Artificial Intelligence Fundamentals

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Introduction

- AI is creating tremendous amounts of value in every industry

- In sectors such as retail, travel, transportation, automotive, materials, manufacturing and so on.
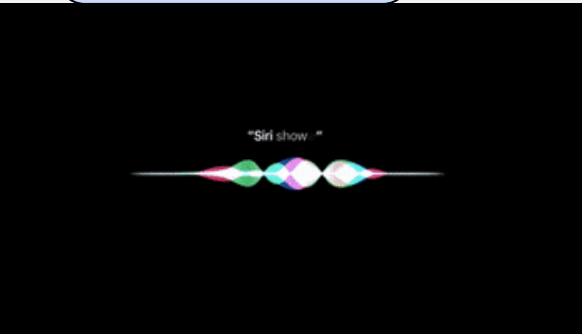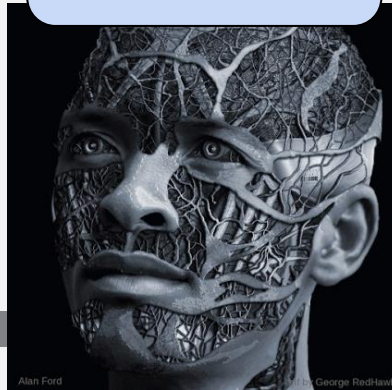
Introduction

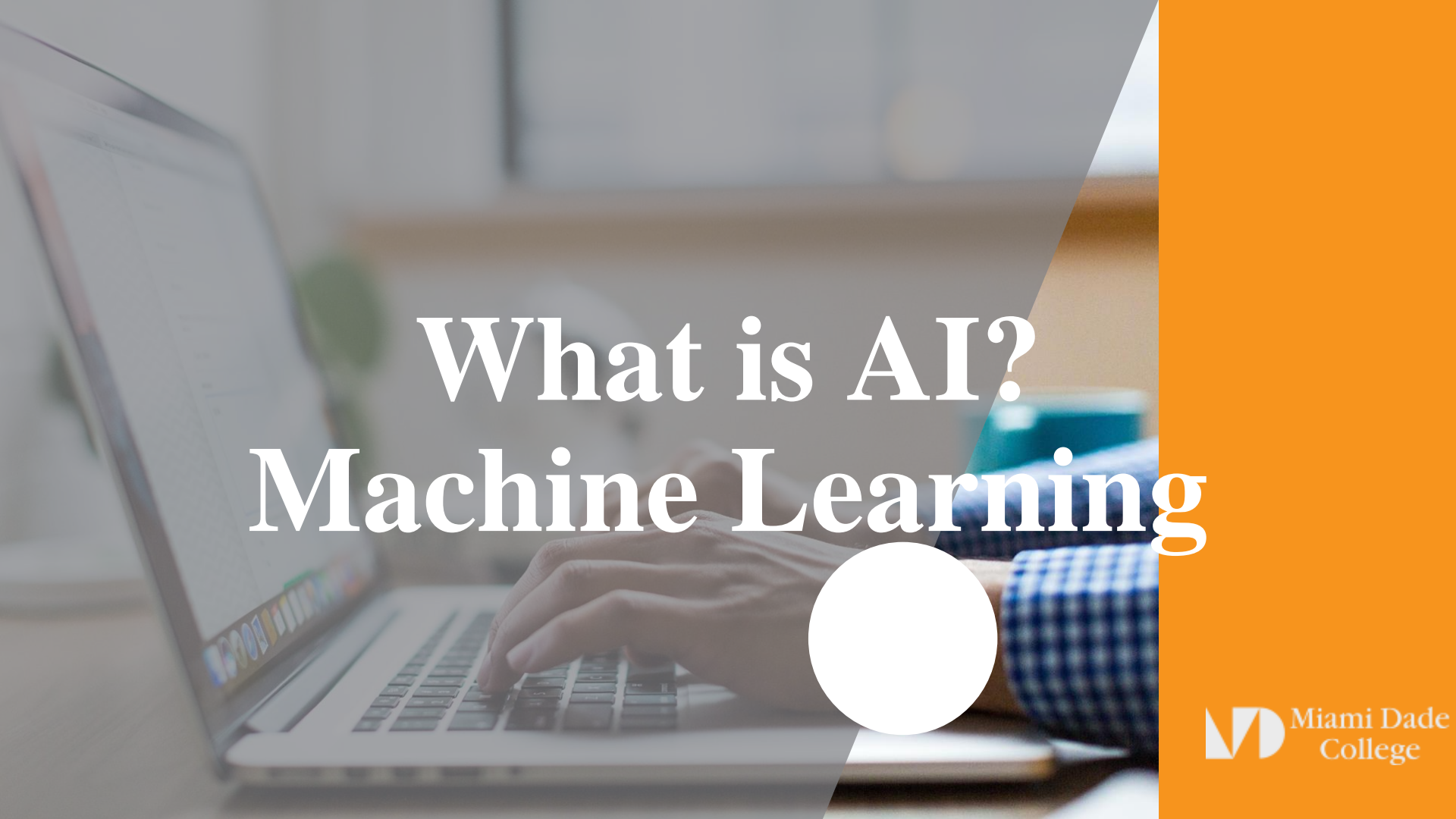
NARROW AI

GENERAL AI

Introduction

AI

ANI

AGI

ASI

What is Data Analytics/Data Science
- **Machine Learning**
- **Data**
- **AI Organizations**
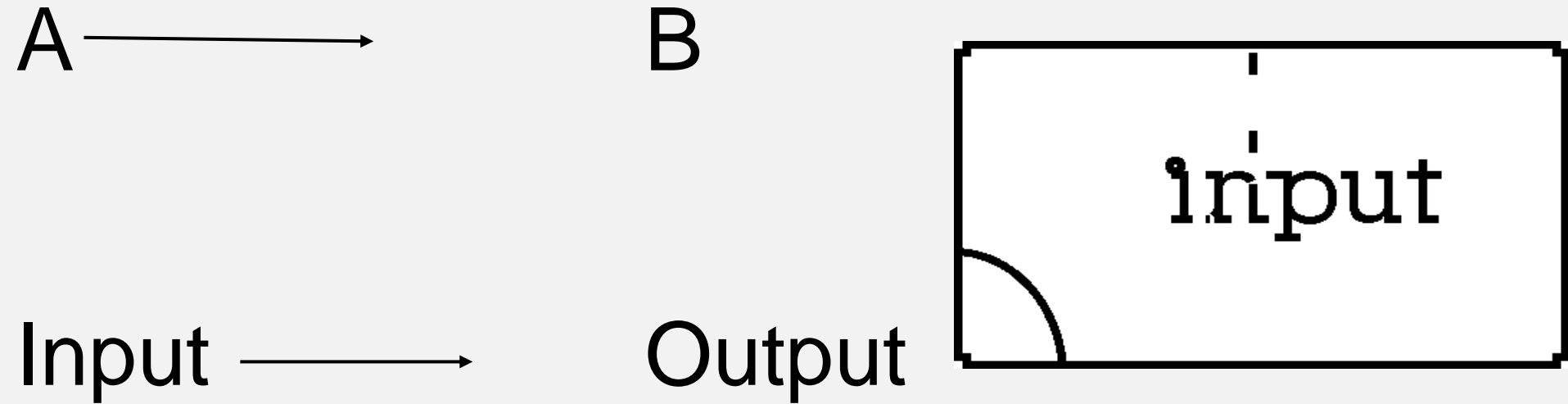- **What can you really do with this?**
- **Deep Learning**

What is AI? Machine Learning

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Machine Learning

- The rise of AI has been largely driven by one tool in AI:
  - **machine learning.**
- In this you'll learn what machine learning is, so that by the end, you will start thinking how machine learning might be applied to a business

Supervised Learning

A

B

Input

Output

Machine Learning

Input → Process → Output	Use Cases
User Information → MODEL → Click?	Social Media. Online Advertising
email → Model → Spam	Spam Filter
Video → Model → Transcript	Speech Recognition
Shopping History → Model → Offers	Recommender Systems
English → Model → Spanish	Speech Translation
Product Image → Model → Defective	QA

INPUT → PROCESS → OUTPUT
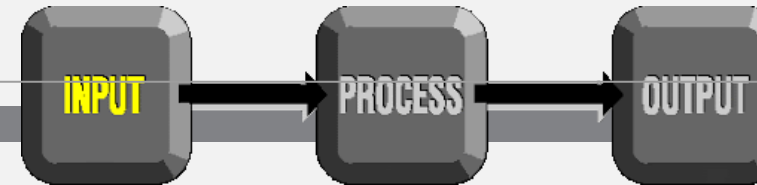
Why Now
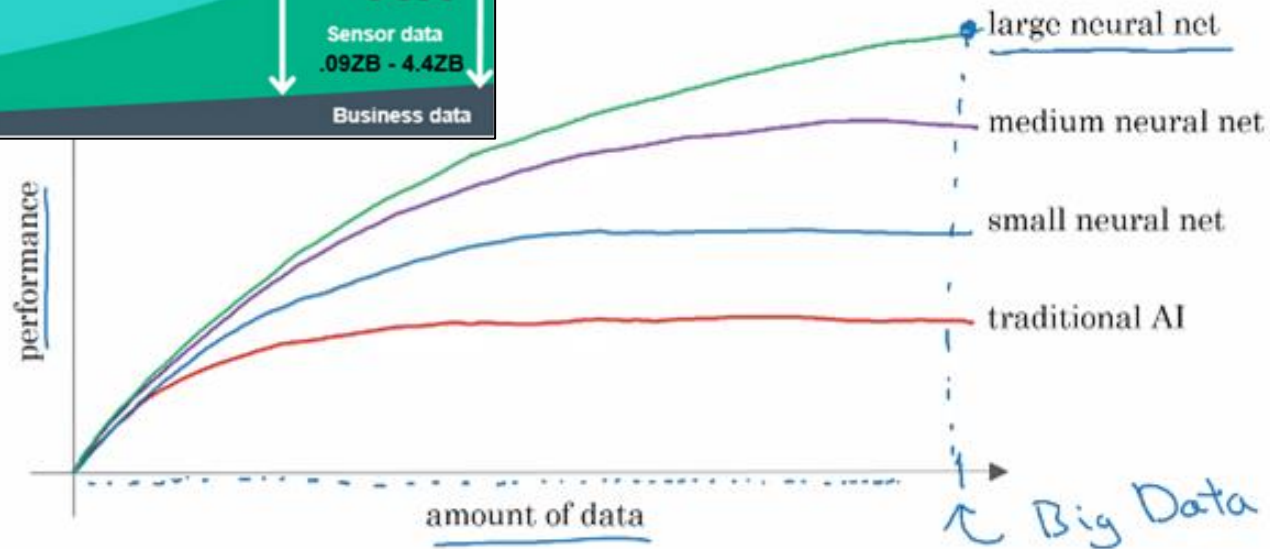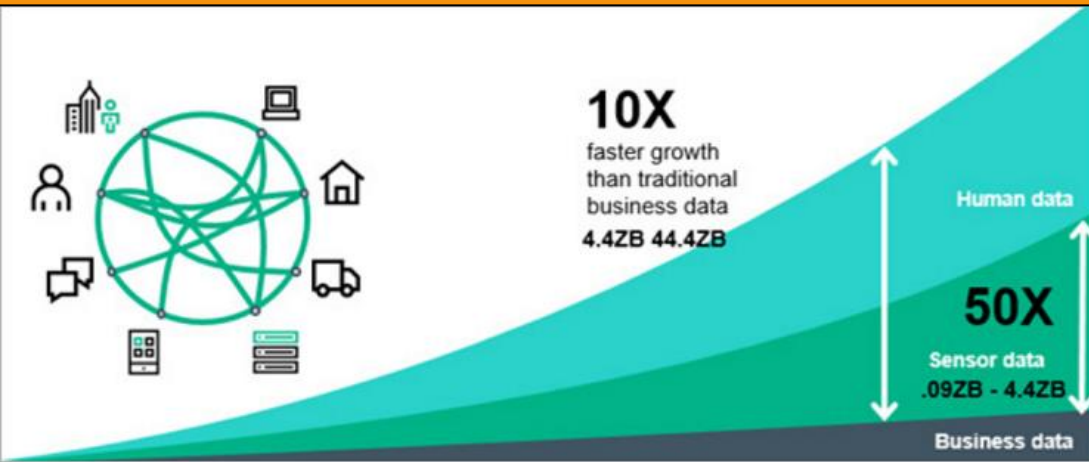
What is AI?
What is data?

Example of Table Of Data (dataset)

Age	Income	Loan Status
21	20000	Rejected
37	55000	Approved
29	35000	Approved
23	17000	Rejected
34	70000	Approved
47	84000	Rejected
25	30000	Approved

Input	Image Label
	Dog
	Dog
	Cat
	Dog
	Cat
	Cat
	Dog

Acquiring Data

- Manual labeling

 cat

 not cat

 cat

 not cat

- From observing behaviors

user ID	time	price ($)	purchased
4783	Jan 21 08:15.20	7.95	yes
3893	March 3 11:30.15	10.00	yes
8384	June 11 14:15.05	9.50	no
0931	Aug 2 20:30.55	12.90	yes

machine	temperature (∘C)	pressure (psi)	machine fault
17987	60	7.65	N
34672	100	25.50	N
08542	140	75.50	Y
98536	165	125.00	Y

A   B

- Download from websites / partnerships

Data is Messy

- Garbage in, garbage out

- Data problems
  - Incorrect labels
  - Missing values

- Multiple types of data

  images, audio, text

  unstructured

size of house (square feet)	# of bedrooms	price (1000$)
523	1	115
645	1	0.001
708	unknown	210
1034	3	unknown
unknown	4	355
2545	unknown	440

structured

What is AI?
The terminology of AI

LEARNING
VOYAGE

The terminology of AI

- You might have heard terminology from AI, such as machine learning or data science or neural networks or deep learning. What do these terms mean?

- In this, you'll see what is this terminology of the most important concepts of AI, so that you will speak with others about it and start thinking how these things could apply in your business.

Machine Learning vs. Data Science

Home prices

size of house (square feet)	# of bedrooms	# of bathrooms	newly renovated	price (1000$)
523	1	2	N	115
645	1	3	N	150
708	2	1	N	210
1034	3	3	Y	280
2290	4	4	N	355
2545	4	5	Y	440

A

B

ML.   A → B

DS

Running AI system
(e.g., websites / mobile app)

Homes with 3 bedrooms are more expensive
than homes with 2 bedrooms of a similar size.

Newly renovated homes have a 15% premium.

Machine Learning vs.Data Science

Machine learning

"Field of study that gives computers the ability to learn without being explicitly programmed."
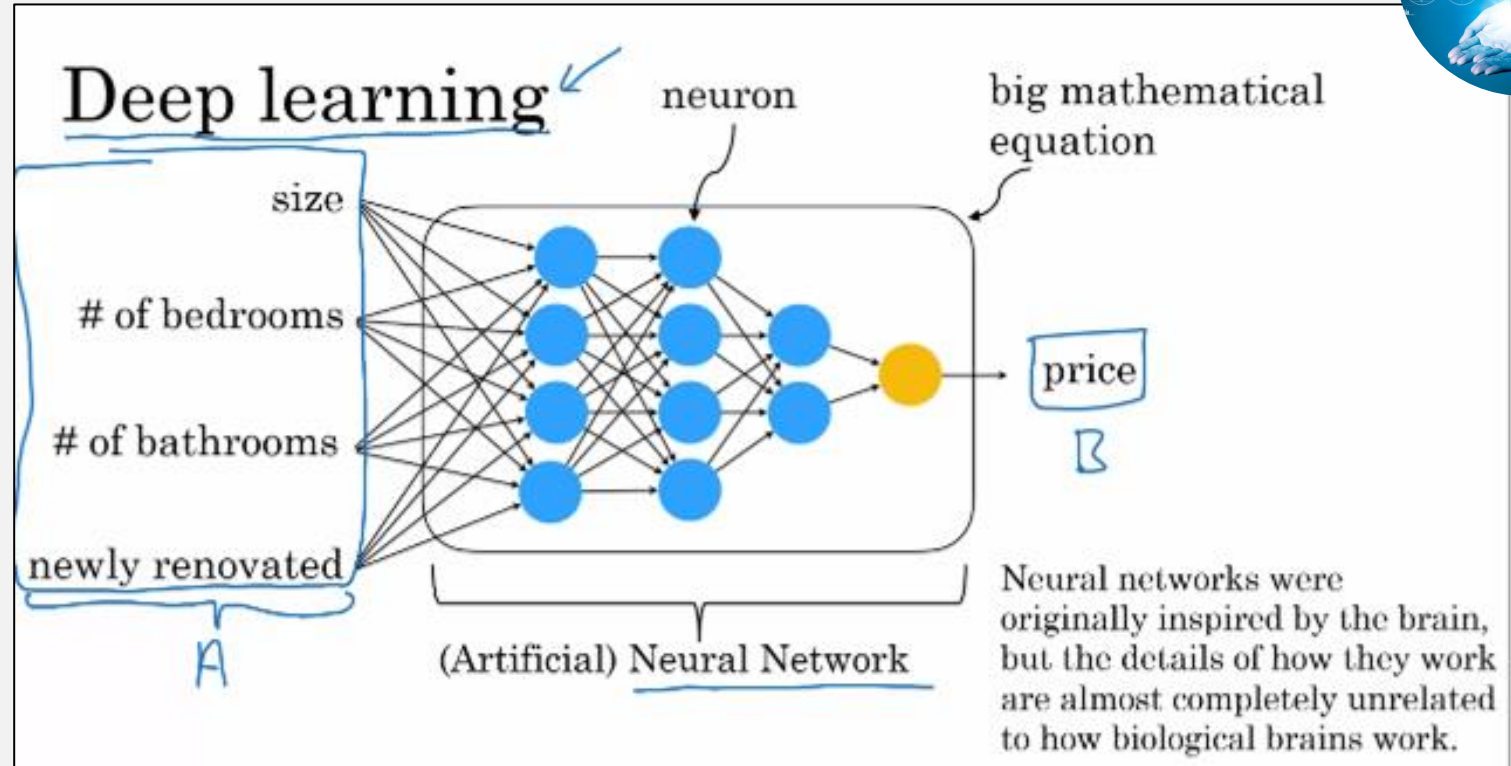
→ software

-Arthur Samuel (1959)

Data science

Science of extracting knowledge and insights from data.

→ slide deck

Deep learning

neuron

big mathematical equation

size

# of bedrooms

# of bathrooms

newly renovated

price

(Artificial) Neural Network

Neural networks were originally inspired by the brain, but the details of how they work are almost completely unrelated to how biological brains work.
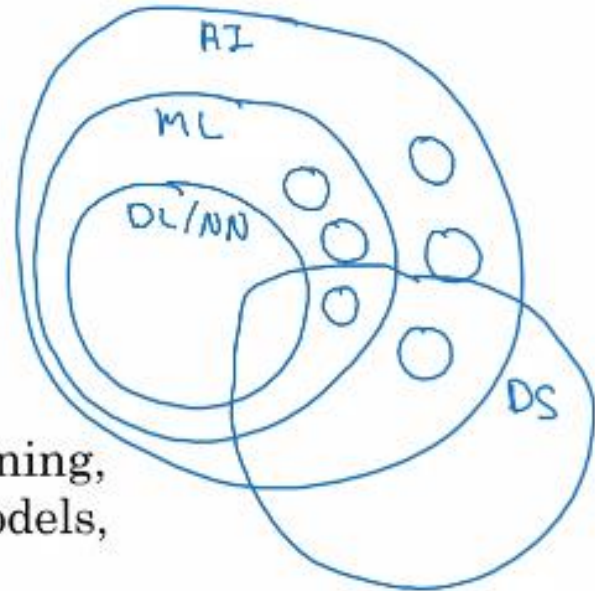
The terminology of AI

AI has many tools

- Machine learning and data science

- Deep learning / neural network

- Other buzzwords: Unsupervised learning, reinforcement learning, graphical models, planning, knowledge graph, ...

What is AI?
What makes an AI company?

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What makes an AI company?

- What makes a company good at AI? Perhaps even more importantly, what will it take for your company to become great at using AI?

- So, what can you do for your company?
- This is the lesson I had learned by watching the rise of the Internet that I think will be relevant to how all of us navigate the rise of AI.

What makes an AI company?

A lesson from the rise of the Internet

Internet Era   AI era

What makes an AI company?

A lesson from the rise of the Internet

Internet Era

Shopping mall + website
≠ Internet company

AI era

Any company + deep learning
≠ AI company

What makes an AI company?

A lesson from the rise of the Internet

Internet Era

Shopping mall + website
≠ Internet company

- A/B testing
- Short iteration time
- Decision making pushed down to engineers and other specialized roles

AI era

Any company + deep learning
≠ AI company

- Strategic data acquisition
- Unified data warehouse
- Pervasive automation
- New roles (e.g., MLE) and division of labor

What is AI?
What machine learning can and cannot do

LEARNING
VOYAGE

What machine learning can and cannot do

- In these slides and the next slides, I hope to help you develop intuition about what AI can and cannot do. In practice, before I commit to a specific AI project, I'll usually have either myself or engineers do technical diligence on the project to make sure that it is feasible.

- This means: looking at the data, look at the input, and output A and B, and just thinking through if this is something AI can really do.

Supervised learning

Input (A)	Output (B)	Application
email	spam? (0/1)	spam filtering
audio	text transcripts	speech recognition
English	Chinese	machine translation
ad, user info	click? (0/1)	online advertising
image, radar info	position of other cars	Self-driving car
image of phone	defect? (0/1)	visual inspection

Anything you can do with 1 second of thought, we can probably now or soon automate.

What machine learning can and cannot do

The toy arrived two days late, so I wasn't able to give it to my niece for her birthday.
Can I return it?

"Refund request"

Oh, sorry to hear that.
I hope your niece had a good birthday.
Yes, we can help with....

Input text → Refund/Shipping/Other

A → B

What Happens If You Try?

Input (A)
User email

Output (B)
2-3 paragraph response

1000 examples

"My box was damaged." → Thank you for your email.

"Where do I write a review?" → Thank you for your email.

"What's the return policy?" → Thank you for your email.

"When is my box arriving?" → Thank yes now your....

What makes an ML Problem Easier

1. Learning a "simple" concept

   ≤ 1 sec

2. Lots of data available

   A, B

   A $\longrightarrow$ B

- One of the challenges of becoming good at recognizing what AI can and cannot do is that it does take seeing a few examples of concrete successes and failures of AI.

- If you work on an average of say, one new AI project a year, then to see three examples would take you three years of work experience and that's just a long time.

Self Driving Car

More examples of what machine learning can and cannot do

- Say you want to build an AI system to look at X-ray images and diagnose pneumonia. So, all of these are chest X-rays.
  - So, the input A could be the X-ray image and the output B can be the diagnosis.

- Does this patient have pneumonia or not?
  - So, that's something that AI can do.

- Something that AI cannot do would be to diagnose pneumonia from 10 images of a medical textbook chapter explaining pneumonia.

X Ray Diagnosis

Can do

Diagnose pneumonia from ~10,000 labeled images

A ⟶ B

Cannot do

Diagnose pneumonia from 10 images of a medical textbook chapter explaining pneumonia
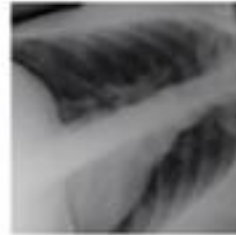
A ⟶ B

Strengths and Weaknesses Of ML

ML tends to work well when:
1. Learning a "simple" concept
2. There is lots of data available

ML tends to work poorly when:
1. Learning complex concepts from small amounts of data
2. It is asked to perform on new types of data

A→B
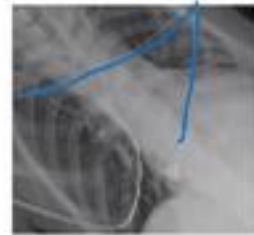
More examples of what machine learning can and cannot do

- I hope these examples are helping you hone your intuitions about what AI can and cannot do. In case the boundary between what it can or cannot do still seems fuzzy to you, don't worry.
- It is completely normal, completely okay. In fact even today, I still can't look at a project and immediately tell is something that's feasible or not.
- I often still need weeks or small numbers of weeks of technical diligence before forming strong conviction about whether something is feasible or not.
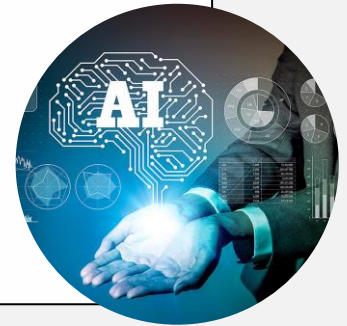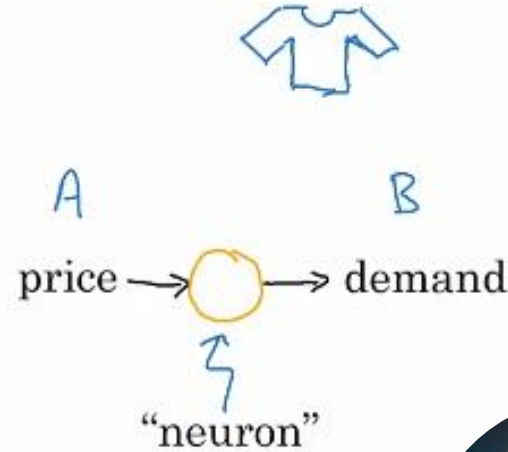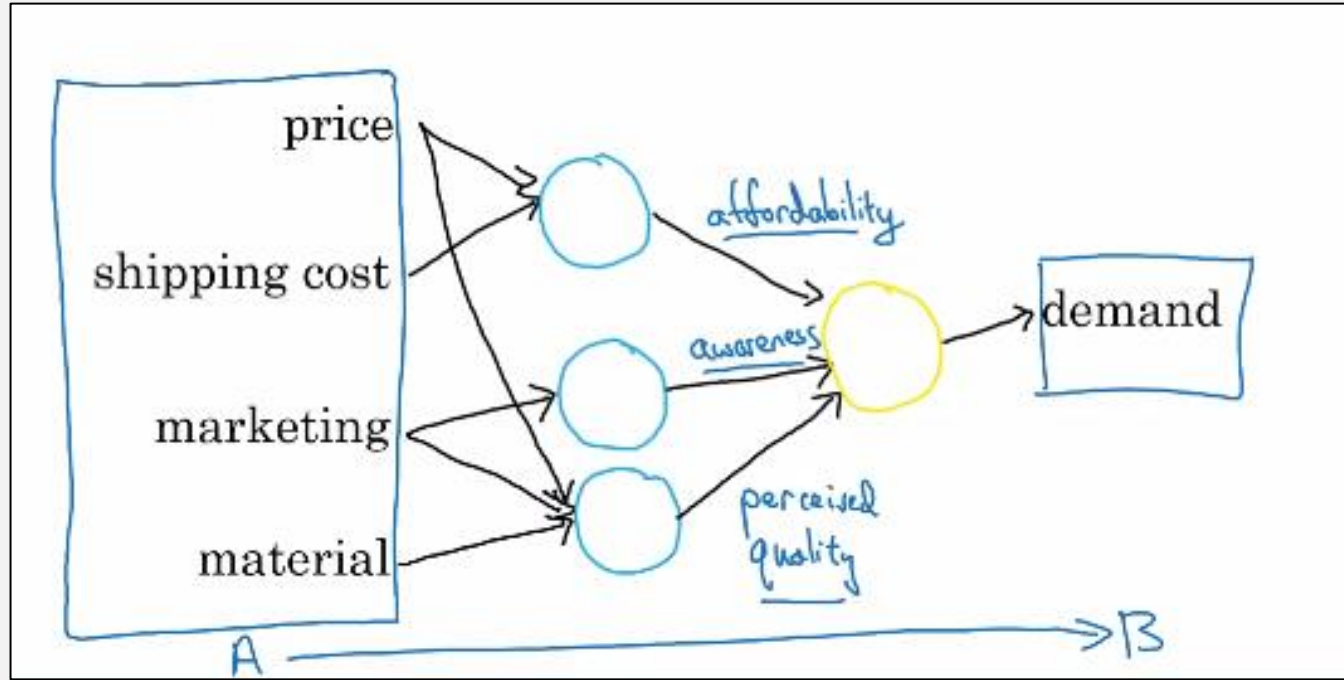
Demand Prediction

- Suppose that instead of knowing only the price of the product, you also have the shipping costs that the customers will have to pay to get the product.

- May be you spend more or less on marketing in a given week, and you can also make the product out of high quality material.
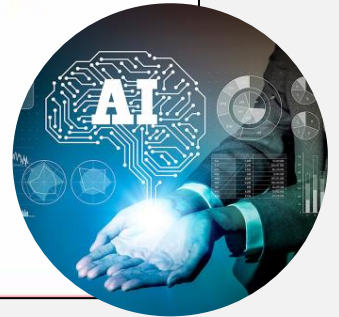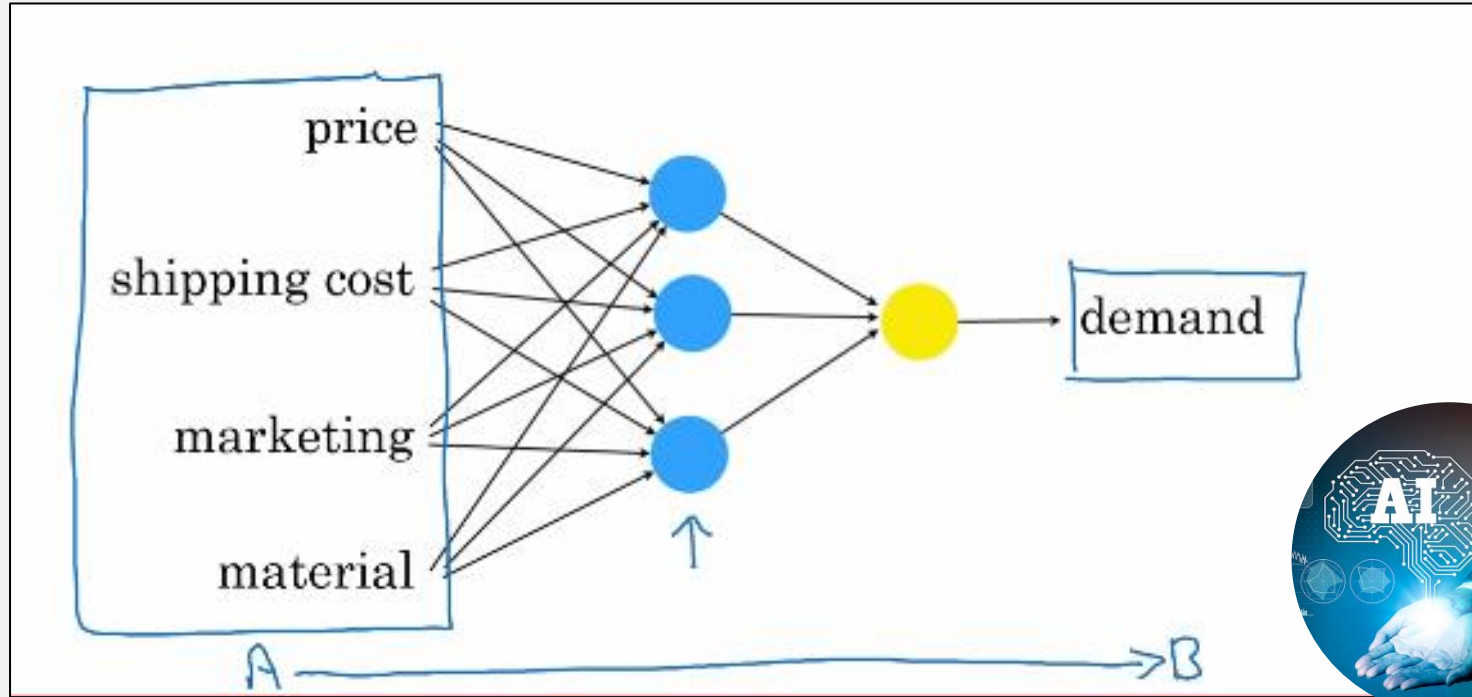
Demand Prediction

Non-technical explanation of deep learning (Part 1, optional)

- So It learns this input output or A to B mapping.

- This is a fairly small neural network with just four artificial neurons.

- In practice, neural networks used today are much larger, with easily thousands, tens of thousands or even much larger than that numbers of neurons.

Demand Prediction

Non-technical explanation of deep learning (Part 1, optional)

- So that's a neural network, is a group of artificial neurons each of which computes a relatively simple function.

- But when you stack enough of them together like Lego bricks, they can compute incredibly complicated functions that give you very accurate mappings from the input A to the output B.

- Now, in this you saw an example of neural networks applied to demand prediction.

Face Recognition

Non-technical explanation of deep learning (Part 2, optional)