CSE 523 : Machine Learning (ML)

Lecture - 1
Introduction to Machine Learning Course

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Outline

- **Introduction to Machine Learning**
  - Traditional Programming vs Machine Learning (ML)
  - When do we use ML?
  - ML Applications and recent developments
  - Artificial Intelligence vs Machine Learning vs Deep Learning
  - What is Machine Learning?

- **About CSE 523 – A Course on Machine Learning**
  - Course Philosophy, Objectives and Outcomes
  - Evaluation Components
  - Project Discussions

- **A Brief on Project Areas**
  - Natural Language Processing (NLP)
  - Intelligent Transportation System (ITS)
  - 5G/6G Wireless Networks
  - Environment and Healthcare
  - Biology/Bioinformatics

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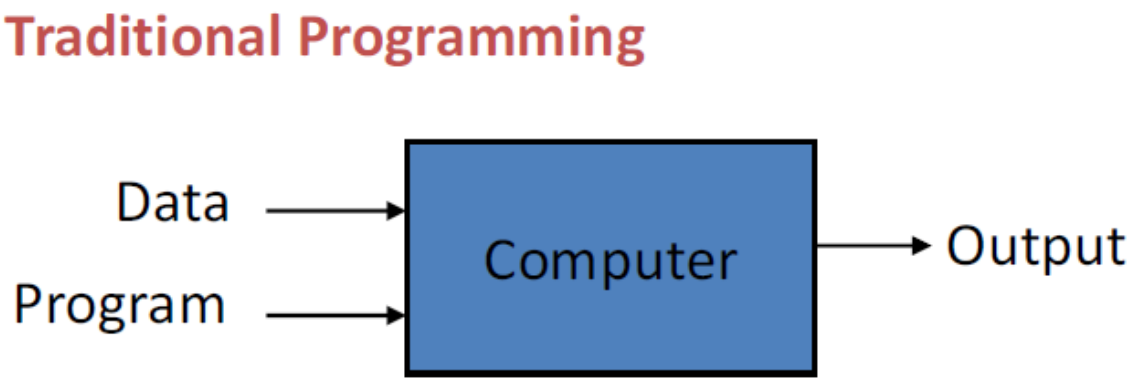
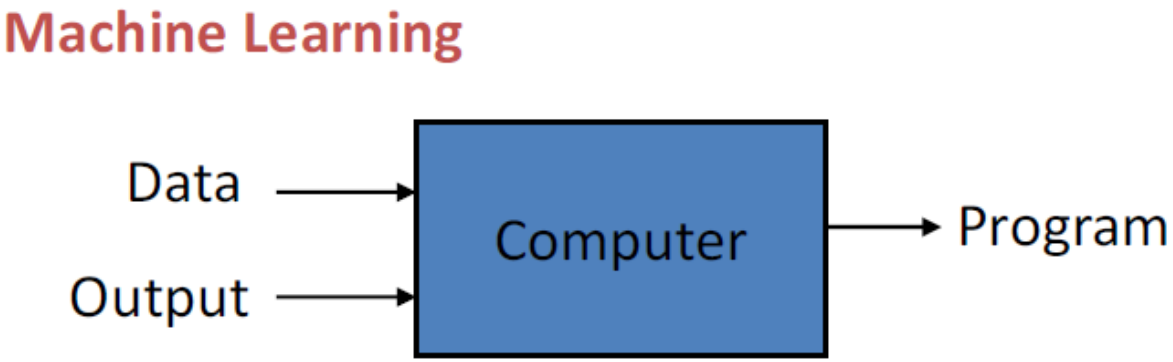
Introduction to Machine Learning

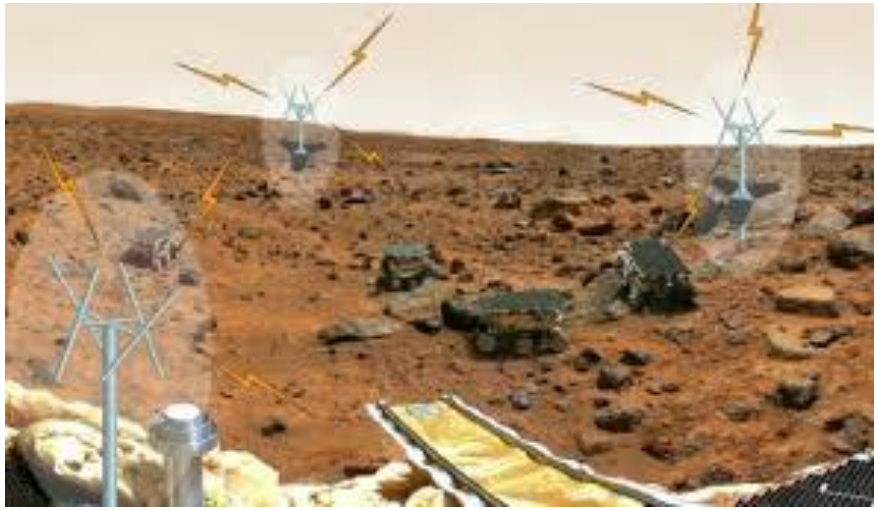
- Traditional Programming vs Machine Learning (1/5)





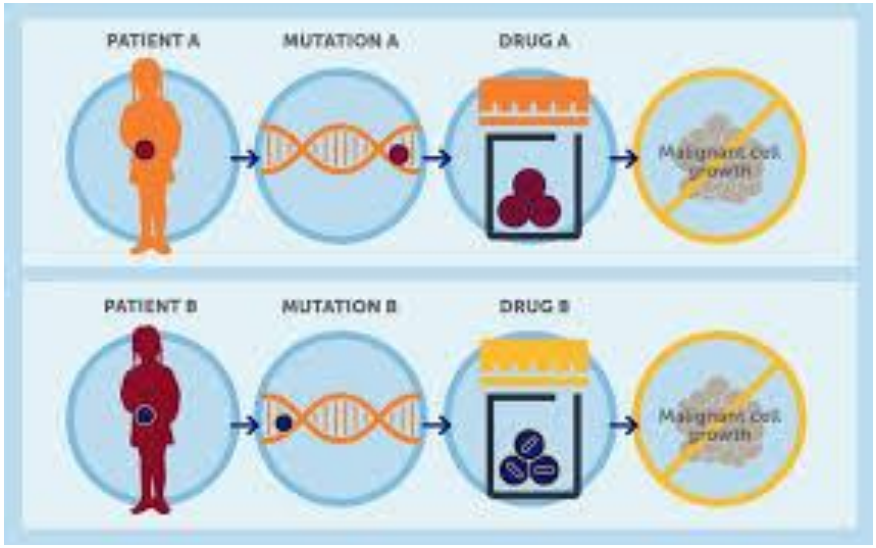
Introduction to Machine Learning

- When do we use ML (2/5)



Human expertise does not exist -
Navigating on Mars

Humans can't explain their expertise:
Speech recognition



Models must be customized:
Personalized medicine

Models are based on huge amounts of data :
Genomics

Introduction to Machine Learning

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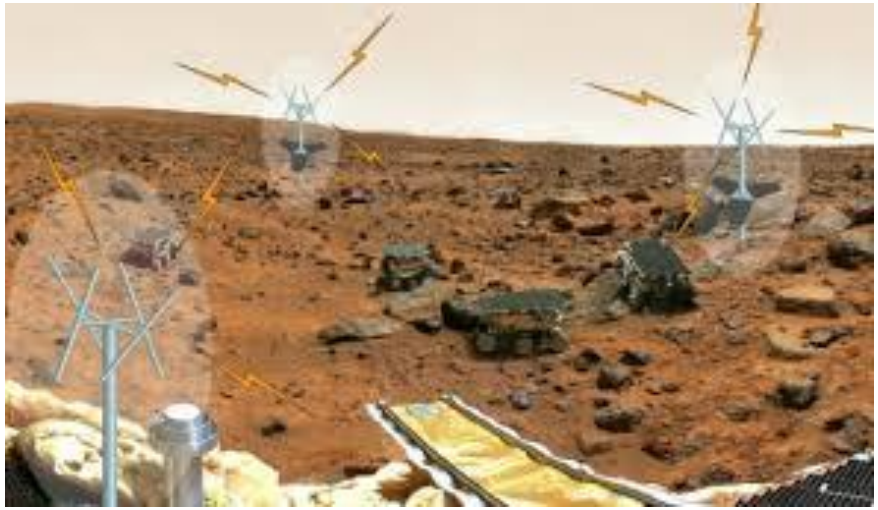

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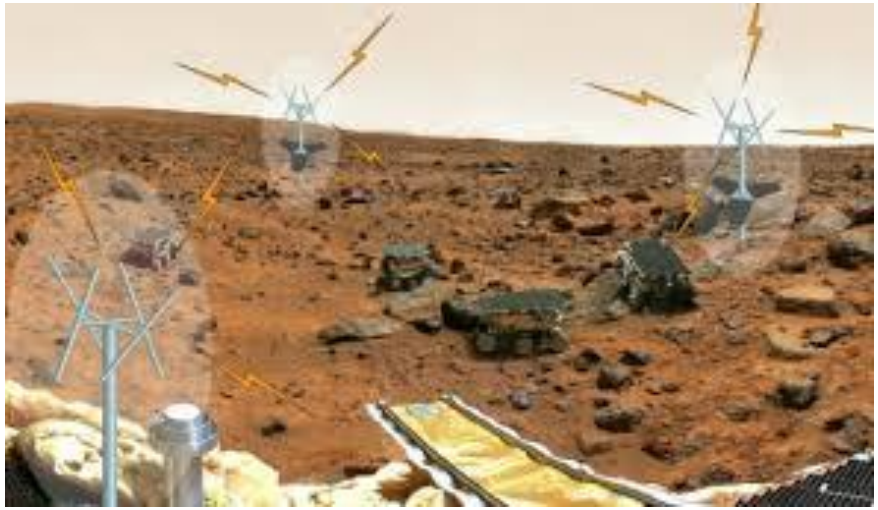

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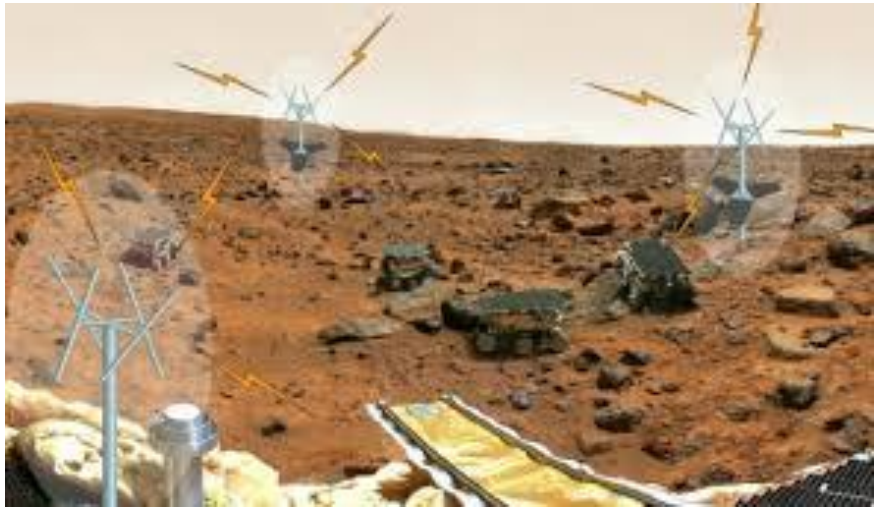

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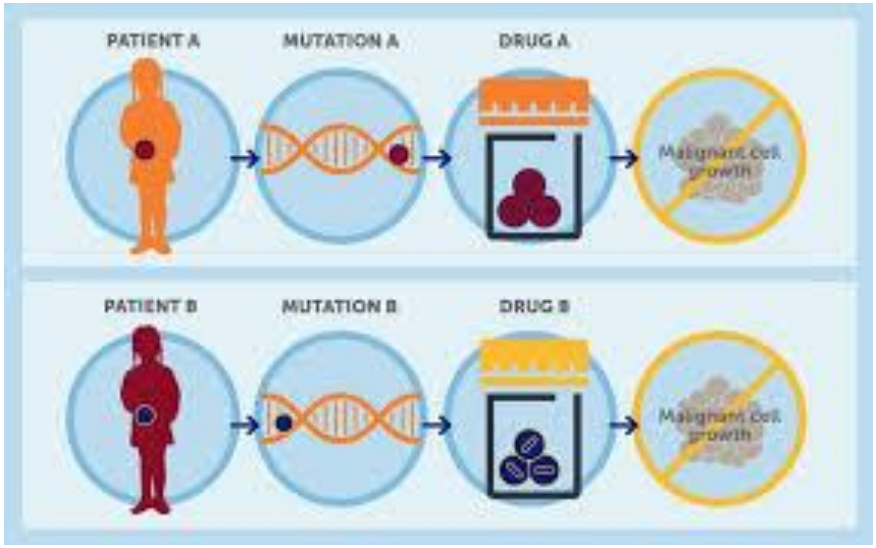

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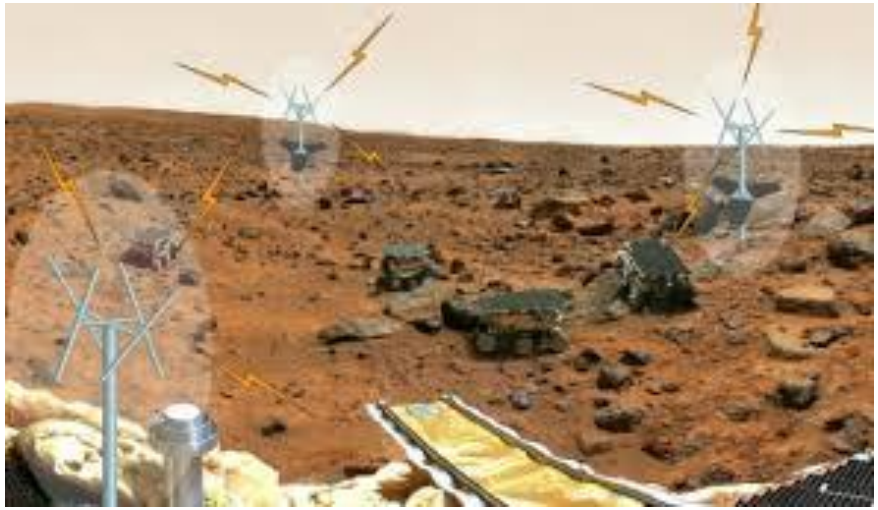

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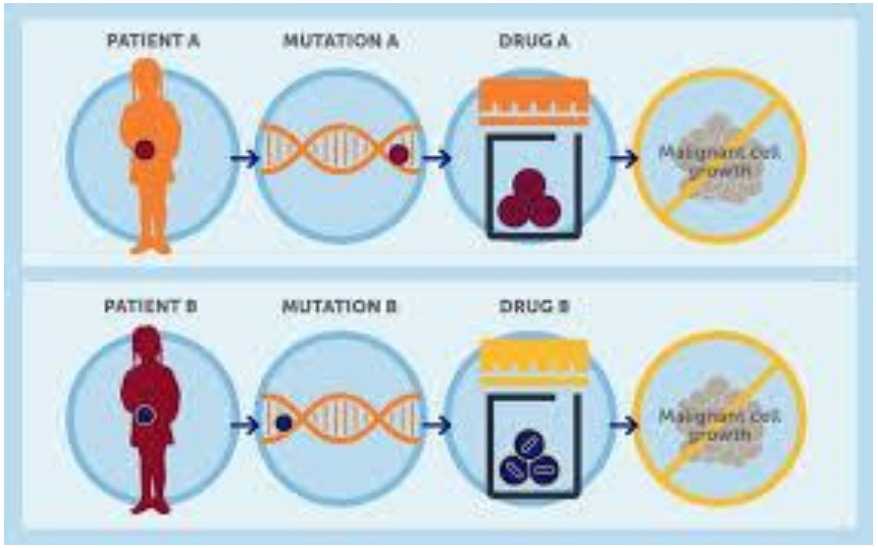

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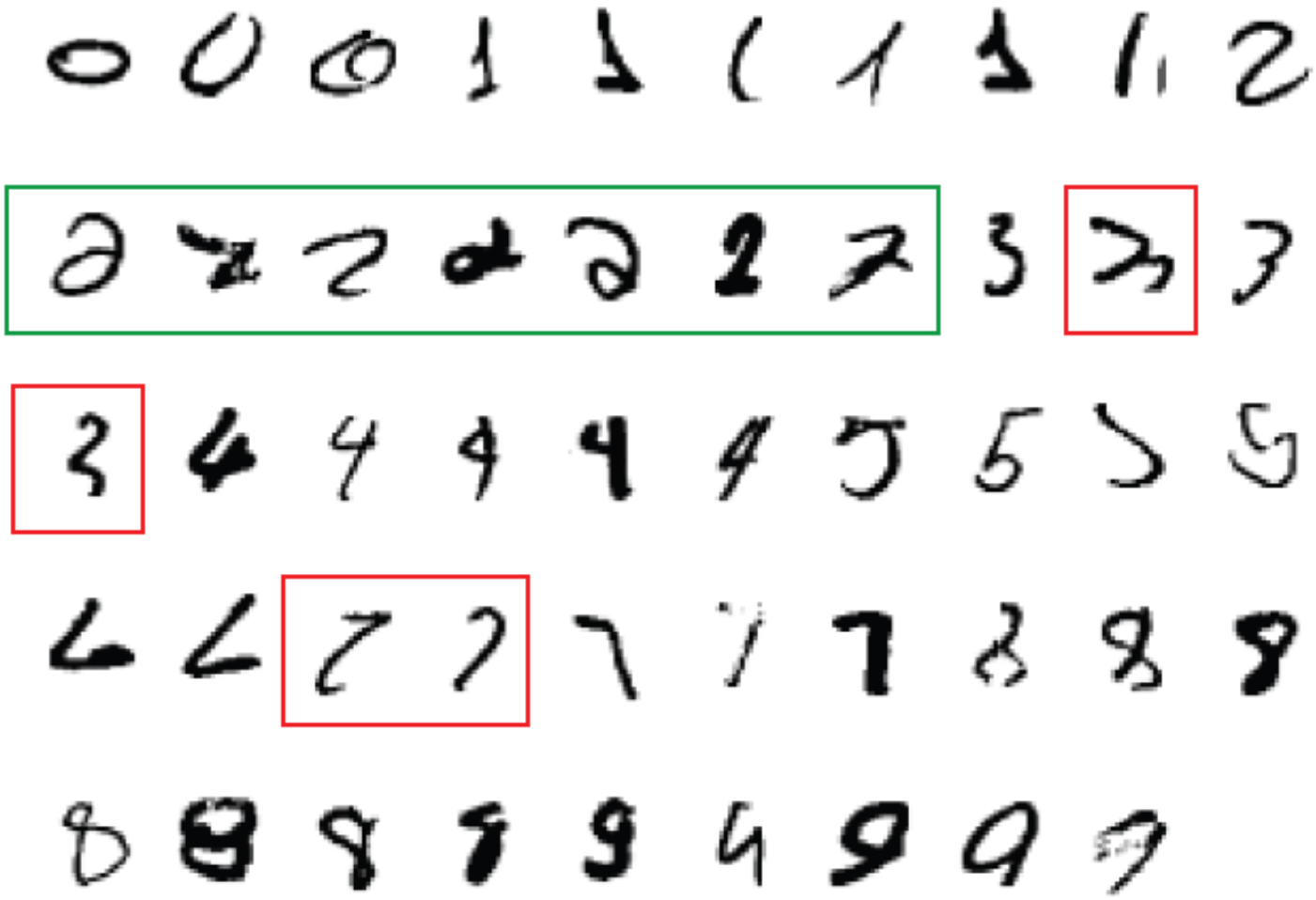
Introduction to Machine Learning

- When do we use ML (2/5)

A classic example of a task that requires machine learning:

It is very hard to say what makes a 2



Slide credit: Geoffrey Hinton

Introduction to Machine Learning

- When do we use ML (2/5)

Some more examples of tasks that are best solved by using a ML algorithm:

Recognizing patterns
– Facial identities or facial expressions
– Handwritten or spoken words
– Medical images

Generating patterns
– Generating images or motion sequences

Recognizing anomalies
– Unusual credit card transactions
– Unusual patterns of sensor readings in a nuclear power plant

Prediction:
– Future stock prices or currency exchange rates

Web search:

- Computational biology
- Finance
- E-commerce
- Space exploration
- Robotics
- Information extraction
- Social networks
- Debugging software

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- ML Applications (3/5)

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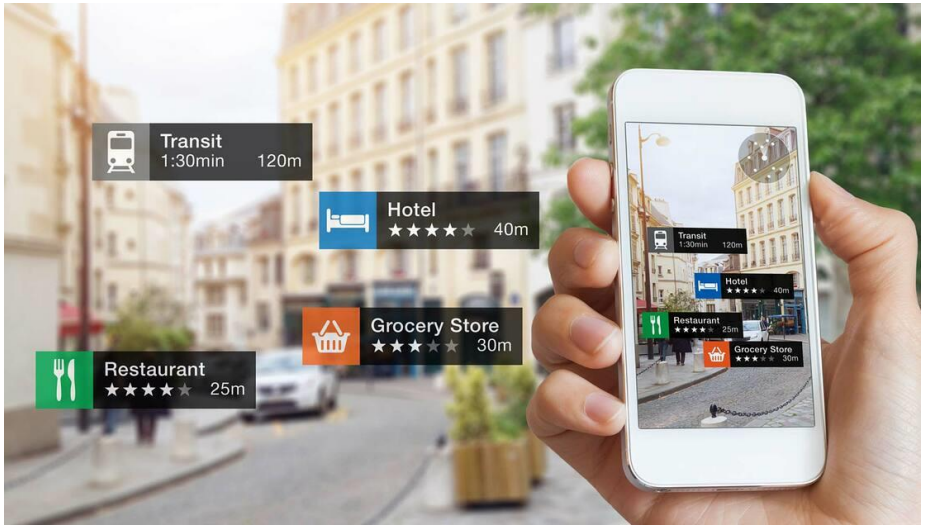

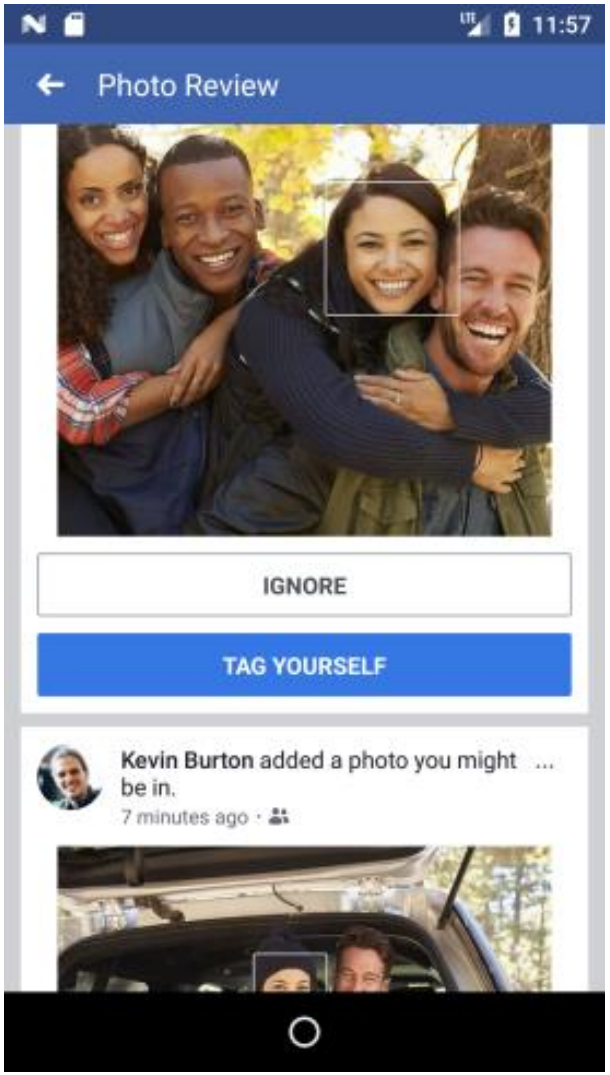

Source: https://www.apple.com/siri/

Introduction to Machine Learning

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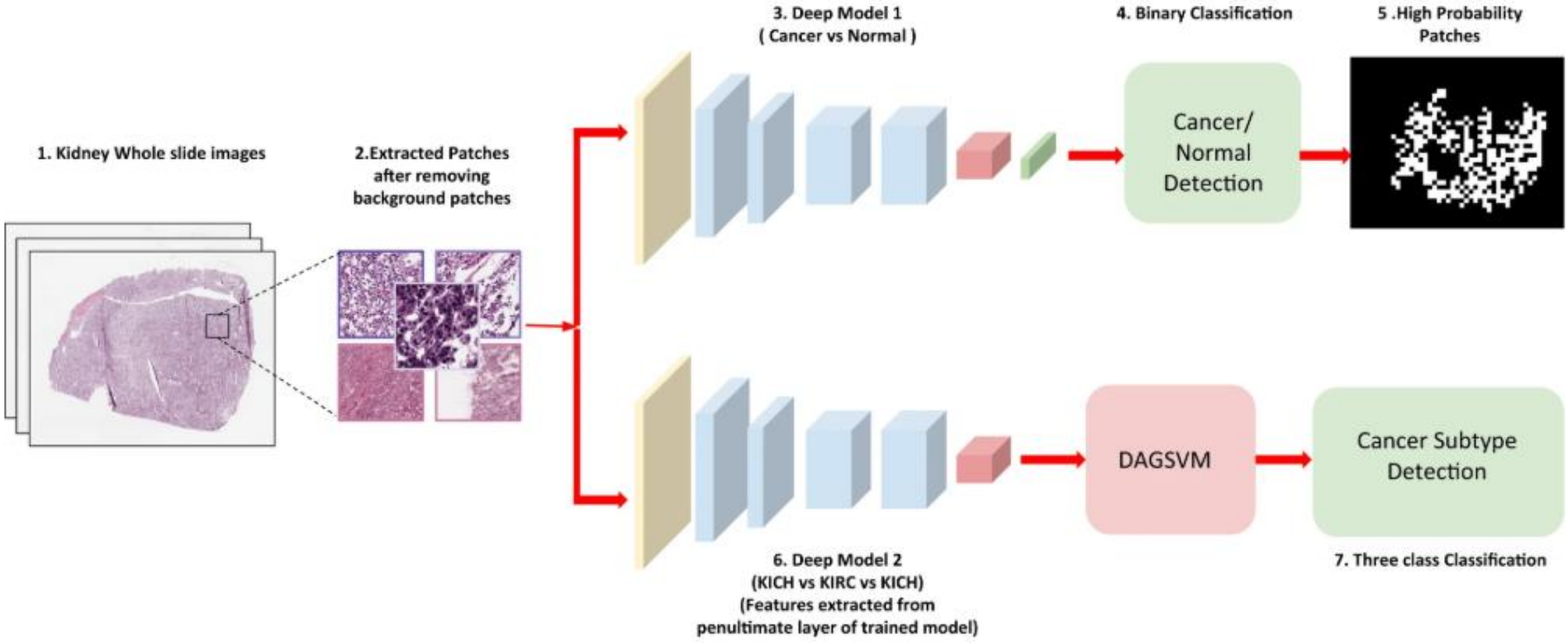
Cancer Detection



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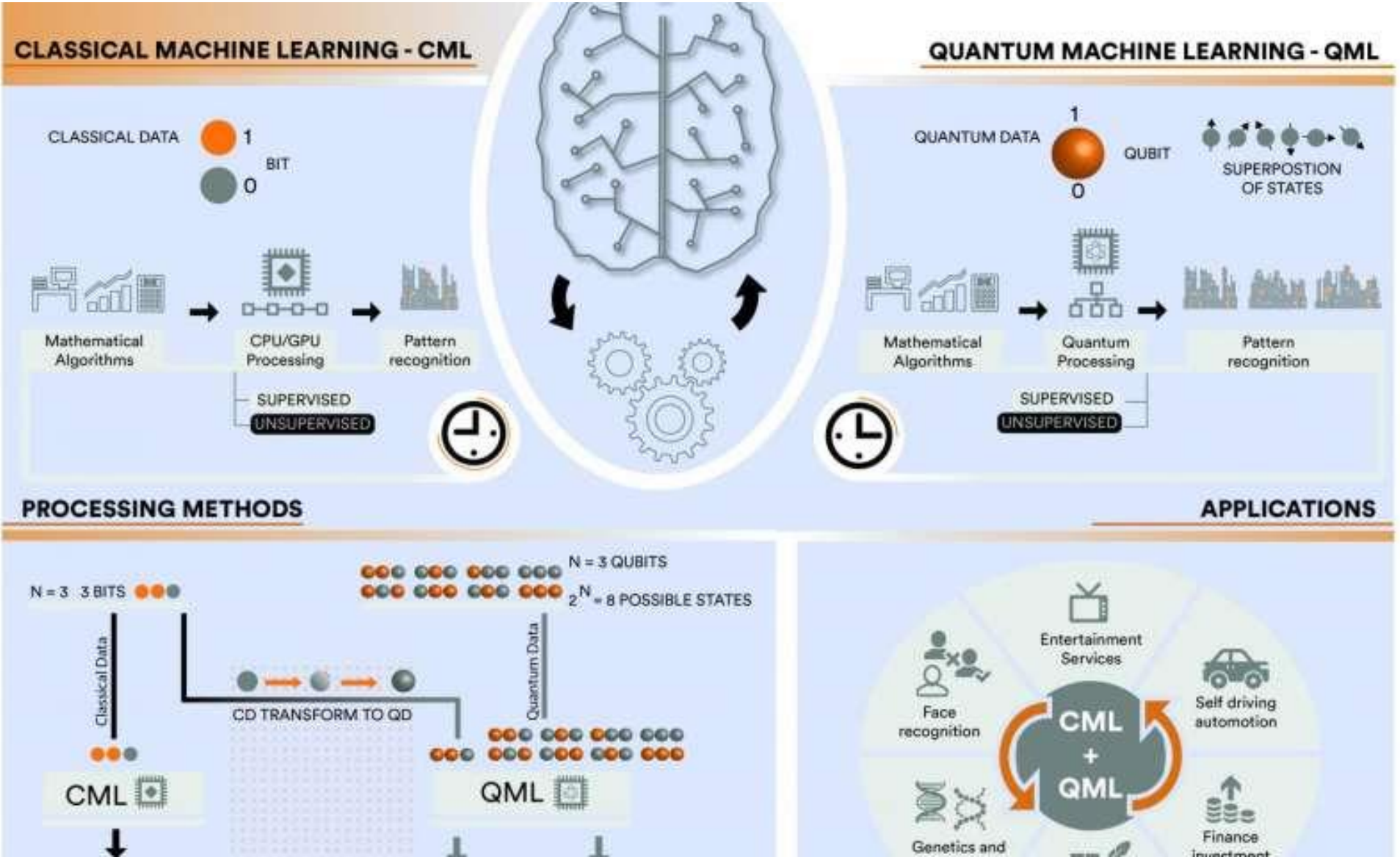

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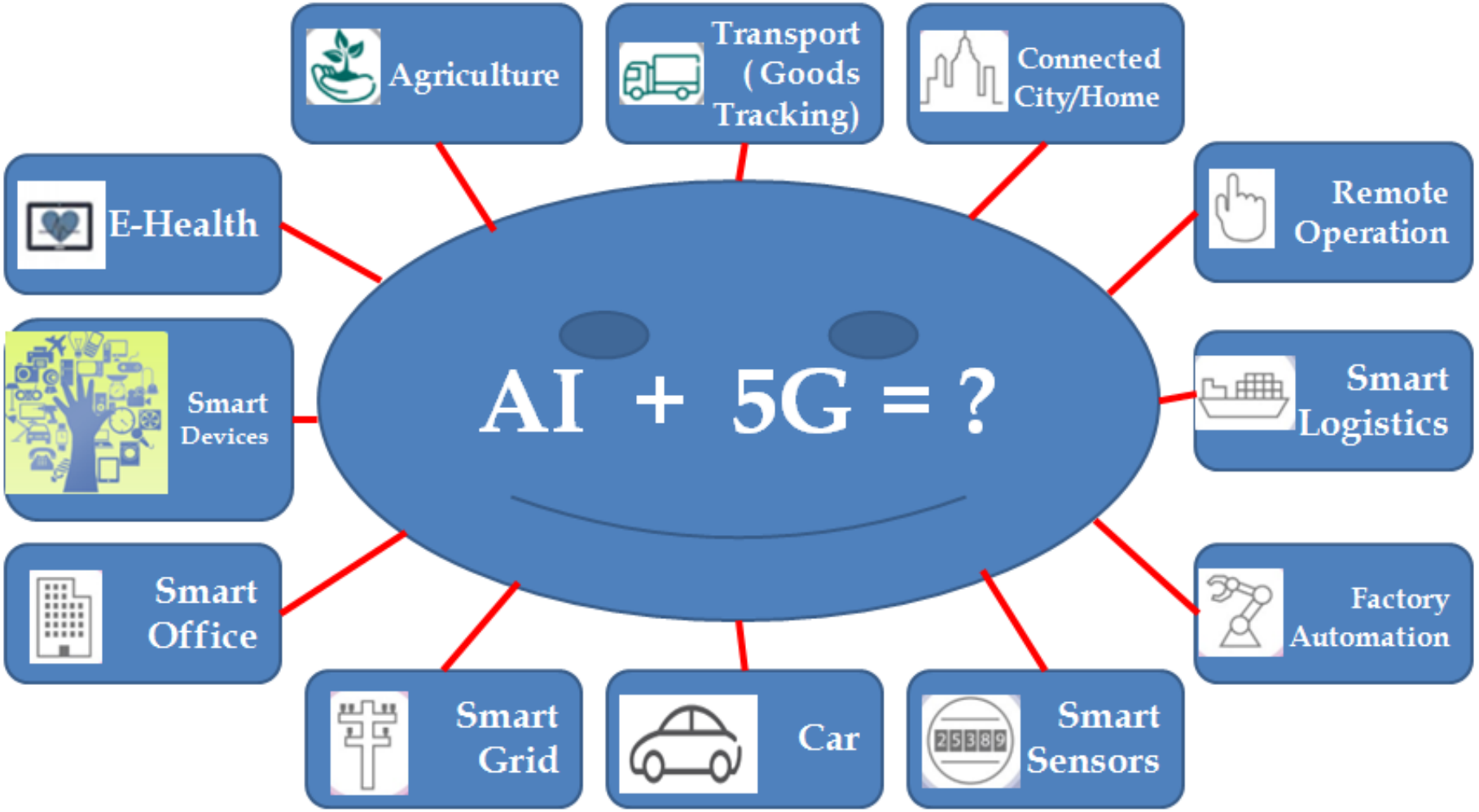

Introduction to Machine Learning

- ML Applications (3/5)

Introduction to Machine Learning

- Artificial Intelligence vs Machine Learning vs Deep Learning (4/5)

The capacity of a computer to **learn** from **experience**, i.e. to modify its processing on the basis of **newly acquired information**.

Introduction to Machine Learning

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Artificial Intelligence

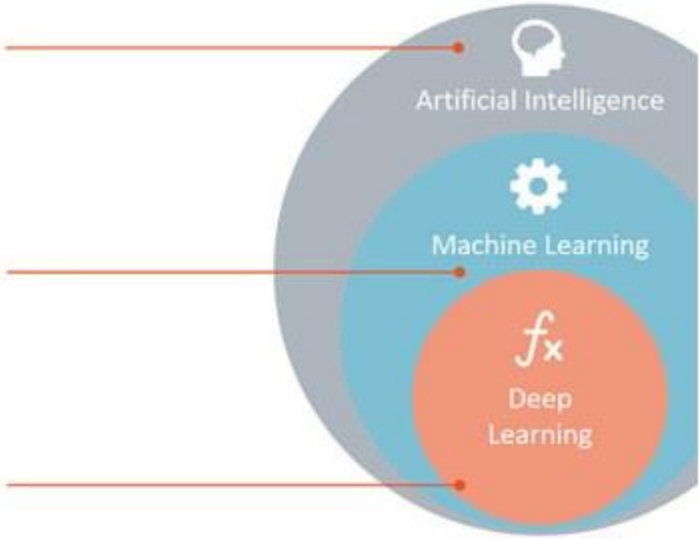
Any technique which enables computers to mimic human behavior.

Machine Learning

Subset of AI techniques which use statistical methods to enable machines to improve with experiences.

Deep Learning

Subset of ML which make the computation of multi-layer neural networks feasible.



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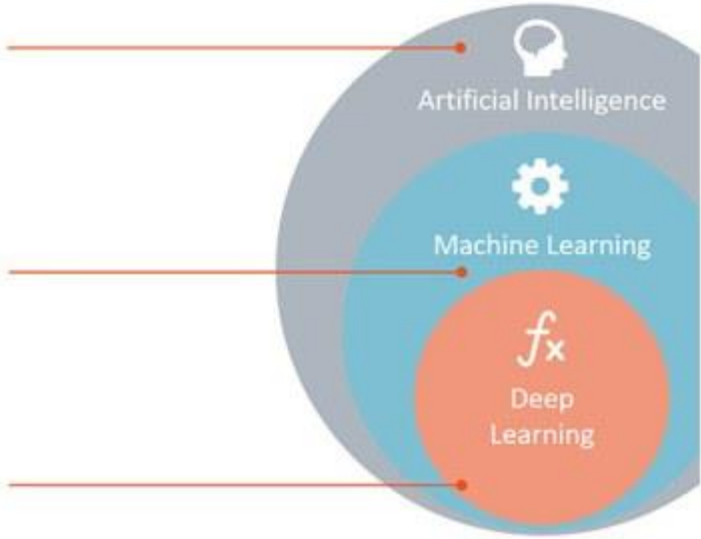

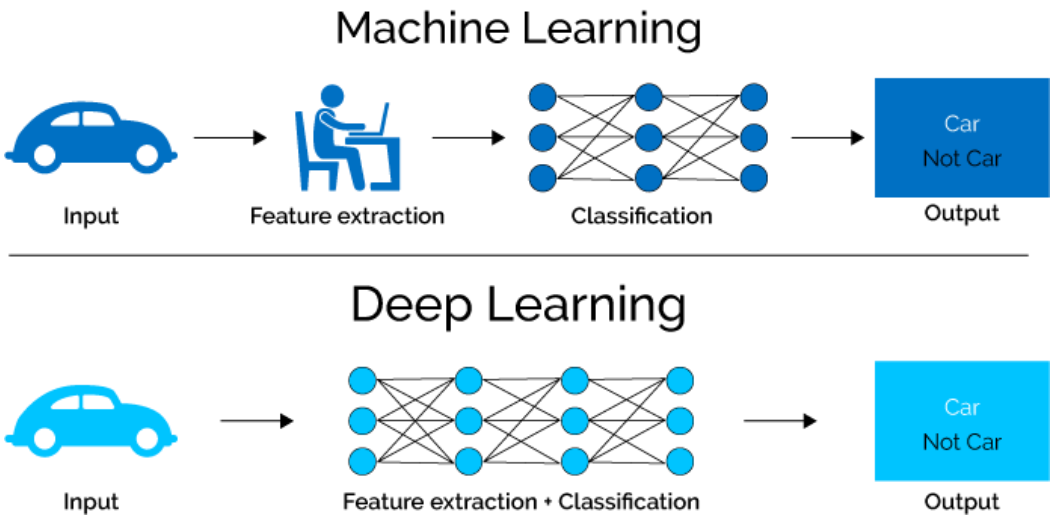

Source:
https://en.oxforddictionaries.com/definition/machine_learning

Introduction to Machine Learning

- What is ML (5/5)

"Learning is any process by which a system improves performance from experience."

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- ✓ Herbert Simon was one of the **founding fathers of artificial intelligence.**
- ✓ No other scientist better understood of computers. the future of machines and the ultimate importance
- ✓ By 1965, Simon was certain that "machines will be capable of doing any work a man can do"
- ✓ His visionary perspective on decision making processes, climate change and flaws in economic theories prove to be even more relevant and crucial in the 21st century.

Introduction to Machine Learning

- What is ML (5/5)

Tom M. Mitchell,
Professor of Machine Learning Department, School of Computer Science, Carnegie Mellon University

"A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E"

Example: Image Classification using ML

E: Past data with images having labels or assigned classes

T: The task of assigning class to new, unlabelled images

P: The performance measure indicated by the percentage of images correctly classified.

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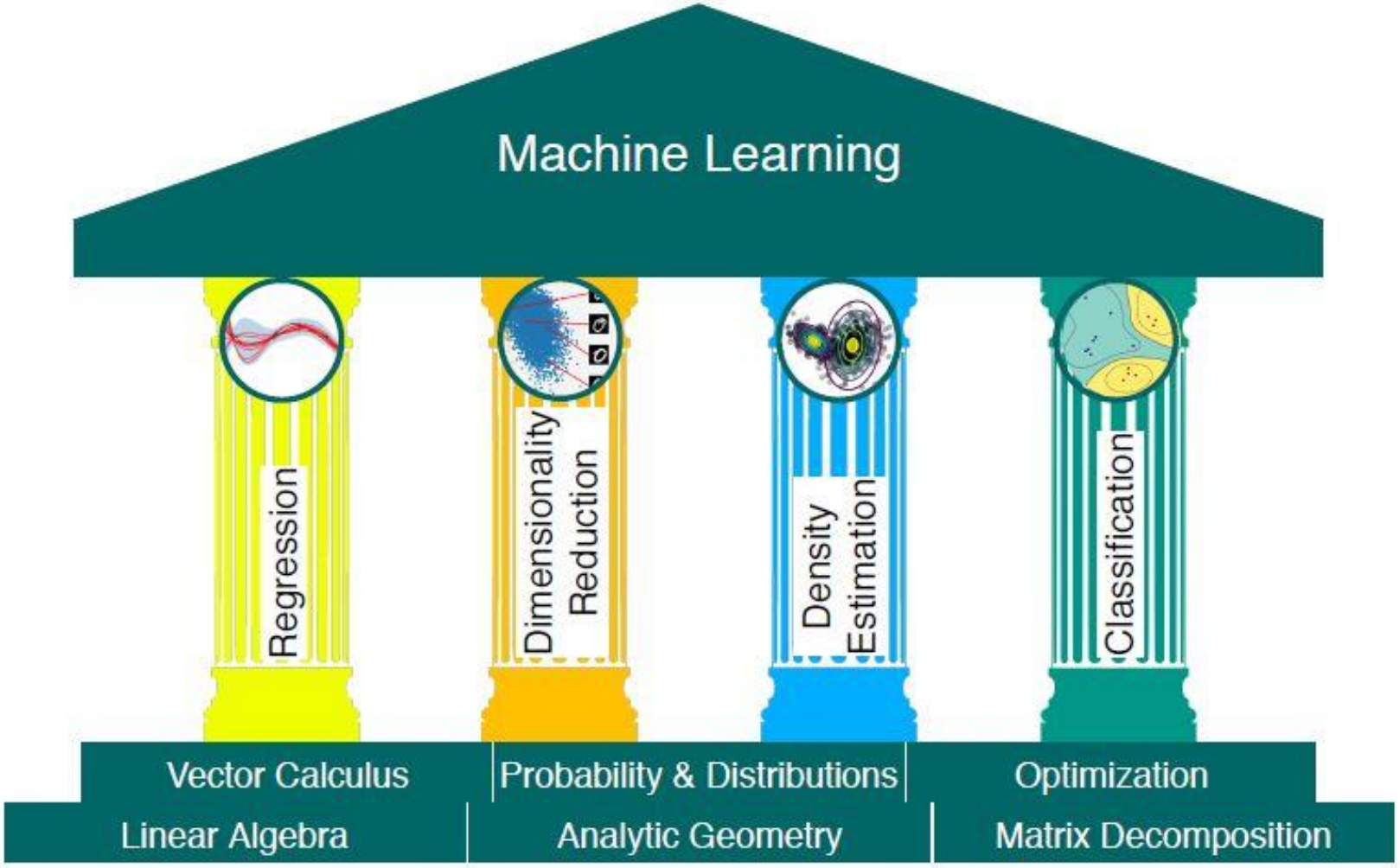
- **Course Philosophy**, Objectives and Outcomes



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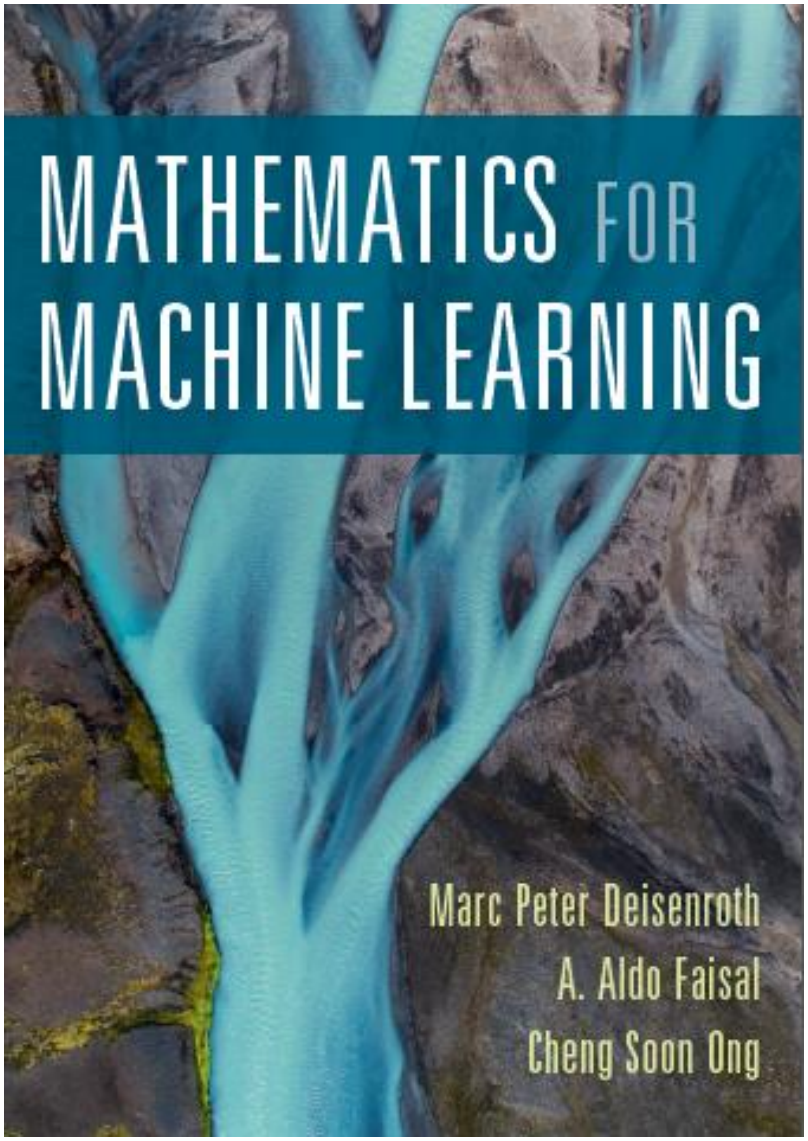

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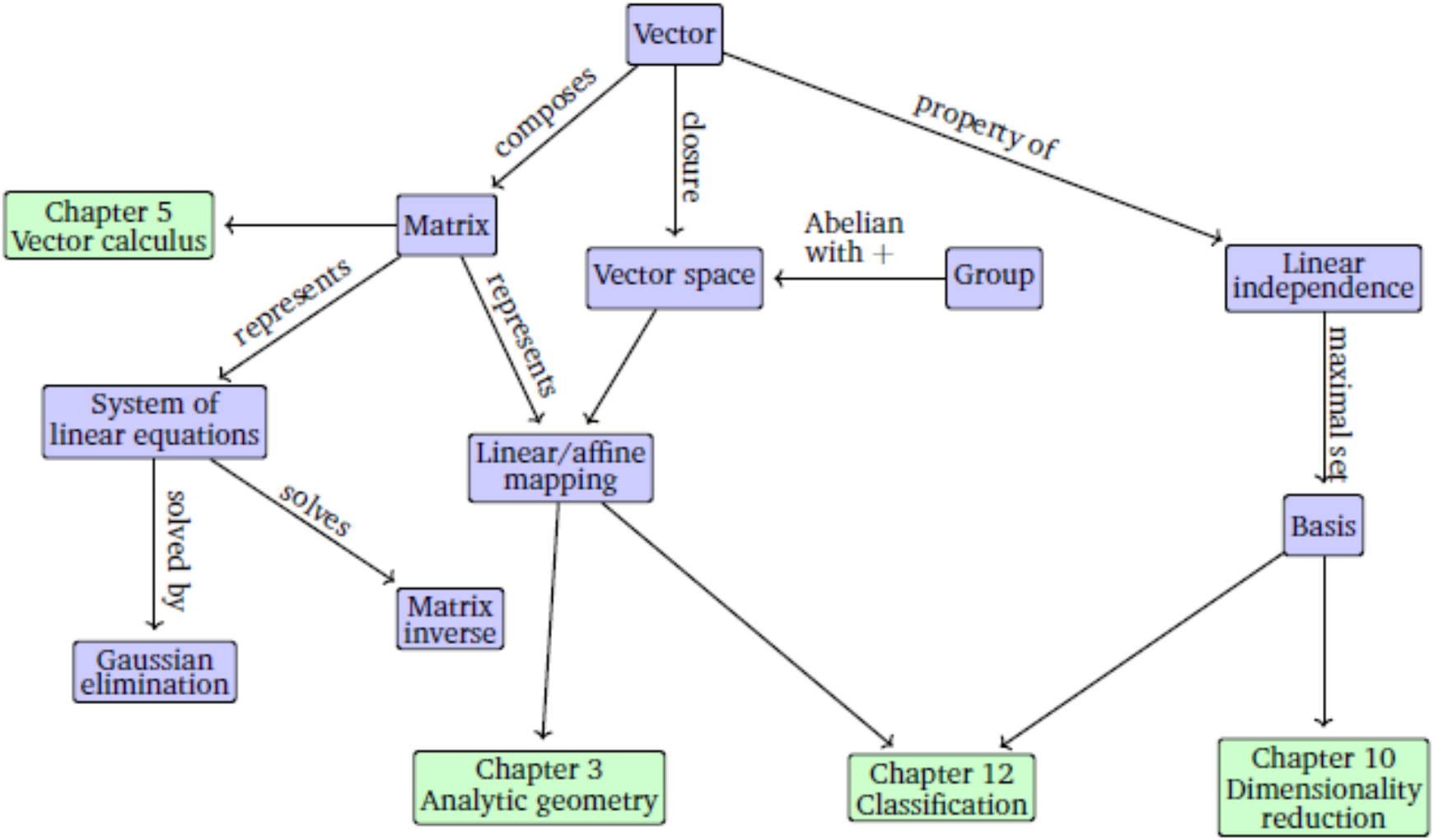

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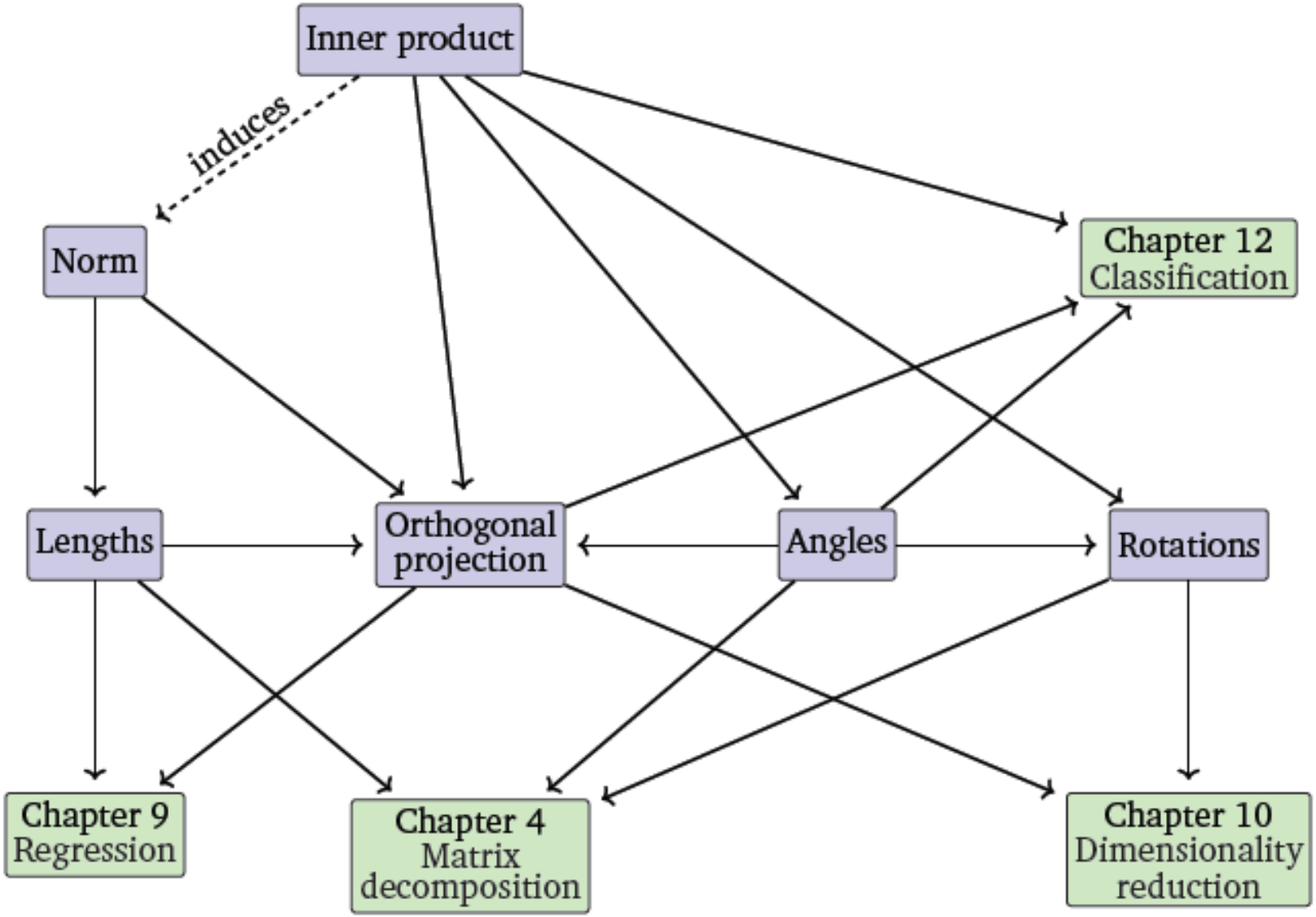

About CSE 523 – A Course on Machine Learning

- Course Philosophy, **Objectives** and Outcomes

The objectives of this course are:

1. To understand the **four pillars of ML** like Regression, Dimensionality reduction, Density estimation and Classification and to learn about various machine learning algorithms.

2. To understand mathematics as a working principle of machine learning models.

3. To implement various ML algorithms in **TensorFlow and to solve various real-world problems** in the areas like Natural language processing, Intelligent Transportation System, 5G/6G wireless networks, Environment and climate change and Bioinformatics.

4. Understanding of **Artificial Neural Network**

5. Focus on supervised and unsupervised form of learning **through case studies**

About CSE 523 – A Course on Machine Learning

- Course Philosophy, Objectives and **Outcomes**

The following are the expected learning outcomes from this course:

1. To apply machine learning **as a tool to address real-life problems**/challenges.

2. Ability **to develop a new machine-learning algorithm** to challenge and address the state of the art machine learning algorithms.

3. To **create a strong foundation** for related courses like Deep Learning, Computer Vision, Reinforcement Learning, Natural language processing and other similar courses that are commonly found in.

4. Learn a course to match the **ABET standard**.

5. Select **an appropriate feature for classification** and derive insight into fundamental building blocks of machine learning.

6. Apply specific machine learning tool based on application context and understand **the mathematical and statistical principles** underlying the tool.

About CSE 523 – A Course on Machine Learning

- Evaluation Components

End semester exam - 40%

Mid semester exam – 25%

Project - 35%

About CSE 523 – A Course on Machine Learning

- Project Guidelines

Can I carry out project in group ?

The B.Tech students can carry their project in a group (max. four students in a group). Students have autonomy to choose the partner. However, M.Tech and PhD students have to carry their project independently only (no group)

How would the project submission be done?

There would be total **FIVE project submissions**. Each project submission is highly correlated to its previous submission, covering different aspects of the course.

1. Project Abstract Submission (in week-3, will be launched soon) (5% weightage)

2. Project Module #1 : Regression (5% weightage)

3. Project Module #2 : Dimensionality reduction (5% weightage)

4. Project Module #3: Density Estimation and Classification (5% weightage)

5. Innovation and final submission (15%)

About CSE 523 – A Course on Machine Learning

- Project Guidelines

What is the project all about?

As a part of the project component comprising of 35% weightage, the students would be required to do a project. There are **five project areas** that have been identified. They are listed as below:

1. Natural Language Processing (NLP)

2. Intelligent Transportation System (ITS)

3. 5G/6G Wireless Networks

4. Environment and Climate change

5. Biology /Bioinformatics

About CSE 523 – A Course on Machine Learning

- Tools / Software / Platform

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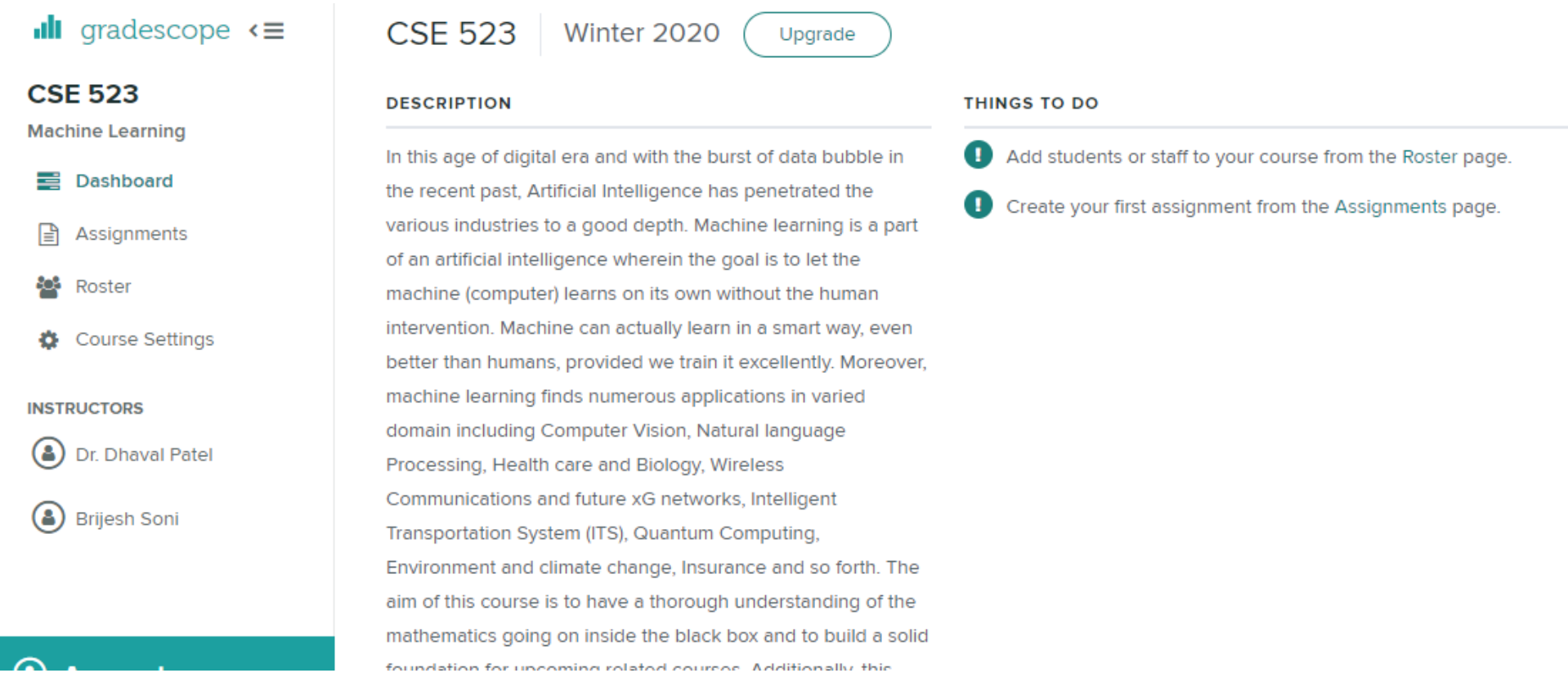

About CSE 523 – A Course on Machine Learning

- Schedule up to Mid Semester Examination

Week #	Execution
Week 1	1. L1 and L2
	2. Project Group Formation
	3. Tutorial #1 – ML lab hands-on, Tensorflow Introduction, Example
Week 2	1. L3 and L4
	2. Project execution and implementation, Research articles in group
	3. Demonstration of Project areas-one implementation
Week 3	1. L5 and L6
	2. Project viva and Abstract Submission
Week 4-5-6	1. L7 to L13
	2. Math Quiz + L1-L6
Midsem Exam	
	Post Midsem Feedback form-I

Thank you !!

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