**SYNAPSE TASK 3**

**3.1 Let’s say you are given a large amount of textual data- messages, emails, books, etc. Before performing any operations on this data, it is necessary to clean and preprocess the data (removing unnecessary words or symbols, etc.). Explain how you would go about preprocessing. What different steps would be followed and why are they necessary?**

Preprocessing textual data is a crucial step in preparing it for analysis or machine learning tasks. Here are the key steps involved in preprocessing textual data and the reasons why each step is necessary:

1. **Text Normalization:**
   * **Case Uniformity:** Convert all text to lowercase to ensure uniformity, eg. "Aarushi" and "aarushi" should be considered the same.
   * **Removing Punctuation:** When punctuation does not contribute to the meaning of the text it can be removed to reduce noise.
   * **Removing Numbers:** Unless numbers are relevant to the analysis, they can be removed.
   * **Removing Extra Whitespaces**
2. **Stemming and Lemmatization:**
   * **Stemming:** Reduces words to their root form (e.g., "running" to "run").
   * **Lemmatization:** Reduces words to their base or dictionary form (e.g., "better" to "good").
   * These steps help in reducing the dimensionality of the data and using same terms for things that mean the same.
3. **Spelling Correction**
4. **Handling Special Characters and Emojis:**
   * Depending on the context, special characters and emojis may be removed or transformed into a meaningful representation.
5. **Removing HTML Tags:**
   * If dealing with web-scraped data, HTML tags can be removed to clean the text.
6. **Handling Contractions:**
   * Expanding contractions (e.g., "don't" to "do not") to ensure uniformity.
7. **Named Entity Recognition (NER):**
   * Identifying and categorizing entities (e.g., names, organizations, dates) in the text can be useful for specific analysis tasks.

**3.2.3 You all must have heard or used ChatGPT at some point in the last year or even before, it's like Janet from the Good Place, always has the answers to your question, though may not be 100% correct always but does get the work done. But it wasn’t always like this. Earlier stages of ChatGPT used to give bogus answers all the time, but over time it learnt how to give appropriate answers, relevant to the context being as accurate as itpossibly can be. This is done through a method called Reinforcement Learning. So for this task, you must understand the working of reinforcement learning, and to find out how it actually works. Additionally, find out some other examples and explain how they work.**

Reinforcement Learning is a type of machine learning where an agent learns to make decisions by receiving feedback from its actions in the form of rewards or punishments, which guides its learning process over time, as it is designed to maximise “reward” gained.

**How Reinforcement Learning Works:**

1. **Environment:**
   * The environment is the external system with which the agent interacts. It provides states and rewards based on the agent's actions.
2. **Agent:**
   * The agent is the decision-maker that interacts with the environment. It chooses actions based on a policy to maximize reward.
3. **States:**
   * States are representations of the current situation of the environment.
4. **Actions:**
   * Actions are the choices available to the agent that influence the state of the environment.
5. **Rewards:**
   * Rewards are feedback signals received from the environment after the agent performs an action. They indicate the immediate benefit of the action.
6. **Policy:**
   * The policy is the strategy that the agent uses to determine its actions based on the current state.
7. **Value Function:**
   * The value function estimates the expected cumulative reward for a state (or state-action pair), guiding the agent to maximize long-term rewards.
8. **Exploration vs. Exploitation:**
   * The agent must balance exploration (trying new actions to discover their effects) and exploitation (using known actions that yield high rewards) to learn effectively.

**Examples of Reinforcement Learning:**

1. **Game Playing (e.g., AlphaGo):**
   * **How it works:**
     + The agent (e.g. AlphaGo, or the play vs computer option in any two player game like chess etc) plays against itself or human opponents to learn the best strategies for winning the game.
     + During training, the agent receives rewards for winning or making good moves and penalties for losing or making poor moves.
     + The policy and value networks guide the agent in selecting moves that maximize the chances of winning.
   * **Outcome:**
     + AlphaGo achieved superhuman performance in the game of Go, defeating world champion players.
2. **Robotics:**
   * **How it works:**
     + Robots use RL to learn tasks such as walking, grasping objects, or navigating environments. The agent (robot) interacts with its physical environment, performing actions to achieve specific goals.
     + Sensors provide feedback on the state of the environment, and the robot receives rewards based on task completion or efficiency.
     + The robot iteratively improves its policy to perform tasks more effectively.
   * **Outcome:**
     + Robots can learn complex tasks autonomously, improving over time through trial and error.
3. **Self-Driving Cars:**
   * **How it works:**
     + Autonomous vehicles use RL to navigate roads, avoid obstacles, and obey traffic rules. The agent (car) interacts with its environment, perceiving states through sensors (e.g., cameras, etc).
     + Actions include steering, accelerating, and braking. Rewards are given for safe driving, staying within lanes, and reaching destinations efficiently.
     + The car learns optimal driving policies by balancing exploration of new routes and exploitation of known safe paths.
   * **Outcome:**
     + Self-driving cars can navigate complex environments, adapt to new situations, and improve safety over time.
4. **Recommendation Systems:**
   * **How it works:**
     + Platforms like Netflix and YouTube use RL to recommend content to users. The agent (recommendation system) suggests items based on user interactions (clicks, views, likes).
     + Rewards are based on user engagement metrics (e.g., watch time, likes). The system learns to recommend items that maximize user satisfaction and engagement.
     + The policy is continually updated based on user feedback to improve recommendations.
   * **Outcome:**
     + Users receive personalized recommendations, enhancing their experience and increasing platform usage.