# 기계학습 기초 및 응용
# Machine Learning

## 0. 과목 소개

Kookmin University, Seoul, Korea



KMU 국민대학교
KOOKMIN UNIVERSITY

# Class logistics

- time and place
  - 10:00~12:00, Sat.
  - Room 447, Bldg. future
- instructor: Prof. Jaekoo Lee
  - jaekoo@kookmin.ac.kr
  - Machine intelligence(MI) lab. [인공지능 연구실]
    - Create AI that turns imagination into reality!
  - Office hours (@Dorm B-609): any time, any where!

- teaching assistants:
  - Youngjun Yoo(junyoo96@kookmin.ac.kr)
- course materials: ecampus.kookmin.ac.kr
- Class schedule
  - 15 weeks

# But, current situtation


| 제목 | 2020학년도 1학기 학사일정 변경에 따른 온라인 수업 안내 | 글쓴이 | 윤보람 |
|---|---|---|---|
| 날자 | 20.03.13 | 조회수 | 1257 |
| 담당부서 | 교무팀 ☎ | 담당자 | |

**2020학년도 1학기 학사일정 변경에 따른 온라인 수업 안내**

**1. 개강일 및 강의실 수업 일정**

- 코로나19에 대응하여 2020학년도 1학기 개강 및 종강 일정을 변경하고 1~4주차 모든 수업을 온라인으로 진행
- 과목별 수업운영방법, 계획 **수업계획서 및 eCampus(가상대학)에서 반드시 확인**

| 구분 | 일정 | 비고 |
|---|---|---|
| 개강일 | **3.16.(월)** | 2주 연기 |
| 강의실수업(출석수업) 시작일 | **4.13.(월)** | 개강 초 4주분 수업을 온라인으로 진행 |

* 실험실습 과목 등 온라인 수업이 진행 불가한 필수 집합 교육은 별도 출석 보강수업으로 진행될 수 있음.
* 상기 일정은 향후 코로나19 진행상황에 따라 변경될 수 있음.

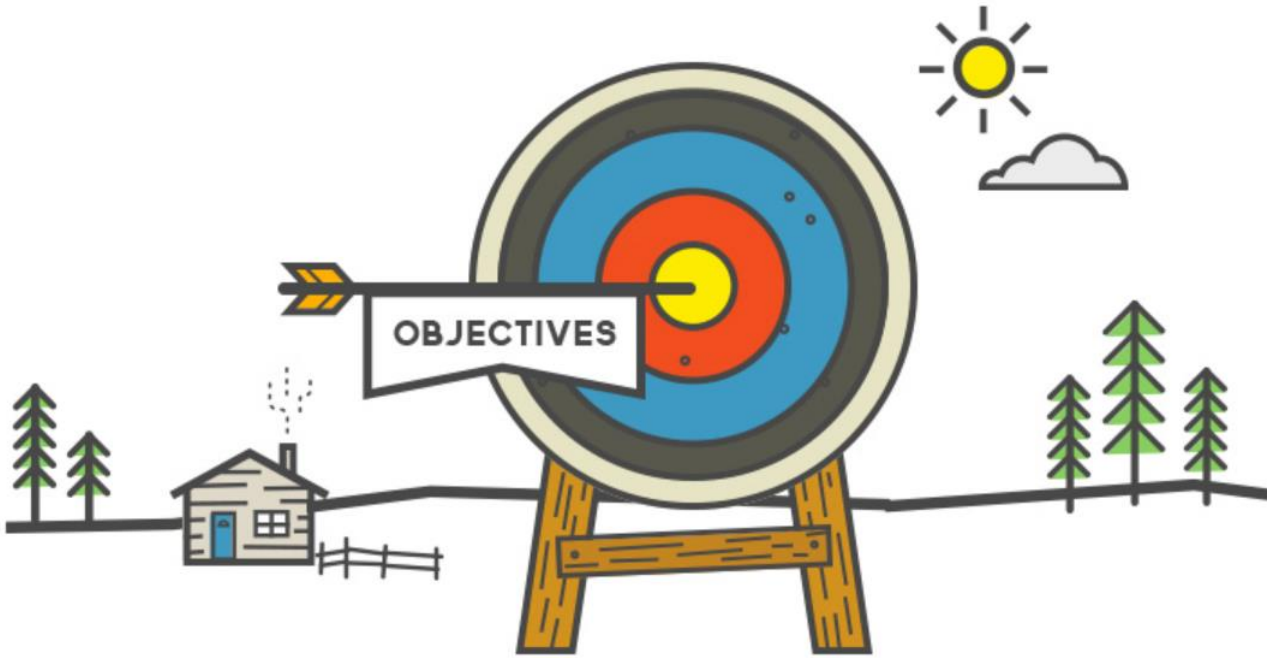
**2. 2020학년도 1학기 온라인 수업 안내**

- 온라인 강의시스템 eCampus 바로가기 : ecampus.kookmin.ac.kr
- eCampus(가상대학) 이용 안내 및 어플리케이션 다운로드 : 매뉴얼은 eCampus 이용안내 > 온라인 강의안내 참조

| 구분 | PC 버전 | 안드로이드용 | 아이폰용 |
|---|---|---|---|
| eCampus(가상대학) | 바로가기 | 다운로드 클릭 | 다운로드 클릭 |
| 실시간 화상강의(ZOOM) | 다운로드 클릭 | 다운로드 클릭 | 다운로드 클릭 |
| 소통채널 K·PUSH+ | - | 다운로드 클릭 | 다운로드 클릭 |

# Class objectives

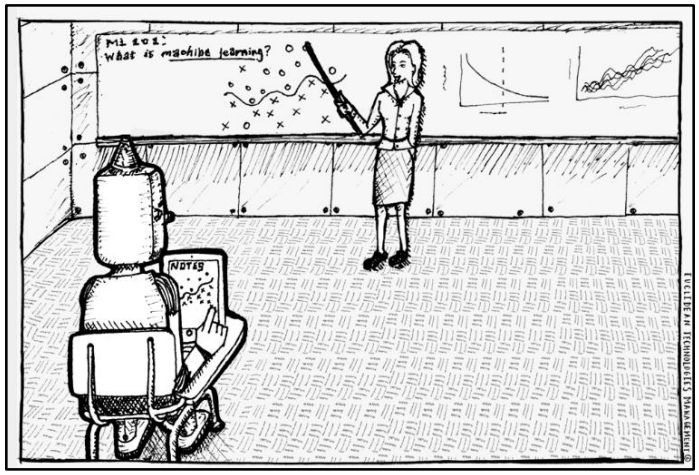
- main objectives:
  - understand fundamentals of machine learning
  - have hands-on experience (using cloud API)
  - motivate to learn recent breakthroughs in machine learning



# Prerequisites

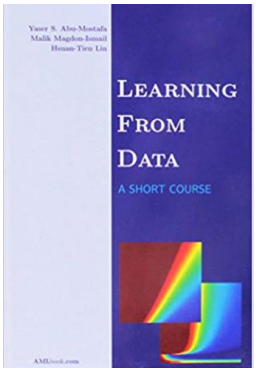
- this class:
  - intended to be the first course in machine learning

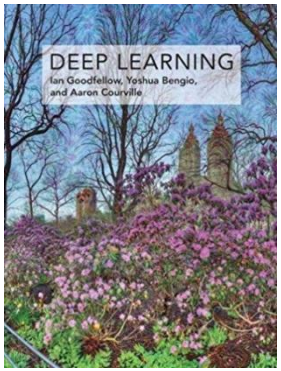
- prerequisites
  - familiarity with programming (e.g., Python)
  - a basic understanding of computational system
  - calculus, probability, statistics and linear algebra

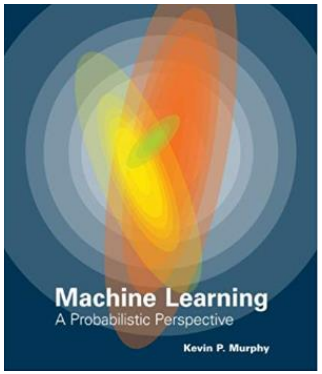


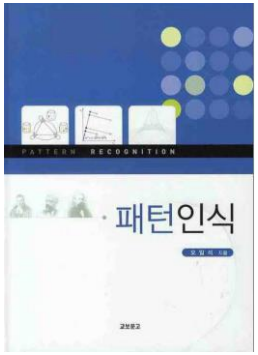
# Textbook

- Learning from Data
  - by Yaser S. Abu-Mostafa
- Deep learning
  - by Goodfellow, Bengio, and Courville
- 패턴인식, 기계학습
  - by 오일석
- Data Science on the GCP
  - by Valliappa Lakshmanan
- Stanford CS231N class materials

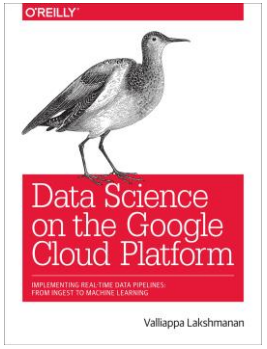






# Software and library

- Python
  - using Jupyter Notebook
  - python.org
- scikit-learn
  - NumPy + SciPy + matplotlib
  - scikit-learn.org
- PyTorch
  - deep learning
  - pytorch.org
- Anaconda or Docker
  - data science platform / application container platform
  - anaconda.com / docker.com
- Cloud platform
  - AWS
  - GCP






# Syllabus (tentative)

| Week | Contents | |
|---|---|---|
| 1 | 수업 소개 | |
| 2 | 인공지능, 기계학습 개념 I | |
| 3 | 인공지능, 기계학습 개념 II | |
| 4 | 인공 신경망 I | |
| 5 | 인공 신경망 II | |
| 6 | PYTHON 및 PYTORCH 실습 | |
| 7 | 심층 학습 I | |
| 8 | 심층 학습 II | |
| 9 | 중간 시험 | |
| 10 | NVIDIA DLI 실습 | |
| 11 | Cloud Platform 활용 I | |
| 12 | Cloud Platform 활용 II | |
| 13 | Cloud Platform 활용 III | |
| 14 | Kaggle 실습 | |
| 15 | 초청 강연 | |

# Performance evaluation

- 3 hands-on experience (45%)
- midterm (30%)
- class contribution (15%)
- class attendance (10%)

# Final remarks

- absolutely no negotiation for your final grades!

# Artificial Intelligence: Past, Present and Future

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Kookmin University, Seoul, Korea

Mar. 20, 2020

KMU 국민대학교 KOOKMIN UNIVERSITY

# Outline

- Introduction
- Artificial intelligence:
  - Definition and Categorization
  - Past
  - Present
    - Examples of remarkable results
    - Hot topics
    - Research and technology trends
  - Future
    - Watch out for 2020
    - Discussion of action items and preparations
- Conclusion
- Question and Answer

**Intelligent Machines**

# Nvidia CEO: Software Is Eating the World, but AI Is Going to Eat Software

Jensen Huang predicts that health care and autos are going to be transformed by artificial intelligence.

# Artificial intelligence

- AlphaGo by DeepMind: Rebirth of AI

# Artificial intelligence

- Evolution of AlphaGo


**알파고 시리즈의 성능 비교** 자료: 네이처

엘로(ELO)는 바둑 실력을 수치화한 점수로 클수록 고수. GPU와 TPU는 각각 그래픽 연산 전용 프로세서와 인공지능용 칩을 말함.

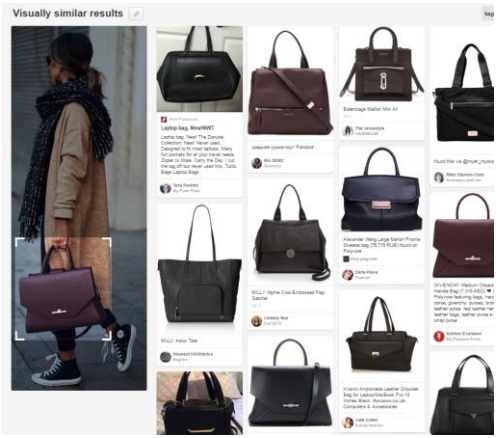
| 이름 | 공개 시점 | 전적 | 엘로(ELO) | 학습법 | 하드웨어 |
|---|---|---|---|---|---|
| 알파고 판 | 2015년 10월 | 판후이 2단에게 5-0 승리 | 3144 | 딥러닝, 강화학습 | GPU 176개, TPU 4개 |
| 알파고 리 | [illegible] | 이세돌 9단에게 4-1 승리 | 3739 | 딥러닝, 강화학습 | GPU [illegible]개, TPU 4개 |
| 알파고 마스터 | 2017년 5월 | 커제 9단에게 3-0 승리 | 4858 | [illegible] 강화학습 | TPU 4개 |
| 알파고 [illegible] | 2017년 10월 | 알파고 리에 100-0, 알파고 마스터에 89-11 승리 | 5185 | 강화학습 | TPU 4개 |

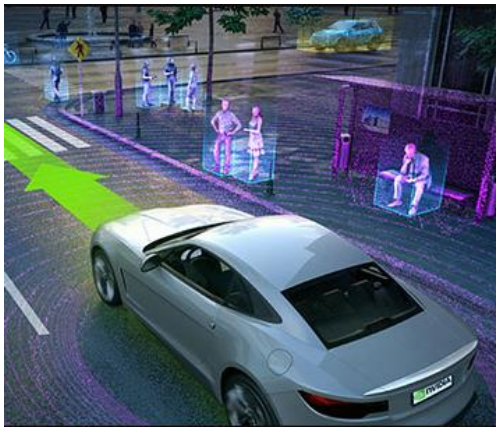
- 2017년: 바둑 은퇴
- 현재: 인공지능 기술을 활용하여 환자 진단과 치료 도움

"놀이터를 떠나 인간 삶으로 들어온 인공지능"

# Artificial intelligence

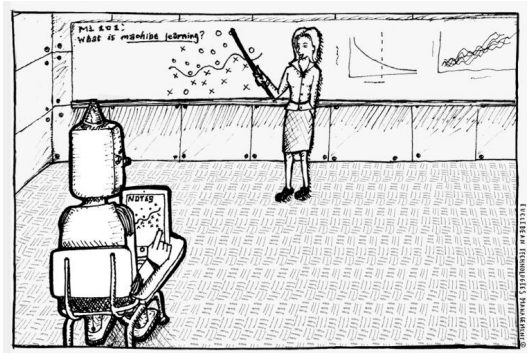
- AI in production
  - Speech recognition
  - Recommender systems
  - Autonomous driving
  - Real-time object recognition
  - Robotics
  - Real-time language translation
  - Many more…


# Artificial intelligence: Definition

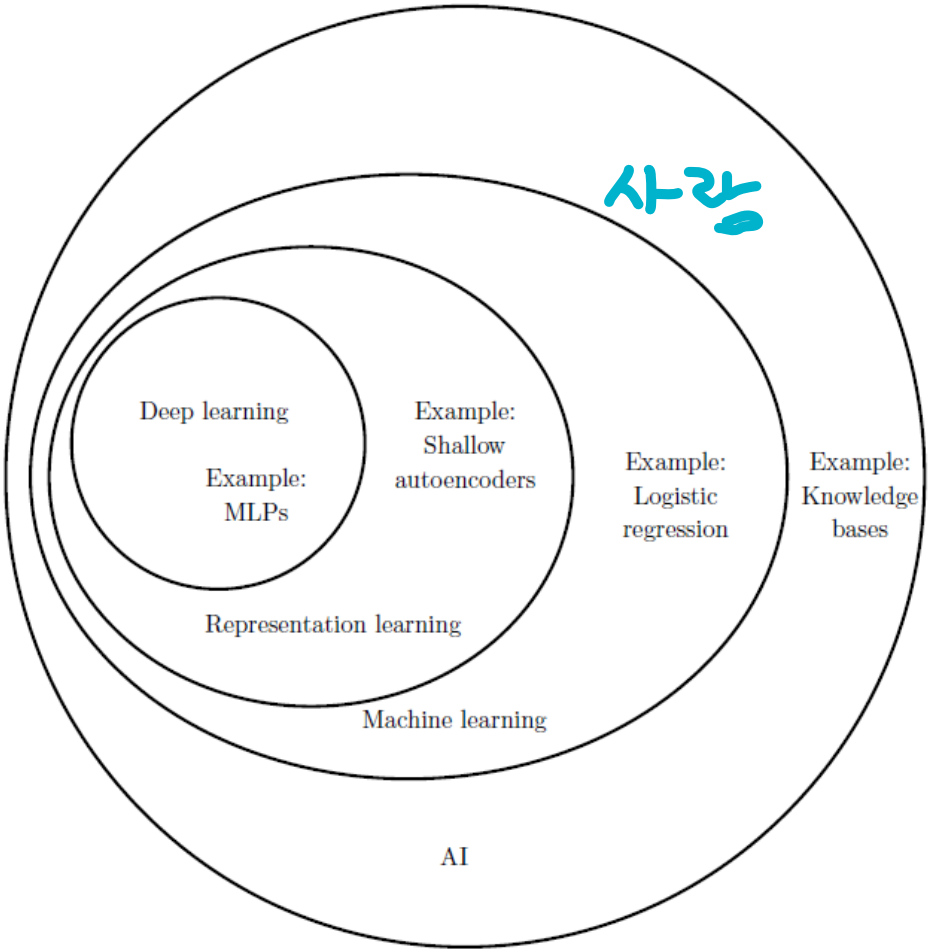
- Artificial intelligence (AI):
  - the simulation of human intelligence processes by machines (computer systems)



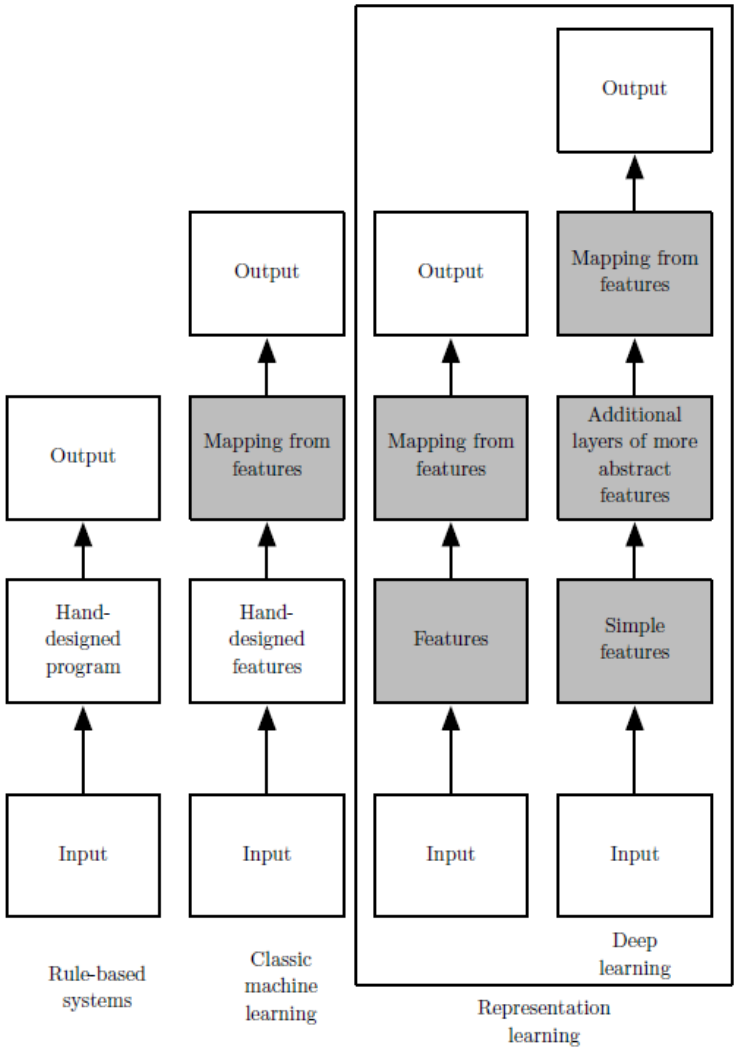

  - include (major components of AI)
    - learning (the acquisition of information and rules for using the information),
    - reasoning (using rules to reach approximate or definite conclusions),
    - knowledge,
    - language understanding, and
    - self-correction
  - Goal:
    - A machine that thinks or acts like a human

# Artificial intelligence: Categorization

- Field of artificial intelligence

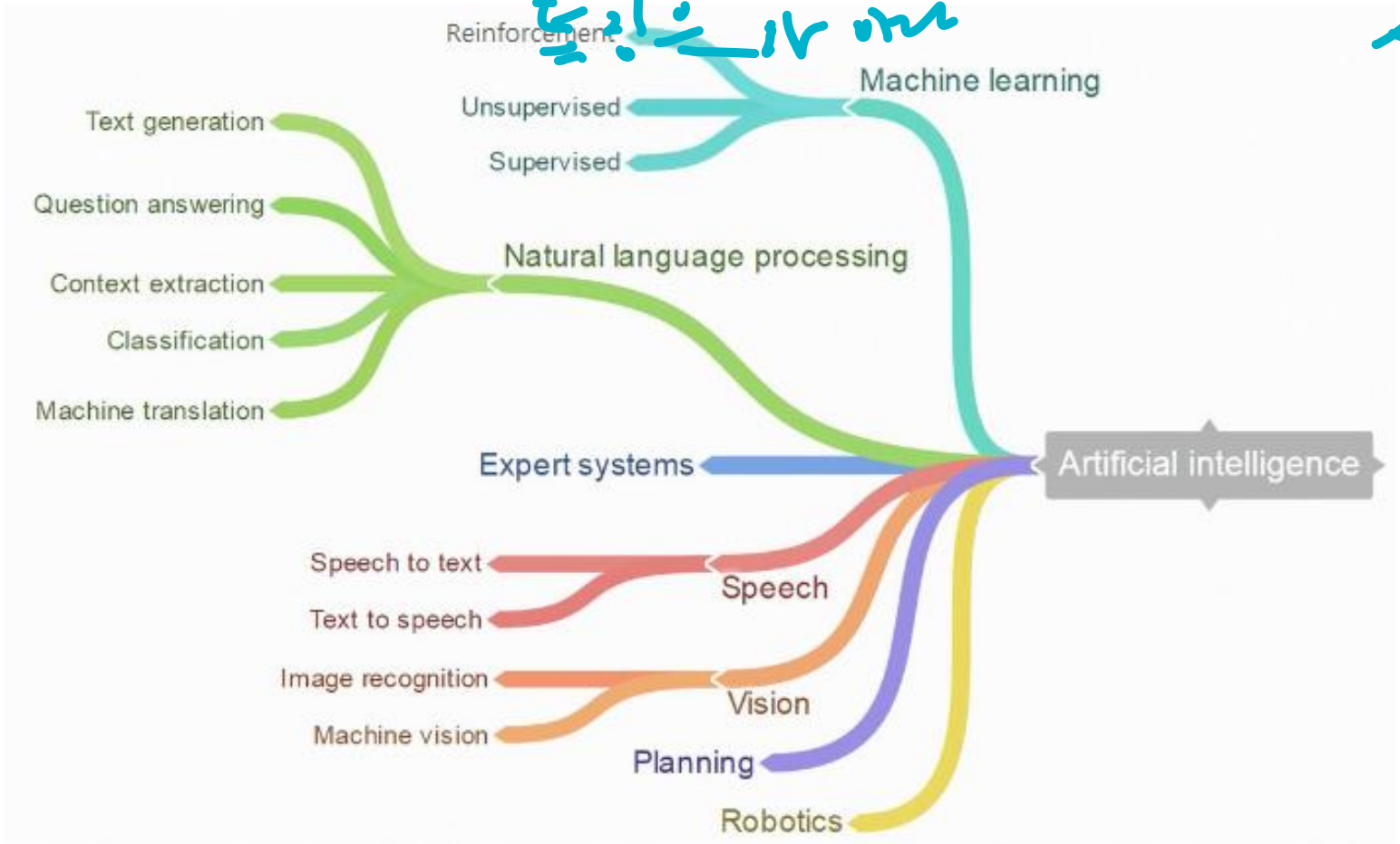



- Key elements of learning
  - Gray box: can be learned from data



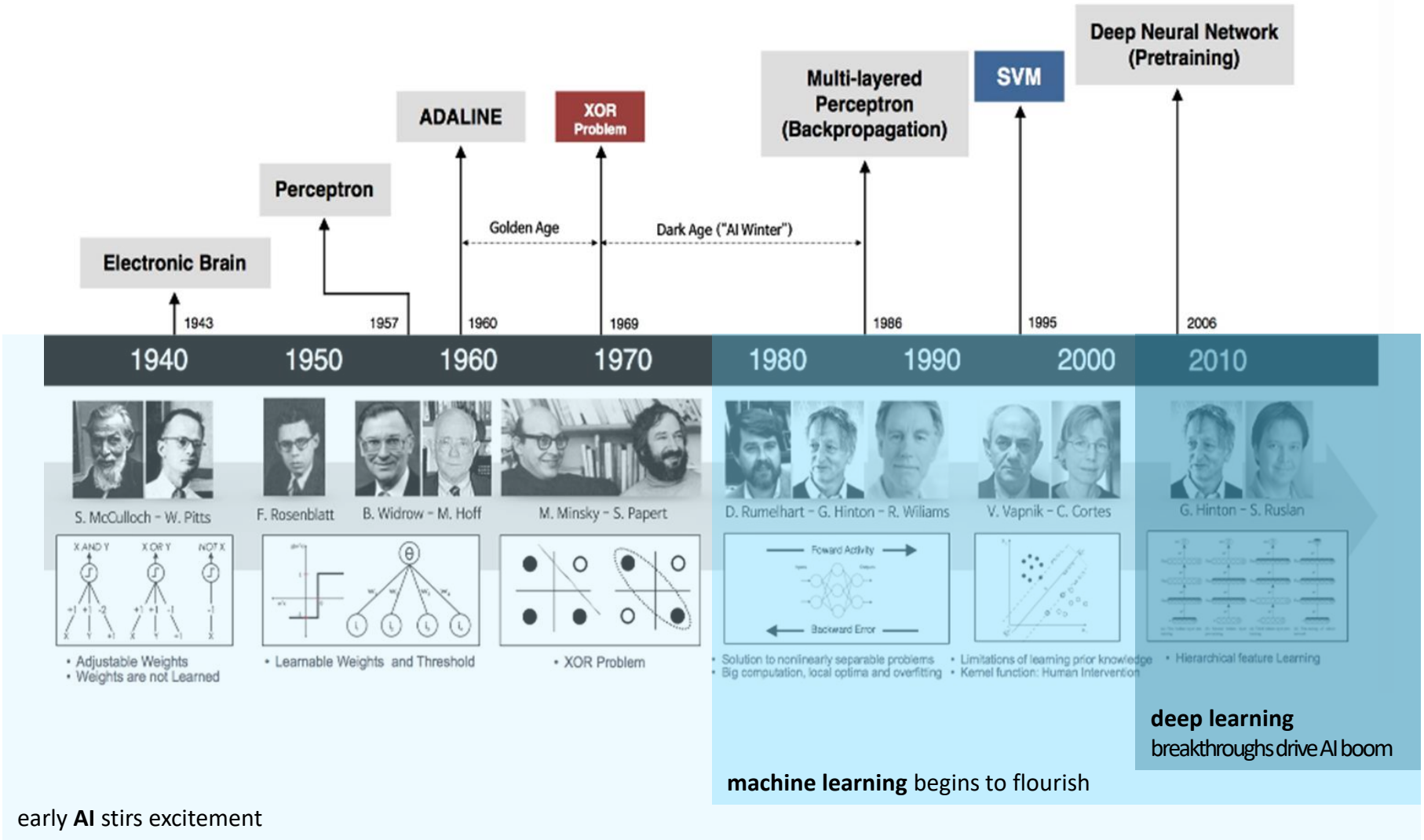
# Artificial intelligence: Problems

- Categories of AI problems

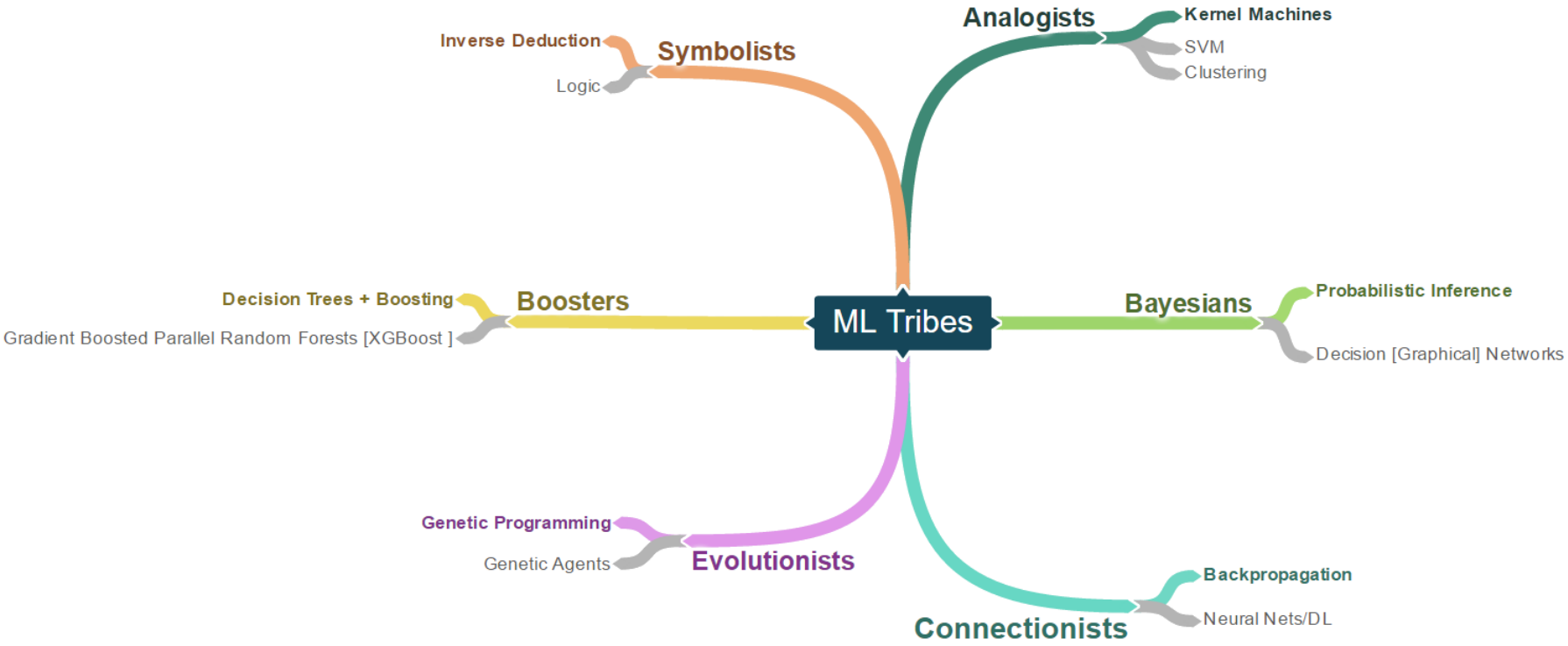
# Artificial intelligence: Past

- A brief timeline of historical events in AI



# Artificial intelligence: Past

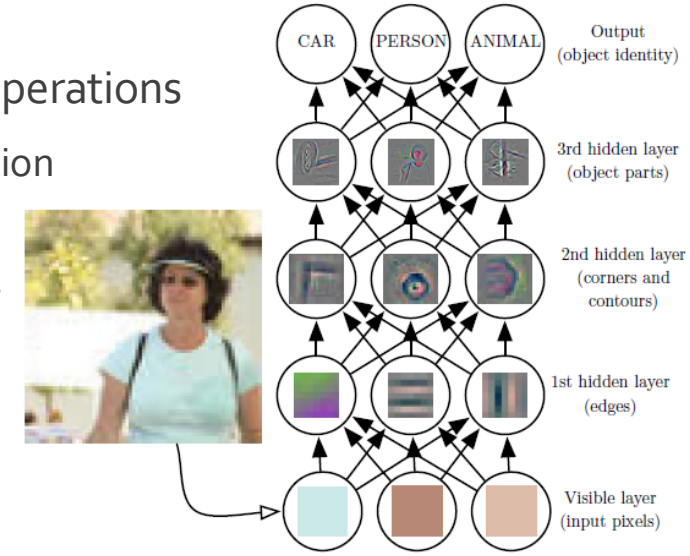
- Machine learning




| Tribe | Origins | Master Algorithm |
|---|---|---|
| Symbolists | Logic, philosophy | Inverse deduction |
| Connectionists | Neuroscience | Backpropagation |
| Evolutionaries | Evolutionary biology | Genetic programming |
| Bayesians | Statistics | Probabilistic inference |
| Analogizers | Psychology | Kernel machines |

# Artificial intelligence: Present

- Deep learning (or representation learning)
  - Neural network with multiple levels of non-linear operations
    - More than one stage of non-linear feature classification
    - Each stage: a kind of trainable feature transform
    - Hierarchy of representations with increasing level of abstraction



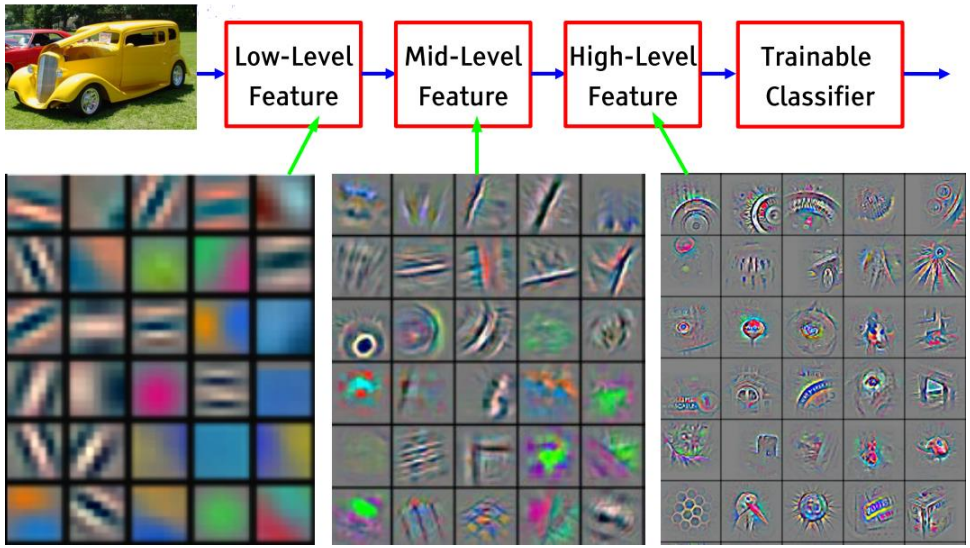



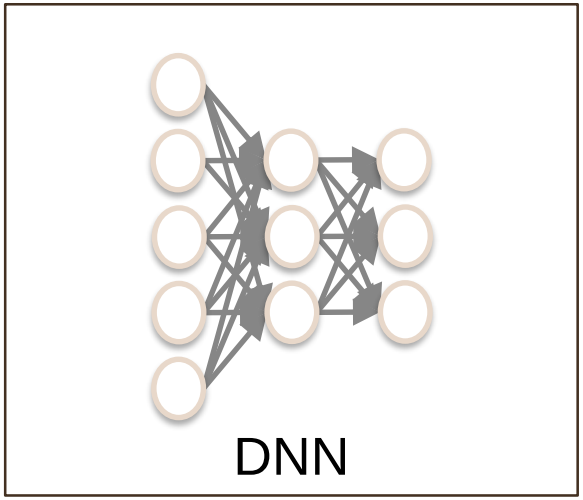

**Image**
pixel → edge → texton → motif → part → object

**Text**
character → word → word group → clause → sentence → story

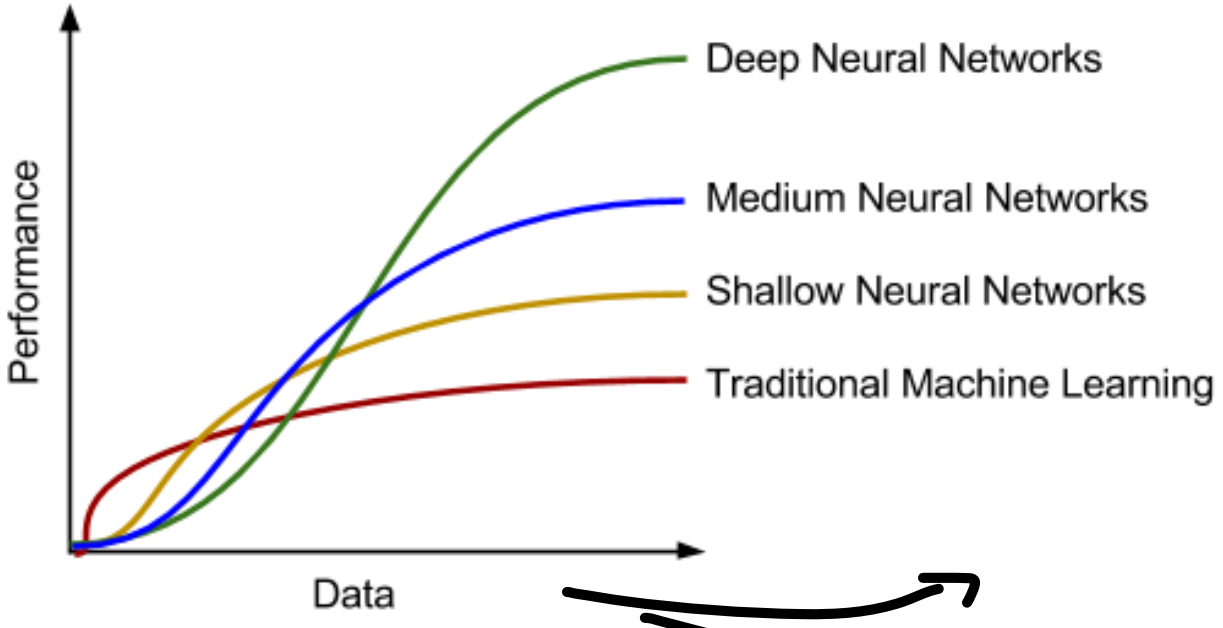
**Speech**
sample → spectral band → sound → … → phone → phoneme → word →

# Artificial intelligence: Present

- Reasons for deep learning's success





# Artificial intelligence: Present

- Today, AI can

# Artificial intelligence: Present

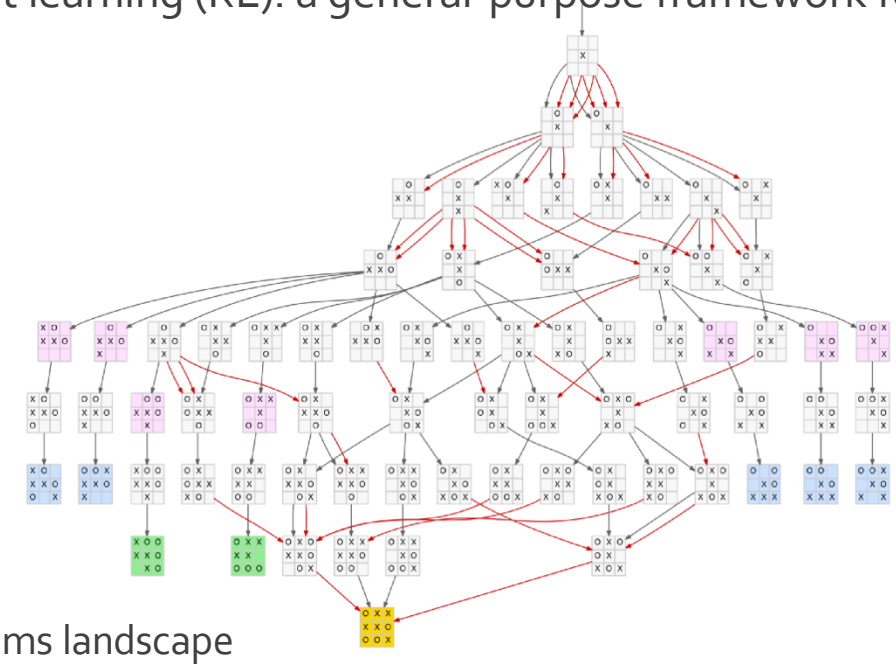
- Today, AI can

# Artificial intelligence: Present

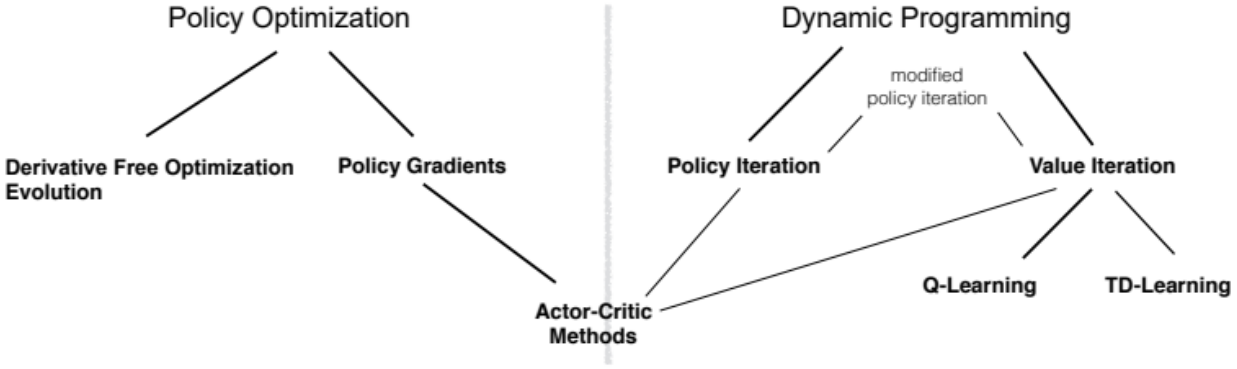
- Hot topics
  - Capsule networks:
    - emulating the brain's visual processing strengths
  - Deep reinforcement learning (DRL):
    - interacting with the environment to solve real problems
  - Generative adversarial networks (GANs):
    - pairing neural nets to spur learning and lighten the processing load
  - Lean and augmented data learning:
    - addressing the labeled data challenge
  - Automated machine learning (AutoML):
    - model creation without programming
  - Hybrid learning models:
    - combining approaches to model uncertainty (e.g., Bayesian deep learning, Bayesian GANs)
  - Explainable artificial intelligence:
    - understanding the black box
  - Deep learning on graphs:
    - Deep learning for 3D structured data (e.g., protein)

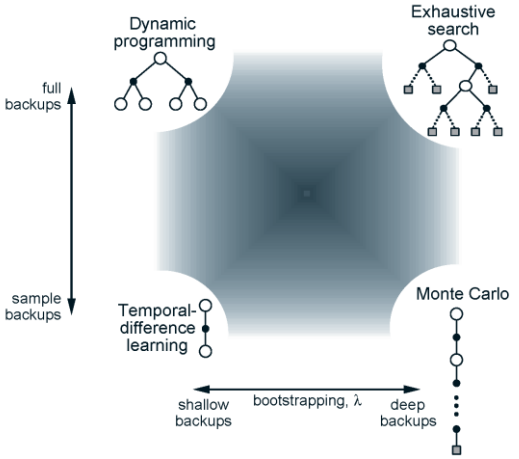
# Artificial intelligence: Present

- Deep reinforcement learning (DRL) = deep learning + reinforcement learning
  - Reinforcement learning (RL): a general-purpose framework for decision-making



  - RL algorithms landscape



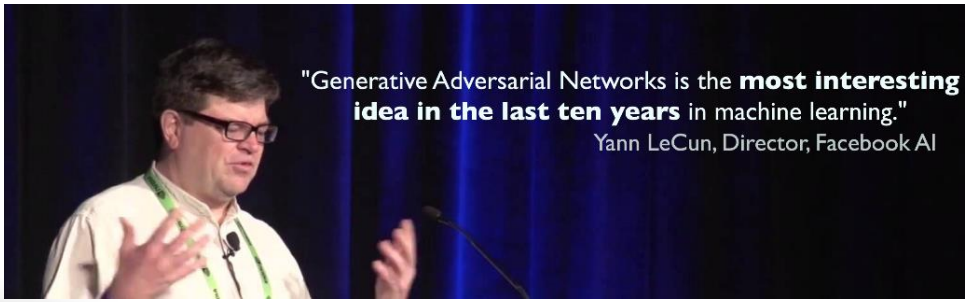




(source: Schulman and Abbeel

# Artificial intelligence: Present

- Hot topics: generative adversarial networks (GANs)

D: Detective

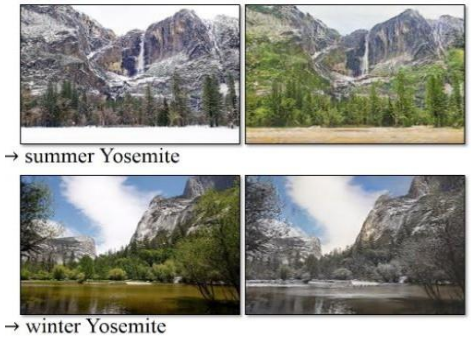



R: Real Data

G: Generator (Forger)

I: Input for Generator

Progressive GAN, Karras 2018.

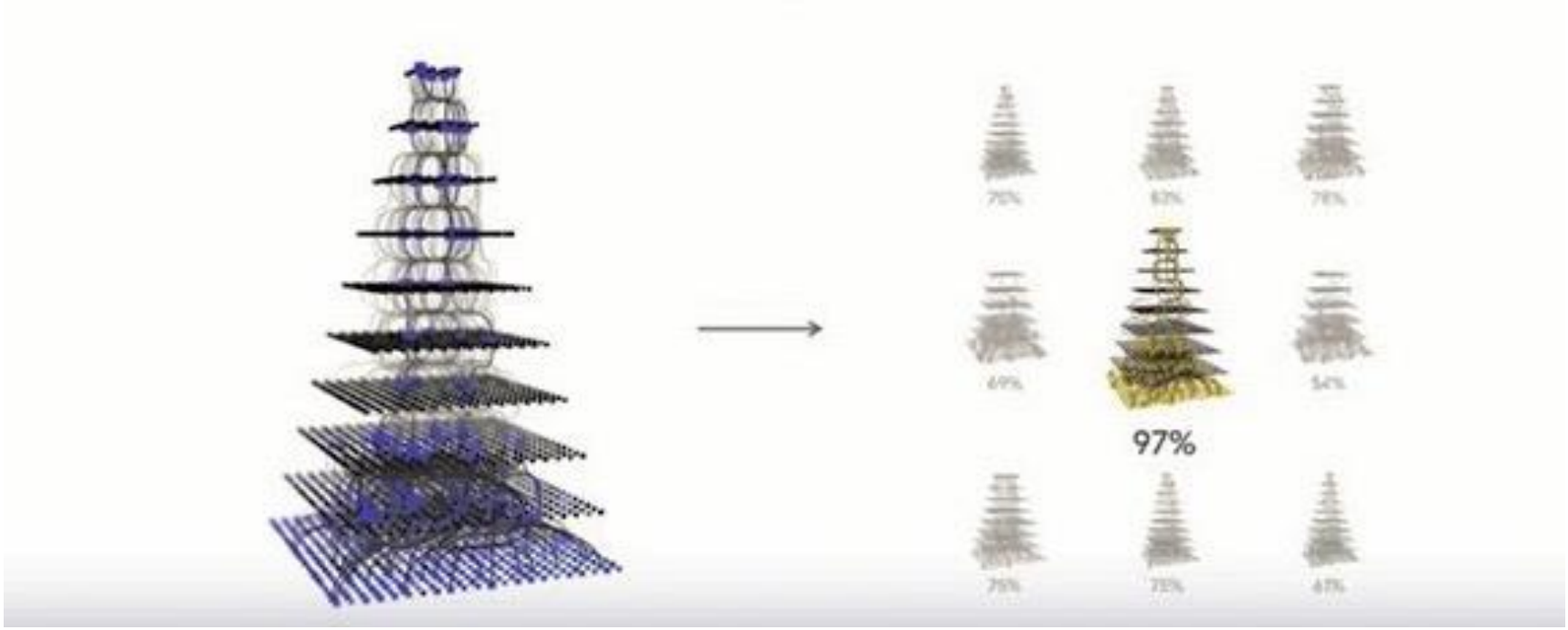



CycleGAN. Zhu et al. 2017.

Pix2pix. Isola 2017.

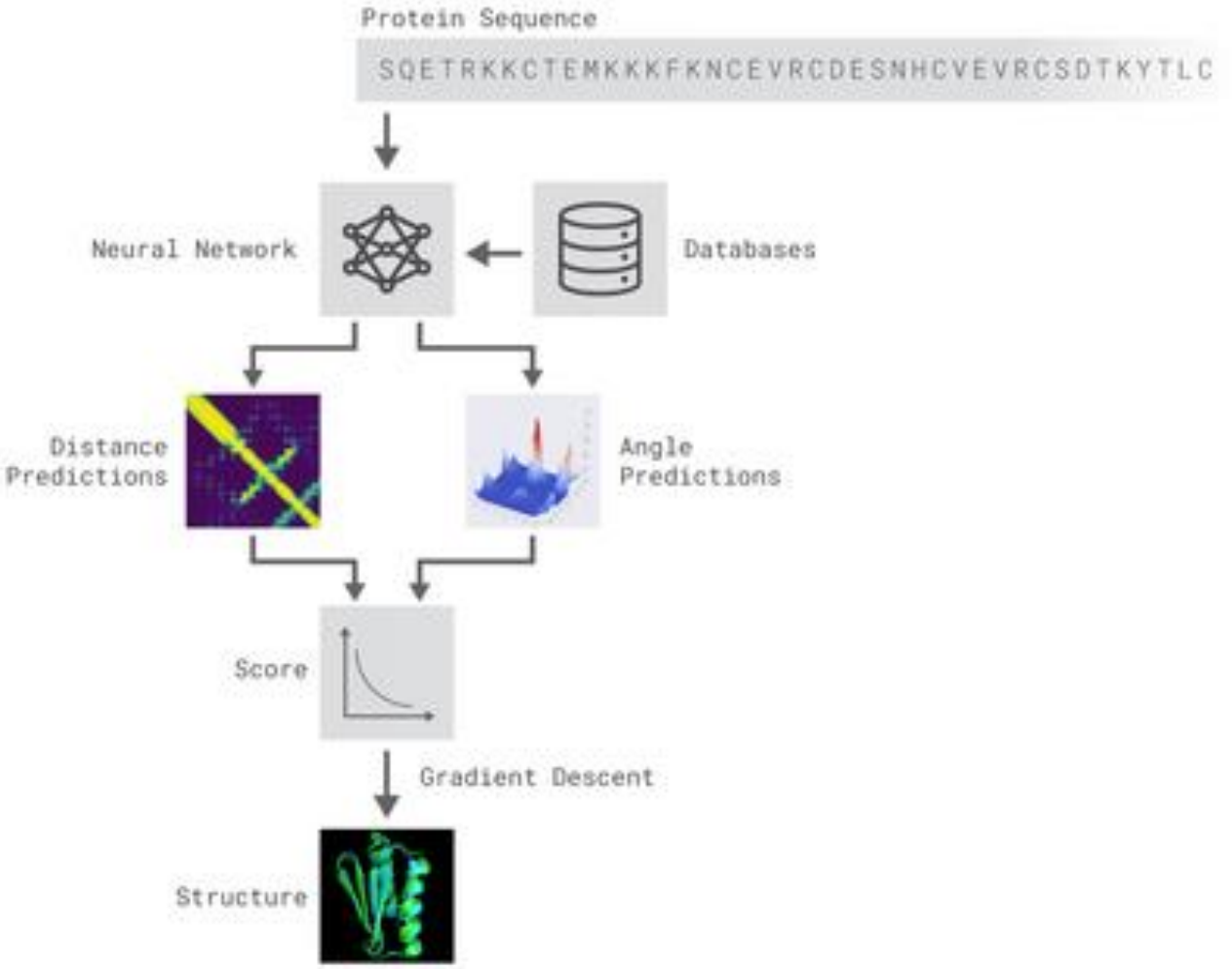
# Artificial intelligence: Present

- Hot topics: automated machine learning (AutoML)
  - CLOUD AUTOML by Google:
    - training custom machine learning models with minimum effort
  - Learning to learn



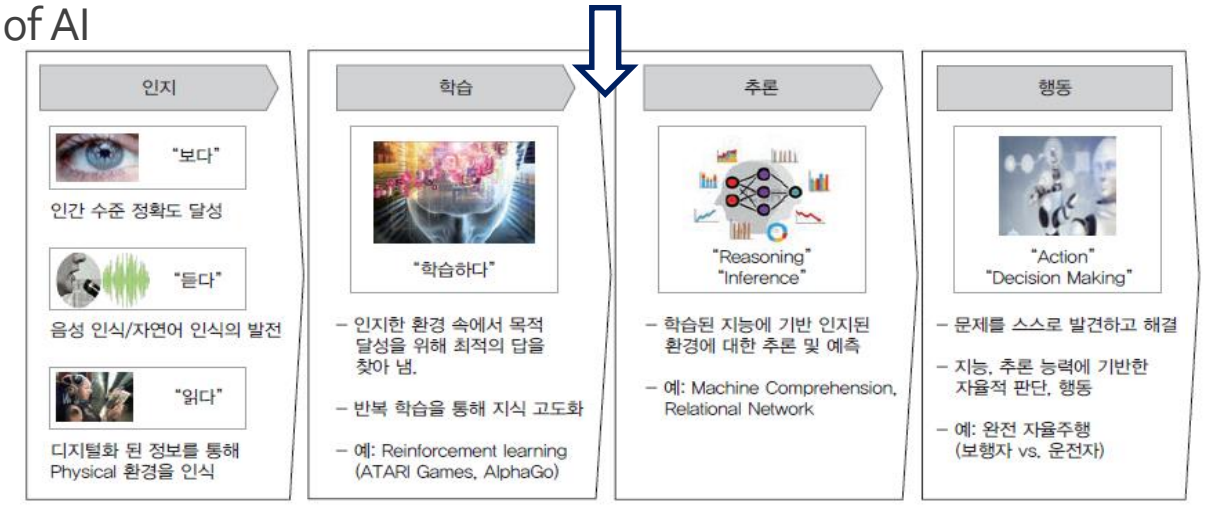
# Artificial intelligence: Present

- Hot topics: deep learning on graphs
  - AlphaFold by DeepMind: using AI for scientific discovery



# Artificial intelligence: Present

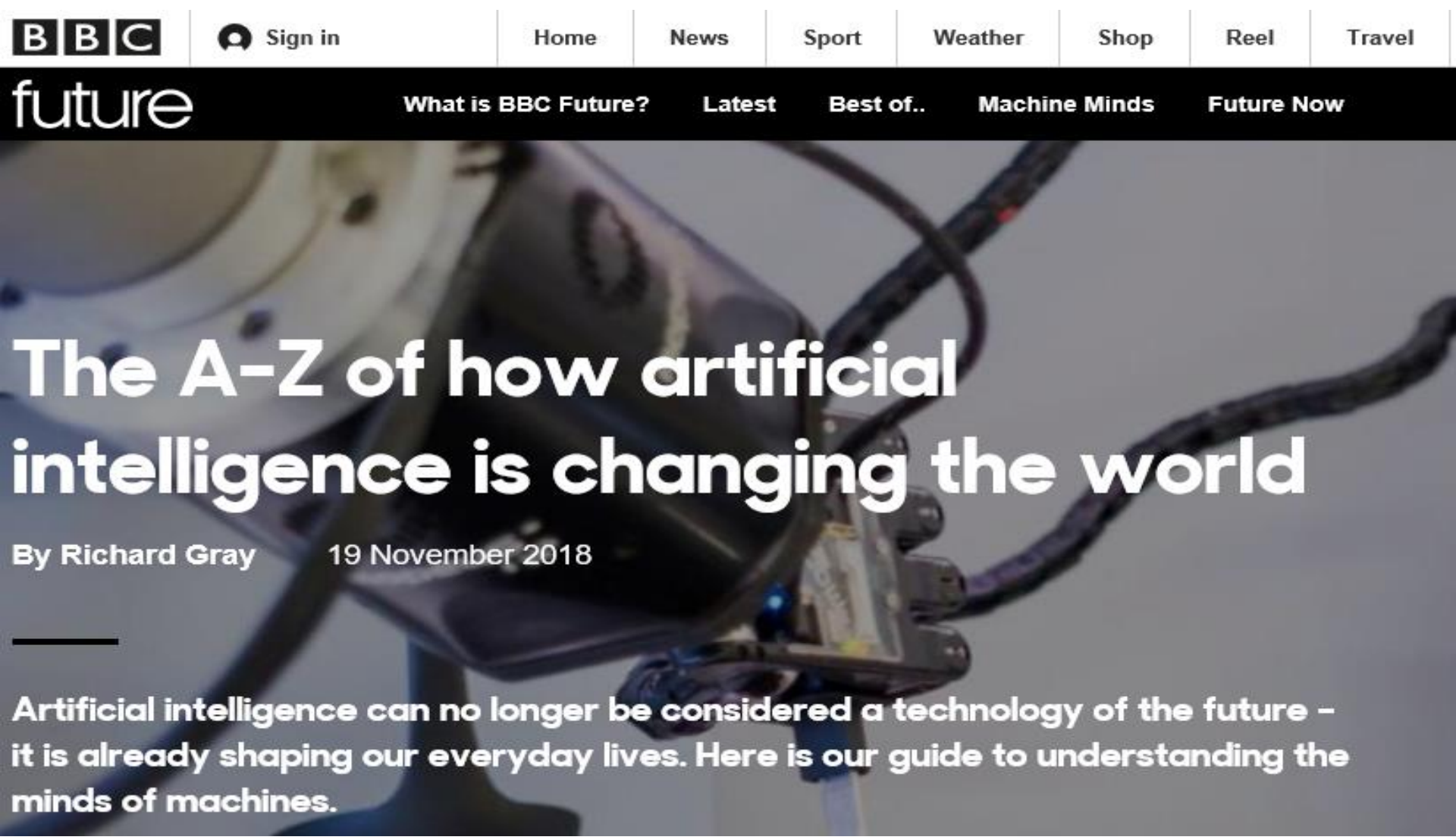
- Research and technology trends
  - Step of AI




[LG경제연구원]

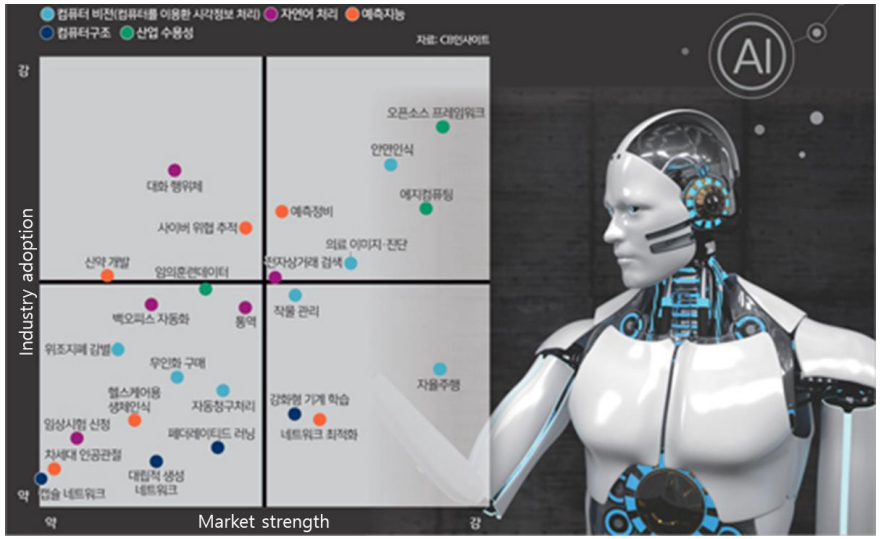
# Wait, let's watch a video!

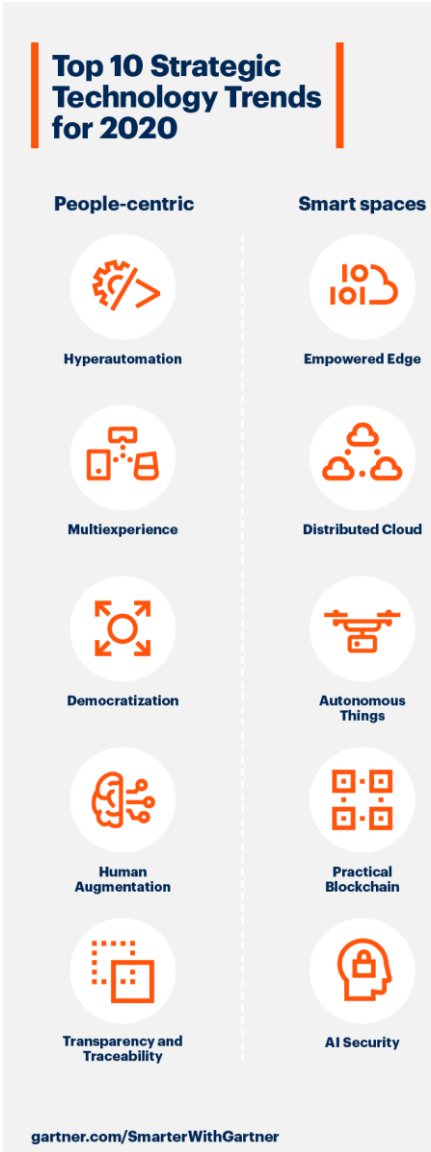
# Artificial intelligence: Future



# Artificial intelligence: Future

- Watch out for 2020
  - AI into real life and business
    - Changing the fundamental structure of small industry
    - e.g., factory, health-care, farm
  - Convergence of IoT and AI at the edge
    - Synergizing with 5G
  - Interoperability among neural networks becomes key
    - Easy development and deployment of AI
  - Automated machine learning will gain prominence
    - Automating the end-to-end process of applying AI to real-world problems



# Conclusion

- This class:
  - intended to be the first course in machine learning
- Prerequisites
  - familiarity with programming
  - calculus, probability, statistics, and linear algebra
  - a basic understanding of computational system
- Objectives:
  - understand fundamentals of machine learning
  - have hands-on experience
  - motivate to learn recent breakthroughs in machine learning

# Question and Answer

- If you have any comments,

  suggestions or questions then please do let me know!

- For more information, contact me

  *jaekoo@kookmin.ac.kr*

Thank you ☺