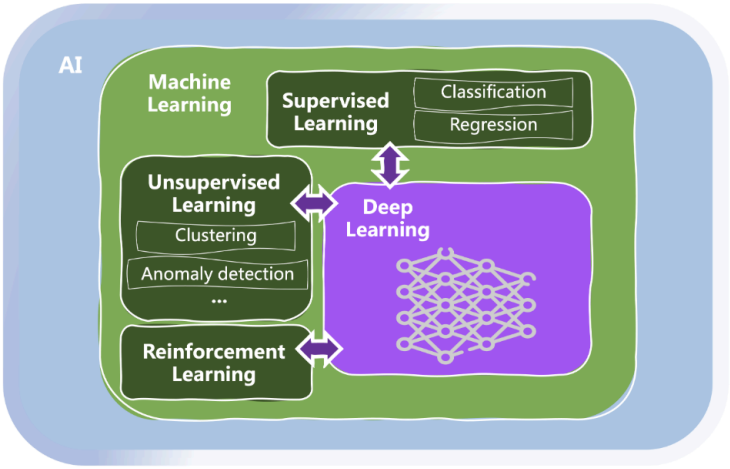
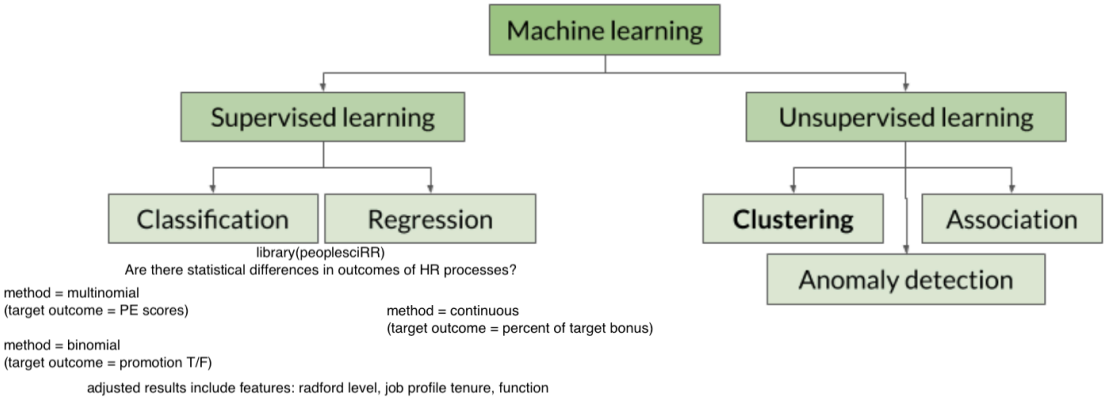
AI Buzz Words

- Generative AI - Generates content
- Agentic AI - Generate content and performs tasks with agency/on its own -
    - Can coordinate with other agents
    - Has role, goal, and backstory
- ANI Artificial Narrow Intelligence -
    - Supervised - ChatBoxes, self driving car. Learns based on inputs
    - Unsupervised -
- AGI Artificial General Intelligence - Hypothetically. AI is able to reason, learn autonomously, solve complex problems, and adapt to new situations, much like a human.
- IoT - Internet of Things - network of physical devices (like sensors and appliances) - detect number of people in room and adjust temperature
- RAG - Retrieval Augmented Generation - can use data sources beyond its model's training data to generate an output

Machine Learning

Source: Datacamp Courses





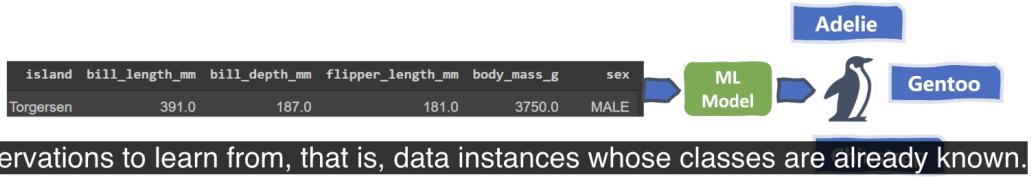
"Predicting the outcome based on gender is the same as seeing how groups differ on the outcome"

Supervised Learning: classification

Classification: assign each data observation the category (*class*) it may belong to

- **Binary classification**: two classes, e.g. positive/negative, male/female, etc.
- **Multi-class classification**: several mutually exclusive classes, e.g. multiple species

> **Supervised learning**: *Data annotation* (getting labelled observations with *known class a priori*) needed to learn/train a **model** capable of making inference

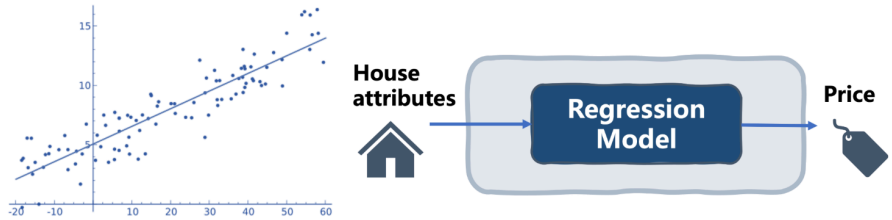


observations to learn from, that is, data instances whose classes are already known.

1:50

Supervised Learning: regression and forecasting

Regression: assign each data observation a numerical output or *label* based on its inputs

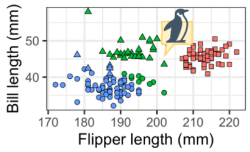


Time series forecasting: predict future values of variable, based on its past behavior

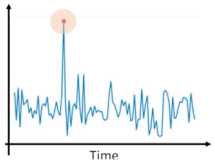
For instance, forecasting the number of daily bus passengers for next month, based on historical data.

Unsupervised and reinforcement learning

Clustering: find subgroups of data with *similar* characteristics (e.g. *k-means* algorithm)

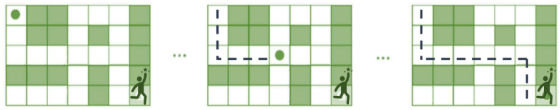


Anomaly detection: detecting *abnormal* data observations e.g. unusual card transactions



Association rule discovery: find common co-occurrences of items in transaction data

Reinforcement learning: learn by *experience* (trial and error) to master a complex task



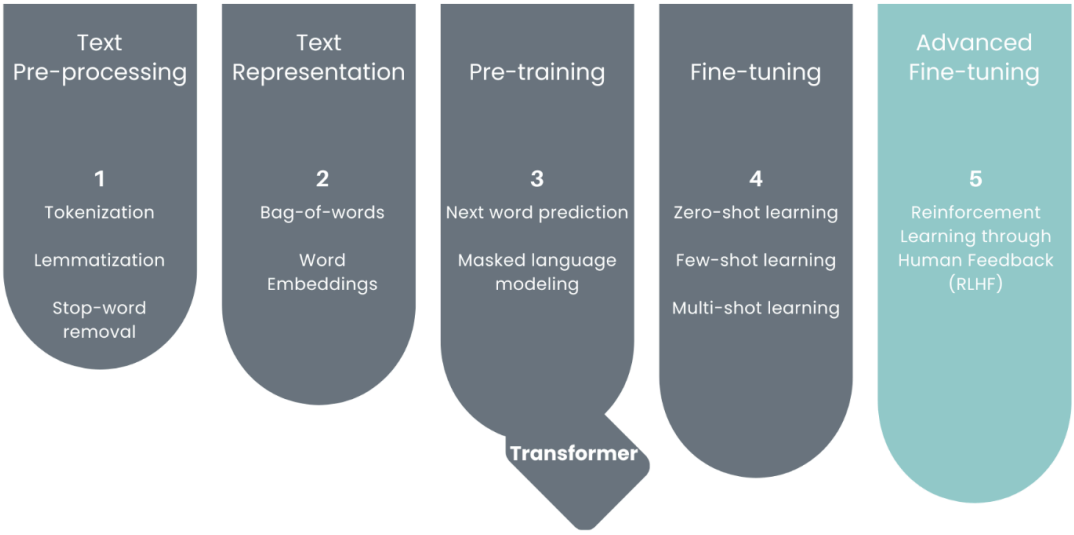
And in reinforcement learning, an AI agent is trained to solve complex

C lusting package in R : https://cran.r-project.org/web/packages/mclust/vignettes/mclust.html

Deep Learning: LLM

Datacamp course: https://www.datacamp.com/courses/large-language-models-llms-concepts

Building Blocks of LLM



Text pre processing

- Tokenization: "Working with natural language processing techniques is tricky" → ["Working", "with", "natural", "language", "processing", "techniques", "is", "tricky", "."].
- Lemmatization: This process of reducing words to their base form is known as lemmatization. For example, "talking", "talked", and "talk" would be mapped to the root word "talk".
- Stop Word Removal - words, such as "with" or "is," are eliminated to identify the most important parts of the sentence.

Text Representation

- Bag of words - converting the text into a matrix of word counts without context/meaning
- Word embedding - semantic meanings of words and representing them as numbers, allowing for similar words to have similar representations

Pre Training

- Next word predictions - supervised learning to generate coherent text by capturing the dependencies between words in the larger context. During training, the model is presented with pairs of input and output examples.
- Masked language modeling - training a model to predict a masked word that is selectively hidden in a sentence.
- Transformer - multiple parts of the sentence simultaneously - ie preprocessing + positional placement + encoders (relationship between words) + Decoders (neural networks of larger concept)

Fine Tuning

- Zero shot learning - perform a task it has not been explicitly trained on. a child has only seen pictures of horses and is asked to identify a zebra with additional information that it looks like a striped horse.
- Few shot learning - to learn a new task with very few examples. (one shot is one example)
- Multishot learning - uses the knowledge learned from previous tasks, along with more examples of the new task, to learn and generalize to new tasks - ie. identifying different dog breeds

Prompt Engineering: the art and science of designing and optimizing prompts to guide AI models, particularly LLMs, towards generating the desired responses. lays a vital role in ensuring accurate, relevant, and safe interactions. Think of it as providing a roadmap for the AI, steering it towards the specific output you have in mind.
https://cloud.google.com/discover/what-is-prompt-engineering#types-of-prompts

Fine Tuning vs. RAG
Most organizations currently don't train their own AI models. Instead, they customize pre-trained models to their specific needs, often using RAG or fine-tuning.

Fine-tuning requires adjusting a model's weights, which results in a highly customized model that excels at a specific task. It's a good option for organizations that rely on codebases written in a specialized language, especially if the language isn't well-represented in the model's original training data.

RAG, on the other hand, doesn't require weight adjustment. Instead, it retrieves and gathers information from a variety of data sources to augment a prompt, which results in an AI model generating a more contextually relevant response for the end user.

https://github.blog/ai-and-ml/generative-ai/what-is-retrieval-augmented-generation-and-what-does-it-do-for-generative-ai/

Advanced Fine Tuning
- RLTHF Reinforcement Learning Through Human Feedback: external expert to validate the data and avoid these inaccuracies.

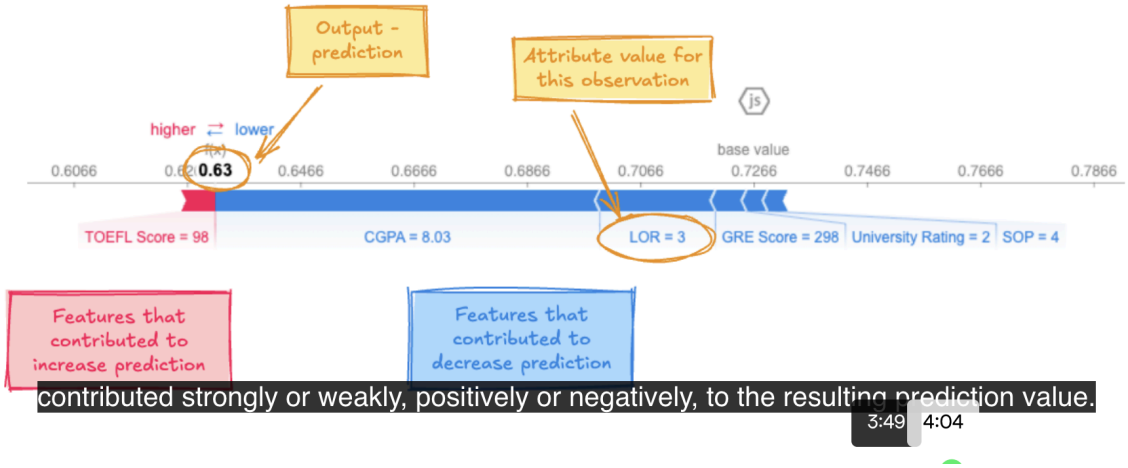
Fine-tuning vs. Pre-training
Fine-tuning is more effective since it can help a model learn, or be trained, using a single CPU and GPU, while pre-training may require thousands of CPUs and GPUs to train efficiently. Additionally, fine-tuning can take hours or days, while training a model from scratch may take weeks or months. Furthermore, fine-tuning requires only a small amount of data, typically ranging from a few hundred megabytes to a few gigabytes, compared to hundreds of gigabytes as are necessary for pre-training.

AI Transparency - XAI

SHAP	LIME	Decision Trees
Highly complex model with difficult to understand decision-making	Extremely precise predictive model, requiring specific explanation for individual predictions	Simple model with a need for clearer understanding of decisions.

XAI tools: feature importance

SHAP (SHapley Additive exPlanations)



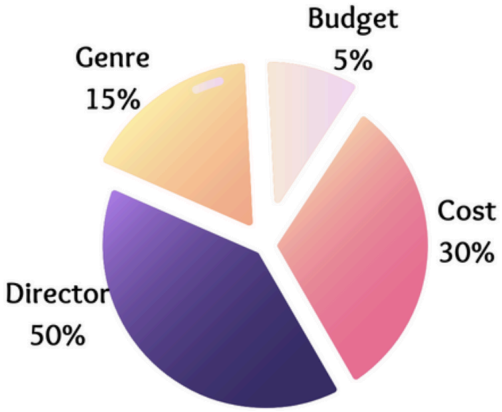
contributed strongly or weakly, positively or negatively, to the resulting prediction value.

3:49 4:04

Explainable AI 50 XP

SHapley Additive exPlanations (SHAP)

- SHAP: A detective of AI, revealing **feature importance**
- SHAP in Action
  - Director: 50%
  - Cast: 30%
  - Genre: 15%
  - Budget: 5%



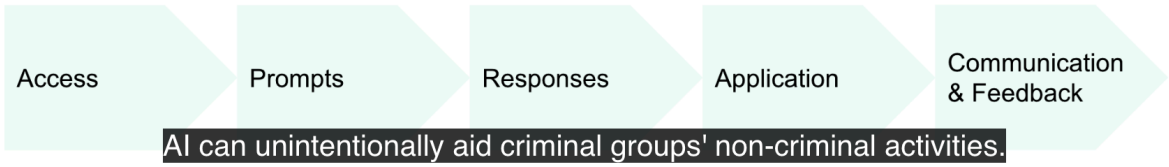
prediction, the cast was 30% responsible, the genre was 15% responsible, and the budget was 5% responsible.

Detection and prevention

Key usage principles

- Human-in-the-loop
- Harm prevention
- Continuous monitoring

Points of Detection and Prevention



AI can unintentionally aid criminal groups' non-criminal activities.

Use the right tool for the job

Discriminative Models

- Predict tomorrow's weather
- Categorize books
- Determine if a picture is a puppy or a bagel

Generative AI

- Write code for a website
- Answer unique customer service questions
- Draw a picture of a cat scuba diving

Artificial General Intelligence

- Complete traditionally human jobs