최신 AI 연구 동향

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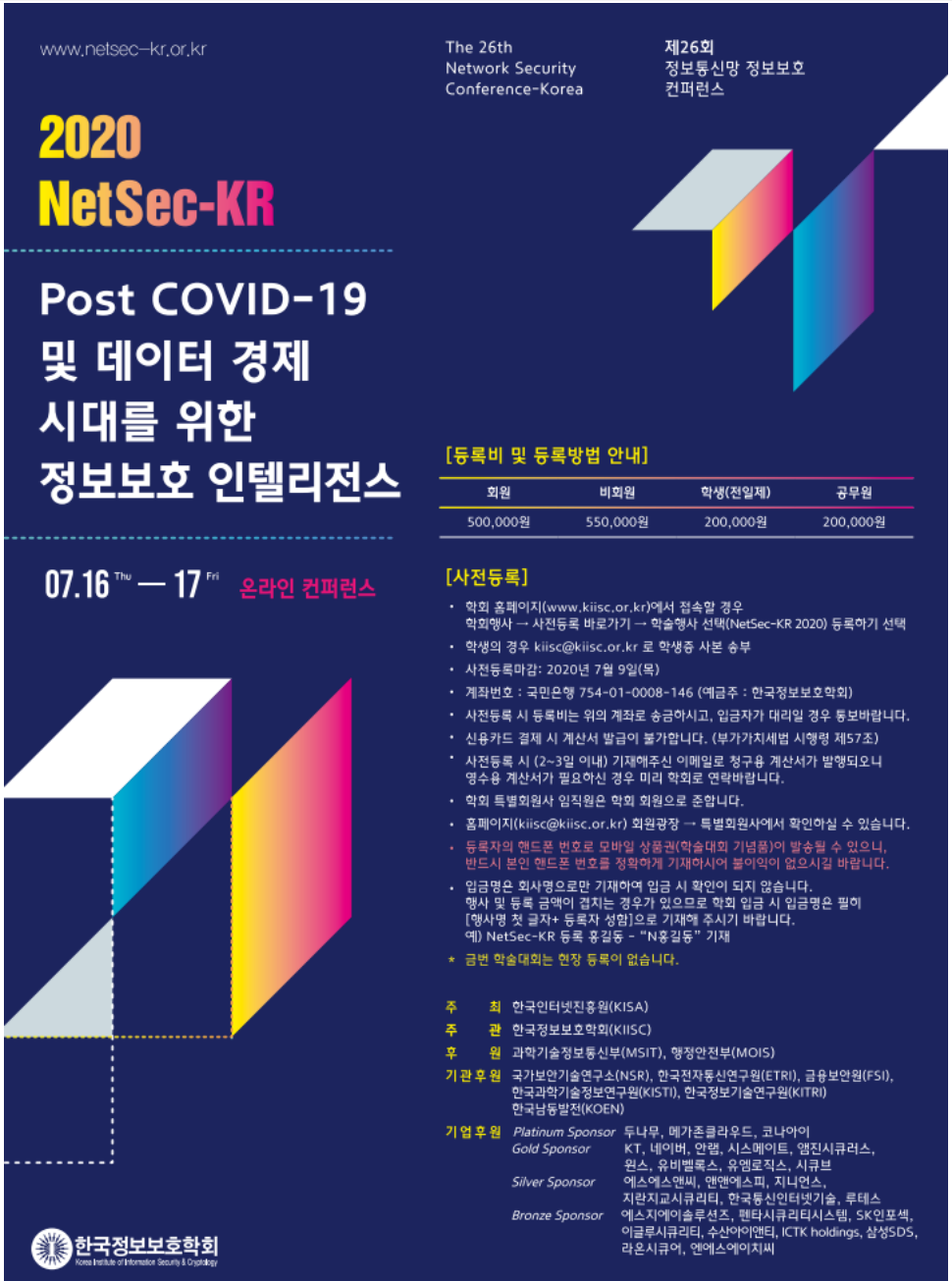
KMU 국민대학교 KOOKMIN UNIVERSITY

Thank you for your invitation



Outline

- Introduction
- Background for deep learning
- Research trends in deep learning
- Conclusion

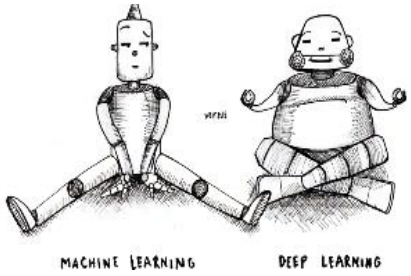
Introduction

- About me
  - Jaekoo lee
    - Kookmin university
    - Assistant professor, School of software, College of computer science
    - jaekoo@kookmin.ac.kr

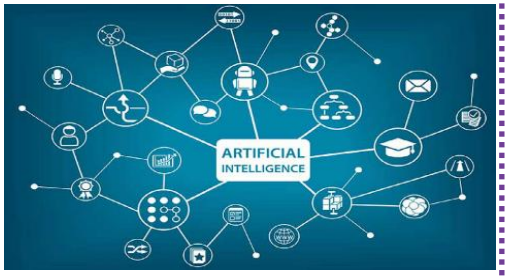
  - Machine intelligence (MI) lab.
    - Our research topics

Bio or health-care analysis | IoT (e.g. sensor) analysis | self-driving car or drone | Security | Apps.

Artificial intelligence



Machine (deep) learning



System (Robot) for intelligence

Fundamentals

Introduction

- Tutorial objectives:
  - understand fundamentals of deep learning
  - review of recent research trends in deep learning
  - motivate to learn recent breakthroughs in deep learning

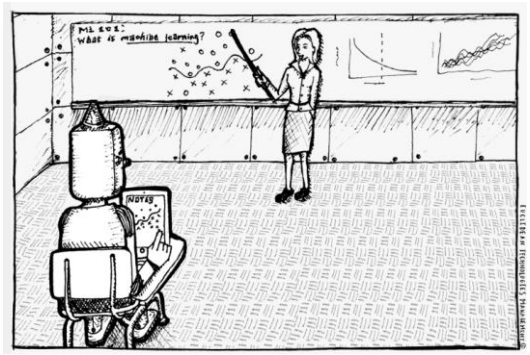
Intelligent Machines

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.

Introduction

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



[from https://www.euclidean.com/]

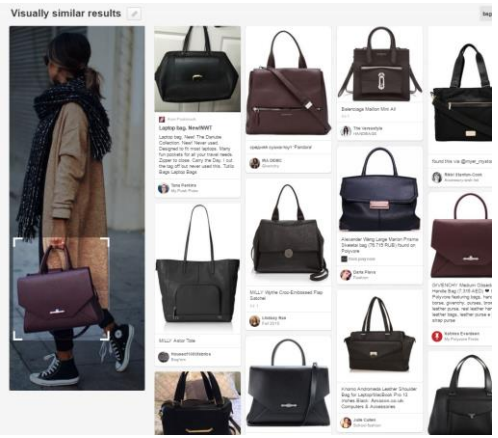
  - include (major components of AI)
    - learning (the acquisition of information and rules for using the information),
    - reasoning (using rules to reach approximate or definite conclusions),
    - knowledge,
    - language understanding, and
    - self-correction

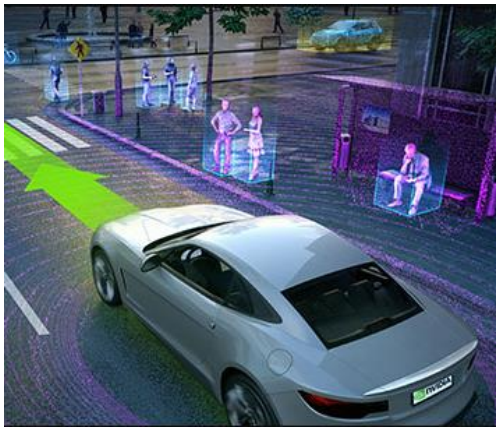
  - Goal:
    - A machine that thinks or acts like a human

Introduction

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

AI systems deployed to billions of users

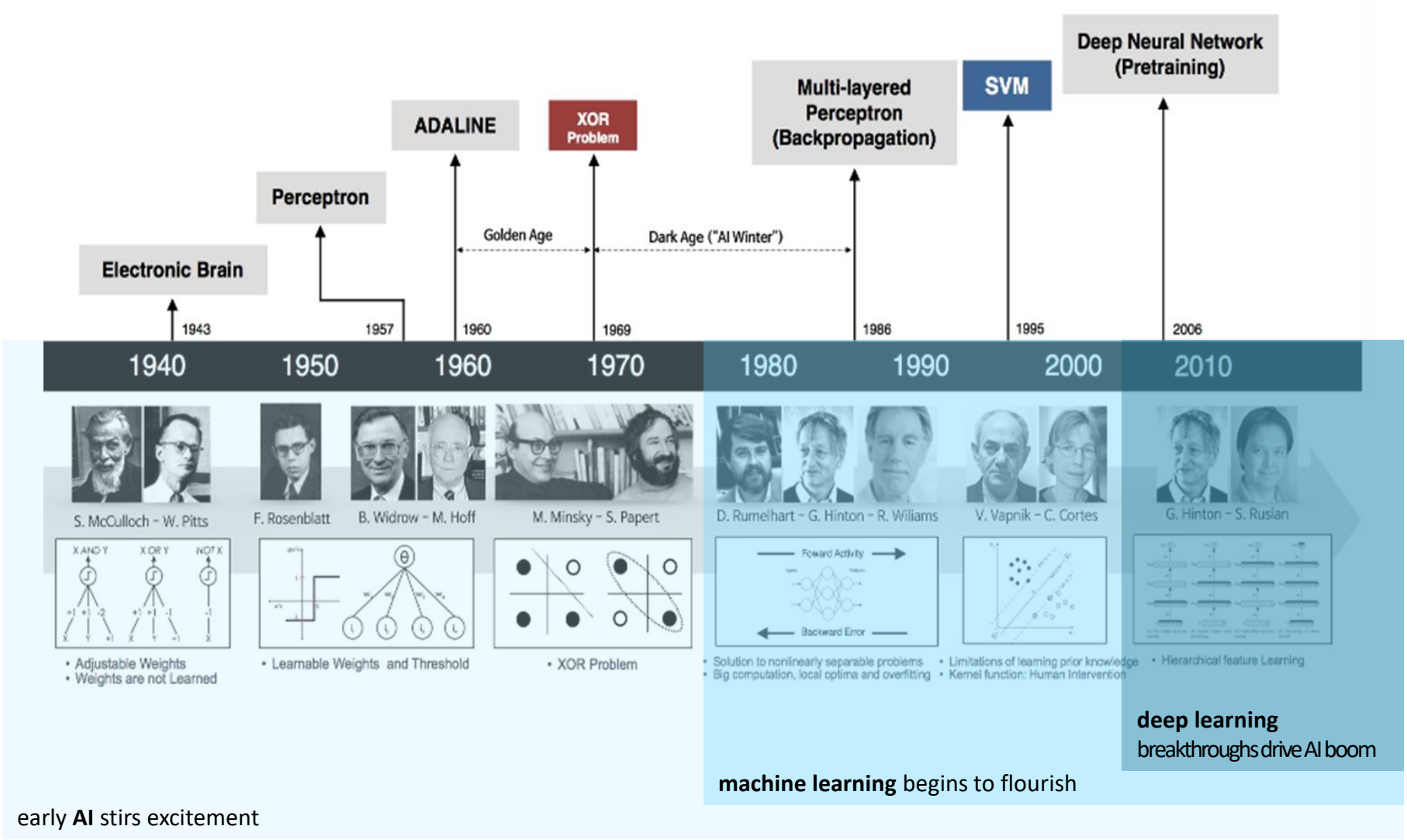




[from https://www.nvidia.com]

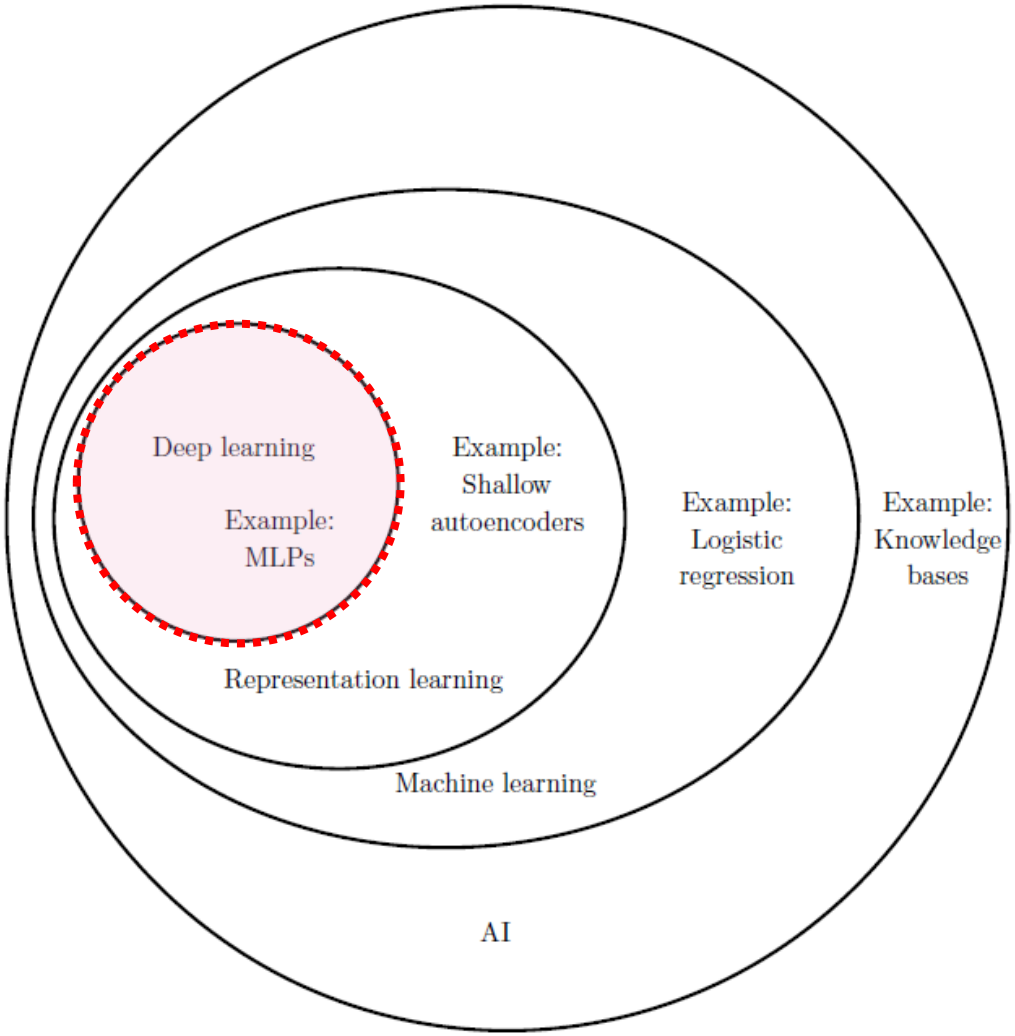
Introduction

- A brief timeline of historical events in AI



Background for deep learning

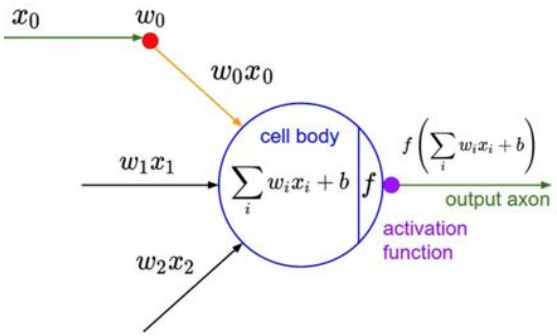
- Field of artificial intelligence



[from book: deep learning @MIT]

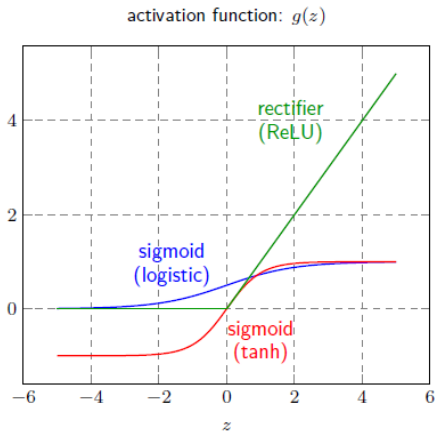
Background for deep learning

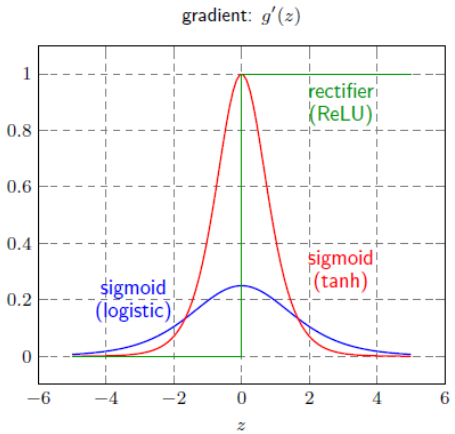
- Basic operation in a node of neural networks
  - inner product == linear function



  - activation function == non-linear function
    - various activation functions

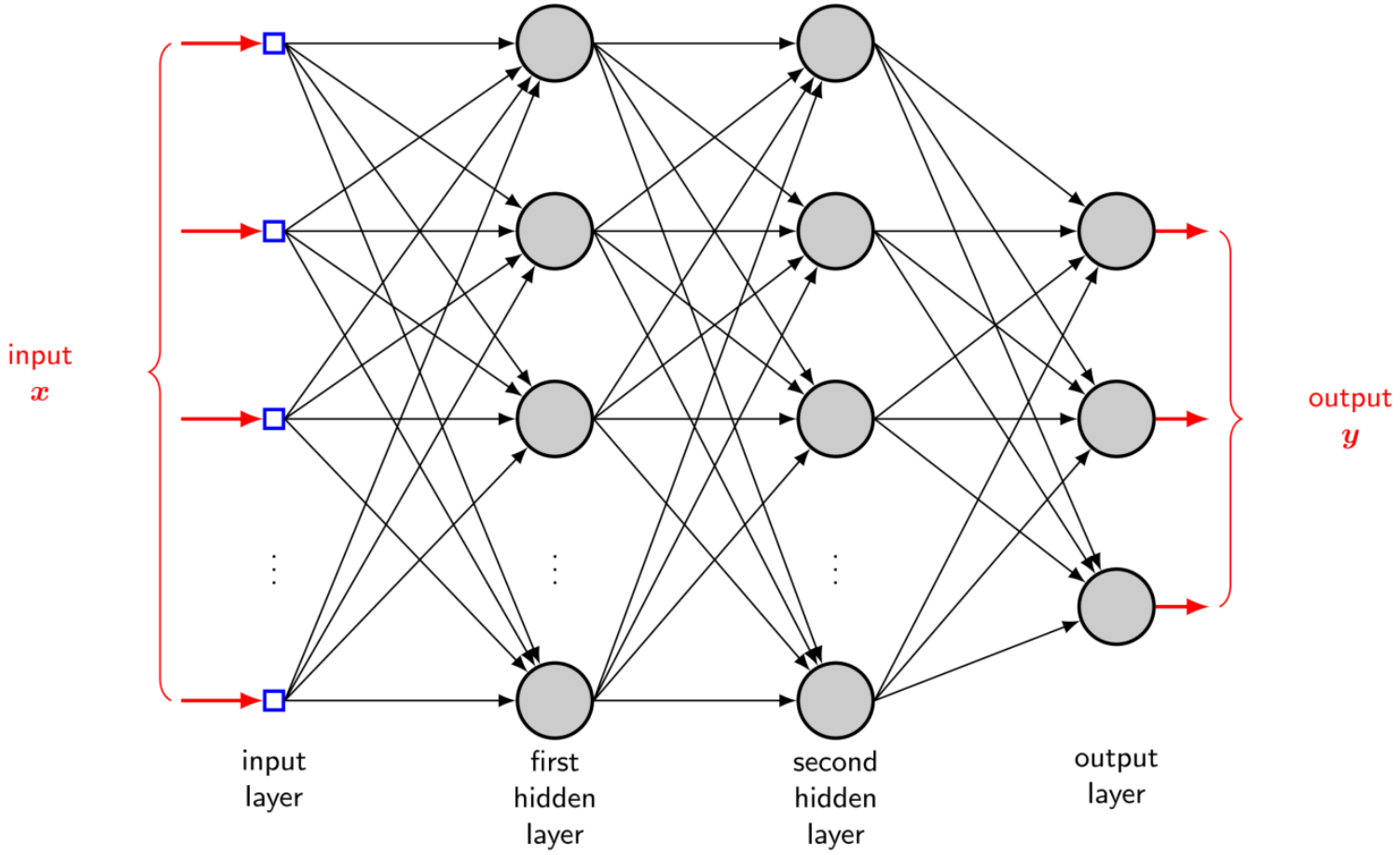
Linear	$\phi(z) = z$	Adaline, linear regression
Unit Step (Heaviside Function)	$\phi(z) = \begin{cases} 0 & z < 0 \\ 0.5 & z = 0 \\ 1 & z > 0 \end{cases}$	Perceptron variant
Sign (signum)	$\phi(z) = \begin{cases} -1 & z < 0 \\ 0 & z = 0 \\ 1 & z > 0 \end{cases}$	Perceptron variant
Piece-wise Linear	$\phi(z) = \begin{cases} 0 & z \leq -½ \\ z + ½ & -½ \leq z \leq ½ \\ 1 & z \geq ½ \end{cases}$	Support vector machine
Logistic (sigmoid)	$\phi(z) = \frac{1}{1 + e^{-z}}$	Logistic regression, Multilayer NN
Hyperbolic Tangent (tanh)	$\phi(z) = \frac{e^z - e^{-z}}{e^z + e^{-z}}$	Multilayer NN, RNNs
ReLU	$\phi(z) = \begin{cases} 0 & z < 0 \\ z & z > 0 \end{cases}$	Multilayer NN, CNNs





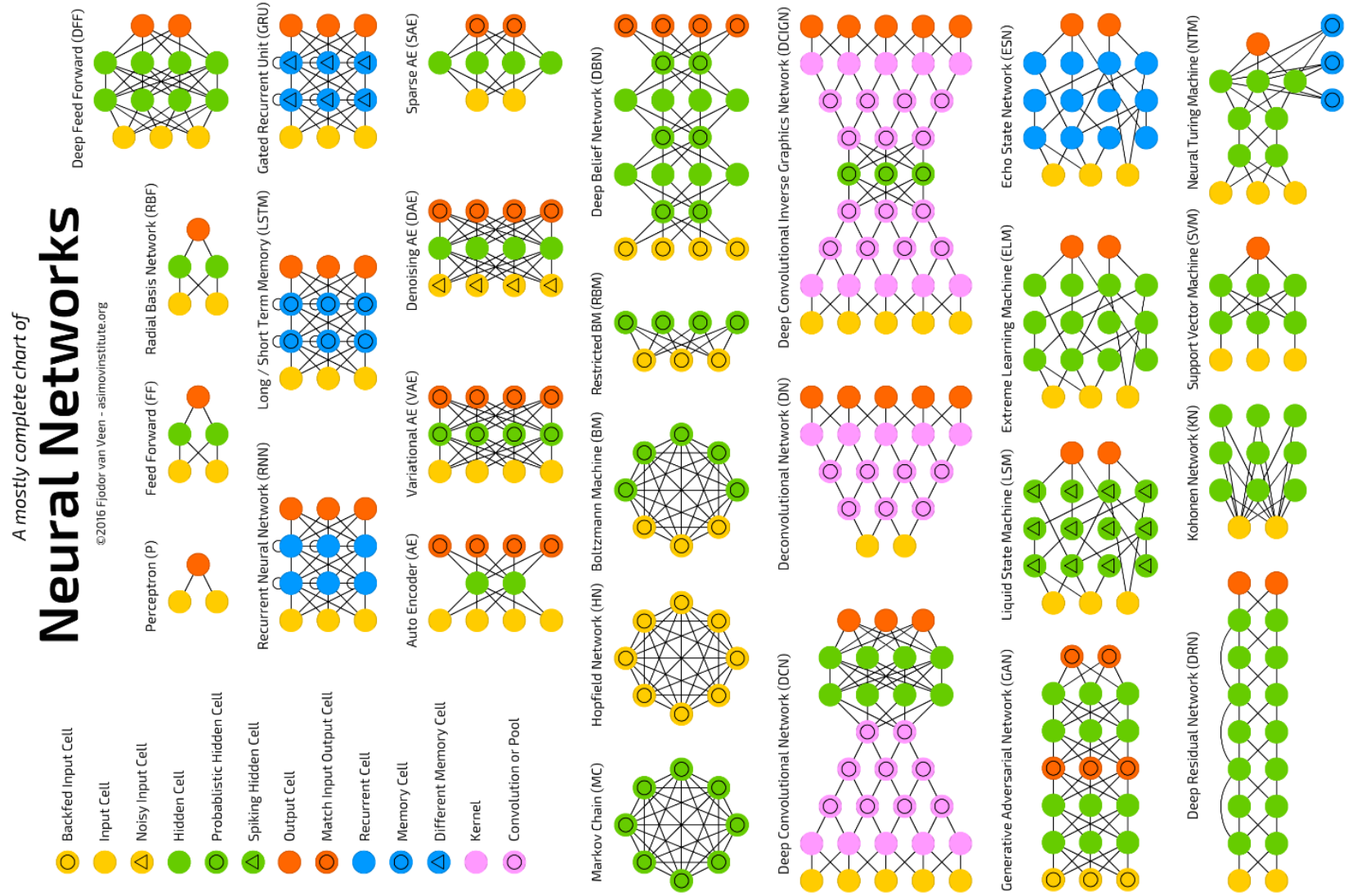
Background for deep learning

- Structure of neural networks (by using connectionism)



Background for deep learning

- Zoo of neural networks



Background for deep learning

- Deep learning
  - deep neural network with multiple levels of linear / non-linear operations
    - introducing representation that are expressed in terms of other (simpler) representations
    - each stage: a kind of trainable feature transform
    - hierarchy of representations with increasing level of abstraction
  - learning representation → data-driven features
  - deep neural network == universal approximator

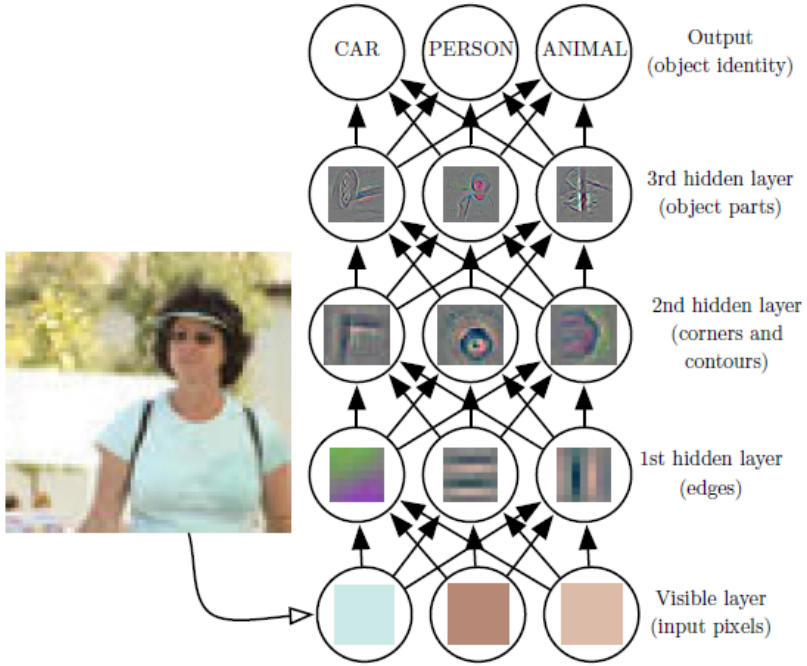


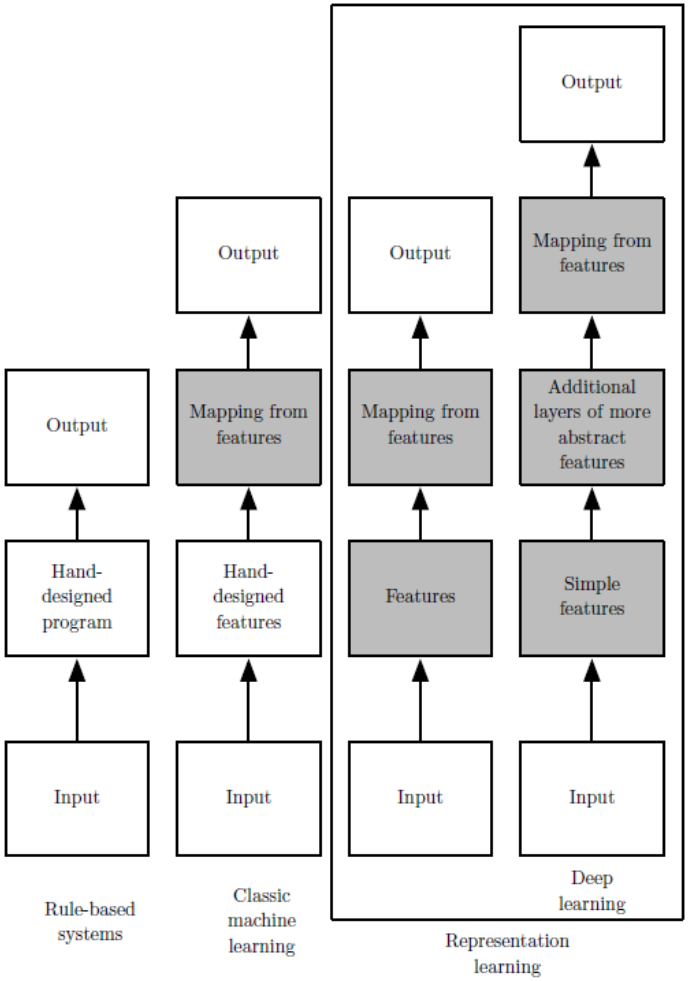
Image
pixel → edge → texton → motif → part → object

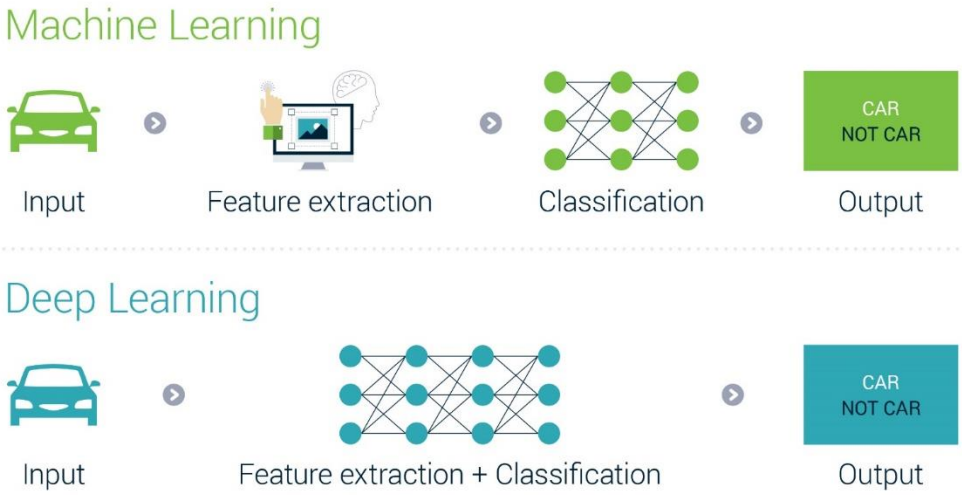
Text
character → word → word group → clause → sentence → story

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

Background for deep learning

- Comparisons between traditional machine learning and deep learning

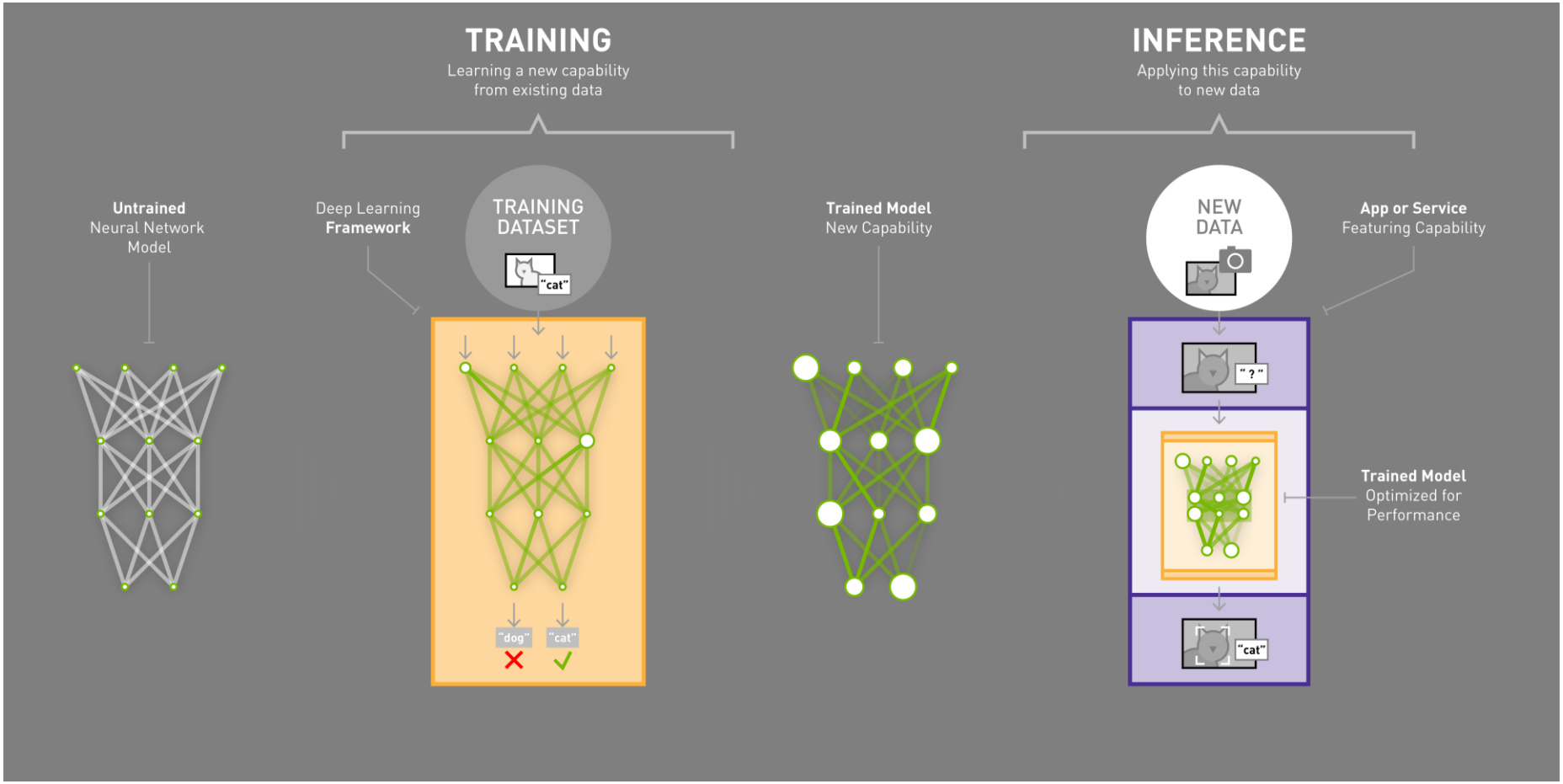




[from https://verhaert.com]

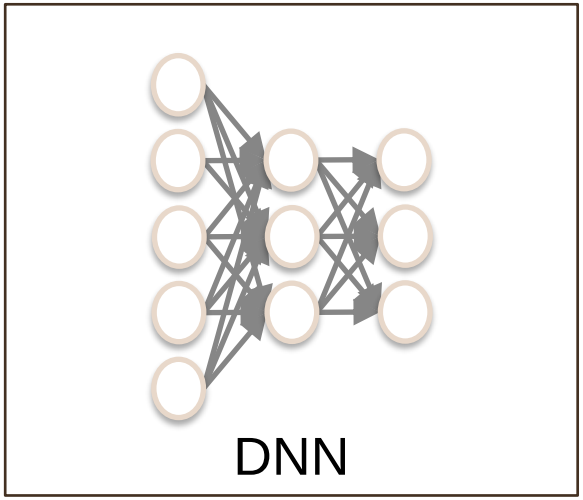
Background for deep learning

- Training and inference



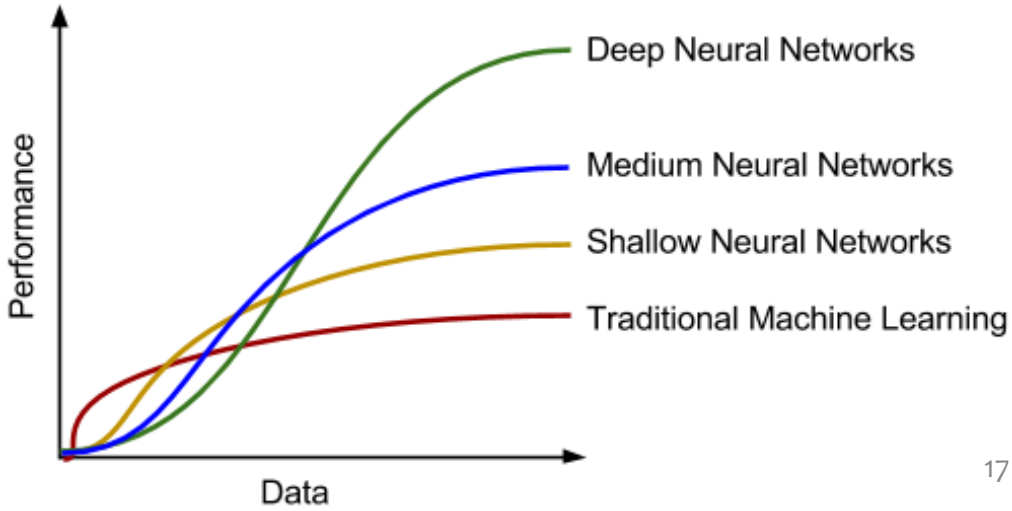
Background for deep learning

- Reasons for deep learning's success



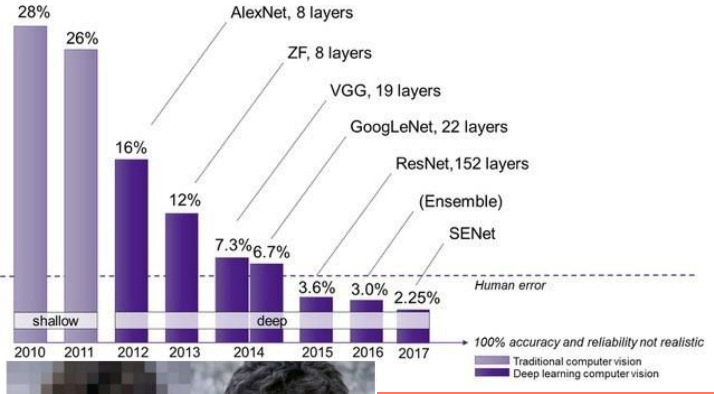
[from https://www.nvidia.com]

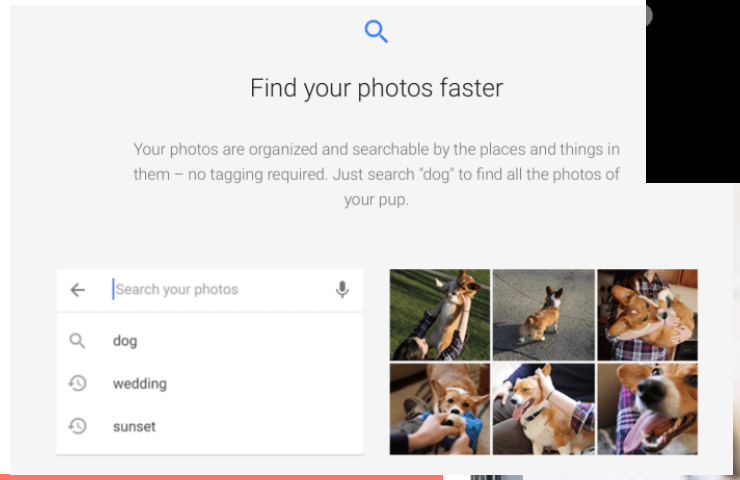
- Performance on |data|

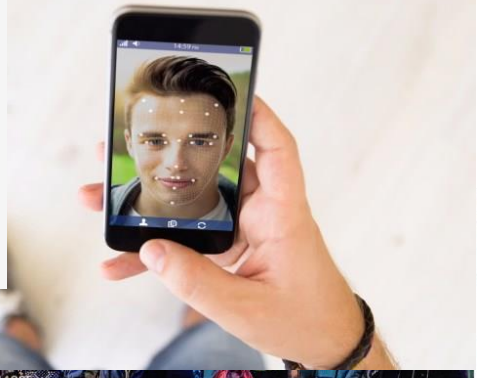


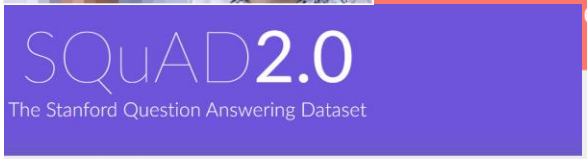
Research trends in deep learning

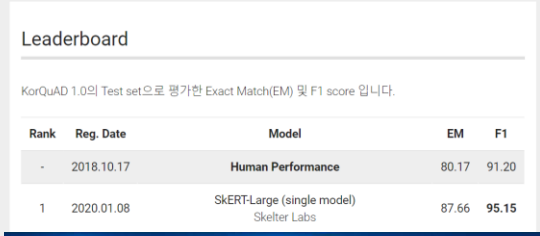
- The power of deep learning

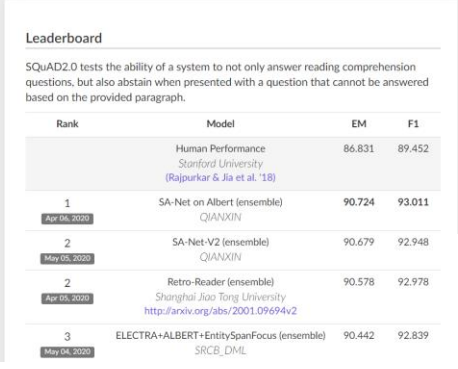


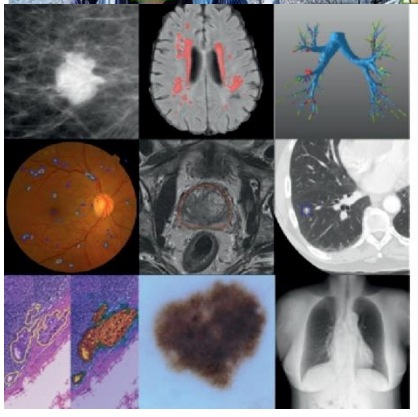












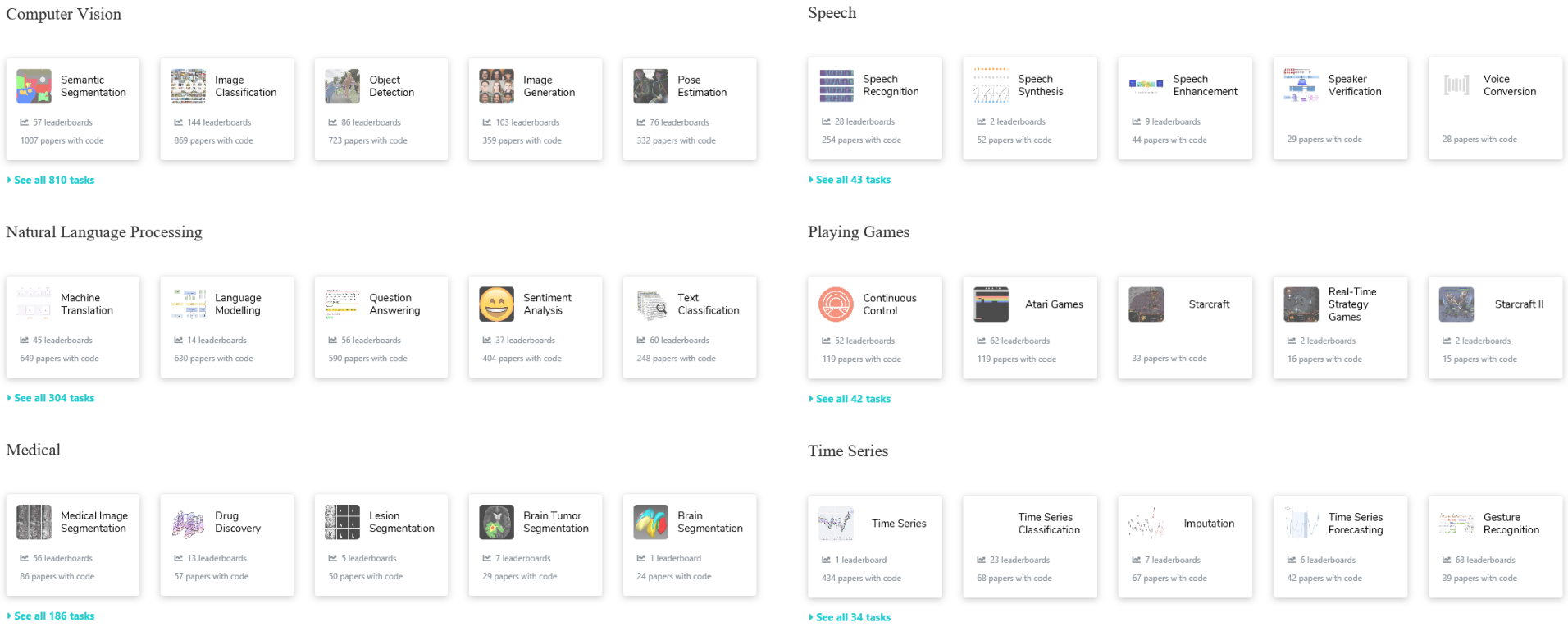
Collage of some medical imaging applications in which deep learning has achieved state-of-the-art results.

From top-left to bottom-right:

1. mammographic mass classification
2. segmentation of lesions in the brain,
3. leak detection in airway tree segmentation,
4. diabetic retinopathy classification
5. prostate segmentation,
6. nodule classification,
7. breast cancer metastases detection,
8. skin lesion classification
9. bone suppression

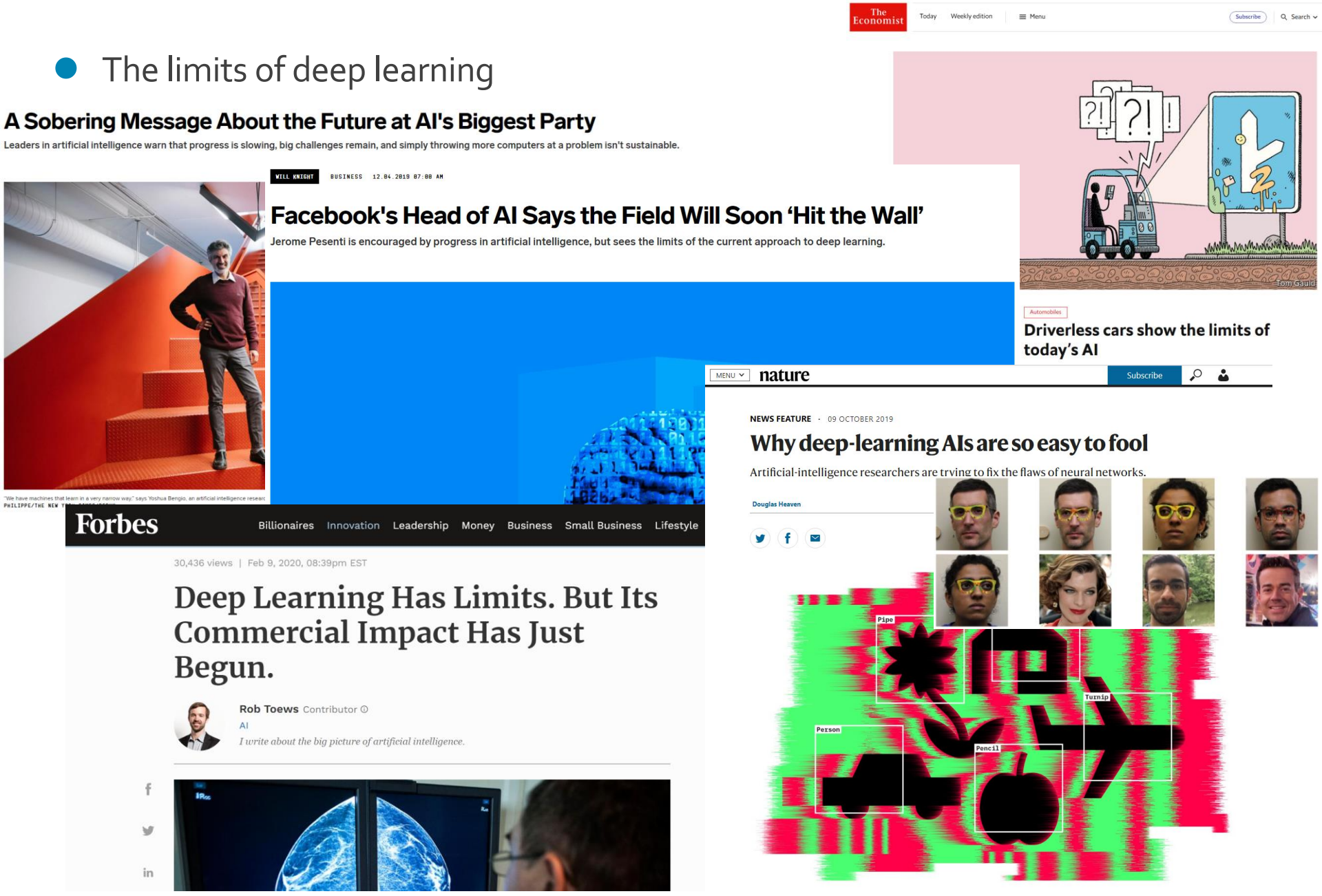
Research trends in deep learning

- The power of deep learning (SOTA)
  - reference from https://paperswithcode.com/sota



Research trends in deep learning

- The limits of deep learning



Research trends in deep learning

Research trends in deep learning

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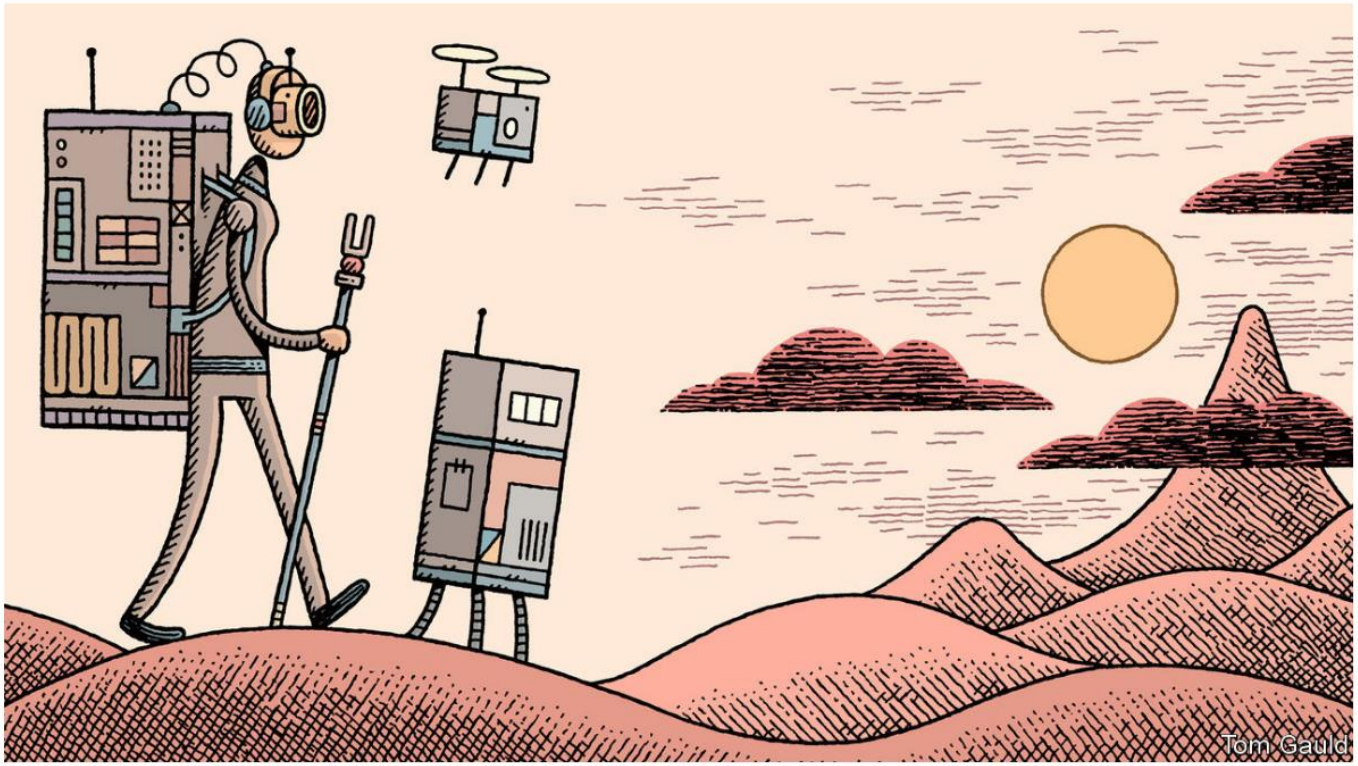

Technology Quarterly

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The future

Humans will add to AI's limitations

It will slow progress even more, but another AI winter is unlikely

Conclusion

- Deep (representation) learning have achieved remarkable improvement
  - e.g., image recognition, voice assistants, security
- Deep change is started by deep learning!
  - deep neural network == (linear + nonlinear)*M == universal approximator
  - change of paradigm → the deep learning revolution
- Deep learning has power and limits
  - rapidly changing, must stay in tune!!
- AI $\overset{\text{enabler}}{\Longleftrightarrow}$ Security

Question and Answer

- If you have any comments,

  suggestions or questions then please do let me know!

- For more information, contact me

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Thank you ☺