The 5 Big Ideas of Artificial Intelligence

Benefit of Artificial Intelligence for Human Development

Prof. Dr. Hasan Amca
Eastern Mediterranean University
9th of December 2022 10: Am

The AI4K12 Initiative

- **This speech, which is supported by the Nigerian Lagos State Ministry of Science and Technology, is**

- **inspired by "The 5 Big Ideas" of AI4K12 Initiative**

  ✓ **which is a joint Project of the AAAI and CSTA**

Computer Supported Telecommunications Applications

AAAI
Association for the Advancement of Artificial Intelligence

Prof. Dr. Hasan Amca
12/9/2022

* Association for the Advancement of Artificial Intelligence
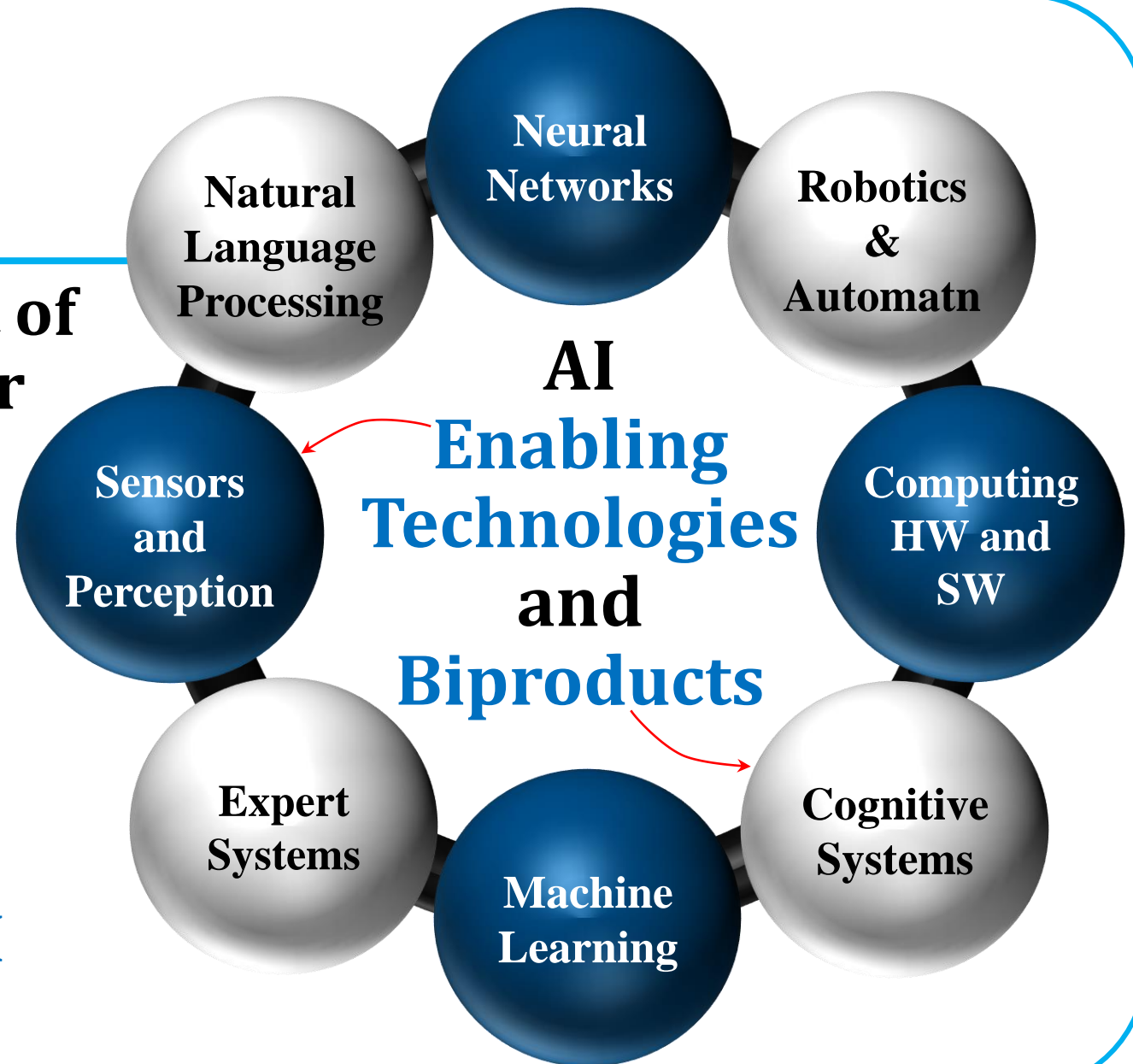** Computer Supported Telecommunications Applications (CSTA)

Agenda

- Before we look at the "**Benefit of Artificial Intelligence (AI) for Human Development**", wee need to know:

  What is AI?

  What are its capabilities?

  What are its limitations?

  How can we benefit from AI for human development?

Natural Language Processing

Neural Networks

Robotics & Automatn

Sensors and Perception

Computing HW and SW

Expert Systems

Machine Learning

Cognitive Systems

AI Enabling Technologies and Biproducts

The Five Big Ideas
of Artificial Intelligence

1. Perception
Computers perceive the world using sensors

2. Representation and reasoning
Agents maintain representations of the world and use them for reasoning
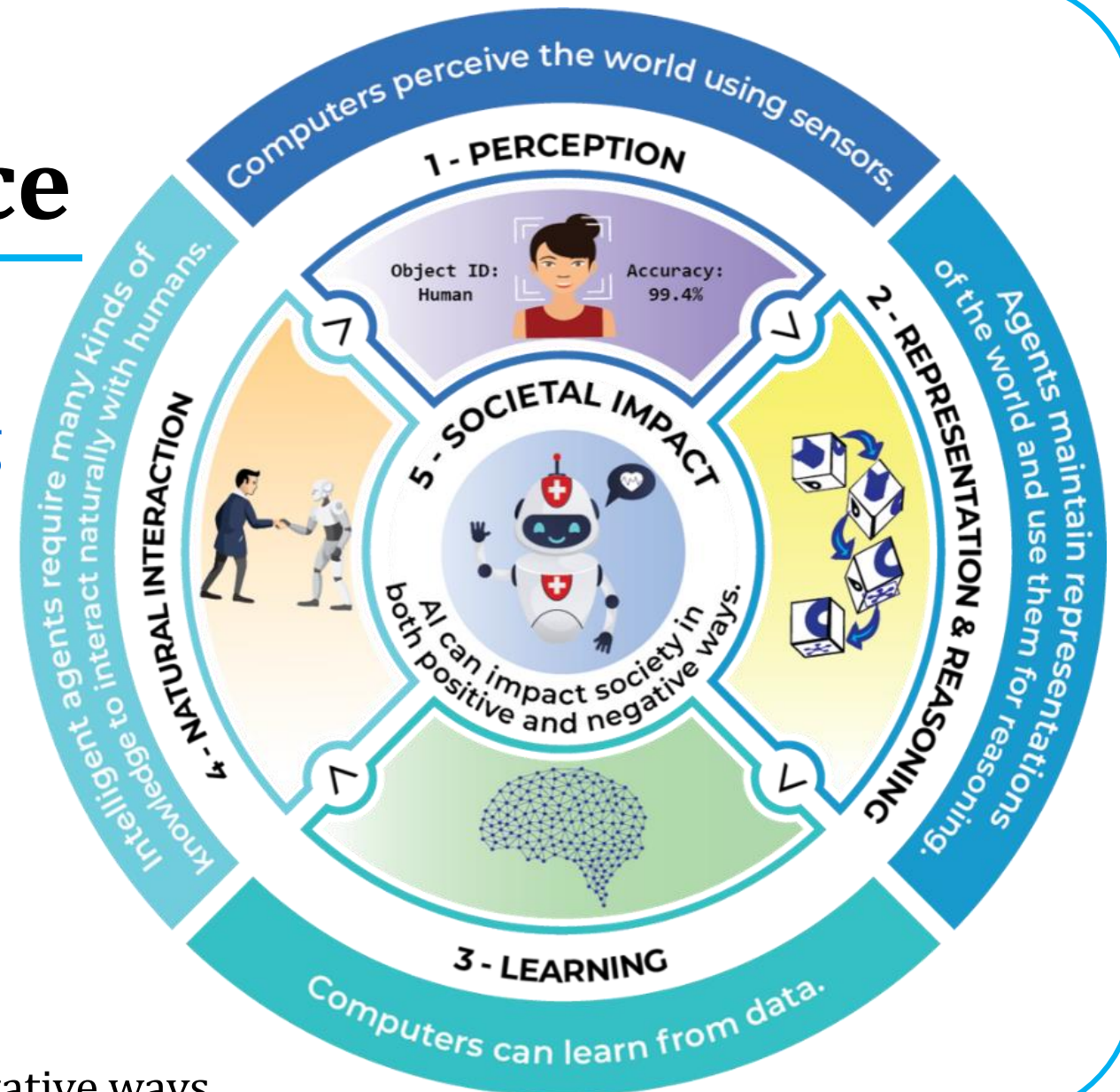
3. Learning,
Computers can learn from data
e.g. **Neural Networks, Machine Learning**

4. Natural interaction
Intelligent agents require many kinds of knowledge to interact naturally with humans.

5. Societal impact.
AI can impact society in both positive and negative ways.

Computers perceive the world using sensors.

1 - PERCEPTION

Object ID: Human   Accuracy: 99.4%

2 - REPRESENTATION & REASONING

Agents maintain representations of the world and use them for reasoning.

5 - SOCIETAL IMPACT

AI can impact society in both positive and negative ways.

4 - NATURAL INTERACTION

Intelligent agents require many kinds of knowledge to interact naturally with humans.

3 - LEARNING

Computers can learn from data.

Prof. Dr. Hasan Amca
12/9/2022

(https://ai4k12.org)

Big Idea 1 Perception

- *The goal of AI perception is*
  - ~ *to **have machines see, hear, taste, smell, feel** and **perceive** the environment*
  - ~ *the **same way as humans** do,*
  - ~ *through **acquisition, selection, organization, interpretation** and **presentation** of **sensory data** that is **captured in the real world**.*

1 - PERCEPTION

Object ID: Human

Accuracy: 99.4%

Computers perceive the world using sensors.
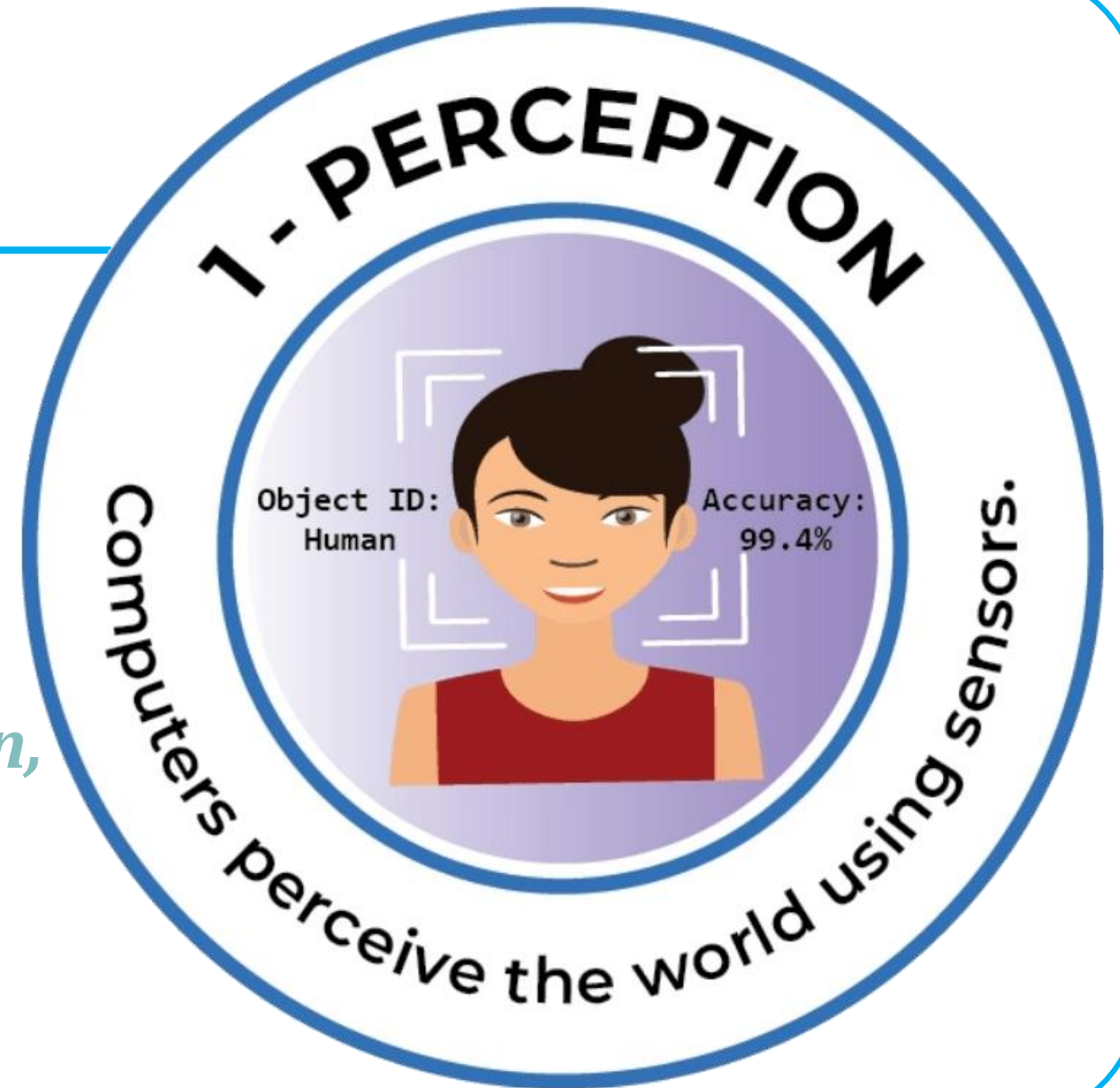
Big Idea 2 - Representation and Reasoning

- *Knowledge representation is responsible for*

  ~ **representing information about the real world so that a computer can understand and utilize this knowledge for reasoning**

  ~ *for solving the complex real-world problems such as diagnosing a medical condition or communicating with humans in natural languages.*
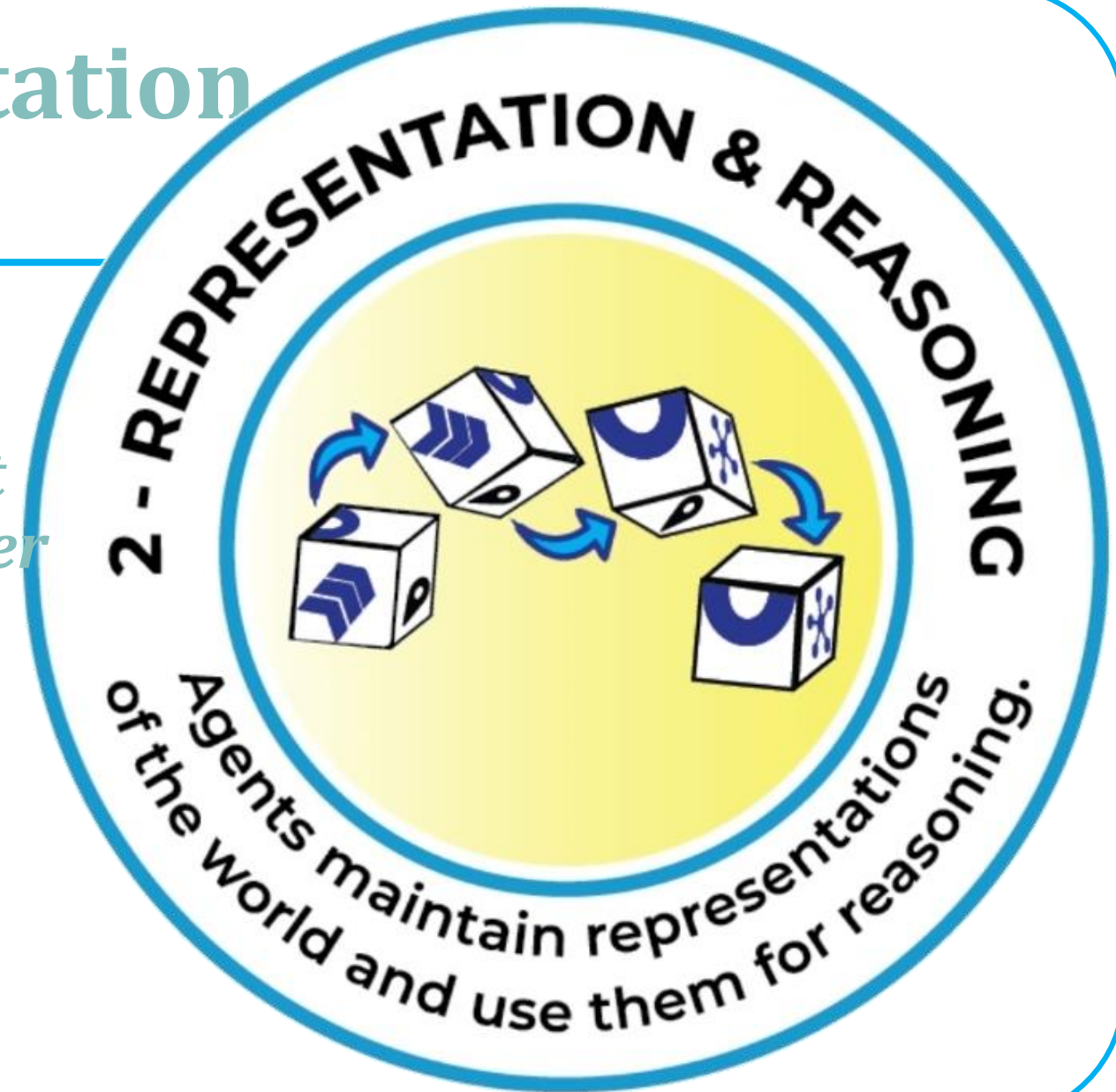
Big Idea 3 Learning

- *Learning is an interactive process of activities*
  - ~ *that results in* **acquiring new knowledge or skills**
  - ~ *through study, experience, or being taught*
  - ~ *which increases the potential for improved performance.*
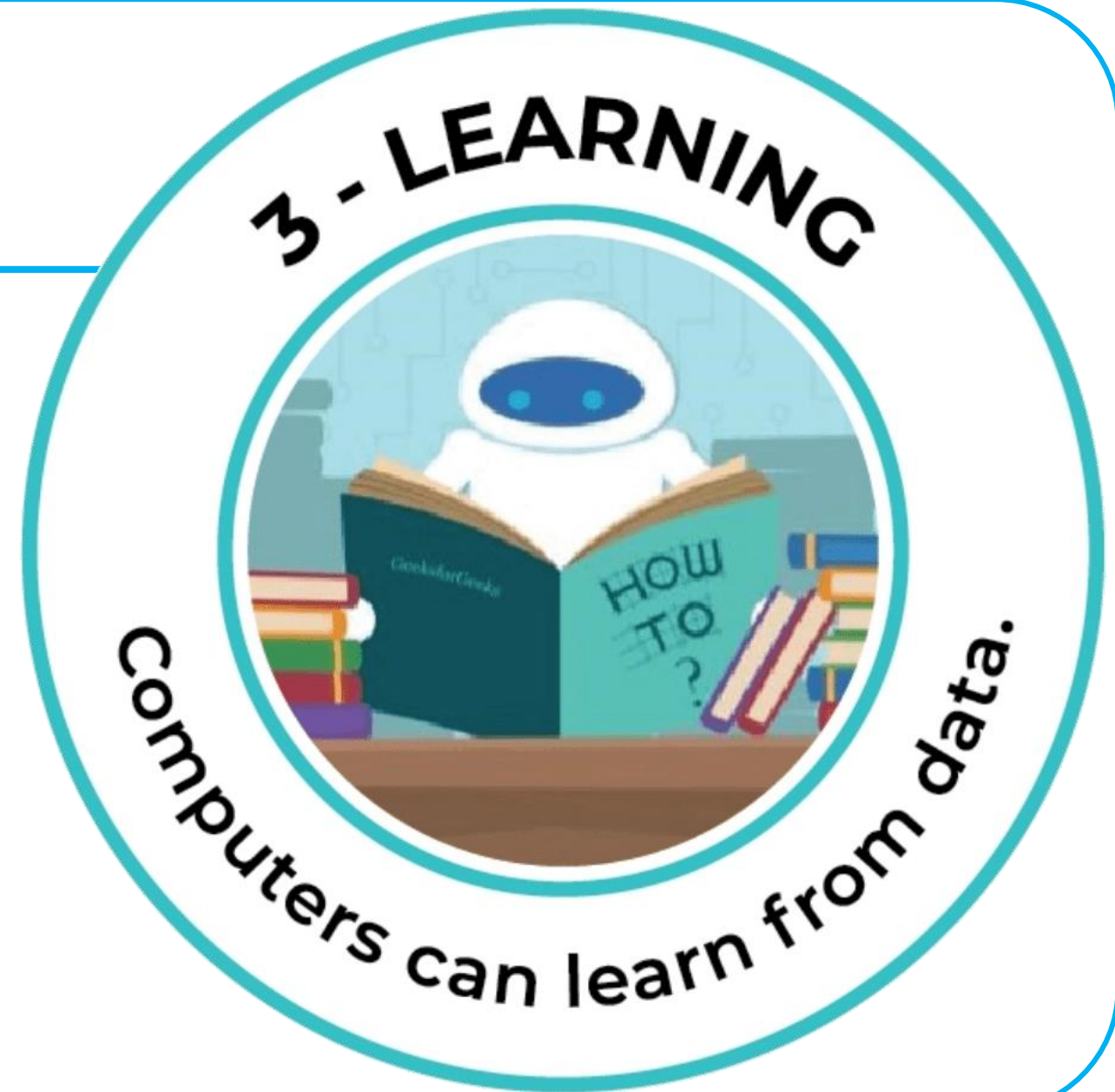
Big Idea 4
Natural Interaction

- *Natural interaction occurs when humans interact with technology*
    - ~ *through gestures, expressions, and movements*
    - ~ *much as they would among humans in everyday life.*

- *Natural interaction involves the capacity for intelligent and cooperative communication.*

4 – NATURAL INTERACTION

Intelligent agents require many kinds of knowledge to interact naturally with humans.

Big Idea 5
Societal Impact

- ***The impact of AI-based solutions reinforced by data driven services and smart decision-making systems*** *is profoundly changing*

  ~ *the way we live, communicate, socialize, entertain and work,*

  ~ *both in positive and negative ways.*

5 - SOCIETAL IMPACT

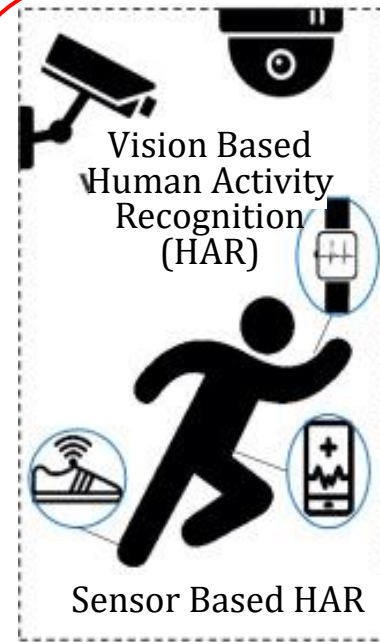AI can impact society in both positive and negative ways.
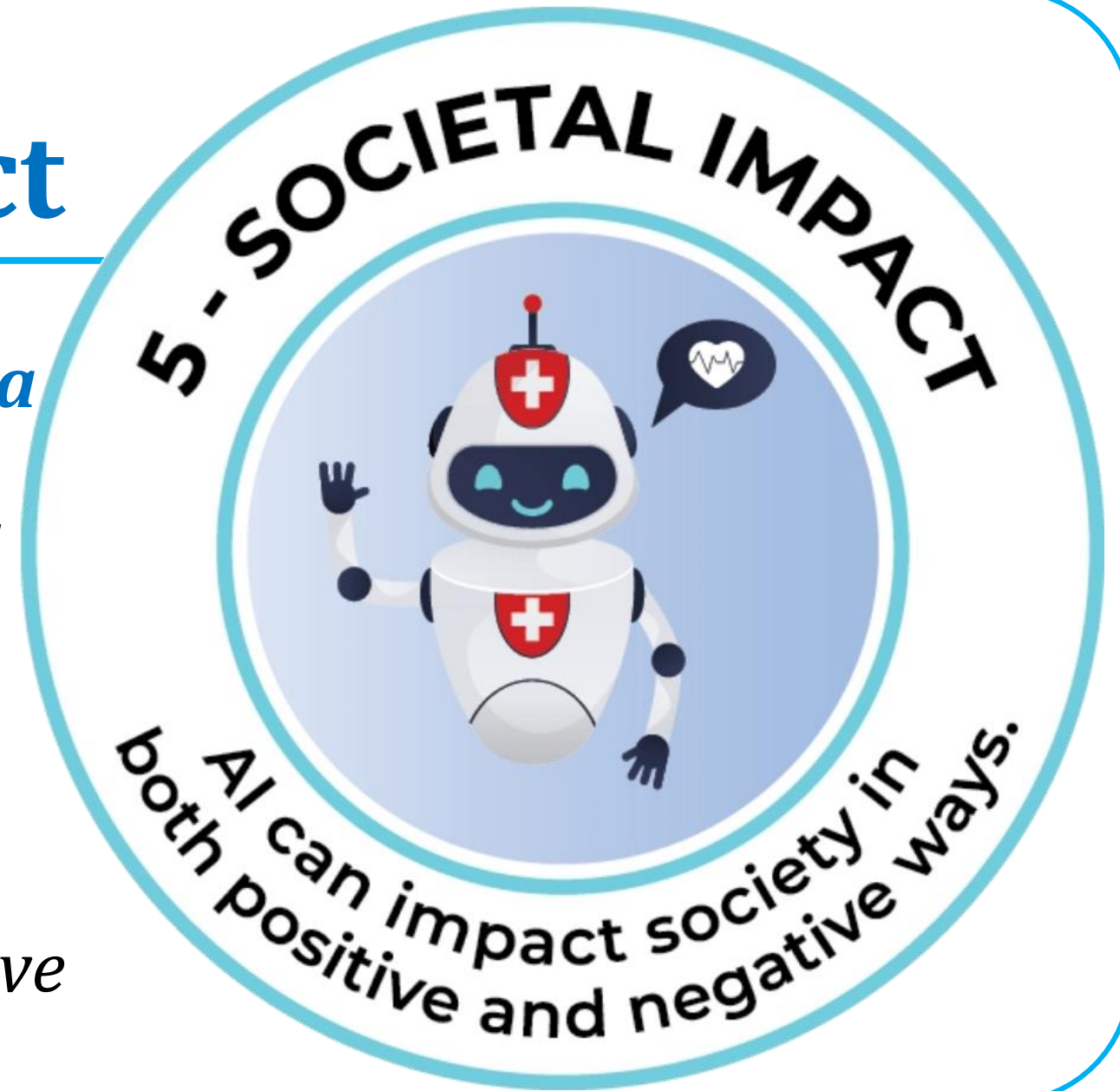
Artificial Intelligence
Definition

- **Artificial Intelligence comprises the concept of**
  - ✓ **computers simulating human behavior**
  - ✓ **by following the patterns of the human brain**
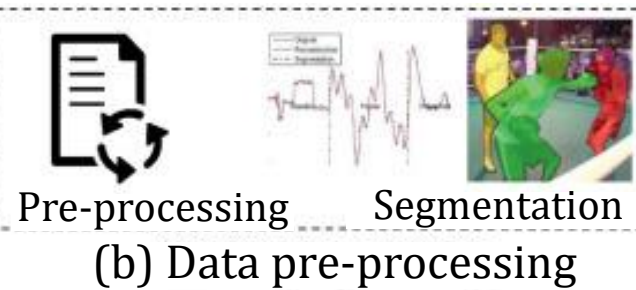 - ✓ **and conducting analysis using the same processing techniques.**
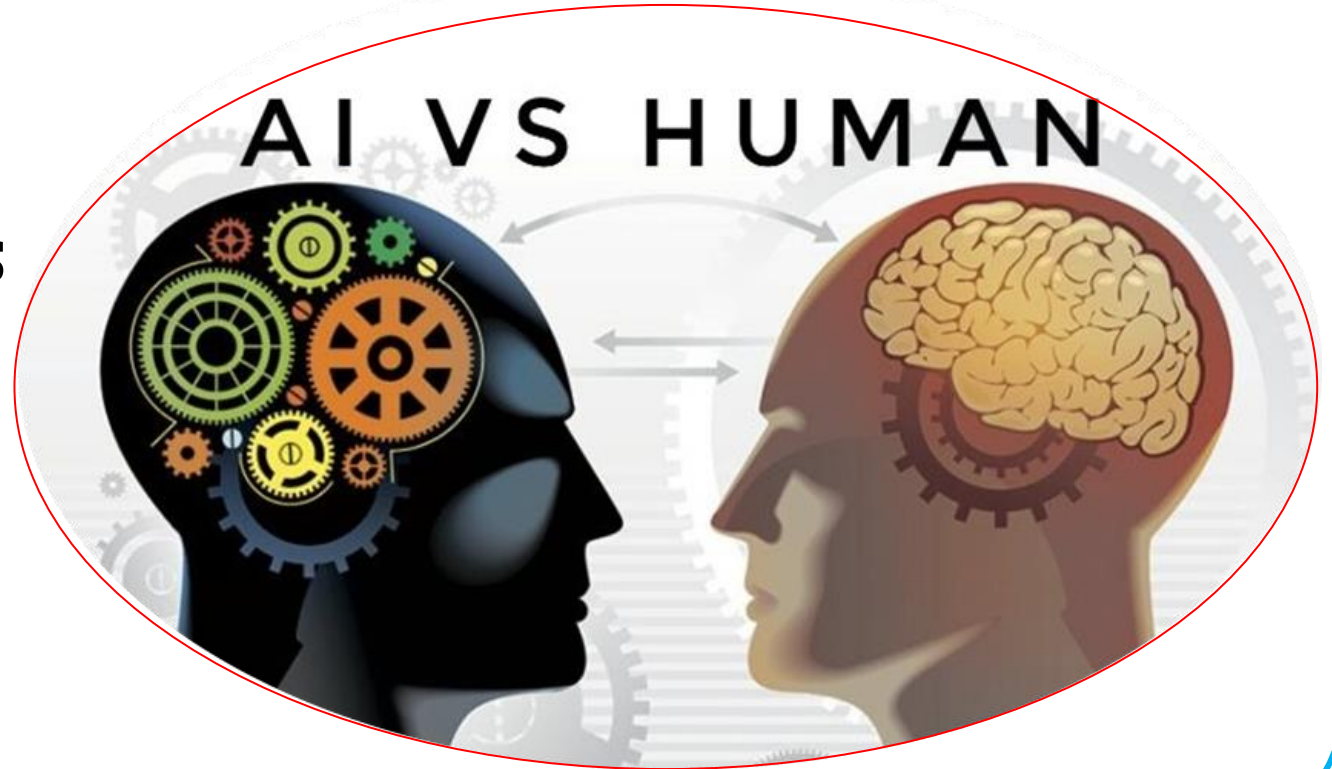
Artificial Intelligence
Hence...

- **An AI system will be able to perform the same activities as a human**
  - ✓ **with superior precision.**

Vision Based Human Activity Recognition (HAR)

Sensor Based HAR

(a) Data collection

Pre-processing   Segmentation

(b) Data pre-processing

Feature extraction   Feature selection   Machine learning

Deep learning
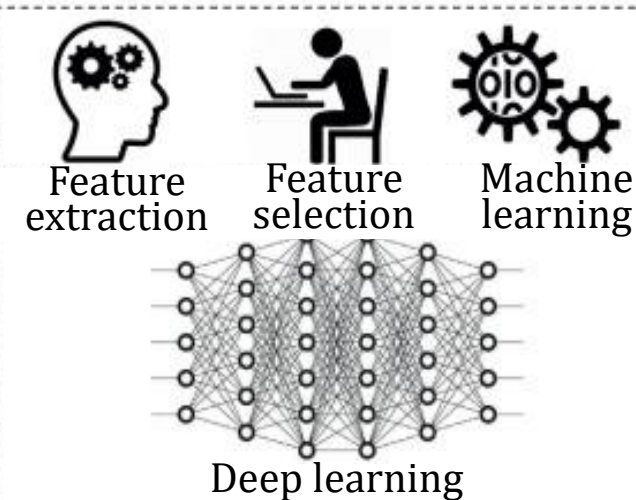
(c) Training

(d) Activity recognition

https://www.sciencedirect.com/science/article/pii/S0031320320303642

Artificial Intelligence Current State of the Art Technology
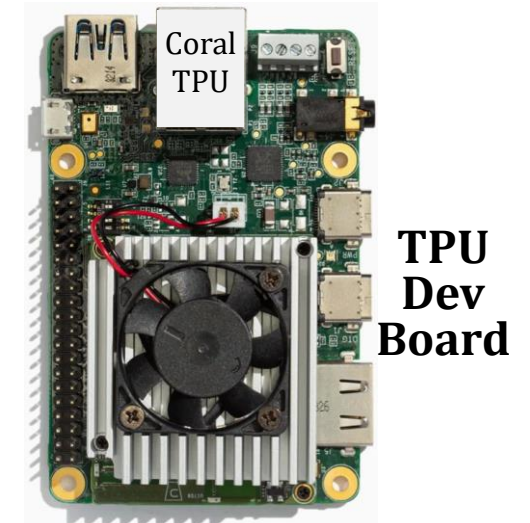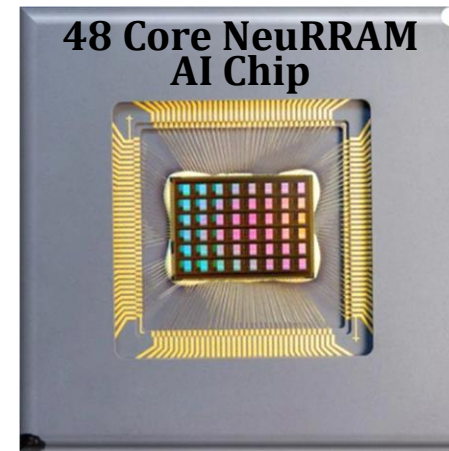
- **Current state of then art technology (AI chip, CPU, GPU and TPU Dev Board) is**
  - ✓ **not powerful enough for mimicking the human brain's energy efficiency,**
  - ✓ **to perform real-time AI applications.**

48 Core NeuRRAM AI Chip

Coral TPU

TPU Dev Board

AMD CPU

GPU

Prof. Dr. Hasan Amca
12/9/2022

https://www.techpowerup.com/cpu-specs/ryzen-threadripper-3990x.c2271
https://www.epey.com/ekran-karti/evga-geforce-rtx-3090-ti-ftw3-gaming.html

https://spectrum.ieee.org/ai-chip
https://coral.ai/products/dev-board/

13
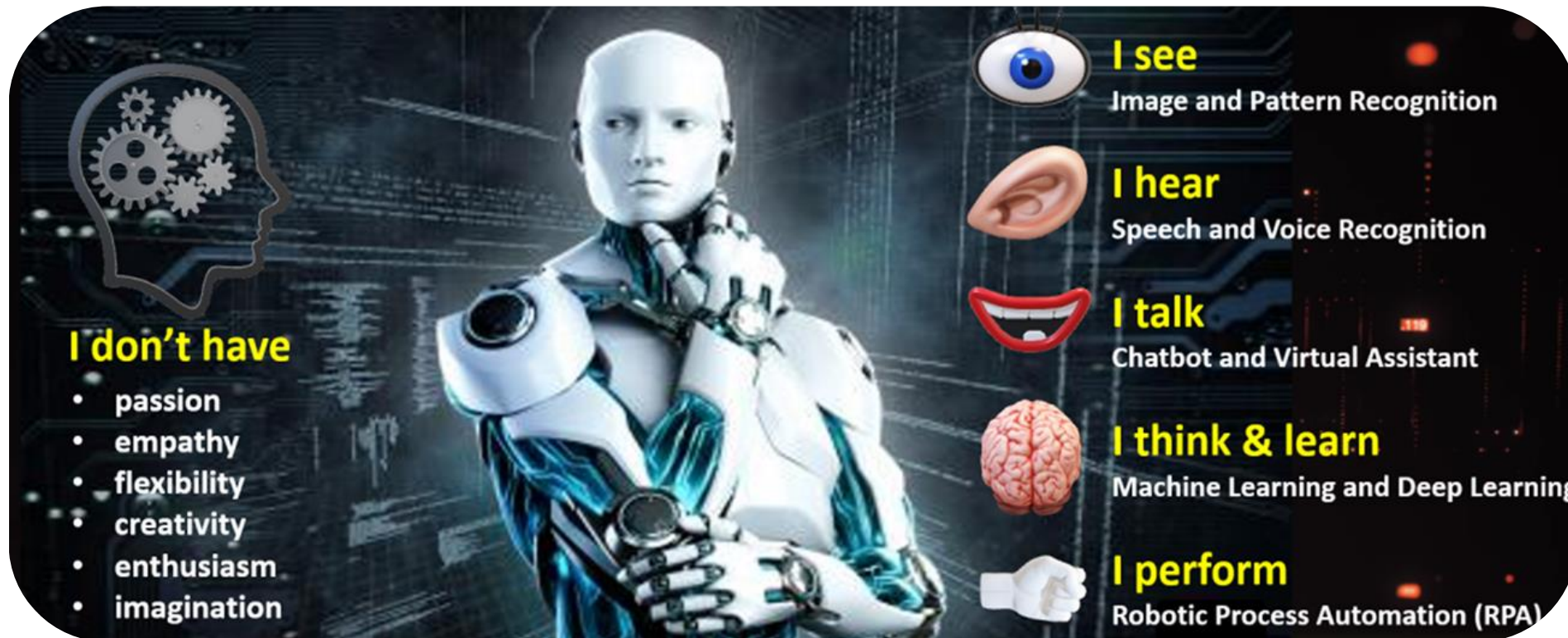
Big Idea 5 - Societal Impact
The Impact of AI on Social Issues

AI can **sense** but cannot **feel**!

I see
Image and Pattern Recognition

I hear
Speech and Voice Recognition

I talk
Chatbot and Virtual Assistant

I think & learn
Machine Learning and Deep Learning

I perform
Robotic Process Automation (RPA)

I don't have
- passion
- empathy
- flexibility
- creativity
- enthusiasm
- imagination

If you teach a machine how to learn, you can not limit what it will learn!

Watch the movie Stealth for details...

Prof. Dr. Hasan Amca
12/9/2022

https://www.linkedin.com/pulse/from-data-driven-ai-powered-organization-unleash-data-halima-%E6%9D%A8%E5%AD%90%E6%AD%A3-/?trk=articles_directory
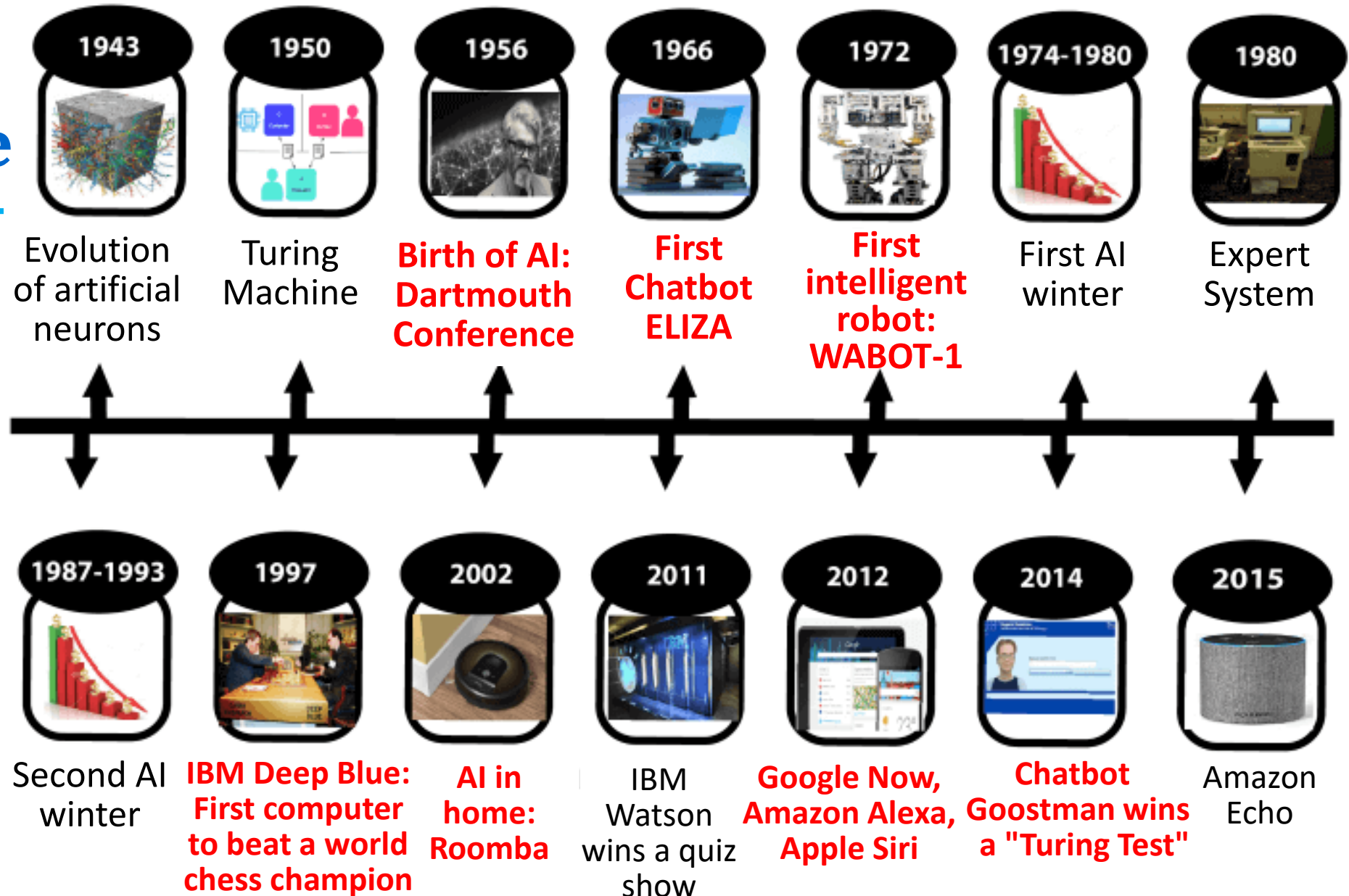
Artificial Intelligence Influence on Society

- **Here is a selection of Sci-Fi movies reflecting**
  - ✓ **AI engagement, how it works and**
  - ✓ **how it can influence societies.**

Artificial Intelligence

History

1943	1950	1956	1966	1972	1974-1980	1980
Evolution of artificial neurons	Turing Machine	**Birth of AI: Dartmouth Conference**	**First Chatbot ELIZA**	**First intelligent robot: WABOT-1**	First AI winter	Expert System

1987-1993	1997	2002	2011	2012	2014	2015
Second AI winter	**IBM Deep Blue: First computer to beat a world chess champion**	**AI in home: Roomba**	IBM Watson wins a quiz show	**Google Now, Amazon Alexa, Apple Siri**	**Chatbot Goostman wins a "Turing Test"**	Amazon Echo

Prof. Dr. Hasan Amca
12/9/2022

https://www.javatpoint.com/history-of-artificial-intelligence

16

Different AI Categories have
Different Impact on Societies

1. Reactive Machines

- This type of AI has **no ability to form memories** or use past experiences to form current decisions
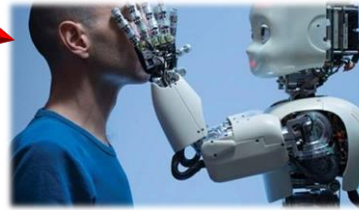- Example: **IBM Deep Blue chess-playing supercomputer, beaten grandmaster Kasparov in 1990s**

2. Limited Memory

- Machines which can **look into the past;**
- **Self-driving cars** can observe other cars' speed and direction
- which **requires identifying specific objects** and monitoring them in time.

3. Theory of Mind

- Machines form **representations about the world and other entities** in world
- In psychology, understanding of people and creatures in the world **can have thoughts and emotions** that affect their behavior.

4. Self-Awareness

- Top level of AI development can build systems that **can form representation about themselves**.
- Leads to **understanding consciousness and build self-conscious machines.**

Prof. Dr. Hasan Amca
12/9/2022

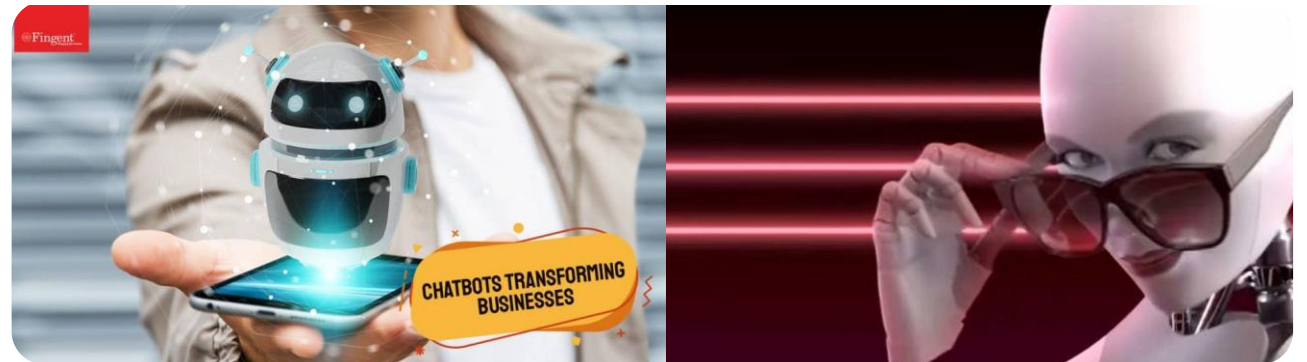# Big Idea 4
Natural Interaction

- **Natural interaction** occurs when humans interact with machines through **gestures, expressions, and movements**,

- much as they would among humans in everyday life.

- It **involves the capacity for intelligent and cooperative communication.**
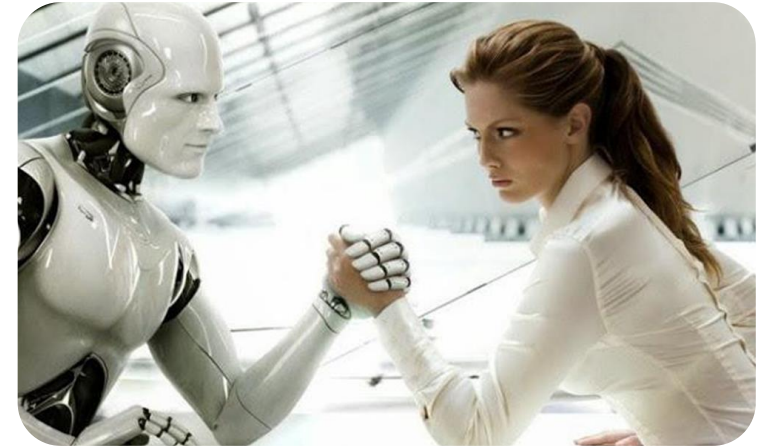
Big Idea 4 - Natural Interaction Natural Language (Applications)

- Natural Language Processing (NLP) tasks computers can perform are
  - ✓ **Text Summarization**: Wordtune, Quillbot, SkimCast, TextSummarization
  - ✓ **Text Generation**: Smodin.io, GrowthBar, Rytr, Jasper, Article Forge, Copysmith
  - ✓ **Question Answering**: Quora, Stack Exchange, Google, Aardvark
  - ✓ **Machine Translation**: Google Translate, Bing Microsoft Translator

- Example Applications
  - ✓ **Chatbots:** looks for keywords in user input to decide what response to give.

https://www.bbc.com/news/business-38207334
https://www.fingent.com/blog/5-leading-chatbot-use-cases-explained-with-real-life-examples/

Big Idea 4 - Natural Interaction (Philosophy of Mind)

- Some AI experts and philosophers argue that
  - ✓ computers can never achieve fully human-like intelligence,
  - ✓ while others believe that AI will eventually exceed human intelligence.

- New human generations have higher IQs **(Flynn effect)**
- Will this **IQ increase** continue forever, or are we on the verge of decline?

Prof. Dr. Hasan Amca
12/9/2022

Big Idea 4 - Natural Interaction (Philosophy of Mind)

- A stronger claim against **AI** is that

  - ✓ because AI **doesn't have a physical body**,

  - ✓ it cannot experience the world the way humans do.

Big Idea 4 - Natural Interaction - Philosophy of Mind

1. Reactive Machines
- This type of AI has **no ability to form memories** or use past experiences to form current decisions
- Example: **IBM Deep Blue** chess-playing supercomputer, which beat grandmaster Garry Kasparov in late 1990s.

2. Limited Memory
- Machines which can **look into the past**
- Self-driving cars can observe other cars' speed and direction
- which **requires identifying specific objects** and monitoring them

3. Theory of Mind
- Machines form **representations about the world and other entities** in world
- In **psychology**, understanding of people and creatures in the world can have **thoughts and emotions** that affect their behavior.

4. Self-Awareness
- Top level of AI development can build systems that **can form representation about themselves**

4. Self-Awareness
- Top level of AI development can build systems that **can form representation about themselves**.
- Leads to understanding **consciousness** and build **self-conscious** machines.

Big Idea 4 - Natural Interaction
Consciousness (Continuous / Discrete)

Big Idea 4 - Natural Interaction Philosophy of Mind

- Does animal consciousness differ from human consciousness?

- If consciousness exists on a scale, can a computer ever meet or exceed humans on this scale?
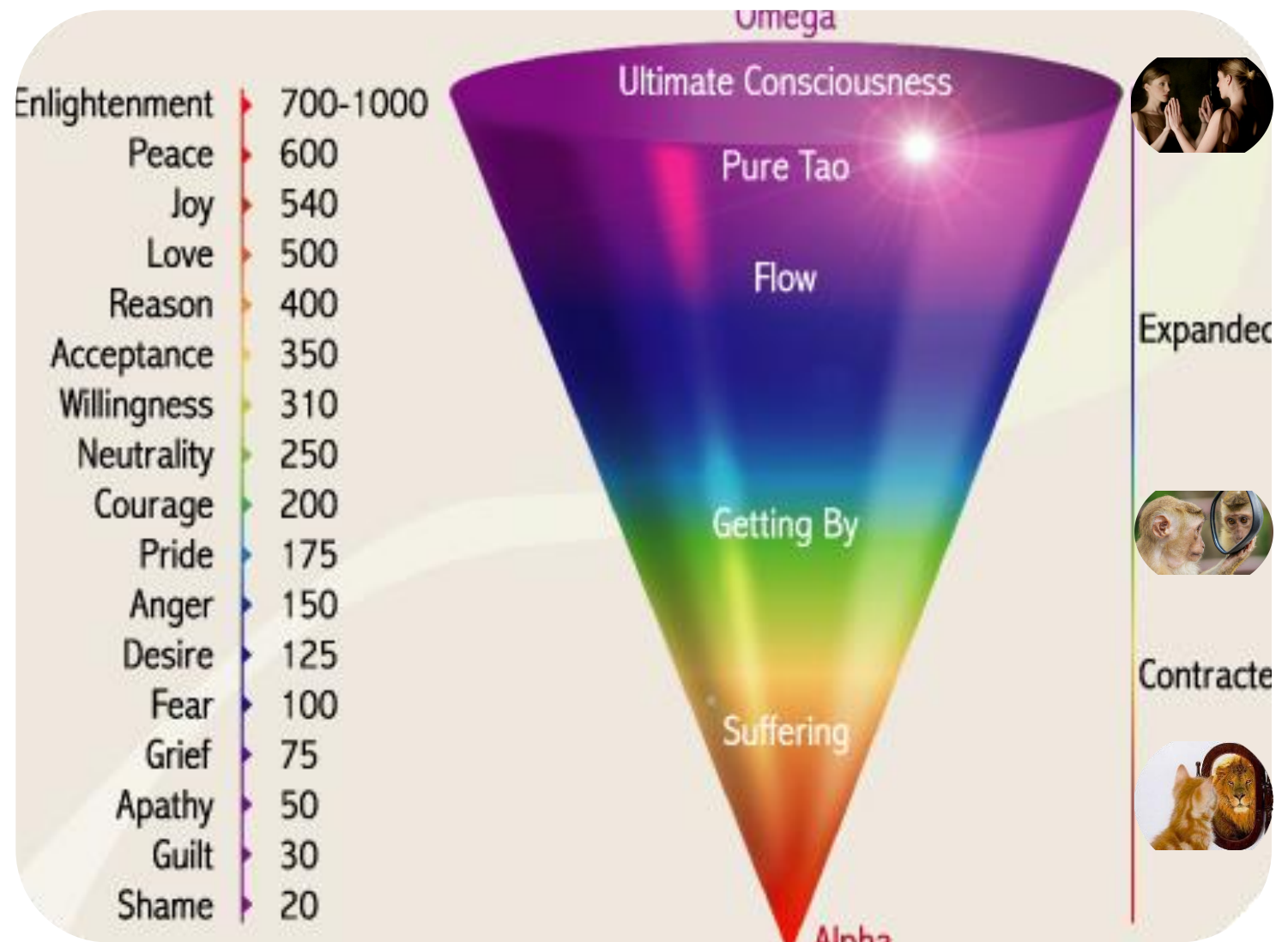
Enlightenment 700-1000
Peace 600
Joy 540
Love 500
Reason 400
Acceptance 350
Willingness 310
Neutrality 250
Courage 200
Pride 175
Anger 150
Desire 125
Fear 100
Grief 75
Apathy 50
Guilt 30
Shame 20

Omega
Ultimate Consciousness
Pure Tao
Flow
Getting By
Suffering
Alpha

Expanded
Contracted

Big Idea 5 - Societal Impact
AI and Industry 5.0

Industrial Revolutions over Time

First Industrial Revolution
Due to mechanical production facilities obtained with the help of water and steam

~1760

Second Industrial Revolution
The result of the division of labor and mass production with the help of electrical energy

~ 1860

Third Industrial Revolution
Advanced automation in production by the means of electronics & informatics

~ 1970

Industry 4.0
cyber-physical systems, IoT, cloud computing, cognitive computing, with an aim of more efficient, economically competent and customer centered production.

~ 2016

Industry 5.0
is a human-centric design solution where the ideal human companion and cobots collaborate with human resources to enable personalizable autonomous manufacturing through enterprise social networks. This, in turn, enables human and machine to work hand in hand.

Big Idea 5 - Societal Impact
AI and Society 5.0

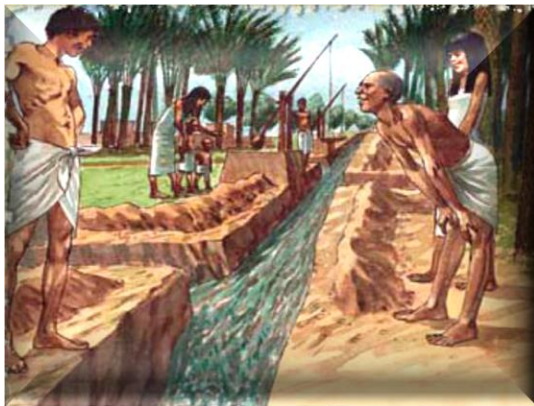**Technology-Based Human-Centered Society:** Economy + social problems in physical + virtual world
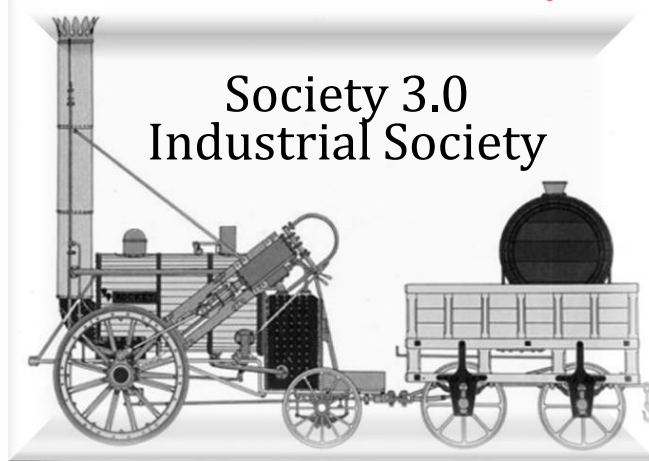

Society 1.0
Hunting Society

Birth of Humanity

~ End of 18th century

Society 3.0
Industrial Society

Society 5.0
Super Smart Society

~ 1st Half of 21st century

Society 5.0
is a human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space.
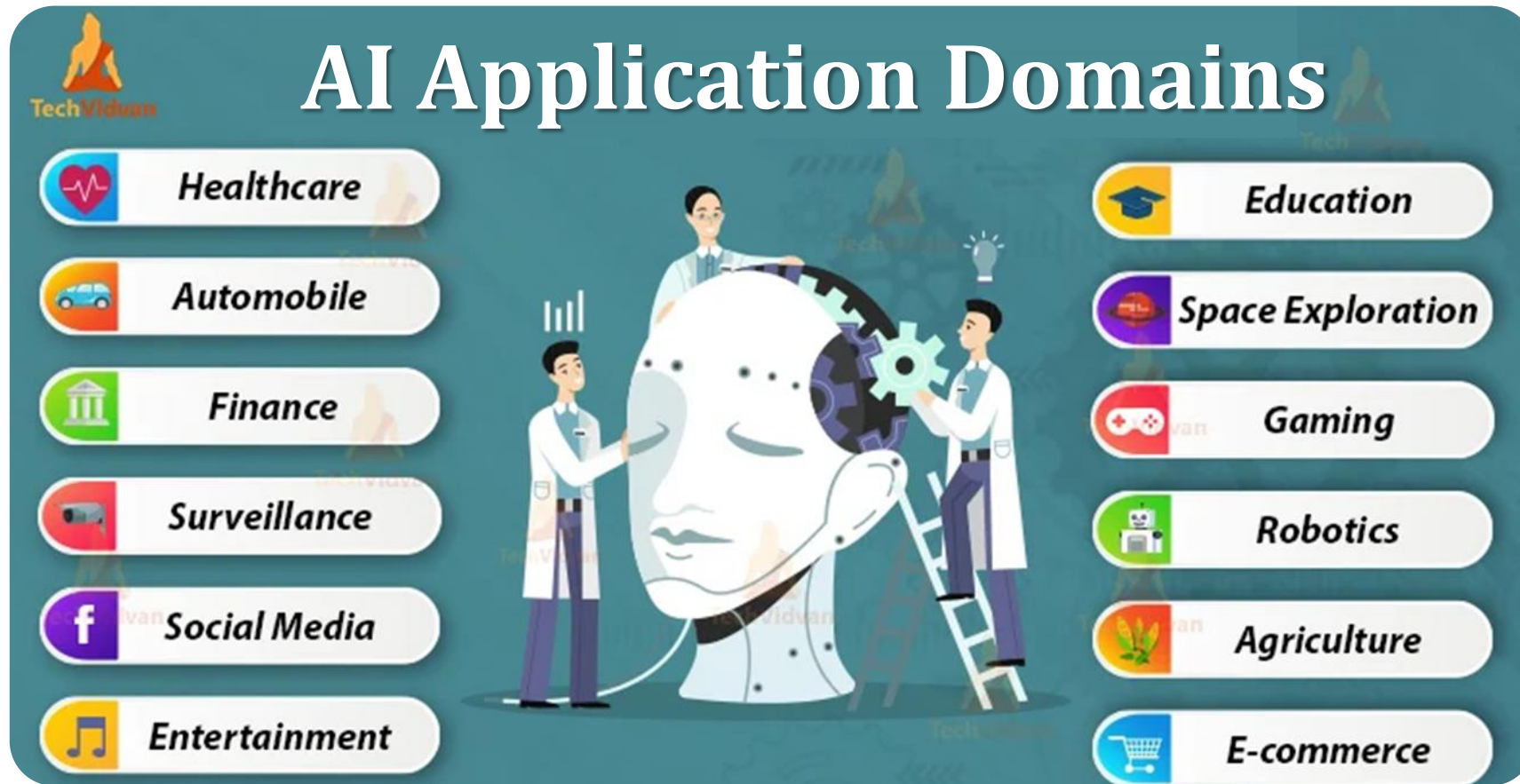
Society 2.0
Agricultural Society

~10000 BC

Society 4.0
Information Society

~ 2nd Half of 20th century

Prof. Dr. Hasan Amca
12/9/2022

https://www8.cao.go.jp/cstp/english/society5_0/index.html
https://www.linkedin.com/pulse/society-50-industry-40-dale-kim/?trk=read_related_article-card_title

29

Societal Impact
Application Domains of AI in Society

AI Application Domains

Healthcare
Automobile
Finance
Surveillance
Social Media
Entertainment

Education
Space Exploration
Gaming
Robotics
Agriculture
E-commerce

Big Idea 5 - Societal Impact
AI in Medicine

- **Medical community is currently under enormous pressure due to**
  - ✓ rising patient expectations,
  - ✓ challenges of worldwide crises such as a pandemic, and
  - ✓ difficulties of complicated administrative and compliance regulations.

Big Idea 5 - Societal Impact
AI in Medicine

- **Today, AI began to give medical professionals crucial assistance as a tool.**
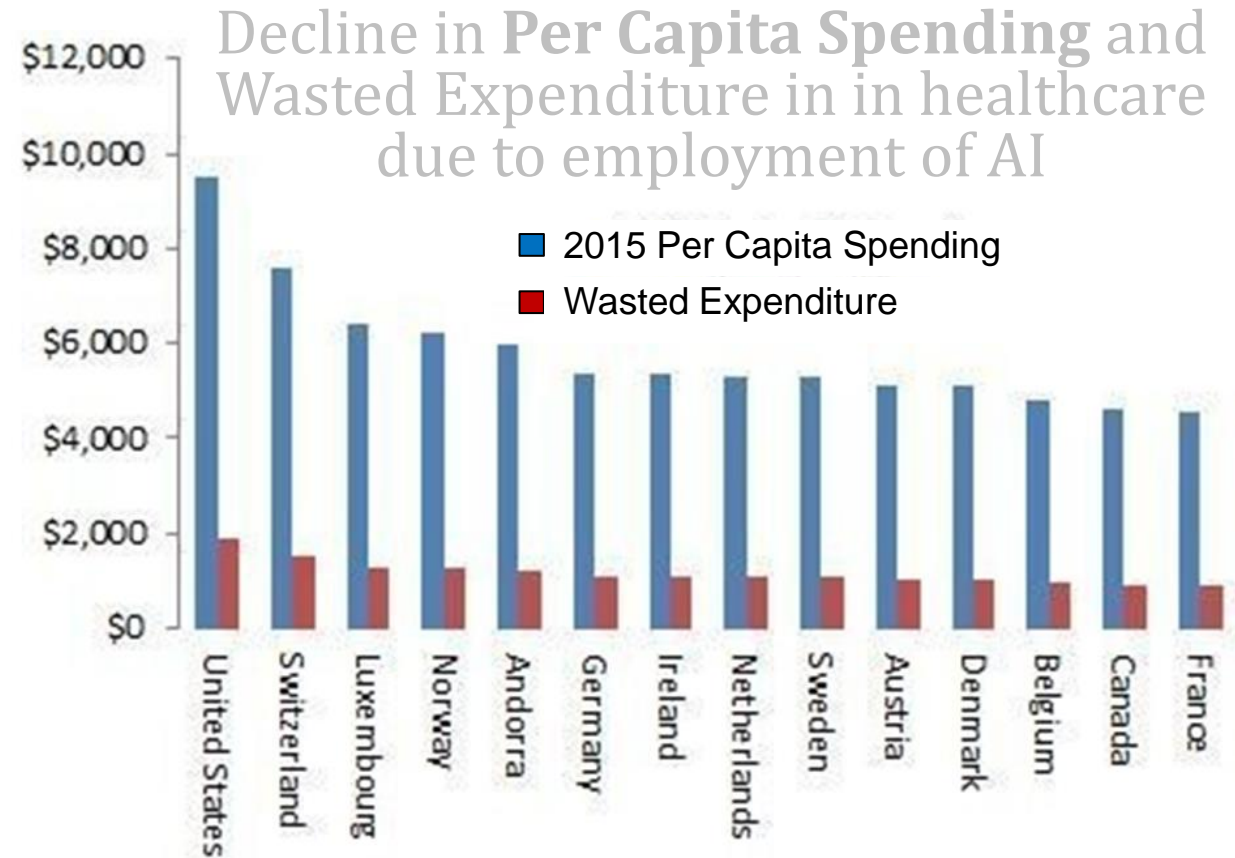
Big Idea 5 - Societal Impact
AI in Medicine

- **But in the future, AI will dominate medical sector as the doctor.**

Elysium medical pod

Big Idea 5 - Societal Impact
# AI in Medicine

- **AI will reduce the pressure on healthcare through,**
  - ✓ **reducing paperwork,**
  - ✓ **improving Access,**
  - ✓ **practicing medicine without borders,**
  - ✓ **switching to a new (digital) platform.**

Decline in **Per Capita Spending** and Wasted Expenditure in in healthcare due to employment of AI

- 2015 Per Capita Spending
- Wasted Expenditure

Big Idea 5 - Societal Impact
AI in Education

- AI can provide **focused and targeted instructions** based on
  - ✓ using **facial gesture detection** or **through the brain signals** to **detect students' level of understanding** the current subject taught.
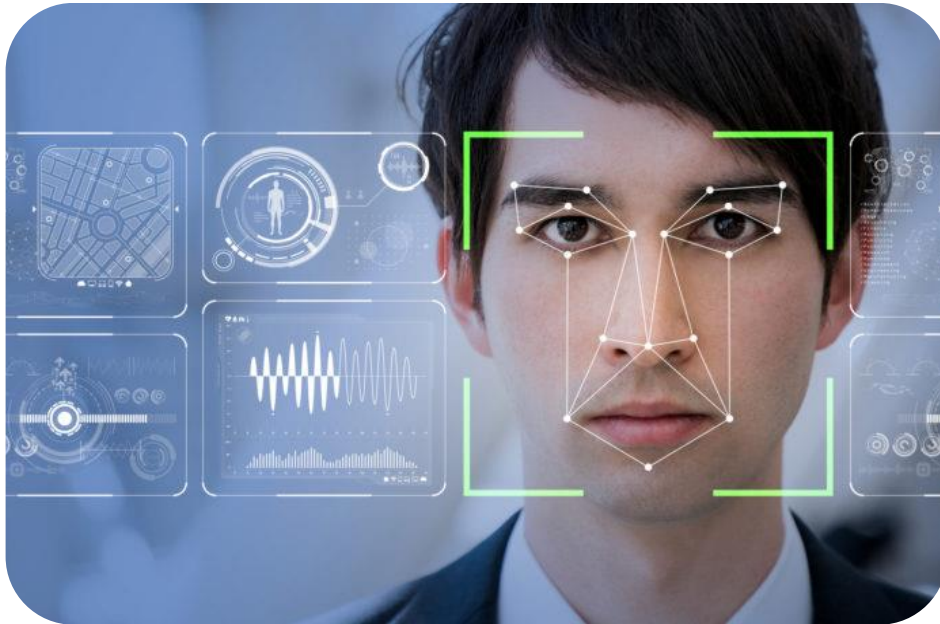
Big Idea 5 - Societal Impact
AI in Education

- AI can be used to improve supervising by tracking student performance,
  - ✓ **such as students with special needs**, **students from different social standing** and **students with language difficulties.**

Prof. Dr. Hasan Amca
12/9/2022

Big Idea 5 - Societal Impact
AI in Education

- AI can make assignment grading easier, less time consuming and fairer
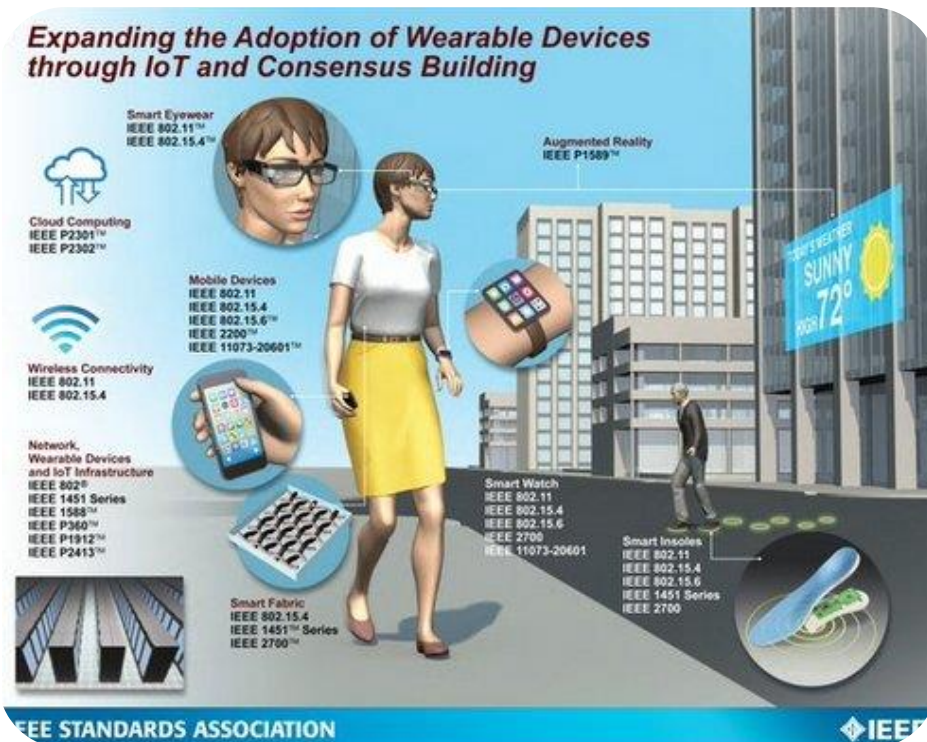 - ✓ So, teachers can spend more time with students.

Big Idea 5 - Societal Impact
AI in Education

- Education, can be more flexible, perceptive and even fun!
  - ✓ Through fashionable attractions and new opportunities offered by AI.

Big Idea 5 - Societal Impact
AI in Education

- With AI, off classroom education will be more interactive.

  ✓ Rather than students just reading and listening,

  ✓ AI will guide them by teaching, continuously assessing the level of learning and interest.
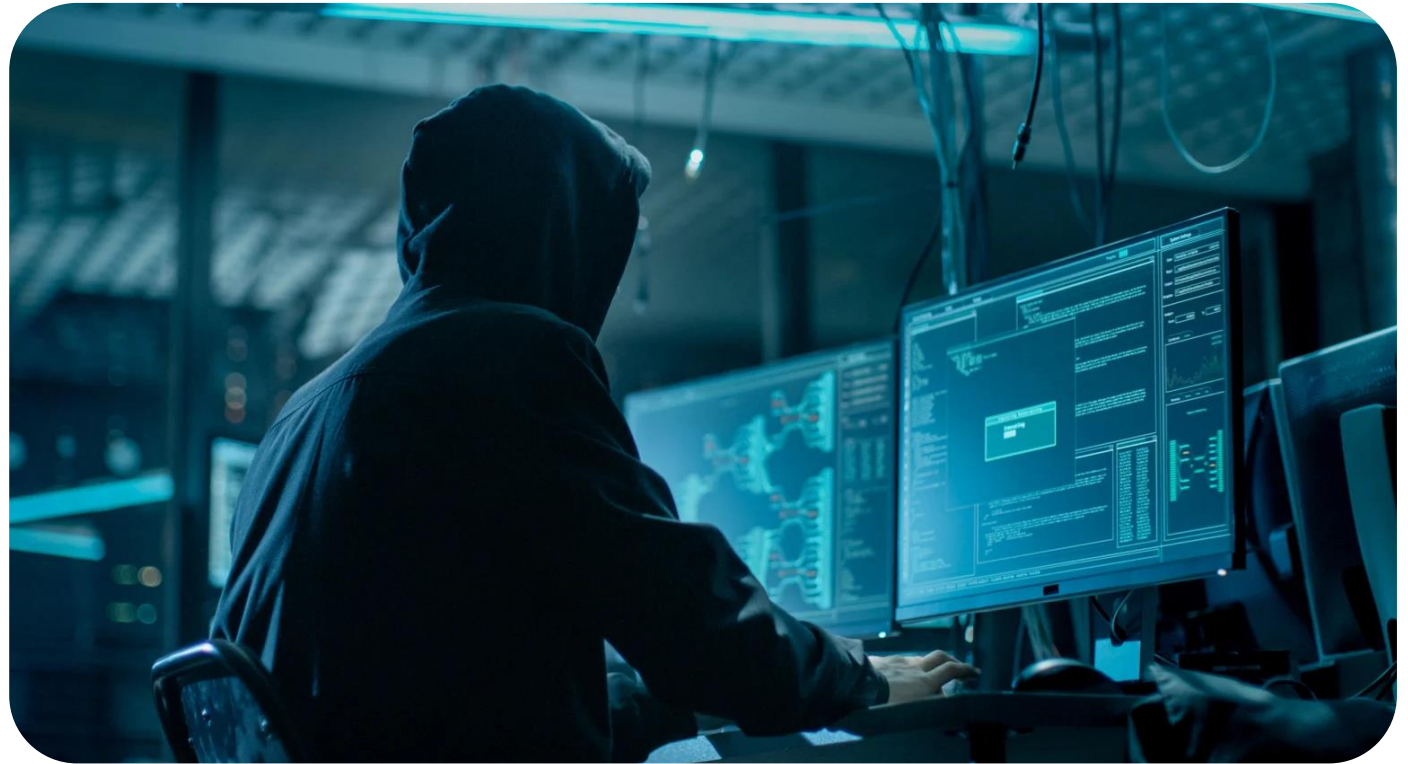
Big Idea 5 - Societal Impact
AI in Education

- AI can provide classroom security to avoid unauthorized people's entry to classes

  ✓ by face, fingerprint, retina, voice or other biometric recognition techniques.
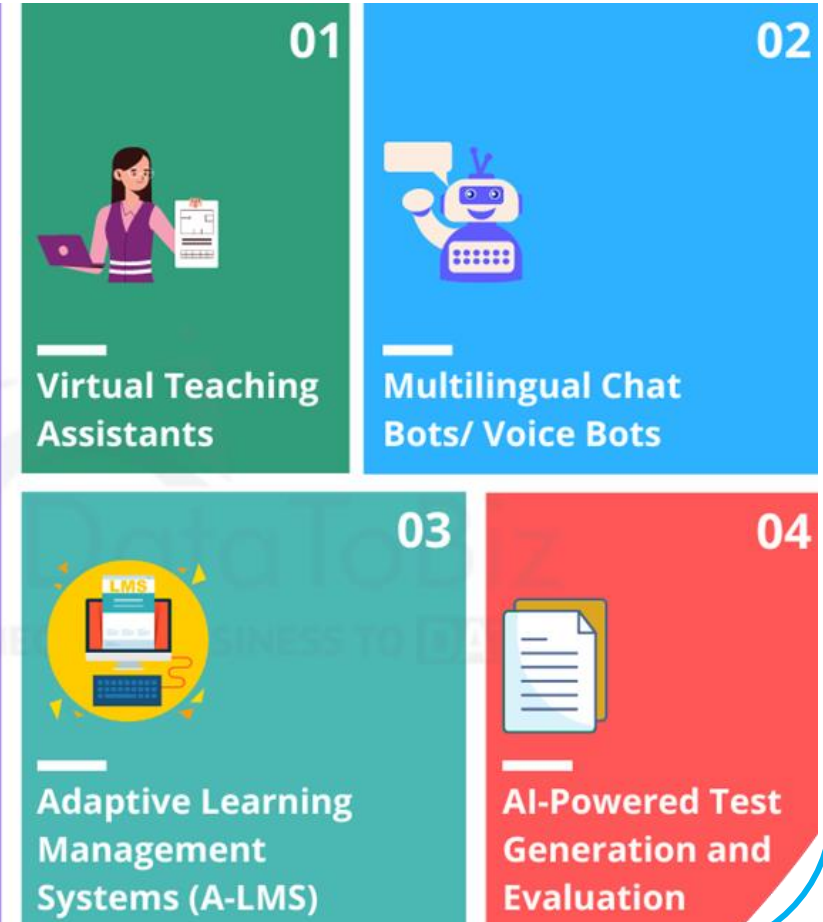
Big Idea 5 - Societal Impact
Ethics of AI making decisions about people

- When AI make decisions about humans, it is important to watch ethical issues such as
  - ✓ fairness, bias, transparency, accountability and **inclusivity**.

Inclusivity: The practice or policy of providing equal access to opportunities and resources...

AI for Inclusive Learning

01 Virtual Teaching Assistants

02 Multilingual Chat Bots/ Voice Bots

03 Adaptive Learning Management Systems (A-LMS)

04 AI-Powered Test Generation and Evaluation

Big Idea 5 - Societal Impact

Artificial General Intelligence
A machine capable of human level understanding could possibly be a threat to humanity and such research may need to be regulated.

Ethics of AI make decisions about people

Automated Decisions
Although the human generated biases prevent AI systems from making fair decisions, these biases are convenient due to some reasons

Ethical Dilemmas of AI

Autonomous Things
devices and machines that work on specific tasks autonomously without human interaction

Lethal Autonomous Weapons
There have been debates on the ethics of using weaponized AI in the military. For example, in 2018, United Nations gathered to discuss the issue.

Unemployment due to Automation
This is currently the greatest fear against AI. According to a CNBC survey, 27% of US citizens believe that AI will eliminate their jobs within five years.
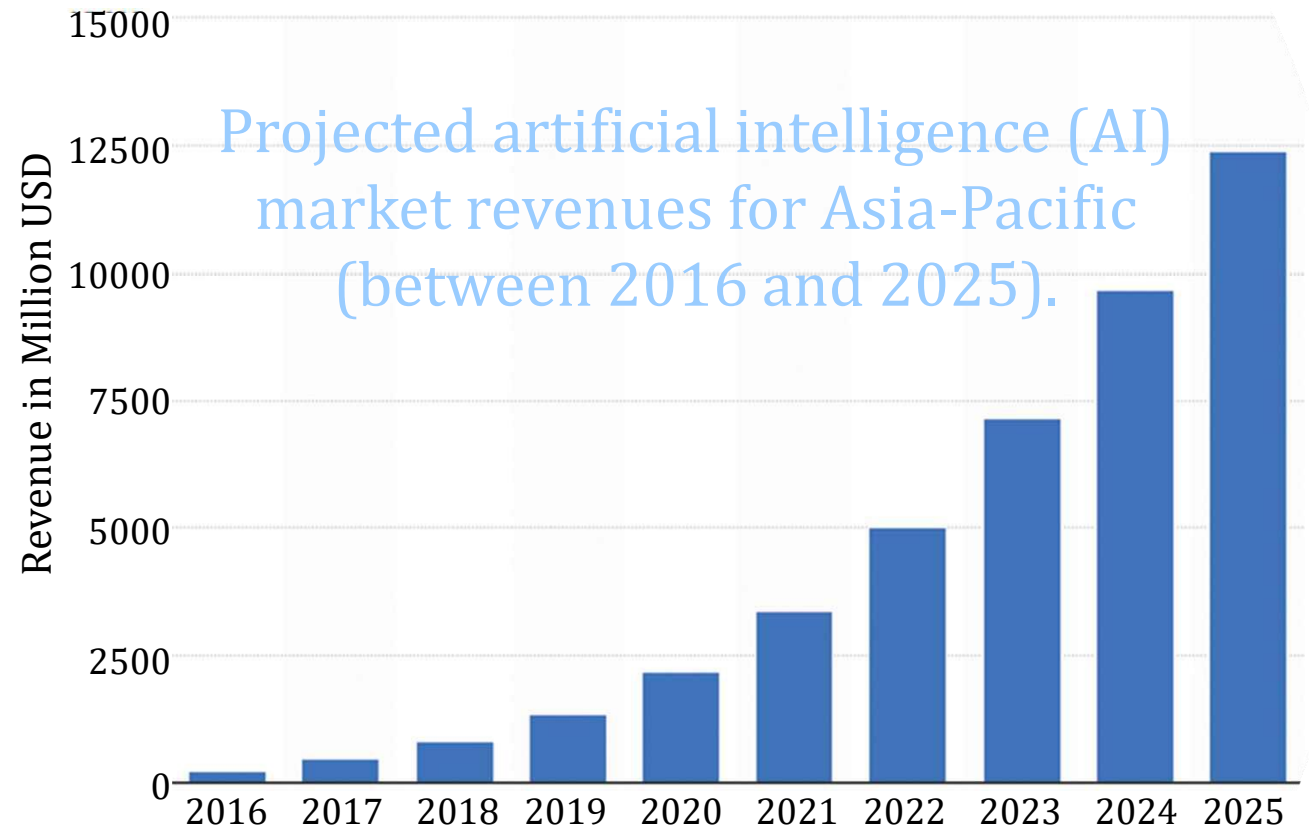
Self-Driving Cars
However, autonomous vehicles pose various risks to AI ethics guidelines. People and governments still question the liability and accountability of autonomous vehicles.

Big Idea 5 - Societal Impact
Economic impacts of AI

- Increased productivity
- New types of services
- Reduction in some types of jobs
- New career opportunities
  - ✓ Data science
  - ✓ NLP
  - ✓ AI consultants
  - ✓ ...

Projected artificial intelligence (AI) market revenues for Asia-Pacific (between 2016 and 2025).

(Bar chart: Revenue in Million USD vs Year, 2016–2025, showing increasing revenue from roughly 250 in 2016 to about 12400 in 2025)

Big Idea 5 - Societal Impact
The Impact of AI on Social Issues

- **AI systems can have unintended Consequences such as**

  1) ignoring social and business implications

  2) ignoring the roles of human employees and customers,

  3) dishonoring fundamental rights to personal security and privacy,

  4) **compromising the value of human life,**

  5) not excluding individual biases.

https://www.inc.com/martin-zwilling/how-to-avoid-these-6-unintended-consequences-of-using-ai-at-your-company.html
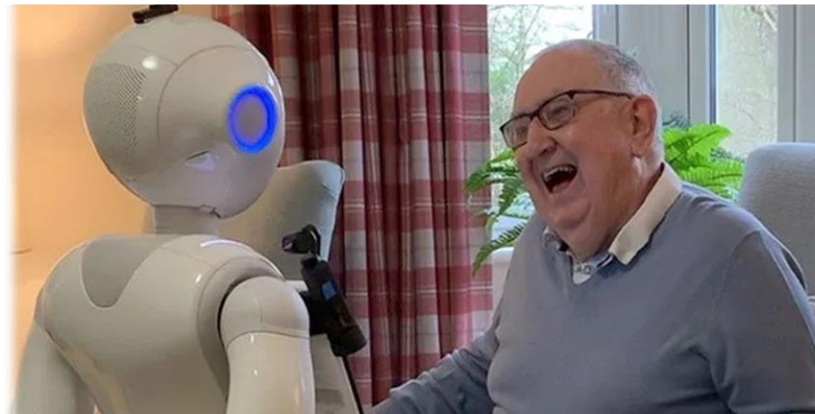
Big Idea 5 - Societal Impact
Impact of AI on Art and Culture

- Living with intelligent assistants and robot companions could be amusing and comfortable.

- **BUT**, would you let your child travel unaccompanied in a self-driving car?
  - ✓ **If your answer is YES, watch The Takeover movie!**

Prof. Dr. Hasan Amca
12/9/2022

The AI4K12 Initiative: Developing National Guidelines for Teaching AI In K-12, David S. Touretzky, Carnegie Mellon University

https://www.sciencefocus.com/news/culturally-competent-robot-improves-mental-health-in-the-elderly/

47

Big Idea 5 - Societal Impact
Impact of AI on Art and Culture

- AI to Preserve Our Cultural Heritage: Digitized art and culturte
- For better understanding, Google for "the last selfie on earth".

www.financebrokerage.com/what-is-an-nft/

Artificial Influencers Lil Miquela

https://www.instagram.com/lilmiquela/

www.digitalmonalisa.com/

https://news.microsoft.com/on-the-issues/2019/07/30/ai-changing-arts-culture/
https://www.forbes.com/sites/cognitiveworld/2019/03/28/artificial-intelligence-for-good-preserving-our-cultural-heritage/?sh=64e2b86e4e96

https://www.linkedin.com/pulse/last-selfie-earth-lesson-artificial-intelligence-cyber-dan-duran/
https://www.coe.int/en/web/culture-and-heritage/culture-and-digitisation

Big Idea 5 - Societal Impact
AI Generated High Quality Artwork

- **AI can generate high quality artwork** in seconds conform to description.

- Draw "AI used as a military weapon and create unfair circumstances".

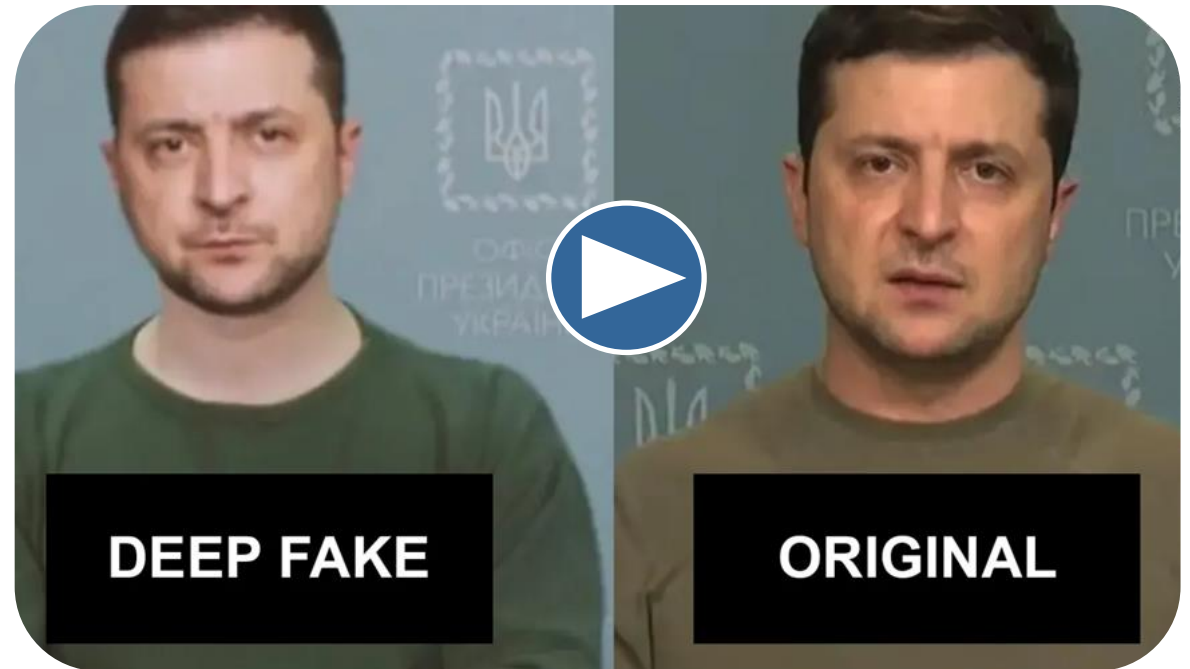- Draw "a small cat chasing a large dog with big ears and long tail"

Big Idea 5 - Societal Impact
AI Faking and Misleading People!

- A **deepfake of Ukrainian president Zelensky** calling on his soldiers to lay down their weapons was uploaded to a hacked Ukrainian news website.

- Such **deepfakes** could cause severe consequences on human life.

Prof. Dr. Hasan Amca
12/9/2022

https://katzlberger.ai/2022/03/25/propagandakrieg-mit-deepfake-video/

50

AI Will Impact Metaverse
Metaverse Will Impact Society?

- Metaverse is the emerging
  - ✓ 3D enabled digital space,
  - ✓ that uses virtual reality, augmented reality,
  - ✓ and other advanced internet and electronic technologies,
  - ✓ **to enable people to have lifelike experience online, in education, entertainment etc...**

Video:https://www.mckinsey.com/Videos/video?vid=6310398117112&plyrid=HkOJqCPWdb&aid=909E4487-FCCF-4364-B77A-03706DCE5CFA

The 5 Big Ideas of Artificial Intelligence

Benefit of Artificial Intelligence to Human Development

Thanks to

**Legos Ministry of Science and Technology
Association for the Advancement of AI
Computer Supported Telecommunication Applications
Pearly Bluewaters**

Prof. Dr. Hasan Amca
Eastern Mediterranean University
9th of December 2022 10: Am