

# 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”*

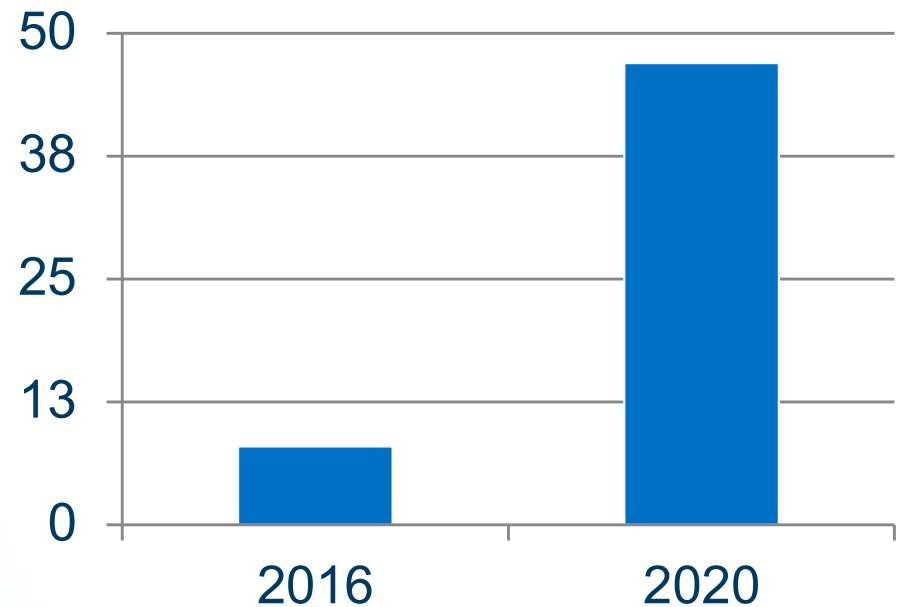
As of 2016, we have achieved near-human performance using the latest AI techniques.

# 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.”*

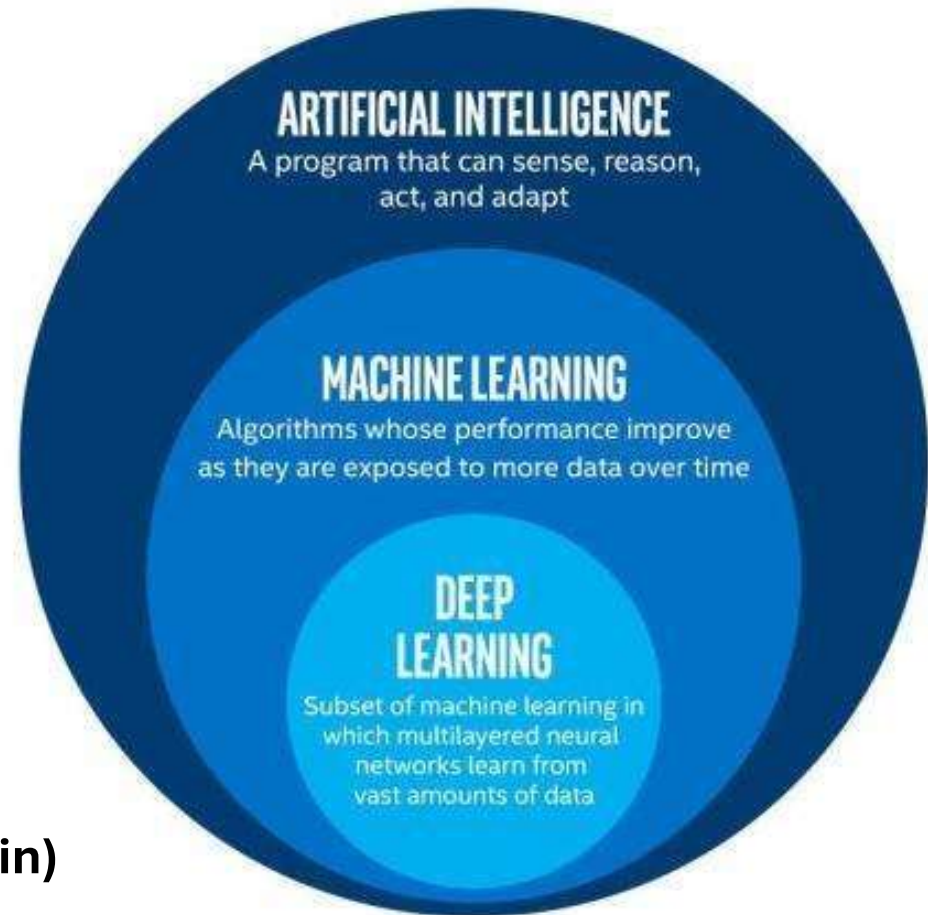
*-Andrew Ng, Stanford University*

*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)

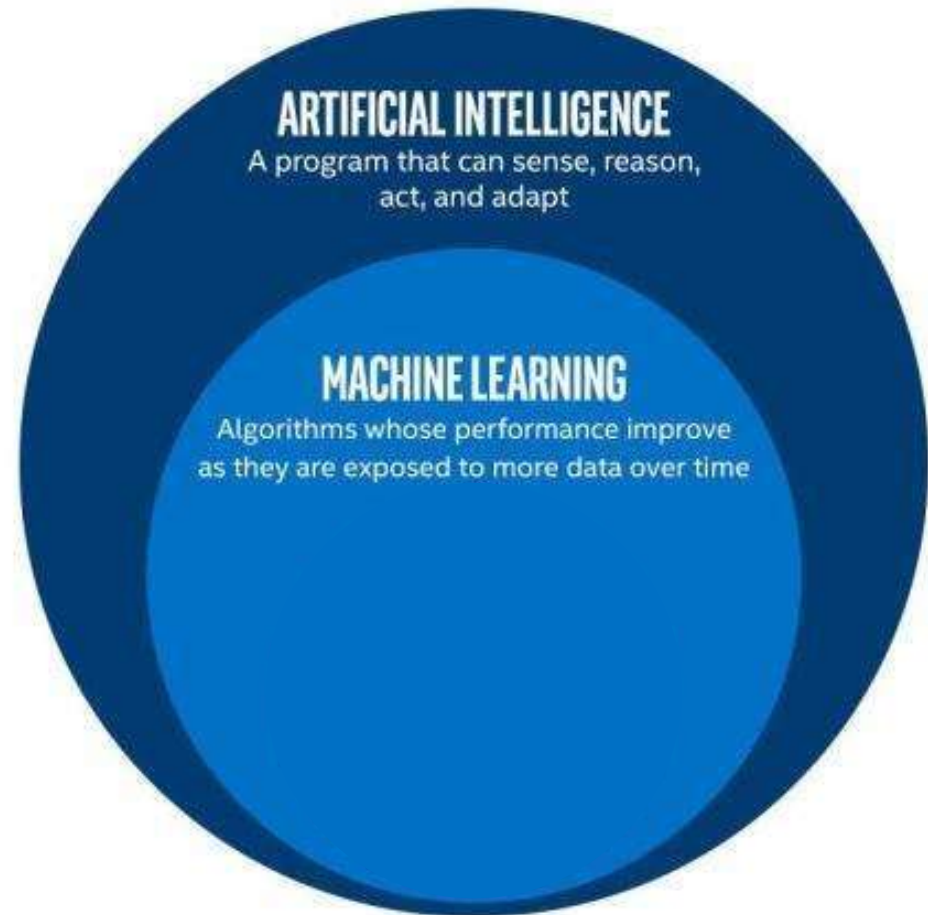
“A program that can sense, reason, act, and adapt.” (Intel)

“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

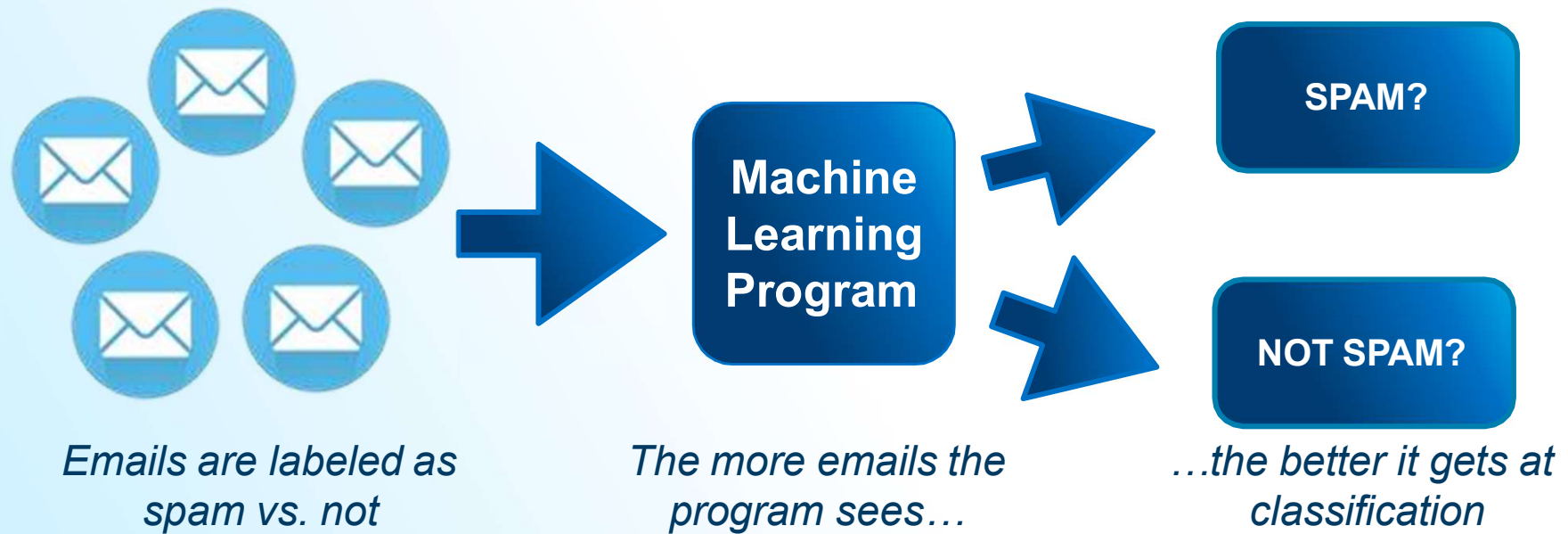
“The study and construction of programs that are *not explicitly programmed*, but learn patterns as they are exposed to more data over time.” (Intel)





# Machine Learning

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



# Machine Learning Terminology

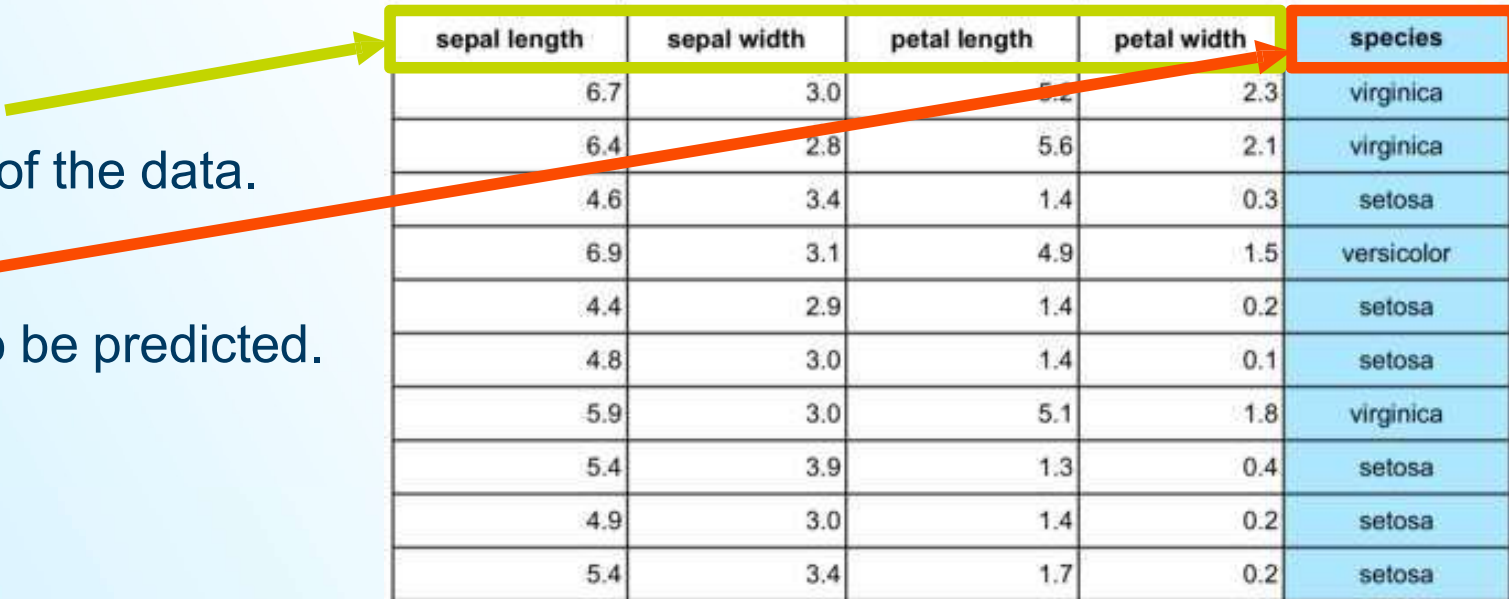
This example is learning to classify a species from a set of measurement features.

**Features:**

Attributes of the data.

**Target:**

Column to be predicted.

A diagram illustrating the relationship between features and the target variable. A yellow box highlights the first four columns of the table (sepal length, sepal width, petal length, petal width), with a yellow arrow pointing from the 'Features' label to this box. An orange box highlights the fifth column (species), with an orange arrow pointing from the 'Target' label to this column.

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.



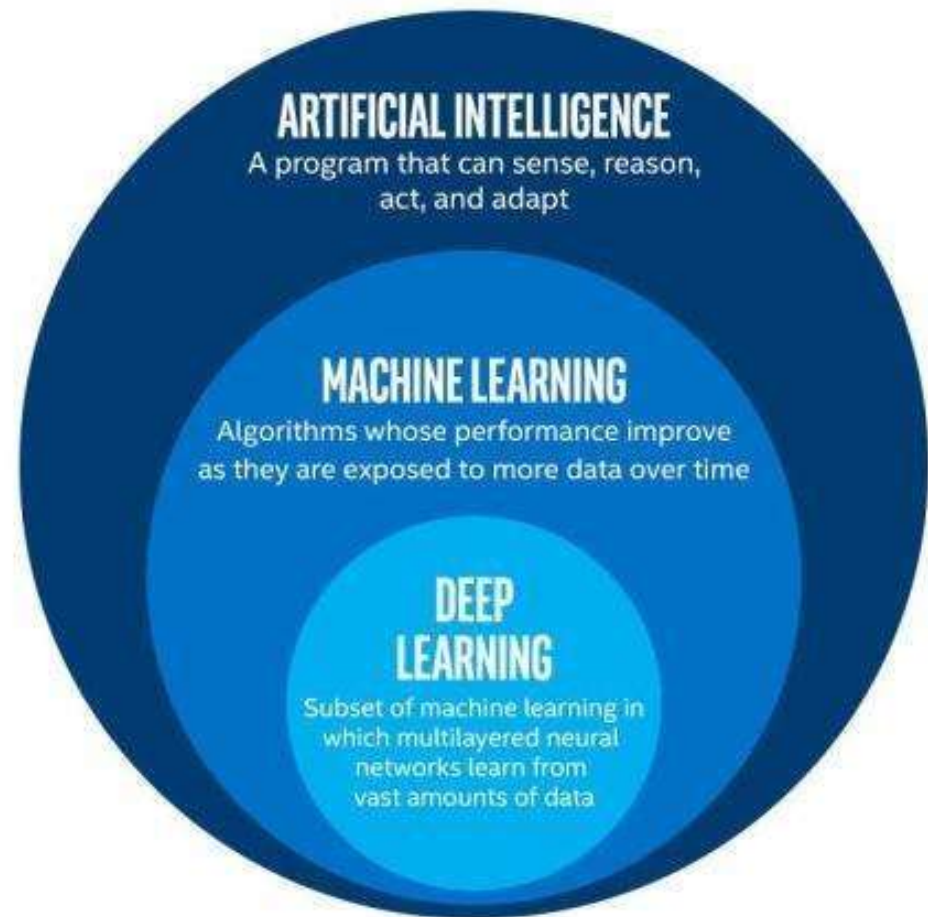
*Dog and cat recognition*



# 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.



**Feature Detection**

**Machine Learning Classifier Algorithm**

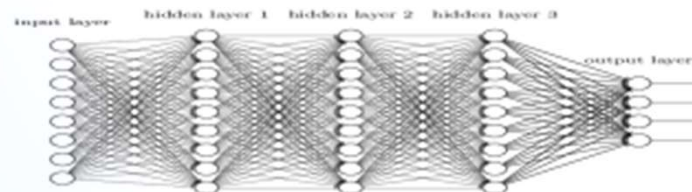
**“Arjun”**

## Deep Learning

Steps 1 and 2 are combined into 1 step.



**Neural Network**



**“Arjun”**

# 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](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](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

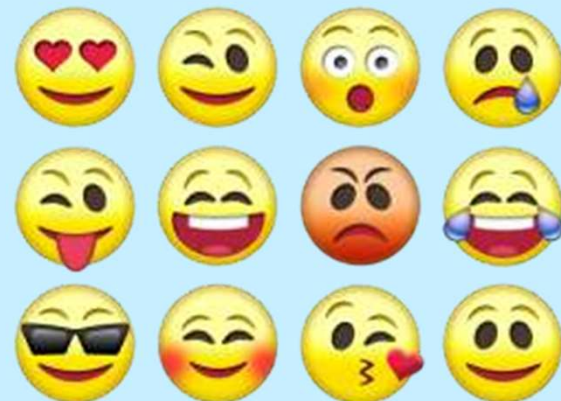


Image recognition and sentiment analysis to ensure that content of the appropriate “mood” is being served.

# AI Omnipresence In Daily Life

## Natural language



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

## Object detection

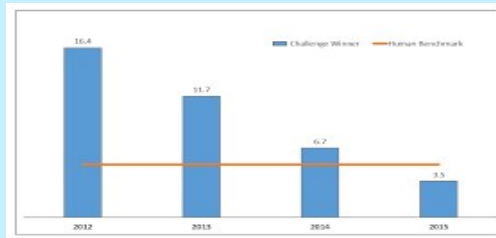


Cameras like Amazon DeepLens\* or Google Clips\* use object detection to determine when to take a photo.

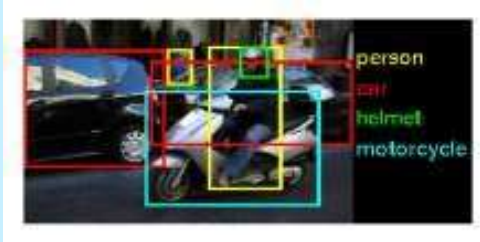
# Latest Developments: Computer Vision



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),  
“Machine Learning” (ML), and “Deep Learning” (DL).
- 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](https://commons.wikimedia.org/wiki/File:John_Robinson_Pierce.jpg)



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