CSPB 3202 HW 5 - Kaggle Competition

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Abstract

This assignment focuses on training a Machine Learning model that can accurately classify images that represent cancer. For this model, the python package Tensorflow was used to train the model. This article will discuss the methodology used to train the model, the results of the model, and the conclusions that can be drawn from the results.

Imports

The first step that was used in creating a model to classify images was to import the necessary libraries. The libraries that were imported and used in this model were:

- **pandas**
- **tensorflow**
  - **keras.preprocessing.image** - ImageDataGenerator: A class that generates batches of tensor image data with real-time data augmentation.
  - **keras.applications** - ResNet50: A pre-trained model that can be used to classify images.
  - **keras.models** - Model: A class that groups layers into an object with training and inference features.
  - **keras.layers**
    - **GlobalAveragePooling2D**: A class that applies average pooling on the spatial dimensions until each spatial dimension is one.
    - **Dense**: A class that implements the operation: output = activation(dot(input, kernel) + bias) where activation is the element-wise activation function passed as the activation argument, kernel is a weights matrix created by the layer, and bias is a bias vector created by the layer (only applicable if use_bias is True).
    - **Input**: A class that is used to instantiate a Keras tensor.
  - **keras.callbacks**:
    - **ModelCheckpoint**: A class that saves the model after every epoch.

Once these models were imported, the model was now set to be trained.

Model Training

To begin training this model, the first step was to get the data from the CSV file that was provided by Kaggle.

Data Preprocessing

The name of the CSV file that was provided was *train_labels.csv*. This file was loaded into a pandas DataFrame where label was loaded into one column and the image ID was loaded into another column.

This data was then split into a training and validation set. The training set was 80% of the data and the validation set was 20% of the data. The intention of using a validation set was an attempt to prevent overfitting of the model.

Data Augmentation

The next step was to then augment the data that was loaded. This was done using the *ImageDataGenerator* class from the *keras.preprocessing.image* module. This class was used to generate batches of tensor image data with real-time data augmentation. The data augmentation that was used was to rescale the images by 1/255, rotate the images by 20 degrees, zoom the images by 20%, and flip the images horizontally.

Model Creation

After the data was processed and then subsequently augmented, the next step was to create the model. The model that was used was the ResNet50 model from the *keras.applications* module. This model was used because it is a pre-trained model that can be used to classify images. The model was then set to be trained on the training data. This model was then trained with a total of 10 epochs. The results of each subsequent epoch were saved using the *ModelCheckpoint* class from the *keras.callbacks* module. This model was then saved using the *model.save()* method.

Model Results

After the model was created, the next step was to evaluate the model. This was achieved by loading the saved model that was previously created and evaluating it in a separate file.

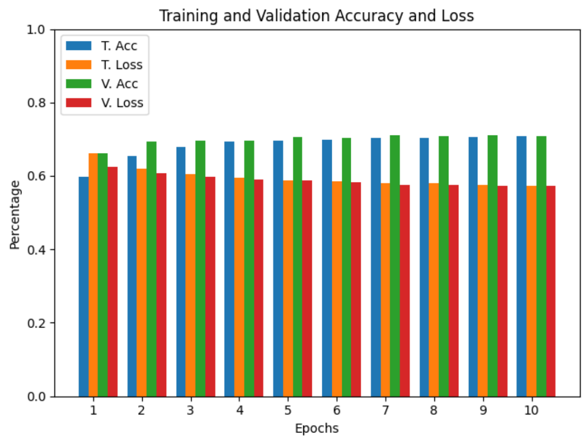
Model Training

The results from the 10 epochs that were trained can be seen in the table below:

#	T. Acc	T. Loss	V. Acc	V. Loss
1	0.5981	0.6611	0.6655	0.6245
2	0.6555	0.6204	0.6942	0.6078
3	0.6774	0.6048	0.6947	0.5972
4	0.6928	0.5944	0.6949	0.5890
5	0.6948	0.5885	0.7049	0.5863
6	0.6977	0.5855	0.7025	0.5819
7	0.7032	0.5799	0.7099	0.5756
8	0.7038	0.5789	0.7086	0.5761
9	0.7062	0.5751	0.7096	0.5739
10	0.7087	0.5720	0.7058	0.5715

Training And Validation Results

We can visualize the results of the epoch accuracy and loss below:



After all 10 epochs were trained, the final values for the accuracy and loss were:

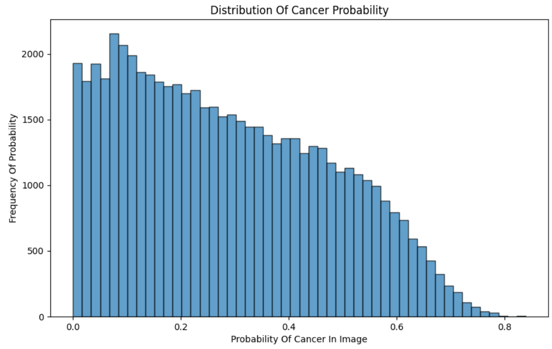
- **Training Accuracy:** 0.7087
- **Training Loss:** 0.5720
- **Validation Accuracy:** 0.7058
- **Validation Loss:** 0.5715

From the beginning to the end of the training, the model improved in accuracy and loss. The total change of the values were:

- **Training Accuracy Change:** 0.1106
- **Training Loss Change:** 0.0891
- **Validation Accuracy Change:** 0.0403
- **Validation Loss Change:** 0.0530

Model Evaluation

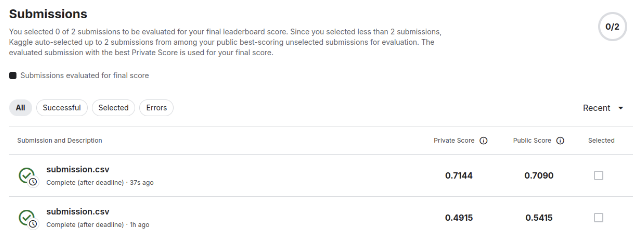
After the model was trained with the 10 epochs, it was evaluated and the results were put into a CSV. Since there are 57,458 images in the test set, it is impractical to show the results in a table format. Instead, the results of the *label* column were plotted in a histogram.



The above image shows a frequency of probability distributions found from the model evaluation. On the x-axis, the probability of the image being positive for cancer is shown. On the y-axis, the frequency of the given probability is shown.

Kaggle Submission

After the model was evaluated, the results were put into a CSV file and then submitted to Kaggle. The screenshot from the Kaggle submission can be seen below:



Due to the Kaggle competition being closed, the results from this model were not able to be placed on the leader board. The final public score of this competition was **0.7090**.

Conclusion

In conclusion, the model that was created was able to classify images that represented cancer with an accuracy of 70.90%. This model was trained with 10 epochs and was able to improve in accuracy and loss and generally performed pretty well. Considering that the model was trained with a pre-trained model, the results were pretty good. The model was able to classify images with a high degree of accuracy and if more fine tuning were possible, the model could have performed even better.

GitHub Repository

The source code that was used to create this model can be found in the following GitHub repository:

- QuantumCompiler - Kaggle Cancer Competition