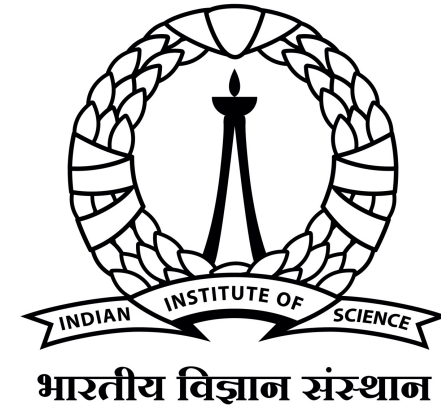




Department of Computational and Data Sciences

*Good  
Morning*



# Introduction to GenAI

ACP in GenAI Cohort 1

Deepak Subramani

Assistant Professor

Dept. of Computational and Data Science

Indian Institute of Science Bengaluru

# Learning Objectives

- Identify examples of GenAI use cases
- Clearly distinguish between GenAI and Predictive AI
  - In terms of tasks
  - In terms of data types
- Name the best models for each task
- Define “Model” in the context of Data Science, AI/ML and GenAI
- Describe a Foundation Model with details on how to view a foundation model
- Describe the process to be followed for solving any business problem using Data Science, AI, ML and GenAI



# Learning Objectives

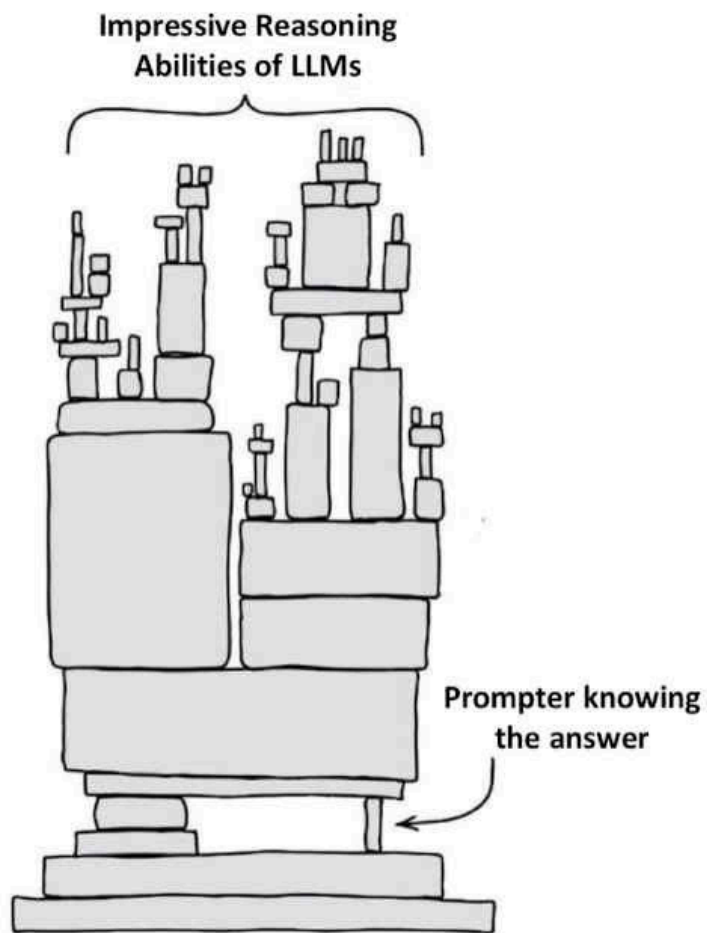
- What is a neural network?
- What are neurons, layers, models?
- What are parameters and hyperparameters?
- What is a loss function?
- What is an optimization algorithm?
- What is Development-Testing paradigm?
- What is an iteration, batch, epoch?

# Learning Objectives

- What is NLP? What is NLU and NLG?
- How is language represented on a computer?
- What are the major steps involved in an NLP application?
- What is the difference between NLU models and NLG models?
- What is tokenization?
- What is a sequence model?
- What is probability?



# Our Future!





# Generative AI Use Cases

- **Healthcare Assistance** – Offering support in areas like patient interaction, medical documentation, and even as assistive tools for diagnosis and treatment planning, though they don't replace professional advice.
- **Personal Assistants** – Managing schedules, setting reminders, answering questions, and even helping with email management and other administrative tasks.
- **Legal and Compliance Assistance** – Assisting in legal research, document review, and drafting legal documents (without replacing professional legal advice).
- **Accessibility Tools** – Enhancing accessibility through tools like voice-to-text conversion, reading assistance, and simplifying complex text.
- **Interactive Entertainment** – In gaming and interactive storytelling, creating dynamic narratives, character dialogue, and responsive storytelling elements.
- **Marketing and Customer Insights** – Analyzing customer feedback, conducting sentiment analysis, and generating marketing content, providing valuable insights into consumer behavior.
- **Social Media Management** – Managing social media content, from generating posts to analyzing trends and engaging with audiences.
- **Human Resources Management** – Aiding in resume screening, answering employee queries, and even in training and development activities.



# Generative AI Use Cases

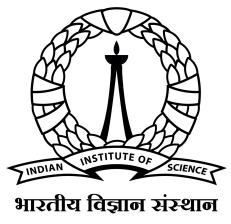
- **Customer Service and Support** – Providing customer support, handling inquiries, resolving issues, and offering information 24/7.
- **Content Creation and Copywriting** – Generating creative content, such as articles, blogs, scripts, and advertising copy.
- **Language Translation and Localization** – Translation services for various content types, aiding in bridging language barriers and localizing content for different regions.
- **Education and Tutoring** – Functioning as personalized tutors, providing explanations, answering questions, and assisting with learning materials in a wide range of subjects.
- **Programming and Code Generation** – Writing, reviewing, and debugging code, thereby speeding up the development process and helping in learning programming languages.
- **Research and Data Analysis** – Sifting through large volumes of text, summarizing information, and extracting relevant data, which is invaluable for research and analysis.





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PIP



Goals/Deliverables

Table

Identify Gap

Working  
# lines of code  
PR

Culture/Behavior/WL

Document

Deliverable  
→ Gap that is identified  
How we are going to measure  
What is the execution

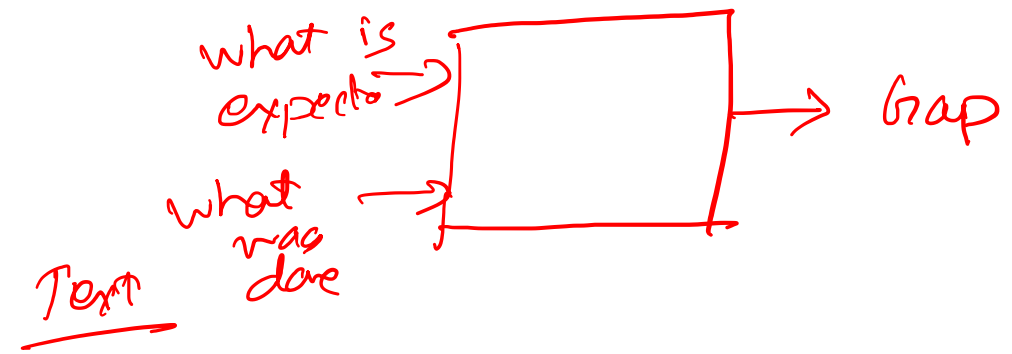


Mission & Vision → Text

Logistics of the plan → time who will coach → Plan text

Input 360 feedback → Text  
Evaluation metrics

10 types

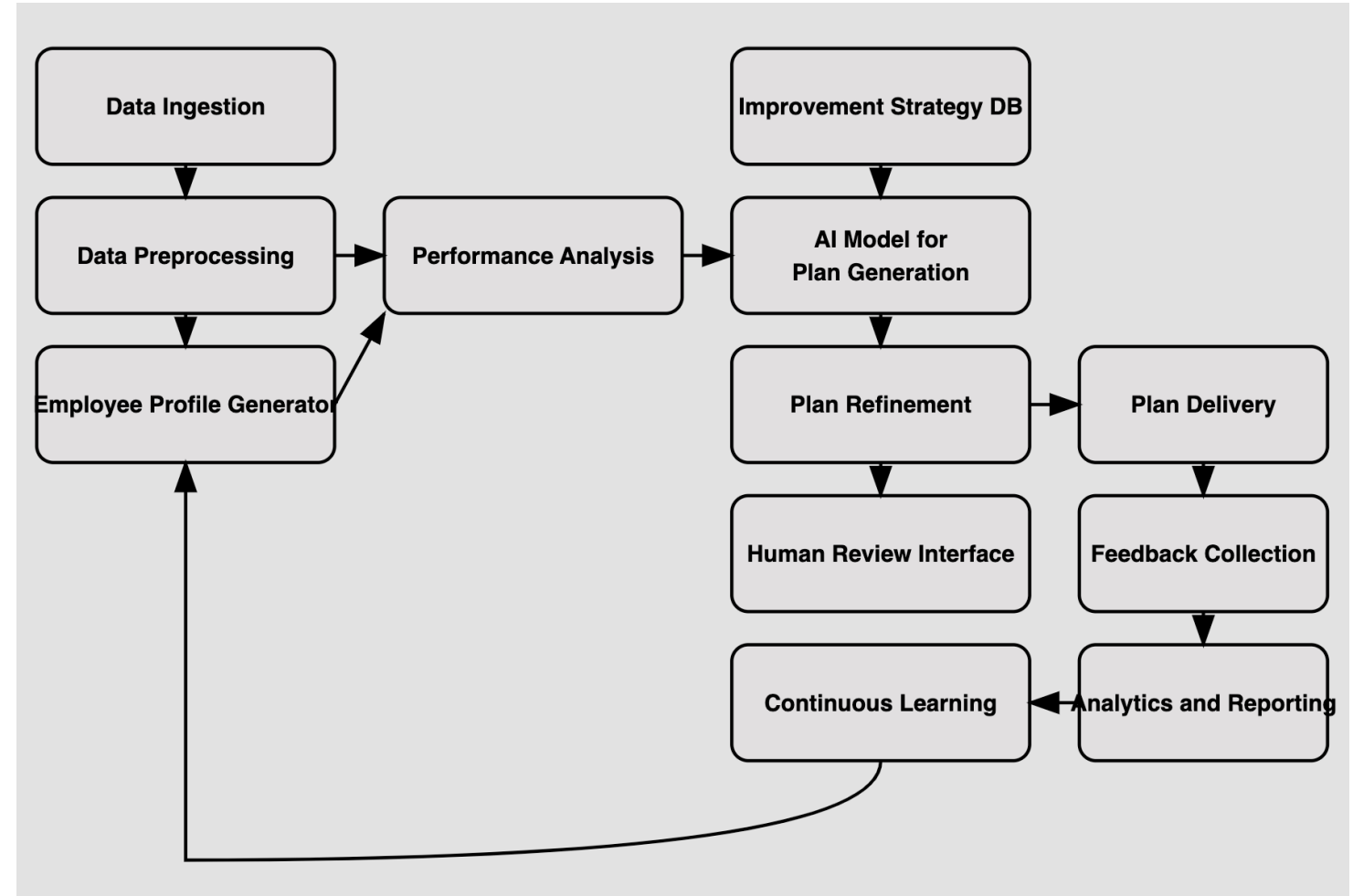






# A GenAI Solution

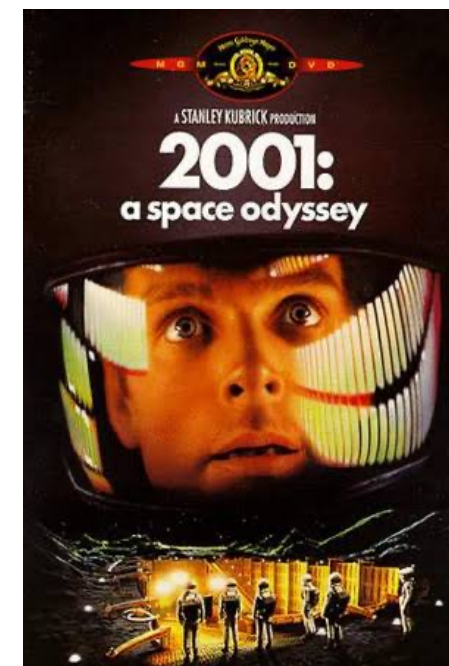
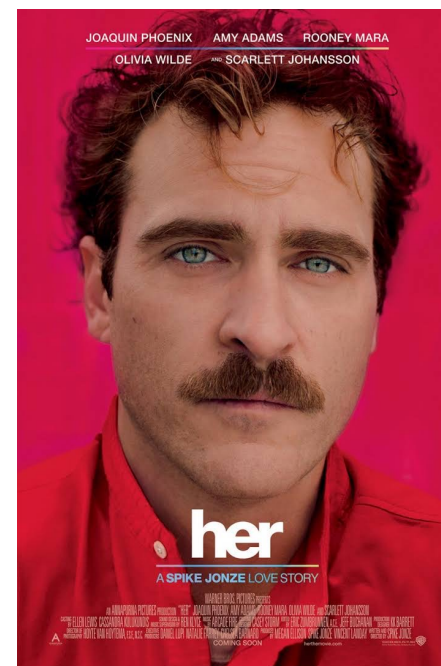
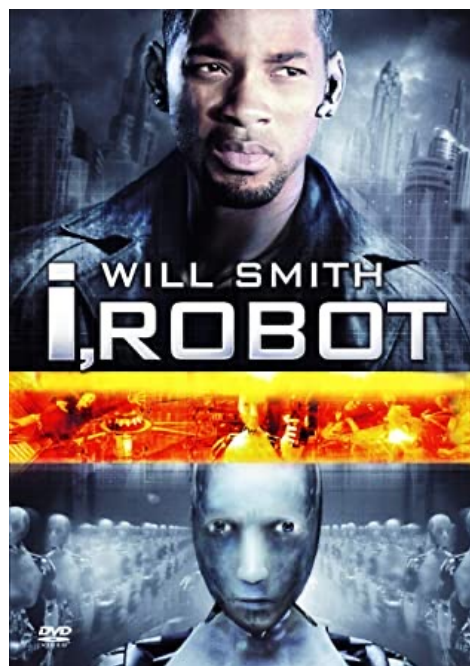
- Create an AI solution for delivering performance improvement programs (PIP) for employees
- Solution needs predictive as well as generative AI





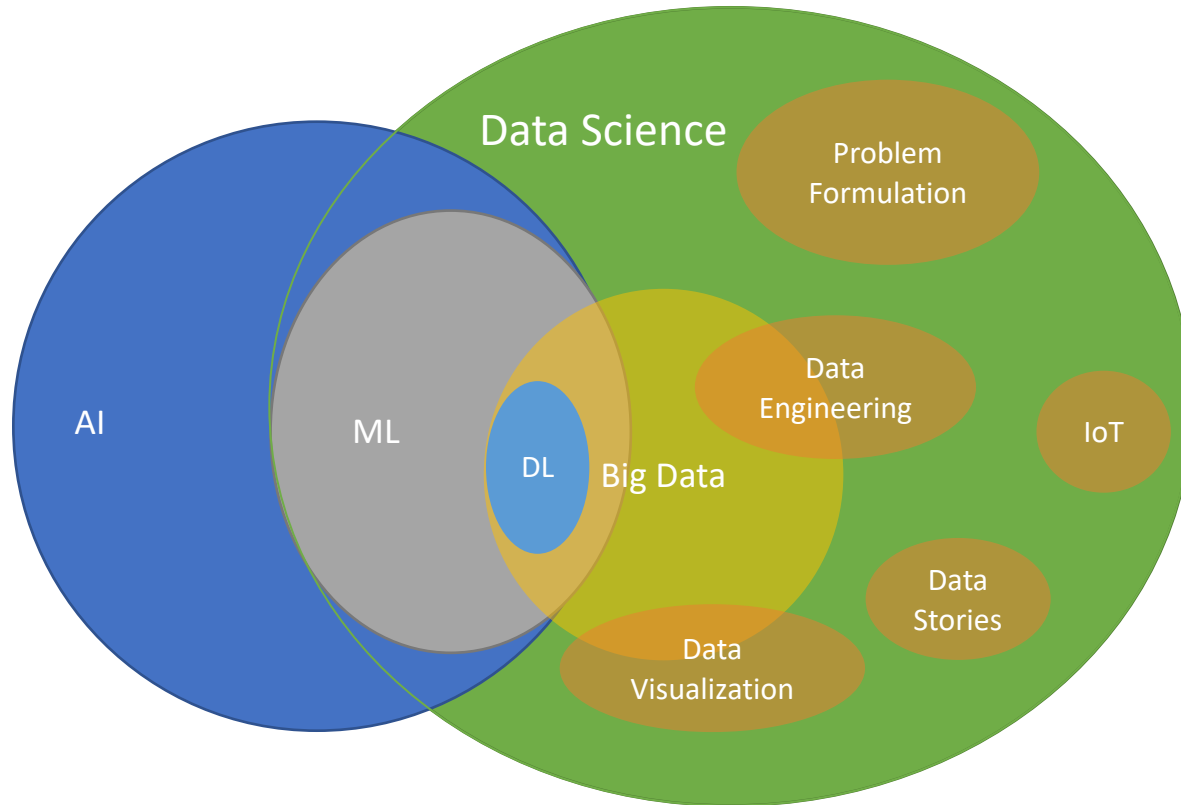
# Artificial Intelligence

- AI: The ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings.
- Can be data-driven or model-driven (rule-based)
- Artificial General Intelligence is the ultimate goal in AI research





# Data Science: ML/AI/DL – What is it?



- Data Science is an umbrella term
- It is the full building that we showed
- It has foundation, pillars, floors, walls, interiors, maintenance
- One can focus on a part of the building and develop deep expertise
- But should know the breadth as well

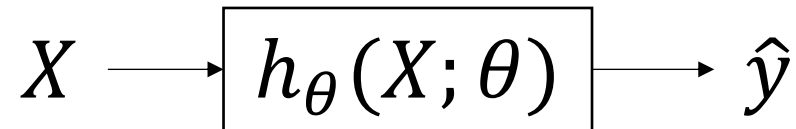
# Machine Learning: Mental Model

Data that can be collected



Quantity that must be predicted to make money

Data that can be collected



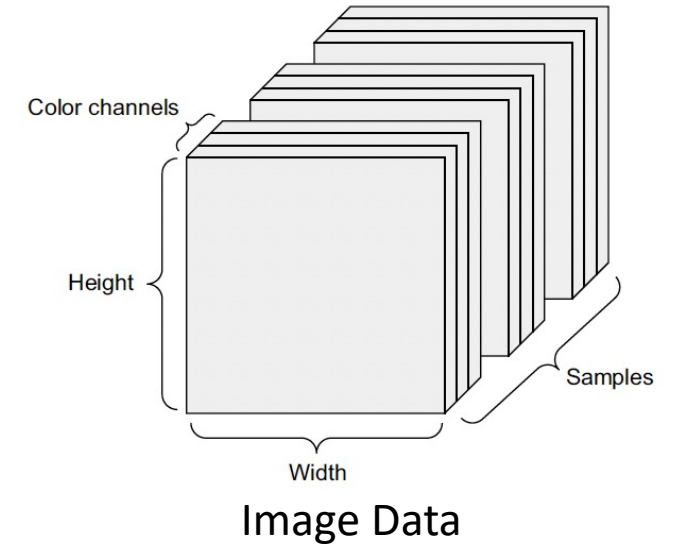
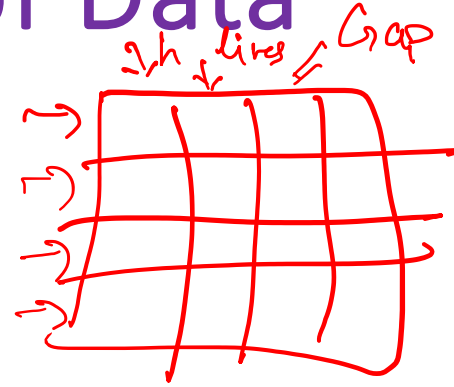
Machine's Prediction

*Tabular/TS  $\rightarrow$  Gradient Boosted Tree*  
*Image/Video  $\rightarrow$  CNN ; VisionTransformer*  
*Text/Audio  $\rightarrow$  Transformer*



# Types of Data

- **Tabular Data**
  - Most common form
  - Arises in almost all business use cases
  - Usually number of data points x features
- **Timeseries Data**
  - Tabular but at different times (a logical ordering in time)
- **Image Data**
  - Increasing in recent years
  - Usually number of data points x height x width x sensor channels
- **Video Data**
  - Time series of image data is video data
  - Vision Tasks
- **Text Data**
  - Language tasks
  - Usually text corpus – Needs to be converted to number – How?
- **Audio Data**
  - Language tasks
  - Usually recording corpus – Signal Processing



# Continuous vs Categorical Data

- Continuous Data – mm of rainfall tomorrow
- Categorical data – Will it rain or no?
- Image Data
- Text Data
- Audio Data



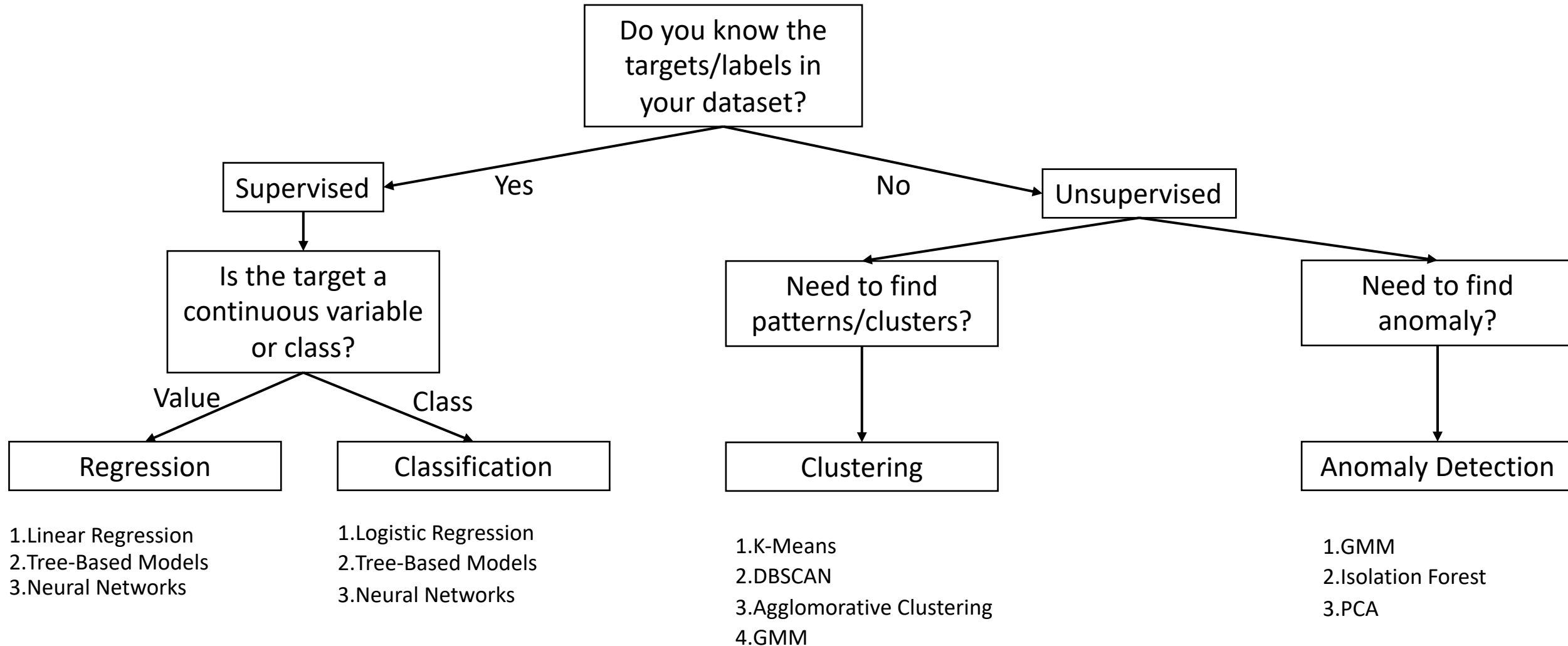
# Predictive AI and Generative AI

- Predictive AI
  - Input: Any of the data modality
  - Output: Continuous or Categorical
- Generative AI
  - Input: Any of the data modality
  - Output: Text, Image, Video, Audio





# Summary of Predictive AI





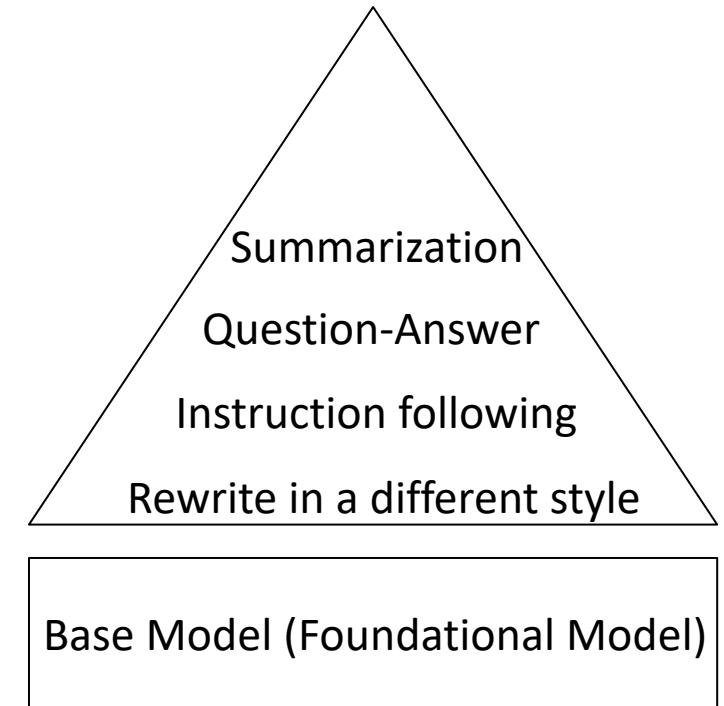
# Generative AI

- Text to Text
  - Text to Image/Video
  - Image/Video to Text
  - Image/Video to Image/Video
  - Text to Audio
  - Audio to Text
  - Text/Image to Code
- 
- Input is the “Prompt”; Model is a Large Language/Vision Model;  
Output is Image/Video/Text/Speech



# Foundational Model

- Large-scale AI model trained on vast amounts of diverse data
- Serves as a base for multiple downstream tasks and applications
- Key characteristics:
  - Broad knowledge and capabilities
  - Prompt engineering to make it perform tasks
  - Retrieval Augmented Generation for tapping into specific data
  - Adaptable through fine-tuning
  - Generalize to new tasks with minimal additional training
- **Examples:** GPT, BERT, T5





# The AI/ML Workflow

HiPPD

1. Frame the AI problem by looking at the business need
  - a. Identify subproblems (One/more of the ~~8~~ tasks a computer can do)
  - b. Establish a current baseline (What is currently done?)
  - c. Define success ←
2. Gather the data and do Data Munging/Wrangling + Baselines
  - a. Explore the data
  - b. Clean data and prepare for the downstream ML models
  - c. Establish a data, domain and SoTA baseline
3. Explore different models, improve them through Cross Validation and perhaps new model design
4. Form an ensemble of multiple models and solutions
5. Present your solution
  - a. Say a story with the data
6. Deploy



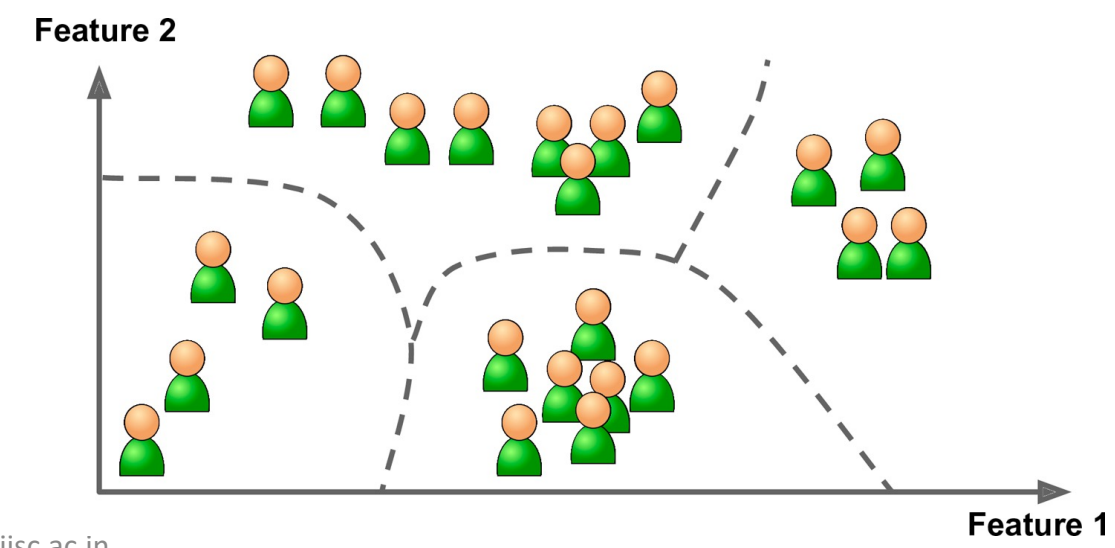
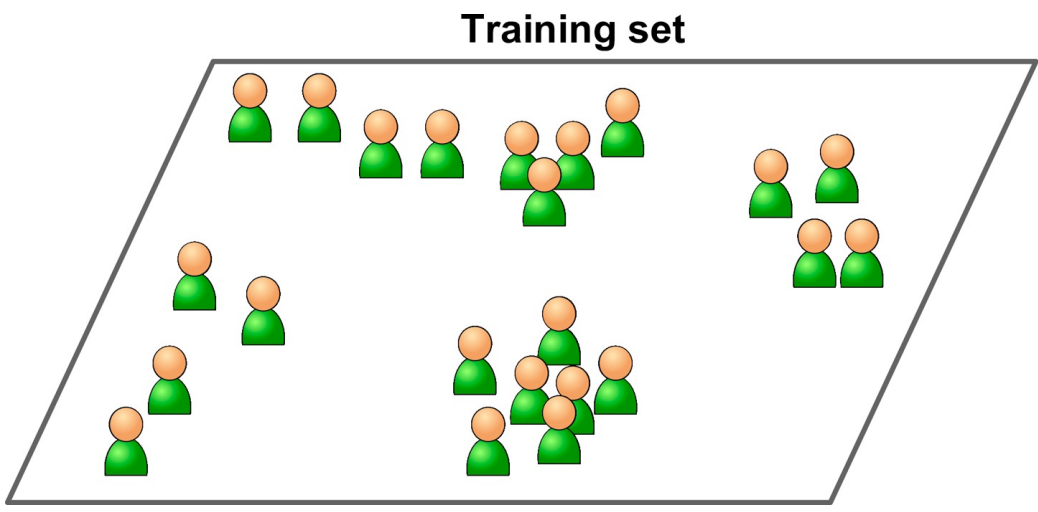
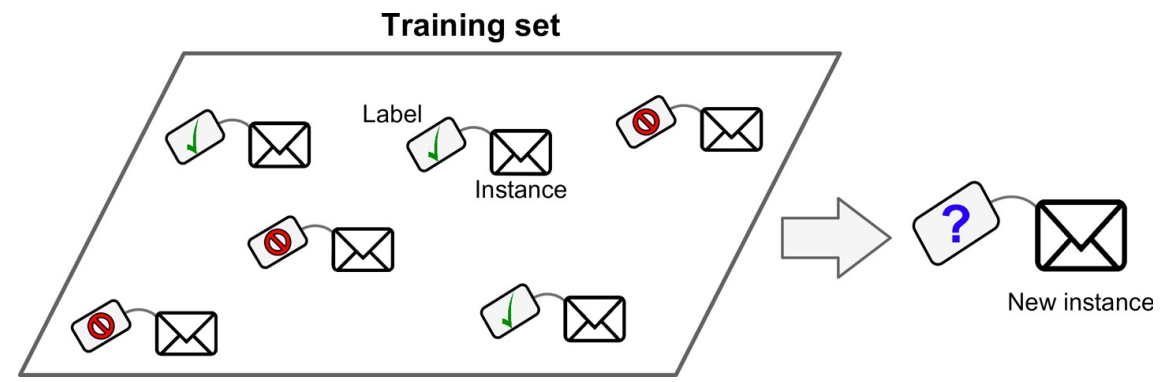
# CRISP-DM

- Cross Industry Standard Process for Data Mining
- Initiative in the mid 90s by European Strategic Programme on Research in Information Technology (ESPRIT)
- The key ideas are in our 6-step process as well



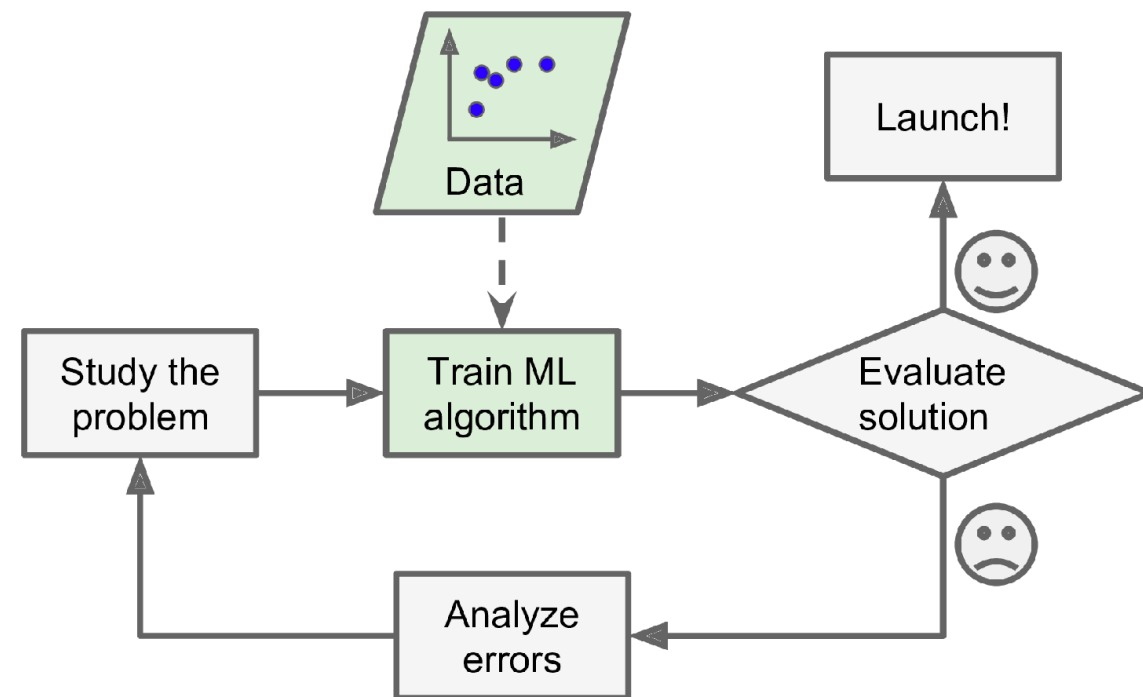
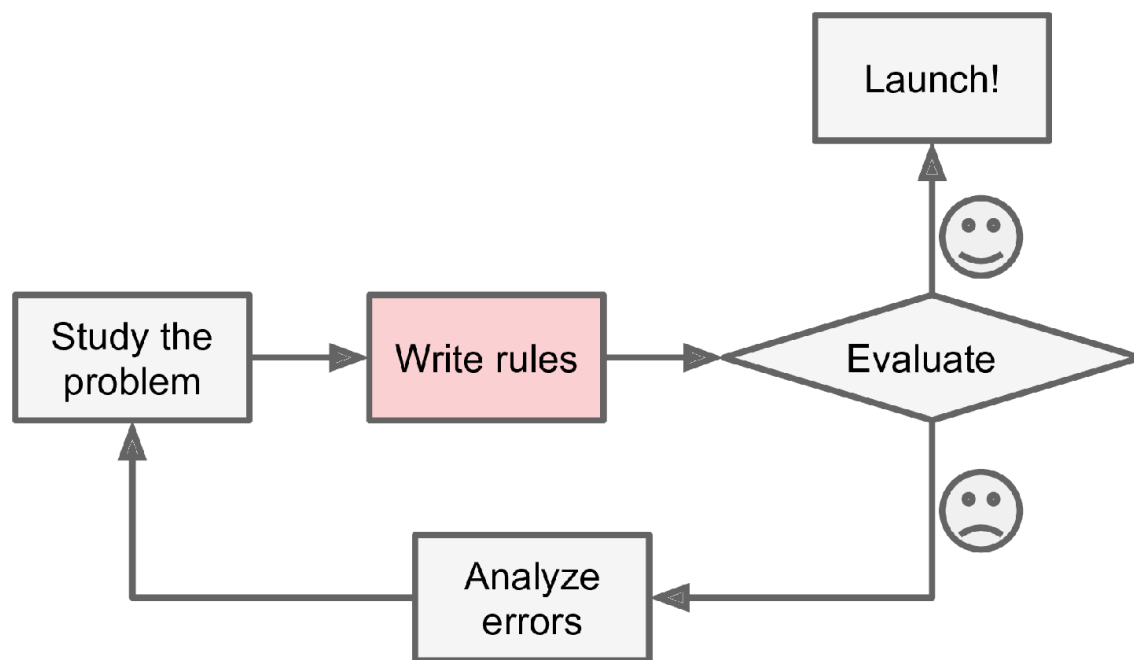


# Tasks in ML/DS/AI: Visual Introduction



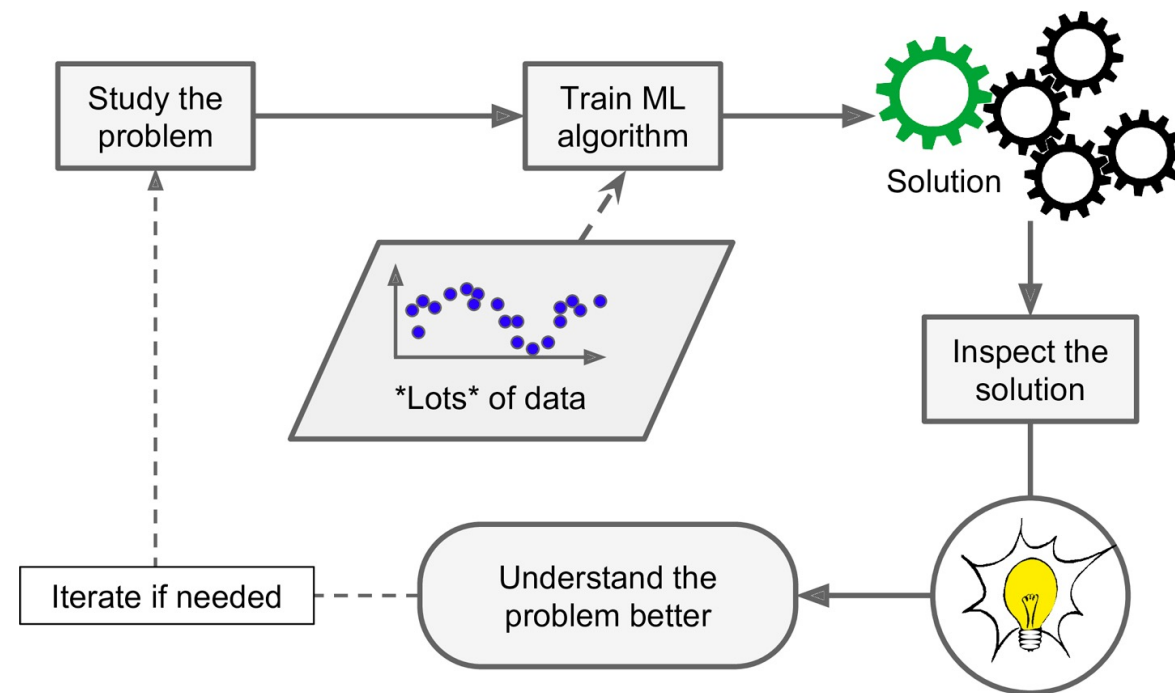
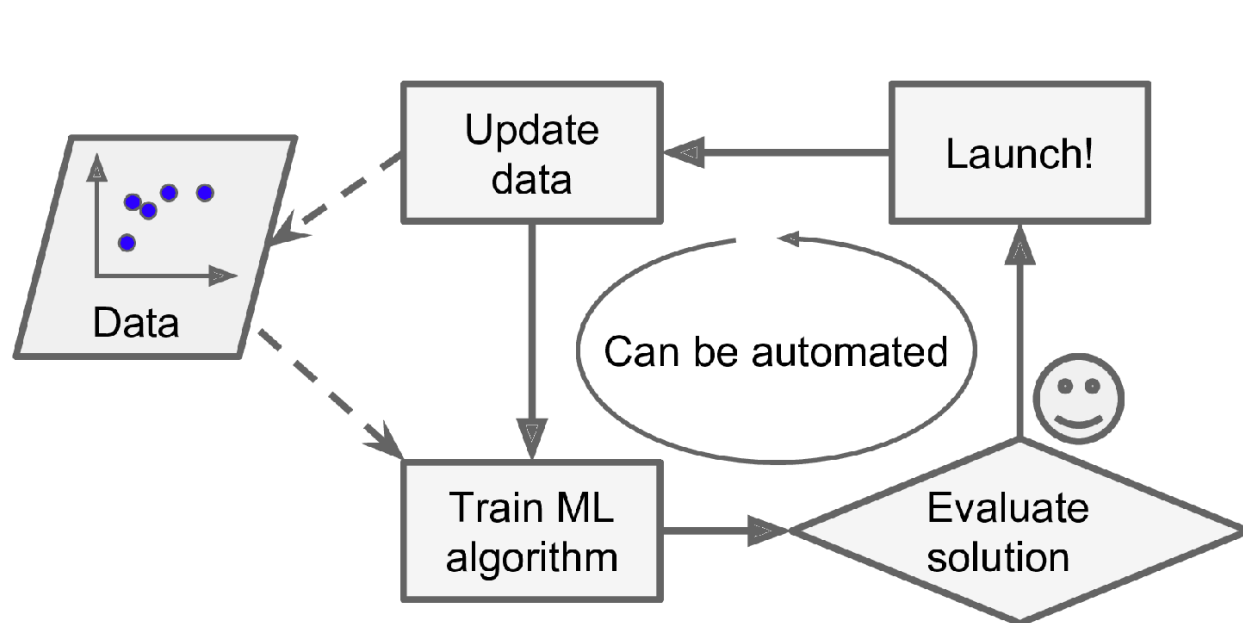


# Traditional Approach vs ML





# Uses of ML







# Three Essential Tasks in Computer Vision

- Image Classification
  - Single Label
    - Binary
    - Multiclass
  - Multi Label
- Image Segmentation
  - Pixel wise identify the class
  - Example: Zoom background replacement
- Object Detection
  - Bounding box around objects
  - Self-driving cars, face detection in cameras

Single-label multi-class classification



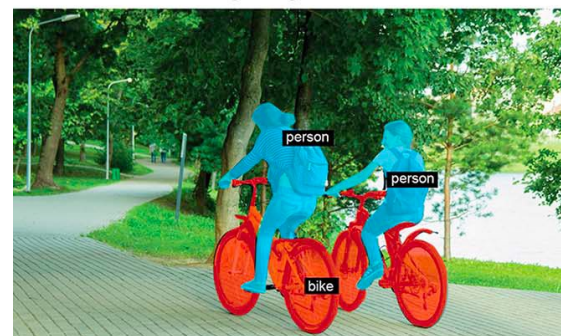
- ☒ Biking
- ☐ Running
- ☐ Swimming

Multi-label classification

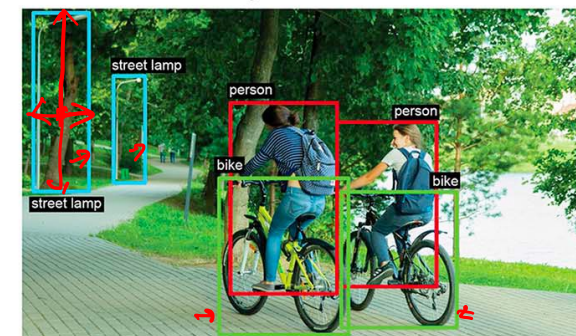


- |  |  |
|--|--|
| <input checked="" type="checkbox"/> Bike   | <input checked="" type="checkbox"/> Tree |
| <input checked="" type="checkbox"/> Person | <input type="checkbox"/> Car             |
| <input type="checkbox"/> Boat              | <input type="checkbox"/> House           |

Image segmentation



Object detection





# NLP: Major Tasks

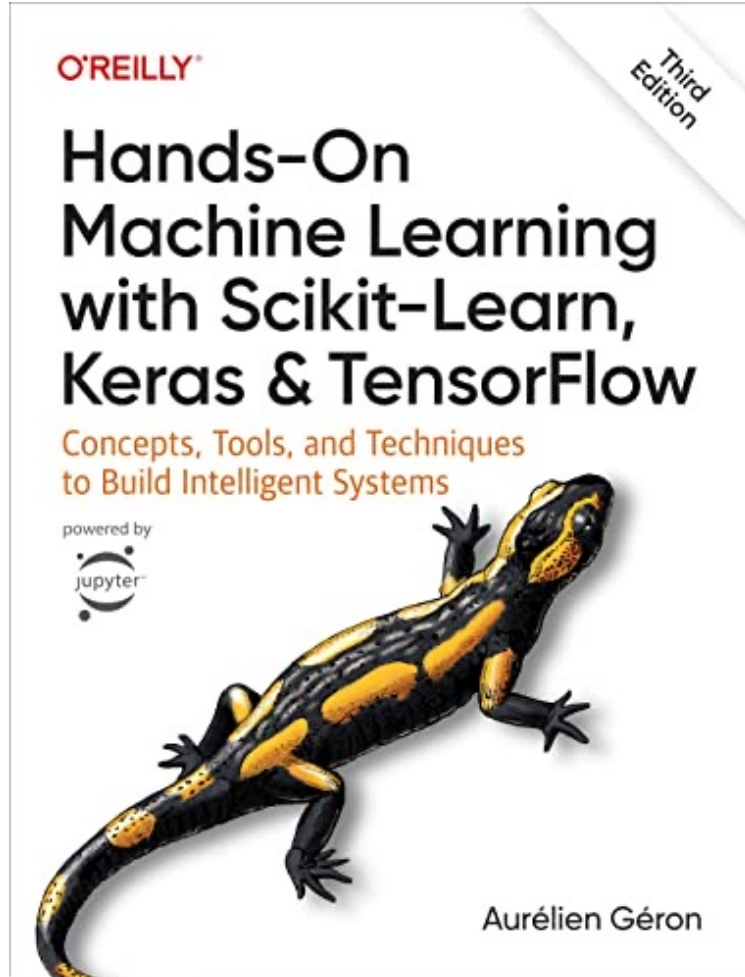
- Modern NLP – Goal is not to understand language, but to ingest a piece of language as input and return useful quantities
- A collection of fundamental tasks repeatedly come in NLP
- Natural Language Understanding
  - “What is the topic of this text?” – Topic Modelling
  - “Is this text inappropriate?” – Content Filtering
  - “Is this text, positive, neutral or negative?” – Sentiment Analysis
  - Named Entity Recognition, Part of Speech Tagging
  - Information retrieval (Keyword based)
- Natural Language Generation
  - “What is the next word or character?” – Language Modeling, Sentence Completion
  - “What is “AI” in tamil?” – Machine Translation
  - “What is the crux of this paragraph?” – Text Summarization
  - Answer to “Where is the nearest hair salon?” – Question Answering

# Explain your work to stakeholders and set expectations

- Success and customer trust are about consistently meeting or exceeding expectations
- The actual model is only half the picture; the level of expectation about system performance matters a lot
- Non-specialists expect AI to punch above its weight
  - They expect the system to “understand” and meet or exceed capability of a human doing the task
- Clearly setting the expectation is important
- Some guidelines
  - Don't talk in easily mis-understood terminology – Accuracy is 98%
  - Show examples of what misclassification looks like
  - Understand if customer cares about False Positive or False Negative more
  - Discuss key parameters – the probability above which a fraud has to be detected
  - Explain how many cases on average we expect the system to be falsely labelled as positive [False Positive, False Negative, Explain in simple language]



# Text Book for ML

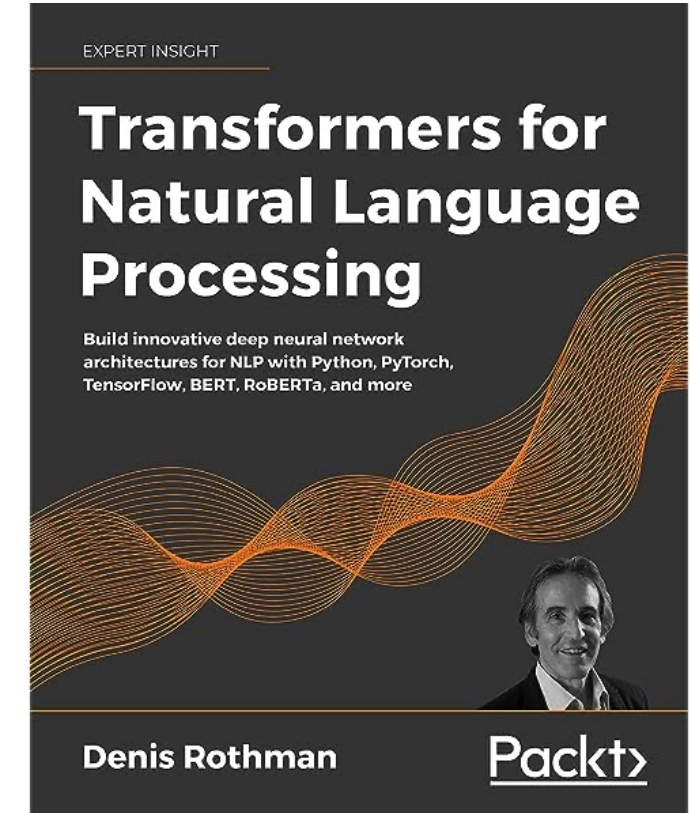
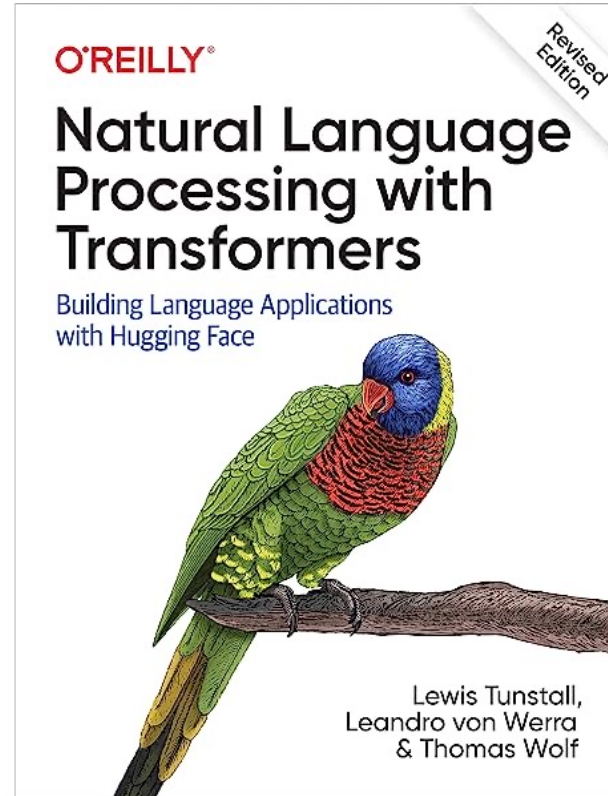
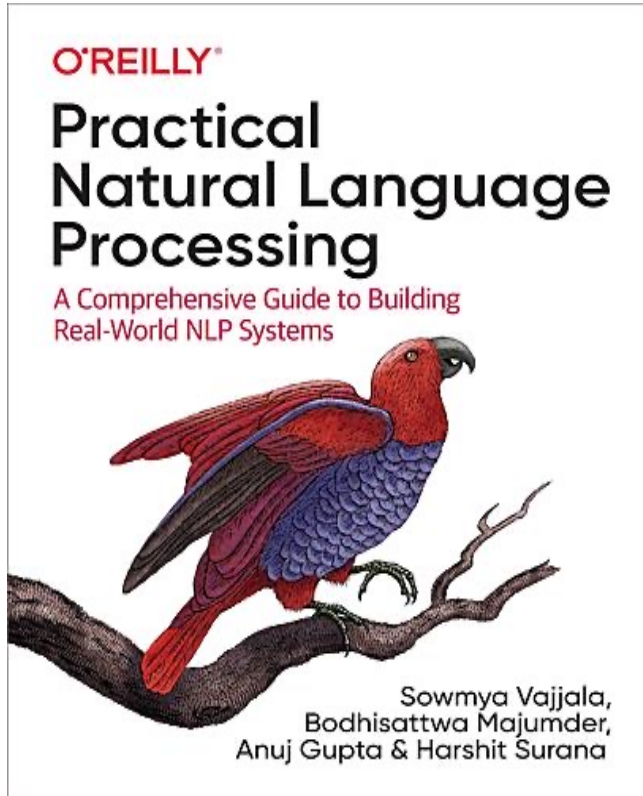


<https://www.amazon.in/Hands-Machine-Learning-Scikit-Learn-TensorFlow-ebook/dp/B0BHCFNY9Q/>



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# Reference Books for NLP



# Reference for Gen AI

- <https://cookbook.openai.com/>