A Framework for Selecting Hyper-Parameters

British International Conference on Databases

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Dementia Awareness + Prevention

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Dementia Awareness + Prevention

Online Environment

Risk Prediction Algorithm

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MOTIVATION

DATA

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DATA

High-Dimensional

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High-Dimensional Variable Interactions

DEEP LEARNING

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ALGORITHM OVERVIEW

Visible Output Layer

Visible Input Layer

DEEP LEARNING

\[ x_1, x_2, \ldots, x_{n-1}, x_n \]

\[ \mathbf{x} \]

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ALGORITHM OVERVIEW

DEEP LEARNING

Visible 
Output Layer

Hidden 
Layers

Visible 
Input Layer

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**ALGORITHM OVERVIEW**

**DEEP LEARNING**

Visible
Output Layer

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Layers

Visible
Input Layer

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**In-MINDD**

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ALGORITHM OVERVIEW

DEEP LEARNING

Visible Output Layer

Hidden Layers

Visible Input Layer

The diagram illustrates a deep learning model with the following layers:

- **Visible Output Layer**: Represents the output layer of the model.
- **Hidden Layers**: Contains multiple hidden layers, each processing intermediate features.
- **Visible Input Layer**: Represents the input layer of the model, receiving input features.

The diagram includes the following elements:

- **Inputs (x)**: The input features to the model.
- **Learned Features (h^{(1)})**: The features learned in the first hidden layer.
- **Connection Weights (W^{(1)})**: The weights connecting the input layer to the first hidden layer.
- **Class (C)**: The class output from the final layer of the model.

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ALGORITHM OVERVIEW

DEEP LEARNING

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Input Layer

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ALGORITHM OVERVIEW

DEEP LEARNING

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Visible Output Layer

Hidden Layers

Visible Input Layer

ALGORITHM OVERVIEW

DEEP LEARNING

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Algorithm 1: Regression

Visible Output Layer

Visible Input Layer

\[ W^{(1)} \]

Connection Weights

Input Features

\[ x_1 \quad x_1 \quad x_2 \quad \ldots \quad x_{n-1} \quad x_n \]

\[ C \quad \text{Class} \]

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Algorithm 2: MLP

Visible Output Layer

Hidden Layers

Visible Input Layer

C — Class

Connection Weights

Input Features

$C \leftarrow \text{Class}$

Connection Weights

Input Features

$x \leftarrow \text{Features}$

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Algorithm 3: RBM

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Algorithm 4: DBN

Visible Output Layer

Hidden Layers

Visible Input Layer

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CONFIGURABLE DEEP NETWORK FRAMEWORK
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Subset of the Data – dimensions

What the variables are

What the predictor is

Purpose
To Choose:
To Choose:
learning rate $\alpha$
EXPERIMENT

REGRESSION

To Choose:

- learning rate $\alpha$
- weight decay term $\lambda$

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To Choose:

- learning rate $\alpha$
- weight decay term $\lambda$
- training iterations $t$
The Grid:
The Grid:

\( \alpha, \lambda: \)

\([0.001, 0.003, 0.009, ..., 0.1, 0.3, 0.9]\)
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EXPERIMENT

REGRESSION

The Grid:

\( \alpha, \lambda: \]

\([0.001, 0.003, 0.009, \ldots, 0.1, 0.3, 0.9]\]

\( t: \]

\([100, 1000, 10000]\]
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Valid. Cost

Training Iterations

100

1,000

10,000

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Valid. Cost

Training Iterations

100
1,000
10,000

Categorical
Continuous
Lambda

Alpha
0.9
0.3
0.09
0.003

0.009
0.003
0.001

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Valid Cost

TEST ERROR
0.3046

Training Iterations
100
1,000
10,000

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Valid. Cost

Training Iterations

0.3046

TEST ERROR

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Valid Cost

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To Choose: RBM
To Choose:

layer 1 nodes $h^{(1)}_n$
To Choose:

layer 1 nodes $h^{(1)}_n$

pre-training epochs $e$
The Grid:

\[ h^{(1)}_n : [10, 30, 337, 900, 1300, 2000] \]
The Grid:

\[ h^{(1)}_n : \]
\[ [10, 30, 337, 900, 1300, 2000] \]

\[ e \]
\[ [1, 5, 10, 15, 20] \]
Parameter Initialisation:

\(-4 \sqrt{\frac{6}{\text{fan\_in} + \text{fan\_out}}}, + 4 \sqrt{\frac{6}{\text{fan\_in} + \text{fan\_out}}}\)
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Valid Cost

Epochs  1  5

Valid Cost

Nodes
10
337
2000

30
900
300

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**EXPERIMENT RESULTS**

**RBM**

Valid. Cost

<table>
<thead>
<tr>
<th>Epochs</th>
<th>1</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nodes</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>30</td>
</tr>
</tbody>
</table>

**MONITORING COST**

-19.580

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To Choose:

Last layer nodes $h^{(1)}_n$
To Choose:

Last layer nodes $h^{(1)}_n$

The Grid:

[10, 30, 337, 900, 1300, 2000]
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### RESULTS

**MLP**

<table>
<thead>
<tr>
<th>Categorical</th>
<th>Continuous</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Valid. Cost

<table>
<thead>
<tr>
<th>Nodes</th>
<th>Test Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0.232</td>
</tr>
<tr>
<td>30</td>
<td>0.291</td>
</tr>
<tr>
<td>100</td>
<td></td>
</tr>
<tr>
<td>337</td>
<td></td>
</tr>
<tr>
<td>900</td>
<td></td>
</tr>
<tr>
<td>1300</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
</tr>
</tbody>
</table>

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Lambda @ 0.03

Alpha 0.001 0.01 0.9

Lambda @ 0.03

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Lambda @ 0.03

Step  

- 3000
- 1000
- 100

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Lambda @ 0.03

<table>
<thead>
<tr>
<th>Alpha</th>
<th>Steps</th>
<th>Test Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.001</td>
<td>3000</td>
<td>0.272</td>
</tr>
<tr>
<td>0.01</td>
<td>1000</td>
<td>0.265</td>
</tr>
<tr>
<td>0.9</td>
<td>100</td>
<td>0.245</td>
</tr>
</tbody>
</table>

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Lambda @ 0.03

Alpha
- 0.001
- 0.01
- 0.9

Steps
- 3000
- 1000
- 100

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FUTURE WORK

Activation functions

Algorithms

Inference

Framework – to Mongo and input from

Visualising learning

Implementing Early Stopping

Mini-batch Stochastic Gradient Descent
Much easier to model when you have one extensible network that can handle many type of data

Constituent models can be used to select a starting point for deep learning configurations
QUESTIONS?
Lambda @ 0.03

![Diagram showing experiment results for DBN with different Alpha values (0.001, 0.01, 0.9) and Steps (3000, 1000, 100). The test error values are 0.272, 0.265, and 0.245 respectively.]

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