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# The History of Artificial Intelligence

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# Learning outcomes

At the end of this module, you should be able to:

- Discuss key eras of the development of artificial intelligence.
- Apply lessons from the past to discussions in the present.
- Make new links between the way we currently build AI, and the effects it has on the people that use it



# Related reading

The Wikipedia entry [History of Artificial Intelligence](https://en.wikipedia.org/wiki/History_of_artificial_intelligence).

[https://en.wikipedia.org/wiki/History of artificial intelligence](https://en.wikipedia.org/wiki/History_of_artificial_intelligence)

[Computer Science Communities: Who is Speaking, and Who is Listening to the Women? Using an Ethics of Care to Promote Diverse Voices \(Links to an external site.\)](https://arxiv.org/abs/2101.07463) Marc Cheong, Kobi Leins, Simon Coghlan. In the ACM Conference on Fairness, Accountability, and Transparency (Facct 2021), 2021. <https://arxiv.org/abs/2101.07463>



# Outline

1. Overview of the history of artificial intelligence
2. *The Golden Era of Artificial Intelligence*
3. Who are the key players and who are not?
4. How our history shapes artificial intelligence and some things we can do about it



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# Overview of the history of AI



# Quiz

What year was the first *programmable computer* built?

- A. 87 BCE
- B. 1642
- C. 1805
- D. 1837
- E. 1943
- F. 1951



# Quiz

What year was the first *programmable computer* built?

- A. 87 BCE Antikythera mechanism
- B. 1642 Pascaline
- C. 1805 Jacquard machine
- D. 1837 Analytical Engine
- E. 1943 Colossus
- F. 1951 CSIRAC



# Timeline

## History of AI Timeline

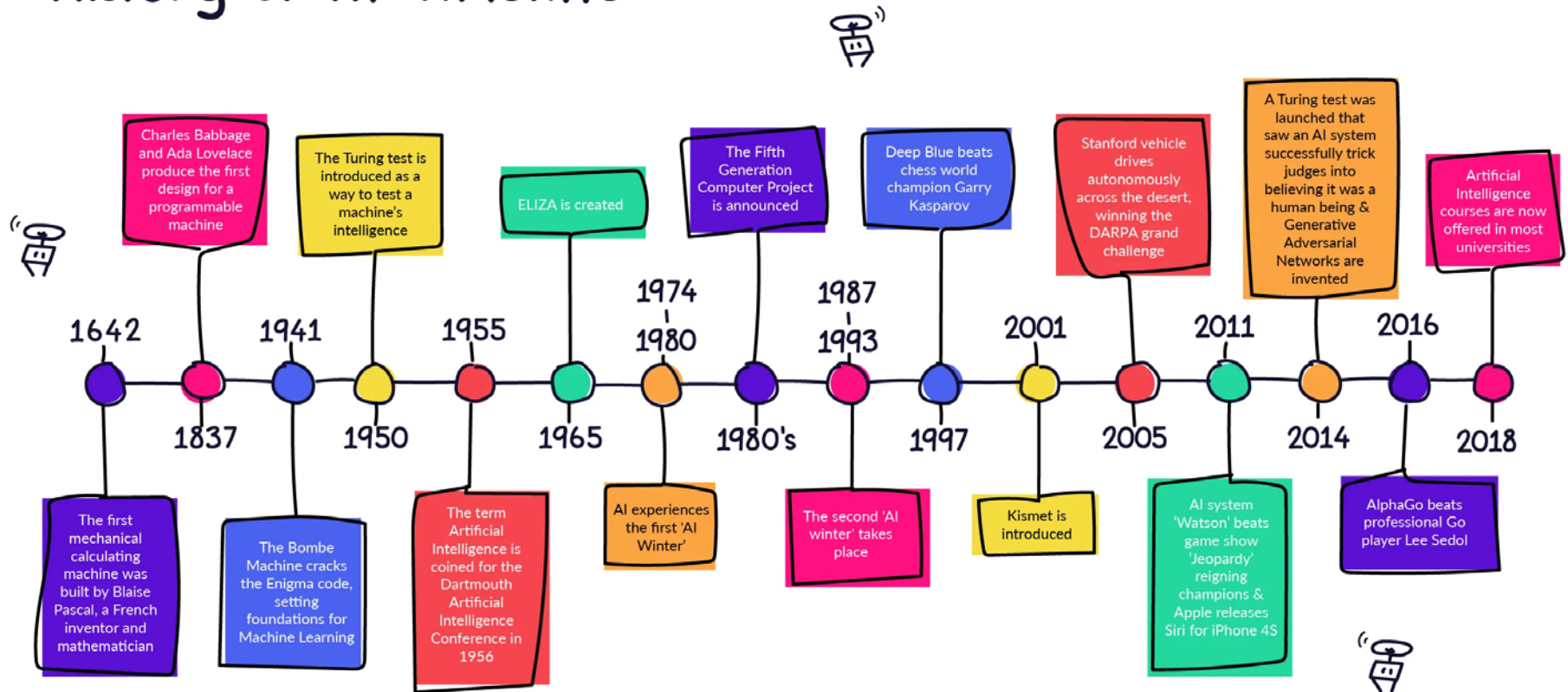


Image Source: History of Artificial Intelligence, Madaleine Thompson, <https://codebots.com/artificial-intelligence/history-of-artificial-intelligence>





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# The Birth of AI (1952- 1955)



# Dartmouth conference (1956)

“We propose that a 2-month, 10-man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. We think that a significant advance can be made in one or more of these problems if a carefully selected group of scientists work on it together for a summer.” – Dartmouth Summer School on AI Proposal

# Dartmouth conference (1956)

All men,  
all white,  
all middle class

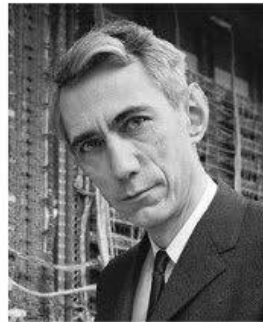
## 1956 Dartmouth Conference: The Founding Fathers of AI



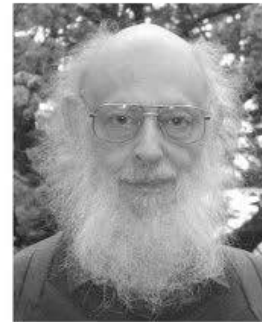
**John McCarthy**



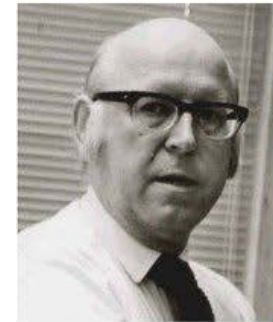
**Marvin Minsky**



**Claude Shannon**



**Ray Solomonoff**



**Alan Newell**



**Herbert Simon**



**Arthur Samuel**



**Oliver Selfridge**



**Nathaniel Rochester**

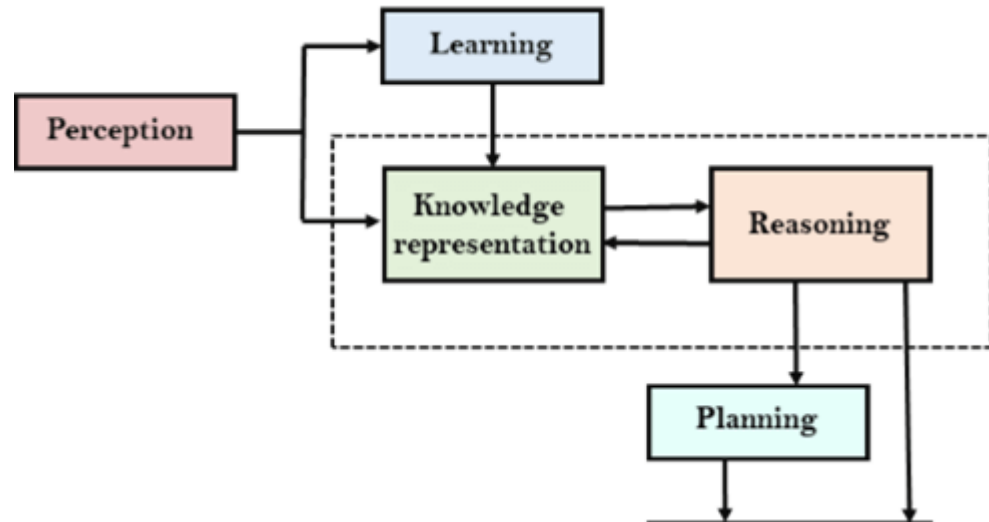


**Trenchard More**

# Dartmouth outcomes

The *divide and conquer* model of artificial intelligence:

- Perception
- Planning
- Learning
- Natural language understanding



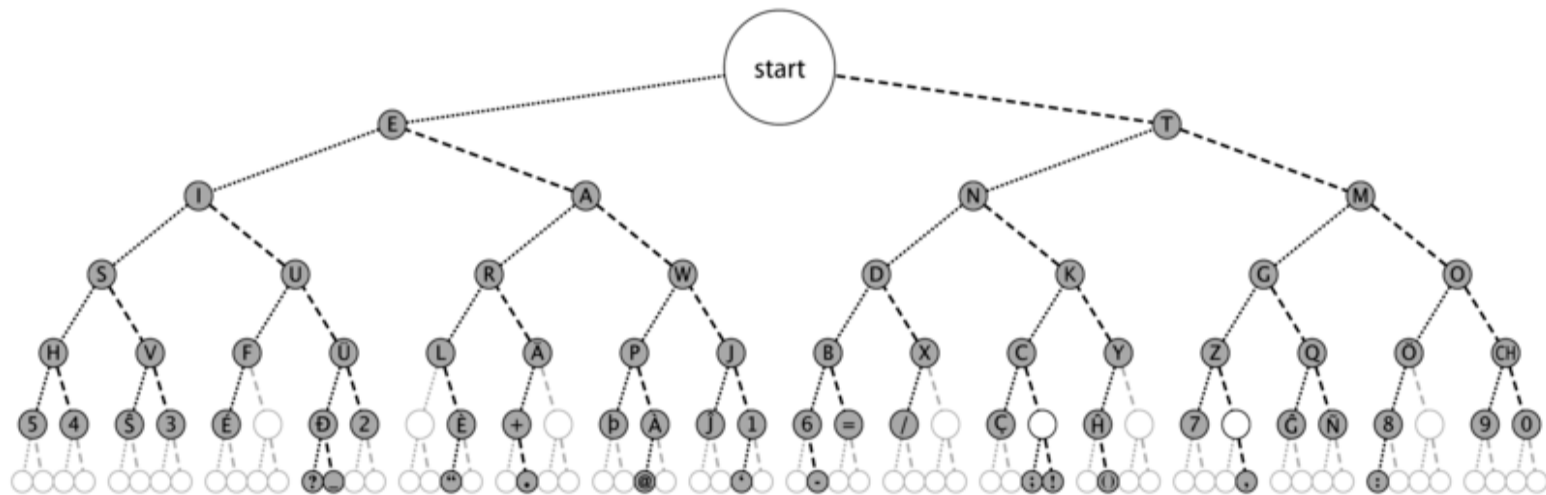




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# **The Golden Age of AI (1956-1974)**

# Golden Age: Reasoning as search





# Golden Age: Reasoning as search

Initial state: At(A), Level(low), BoxAt(C), BananasAt(B)  
Goal state: Have(bananas)

Actions:

```
// move from X to Y
```

```
_Move(X, Y)_
```

```
Preconditions: At(X), Level(low)
```

```
Postconditions: not At(X), At(Y)
```

```
// climb up on the box
```

```
_ClimbUp(Location)_
```

```
Preconditions: At(Location), BoxAt(Location), Level(low)
```

```
Postconditions: Level(high), not Level(low)
```

```
// climb down from the box
```

```
_ClimbDown(Location)_
```

```
Preconditions: At(Location), BoxAt(Location), Level(high)
```

```
Postconditions: Level(low), not Level(high)
```

```
// move monkey and box from X to Y
```

```
_MoveBox(X, Y)_
```

```
Preconditions: At(X), BoxAt(X), Level(low)
```

```
Postconditions: BoxAt(Y), not BoxAt(X), At(Y), not At(X)
```

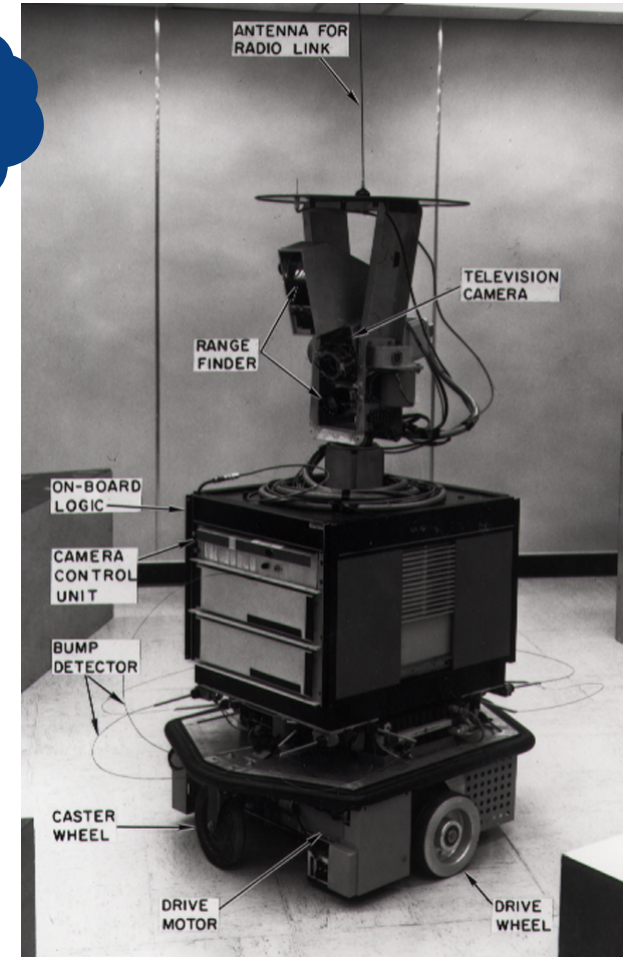
```
// take the bananas
```

```
_TakeBananas(Location)_
```

```
Preconditions: At(Location), BananasAt(Location), Level(high)
```

```
Postconditions: Have(bananas)
```

All men,  
all white

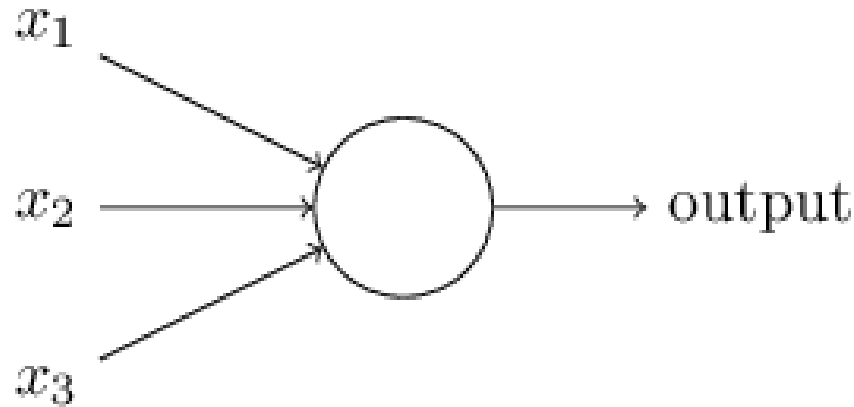


Shakey the robot and A\* -- Hart,  
Nilsson, and Raphael (1968)

Stanford Research Institute Problem Solver (STRIPS) --  
Fikes and Nilsson (1971)

# Golden Age: Perceptrons and neural networks

All men,  
all white



Single-layer perceptron – Rosenblatt (1958)

“the embryo of an electronic computer that [the Navy] expects will be able to walk, talk, see, write, reproduce itself and be conscious of its existence.” -- New York Times on the *Perceptron* (1958)



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# **The First AI Winter (1974-1980)**



# What went wrong?

The outcomes failed to live up to the *hype!* Why?:

- *Scalability*: problems easily solved on toy problems did not scale once simplifying assumptions were dropped.
- *Commonsense knowledge*: People use a lot of commonsense knowledge to reason, which proved impossible to encode by hand
- *Perceptron limitations*: Minsky and Papert proved major limitations of single-layer perceptrons
- *Moravec's paradox*: "It is comparatively easy to make computers exhibit adult level performance on intelligence tests or playing checkers, and difficult or impossible to give them the skills of a one-year-old when it comes to perception and mobility" – **Hans Moravec** (1988)

# What was the result?

Lack of progress meant:

- Funding dried up. See the *Lighthill Report* in England
- Interest in AI died down
- Much criticism from philosophers and cognitive scientists







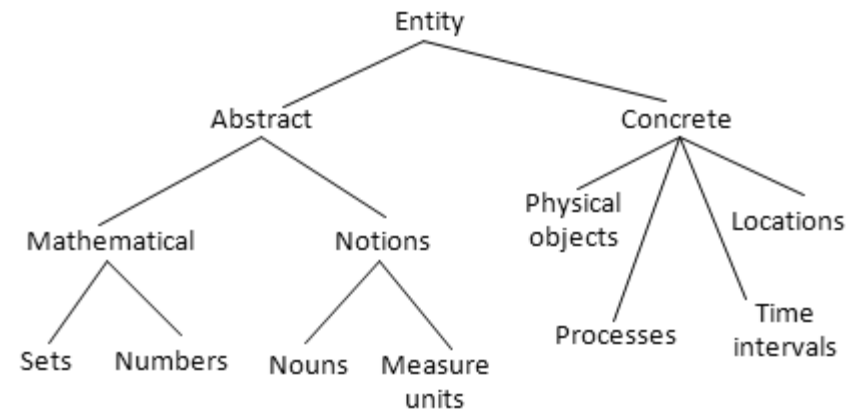
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# The Knowledge Era (1980- 1987)



# Knowledge era: Knowledge-based systems

```
mother_child(trude, sally).  
father_child(tom, sally).  
father_child(tom, erica).  
father_child(mike, tom).  
  
sibling(X, Y) :- parent_child(Z, X),  
                 parent_child(Z, Y).  
  
parent_child(X, Y) :- father_child(X, Y).  
parent_child(X, Y) :- mother_child(X, Y).  
  
?- sibling(sally, erica).  
Yes
```



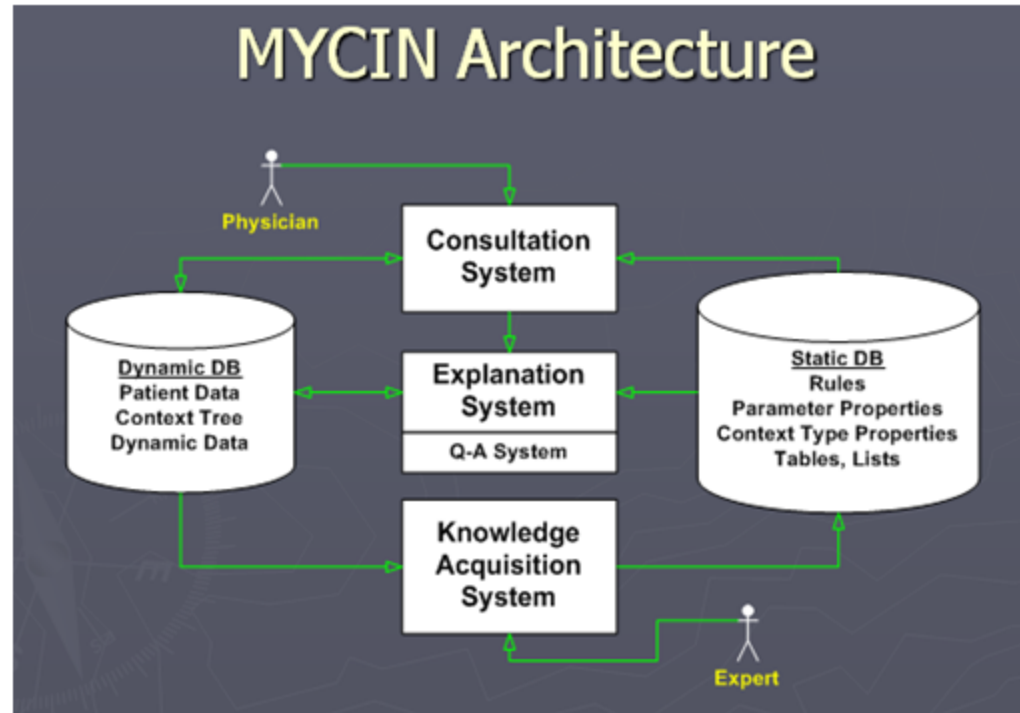
Formal ontologies

Prolog – Colmerauer and Roussel (1972)

Both men

# Knowledge era: Expert systems

All men



MYCIN expert system for diagnosis of blood diseases – Shortcliffe, Buchanan, and Cohen (1970s)



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# **The Second AI Winter (1987-1993)**



# What went wrong?

The outcomes failed to live up to the *hype*... again! Why?:

- *Scalability*: knowledge encoded for toy problems proved difficult on more complex and larger problems.
- *Maintenance*: Maintaining knowledge bases required ongoing expert interaction and knowledge engineering – this is very expensive.
- *The qualification problem*: The impossibility to encode *all* required preconditions for an action to work:

"[T]he successful use of a boat to cross a river requires, if the boat is a rowboat, that the oars and rowlocks be present and unbroken, and that they fit each other. Many other qualifications can be added, making the rules for using a rowboat almost impossible to apply, and yet anyone will still be able to think of additional requirements not yet stated." – McCarthy (1980)

# What was the result?

Lack of progress meant:

- Funding dried up; DARPA declared AI was “not the next wave”
- Interest in AI died down
- AI companies went bankrupt (the commercial wave ended)



This is NOT a copy of the slide from the first AI winter – the similarities are obvious: too much hype lead high expectations, which were not met, thus changing people’s perceptions of AI.

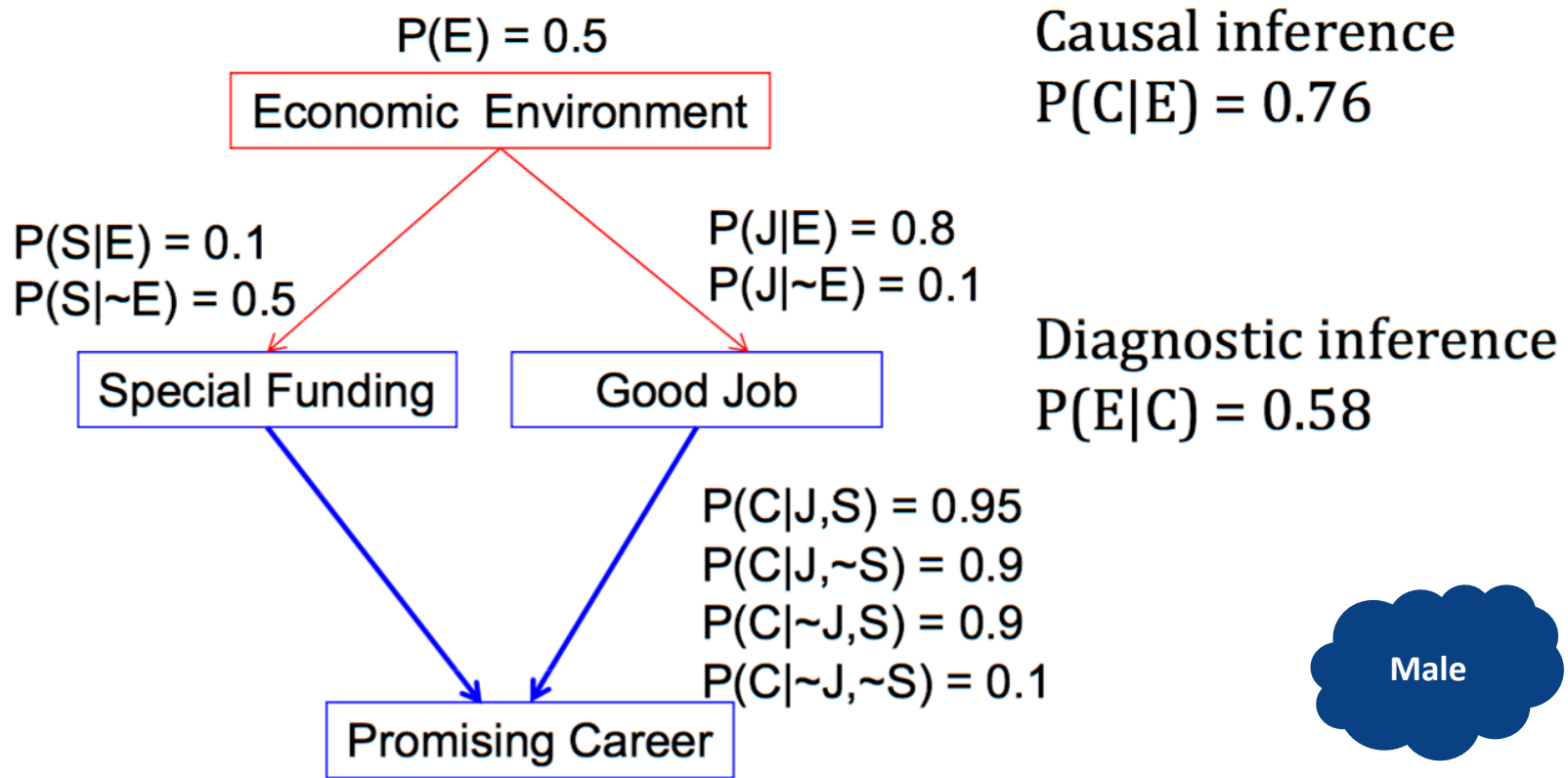


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# The AI Revival (1994- present)

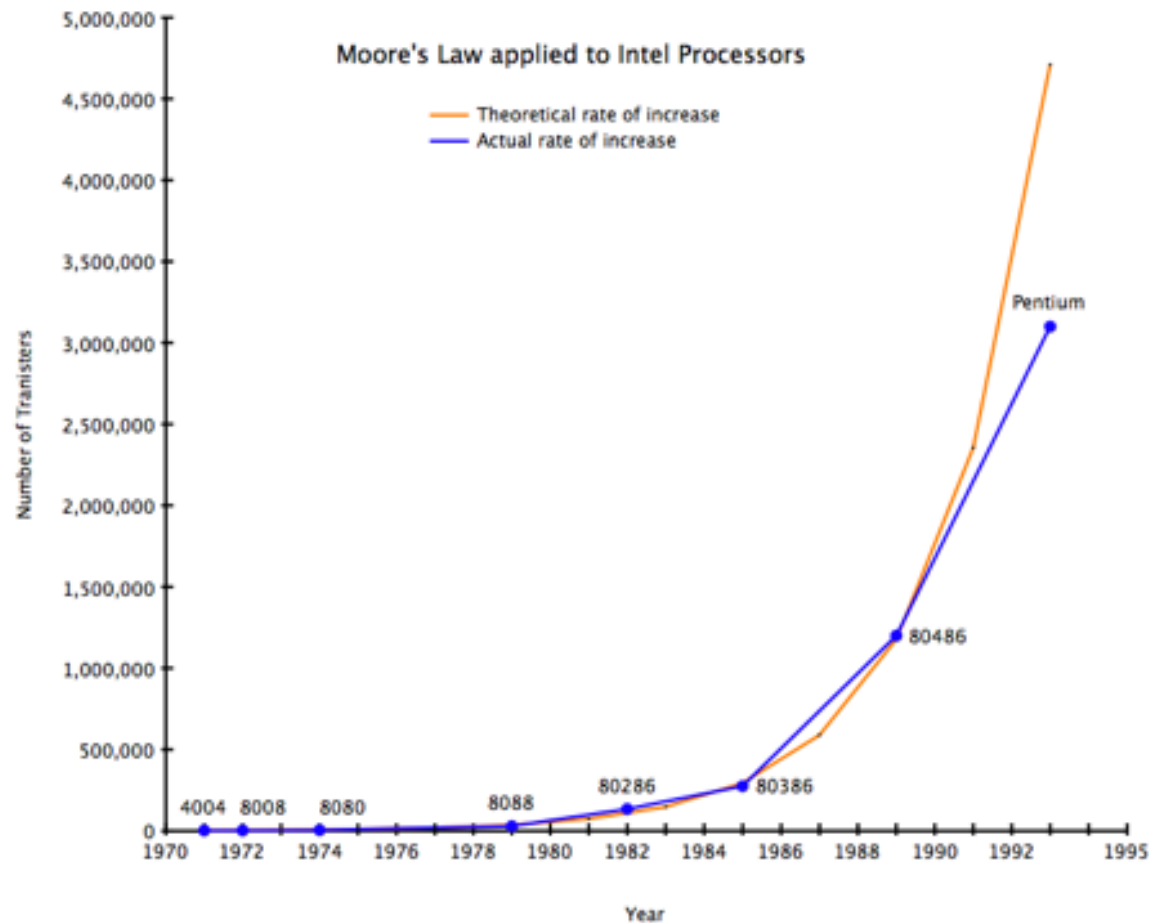


# Current era: Intelligent agents and decision theory



Bayesian Networks – Pearl (1988)

# Current era: Computational power



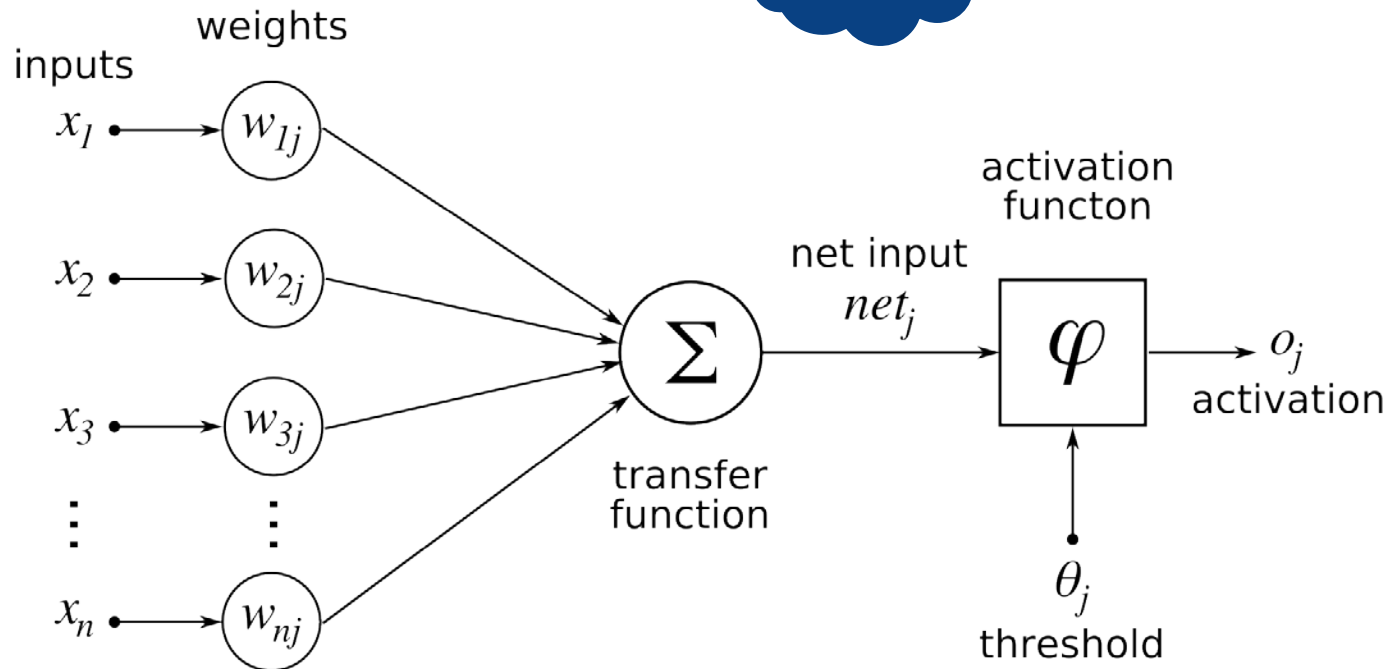
# Current era: The Internet and big data



Image source: <https://www.promptcloud.com/blog/want-to-ensure-business-growth-via-big-data-augment-enterprise-data-with-web-data/>

# Current era: Machine learning

All men



Backpropagation in deep neural networks – Rumelhart, Hinton, and Williams (1986)



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# The Third AI Winter?



# We've been here before

"There is no reason and no way that a human mind can keep up with an artificial intelligence machine by 2035." —**Gray Scott** (2017)

"We will have fully self-driving cars on

"Artificial  
to, say, 20  
machine i

## Amara's Law

We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run.

urther

"In from three to eight years we will have a machine with the general intelligence of an average human being." — **Marvin Minsky** (1970)

"Machines will be capable, within twenty years, of doing any work a man can do"  
— **Herbert Simon** (1956)





# What are some possible risks?

“By far the greatest danger of Artificial Intelligence is that people conclude too early that they understand it.”

– **Eliezer Yudkowsky**

“People worry that computers will get too smart and take over the world, but the real problem is that they're too stupid and they've already taken over the world.”

– **Pedro Domingos**



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# AI History and representation

# Representation in AI/CS



Ada Lovelace



Grace Hopper



Timnit Gebru  
(founded Black in AI)

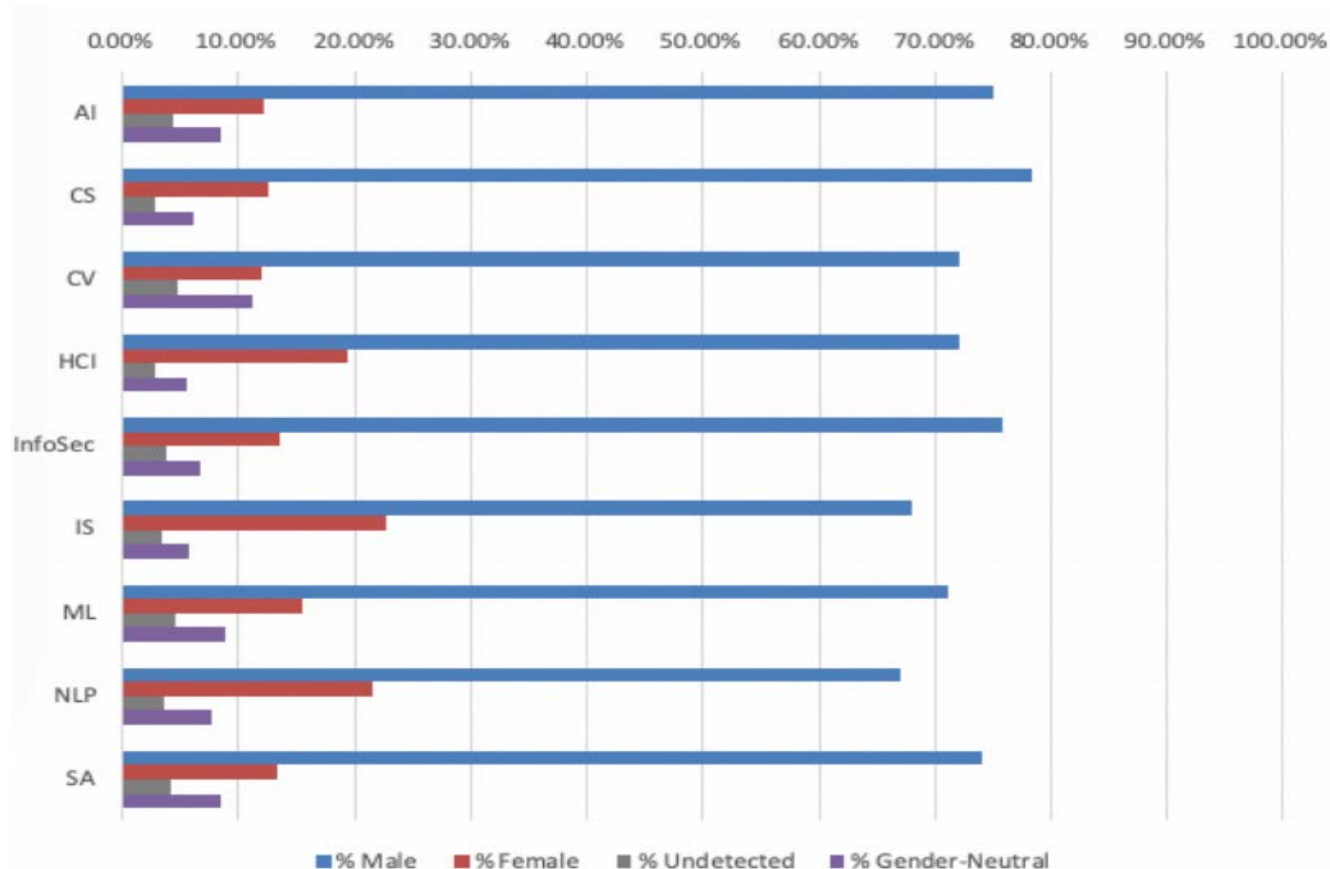


Alan Turing



Fei Fei Li

# Under-representation in AI today



Source: Computer Science Communities: Who is Speaking, and Who is Listening to the Women? Using an Ethics of Care to Promote Diverse Voices. Marc Cheong, Kobi Leins, Simon Coghlan. In *ACM Conference on Fairness, Accountability, and Transparency (FAccT)*, 2021

# Effects of under-representation








# Effects of under-representation

A lack of diversity in AI/CS implies a lack of:

- Fairness
- Privacy
- Accessibility and inclusion
- Safety
- Transparency
- *Functionality*
- *Etc.*



Design decisions, data, attitudes, etc., are all influenced by who we are as individuals, as teams, and as societies

**The History (that influences) AI = The History of Culture and Society**

# Diversity



Diversity in teams:

- **Diversity is:** Gender, culture, ethnicity, sexual orientation, disability, family status, class, education.
- Diversity promotes diverse viewpoints
- Diversity makes us question things more

Diversity of inputs:

- Get out of the building!

**This is not just good for the soul: it is good for business!**

# History of AI: summary

## History

Dartmouth conference is the  
“birth” of artificial intelligence

AI winters caused by hyped  
expectations being unmet

### Eras of artificial intelligence

Golden era

Knowledge era

Revival era

Will we have another AI  
winter/autumn?

## History and representation

AI has been driven *mostly* by male,  
western culture

Huge contributions for non-male,  
non-Western culture, but not  
enough

Culture (and therefore history)  
influences design decisions

### Diversity

Diverse teams

Diverse inputs



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# Thank you

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