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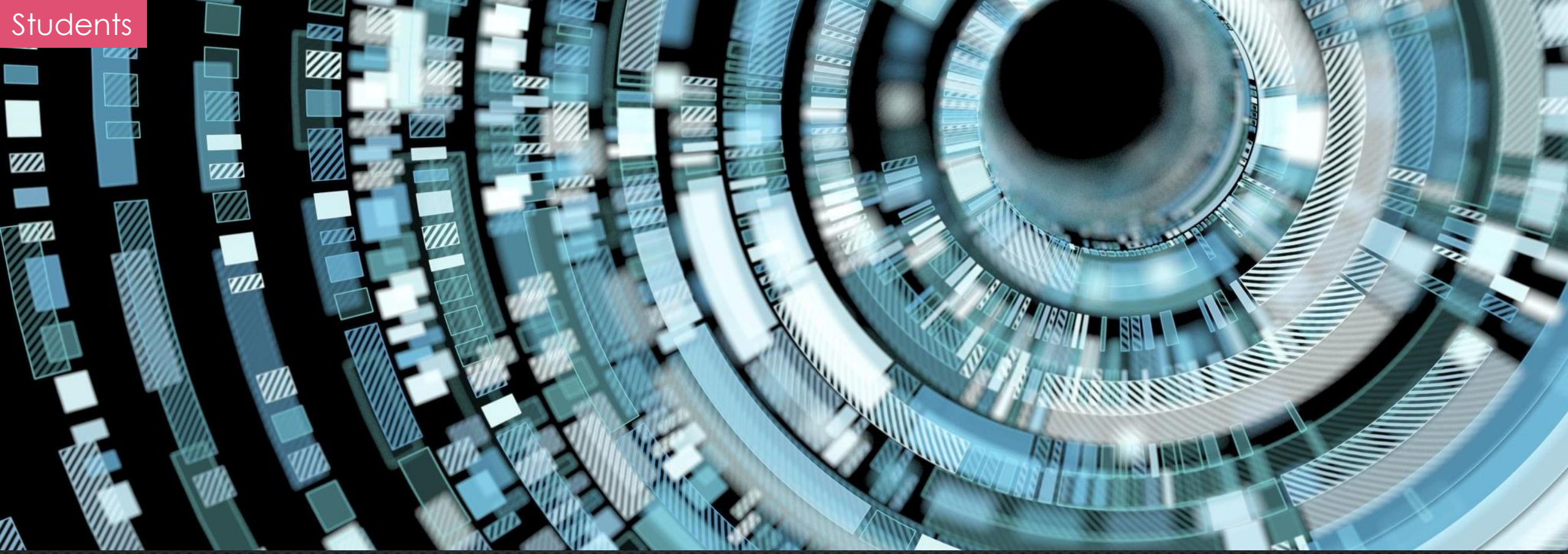

ARTIFICIAL INTELLIGENCE

CSC 361

CHAPTER 1

Introduction to AI

AI IN FICTION

An intelligent killing robot

Smart machines that took over the world and made humans live in a simulated world

AI IN FICTION

an artificial lifeform, an android who desires to be human

Capable of emotions such as loneliness and love

WHAT IS AI IN REALITY?

Artificial Intelligence

"Artificial"
the clear part

"Intelligence"
the ambiguous part

"ARTIFICIAL"

- Create artifacts, software or hardware, that are intelligent.
- AI relies mainly on computers to achieve its goals.
- AI is an engineering discipline, not a science (at least for now)!
  - because its primary focus lies in **creating practical systems and solving real-world problems** rather than solely understanding the underlying principles of natural phenomena.
- The objective of AI is not to study human or animal intelligence. This is part of psychology. However, there is an interaction between the two disciplines.
- Like any engineering discipline, the outcomes of AI research are evaluated according to their usefulness.

"INTELLIGENCE"

- There is no universally-accepted definition of intelligence.
- The definition of intelligence is **controversial**. Some groups of psychologists have suggested the following definitions:

  - From "Mainstream Science on Intelligence" (1994), an op-ed statement (subjective) in the Wall Street Journal signed by fifty-two researchers (out of 131 total invited to sign):"A very general mental capability that, among other things, **involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience**."

  - David Wechsler: " The aggregate or global capacity of the individual to **act purposefully**, **to think rationally**, and to **deal effectively with his environment**."

  - Alfred Binet: "**Judgment**, otherwise called "**good sense**," "**practical sense**," "initiative," the faculty of **adapting one's self to circumstances** ... auto-critique.

DEFINITION OF AI

- Like intelligence: there is **no generally accepted definition of AI.**
- These are some definitions given by prominent AI researchers:
  - **Herbert Simon: "**We call programs intelligent if they exhibit behaviors that would be regarded intelligent if they were exhibited by human beings.**"**
  - **John McCarthy**: "It is the **science and engineering of making intelligent machines, especially intelligent computer programs**. It is related to the similar tasks of using computers to understand human intelligence, but **AI does not have to confine itself to methods that are biologically observable**."
- Now shift towards **rationality** instead of intelligence

Herbert Simon: Turing Award 1975, Nobel Prize in Economics 1978

John McCarthy

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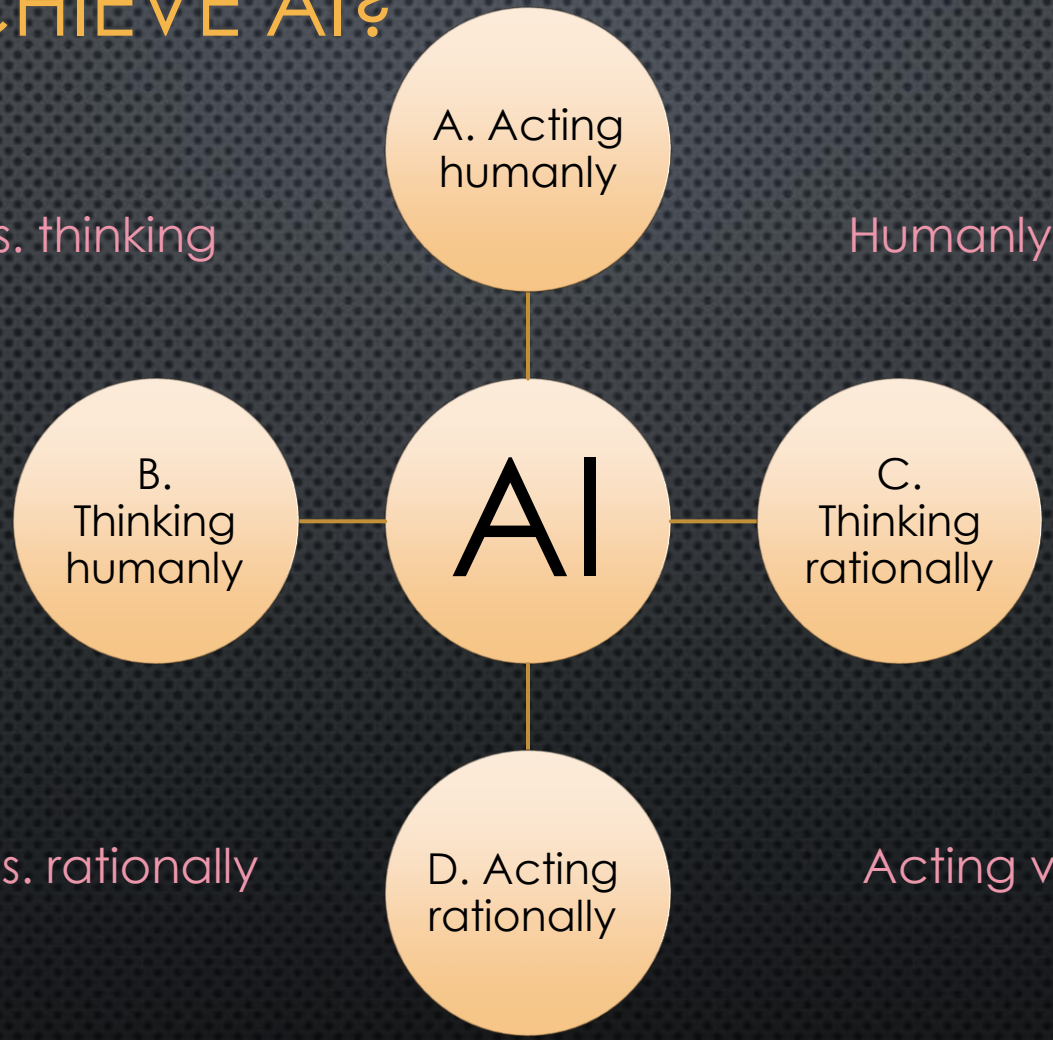
HOW TO ACHIEVE AI?



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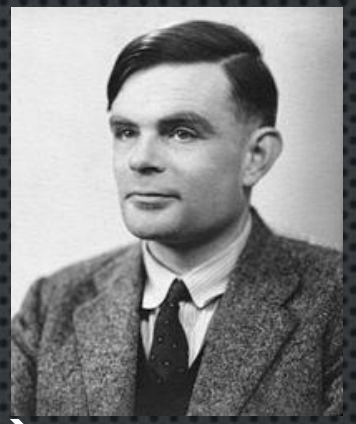
A. ACTING HUMANLY



- To be intelligent, a program should simply act like a human → Turing test
- The **Turing Test (1950):**

Alan Turing

1912-1954

A machine can be said to be "intelligent" if it behaves exactly like a human being.

Hide a human in a room and a machine in another room and type questions:
if you cannot find out which one is which based on their answers,
then the machine is intelligent

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A. ACTING HUMANLY

- To pass the Turing test, the computer/robot needs:
  - **Natural language processing (NLP)** to communicate successfully.
    - **Computer vision** to perceive objects. (Total Turing test)
    - **Robotics** to manipulate objects and move. (Total Turing test)
  - **Knowledge representation** to store what it knows or hears.
  - **Automated reasoning** to answer questions and draw conclusions using stored information.
  - **Machine learning** to adapt to new circumstances and to detect and extrapolate patterns.
  - These are the main branches of AI.

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B. THINKING HUMANLY

- Real intelligence requires thinking → think like a human
- First, we should know how a human thinks: not easy, but psychology can help"
  - We can study the behavior of humans and deduce the reasoning behind actions
  - We can observe the brain with MRI machines
  - We can propose models of thought and test them through experiments on humans
- Resulted in the field of cognitive science: a merger between AI and psychology.

PROBLEMS WITH IMITATING HUMANS

- The human thinking process is difficult to understand:
  - how does the mind arise from the brain?
  - unconscious tasks such as vision and speech understanding.
- Humans are not perfect! We make a lot of systemic mistakes

C. THINKING RATIONALLY

- Instead of thinking like a human: think rationally.
- Find out how correct thinking must proceed: **the laws of thought**.
- Aristotle syllogism: "Socrates is a man; all men are mortal, therefore Socrates is mortal."
- This initiated logic: a traditional and important branch of mathematics and computer science.
- Problem: it is not always possible to model thought as a set of rules; sometimes there are imprecisions.
- Even when a modeling is available, the complexity of the problem may be too large to allow for a solution.

D. ACTING RATIONALLY

- Logical thinking is only one aspect of appropriate behavior: reactions like getting your hand off a hot surface is not the result of a careful deliberation, yet it is clearly rational.
- Sometimes there is no correct thing to do, yet something must be done.
- Instead of insisting on how the program should think, we insist on how the program should act: we care only about the final result.

- Rational acting:
  - **Rational agent: acts as to achieve the best outcome**

ACTING RATIONALLY

This is how birds fly

Humans tried to mimic
birds for centuries

This is how humans finally achieved "artificial flight"

RELATIONS TO OTHER FIELDS

- **AI is tightly related to many fields including:**
  - Philosophy,
  - Mathematics,
  - Economics,
  - Neuroscience,
  - Psychology,
  - Computer engineering,
  - Linguistics…

APPLICATIONS OF AI: CHESS

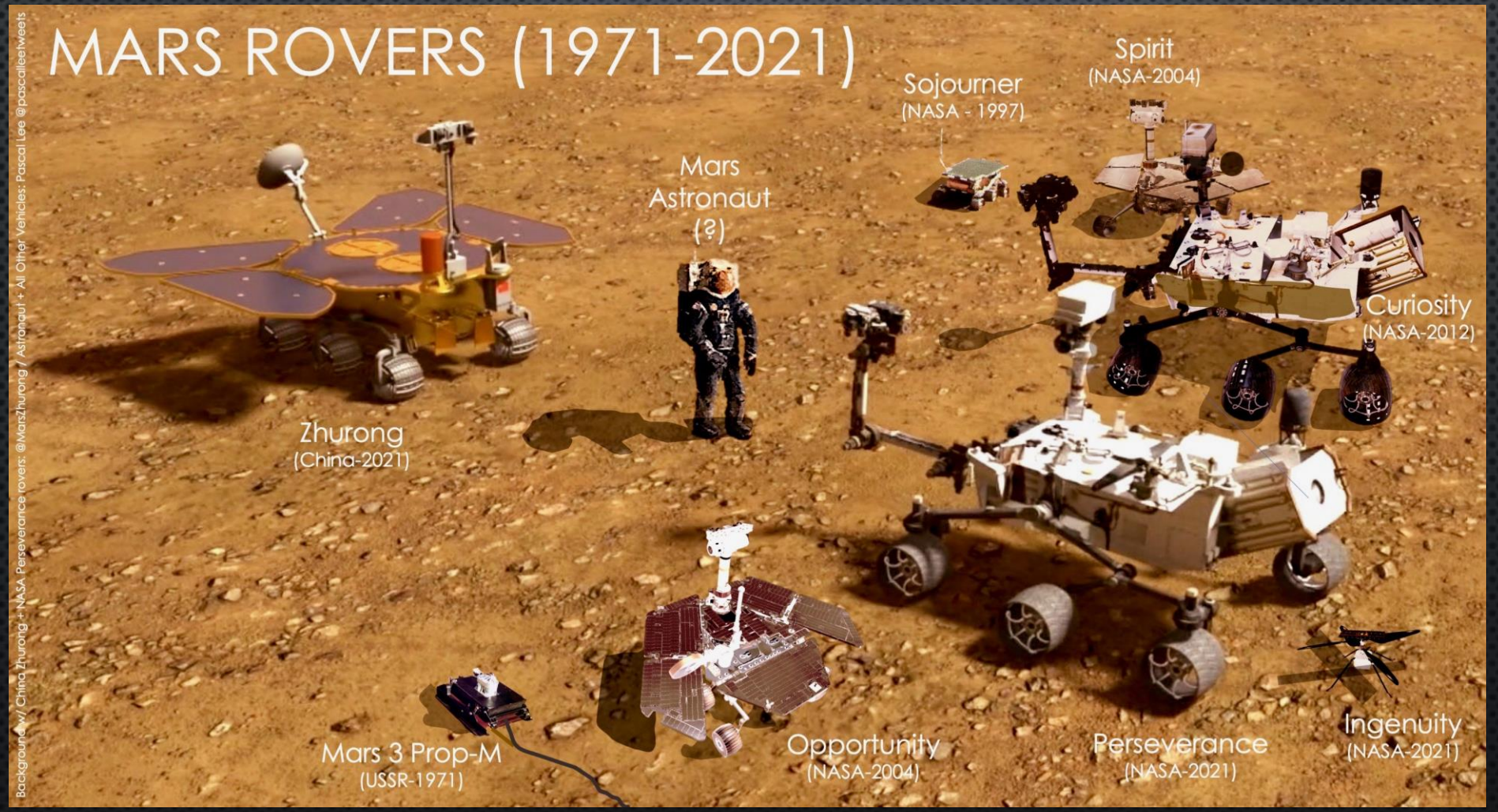
- Game playing
  - IBM Deep Blue vs. Gasparov:

Deep Blue wins in 1997

APPLICATIONS OF AI: NLP

- Natural language processing
  - Watson: a program created by IBM, that can answer questions in natural language. He even plays in Jeopardy!
  - In 2011, Watson beats two champions of the game and wins 1 million US Dollars.
  - Watch Watson: https://www.youtube.com/watch?v=P18EdAKuC1U

APPLICATIONS OF AI: ROBOTICS



APPLICATIONS OF AI: ROBOTICS

- Robotics
  - Sophia is a humanoid robot with unique features developed by Hanson Robotics Limited (Hong Kong).
  - Sophia is embedded with artificial intelligence, sensors, algorithms, visual data processing, Google Chrome's voice recognition technology and facial recognition.
  - Her human like skin is made up of patented silicon. She can show more than 62 facial expressions. Her eyes consist of camera which are paired with algorithm.
  - She has a wide range of sensors which helps her to detect sound and distance from people.

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APPLICATIONS OF AI: COMPUTER VISION

- Computer vision:
  - Google's Automated Cars (2010): uses video cameras, radar sensors and a laser range finder to "see" other traffic, detailed maps
  - Google pushed a law that allows autonomous cars to drive in the streets of the state of Nevada in June 2011.
  - Watch the Waymo driverless car (formerly the Google self-driving car project): https://www.youtube.com/watch?v=__EoOvVkEMo

SUMMARY

- This course is concerned with creating rational agents: **artificial rationality**.
- AI has passed the era of infancy and is now tackling real life, complex problems, and is succeeding in many of them.
- AI has had a turbulent history with many ups and downs, phenomenal successes and deep disappointments resulting in fund cutbacks and economic losses.
- AI has flourished in the last two decades because of a shift in researcher mentality towards a rigorous scientific methodology:

Firm theoretical basis & Serious experiments