MACHINE LEARNING (ML) AND ARTIFICIAL INTELLIGENCE (AI)

Subject: Computer: The Internet and Society 3(3-0-6)
Semester 1/63
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Courtesy: Dr. Jirawat Thaenthong

AGENDA

- What is machine learning (ML)?
- How does ML work?
- ML Applications
- What is Artificial Intelligence (AI)?
- AI vs ML
- AI/ML Breakthroughs

MACHINE LEARNING

1. WHAT IS MACHINE LEARNING?

Machine Learning (ML) is the field of study that gives computers the capability to learn without being explicitly programmed.

THE ABILITY TO LEARN

1. Learn to recognize objects (e.g., human, shoes, car)
2. Learn to make decision (e.g., self-driving car – when to brake and when to accelerate)
3. Learn to play games or solve puzzles
4. Etc.

CONT.

Learn from example through self-improvement and without being explicitly coded by programmer.

The breakthrough comes with the idea that a machine can singularly learn from the data (i.e., example) to produce accurate results.

WHY DO WE NEED MACHINE LEARNING (ML)?

- The most suitable reason for doing this is, “We need a machine to support decision making based on data, with efficiency and scale”.

- When we have big data, we need ML to work a lot of task analysis instead of using humans (ML analyses data faster than humans).

For example:

iPhone uses machine learning to generate a Face identification (ID) for verification so you can quickly unlock your iPhone.

TASK (5 MINUTES)

A typical machine learning task is to provide users a recommendation.

Can you give an example of a computer system/application that provides suggestions based on your experience?

2. WHY & WHEN TO MAKE MACHINES LEARN?

Lack of human expertise

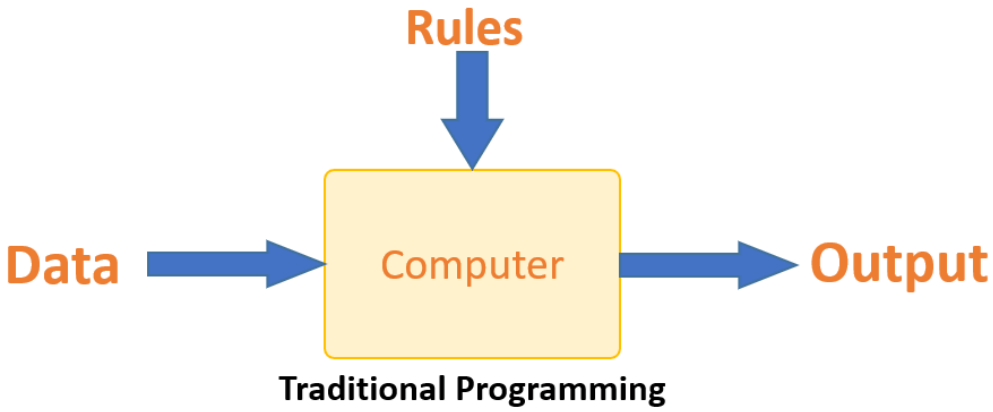
Dynamic scenarios

- Scenarios that keep changing over time.
- Make decisions based on dynamic data.
- Reduce human workload.

Difficulty in translating expertise into computational tasks

- Speech recognition
- Chinese to English translator
- English to Any languages translator
- Face detection
- Object movement detection

3. MACHINE LEARNING VS. TRADITIONAL PROGRAMMING



Traditional Programming

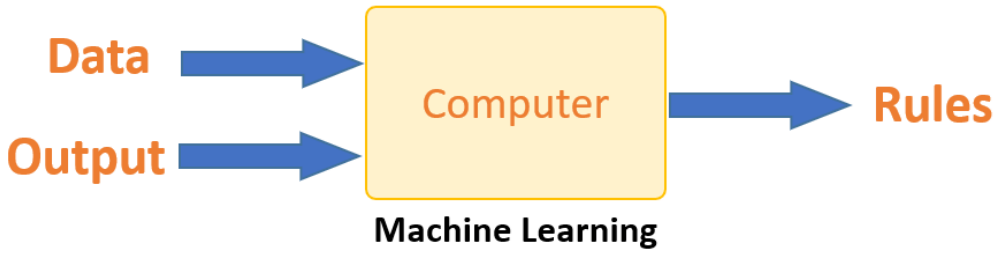
In traditional programming, a programmer codes all the rules.

The machine will execute an output based on the rules.

When the system grows complex, more rules are needed.

Unsustainable to maintain.

CONT.



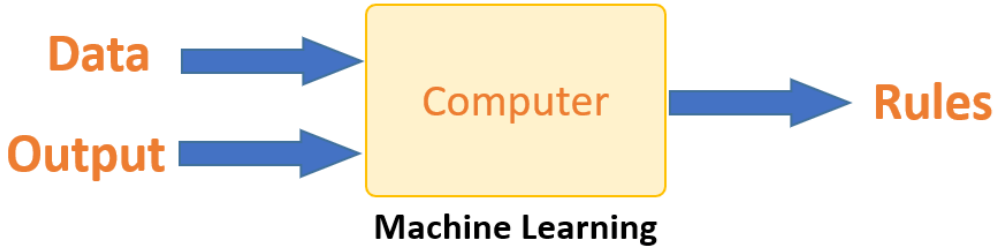
ML tries to overcome this issue.

Learns how the input and output data are correlated and it writes a rule.

No need to write new rules for new data.

ML programs adapt with new data and experiences to improve efficacy over time.

EXAMPLE: CAR DETECTION



Input

Output

Car Image

Non-Car Image

ML generates a model (set of rules) based on these inputs and outputs.

We then can use this model to detect whether a new image is a car image!

4. HOW DOES MACHINE LEARNING WORK?

Like human beings: learn from experience.

Human:

- The more we know, the more easily we can predict.
- With unknown situations, fail to predict correctly.

ML:

- Need examples (input/output)
- More likely to predict correctly if fed with similar examples
- With unseen examples, difficult to predict.

4. HOW DOES MACHINE LEARNING WORK?

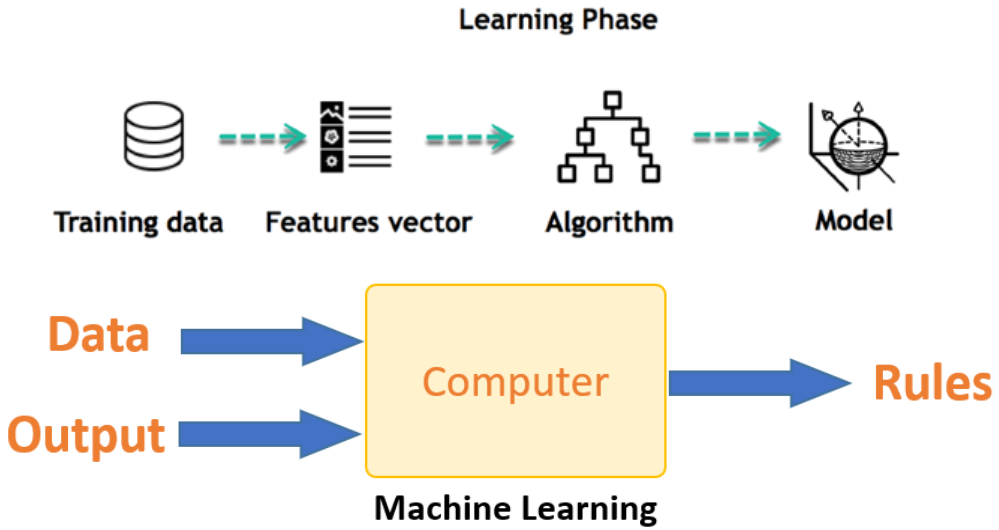
Steps:

1. Learning Phase

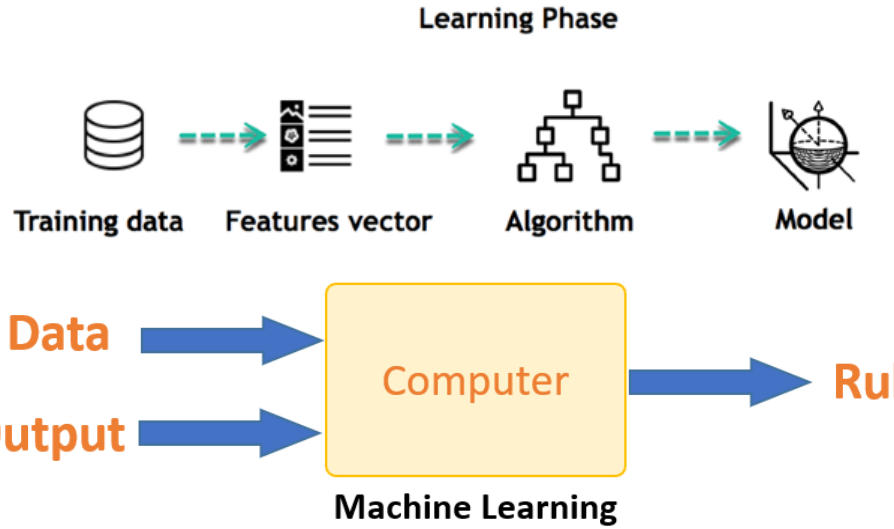
2. Prediction Phase

LEARNING PHASE

- Learns through the discovery of patterns.
- Discovery of patterns implies a lot of **data**.



LEARNING PHASE

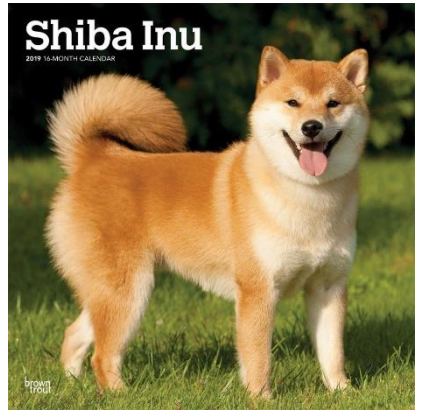


- Learns through the discovery of patterns.
- Discovery of patterns implies a lot of **input data**.
- Convert each data into a **feature vector**: a compressed version of data describing important patterns/characteristics
- Fancy algorithms to transform a collection of feature vectors into a **model (set of rules)**.

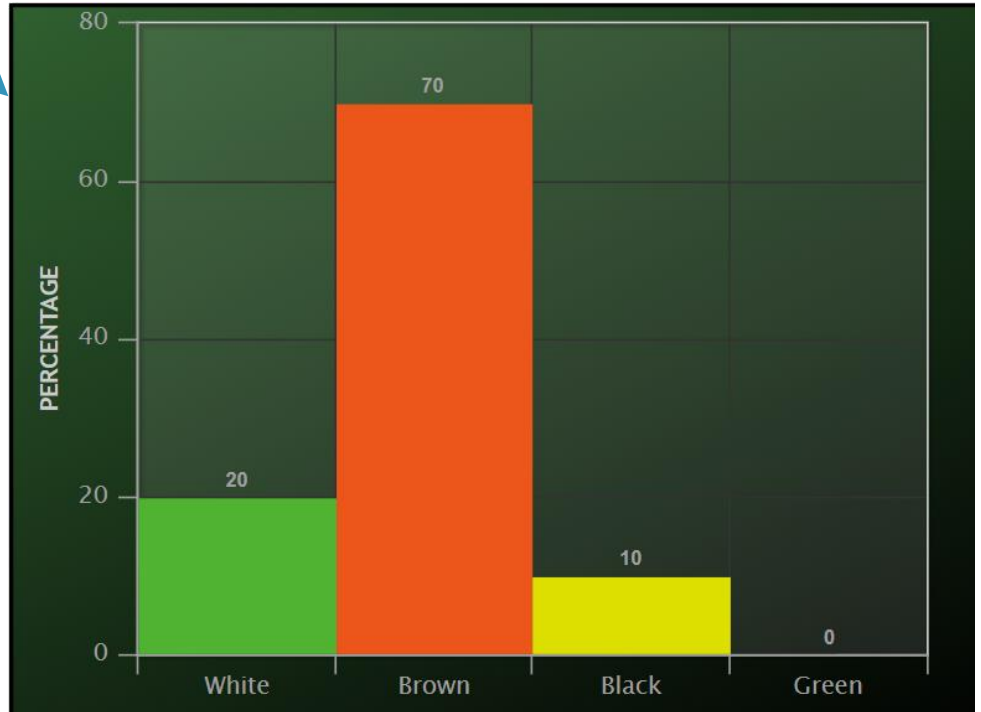
Learning phase = a lot of input data => feature vectors => model

EXAMPLE: RECOGNIZING SHIBA INU IMAGES

Input Data



Feature Vector:
Histogram of Color



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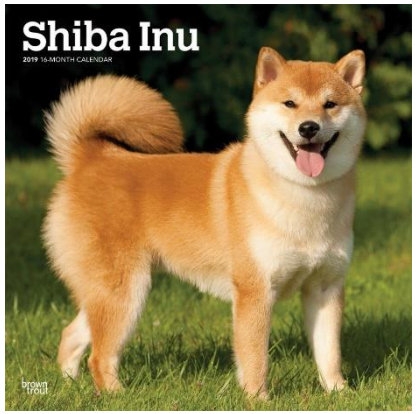
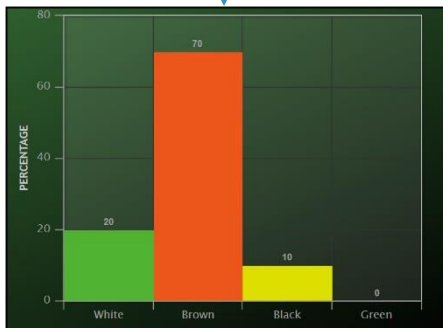
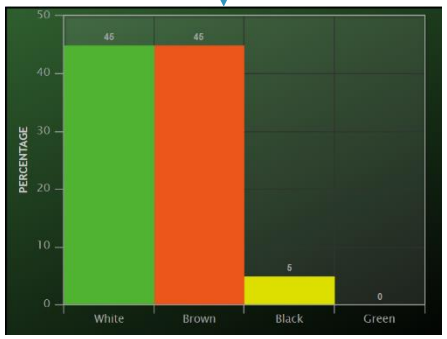
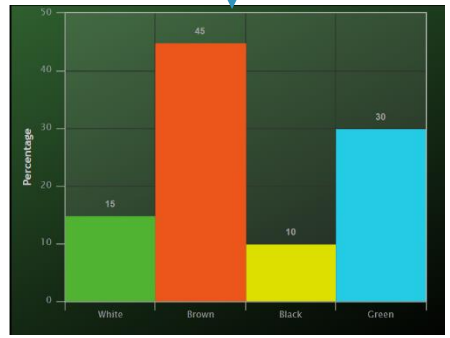
Input Data

Feature Vector: Histogram of Color







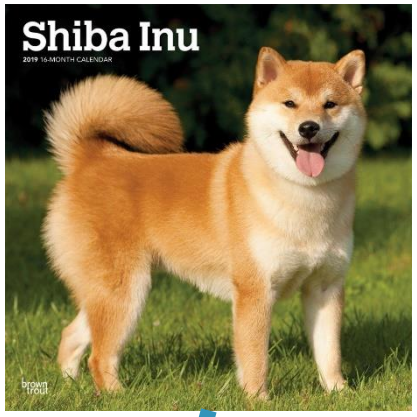


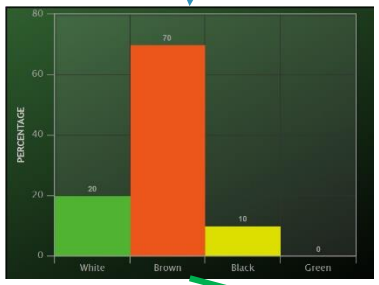
EXAMPLE: RECOGNIZING SHIBA INU IMAGES

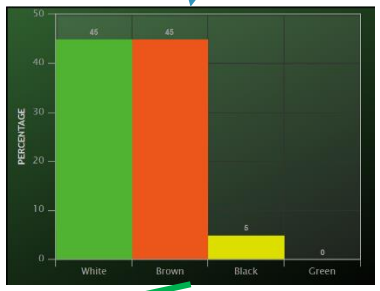
Input Data

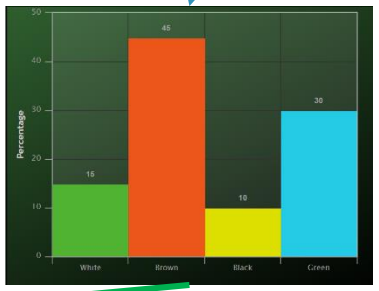
Feature Vector: Histogram of Color

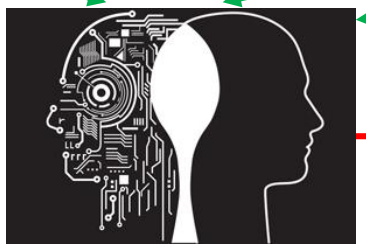
Model





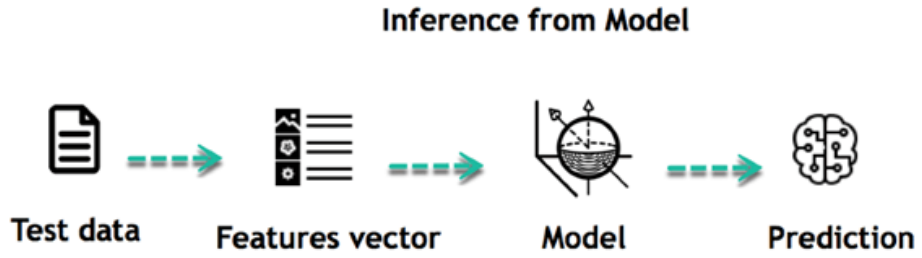






Model (a set of rules): white > 5% and brown > 15% and black > 2%

PREDICTION PHASE
(INFERENCE FROM MODEL)



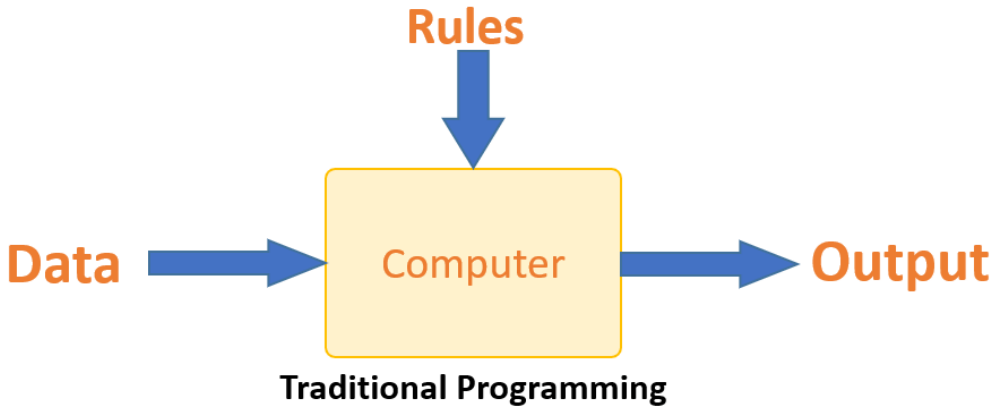
Test a trained model on never-seen-before data.

Go to similar process as the **first half of training phase**:

- New data is transformed to a feature vectors.
- Instead of creating a new model, use the trained model to give a prediction based on feature vectors

Model is untouched; No need to update the rules of the model.

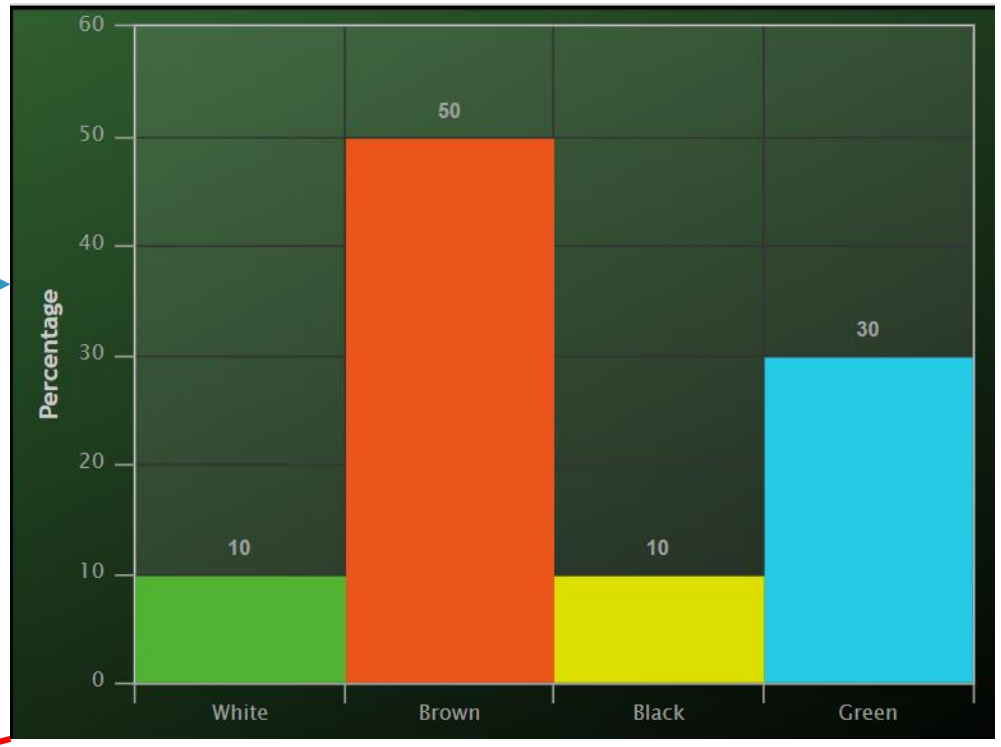
Use the model previously trained to make inference on new data.



EXAMPLE: PREDICTING SHIBA INU IMAGES

New Data

(1) Feature Extraction



(2) Test Against

Model (from learning phase): white > 5% and brown > 15% and black > 2%

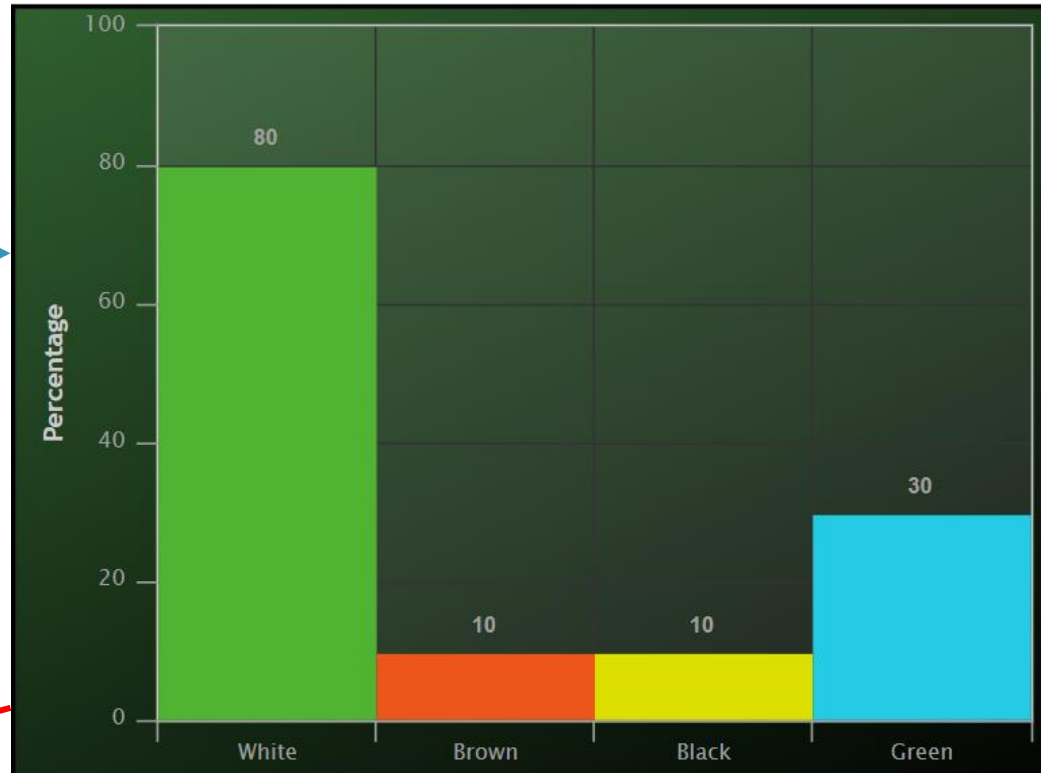
(3) Is Shiba Inu?

Yes!!

WHAT ABOUT THIS IMAGE

New Data

(1) Feature Extraction



(2) Test Against

Model (from learning phase): white > 5% and brown > 15% and black > 2%

(3) Is Shiba Inu?

NO!!

6. WHY DOES ML BECOME POPULAR JUST NOW, AND NOT 20 YEARS AGO?

1) Most ML algorithms require powerful hardware run

A co-founder of famous ML company, Google DeepMind, says it would take around 250 million years to run his ML algorithm on a computer from 1990. Whereas, it takes only one day to run on a modern computer.

6. WHY DOES ML BECOME POPULAR JUST NOW, AND NOT 20 YEARS AGO?

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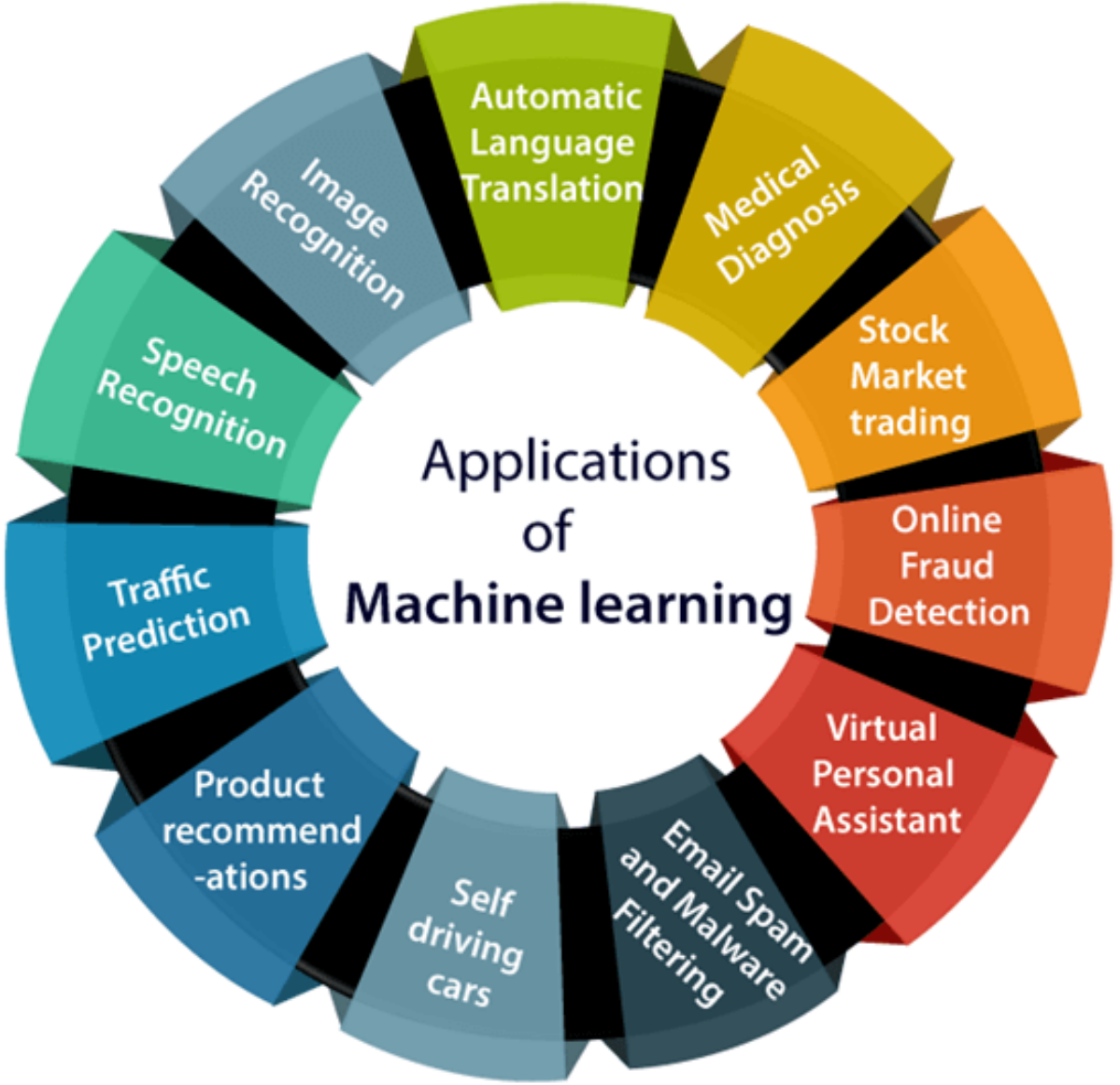
2) ML needs a lot of data

20 years ago, there was no way to quickly obtain enough data for performing ML.

Question: Why is it possible now to have a lot of data quickly?

7. APPLICATION OF MACHINE LEARNING



Credit: https://www.javatpoint.com/applications-of-machine-learning

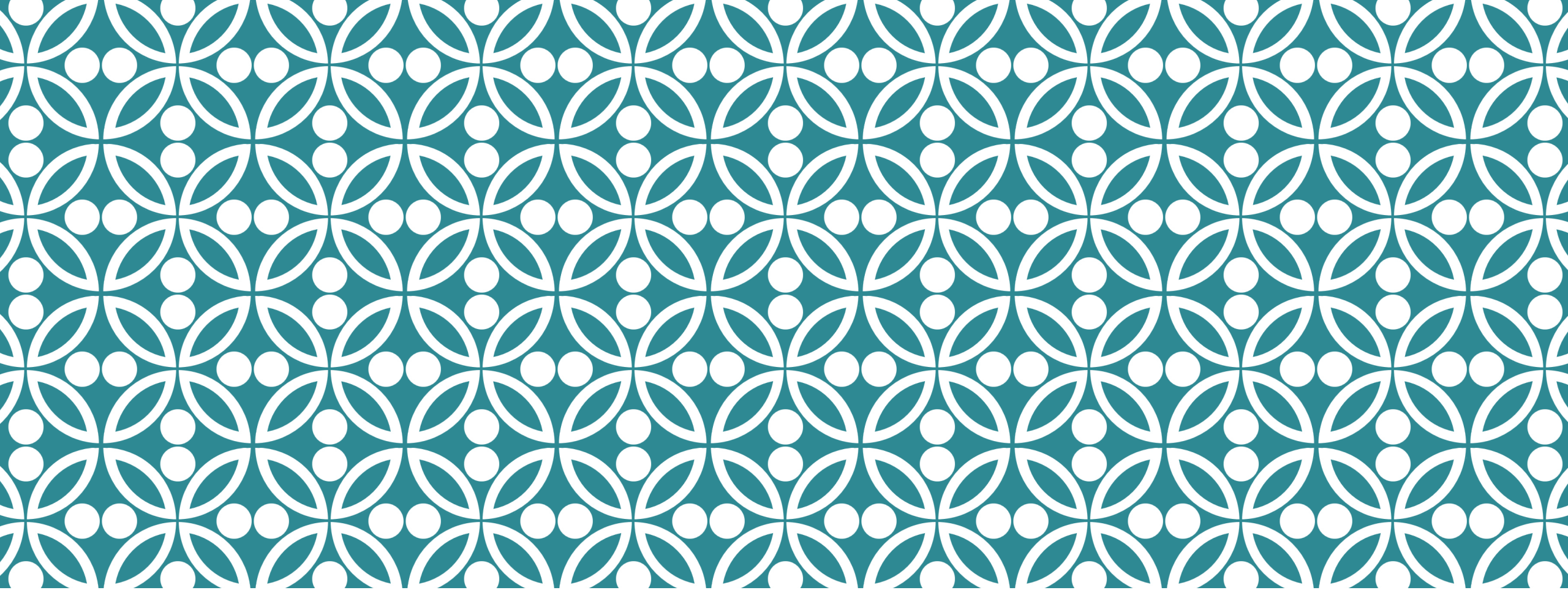
ML APPLICATIONS

- deepl.com: Learn to translate from one language to another based on the context
- Baidu's autonomous cars: Learn to recognize environments, e.g. streets, cars, people
- Medical diagnosis: Learn to predict diabetes based on patient's information, e.g., age, sex, body mass index, blood pressure, etc.
- iFlytek: Learn to recognize your voice and translate to text

ACTIVITY I (10 MINUTES)

Give other websites or mobile applications using Machine Learning. Explain how they use ML.

Websites/Mobile apps	How machine learning is used



ARTIFICIAL INTELLIGENCE

1. WHAT IS ARTIFICIAL INTELLIGENCE (AI)?

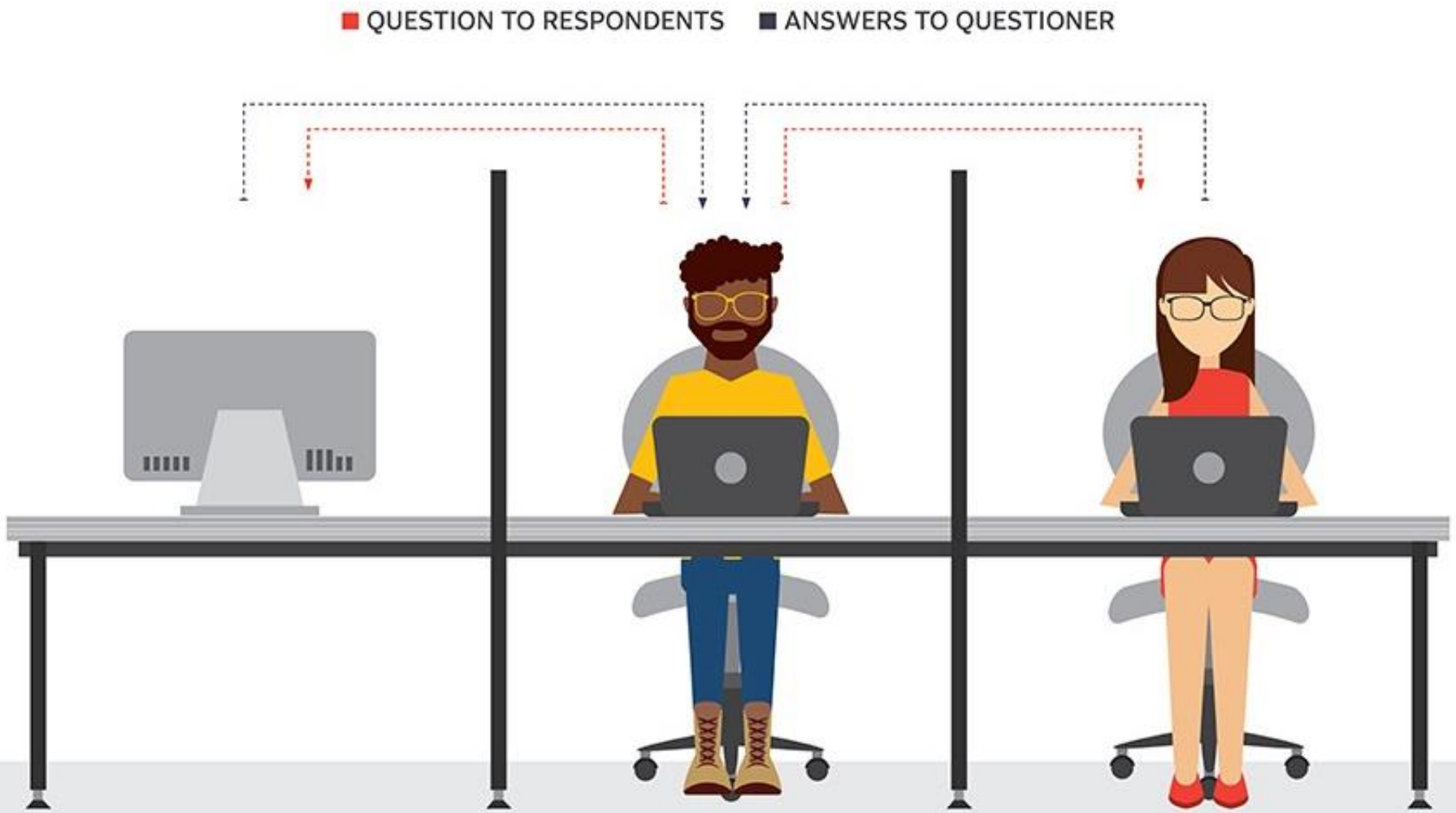
A field in computer science that tries to answer the following question:

Can we create machines that think and act like humans?

If you are interested, read this article: COMPUTING MACHINERY AND INTELLIGENCE

Turing test

During the Turing test, the human questioner asks a series of questions to both respondents. After the specified time, the questioner tries to decide which terminal is operated by the human respondent and which terminal is operated by the computer.



FOUR DIFFERENT APPROACHES EXPLORED IN AI

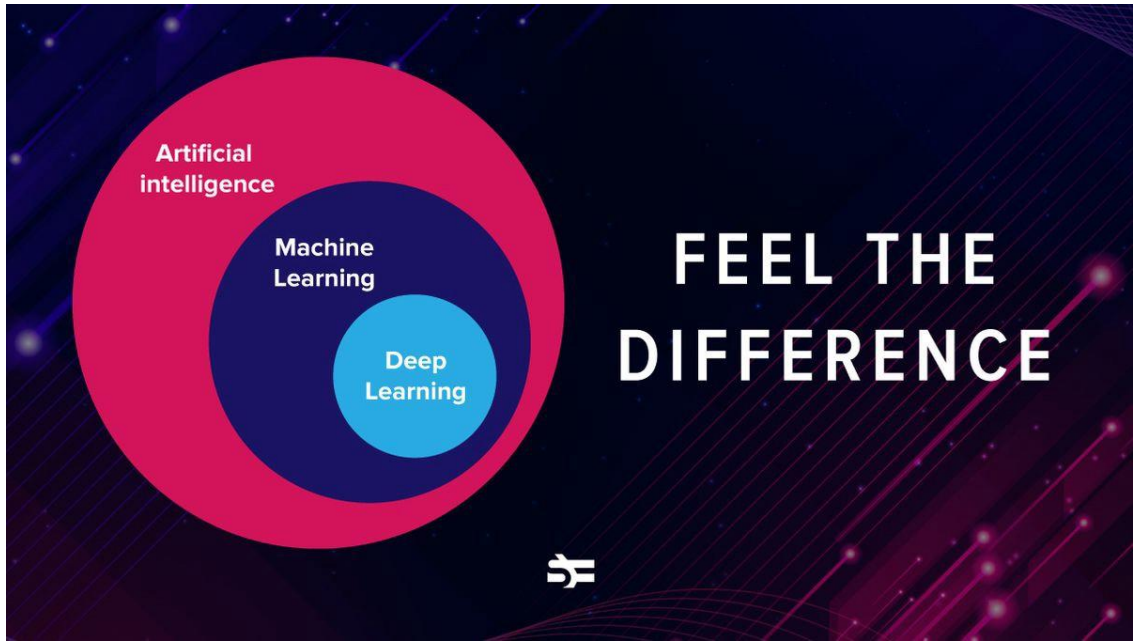
1. Thinking humanly – think like a human
2. Thinking rationally – think with logic and reasoning
3. Acting humanly – act like a human
4. Acting rationally – act with logic and reasoning

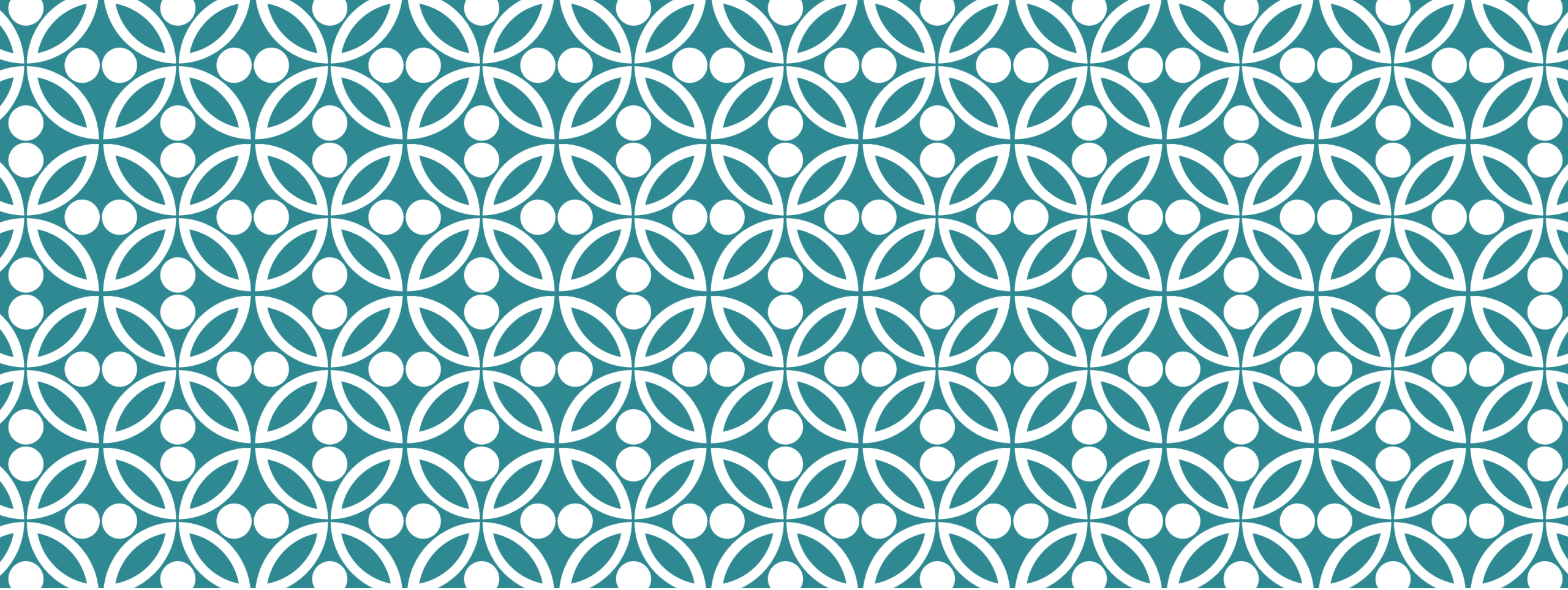
2. MACHINE LEARNING VS ARTIFICIAL INTELLIGENCE

ML is a subset of AI

To become like humans, AI needs to:

1) Have reasonings and problem solving
2) Have planning (set a goal and achieve it)
3) Learn through experiences
4) Read and understand human languages
5) Understand human emotion
6) Etc.





ARTIFICIAL INTELLIGENCE & MACHINE LEARNING BREAKTHROUGHS

1) ALPHAGO

Go is a very complex game with many possible moves, more than subatomic particles in the Universe

The company DeepMind uses AI/ML to build a computer Go program, called AlphaGo

In March 2016, AlphaGo beat the world champion 4-1 games

It was a big deal because it was the first time that AI beats the best Go player in the world

AlphaGo Movie: https://www.youtube.com/watch?v=WXuK6gekU1Y

2) DEEPFAKE

Fake videos in which a person is replaced with someone else. Not only just that person's face, but also his voice.

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Fake videos in which a person is replaced with someone else. Not only just that person's face, but also his voice.

Applications:

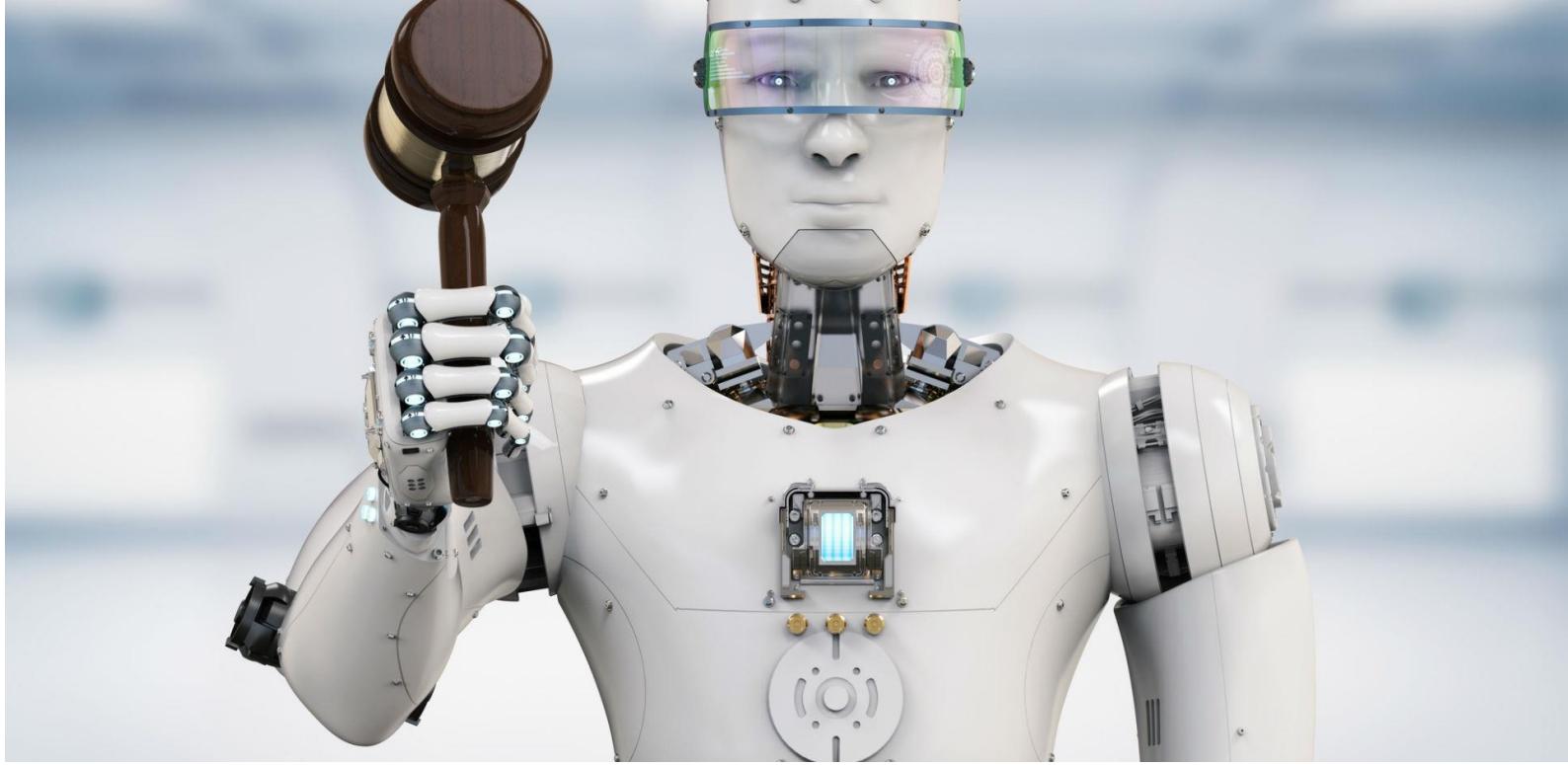
1) Acting: Insert faces into existing films, e.g., in Star Wars: Rouge One, 2016

2) Social Media: Can swap your face with celebrities, post the videos on social media: examples of tools are Zao and Deepfakes web β

3) Fraud: Can create fake videos of anyone saying anything

FUTURE AI/ML: AI JUDGES?

AI judges give verdicts via chat app



Q/A

GROUP ASSIGNMENT

Do the research and find a website or an application that uses Machine Learning (or Artificial Intelligence)

Suggested Topics:

- Explain the details of this website/application
- Explain how Machine Learning is used in that application/website (e.g., what kind of information it is trying to predict? How does it get input data to train machine learning model?)
- Explain how the website/application can gain benefits from using Machine Learning (e.g., increase in revenue)

Present in class next week (5-10 minute)

IN-CLASS ASSIGNMENT NEXT WEEK!

- Be sure to not miss the Thursday class next week