

Assignment: Exploring Traditional CNNs with Different Activation Functions and Convolutional Layers

Scenario:

You are a machine learning researcher working on image classification tasks at a leading research institute. Your team has been assigned a project to investigate the impact of different activation functions and convolutional layers on the performance of traditional Convolutional Neural Networks (CNNs) for image classification. Your goal is to build and compare several CNN architectures using various activation functions and convolutional layer configurations to determine their effectiveness in classifying images accurately.

Assignment Tasks:

1. Dataset Selection:

a. Choose a suitable image dataset for the image classification task. It could be a well-known dataset like CIFAR-10, MNIST, or any other dataset that suits your research.

2. Implementing Traditional CNNs:

a. Design and implement a base CNN architecture using a deep learning library of your choice (e.g., TensorFlow, PyTorch, Keras).

b. Configure the basic CNN architecture with standard components, such as convolutional layers, pooling layers, and fully connected layers.

c. Train the base CNN on the selected dataset to establish a baseline performance.

3. Activation Functions:

a. Introduce and implement at least three different activation functions (e.g., ReLU, Leaky ReLU, Sigmoid, Tanh, etc.).

b. Replace the activation function in some or all of the convolutional layers with the alternatives you've chosen.

c. Train the modified CNN models with different activation functions using the same dataset.

4. Convolutional Layer Configurations:

a. Investigate and implement different convolutional layer configurations, such as varying the number of filters, kernel sizes, and strides.

b. Design and train CNN models with different convolutional layer setups while keeping the rest of the architecture fixed.

5. Performance Evaluation:

a. Evaluate the performance of each CNN model based on accuracy, precision, recall, and F1-score metrics.

b. Create comparative plots and tables to visualize and compare the results of different activation functions and convolutional layer configurations.

c. Analyze and interpret the impact of these modifications on the CNN's classification performance.

6. Discussion:

- a. Summarize the results and findings from your experiments with different activation functions and convolutional layer configurations.
- b. Discuss the strengths and weaknesses of each activation function and convolutional layer setup in improving the CNN's performance.
- c. Explain any observed trends or patterns that emerge from the evaluation process.

7. Conclusion and Future Work:

- a. Provide a conclusion based on the outcomes of your experiments.
- b. Suggest potential areas of future work, such as exploring more advanced activation functions or conducting experiments on larger and more complex datasets.

8. Report and Presentation:

- a. Prepare a detailed report documenting your research, implementation, and results.
- b. Create a presentation to deliver your findings.

Note: While implementing the CNN models, you can refer to existing research papers and tutorials on traditional CNN architectures, activation functions, and convolutional layer configurations. Properly cite any external sources used. Feel free to collaborate and seek guidance from your instructor during the assignment. Good luck with your investigation!