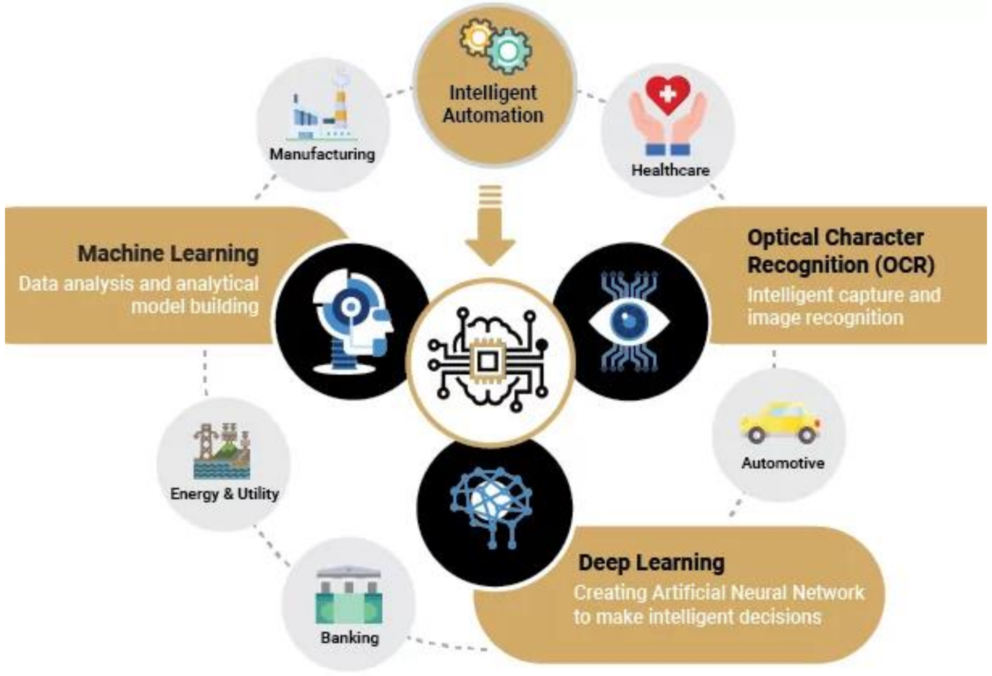

# Learning Journey portfolio

- Lionel Silva
- 08/04/2024
- ITAI 1378 Computer Vision
- Summer 2024

Professor: Patricia McManus | CRN:12461

# Introduction

- The objective of this course is to provide you with the knowledge and skills necessary to achieve your professional goals in computer vision . You will learn the basics of computer vision and its fundamental platforms, as well as the most recent cameras, lidar sensors, high resolution, 3D and stereo vision, and light capture. Furthermore, you will gain an understanding of the algorithms and techniques that enable computers to process images and videos, and how the Machine Learning process aids in the progress of image understanding from in immense set of data.



# GitHub Portfolio Presentation Link

- https://github.com/Leon87551/Pf_LionelSilva_ITAI-1378.git

# Module 2 Camera & Sensors

•We learned about the different types of cameras and sensors and their applications.

•Primary computer cameras utilize image sensors and algorithms to capture and explain visual information. Their applications include robotics, automation, and surveillance.

•RGB cameras, being popular computer vision cameras, are widely used in a variety of applications such as object detection, facial recognition, and traffic monitoring.

•Depth cameras create 3D maps of the surroundings by calculating the space among objects in the scene. They are used in gesture recognition, robotics, and augmented reality applications.

•Thermal cameras capture images by detecting the heat emitted by objects and are utilized in applications like firefighting, medical imaging, and surveillance. Stereo cameras utilize two or several cameras to capture 3D images and are employed in applications such as autonomous vehicles and mapping.

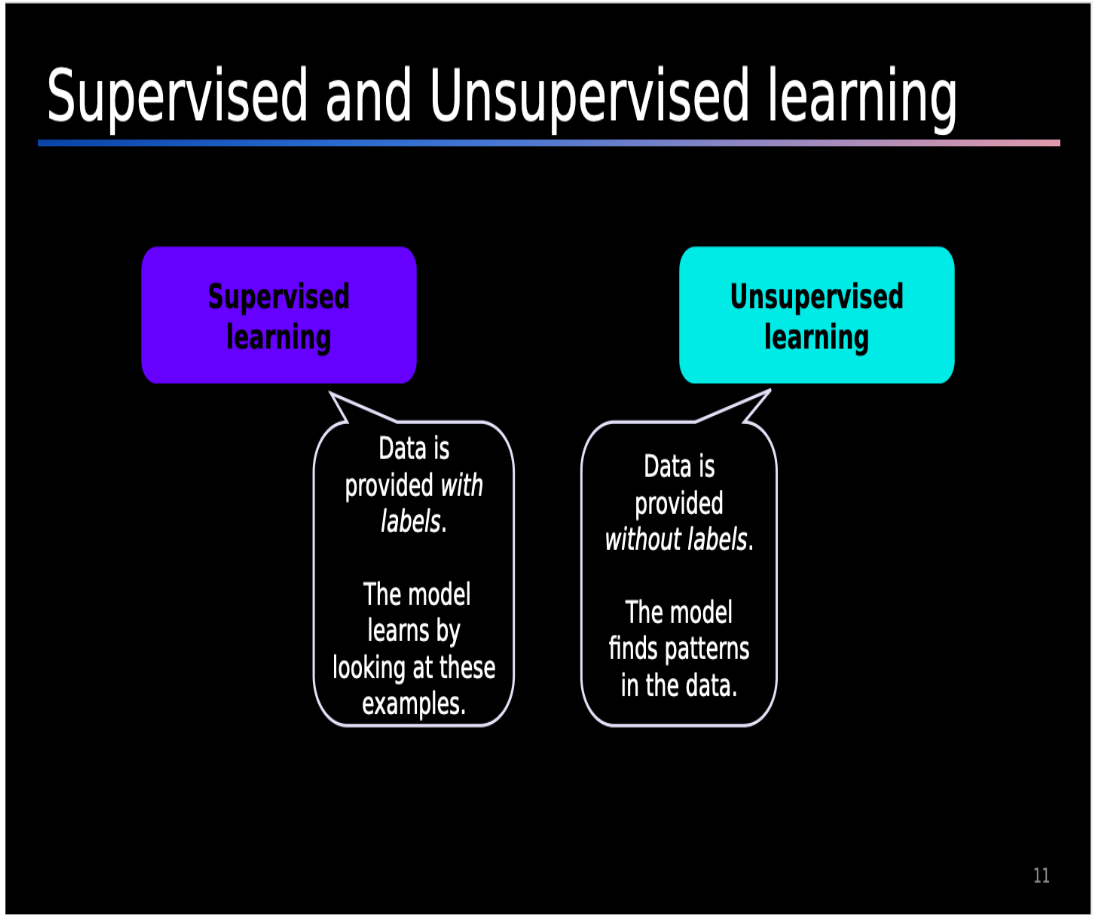
- LiDAR (Light Detection and Ranging) is a remote sensing technology that utilizes laser pulses to calculate length and make 3-D maps of the surroundings. It is usually in self-driving cars and other robotics applications.
- Radar (Radio Detection and Ranging) is a remote sensing technology that utilizes radio waves to reveal and find objects. It prevents collision and changeable cruise control in automotive applications.

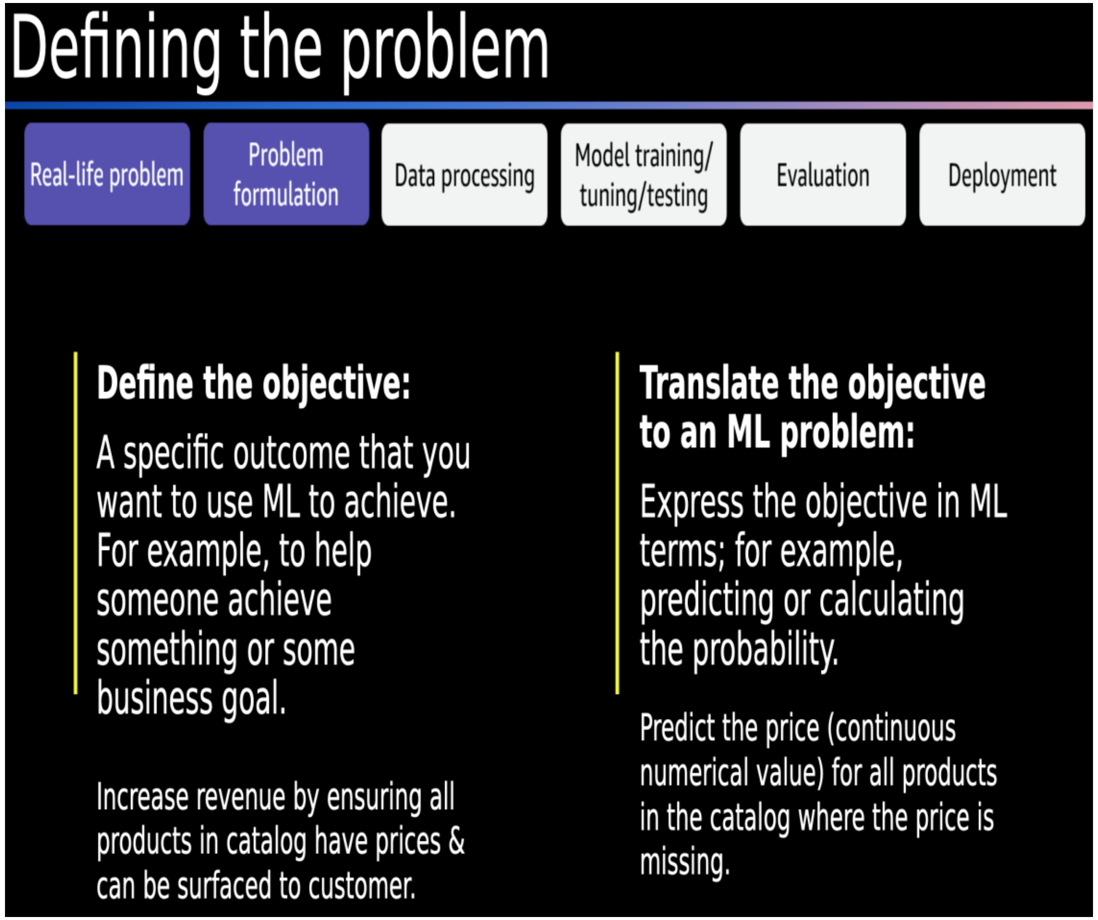
# Module 5: Machine Learning for computer vision

- This module covered the following:
- Data Types: Tabular, Image, and Text.
- Features and Labels in ML: Structuring Tabular Data for ML Tasks.
- Supervised vs. Unsupervised Learning: Concepts and Applications
- ML Lifecycle: problem definition, data processing, model Training, and Model evaluation and comparison.

- What I learned in this module is the three types of ML :
- Supervised learning needs training data with labels. While unsupervised learning does not need labeled data. Moreover, Reinforcement Learning uses a trial-and- error method to learn.
- Activities: L05 Image Classification with Nearest Neighbors.

# Module 5: Machine Learning for computer vision



# Module 6: Basics of Neural Network

- This module covered the following:
- Artificial Neuron
- Machine Learning basics
- Neural Network components
- Training Neural Networks
- Training Neural Networks
- Neural Network Architectures

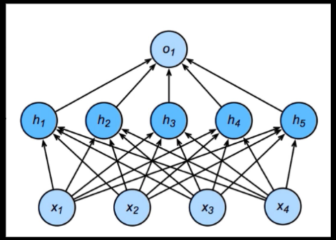
•A neural network is a computational model stimulated by the form and role of the human brain.

I learned about the training process initialization, feedforward, loss calculation, backpropagation, weight update, iteration, and evaluation. In addition, I learned the architecture of neural networks. There were single-neuron output and multi-neuron output. In a single-neuron output, regression or binary classification is made. In contrast, the multi-neuron output makes multiclass classification.

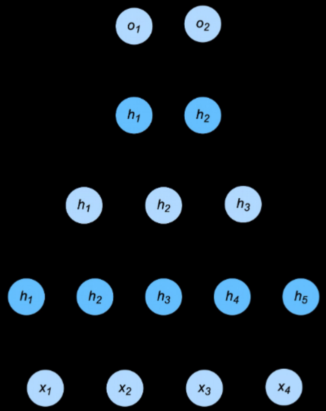
# THE LEARNING PROCESS

- **Initialization:** Start with random weights for connections between neurons.
- **Feedforward:** Input data is fed into the network and processed through each layer to get the output.
- **Loss Calculation:** Determine the error of the output by comparing it with the expected result using a loss function.
- **Backpropagation:** Calculate the gradient of the loss function with respect to each weight by the chain rule, moving from the output layer backward to input layers.
- **Weight Update:** Adjust the weights of the connections to minimize the loss, typically using optimization algorithms like gradient descent.
- **Iteration:** Repeat the feedforward, loss calculation, backpropagation, and weight update steps until the model performs satisfactorily.
- **Evaluation:** Validate the model using a separate dataset not seen by the network during training to test its generalization capability.

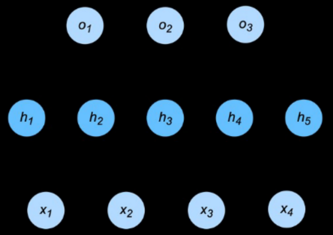
# NEURAL NETWORK ARCHITECTURES (1 OF 2)




**Single-neuron output:**
Make regression or binary classification




**Two-neuron output:**
Make binary classification




**Multineuron output:**
Make multiclass classification

# Module 6: Basics of Neural Network

- Assignments:
- A06 –TensorFlow Playground
- Lab 06 Chihuahua or Muffin ?
- In A06 I gained understanding on how parameters affect the performance of the networks. In the lab 06, we learned how to import data to classify, distinguish, and identify images. We attained knowledge on how to develop a deep neural network model using the Chihuahua or muffin. By using datasets to train, test, and validate, we were able to understand how deep learning and neural networks work in conjunction.

- Challenges encountered:
- I had a few challenges with this assignment. To start with, I had to learn how to use AWS SageMaker Studio Lab. I overcome this challenge by watching a YouTube video tutorial for beginners. This made it easy to navigate the studio and complete my lab.
- Potential real-world applications:
- This model is useful in real-world applications where objects must have to identified certain features for quality control. For example, this model can be used in manufacturing to detect defect parts. As well to detect a good part. This model is useful in real world applications to validate only good parts. This model helps manufacturing plants to meet their quality standards.
- My reflection on this lab is to be knowledgeable in deep learning and neural networks, you must understand what each code dataset you are imputing means.

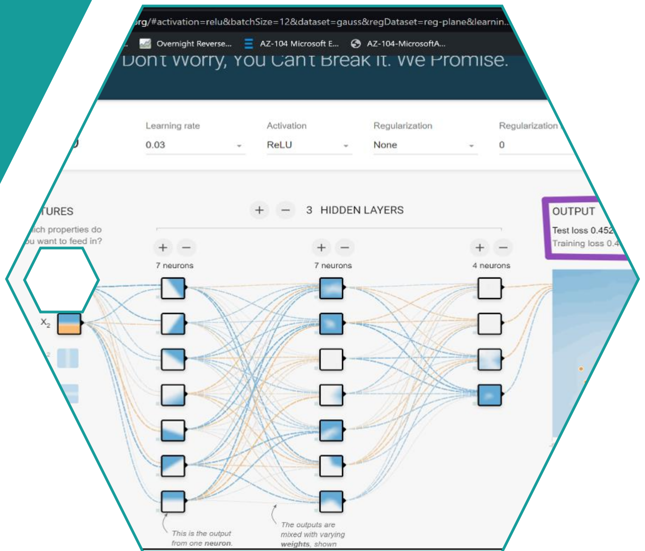

a certain number of epochs.
unit="epoch"):
ebook(dataloaders[phase], desc=phase, unit="batch", leave=False):
appropriate device (GPU or CPU)
previous gradients


L06


50% Chi, 50% Muff
50% Chi, 50% Muff
50% Chi, 50% Muff
50% Chi, 50% Muff
50% Chi, 50% Muff
50% Chi, 50% Muff
50% Chi, 50% Muff
50% Chi, 50% Muff
50% Chi, 50% Muff
50% Chi, 50% Muff
50% Chi, 50% Muff
50% Chi, 50% Muff


A06

L06


Learning rate
0.03
Activation
ReLU
Regularization
None
Regularization
0
3 HIDDEN LAYERS
OUTPUT
7 neurons
7 neurons
4 neurons

# Module : 7 Convolutional Neural Networks

- This module covered the following:
- Introduction to Convolutional Neural Networks.
- Core components of CNNs and how they process images.
- CNN training and leveraging libraries
- Applications, challenges, and future research.
- Computer Vision datasets.

•A convolutional neural network (CNN) is a deep learning algorithm that extracts features and identifies patterns. CNNs outperform traditional methods at comprehending spatial structure in images.

I learned about the training CNNs, libraries, applications, challenges, future research, core components and cv datasets. The core concepts included:

•Convolutional layers feature extraction.

•Pooling layers minimize dimensionality.

•Fully connected layers classification.

# Module 7: Convolutional Neural Networks

- •Assignments:
- •A07 –ITAI 1378 Manual CNN
- •L07 Chihuahua or Muffin with CNN
- •In A07, I gained an understanding of the task of Convolutional layers and filters in image processing. In the L07, I learned that CNN, when it extracts significant features from images, does it with enhanced precision.

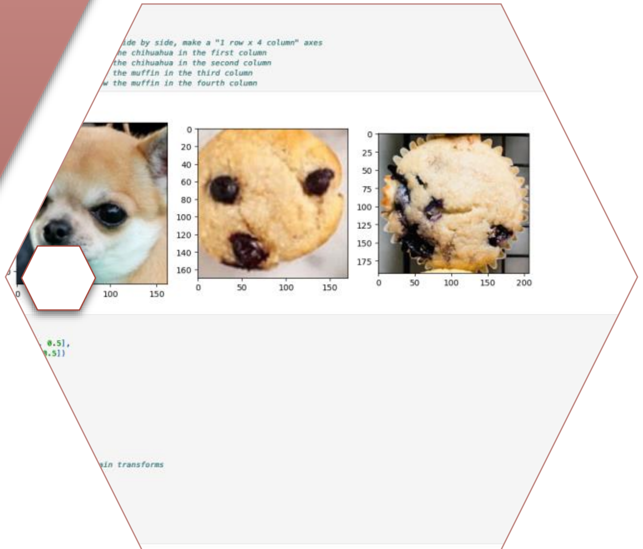
- Challenges encountered:
- The challenges I faced were when I had to fix the errors in the program's cells. I encountered errors in the program that I could not solve, but going through the program was still a rewarding experience. I gained a solid understanding of the code in the program, and I am confident in my ability to become an expert programmer.
- My reflection on this lab is it provides a solid understanding of why CNN outperforms traditional neural networks. Additionally, it explored ethical concerns in areas like deep fake creation, invasion of privacy, and image manipulation.

L07


49% Chi, 51% Muff
49% Chi, 51% Muff
49% Chi, 51% Muff
Muff
49% Chi, 51% Muff
49% Chi, 51% Muff
49% Chi, 51% Muff
48% Chi, 52% Muff
49% Chi, 51% Muff
48% Chi, 52% Muff

L07

L07



# Module : 8 CNN Basic Architecture And Transfer Learning

This module covered the following:

- Convolutional Neural Networks (CNNs) Recap
- Basic concepts and applications
- Image datasets
- Transfer Learning
- Concept and motivation
- Approaches and techniques
- Pre-trained models and toolkits
- Basic CNN Architectures
- Historical perspective
- Key innovations
- Deep dive into:
- LeNet
- AlexNet

I learned about the importance of transfer learning, which includes time/resource efficiency and performance. I also learned how CNN architecture has evolved over time. Lastly, I gained knowledge on AlexNet, which is used to artificially enlarge training datasets.

# Module : 8 CNN Basic Architecture And Transfer Learning

- Assignments:
- A08 –ITAI 1378 Manual cv
- In A08 we learned about the key concepts, which include bounding boxes, annotations, IoU, and confidence score. A *Bounding box* is a virtual box encompassing an object in an image. *Annotations* are the format used to label images given to a dataset. The confidence score indicates the possibility of an object being present in the bounding box. In addition, we also cover the algorithms like R-CNN, Faster-R-CNN, Fast R-CNN, and SSD. These algorithms play a crucial role in object detection for example Faster-R-CNN evaluates a region-based object classification (ROI) by using the feature maps given through the convolutional layer. In SSD the algorithm executes real-time detection in numerous objects in an image with high precision. R-CNN uses a discriminating search technique to identify RoIs in the input images.

- Challenges encountered:
- No challenges for this assignment.
- My reflection on this assignment:
- This cheat sheet will benefit us in the future when performing object detection tasks because we have gained enough knowledge of the steps to take when starting one. We have also gained knowledge of the fundamentals of key concepts, common challenges and solutions, and the libraries and tools needed for the task.

A08

A08

A08

etection Cheat Sheet

ence Guide for Object
sks

Silva Hac-King-Do ITAI 1378 CV

o Benson

row

am

cepts

ox is a virtual box utilized to encompass an object of i
deo. It serves as a reference point for the object recogni
etermine the position and dimension of the object within t

ons: labels images in a provided dataset to train machine lea
ist of annotation formats (including bounding boxes) XML
Pickle.

er Union (IoU) evaluates the similarity between a
s by computing the ratio of their intersection to

etection Algorithms

NN uses a discriminating search technique to identify RoIs in the i
region-wise classifier based on DCN (Deep Convolutional Neural Netw
cl he RoIs.

gion-based convolutional neural network is an object detection
n (Fast-R-CNN) by using region proposal network (RPN). The sys
gion-based object classification (ROI pooling) by using the features
ugh the convolutional layer.

-CNN is an upgraded version of the R-CNN that collects CNN
gion of interest (ROI) into one forward pass across the imag

le Shot Detector is a CV and ML algorithm that is used
executes real time detection of numerous objects in

# Module : 09 Advanced CNN Architecture And Object Detection & Recognition

- This module covered the following:

•Basic CNN architectures
• Transfer Learning
Advanced CNN Architectures
Object Detection
• Bounding Boxes
• Two stage detection
• One stage detection

I learned about the differences between one-stage and two-stage detectors. In one-stage detectors, speed is prioritized, and in two-stage detectors, accuracy is prioritized. I also learned that bounding boxes are important for determining an object's location.

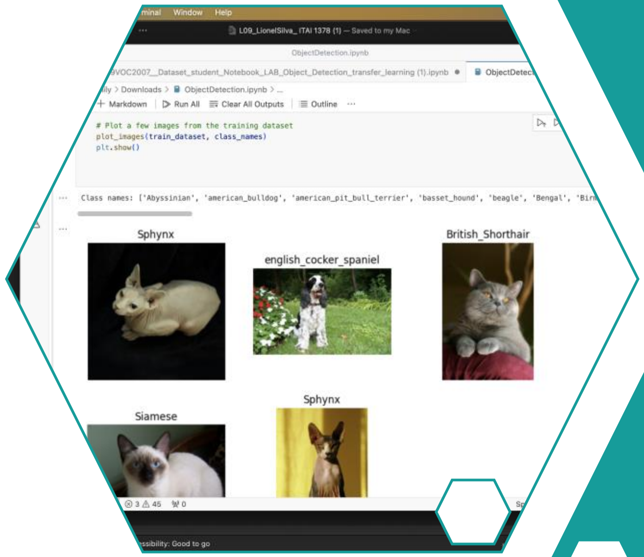
# Module : 09 Advanced CNN Architecture And Object Detection & Recognition

- Assignments:
- L09 Object detection using Transfer learning and Pascal VOC 207 Dataset
- Object detection challenge

- Challenges encountered:
- The Pascal VOC dataset had incorrect labeling. CIFAR-10 images were constantly out of focus, and COCO caused timeouts. In contrast, the Oxford – IIIT dataset proved to be the most effective dataset for our needs. The images were clear, labeled properly, and processed efficiently.
- Reflection on these assignments:
- This experience testing different kinds of datasets will help you pick the one that is appropriate for your application.

# L09


# L09




# Object Detection Challenge