

COMP 605

Introduction to Artificial Intelligence

Learning Outcomes

1. Introduction to Artificial intelligence
2. Understand how to evaluate models generated from data using Neural Networks
3. How Natural Language Processing (NLP) allows machine to break down and interpret human language
4. Understand how Computer vision enables us to derive meaningful information from digital images and videos
5. Reinforcement Learning
6. Learn OpenCV programming for computer vision applications

LO 1

An Introduction to AI

Learning Objectives

You will be able to:

- Define “Artificial Intelligence” (AI),
“Machine Learning” (ML), and “Deep Learning” (DL)
- Explain how DL helps solve classical ML limitations.
- Explain key historical developments,
and the “hype-AI winter cycle.”
- Differentiate modern AI from prior AI.
- Relate sample applications of AI.



AI Breakthroughs

Image classification



“Dog”



“Cat”

As of 2015, computers can be trained to perform better on this task than humans.

Machine translation

“I am a student”



“Je suis étudiant”

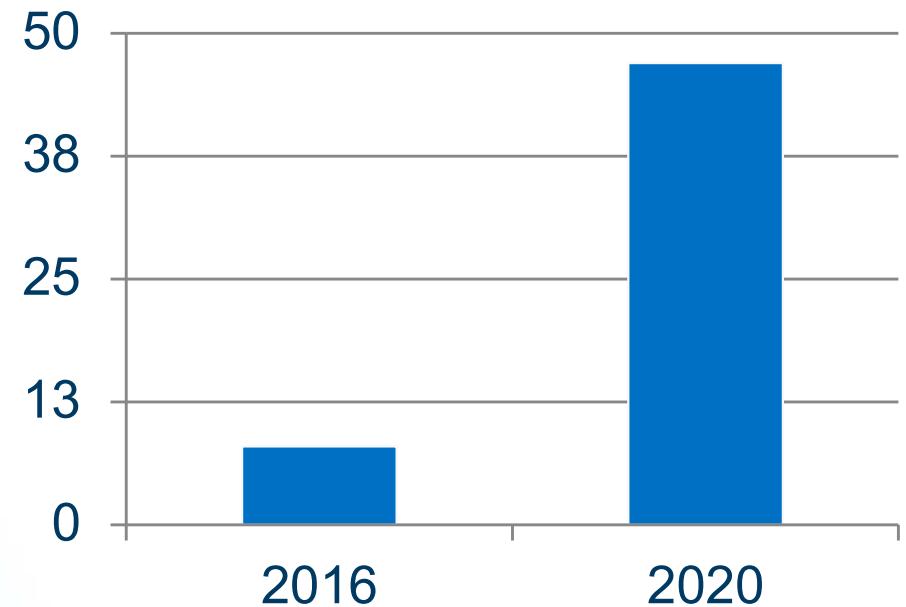
As of 2016, we have achieved near-human performance using the latest AI techniques.

AI Is The New Electricity

"About 100 years ago, electricity transformed every major industry. AI has advanced to the point where it has the power to transform...every major sector in coming years."

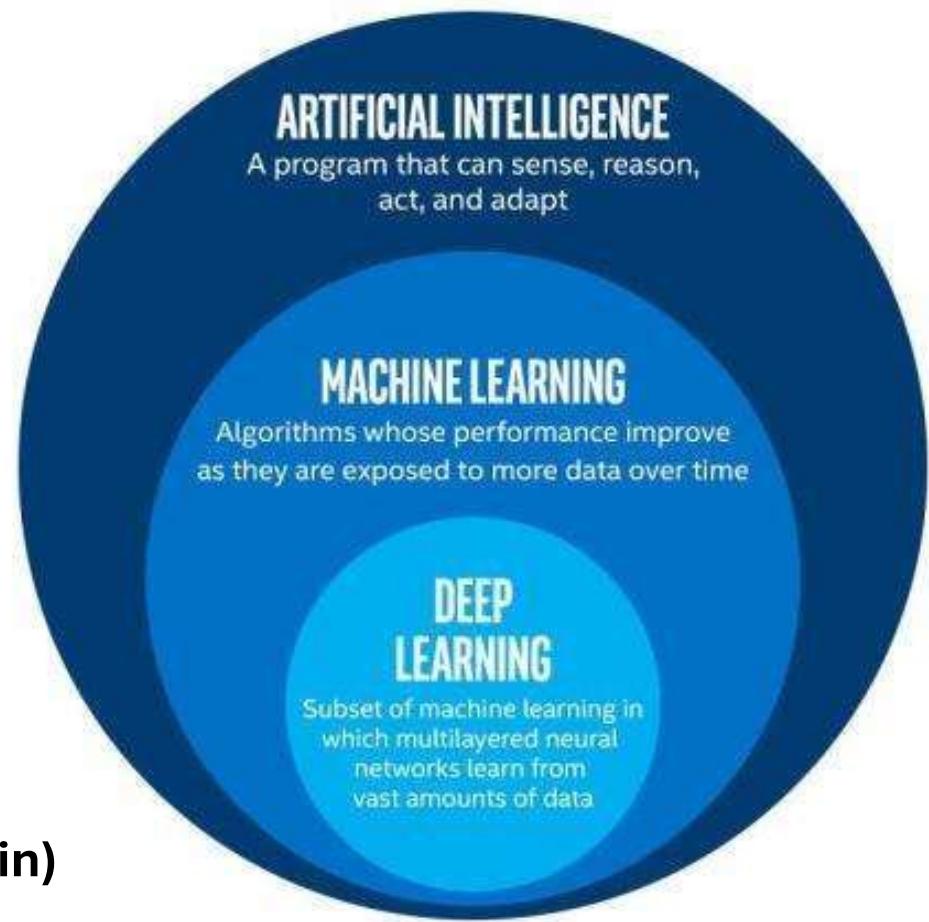
-Andrew Ng, Stanford University

Projected Revenue (in billions USD) Generated from AI, 2016-2020 (IDC)



Definitions

- Artificial Intelligence
- Machine Learning
- Deep Learning



Group Activity 1: AI vs ML vs DL (20 min)

Artificial Intelligence

“A branch of computer science dealing with the simulation of intelligent behavior in computers.” (Merriam-Webster)

“A program that can sense, reason, act, and adapt.” (Intel)

“Colloquially, the term ‘artificial intelligence’ is applied when a machine mimics ‘cognitive’ functions that humans associate with other human minds, such as ‘learning’ and ‘problem solving’.” (Wikipedia)

Machine Learning

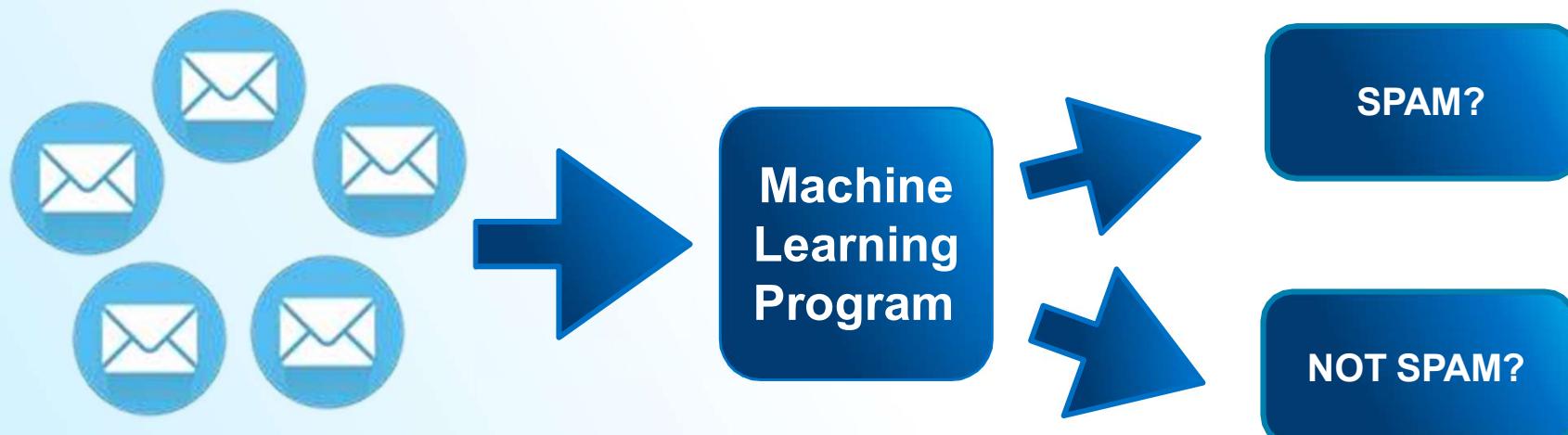
“The study and construction of programs that are *not explicitly programmed*, but learn patterns as they are exposed to more data over time.” (Intel)





Machine Learning

These programs learn from repeatedly seeing data, rather than being explicitly programmed by humans.



Emails are labeled as spam vs. not

The more emails the program sees...

...the better it gets at classification

Machine Learning Terminology

This example is learning to classify a species from a set of measurement features.

Features:

Attributes of the data.

Target:

Column to be predicted.

sepal length	sepal width	petal length	petal width	species
6.7	3.0	5.2	2.3	virginica
6.4	2.8	5.6	2.1	virginica
4.6	3.4	1.4	0.3	setosa
6.9	3.1	4.9	1.5	versicolor
4.4	2.9	1.4	0.2	setosa
4.8	3.0	1.4	0.1	setosa
5.9	3.0	5.1	1.8	virginica
5.4	3.9	1.3	0.4	setosa
4.9	3.0	1.4	0.2	setosa
5.4	3.4	1.7	0.2	setosa

Two Main Types of Machine Learning

	Dataset	Goal	Example
Supervised Learning	Has a target column	Make predictions	Fraud detection
Unsupervised Learning	Does not have a target column	Find structure in the data	Customer segmentation

Machine Learning Example

- Suppose you wanted to identify fraudulent credit card transactions.
- You could define features to be:
 - Transaction time
 - Transaction amount
 - Transaction location
 - Category of purchase
- The algorithm could learn what feature combinations suggest unusual activity.



Machine Learning Limitations

- Suppose you wanted to determine if an image is of a cat or a dog.
- What features would you use?
- This is where **Deep Learning** can come in.

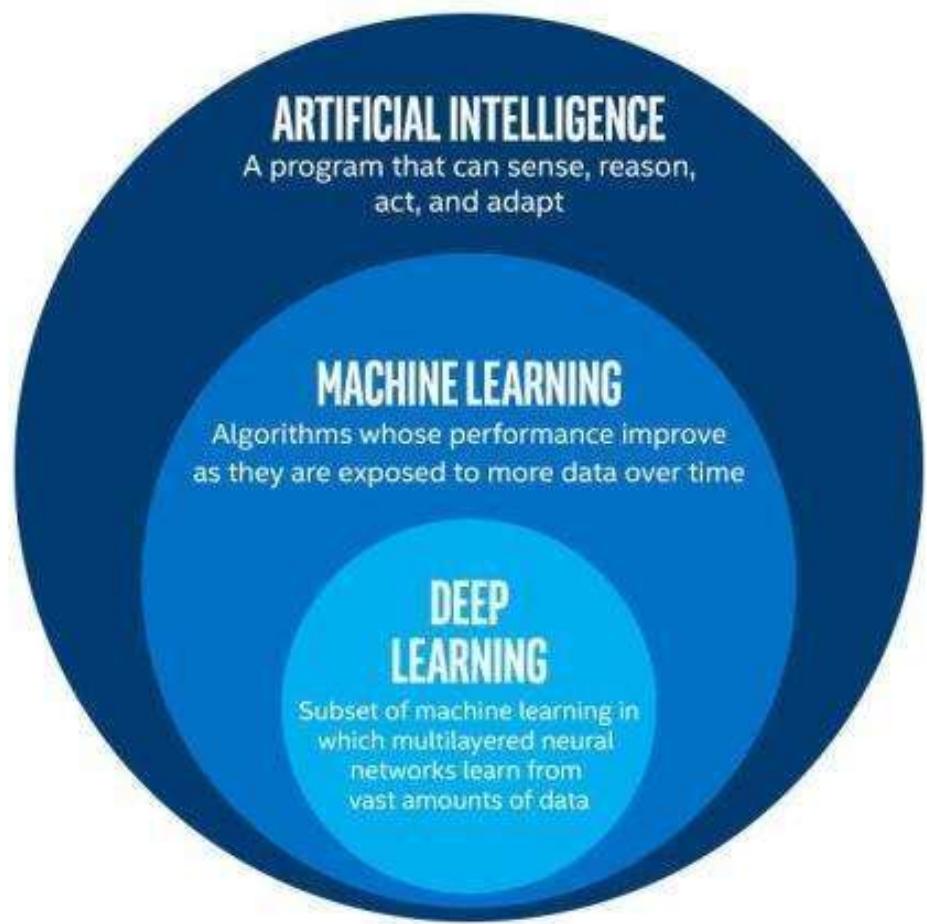


Dog and cat recognition

Deep Learning

“Machine learning that involves using very complicated models called “deep neural networks”.” (Intel)

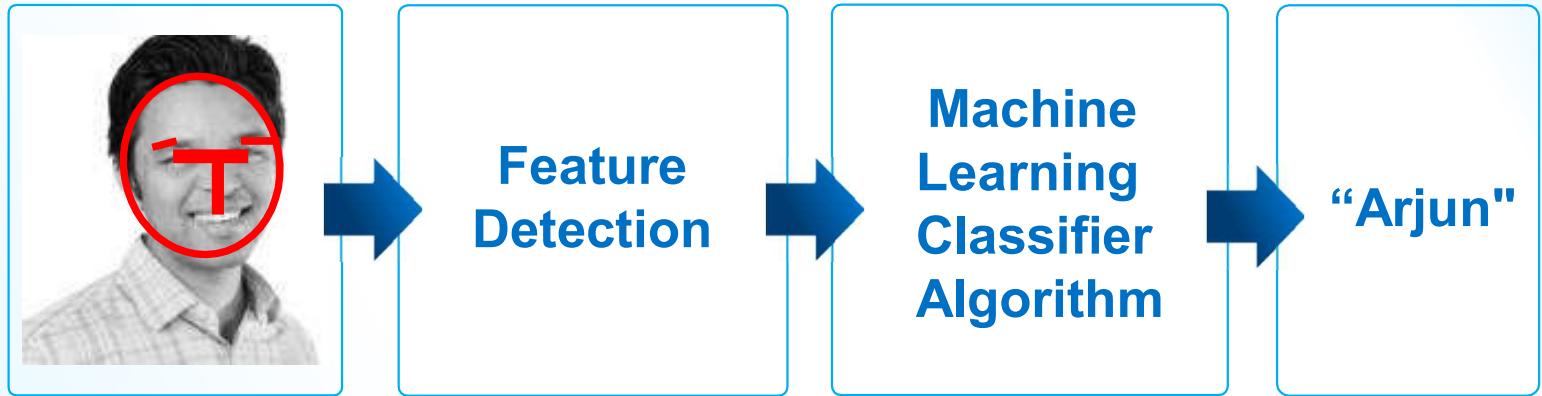
Models determine best representation of original data; in classic machine learning, humans must do this.



Deep Learning Example

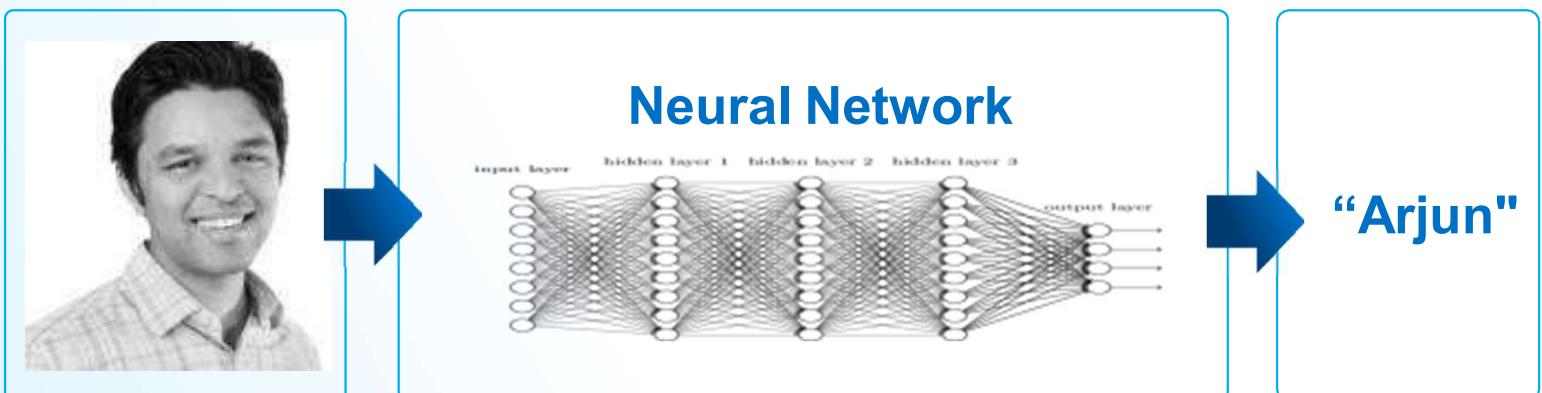
Classic Machine Learning

Step 1: Determine features.
Step 2: Feed them through model.



Deep Learning

Steps 1 and 2 are combined into 1 step.



Group Activity 2: Roles in the Data Ecosystem (15 min)

AI: Mimics intelligence

ML: Learns from data

DL: Learns features automatically

Data Analyst: Explains past

Data Scientist: Predicts future

Data Engineer: Builds foundation

Simple Explanation:

Data Engineer → brings water

Data Analyst → checks water quality

Data Scientist → predicts future water needs

Group Activity 3: Case Study Mapping (15min)

Case A: Credit Card Fraud

Case B: Netflix Recommendation

Case C: Traffic Signal Optimization

Case D: Face Unlock in Mobile

Case	Technique	Why	Roles Involved
Credit Card Fraud			
Netflix Recommendation			
Traffic Signals			
Face Unlock			

History of AI

History timeline:

https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_history_and_evolution.htm

AI history and introduction:

https://learning.oreilly.com/library/view/artificial-intelligence-basics/9781484250280/html/480660_1_En_1_Chapter.xhtml

AI without ML: <https://www.linkedin.com/pulse/what-artificial-intelligence-without-machine-learning-claudia-pohlink/>

The 10 Stages of AI :<https://www.youtube.com/watch?v=uQn3oi0SMbo>

Class exercise

- Course outline 10 min
- Reading: AI History timeline: <https://www.javatpoint.com/history-of-artificial-intelligence> 20 min
- Major AI break through events (2010-2025) 20 min

Transformative Changes



Health

- Enhanced Diagnostics
- Drug Discovery
- Patient Care
- Research
- Sensory Aids



Industrial

- Factory Automation
- Predictive Maintenance
- Precision Agriculture
- Field Automation

Source: Intel forecast

Transformative Changes



Finance

Algorithmic
Trading

Fraud Detection

Research

Personal
Finance

Risk Mitigation



Energy

Oil & Gas
Exploration

Smart
Grid

Operational
Improvement

Conservation

Source: Intel forecast

Transformative Changes



Government

Defense

Data
Insights

Safety &
Security

Engagement

Smarter
Cities



Transport

Autonomous
Cars

Automated
Trucking
Aerospace

Shipping
Search &
Rescue

Source: Intel forecast

Transformative Changes



Other

Advertising

Education

Gaming

Professional & IT
Services

Telco/Media

Sports

Source: Intel forecast

Applications: AI Omnipresence In Transportation

Navigation



Google & Waze find the fastest route, by processing traffic data.

Ride sharing



Uber & Lyft predict real-time demand using AI techniques, machine learning, deep learning.

AI Omnipresence In Social Media

Audience



Facebook & Twitter use AI to decide what content to present in their feeds to different audiences.

Content



Image recognition and sentiment analysis to ensure that content of the appropriate “mood” is being served.

AI Omnipresence In Daily Life

Natural language



We carry around powerful natural language processing algorithms in our phones/computers.

Object detection

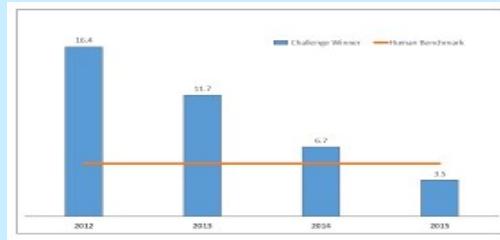


Cameras like Amazon DeepLens* or Google Clips* use object detection to determine when to take a photo.

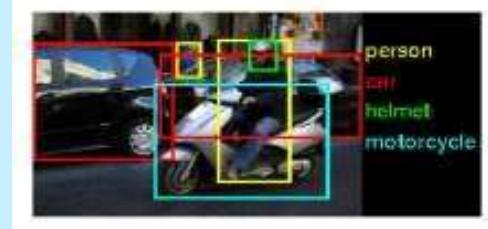
Latest Developments: Computer Vision



Deep Learning
“proven” to work for
image classification.



Models outperform
humans on image
classification.



Object detection
models beat previous
benchmarks.

2012

2015

2016

Summary

- Define “Artificial Intelligence” (AI),
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- Explain how DL helps solve classical ML limitations.
- Differentiate modern AI from prior AI.
- Relate sample applications of AI.



References

Ai face image: ✓ <https://pixabay.com/en/girl-woman-face-eyes-close-up-320262/>

Dog image: ✓ <https://www.pexels.com/photo/adorable-animal-breed-canine-356378/>

Cat image: ✓ <https://www.pexels.com/photo/adorable-animal-baby-blur-177809/>

Brain image: ✓ <http://www.publicdomainpictures.net/view-image.php?image=130359&picture=human-brain>

Email icon: ✓ <https://pixabay.com/en/mail-message-email-send-message-1454731/>

Credit card: ✓ <https://www.pexels.com/photo/atm-atm-card-card-credit-card-371066/>

Dog and cat image: ✓ <https://pixabay.com/en/cat-dog-animals-pets-garden-71494/>

John Pierce: ✓ https://commons.wikimedia.org/wiki/File:John_Robinson_Pierce.jpg



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