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GeoNeurale – Wavefields

ARTIFICIAL INTELLIGENCE APPLICATIONS FOR GEOSCIENTISTS AND ENGINEERS

MAXIMAL PROGRAM - WINTER STAGE 2019 UTG AUGSBURG : Detp. AI / GEOPHYSICS

MOTIVATION

- Linear and Non-Linear Models
- Binary classification
- Supervised learning methods in Petrophysical Analysis
- Unsupervised learning methods in Petrophysical Analysis
- Supervised learning Methods in Seismic Analysis
- Unsupervised learning Methods in Seismic Analysis

FULLY CONNECTED LAYERS NEURAL NETWORKS

- Logistic Regression
- Cost Function
- Gradient Descent
- Forward Propagation
- Backwards Propagation
- Derivation of Loss and Cost Function
- Interlayers Derivatives
- Python/numpy vectors
- Vectorization
- Broadcasting
- Shallow Neural Networks
- Deep Neural Networks
- Dimensioning layers parameters in deep neural networks
- Activation Functions: Sigmoid, Tanh, Relu and relative gradients
- Vectorized implementations
- Iterative optimization processes
- Regularization
- Batch and mini-batch gradient descent

Gradient descent with momentum
RMSprop
Adam optimization algorithm
Hyperparameter optimization
Batch Norm
Softmax regression
Orthogonalization
Bayes error
Error analysis: bias and variance
Transfer learning

CONVOLUTIONAL NEURAL NETWORKS

Edge detection
Convolutions on RGB images
Multiple filters
Deep convolutional networks
Residual networks
1x1 convolutions
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
Content cost function
Style of an image, style matrix
Style cost function
1D, 2D, 3D convolutions

NEURAL NETWORKS SEQUENCE MODELS

Recurrent neural networks (RNN)

Forward and backpropagation

RNN architectures

Vanishing gradients

Gated Recurrent and long short term memory unit

Bidirectional RNN

Attention model

NN APPLICATIONS IN 3D SEISMIC AND PETROPHYSICS

High and low resolution measurements

Spatial variability of high and low resolution parameters

Spatial covariance of petrophysical and seismic properties

The variographic function

Kriging property distributions methods

Gaussian property distributions methods

Static models and multiple realizations statistics

Heterogeneity and azimuthal anisotropy of petrophysical and seismic attributes

Spatial upscaling of petrophysical parameters into the seismic cube

Deterministic and stochastic methods in seismic inversion

Amplitude, complex and time seismic attributes

Multiattributes validation

Using multiattributes for property spatial prediction

Distributing petrophysical and seismic properties on the 3D seismic cube

Predicting missing logs

SPECIFIC EXAMPLES AND CASE STUDIES IN EACH DISCIPLINE