CPEN 355 Lecture1: Course Introduction

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University of British Columbia

Instructor

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Adjunct Professor @ UBC

Senior Machine Learning Scientist @ Lululemon

Past Experience:

Research Engineer @ Honda Research Institute

PhD from ECE @ UBC ‘19

AI in Hollywood?

NBC NEWS 2024 ELECTION POLITICS U.S. NEWS WORLD BUSINESS SPORTS HEALTH SHOPPING TIPLINE WATCH LIVE

ARTIFICIAL INTELLIGENCE

Actors vs. AI: Strike brings focus to emerging use of advanced tech

SAG-AFTRA has joined the Writer's Guild of America in demanding a contract that explicitly demands AI regulations to protect writers and the works they create.

"They proposed that our background performers should be able to be scanned, get paid for one day's pay, and their company should own that scan, their image, their likeness, and should be able to use it for the rest of eternity in any project they want, with no consent and no compensation," he said.

ML career

LinkedIn | Jobs | Machine Learning | United States

Any time | Company | Job type | Experience level | Location | S

Get notified about new **Machine Learning** jobs in **United States.**

Sign in to create job alert

82,000+ Machine Learning Jobs in United States

Data Scientist - Multiple Locations

Microsoft · New York, United States

1 week ago · Over 200 applicants

See who Microsoft has hired for this role

Apply | Save

Pay found in job post

Retrieved from the description.

Base pay range

$81,900.00/yr - $174,600.00/yr

Senior Applied Scientist

Microsoft · Mountain View, CA

3 days ago · 26 applicants

See who Microsoft has hired for this ro

Apply | Save

Pay found in job post

Retrieved from the description.

Base pay range

$117,200.00/yr - $250,200.00/yr

The Product Ads Algorithm & Infrastructure tea

hiring a **Senior Applied Scientist.**

Applied Research Scientist - Reality Labs Research

Meta · Sunnyvale, CA

6 days ago · 38 applicants

See who Meta has hired for this role

AI Research Scientist - Language - Core AI

Meta · New York, NY

2 weeks ago · 29 applicants

See who Meta has hired for this role

Apply | Save

– tall

n of

Meta provided pay range

This range is provided by Meta. Your actual pay will be based on your skills and experience — ta with your recruiter to learn more.

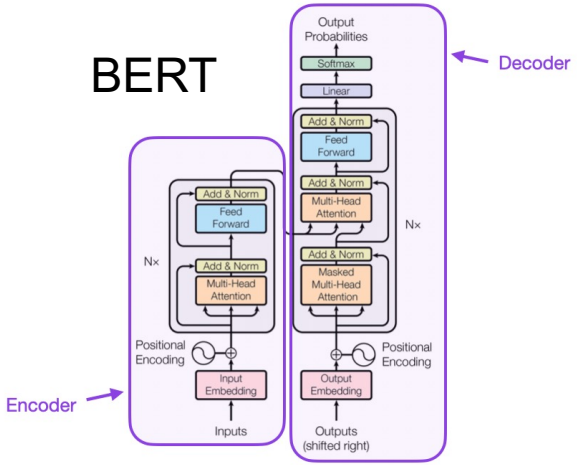
Base pay range

$143,000.00/yr - $208,000.00/yr

Meta is seeking a Research Scientist to join Reality Labs XRTech Core AI organization. The organization focuses on developing efficient foundationa

Engineering + ML

BERT



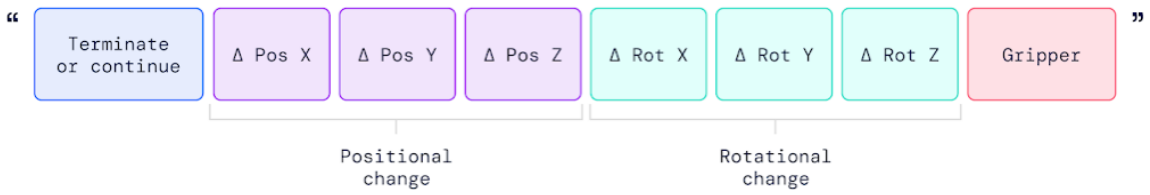
Use ML to augment engineering

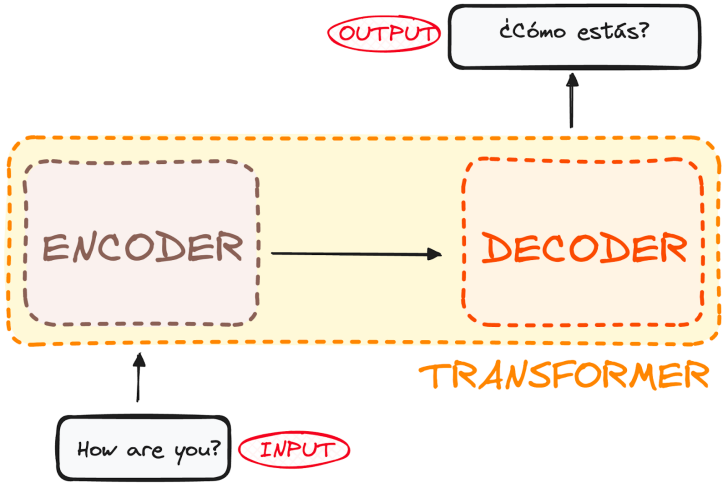
ChatGPT

Google DeepMind

RT-2: New model translates vision and language into action

To control a robot, it must be trained to output actions. We address this challenge by representing actions as tokens in the model's output – similar to language tokens – and describe actions as strings that can be processed by standard natural language tokenizers, shown here:





Intuition Perspective

Language translator using a **transformer**

https://deepmind.google/discover/blog/rt-2-new-model-translates-vision-and-language-into-action/

Research at Honda

Large-Area Conformable Sensor for Proximity, Light Touch, and Pressure-Based Gesture Recognition

Mirza S. Sarwar, Katsu Yamane
Honda Research Institute, USA

International Conference on Intelligent Robots and Systems (IROS 2021)

Not just Engineering

Psychology

Biology

Business

Physics

Economics

Pharmacy

Finance

Chemistry

Archeology

Applied Scientist at FAANG/MAG7 Breadth

[NOT OUR SYLLABUS]

supervised	unsupervised	probabilistic graphical models	dimensionality reduction	sequential model	reinforcement learning	NLP	Computer Vision	Training and optimization	evaluation metrics
linear and logistic regression	clustering	baysian network	VAE	hidden markov model	state-action-reward-state-action	statistical language modelling	Object detection	adaptive gradient approach	accuracy
naïve bayes classifier	kmeans	markov network	t-sne	conditional random field	explore-exploit	LDA	image recognition	regularization and overfitting	precision
bagging and boosting	anomaly detection	variational inference	PCA	RNN	multi-armed bandit	NER	pattern recognition	loss functions	recall
knn	markov methods	markov chain	SVD	NER	epsilon greedy	word embedding	facenet	baysian vs maximum likelihood	area under ROC
trees	DBSCAN	monte carlo methods	spectral clustering	POS tagging	UCB	word2vec	CNN	dealing with loss imbalance	r-squared
neural network	self-organizing maps	LDA	matrix factorization		thompson sampling	sentiment analysis	yolo	k-fold cross validation	map
SVM	deep belief nets	belief propagation			Q-learning	BERT		bias and variance	mean reciprocal rank
Random forest	expectation maximization	gibbs sampling			Deep Q networks	ULMFit			equal error rate
gradient boosted trees	gaussian mixture models								
kernel methods	evaluation for clustering								
stochastic gradient descent									
sequence modelling									
bayesian linear regression									
gausian processes									
over and underfitting									
regularization									
evaluation metrics									

Outline

- Linear Algebra basics
- Probability basics
- Supervised
  - Linear regression
  - Classification (logistic regression)
  - Model evaluation
  - Naïve Bayes classifier
  - SVM
  - Trees, boosting and bagging
  - Random forest
  - KNN
- Unsupervised
  - Clustering
  - VAE (if time permits)
- Dimension reduction
  - PCA
- Neural Network
- State of the Art

Industry speakers

Math + Ability to build

(tutorials)

Develop an intuition.

Grade structure

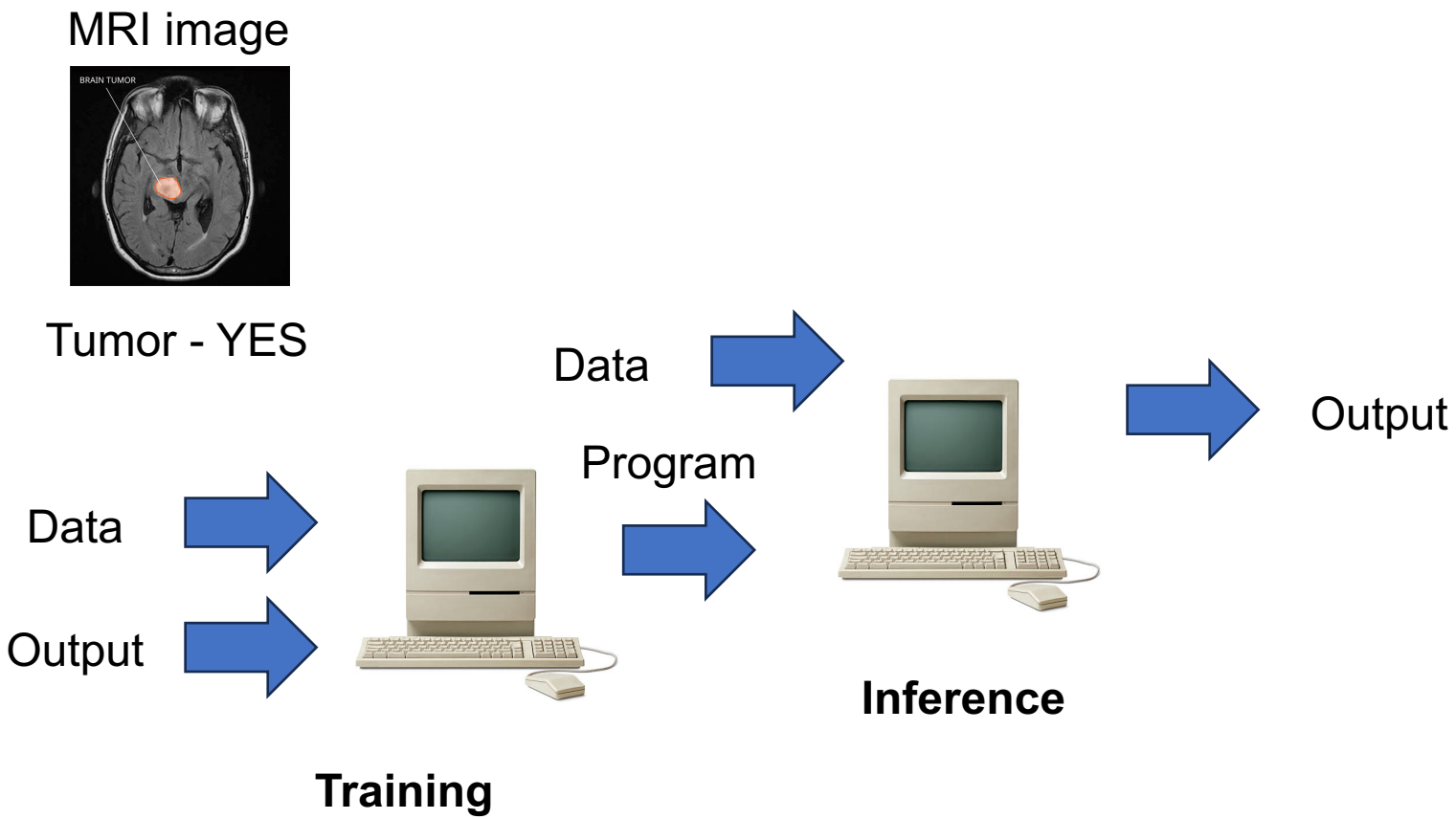
- 4 Quiz: 40% = 4*10%
  - Concept and Math

- 1 Assignment : 20%
- Final project: 30%
- Class participation and bonus: 10%

What is machine learning?

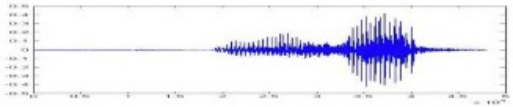
Formally (Mitchell 1997):

Algorithms that *improve* on some *task* with *experience*



ML ≈ Looking for Function

- Speech Recognition

$f($  $)=$ "How are you"

- Image Recognition

$f($ $)=$ "Cat"

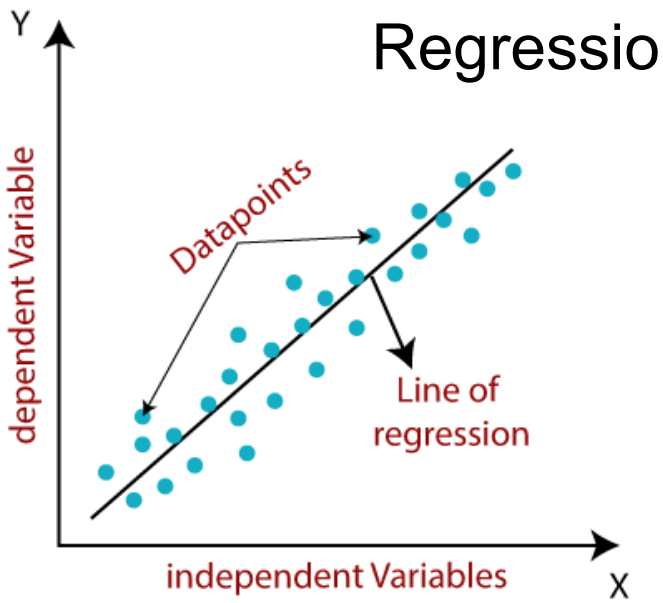
- Playing Go

$f($ $)=$ "5-5" (next move)

Referring to Hung-Yi Lee's teaching notes

Different Type of Functions

Linear Regression



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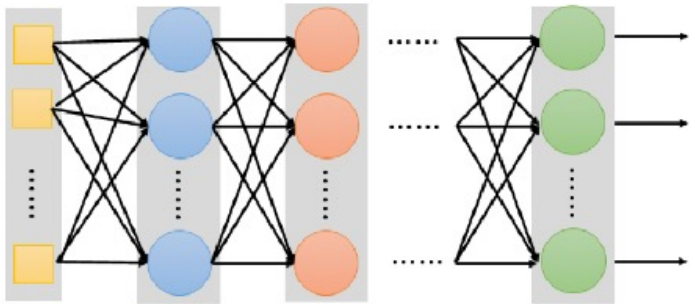
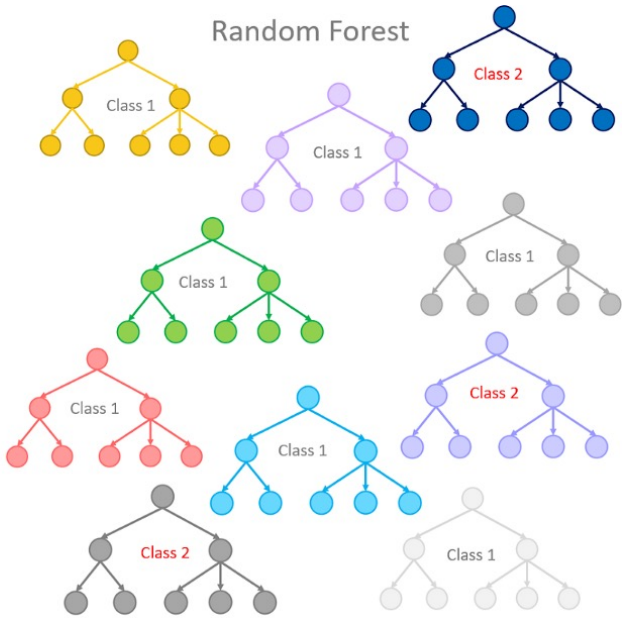
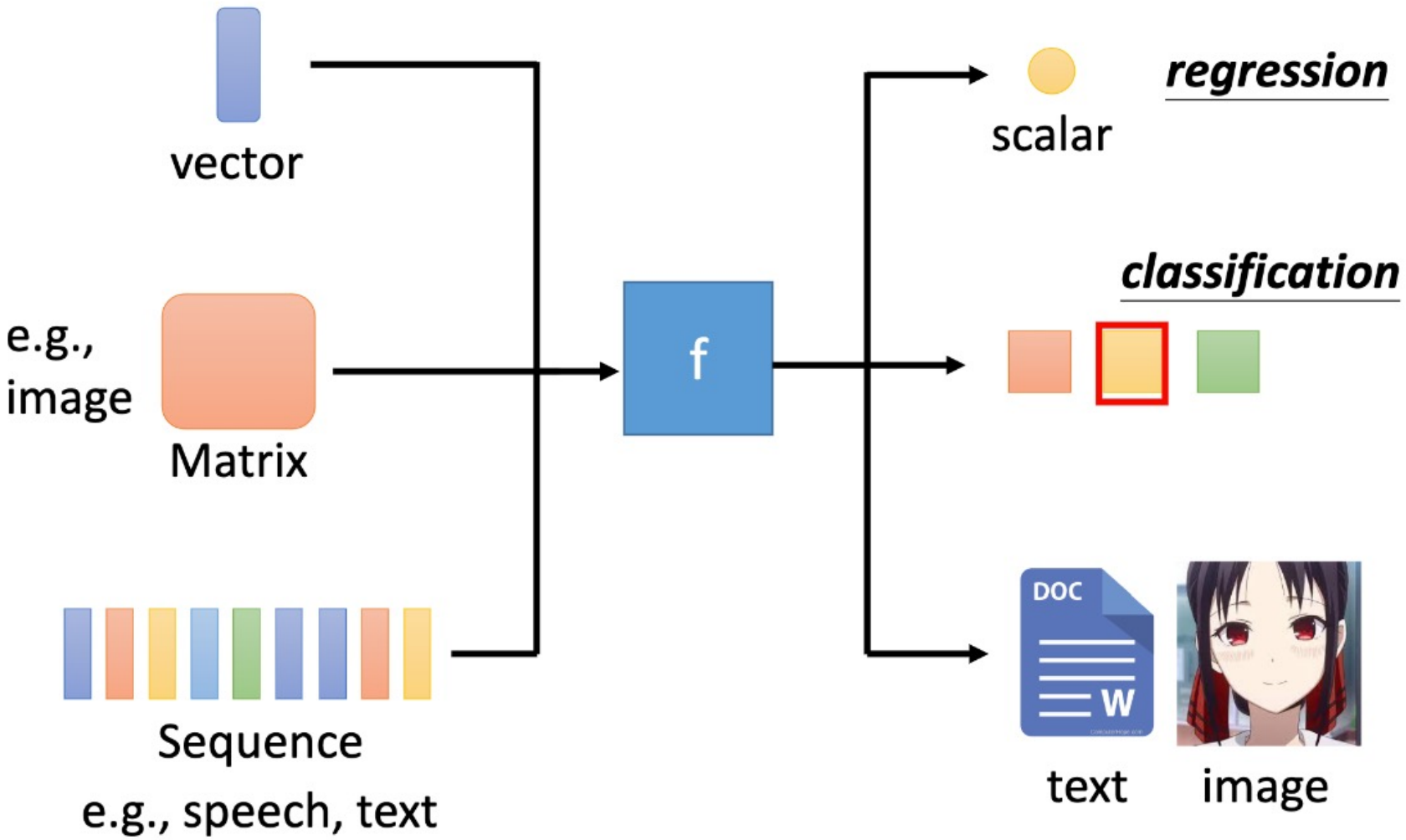


Neural Network

Random Forest



Different Type of Inputs/Outputs



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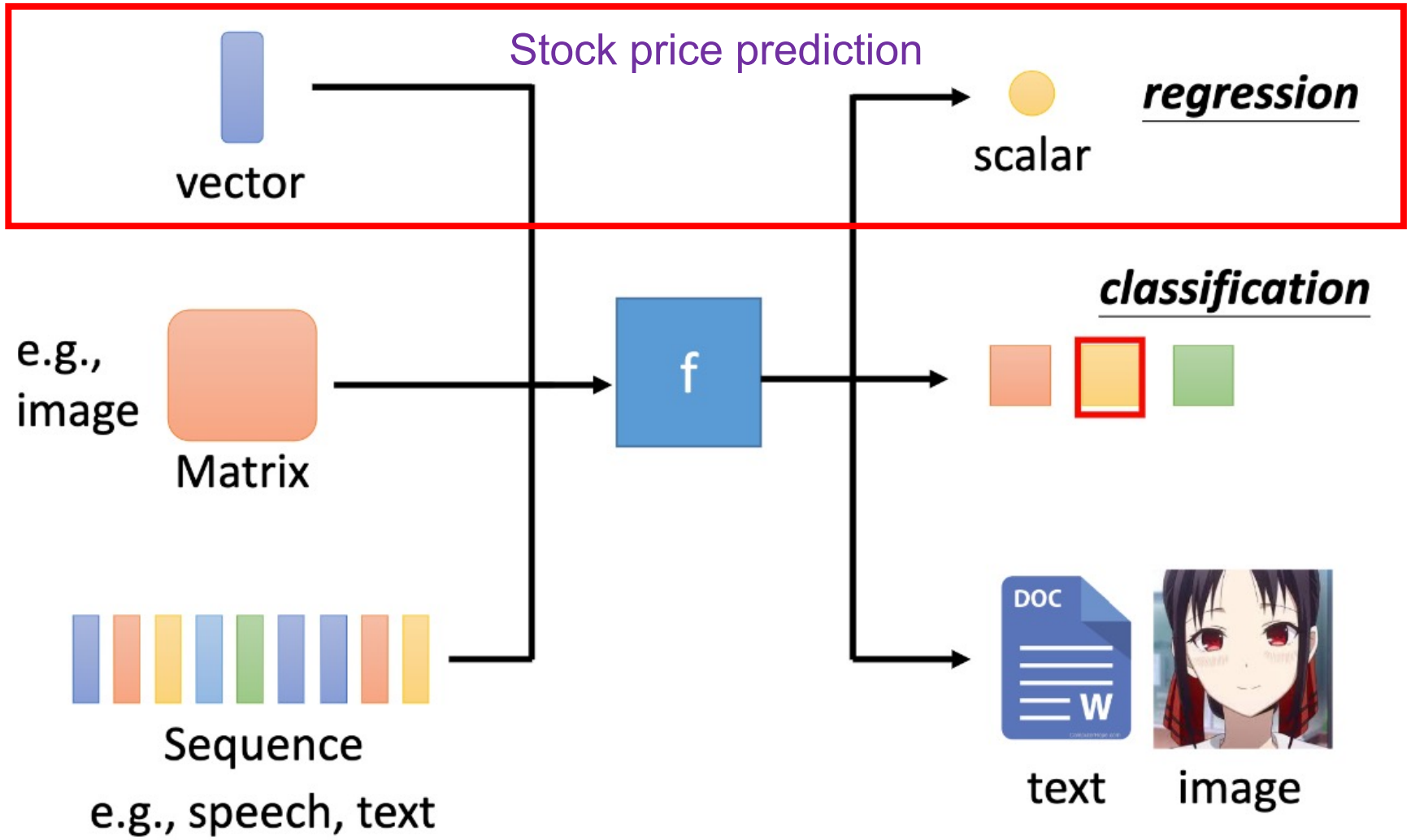

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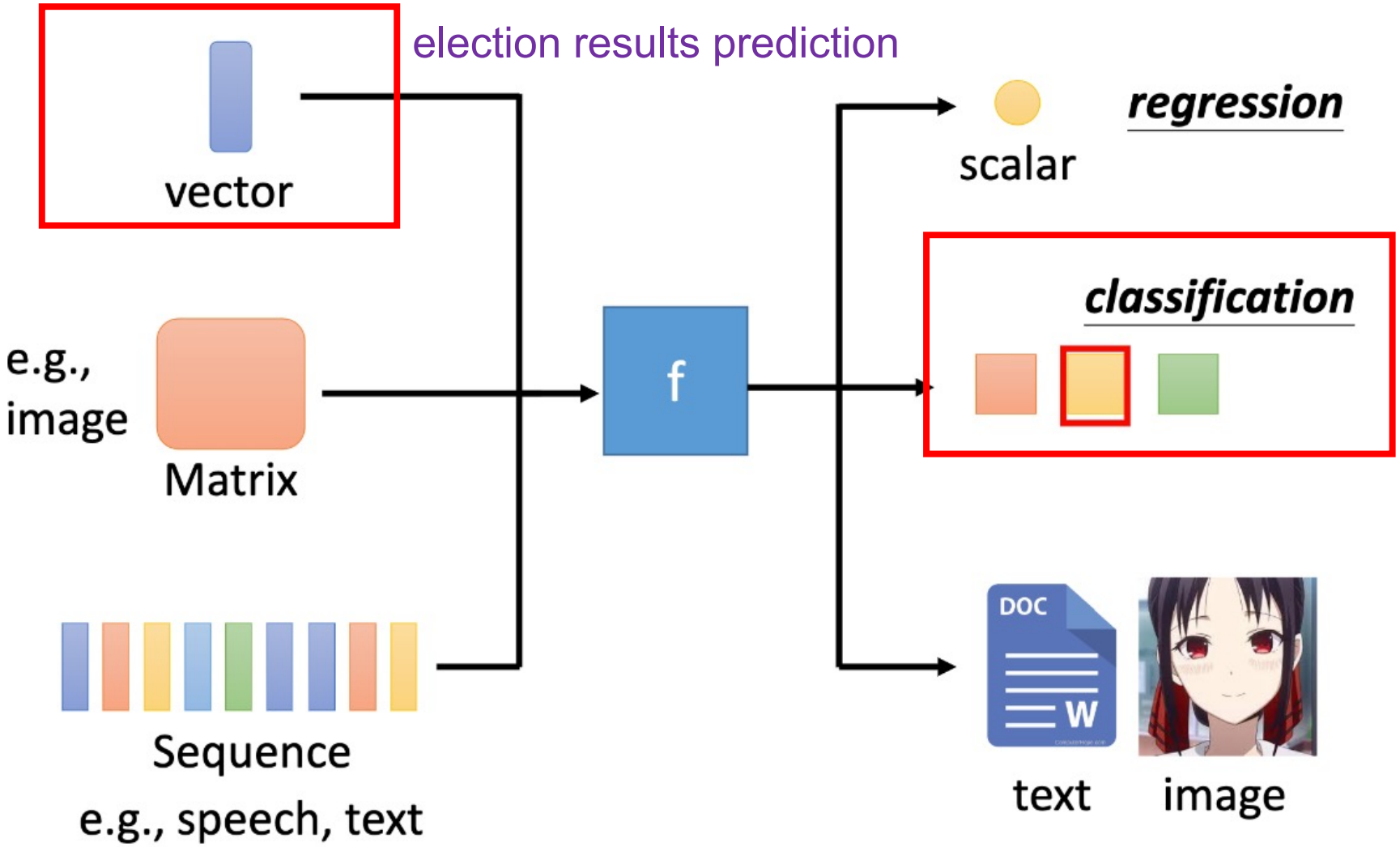

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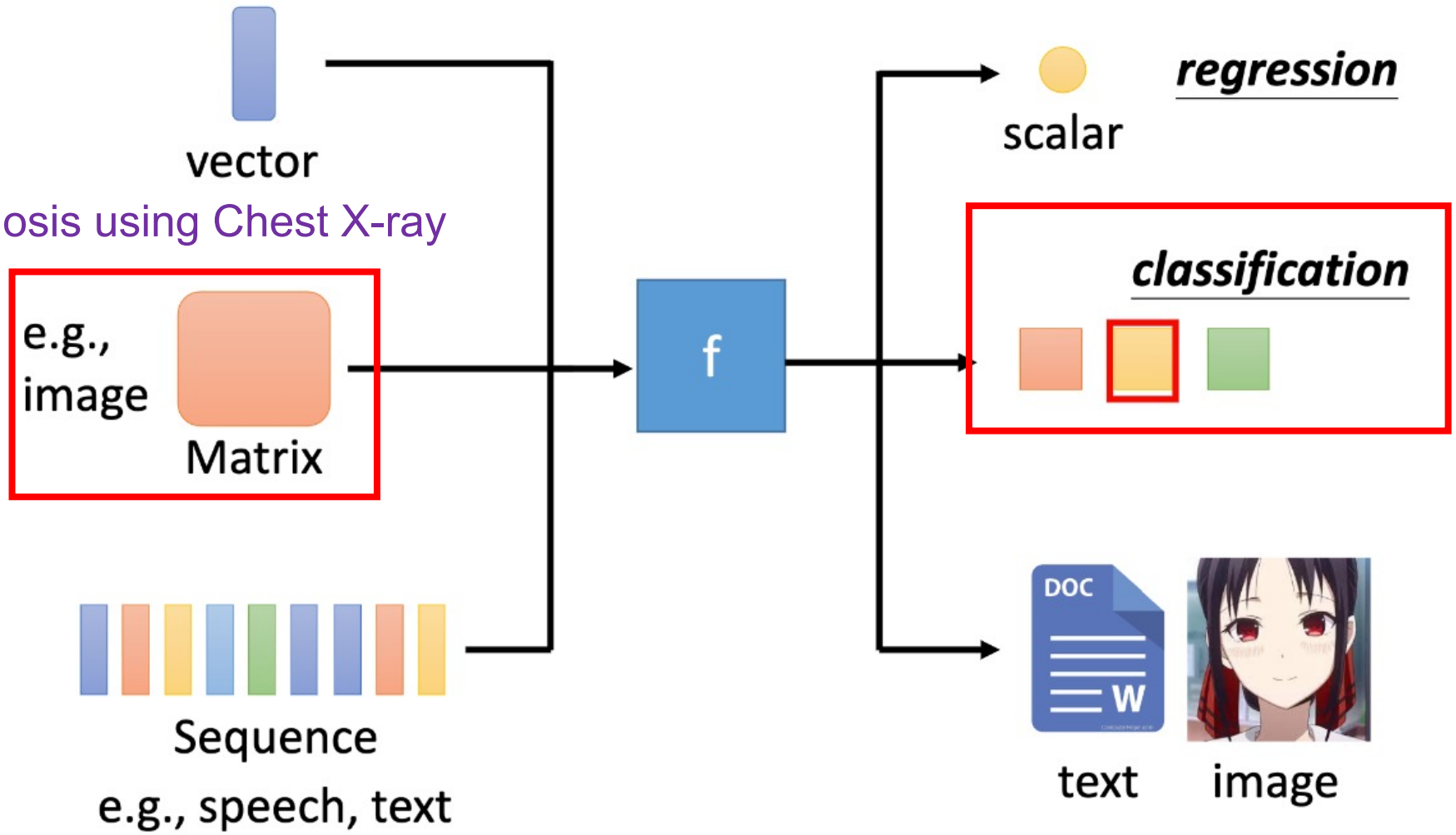

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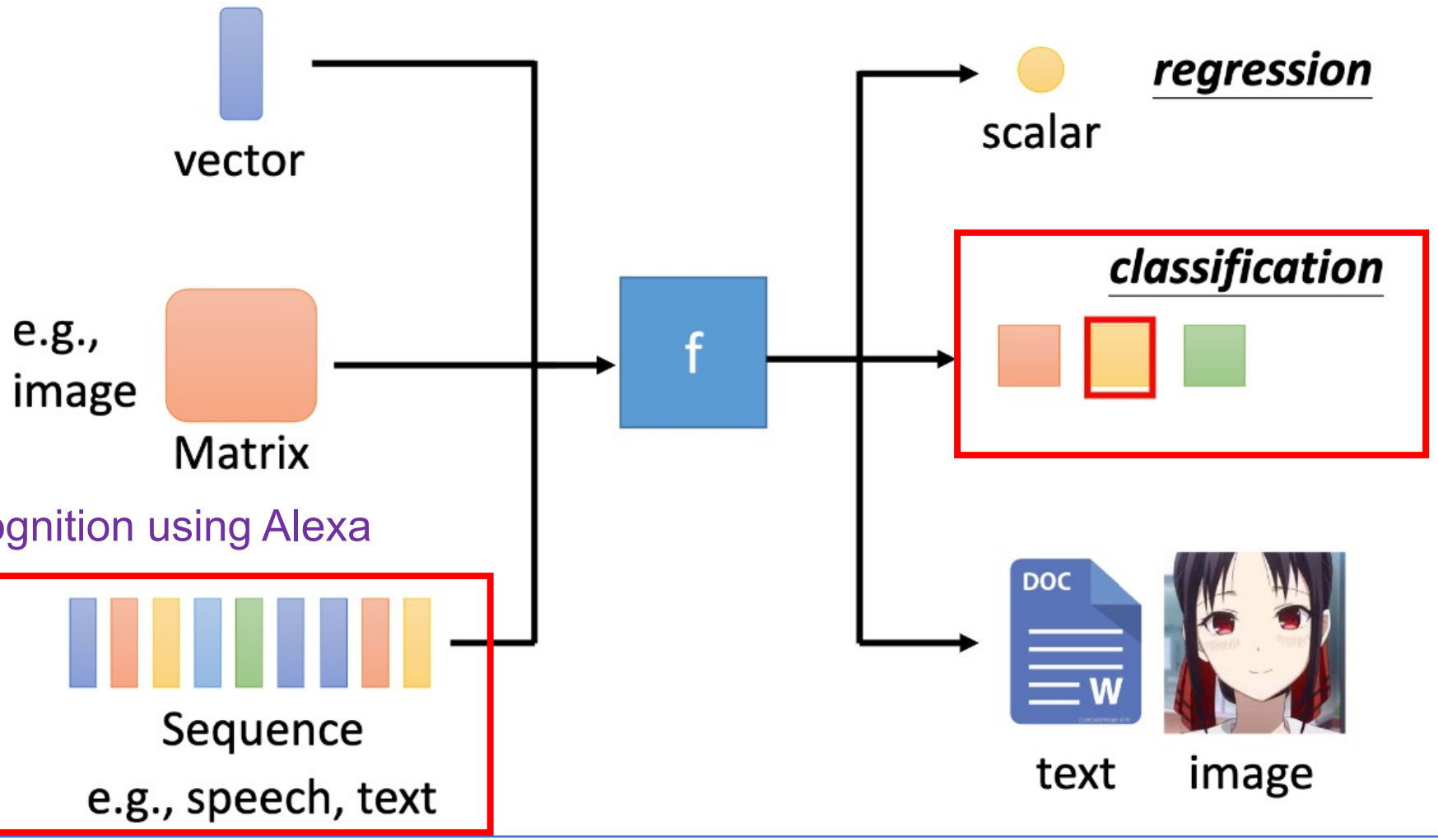

Speech Recognition using Alexa

Referring to Hung-Yi Lee's teaching notes

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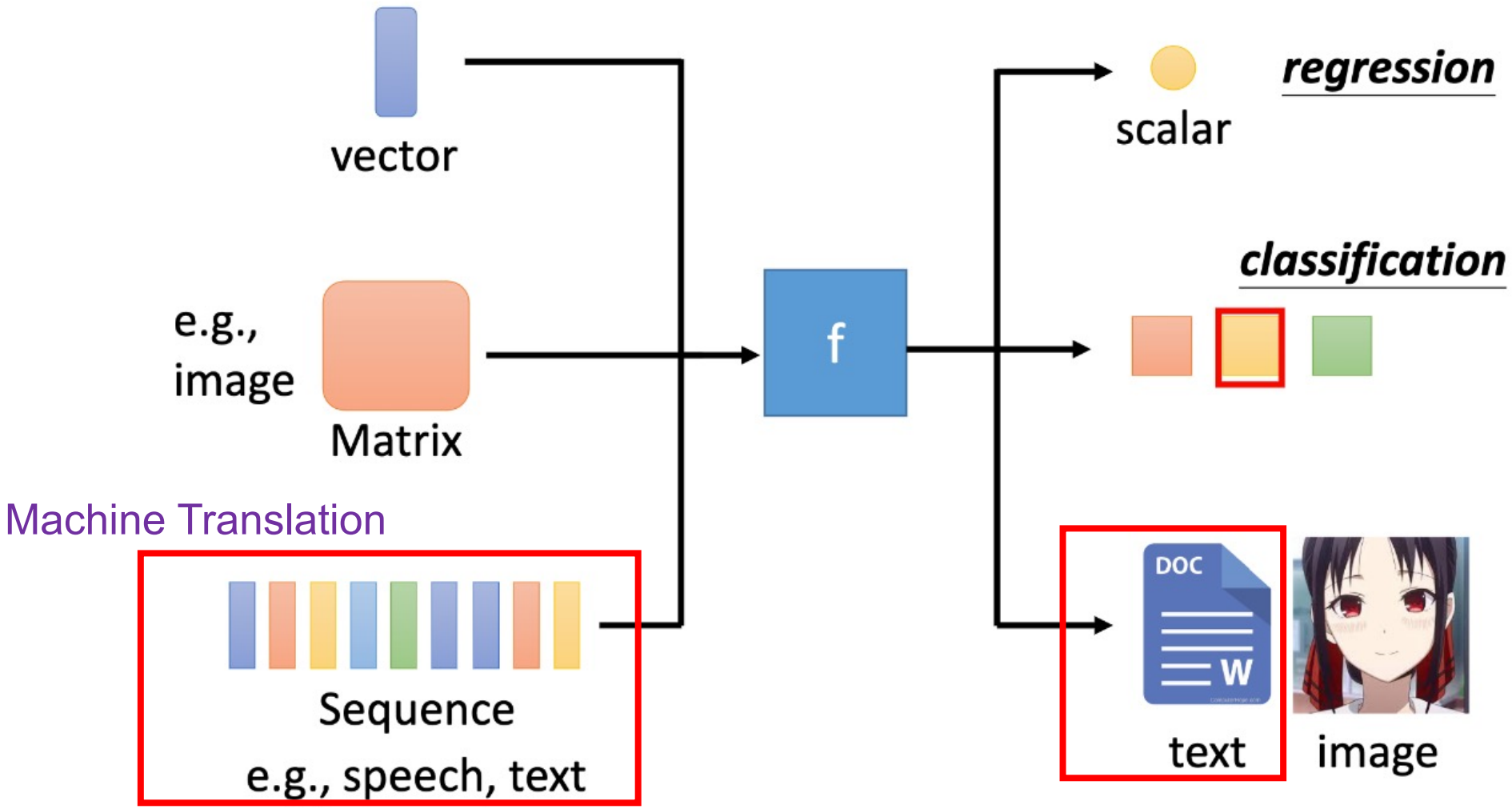

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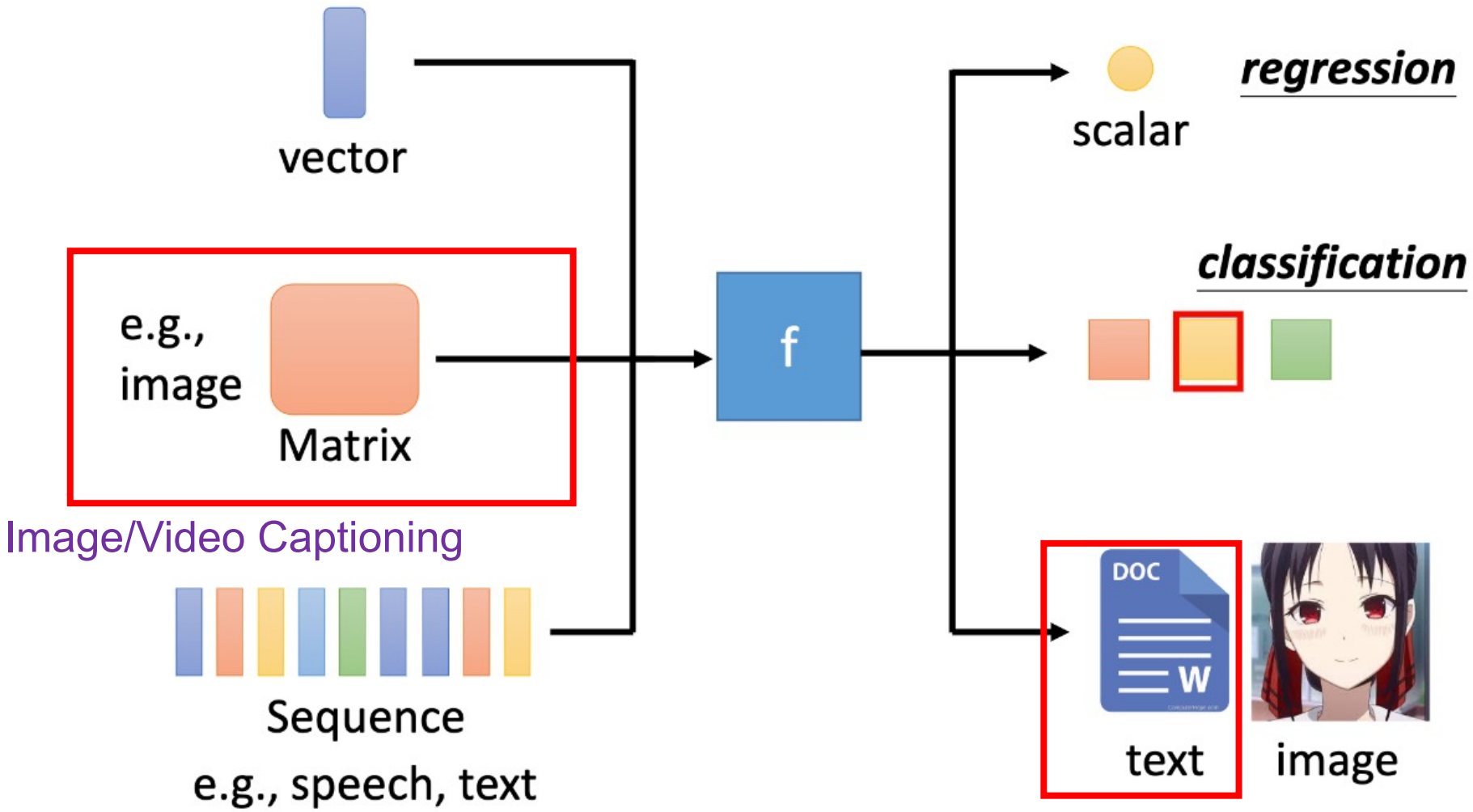

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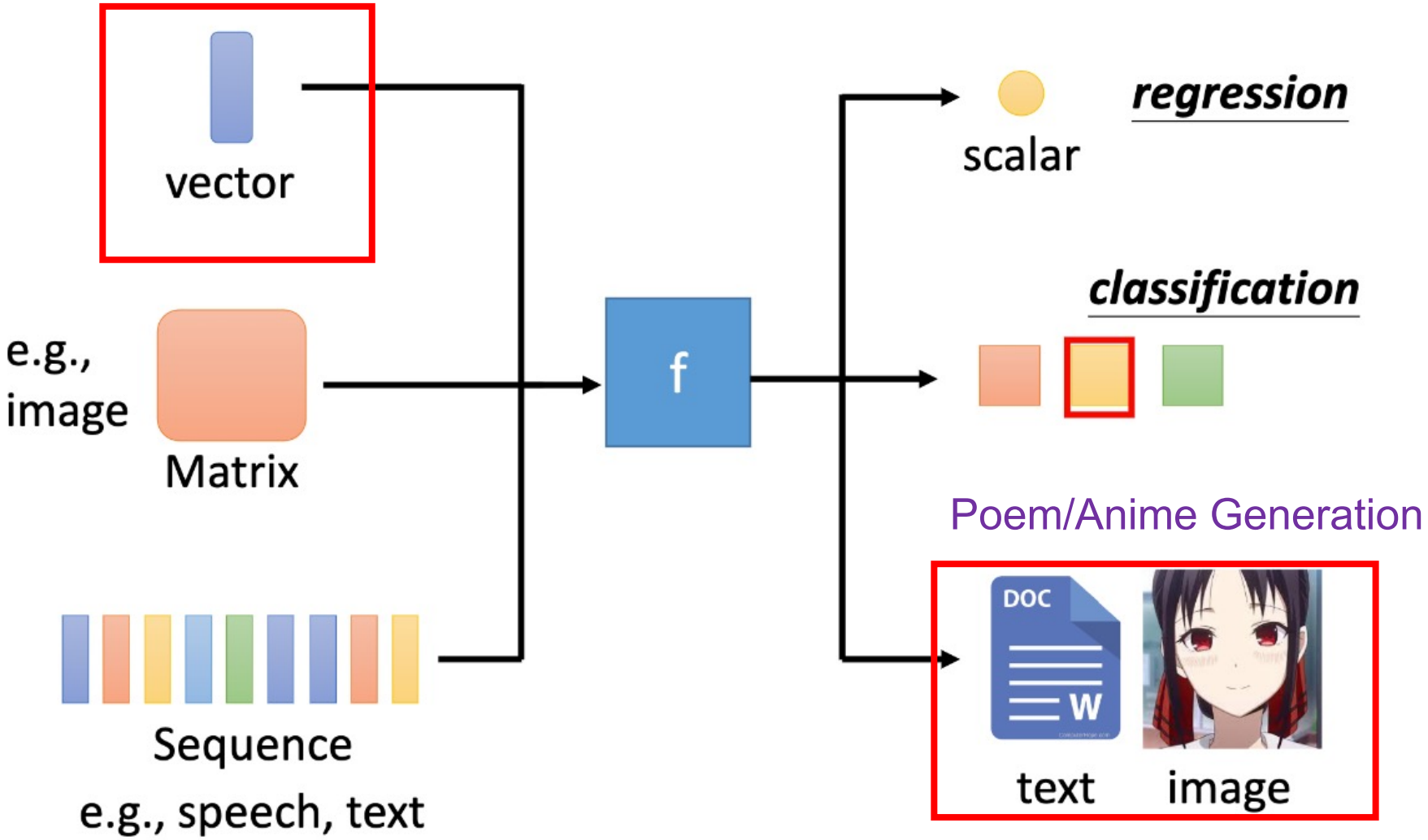
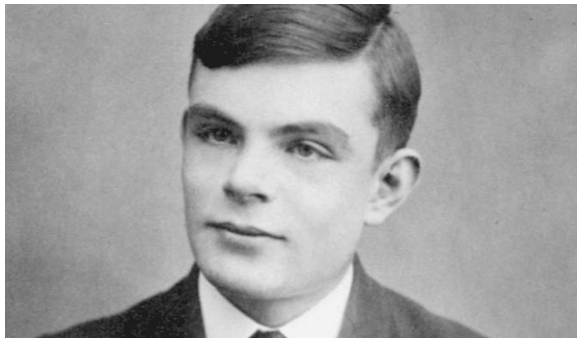


Referring to Hung-Yi Lee's teaching notes

Notable Names in AI

- Alan Turing (father of modern computer science):

"What we want is a machine that can learn from experience," and that the "possibility of letting the machine alter its own instructions provides the mechanism for this."[4]



- Geoffrey Hinton

"I have always been convinced that the only way to get artificial intelligence to work is to do the computation in a way similar to the human brain. That is the goal I have been pursuing. We are making progress, though we still have lots to learn about how the brain actually works."

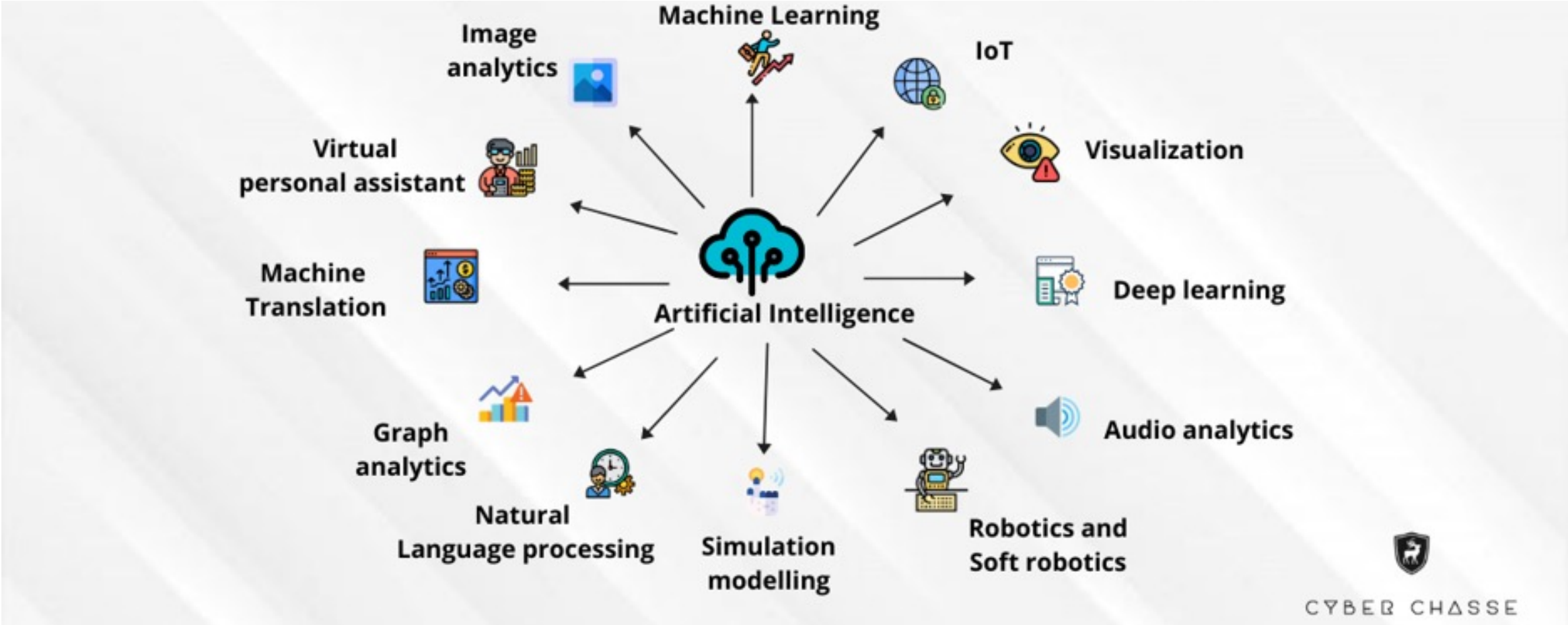
GODFATHERS OF AI

Yann Lecun (NYU, Founded Facebook's AI Research lab (FAIR))

Yoshua Bengio

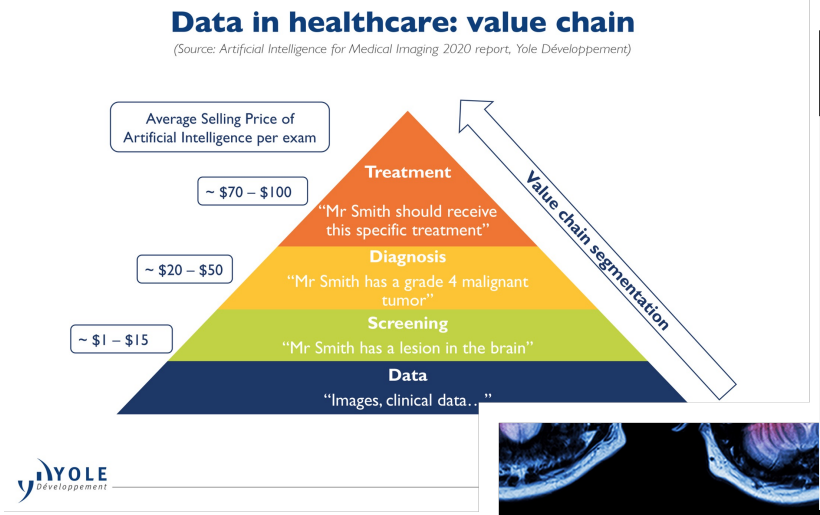
[4]Turing gave quite possibly the earliest public lecture (London, 1947) to mention computer intelligence. http://www.vordenker.de/downloads/turing-vorlesung.pdf

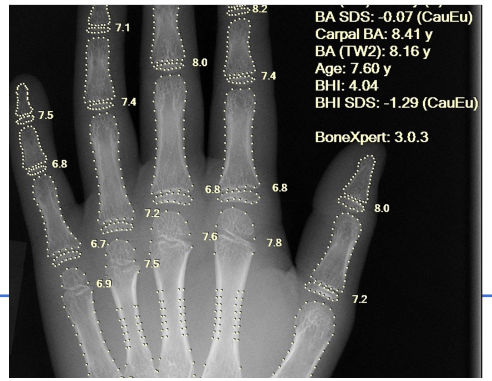
Scope of Today's AI

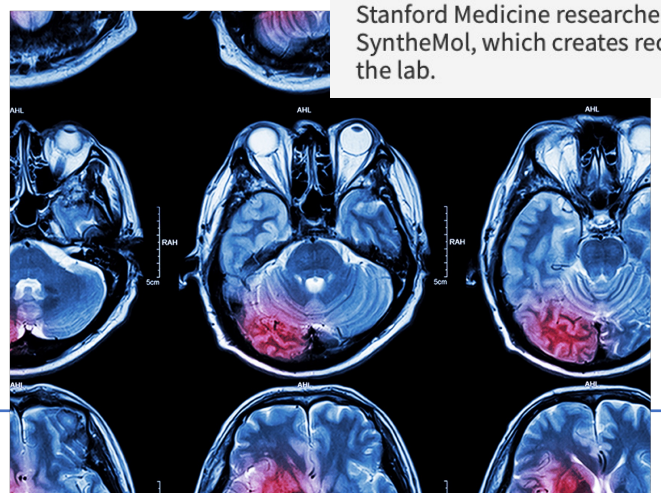


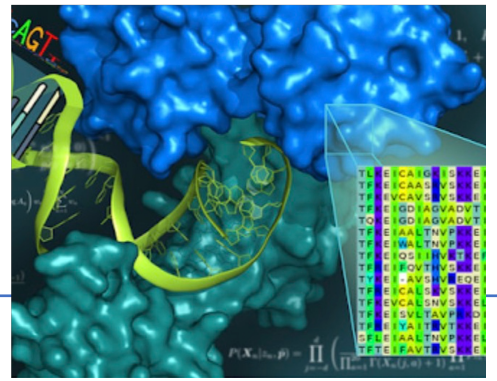
AI in healthcare

- AI in healthcare are applied to practices such as diagnosis processes, treatment protocol development, drug development, personalized medicine, patient monitoring and care.









AI in autonomous driving

- Autonomous driving is one of the key application areas of AI, as modern AI can help autonomous vehicles understand the surroundings and perform path planning.

The Self-Driving Car Companies Going The Distance

Number of autonomous test miles and miles per disengagement (Dec 2019-Nov 2020)*

	Miles	Miles per disengagement
Waymo (Alphabet)	628,839	29,945
Cruise (GM)	770,049	28,520
AutoX	40,734	20,367
Pony.AI	225,496	10,738
Argo.AI (Ford, VW)	21,037	10,519
WeRide	13,014	6,507
DiDi Chuxing	10,401	5,201
Nuro	55,370	5,034

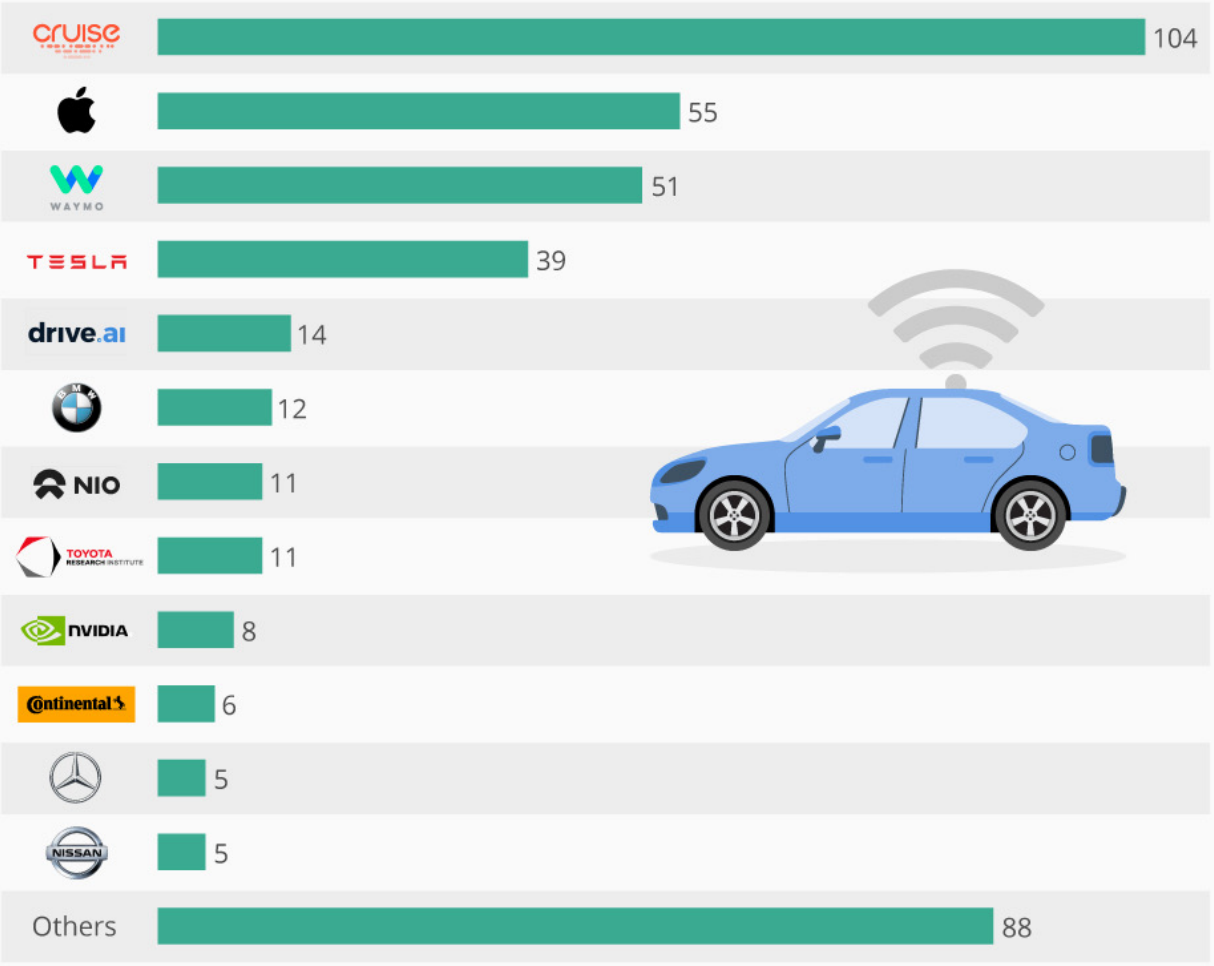
* Cases where a car's software detects a failure or a driver perceived a failure, resulting in control being seized by the driver.

Source: DMV California, via The Last Driver License Holder

Forbes statista

These Companies Are Testing Self-Driving Cars in California

Number of autonomous vehicles registered to be tested on public roads in California*



* As of May 9, 2018

@StatistaCharts Source: California DMV/Business Insider

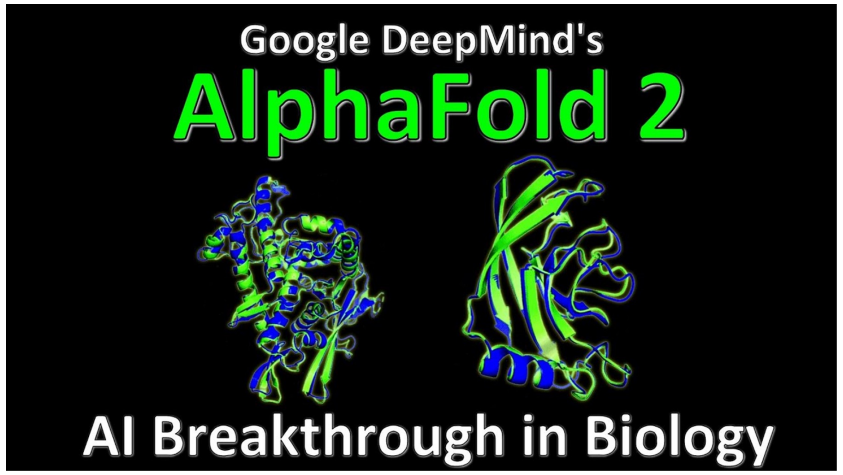
statista

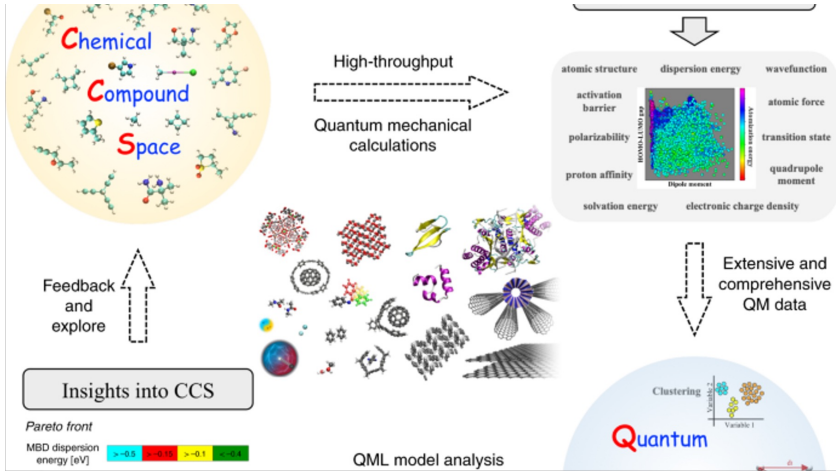
AI in robots

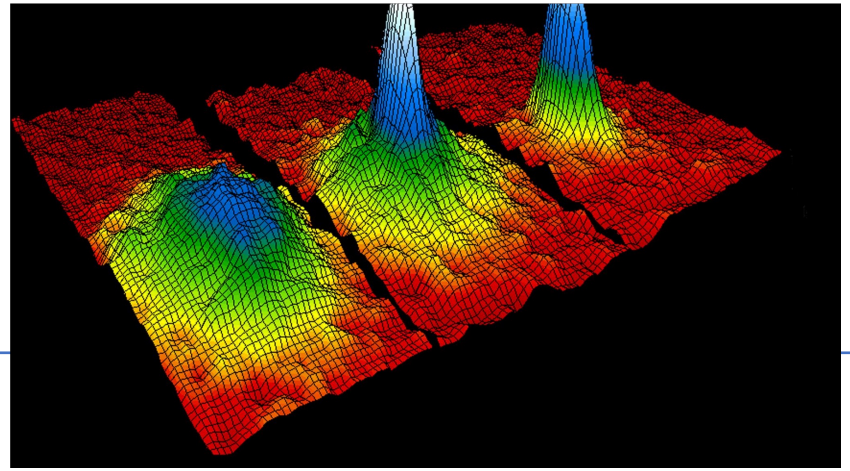
- Robot learning is a research field at the intersection of AI and robotics. It studies techniques allowing a robot to acquire novel skills or adapt to its environment through learning algorithms.

AI in science

- AI algorithms have helped the scientific research of biology, chemistry, physics, finance and so on.

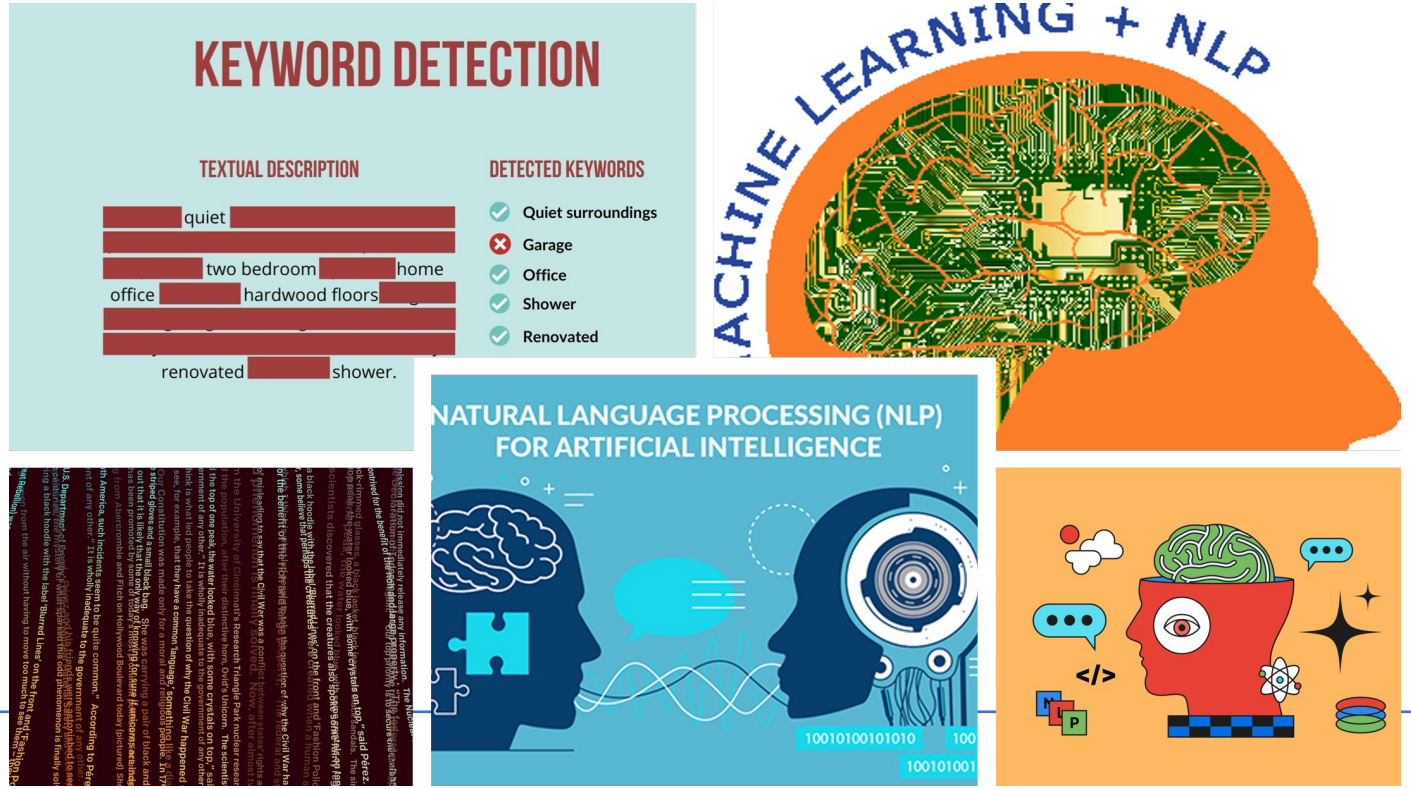






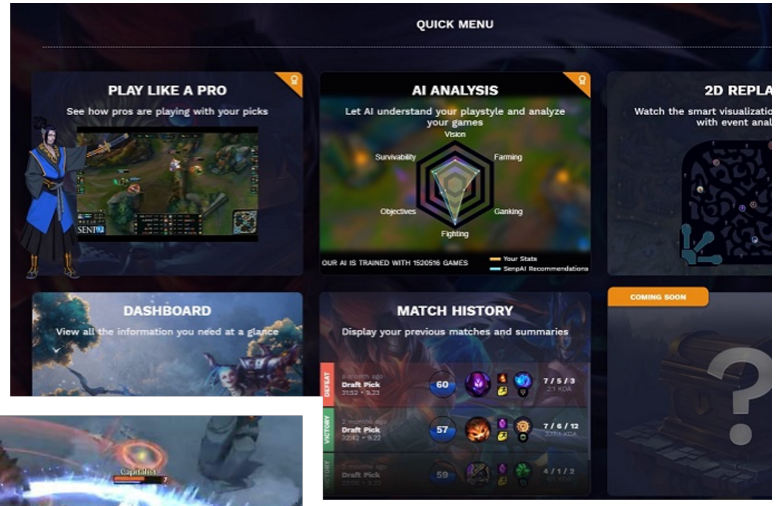
AI in languages

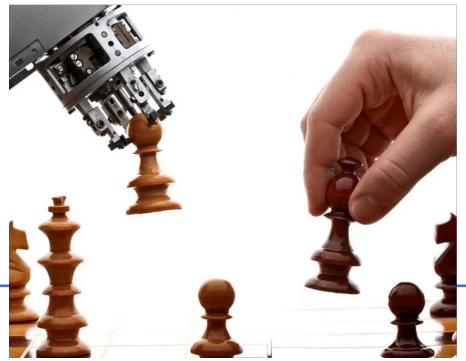
- Natural language processing (NLP) is a subfield of linguistics, computer science, and artificial intelligence concerned with the interactions between computers and human language, in particular how to program computers to process and analyze large amounts of natural language data.



AI in gaming

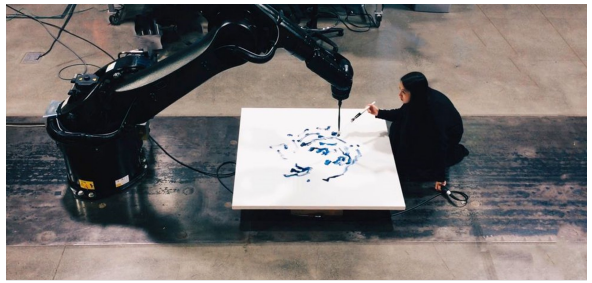
- AI is used to generate responsive, adaptive or intelligent behaviors primarily in non-player characters (NPCs) similar to human-like intelligence in gaming.

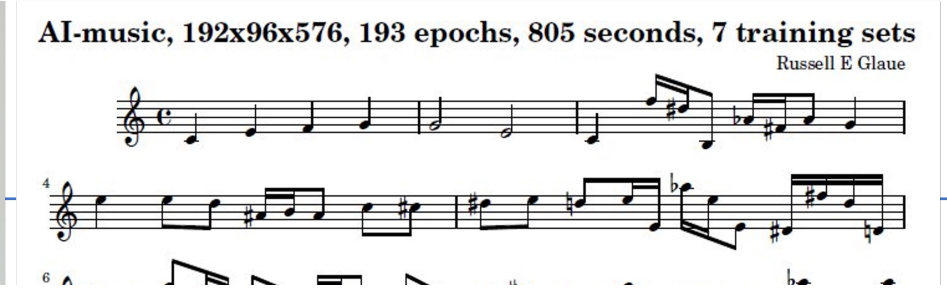




AI in art

- AI in Art refers to any artwork created with the assistance of AI. It includes works created autonomously by AI systems and works from a collaboration between human and AI.



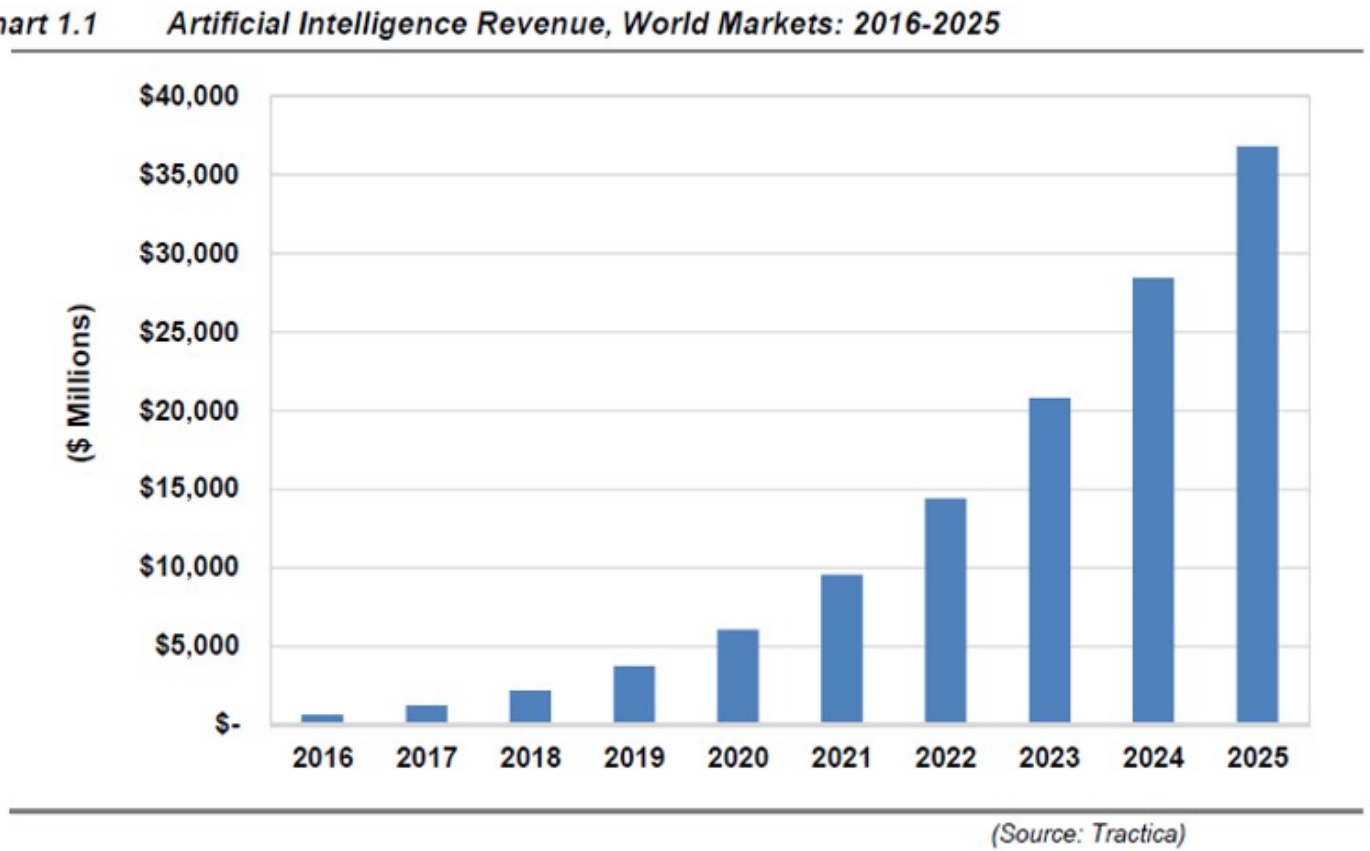


Nowadays AI industry

1	Chips & hardware	NVIDIA, Google, Qualcomm, IBM, amazon, Apple, Microsoft, intel, Graphcore, Samsung, AMD
2	Platform & infrastructure	Google Cloud Platform, amazon web services, Microsoft Azure, Alibaba Cloud aliyun.com, IBM Cloud
3	Frameworks & algorithms	IBM, amazon, Microsoft, Google, Facebook, Baidu
		Conversational agents**: MindMeld
		Speech: SoundHound
		NLP & Semantics: LEXALYTICS
		Core Algorithms: DeepMind, vicarious, Numenta
		Vision: clarifai, Captricity
4	Enterprise Solutions	IBM, ORACLE, salesforce, SAP, Microsoft
		Customer Management: DigitalGenius, ZipRecruiter, ACTIONIQ
		HR & Talent: Hire Vue, workey
		Marketing & Sales: Insider Sales.com, 6sense, afiniti
		RPA, Other: blueprism, UiPath
		Intelligence & Analytics: Digital Reasoning, Dataminr
		Cybersecurity: DARKTRACE, CYLANCE
		Tools: PETUUM, SELDON, tamr
		Consultants: KPMG, pwc, accenture, Deloitte.
5	Vertical Industry solutions	Healthcare & Life Sciences: TEMPUS, BenevolentAI, babylon health, zymergen, DeepMind
		Finance & Insurance: zest finance, affirm, NUMERAI
		Agriculture: BENSON·HILL, FarmersEdge, prospera
		Automotive: drive.ai, ZOOX, WAYMO
		Legal & Compliance: Luminance, casetext, onfido, ROSS
		Industrials, Robotics & Logistics: brain corp, anki, deepvu, LOGILITY, Vekia
6	Corporates	Healthcare: NHS, gsk
		Finance & Insurance: AXA, usbank, J.P.Morgan
		Tech & Telco: Alibaba.com, Microsoft, Google, Facebook, Baidu
		Agriculture: MONSANTO, CONAGRA
		Automotive: Ford, GM
		Legal & Compliance: ALLEN & OVERY, WHITE & CASE
		Industrials, GENERAL ROBOTICS, GE, BOEING
		Retail, media, other: TARGET, Disney

The rise of AI market

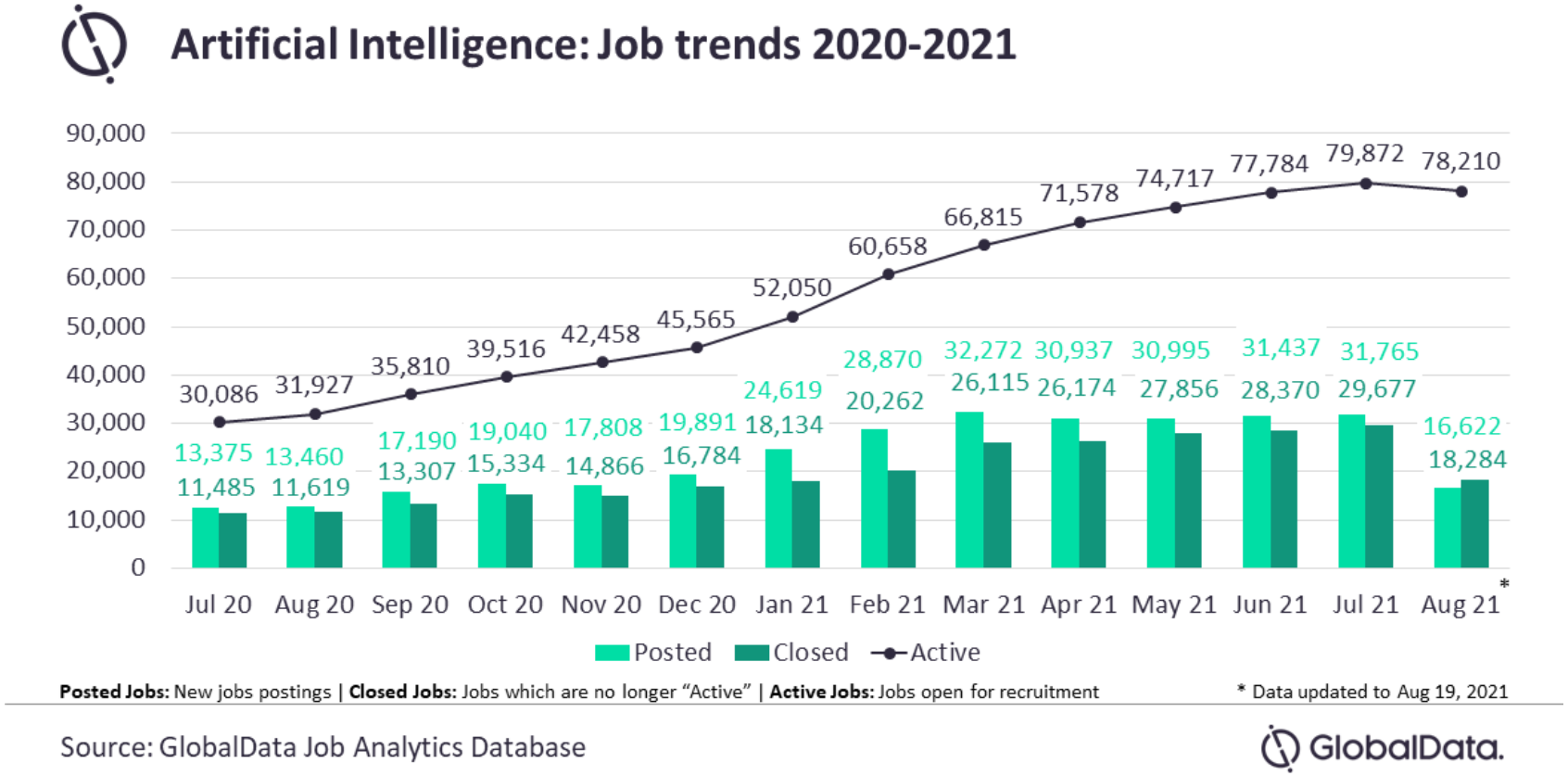
- A new report forecasts that the annual global revenue for artificial intelligence products and services will grow from 643.7 million in 2016 to $36.8 billion by 2025 [9]:



[9]News: Market for Artificial Intelligence Projected to Hit $36 Billion by 2025

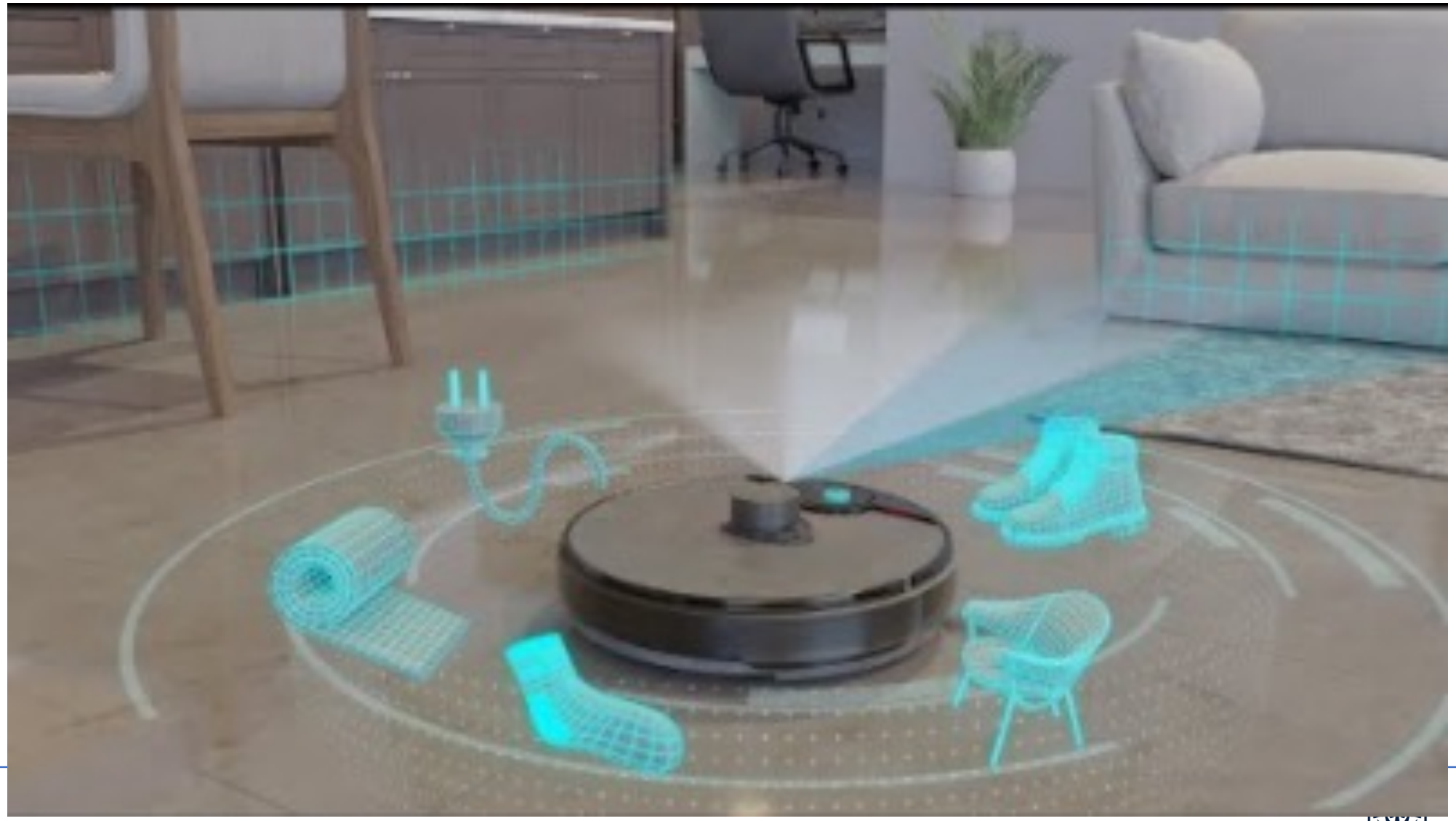
The rise of AI jobs

- AI-related jobs have increased by 165% since July 2020 due to rapid rise of digitization [10]:



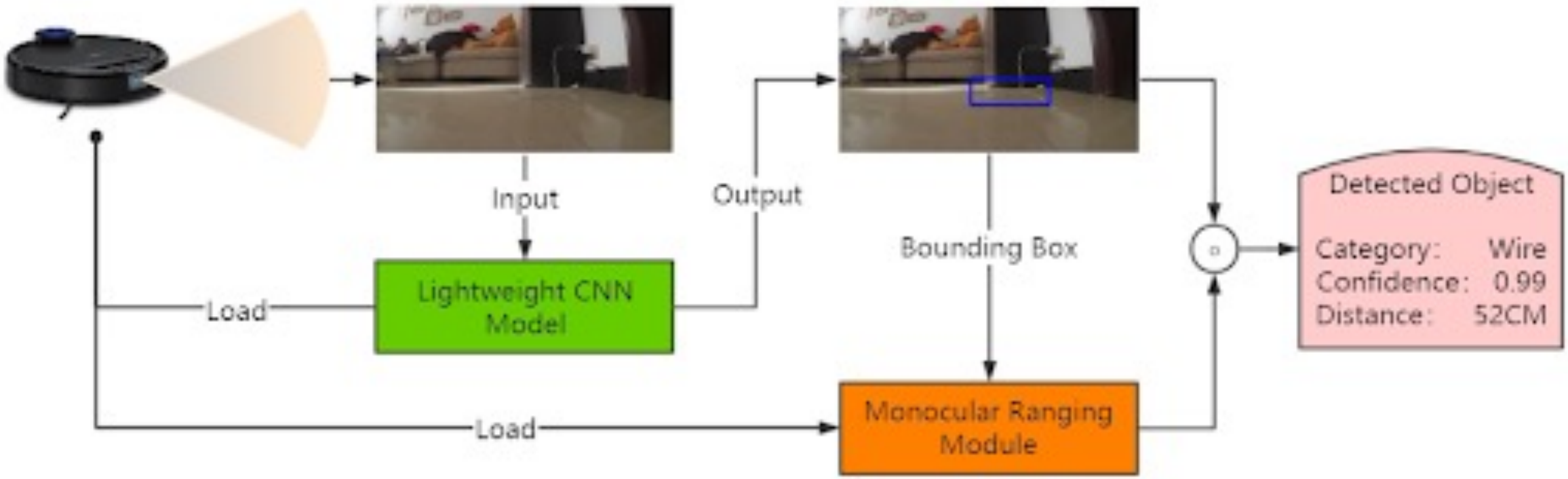
[10]https://www.globaldata.com/ai-related-jobs-increased-165-since-july-2020-duerapid-rise-digitization-says-globaldata/

Example: ML in Daily Life



ML system for cleaning robot

A pipeline describing how to combine different components



How do you want to leverage ML?

What will be your own answer at the end of this semester?

- An interesting course that you have taken?
- A research area that you want to study in your graduate school?
- An area in which you want to develop your career?

Carpe Diem

SEIZE THE DAY

Make your life an extraordinary one!
- Dead Poet's Society