Applied Learning Assignments 1:

Q1. Which of the following is NOT a key component of a Convolutional Neural Network (CNN)? a) Convolutional layer

b) Pooling layer

c) Recurrent layer

d) Fully connected layer

**Answer:** C

Q2. What is the primary purpose of a pooling layer in a CNN?

a) To increase the spatial dimensions of the feature maps.

b) To reduce the spatial dimensions of the feature maps and introduce invariance to small translations.

c) To extract high-level features from the input data.

d) To classify the extracted features.

**Answer**: B

Q3. Explain the concept of "memory" in the context of RNNs.

**Answer:**

In Recurrent Neural Networks (RNNs), "memory" refers to the network's ability to retain and use information from previous time steps when processing sequential data.

* Unlike standard neural networks that assume inputs are independent, RNNs maintain a hidden state that gets updated at each time step.
* This hidden state acts like memory, carrying forward relevant information from earlier inputs in the sequence.
* This allows RNNs to capture temporal dependencies, such as word order in a sentence or patterns over time in time-series data.

Q4. What is the vanishing gradient problem, and how does it affect RNNs?

The vanishing gradient problem occurs during backpropagation, when gradients (used to update weights) become very small as they are propagated backward through many layers or time steps.

**How it Affects RNNs:**

In RNNs, especially vanilla RNNs, backpropagation happens through time (BPTT). If the network is processing a long sequence, the gradients can shrink exponentially, causing:

* Very small weight updates
* Slow or no learning
* Inability to capture long-term dependencies (i.e., the network "forgets" earlier inputs)

**Example:**

If you're training an RNN to predict the next word in a sentence and it needs to remember something from 20 steps ago, the vanishing gradient may prevent it from learning that long-distance relationship.

Q5. Describe a real-world application of RNNs, and explain how they are used in that context.

**Answer:**

### **Application**: Language Translation (Machine Translation)

#### Example: Translating English to French

RNNs are widely used in machine translation systems like **Google Translate** (especially before the rise of Transformers). The goal is to convert a sentence from one language to another.

### **How RNNs Are Used:**

Encoder–Decoder Architecture:

* The encoder RNN reads the input sentence (e.g., "I love you") one word at a time and compresses the information into a context vector (memory).
* The decoder RNN then takes this context vector and generates the translated output (e.g., "Je t'aime") word by word.

Sequence Handling:  
RNNs are great for this because they remember order and context, which is essential for language understanding.