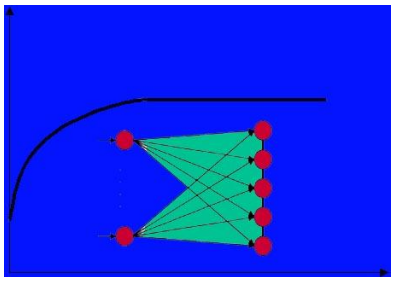

GeoNeurale-Wavefields
Neural-Geophysics Lab - Augsburg

TRAINEESHIP WINTER 2020
1st October – 31st December 2020

CONVOLUTIONAL AND RECURRENT NEURAL NETWORKS APPLICATIONS FOR 3D SEISMIC / PETROPHYSICS AND GENERAL APPLICATIONS

AUDIENCE:
Geophysicists, Geoscientists, Petrophysicists, Engineers, Physicists, Mathematicians, Chemists

PROGRAM

1.
3D SEISMIC AND PETROPHYSICS

Basic concepts of 3D Seismic acquisition, processing, inversion, attributes interpretation.
Basic concepts of Petrophysics acquisition, processing, interpretation.
Basic concepts of Geostatistics and Stochastic Inversion.

2.
OVERVIEW ON SUPERVISED AND UNSUPERVISED MACHINE LEARNING APPLICATIONS

Specific Neural Networks applications in 3D Seismic, Petrophysics, Spatial Statistics.
General Neural Networks applications (classification, autonomous driving, image recognition, natural language processing, sentiment analysis, music generation, spectral analysis).

3.
OVERVIEW OF HIGH LEVEL PROGRAMMING FRAMEWORKS

Python, TensorFlow, Keras, Pandas
Python libraries: Numpy, Matplotlib, SciPy

4.
SHALLOW AND DEEP NEURAL NETWORKS

Linear and logistic regression
Cost function
Gradient descent
Forward and backwards propagation
Loss and cost function
Backpropagation derivatives
Activation functions: Sigmoid, Tanh, Relu and relative gradients
Softmax regression

5.
OPTIMIZATION AND REGULARIZATION PROCESSES

Batch and mini-batch gradient descent
Gradient descent with momentum
RMSprop
Adam optimization algorithm
Hyperparameter optimization
Batch Norm
Orthogonalization
Bayes error
Bias and variance
Transfer learning

6.
CONVOLUTIONAL NEURAL NETWORKS

Edge detection
Convolutions on RGB images
Multiple filters
Deep convolutional networks
Residual networks
1x1 convolutions
LeNet-5, AlexNet, VGG, ResNet, Inception networks
Transfer learning

Localization and detection
Landmark detection
Sliding windows detection
Turning full connected layers into convolutional layers
Convolution implementation of sliding windows

Yolo algorithm
Bounding boxes
Non-max suppression
Anchor boxes
Training the Yolo algorithm

Face / object verification and face recognition
Siamese network
Learning similarity function
Visualization of deep network learning process from shallow to deep layers
Neural style transfer
1D, 2D, 3D convolutions

7.
NN SEQUENCE MODELS

Recurrent neural networks (RNN)
Forward and backpropagation
RNN architectures
Vanishing gradients
Bidirectional RNN
LSTM
Attention model
Natural language processing
Word vector
Embedding

8.
NEURAL NETWORKS APPLICATIONS IN 3D SEISMIC AND PETROPHYSICS

Available techniques (Hampson-Russell Seismic Inversion software):
Distribution of petrophysical properties within the 3D seismic cube with neural networks
Predicting missing logs in the static model with neural networks
Fault detection

Seismic processing, seismic Inversion, non-biased petrophysical analysis: applications

Automatic first break picking
Noise removal
Seismic data de-noising
Trace Editing
Velocity analysis
Velocity spectra
Thau-P transform

AVO/AVA,
Prestack and poststack seismic inversion
Stochastik seismic inversion
Seismic attributes
Features and fault recognition

Log predictions
Distribution of petrophysical properties in the 3D seismic cube

Neural-Geophysics Lab Augsburg – research program:

Convolutional Neural Networks and Spatial Statistics
The variographic function
Kriging and Gaussian property distributions methods
Non-linear cross-validation
Spatial variability of high and low resolution parameters
Spatial covariance and the neural convolutional process
Prestack seismic inversion analysis and QC with neural networks
The analysis of seismic attributes within the neural convolutional algorithm
The anisotropy theory and anisotropy diagnostics through neural network
Spatial model upscaling diagnostics with neural networks

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