

# Directed Reading

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# Agenda

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- Dataset
- Deep-Net Strategy
- Result
- Final Report
- Tools learned

# Dataset

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- **Total fundus images:** 208
- **Classes:** 4
- **Normal images:** 54
- **DR1 images:** 42
- **DR2 images:** 60
- **DR3 images:** 52

## Constant HyperParameters

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- **Epochs:** 30
- **Activation hidden layer:** Rectifier Linear Unit(ReLU)
- **Activation output layer:** Softmax
- **Loss function:** Categorical-Crossentropy
- **Dropout:** 0.5
- **Optimizer:** Adam



**(a)** Normal

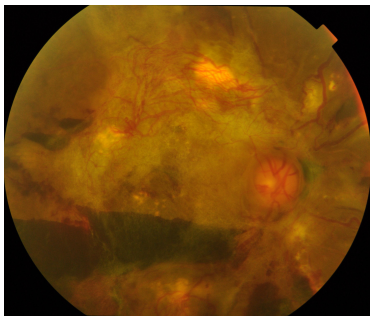


**(b)** DR1

**Figure 1:** Color fundus images representing Normal and Stage-1 DR



(a) DR2



(b) DR3

**Figure 2:** Color fundus images representing Stage-2 and 3 of DR

1. Conv-Net on gray-scale fundus images
2. Conv-net on color fundus images
3. Conv-net on augmented fundus images
4. Transfer learning using VGG16 on color fundus images
5. Transfer learning using VGG19 on color fundus images
6. Fine tuning using VGG16 on color fundus images
7. Fine tuning using VGG19 on color fundus images

**For jupyter notebooks (code files), click link below**

`https://github.com/zubairqalbi/DR\_Report`



## CNN on gray fundus images

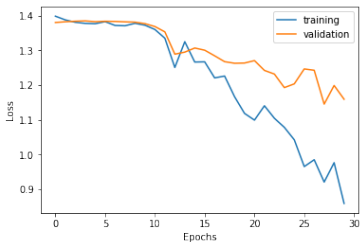
**Table 1:** Training and Testing

<b>Train Loss</b>	<b>Train Accuracy</b>	<b>Test Loss</b>	<b>Test Accuracy</b>
0.8588	0.6154	1.1591	0.4808

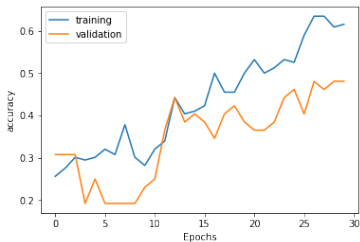
**Table 2:** Classification Report

	<b>Precision</b>	<b>Recall</b>	<b>F1-Score</b>	<b>Support</b>
<b>Normal</b>	0.31	0.40	0.35	10
<b>DR1</b>	0.67	0.55	0.60	11
<b>DR2</b>	0.50	0.56	0.53	16
<b>DR3</b>	0.50	0.40	0.44	15
<b>Weighted avg</b>	0.50	0.48	0.48	52

## Continued...



(a) Loss



(b) Accuracy

**Figure 3:** Loss and Accuracy on gray-scale fundus images

## CNN on color fundus images

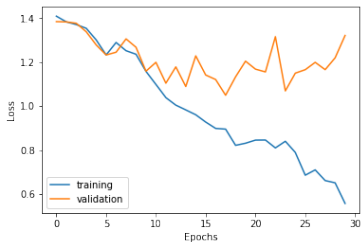
**Table 3:** Training and Testing

<b>Train Loss</b>	<b>Train Accuracy</b>	<b>Test Loss</b>	<b>Test Accuracy</b>
0.5568	0.7628	1.3214	0.6923

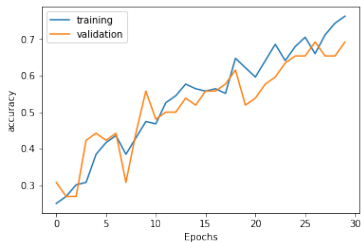
**Table 4:** Classification Report

	<b>Precision</b>	<b>Recall</b>	<b>F1-Score</b>	<b>Support</b>
<b>Normal</b>	0.53	0.91	0.67	11
<b>DR1</b>	0.90	0.69	0.78	13
<b>DR2</b>	0.73	0.57	0.64	14
<b>DR3</b>	0.75	0.64	0.69	14
<b>Weighted avg</b>	0.73	0.69	0.70	52

## Continued...



(a) Loss



(b) Accuracy

**Figure 4:** Loss and Accuracy on color fundus images

## CNN on augmented fundus images

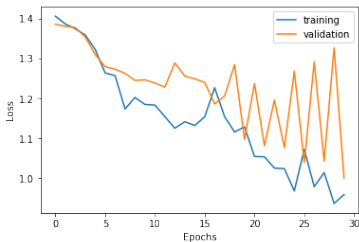
**Table 5:** Training and Testing

<b>Train Loss</b>	<b>Train Accuracy</b>	<b>Test Loss</b>	<b>Test Accuracy</b>
0.9614	0.5495	1.0002	0.4808

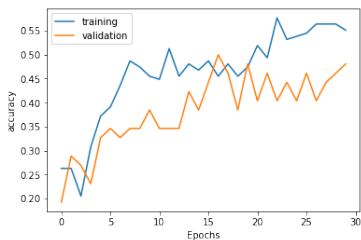
**Table 6:** Classification Report

	<b>Precision</b>	<b>Recall</b>	<b>F1-Score</b>	<b>Support</b>
<b>Normal</b>	0.50	0.73	0.59	11
<b>DR1</b>	1.00	0.67	0.80	12
<b>DR2</b>	0.42	0.42	0.42	19
<b>DR3</b>	0.11	0.10	0.11	10
<b>Weighted avg</b>	0.51	0.48	0.48	52

## Continued...



(a) Loss



(b) Accuracy

**Figure 5:** Loss and Accuracy of augmented color fundus images

## TL using vgg16 on color fundus images

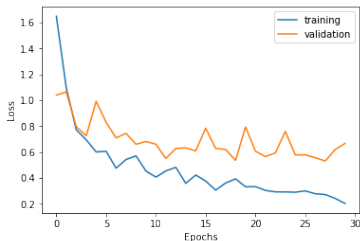
**Table 7:** Training and Testing

<b>Train Loss</b>	<b>Train Accuracy</b>	<b>Test Loss</b>	<b>Test Accuracy</b>
0.2025	0.9187	0.6669	0.7250

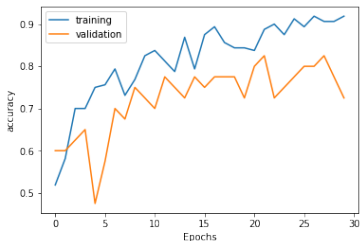
**Table 8:** Classification Report

	<b>Precision</b>	<b>Recall</b>	<b>F1-Score</b>	<b>Support</b>
<b>Normal</b>	0.40	0.29	0.33	7
<b>DR1</b>	0.94	0.74	0.83	23
<b>DR2</b>	0.59	1.00	0.74	10
<b>Weighted avg</b>	0.76	0.72	0.72	40

## Continued...



(a) Loss



(b) Accuracy

**Figure 6:** Loss and Accuracy after applying transfer learning using VGG16 on augmented color fundus images



## TL using vgg19 on color fundus images

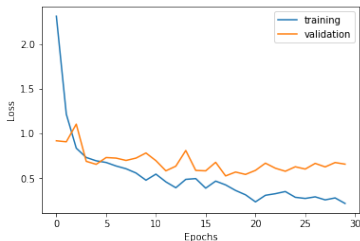
**Table 9:** Training and Testing

<b>Train Loss</b>	<b>Train Accuracy</b>	<b>Test Loss</b>	<b>Test Accuracy</b>
0.2166	0.9187	0.6566	0.7500

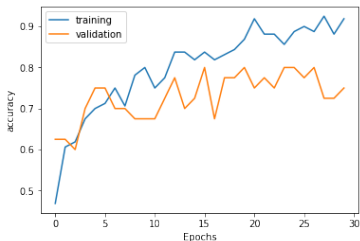
**Table 10:** Classification Report

	<b>Precision</b>	<b>Recall</b>	<b>F1-Score</b>	<b>Support</b>
<b>Normal</b>	0.60	0.43	0.50	7
<b>DR1</b>	0.85	0.74	0.79	23
<b>DR2</b>	0.67	1.00	0.80	10
<b>Weighted avg</b>	0.76	0.75	0.74	40

## Continued...



(a) Loss



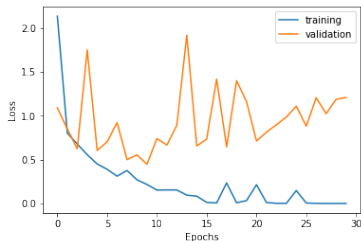
(b) Accuracy

**Figure 7:** Loss and Accuracy after applying transfer learning using VGG19 on augmented color fundus images

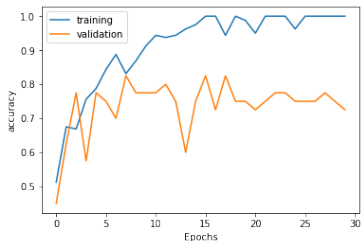
**Table 11:** Training and Testing

Train Loss	Train Accuracy	Test Loss	Test Accuracy
$3.2858e - 05$	1.0000	1.2077	0.7250

## Continued...



(a) Loss



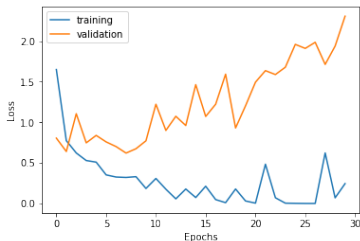
(b) Accuracy

**Figure 8:** Loss and Accuracy after applying fine tuning by removing top four layers of VGG16 on augmented color fundus images

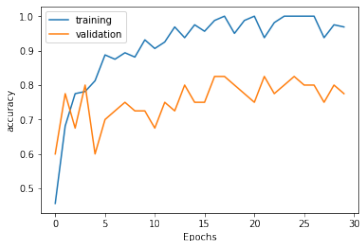
**Table 12:** Training and Testing

<b>Train Loss</b>	<b>Train Accuracy</b>	<b>Test Loss</b>	<b>Test Accuracy</b>
0.2444	0.9687	2.3069	0.7750

## Continued...



(a) Loss



(b) Accuracy

**Figure 9:** Loss and Accuracy after applying fine tuning by removing top four layers of VGG19 on augmented color fundus images

**Click on link below to see the directed reading report**

[https://github.com/zubairqalbi/DR\\_Report](https://github.com/zubairqalbi/DR_Report)

## Research document writing tools Learned

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- $\text{\LaTeX}$  (Miktex with TexStudio)
- $\text{\LaTeX}$  (Miktex with TexMaker)
- $\text{\LaTeX}$  with Lyx
- BibTeX management with Mendeley Desktop
- BibTeX management with JabRef
- BibTeX management with Zotero
- Beamer



**Image segmentation using deep neural networks**

## Reference Platforms

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- **Github**
- **Kaggle**
- **Keras Documentation**
- **EliteDataScience**