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BIOMEDICAL & CLINICAL ENGINEERING
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Artificial Intelligence in Health Care Workshop
Prof. Ahmed Albarrak
Dr. Sarah Alkhodair
Within the 21st International Operations & Maintenance Conference in the Arab Countries
An Initiative by
OMAINTEC
المجلس العربي للتشغيل والصيانة
Arab Operations & Maintenance Council
Organized by
EXICON.
International Group
مجموعة أكزيكون الدولية
Collaborators
EGYPT

Exercise – 5 minutes

- Decision Support System (DSS)
- Decision Tree
- Regression Analysis
- Data Mining
- Artificial Intelligence
- Machine Learning

What does it mean?
Give an example.

Discussion

"Modern healthcare is the
most complex human
***activity**, due to*
interpersonal relationships
between many different clinicians with
different expertise and interests, and we haven't figured out how to make that work well.
We have come to a full stop against a complex environment that resists accepting change on the scale clearly required"

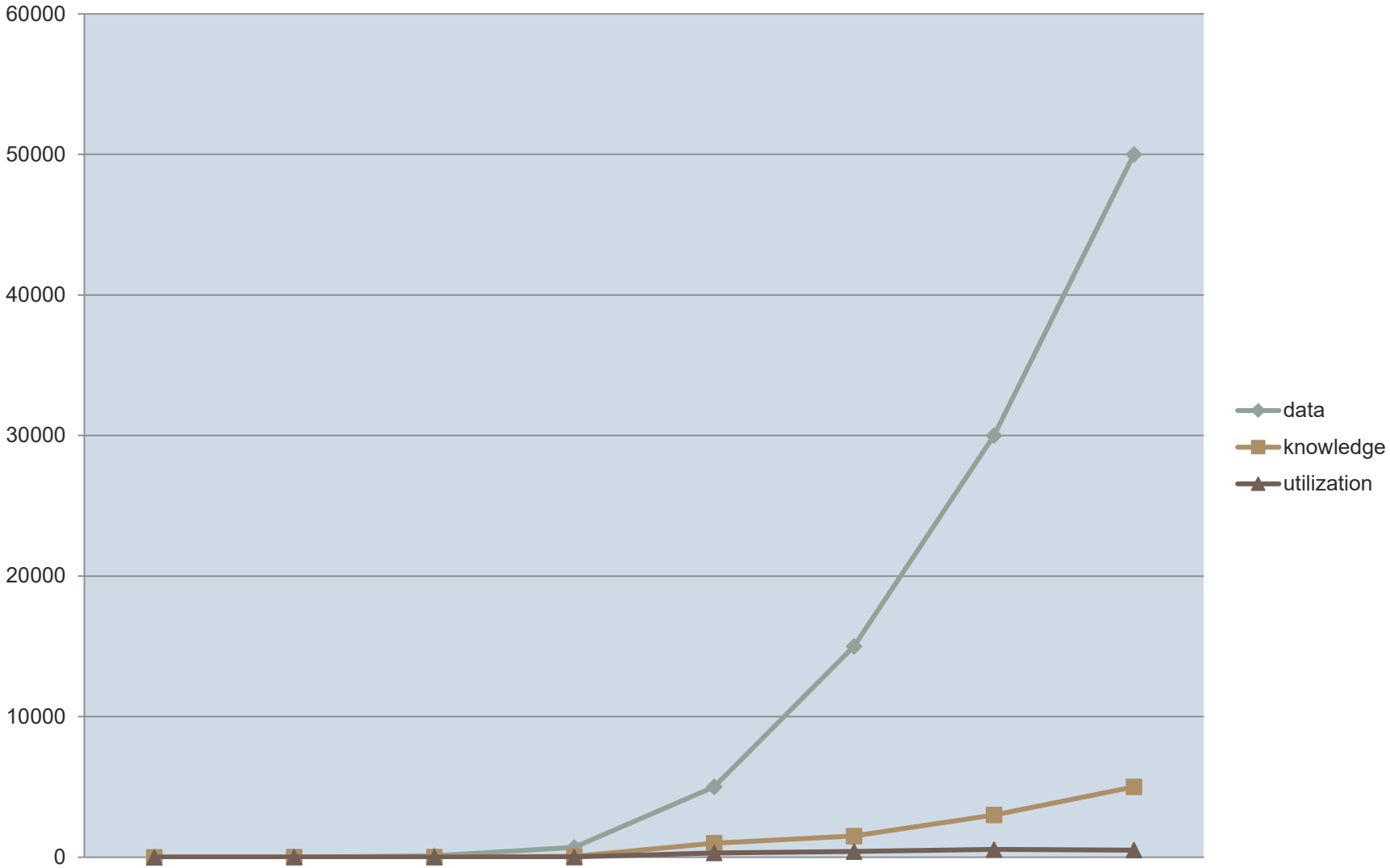
Lucian Leape, MD

Founder of the Modern Patient Safety Movement
Adjunct professor of health policy at Harvard University
"Error in Medicine," published in JAMA, 1994

"Information is the oil of the 21st century, and analytics is the combustion engine."

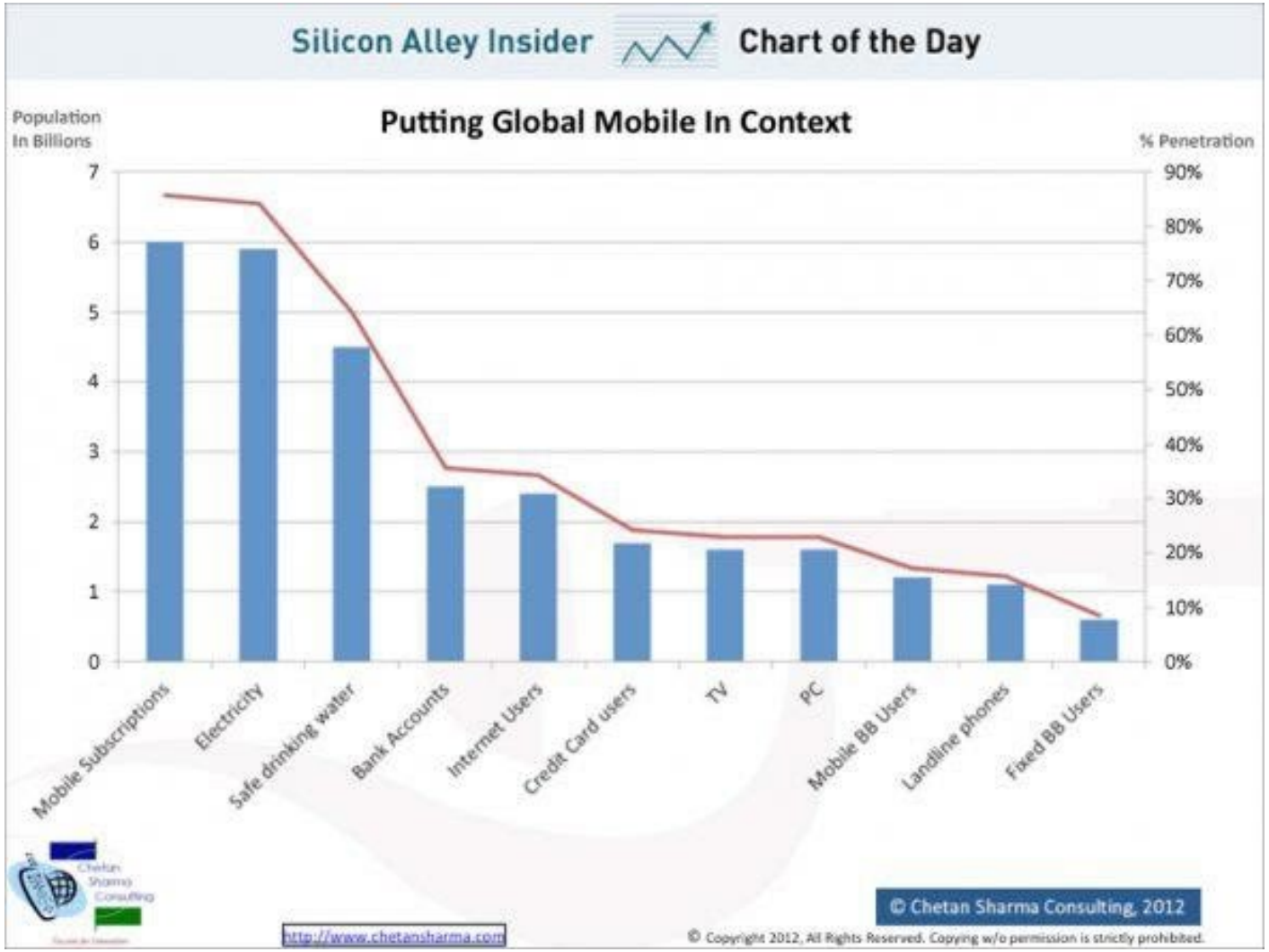
- Peter Sondergaard (1965 -), senior vice president and global head of Research at Gartner, Inc.

Data – knowledge - utilization



mHealth

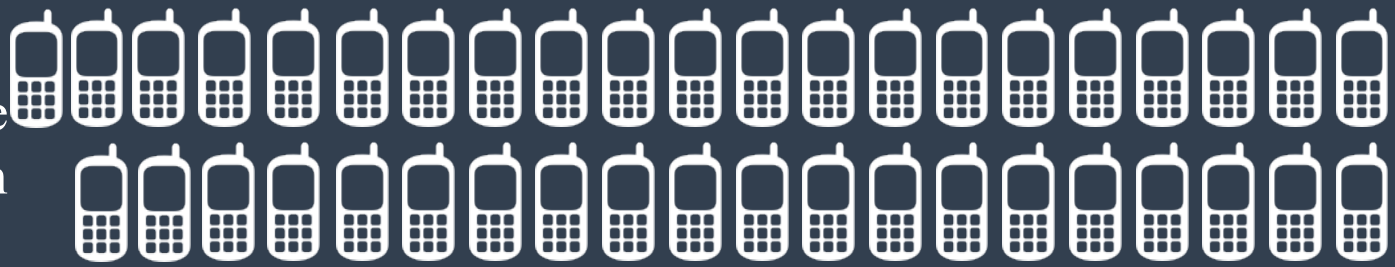
Mobile is the most Pervasive technology ever invented



The mHealth Opportunity

7 Billion
People

By 2014
More mobile phones than people



Expanding the coverage and reach of critical health information and services and moving towards citizen - centered health and well -being

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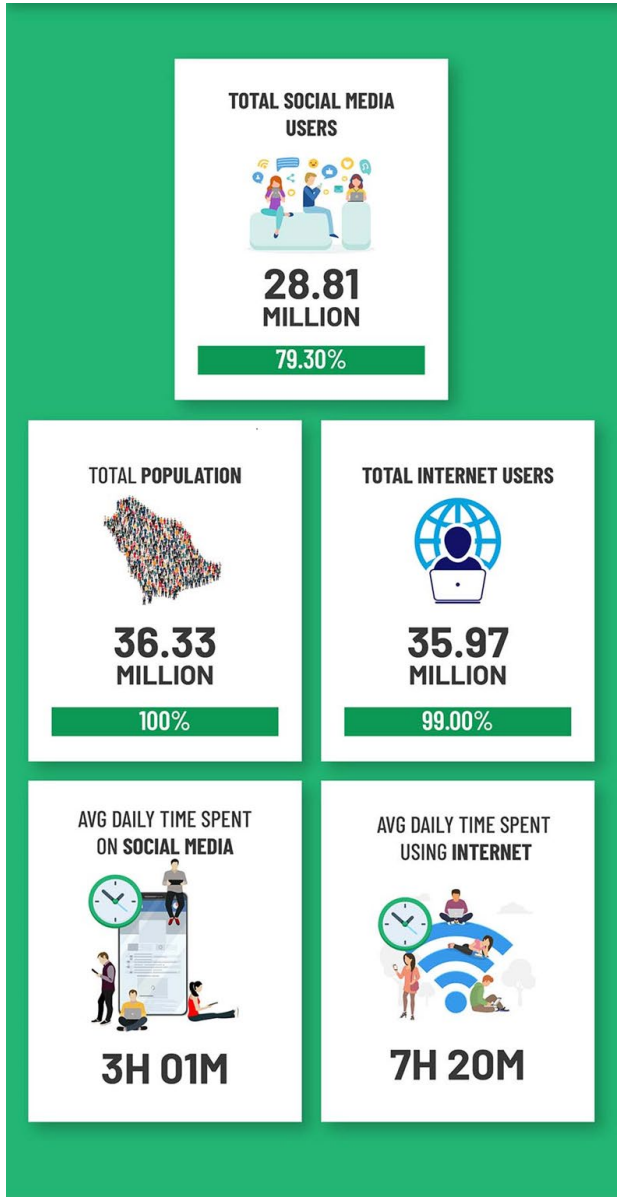
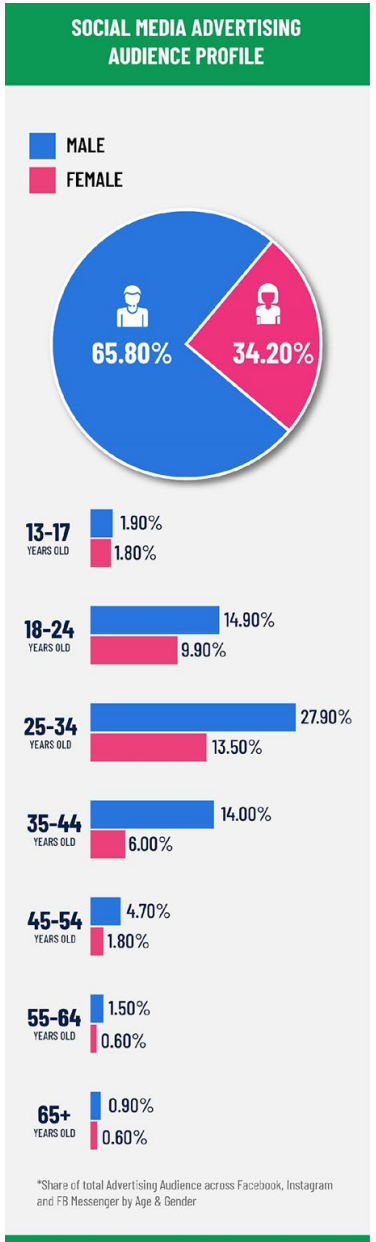
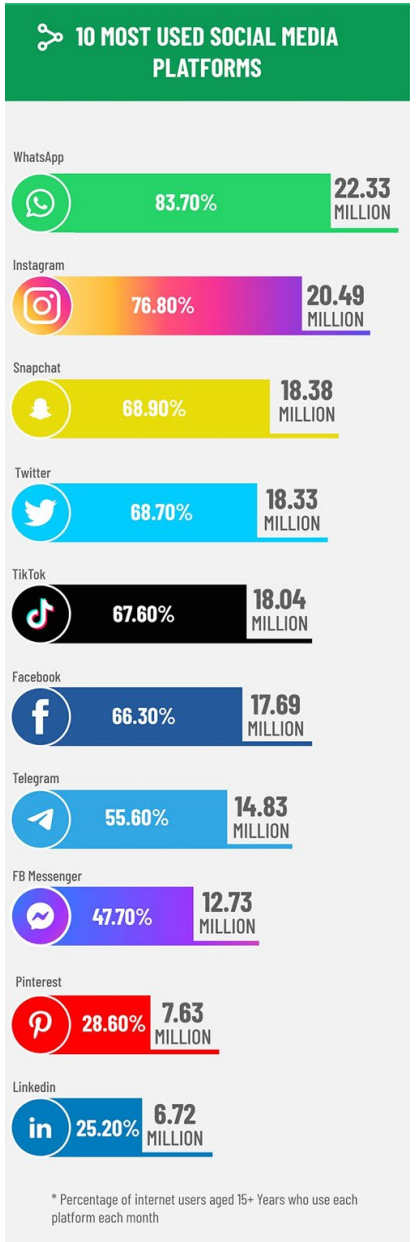
Mobile health

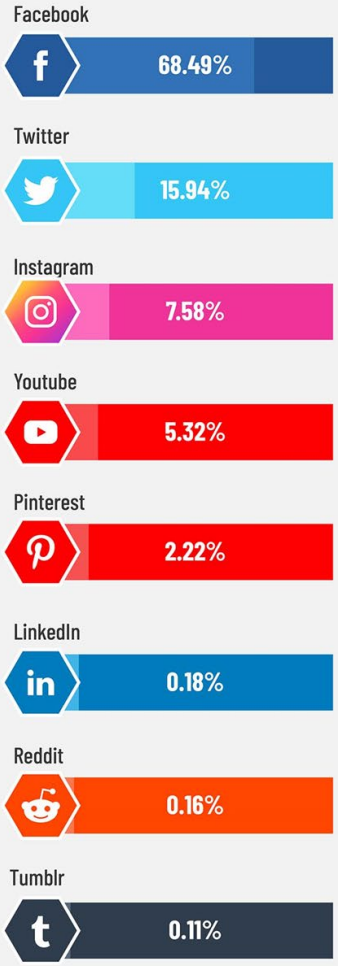






Mobile health

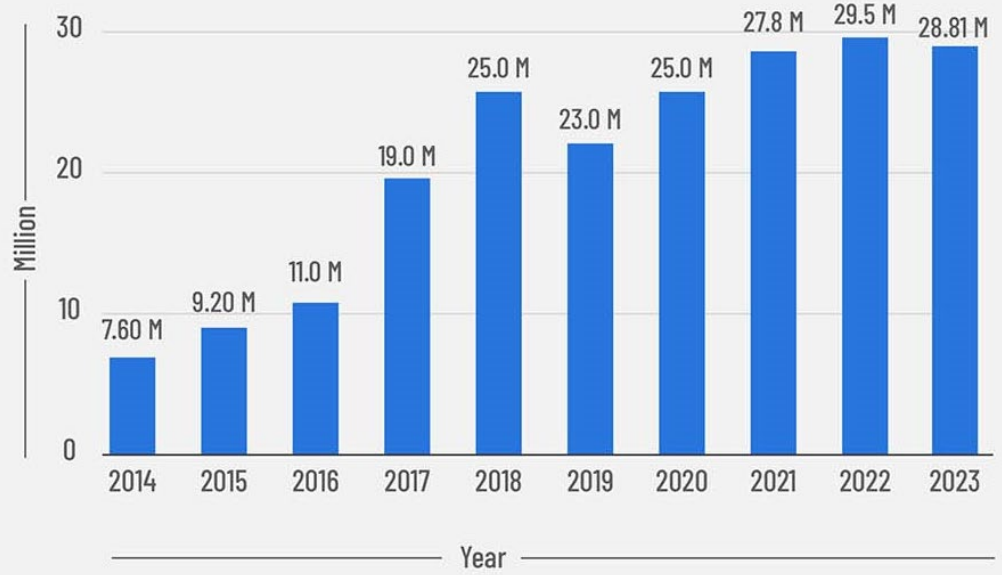
WEB TRAFFIC REFERRALS FROM SOCIAL MEDIA



* Share of web traffic arriving on third party websites via clicks or taps on links published in social media platforms (Any Device)

iainsight.com/l

KSA SOCIAL MEDIA USERS BY YEAR



10 MAIN RESONS FOR USING SOCIAL MEDIA

* Primary reasons why internet users aged 16 to 64 use social media platforms

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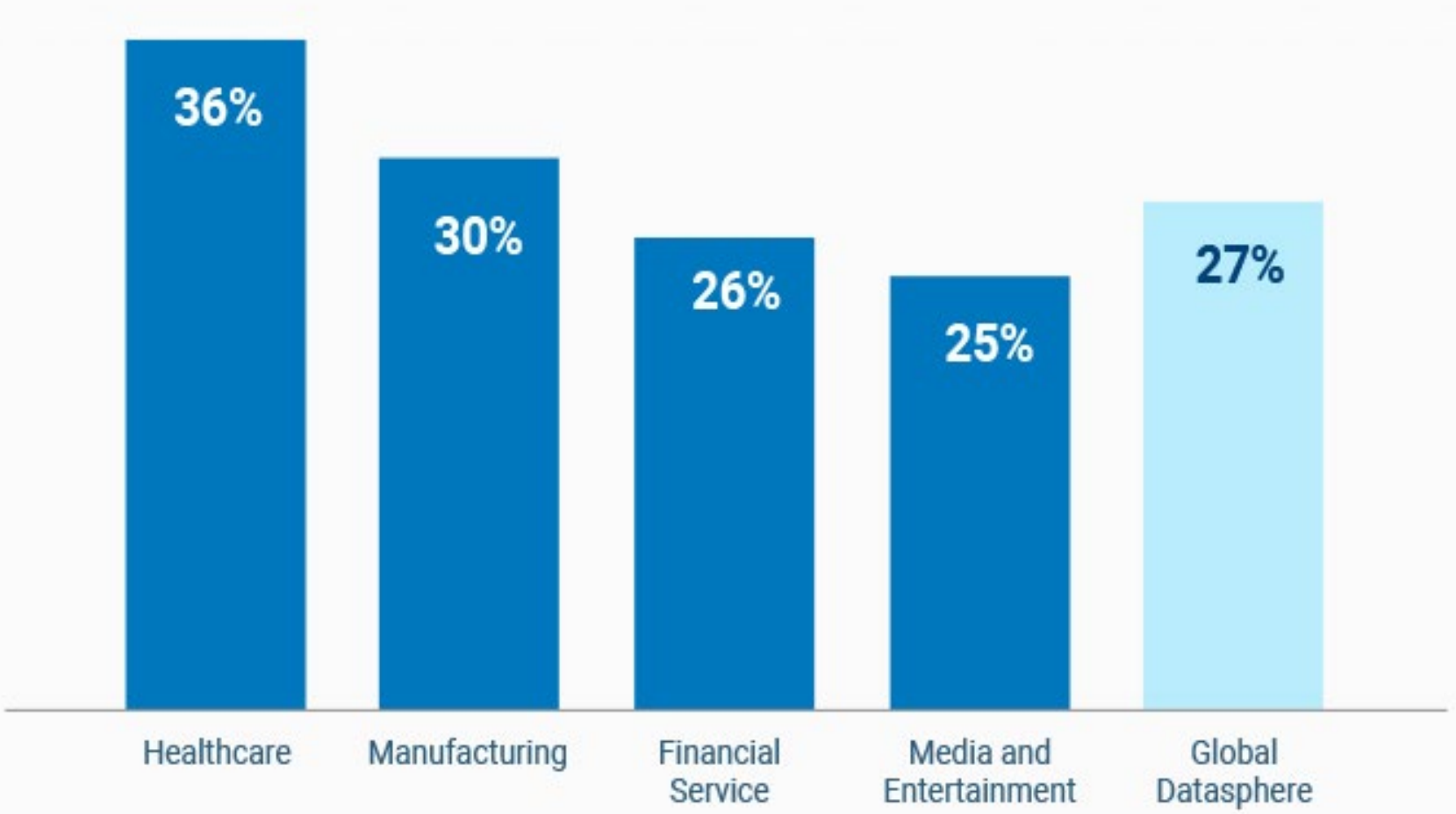
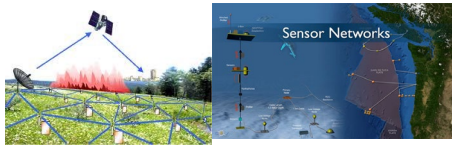
2018-2025 Data – Compound Annual Growth Rate (CAGR)



Source: Coughlin et al Internal Medicine Journal article "Looking to tomorrow's healthcare today: a participatory health perspective". IDC White Paper, Doc# US44413318, November 2018: The Digitization of the World – From Edge to Core".

Big Trends in Healthcare

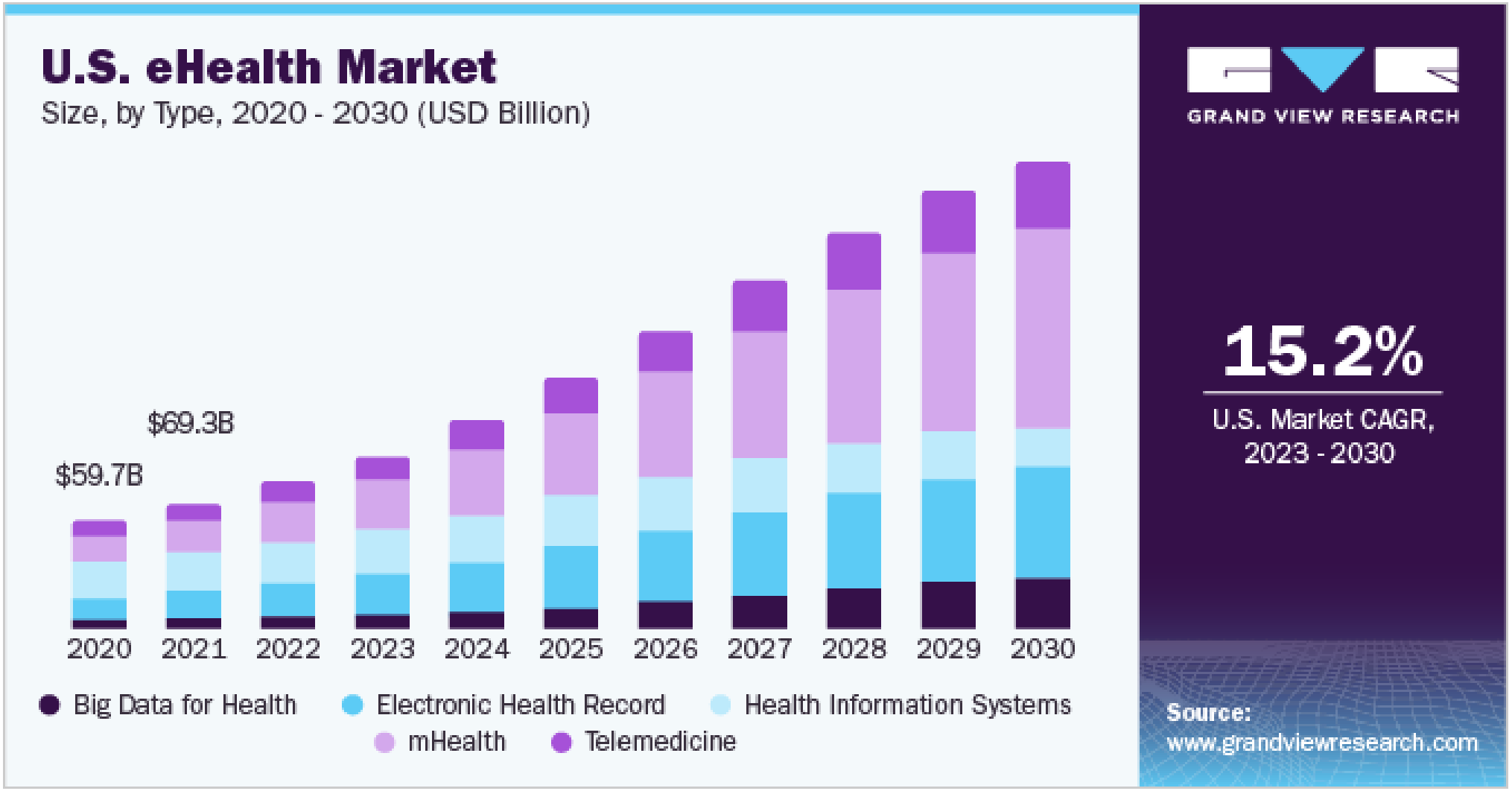
- Healthcare service model is transitioning into Patient Centered care model driven by the healthcare reforms and the need to cut costs while improve outcomes.
- Data is begin generated fast and have to be processed faster
- Simultaneous Data Analytics
- **Overall**
  - The progress and innovation in general is no longer hindered by the ability to collect data
  - However, by the ability to manage, analyze, visualize, and utilize knowledge from the collected data in a timely manner



Sensor and environmental health
(measuring all kinds of data)

Social media and networks
(all of us are generating data)

Mobile health
(tracking all objects all the time)



https://www.grandviewresearch.com/industry-analysis/e-health-market

What is Artificial Intelligence?

- Artificial intelligence is *the capability of a machine to imitate intelligent human behavior.*

- "Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment."

AI in Healthcare Today

- The complexity and rise of big data in healthcare have led to a adopting AI in the healthcare to perform/assist several healthcare tasks.
  - More data, better data, more connected data.
  - Growing number of use cases.

- Studies suggest that AI can perform as well as or better than humans at key healthcare tasks, such as diagnosing disease.

- Algorithms are already outperforming radiologists at spotting malignant tumors, and guiding researchers in how to construct cohorts for costly clinical trials.

Areas of Impact for AI in healthcare

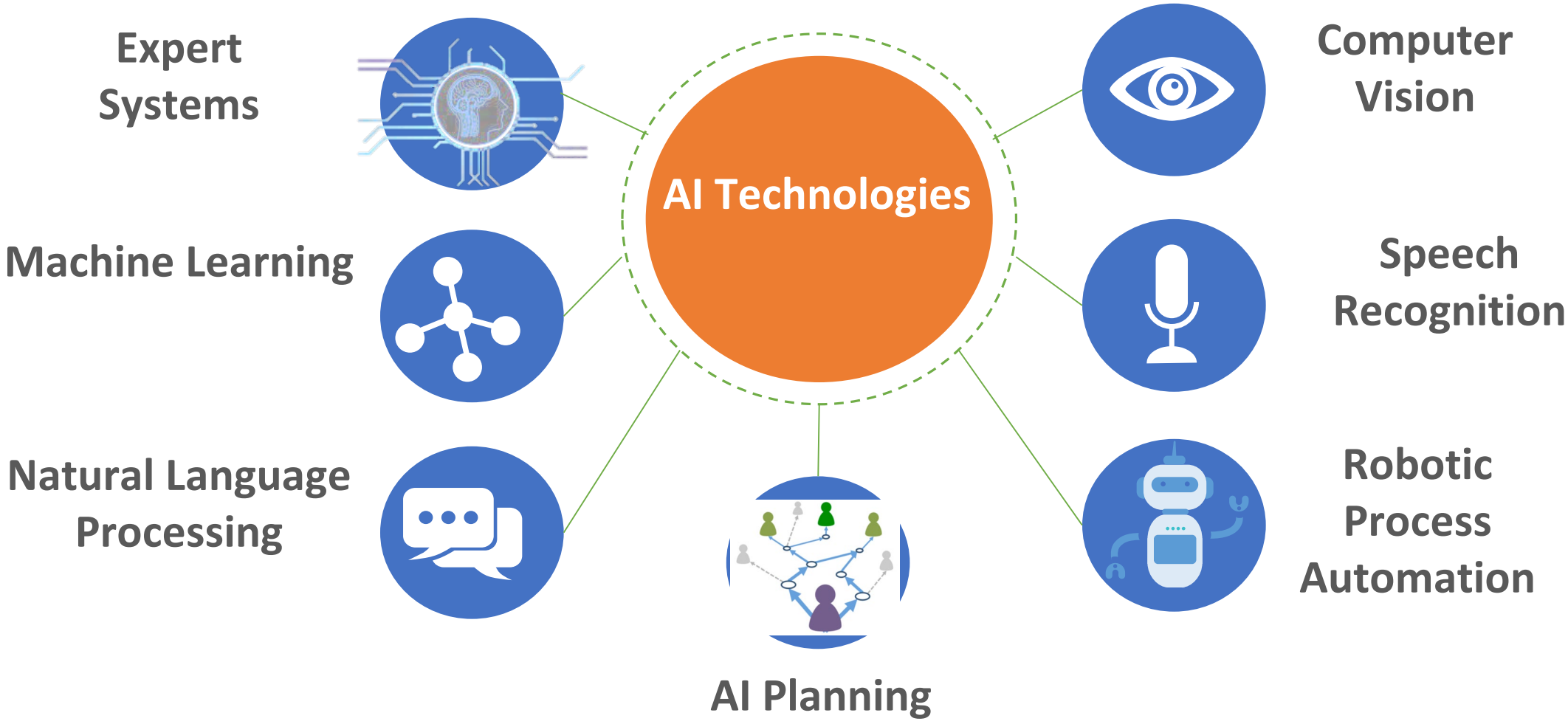
Improving population-health management

Improving operations

Strengthening innovation

https://eithealth.eu/wp-content/uploads/2020/03/EIT-Health-and-McKinsey_Transforming-Healthcare-with-AI.pdf

Major Technologies Behind AI



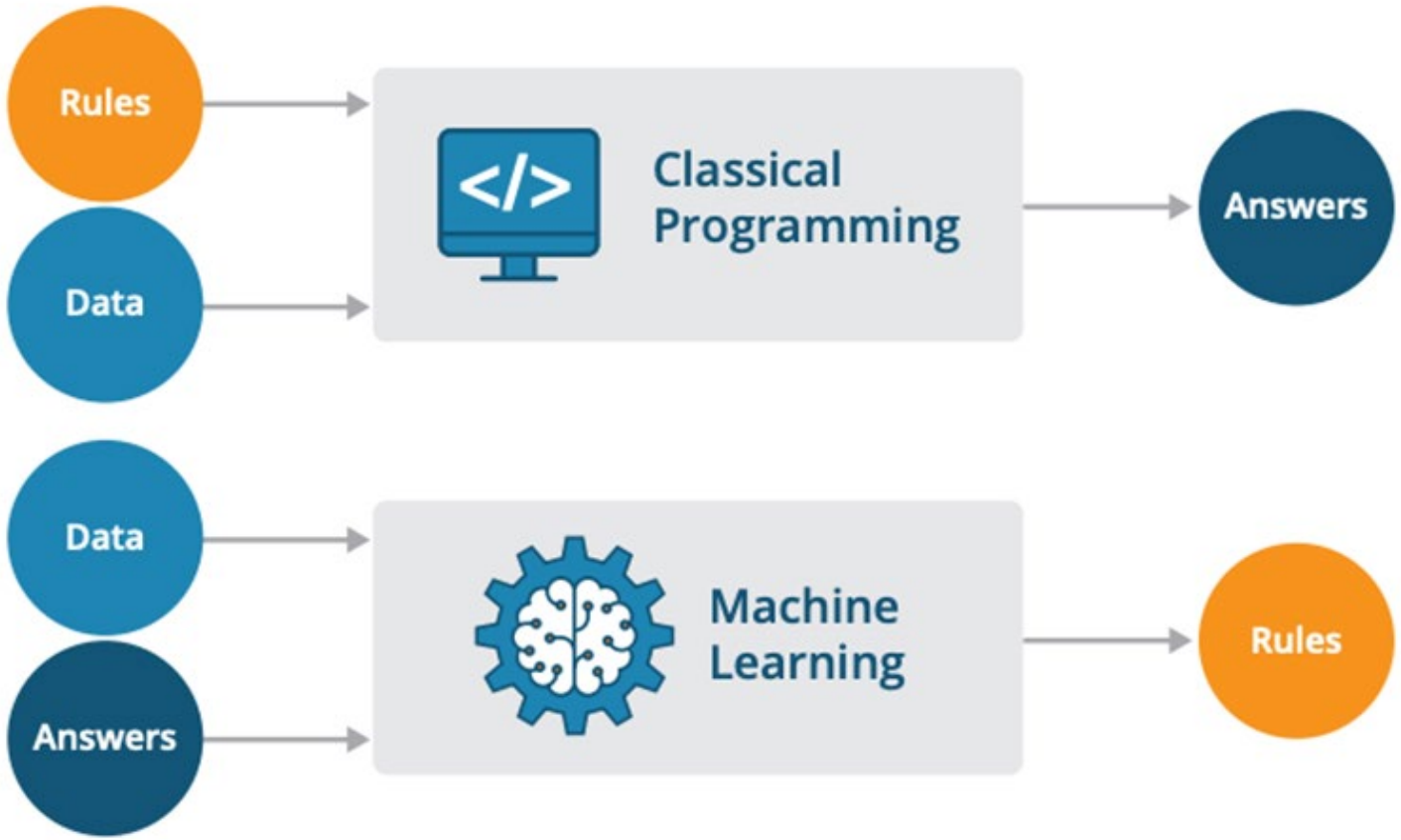
Machine Learning (ML)

- “Machine Learning: Field of study that gives computers the ability to learn without being explicitly programmed.” -Arthur Samuel (1959)

- Machine learning covers a range of statistical techniques giving computers the **ability to learn** and improve their capacity to execute a task.

- ML Goal: to automate decision making from data without developers manually specifying rules about the decision-making process.

Machine Learning Vs Traditional Programming



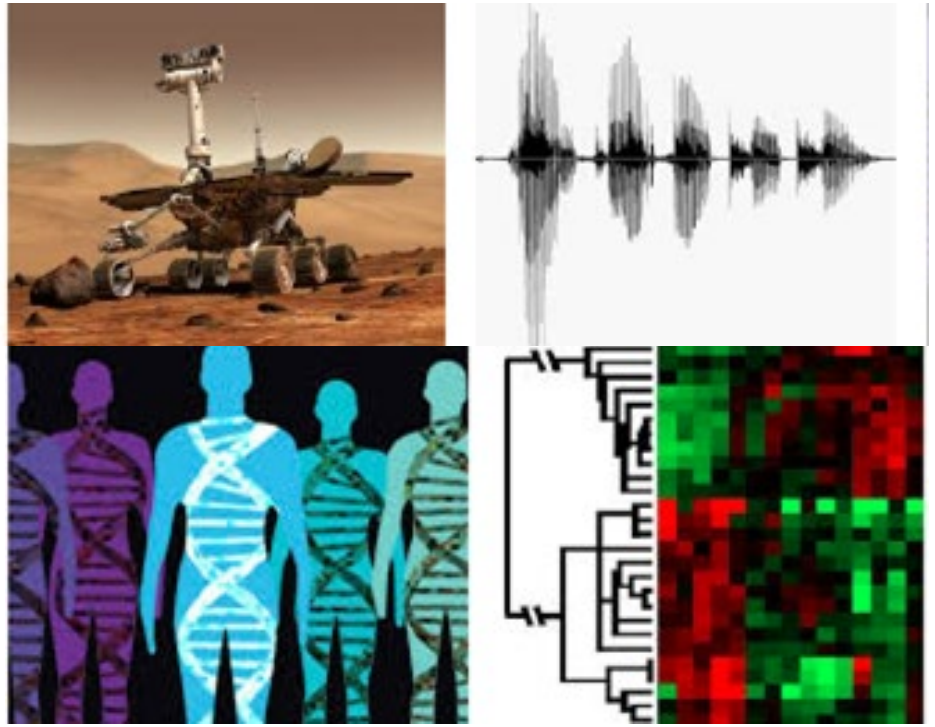
Source: https://sravya-tech-usage.medium.com/traditional-programming-vs-machine-learning-e9bbed5e491c

When Do We Use Machine Learning?

- *You cannot code the rules:*
  - Many human tasks cannot be adequately solved using a simple (deterministic), rule-based solution.
  - A large number of factors could influence the answer.
- *You cannot scale:*
  - You might be able to manually deal with a few data samples.
  - However, this task becomes tedious for millions of them (huge volume of data, Big data).
  - ML solutions are effective at handling large-scale problems.

When Do We Use Machine Learning?

- *Human Expertise does not exist.*
  - *Navigation on Mars*
- Human cannot explain their expertise.
  - Speech recognition
- Models must be customized.
  - Personalized Medicine



When Do We Use Machine Learning?

- Do **not** use ML if you can determine a target value by using simple rules, computations, or predetermined steps that can be programmed without needing any data-driven learning.

- Learning is not always useful!
  - No need to learn how to calculate a payroll.

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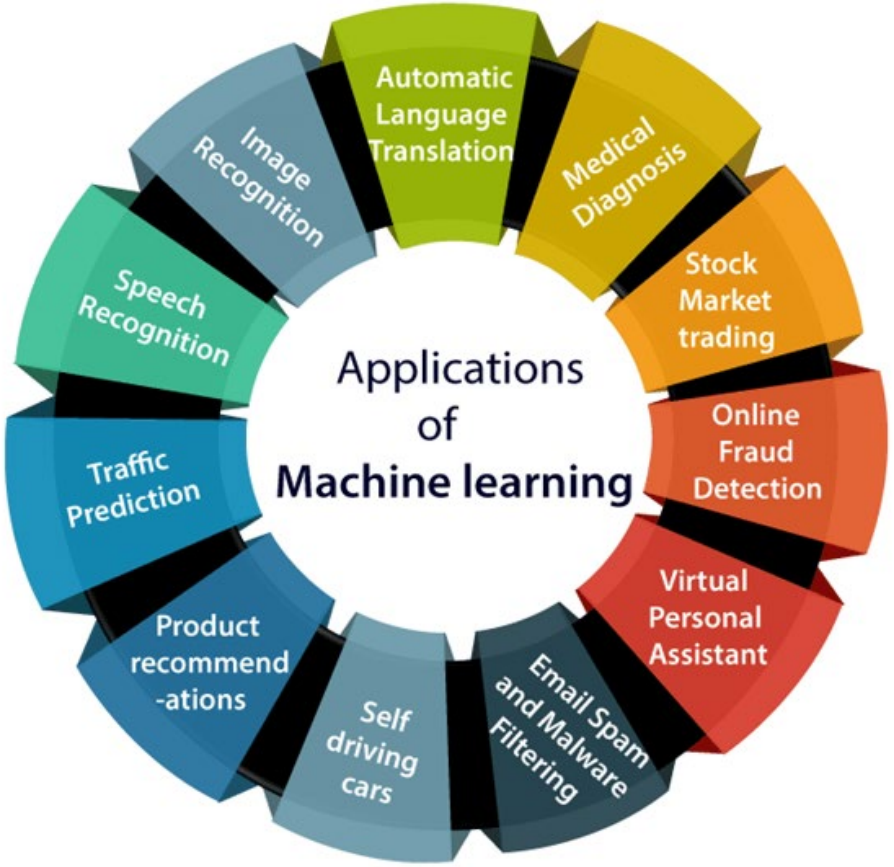
How do we know ML can be applied to a problem?

1. A pattern exist
2. We cannot pin it down mathematically
3. We have data on it

Sample Areas and Applications

- Healthcare
- Education
- Computational biology
- Finance
- E-commerce
- Space exploration
- Robotics
- Information extraction
- Social Networks
- Software Engineering
- **[Your favorite area]**



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

What do we mean by Learning?

- Learning?
  - “Learning is any process by which a system improves performance from experience.” - Herbert Simon

Let’s re-define Machine Learning: Definition by Tom Mitchell (1998):

- The study of algorithms that
  - improve their performance P
  - at some task T
  - with experience E.
  - A well-defined learning task is given by <P, T, E>.

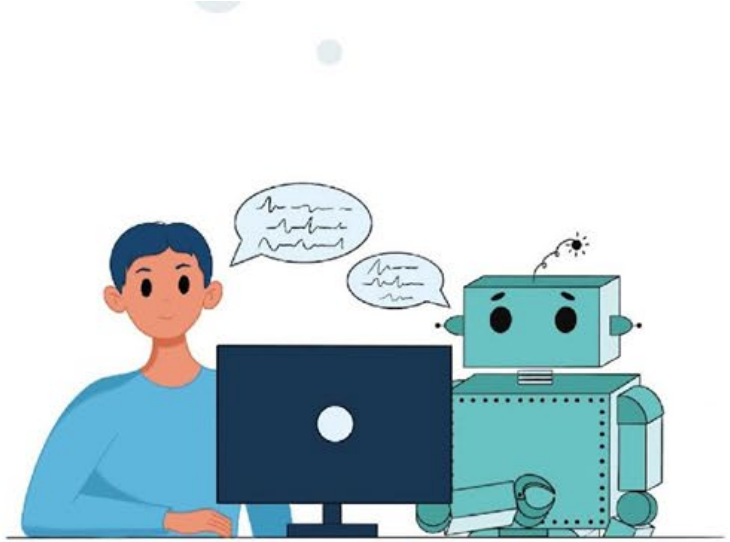
The Learning Task

Defining the Learning Task

- The Learning Task:
  - We want to Improve on task T, with respect to performance metric P, based on experience E.

- Define precisely:
  - **T:** the task you are want to accomplish.
  - **E:** the experience you want the ML model to learn from
  - **P:** the performance measure that will be used to evaluate the model.

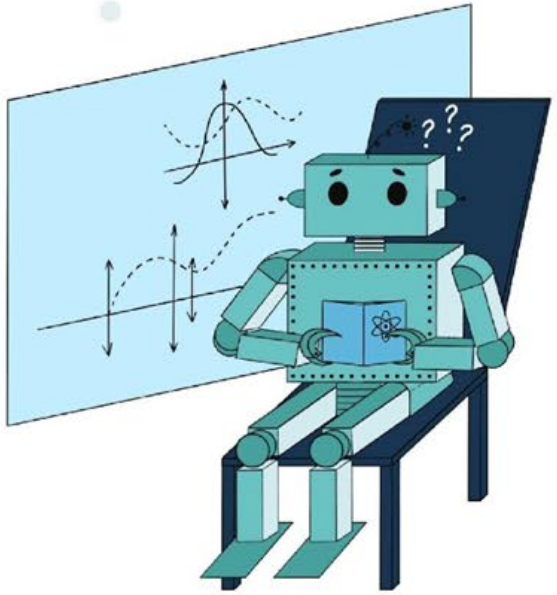
Types of Learning



Supervised Learning

Task-driven

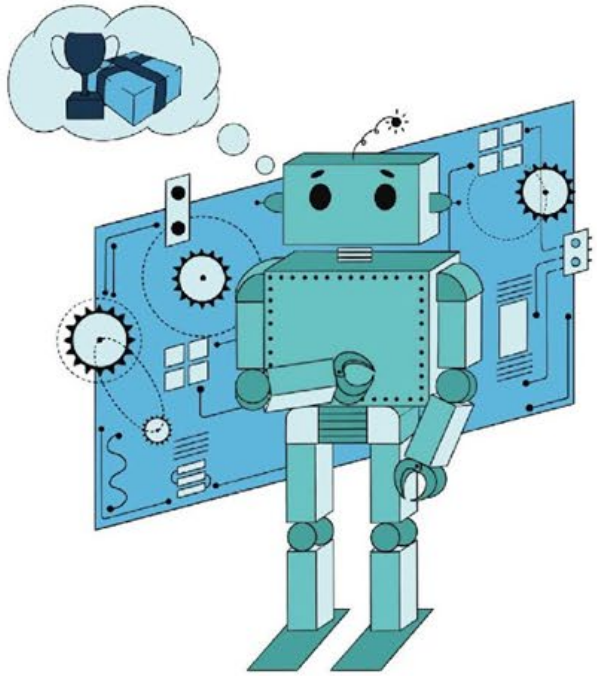
Given: training data + desired outputs (labels)



Unsupervised Learning

Data-driven

Given: training data (without desired outputs)



Reinforcment Learning

Learn from mistakes

Rewards from sequence of actions.

https://blog.autify.com/machine-learning-in-software-testing

Exercise: Designing a Learning System

Designing a Learning System

1. Define the problem very well
2. Define the scope of your proposed solution
3. Define your settings and populations accordingly
4. Choose the training experience (dataset) – the E
5. Choose exactly what is to be learned – the T
6. Choose a learning algorithm to infer the target function from the experience.
7. Choose the performance and evaluation measures – the P

Based on slide by Ray Mooney

Discussion

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THANK YOU!

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