Deep learning for cellular image analysis
Paper Summary

The above review paper goes on to talk at length about the use of deep learning in the field of cellular image analysis. The paper initially talks about the practical mechanics of deep learning wherein it goes on to explain the technical terms related to deep learning while dealing with the biological data. It talks about the data preparation step where data augmentation (flipping, rotating, hue) player a great role. Transfer learning is also talked about and said that its use takes the mode more toward the generalization of results and how that is useful for the problem statement. The paper says the initial step to be the biggest barrier and at the end of this step, the data is prepared to be modeled for which we have a lot of tools at hand. The paper then moves forward by talking about the training of the classifier. The linear classifier is discussed first followed by the more complex networks like Neural networks and CNN. The use of regularization to reduce the overfitting problem is discussed in the context of linear classifiers. This technique does not scale with the complexity of the model and thus for more complex models, we use the Dropout layer as the means to achieve the regularization. This also builds the platform for troubleshooting why the model metrics (Accuracy/F1 score) are bad sometimes and then gives us the steps and understanding on what to do to improve that. In general, we first measure the loss and optimize on basis that. At the same time, the model also calculates the accuracy/F1 score to measure the performance on unseen data. If this performance is bad then we check things like

1. What metric are we using? If We are using accuracy, is our data balanced?
2. Are we overfitting the given data? If yes then, is our dataset too small? Is the complexity of our model too high? Should we use transfer learning?
3. Is there a scope of improvement? Are hyperparameters tuned properly? Is loss function still decreasing?
4. If the code is giving out the errors then is our dimensions manipulation correct or not?

The paper then talks about the biological application where we can use deep learning to reduce human effort or achieve better results. Image Classification is one of the fields where we use deep learning to classify tissue images into different categories based on their shapes, sizes, and textures. This problem can be posed as a multiclass classification problem. Image Segmentation is also one of the uses where we use complex models to exactly locate a particular disease or tissue type. This problem can be posed as a regression problem where we predict the coordinates of the desired points. Object tracking is also one of the fields where we use DL to track the movement of a particular disease or displacement of muscles or bones. In all the above applications discussed the paper discussed the previous model works and the recent breakthrough to achieve better results. Models like CNN, R-CNN are discussed with architectures like U-net, Object detection(Yolo), Deepcell, and Mask R-CNN. The paper also gives the resources for data used and discussed that is present on public forums. While talking about future work the authors encourage the wider use of tools mentioned. They go on to highlight the importance of 2D and 3D visualization to understand data.