Artificial General Intelligence for the Internet of Things

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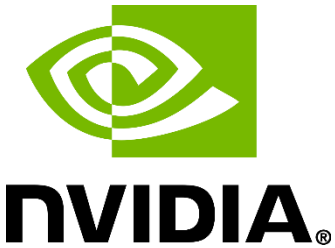
GTC San Jose
May 2017

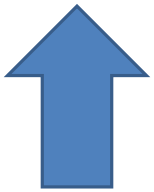


Internet of Things

Heterogeneous Systems

Resource Constraints

Higher-Order Intelligence



Distributed Intelligence

Deep Neural Networks

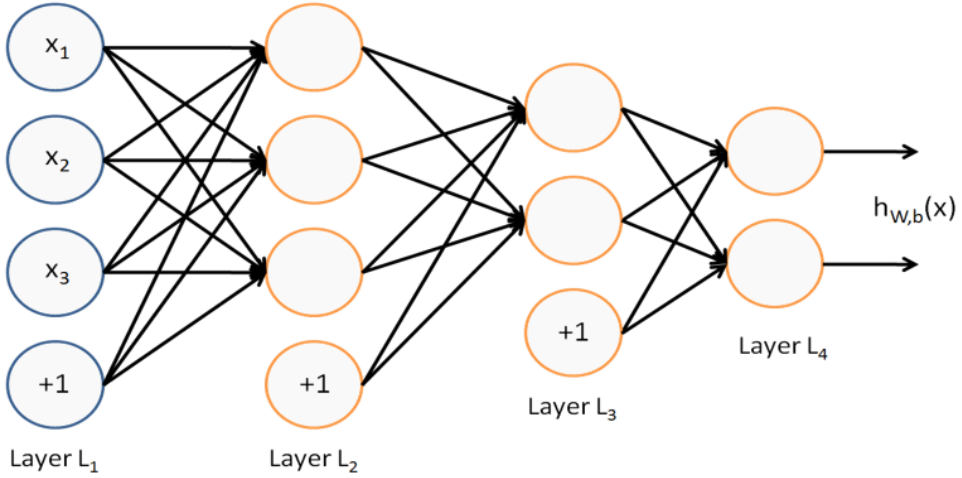
Reinforcement Learning

Machine Reasoning

Deep Learning

WHAT IS DEEP LEARNING?

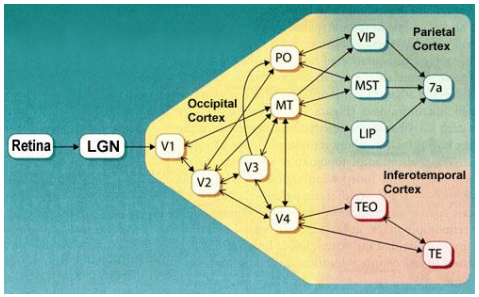
Biologically-inspired multi-layer neural networks



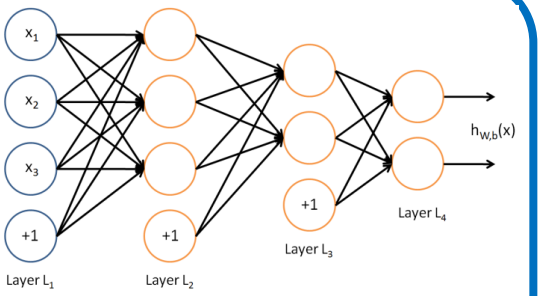
Deeper layers learn higher-order features

DEEP LEARNING FOR SENSOR NETWORKS

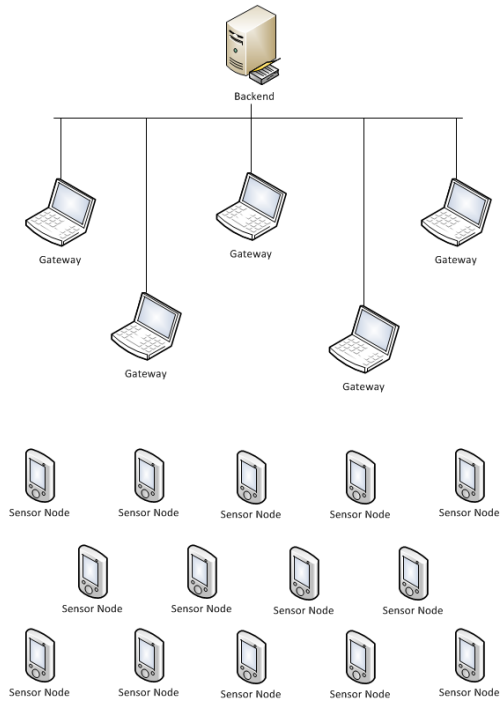
Sensor networks form the nervous system of smart cities.



Deep visual cortex



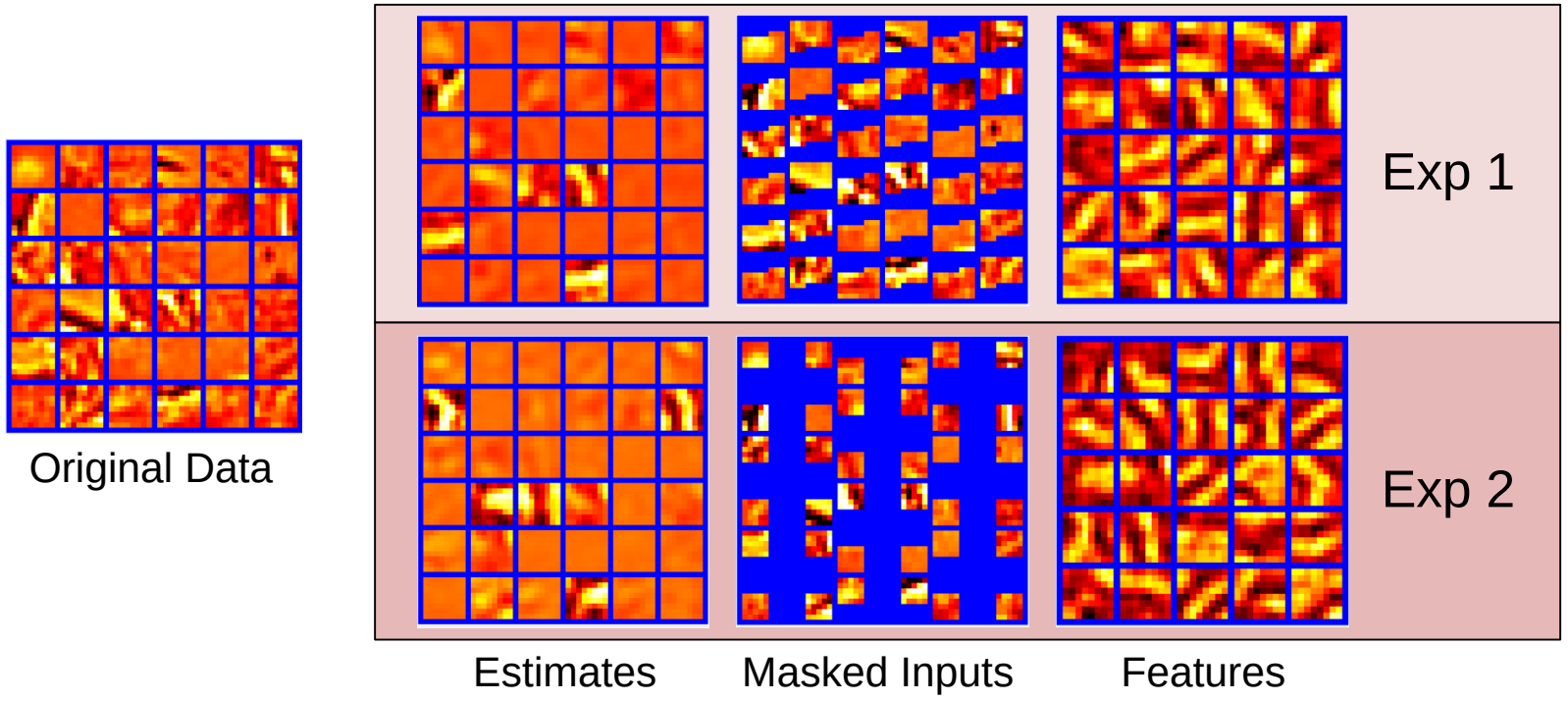
Deep learning



Sensor networks

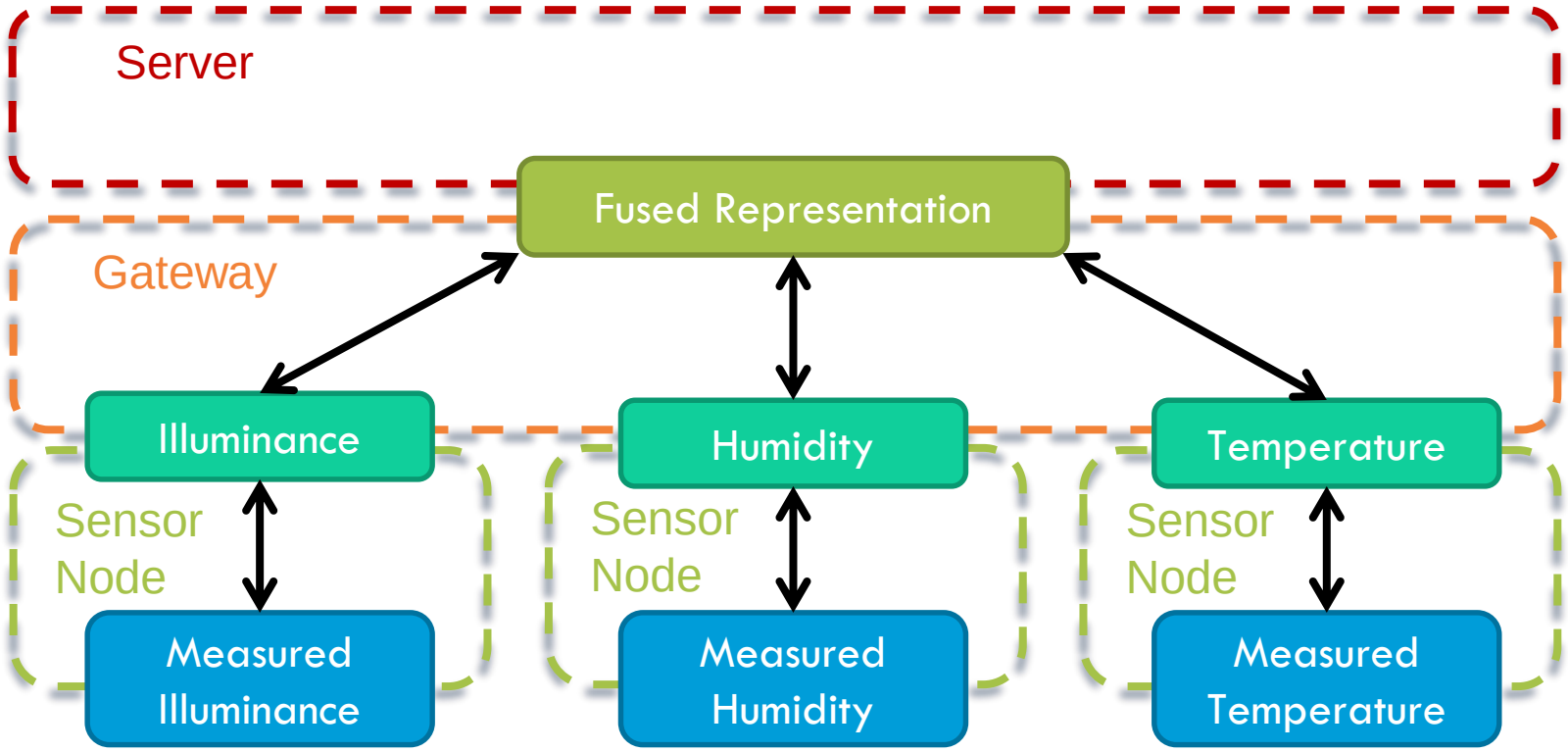
STRUCTURED MISSING DATA

Joint work with Liangze Wong, Daniel Chen, Huiling Chen (A*STAR)

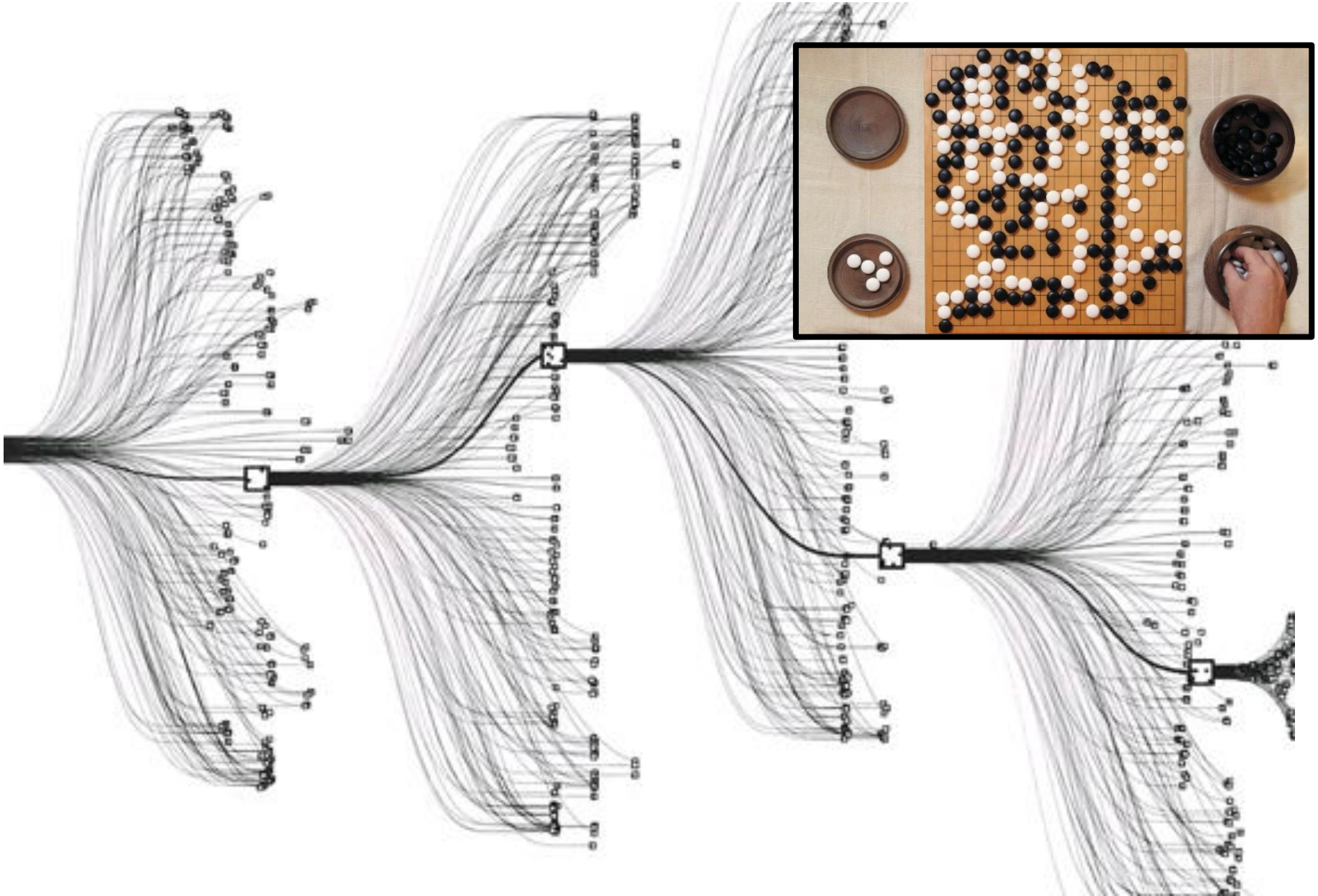


MULTIMODAL SENSOR FUSION

Joint work with Wenyu Zhang, Zuozhu Liu, Tony Quek



REINFORCEMENT LEARNING



How can the network learn to accomplish given tasks and distribute required steps while managing resources efficiently?

self-programming machines?

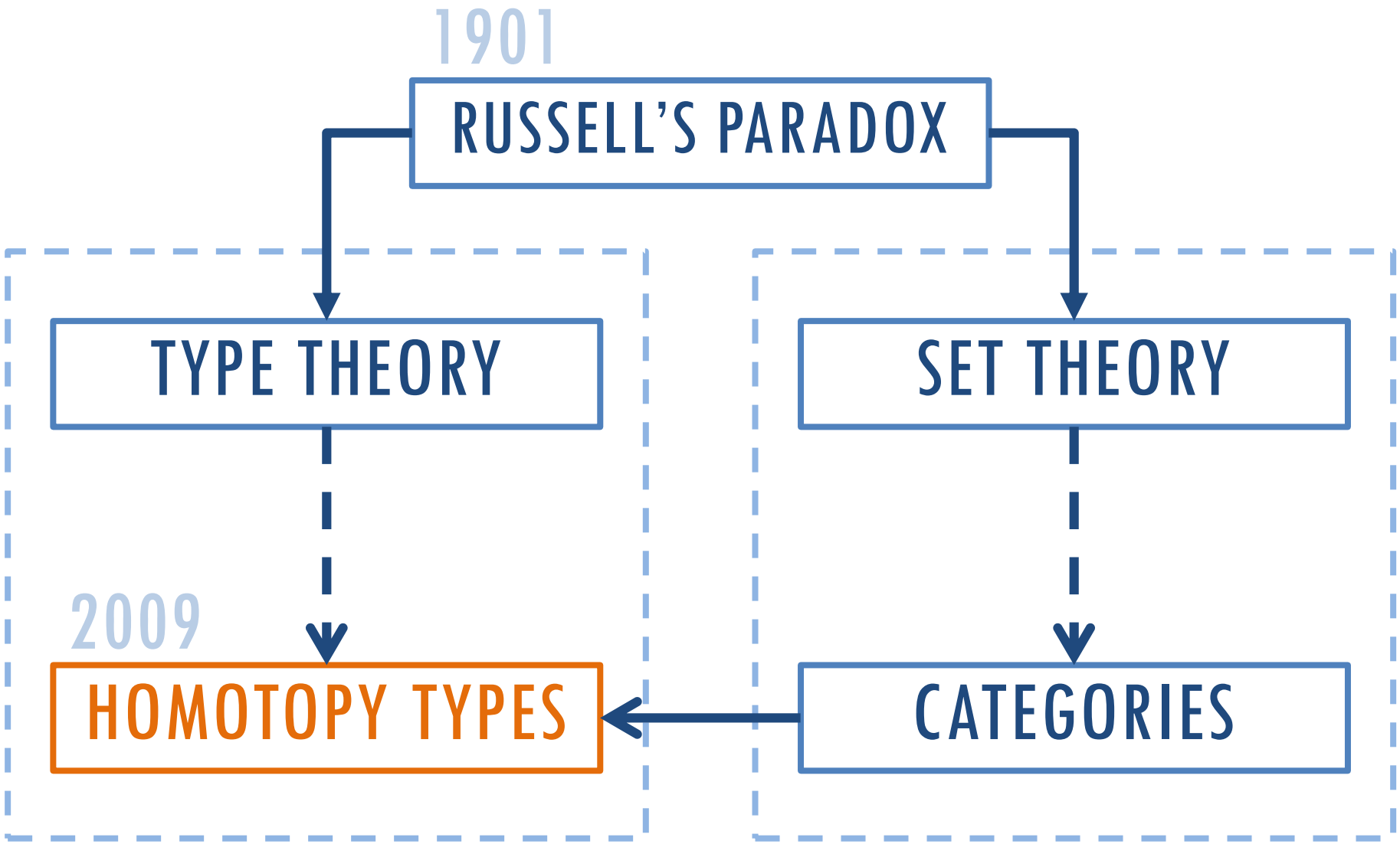
machine reasoning?

How can the network learn to accomplish given tasks and distribute required steps while managing resources efficiently?

what objective function should we use?

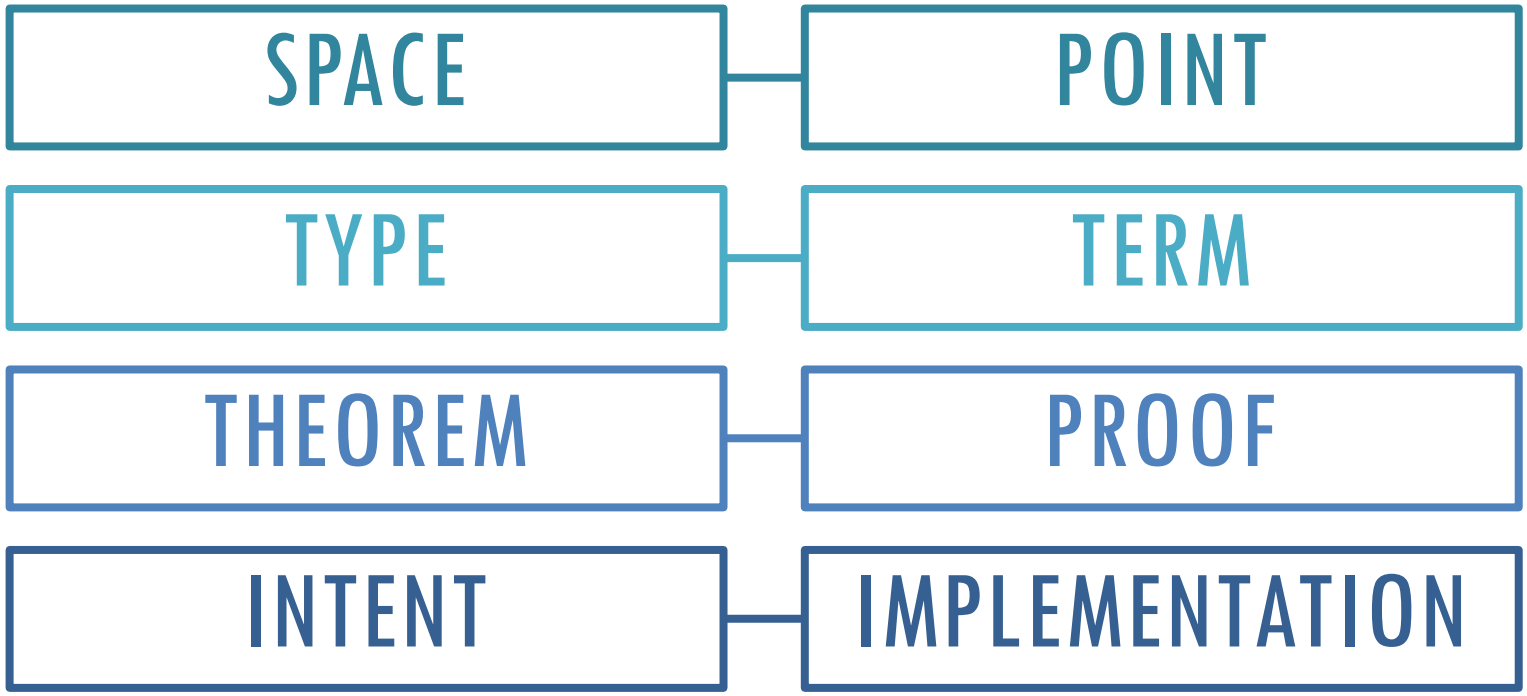
what is the action space?

Machine Reasoning

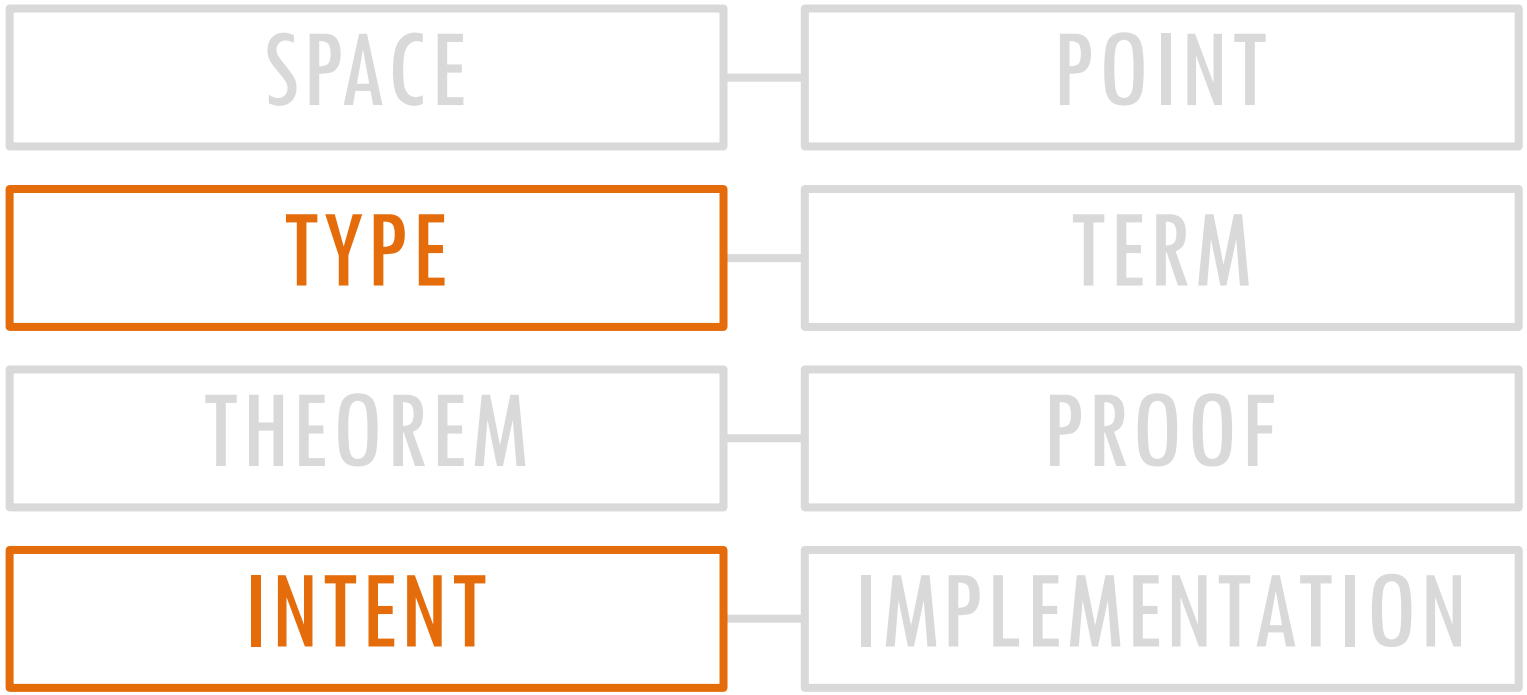

1901
RUSSELL'S PARADOX
TYPE THEORY
SET THEORY
2009
HOMOTOPY TYPES
CATEGORIES


Univalent Fo
Homotopy
Vladimir Voevodsky

CURRY-HOWARD CORRESPONDENCE



CURRY-HOWARD CORRESPONDENCE



Traditional Programming

```
for (int i = 1; i <= 10; i++) {
   System.out.println("the number is " + i);
}
```

Intentional Programming

```
<<print the numbers 1 to 10>>
```

```
<<print elements of list>>
(<<list with numbers 1 to 10>>)
```

INTENT AS A TYPE

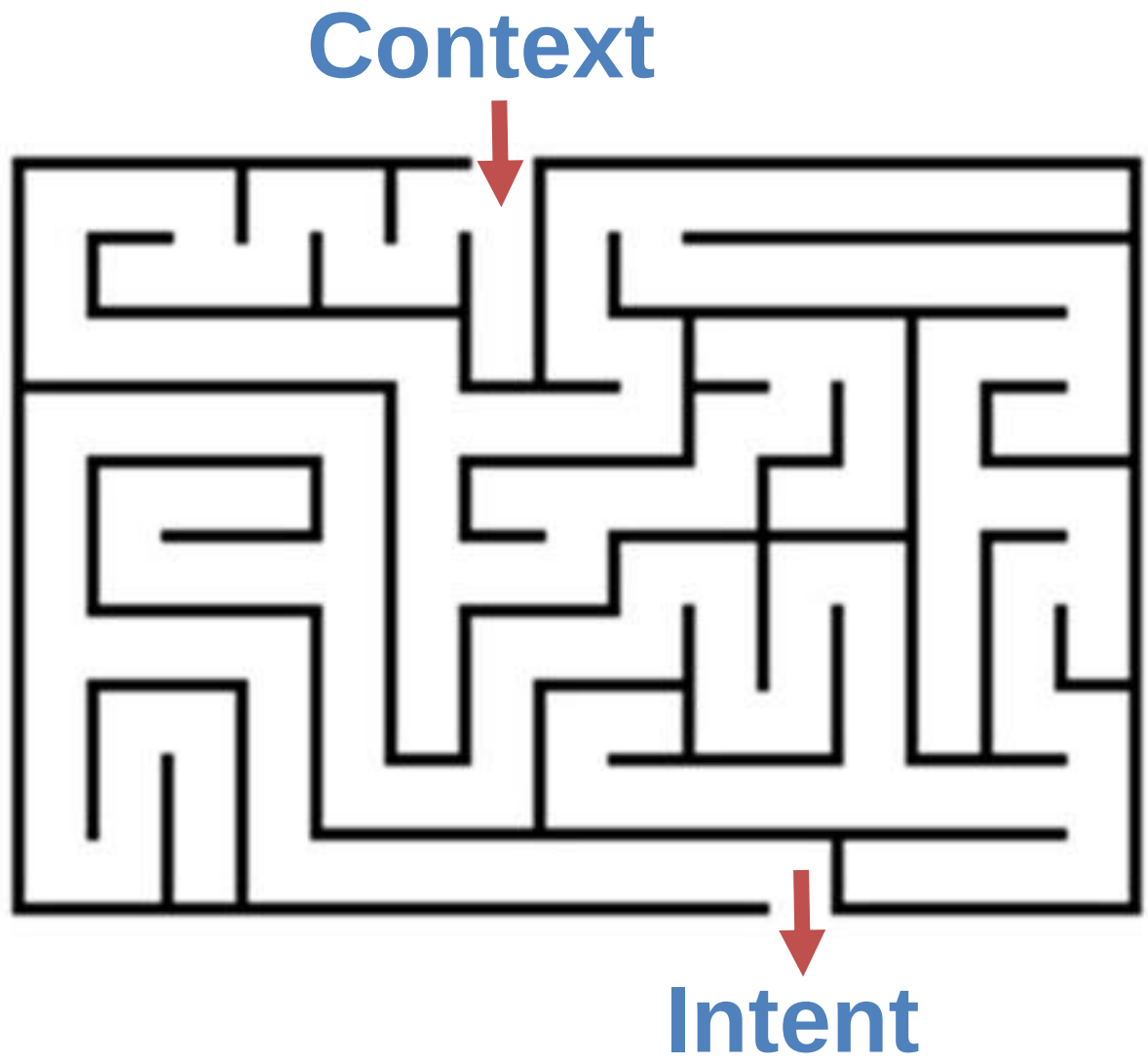
Poor Type System

$$\text{sort}: \text{list nat} \to \text{list nat}$$

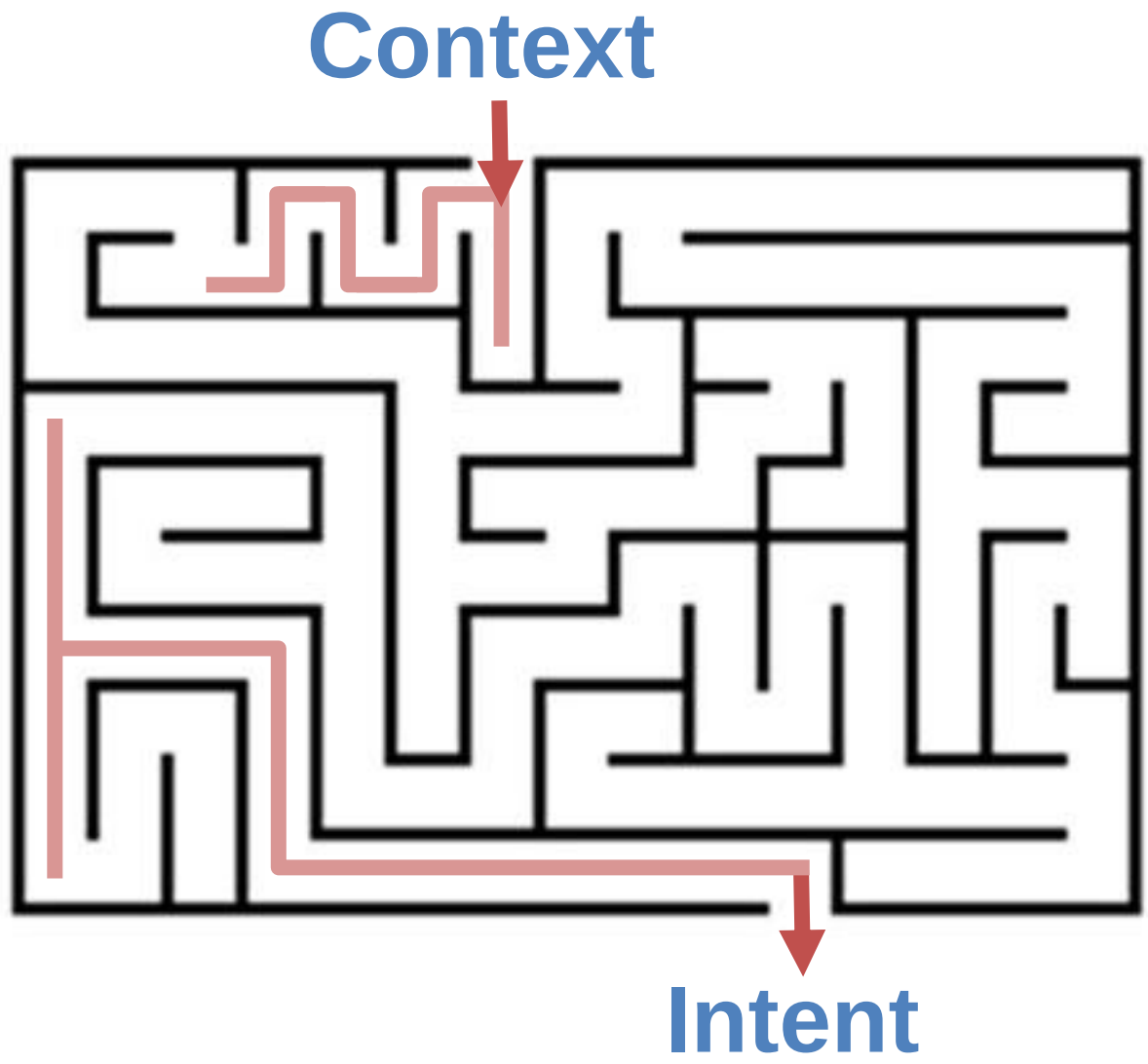
Rich Type System

$$\text{sort}: \forall\ (\ell : \text{list nat}), \{\ell' : \text{list nat} \mid \text{sorted}\ \ell' \wedge \text{same\_elements}\ \ell\ \ell'\}$$

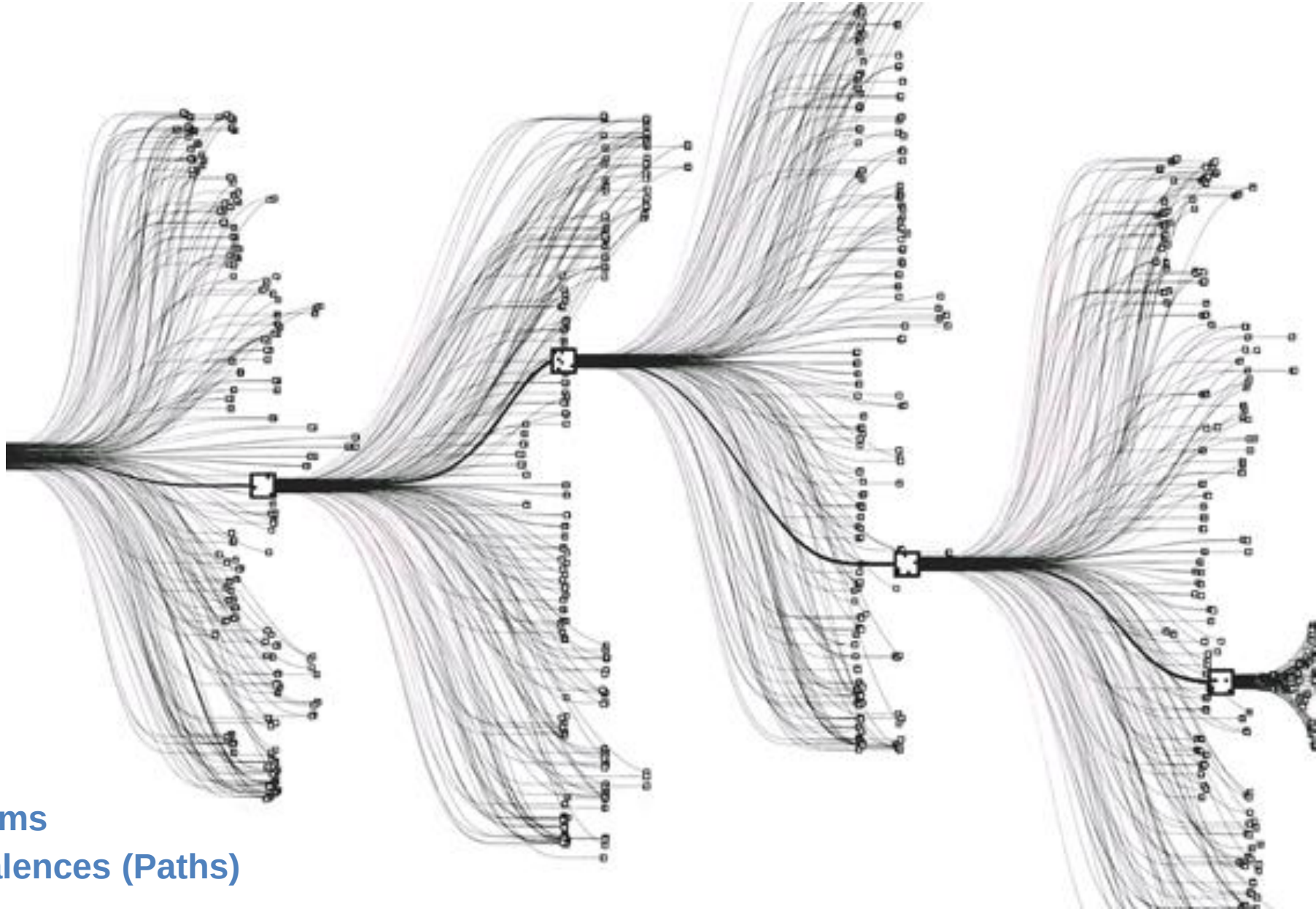
FINDING IMPLEMENTATIONS FOR INTENTS



EQUIVALENT PROBLEMS THROUGH PATHS

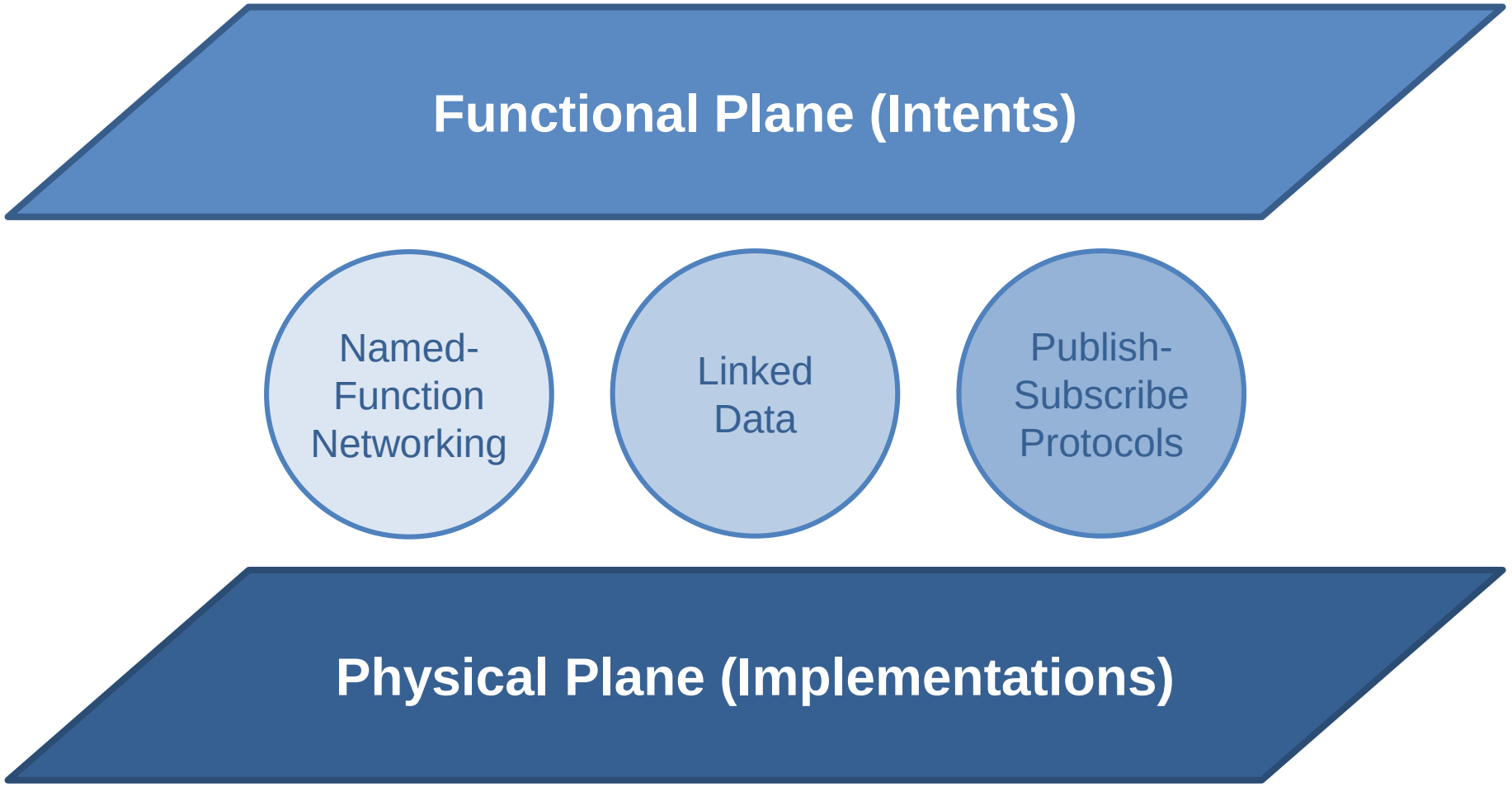


INTUITION FOR PROBLEM-SOLVING

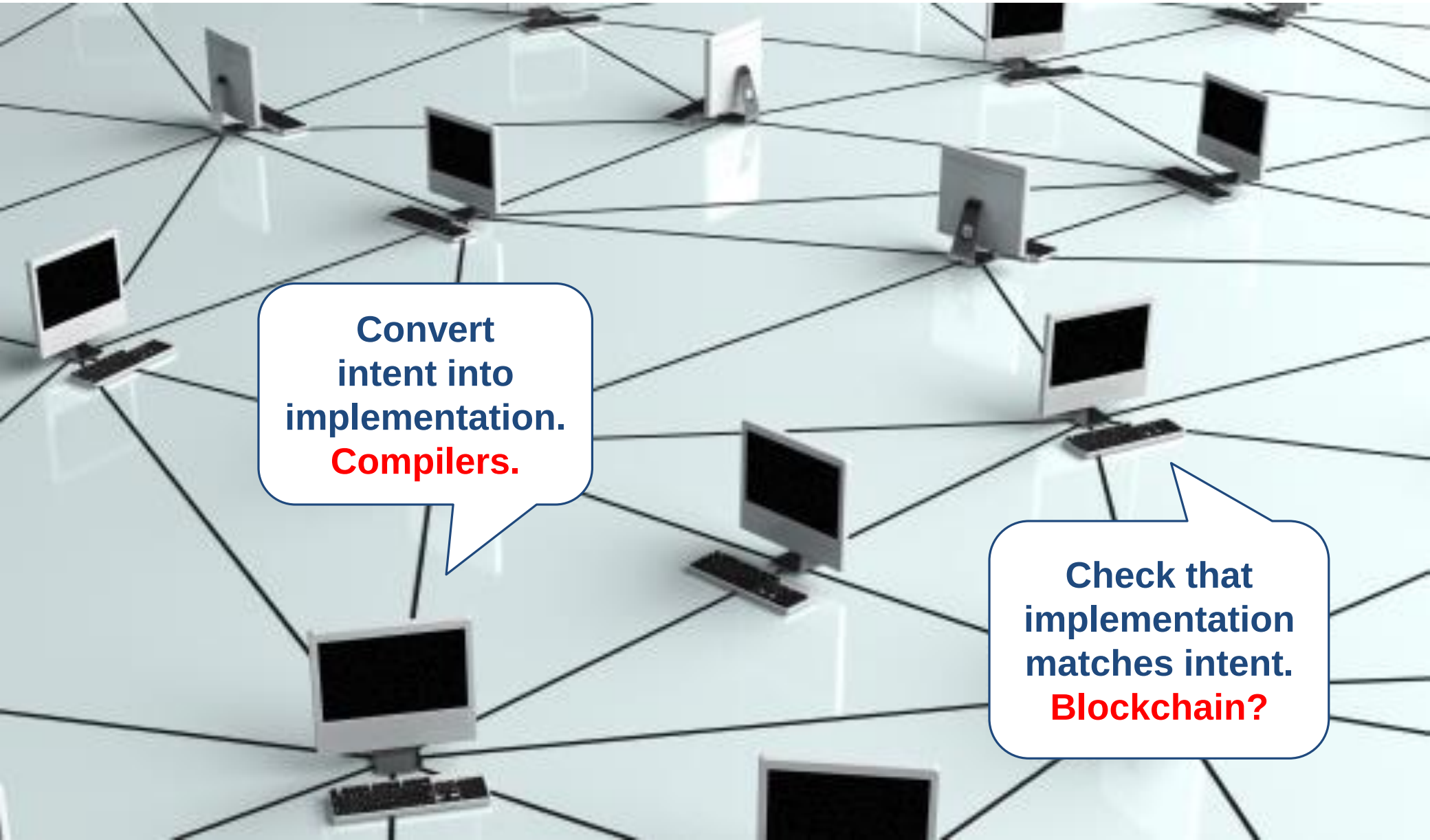


- Problems
- Equivalences (Paths)

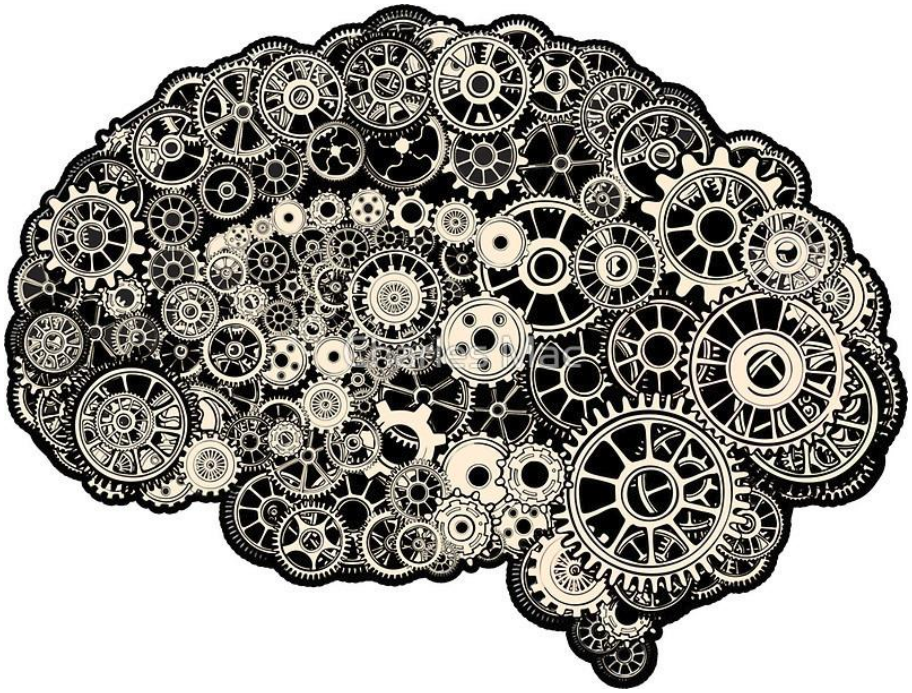
INTERNET OF THINGS



CRITICAL SERVICES



THANK YOU



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