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**Model Overview**

* **Model Type**: Convolutional Neural Network (CNN) based on ResNet50 architecture.
* **Objective**: Classify images into three categories: bacteria, normal, and virus.
* **Framework**: TensorFlow and Keras.

**Datasets**

* **Training Directory**: /kaggle/input/pnemonia/pnemonia/train
* **Validation Directory**: /kaggle/input/pnemonia/pnemonia/val
* **Sample Images**:
  + Bacteria: 0(1).jpeg
  + Normal: 3100.jpeg
  + Virus: 2029.jpeg

**Data Preprocessing**

* **Grayscale Conversion**: Convert images to grayscale with target size of 150x150 pixels.
* **ImageDataGenerator**:
  + Augmentation for training data: rescale, shear, zoom, horizontal flip.
  + Rescale validation data.

**Model Architecture**

* **Base Model**: ResNet50 (pre-trained on ImageNet).
* **Additional Layers**: GlobalAveragePooling2D, Dropout, Dense layers.
* **Output Layer**: Softmax activation for multi-class classification.

**Training**

* **Optimizer**: Adam with a learning rate of 1e-4.
* **Loss Function**: Categorical Crossentropy.
* **Metrics**: Accuracy.
* **Epochs**: 25.
* **Data Augmentation**: Applied to training data for better generalization.

**Evaluation**

* **Validation Accuracy**: Calculated after each epoch.
* **Metrics**: Precision, Recall, F1 Score.
* **Classification Report**: Detailed report including precision, recall, and F1 score.

**Prediction and Visualization**

* **Function**: preprocess\_and\_predict(img\_path) - Preprocesses an image and predicts its class.
* **Visualization**:
  + Function: predict\_and\_plot\_images\_in\_folder(folder\_path)
  + Displays up to 16 images with predicted class labels.

**Key Functions**

1. **convert\_to\_grayscale**: Converts images to grayscale.
2. **preprocess\_and\_predict**: Preprocesses an image and predicts its class.
3. **predict\_and\_plot\_images\_in\_folder**: Predicts and plots image classes from a specified folder.

**Outputs**

* **Training and Validation Accuracy**: Plotted over epochs.
* **Classification Report**: Displayed with precision, recall, and F1 scores.
* **Predicted Class Labels**: Visualized on sample images from a specified folder.