Capstone Project: Deep Learning

Identification of Plasmodium spp. from Thin Blood Smears using Deep Learning.

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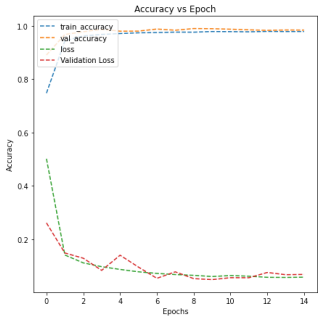
Problem Definition

- Malaria is a parasite transmitted by mosquitos.
- There are 241 million infections and 627,000 deaths annually.
- Thin blood smears read by trained and certified Parasitologist with specialized training.
- Subject matter expertise is a small group of individuals.
- A computer vision model can be trained to identify Malaria infections.

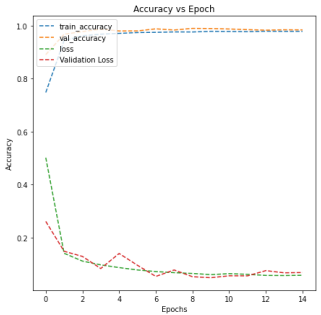
Solutions Design

- Differential microscopy allows identification of key features.
- Two dimensional convolutional layers with
  - Dense layers, pooling, normalization, regularization, reshaping
- Model Evaluation Metric minimizes validation loss.
- Model Performance Metric is the ratio of recall and precision to maximize overall performance.
- Reduce false reporting to the minimum.

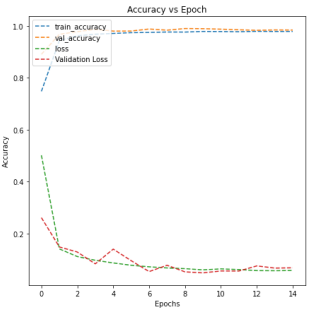
Model Performance



Base Model



Model 2



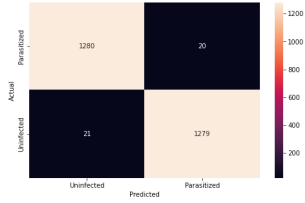
VGG16 Model

Model Evaluation

```
82/82 [==============================] - 3s 40ms/step
              precision    recall  f1-score   support

           0       0.98      0.98      0.98      1300
           1       0.98      0.98      0.98      1300

    accuracy                           0.98      2600
   macro avg       0.98      0.98      0.98      2600
weighted avg       0.98      0.98      0.98      2600
```

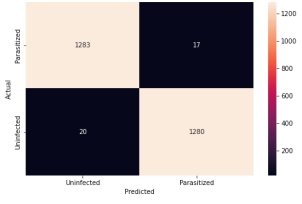


Base Model

```
82/82 [==============================] - 5s 63ms/step
              precision    recall  f1-score   support

           0       0.98      0.99      0.99      1300
           1       0.99      0.98      0.99      1300

    accuracy                           0.99      2600
   macro avg       0.99      0.99      0.99      2600
weighted avg       0.99      0.99      0.99      2600
```

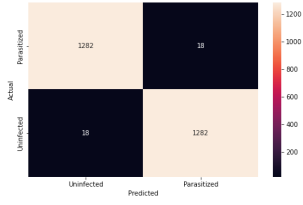


Model 2

```
82/82 [==============================] - 3s 41ms/step
              precision    recall  f1-score   support

           0       0.99      0.99      0.99      1300
           1       0.99      0.99      0.99      1300

    accuracy                           0.99      2600
   macro avg       0.99      0.99      0.99      2600
weighted avg       0.99      0.99      0.99      2600
```



VGG16 Model

Key Observations & Insights

- VGG16 performs better than Model 2.
- False reporting has serious health outcomes, minimizing false reporting is a key performance indicator for the model.
  - False Negatives: serious negative health outcomes including death without treatment.
  - False Positives: negative health outcomes due to toxicity of treatment.
- The VGG16 matches the current accuracy and precision for light microscopy.

Recommendations

- The VGG16 model is recommended to identify Malaria in blood smear images.
  - Positive Predictive Value (Precision): 99%
  - Correct Identification (Accuracy): 99%
  - Predictive Performance (Recall): 99%
  - Ratio of False Identifications (F1 Score): 99%
  - False Negatives: <1%
  - False Positives: <1%

Works Cited

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