**Assignment for Week 1.**

Name: Josi Kie Nababan

Answer:

**1. RESTNET**

A convolutional neural network that is designed for computer vision image classification tasks.

Pros:

* Avoid or mitigate vanishing gradient problems. Restnet allows gradient to flow through on the short paths, which can avoid the problem of vanishing gradient on a deep neural network. The short parts can carry along the gradient to the very deep networks. Vanishing gradient is a problem that could occur when training a model on a deep neural network. During the model training, gradient control on how much the model learns. Vanishing gradient can cause little to no training, then the model will have poor predictive performance. With Restnet, the vanishing gradient can be avoided or mitigated.
* Found the stable point faster. The jump connections allow direct flow of gradient. (Gradient is a derivative function that has more than two input variable)
* Restnet has better performance so it improves the accuracy.

Cons:

* More complexity. The hop connections on Restnet make Restnet more complex than traditional deep neural networks. More complex means memory and computational demand can be higher.
* Difficult to interpret. It is hard to interpret how Restnet makes decisions. Restnet has a complex nature.
* Only suitable for specific tasks like computer vision and natural language processing.

High level structure of the algorithm:

Parts of restnet architecture: Input pre-processing, Cfg[0] blocks, Cfg[1] blocks, Cfg[2] blocks, Cfg[3] blocks, and Fully connected layers.

The structure: a[l]=g(z[l+1]+a[l])

**2. DENSENET**

DenseNet is a densely connected-convolutional network. DenseNet is similar to Restnet, but they have fundamental differences. While Restnet takes only a previous output as an input for future layers, DenseNet takes all the previous outputs as input for the future layer.

Pros:

* Tackles Overfitting. DenseNet lowers the numbers of parameters, it also enables the reuse of features, and enhances the model capacity to generalize unknown data. That’s why it can tackle overfitting.
* Mitigates vanishing gradients problem. DenseNet allows gradients to flow across the whole network.
* Manages redundancy. Feature reuse offered and lowering the number of parameters makes DenseNet successfully manage redundancy.

Cons:

* From [a research paper](https://www.hindawi.com/journals/bmri/2022/2384830/), I found one disadvantage of DenseNet is the feature that maps of each layer are spliced with the previous layer, and the data replicated multiple times.

High level structure of the algorithm:

The structure: a[l]=g(a[0],a[1], a[2], a[3], ….., a[l-1])

**3. VGG**

VGG stands for visual geometry group. It is a classical convolutional neural network. Developed to increase the depth of such convolutional neural networks.

Pros:

* VGG can make the decision function more nonlinear without modifying the receptive fields by using a 1x1 convolutional layer.
* It uses a very smaller receptive compared to AlexNet.
* Easy to understand because VGG is standard architecture for CNN.
* It is available on the popular machine learning libraries.
* Faster when training model.

Cons:

* Because of the vanishing gradient problem and the deep network, training different task can be difficult.
* It has over 100 million trained weights. The model size will be large, approximately 500MB on disk.

High level structure of the algorithm:

Part of its architecture: input, convolutional layers, ReLu activation, Hidden layers, Pooling layers, Fully connected layers.

**4. Inception**

Inception is a deep neural network that consists of repeating blocks where output of a block is used for the next input. It is designed to reduce computational expenses.

Pros:

* Efficiency at utilizes computing resources with minimal increase in computational load.
* It can extract features from input data at varying scales.

Cons:

* Larger models are prone to overfit especially with limited number of label samples.
* Models can be biased to classes that have labels present in higher volume than the other.

High level structure of the algorithm:

Inception v1 has 27 layers. Here is the modal summary of inception: max pool, inception(3a), inception(3b), max pool, inception(4a), inception(4b), inception(4c), inception(4d), inception(4e), max pool, inception(5a), inception(5b), avg pool, dropout (40%), linear and SoftMax.