NANYANG TECHNOLOGICAL UNIVERSITY

School of Mechanical & Aerospace Engineering

Design, Machine, Control, Intelligence

Keynote Speech

智理学：人工智能的真实基础

Science of Mind as

True Foundation of Artificial Intelligence

Acknowledgement

This research is mainly financed by a grant from Future Systems Directorate, Singapore Government

XIE Ming, PhD (France)

mmxie@ntu.edu.sg

http://personal.ntu.edu.sg/mmxie

ABOUT NTU

Vision and Mission

A great global university founded on science and technology, nurturing leaders and creating societal impact through interdisciplinary education and research.

Leadership

Professor Ho Teck Hua
President and Distinguished University Professor

Professor Christian Wolfrum
Deputy President and Provost

Ranked Among the Best in the World

- 3rd — Nature Index Young University Rankings
- 1st — Times Higher Education Young University Rankings
- 3rd — US News and World Report Best Global Universities in Asia
- 4th — Times Higher Education Asia University Rankings
- 15th — QS World University Rankings
- 4th — QS Asia University Rankings
- 27th — US News and World Report Best Global University Rankings
- 30th — Times Higher Education World University Rankings
- 10th — QS World's Most Photogenic Universities

Ranked Among the Best in the World

NTU 2025 Strategic Plan

NTU 2025 reinforces NTU's strong commitment to the four core pillars of the University:

- Education
- Research
- Innovation
- Community

Addressing humanity's grand challenges:

- Mitigating our impact on the environment
- Harnessing the science, art and technology of learning
- Addressing technology's impact on humanity;
- Responding to the needs and challenges of healthy living and ageing

15-Year Sustainability Manifesto

Solidifying the University's position as a global leader in sustainability

- NTU's sustainability manifesto goals: carbon neutrality by 2035, halve net energy utilisation and new sustainability courses
- First university in the world to launch a sustainability-linked bond with an AAA credit rating from Moody's
- Sustainable campus with eight zero-energy buildings, the most amongst organisations in Singapore
- Home to two of Asia's largest wooden buildings, Gaia and The Wave
- Winner of ISCN's Whole Systems Approach Excellence Award in recognition of sustainable practices in the areas of research, education, community engagement, and infrastructure developments

Main Campus

200 hectares

State-of-the-art-facilities

25 halls of residence

The NTU Smart Campus is a living testbed of tomorrow's technologies and frequently named among the most beautiful campuses in the world.

Medical Campus

School of Medicine

Learning and research

Sports and recreation

Home to the Lee Kong Chian School of Medicine in Novena, Singapore's healthcare district. The school aims to be a model for innovative medical education and a centre for transformative research.

At a Glance

35,400 students

24,800 undergraduates
10,600 postgraduates

8,000

faculty, researchers and staff from 73 countries

300,900 alumni

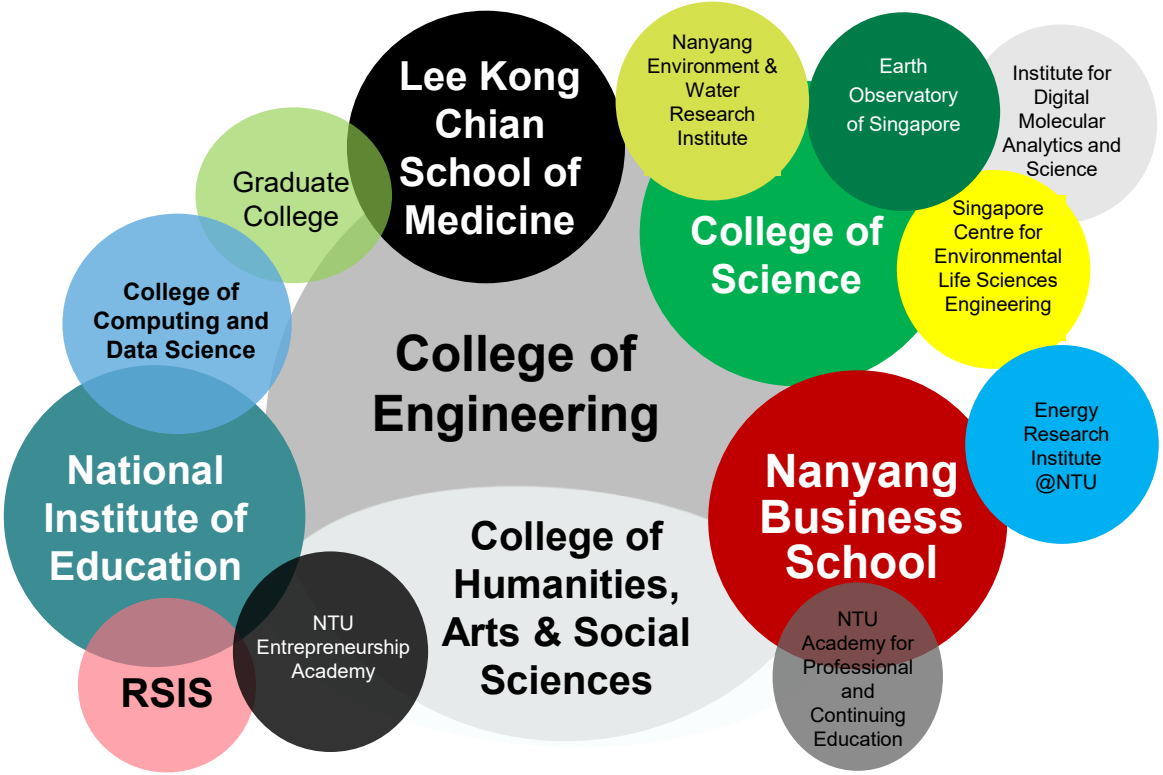
representing 172 nationalities

At a Glance

6
Colleges

15
Schools

World-class institutes & research centres



NTU Academy for Professional and Continuing Education

- Consolidates continuing education and training capabilities and expertise within the University
- Enriches the lifelong learning experience of adult learners, including the University's alumni, making it easier for them to take charge of their own continuing education
- The FlexiMasters programme for continuing education at the Master's degree level, launched in 2020, has grown to more than 35 curricular offerings from all parts of the University

Global Alliance of Industries @ NTU

- Catalysing new university-industry partnerships through multiple consortia, corporate laboratories, multidisciplinary institutes and technology invention disclosures
- Over 250 industry partners and 20 corporate and joint labs with global entities such as Alibaba, Continental, Hewlett-Packard, Nanofilm Technologies, Rolls-Royce and Schaeffler

Top Industry Partners

Top Academic Partners


UC Berkeley

Northeastern University


Australian National University


University of British Columbia


Imperial College London

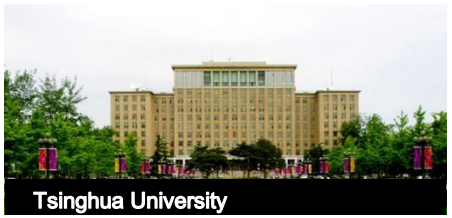
Karolinska Institute


TUM


Seoul National University


Indian Institute of Technology, Madras


University of Toronto


Tsinghua University


University of Pennsylvania

NANYANG TECHNOLOGICAL UNIVERSITY

School of Mechanical & Aerospace Engineering

Design, Machine, Control, Intelligence





Welcome You to NTU

ABOUT SPEAKER

Professor Xie Ming has been:

- Dean/Professor, School of Electrical Engineering and Control Science, Nanjing Tech University, China.
- Guest Professor, Huazhong University of Science and Technology, China.

Professor Xie Ming is now:

- President, Robotics Society of Singapore
- Editor-in-Chief, International Journal of Humanoid Robotics.
- Associate Professor, Nanyang Technological University, Singapore.

Professor Xie Ming has published:

- Three books in English
- Two edited books in English
- Two books in Chinese
- Over 40 International Journal Papers
- Over 100 International Conference Papers

Professor Xie Ming has received many awards and over 10 granted patents.

Ming XIE

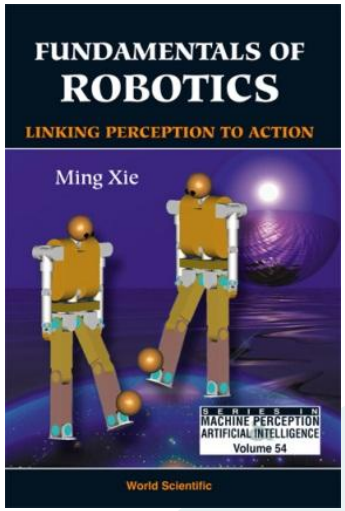
Associate Professor (1999 - present)
http://personal.ntu.edu.sg/mmxie

1984: B.Eng (China)
1986: Msc (France)
1989: Ph.D (France)

Recipient of
Chinese Government's
Overseas Scholarship
(1984 - 1989)

Knowledge
Discovery

2003



Technology
Invention

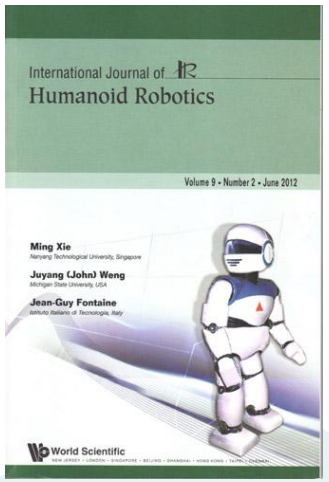
2008

Product
Innovation

(Robot Driver)

(Robot Worker)

2004

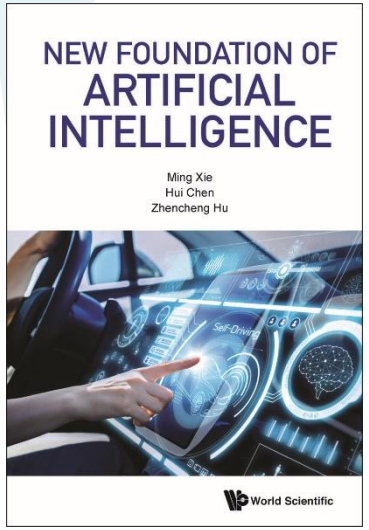


Social
Service

2010

RSS
Robotics Society of Singapore

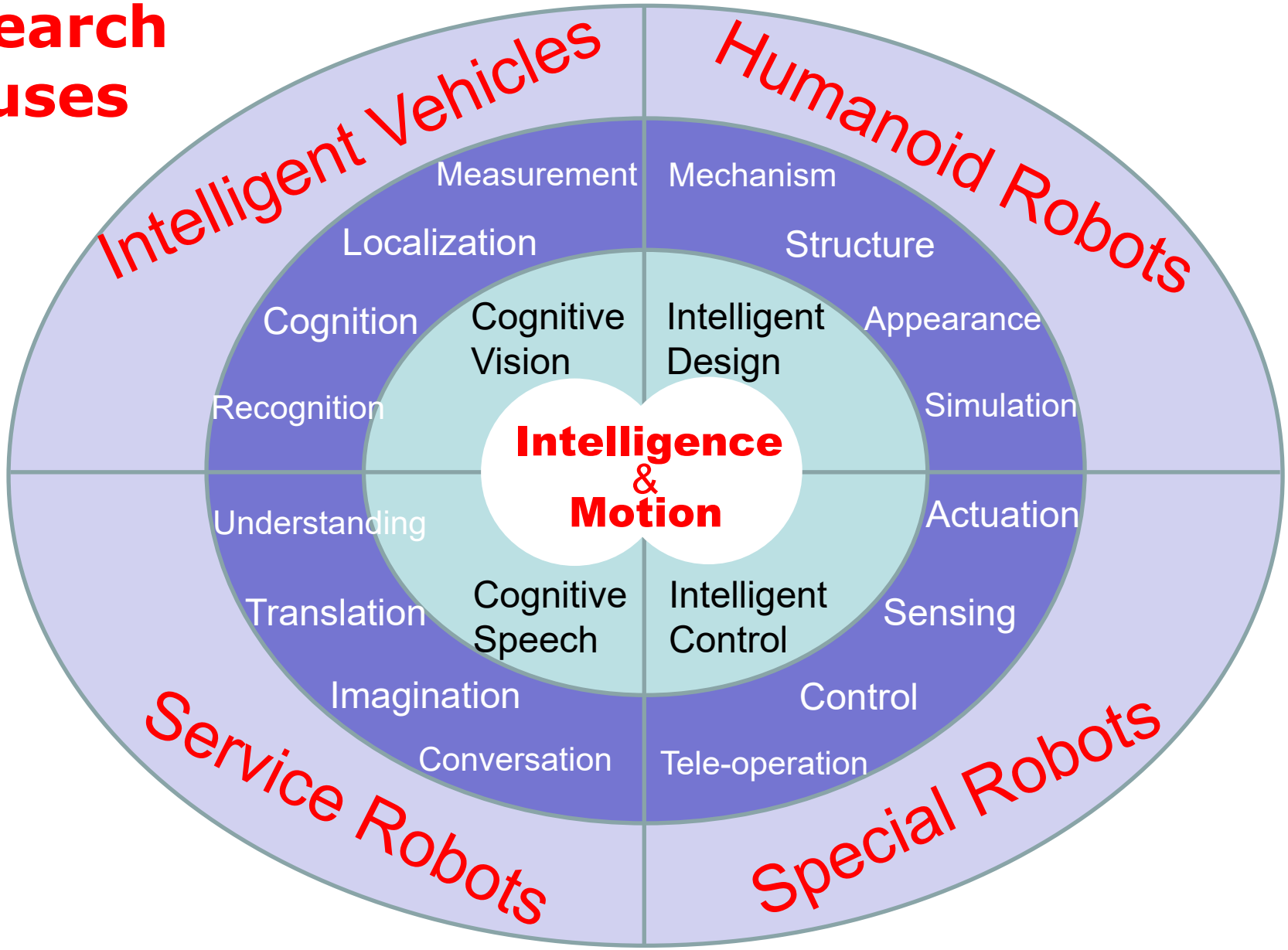
2021



Teaching Portfolio

1. Sensors
2. Robotics
3. Microprocessors
4. Machine Intelligence

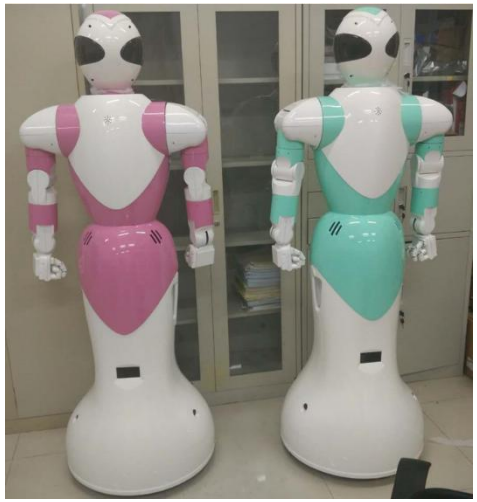
Research Focuses




CCTV 新闻
重播

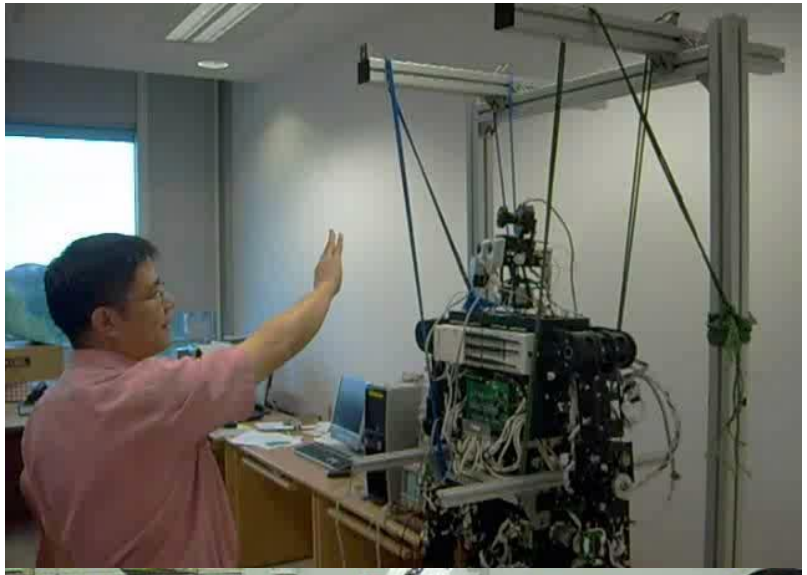
Small-sized Humanoid Robot

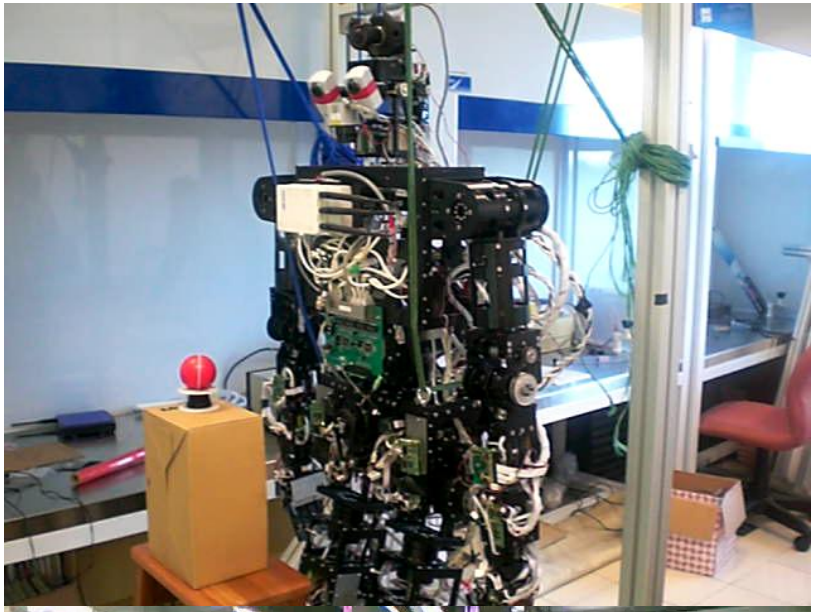
Medium-sized Humanoid Robot

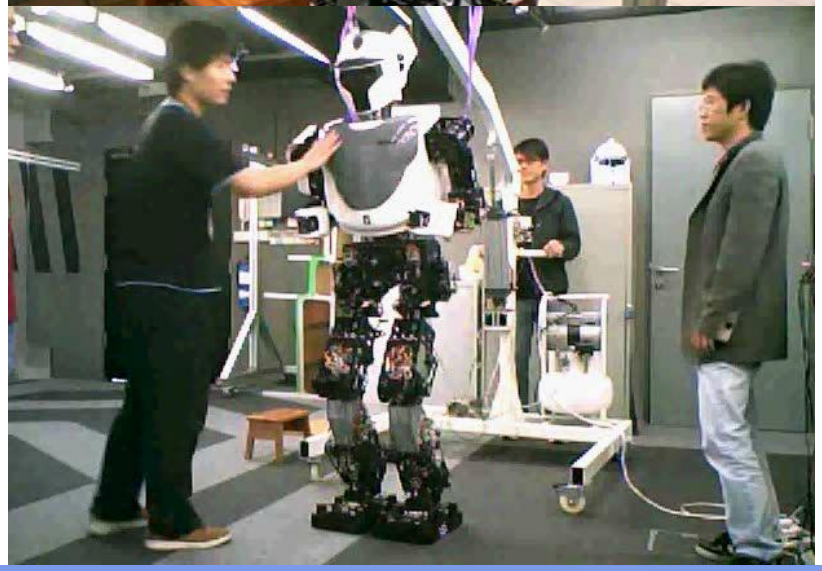


Full-sized Humanoid Robot

Some Demonstrations ...







WARM UP QUESTIONS …

Warm-Up Question 1

- Which one of the following two systems is the generator of Artificial Intelligence?

  (人工智能? 人工心智?)

  – A) Artificial Brain 人工大脑

  – B) Artificial Mind 人工识觉

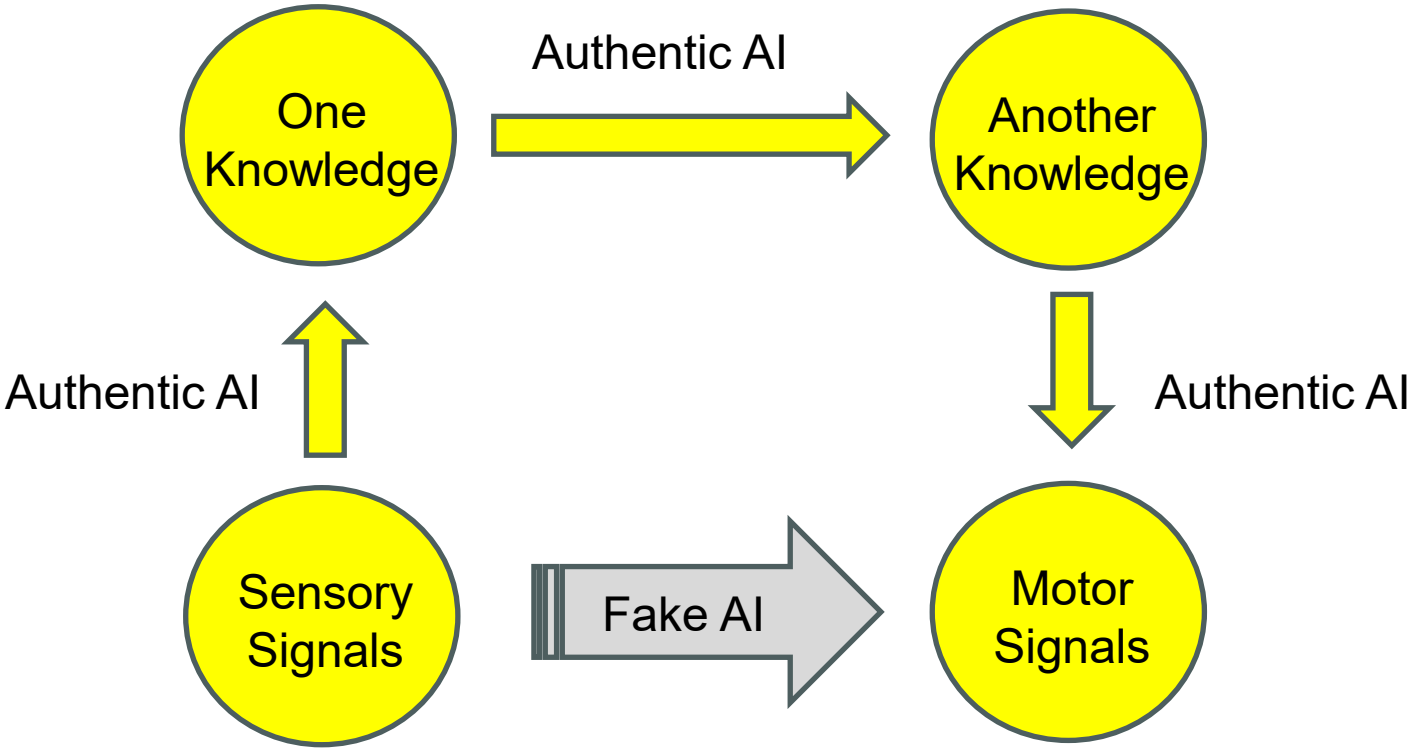
Warm-Up Question 2

- Which one of the following four termonologies is a synonym for Learning?
  - A) Cognition
  - B) Optimization
  - C) Tuning
  - D) Calibration

Warm-Up Question 3

- Which one of the following four transformations is not a process of Authentic AI?
  - A) Signal to Signal
  - B) Signal to Knowledge
  - C) Knowledge to Knowledge
  - D) Knowledge to Signal

Authentic AI versus Fake AI



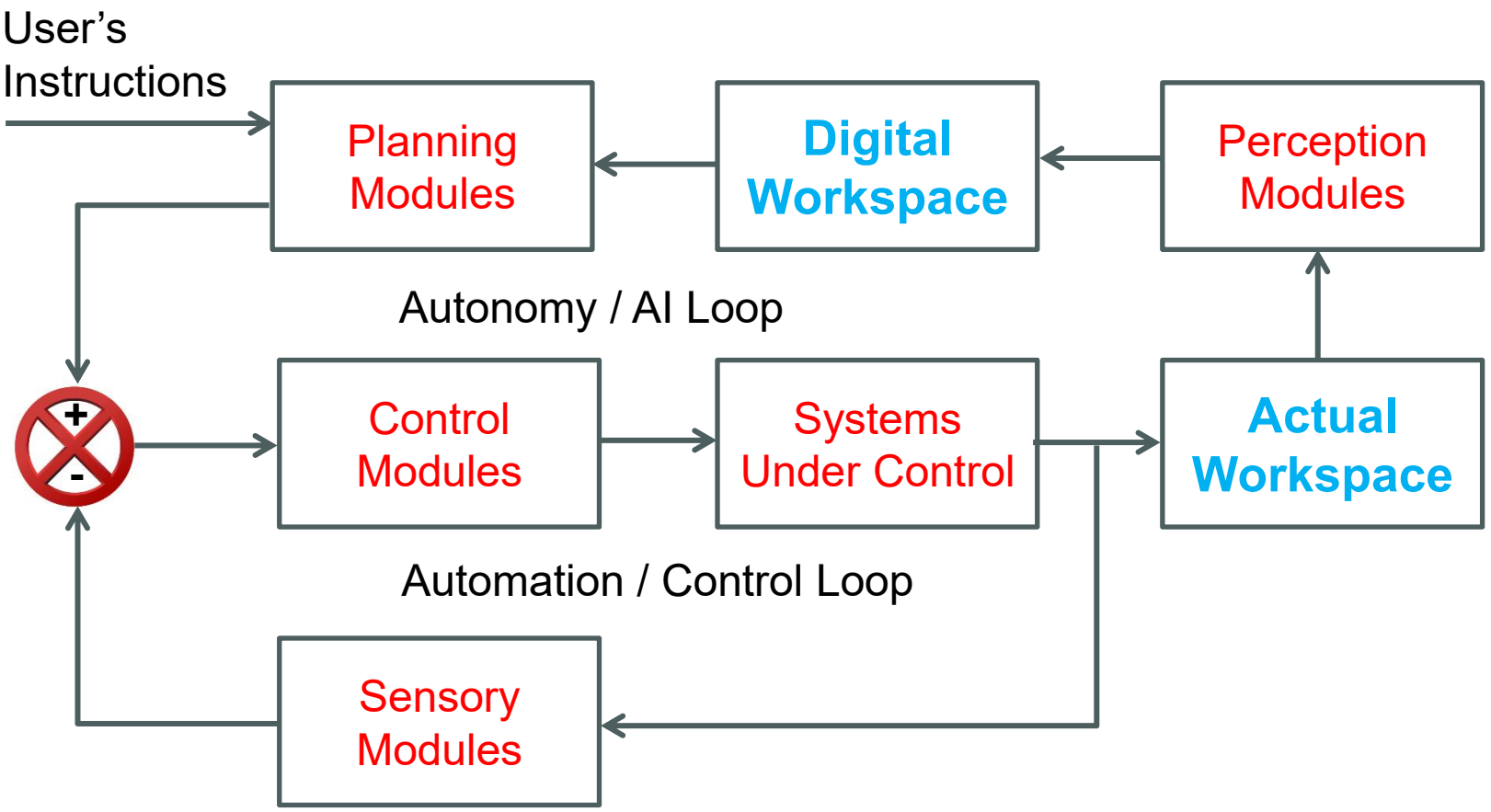
Warm-Up Question 4

- Which one of the following two theories empowers the achievement of Automation?
  - A) Control Theory
  - B) Mind Theory (or AI Theory)

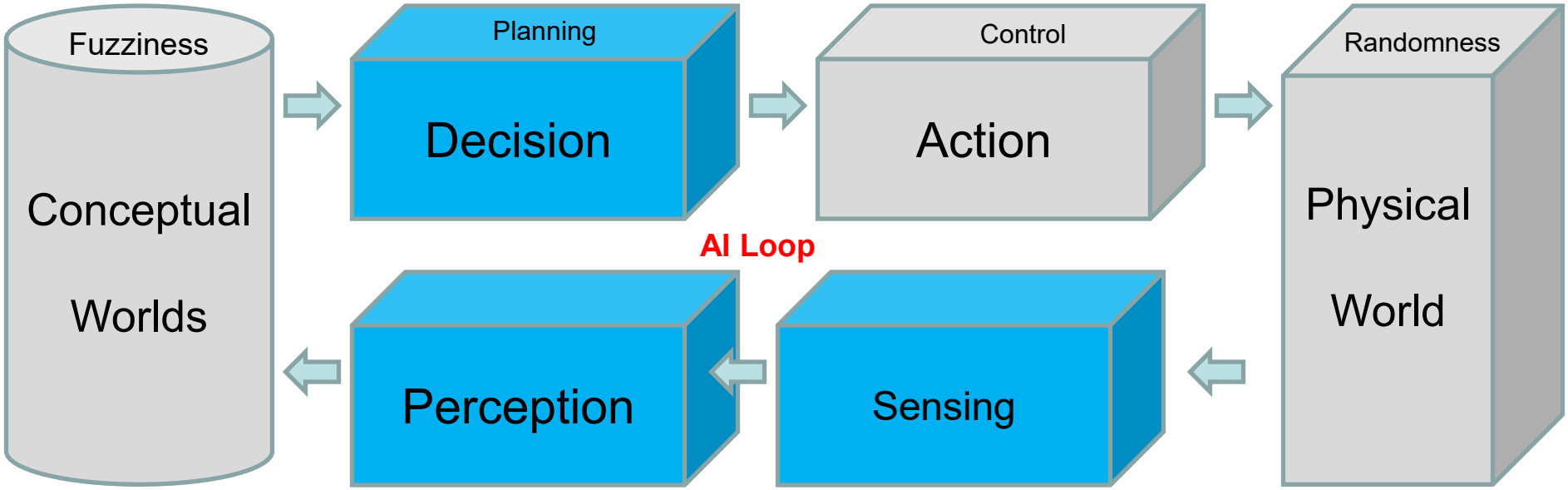
Warm-Up Question 5

- Which one of the following two theories empowers the achievement of Autonomy?
  - A) Control Theory
  - B) Mind Theory (or AI Theory)

Automation versus Autonomy



AI is the mental capability of a system which consists of …

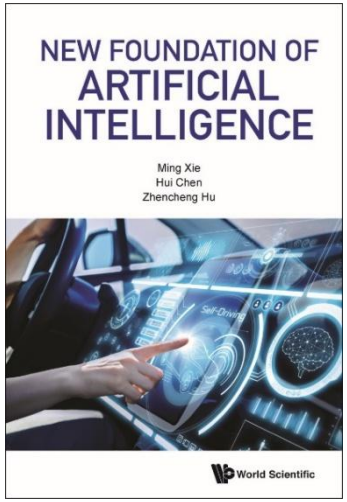


The true nature of AI could be easily understood from Chinese language …

- 从哲学的角度来讲，智能是识与觉所展示出来的能力。就我们人类而言，我们的识与觉包含： 1. 眼识（视觉）、2. 耳识（听觉）、3. 身识（触觉）、4. 鼻识（嗅觉）、5. 舌识（味觉）、6. 意识（醒觉）、7. 我识（末那识、自觉）、8. 藏识（阿赖耶识、圆觉） 。

- 从科学的角度来看，智能是一个系统所展示的能力。它包含：1. 这个系统的输入(可以被感知的信号)，2. 这个系统的输出(含两部分：一是从可以被感知的信号中获取的知识，二是从指令型知识中产生的可以控制行为的信号)。

Key Takeaways …



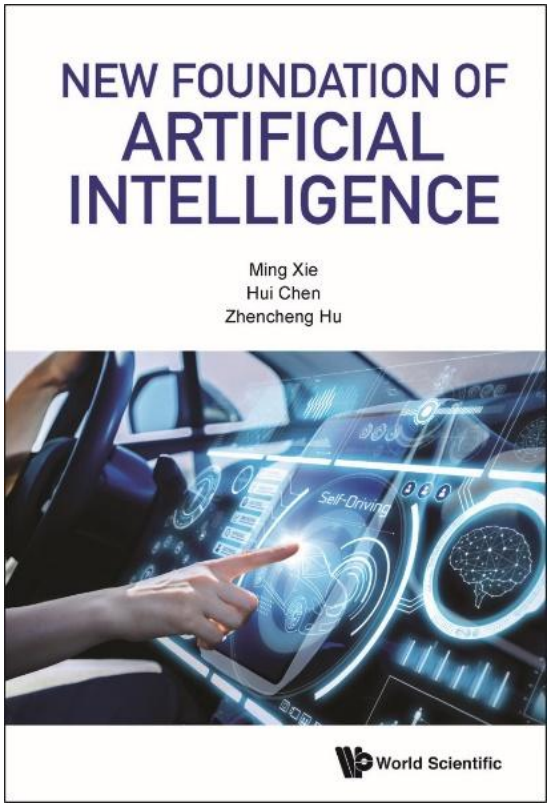
- What is Brain?
  - It is a system which provides a) computation, b) memory and c) interface to sensory systems as well as actuation systems.
- What is Mind?
  - It is a system which could transform: a) signals to knowledge, b) knowledge to knowledge and c) knowledge to signals.
- What is Intelligence?
  - It is the capabilities of Mind, which are supported by Brain.
- What is Artificial Intelligence?
  - It is the capabilities of Artificial Mind, which are supported by Artificial Brain.

"什么是智能？由知、识、觉、思、行产生的综合能力"，– 谢 明

Outline of Today's Talk

- Old Foundation of Artificial Intelligence
- New Foundation of Artificial Intelligence
- Discussions and Conclusions

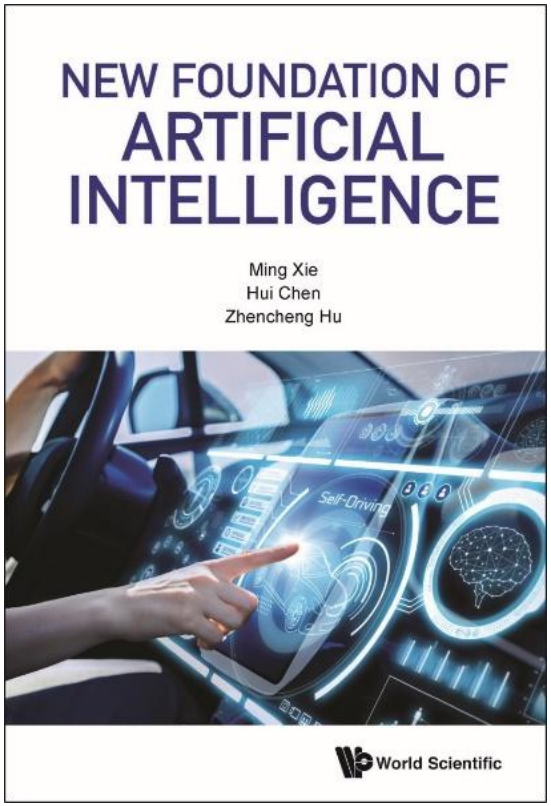
Science of Mind



Outline of Today's Talk

- Old Foundation of Artificial Intelligence
- New Foundation of Artificial Intelligence
- Discussions and Conclusions

Science of Mind

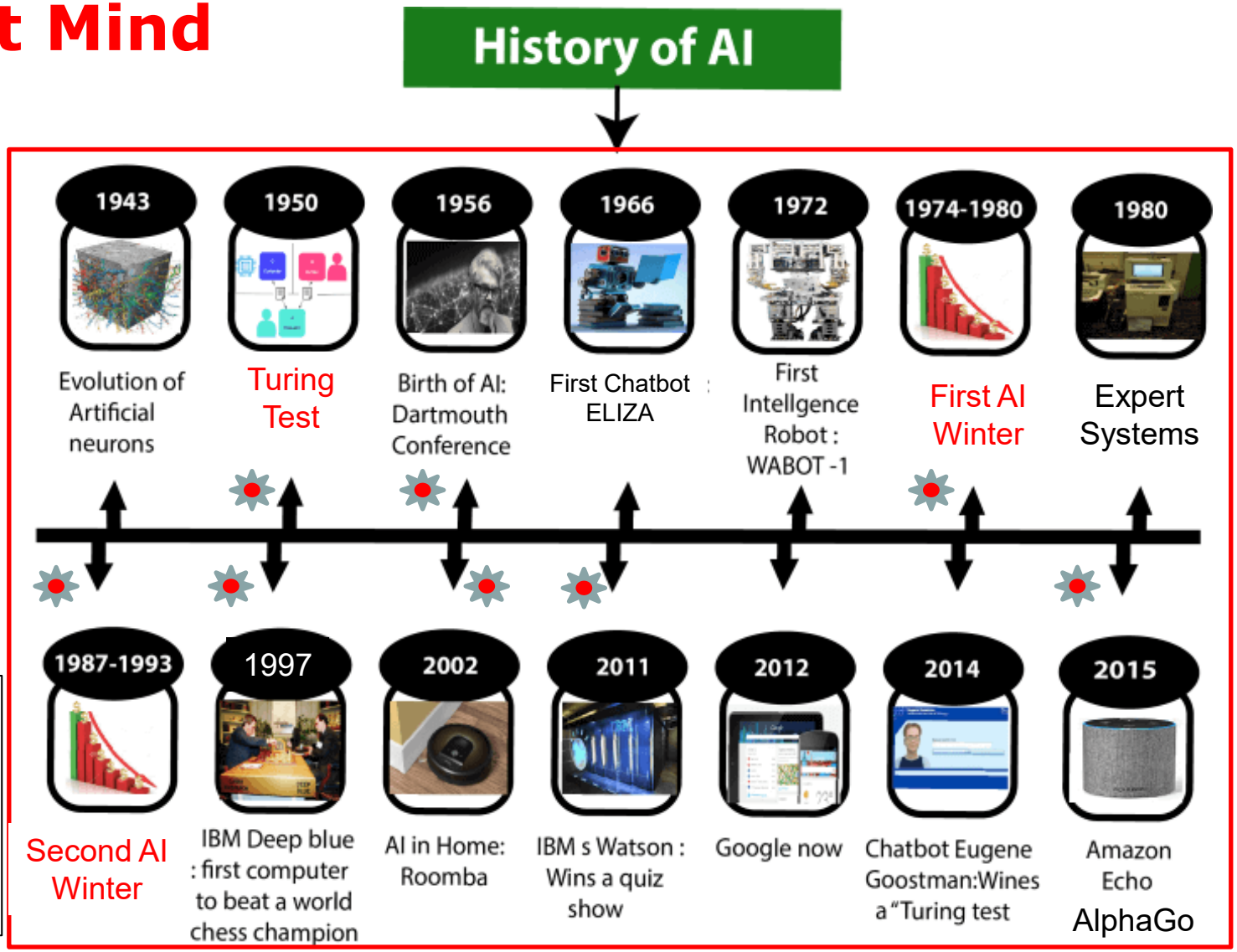


SPECIAL PATTERN OF AI HISTORY

History of Artificial Intelligence or Intelligent Mind

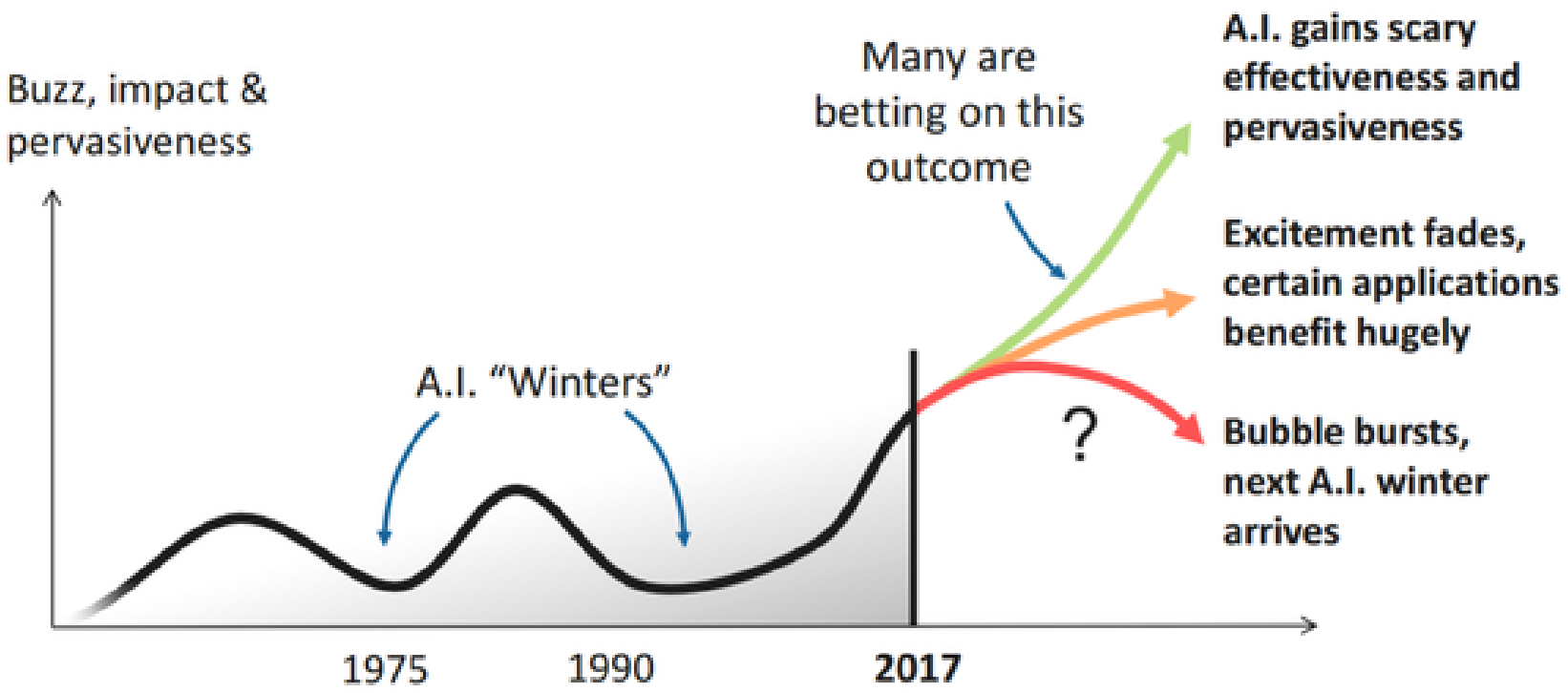
Big Question:

Does intelligence arise from brain or mind?



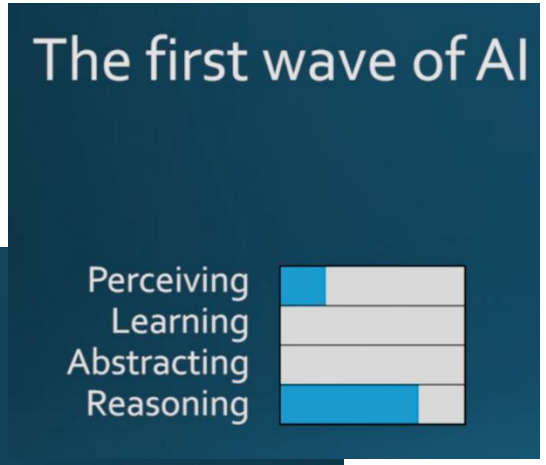
Special Pattern of AI's History

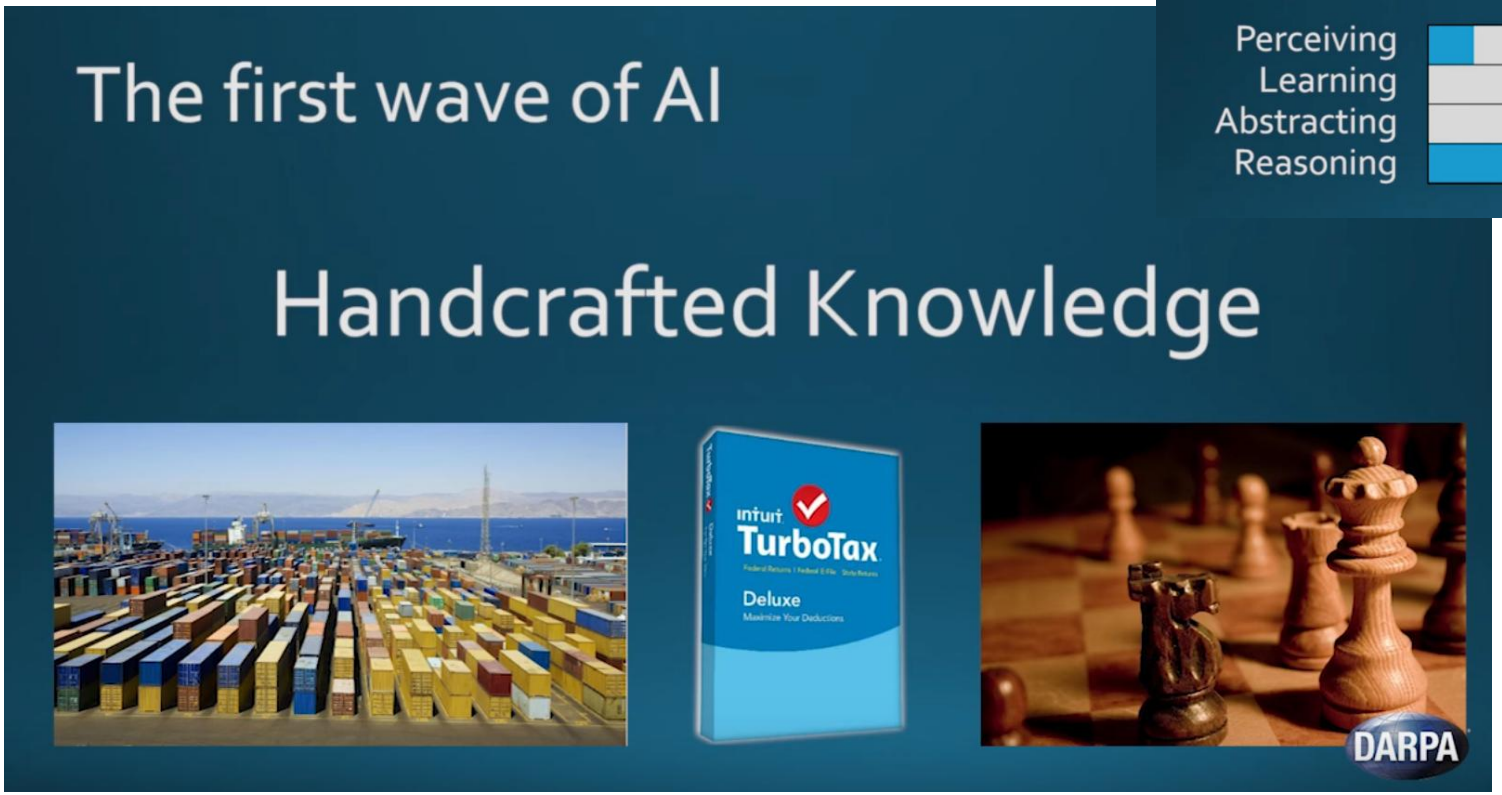
AI is enjoying significant hype and investment



2009	AI 3.0 (Machine's Self-Intelligence) (机器内智) (自具之智，人赋)
2000	AI 2.0 (Machine Learning) (机器学习)
1956	AI 1.0 (Machine Thinking) (机器思考)

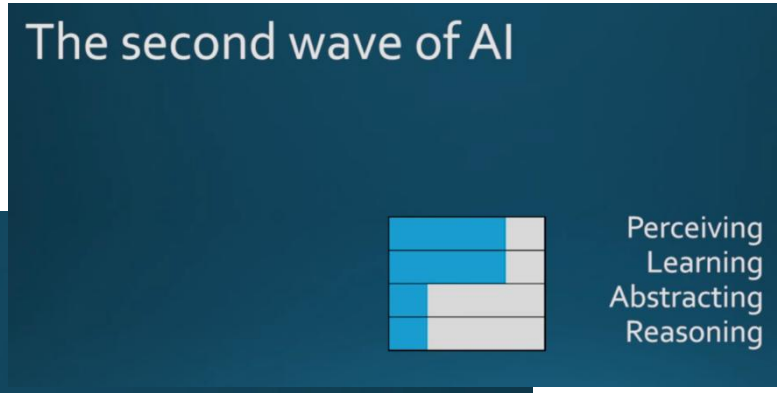
DARPA's Viewpoints (Wave 1)

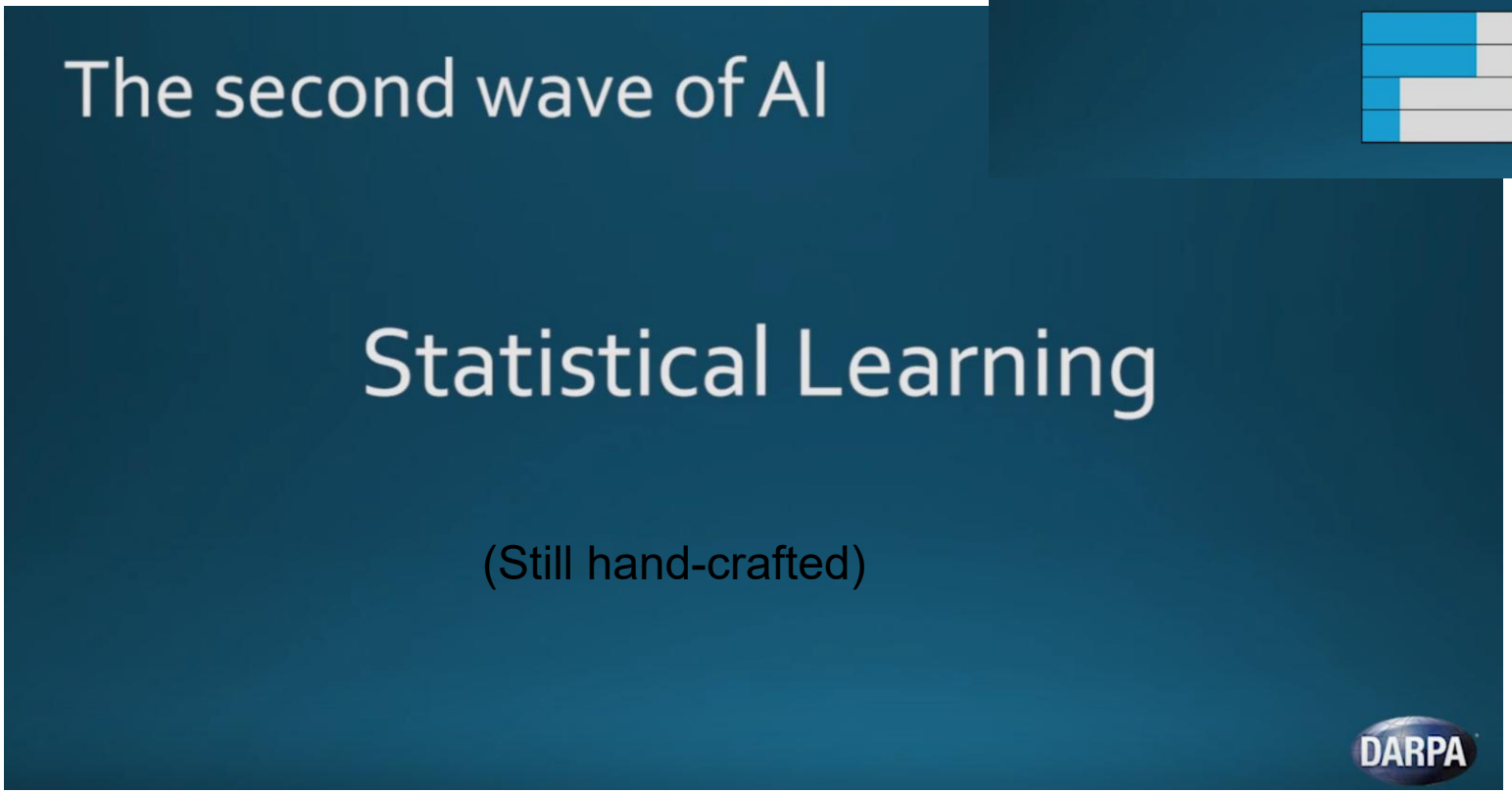




2017.2

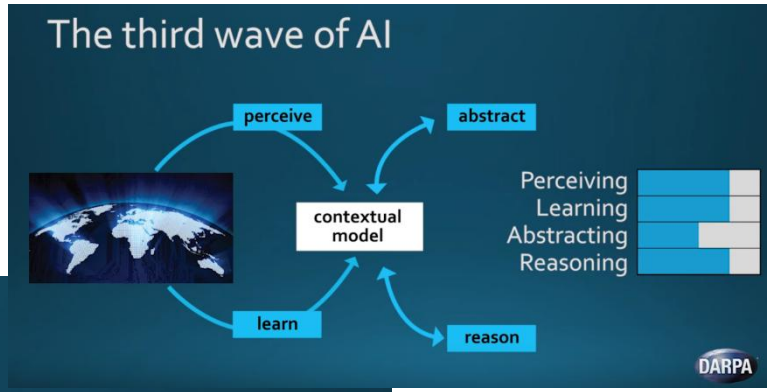
DARPA's Viewpoints (Wave 2)

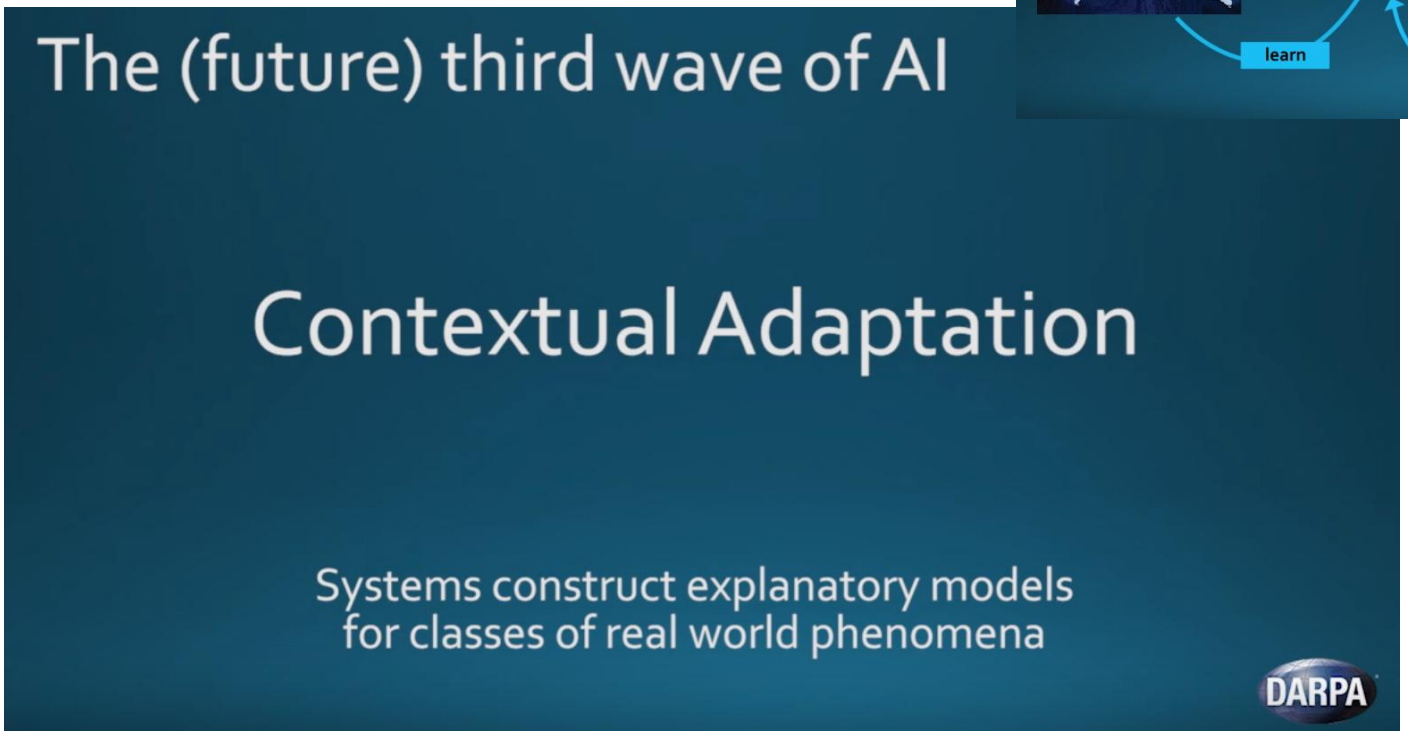




2017.2

DARPA's Viewpoints (Wave 3)

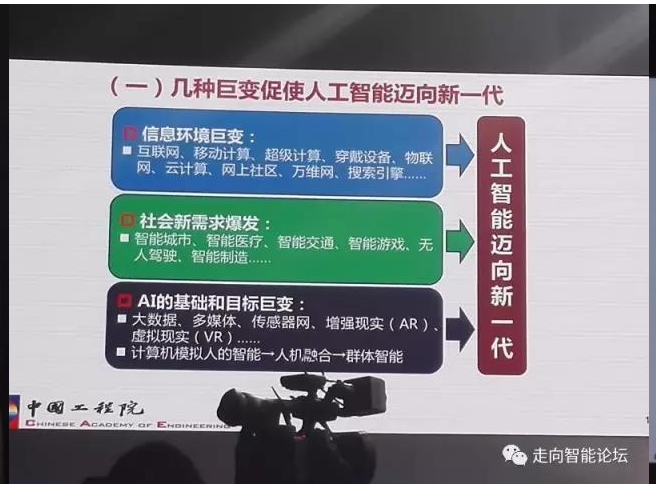


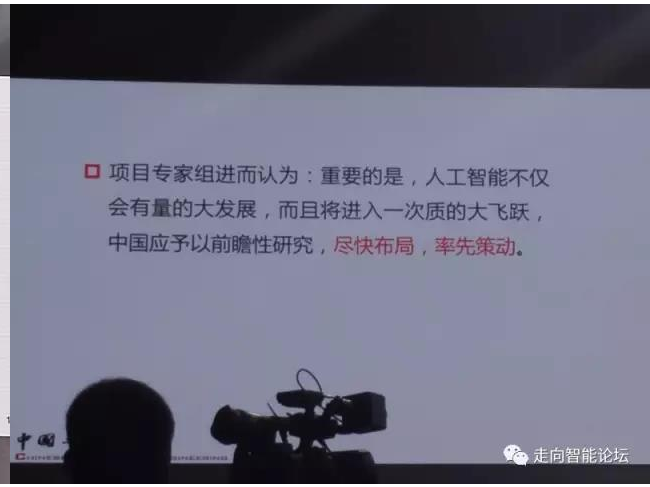


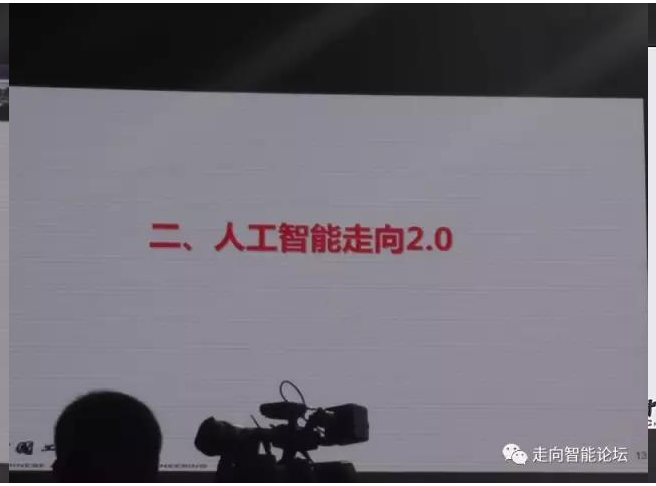
2017.2

China's Viewpoints (AI 2.0)

2017-6

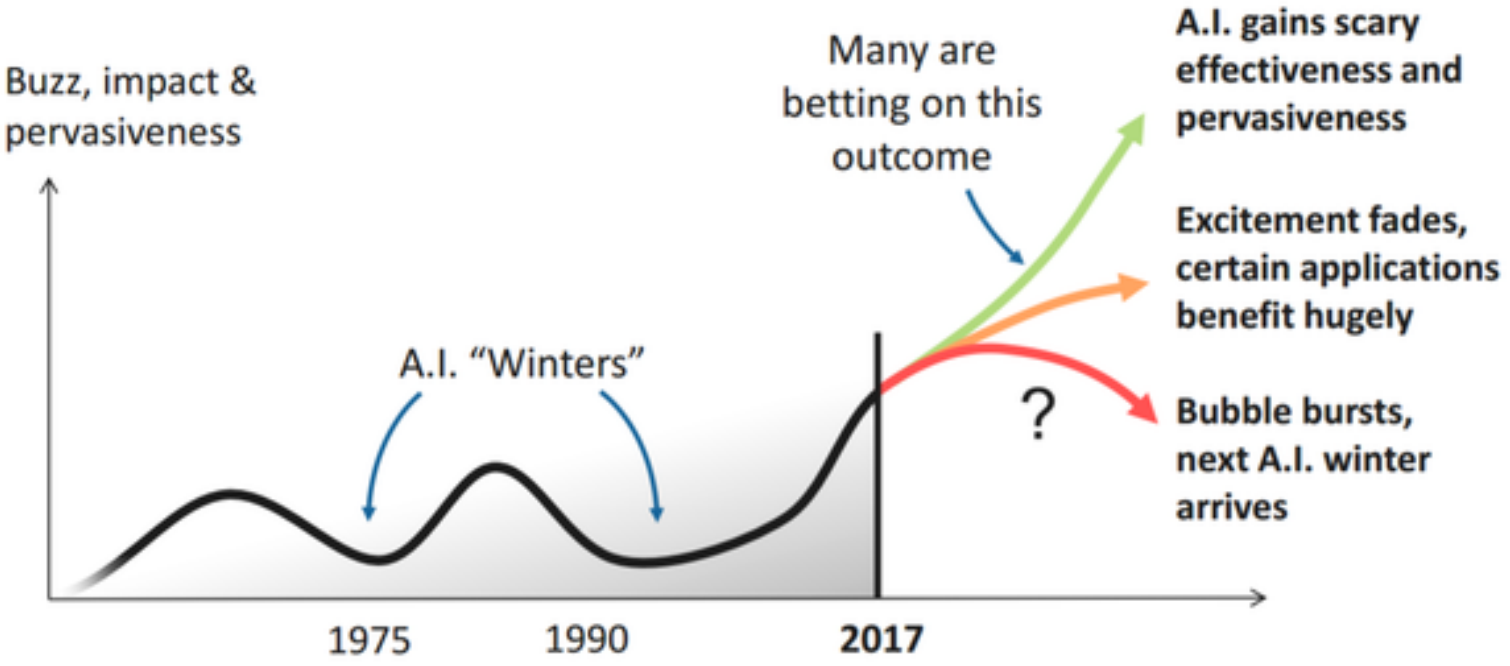






What are the root causes behind such pattern of history?

AI is enjoying significant hype and investment



2009	AI 3.0 (Machine's Self-Intelligence) (机器内智) (自具之智，人赋)
2000	AI 2.0 (Machine Learning) (机器学习)
1956	AI 1.0 (Machine Thinking) (机器思考)

ROOT CAUSE NO.1

Root Cause 1

AI Researchers' Ignorance About Biological Manufacturing …

- Development is a long process of biological manufacturing.
- Development of brain has nothing to do with design of mind.

- Quantitative changes lead to the so-called Mechanical Manufacturing
- Qualitative changes lead to the so-called Chemical Manufacturing
- Fissions lead to the so-called Biological Manufacturing

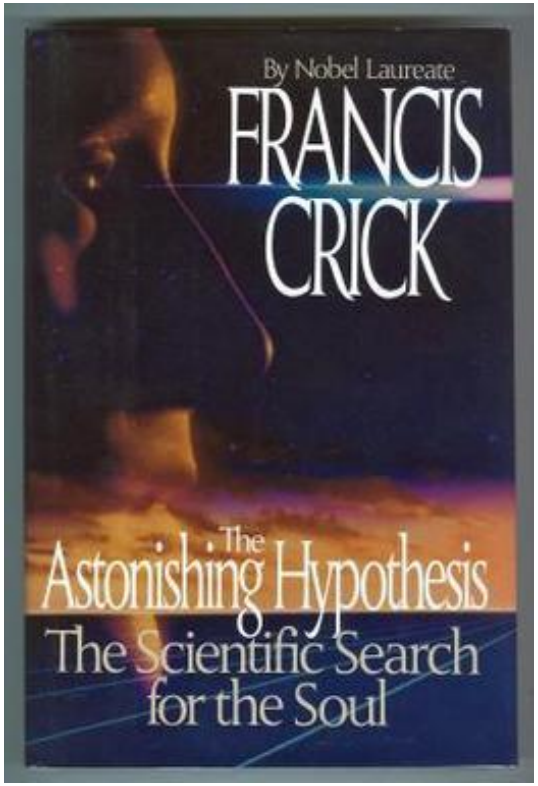
Example of Biological Manufacturing

ROOT CAUSE NO.2

Root Cause 2

What is the astonishing hypothesis?

- ***The Astonishing Hypothesis*** is a 1994 book by scientist Francis Crick about consciousness. Crick, one of the co-discoverers of the molecular structure of DNA, later became a theorist for neurobiology and the study of the brain.
- *The Astonishing Hypothesis* is mostly concerned with establishing a basis for scientific study of consciousness.
- However, Crick places the study of consciousness within a larger social context. Human consciousness according to Crick is central to human existence and so scientists find themselves approaching topics traditionally left to philosophy and religion.

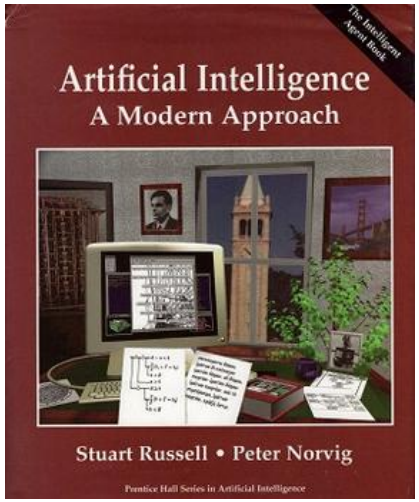


He made suggestion that by analyzing brain's signals, one should be able to discover the details of mind or soul.

ROOT CAUSE NO.3

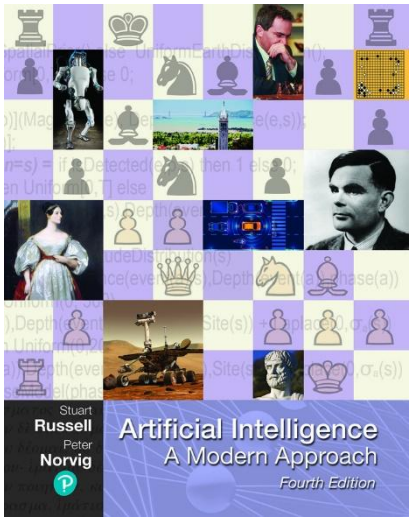
Root Cause 3

What is the most influential book in AI?



- It is used in over 1400 universities worldwide and has been called "the most popular artificial intelligence textbook in the world". It is considered the standard text in the field of artificial intelligence.

- The editions of the book include:
  - 1st Edition, 904 pages, 1995
  - 2nd Edition, 1043 pages, 2003
  - 3rd Edition, 1093 pages, 2010
  - New Edition, 1152 pages, 2021



The book considers that robotics is part of AI

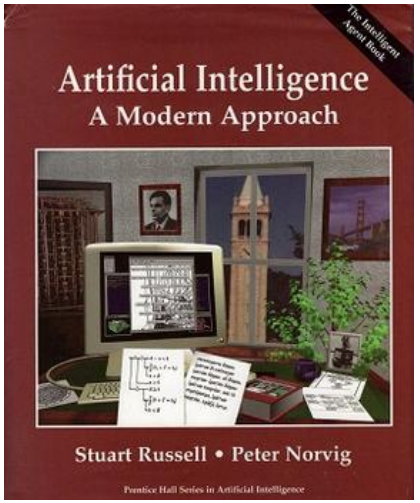
ROOT CAUSE NO.4

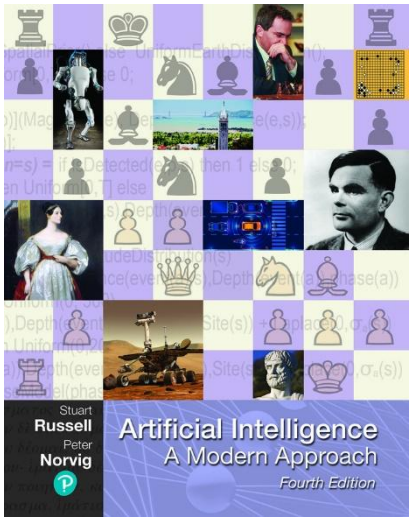
Root Cause 4a

Inappropriate Definition of Artificial Intelligence …

- Many people believe that Artificial Intelligence refers to computer-aided human intelligence, which aims at programming human ways of doing perception, planning and action.

- Computer-aided Intelligence is not equal to Computer Intelligence!



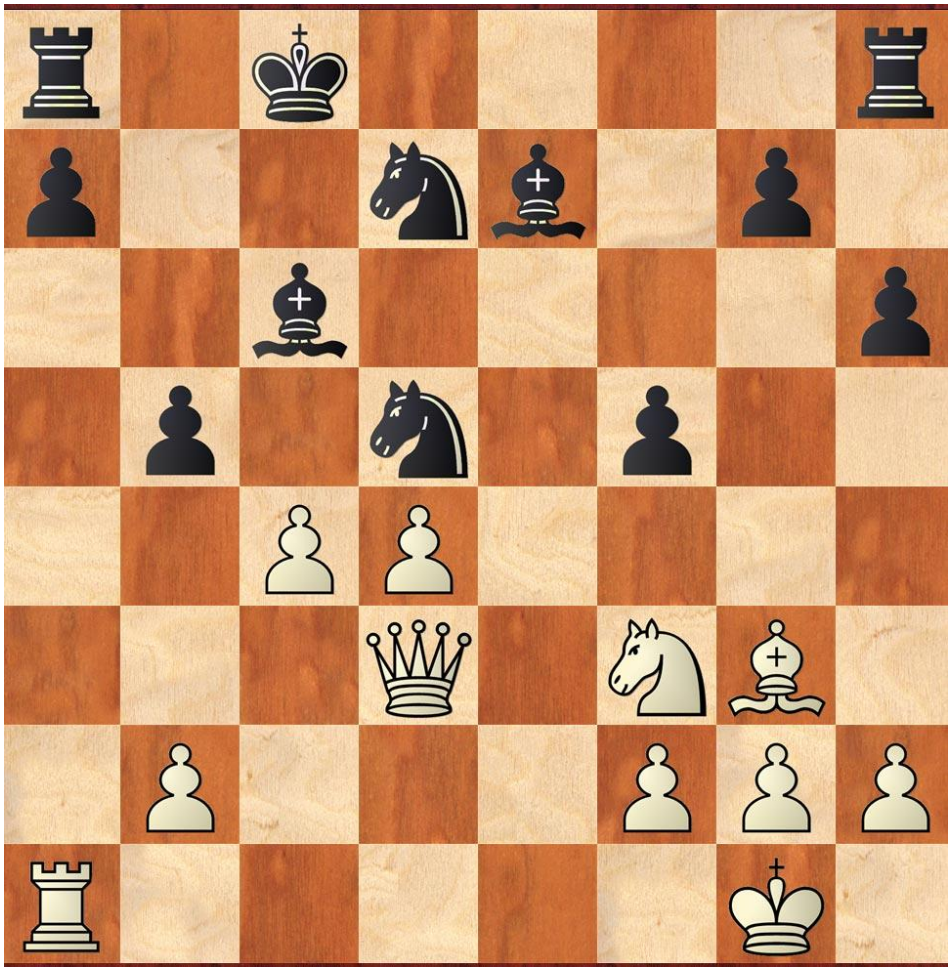


Root Cause 4b

What was the contribution from Deep Blue project?

- **Deep Blue** was a chess-playing computer developed by IBM. It is known for being the first computer chess-playing system to win both a chess game and a chess match against a reigning world champion under regular time controls.

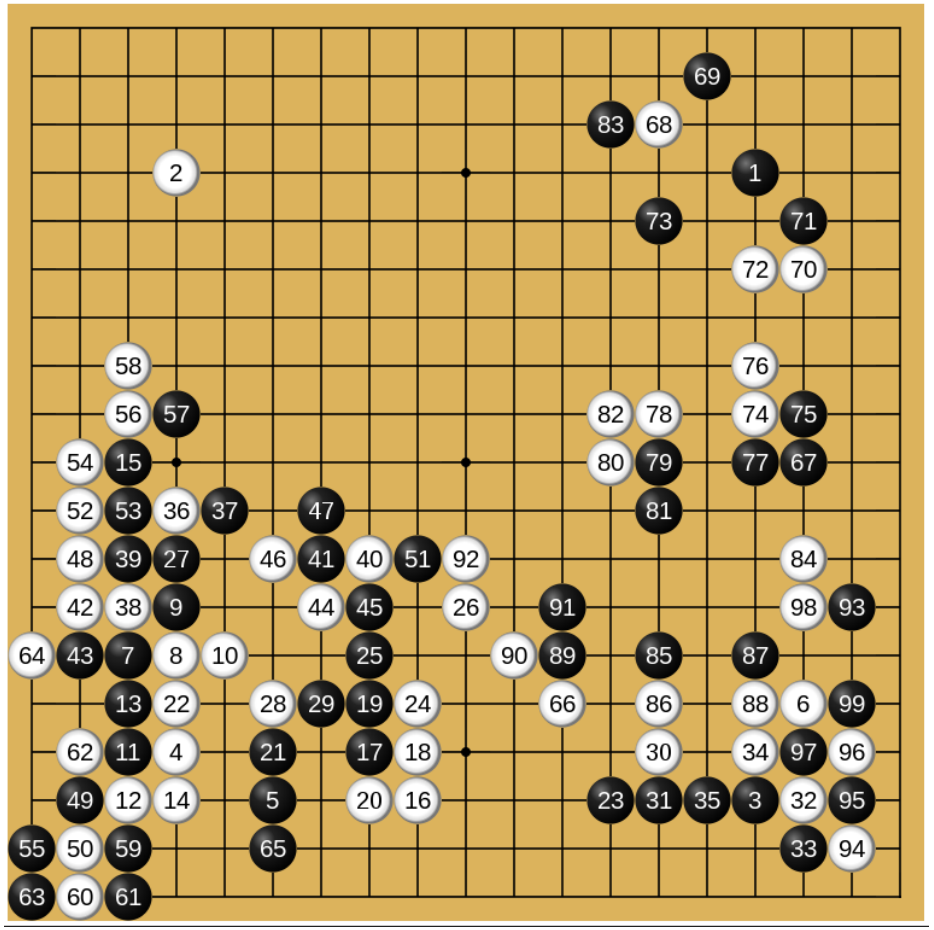
- Deep Blue won its first game against a world champion on 10 February 1996, when it defeated Garry Kasparov in game one of a six-game match.



Root Cause 4c

What was the contribution from Alpha Go project?

- **AlphaGo** is a computer program that plays the board game Go.It was developed by Alphabet Inc.'s Google DeepMind in London.
- In October 2015, AlphaGo became the first computer Go program to beat a human professional Go player without handicaps on a full-sized 19×19 board.
- In March 2016, it beat Lee Sedol in a five-game match, the first time a computer Go program has beaten a 9-dan professional without handicaps.



ROOT CAUSE NO.5

Root Cause 5a

People still believe that Intelligence arises from brain …

Root Cause 5b

USA's Brain Initiative …

- In April 2013, the President announced the launch of the BRAIN (Brain Research through Advancing Innovative Neurotechnologies) Initiative® – a bold, new initiative focused on revolutionizing our understanding of the human brain.

- The initiative will accelerate the development and application of new technologies that will enable researchers to produce dynamic pictures of the brain that show how individual brain cells and complex neural circuits interact at the speed of thought. These technologies will open new doors to explore how the brain records, processes, uses, stores, and retrieves vast quantities of information, and shed light on the complex links between brain function and behavior.

Root Cause 5c

Europe's Brain Project …

- The Human Brain Project (HBP) is one o the three FET (Future and Emerging Technology) Flagship projects.
- Started in 2013, it is one of the largest research projects in the world . More tha 500 scientists and engineers at over tha 140 universities, teaching hospitals, and research centres across Europe come together to address one of the most challenging research targets – the human brain.
- The Human Brain Project aims to put in place a cutting-edge research infrastructure that will allow scientific and industrial researchers to advance ou knowledge in the fields of neuroscience computing, and brain-related medicine.

Human Brain Project

500+ Researchers	16 Countries	607 M Euro*
123 Institutions	10 Years**	2,000 Publications

1 Research infrastructure: EBRAINS

* including partner contributions
** 2013–2023

China's Initiative …

习近平：在中国科学院第十七次院士大会、中国工程院第十二次院士大会上的讲话

（2014年6月9日）

习近平

2014年06月10日07:02　　来源：人民网－人民日报

各位院士，同志们，朋友们：

今天，群英荟萃，群贤毕至，中国科学院第十七次院士大会、中国工程院第十二次院士大会开幕了。有机会同大家见面，感到十分高兴。首先，我代表党中央、国务院，对两院院士大会的召开，表示衷心的祝贺！向两院院士和全国广大科技工作者，表示诚挚的问候！向前来参加会议的外籍院士和国际科学界的朋友们，表示热烈的欢迎！

(to continue …)

前几天，我看了一份材料，说“机器人革命”有望成为“第三次工业革命”的一个切入点和重要增长点，将影响全球制造业格局，而且我国将成为全球最大的机器人市场。国际机器人联合会预测，“机器人革命”将创造数万亿美元的市场。由于大数据、云计算、移动互联网等新一代信息技术同机器人技术相互融合步伐加快，3D打印、人工智能迅猛发展，制造机器人的软硬件技术日趋成熟，成本不断降低，性能不断提升，军用无人机、自动驾驶汽车、家政服务机器人已经成为现实，有的人工智能机器人已具有相当程度的自主思维和学习能力。国际上有舆论认为，机器人是“制造业皇冠顶端的明珠”，其研发、制造、应用是衡量一个国家科技创新和高端制造业水平的重要标志。机器人主要制造商和国家纷纷加紧布局，抢占技术和市场制高点。看到这里，我就在想，我国将成为机器人的最大市场，但我们的技术和制造能力能不能应对这场竞争？我们不仅要把我国机器人水平提高上去，而且要尽可能多地占领市场。这样的新技术新领域还很多，我们要审时度势、全盘考虑、抓紧谋划、扎实推进。

2014.6.9

ROOT CAUSE NO.6

Root Cause 6a

Fake AI: Is Deep Machine Tuning equal to Deep Machine Learning? (from MIT)

Example of Machine's Fake Learning

GYSS SINGAPORE

8-12 JANUARY 2024

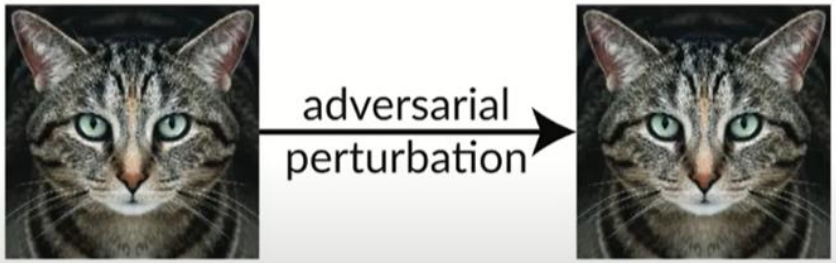
GLOBAL YOUNG SCIENTISTS SUMMIT

EXCITE • ENGAGE • ENABLE

Organised by
NATIONAL RESEARCH FOUNDATION
PRIME MINISTER'S OFFICE
SINGAPORE

Adversarial Examples:

- Were discovered in 2013 by Szegedy et al and Biggio et al
- Have major security implications and applications



Salad made of avocado

Another Example of Machine's Fake Learning

GYSS SINGAPORE

8-12 JANUARY 2024

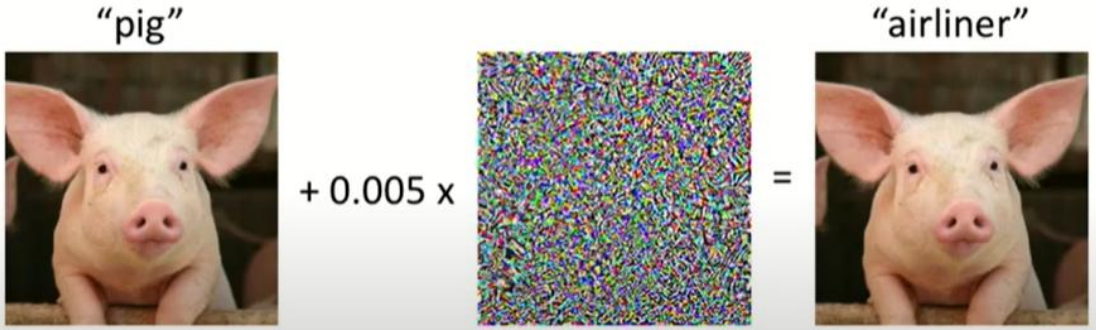
GLOBAL YOUNG SCIENTISTS SUMMIT

EXCITE • ENGAGE • ENABLE

Organised by

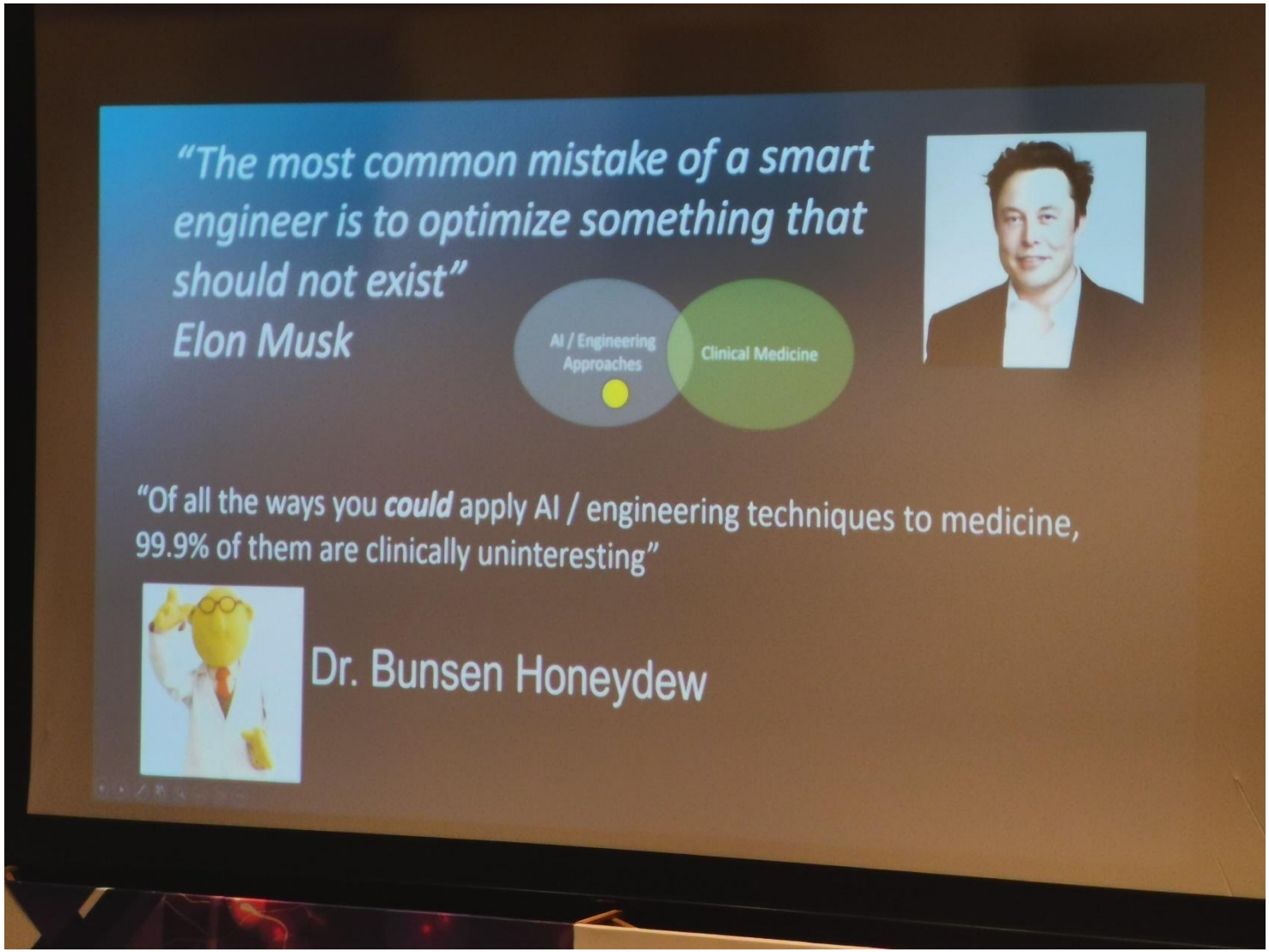
NATIONAL RESEARCH FOUNDATION
PRIME MINISTER'S OFFICE
SINGAPORE

Pigs can fly:



Root Cause 6b

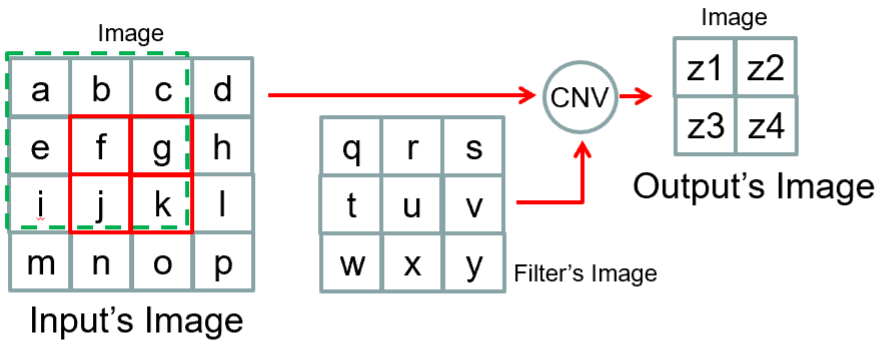
Fake AI: (from a talk by NUS)

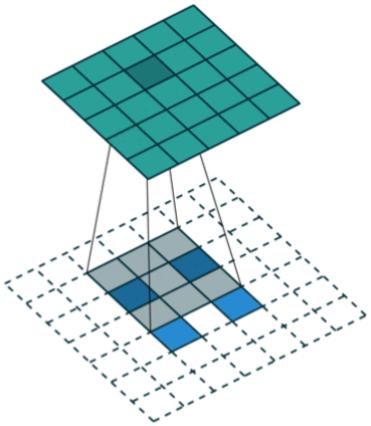


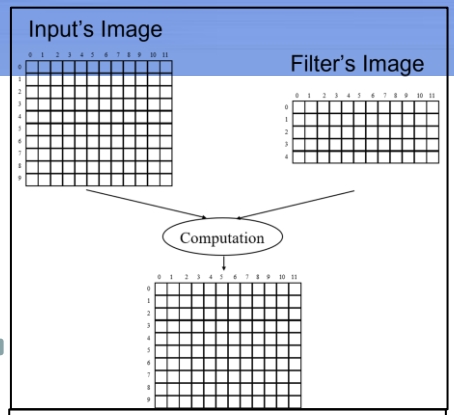
Root Cause 6c

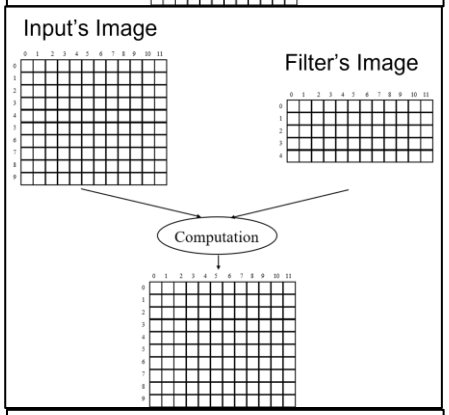
Fake AI: One Illustration of Convolution

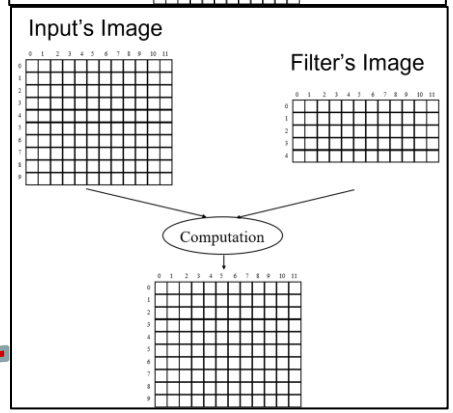
- Computational Neural Network (i.e. ComNN)





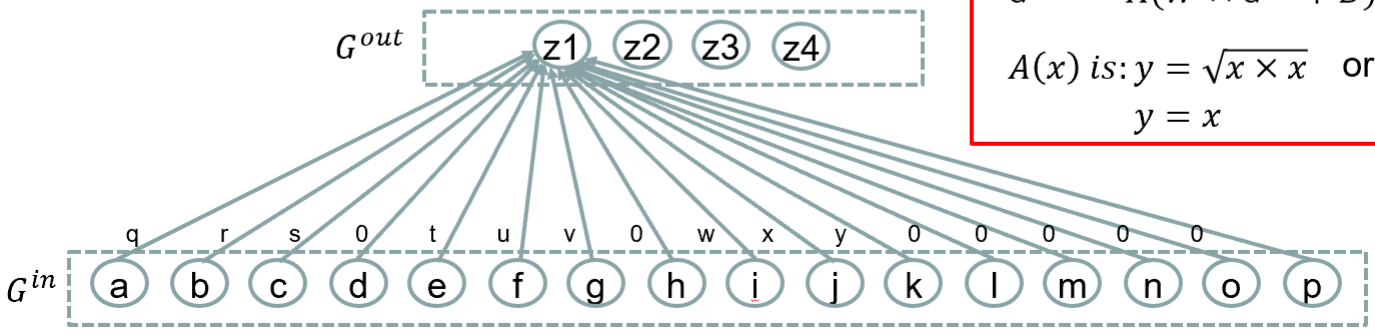






$$G^{out} = A(W \times G^{in} + B)$$

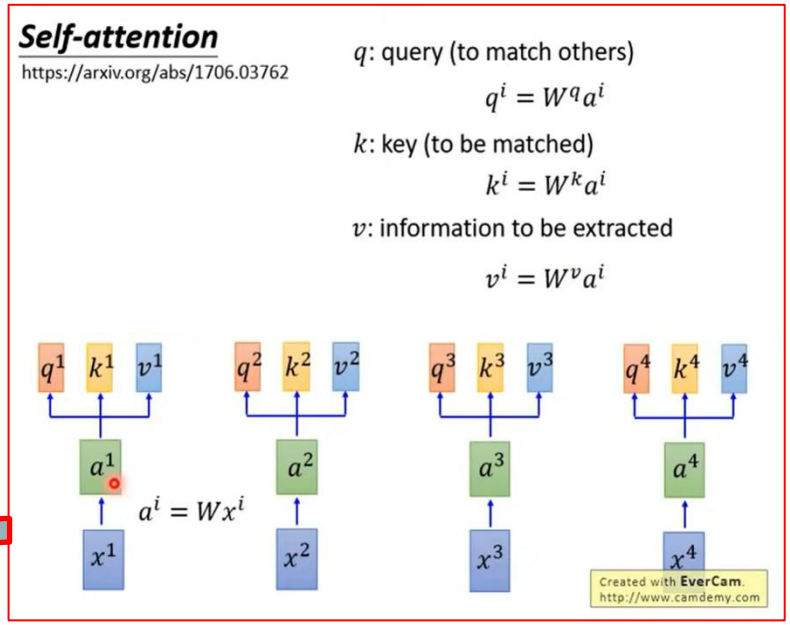
$$A(x)\ is: y = \sqrt{x \times x} \quad \text{or} \quad y = x$$

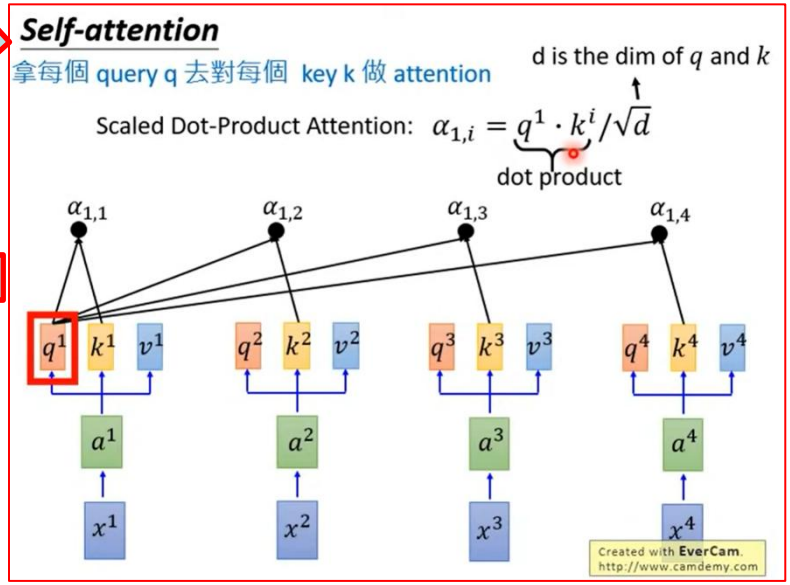


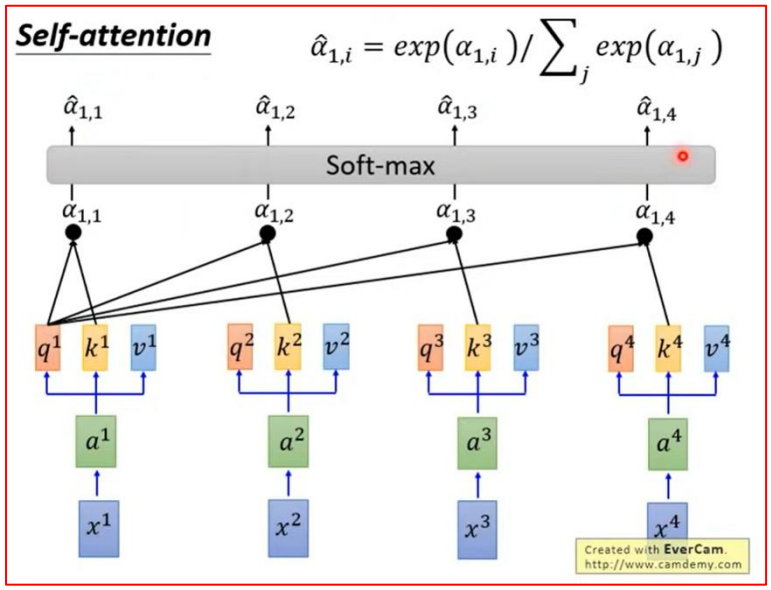
. . . . . .

Root Cause 6d

Fake AI: One Illustration of Transformer

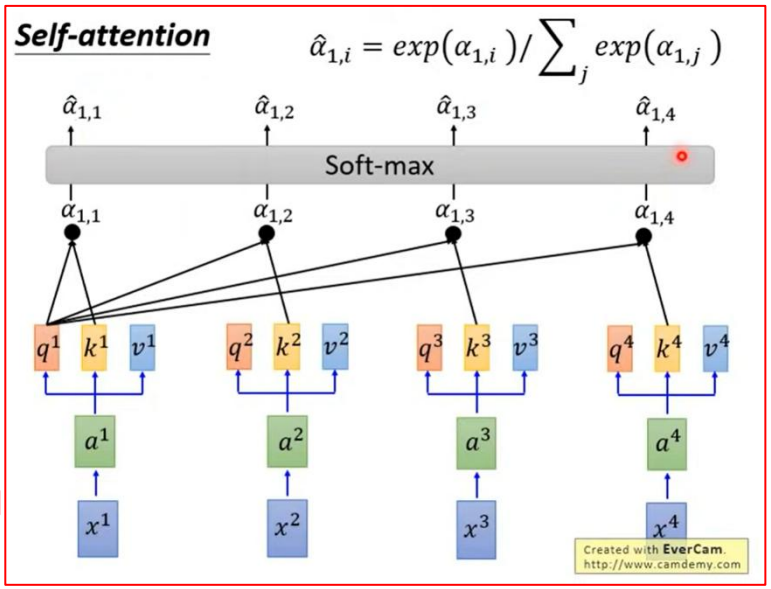


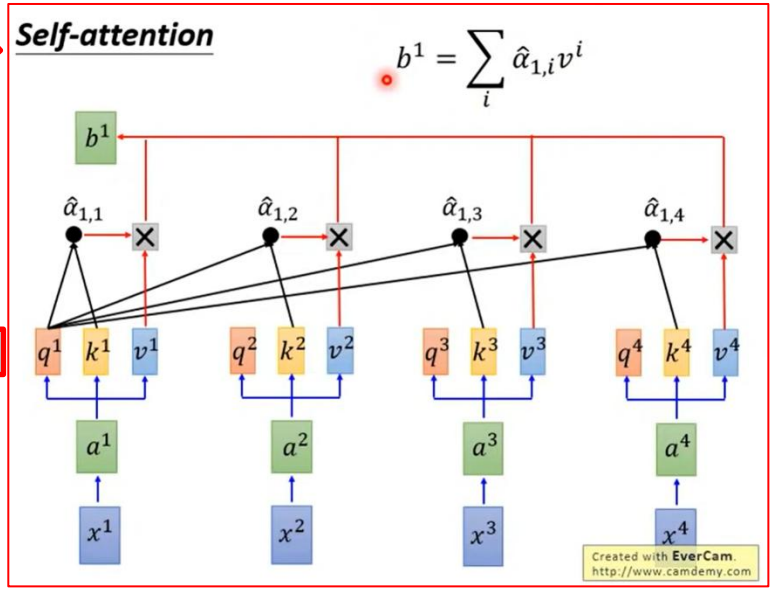


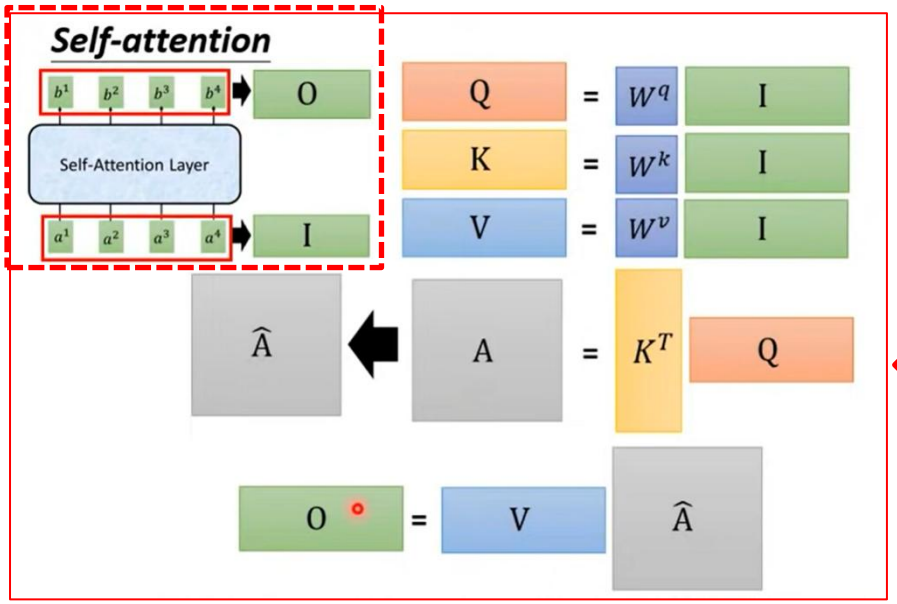


Root Cause 6e

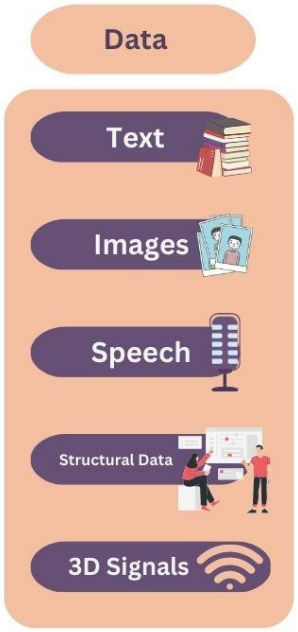
Fake AI: One Illustration of Transformer (continued …)

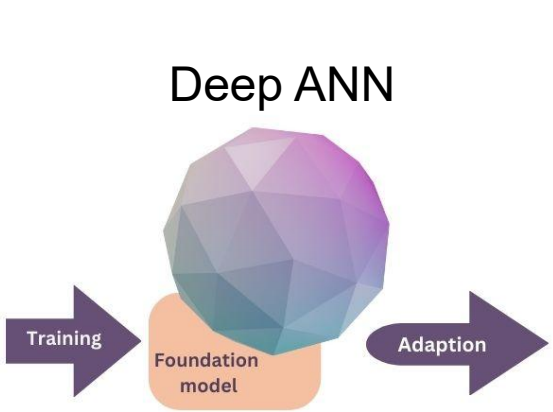


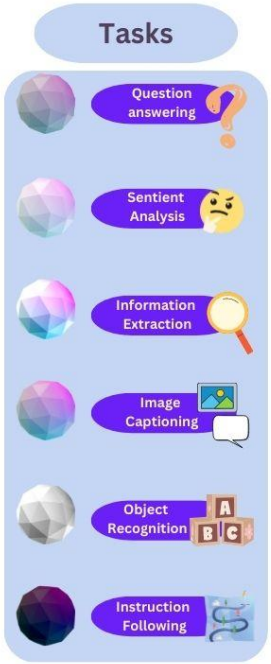


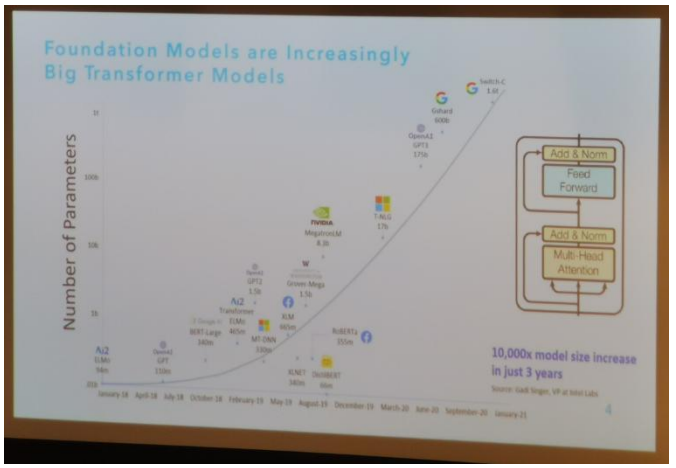


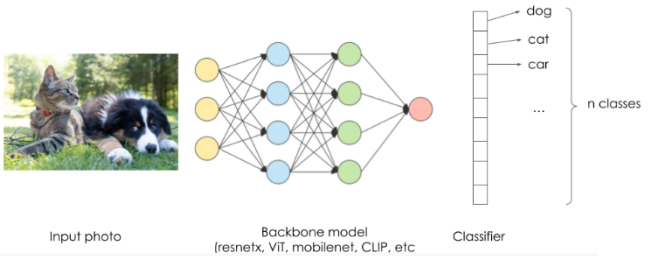
Huge Investment Wasted to FMs …

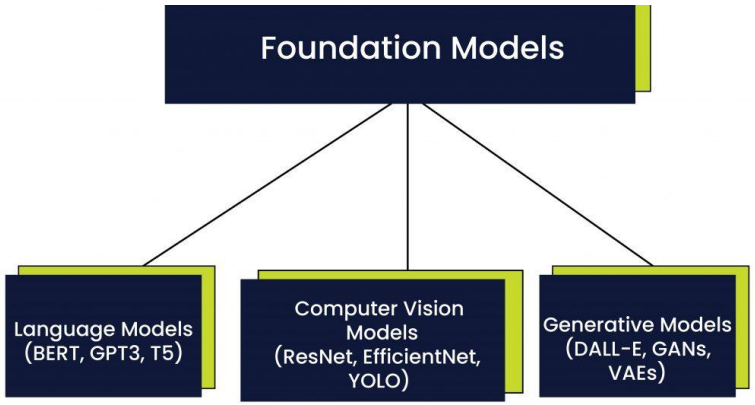


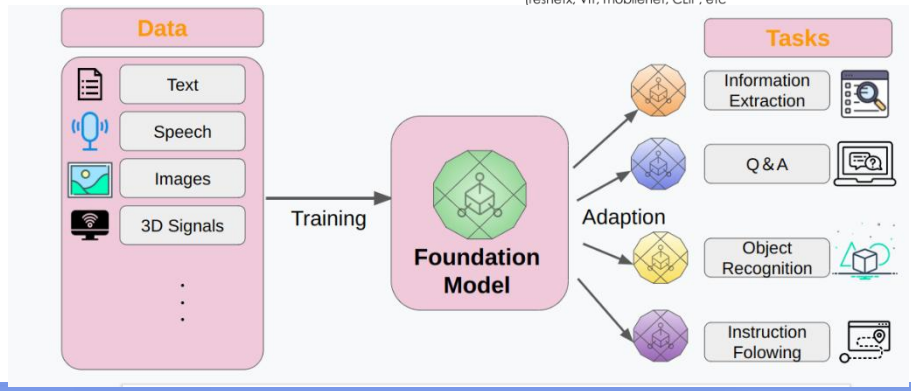




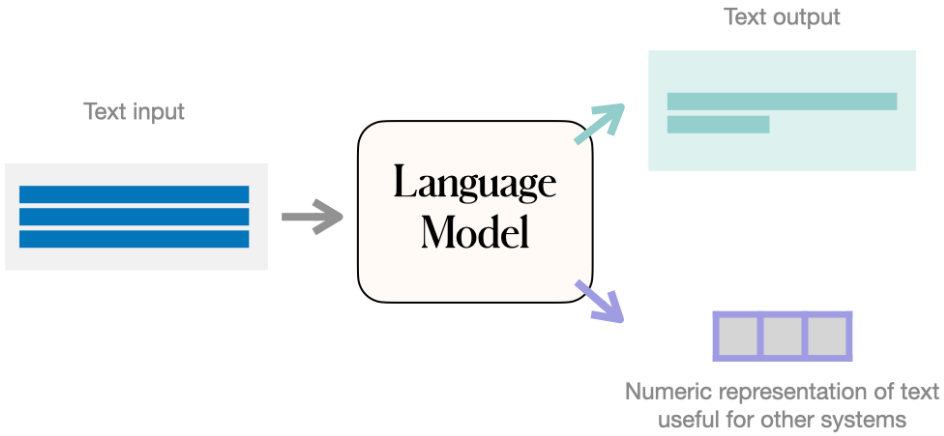


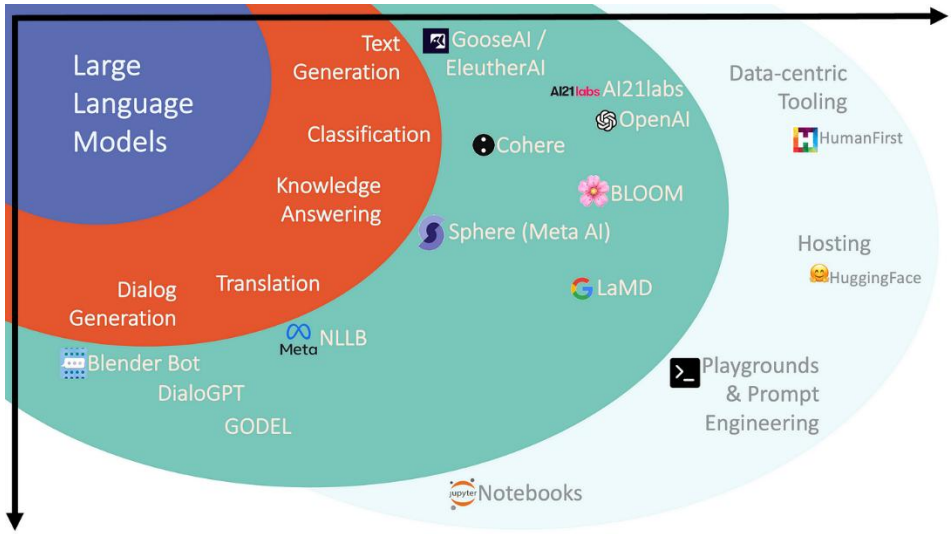


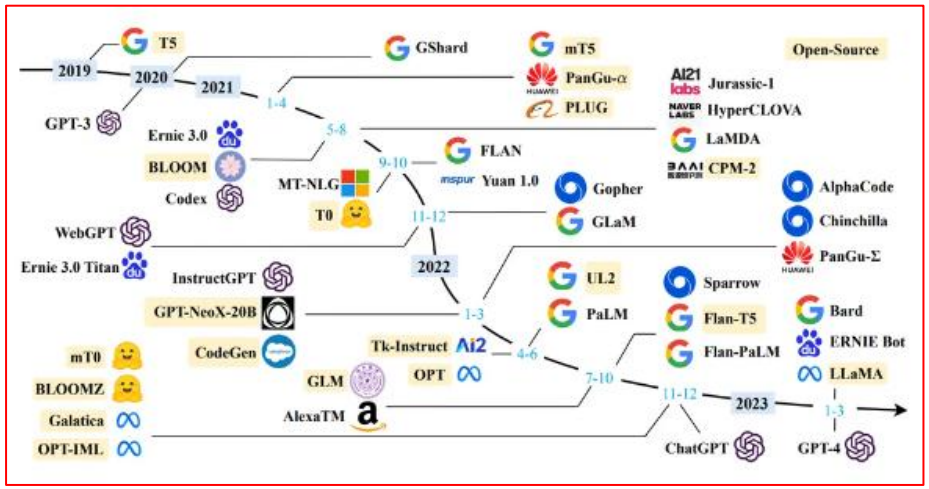


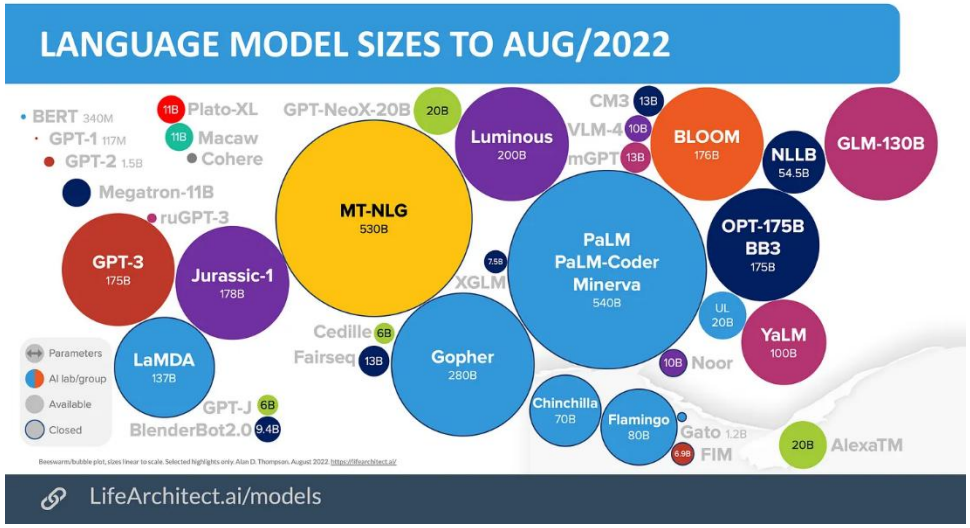


Huge Investment Wasted to LLMs …









HOW TO CLEAN UP MISCONCEPTIONS IN AI?

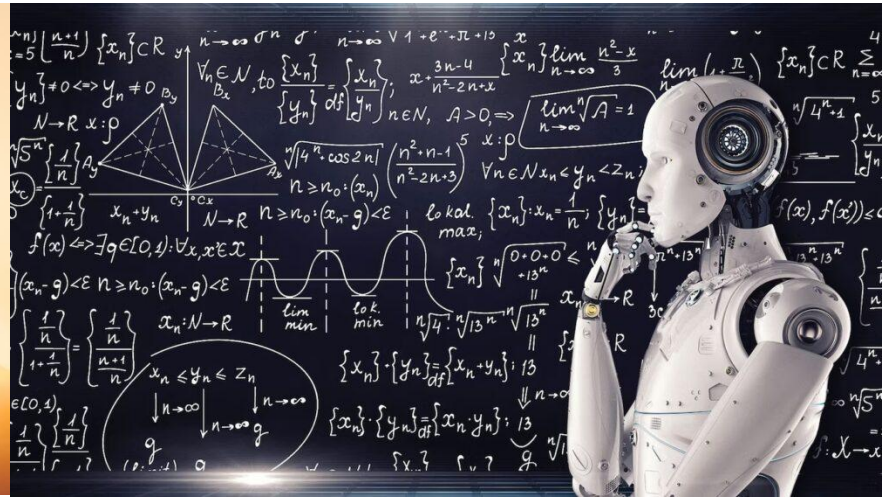
How to avoid stupidity in AI?

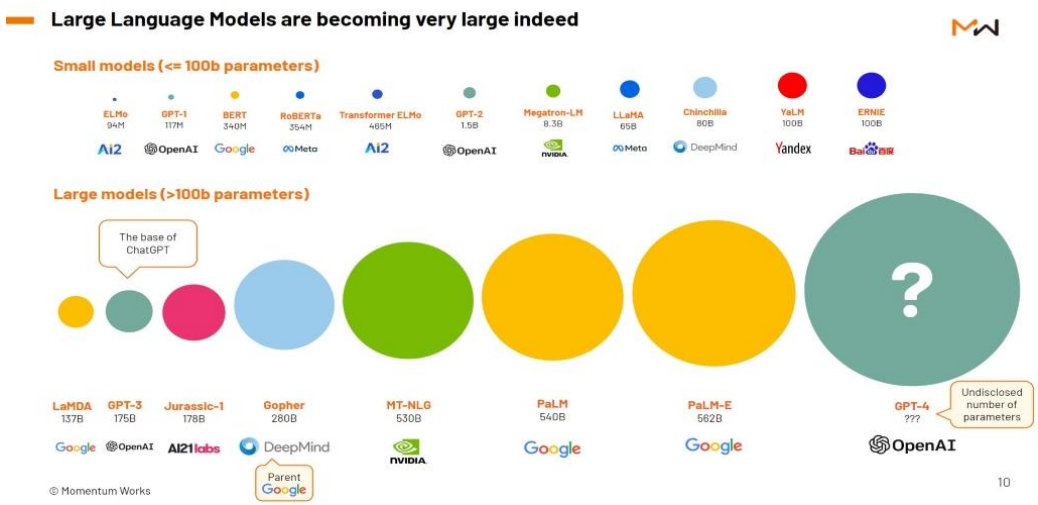
Does Intelligence arise from neural systems?

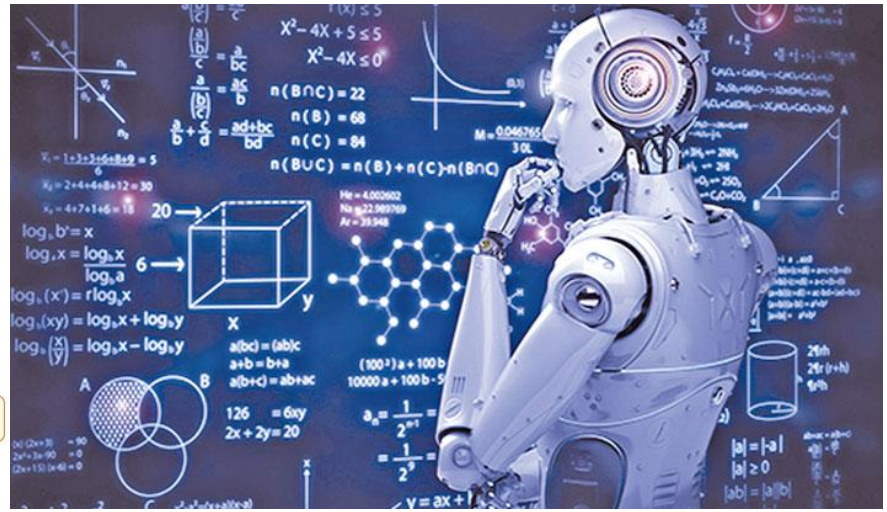
Although computer-generated
artificial intelligence eludes us,
artificial stupidity has been perfected.

P.J. O'Rourke

Why to name Text Models as Language Models?







Mathematics Behind the Buzz Words "Foundation Models (FM)" or "Large Language Models (LLM)" ...

analytical representation of an artificial neural network with a single hidden layer could be described by the following equation in matrix form:

$$G^{out} = A(W \times G^{in} + B) \quad (1)$$

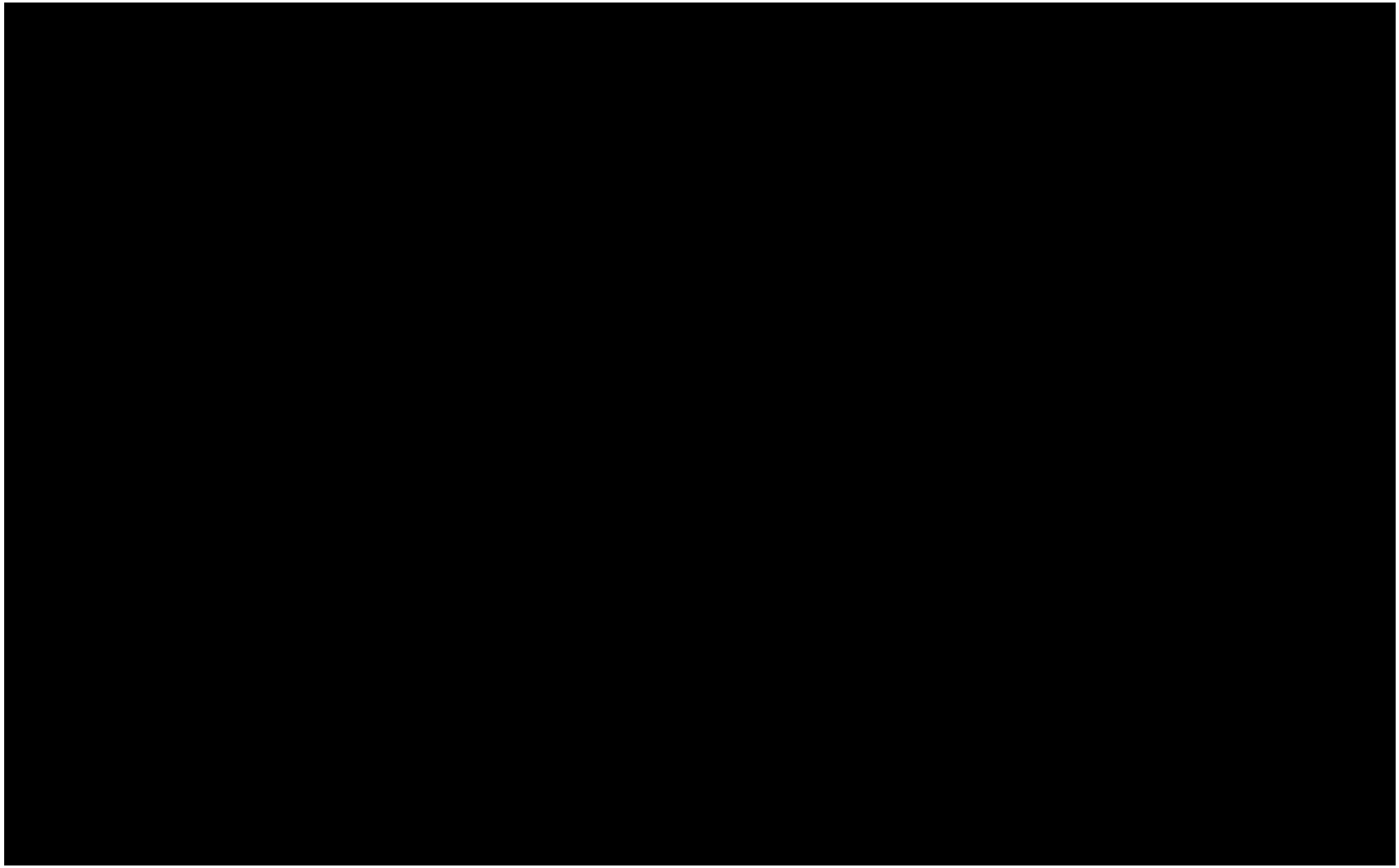
Single Hidden Layer

$$G^{out} = A_h(W_h \times A_{h-1}(\dots A_2(W_2 \times A_1(W_1 \times G^{in} + B_1) + B_2) \dots) + B_h) \quad (2)$$

where h represents the number of hidden layers (i.e., $h = 1,2,3, \dots$), W_h is the matrix of coefficients at h^{th} hidden layer, B_h is the bias vector or matrix at h^{th} hidden layer, and A_h is the activation function at h^{th} output layer. It is important to take note that the sizes of the weighting coefficient matrices do not need to be the same as long as any pair of two adjacent matrices in multiplication satisfy the constraint in which the number of columns in the left matrix is equal to the number of rows in the right matrix.

Xie M., 2024, Top-down Design of Human-like Teachable Mind, Special Issue in Celebrating IJHR's 20th-Year Anniversary, International Journal of Humanoid Robotics.

Speech on 18 October 2023



Singapore's AI Strategy 2.0

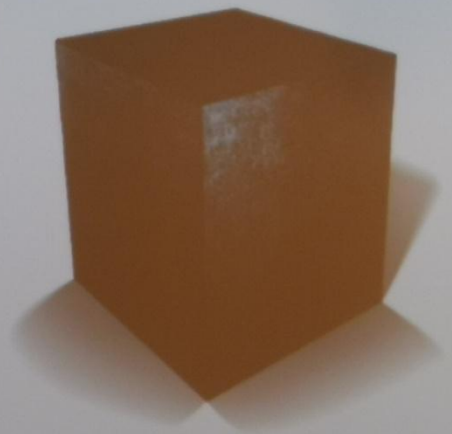
NTU's AI-Related Position Statement No. 1:

Statement 1: Explainability

Deployed AI tools should have max effort of explainability and interpretability unless there are clear benefits to the patient of black box models

Because of their complexity, such tools often provide answers beyond biological rationalization and human comprehension, are widely treated as "black boxes".

Do we require AI algorithm be 100% interpretable? It has been argued that many time-honored effective drugs such as aspirin, metformin, acetaminophen that have been used for decades with undisputed efficacy, yet their mechanism of action are still unclear.



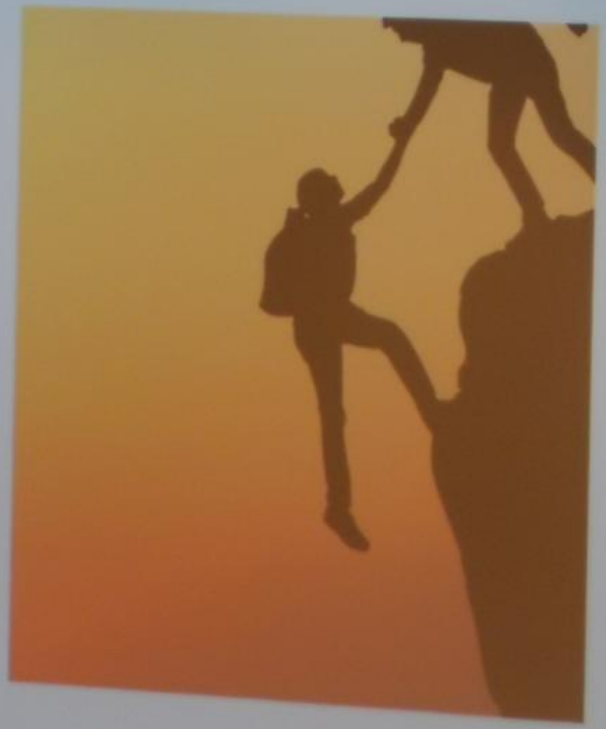
NTU's AI-Related Position Statement No. 13:

Statement 13: Trust

A government-and-professional led program to build trust on AI usage in clinical practice based on evidence should be established

Trust is defined as belief or confidence in the reliability, credibility and integrity of a person, system or technology which leads to usage or action (Mayer et al. 1995)

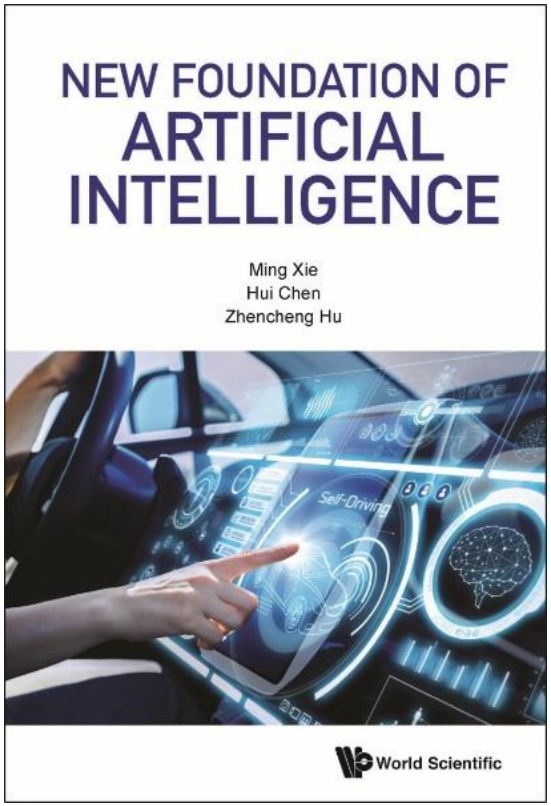
Engagement of users is a key step for strengthening respect of persons and building public trust.



Outline of Today's Talk

- Old Foundation of Artificial Intelligence
- New Foundation of Artificial Intelligence
- Discussions and Conclusions

Science of Mind



Old Definitions of Artificial Intelligence

AI 1.0: Machine Thinking

- Artificial intelligence refers to computer-aided human intelligence, which aims at programming human ways of doing reasoning, inference and decision-making.

AI 2.0: Machine Learning

- Artificial intelligence refers to computer-aided human intelligence, which aims at programming human ways of doing learning of knowledge about truths and skills.

- Computer-aided Intelligence is not equal to Computer Intelligence!

- Computer-aided Intelligence is not equal to Computer Intelligence!

What should be the new paradigm in AI?

Old: Bottom-up Evolution

- Mind Is What Brain Does
- Mind Comes from Evolution
- Development without Design
- Computer-aided Intelligence
- Tuning Is Learning

New: Top-Down Design

- Mind Is Not Brain
- Mind Comes from Design
- Production after Design
- Self-Intelligence
- Tuning Is Not Learning

New Outlook of Body-Brain-Mind

身体 Body	大脑 Brain	识体 Mind
- Action - Reaction	- Memory - Computation	- Cognition - Recognition

Last Frontier in Science: "Science of Mind"
How to design machine's mind?

Coarse Mind 第1–6识觉

Subtle Mind 第7识觉

+

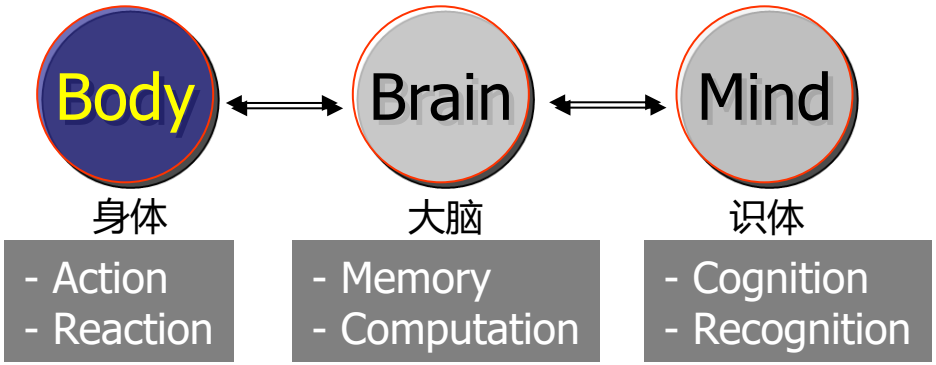
Deep Mind 第8识觉

=

- Soul
- Life

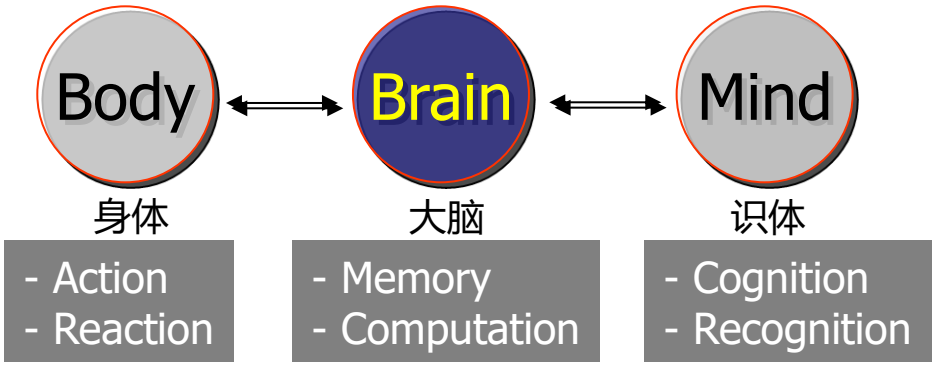
What is body?

- A body is a motion system which could undertake action and reaction.



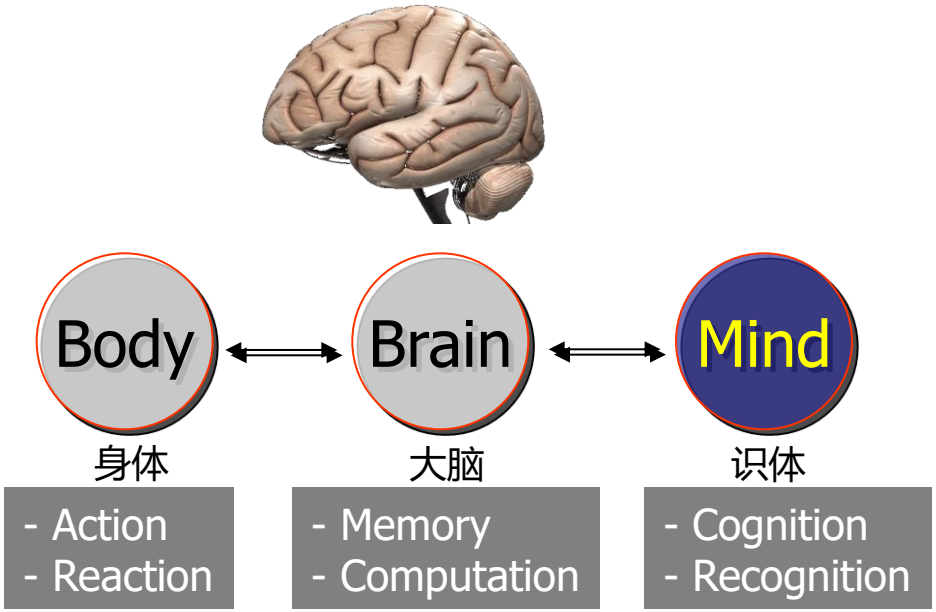
What is brain?

- A brain is a computing system which could undertake computation and memorization.



What is mind?

- A mind is a knowledge system which could undertake cognition and recognition.



Astonishing Truth Between Brain and Mind …

- Energy -> Signal -> Data -> Big Data -> Big Intelligence

Astonishing Truths Between Brain and Mind ...

- Life never dies
- Life reincarnates
- One body has one brain
- One brain could house different minds

Astonishing Truths Between Brain and Mind …

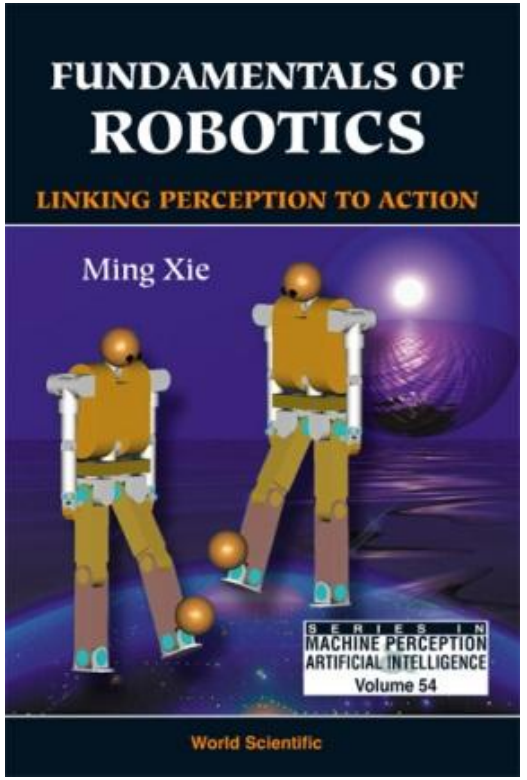
- Life never dies
- Life reincarnates
- One body has one brain
- One brain could house different minds
- One mind has multiple settings

How to make machines to learn?

How to design educable robots or machines?

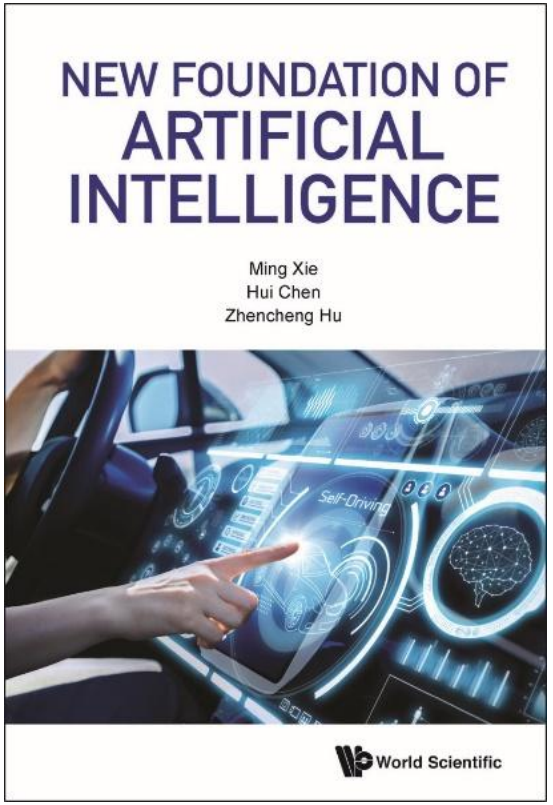
- In my book published in 2003, I said that the necessary condition for a machine to be able to learn is to be educable.

- How much promise remains for entrepreneurs? Plenty, Gates insisted during a tour of several top universities in 2004. In a stop at MIT, a student asked Gates if another tech company could ever match Microsoft's success. **"If you invent a breakthrough in artificial intelligence so machines can learn," he responded, "that is worth 10 Microsofts."**



What should be the new foundation of AI?

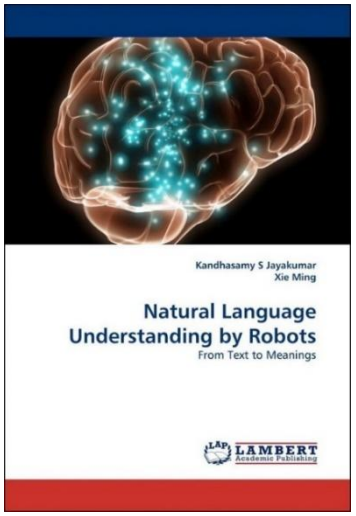
- The foundation of Artificial Intelligence should be machine's self-intelligence, which aims at discovering and implementing the principles behind the transformations from signals to cognitive states of knowing the meanings inside the signals.

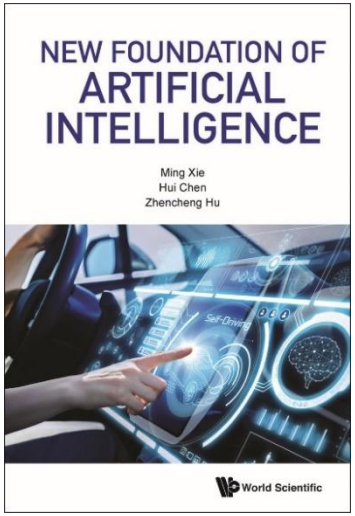


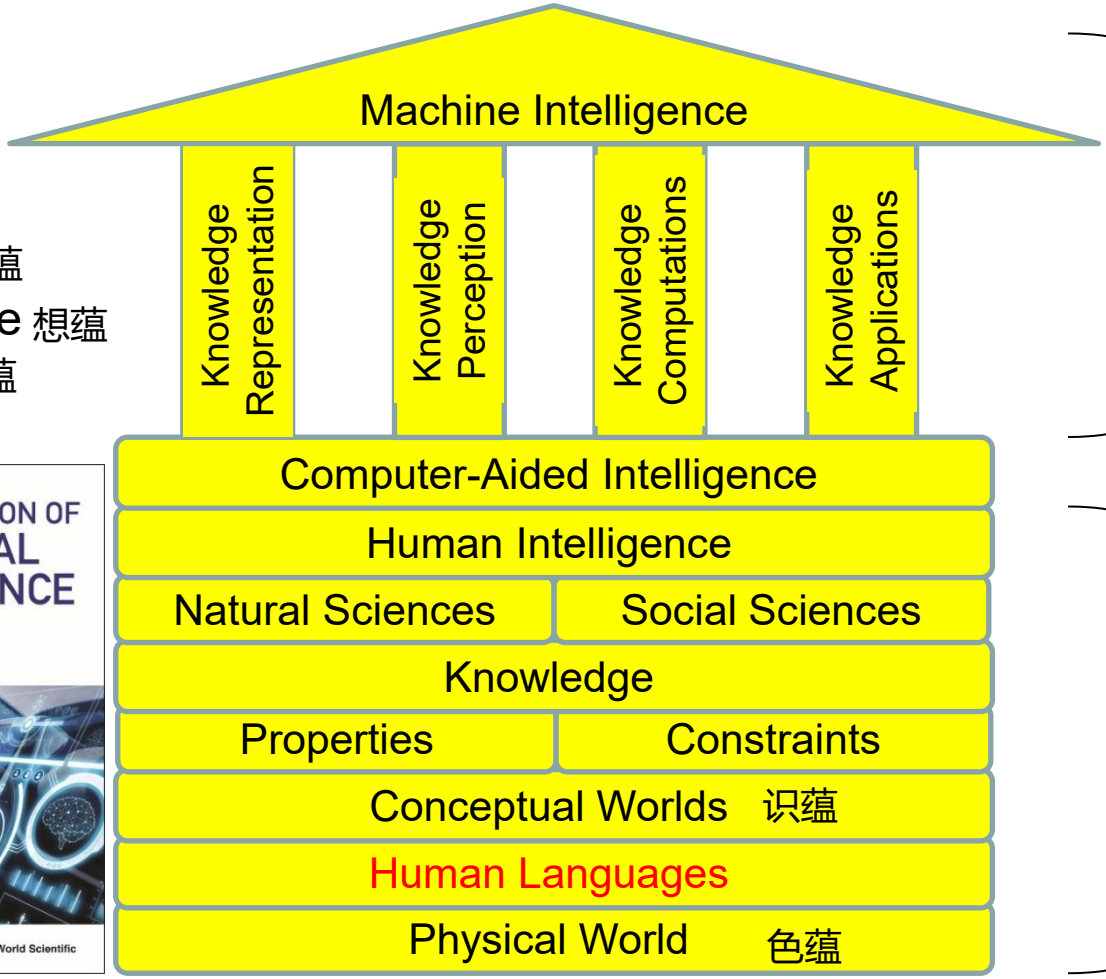
New Foundation of Artificial Intelligence

- One Tool
- Two Worlds
- Three Intelligences
- Four Pillars

- Signal to Knowledge 受蕴
- Knowledge to Knowledge 想蕴
- Knowledge to Signal 行蕴





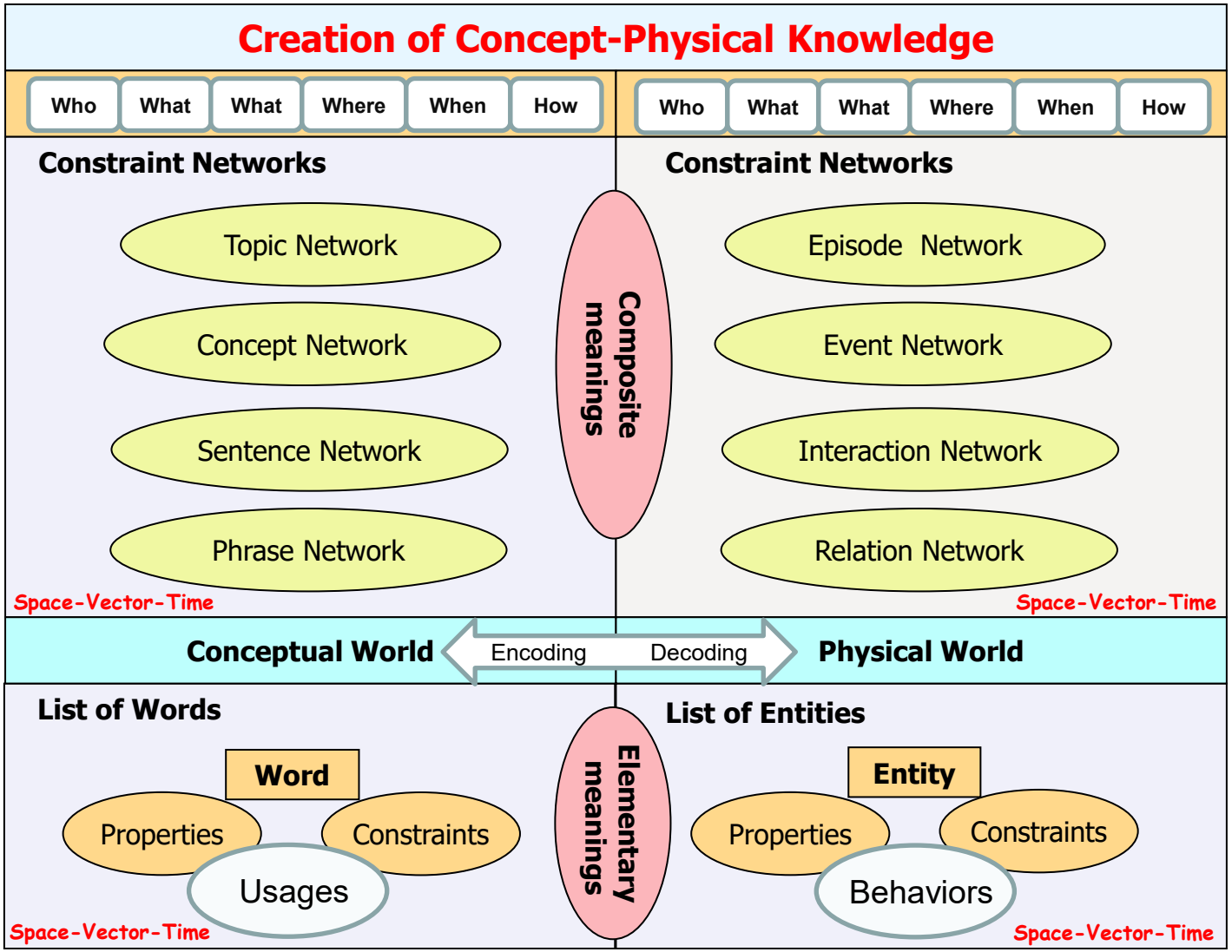


Pillar No. 1 of Artificial Intelligence

大知识模型

KNOWLEDGE REPRESENTATION

Large Knowledge Model: KnowNet

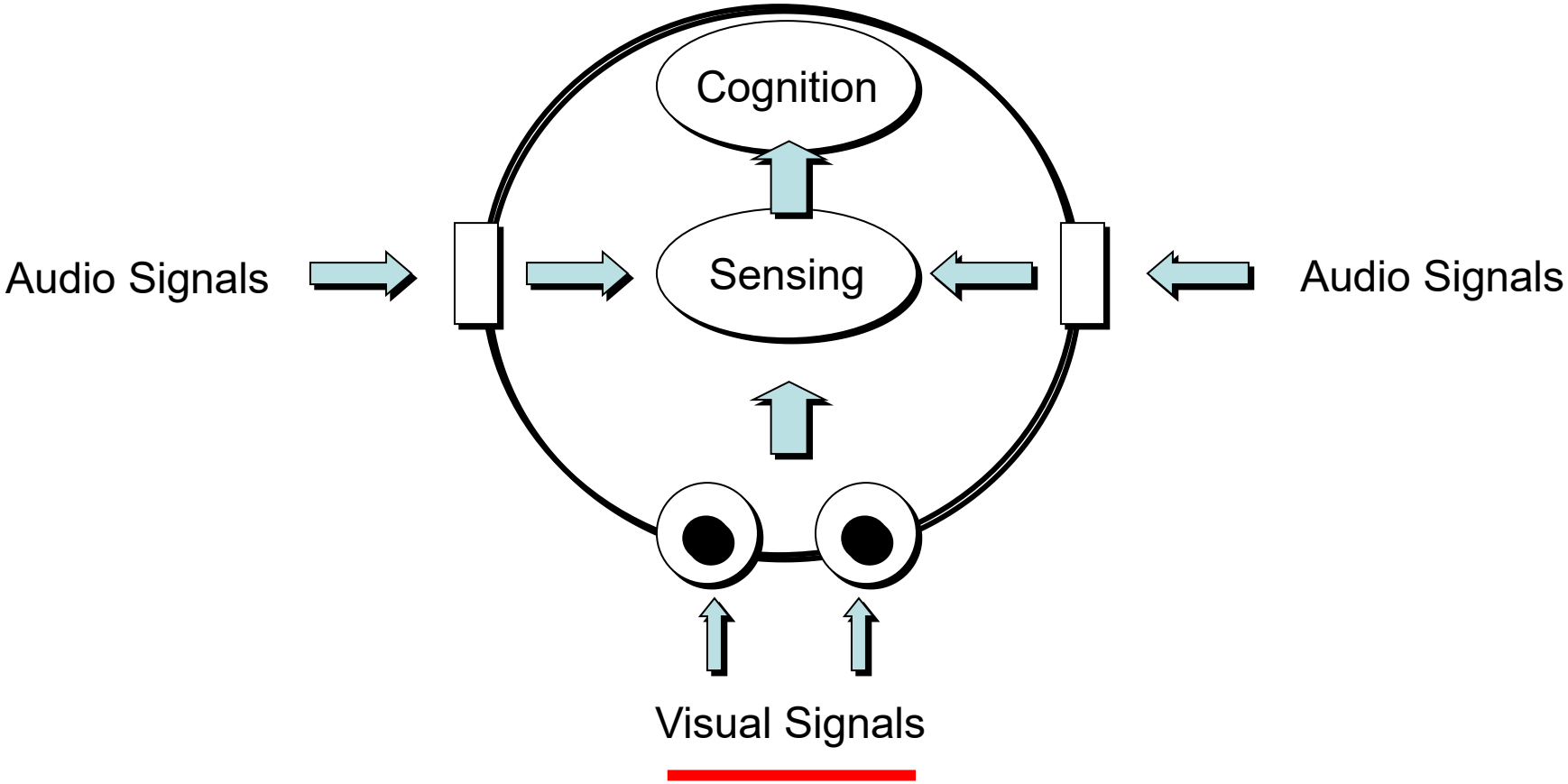


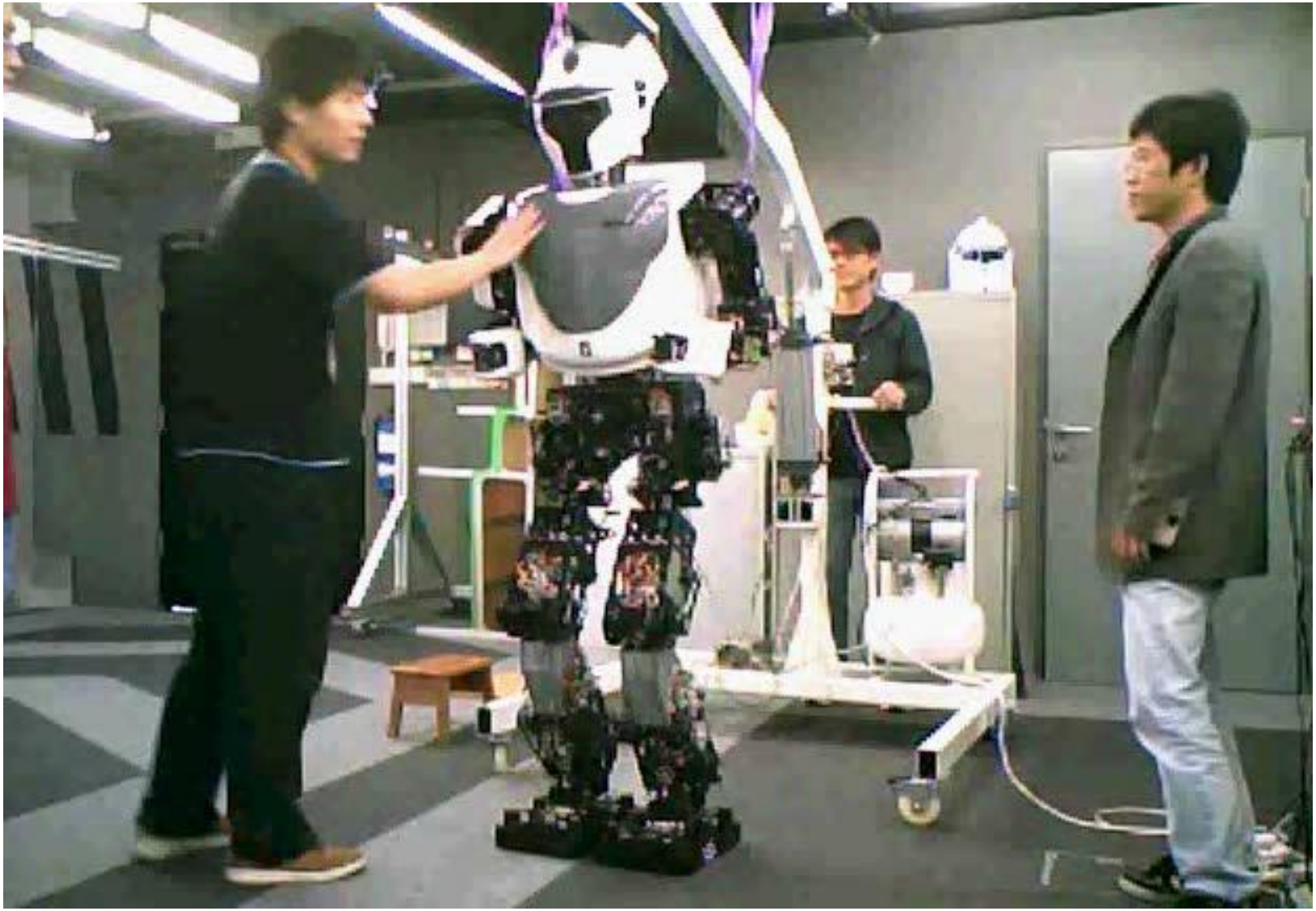
Pillar No. 2 of Artificial Intelligence

从感知到心识的能力

SIGNAL-TO-KNOWLEDGE TRANSFORMATION

Typical Scenario of Transforming Signals to Knowledge …





Pillar No. 3 of Artificial Intelligence

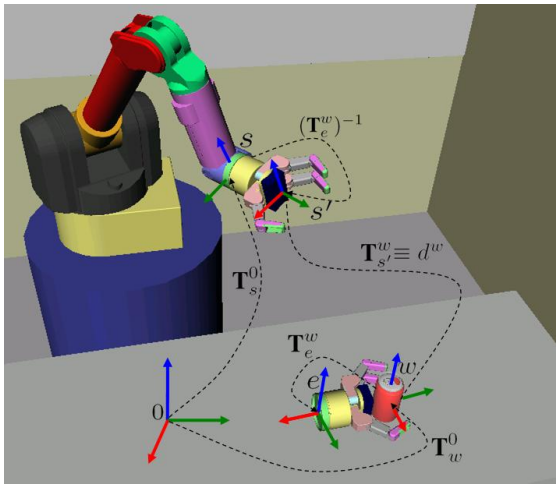
从心识到心识的能力

KNOWLEDGE-TO-KNOWLEDGE TRANSFORMATION

Typical Scenario of Transforming Knowledge to Knowledge …

Case for Robot Hand

- For example, a motion may require a robot arm to move its hand from the current pose at rest to a final pose at rest. How to determine: $[x(t), y(t), z(t), \theta(t)]$



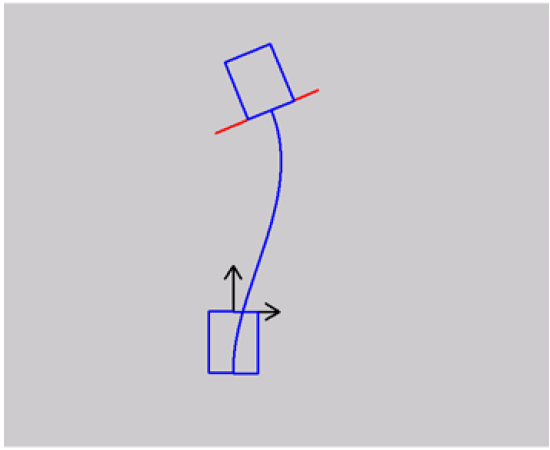
Output Knowledge of Three Trajectories

- Rest to Velocity
- Velocity to Velocity
- Velocity to Rest

Case for Mobile Base

- For example, a mobile robot may enter a parking lot from its initial pose at rest and stops at the parking lot after the parking is accomplished. How to determine:

$[v(t)\ \theta(t)]$ or $[v_l(t)\ v_r(t)]$



Pillar No. 4 of Artificial Intelligence

从心识到行为的能力

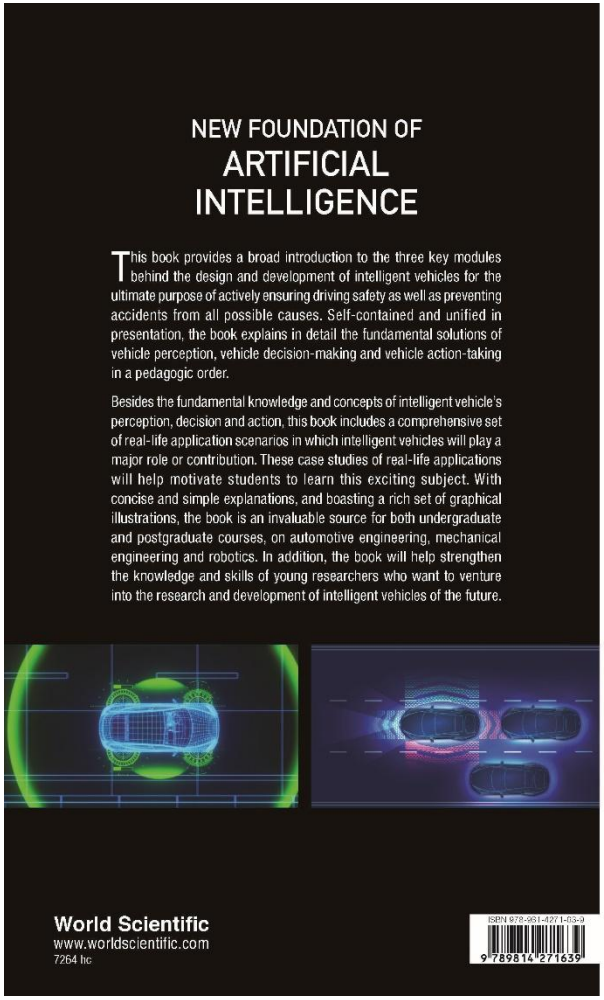
KNOWLEDGE-TO-SIGNAL TRANSFORMATION

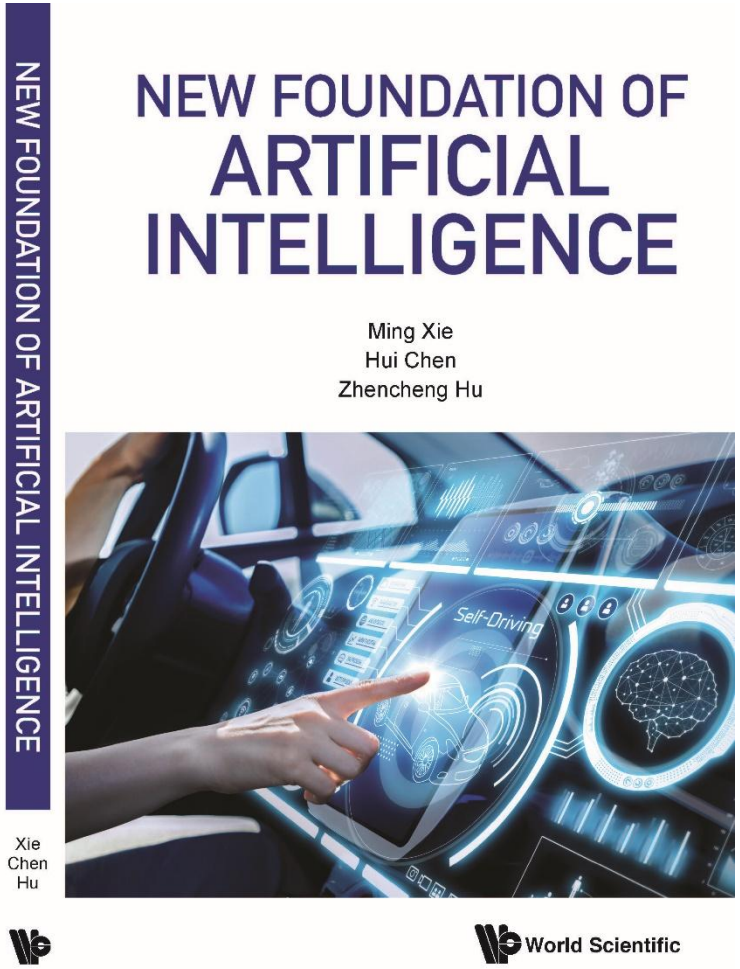
Typical Scenario of Transforming Knowledge to Signals …

NEW THEORY OF AI

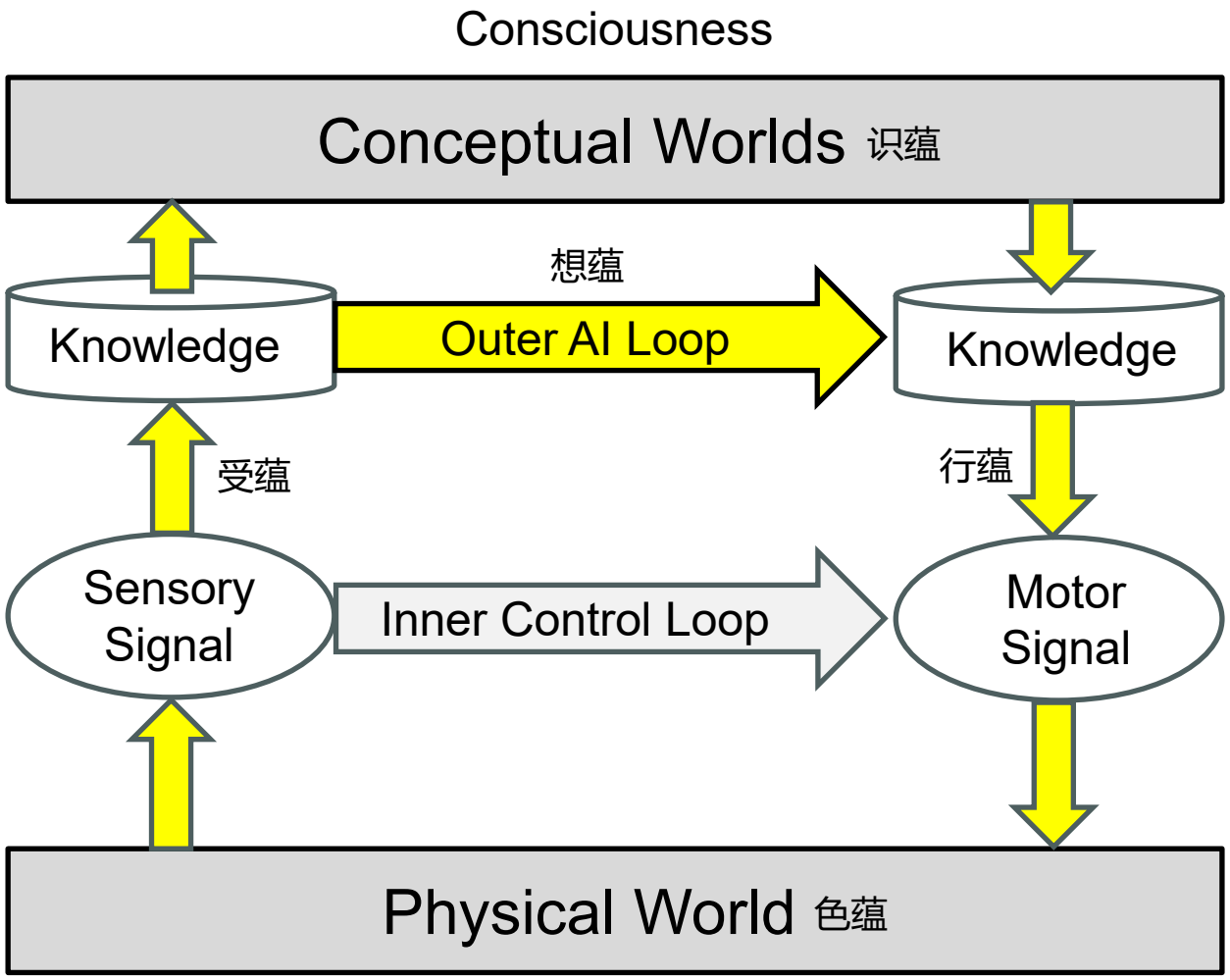
New Book in Artificial Intelligence

February 2021



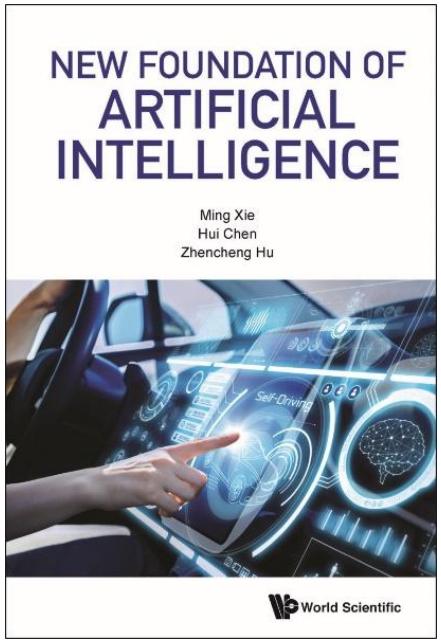


What should be the new framework of AI?



What is consciousness?

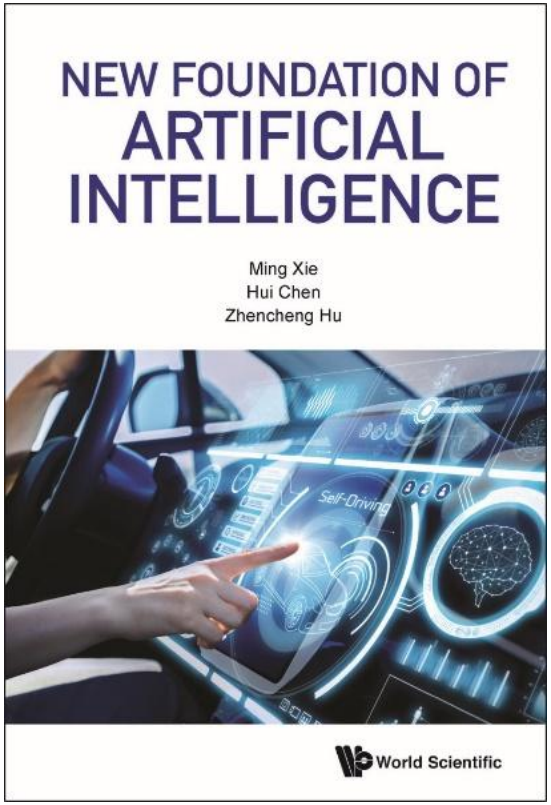
It is the state of being aware of and responsive to one's surroundings.



What should be the new definition of AI?

Definition of AI 3.0

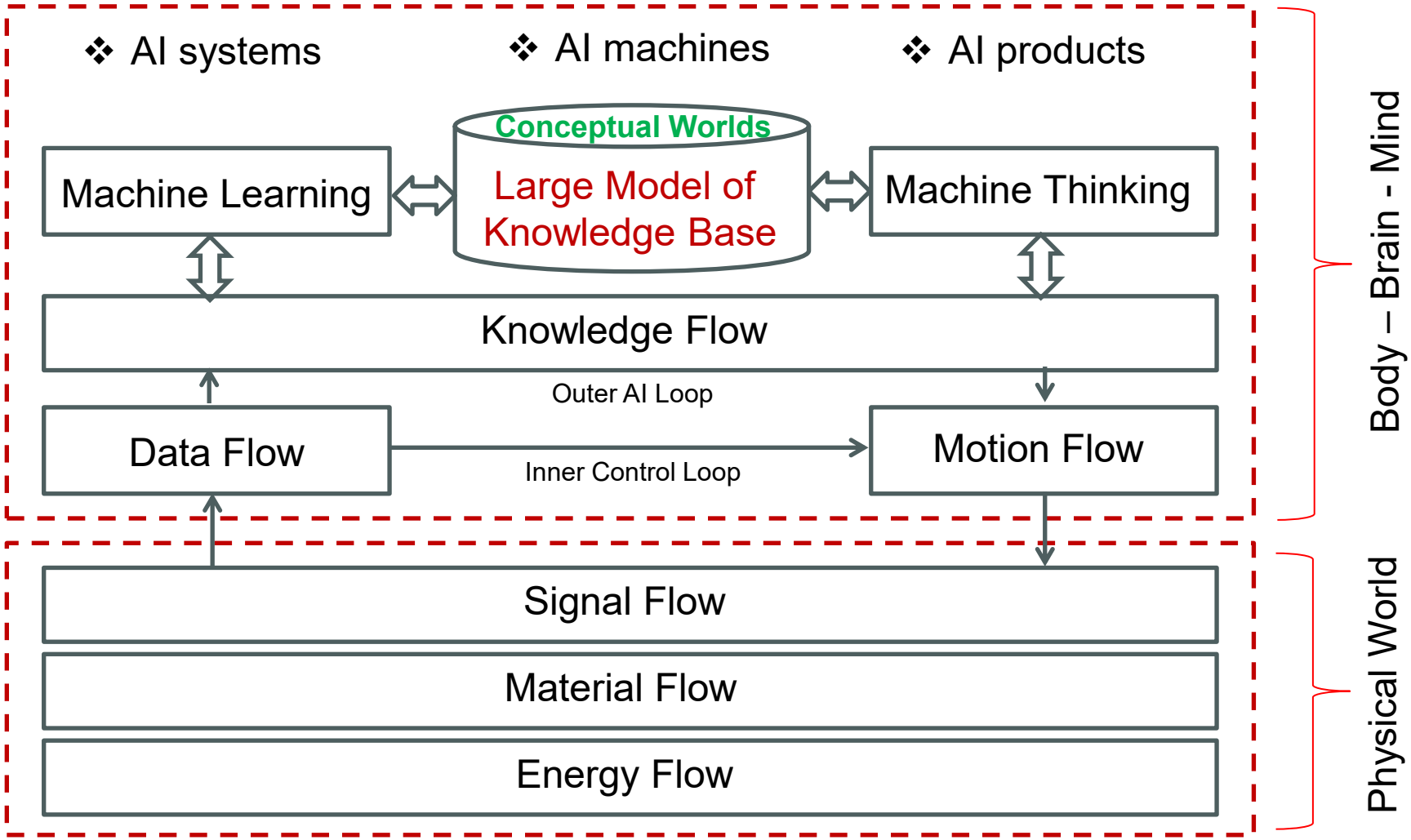
- Artificial intelligence refers to any machine's mental capabilities of acquiring, representing, memorizing, transforming, transferring, and applying knowledge about truths and skills.



Learning = Representation + Memorization

Knowledge = Statics (Truths) + Dynamics (Skills)

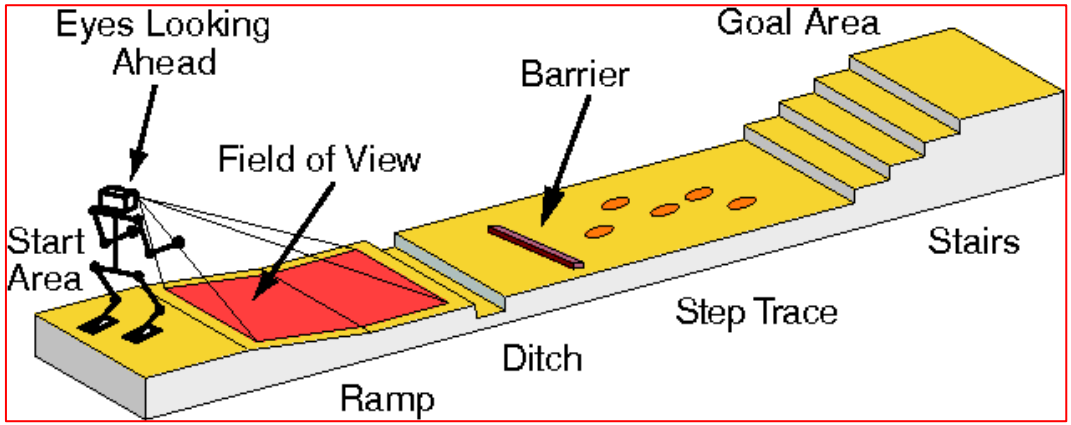
What should be the new blueprint of AI systems, AI machines or AI products?



What should be the new way of evaluating the levels of intelligence from AI systems, AI machines or AI products?

- My suggestion is to advocate the following better version of test:

- Define intelligence as being a metrics which is inversely proportional to the time taken by an intelligent entity to complete a given task such as writing, reading, talking, making, playing, etc.



$$Intelligence = \frac{1}{Time\ Taken\ for\ a\ Task}$$

Old Turing Test

What should be the new pattern of AI history?

- AI 1.0 Machine Thinking
- AI 2.0 Machine Learning
- AI 3.0 Machine Self-Intelligence

1943-1956
John McCarthy
Marvin Minsky
Nathaniel Rochester
Claude Shannon
1956 Dartmouth Workshop

Inference and Reasoning

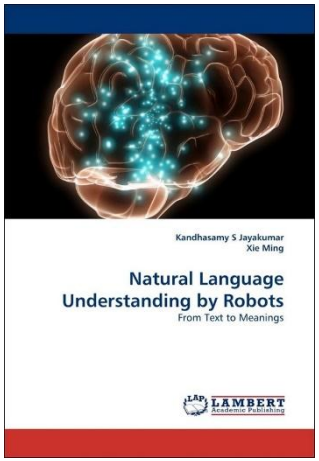
1992-2000
John Weng
James McCelland
Alex Pentland
2000 MSU Workshop

Development and Learning

2003-2009
Ming Xie
2009 IJHR Paper

Language and Cognition

2010



First Generation of Artificial Intelligence

Second Generation of Artificial Intelligence

Third Generation of Artificial Intelligence

AI's Foundation

Finding the Root of AI

Impacts of AI 3.0 to Our Modern Life

Knowledge
- **Vision-centric Intelligence and Its Applications**
- **Speech-centric Intelligence and Its Applications**
  From MAT (Machine-Aided Translation) to MT*

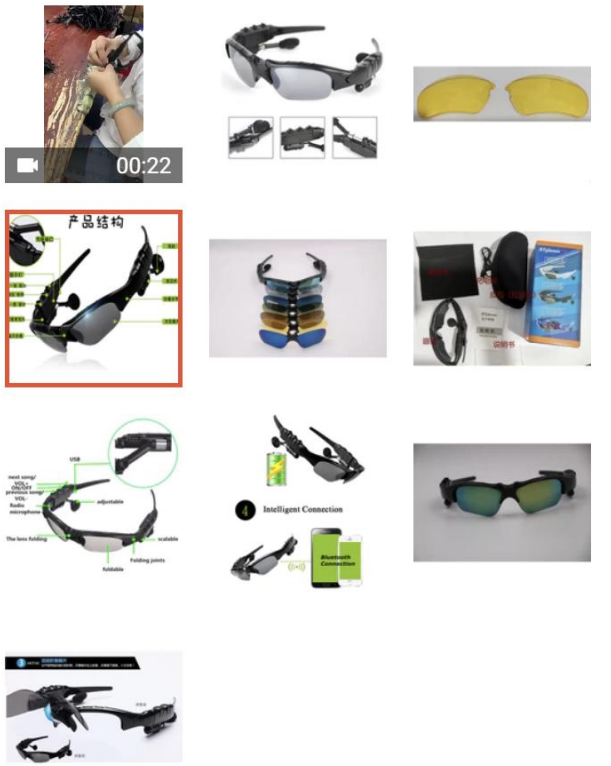
Skill
- **Planning-centric Intelligence and Its Applications**
- **Control-centric Intelligence and Its Applications**

Creativity
- **Data-centric Intelligence and Its Applications**
  How to creatively use data to achieve better outcomes?
- **Design-centric Intelligence and Its Applications**
  How to creatively use knowledge to design better products?
  From CAD (Computer-Aided Design) to CD*

Exampel of AI Glasses

Example of AI Earphones

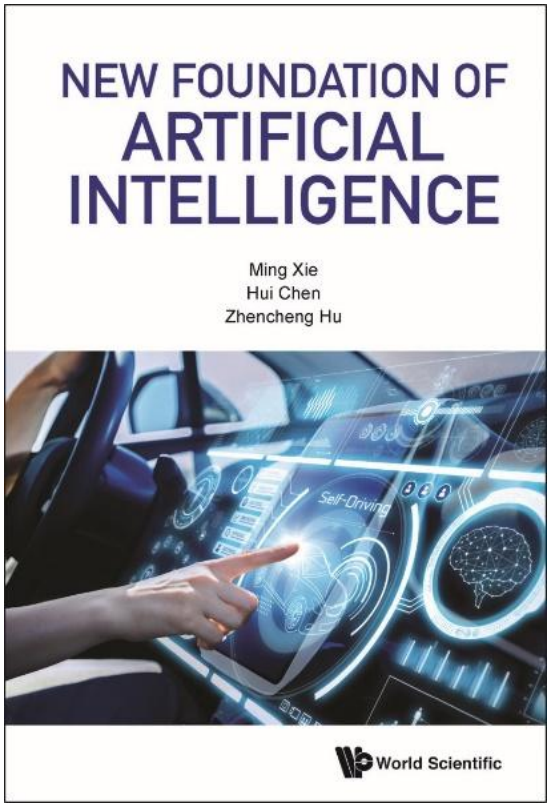
Glasses Headset HBS-368 Smart Glasses 5.0 Call Real Stereo Glasse...



Outline of Today's Talk

- Old Foundation of Artificial Intelligence
- New Foundation of Artificial Intelligence
- Discussions and Conclusions

Science of Mind



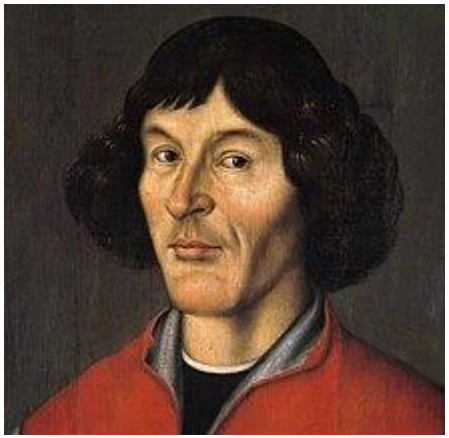
Dilemma before 15th Century

In the study of astronomy, one of the biggest dilemma was about the center of the solar system:

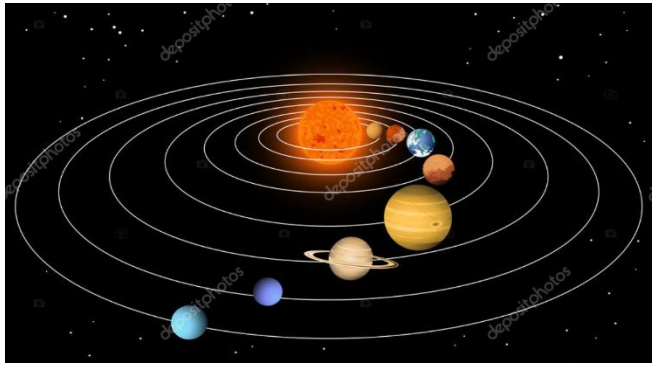
- Hypothesis 1 (Geo-centrism): Earth is the center of the solar system.

  (e.g., What is 昆仑? Point of Sunrise? Point of Sunset?)

- Hypothesis 2 (Helio-centrism): Sun is the center of the solar system.



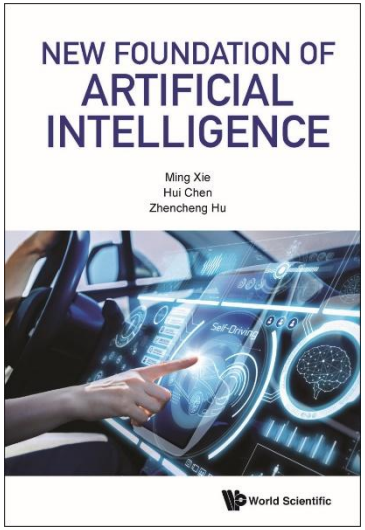
Nicolaus Copernicus
(1473 - 1543)



Dilemma before 21th Century

In the study of artificial intelligence, one of the biggest dilemma was about the origin of intelligence:

- Hypothesis 1 (Brain-centrism): Brain is generator of intelligence.
- Hypothesis 2 (Mind-centrism): Mind is generator of intelligence.



2021

It is an Interesting Parallel in History …

Earth-Sun Relationship

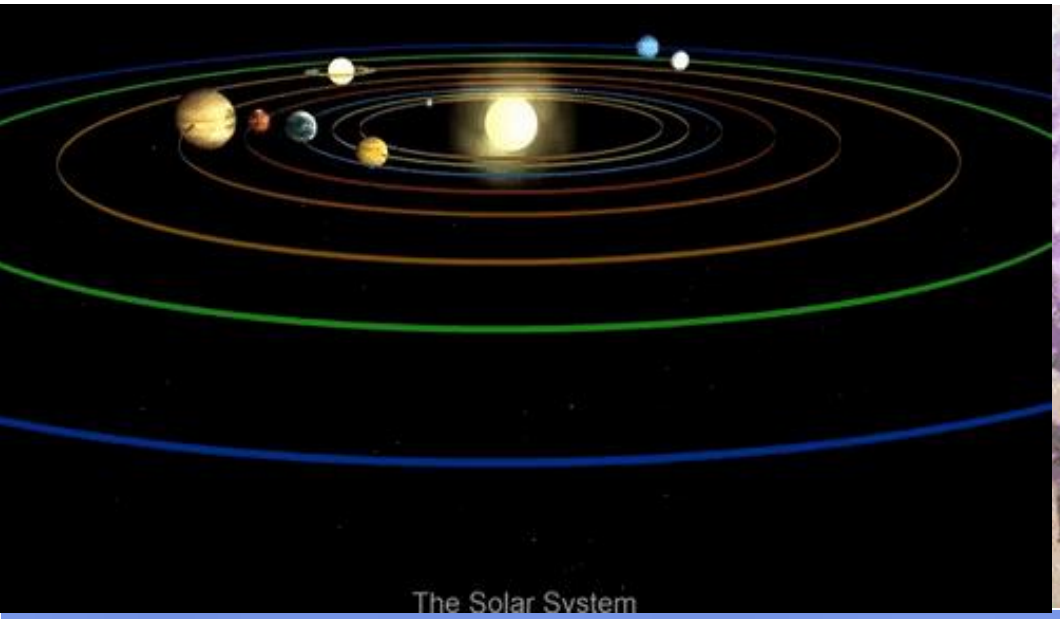
- Nicolaus Copernicus was an astronomer who proposed a heliocentric system, that the planets orbit around the Sun; that Earth is a planet which, besides orbiting the Sun annually, also self-rotates once daily on its own axis. Sun is at the center of the universe, but not Earth which orbits the Sun.

Brain-Mind Relationship

- Brain provides hardware support to the functionalities of Mind. Brain's primary functions are computation and memorization (or storage), while Mind's primary functions are cognition and recognition. Mind is at the root of natural or artificial intelligence. Intelligence arises from Mind directly, but not Brain which supports Mind.

What is our mission on Earth?

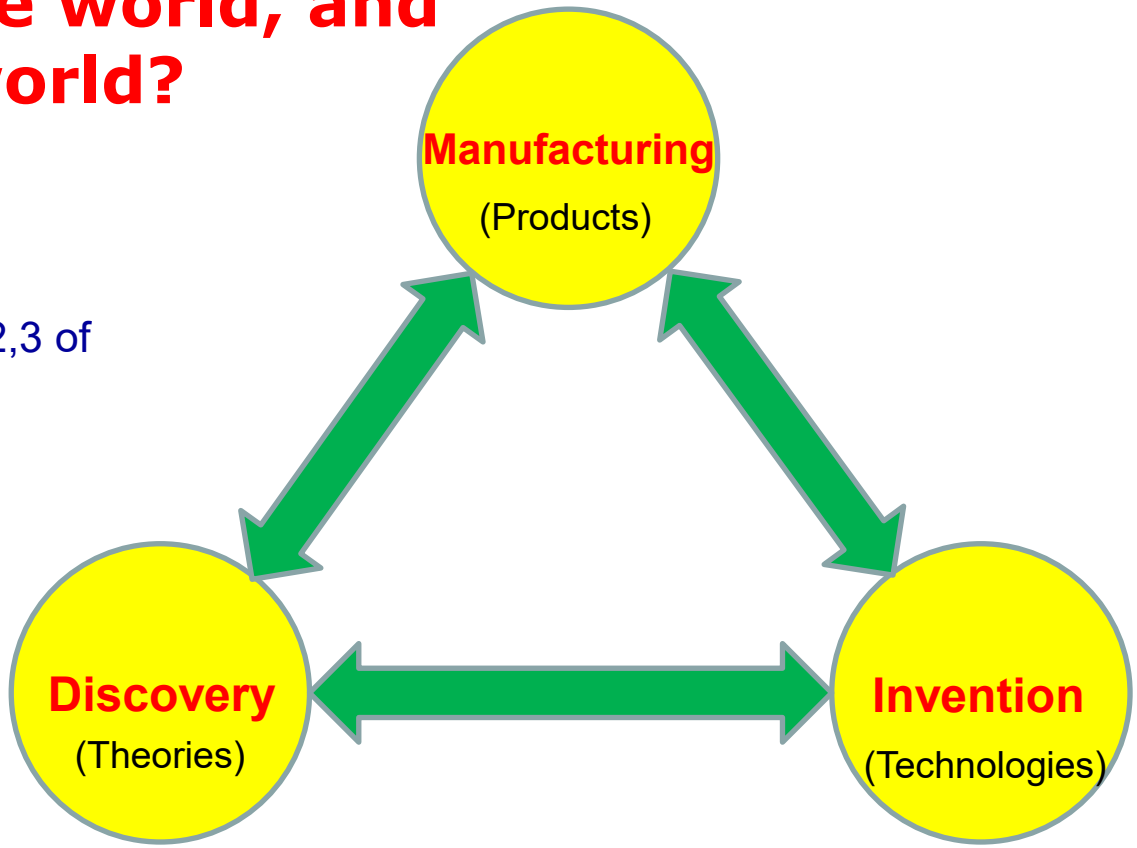
- (1) to understand the world, and
- (2) to improve the world?



How to fulfill our missions on Earth, which include:
(1) to understand the world, and
(2) to improve the world?

Research comes first:

- What is research? What are the 1,2,3 of research?



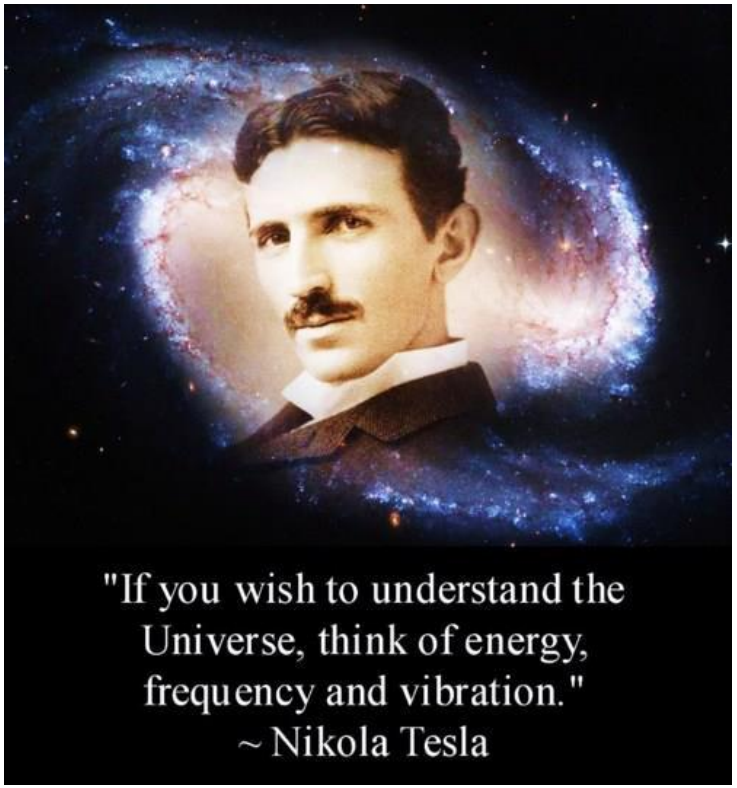
One Objective:
1. Research has one objective which is to create values by finding better ways of solving problems.

Two Driving Forces of Research
1. Scientific Problems
2. Social Needs

Three Outcomes:
1. Creation of Better Theories
2. Creation of Better Technologies
3. Creation of Better Products

How to understand the universe?

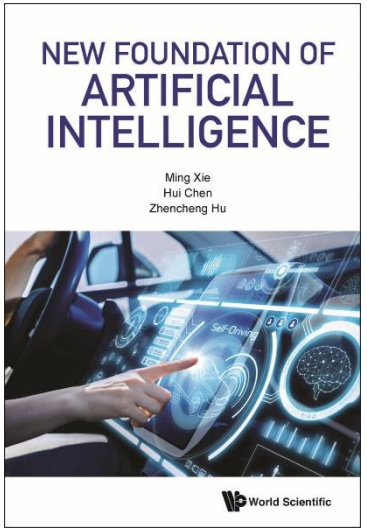
- If you wish to understand the secrets of the universe, think in terms of energy, frequency and vibration. – Nikola Tesla



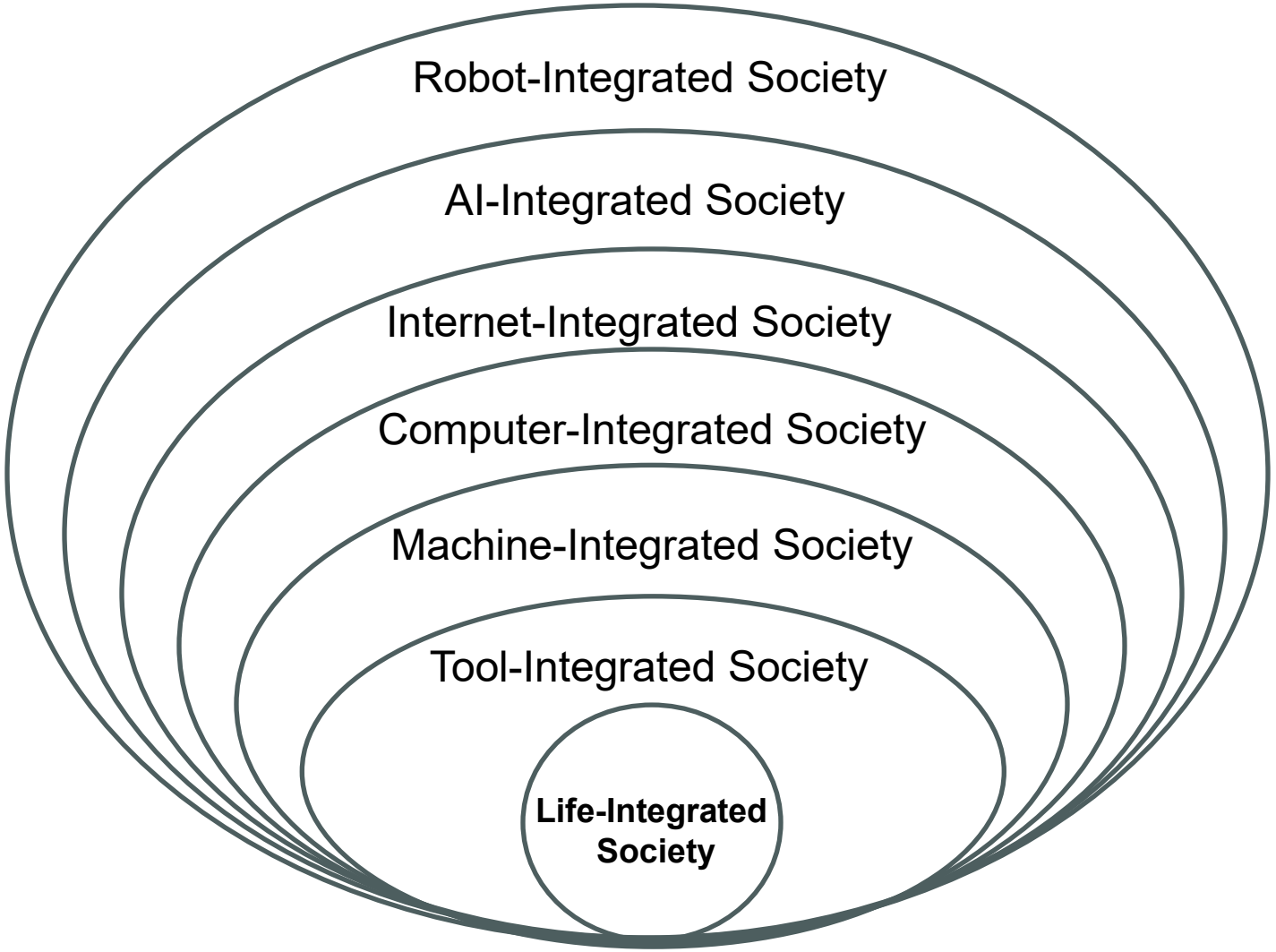
How to understand the world?

- If you wish to understand the world, think in terms of systems, devices and materials – Ming XIE

- If you wish to understand the meanings of the world, think in terms of space (空), vector (色) and time (无常)? - Ming XIE



How to improve the world?



How to improve the world?

- To invent smarter products,
- To invent smarter systems, and
- To invent smarter machines.

Q1: Why are we inventing machines?

延伸人类的体能

To extend our physical capabilities

- 标志性理论
  - 空气动力学

  Aerodynamics Theory
- 标志性产品
  - 飞行器

  Aircraft Products
- 标志性产业
  - 航空航天产业

  Aerospace Industry

延伸人类的智能

To extend our mental capabilities

- 标志性理论
  - 人工智能学

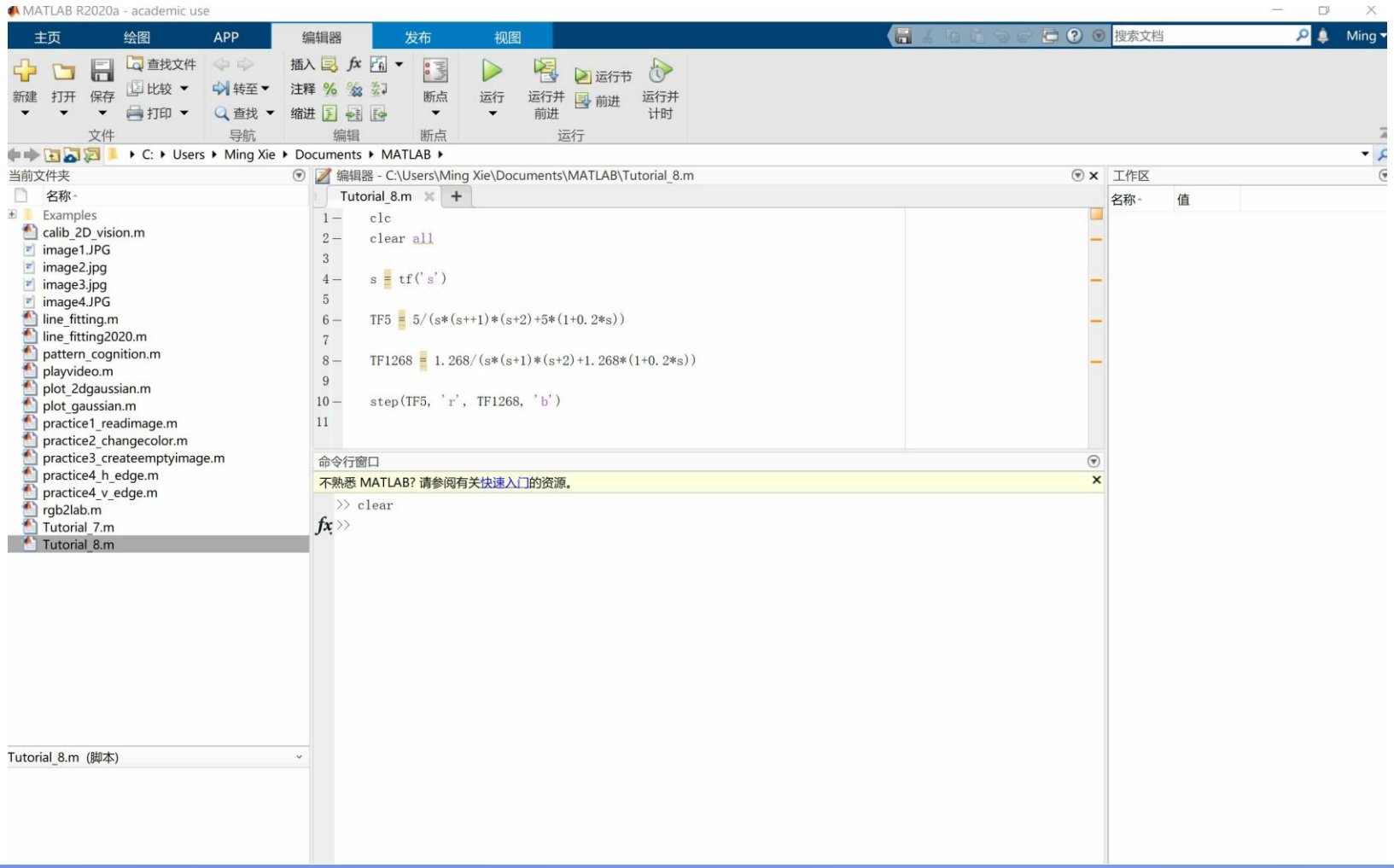
  AI Mind Theory
- 标志性产品
  - 智能软件

  Smart Software Products
- 标志性产业
  - 信息数据产业

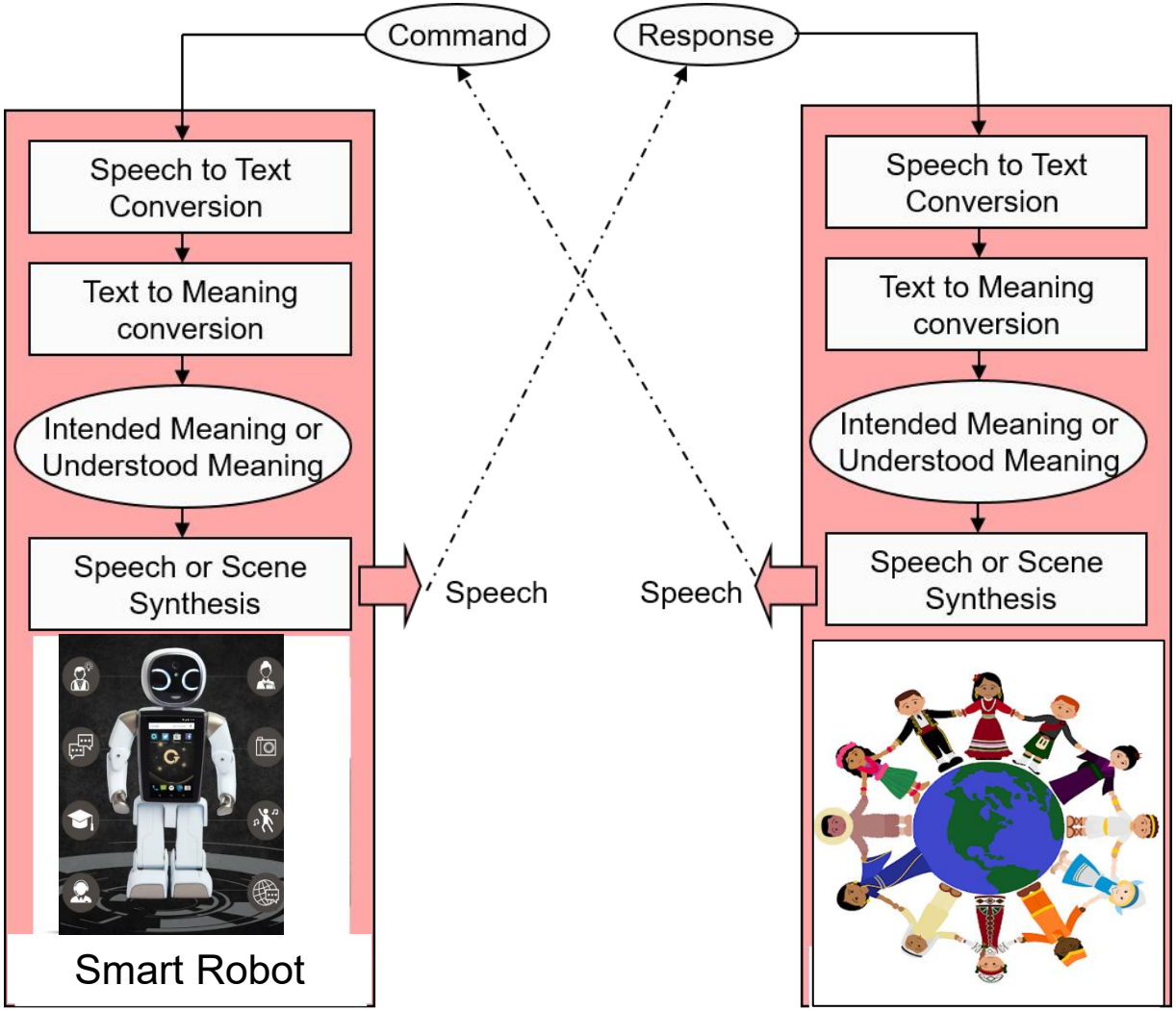
  Big and Smart Data Industry

Q2: Could machines' bodies outperform human beings' bodies?

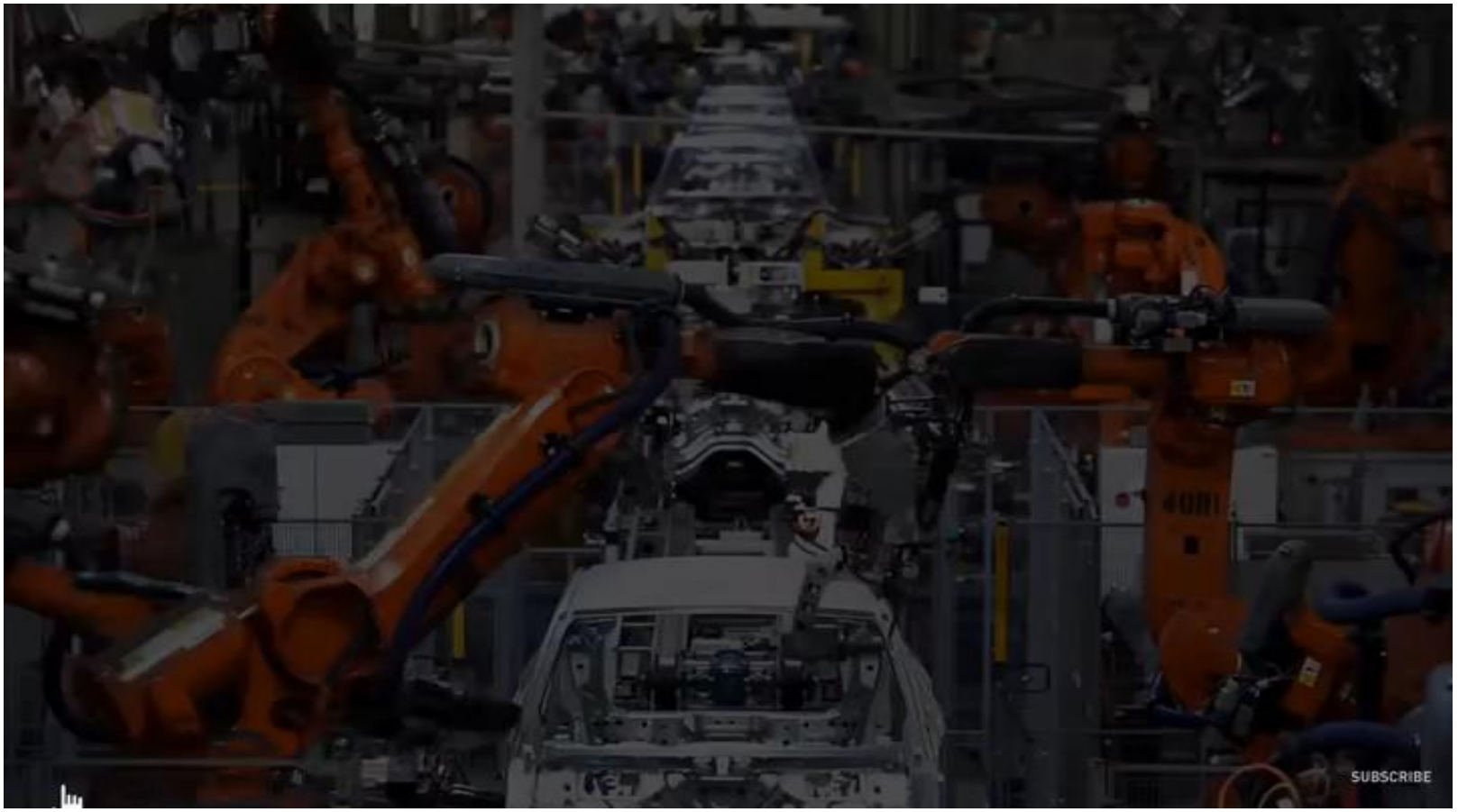
Q3: Could machines' brains outperform human beings' ones?



Q4: Could machines' minds outperform human beings' minds?



Q5: Could Artificial Intelligence help kids to happily grow human intelligence through incremental learning?



Q6: What is intelligence?

My answer:

- Intelligence is the mental ability of transforming sensory signals to knowledge, knowledge to knowledge, and knowledge to motor signals.

- Intelligence is inversely proportional to the time taken for the accomplishment of any given task.

$$Intelligence = \frac{1}{Time}$$

什么是知识？（cognition + recognition）

认知

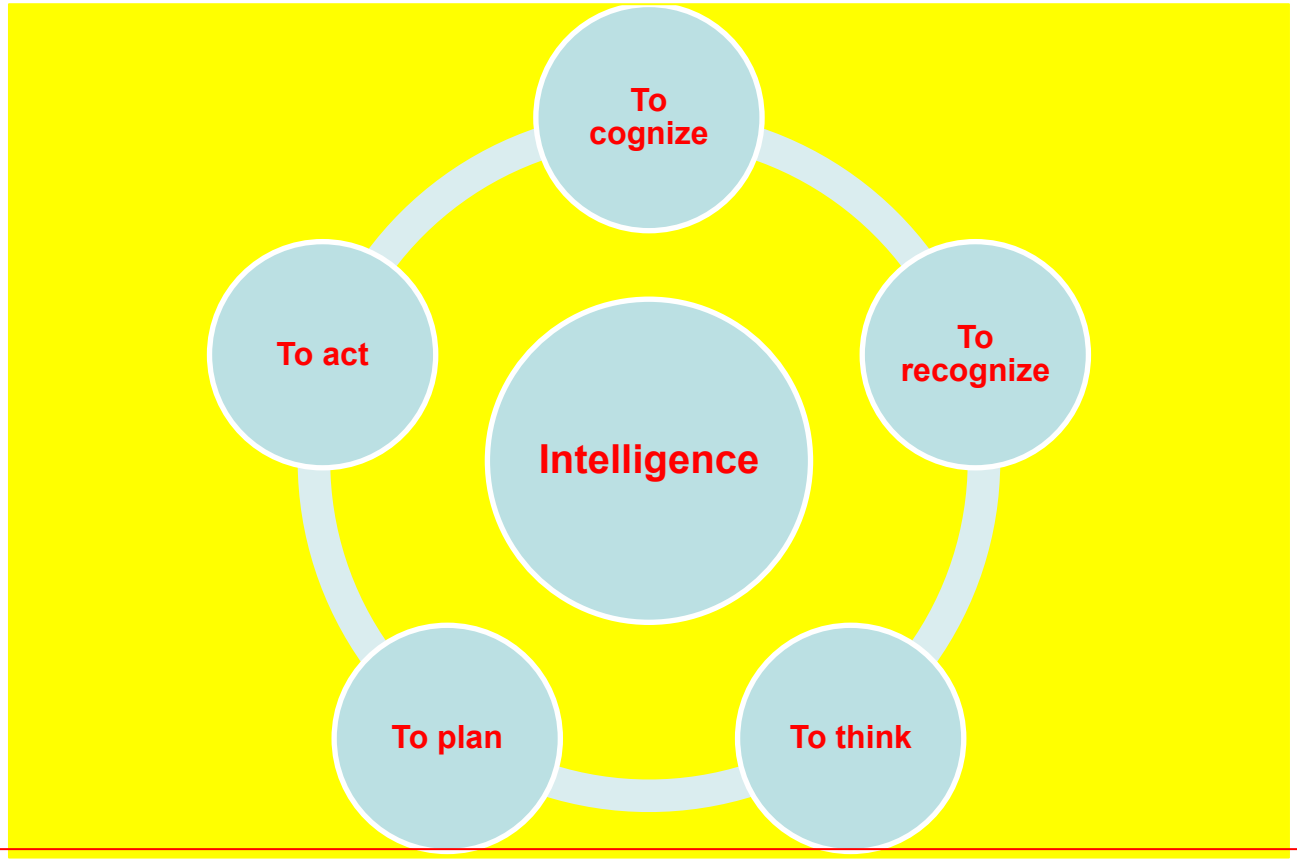
识别

- 狭义的知识是指可被知、可被识的对象。

- 广义的知识是指知识系统，它包含：可被知与可被识的输入，感知与心识，以及由感知与心识产生的输出。

New Definition of Intelligence

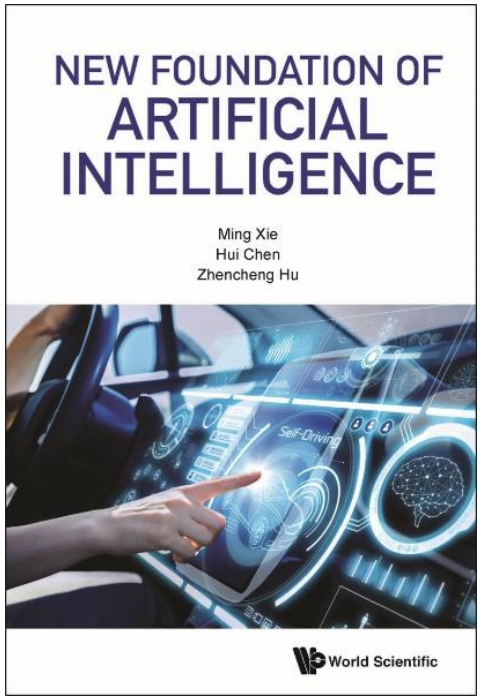
- Intelligence refers to the mental capabilities of undertaking mental activities such as: to cognize, to recognize, to think, to plan, and to act.

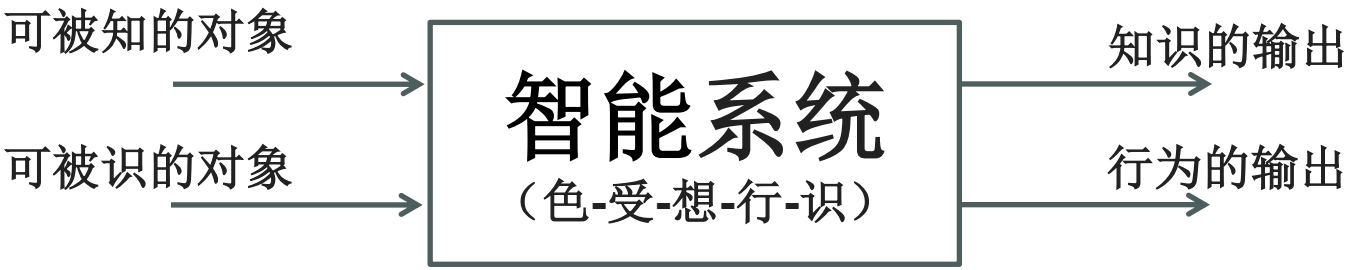


"什么是智能？由知、识、觉、思、行产生的综合能力", – 谢 明

什么是智能？

- 获取和应用知识的能力，即：
  - 从感知到心识的能力。
  - 从心识到心识的能力。
  - 从心识到行为的能力。





Q7: What is learning and knowledge?

My answer:

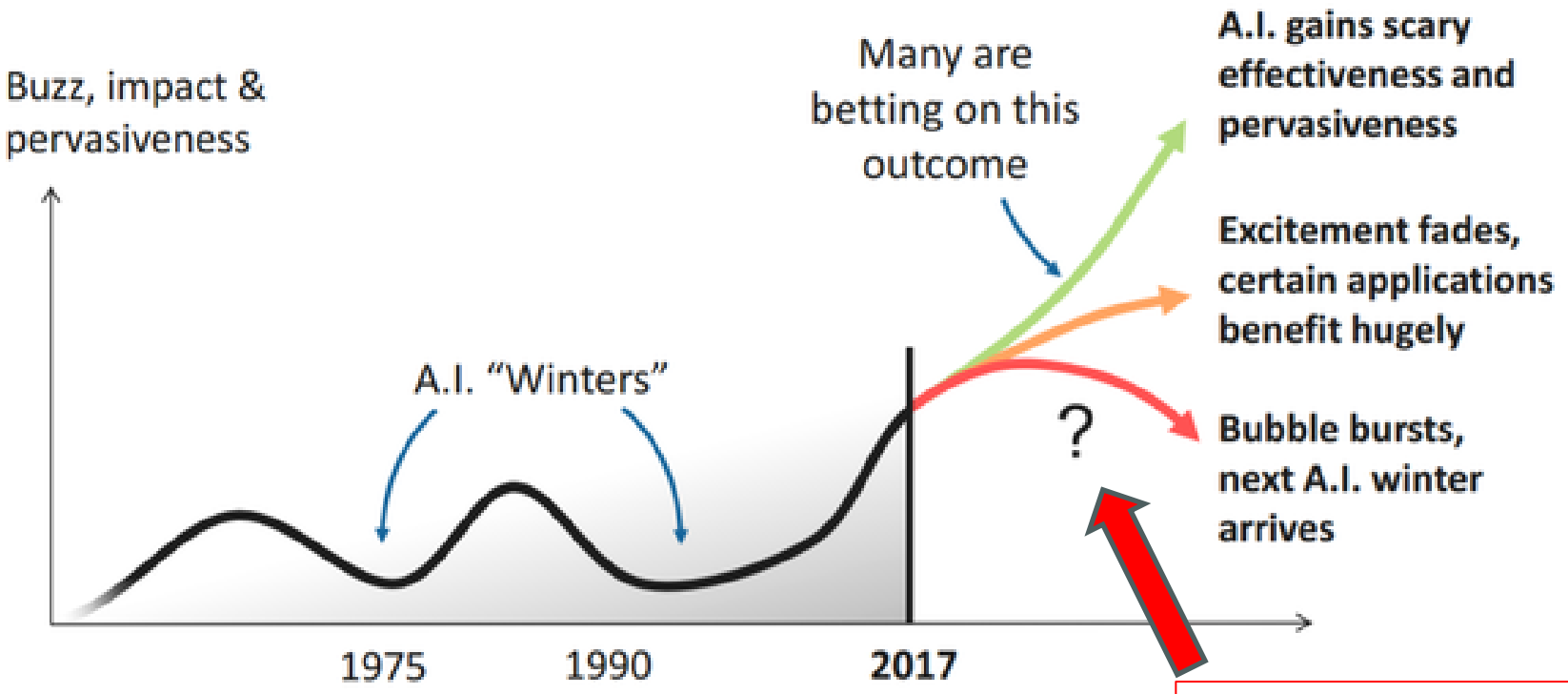
- Learning is a mental process in which repeatable, re-usable and transferrable knowledge is being represented and memorized.

- Knowledge refers to the properties, constraints and behaviors of an entity and a system.

Knowledge = Statics + Dynamics

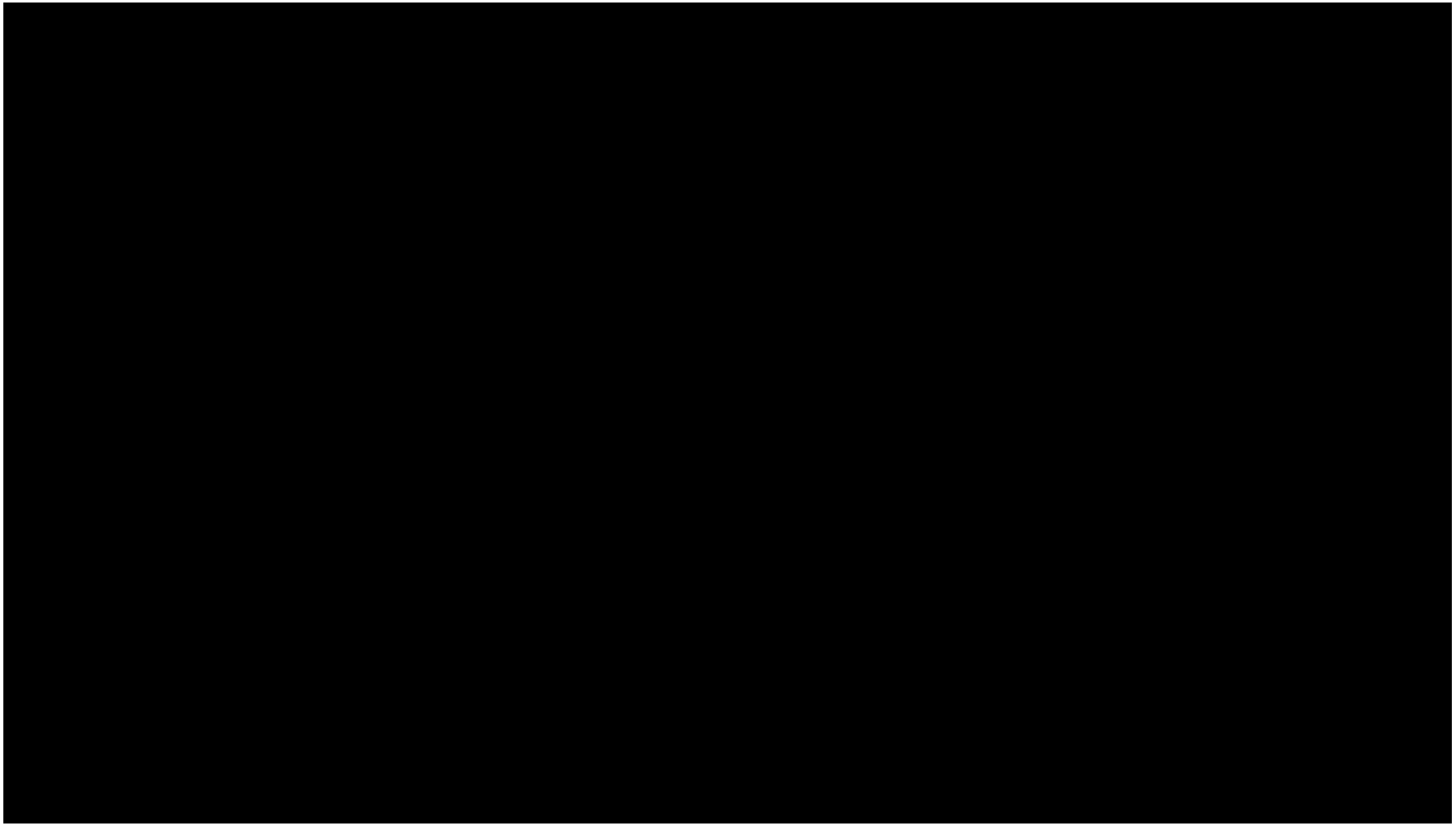
Q8: Will AI face a third wave?

AI is enjoying significant hype and investment



Pessimistic View …

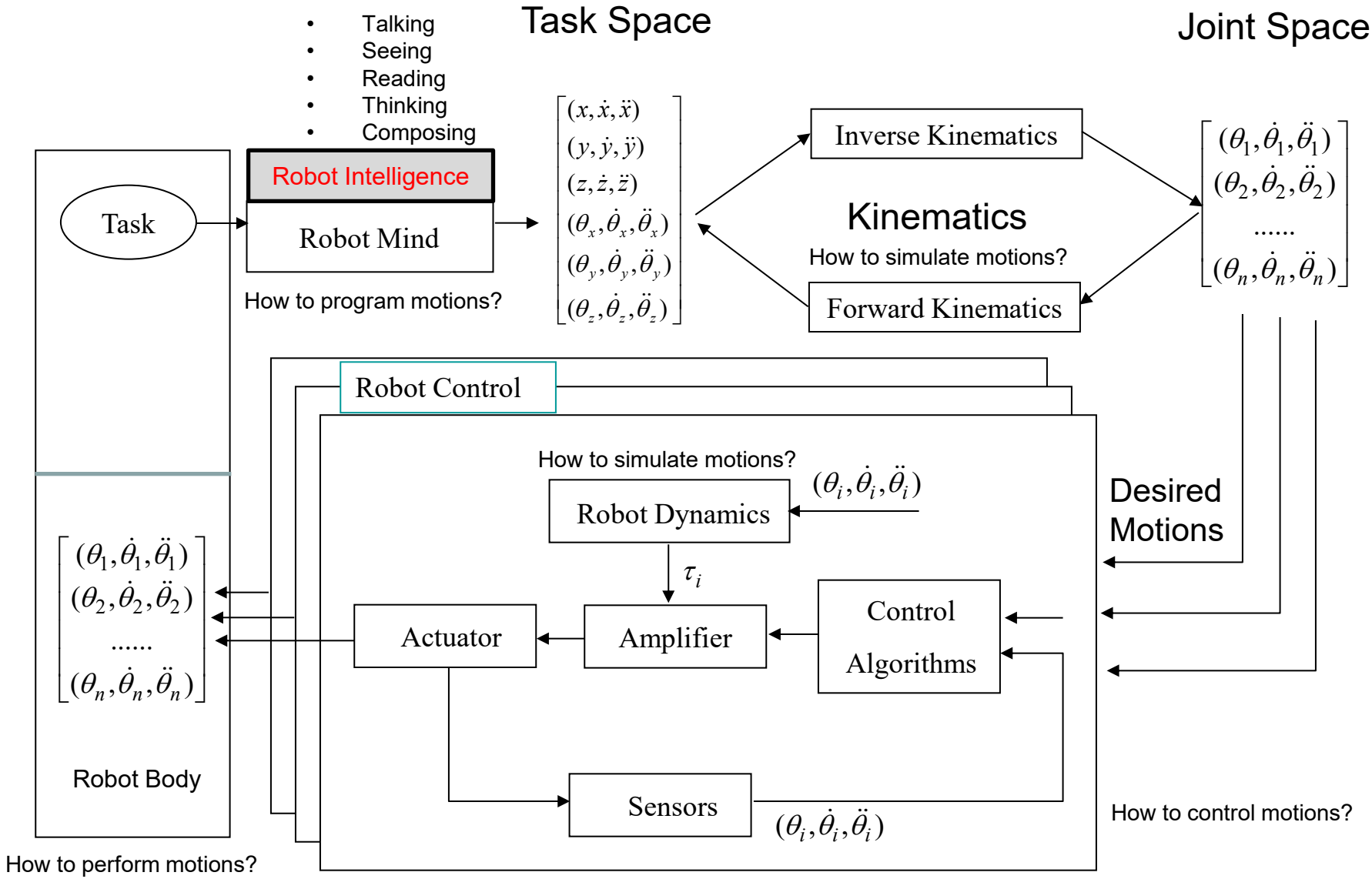
With the Rise of Robotics …



Example of AI-Driven Robot …

More Example of AI-Driven Robot …

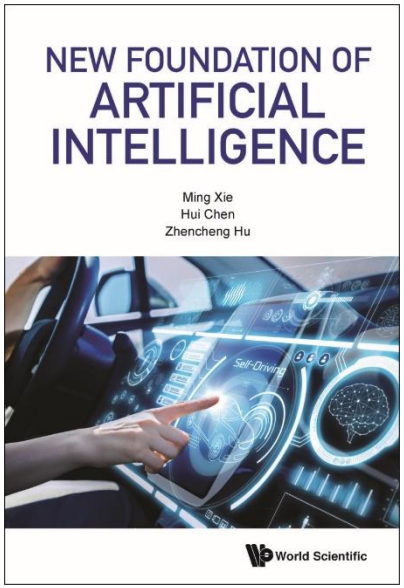
Robotics Will Drive the Development of AI

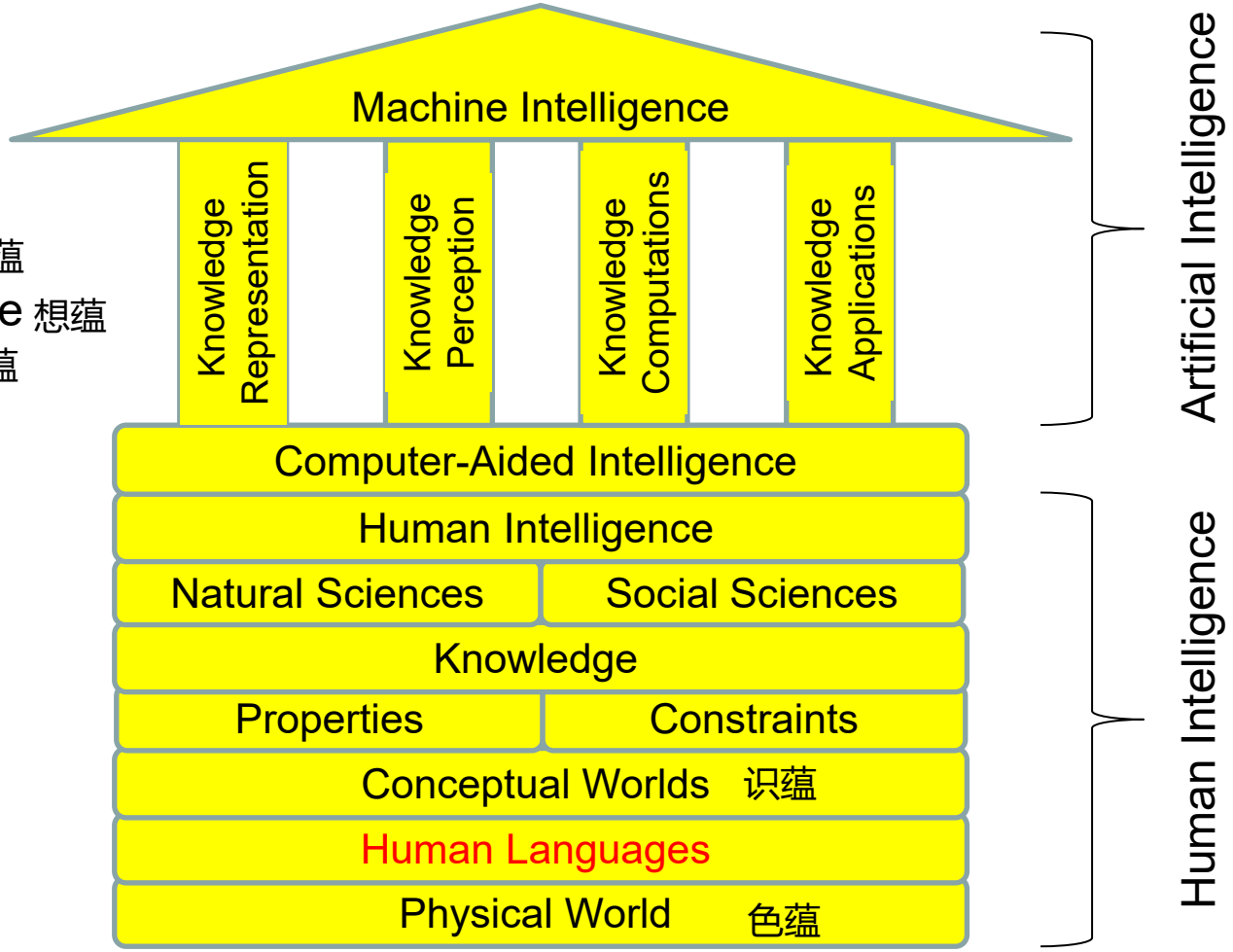


AI will now undergo its steady growth …

- One Tool
- Two Worlds
- Three Intelligences
- Four Pillars

- Signal to Knowledge 受蕴
- Knowledge to Knowledge 想蕴
- Knowledge to Signal 行蕴

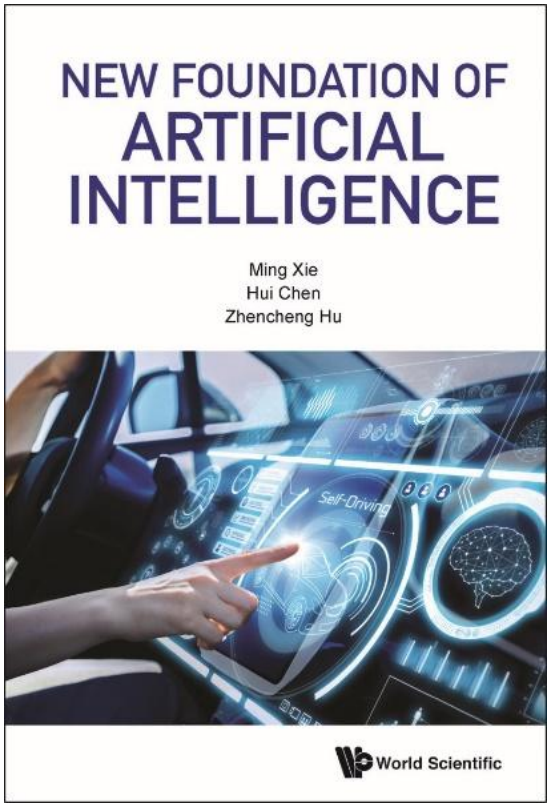




Summary of Today's Talk

- Old Foundation of Artificial Intelligence
- New Foundation of Artificial Intelligence
- Discussions and Conclusions

Science of Mind



"Ask not what your country can do for you – ask what you can do for your country," - John F. Kennedy

"Do not think that you are needy – think that you are needed in the world", - Manis Friedman

"Study will make you knowledgeable, resourceful, and hence more needed", - Xie Ming

Thank You for Listening!