**Lab 04 – Chihuahua or Muffin Workshop**

ITAI 1378

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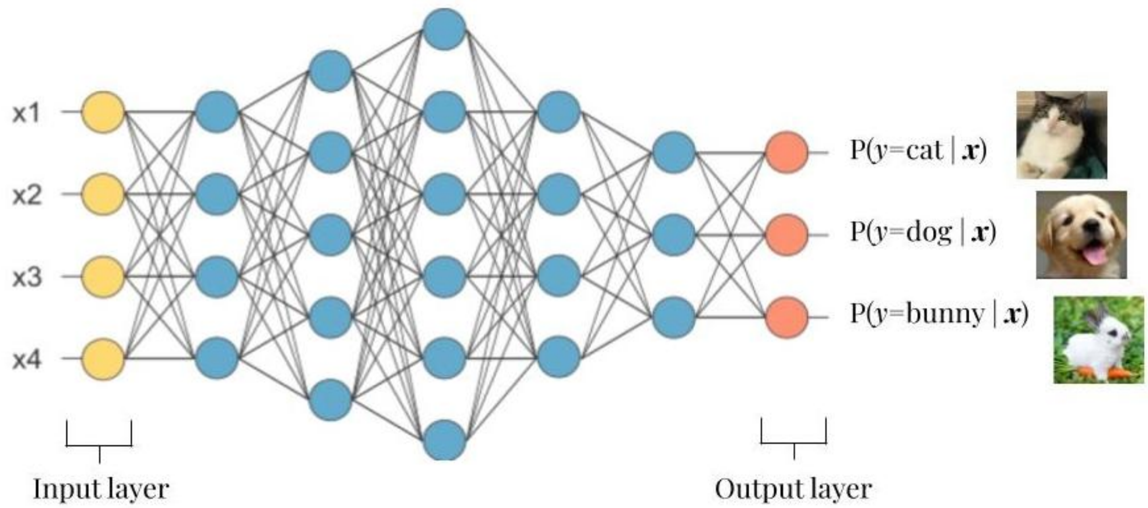
**Traditional Neural Network**




A neural network is a computational model that organizes simple processing units, known as neurons, into layers. These layers help the network detect patterns and make predictions. The structure typically includes an input layer (where raw data is introduced), one or more hidden layers (which apply transformations like linear mappings), and an output layer (that uses nonlinear activation to generate predictions) *(GeeksforGeeks, 2025; IBM, 2025)*. A neural network includes several components: neurons, which are its basic processing units; connections between neurons, controlled by parameters called weights and biases; and learning mechanisms that adjust those parameters to improve performance over time *(GeeksforGeeks, 2025)*.

There are different ways to train a neural network: we can use supervised learning (a labeled dataset), unsupervised learning (an unlabeled dataset, the purpose is to find patterns), and reinforcement learning (uses a system of reward and punishment to promote good practices). There are different types of neural networks, like Recurrent Neural Networks, Convolutional Neural Networks, Feedforward Networks, etc., but this lab is focused on the most basic structure.

**Model Performance**

When I was familiar with the concepts of this lab, it was the first time I had hands-on experience with a NN model. I explored the "chihuahua vs muffin" challenge in Machine Learning, where our goal is to train a model to differentiate between similar objects. As Yao (2017) highlights, this workshop is a good example that demonstrates the limits of image classification systems when faced with ambiguous visual cues. The purpose of the model is to determine if the input image is a chihuahua or a muffin. I know we can all distinguish the difference, but for a machine, it might not be that easy. If we search the web, we can find several similar images, such as:


I trained my model with 150 images; I used 120 for training and 30 for validation. We need to make sure the model learns and doesn't just memorize, and we need to define the loss function so our model can optimize based on feedback. This is the output after defining the training loop, loss function, and optimizer:


We can observe that it is not 100 percent accurate; there are a couple of muffins that are closer to being chihuahuas than muffins, and there are some chihuahuas that can pass by muffins.

**Results**

As we can observe, the model is not 100 percent accurate. Our model's training results are:

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train error: 0.6656, Accuracy: 0.6833

validation error: 0.6098, Accuracy: 0.8667

Epoch 2/3
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train error: 0.5664, Accuracy: 0.8667

validation error: 0.5241, Accuracy: 0.9000

Epoch 3/3
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train error: 0.4750, Accuracy: 0.9167

validation error: 0.4603, Accuracy: 0.9333
```

Our model was trained over 3 epochs; we can observe that the model improves. We don't have overfitting, and we have good generalization because there is no divergence between training and validation, and the accuracy improvement shows that the model is learning.

**Challenges and Solutions**

The challenges that I encountered are the validation accuracy; besides that, the workshop was pretty clear and interactive. The way I would improve the model is by adding more epochs (let's remember that the best performance comes from more practice), changing the learning rate, using a different optimizer, adding more layers and layer dimensions, changing the image size, and using data augmentation transforms.

**Real-World Applications**

Some of the real-world applications for Traditional Neural Networks include:

- Finance (can be used for things like credit scoring and fraud detection)
- Healthcare (can be used for things like disease risk classification)
- Insurance (can be used for things like risk of accidents and costs of claims)
- Communications (can be used for things like spam classification)

**Ethical Considerations**

The ethical considerations regarding Traditional Neural Networks include:

- Transparency: Neural Networks often function as "black boxes," making it difficult to interpret their decision-making logic *(Meegle, n.d.)*.
- Fairness: If our data is not diverse, the model can amplify biases leading to discrimination.
- Accountability: It is difficult to determine who is responsible when there is an error.
- Privacy: The dataset contains large amounts of data that might contain sensitive personal information.
- Safety: There are risks of malfunction and misuse.
- Societal Impact: Job displacement and the environmental impact.

**References**

GeeksforGeeks. (2025, October 7). *What is a neural network — A beginner's guide*. GeeksforGeeks. https://www.geeksforgeeks.org/machine-learning/neural-networks-a-beginners-guide/

IBM. (2025, September 10). *What is a neural network?* https://www.ibm.com/think/topics/neural-networks

Yao, M. (2017, October 12). *Chihuahua or muffin? My search for the best computer vision API*. freeCodeCamp. https://www.freecodecamp.org/news/chihuahua-or-muffin-my-search-for-the-best-computer-vision-api-cbda4d6b425d/

Meegle. (n.d.). *Neural network ethics*. https://www.meegle.com/en_us/topics/neural-networks/neural-network-ethics