



SEED // SEARCH FOR EXTRAORDINARY EXPERIENCES DIVISION



# Deep Learning in Games

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@singhblom

# What is Machine Learning?

# What is Artificial Intelligence?



or ...

# Guess the function!

$$f(2) = 4$$

$$f(8) = 16$$



$$f(x) = 2x$$

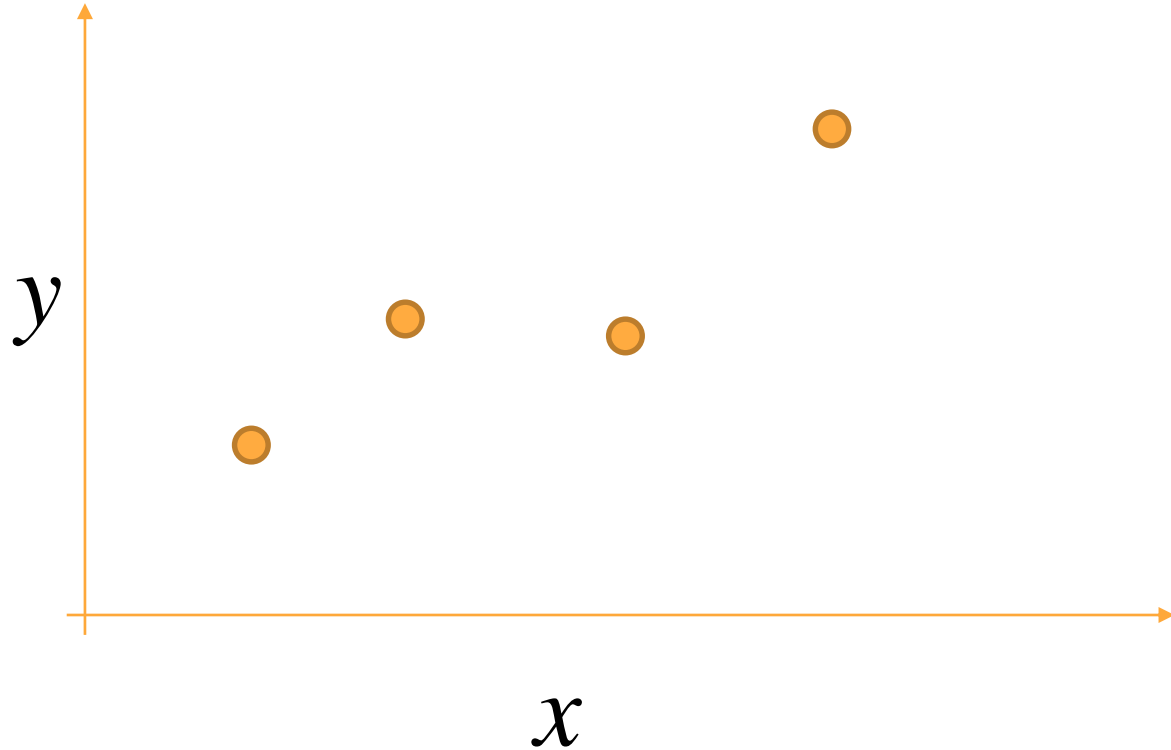
How does the  
machine guess?

It learns from the data.

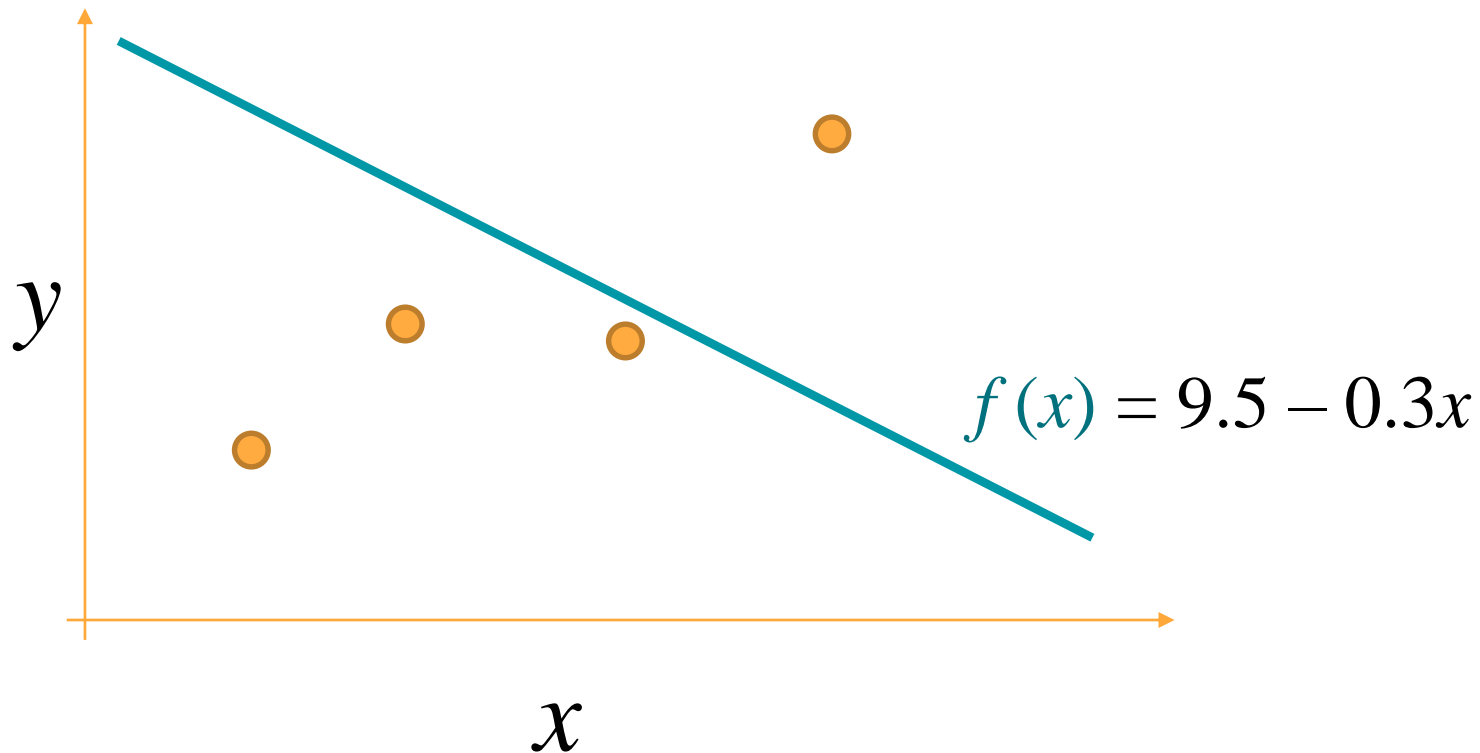
It learns from the data.

(That's why we call it machine learning!)

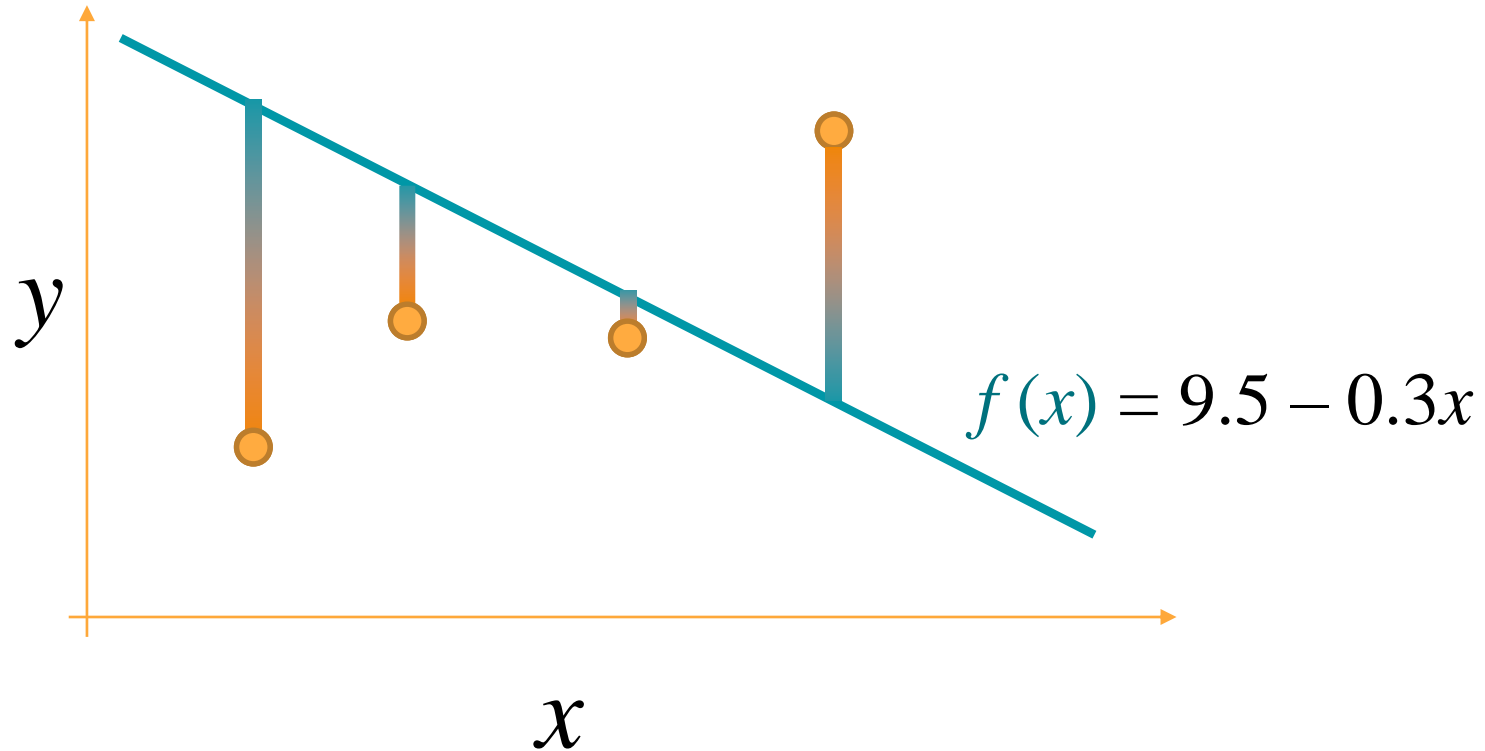
# Guess a straight line!



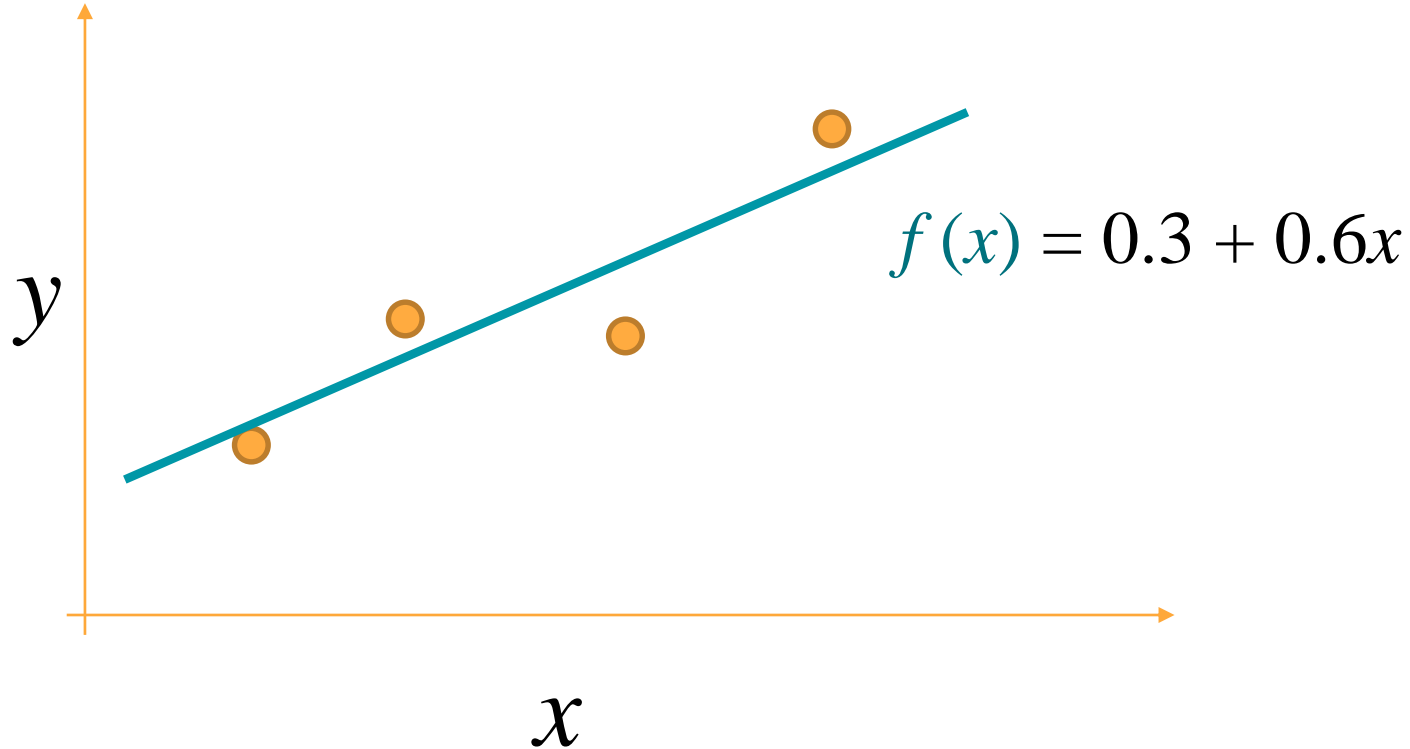
# Guess a straight line!



# Guess a straight line!

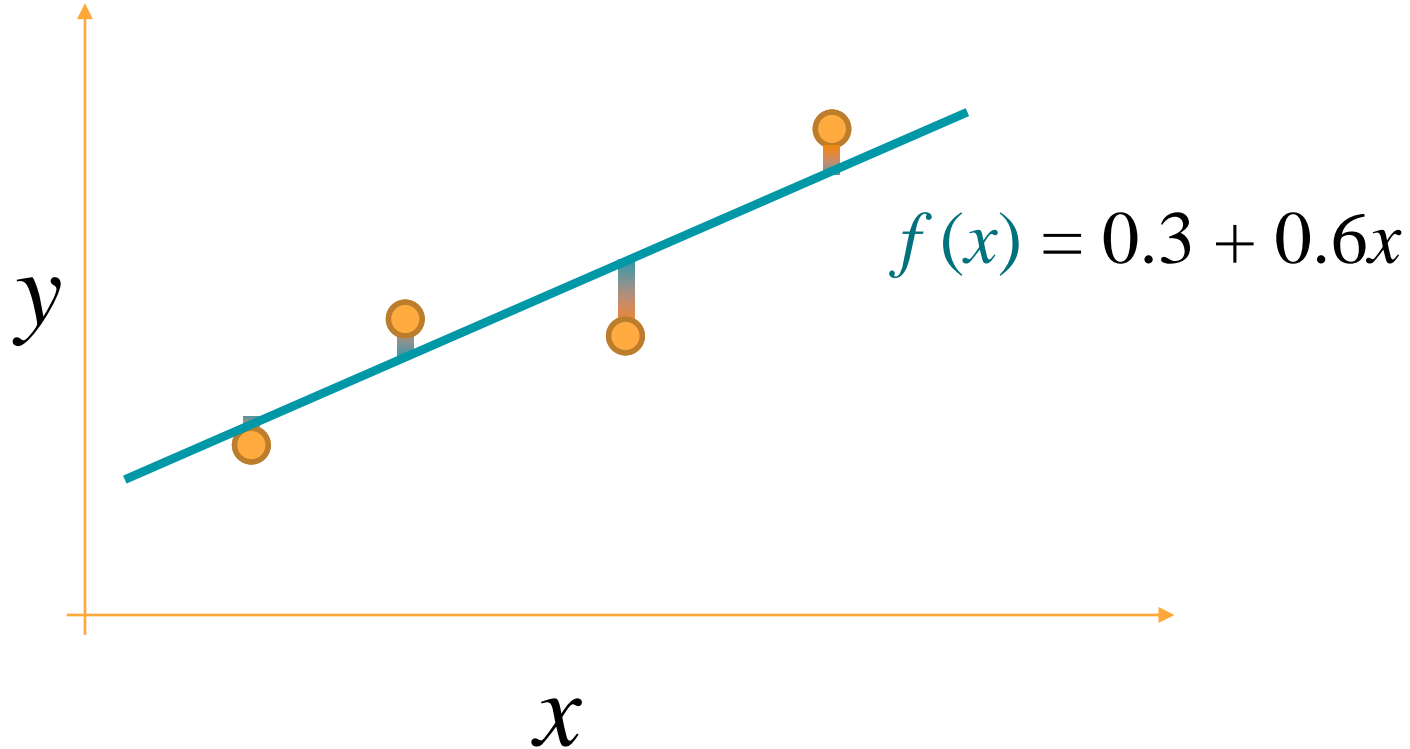


# Guess a straight line!





## Guess a straight line!



# Guess a straight line!

$$f(x) = 0.3 + 0.6x$$



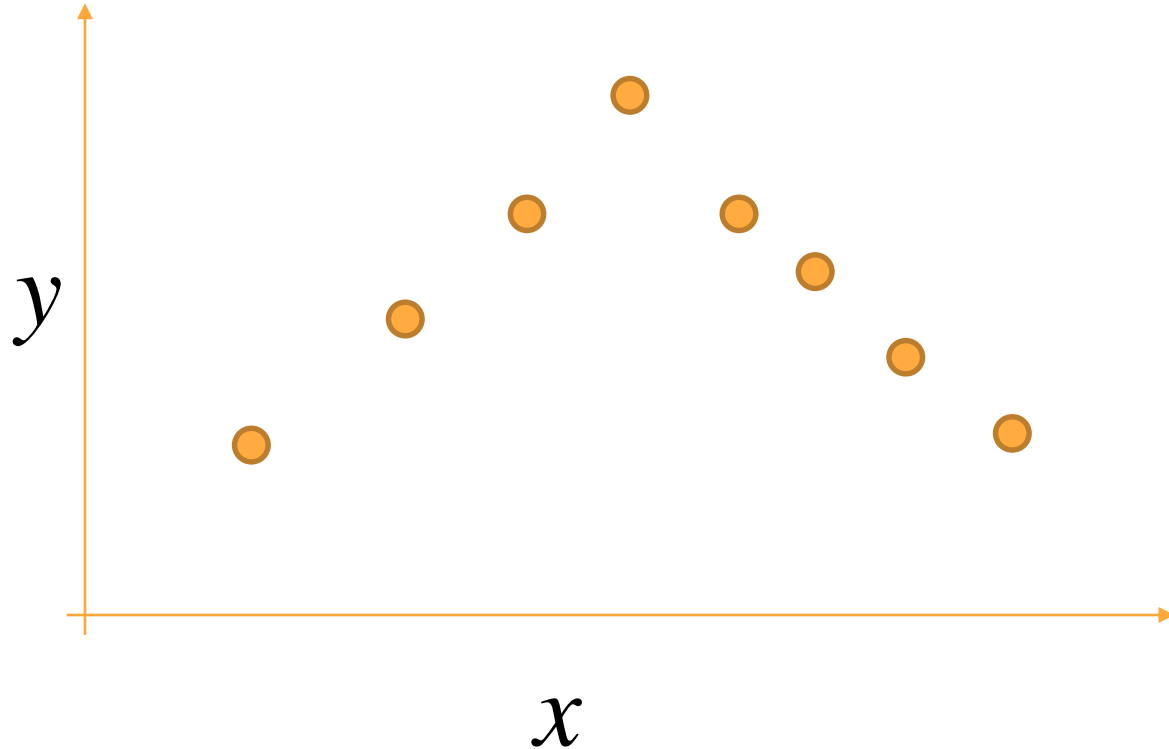
$$f(x) = 9.5 - 0.3x$$



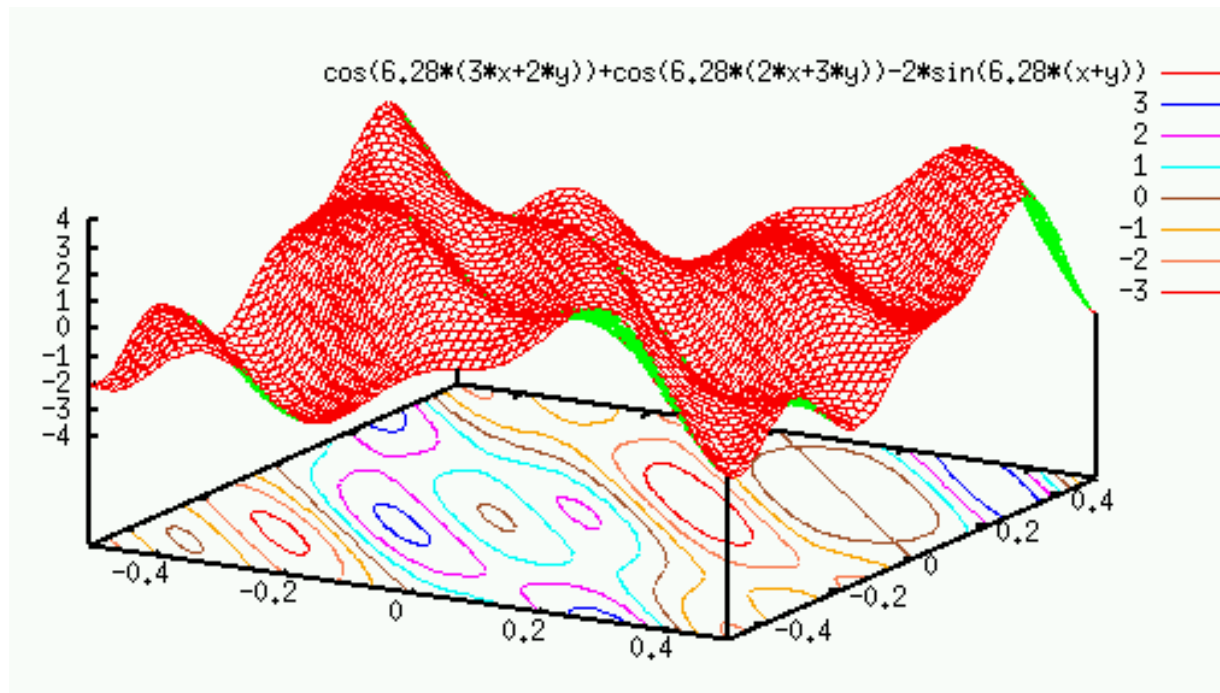
# That is all there is to it!

1. Data –  $f(x) = y$  pairs.
2. A way to tell the machine how bad a guess is.
3. Some idea of what kind of function the machine is allowed to guess – straight line? Curve? Something stranger?

Guess a straight line!

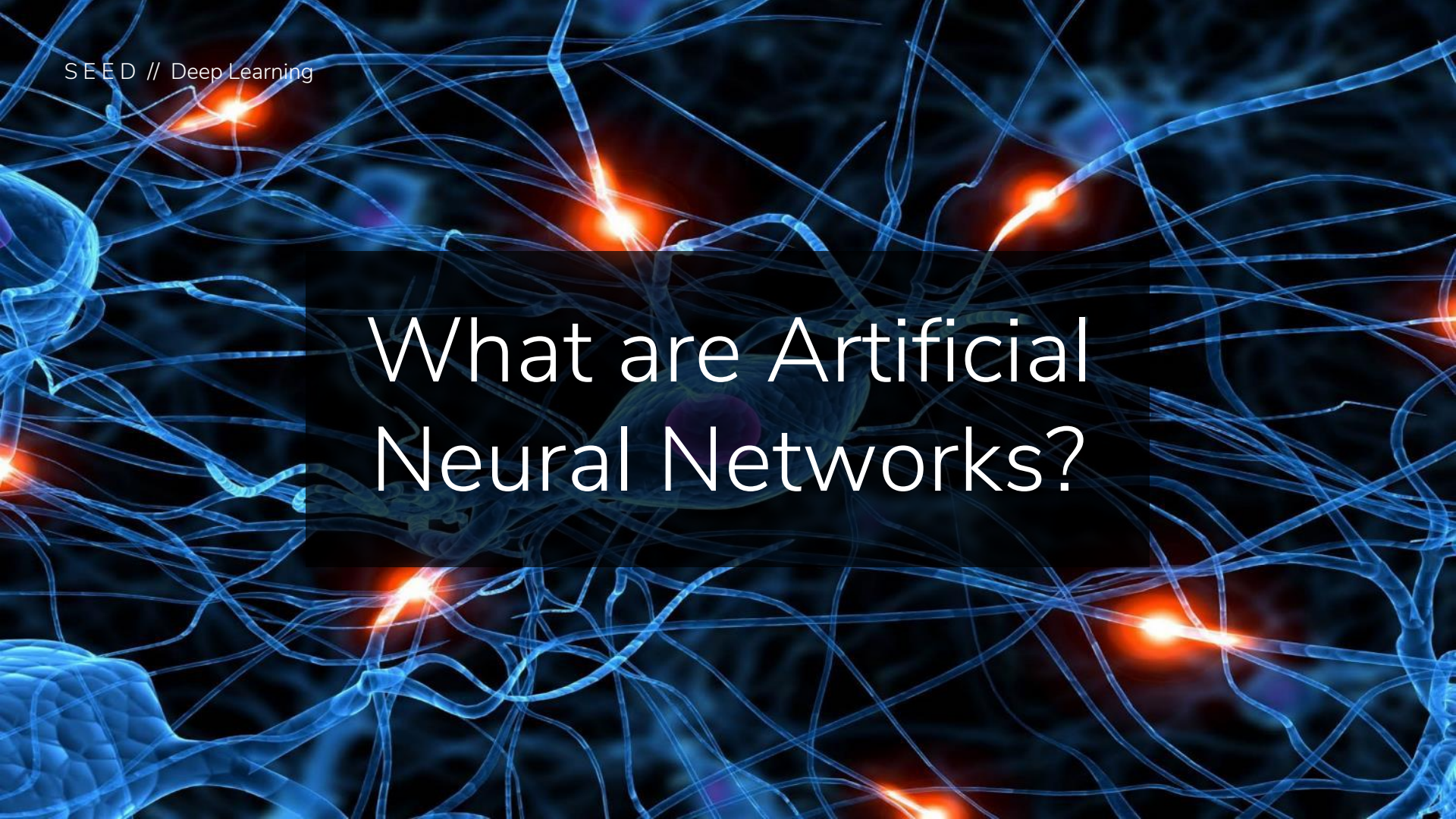


# Guess a straight line!



# What is Deep Learning?

# What are Artificial Neural Networks?



*f*







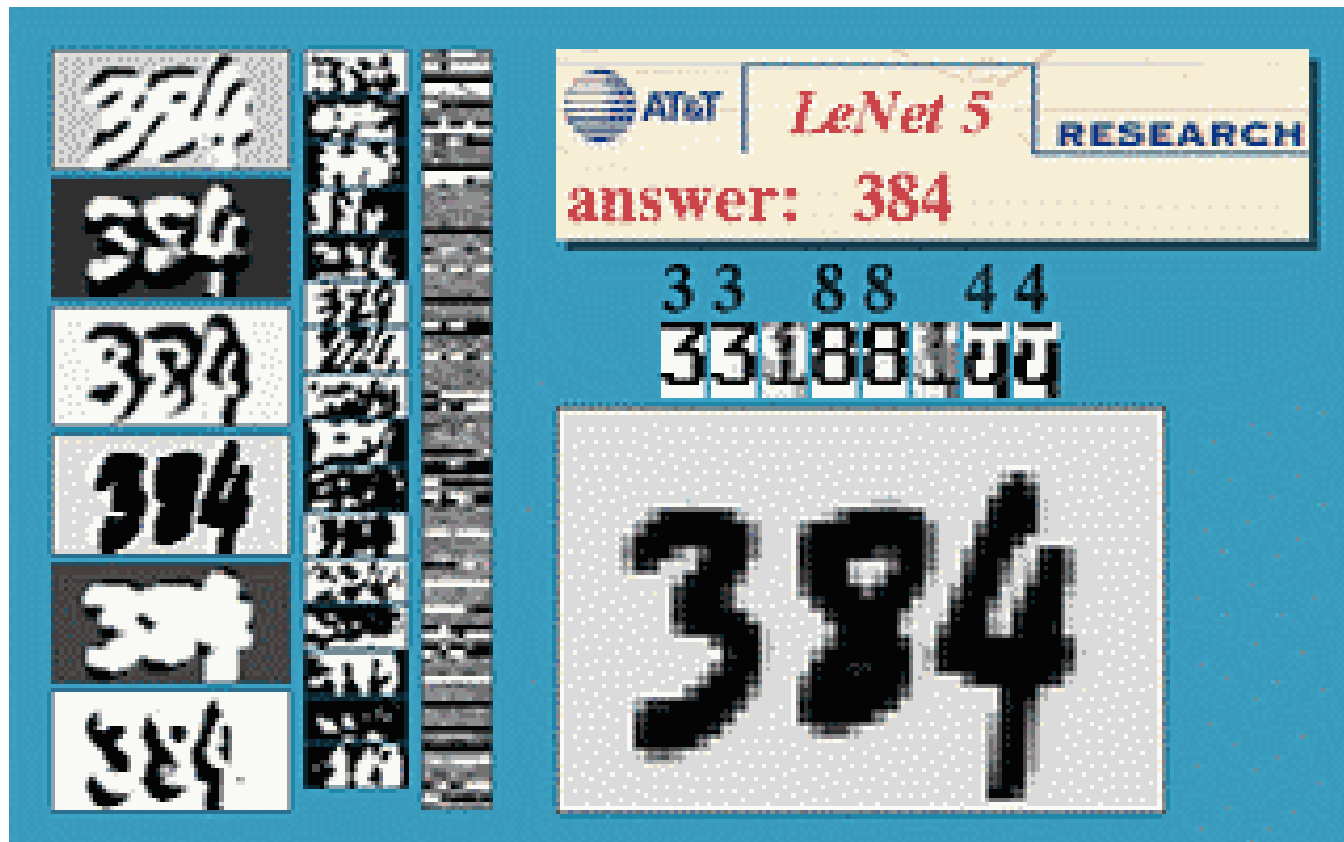
$$f\left(\text{img}\right) = 8$$




$$f(\text{5}) = 5$$

$$f\left(\text{digit 0 image}\right) = 0$$

$$f(\text{digit 6}) = 6$$





SEED // Deep learning



mammal → placental → carnivore → canine → dog → working dog → husky



vehicle → craft → watercraft → sailing vessel → sailboat → trimaran




$$f(\text{img}) = \text{cat}$$


$f$  ( "Have you seen  
Suicide Squad?" ) =

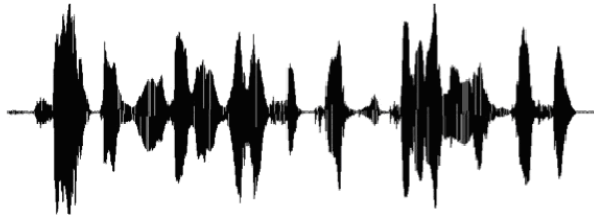
"I saw it in a theater once and  
it was great.

It was very... I don't know,  
a little dark.

I like the psychological  
effects and the way it  
portrays the characters."

$$f \left( \text{Image of a person flying a kite on a beach} \right) = \text{"A person flying a kite on a beach"}$$


$$f \left( \text{audio waveform} \right) = \text{"A coffee, please."}$$

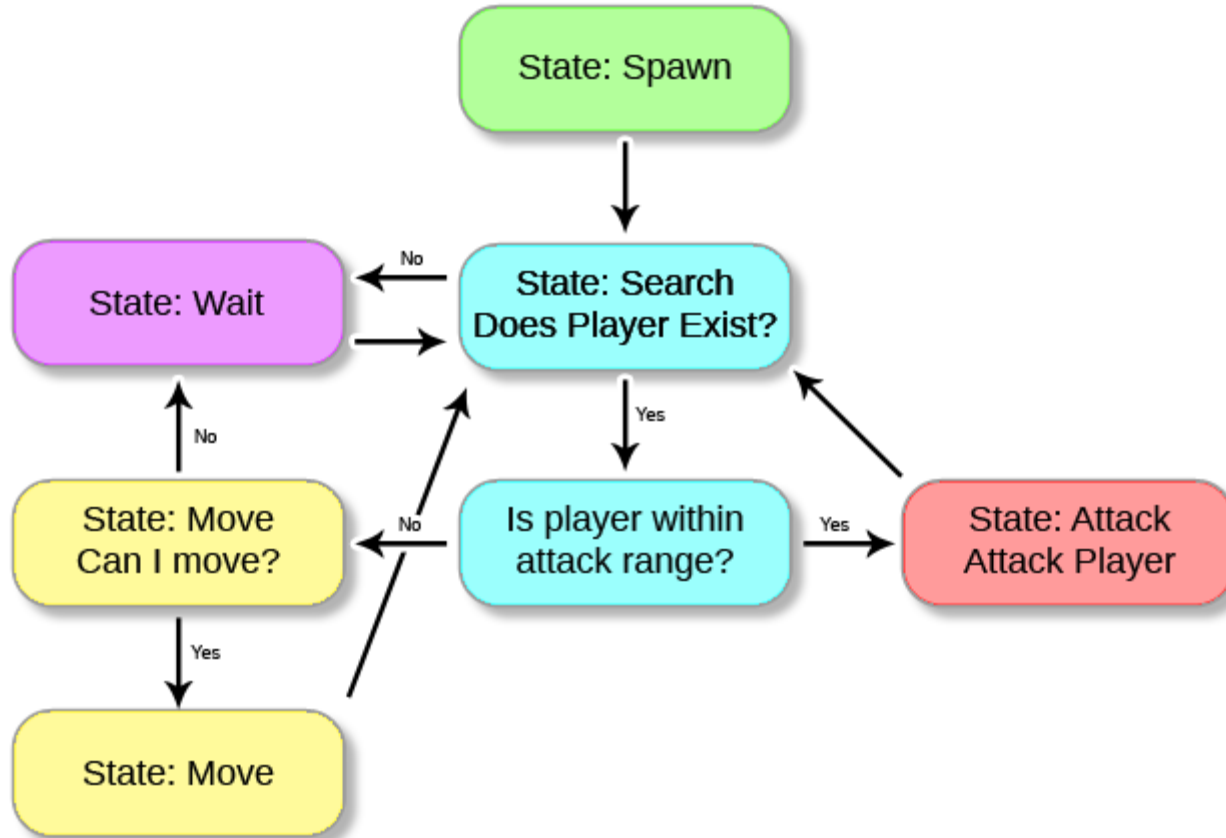
$$f\left(\text{"A coffee, please."}\right) = \text{[Waveform]}$$
A black waveform representing the audio signal of the sentence "A coffee, please." The waveform shows the amplitude of the sound over time, with several distinct peaks and troughs corresponding to the words in the sentence.

$$f \left( \text{img\_horse} \right) = \text{img\_zebra}$$

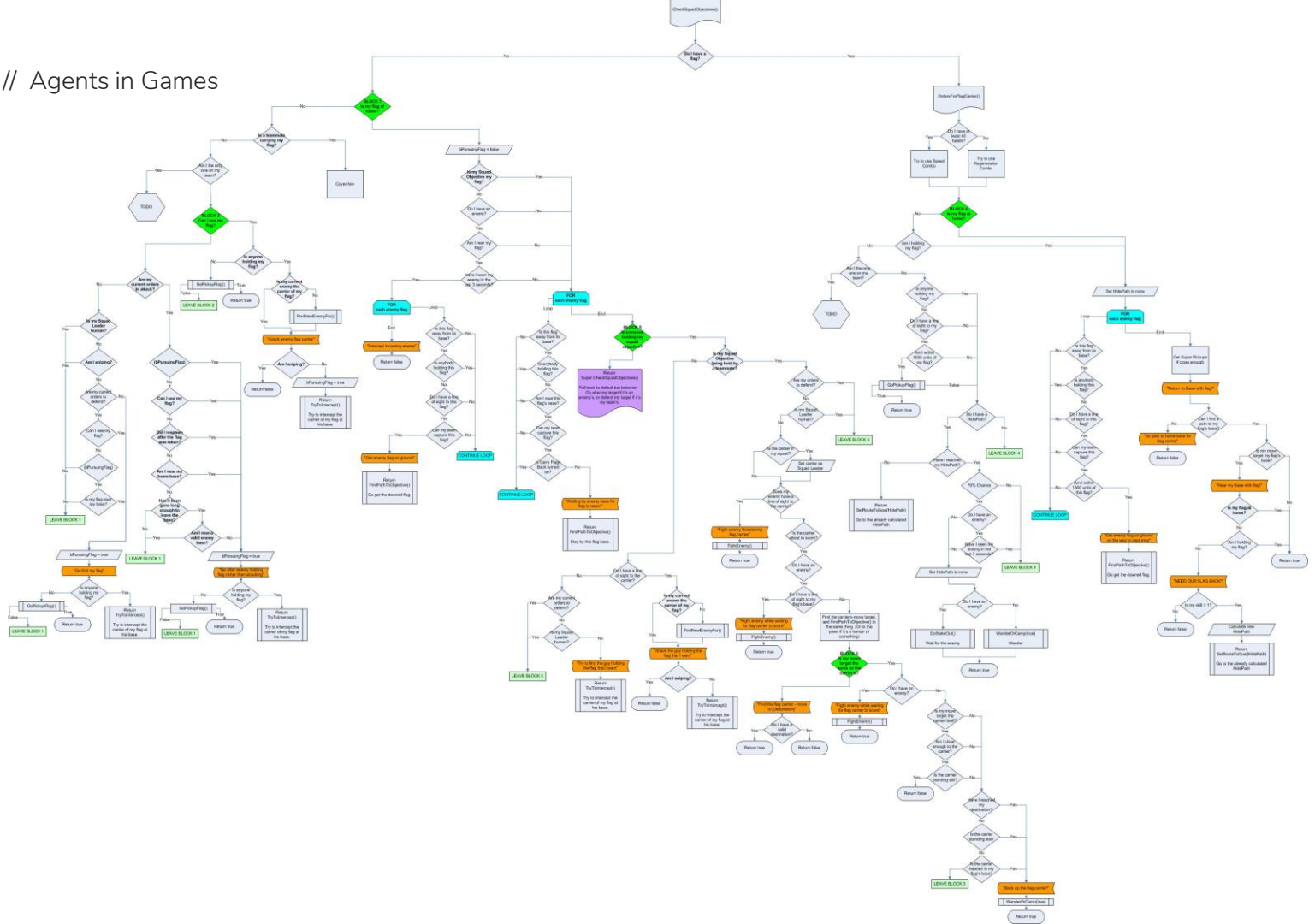
The image shows a mathematical function  $f$  applied to an input image of a brown horse in a field, resulting in an output image of a zebra in the same field. This illustrates a concept of feature extraction or transformation in deep learning, where the model identifies the underlying features of the input image and maps them to a different class or representation.



# Agents in Games



# SEED // Agents in Games



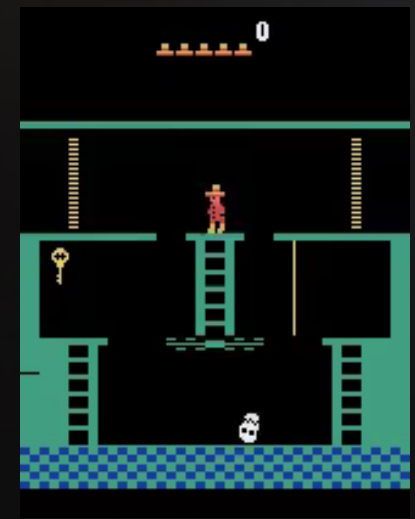
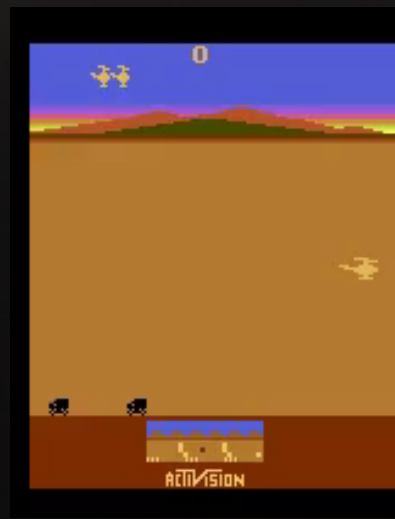
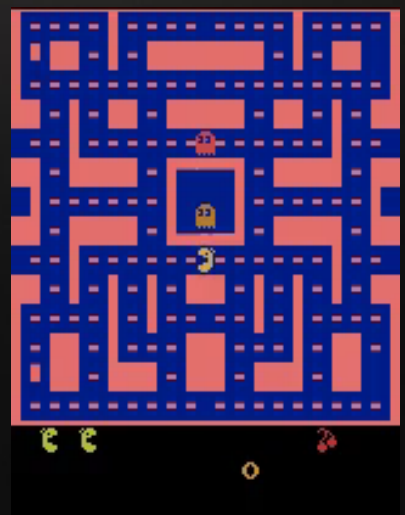
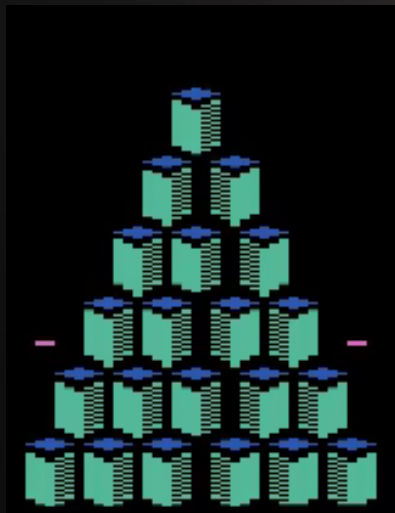
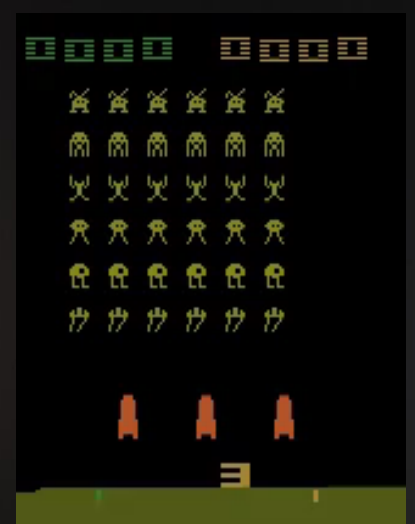
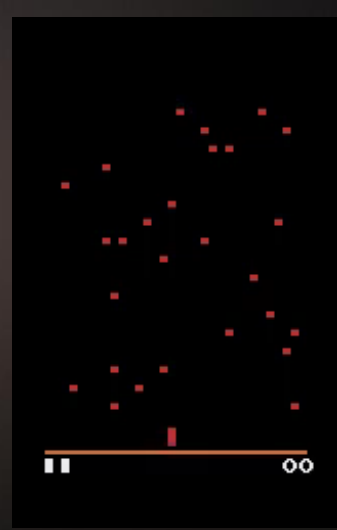
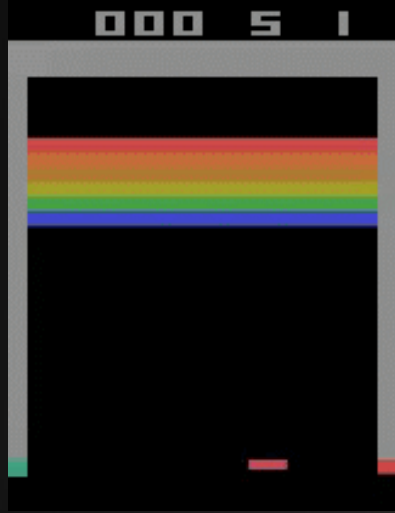
$f$  (



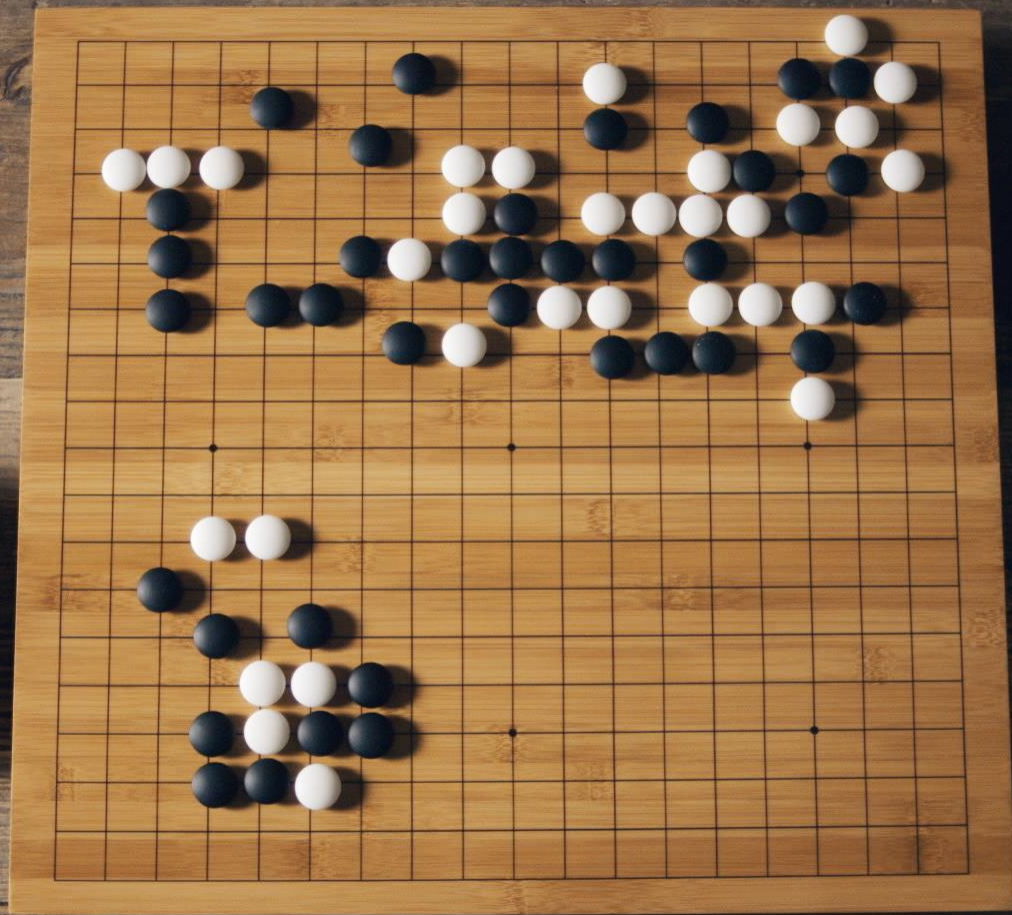
)

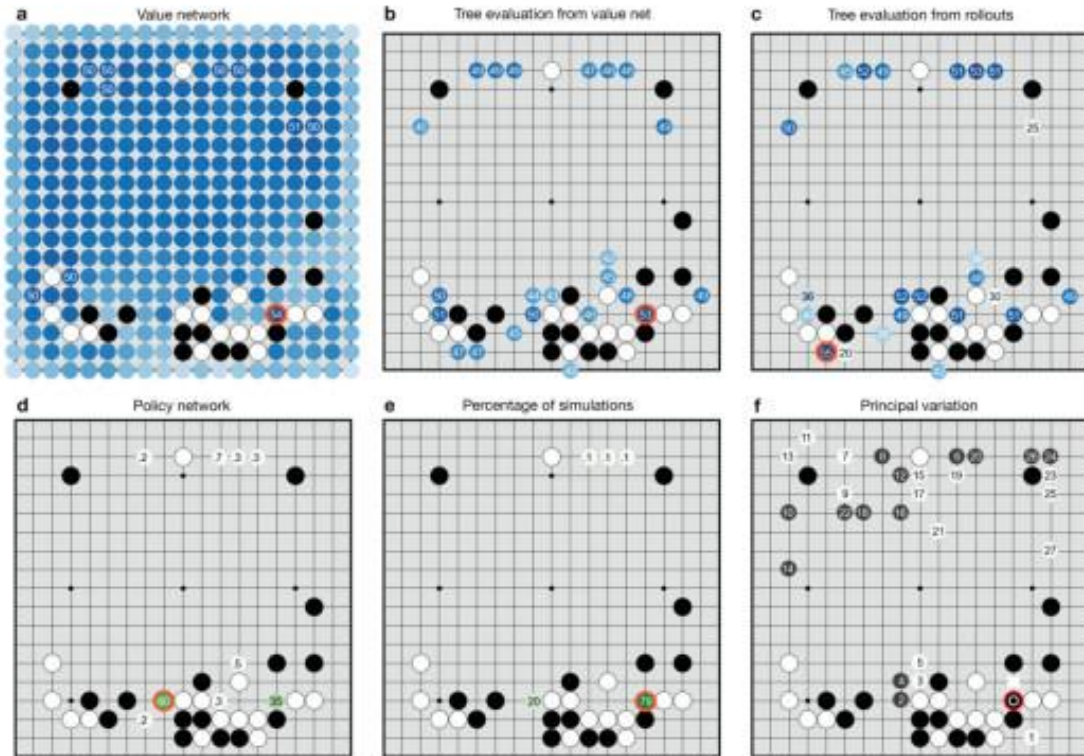
=















AlphaGo



Lee Sedol



SEED // Animation

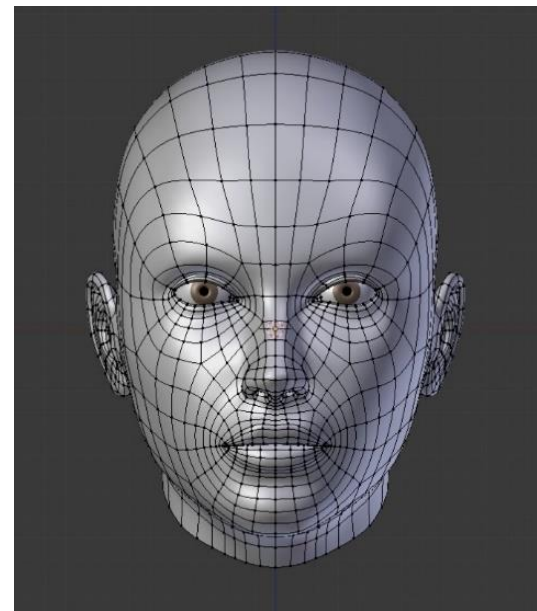
# Animation



11:16:58:16



$$f \left( \text{audio waveform} \right) =$$





Video-based performance capture



Our audio-based result

SEED // All the things!

# Learn all the things!

SEED // All the things!



$f$  (



)

=





Particles: 2'429'578, Foam: 2'218'853

PHYSICS FORESTS



SEED // All the things!



SEED // All the things!

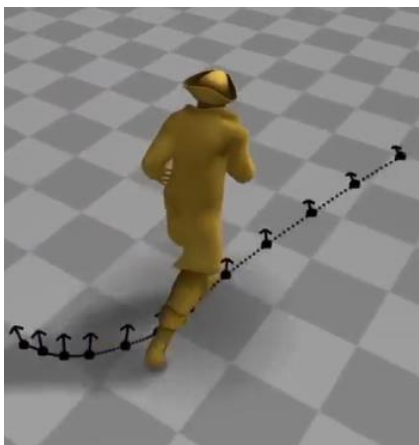


11.9 fps

Frame by frame detection (no tracking)



SEED // All the things!



$f$  (

)

=





SEED // All the things!

$$f(\text{cat}) = \text{cat}$$

$$f(\text{audio waveform}) = \text{3D wireframe face}$$

$$f(\text{game screen}) = \text{joystick}$$

"I saw it in a theater once and it was great.

$$f(\text{game character}) = \text{joystick}$$

$$f(\text{"Have you seen Suicide Squad?"}) = \text{It was very... I don't know, a little dark.}$$

I like the psychological effects and the way it portrays the characters."

$$f(\text{8}) = \text{8}$$

$$f(\text{audio waveform}) = \text{"A coffee, please."}$$

$$f(\text{apple}) = \text{apple}$$

$$f(\text{"A coffee, please."}) = \text{audio waveform}$$

SEED // Final remark

It's all just function guessing – or – A new paradigm for computing

Instead of programming – showing

Same method for every problem

Greatest paradigm change in computing since transistors



FIN



SEED // Thank you

## Stockholm

Hector Anadon Leon

Jorge del Val Santos

Mattias Teye

Anastasia Opara

Camilo Gordillo

Joakim Bergdahl

Jack Harmer

Linus Gisslén

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Paul Greveson

Niklas Nummelin

Ken Brown

Mark Kyobe

Effeli Holst

Jenna Frisk

Ida Winterhaven

Tomasz Stachowiak

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Graham Wihlidal

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