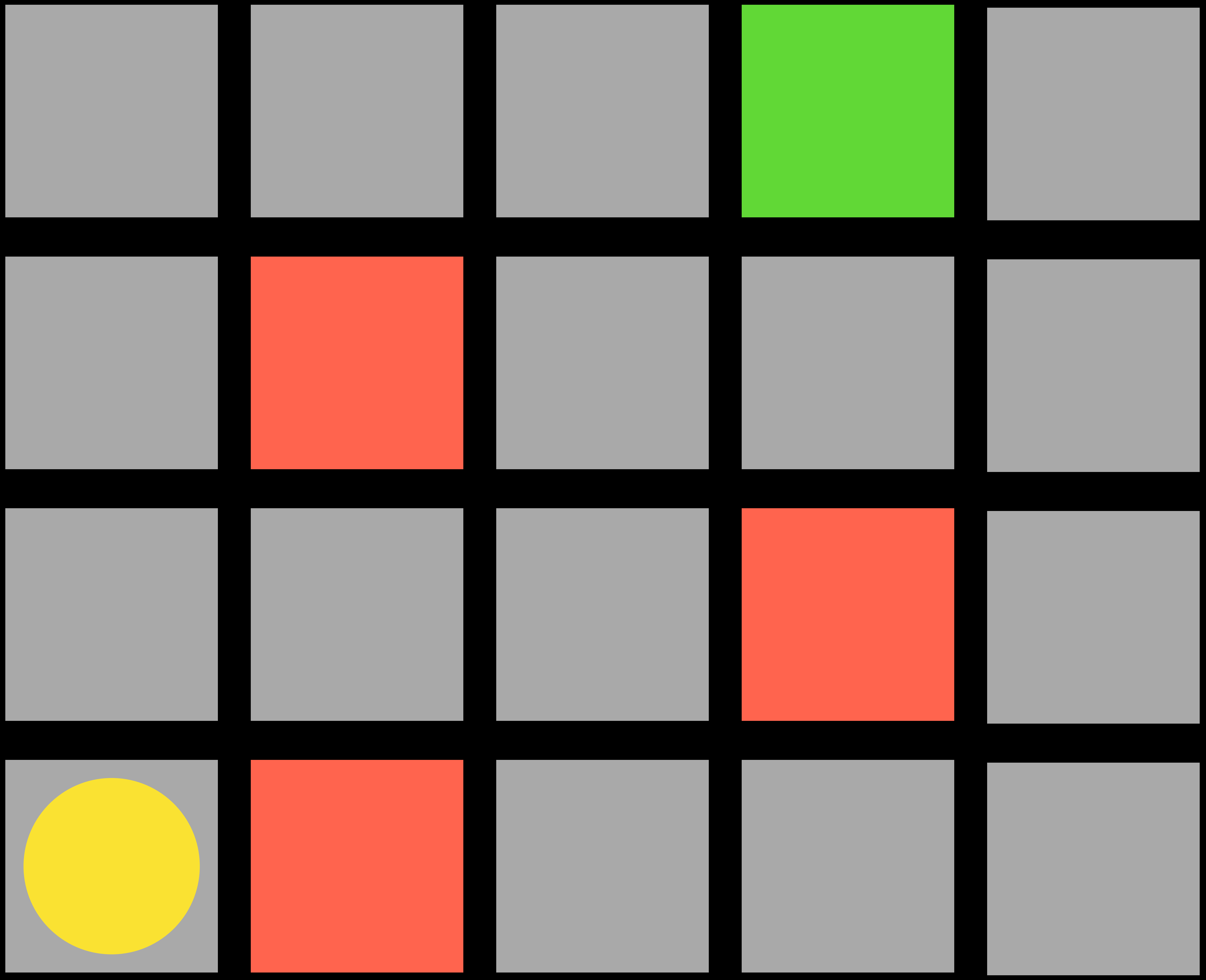
# Minimax

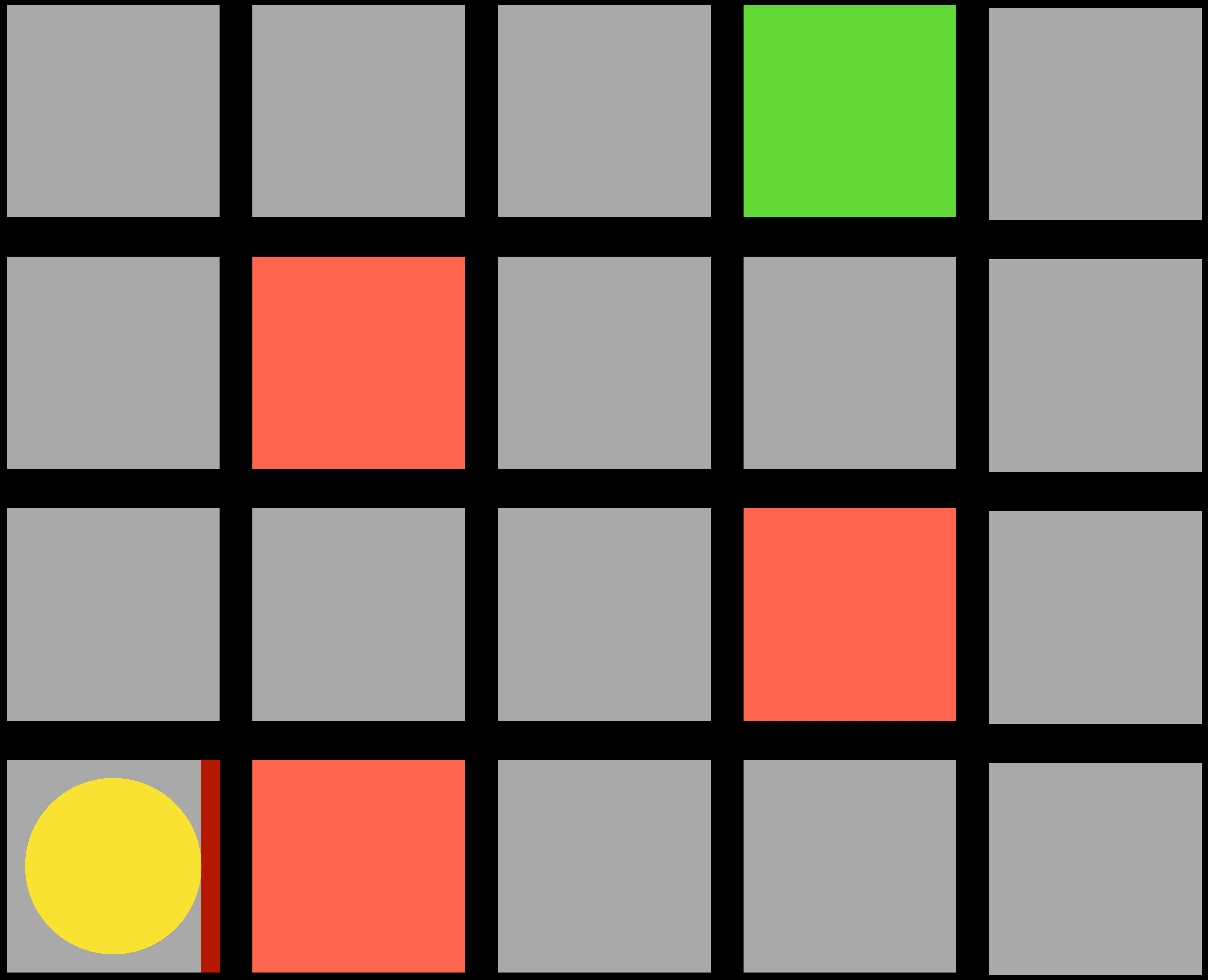
```
if player is X:
    for all possible moves:
        calculate score for board
    choose move with highest score

else:
    for all possible moves:
        calculate score for board
    choose move with lowest score
```

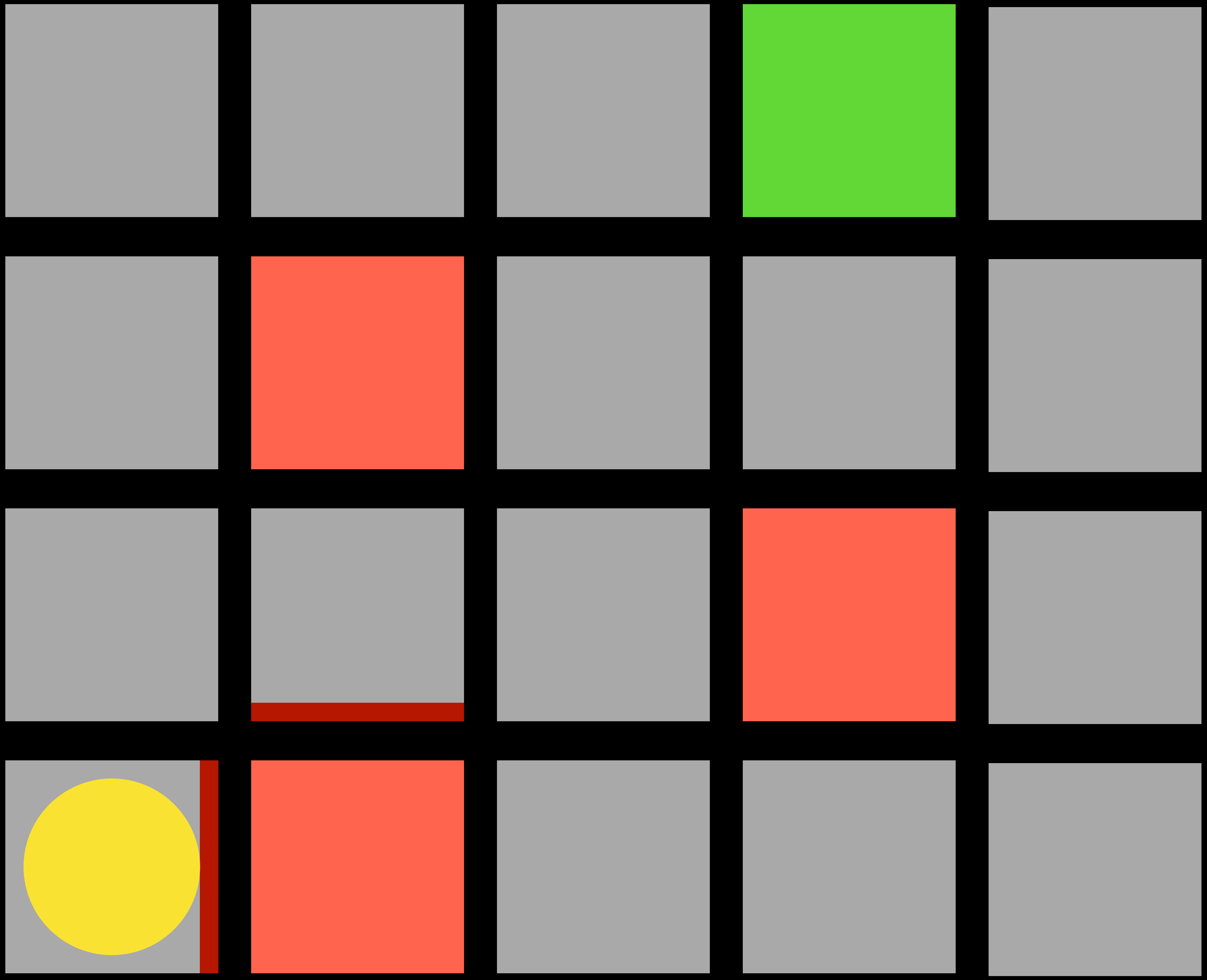
# Machine Learning

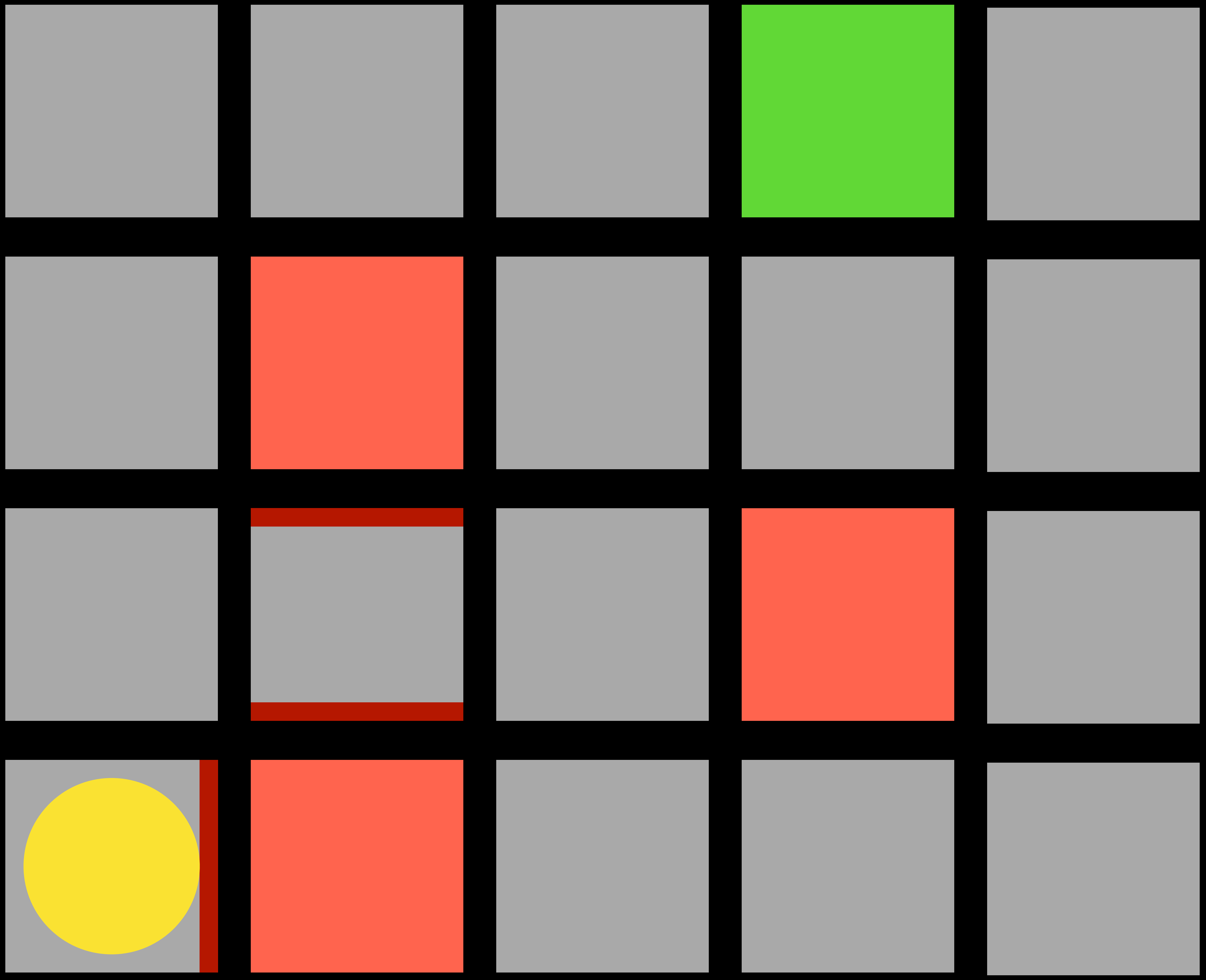
# Reinforcement Learning

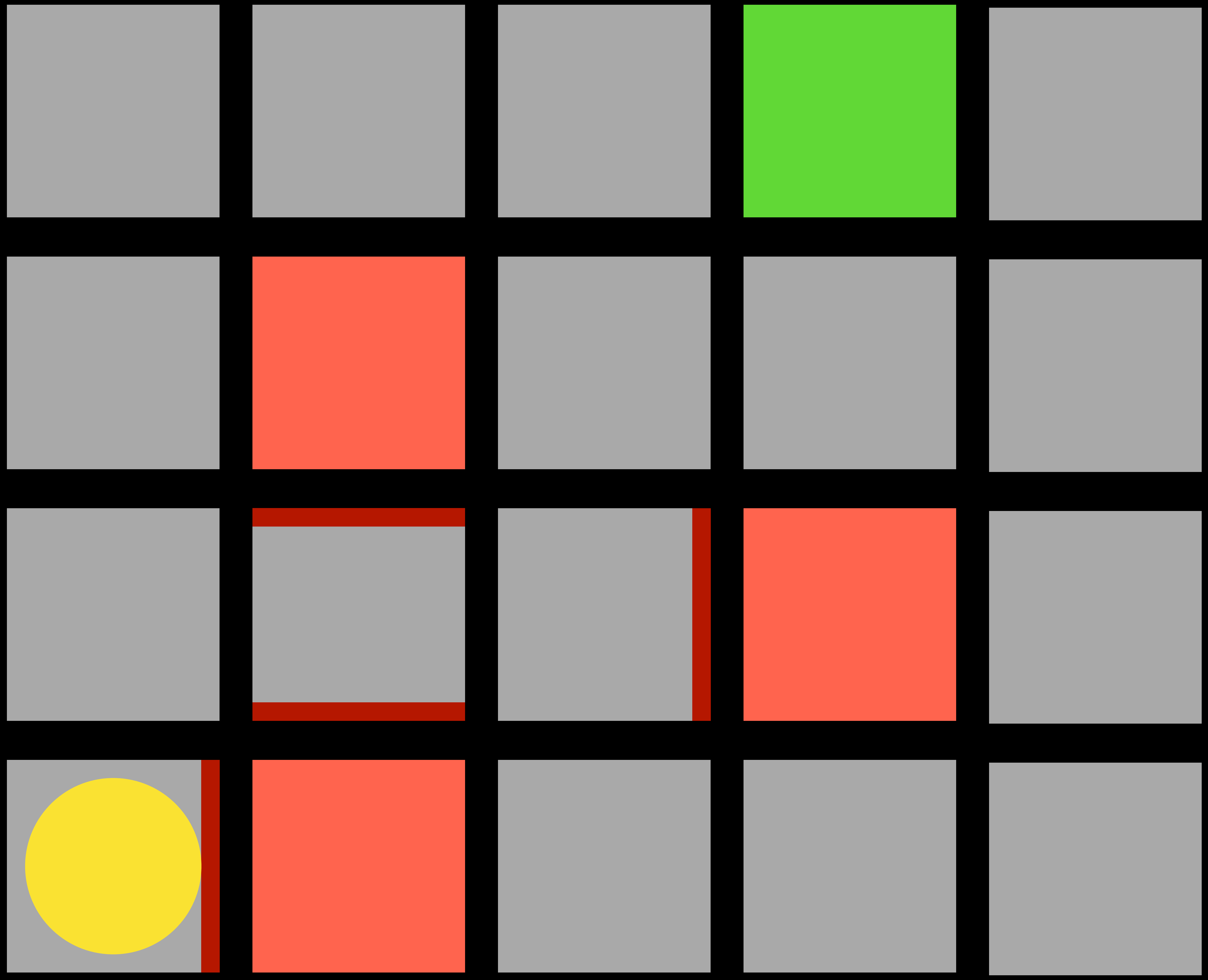


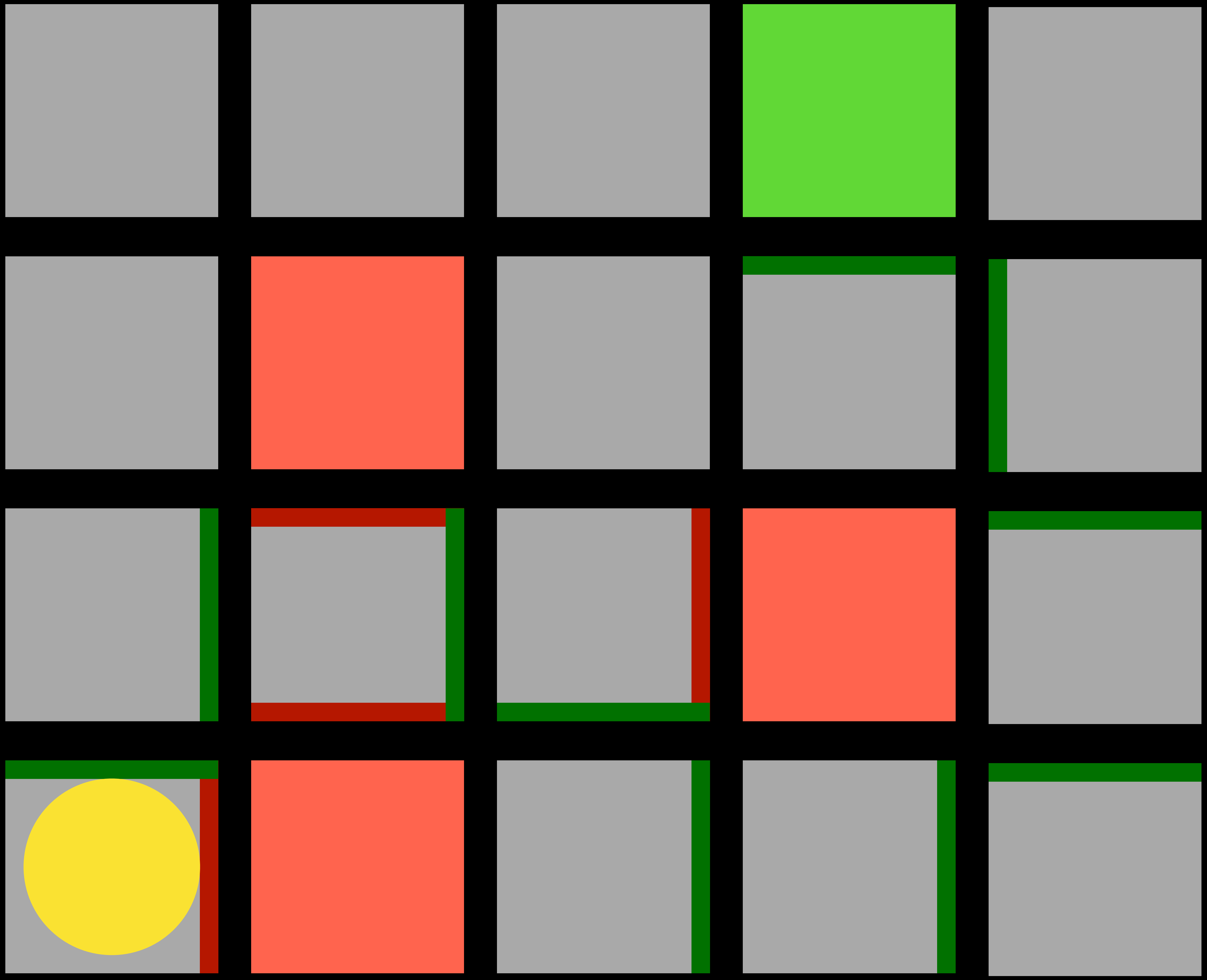


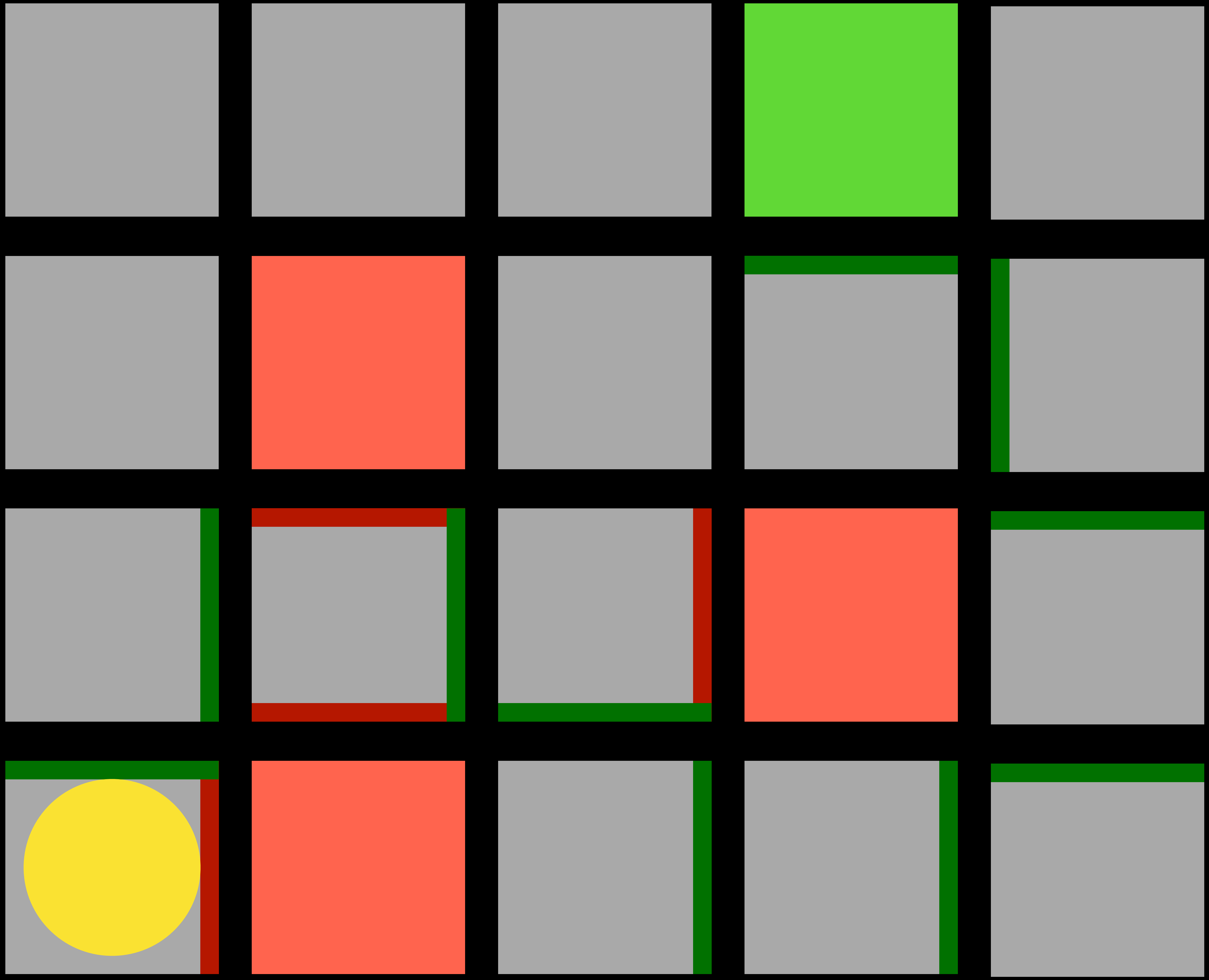










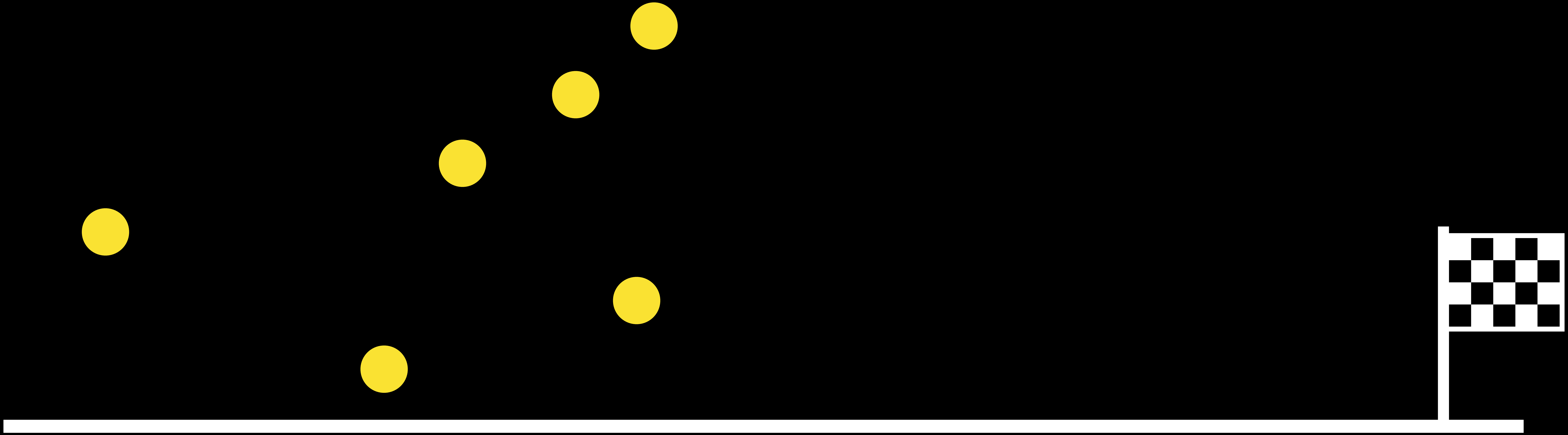


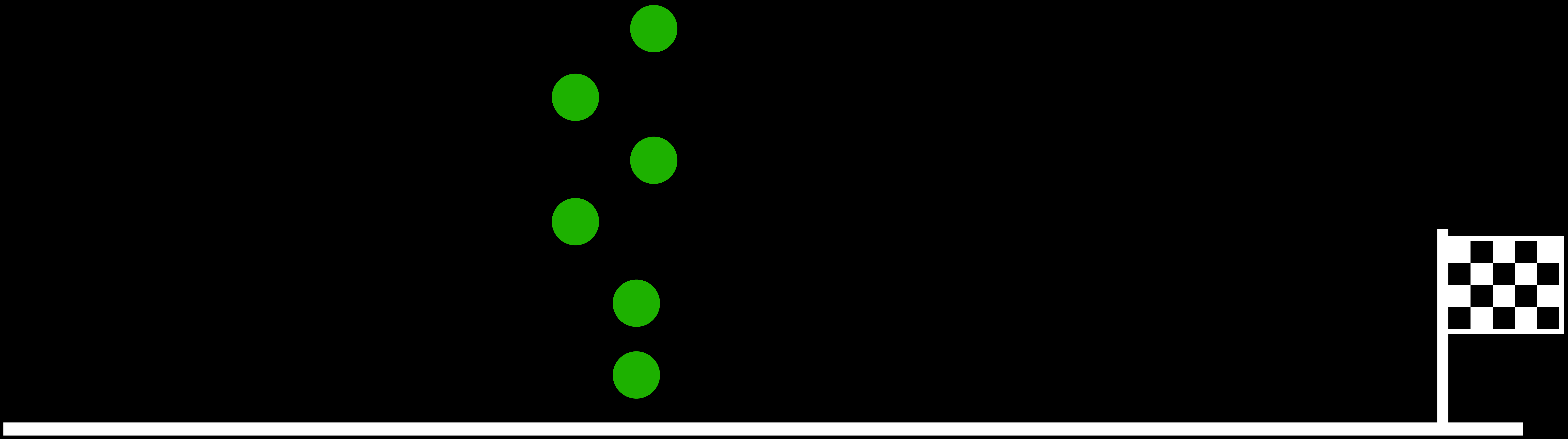
# Explore vs. Exploit

# Explore vs. Exploit Strategy

```
epsilon = 0.10

if random() < epsilon:
    make a random move
else:
    make the move with the highest value
```

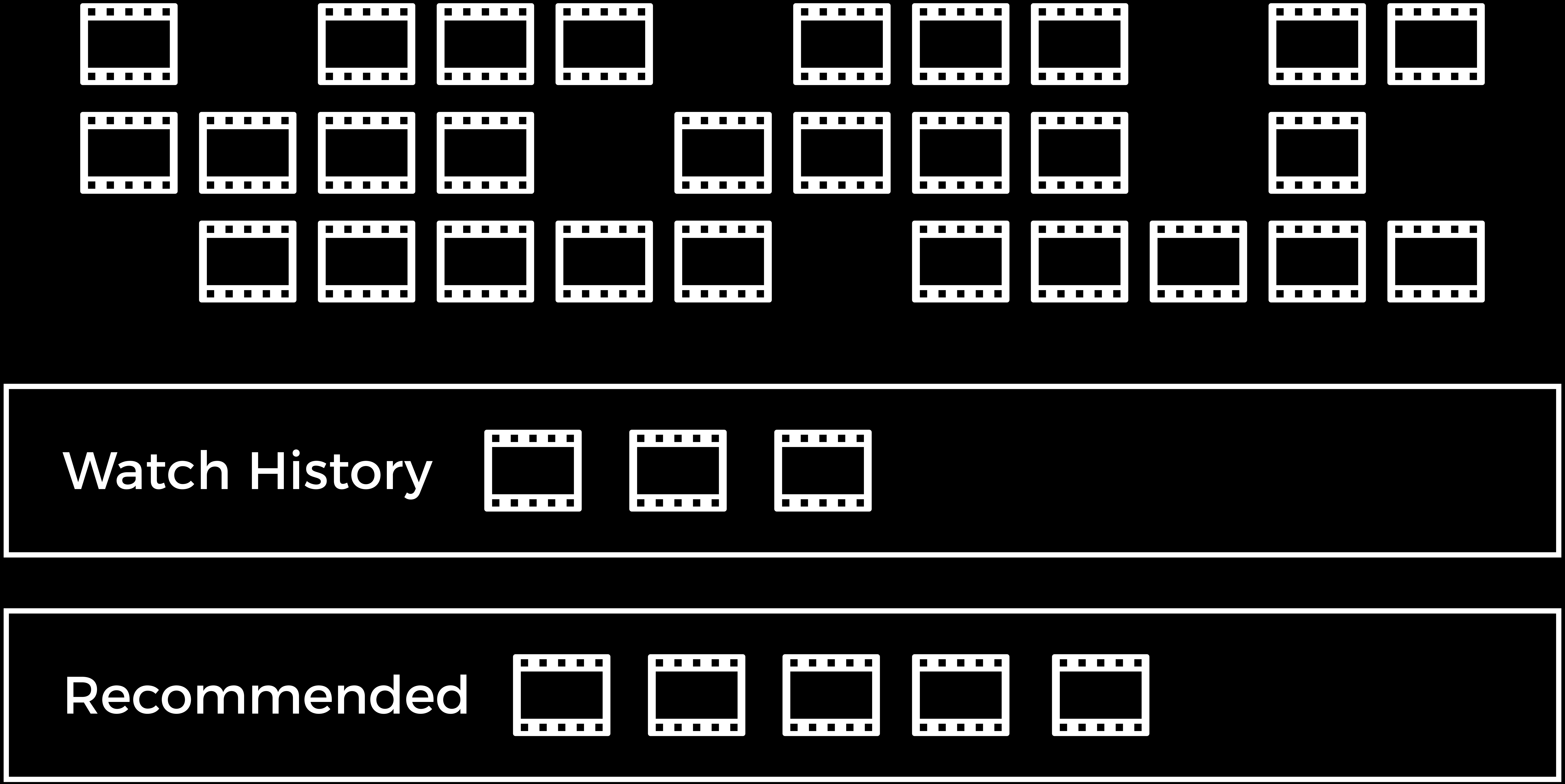
# Genetic Algorithms





# Genetic Algorithm

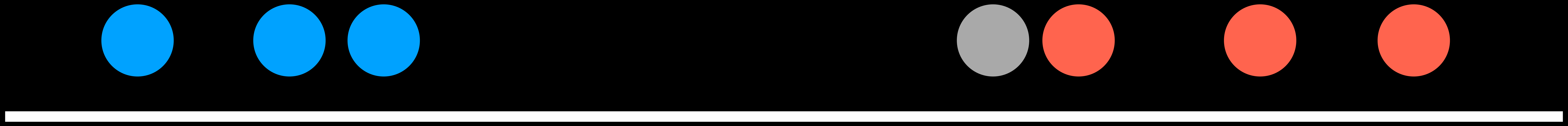
```
make initial generation of candidates randomly
repeat until successful:
    for each candidate:
        calculate candidate's fitness
    remove least fit candidates
    make new generation from remaining candidates
```

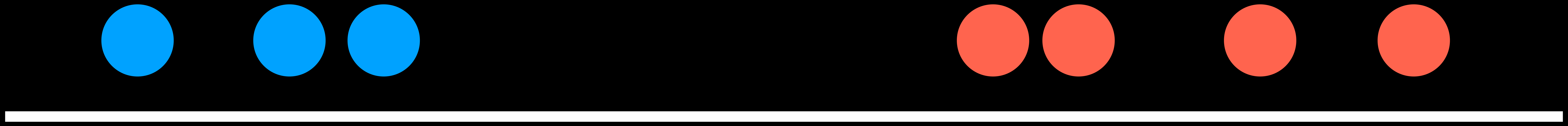


Watch History

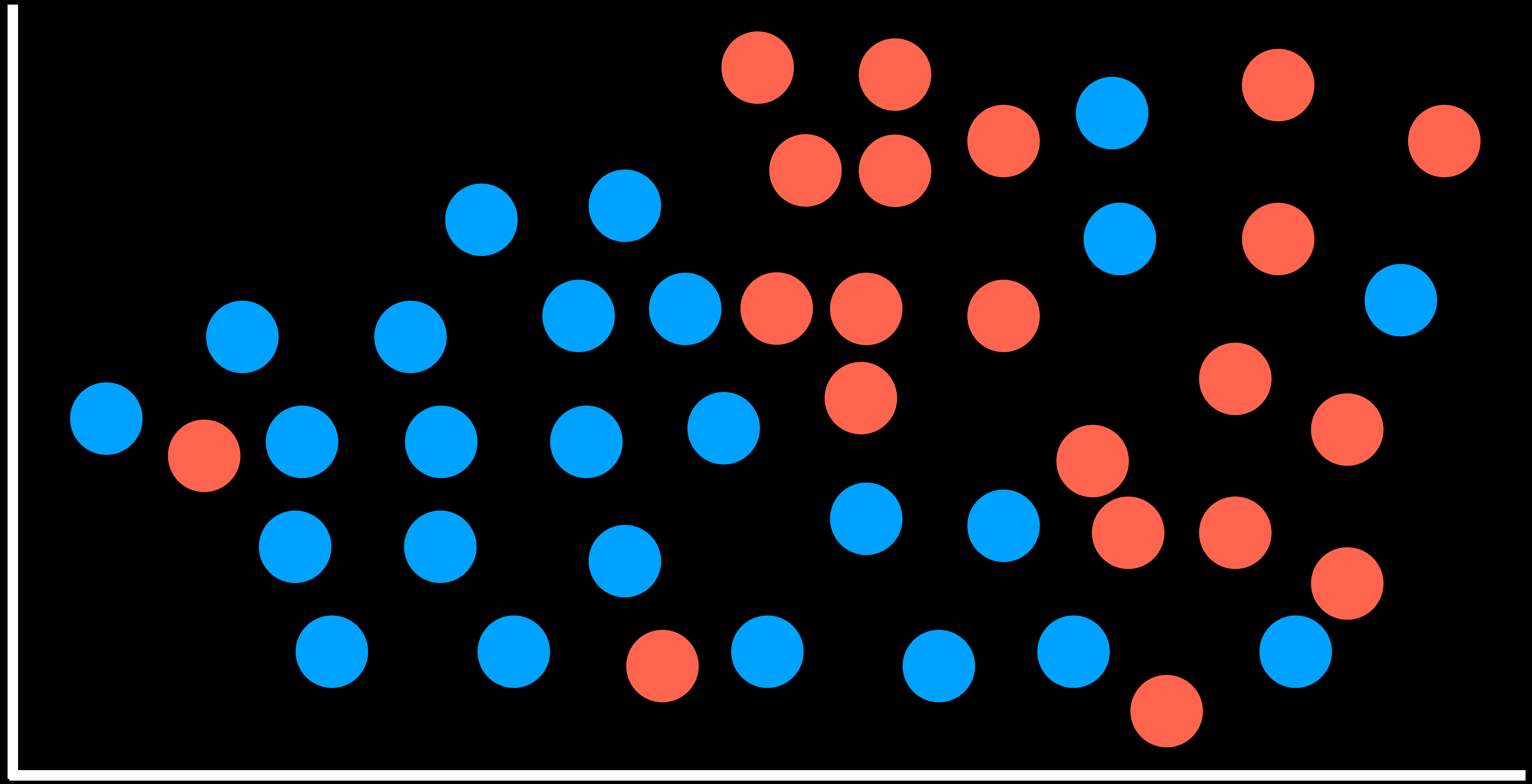
Recommended

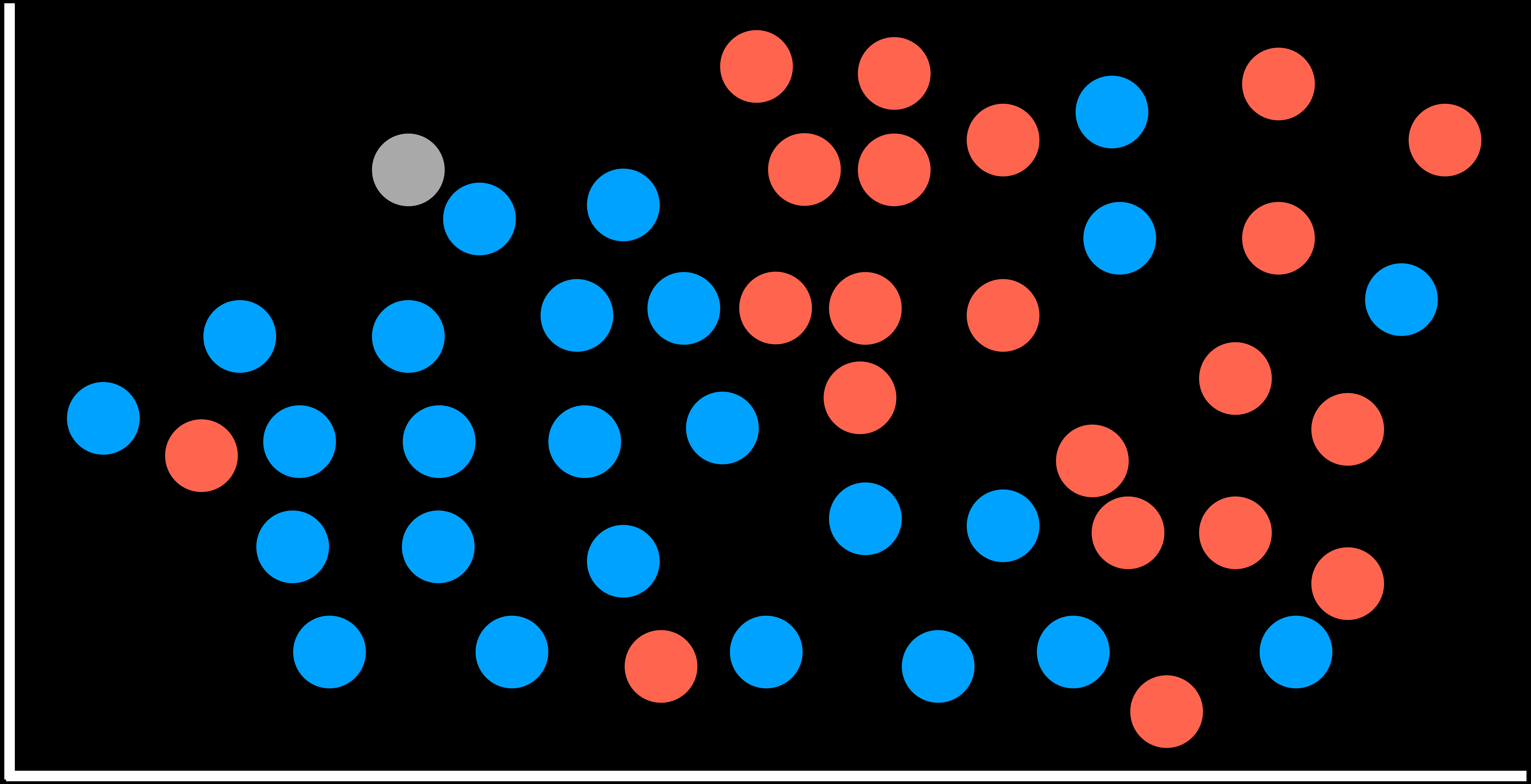
# Classification

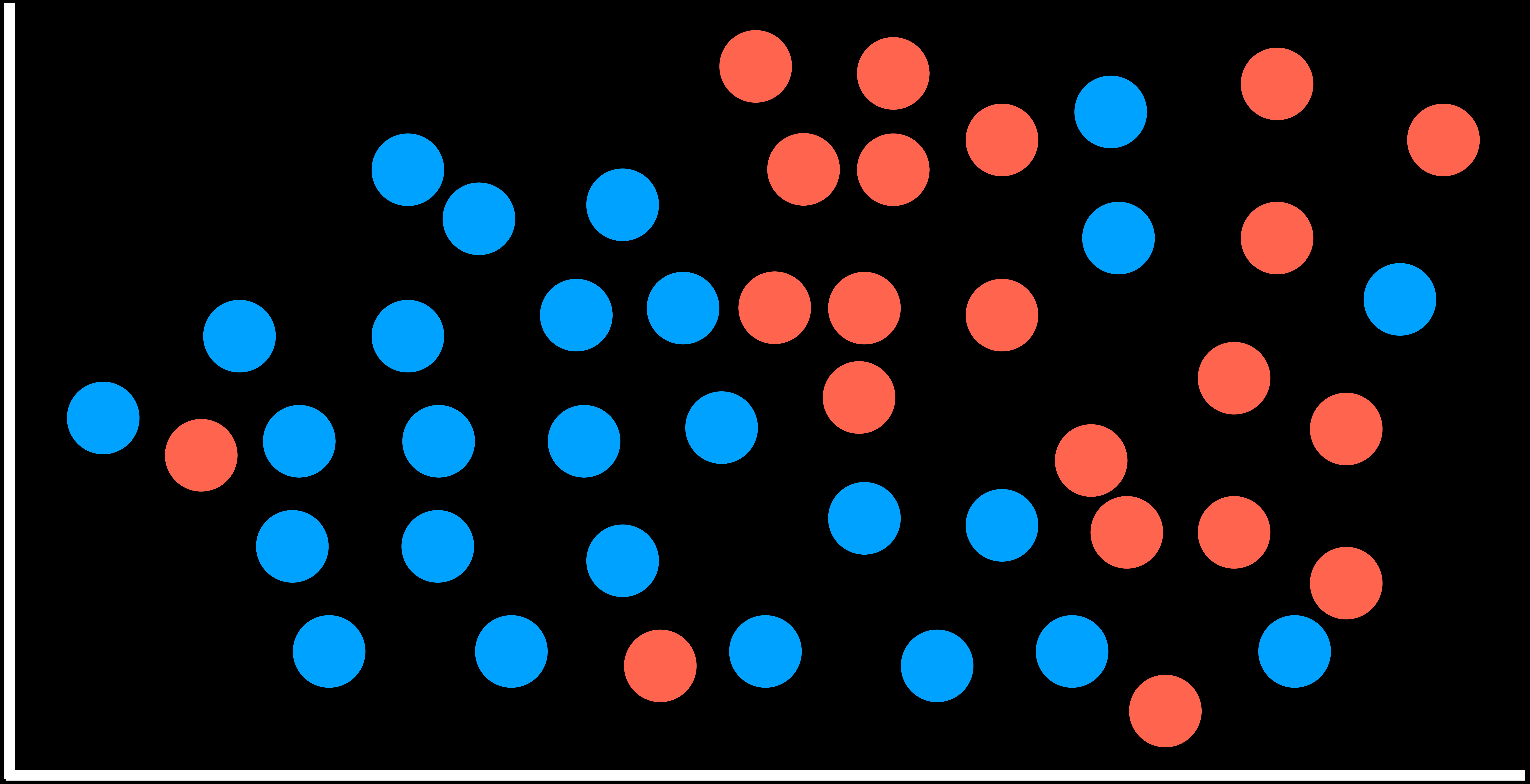


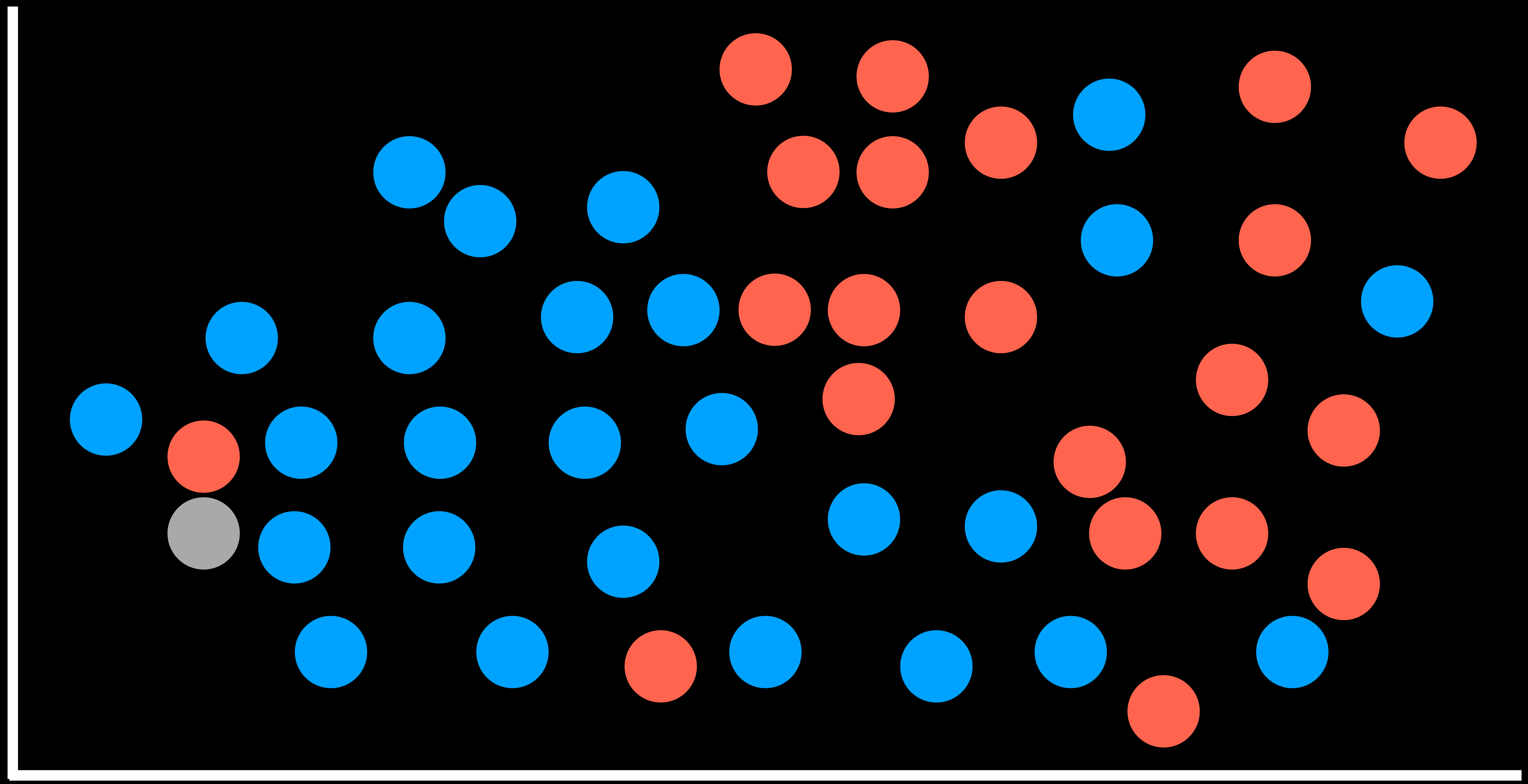


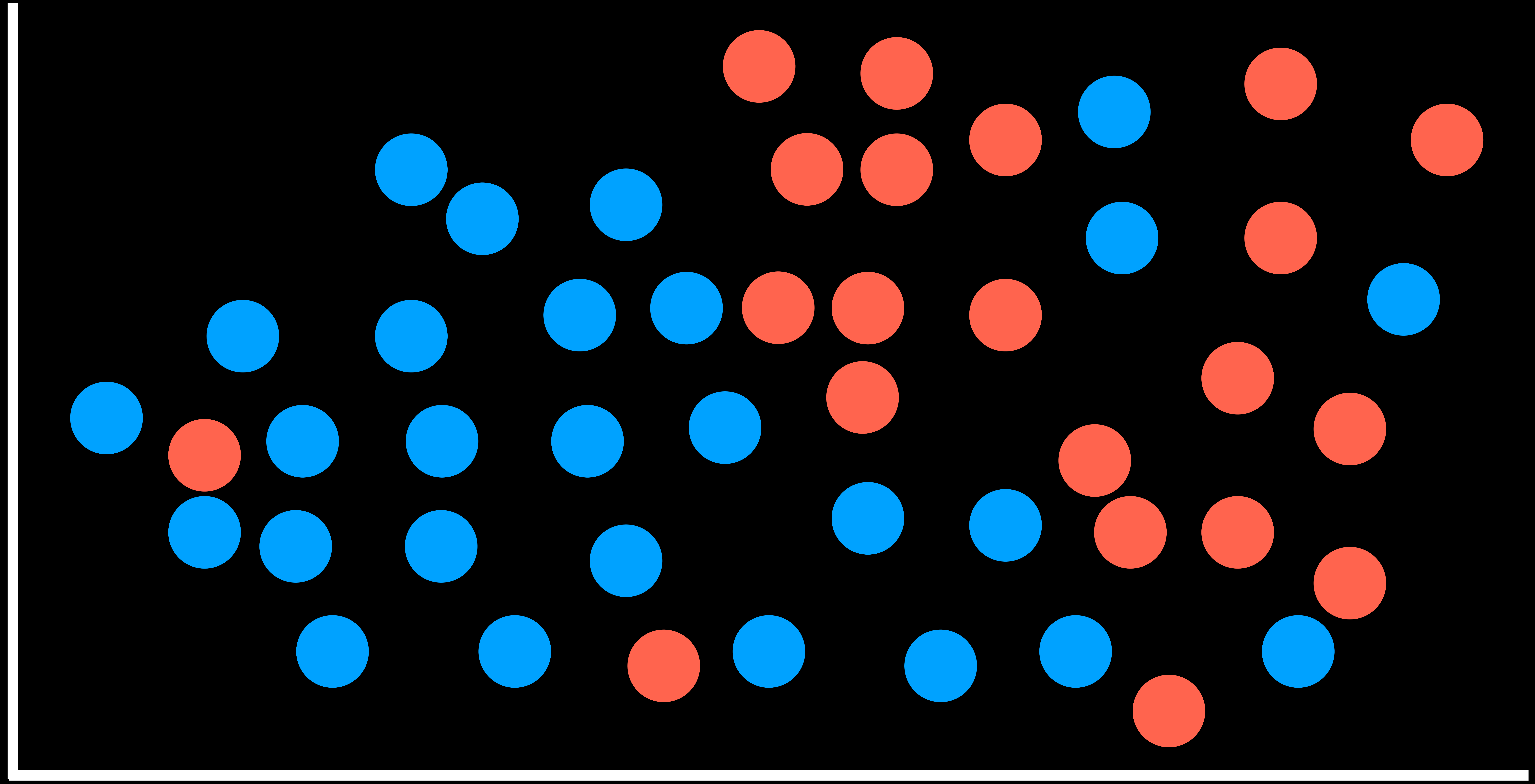
Nearest-Neighbor Classification



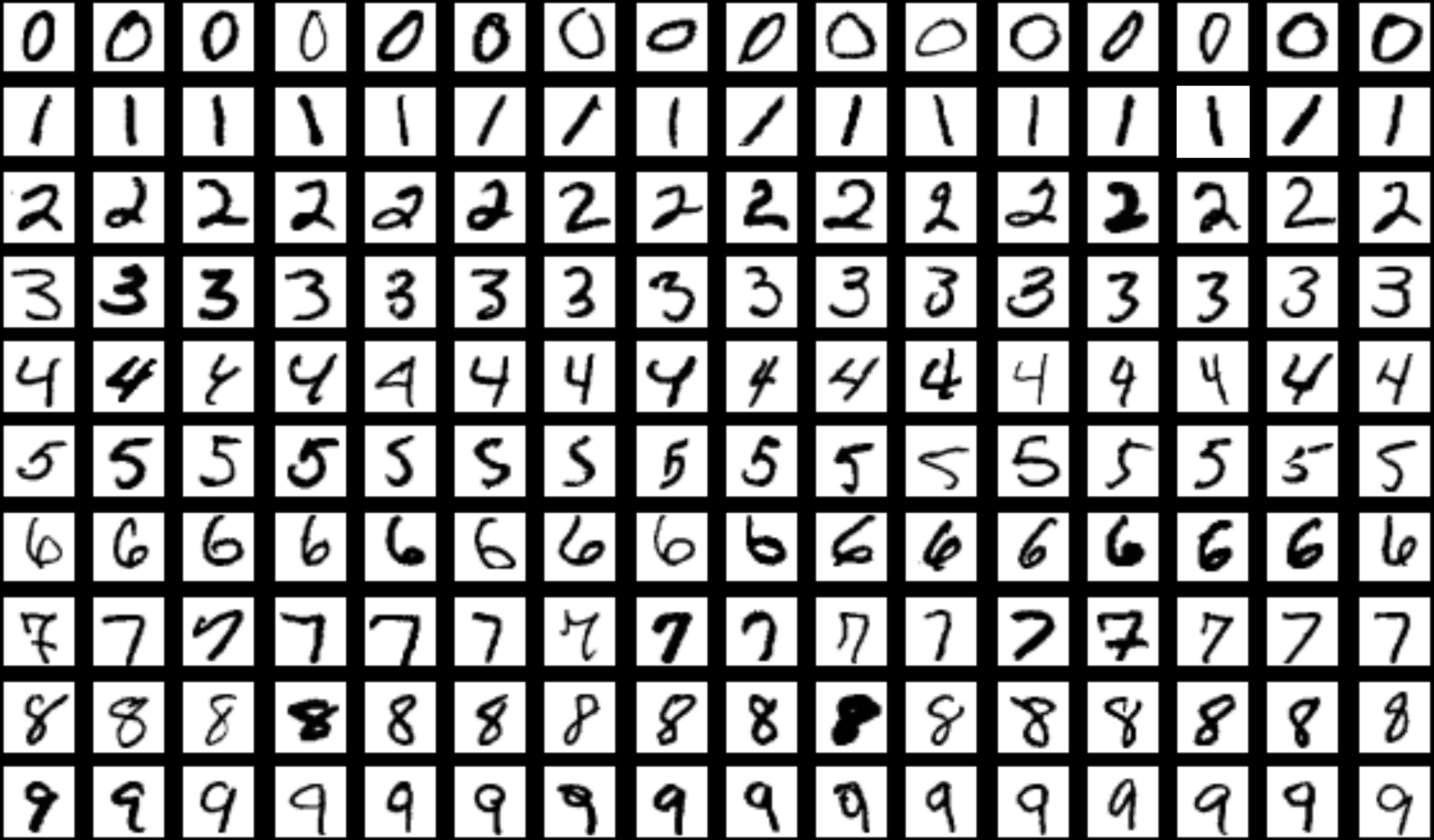


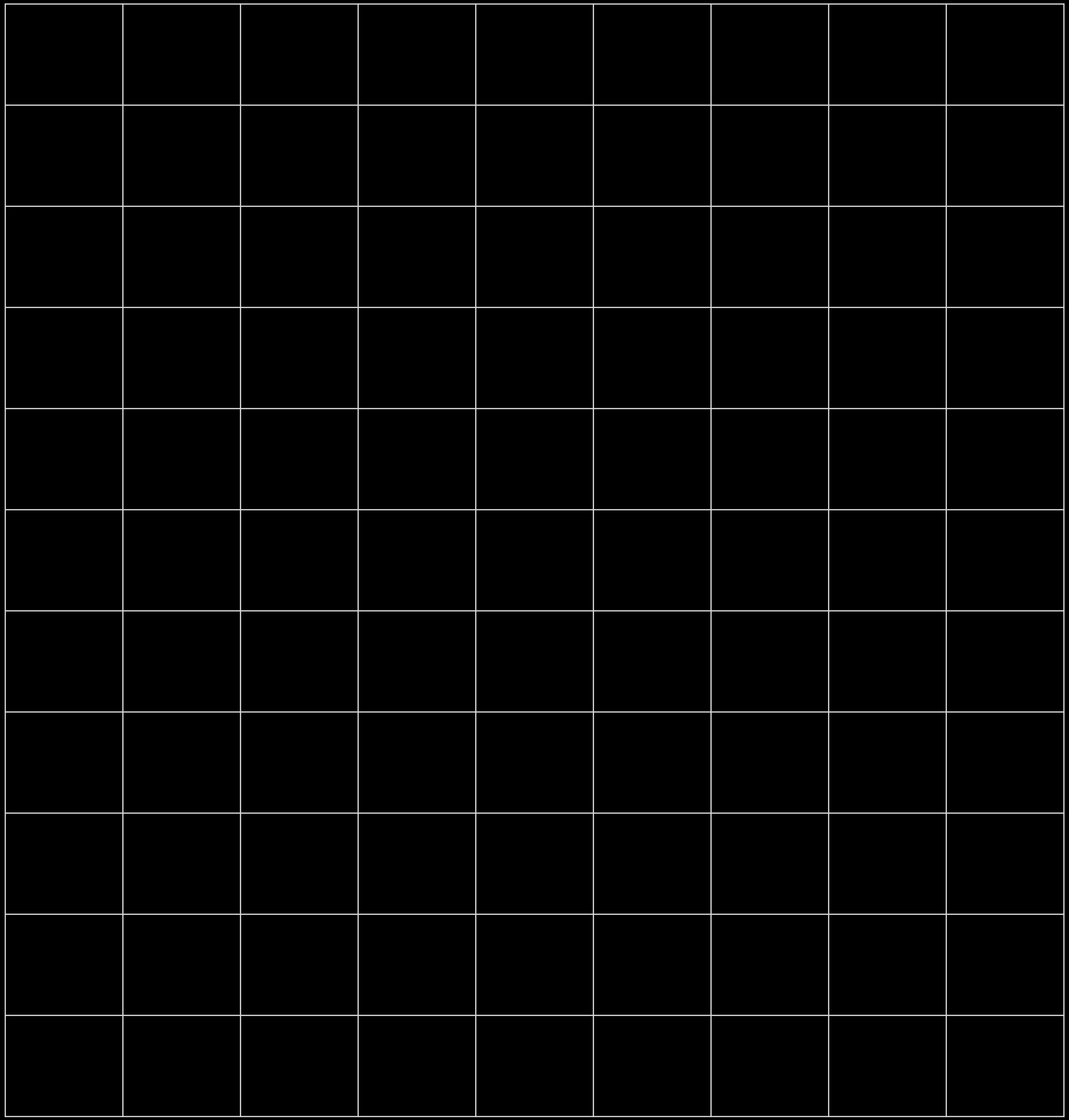


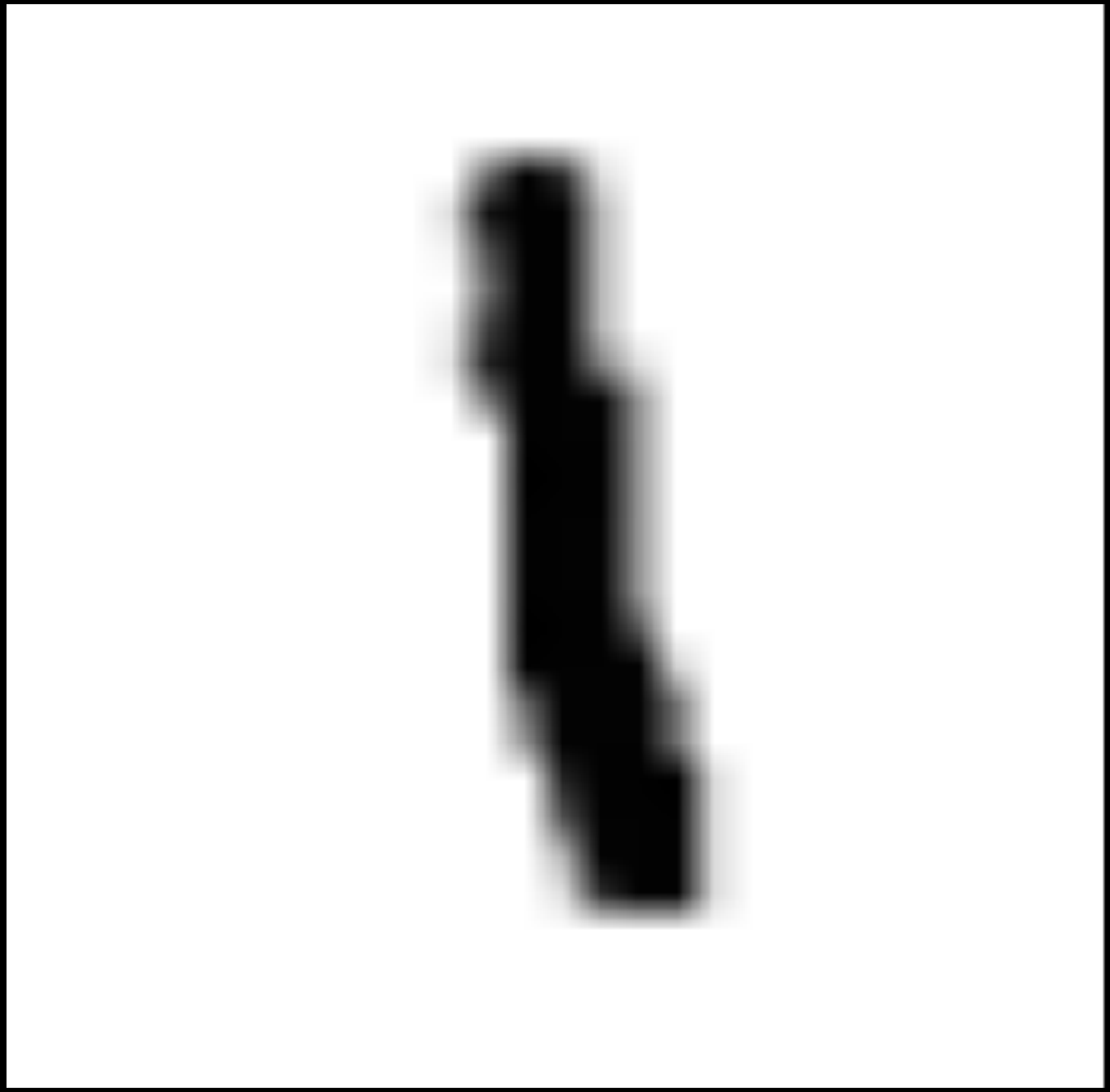




# k-Nearest-Neighbor Classification







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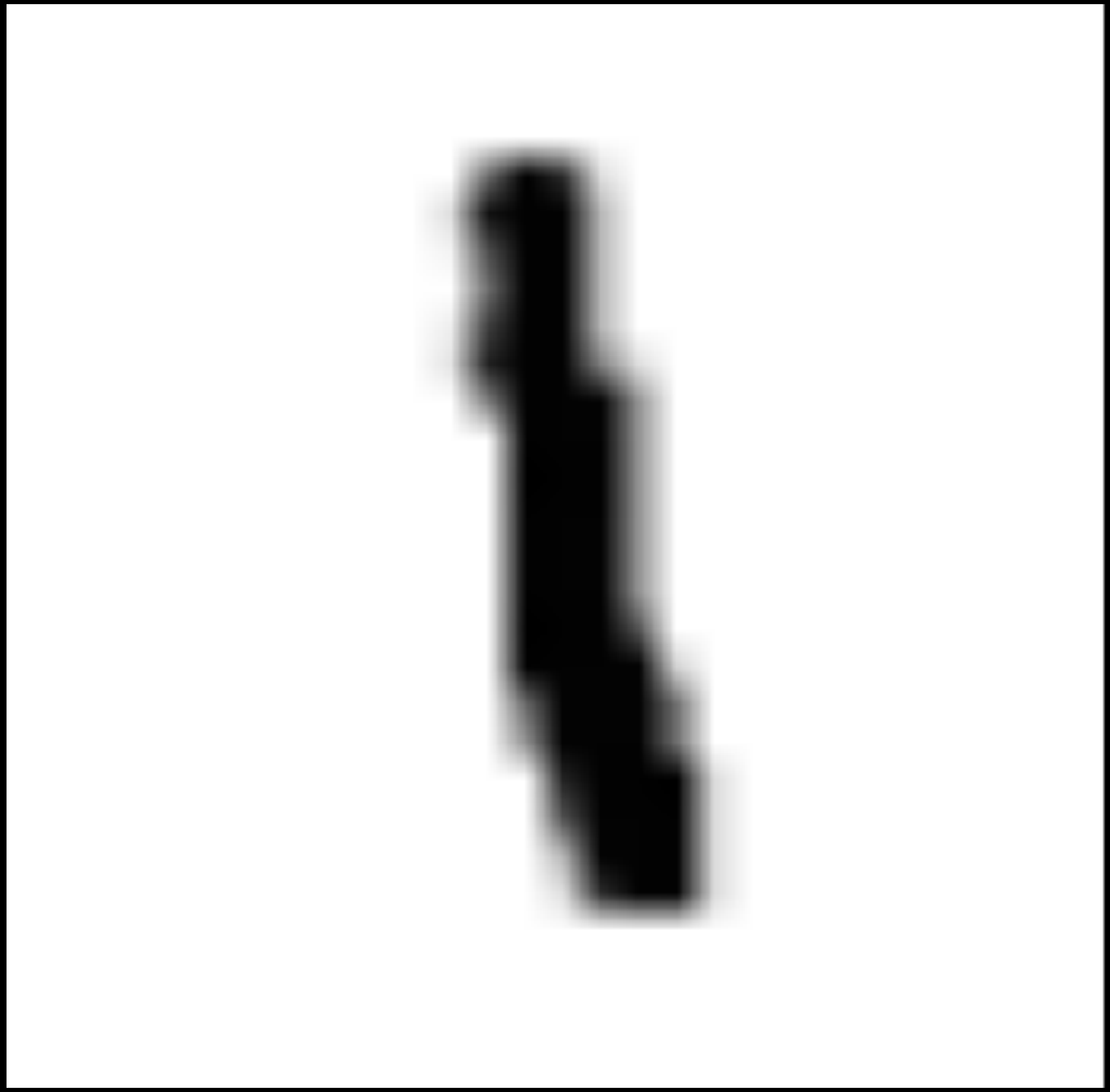
| 0 | 0 | 0 | 0.8 | 0.9 | 0.9 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0.9 | 0.9 | 0.9 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0.9 | 0.9 | 0.9 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0.9 | 0.9 | 0.9 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0.9 | 0.9 | 0.9 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0.9 | 0.9 | 0.9 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0.9 | 0.9 | 0.9 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.8 | 0.6 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



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|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0.6 | 0.8 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0.8 | 0.9 | 0.9 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0.9 | 0.9 | 0.9 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0.9 | 0.9 | 0.9 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0.9 | 0.9 | 0.9 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0.9 | 0.9 | 0.9 | 0 | 0 | 0 |
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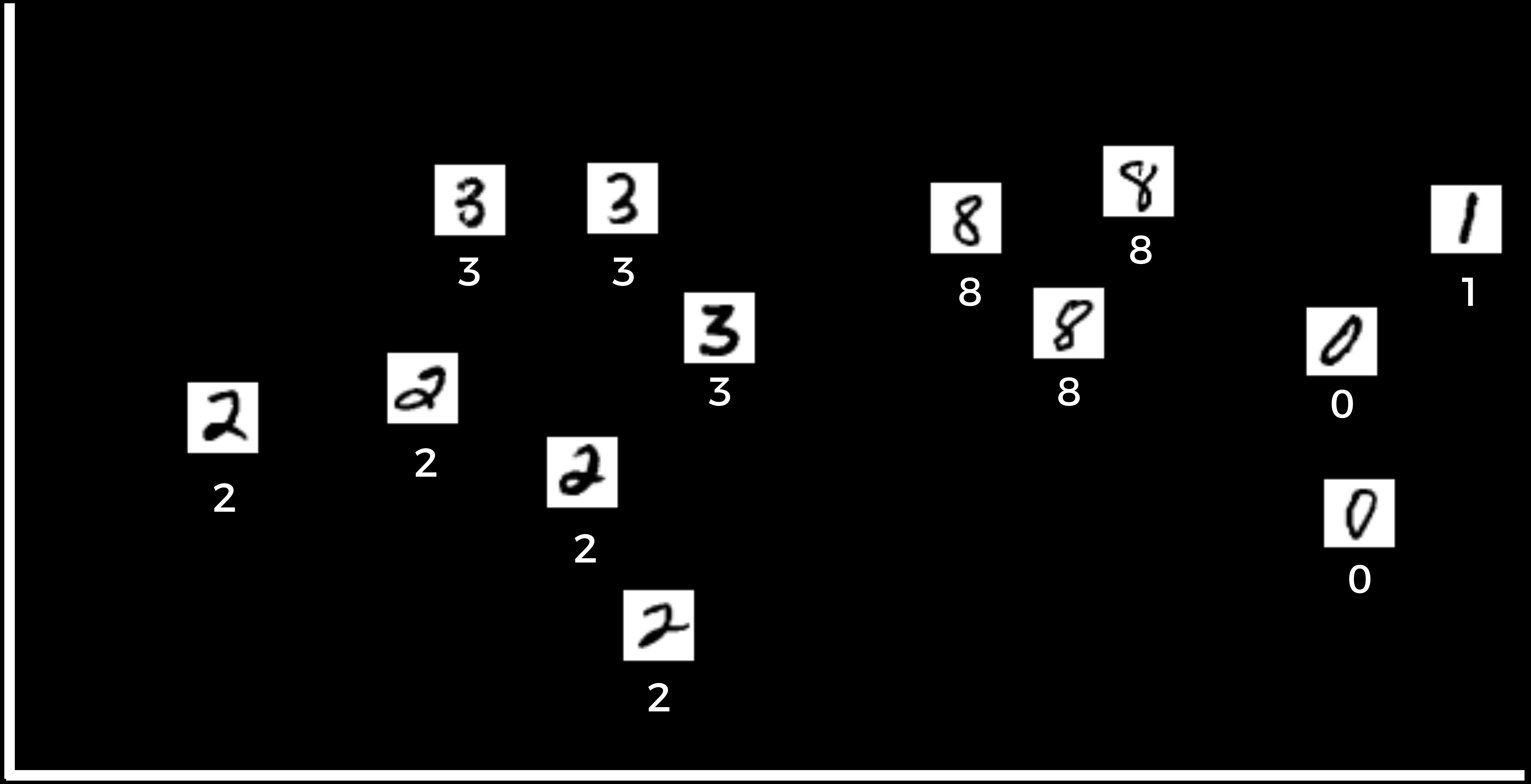
| 0 | 0 | 0 | 0.9 | 0.9 | 0.9 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0.8 | 0.6 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



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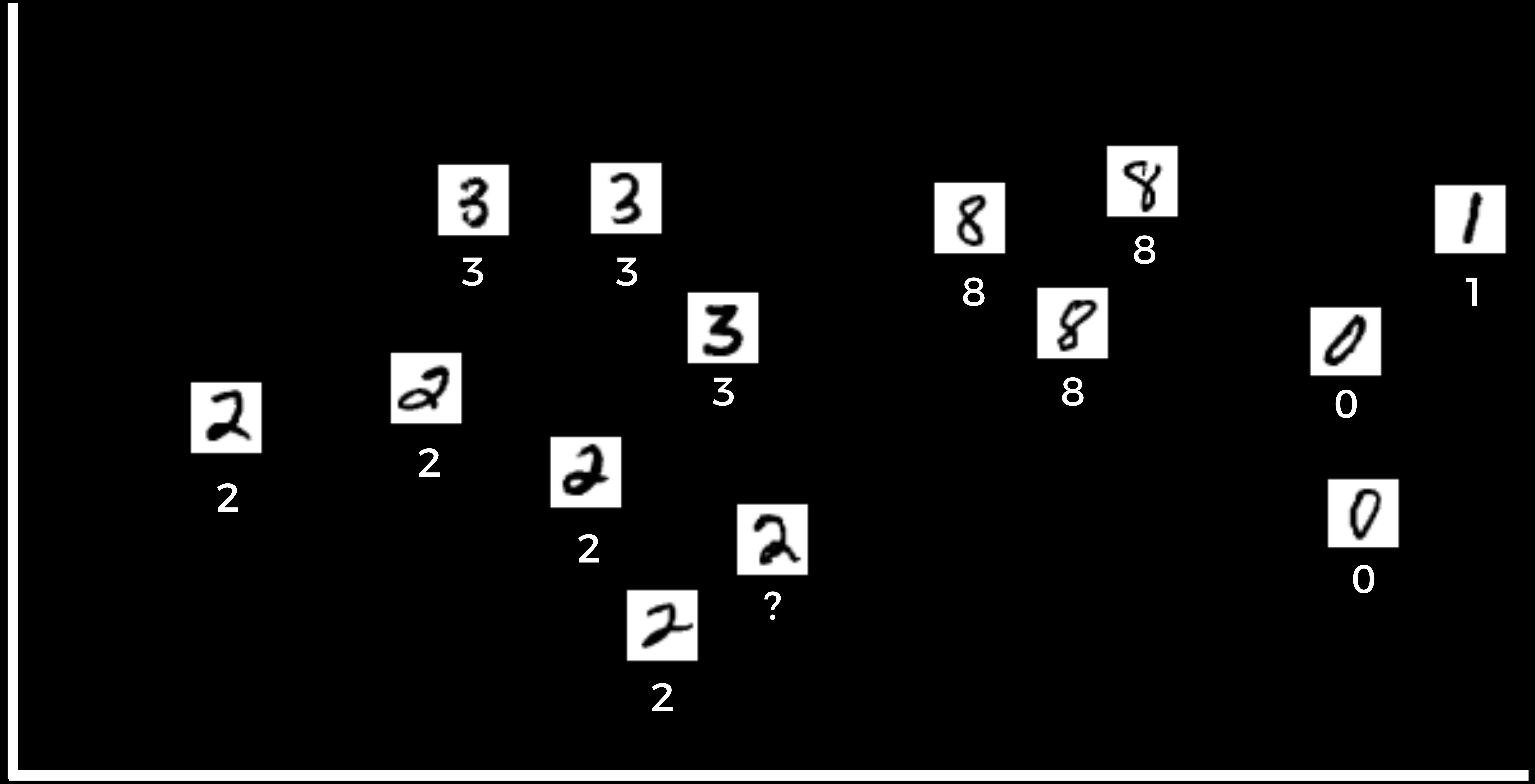
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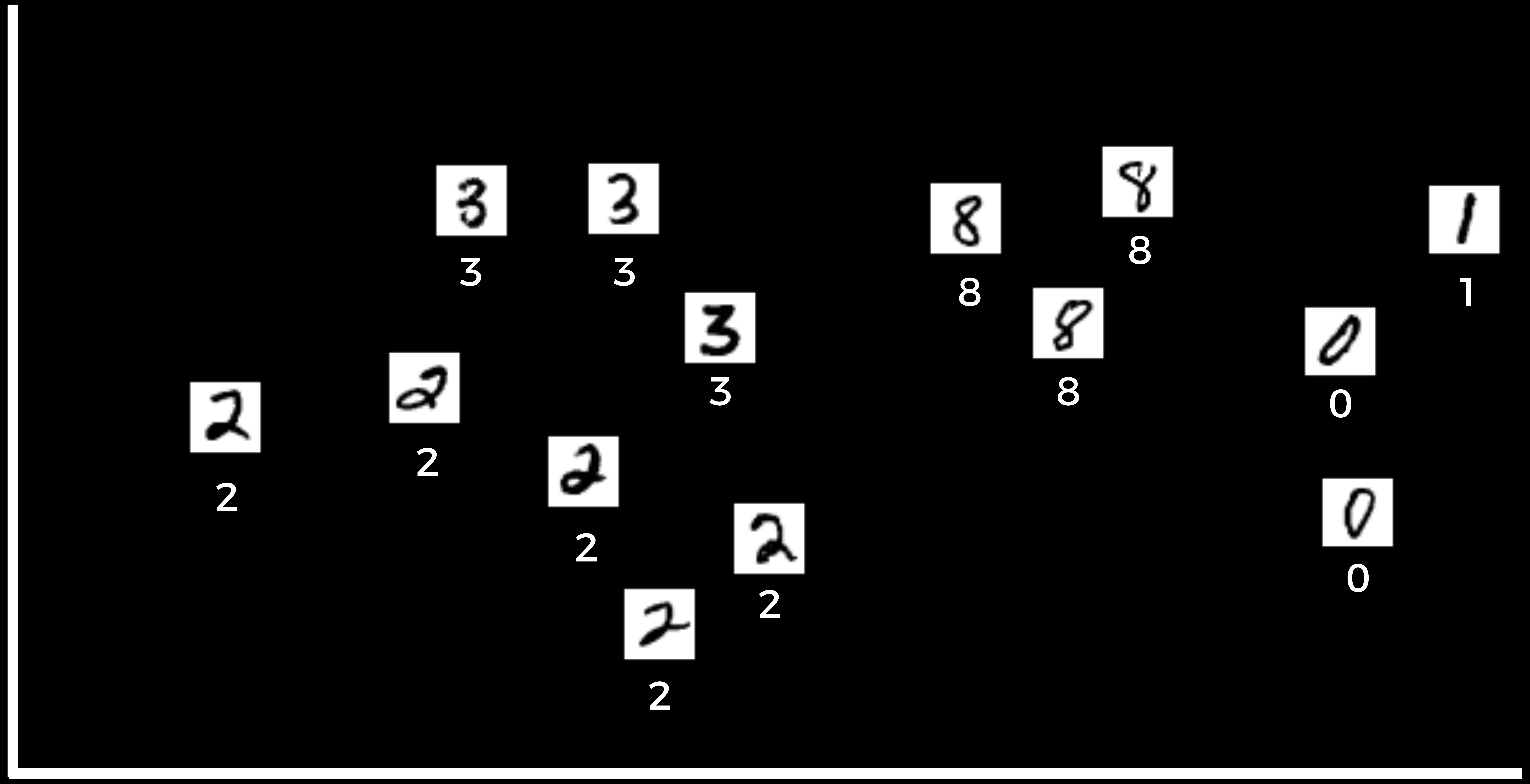
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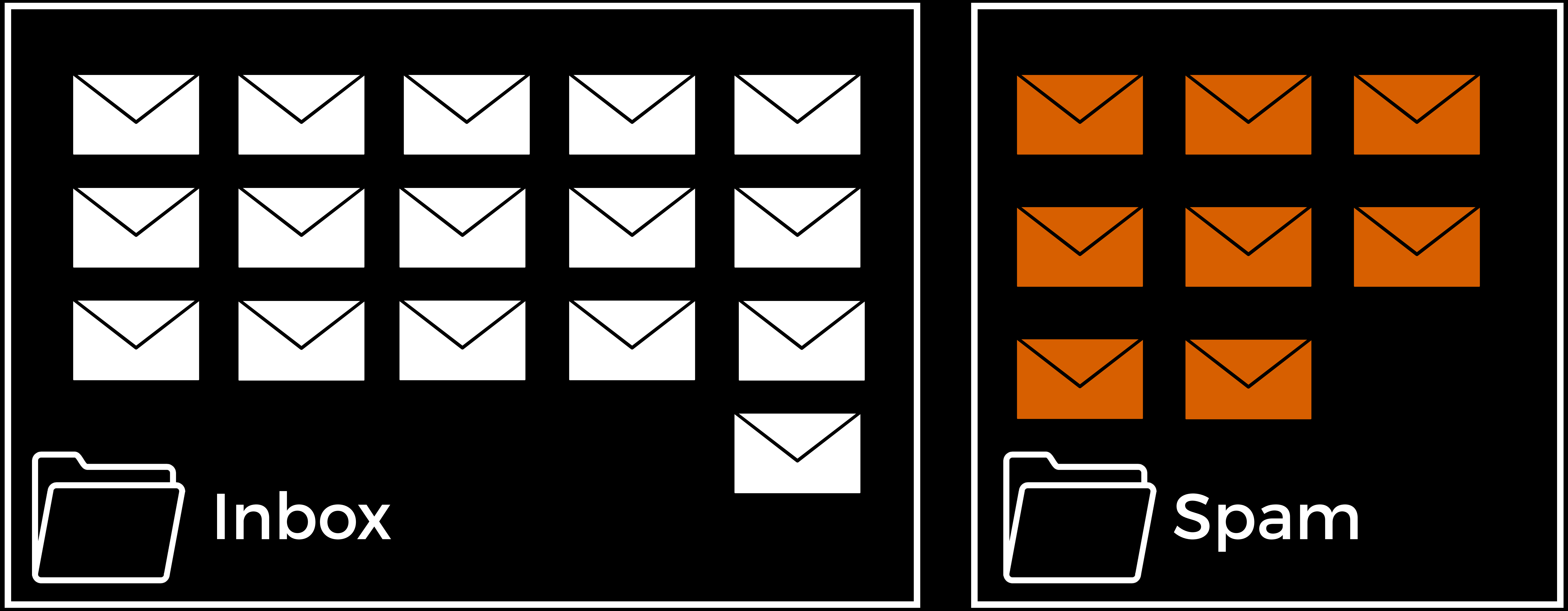
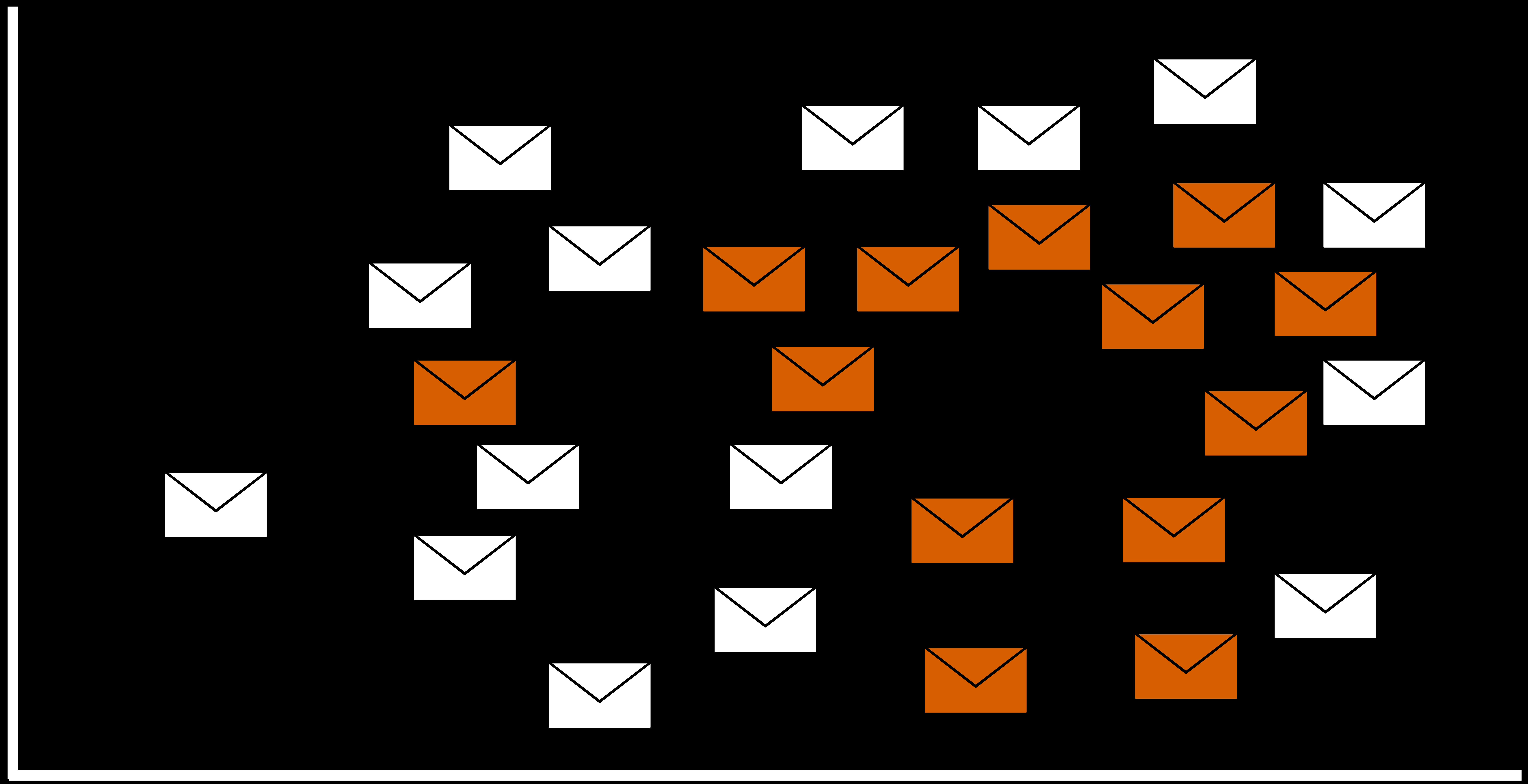
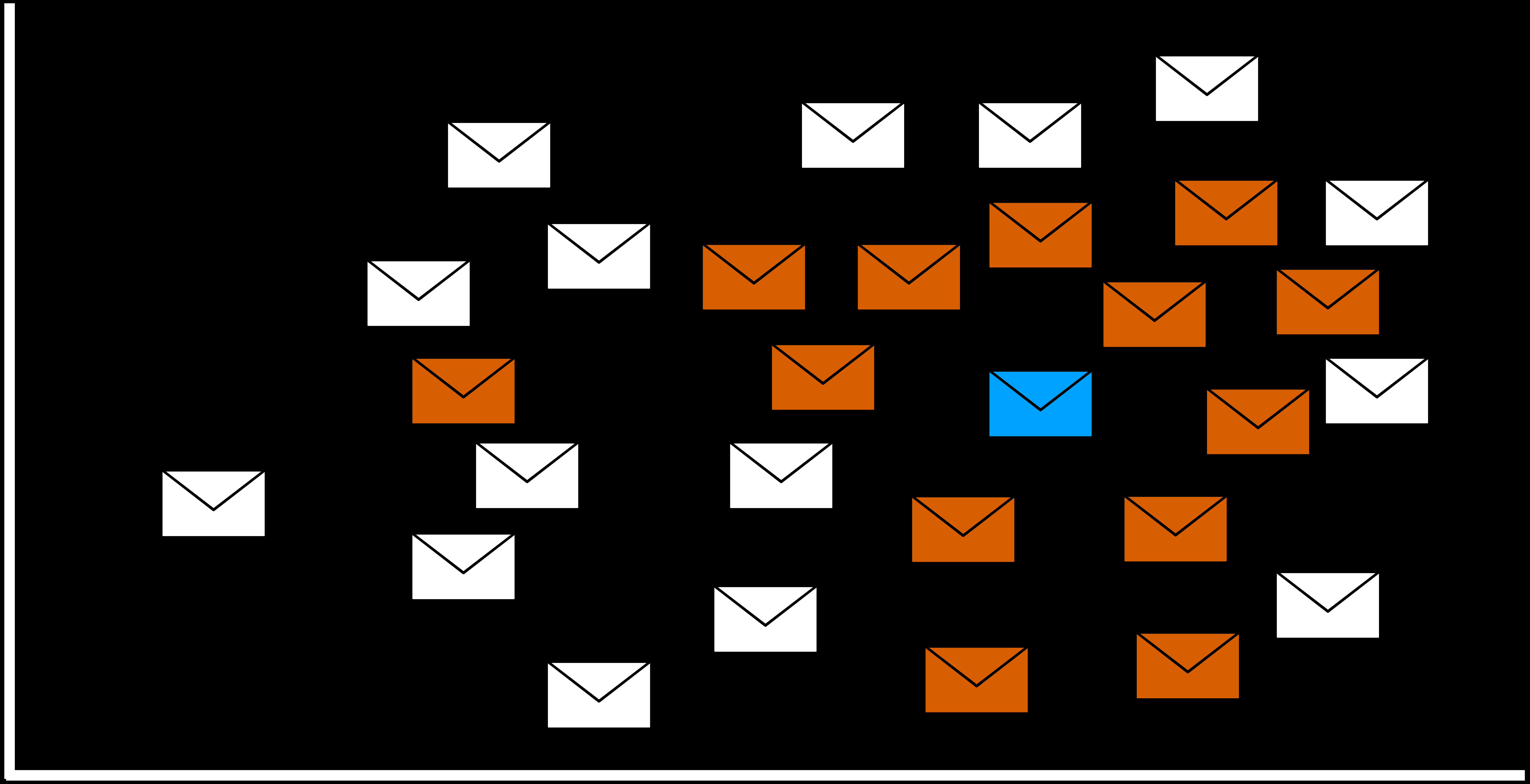


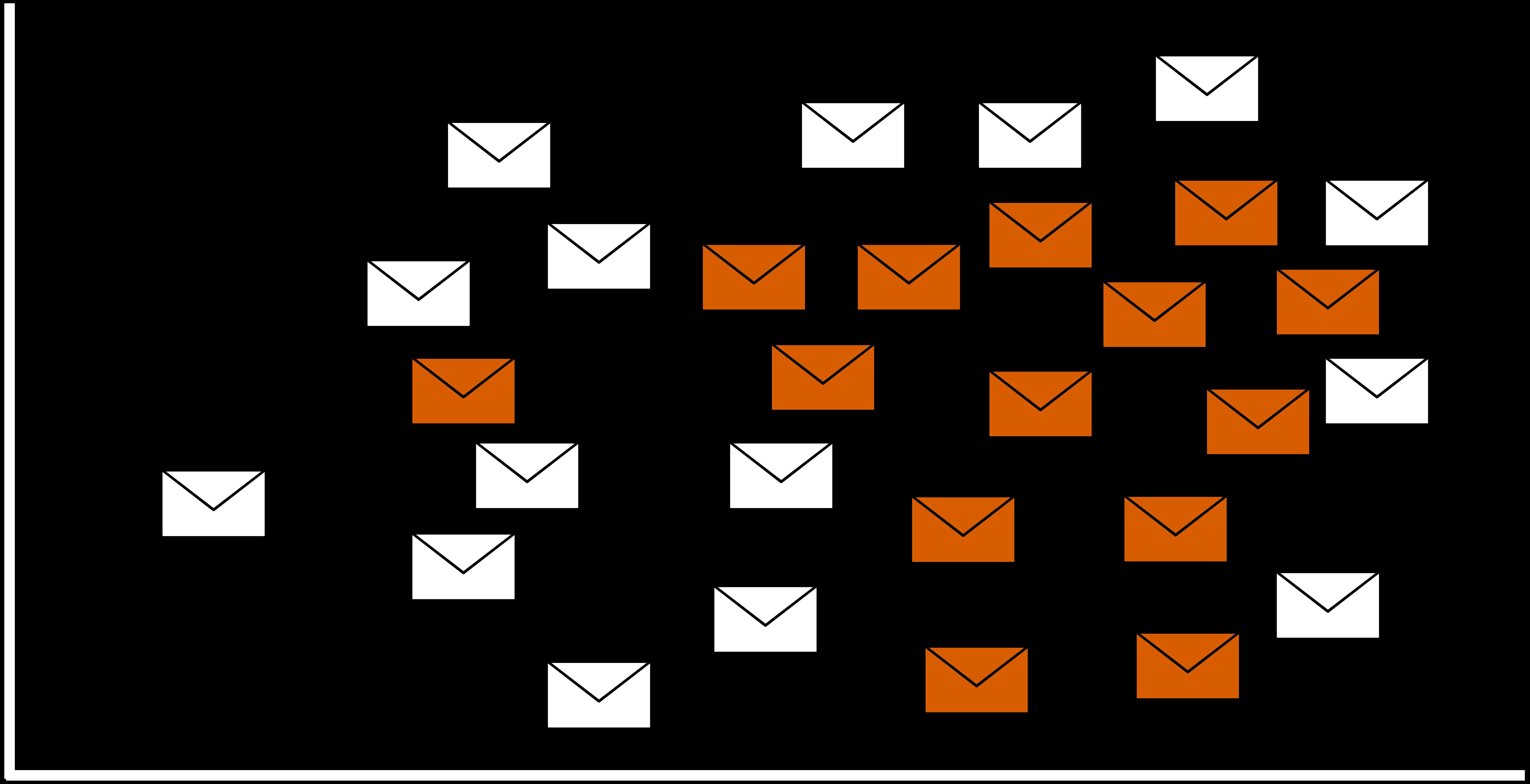
Inbox

Spam

[1, 2, 5, 2, 3, 1, 2, 8, 1, 3]







# Artificial Intelligence