THE UNIVERSITY
of ADELAIDE

Faculty of SET / School of Computer Science

TECH 1004 AI Technologies
What is AI?

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seek LIGHT

Review

- Key Course Information
- What is AI
- What can AI do
- Brief history of AI
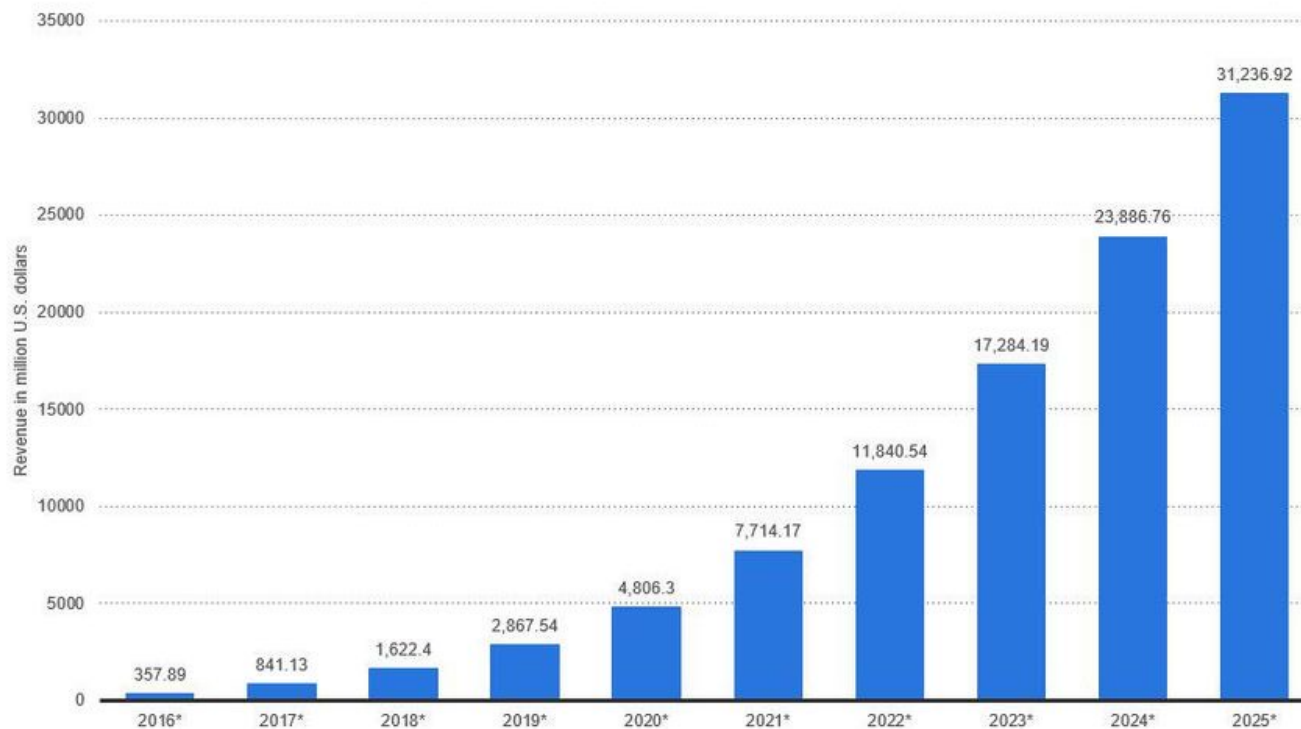- Finish the quiz on MyUni

Outline

- Trend in AI
- Agent
- Strong vs Weak AI
- Symbolic AI vs Connectionist AI

AI Trend-Enterprise Revenues

Enterprise artificial intelligence market revenue worldwide 2016-2025
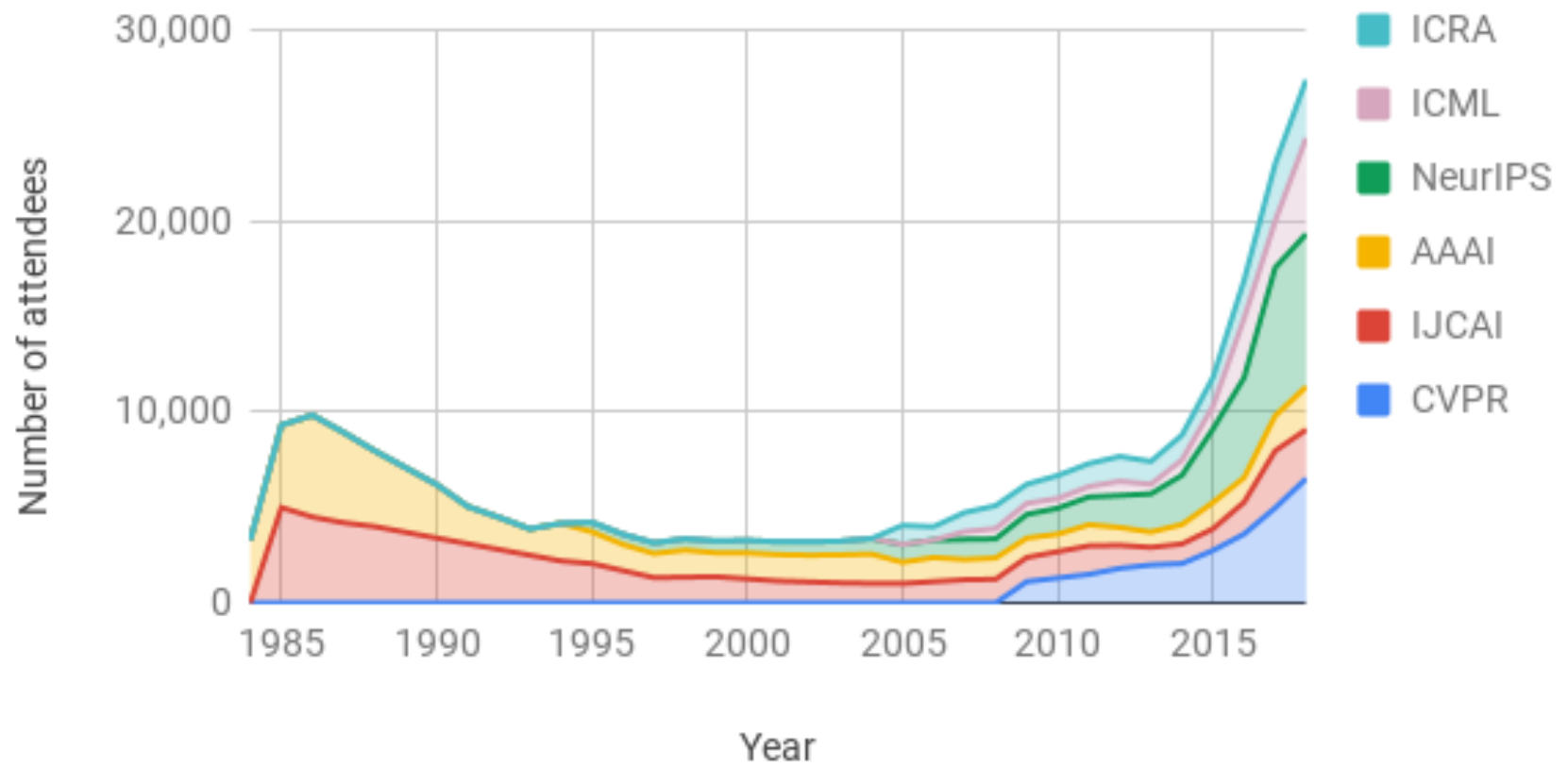
Revenues from the artificial intelligence for enterprise applications market worldwide, from 2016 to 2025 (in million U.S. dollars)
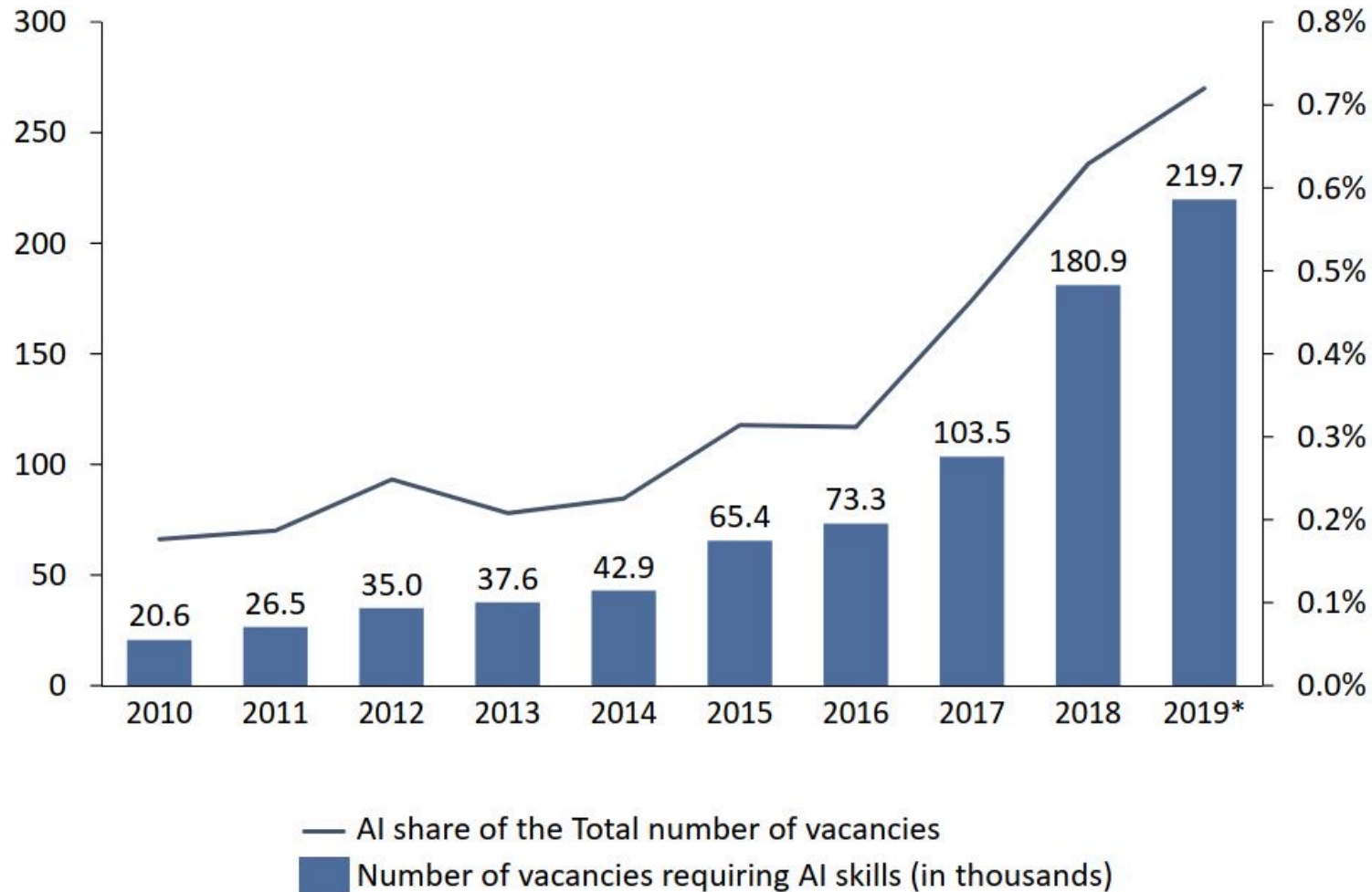
AI Trend- Research

Attendance at large conferences (1984-2018)

Source: Conference provided data

AI Trend- Demand for AI skills (US)

Legend:
— AI share of the Total number of vacancies
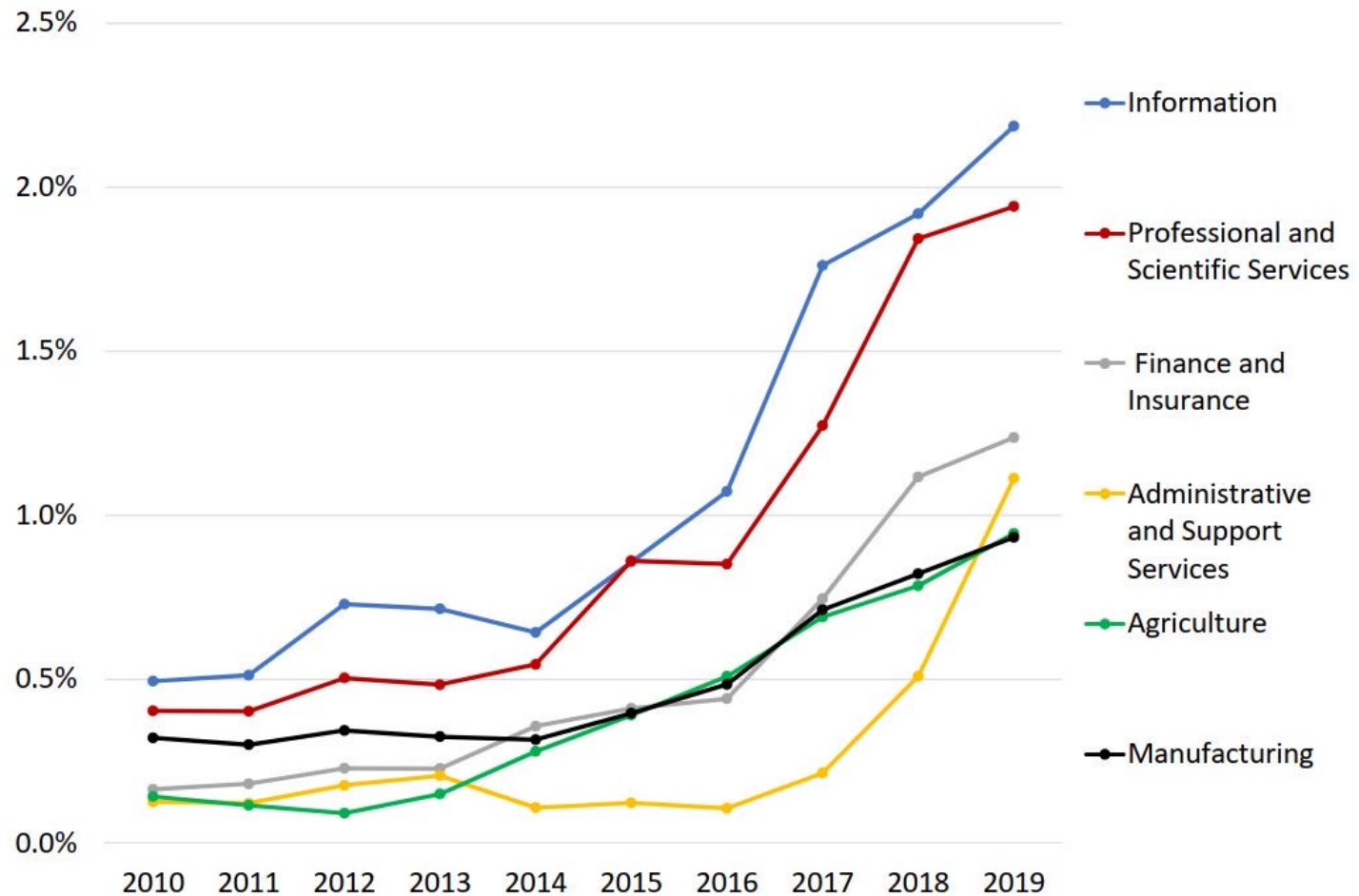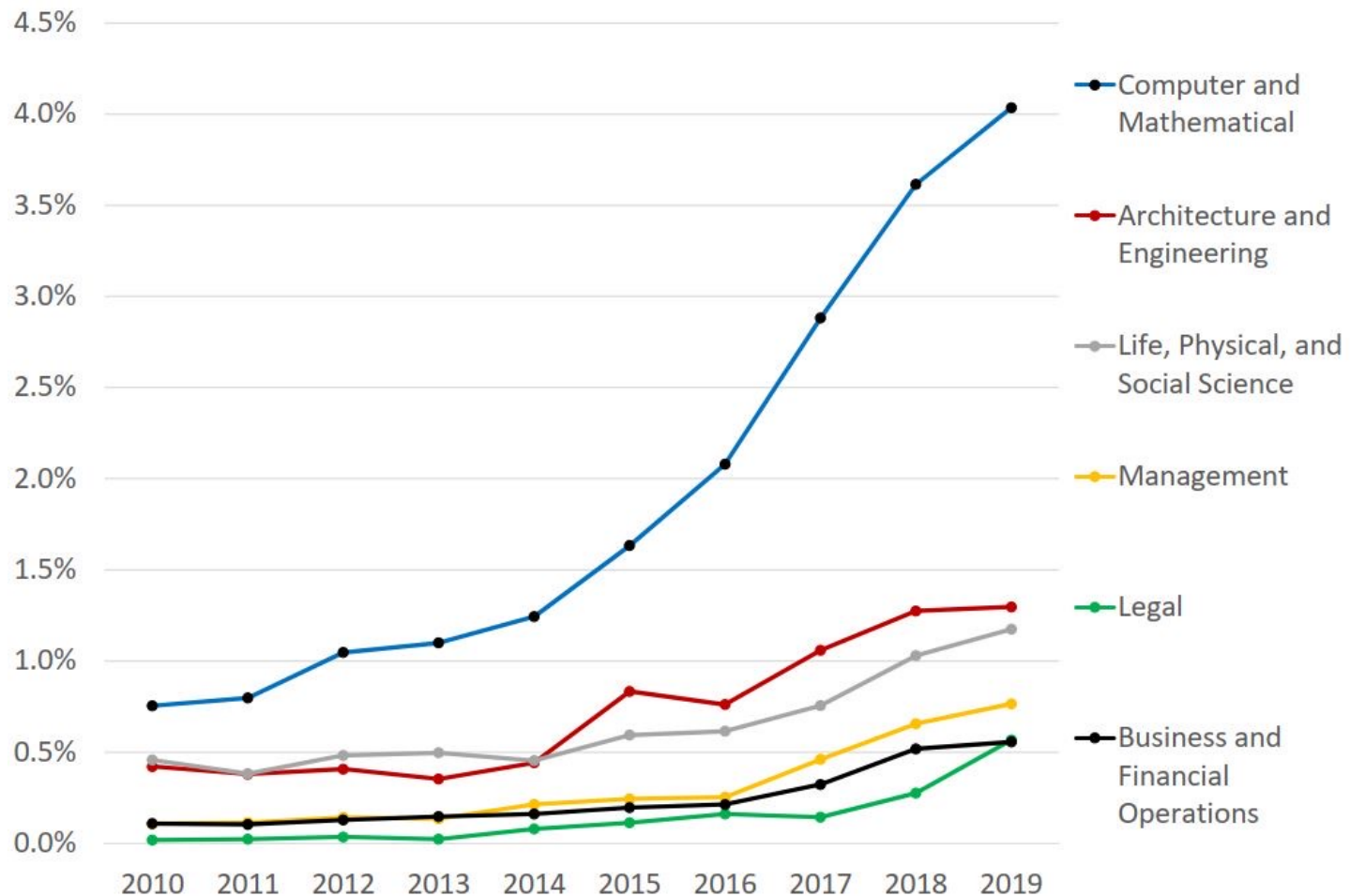▪ Number of vacancies requiring AI skills (in thousands)

Source from Alekseeva et al. (2020), CEPR

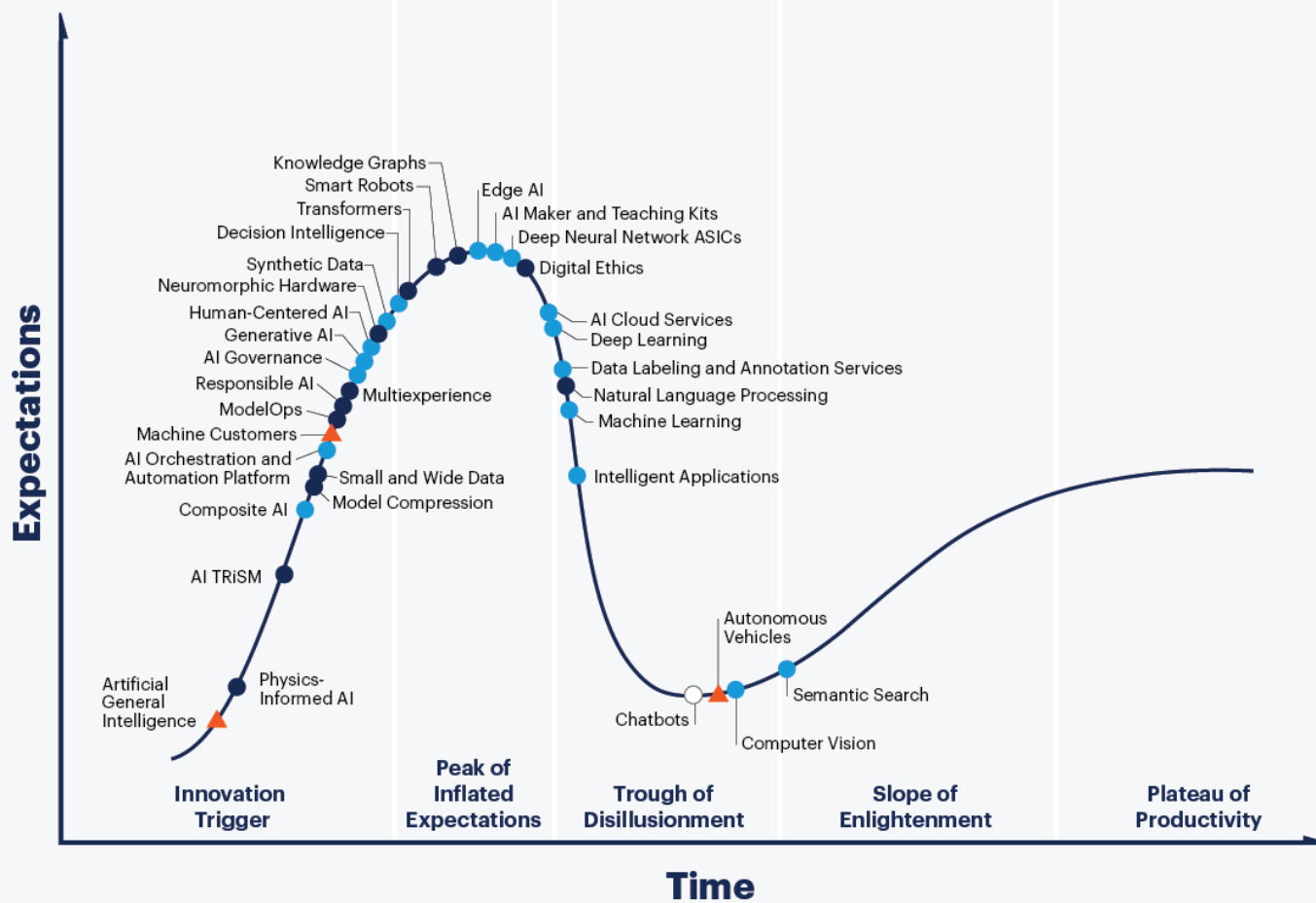# Demand for AI Skills across Industries

Source from Alekseeva et al. (2020), CEPR

Demand for AI Skills across Occupations

Source from Alekseeva et al. (2020), CEPR

Hype Cycle for Artificial Intelligence, 2021

Agent

Agent

- In AI, an agent is anything that is **capable of acting** <u>upon information that it perceives from its environment</u>.

- An agent acts intelligently if:
  - its actions are appropriate for its goals and circumstances;
  - it is flexible to changing environments and goals;
  - it learns from experience;
  - it makes appropriate choices.

Rational Agent

- For each possible percept sequence, a rational agent should **select an action** that is expected to **maximize its performance measure**, given the evidence provided by **the percept sequence** and whatever **built--in/prior knowledge** the agent has.

Agent and Environment
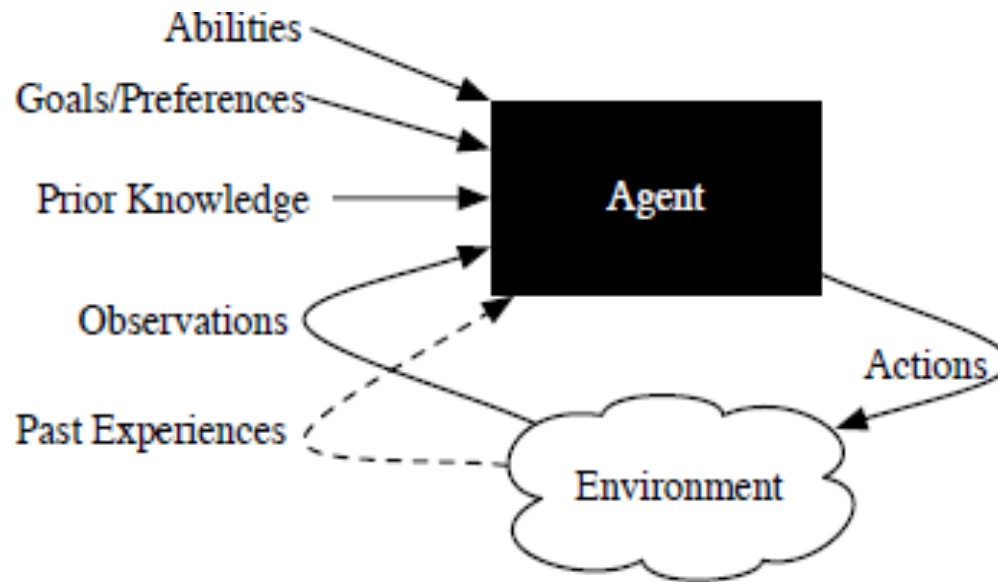
Figure: A very general illustration of an agent acting in an environment

Inputs to an Agent

Goal: 8.2m

Leave the bedroom, and enter the kitchen. Walk forward, and take a left at the couch. Stop in front of the window.

An agent depends on its:
- Abilities:
    - primitive actions it is capable of carrying out
- Goals/preferences:
    - that it must try to achieve or preferences over states of the world
- Prior knowledge:
    - of the agent and about the environment
- History of interaction with the environment:
    - current observations – what it observes now
    - past experiences – what it has observed in the past

Uncertainty

Uncertainty

- Predictions are based on the probability
- Types of uncertainty:
  - definitive predictions: it will rain tomorrow;
  - disjunctions: turn left or stop;
  - point probabilities: the probability of rain tomorrow is 2%;
  - probability ranges: it will rain with probability in the range: [0.01, 0.34].

Uncertainty-Why Probability?

- Probabilities help an agent to
  - predict the chance that an event will happen
  - make the best decision among a set of options.
- Probabilities can be learnt from data and prior knowledge.

Sensing Uncertainty

- For an agent, the state of the world can be either **fully-observable** or **partially-observable**.

- Fully-observable is when the agent knows the state of the world from direct observations.

- Partially-observable is when the agent does not directly observe the state of the world; observations can be noisy or many possible states can result in the same observation.

Computational Limitations

- Sometimes an agent can decide on its best action quickly.
- However, often there are computational resource limitations that determine the best action.
- Perfect rationality, where an agent reasons about the best action without taking into account its limited computational resources.
- Bounded rationality, where an agent decides on the best action it can find given its limited computational resources.
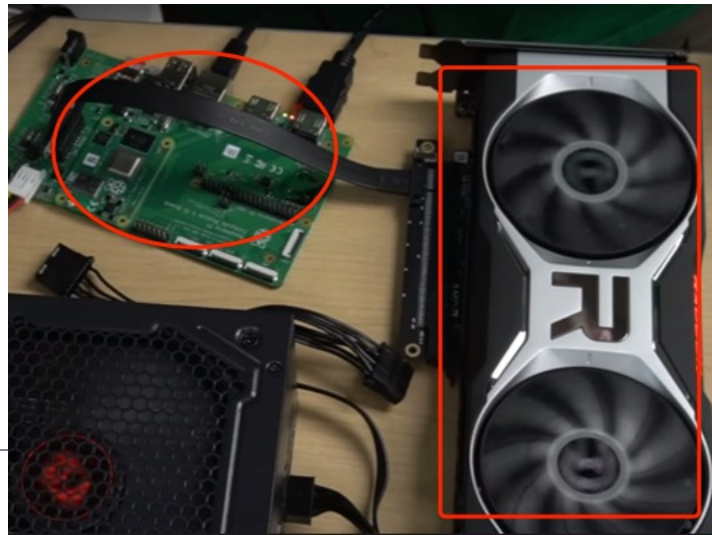
Strong vs Weak AI

Strong AI or Weak AI?

- **Turing Test**: if a system in which humans are unable to distinguish between a human and a machine, it is strong AI.

- **ELIZA**: a computer program that uses primitive natural language processing techniques and "simulates" a Rogerian **psychotherapist**. By Prof. Joseph Weizenbaum

  - Input sentences are analyzed on the basis of decomposition rules which are triggered by key words appearing in the input text.

  - Responses are generated by reassembly rules associated with selected decomposition rules.

  - **ELIZA passes the Turing Test**: program was able to fool some people into believing that they were talking to a real person.

ELIZA: Example Dialogue

Men are all alike.

IN WHAT WAY?

They're always bugging us about something or other.

CAN YOU THINK OF A SPECIFIC EXAMPLE?

Well, my boyfriend made me come here.

YOUR BOYFRIEND MADE YOU COME HERE?

He says I'm depressed much of the time.

I AM SORRY TO HEAR YOU ARE DEPRESSED.

It's true.
I am unhappy.

(The capitalized lines are machine responses)

```python
pairs = (
    (
        r"I need (.*)",
        (
            "Why do you need %1?",
            "Would it really help you to get %1?",
            "Are you sure you need %1?",
        ),
    ),
    (
        r"Why don\'t you (.*)",
        (
            "Do you really think I don't %1?",
            "Perhaps eventually I will %1.",
            "Do you really want me to %1?",
        ),
    ),
    (
        r"Why can\'t I (.*)",
        (
            "Do you think you should be able to %1?",
            "If you could %1, what would you do?",
            "I don't know -- why can't you %1?",
            "Have you really tried?",
        ),
    ),
    (
        r"I can\'t (.*)",
        (
            "How do you know you can't %1?",
            "Perhaps you could %1 if you tried.",
            "What would it take for you to %1?",
        ),
    ),
    (
        r"I am (.*)",
        (
            "Did you come to me because you are %1?",
            "How long have you been %1?",
            "How do you feel about being %1?",
        ),
    ),
    (
        r"I\'m (.*)",
        (
            "How does being %1 make you feel?",
```

```python
reflections = {
    "i am": "you are",
    "i was": "you were",
    "i": "you",
    "i'm": "you are",
    "i'd": "you would",
    "i've": "you have",
    "i'll": "you will",
    "my": "your",
    "you are": "I am",
    "you were": "I was",
    "you've": "I have",
    "you'll": "I will",
    "your": "my",
    "yours": "mine",
    "you": "me",
    "me": "you",
}
```

NLTK

Loebner Prize

- The Loebner Prize is an annual competition in AI that awards prizes to the chatbot considered by the judges to be the most human-like.
- The contest was launched in 1990 by Hugh Loebner
- The setting of the competition is similar to the Turing Test.
- Defunct since 2020
- https://en.wikipedia.org/wiki/Loebner_Prize

Strong AI

- Strong AI requires to do the following things:
  - reason, solve puzzles, make judgement under uncertainty
  - represent knowledge, including commonsense knowledge
  - plan
  - learn
  - communicate in natural language
- and relies on the following features:
  - consciousness
  - self-awareness
  - sentience
  - sapience

Weak AI

- Weak AI
  - not intended to display human-like intelligence in general
  - only simulates human behavior
  - typically focuses on a narrow task (e.g. playing chess)
- A lot of weak AI is based on rules:
  e.g., rule-based expert systems, rule-based categorization
- Recently, greater focus on machine learning:
  - clustering (grouping similar items together)
  - categorisation (of text, images, audios,...).
  - recognition (speech, gesture, handwriting,...)
  - autonomous performance (robots, cars,...)

Strong vs Weak AI

Discussion

- Have we achieved Strong AI?
- Do we really need Strong AI?

Strong vs Weak AI

"Australian startups generated 300 times less funding than Israeli and Canadian startups." according to AustCyber. It's not just that Israel and Canada have invested far more than Australia, it's that their strategy is completely different. In Israel the government investment fund aims to have a success rate of less than 6%. If more than 6% of their investments succeed they increase their risk apatite. This means they are not competing with commercial VC, and tha[t] new founders and big ideas. It's a a long-term i[nvestment] that drives the commercial outcomes they coul[d]

Chalmers Ed Husic MP Dr. Michael G. Kollo Cr[...]
https://lnkd.in/gDTZxCxd

"The Digital Intelligence Index ranks Australia 88th of the 90 countries analysed when it comes to our speed of improvement. The only two countries slower than Australia are Hungary and Nigeria".
Marek Kowalkiewicz, Kym Schutz, Jim Chalmers

Did someone drop a zero? Australia's digital economy budget spend should be 10 times bigger
theconversation.com · 4 min read

Symbolic AI vs Connectionist AI

Symbolic AI vs Connectionist AI

- Symbolic AI refers to the fact that all steps are based on symbolic **human readable representations** of the problem that use **logic and search** to solve problem.
  - Other names: "classical AI," "rule-based AI," and "good old-fashioned AI."

- Connectionist AI refers to a computational system is built to simulates how **human brain** works and its complex network of interconnected neurons.

Symbolic AI

- In the Symbolic approach, AI applications process strings of characters that represent real-world **entities** or **concepts**. Symbols can be **arranged in structures such as lists, hierarchies, or networks** and these structures **show how symbols relate to each other**.
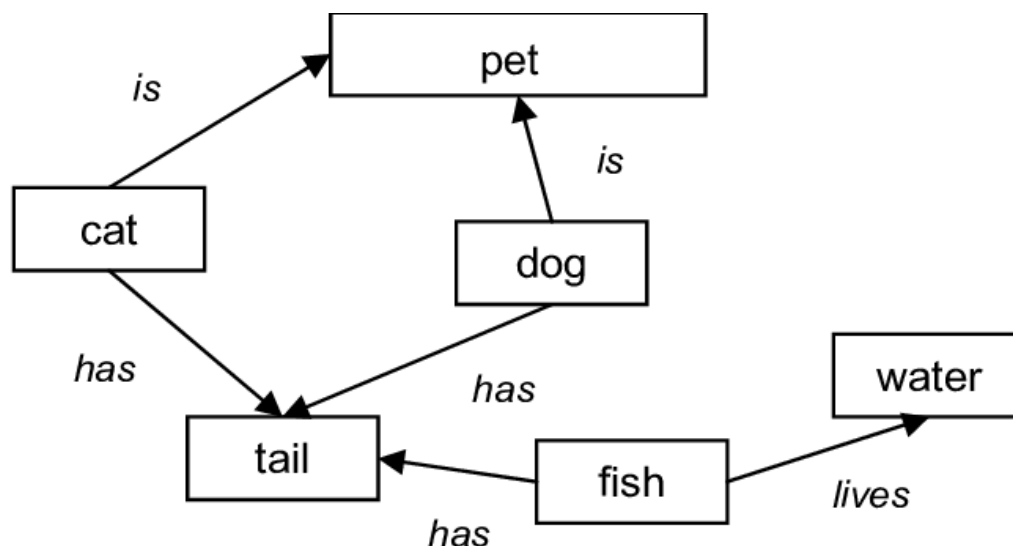

One example of symbolic approaches is Semantic Web (Lula et al 2014)

Symbolic AI

- Advantage: A Symbolic approach offers good performances in reasoning, is able to give explanations and can manipulate complex data structures.

- Disadvantage: For learning process – the rules and knowledge has to be **hand coded** which is a hard problem.
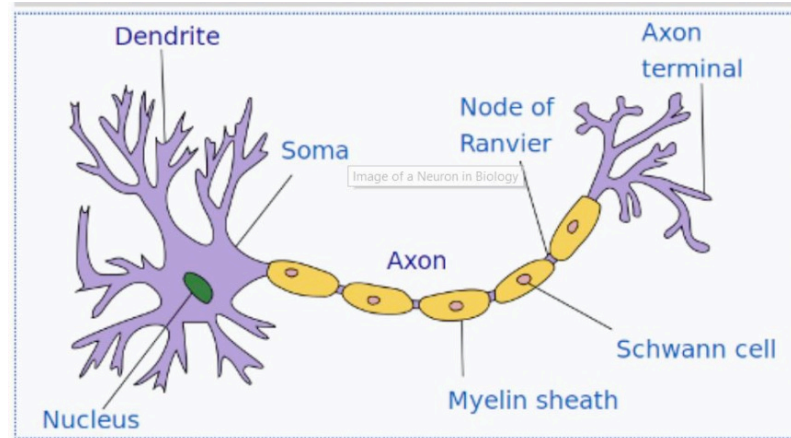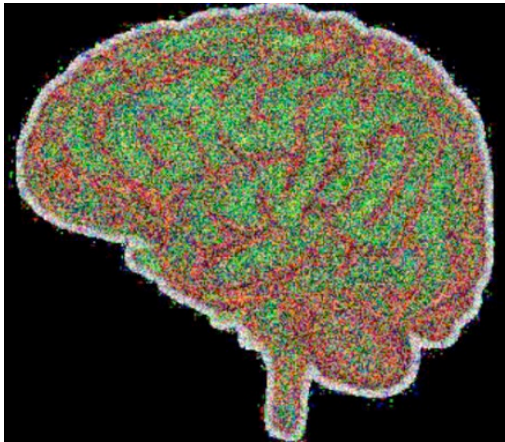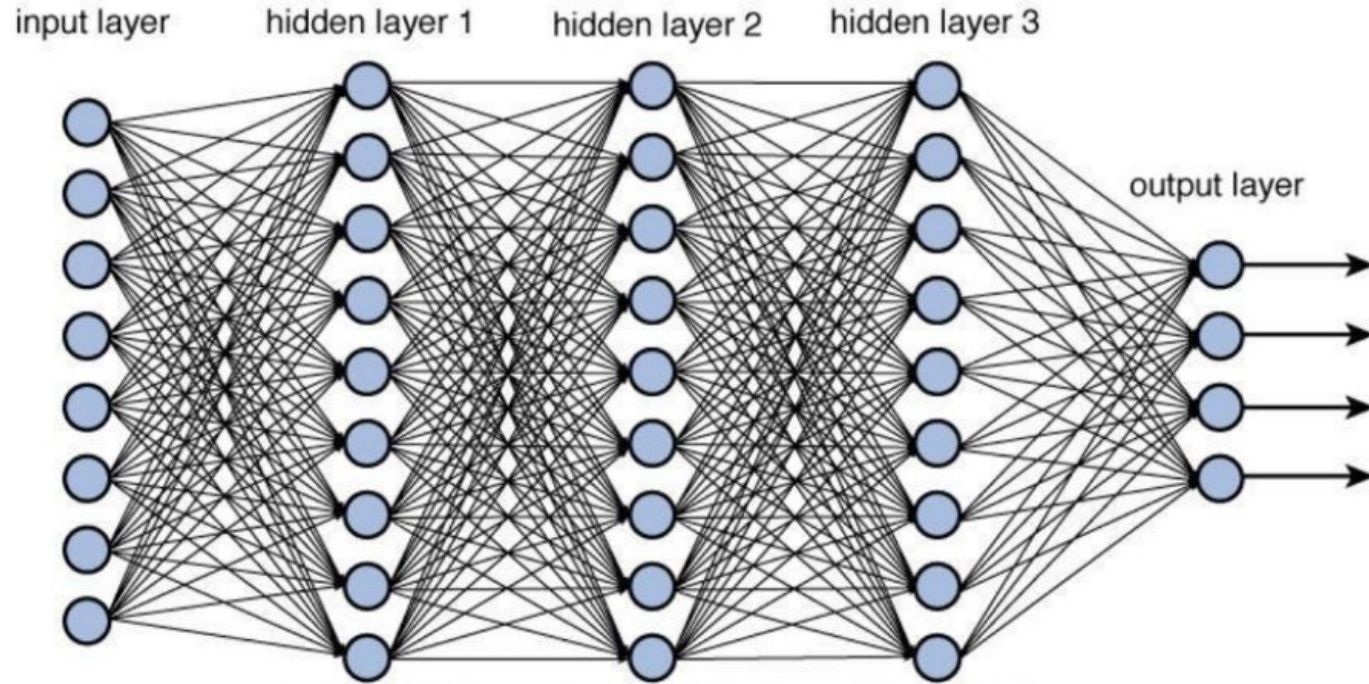
Connectionist AI

- Connectionist models refer to those **bio-inspired networks** composed of a large number of homogenous units and weighted connections among them, analogous to **neurons** and **synapses** in brains.
  - Also named "Non-symbolic AI"
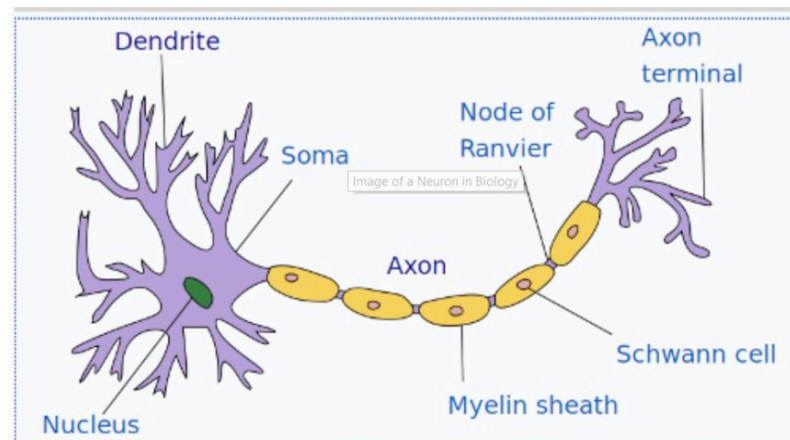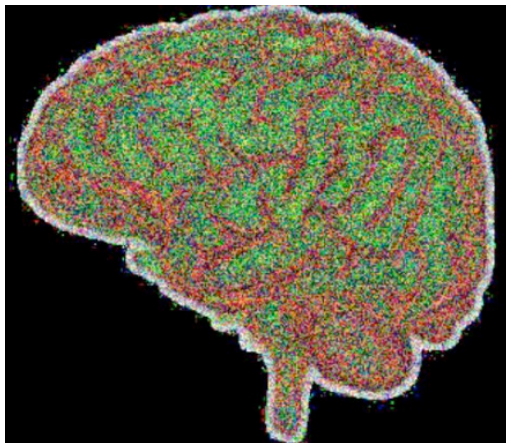
Deep Neural Network

Connectionist AI

- Key advantages: The strengths of the connections AI are that **they can deal with messy and unstructured data**; analyze and construct its own **implicit knowledge from raw data**; and **update the knowledge dynamically** by new training data.

- Key disadvantage: difficult to understand how the system came to a conclusion.

Symbolic AI vs Connectionist AI

	Symbolic	**Connectionist**
Representation	Discrete, e.g., strings, graph	Continuous, e.g., vectors, matrices, tensors.
Computation	Logical reasoning or symbolic operation	Differentiable operation, e.g., gradient descent
Knowledge	Propositions, rules, n-tuples in the form of logical expressions	Parameters in NN

Take-Home Messages

- Artificial Intelligence is concerned with the development of programs that enable computers to display behavior that can broadly be characterized as intelligent.

- An agent is an entity that acts in an environment.

- Agents need to act even if they are uncertain.

- Agents might have different kinds of goals and preferences.

Take-Home Messages

- Strong AI claims that a machine can be programmed to actually be a mind.

- Weak AI claims that a machine can be programmed to simulate (some forms of) human intelligence.

- Turing Test canot not directly test whether the computer behaves intelligently; it can tests only whether the computer can mimic human responses under specific conditions.

- Combining the Symbolic AI vs Connectionist AI would achieve better AI.

Acknowledgement

- Some slides are adapted from COMP 329, MQ by Dr. Jia Wu.