Machine Learning Intro

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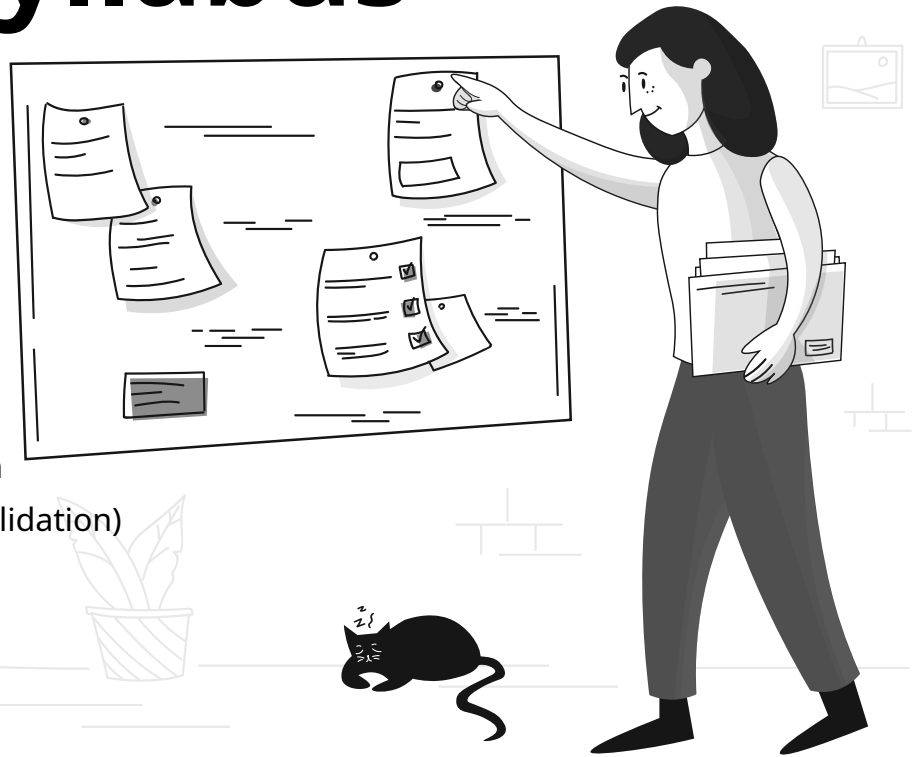
Course Syllabus

- **Intro to Machine Learing & Environment Setup**
  - task: Setup the environment
- Foundations: Key Linear Algebra & Stats + Hands-on NumPy
- Data Handling & Visualization + Hands-on Pandas
- The ML Workflow + Linear Regression with Scikit-learn
- Classification Models (Logistic Regression, KNN) with Scikit-learn
- Model Evaluation & Improvement (Metrics, Overfitting, Cross-Validation)
- Mini-Project: Putting it all together with Scikit-learn
- Introduction to Neural Networks
- Building a Neural Network with a Framework
- Course Project Description + Where to Go From Here

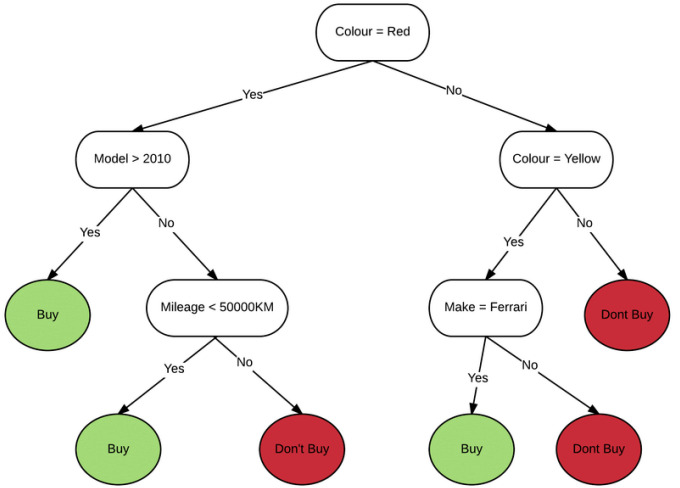


AI vs Machine Learning

- What is AI?
- What is ML?
- Deep learning?

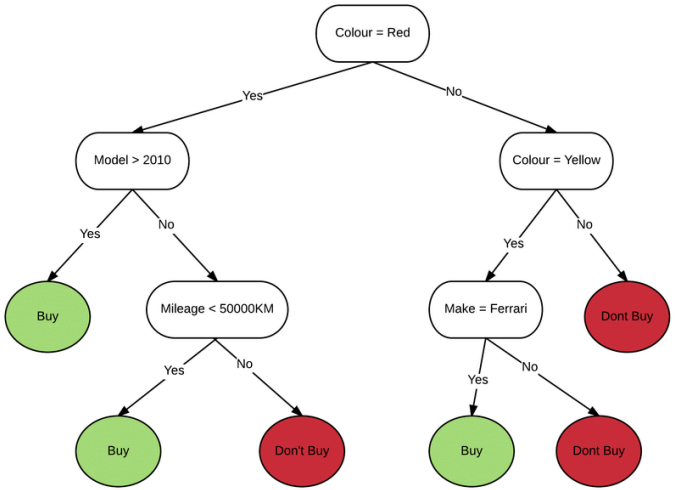
Artificial Intelligince

- Artificial Intelligince (AI): AI is a Computer Science concept that tackles creating systems that take smart decisions that a human would.
- Example: Decision Trees.



Artificial Intelligince

- Decision Trees: A Decision Tree is a tree that asks a few yes/no questions to make a decision, take for example the decision to buy a car or not:



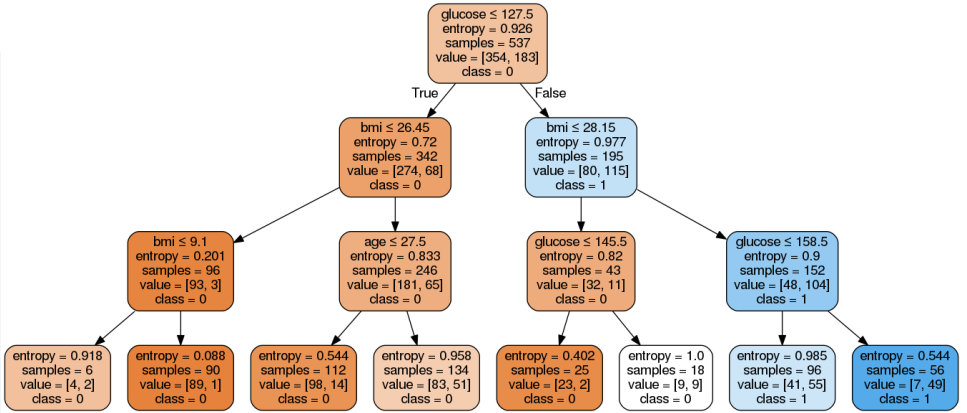
Artificial Intelligince

- A Decision Tree is a very basic model that can be static or a machine learning model, either case it is generally used for AI in video games (static) or simple classification (ML).

Artificial Intelligince

- Decision Tree (Static):

- Decision Tree (ML):

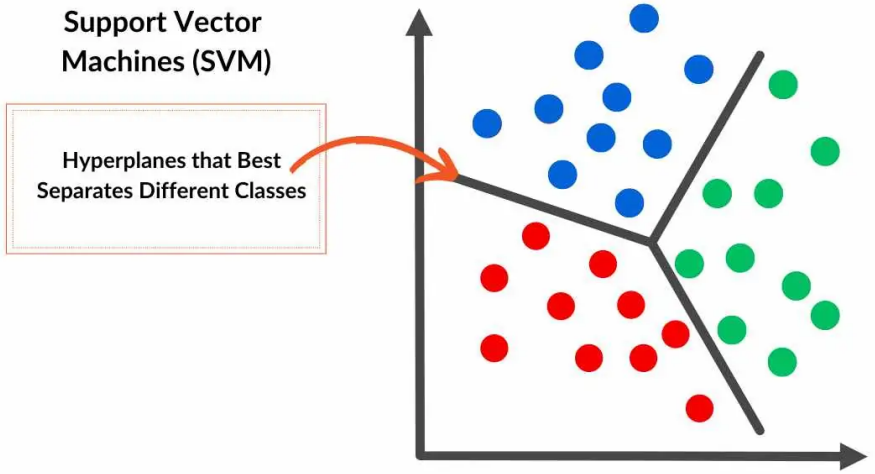


Machine Learning

- Machine Learning (ML): ML is a sub-science of AI that instead of relying on static algorithms, it tries to learn/capture patterns in data dynamically in order to scale to more complex/larger problems.
- Example: Support Vector Machines (SVMs).

Machine Learning

- Support Vector Machines (SVMs): is a Supervised ML algorithm that learns from the provided data to map a X input to a Y output.



AI vs ML?

- Both AI and ML tackle the problem of creating a Intelligent system that can take smart decision that a human would take (mostly).
- AI can be both static and learning (e.g. decision trees), ML is the sub-science that focuses on the systems learning from data.

AI vs ML?

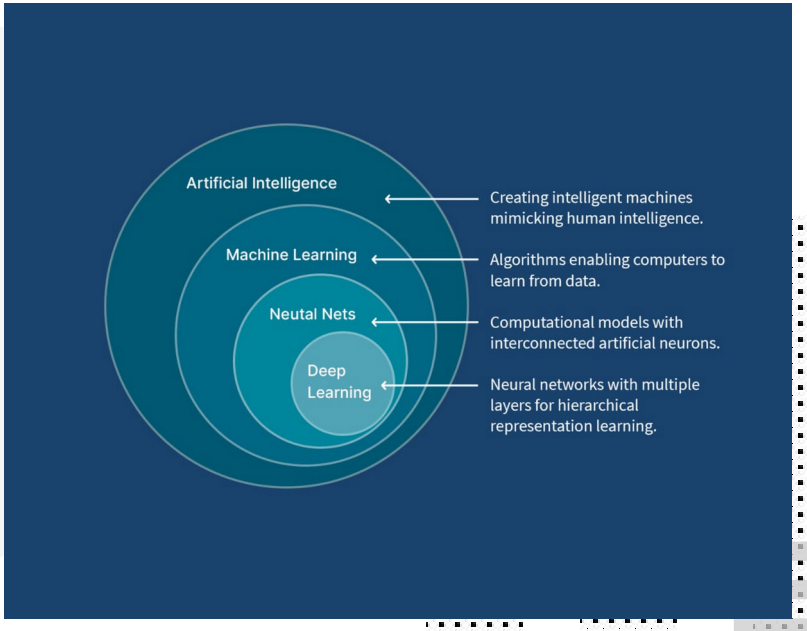
- So which should you use? Answer: Depends.
- Traditionally, complex games like chess or shooter AI relied on static, rule-based models designed by developers. While very effective, they don't adapt. In contrast, an ML model, particularly with Reinforcement Learning, can learn strategies developers may not even think of by playing the game millions of times.
- And a static model can not learn from (large/complex) data and adapt to it.

AI vs ML: Combination?

- While most problems can easily be sovled with a singular technique (i.e. ML or static AI), you can combine both to create a more efficient system instead of a larger ML model.
- When? If your data is too complex you can use a simple static algorithm to simplifiy it before passing to ML, on the other hand if you have a very specific problem that has defined mechanics but does not have defined decisions.

Deep Learning?

- Deep learning (DL): DL is a sub-science of Machine learning that aims to handle more complex data (e.g. images, text, audio, etc…) using larger (deeper) models.
- Example: Neural Networks.



Supervised vs Unsupervised

- What is Supervised learning?
- What is Unsupervised?
- Reinforcement Learning?

Supervised Learning

- Supervised Learning: Supervised learning is a technique in ML that aims to teach the model how to map from provided data to an expected result.
- Both the data and the result are intially given to the model, then the model is only given data and predicts the result without help.
- Example: given the size of a house, it’s location and number of rooms (provided info) the model would learn its price (expected result).

Unsupervised Learning

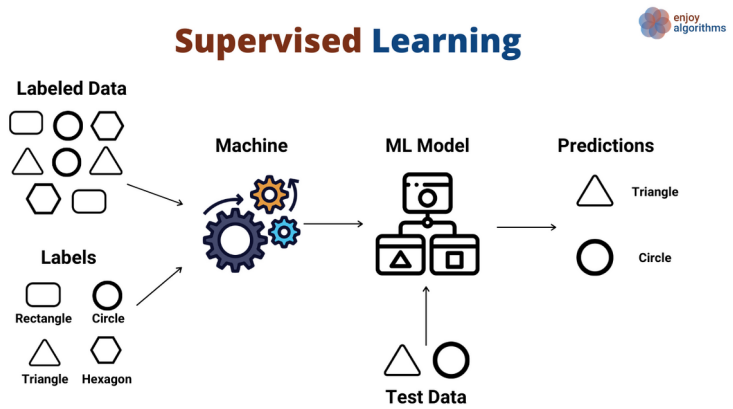
- Unsupervised Learning: Unsupervised learning is a technique in ML that aims to for the model to learn patterns in the data to classify/cluster/group similar instances togther.
- Only the data is given to the model and the model prediction is a group/class.
- Example: given a picture of a cat/dog, the model would learn to group cats togther and dogs in a different group.

Reinforcement Learning

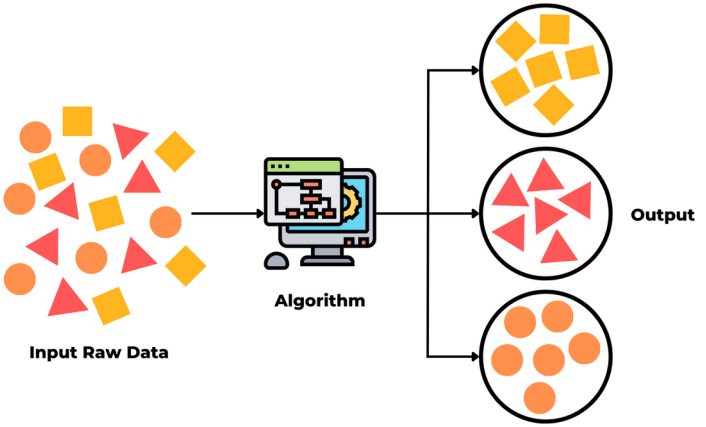
- Reinforcement Learning: Reinforcement learning is a technique in ML that when given a set of actions and a environmnet state the model would choose the best action based on a punishment/reward system.
- Given the set of actions the model would look the current state of the environment and intially act randomly and be punished for taking a bad decision and rewarded for a good one.
- Example: learning to drive (in a game), the model would look at the road ahead and determine a direction, a crash would be punished for and driving safely would be rewarded for.

Supervised vs Unsupervised vs RL

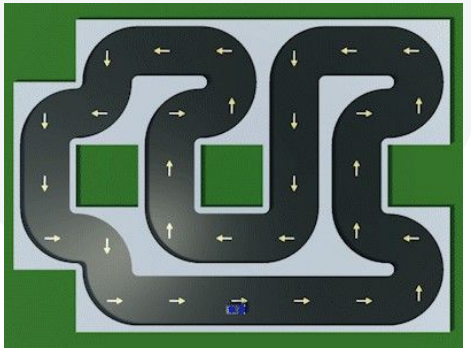
- Supervised learning:



- Unsupervised learning



- Reinforcement learning:



AI Workflow

AI Workflow

01

- Data Gathering: data gathering is getting the actual data, either from web scraping or from an already existing dataset.

02

- Data Prep/cleaning: prep-ing/cleaning is dropping unnecessary columns, filling blank values and formating the dataset for the model to work on.

03

- Model Training/Evaluation: consists of selecting a fitting model for the problem, training it on the data, evaluating it to see if it is ready for production.

04

- Deployment: is integrating the trained model into your application, hosting it, and monitering it routinely to see if it needs retraining to adapt to changes in data.

AI Workflow: Tools

- Data Gathering:
  - Web-scraping: Scrapy, Beatiful Soup.
  - Existing: Kaggle, Hugging face.
- Data Prep/cleaning: Numpy, Pandas.
- Model Training/Evaluation: Sci-kit learn (ML), Pytorch (DL), Tensorflow (DL).
- Deployment: Flask, FastAPI, Django, etc… .

AI Usage

- When to use?
- When to not?
- Real World AI Applications.

AI Usage: When to use?

- AI is a tool, a very versatile tool. But it is expensive, and takes many steps to achieve a working model (e.g. gathering, preping, etc) and they are generally not very perfomant (especially larger models) compared to an optimized rule-based algorithm. It is used when a problem no defined rules that achieve a viable accuracy or when the data is too complex to do a simple programming approach on.
- Example: classification on images, text, audio, making a decision that relies on too many variables.

AI Usage: When not to use?

- When the Problem is reliant on simple data, small number of variables, then you can generally design/use a simple algorithm to take a decision (e.g. a simple search algo.).
- Example: mapping a input to an output via a simple equation, limited number of outcomes that you simply seach through.

AI Applications

- Recommendation Engines: Netflix, Spotify, Amazon ("Because you watched...")
- Image Recognition: Facebook photo tagging, Google Photos search ("Show me pictures of dogs").
- Natural Language Processing (NLP): Spam filtering in Gmail, Siri/Alexa, Google Translate.
- Autonomous Systems: Self-driving cars, warehouse robots.

Thank you, Next is Environment Setup...