Artificial Neural Network

Types of Neural Networks

Types of Neural Networks

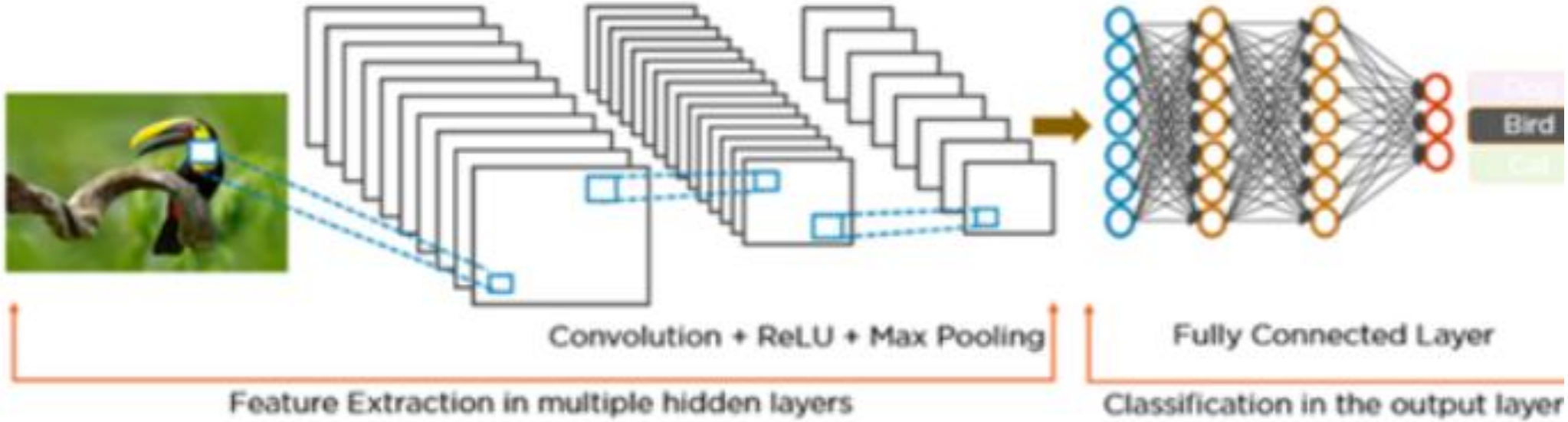
- Convolutional neural networks (CNNs)
- Recurrent neural networks (RNNs)
- Transformer neural networks

Convolutional Neural Networks (CNN)

Purpose: Designed for image-related tasks (e.g., image classification, object detection, handwriting recognition).

- **Key Features:**
- Uses **convolutional layers** to detect patterns such as edges, textures, and shapes in images.
- **Pooling layers** reduce spatial dimensions and retain important features.
- Excellent at handling **spatial data** (2D structures like images).
- **Applications:**
- Facial recognition
- Medical image analysis
- Self-driving car vision systems

Convolutional Neural Networks (CNN)

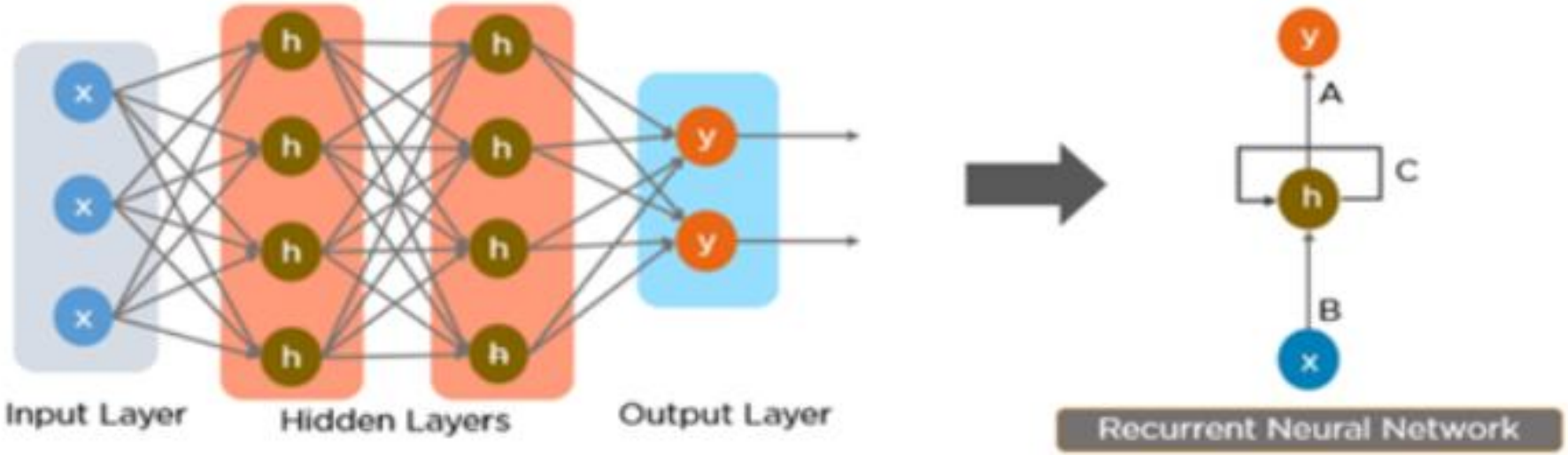


Recurrent Neural Networks (RNN)

Purpose: Designed for **sequential data** (e.g., time series, text, audio).

- **Key Features:**
- Maintains a **memory of previous inputs** through hidden states.
- Ideal for data where **order matters** (e.g., predicting next word in a sentence).
- Can suffer from **vanishing gradient**, which is addressed in variants like **LSTM** and **GRU**.
- **Applications:**
- Language translation
- Speech recognition
- Stock price prediction

Recurrent Neural Networks (RNN)



Final Exam Paper Review

Candidate Number _____ **Table Number** _____

Tutorial Group _____

Instruction to Candidates:

1. Answer **ALL** the questions in the question booklet provided.
2. The breakdown of exam questions by Module Learning Outcome(s) and its associate weightage is as follows:

MLO	Question(s)	Marks
MLO2	Question 1	10
MLO2	Question 2	10
MLO3	Question 3	10
MLO3	Question 4	10
	TOTAL	**40**

Question	Topic	Focus	Cognitive Level	Skills Tested
Q1	Concept of Genetic Algorithms, Probability and Bayesian Networks, Neural Networks, Machine Learning System Design	Conceptual + Functional Understanding	C3	Explanation, computation
Q2		Programming	C3	Coding logic, state representation, optimization
Q3	Introduction to parallel computing, Parallel Fundamentals and Decomposition, Architecture and Programs	Application in Parallel Tasks	C4	Application of knowledge, logical structuring, problem-solving
Q4		Comparative Analysis	C4	Analytical thinking, evaluation of alternatives, reasoning

Sample Question

Question 1: (10 marks)

A credit scoring company uses a simple neural network to predict loan defaults based on income, credit score, and loan amount.

a) Outline the forward propagation steps for one input instance using a single hidden layer network.
(5 marks)

b) Explain how backpropagation updates weights in the network during training.
(3 marks)

c) Explain how backpropagation updates weights in the network during training.
(2 marks)

Sample Answer

a) Outline the forward propagation steps for one input instance using a single hidden layer network.

Answer:

1. **Input Preparation:**
   The customer's income, credit score, and loan amount are first collected and converted into numerical values that the network can work with. These inputs are then scaled (normalized) so that they fall within a specific range, like 0 to 1. ***(1 mark)***
2. **Processing in the Hidden Layer:**
   Each of these inputs is passed to the hidden layer of the neural network. The network uses internal weights to evaluate how much influence each input has and adds a bias to help with flexibility. ***(1 mark)***
3. **Activation Function:**
   The hidden layer uses an activation function like ReLU or sigmoid to decide how much signal should be passed forward based on the combined input. ***(1 mark)***
4. **Generating an Output Signal:**
   The processed signals from the hidden layer are passed to the output layer, which performs a similar step to generate the final output. ***(1 mark)***
5. **Final Prediction:**
   The output is a number between 0 and 1 that represents the likelihood that the customer will default on the loan. The closer the number is to 1, the higher the risk. ***(1 mark)***

Sample Answer

B) Explain how backpropagation updates weights in the network during training. ***(3 marks)***

Answer:

1. **Calculating Error:**
   After the network makes a prediction (e.g., predicting a low chance of default), it compares this prediction with the actual outcome (whether the person really defaulted). The difference between the two is the **error**. *(1 mark)*
2. **Tracing the Error Backward:**
   Backpropagation allows the network to **trace the error back** through each layer to figure out which connections (weights) were most responsible for the incorrect prediction. *(1 mark)*
3. **Updating Weights:**
   The weights in the network are then **adjusted slightly** to reduce the error the next time. This is done repeatedly using many loan cases until the network becomes more accurate at predicting defaults. *(1 mark)*

Sample Answer

c) Mention one drawback of overfitting in this context and how it can be minimized. ***(2 marks)***

Answer:

- **Drawback:**
  The neural network may perform very well on training data but fail to generalize to unseen applicants, leading to incorrect loan approvals or rejections. *(1 mark)*
- **Mitigation Strategy:**
  Use techniques like regularization (L2), dropout, or cross-validation to improve generalization. *(1 mark)*

🎓 Exam Policy: Do’s and Don’ts (Taylor’s University)

- ✅ **Bring your Student ID card** and place it visibly on your desk.
- ✅ **Arrive at least 15 minutes before** the exam begins.
- ✅ **Use only approved writing instruments and calculators** (if allowed for the paper).
- ✅ **Follow all instructions** given by the invigilators throughout the exam session.
- ✅ **Students who require a dictionary** must:
  - ✅ Get **prior written approval** from the module leader.
  - ✅ Present a **signed support letter** before the exam day.
  - ✅ Use **only approved hardcopy dictionaries**, which will be inspected before use.

🎓 Exam Policy: Do's and Don'ts (Taylor's University)

❌ **Don'ts:**

- ❌ **Do not cheat** – academic dishonesty can lead to **disciplinary action**, including failure or expulsion.
- ❌ **Do not bring unauthorized materials** (notes, papers, smartwatches, phones, etc.) into the exam hall.
- ❌ **Do not communicate** or attempt to copy from others during the exam.
- ❌ **Do not leave your seat** without permission from the invigilator.
- ❌ **Do not use digital or electronic dictionaries** – only pre-approved hardcopy ones are permitted.