Counting Cells from Microscopy Images Using Convolutional Neural Networks

COMP90055 Computing Project

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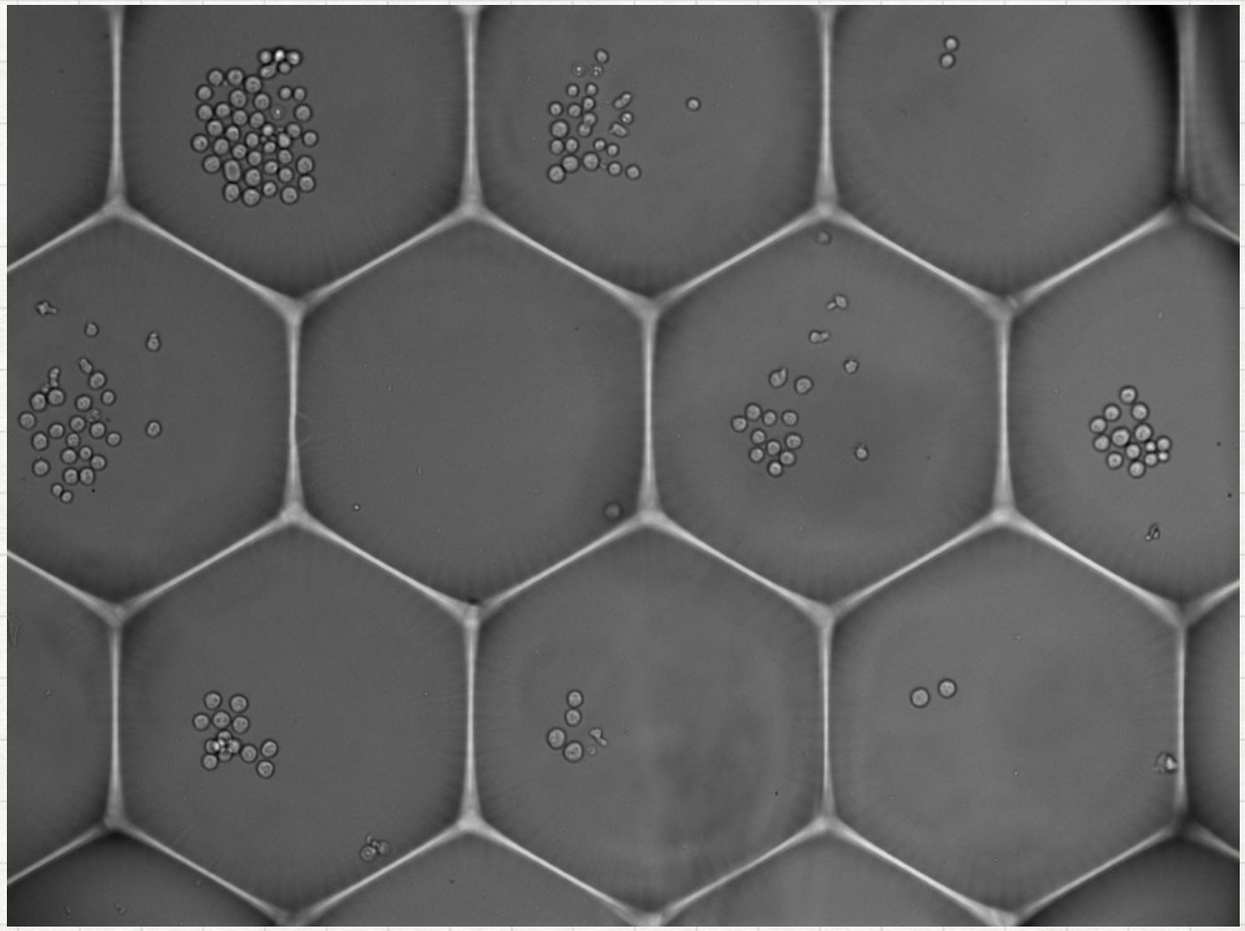
MOTIVATION

COUNTING CELLS FROM MICROSCOPY IMAGES USING CONVOLUTIONAL NEURAL NETWORKS

- Counting cells from microscopy images is an tedious and time-consuming task encountered in many real-word applications, including drug screening and mathematical modelling.

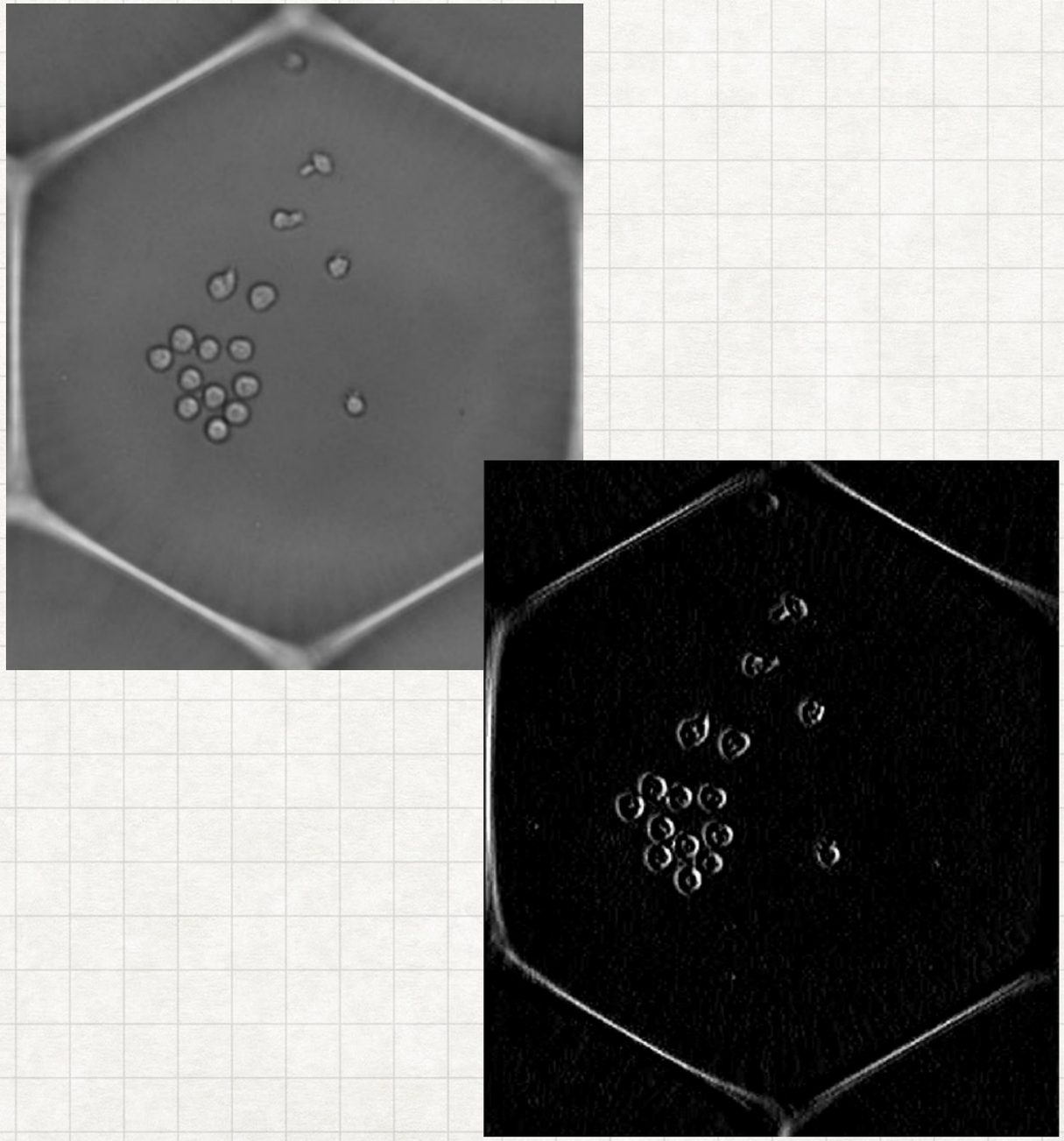
- Challenges in this problem include the substantial variability in cell appearance across experiments and the limited amount training data.



MOTIVATION

COUNTING CELLS FROM MICROSCOPY IMAGES USING CONVOLUTIONAL NEURAL NETWORKS

- **CNN - Convolutional Neutral Network**
- Is a type of feed-forward artificial neural network. They have wide applications in image and video recognition, recommender system and NLP.
- When used in image recognition, CNN consists of multiple layers of filter to process small portion of input image, aka receptive fields.



LITERATURE REVIEW

- Contributions and advantages of previous work
  - Using many neural networks model like CNN, DNN
  - Counting cell in crowed microscopy images with density estimation avoid the difficult detection and segmentation of individual cells
  - Using pixel values as input bypass problem of decreasing classification accuracy by feature selection
  - Using foveation and nonuniform sampling to manipulate its input data in order to improve network performance

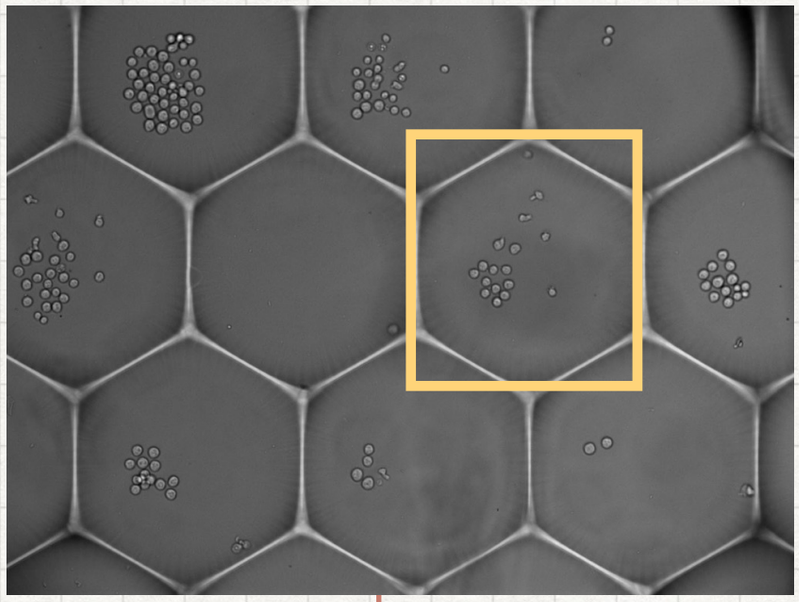
- Limitation of previous work
  - Haven’t focused on the relationship between amount of training data and the accuracy result
  - Haven’t manipulated LeNet model to improve network performance

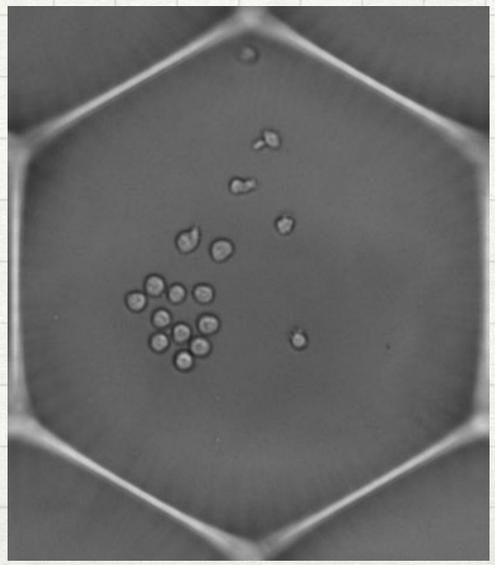
PROBLEM STATEMENT

- Develop a Convolutional Neural Network approach to count cells from microscopy images.
- Output of project is a CNN model that takes N training images as input and predicts the number of cells for a test image with accuracy Pearson correlation more than X (N = 1000~5000, X = 0.7 in this case)
- Through this project, we are going to find out the minimum number of manually labelled images required to train a CNN model that can count cells well.

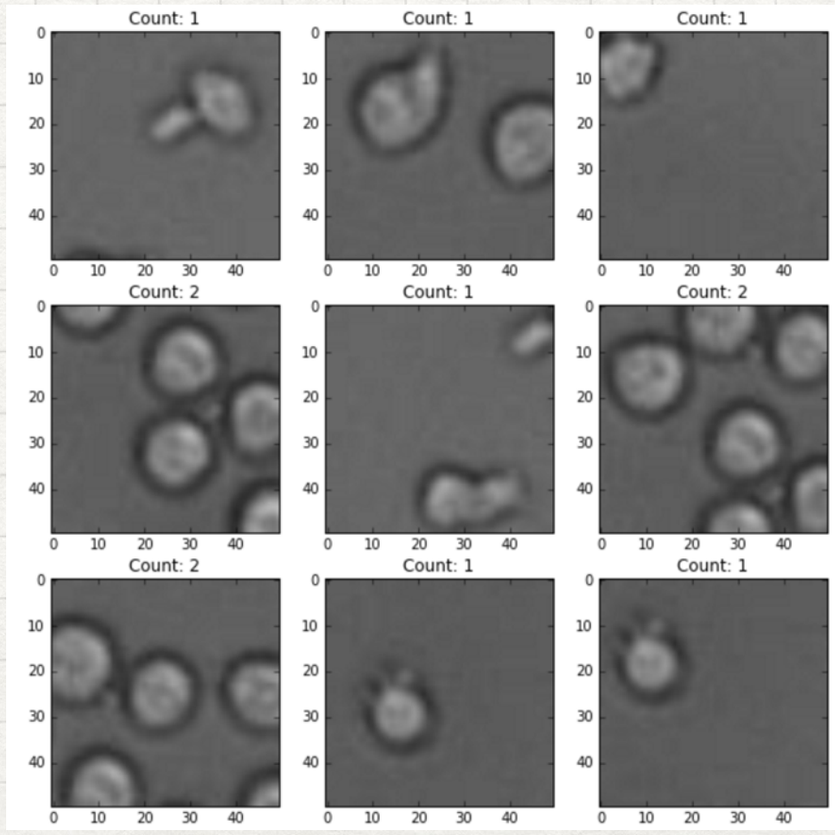
METHODOLOGY

- Generate more training data based on limited amount of manually labelled images



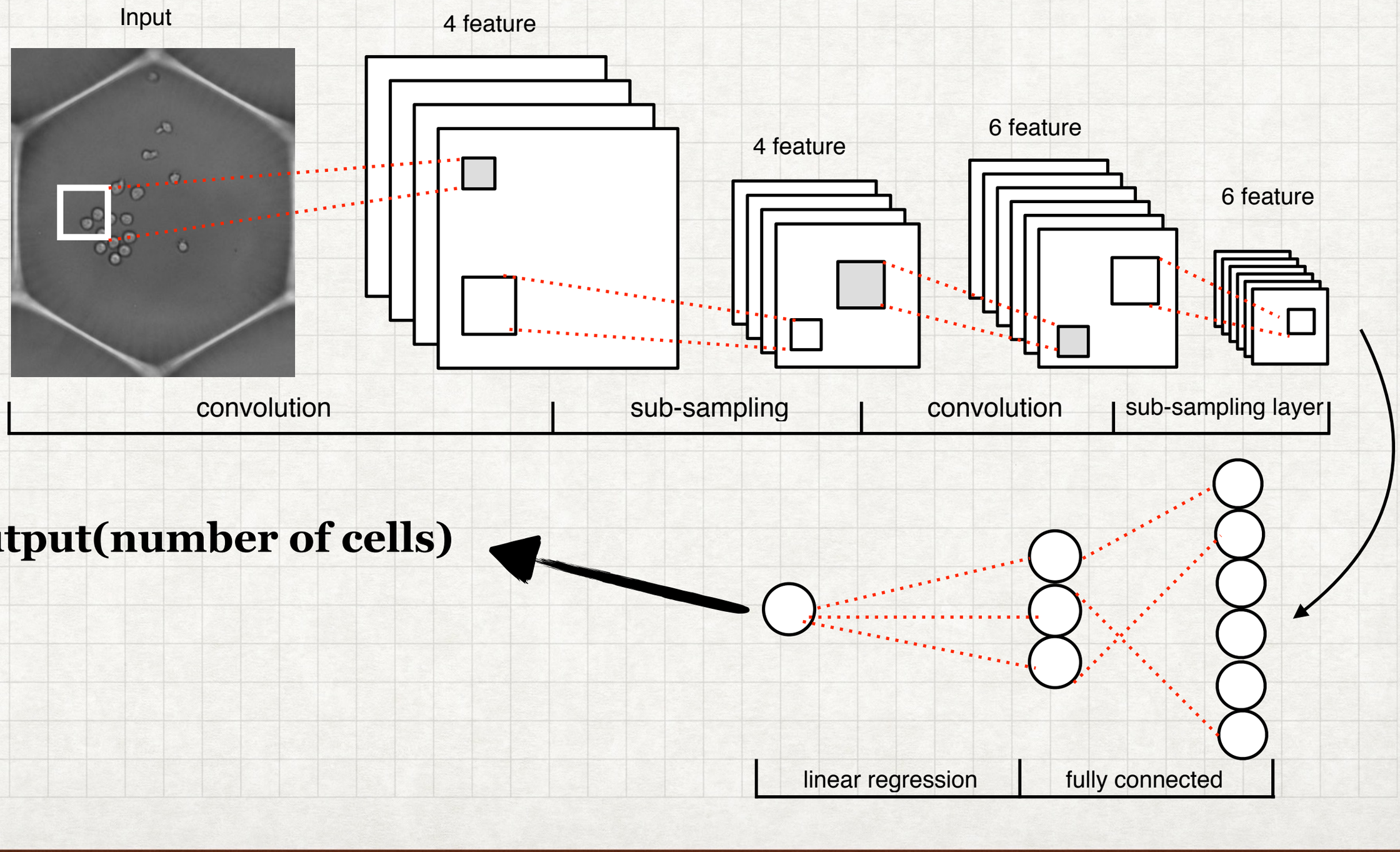


NUM	X	Y
1	110.0	239.0
2	124.0	226.0
3	128.0	273.0
4	130.0	255.0
…	…	…



METHODOLOGY

- Build improved LeNet models(Convolutional layer + max-pooling layer + full-connected layer + linear regression layer) to count cells
- Total number of parameters in our current CNN: 125+1250+81000+100 = 82475

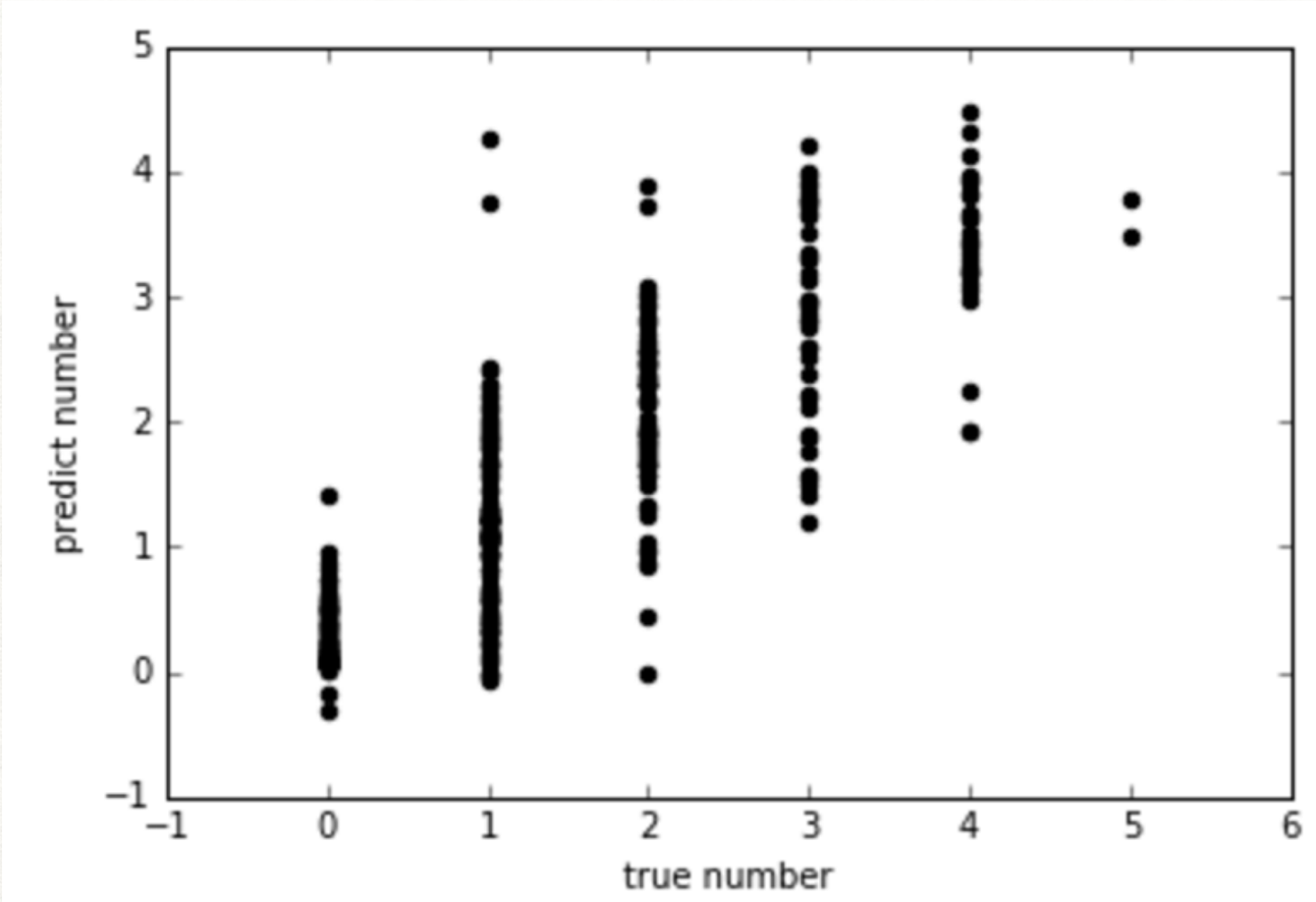


CONCLUSIONS AND FUTURE WORK

- CONCLUSIONS
  - Motivation of our project
    - Counting cells is useful but time-consuming in real life
    - CNN can be used to build a model that solve this problem easily
  - Statement of our problem
    - Build a CNN model that can predict the number of cells in a new input image with accuracy more than a specific value
    - Find out the minimum number of manually labelled images required to train this model well
  - Methodology used in solving this problem
    - Generate more training data on original manually labelled images
    - Build improved LeNet models with multiple layers

CONCLUSIONS AND FUTURE WORK

- FUTURE WORK
  - Current result
    - Image shows result test on 500 dataset with X axis as true number of cells and Y axis as predicted number of cells



  - Next step
    - Evaluate different network configurations by changing number of network layers or number of parameters in each layer
    - Test whether generating even more data is beneficial

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THANK YOU