Framing Problems in **Machine Learning**

An Introduction

Types of Problems

- Before jumping into modeling, decide on what problem you want to work on and whether a model is suitable for solving the problem

Types of Problems

- If a model could potentially help solve a problem: what is the input, and what is the output?

Regression

- From input variables, predict a continuous (real-numbered) value

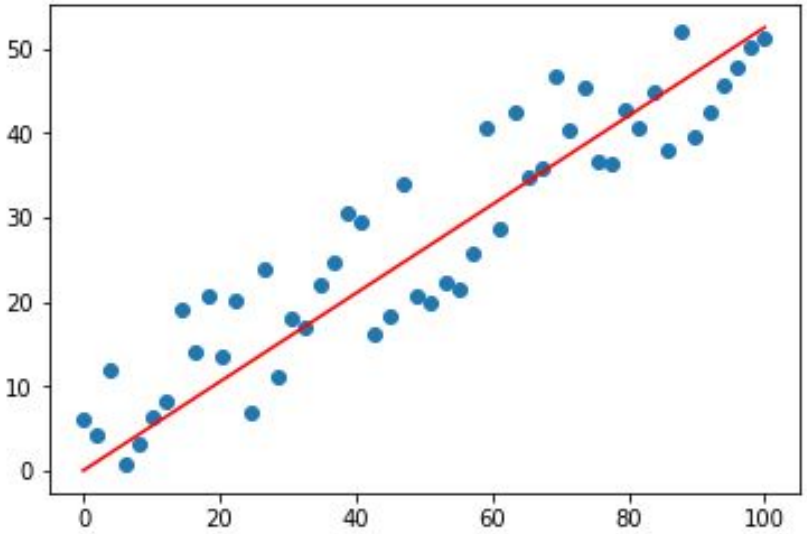
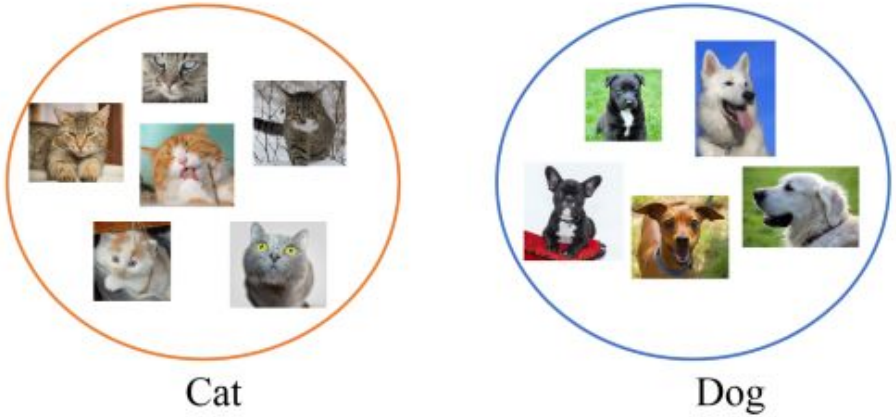


Image source:
https://www.kaggle.com/code/sasakitetsuya/dog-and-cat-classification-by-mobilenet

Classification

- From input variables, predict a class that the data point belongs to
- e.g., image classification



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Other Types of Problems

- Text-to-text (e.g., using an LLM)
- Text-to-image (e.g., image generation using diffusion models)
- Image-to-text (e.g., captioning)
- Image-to-image (e.g., segmentation)

- These problems can be decomposed into regression and classification problems (predicting more than one value), but there exists special paradigms to deal with these cases

Other Types of Problems

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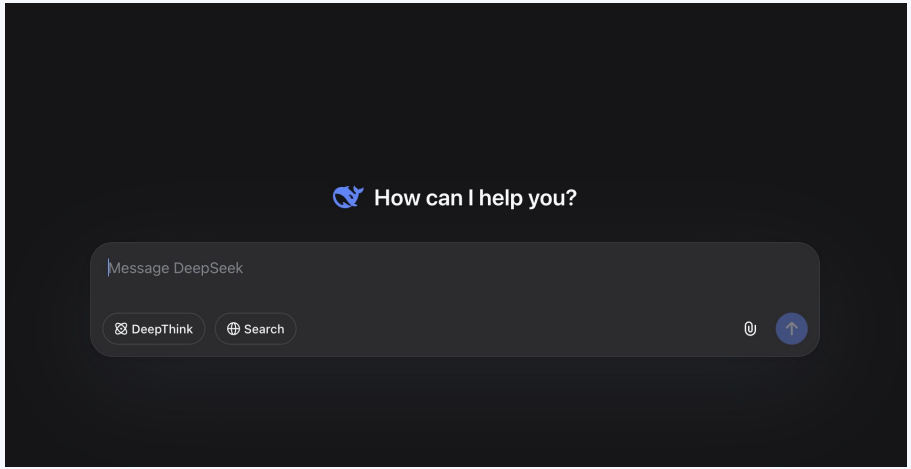

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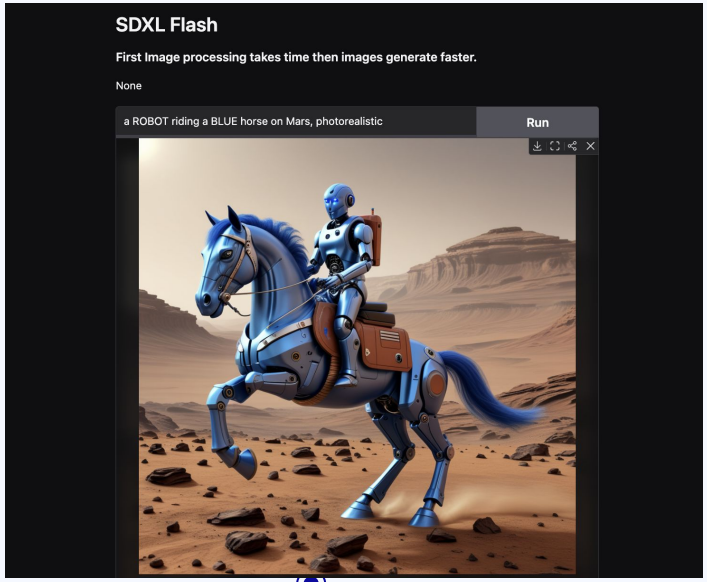

Other Types of Problems`

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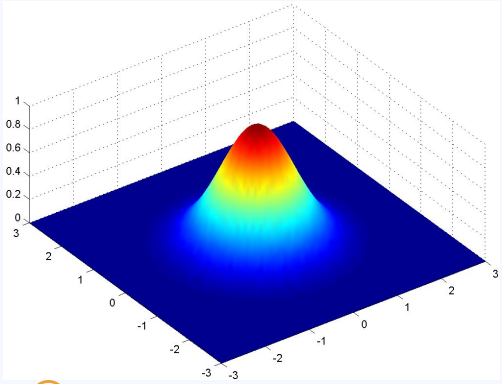
Other Types of Problems

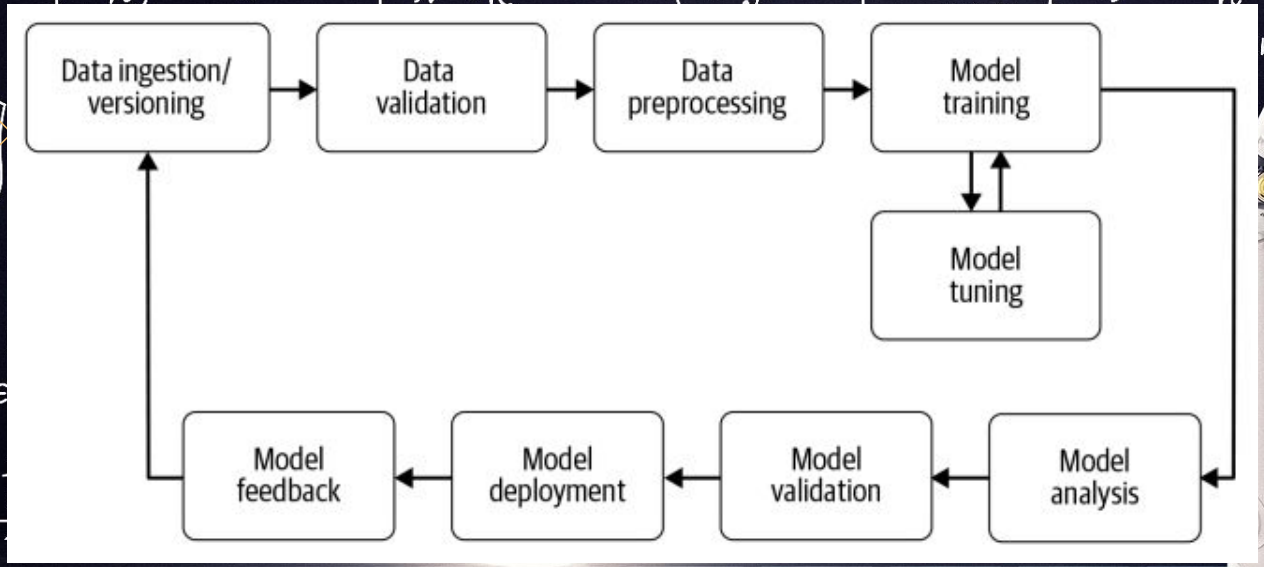
- Image-to-image (e.g., segmentation)

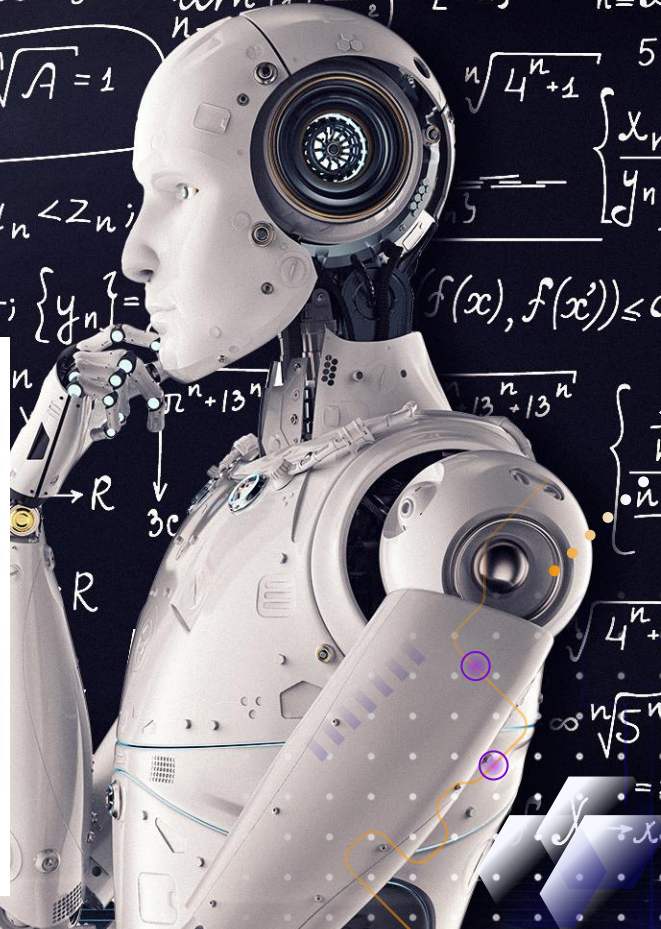
Examples

- What kind of problem is predicting exam scores?
- What kind of problem is spam detection?



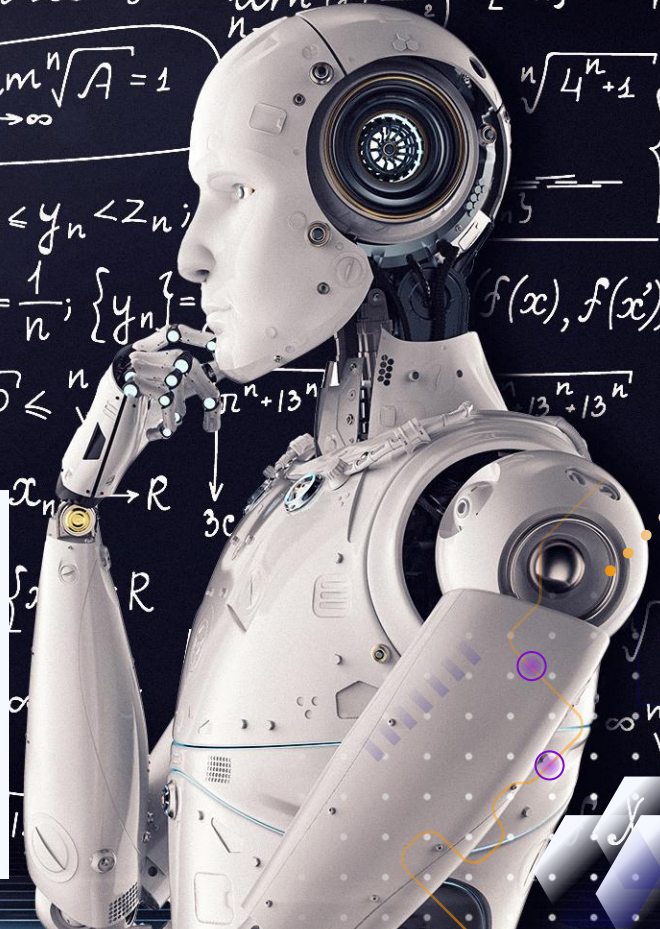
Machine Learning Procedure





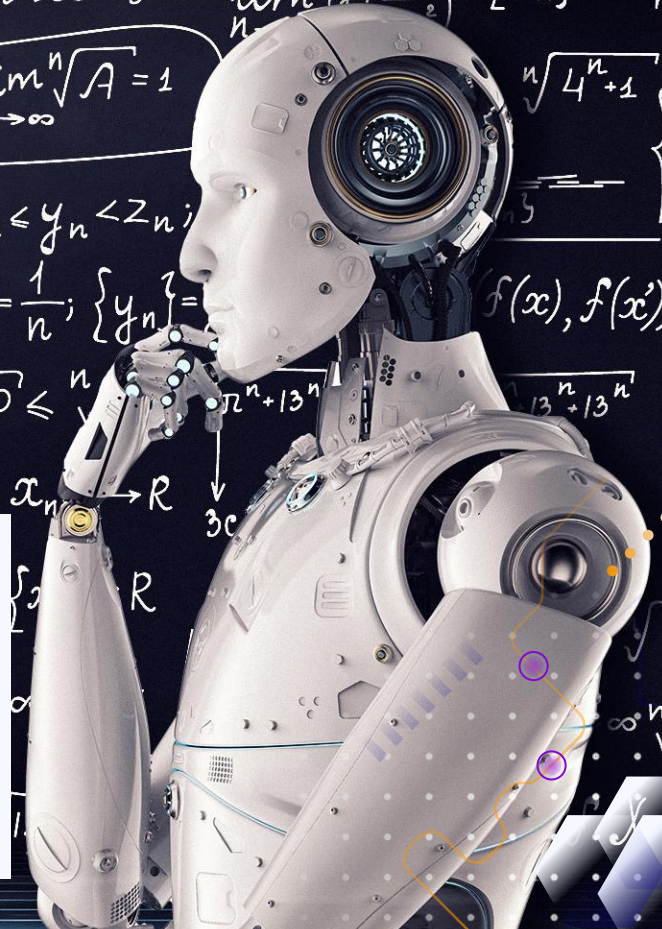
When to Use Machine Learning

- If you already have a good fixed rule-based solution (such as a fixed mathematical formula), you might not need to use machine learning
- unless you can see significant room for improvement (like if there are so many cases that it's impractical to enumerate them all)



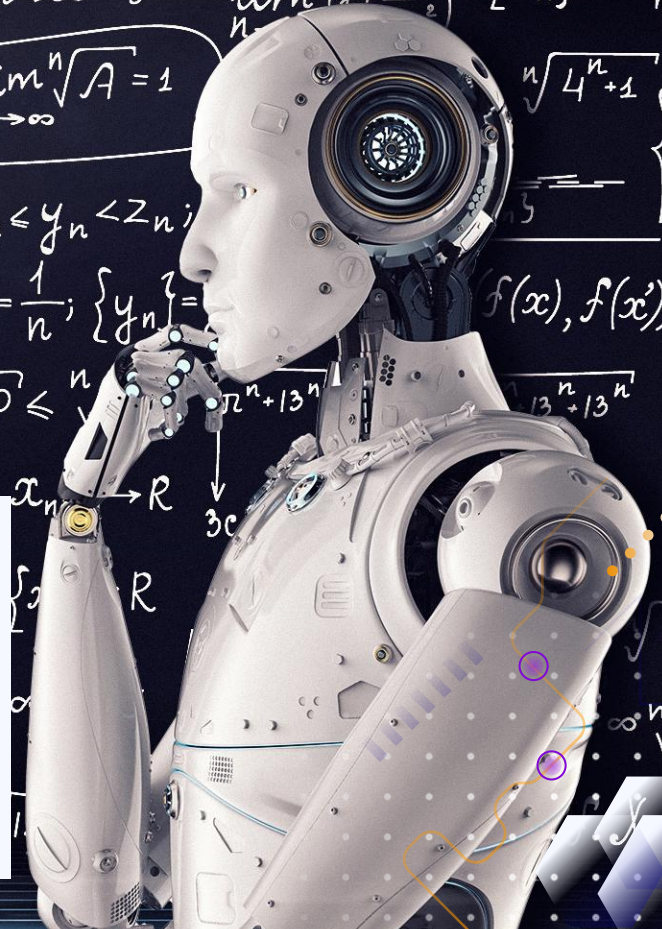
When to Use Machine Learning

- One of the downsides of machine learning is that it makes things less interpretable
- Interpretability of your solution is key to building trust with your potential users and fellow researchers



When to Use Machine Learning

- Every machine learning problem is an optimization problem
- If you encounter an optimization problem on a dataset, or if you need to solve such a problem to explore structures within the data, machine learning is the right tool 🤗

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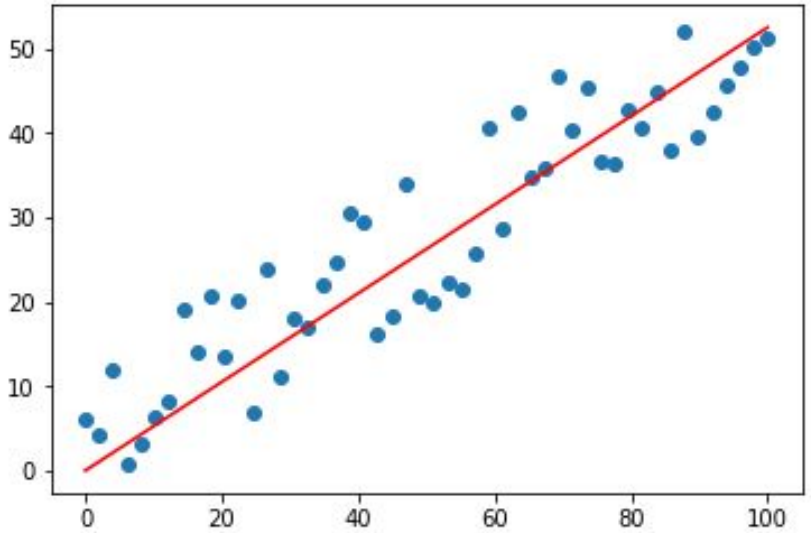

Image source: https://ml-explained.com/blog/linear-regression-explained

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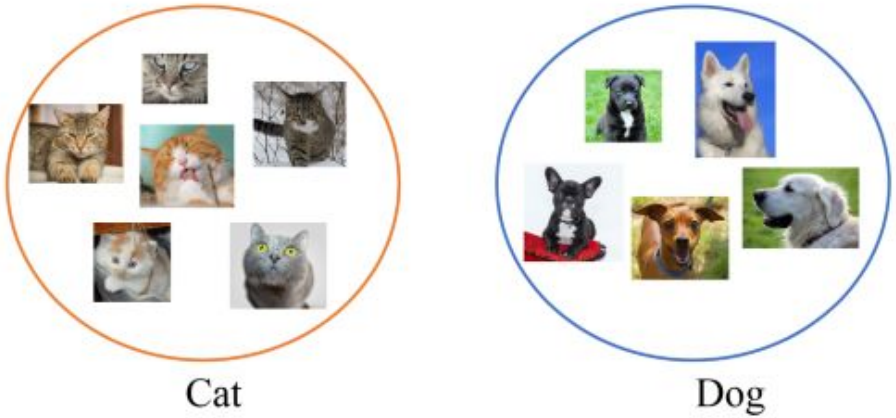

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