



PART I: Introduction to Artificial Intelligence and Machine Learning

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Fellow and Board of Directors, Alberta Machine Intelligence Institute (Amii)*

Learning Objectives

1. Be able to talk about **artificial intelligence** (AI) and **machine learning** (ML);
2. Be able to share one or more **recent advances** in AI;
3. Have an understanding of **what, how,** and **when** machines might learn.

Learning Objectives

1. Be able to talk about **artificial intelligence** (AI) and **machine learning** (ML);
2. **Mystify** AI;
3. **Demystify** AI.

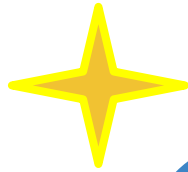


No math! I promise!



Before we get started...

(Blickets
& borks.)



Quiz Time!





**Hallmarks of Intelligence:
Artificial, Machine (and Human)**

Intelligent or not?



Intelligent or not?



Intelligent or not?



Intelligent or not?



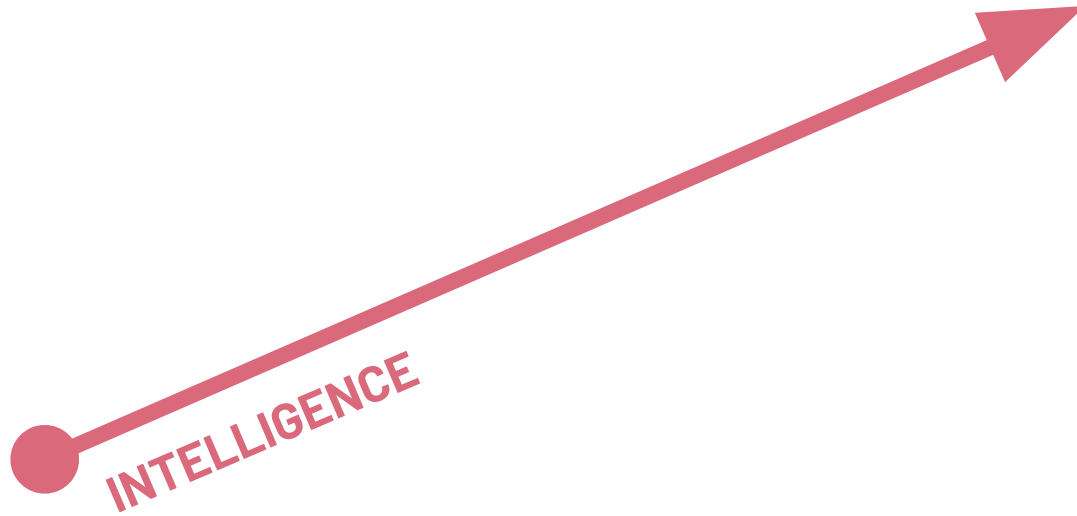
Intelligent or not?



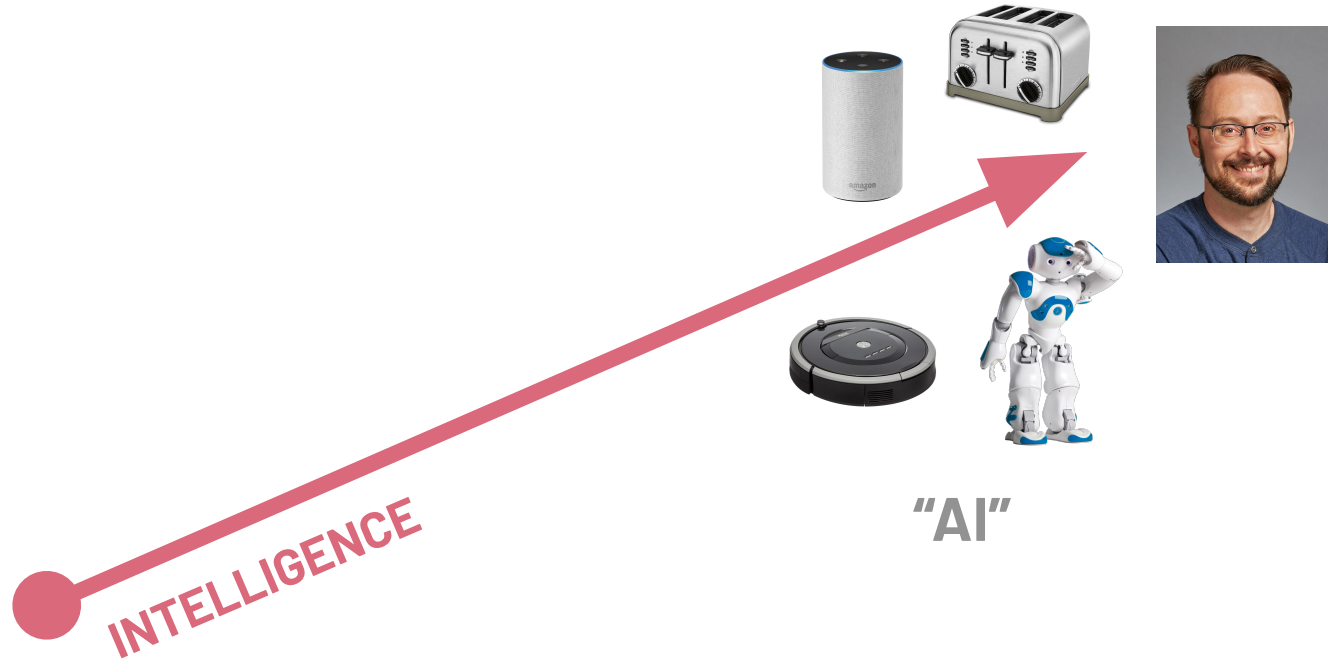
Intelligent or not?



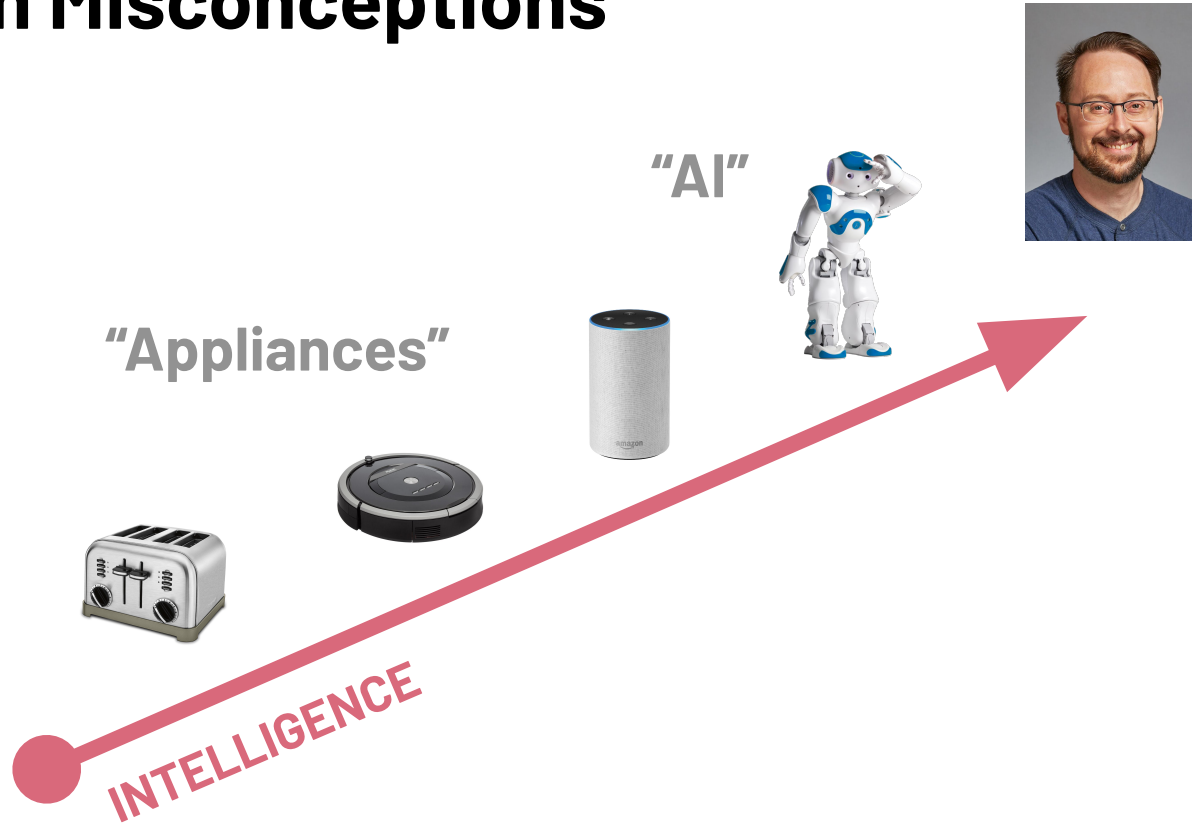
Common Misconceptions



Common Misconceptions

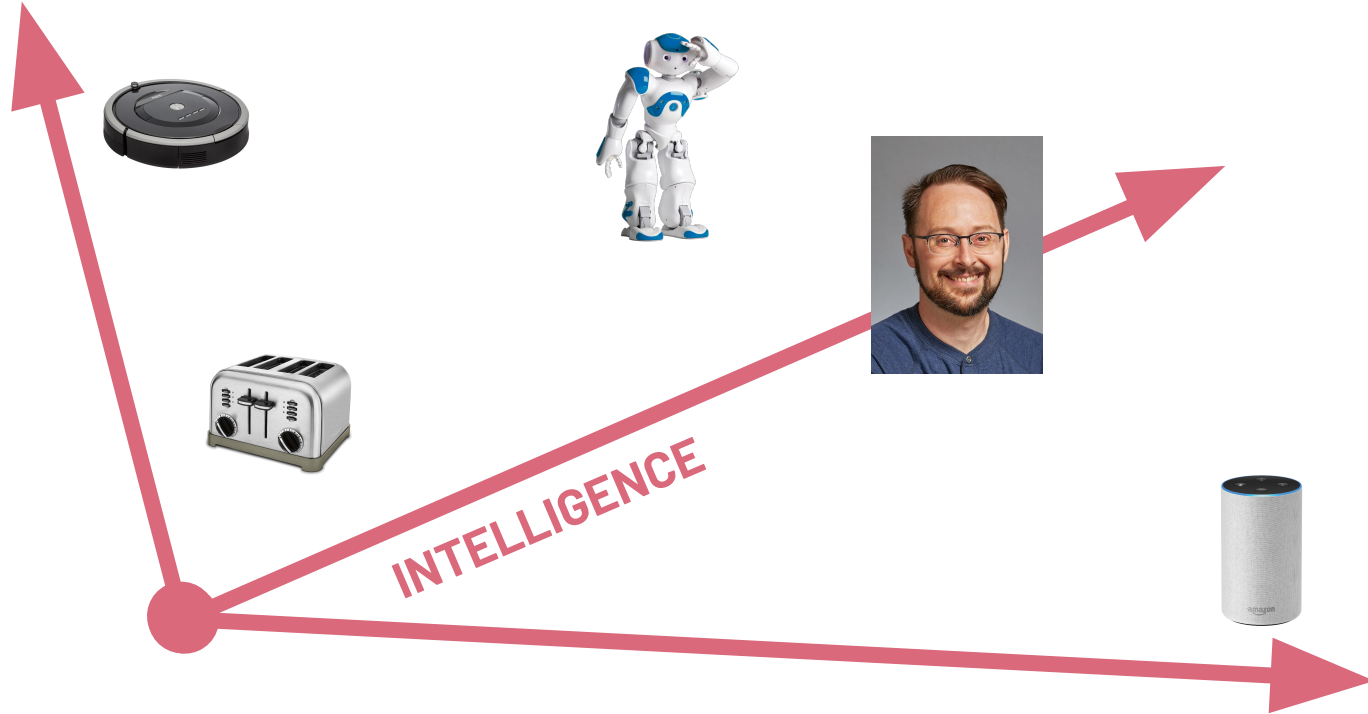


Common Misconceptions



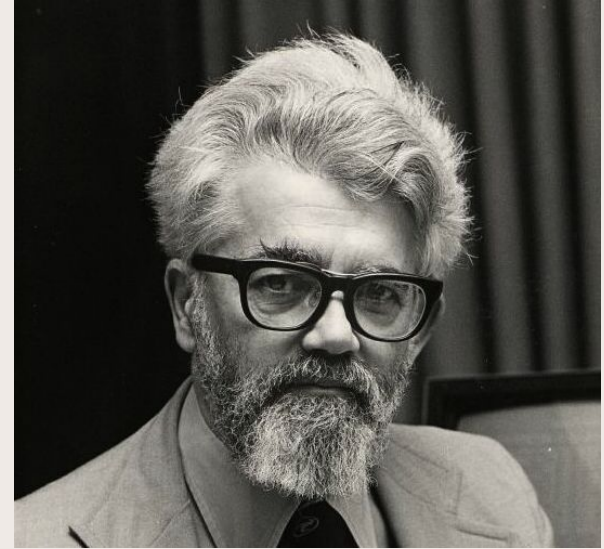
Data, Goals, Decisions

Seeing, Acting, Thinking



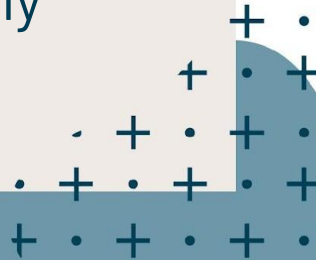
Intelligence:

“... is the computational part of the ability to achieve goals in the world.”



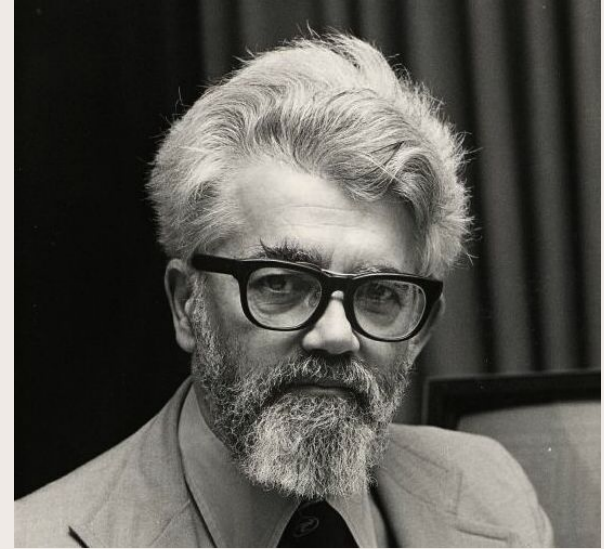
John McCarthy
(1927 – 2011)

<http://jmc.stanford.edu/artificial-intelligence/index.html>



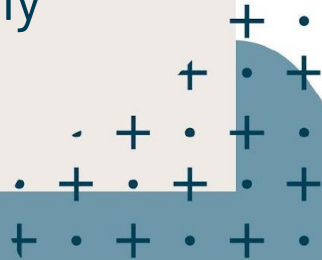
Artificial Intelligence:

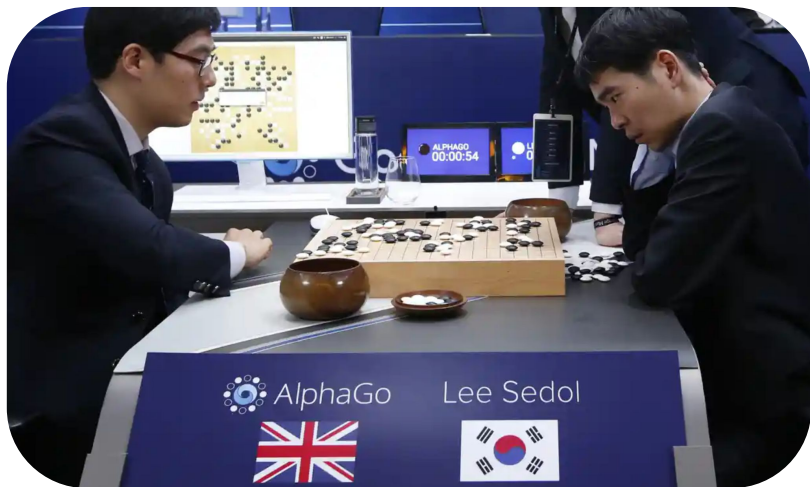
“... is the science and engineering of making intelligent machines, especially intelligent computer programs.”



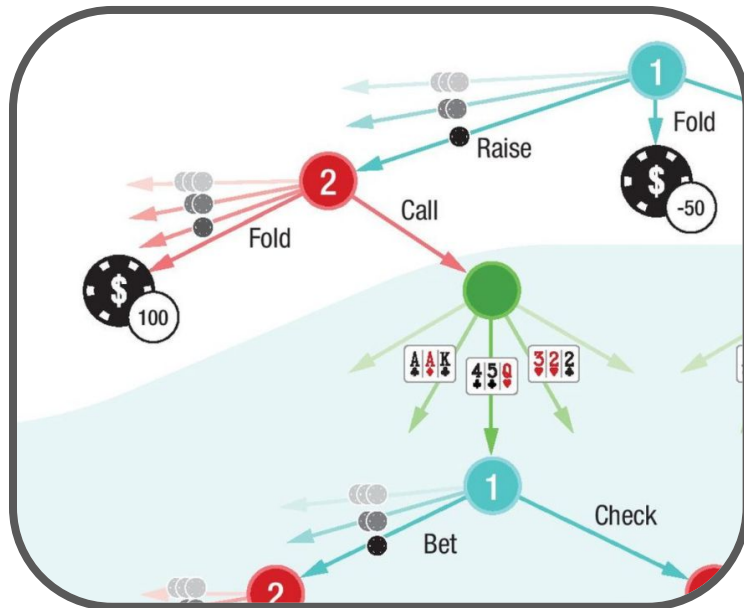
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<https://www.deepmind.com/research/highlighted-research/alphago>



<https://www.deepstack.ai/>

GAMES

Go, Poker, Chess, Checkers, Shogi,
Diplomacy, Stratego, Scotland Yard...



<https://openai.com/research/vpt>

& VIDEO GAMES

Gran Turismo,
Minecraft, Atari,
Capture the Flag,
StarCraft II, Dota 2, ...



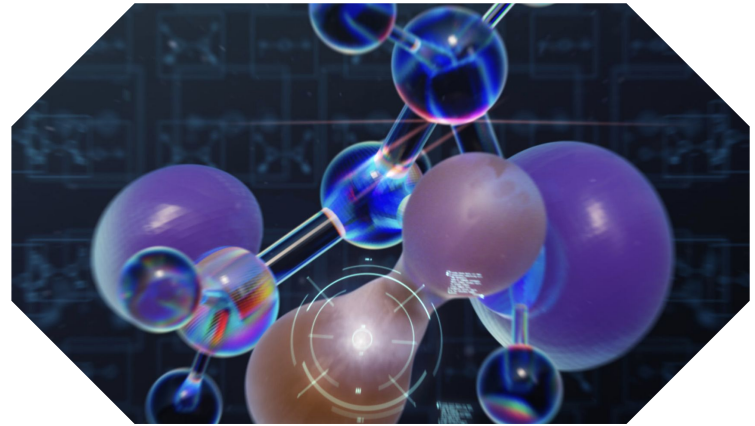
<https://www.gran-turismo.com/us/gran-turismo-sophy/>



<https://www.deepmind.com/blog/accelerating-fusion-science-through-learned-plasma-control>

PHYSICS & CHEMISTRY

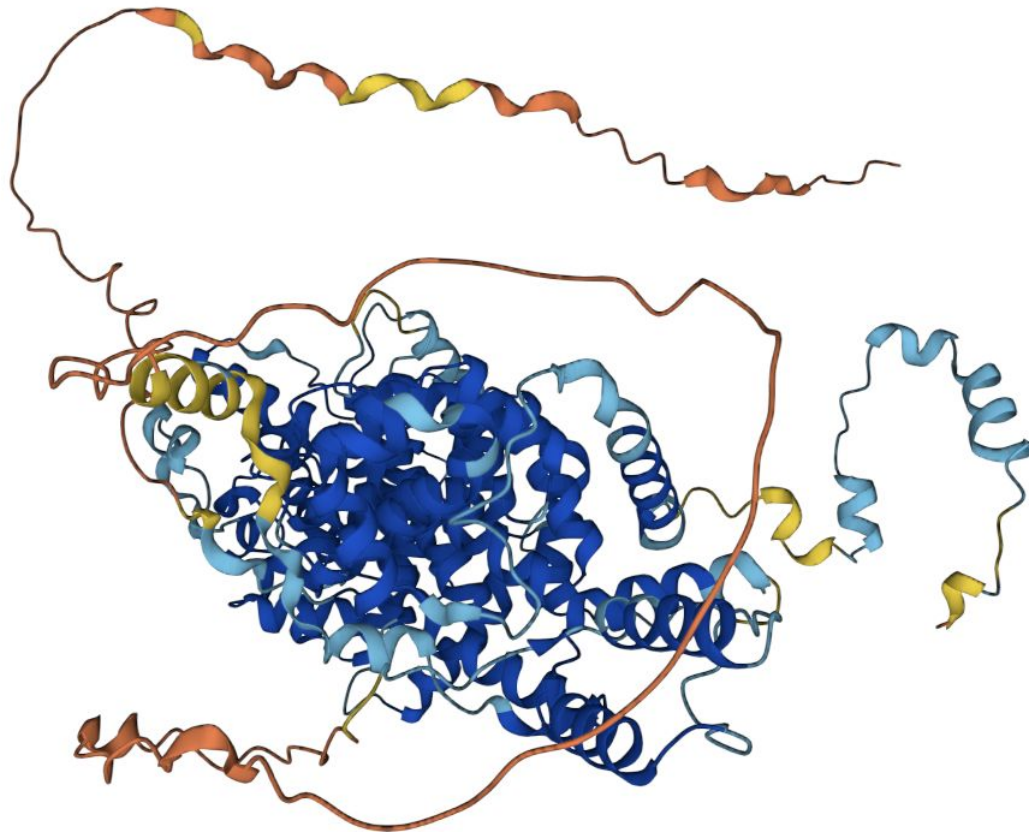
Nuclear Fusion,
Quantum Chemistry,
Glass Physics, ...



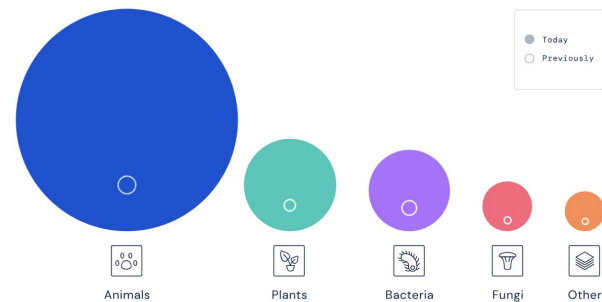
<https://www.deepmind.com/blog/simulating-matter-on-the-quantum-scale-with-ai>

& BIOLOGY

AlphaFold

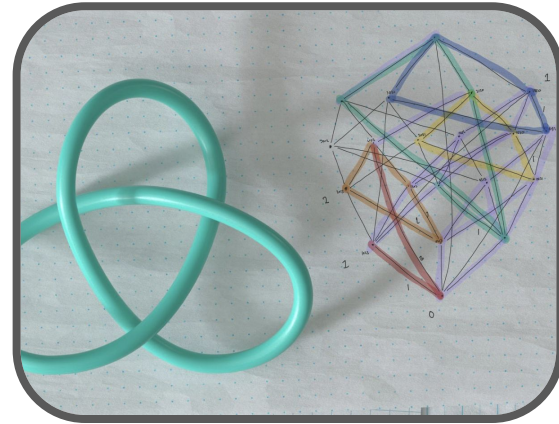


<https://www.deepmind.com/research/highlighted-research/alphafold>
<https://alphafold.ebi.ac.uk/>



& APPLIED / PURE MATH

Math Word Problems,
Theorem Proving,
Guiding Conjectures, ...



<https://www.deepmind.com/blog/exploring-the-beauty-of-pure-mathematics-in-novel-ways>

Question

Ali is a dean of a private school where he teaches one class. John is also a dean of a public school. John has two classes in his school. Each class has $\frac{1}{8}$ the capacity of Ali's class which has the capacity of 120 students. What is the combined capacity of both schools?

Answer

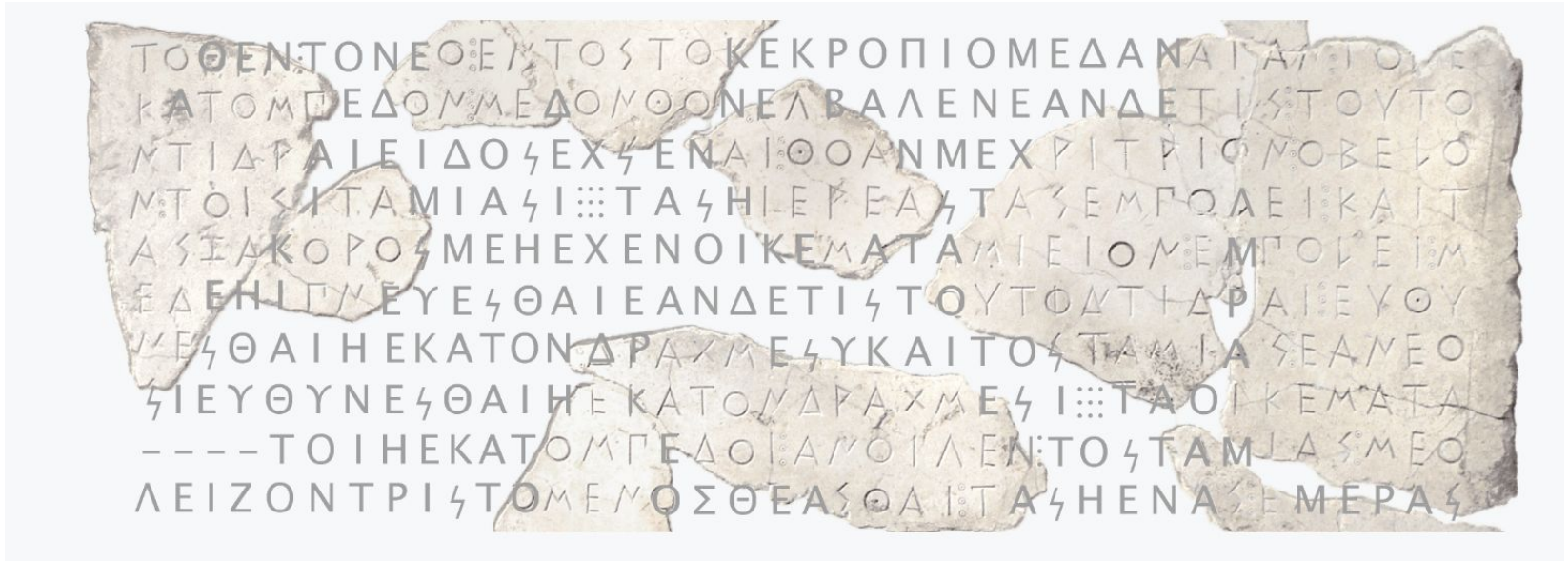
Method: 175B Verification

Ali's class has a capacity of 120 students.
Each of John's classes has a capacity of $120/8 = 15$ students.
The total capacity of John's two classes is 15 students * 2 classes = 30 students.
The combined capacity of the two schools is 120 students + 30 students = **150 students.**

<https://openai.com/research/solving-math-word-problems>

& HUMANITIES

e.g., Restoring Ancient Texts



<https://ithaca.deepmind.com/>

& CLIMATOLOGY

& ECOLOGY

& ECONOMICS

& GOVERNANCE

& LAW

& COMPUTING SCIENCE

& TRANSPORTATION

& MEDICINE

& ART

& DESIGN

& CLIMATOLOGY

& ECOLOGY

& ECONOMICS

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Weather Nowcasting

Biodiversity Analysis

Learned Bartering

Fair Taxation Design

Legal Reasoning

Human-level Coding

Self-driving Vehicles

Expert Diagnosis

2D Visuals Creation

3D Asset Creation

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Self-driving Vehicles

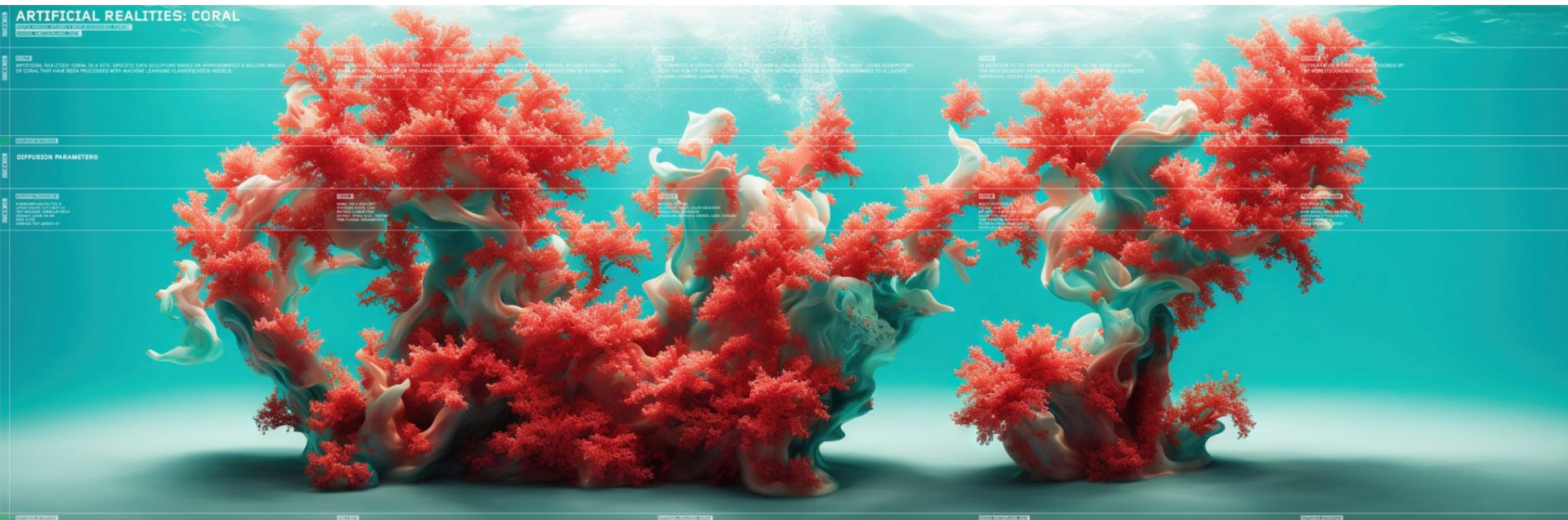
Expert Diagnosis

2D Visuals Creation

3D Asset Creation

IMMERSIVE ART INSTALLATIONS

by Refik Anadol

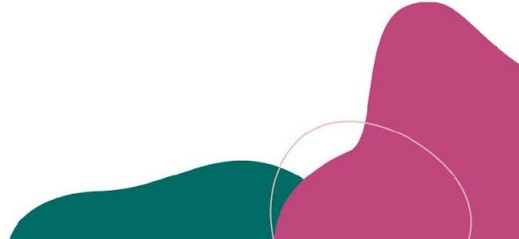



<https://refikanadol.com/works/artificial-realities-coral/>



KEY POINT

All of the examples we saw are
specialized AI tools
trained for specific things





Why Machine Intelligence?

Enhanced control over a changing and increasingly complex world.

Anticipation of future events and outcomes.

General tools for solving hard problems.





Why Machine Intelligence?


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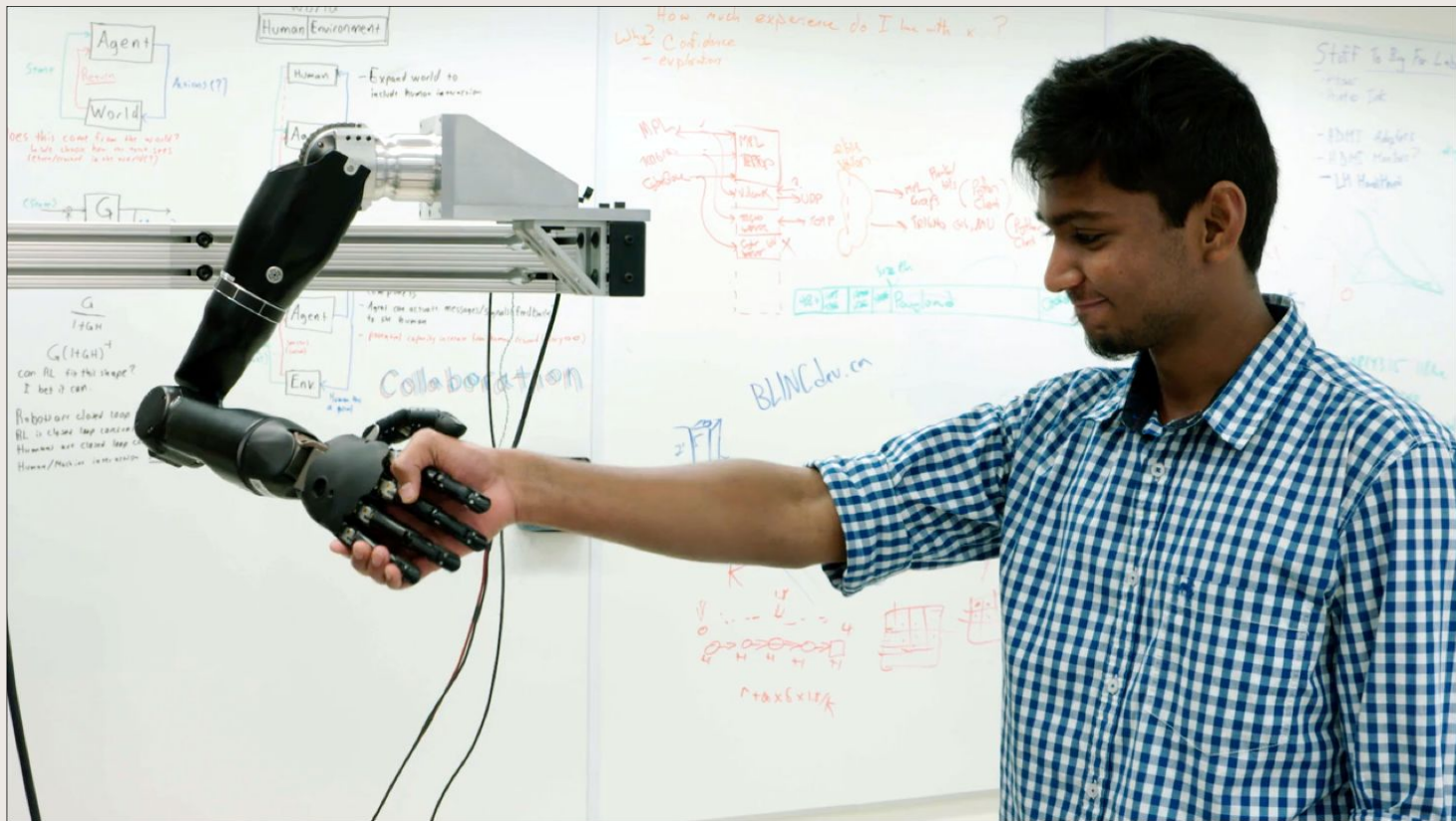
Anticipation of future events and outcomes.

General tools for solving hard problems.

Controlling complex systems and extracting knowledge from massive amounts of data.

Examples: finance, healthcare, energy, resources, transport, information processing.





BLINC Lab / SMART Network
August 2016

Why Machine Learning?

Things are Unknown:
known ends but unclear means.



Things are Complex:
scaling up is demanding or impossible.

Things Change:
systems need to adapt!



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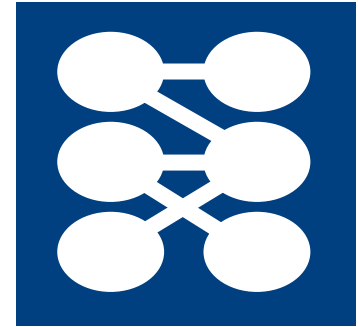
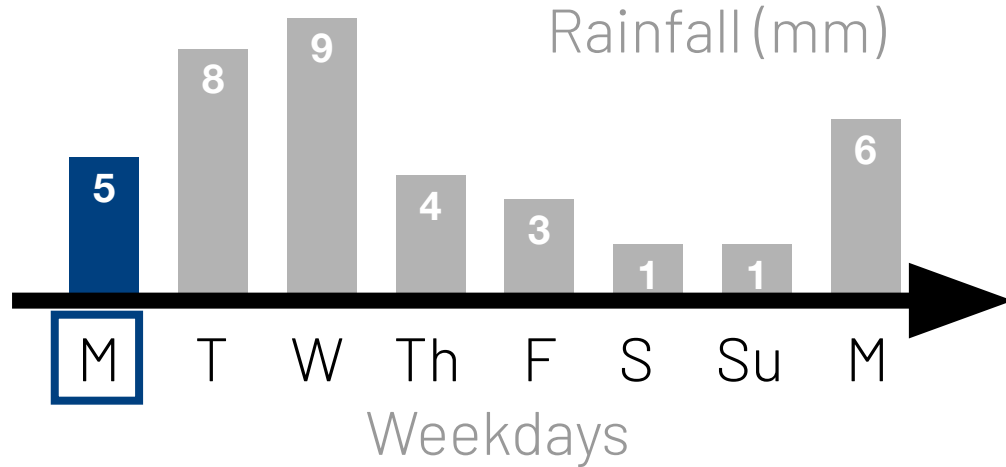


What to Learn



- **Knowledge Learning (Prediction):** building up knowledge.
- **Behaviour Learning (Control):** using knowledge to act.
- **Perception Learning (Representation):** structuring knowledge.

Prediction Learning

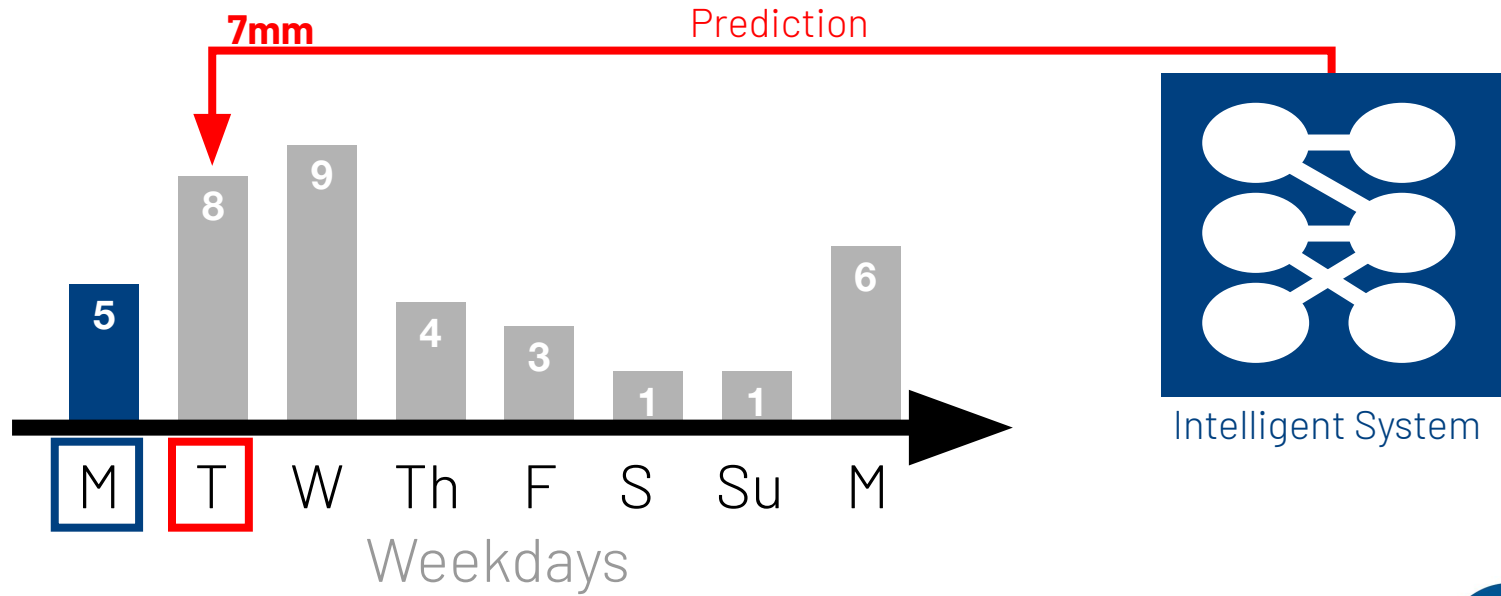


Intelligent System

One-step prediction.



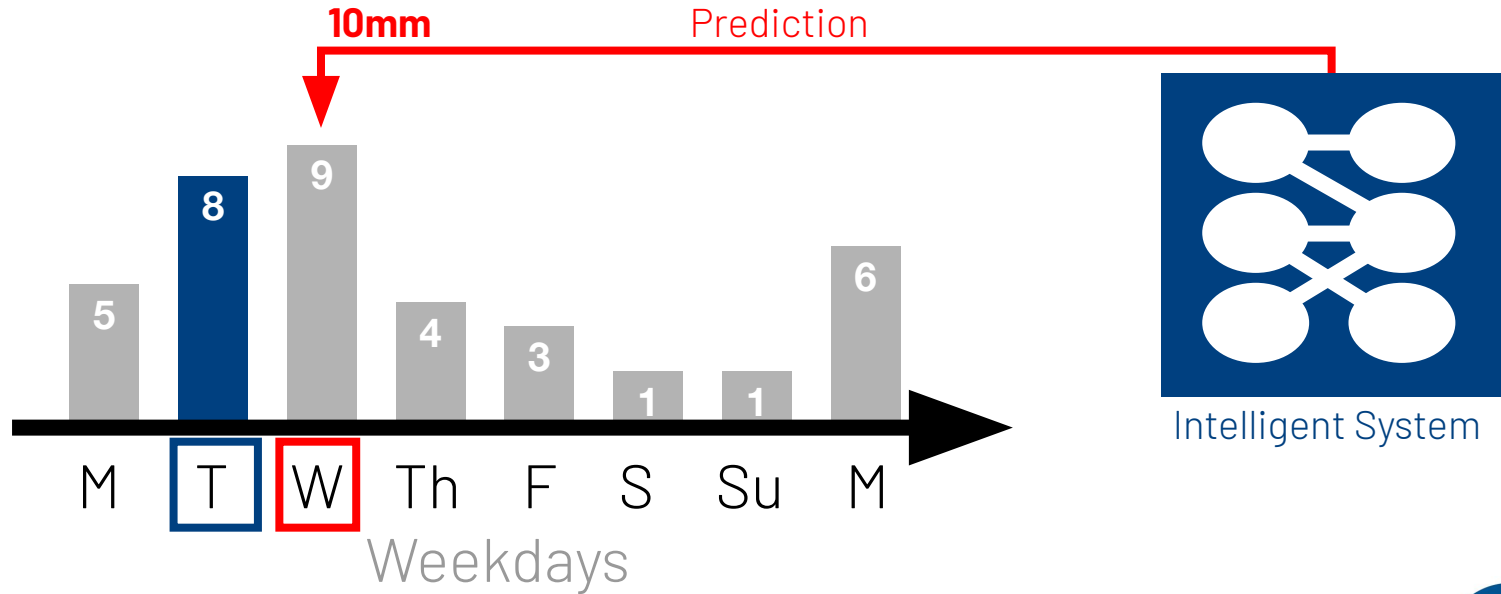
Prediction Learning



One-step prediction.



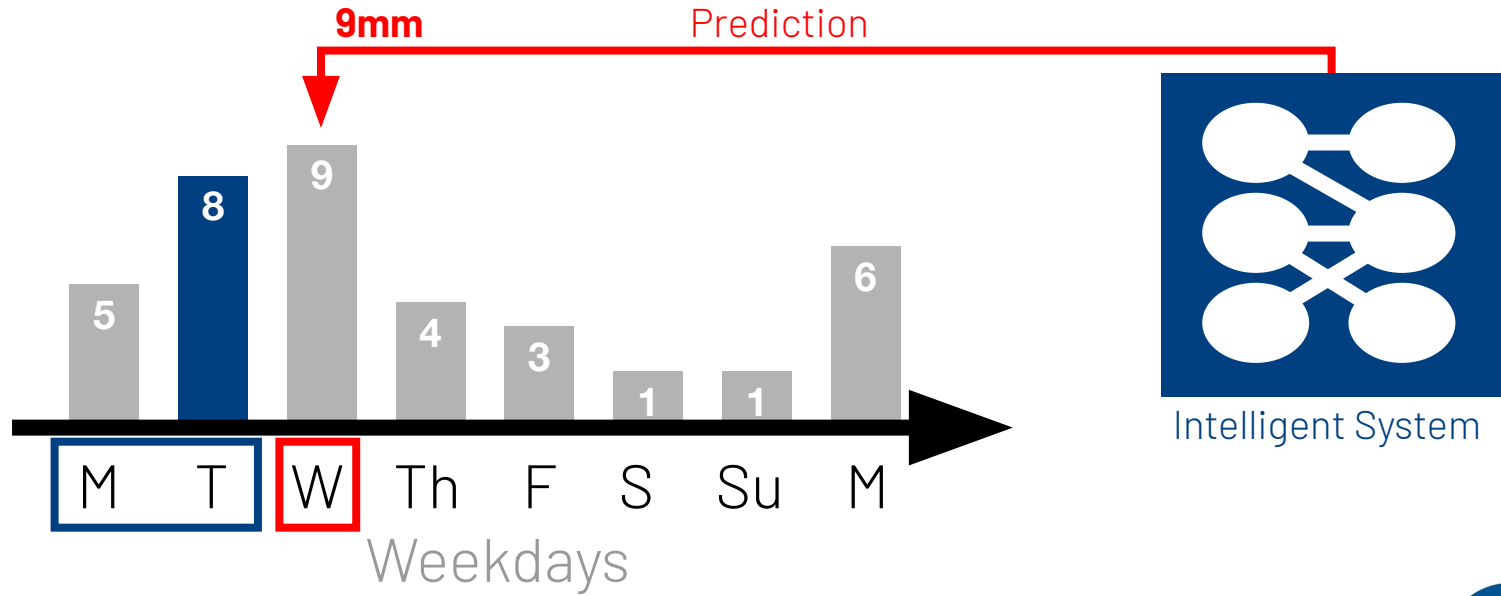
Prediction Learning



One-step prediction.



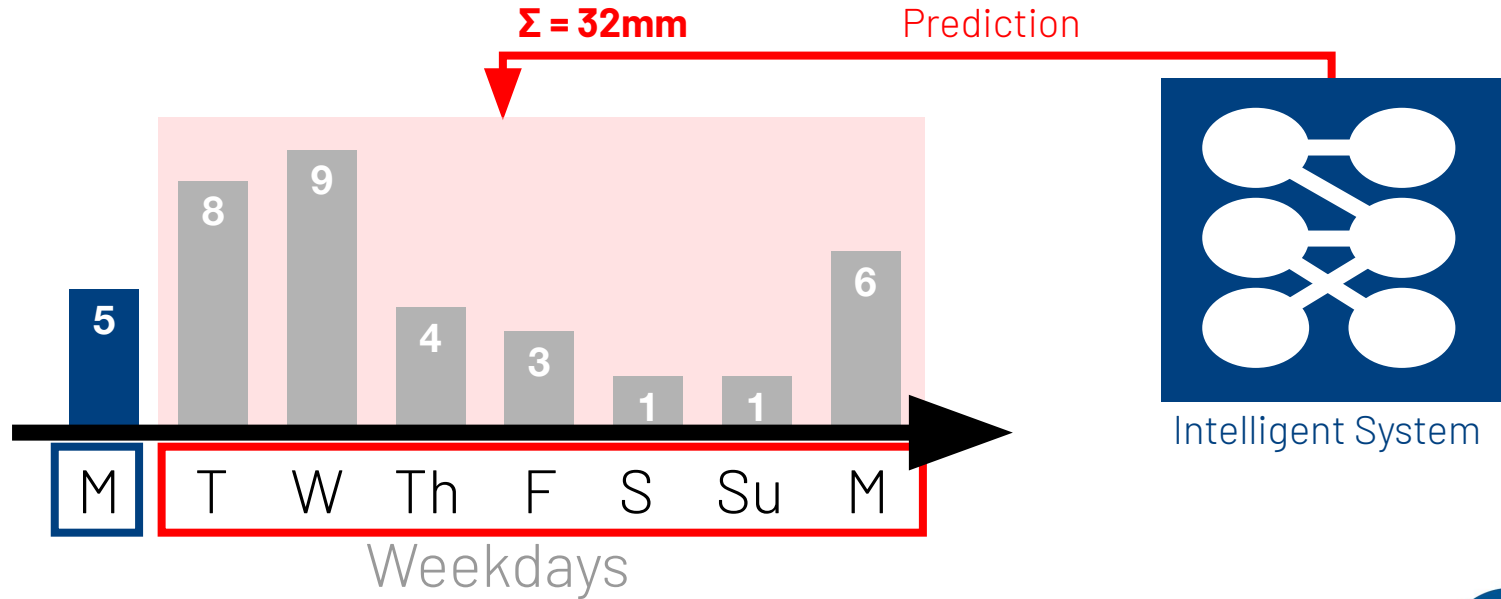
Prediction Learning



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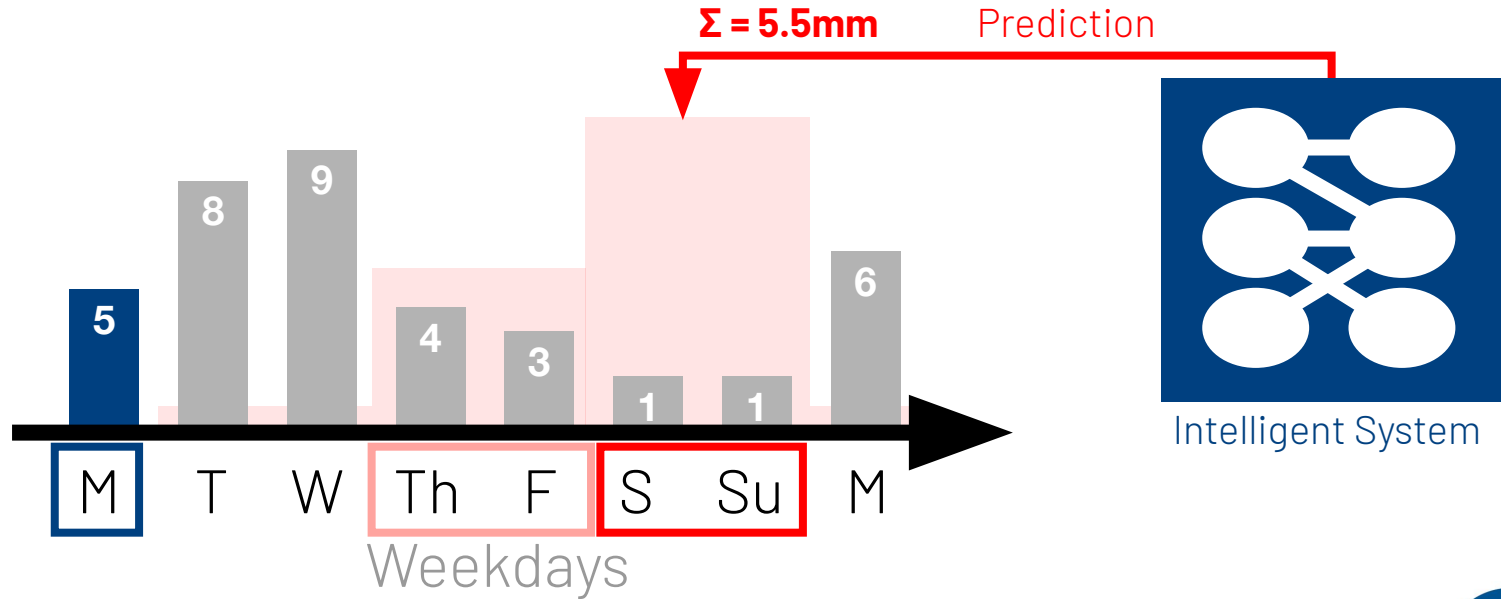
Prediction Learning



Temporally extended prediction.



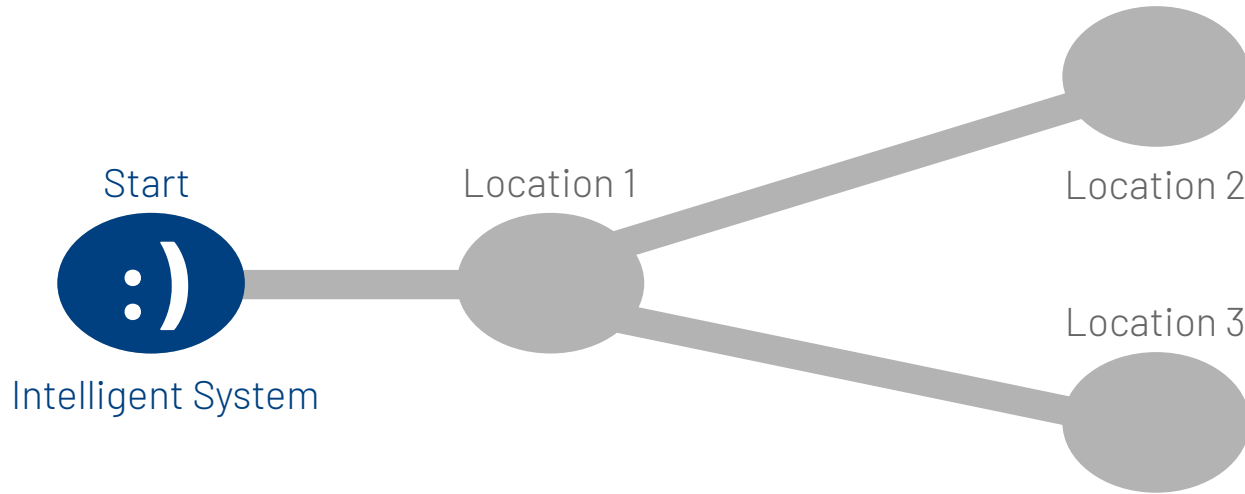
Prediction Learning



Temporally extended prediction.



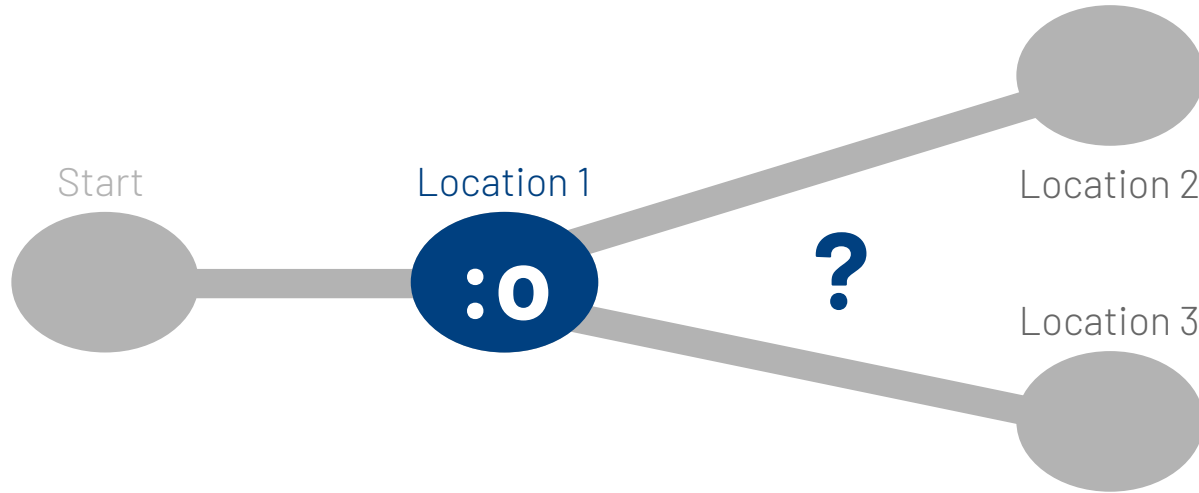
Control Learning



Using values.



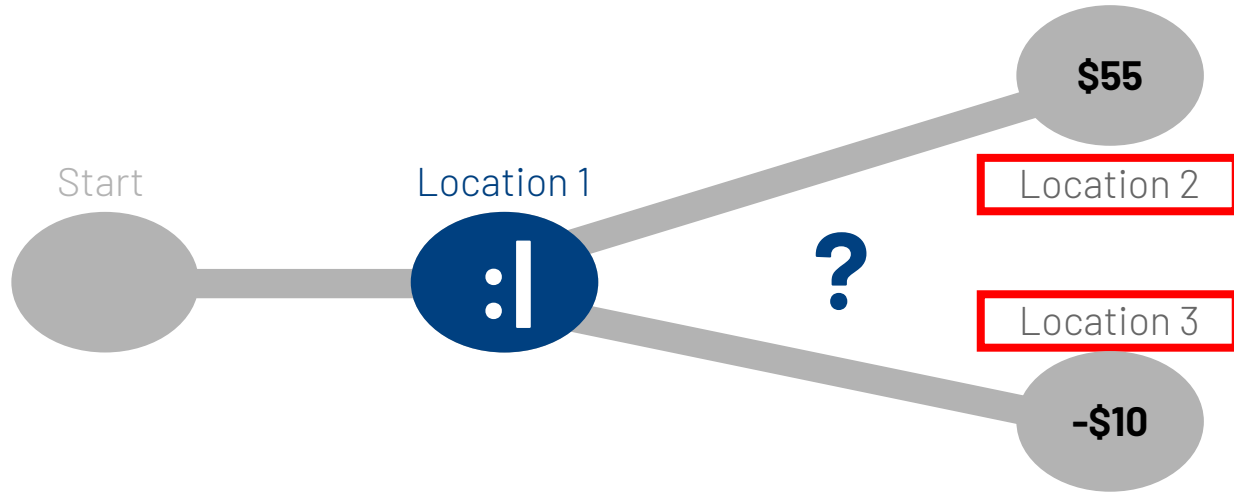
Control Learning



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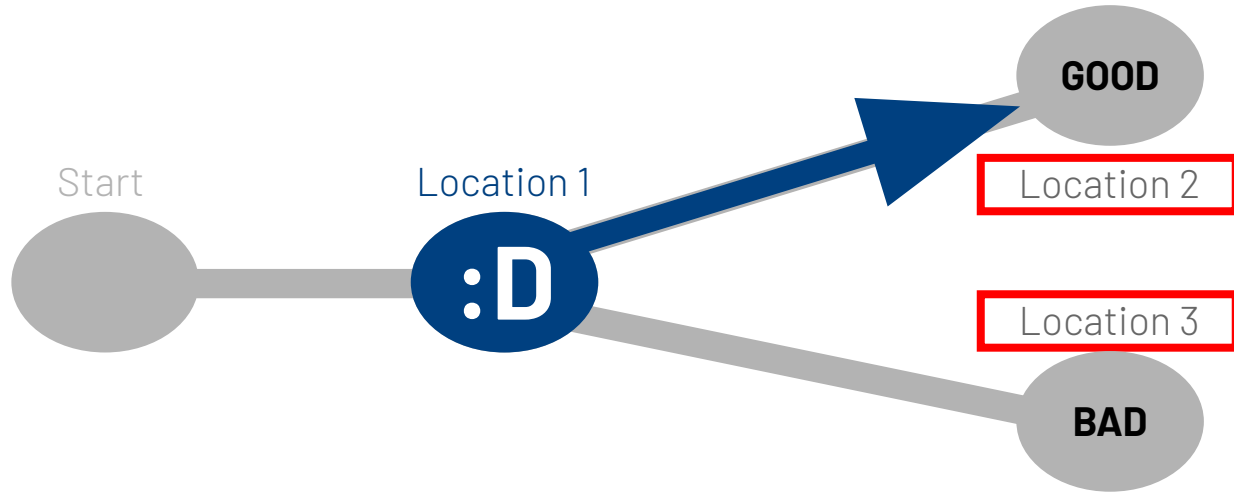
Control Learning



Using values.



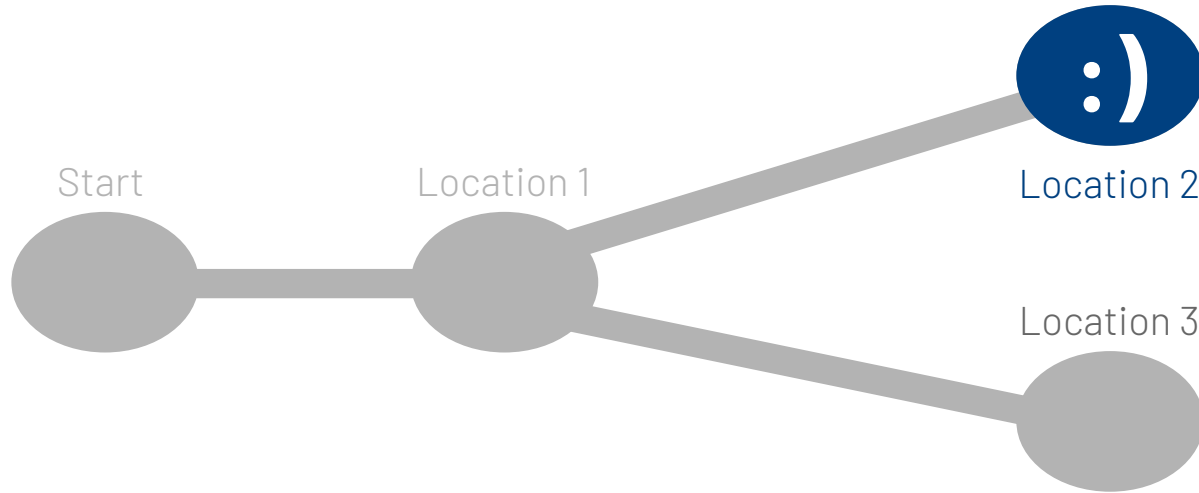
Control Learning



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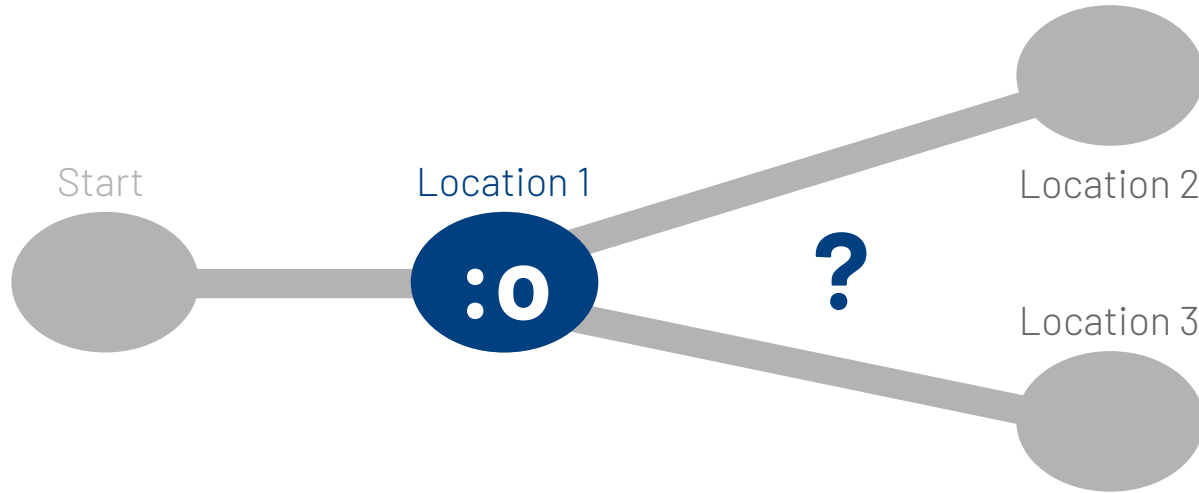
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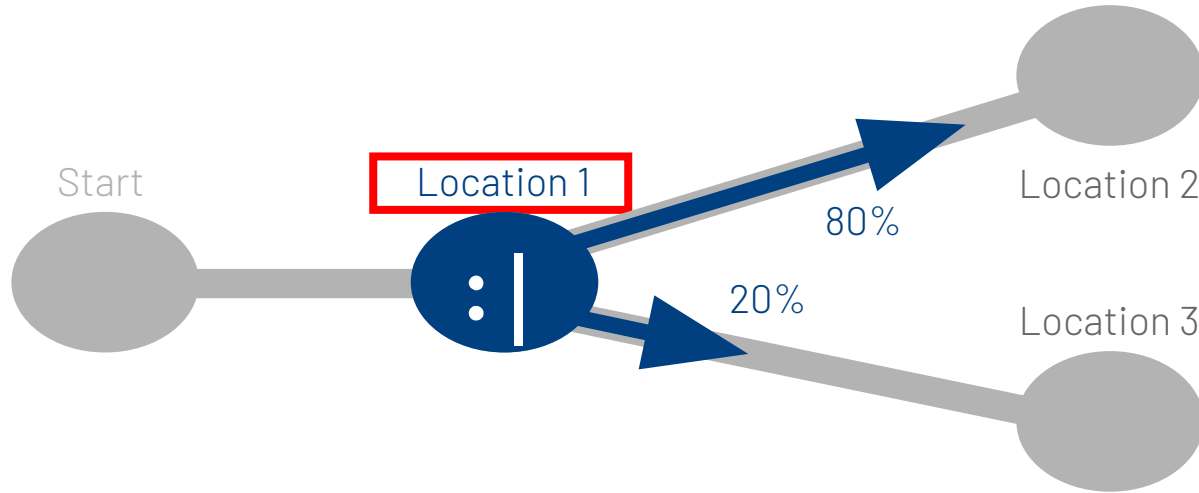
Control Learning



Using a learned *policy*.



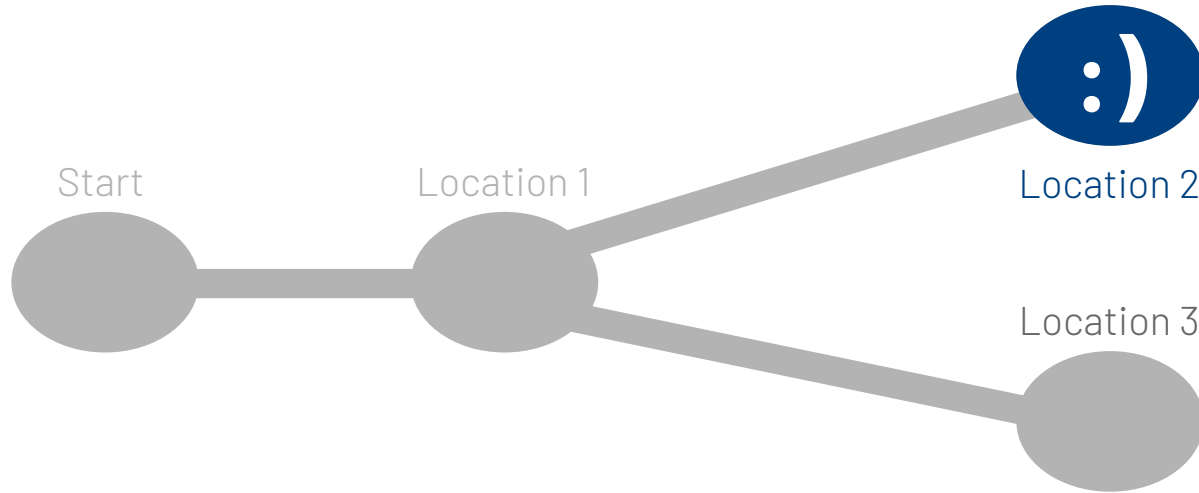
Control Learning



Using a learned *policy*.



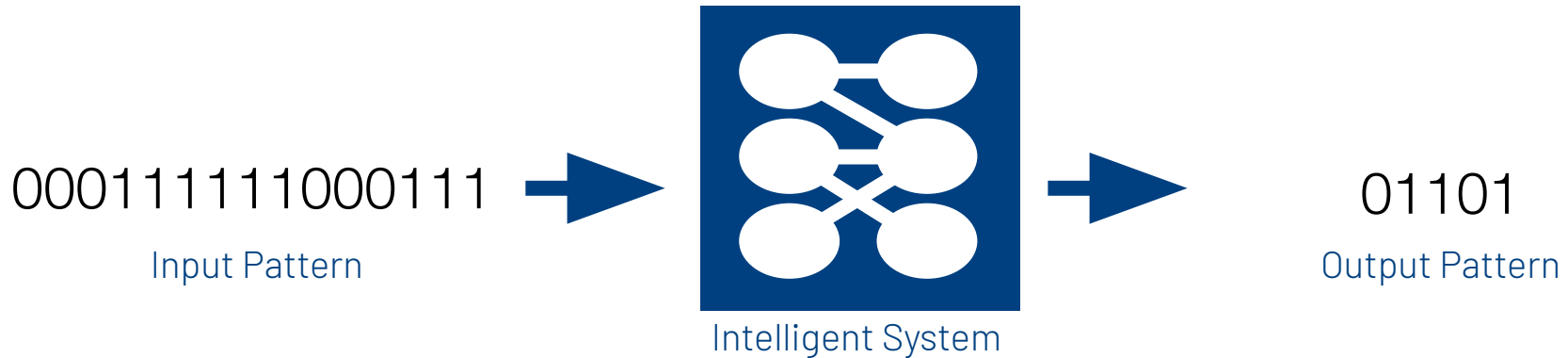
Control Learning



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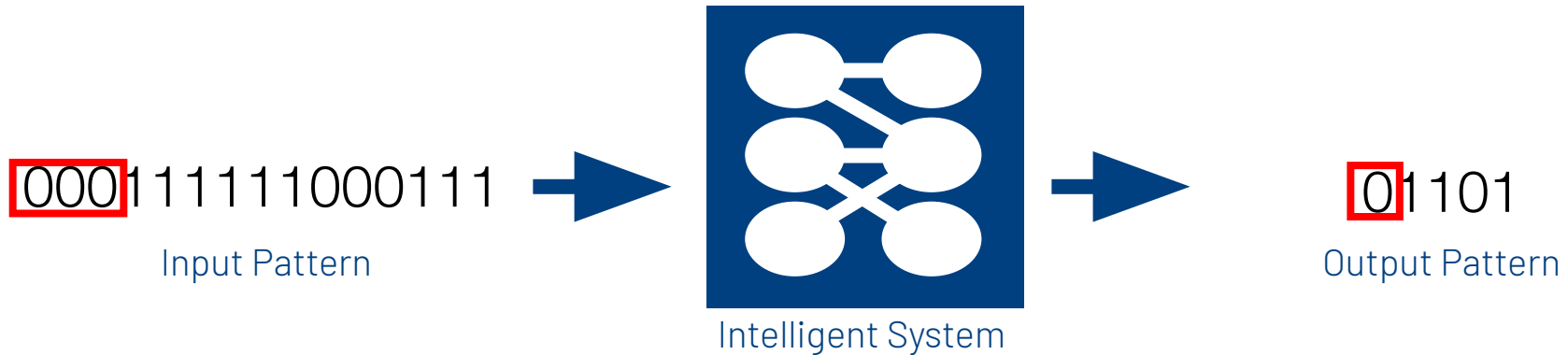
Representation Learning



Simplifying the world.



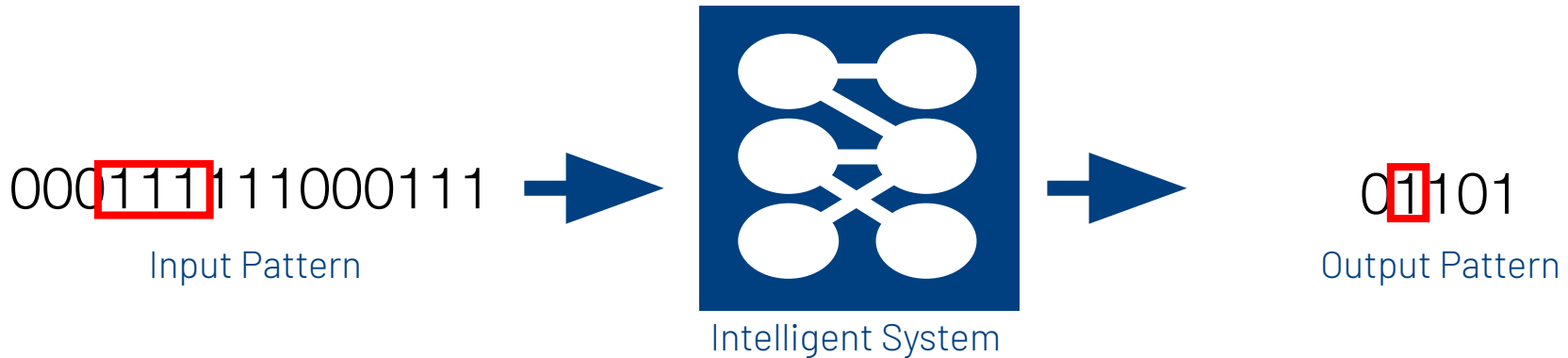
Representation Learning



Simplifying the world.



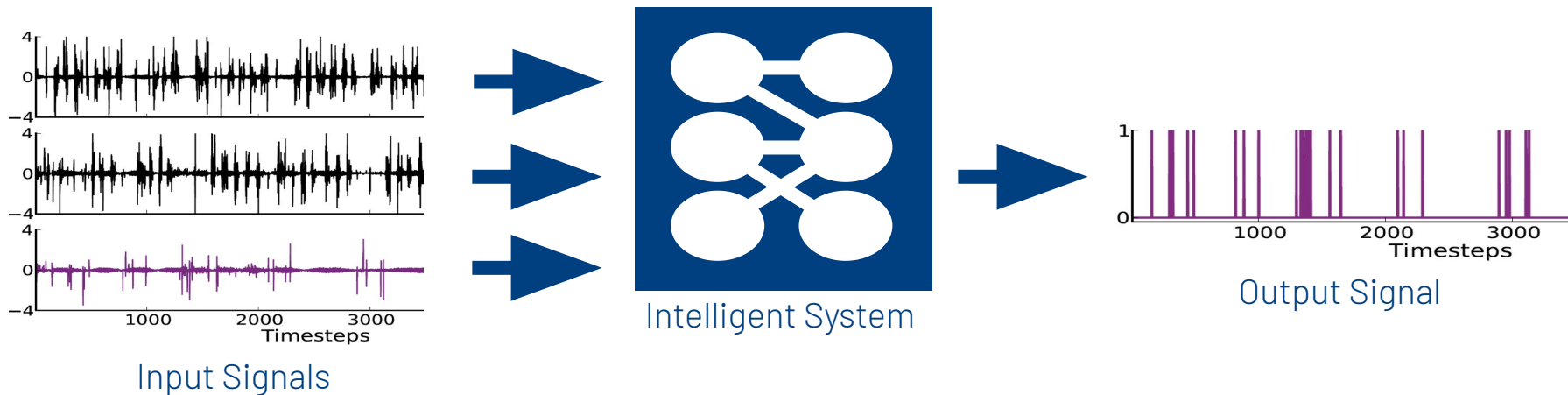
Representation Learning



Simplifying the world.



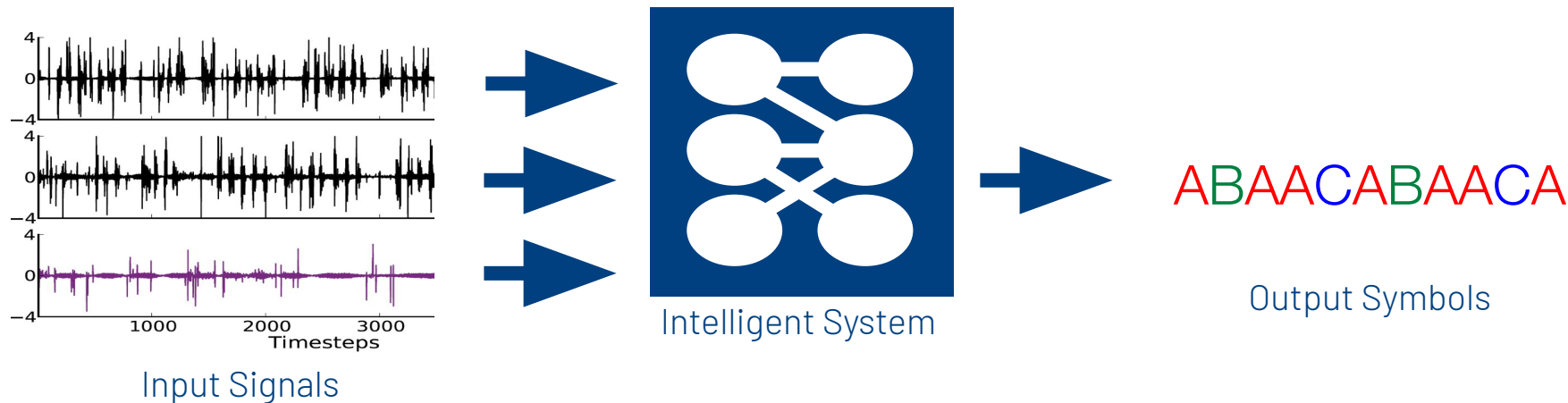
Representation Learning



Simplifying the world.



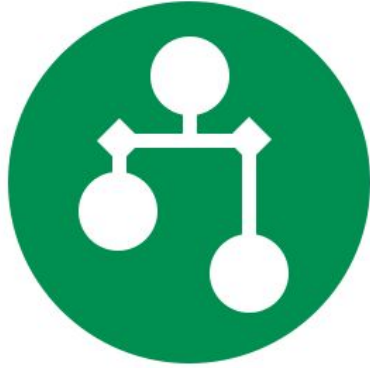
Representation Learning



Simplifying the world.



How to Learn

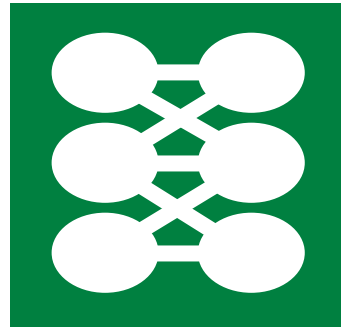
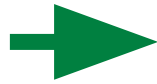


- **From labeled examples:** e.g., prediction learning.
- **Finding structure in the data:** e.g., representation learning.
- **Through trial and error:** e.g., control learning.

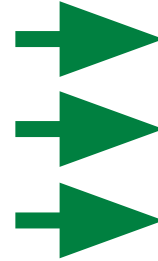
From Labeled Examples



Inputs



Learning System



Japan

Iceland

Argentina

Outputs

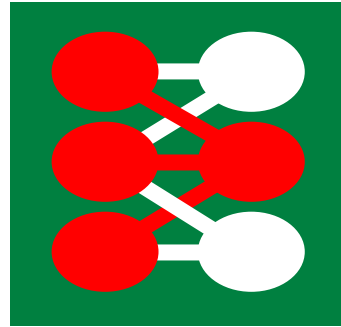
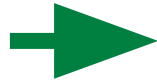
Prediction Learning.



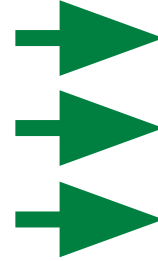
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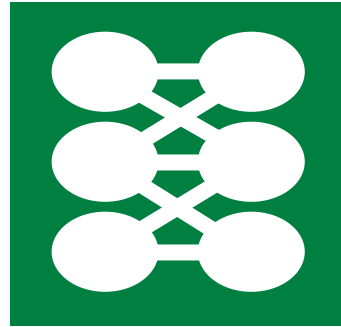
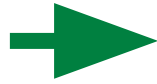
Prediction Learning.



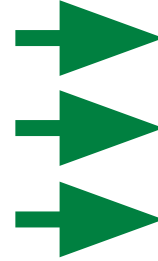
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Inputs



Learning System



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Outputs

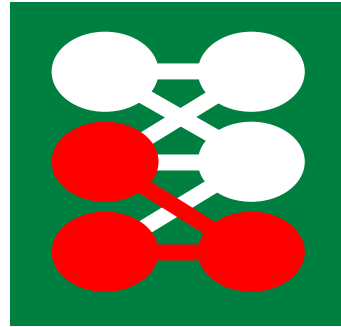
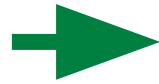
Prediction Learning.



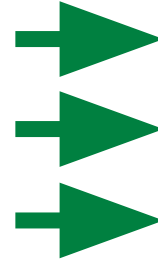
From Labeled Examples



Inputs



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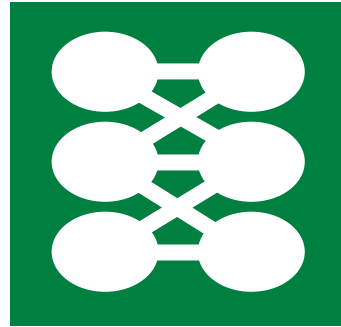
Prediction Learning.



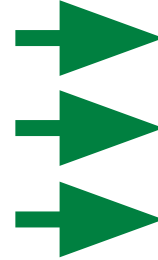
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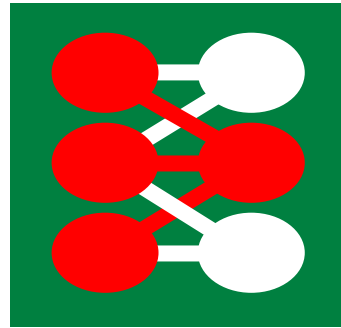
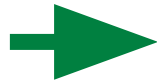
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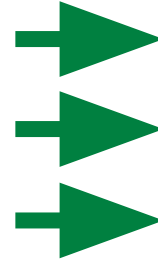
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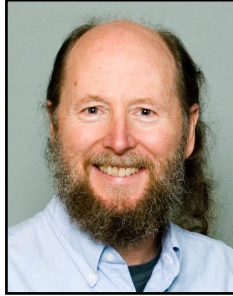
Prediction Learning.



Finding Structure in the Data



A



B

Make two groupings.

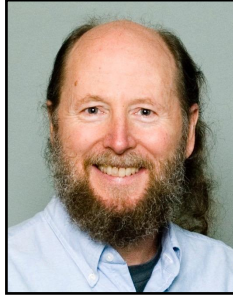
Representation Learning.



Finding Structure in the Data



A



B



C

Make two groupings.

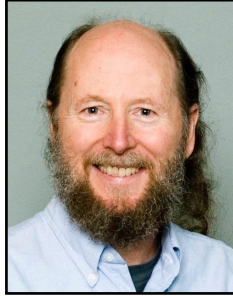
Representation Learning.



Finding Structure in the Data



A



B



C



D

Make two groupings.

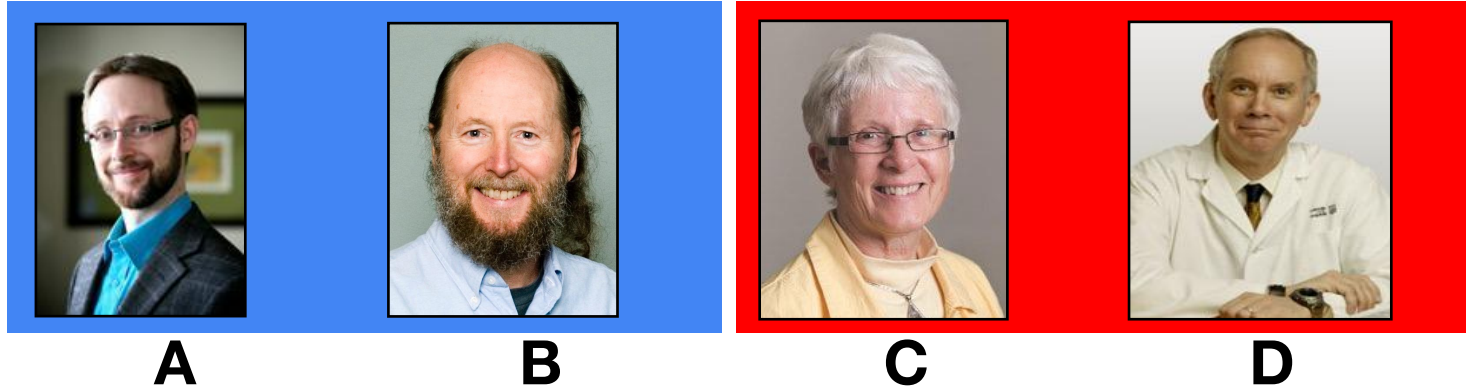
Representation Learning.



Finding Structure in the Data

Beards

No Beards



Make two groupings.

Representation Learning.



Finding Structure in the Data

No Visible Teeth



A

Visible Teeth



B



C

No Visible Teeth



D

Make two groupings.

Representation Learning.



Finding Structure in the Data

Not Patrick's Mother



A

Patrick's Mother



B



C

Not Patrick's Mother



D

Make two groupings.

Representation Learning.



Through Trial and Error

Volunteer



When to Learn



- **In real time:** during use; online learning.
- **From past experience:** offline or batch learning.

KEY IDEA

Many possible (*compatible and interchangeable*) ways for a machine to acquire and use knowledge.





*Demo
Time!*

Learning Objectives

1. Be able to talk about **artificial intelligence** (AI) and **machine learning** (ML);
2. Be able to share one or more **recent advances** in AI;
3. Have an understanding of **what, how,** and **when** machines might learn.

Learning Objectives

1. Be able to talk about **artificial intelligence** (AI) and **machine learning** (ML);
2. **Mystify** AI;
3. **Demystify** AI.

Next week:

- **What is that ChatGPT thing everyone is talking about?**
- **Does it actually work?**
- **It does?! Tell me how. (Without math plz.)**
- **What can it do?**
- **That might change life a bit, right?**

**Thank you,
and questions!**



Marvin from *HHGTTG*