Cyclone Intensity estimation

1) 2021 - Koushik Biswas

* Dataset ⇒ Origin, Latitude, Longitude, pressure drop, Estimated centre pressure
  ⇒ 2 cyclone.
* Maximum sustained wind speed.
* Algo : DT, RF, XGBoost, Gradient Boosting Machine, LR, SVM, Naive Bayes
* Classification accuracy like Low pressure Area, Depression, cyclonic storm
* Best result : XGBoost, Decision tree.
* Used RMSE, R^2 values
* Vayu, Fani cyclone estimation.

wind speed

38 mph → Tropical depression

39 - 73 mph → Tropical storm

Saffir Simpson :-

Category 1:

74 - 95 mph

minimal damage, can uproot trees, cause flooding.

2) 96 - 110 mph.

Moderate, No major destruction to building, can uproot trees, signs shortage of water and electricity.

3) 111 - 129 mph

Extensive - structural damage to buildings, serious flood.

Evacaution needed.

4) 130 - 156 mph

Extreme - All signs and trees blown down.

Evacaution probable.

5) > 156

catastrophic - Building destroyed, Evacaution of upto miles.

⇒ to assess Intensity of tropical cyclone accurately, best way to collect and analyze wind speed information near centre of storm.

⇒ owing to limitation of surface observations, important tool for forecasters to assess intensity of tropical cyclones is to make use of satellite information, which has advantage of excellant and extensive coverage.

⇒ Dvorak technique analyzes distribution and Patterns of cloud top temperatures of tropical cyclone.

↳ Analyzing evolution its cloud patterns.

↳ Advantages: no geographical limitations on location of tropical cyclone.

As far as few thousand kilometers away.

↳ Disadvantages: It lies on subjectivity arising from judgement of cloud patterns.

It based on statistical analysis of Past tropical cyclones, larger errors (for extreme cases).

⇒ Radar observation data:

Surveillance range of Doppler radar, by making reference to maximum wind speed derived from movement of rain echoes.

↳ It indicated that there is proportionate relationship between maximum wind speed by doppler radar and intensity of tropical cyclone

↳ Speed taken as either 1-minute at standard reference height of 10 meters.

Low pressure area - 31 kmph

Depression - 31-49 kmph

Deep depression - 50-61 kmph

Cyclonic storm - 62-88 kmph.

Severe cyclonic storm - 89-117 kmph.

Very Severe cyclonic storm - 118-166 kmph

Extremely Severe cyclonic storm - 167-221 kmph

Super cyclonic storm - More than 222 kmph

⇒ The amount of pressure drop in center and rate at which it increases outwards gives intensity of cyclones and strength of winds.

⇒ Characteristics:

1) Location

⇒ VGG → works on depth of accuracy

↳ Introducing multiple convolution layers with smaller kernel sizes instead of one conv layer.

↳ 3 Relu layers

↳ More layer - Better understanding.

↳ constantly learning, relearning is a problem with VGG which is why loss seems to unpredictable (explosion of gradients).

1 2nd no

	Techniques used	Dataset	Advantage	Disad
1)		Textual dataset contain Origin, latitude etc..	It improved higher accuracy in XGBOOST	Not based on satellite imagery
2)	Lunet, Alexnet-CNN.	Images of classified cyclones	Best classifier.	Intensity estimate accuracy is more
3)	CNN architecture.	Cyclone Satellite images	Achieved higher accuracy	than only DAVT-
4)	CNN with attention layer	cyclone satellite images.	Achieved higher accuracy than CNN architecture.	

—— X ——

Advantages of VGG.

↳ Increase in accuracy, improvement in speed

↳ Increase in no of layers with smaller kernels saw an increase in non-linearity which is always a positive.

Dis: ↳ Vanishing gradient problem / Learning rate is also less.

— X — Resnet:

↳ Does not need to fire all neurons in every epoch. Reduce training time.

↳ compare with VGGNet, Inception proved to be more computationally efficient both in no of parameter generated by network and economic cost incurred.

Convolution:-

↳ Mathematical operation on two functions that produce third function that expresses how shape of one modified by other.

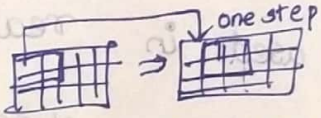
↳ RGB is matrix of pixel values having three planes.

↳ Greyscale image is same but it has single plane.

↳ Pooling layer responsible for reducing spatial size of convolved feature - This to decrease computational power required to process the data by reducing dimensions.

↳ Maxpooling → select maximum value of image in kernel. It perform noise suppressant. It perform denoising along with dimensionality reduction.

↳ Stride : How much we move convolution filter at each step. Default = 1.



Bigger strides → less overlap between receptive fields → Feature map become smaller.

↳ Padding is used to preserve size of feature maps, otherwise they shrink at each layer.

↳ Pooling :- → Reduce no of Parameter, shortens the training time and combats overfitting.

↳ Downsampling the feature map while keeping important information.

↳ Hyperparameters :-

Filter size

Filter count. [32 - 1024]

Stride

Padding.

↳ Fully connected

Convolution and Pooling layers are 3D, so FC expects 1D vector of numbers. so, Flatten the output of final Pooling layer to vector and that becomes input to FC.

~~CONVNet~~ :-

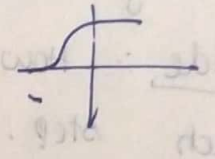
Activation function :

It decides what is to fired to next neuron.

Important feature is to add non-linearity into neural network.

Sigmoid :

$$sig(t) = \frac{1}{1+e^{-t}}$$

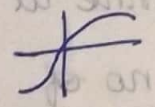


Never used in real models.

It for binary classification.

It not zero centered.

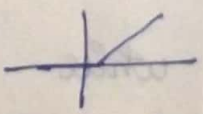
Tanh :-



It solves zero centred.

Relu : Rectified linear unit

$$max(0, x)$$



No vanishing gradient,

It suffer from dying Relu, since output is zero for all negative inputs.

It doesnot activate all neurons at the same time.

Neurons will only deactivated if output of linear transformation is less than 0.
It output input directly if positive Orelse Zero.

Softmax:-

combination of multiple sigmoids.

0-1 values - probabilities of data point.

Sigmoid - binary class

Softmax - multiclass.

⇒ Relu only used in hidden layers.

Inception net: