Generated Question Paper

Okay, here's the finalized question paper, incorporating all the elements: **Question Paper: Convolutional Neural Networks** **Instructions:** * Answer all questions. * Marks for each question are indicated in parentheses. * Use clear and concise language. **Section A: Short-Answer Questions (2 Marks Each)** *Focus: Remembering and Understanding* 1. What are the three main types of layers found in a CNN? (2) 2. Name two common types of pooling layers used in CNNs. (2) 3. Explain the purpose of the convolutional layer in a CNN. (2) 4. Why is a pooling layer used in a CNN? (2) **Section B: Long-Answer Questions (10 Marks Each)** *Focus: Evaluating and Creating* 1. **Multi-Part Question:** a) Critically evaluate the trade-offs between using max pooling and average pooling in a CNN architecture. Consider scenarios where one might be more appropriate than the other. (4) b) Analyze the impact of using a fully connected layer versus a convolutional layer in the early stages of a CNN, particularly when dealing with image data. What are the advantages and disadvantages of each approach in terms of preserving spatial information and computational efficiency? (6) 2. **Multi-Part Question:** a) The text mentions that CNNs are robust to small shifts in input data due to pooling. Evaluate the extent to which this robustness holds true in real-world scenarios, considering different types of image transformations (e.g., rotations, scaling, perspective changes). (5) b) Discuss the limitations of CNNs in terms of interpretability. How does the "black box" nature of CNNs affect their reliability and trustworthiness in critical applications? Suggest potential methods to improve the interpretability of CNN models. (5) 3. **Multi-Part Question:** a) Design a novel CNN architecture for a specific image classification task (e.g., classifying different types of flowers). Describe the number and types of layers you would use, including the activation functions, pooling strategies, and the rationale behind your choices. (6) b) Propose a method to visualize the feature maps generated by different convolutional layers in your designed CNN. Explain how this visualization could help in understanding what the network has learned and in identifying potential issues with the model. (4) 4. **Multi-Part Question:** a) Based on the provided information, create a model to explain how the dimensions of the output feature map are calculated after a convolution operation, considering input size, filter size, padding, and stride. Provide a step-by-step example with specific values. (6) b) Develop a strategy to address the issue of overfitting in a CNN, considering the limitations of the provided text. Your strategy should include specific techniques and explain how they would help to improve the generalization performance of the model. (4) **Section C: Diagram & Scenario-Based Questions (10 Marks Each)** *Focus: Applying and Creating* 1. **Diagram and Label:** Draw a simplified diagram of a CNN architecture, including at least one convolutional layer, one pooling layer, and one fully connected layer. Label each layer and indicate the flow of data between them. Briefly explain the function of each labeled layer. (10) 2. **Feature Map Visualization:** Given an input image and a 3x3 filter, draw a simplified representation of how a convolutional layer would process this input. Show the resulting feature map after applying the filter. Assume a stride of 1 and no padding. Label the input, filter, and output. (10) 3. **Self-Driving Car Scenario:** A self-driving car uses a CNN to identify road signs. Describe how the convolutional, pooling, and fully connected layers would work together to enable the car to recognize a stop sign. Explain the role of each layer in this process. (10) 4. **Medical Image Analysis:** A CNN is used to detect tumors in medical images. Explain how the CNN would process a 3D medical image (e.g., MRI scan). Describe the challenges of processing 3D data and how the CNN architecture might be adapted to handle this. (10)