인공지능

22년 삼성 AI 전문가과정
6월 7일 화요일 1교시
장병탁

1차시 : Introduction

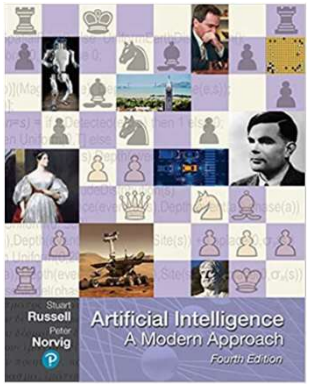
서울대학교 컴퓨터공학부
담당 교수: 장병탁

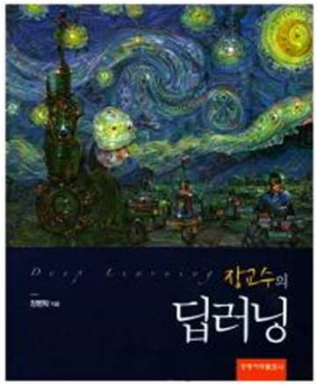
Seoul National University
Byoung-Tak Zhang




Course Overview (1/3)

4190.408 Artificial Intelligence, Spring 2022 (SNU Hybrid Course)





- **Textbooks**
  - (Primary) Russell & Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson, 2021.
  - (Secondary) 장교수의 딥러닝 (홍릉과학출판사), 2017
- **Class hours:** Tue/Thu 2:00-3:15pm
- **SNU hybrid course (3 modes)**
  - **Hybrid (15):** Offline (Bldg 43-1, Room 306) + Online (Zoom)
  - **Video (6):** Pre-recorded video lectures
  - **Online (4):** Zoom, TA tutorial sessions
- **Teaching assistants**
  - Chang-Hoon Jeong (Head TA), Yeon-Ji Song, Yun-Hyeok Kwak, You-Won Jang, Jun-Seok Park, Jung-Hyun Kim
  - Contact: chjeong@bi.snu.ac.kr

Course Overview (2/3)

Teaching Assistants

(Head TA)

PhD Student	MS Student	MS Student	PhD Student	PhD Student	MS Student
Dept. of Computer Science and Engineering	Interdisciplinary Program in Neuroscience	Interdisciplinary Program in Neuroscience	Interdisciplinary Program in Neuroscience	Dept. of Computer Science and Engineering	Interdisciplinary Program in Artificial Intelligence

Course Overview (3/3)

- **Ten** homework assignments
  - Exercises in the course textbooks https://aimacode.github.io/aima-exercises/
- **Two** exams
  - Midterm exam and Final exam
- **Two** projects
  - Project 1: Disease diagnosis using Bayesian networks
  - Project 2: Your own AI projects with deep learning
- **Four** TA tutorial sessions **(Weeks 7 & 11)**
  - Scientific computing with Python (Week 7, Tue)
  - Bayesian Networks (Week 7, Thu)
  - Deep neural networks (Week 11, Tue)
  - Advanced deep learning (Week 11, Thu)

- Grading Policy
  - Attendance/Participation (10%)
  - Assignments (20%)
  - Projects (20%)
  - Midterm Exam (25%)
  - Final Exam (25%)

Check out more details on the course!

Course: https://bit.ly/snu-ai-2022-spring-course

Syllabus: https://bit.ly/snu-ai-2022-spring-syllabus

Lecture Overview

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Lecture 1. Introduction

출처: Figure #7

- ➢ What is the Artificial Intelligence (AI)?
  - ■ Thinking Humanly
  - ■ Thinking Rationally
  - ■ Acting Humanly
  - ■ Acting Rationally
- ➢ The Foundations of AI
  - ■ Philosophy, Mathematics, Psychology, Economics, Linguistics, Neuroscience, Control theory
- ➢ History of Artificial Intelligence (AI)
  - ■ AI's Winter & Deep Learning
- ➢ State of the Art
  - ■ What can AI do today? What are the applications of AI?

"A computer would deserve to be called intelligent if it could deceive a human into believing that it was human."

Alan Mathison Turing (1912-1954)

What Is AI?

Approaches to AI

Thinking Humanly	Thinking Rationally
• The new effort to make computers think . . . machines with minds. • Automation of activities … human thinking, such as decision making and problem solving.	• The study of mental faculties through the use of computational models. • The study of the computation that make it possible to perceive, reason, and act.
Acting Humanly	**Acting Rationally**
• The art of creating machines that perform functions that require intelligence when performed by people. • The study of how to make computers do things at which, at the moment, people are better.	• Artificial intelligence is the study of the design of intelligent agents. • AI is concerned with intelligent behavior in artifacts.

Lecture 1. Introduction

- 1943-1956: The birth of artificial intelligence
- 1956-1969: Early enthusiasm, great expectation
- 1970-1985: Expert systems become industry
  DENDRAL, MYCIN, X-Con
- 1986-: Return of neural networks (learning systems)
- 1987-2005: AI's Winter & AI adoptsv scientific methods
  Machine learning (& neural networks)
  Probabilistic inference (& Bayesian networks)
  Intelligent agents (& mobile robots)
- 2000s: Very large data sets (Web, SNS, mobile)
  Machine learning applications
- 2012-present: Deep learning becomes industry

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Outline (Lecture 1)

Stuart Russell & Peter Norvig (2021), Artificial Intelligence: A Modern Approach (4th Edition)

1.1. What Is AI?

1.1 What Is AI? (1/6)

Approaches to AI

Thinking Humanly	Thinking Rationally
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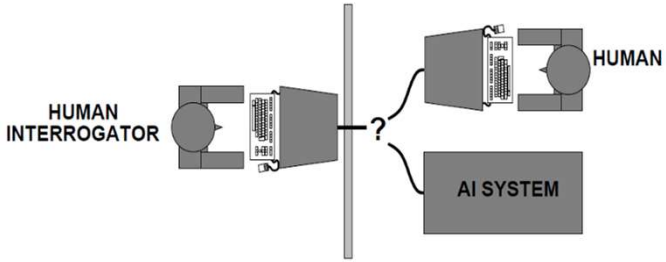
1.1 What Is AI? (2/6)

성능 테스트 - > 사람과 대결

1) Acting humanly: The Turing test approach

- ➢ Build a machine that behaves intelligently like humans
  - ■ Turing test or imitation game (1950): operational definition of intelligence
  - ■ *A computer passes the test if a human interrogator, after posing some written questions, cannot tell whether the written responses come from a person or a computer*
  - ■ Predicted that by the year 2000, a machine might have a 30% chance of fooling a lay person for 5 minutes
- ➢ Key capabilities
  - ■ Natural language processing
  - ■ Knowledge representation
  - ■ Automated reasoning
  - ■ Machine learning



출처: Figure #1

- ➢ "Can machines think?"→ "Can machines behave intelligently?"
- ➢ Turing's test deliberately avoided direct *physical* interaction between the interrogator and the computer
- ➢ Total Turing Test requires additionally: computer vision and robotics

1.1 What Is AI? (3/6)

2) Thinking humanly: The cognitive modeling approach

- ➢ Build a human-level general intelligence like human minds
  - ■ How to know the actual workings of human minds: cognitive science
- ➢ Once we have a sufficiently precise theory of the human mind, it becomes possible to express the theory as a computer program
  - ■ General problem solver (GPS) (Newell & Simon, 1961)
- ➢ AI as science: If the program's input-output behavior matches human behavior, that is evidence that some of the program's mechanisms could also be operating in human.

- ➢ Cognitive science brings together computer models from AI and experimental techniques from psychology to construct precise and testable theories of the human mind.

1.1 What Is AI? (4/6)

3) Thinking rationally: The laws of thought approach

- Build a machine that thinks right (or reasons rationally)
- Normative (or prescriptive) rather than descriptive
  - Aristotle: what are correct arguments/thought processes?
  - Syllogism: deriving correct conclusions from correct premises
  - Logic: notation and rules of derivation for thoughts
- Logicist tradition in AI: "good-old-fashioned AI" (GOFAI) < - > neuro symbolic AI
- Obstacles:
  - Not easy to convert informal knowledge to formal terms in logic
  - Logical reasoning systems can exhaust computational resources
  - Not all intelligent behavior is mediated by logical deliberation

1.1 What Is AI? (5/6)

4) Acting rationally: The rational agent approach

- Build a machine that behaves rationally or does the right thing
  - A rational agent is one that acts so as to achieve the best expected outcome
  - The right thing: that which is expected to maximize goal achievement, given the available information
- Doesn't necessarily involve thinking (e.g., blinking reflex) but thinking should be in the service of rational action
  - To act rationally requires to reason logically to the conclusion
- Advantages:
  - More general than the "laws of thought" approach: beyond correct inference
  - Rationality is mathematically well defined and completely general

1.1 What Is AI? (6/6)

Rational Agents

- An **agent** is an entity that perceives and acts
- This course is about designing rational agents
- Abstractly, an agent is a function from percept histories to actions:

$$f : \mathcal{P}^* \rightarrow \mathcal{A}$$

- For any given class of environments and tasks,
  we seek the agent (or class of agents) with the best performance

- Caveat:
  - Computational limitations make perfect rationality unachievable
  - Design best program for given machine resources

1.2. The Foundation of AI

1.2 The Foundations of AI

AI prehistory

- Philosophy : logic, methods of reasoning
- Mathematics : formal representation and proof, algorithms, computation
- Psychology : human mind, thinking, acting
- Economics : formal theory of rational decisions
- Linguistics : knowledge representation, grammar
- Neuroscience : plastic physical substrate for mental activity
- Control theory : homeostatic systems, stability

obj function - > loss, panalty, ...

vision으로 확장

제어 - > 행동

1.3. The History of AI




1.3 History of AI (1/4)

1943-1956:	The birth of artificial intelligence
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	Machine learning applications
2012-present:	Deep learning becomes industry

1.3 History of AI (2/4)

1943	McCulloch & Pitts: Boolean circuit model of brain
1950	Turing's “Computing Machinery and Intelligence"
1952~69	Early enthusiasm, great expectation
1950s	Early AI programs, including Samuel's checkers program,
	Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
1956	Dartmouth meeting: “Artificial Intelligence” adopted
1965	Robinson's complete algorithm for logical reasoning
1966~74	AI discovers computational complexity
	Neural network research almost disappears

1.3 History of AI (3/4)

출처: Figure #1

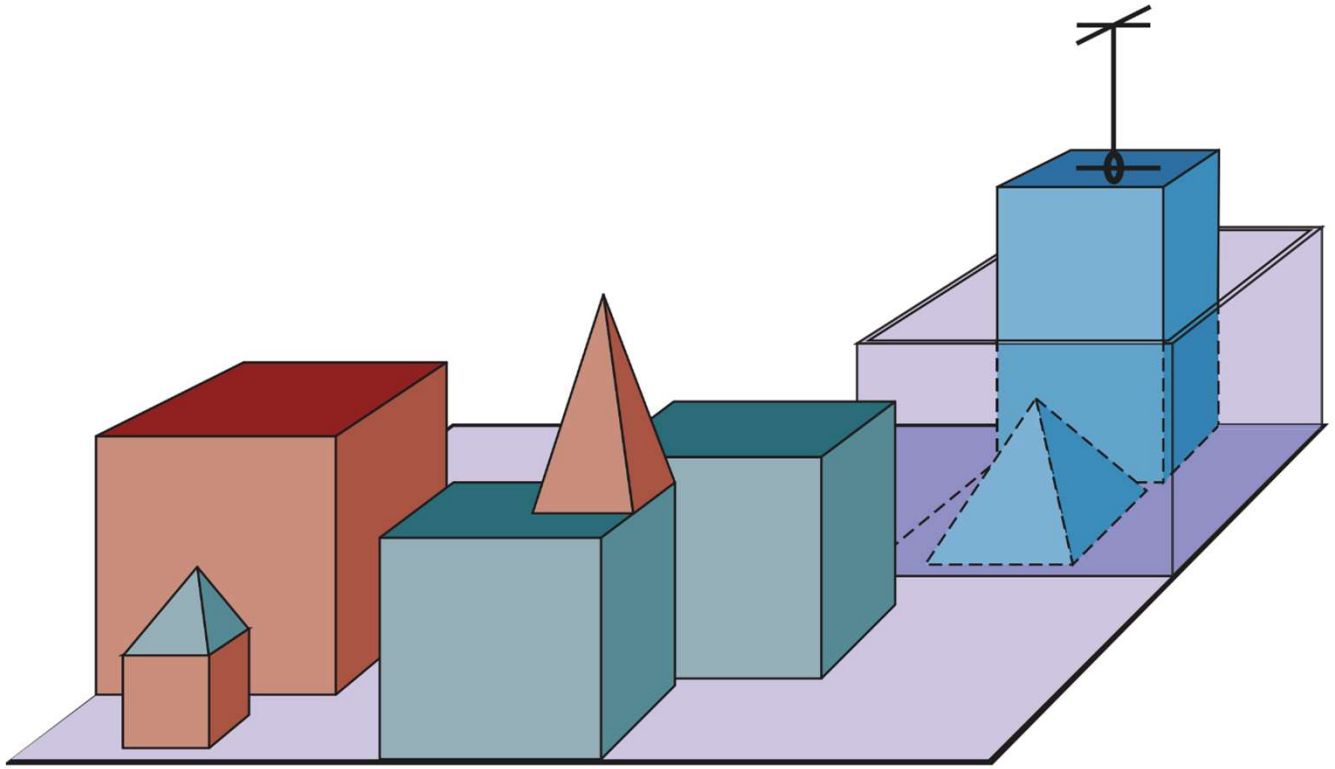


Figure 1.3 A scene from the blocks world. SHRDLU (Winograd, 1972) has just completed the command "Find a block which is taller than the one you are holding and put it in the box."

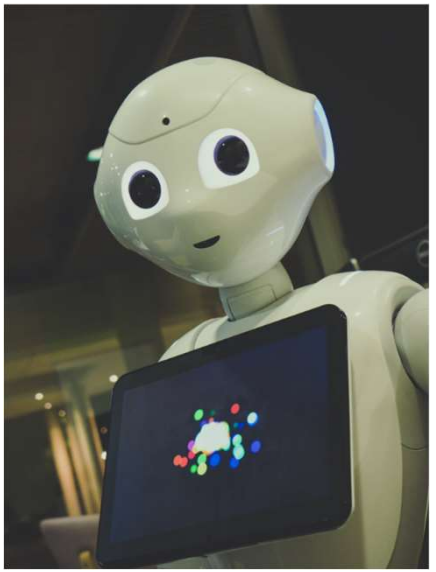
1.3 History of AI (4/4)

1969~79	Early development of knowledge-based systems
1980~88	Expert systems industry booms
1988~93	Expert systems industry busts: “AI Winter"
1985~95	Neural networks return to popularity
1988~	Resurgence of probability; general increase in technical depth
	“Nouvelle AI”: ALife, GAs, soft computing
1995~	Agents, agents, everywhere…
2005~	Human-level AI back on the agenda
2010~	Self-driving cars, Watson, Siri, Alexa, …
2012~	Deep learning becomes industry
2016~	AlphaGo, GPT-3, DALL·E

1.4. State of the Art

1.4 State of the Art (1/2)

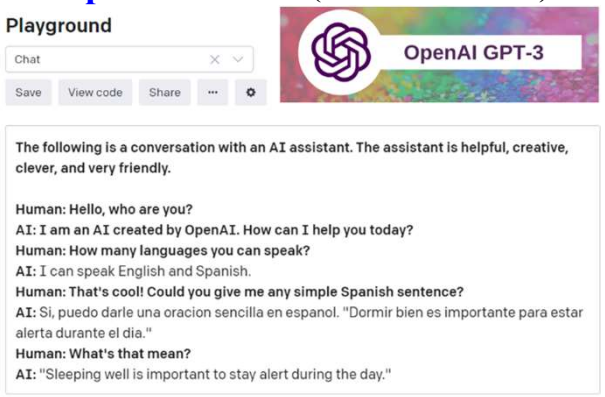
What can AI do today?



- Self-driving cars: Stanley (Stanford)
- Speech recognition: Duplex (Google)
- Face recognition: DeepFace (Facebook)
- Image generation: GAN (NVIDIA)
- Personal assistant: Siri (Apple), Alexa (Amazon)
- Planning and scheduling: Sojourner (NASA)
- Game playing: AlphaGo (DeepMind)
- Autonomous robots: Rosie (TUM), Atlas (Boston Dynamics)
- Machine translation: NeuralMT (Google)

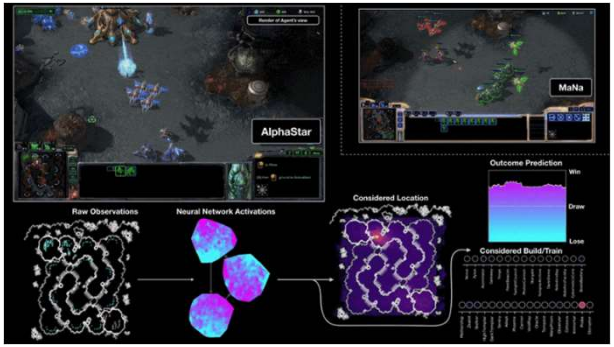
1.4 State of the Art (2/2)

OpenAI GPT-3 (Brown et al. 2020)



출처: Figure #2

AlphaStar (Vinyal et al. 2019)

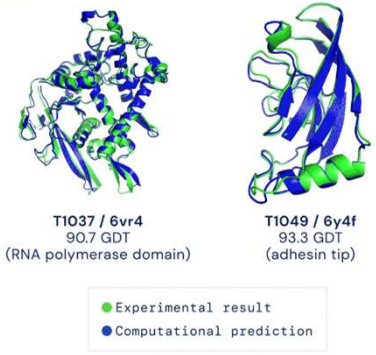


출처: Figure #3

QT-Opt (Kalashnikov et al. 2018)

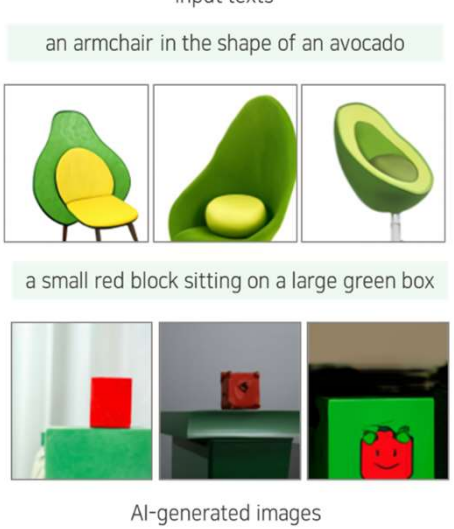
출처: Figure #4

AlphaFold (Perez et al. 2022)



출처: Figure #5

DALL·E (Ramesh et al. 2021)



출처: Figure #6

Summary

1. Intelligence is concerned mainly with rational action.
2. Ideally, an intelligent agent takes the best possible action in a situation.
3. AI is an interdisciplinary effort that has been influenced by and has influenced other disciplines, such as philosophy, mathematics, psychology, and neuroscience.
4. The history of AI has had cycles of success, misplaced optimism, and resulting cutbacks in enthusiasm and funding.
5. AI has advanced more rapidly in the past decade because of greater use of the scientific method in experimenting with and comparing approaches.
6. Deep learning has revolutionized AI by enabling intelligent systems to be developed automatically by data-driven learning rather than knowledge-based programming when big data are available.

References

Figures

#1 Stuart J. Russell and Peter Norvig. Artificial Intelligence: A Modern Approach (4rd Edition). Pearson

#2 GPT-3 Powers the Next Generation of Apps. OpenAI. https://openai.com/blog/gpt-3-apps/

#3 Alphastar: Mastering the real-time strategy game starcraft II. DeepMind. https://deepmind.com/blog/article/alphastar-mastering-real-time-strategy-game-starcraft-ii

#4 Scalable Deep Reinforcement Learning for Robotic Manipulation. Google Research. https://ai.googleblog.com/2018/06/scalable-deep-reinforcement-learning.html

#5 AlphaFold: A solution to a 50-year-old grand challenge biology. DeepMind. https://deepmind.com/blog/article/alphafold-a-solution-to-a-50-year-old-grand-challenge-in-biology

#6 DALL-E Creating Images from Text. OpenAI. https://openai.com/blog/dall-e/

#7 http://www.icorp.com.mx/blog/automatizacion-robotica-de-procesos/