A Framework for Selecting DEEP LEARNING Hyper-Parameters

British International Conference on Databases

Jim O' Donoghue

7th July 2015

In-MINDD is funded under the European Union Seventh Framework Programme, Grant Agreement Number 304979

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INTRODUCTION

BACKGROUND IN-MINDD

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BACKGROUND IN-MINDD

Dementia Awareness + Prevention

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BACKGROUND IN-MINDD

Dementia Awareness + Prevention

Online Environment

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Risk Prediction Algorithm

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BACKGROUND IN-MINDD

Dementia Awareness + Prevention

Online Environment

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INTRODUCTION MOTIVATION

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INTRODUCTION MOTIVATION

DATA

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INTRODUCTION MOTIVATION

DATA — High-Dimensional

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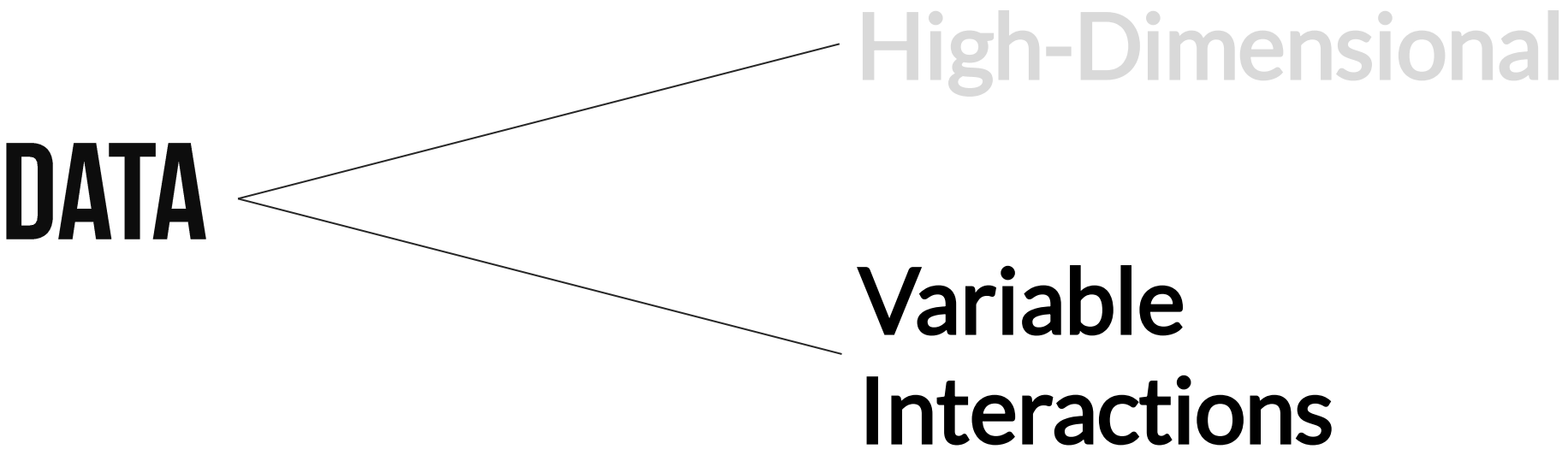
INTRODUCTION MOTIVATION



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INTRODUCTION MOTIVATION

DATA

High-Dimensional

Variable Interactions

DEEP LEARNING

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INTRODUCTION MOTIVATION

DATA

High-Dimensional

Variable Interactions

DEEP LEARNING

Hyper-Parameter Selection

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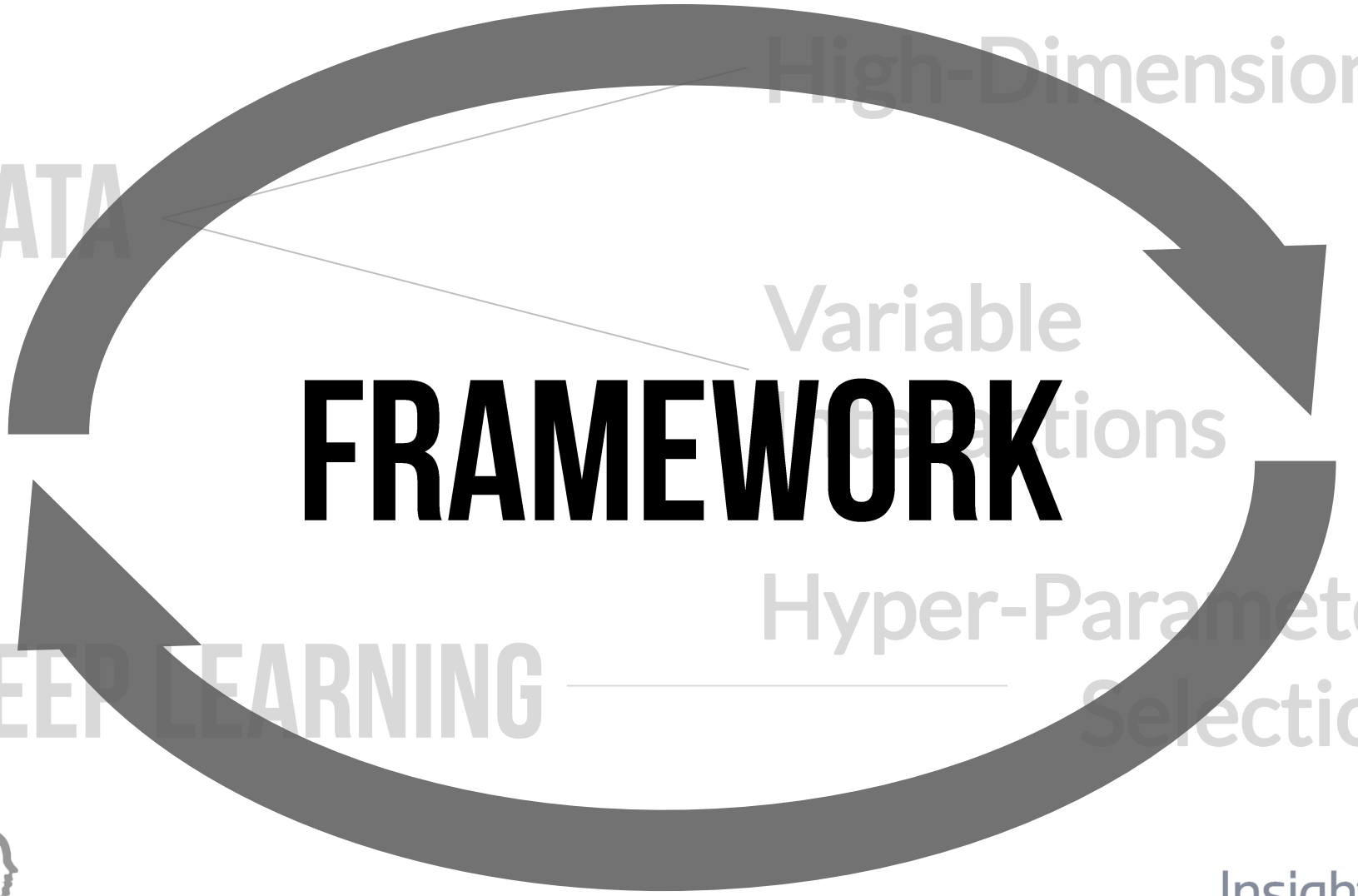

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ALGORITHM OVERVIEW

DEEP LEARNING

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ALGORITHM OVERVIEW DEEP LEARNING

Visible
Output Layer

C — Class

Visible
Input Layer

x — Input Features

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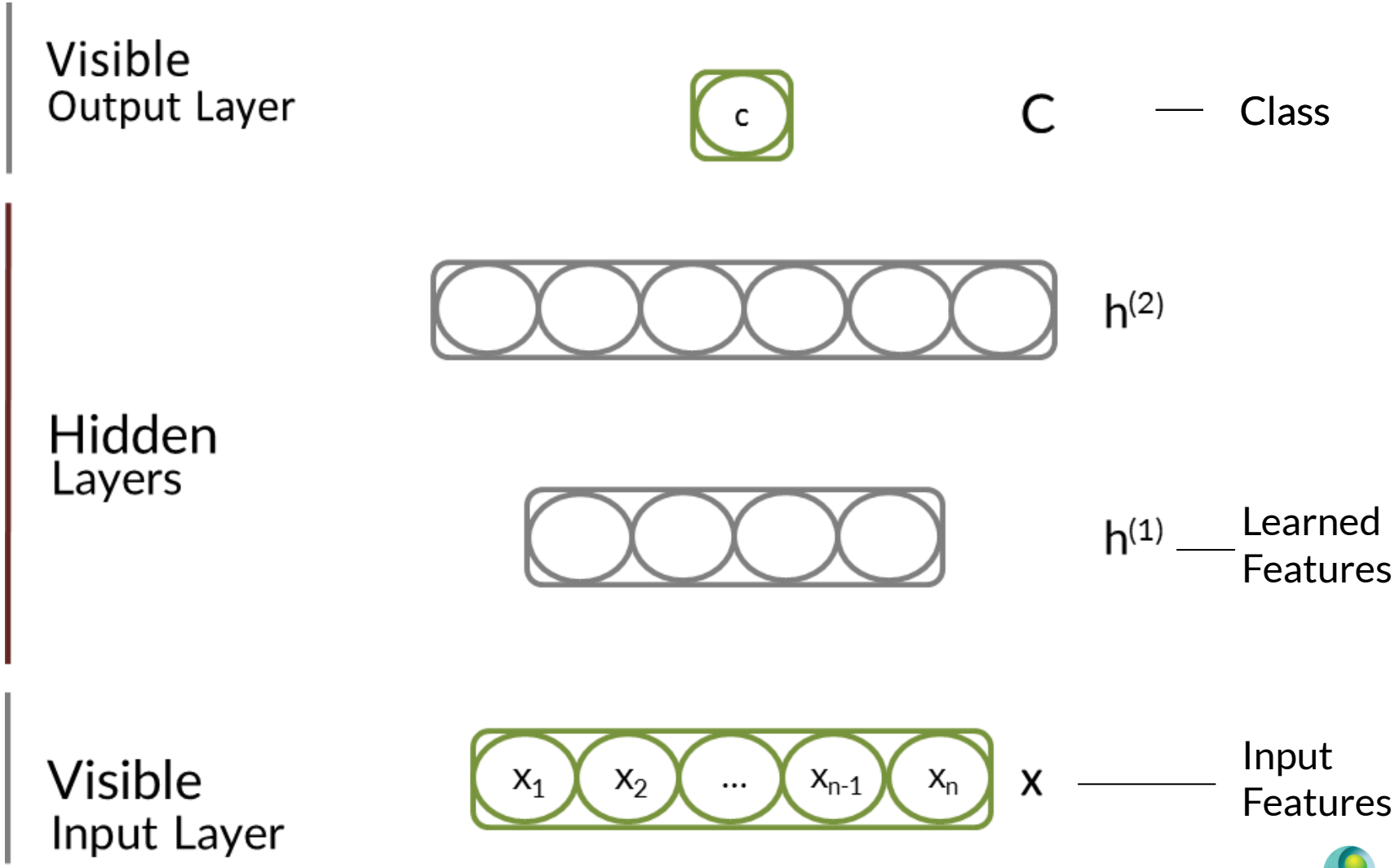
ALGORITHM OVERVIEW DEEP LEARNING



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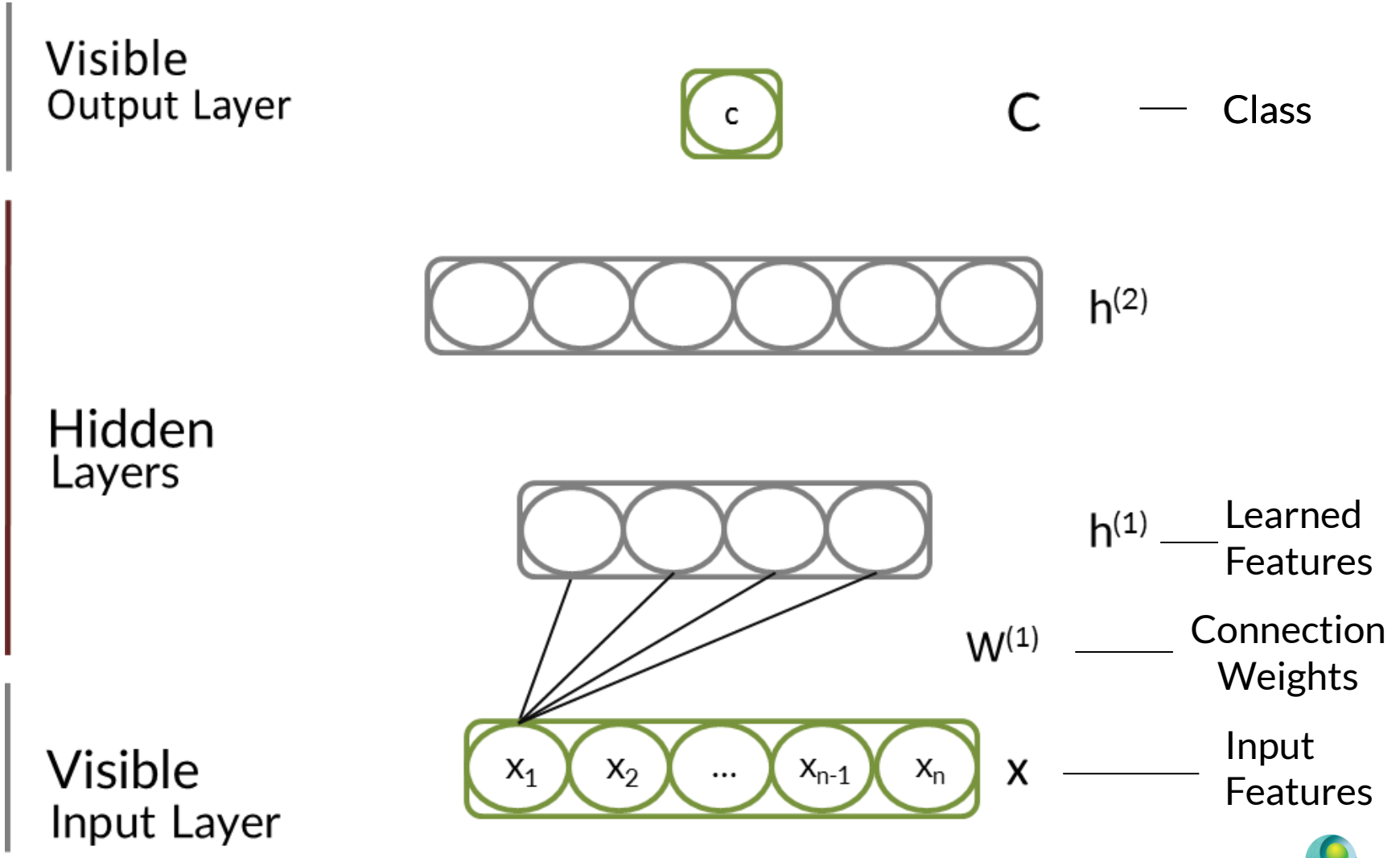

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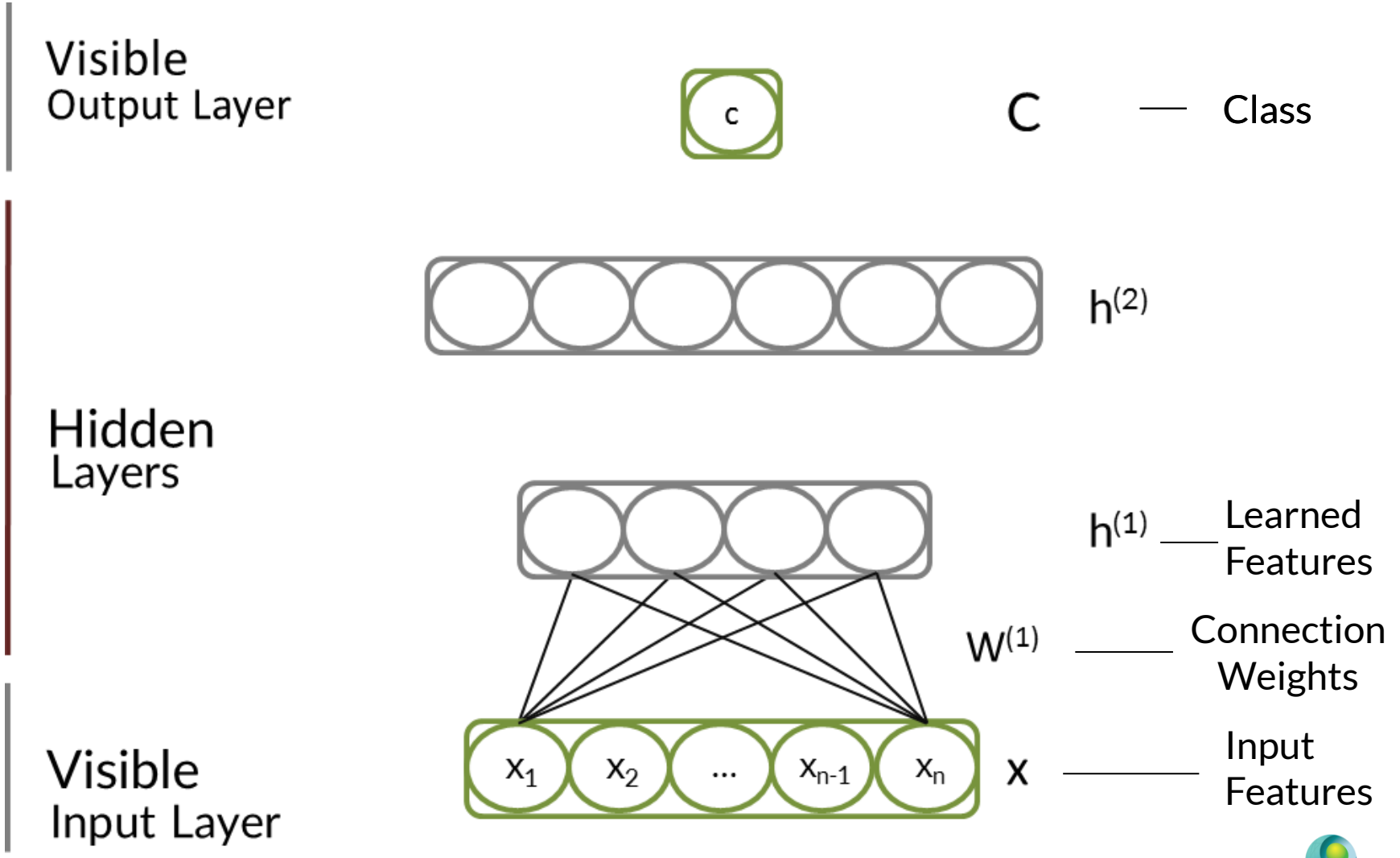

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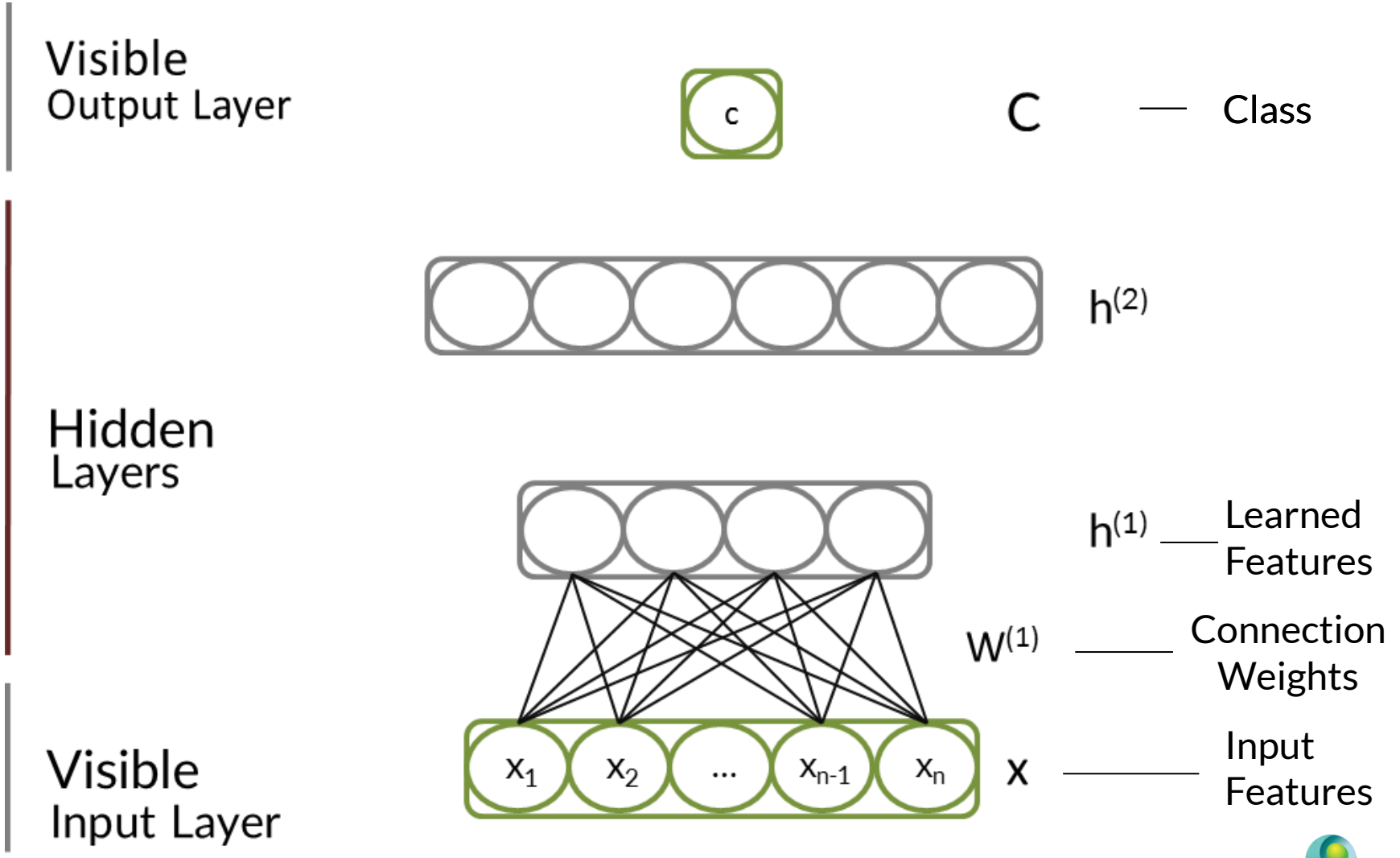

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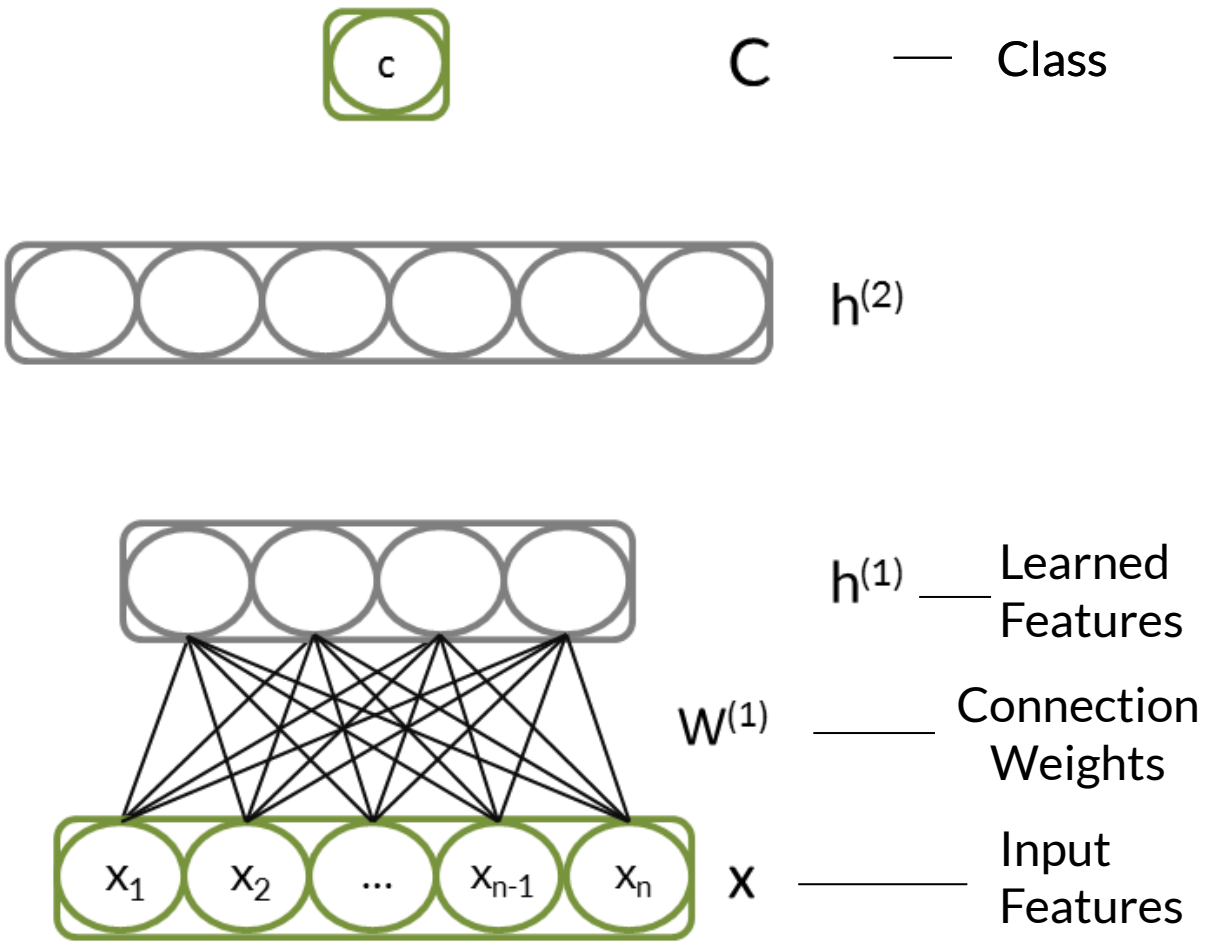
ALGORITHM OVERVIEW DEEP LEARNING

Visible
Output Layer

Hidden
Layers

Visible
Input Layer



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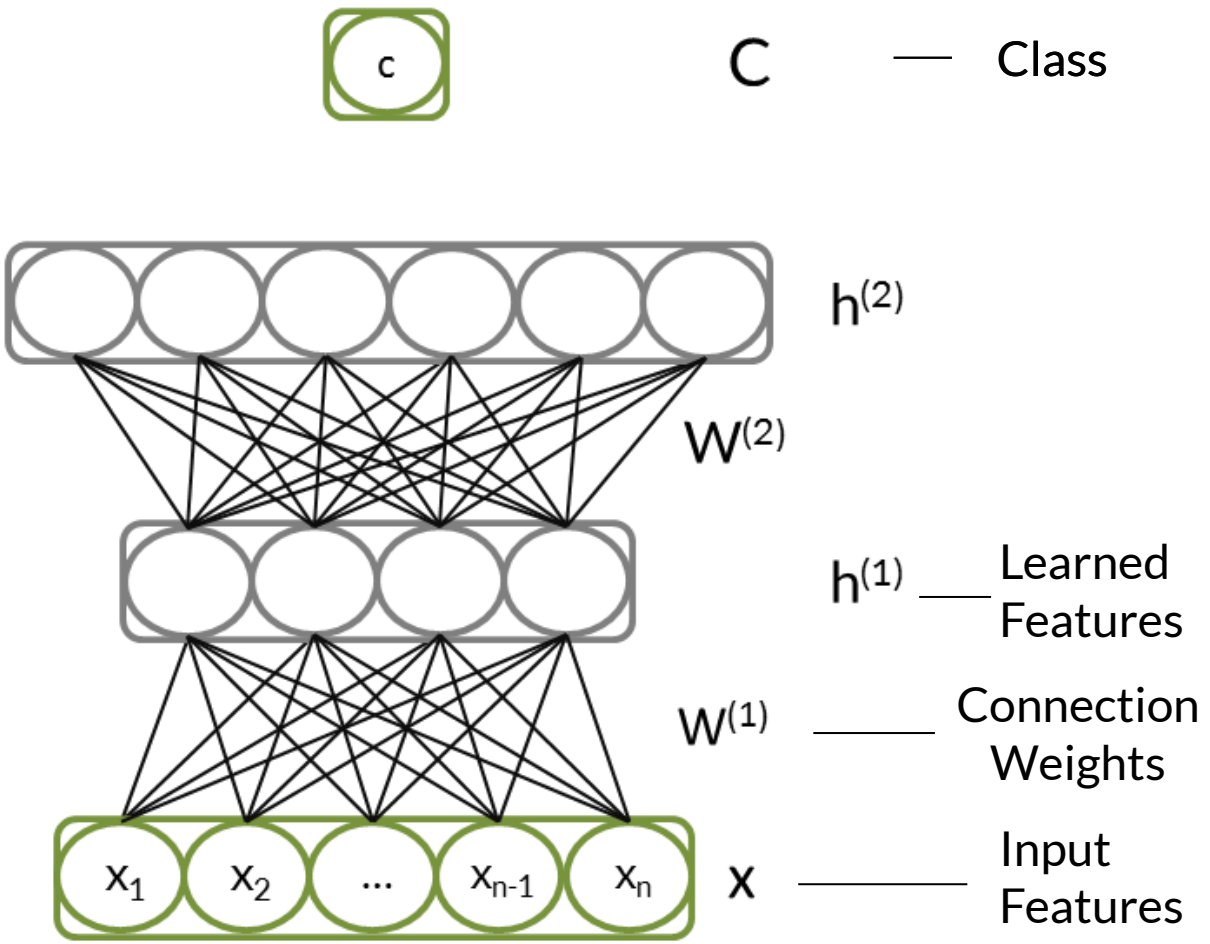

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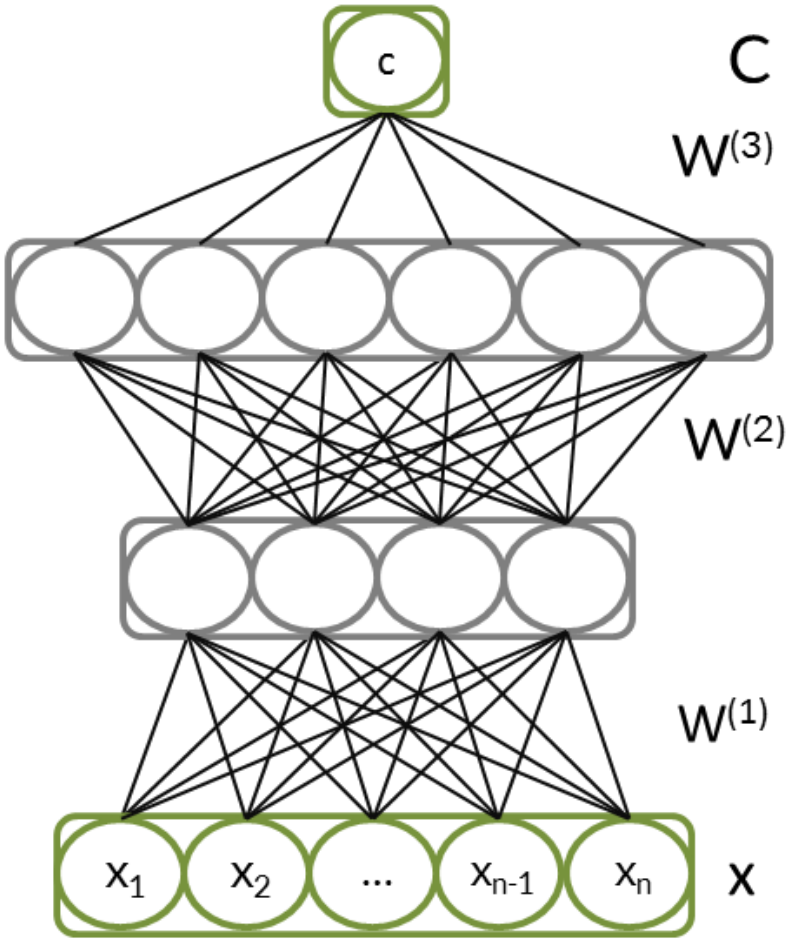

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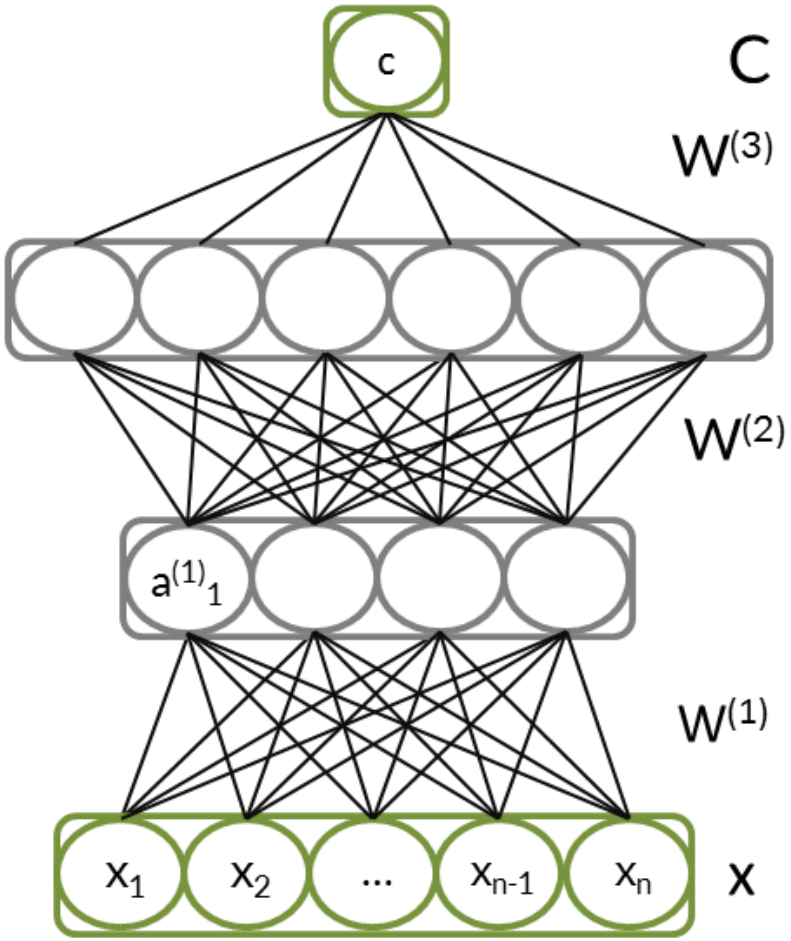

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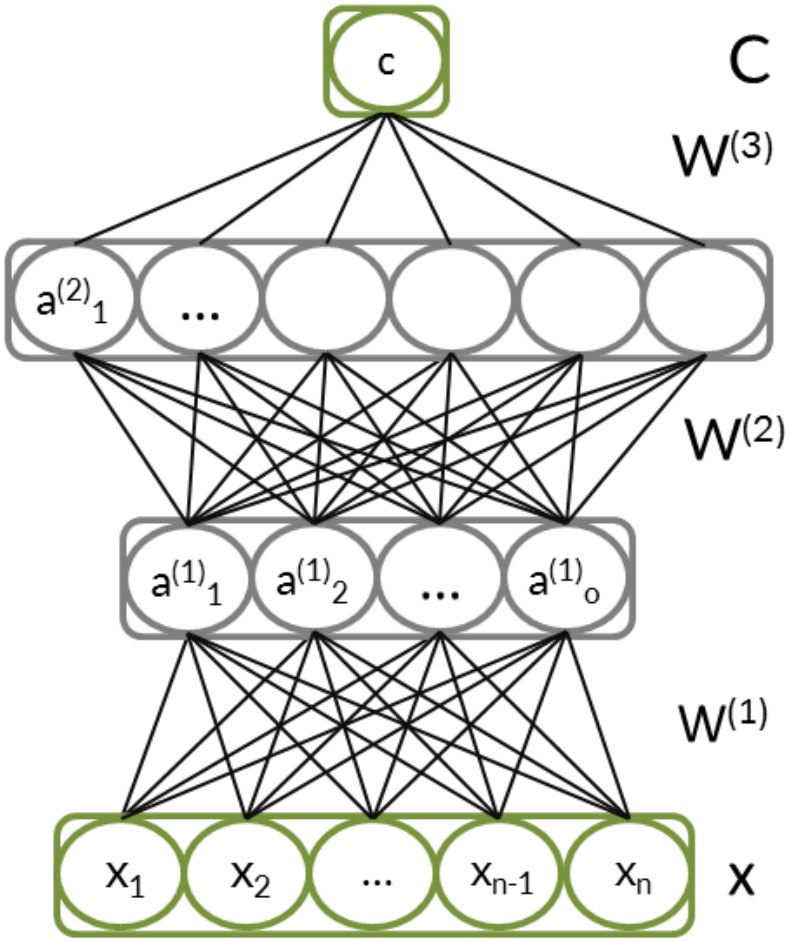

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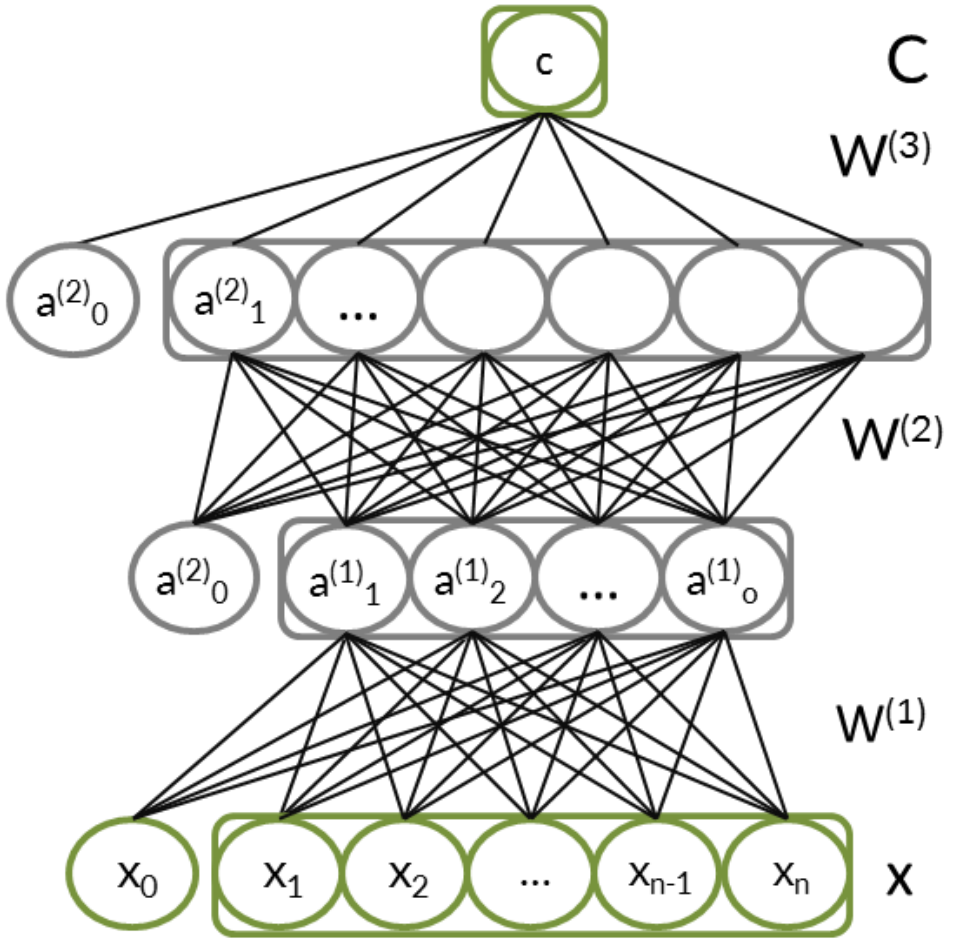

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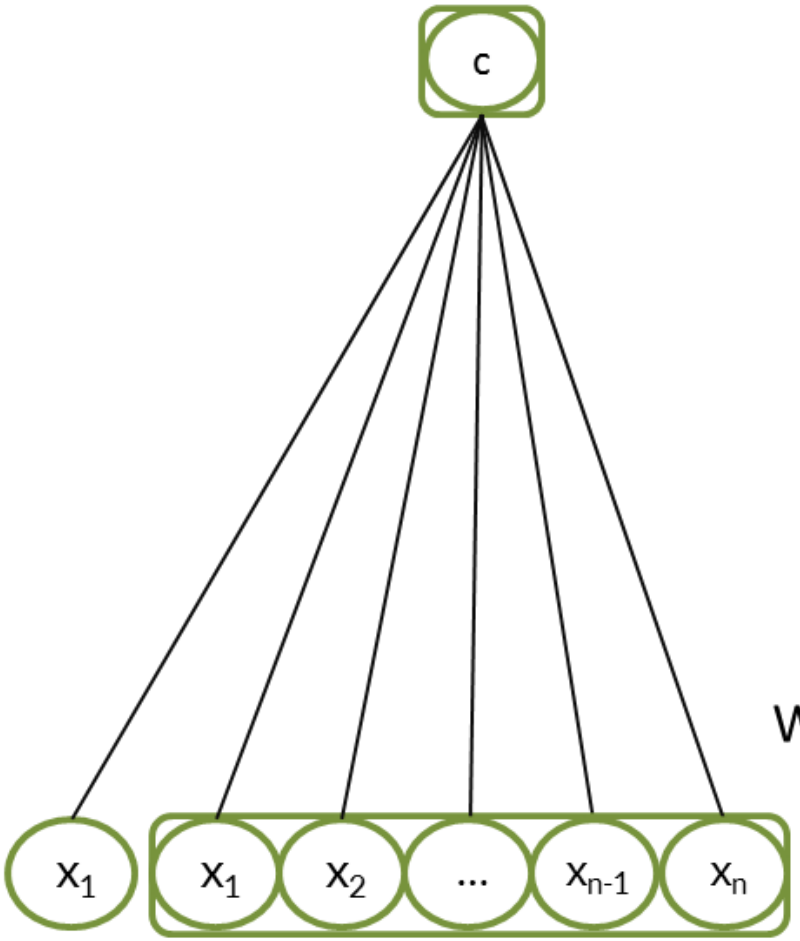
ALGORITHM 1 REGRESSION

Visible
Output Layer



C — Class

W(1) — Connection Weights

x — Input Features

Visible
Input Layer

In-MINDD

Insight

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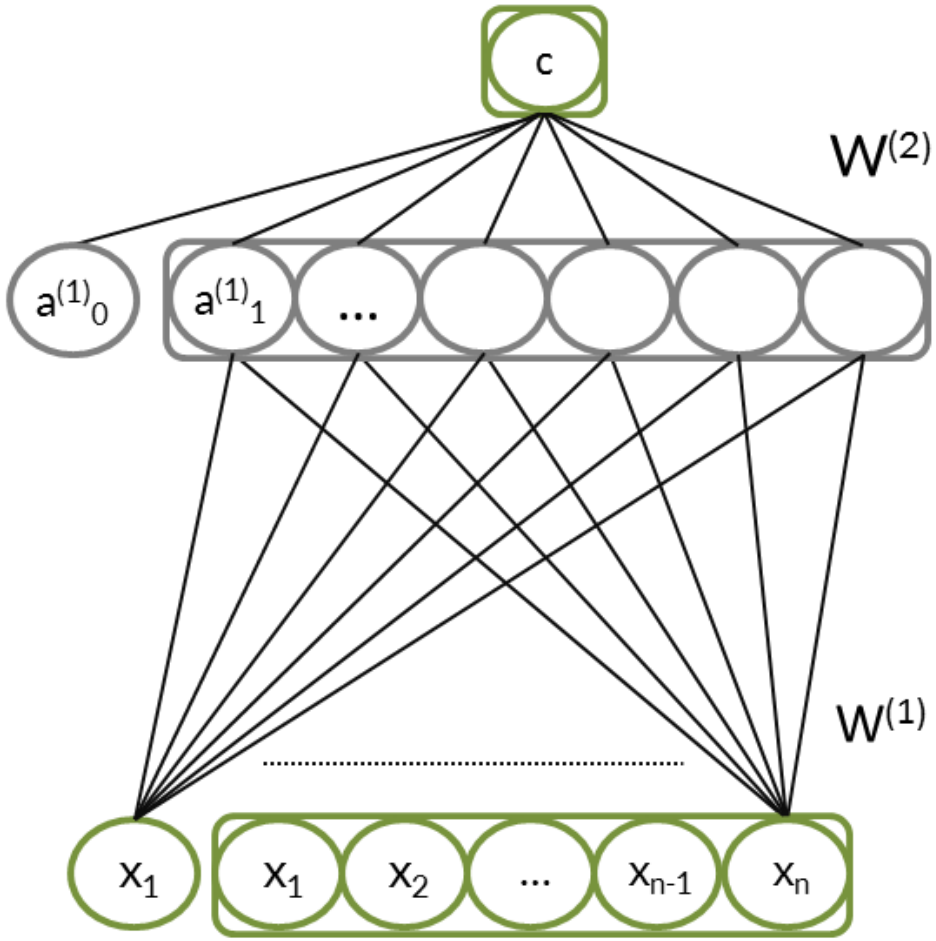
ALGORITHM 2 MLP

Visible
Output Layer

Hidden
Layers

Visible
Input Layer



C — Class

Connection Weights

x — Input Features

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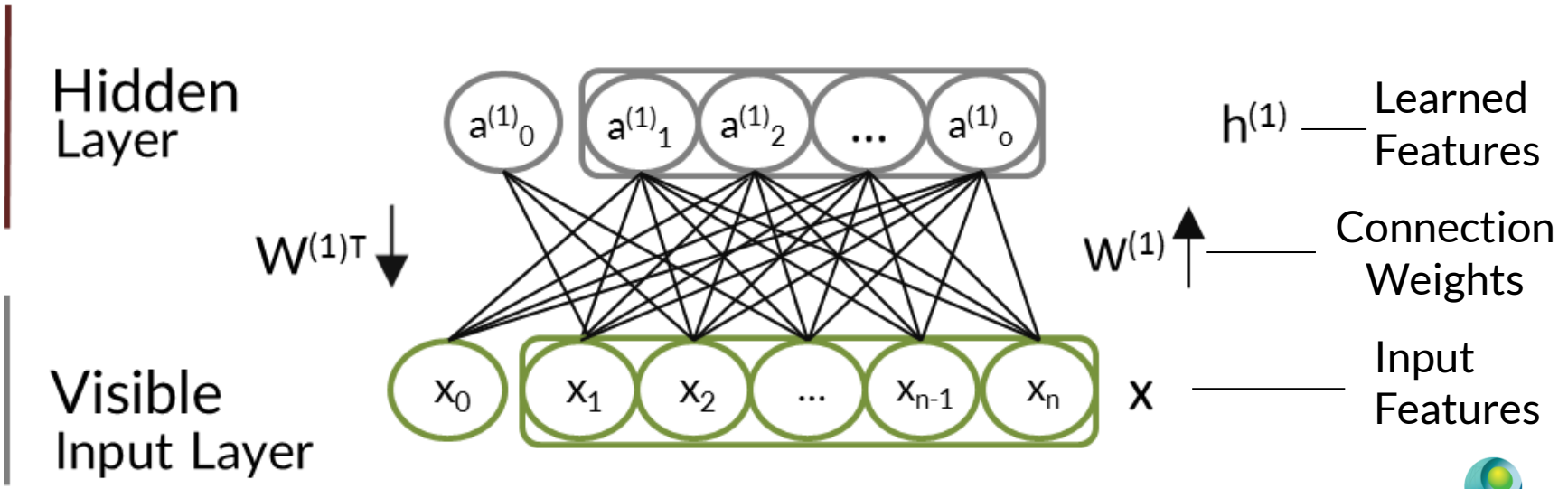
ALGORITHM 3 RBM



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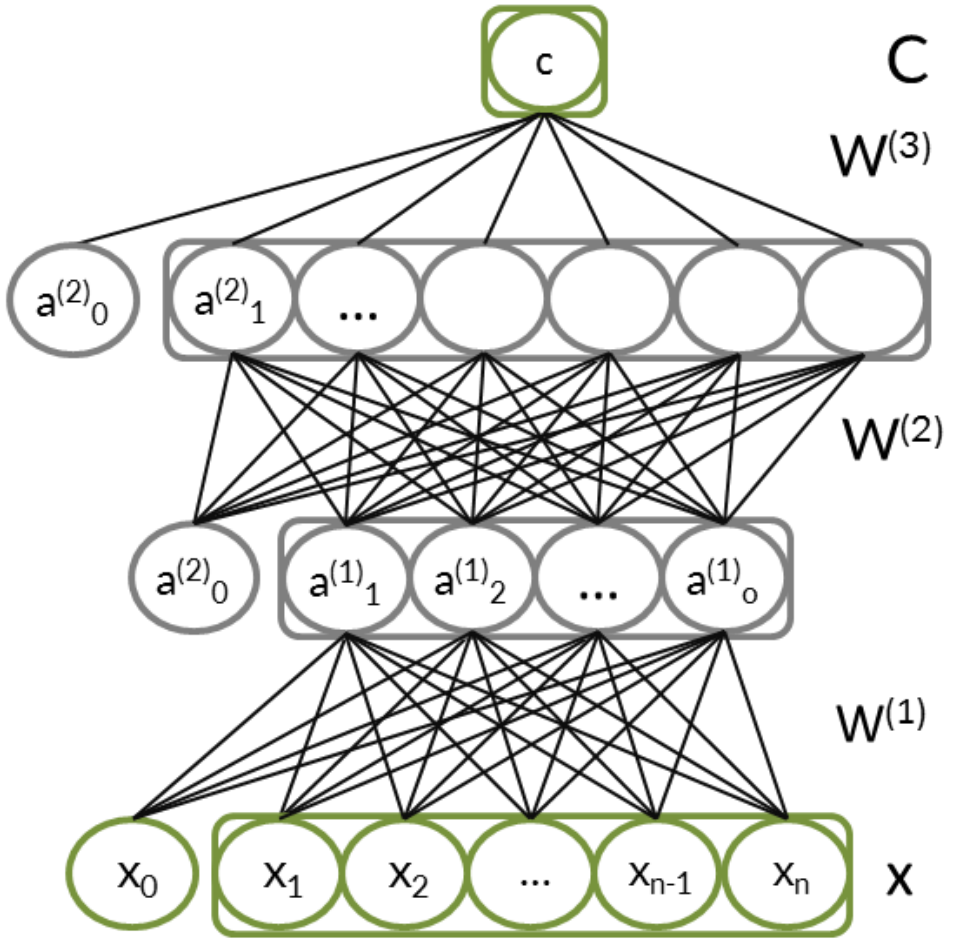
ALGORITHM 4 DBN

Visible
Output Layer

Hidden
Layers

Visible
Input Layer



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CONFIGURABLE DEEP NETWORK FRAMEWORK

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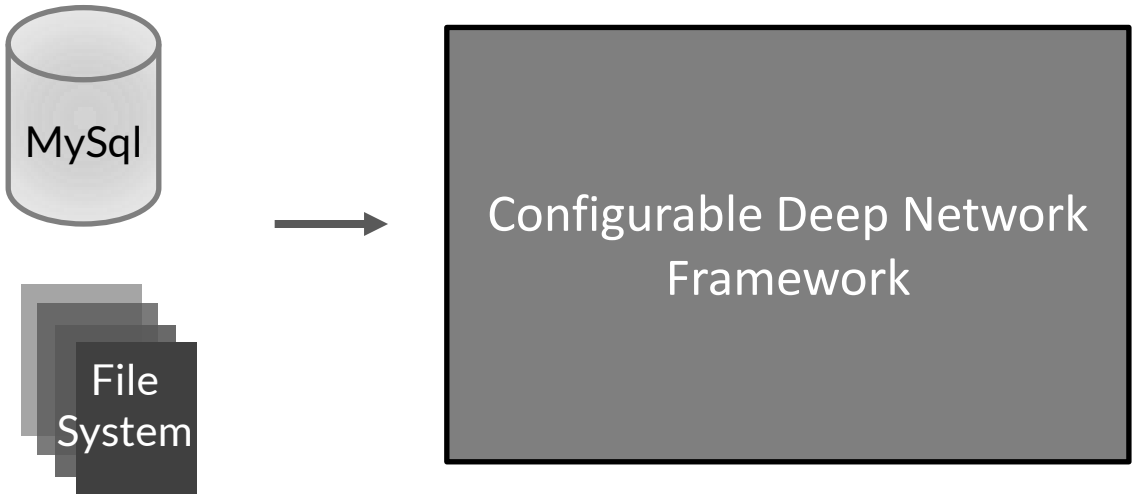

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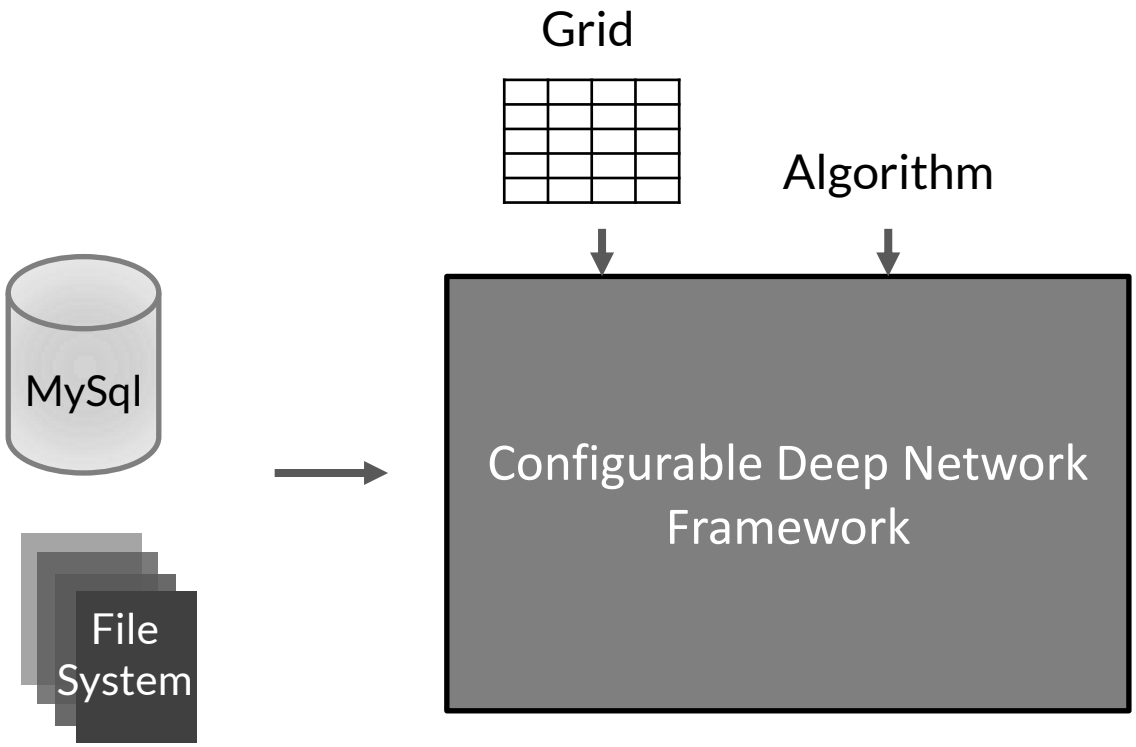

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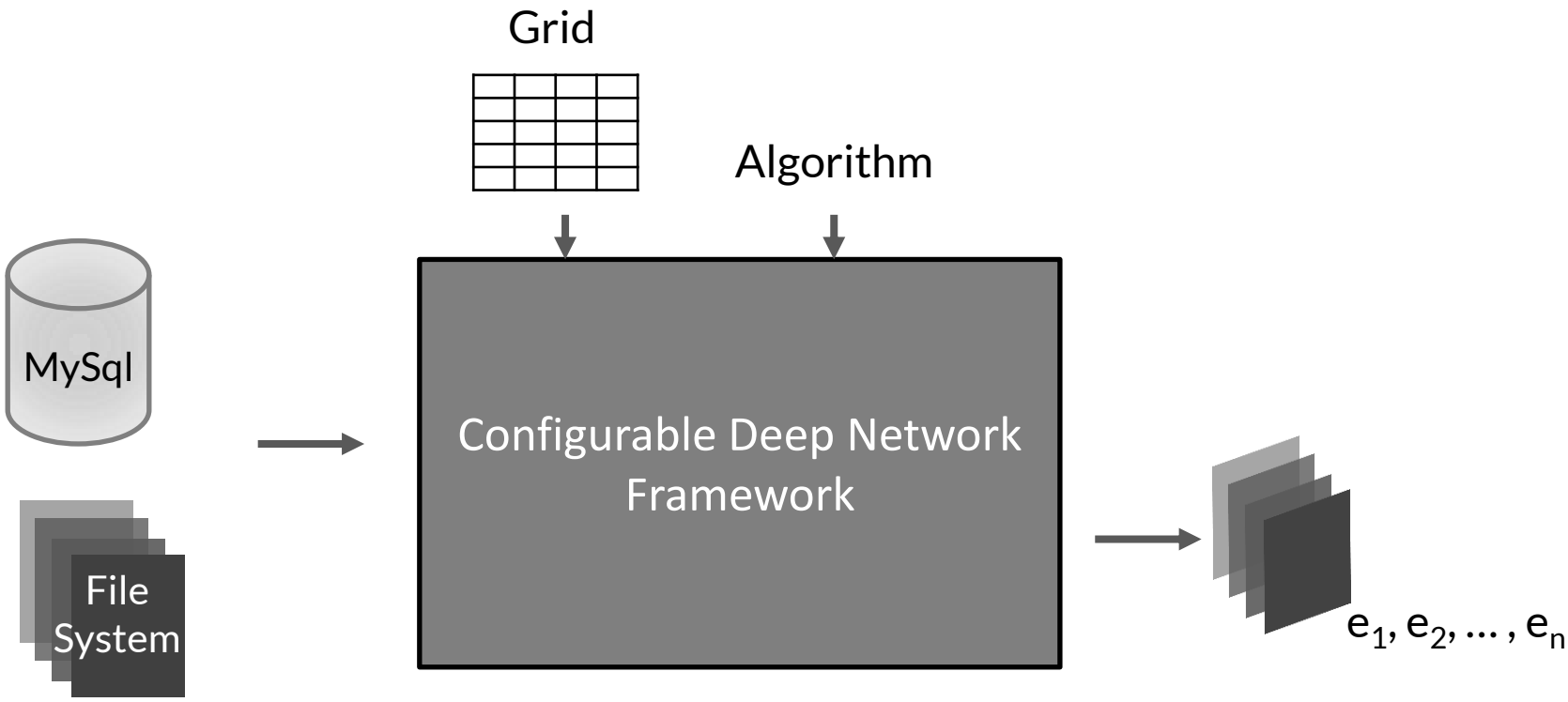

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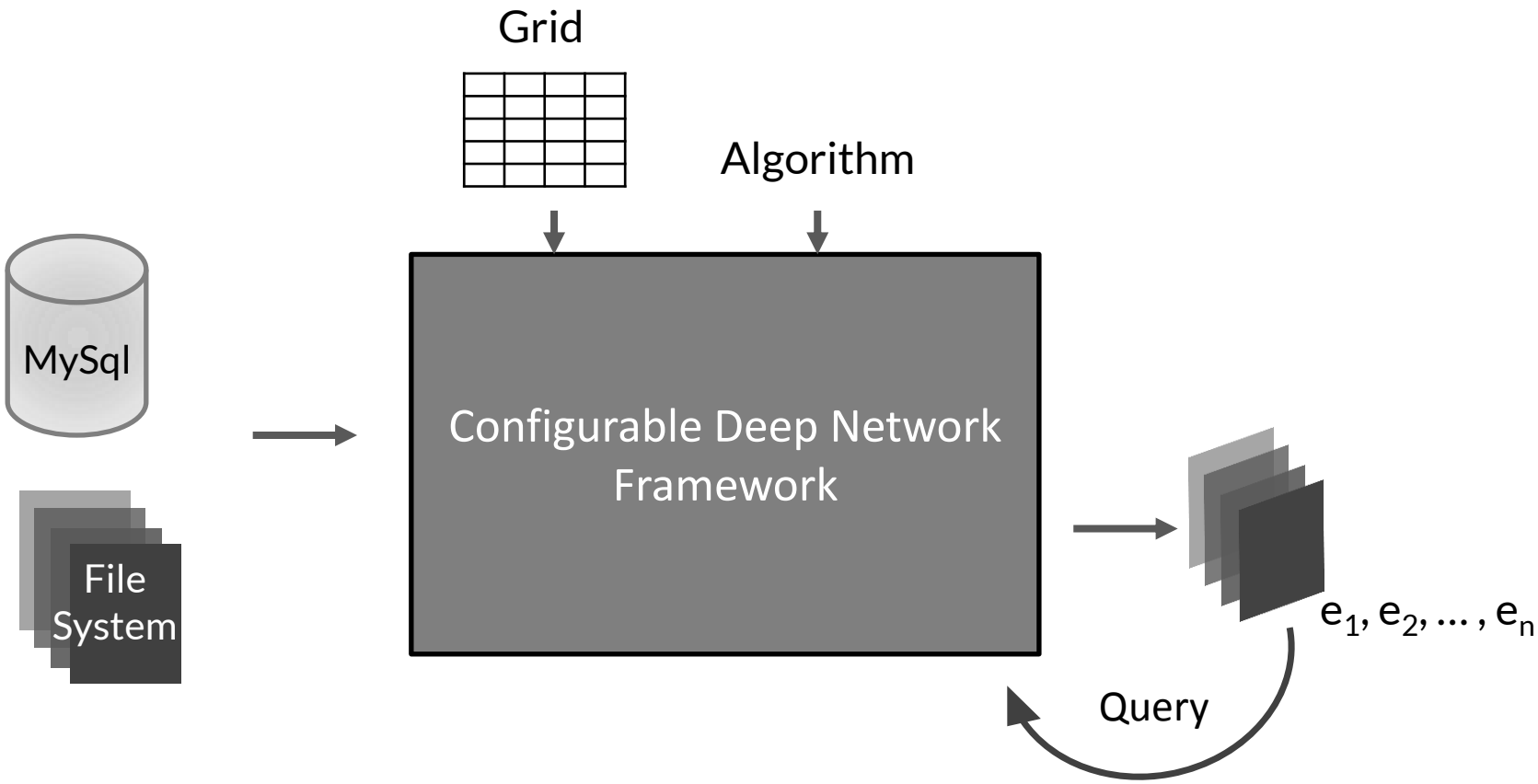

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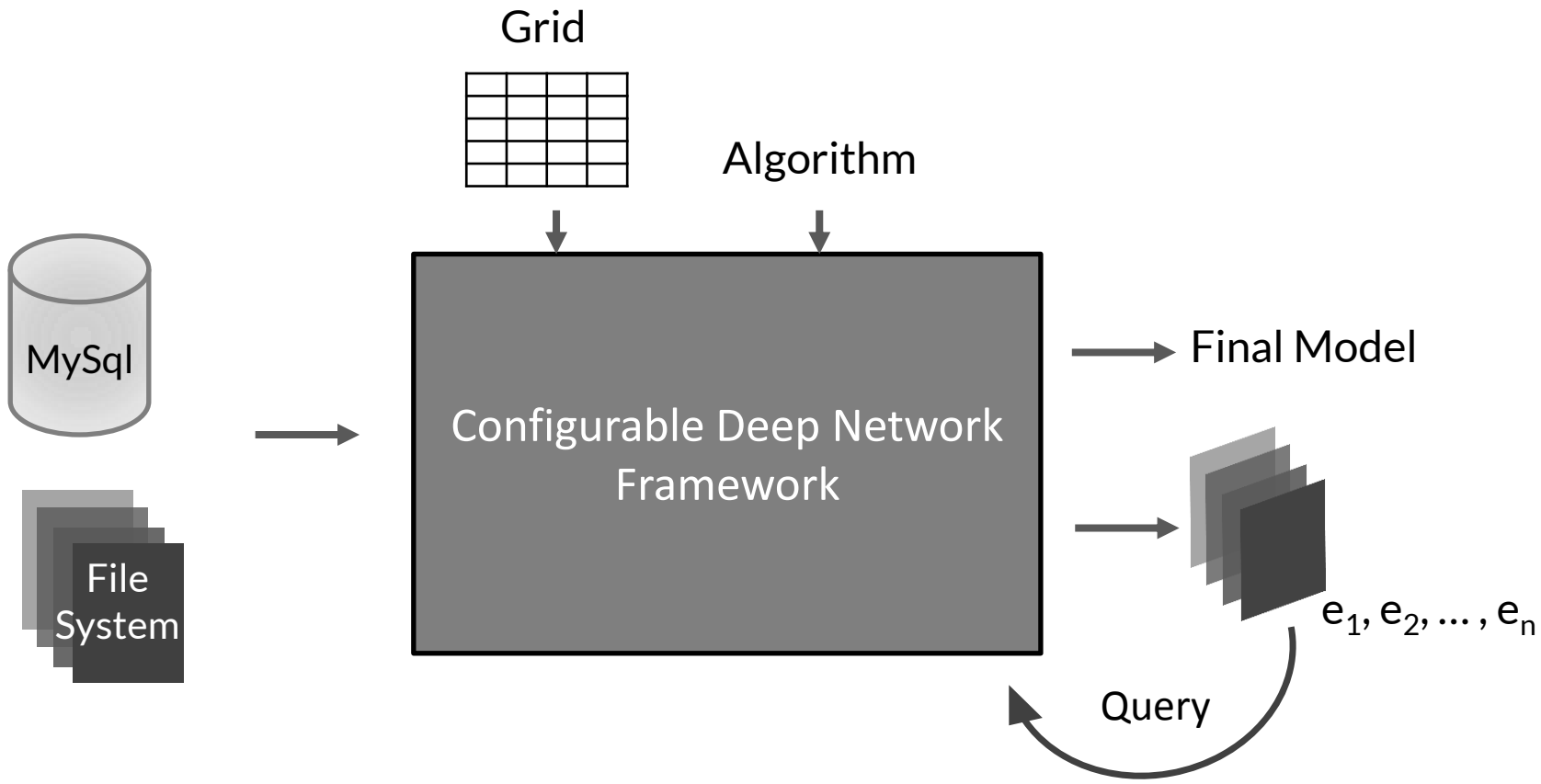

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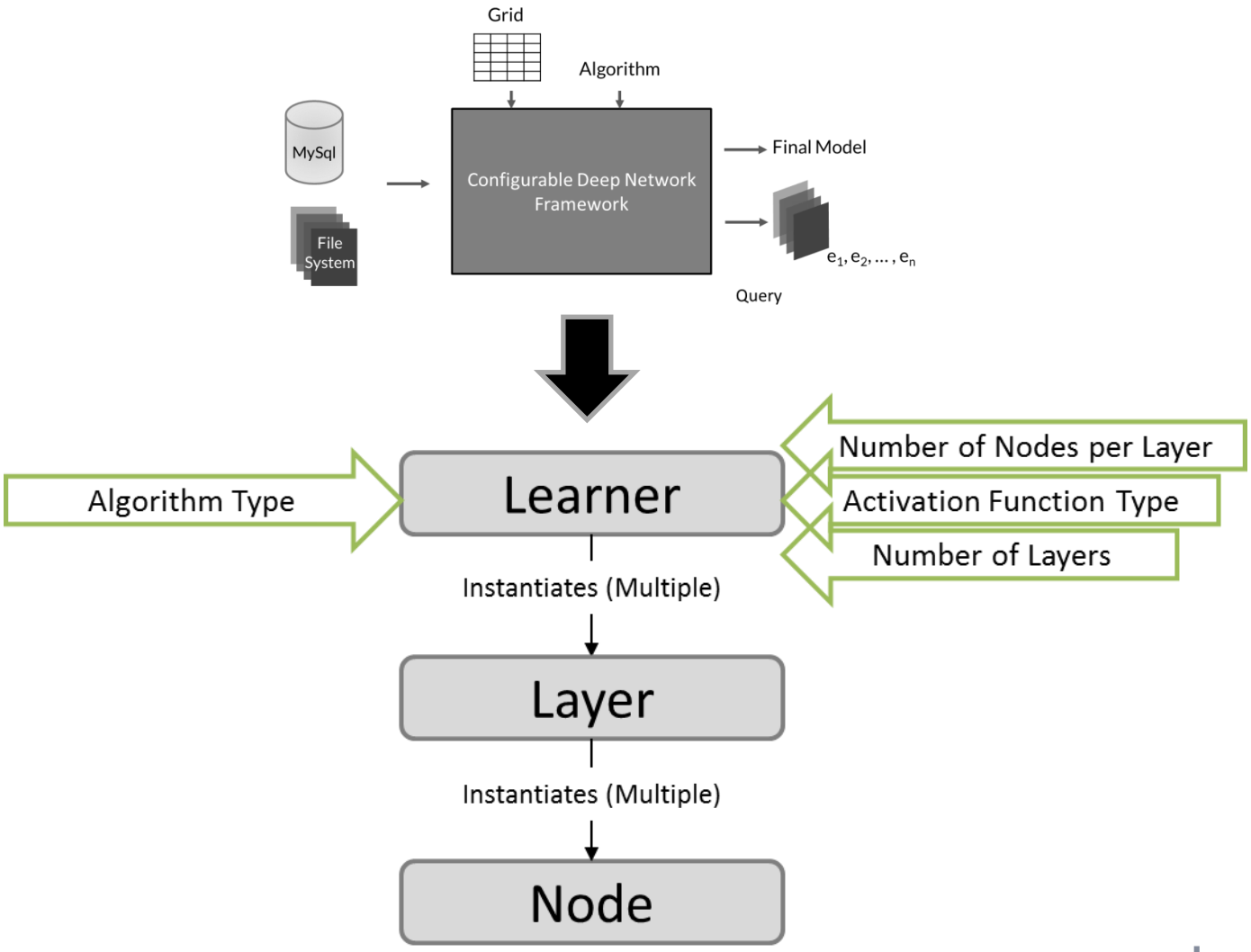

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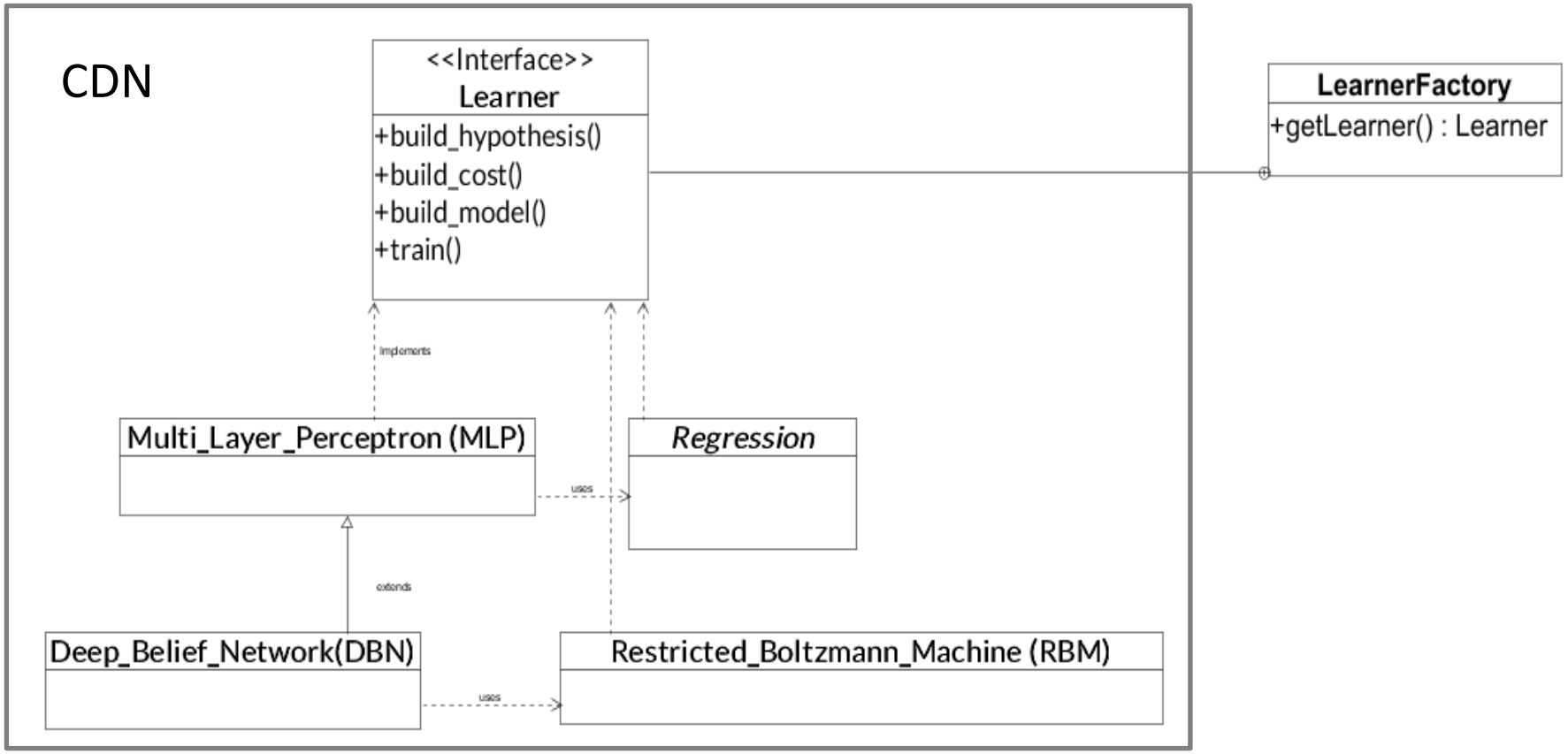
CONFIGURABLE DEEP NETWORK

ALGORITHM ARCHITECTURE



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EXPERIMENTS DATASET PREPARATION

Subset of the Data – dimensions

What the variables are

What the predictor is

Purpose

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EXPERIMENT

REGRESSION

To Choose:

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EXPERIMENT

REGRESSION

To Choose:

learning rate α

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EXPERIMENT

REGRESSION

To Choose:

learning rate α

weight decay term λ

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EXPERIMENT

REGRESSION

To Choose:

learning rate α

weight decay term λ

training iterations t

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EXPERIMENT

REGRESSION

The Grid:

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EXPERIMENT

REGRESSION

The Grid:

α, λ:

[0.001, 0.003, 0.009, … , 0.1, 0.3, 0.9]

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EXPERIMENT

REGRESSION

The Grid:

α, λ:

[0.001, 0.003, 0.009, … , 0.1, 0.3, 0.9]

t:

[100, 1000, 10000]

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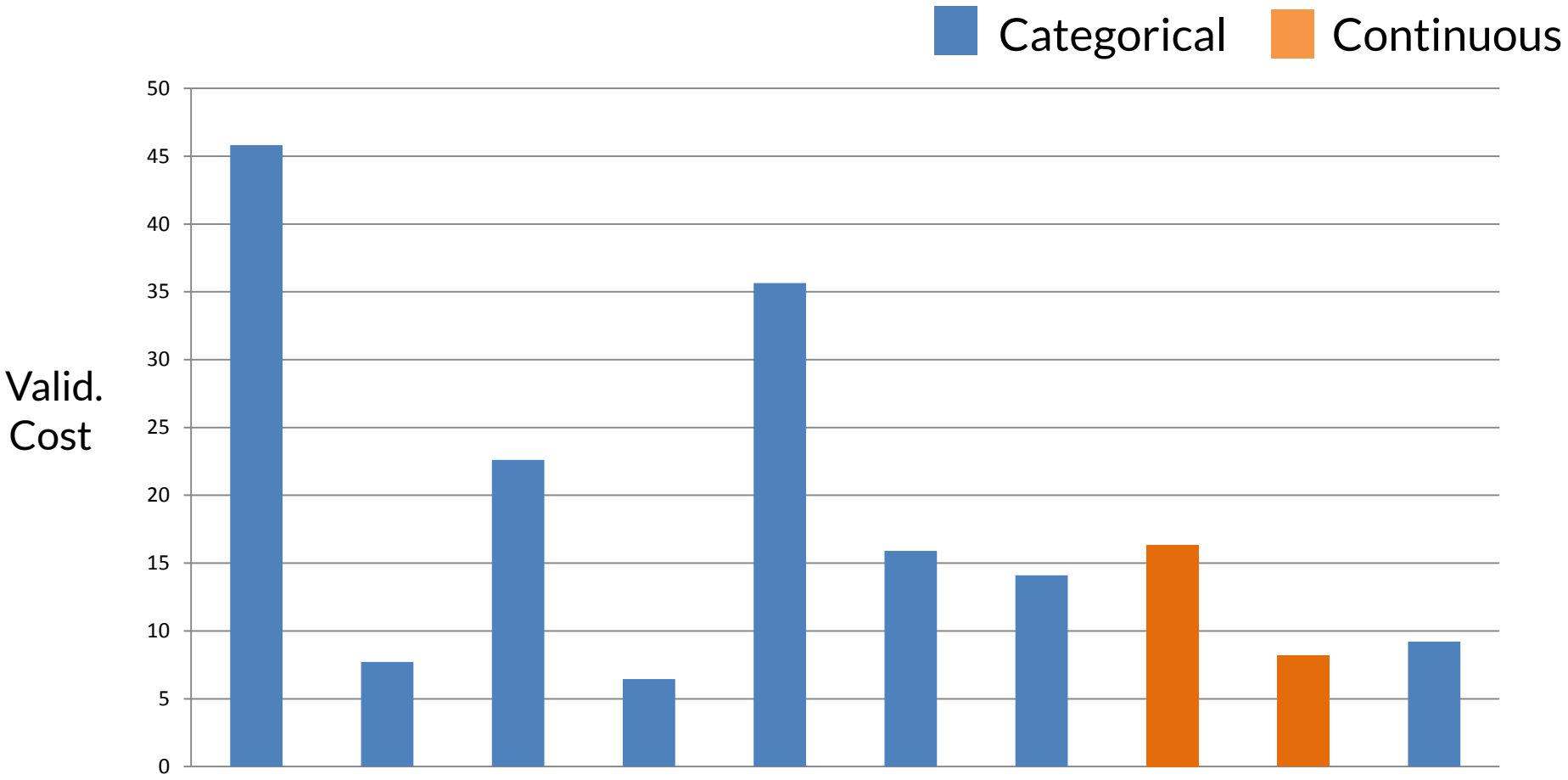
EXPERIMENT RESULTS REGRESSION



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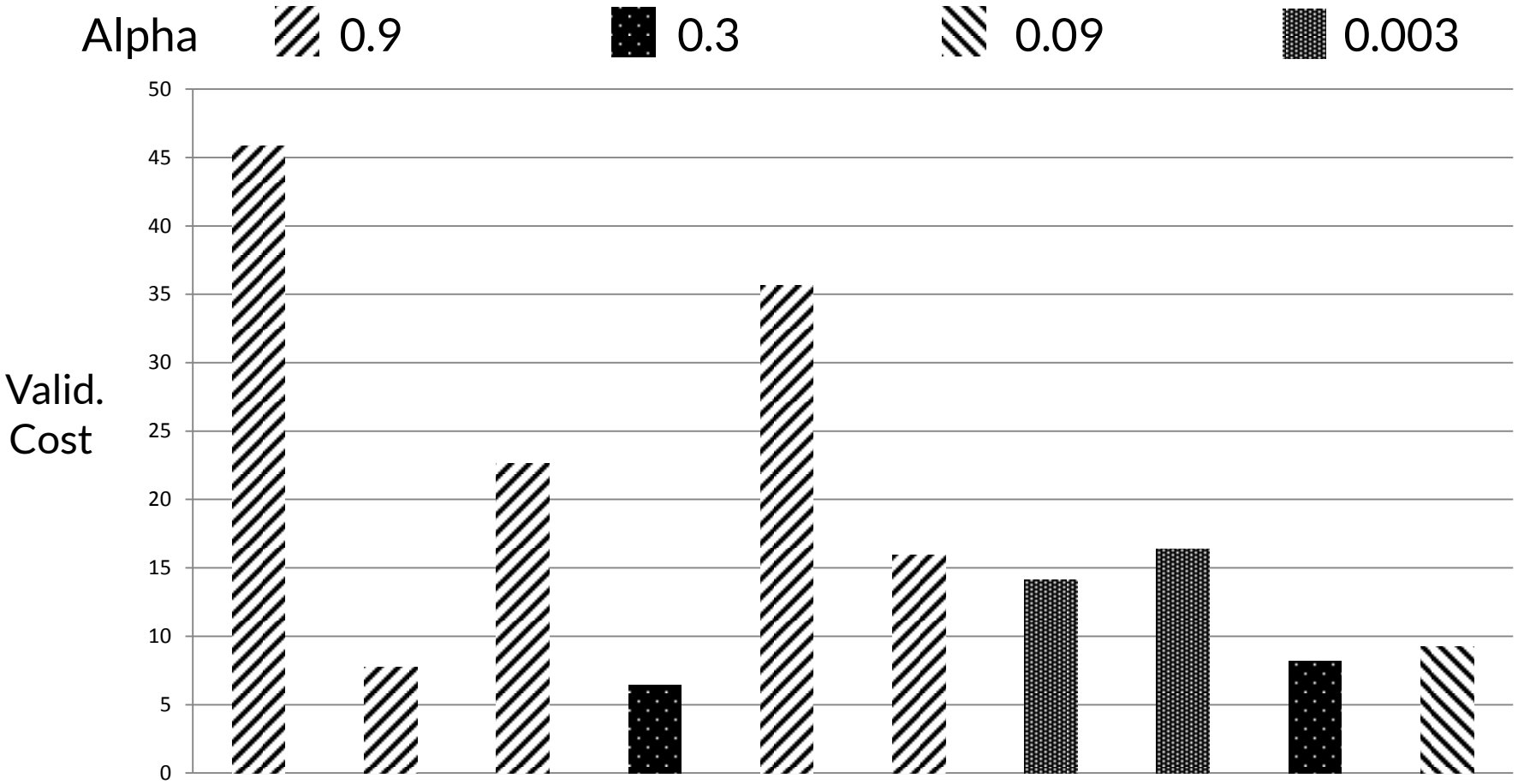

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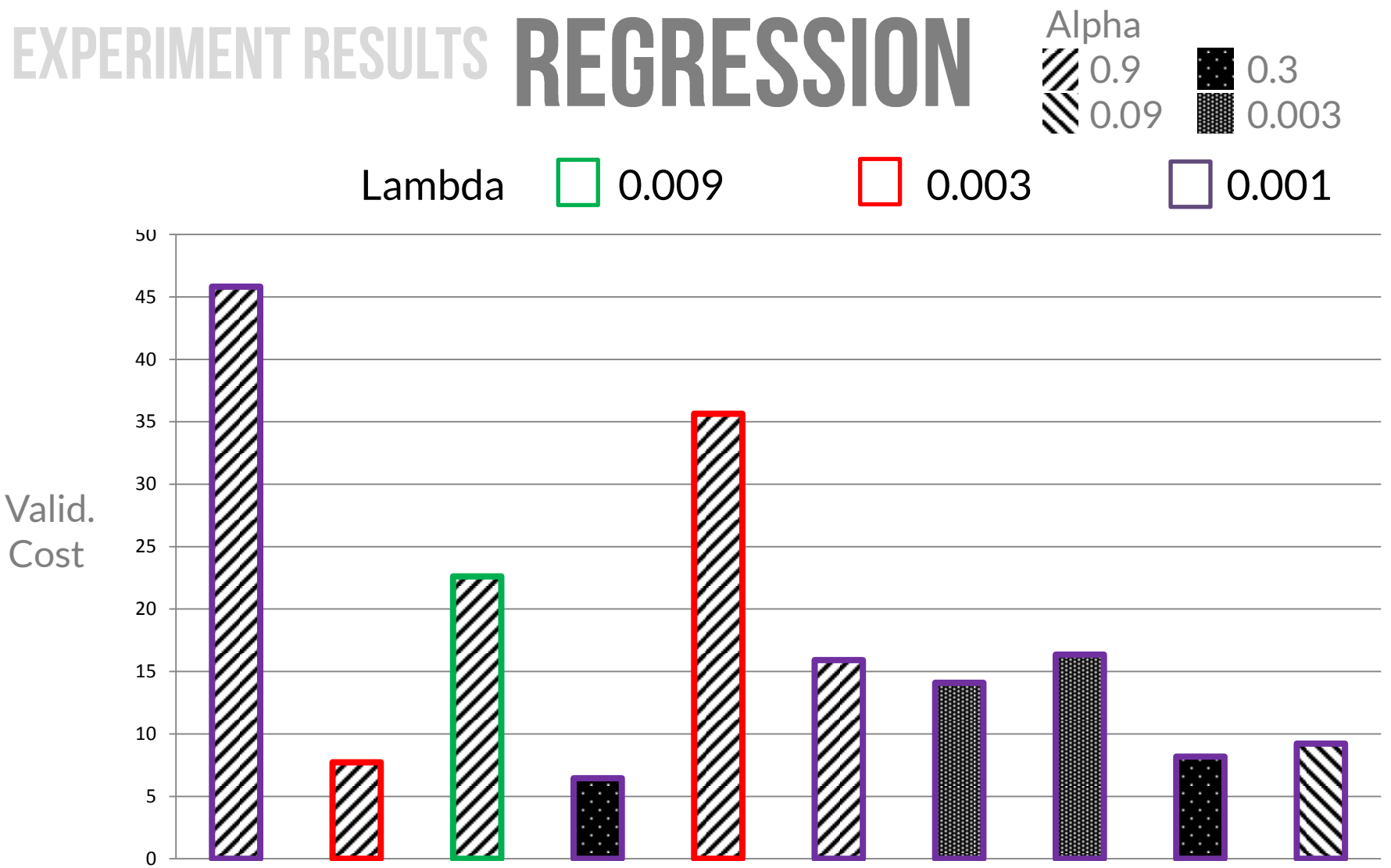

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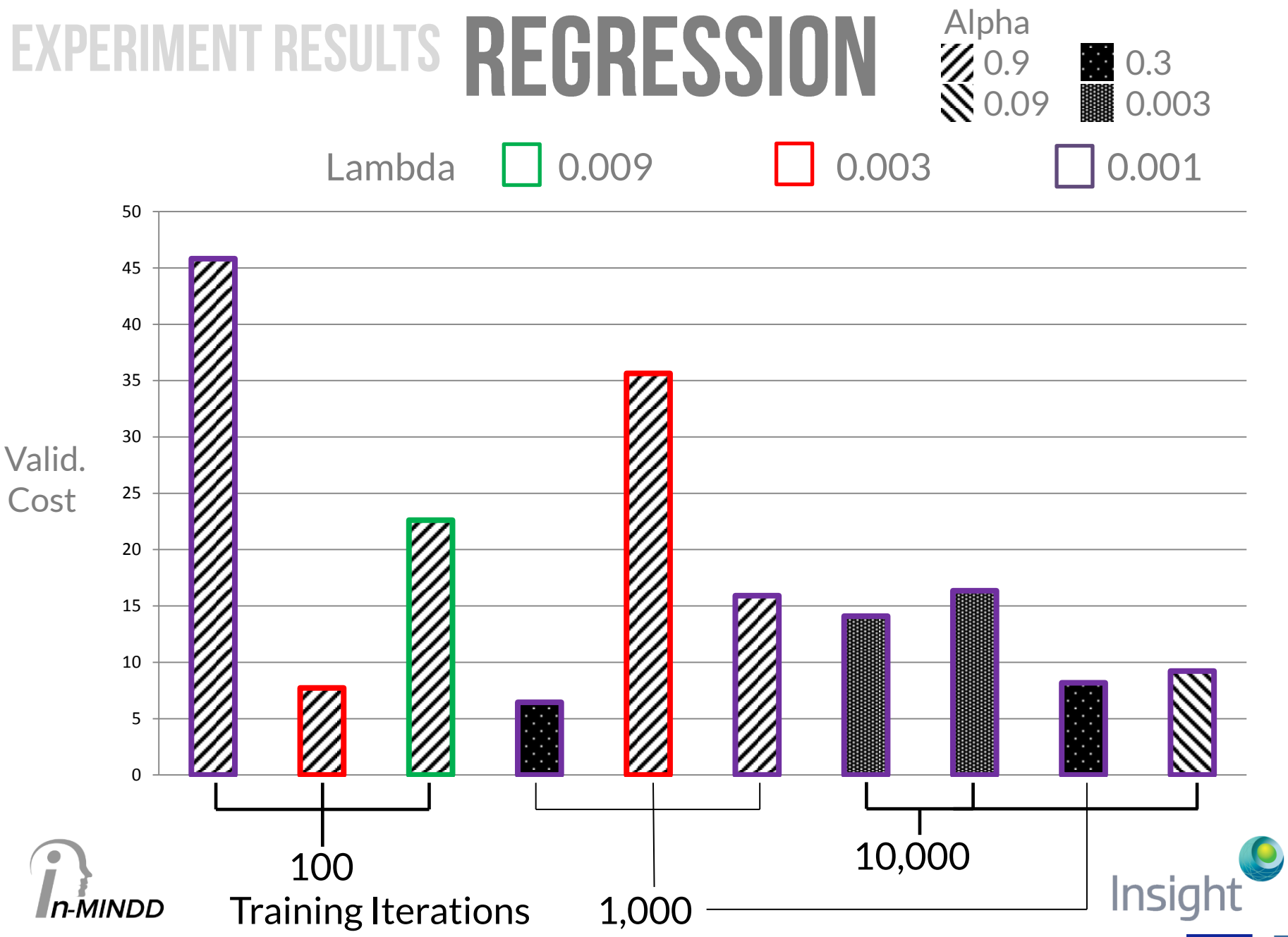

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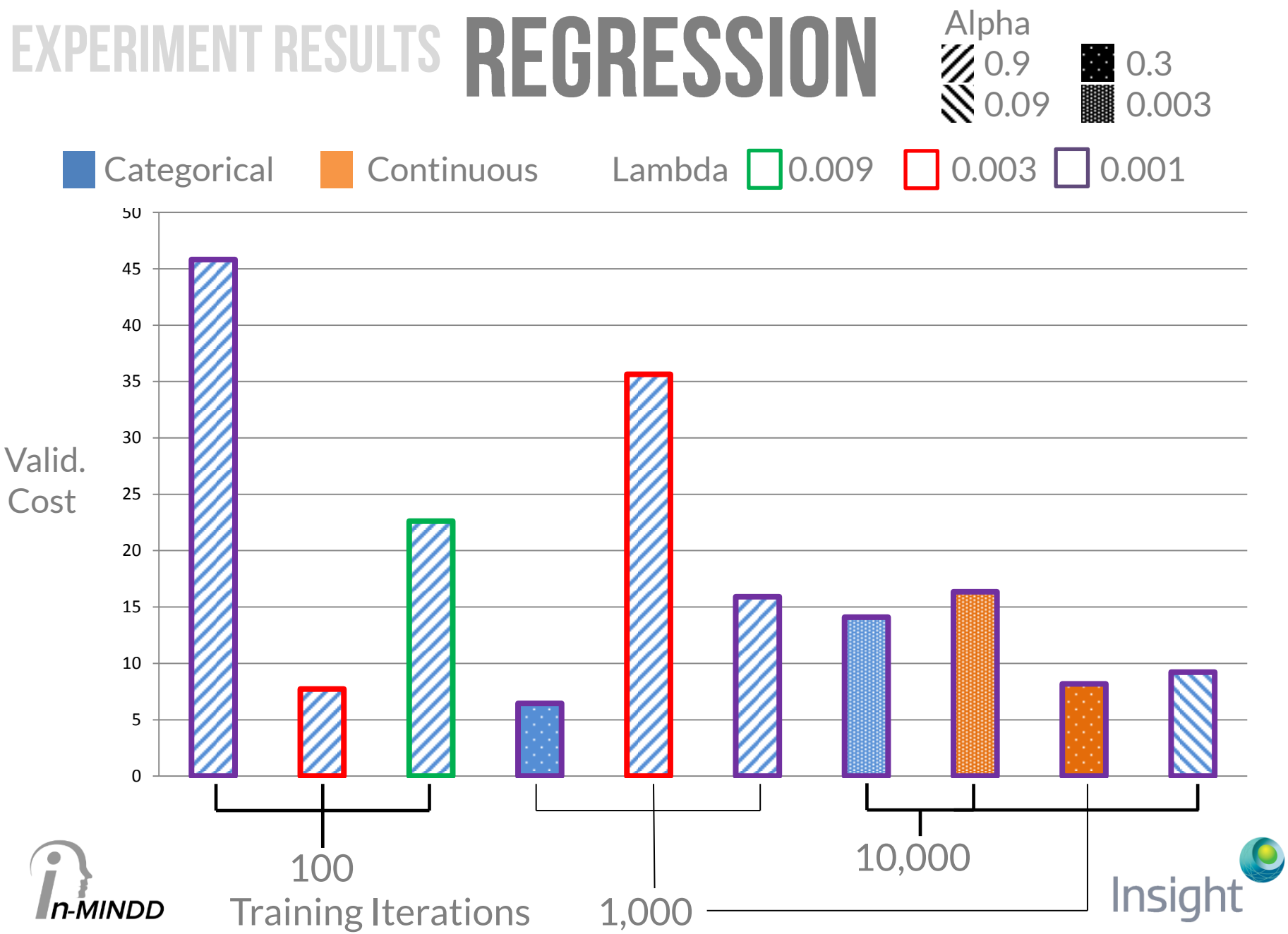

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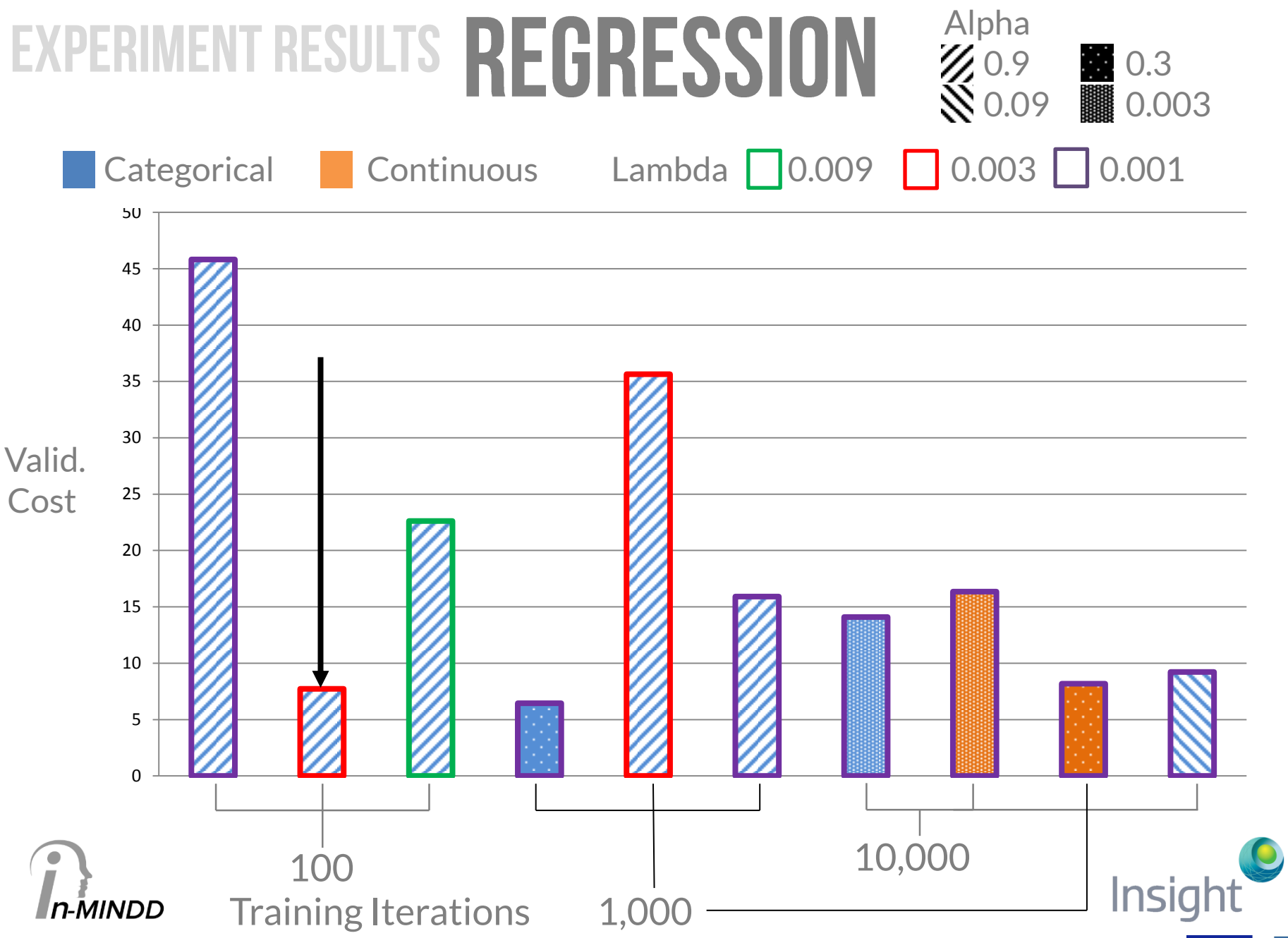

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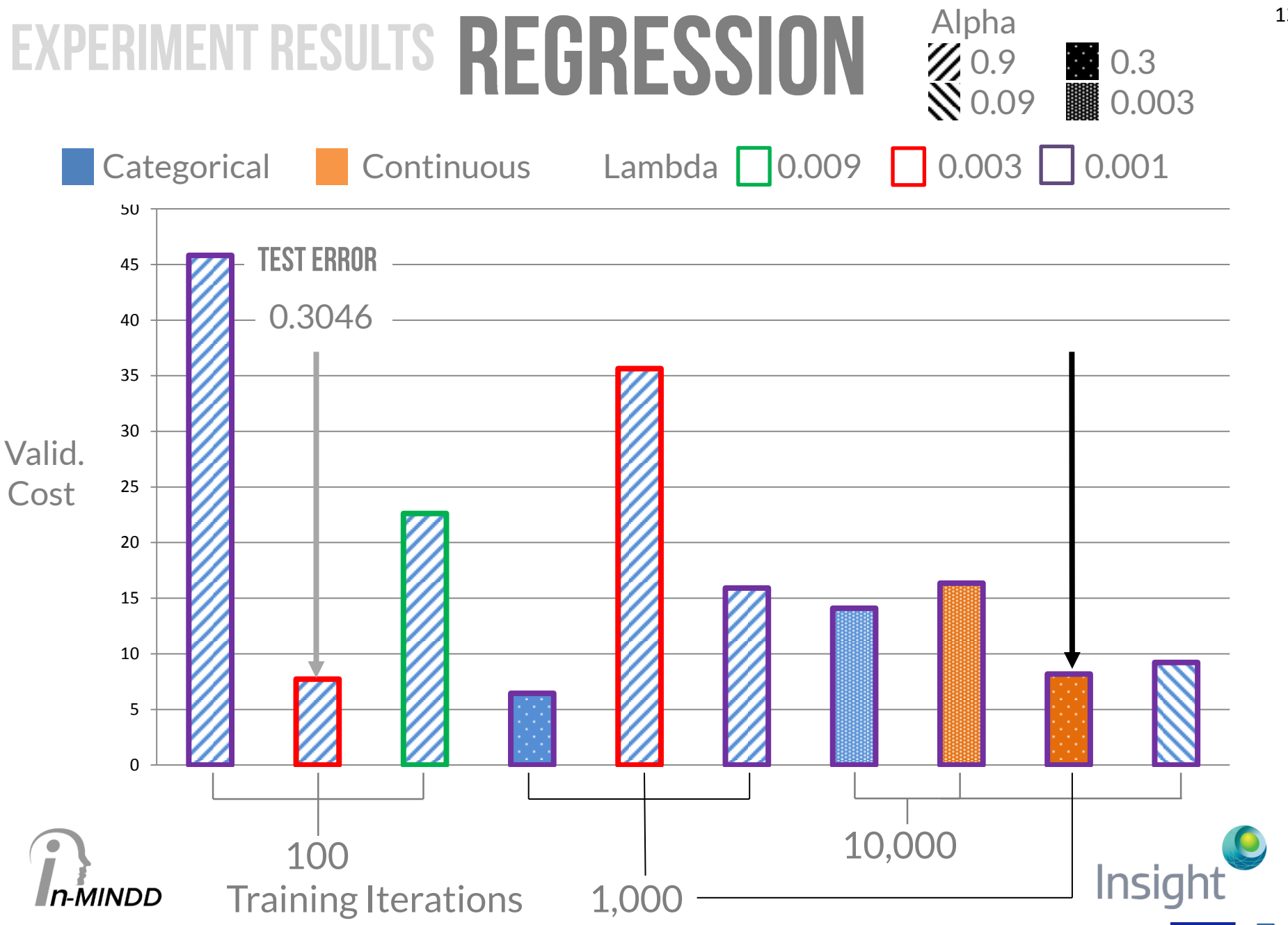

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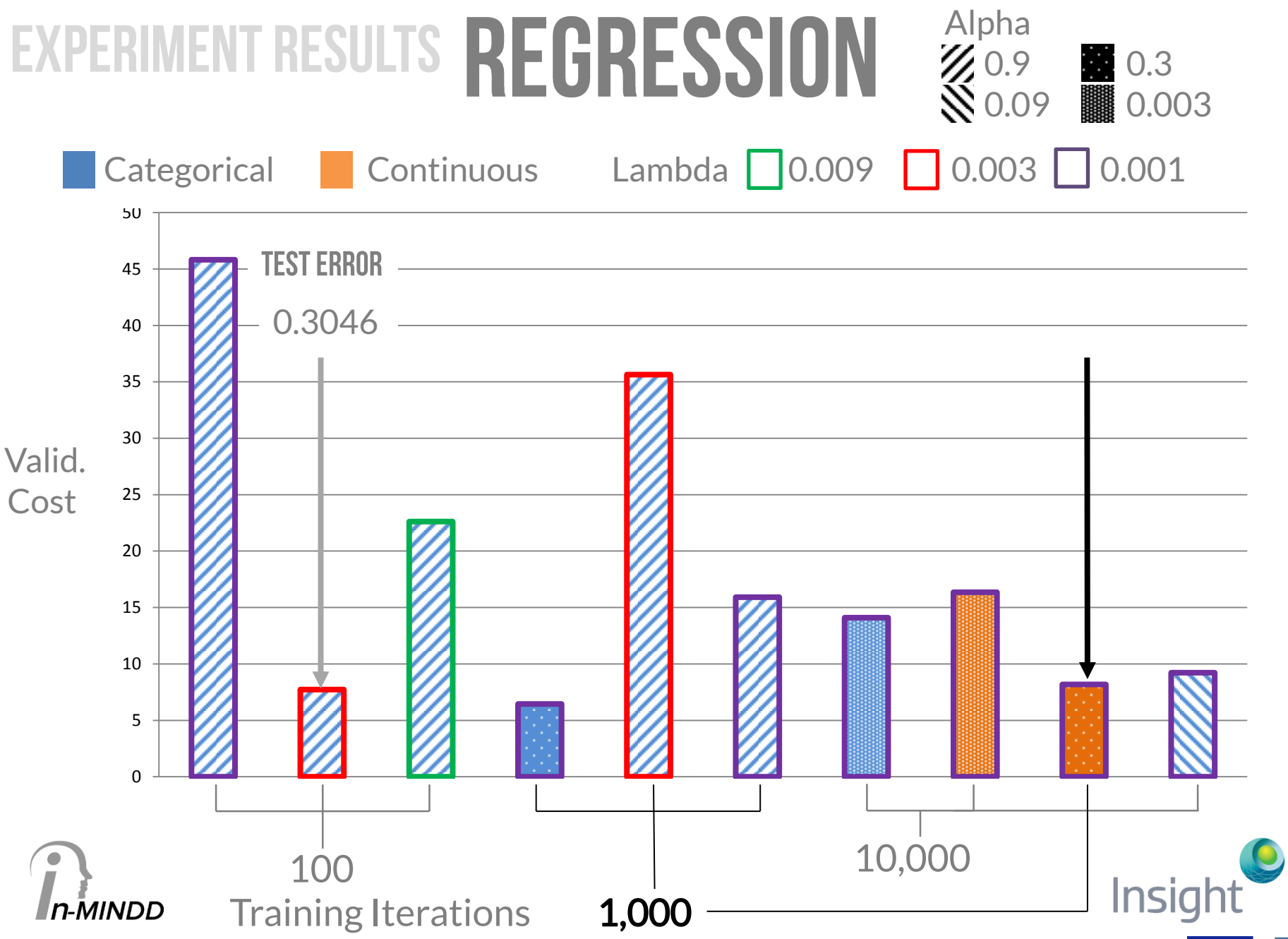

In-MINDD

Insight

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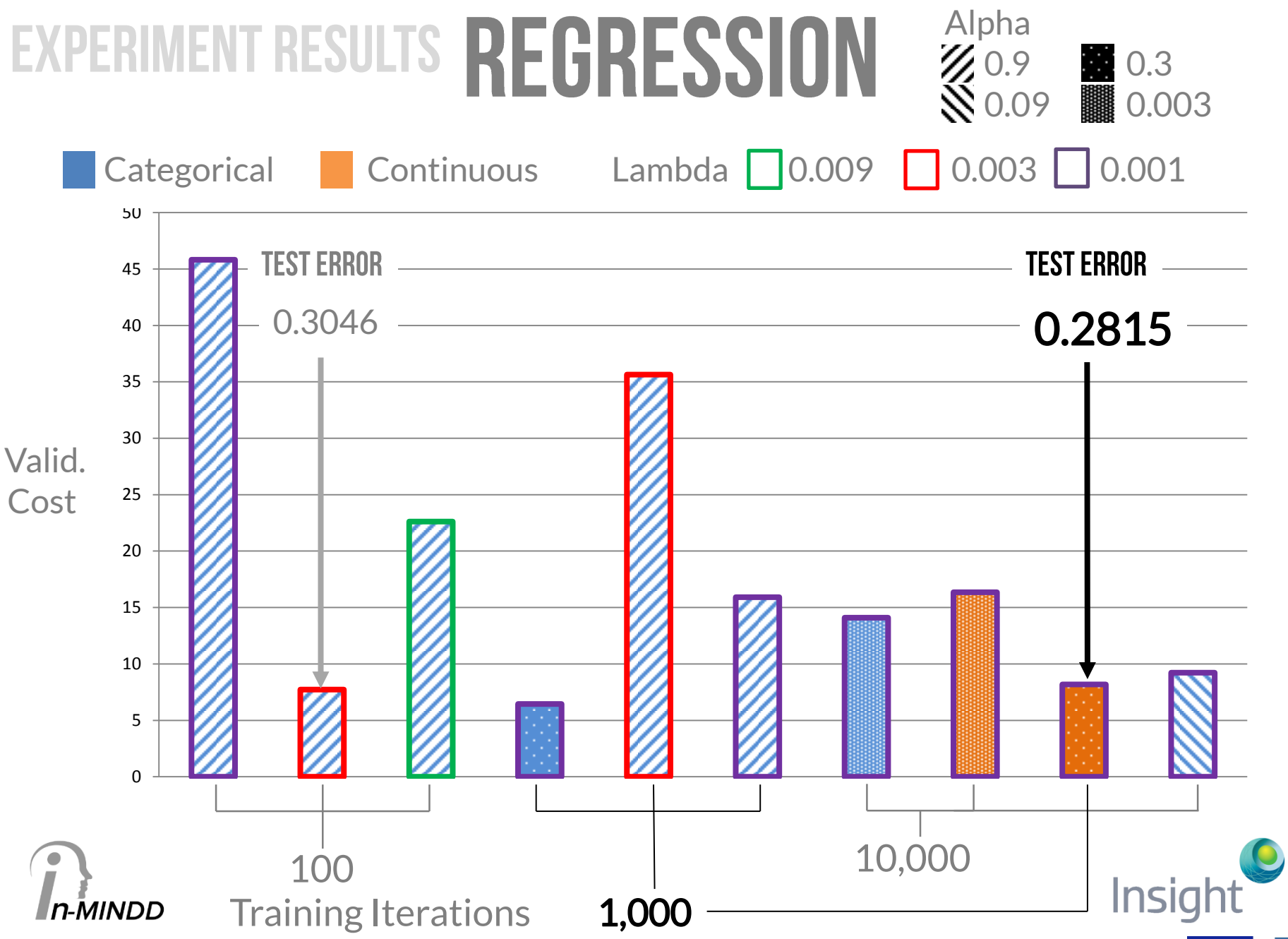
EXPERIMENT RESULTS REGRESSION



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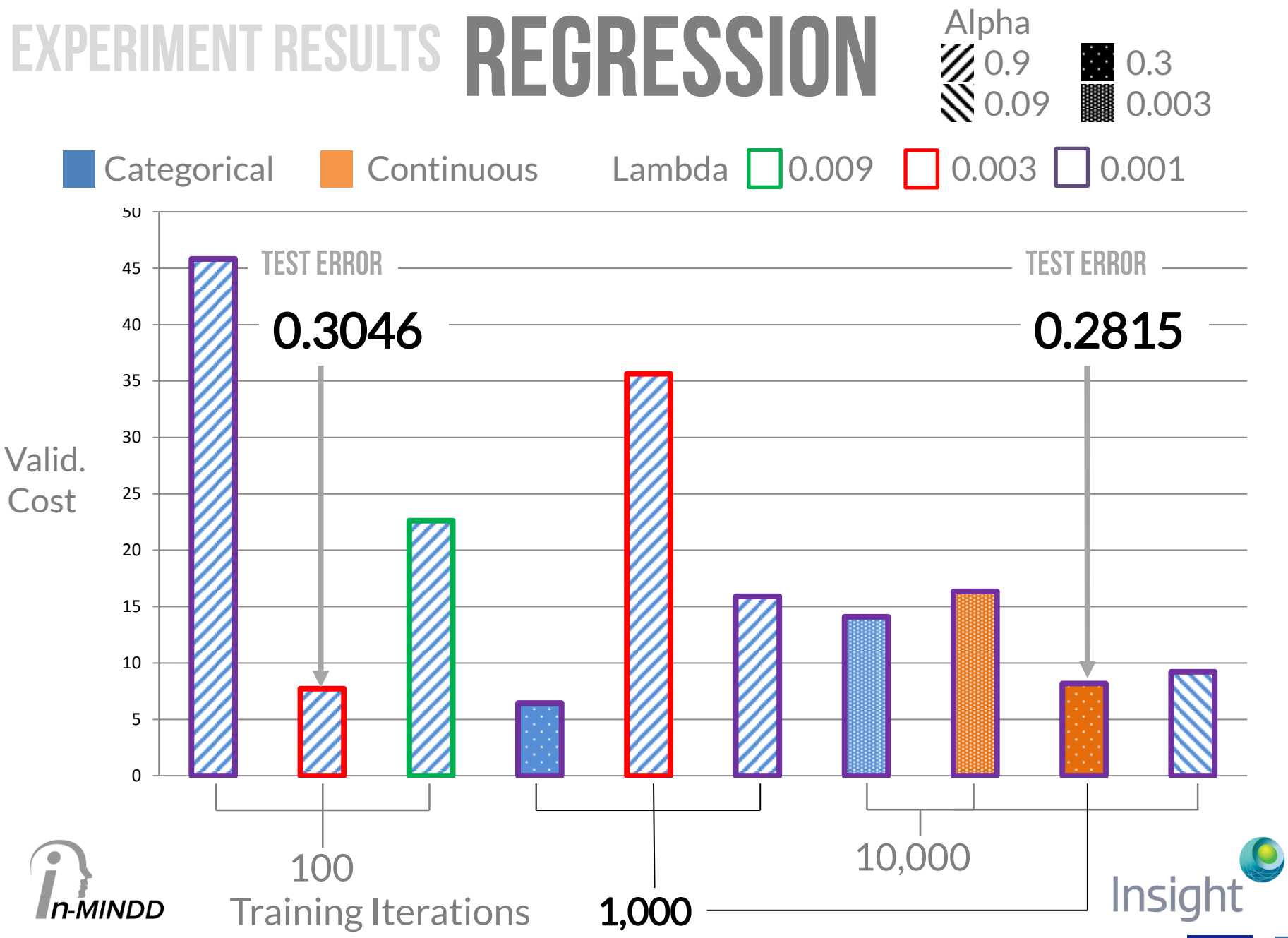

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EXPERIMENT

RBM

To Choose:

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EXPERIMENT

RBM

To Choose:

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

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EXPERIMENT

RBM

To Choose:

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

pre-training epochs e

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EXPERIMENT

RBM

The Grid:

$h^{(1)}_n$:

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

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EXPERIMENT

RBM

The Grid:

$h^{(1)}_n$:

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

e

[1, 5, 10, 15, 20]

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EXPERIMENT

RBM

Parameter Initialisation:

$$-4\frac{\sqrt{6}}{fan\_in + fan\_out}, +4\frac{\sqrt{6}}{fan\_in + fan\_out}$$

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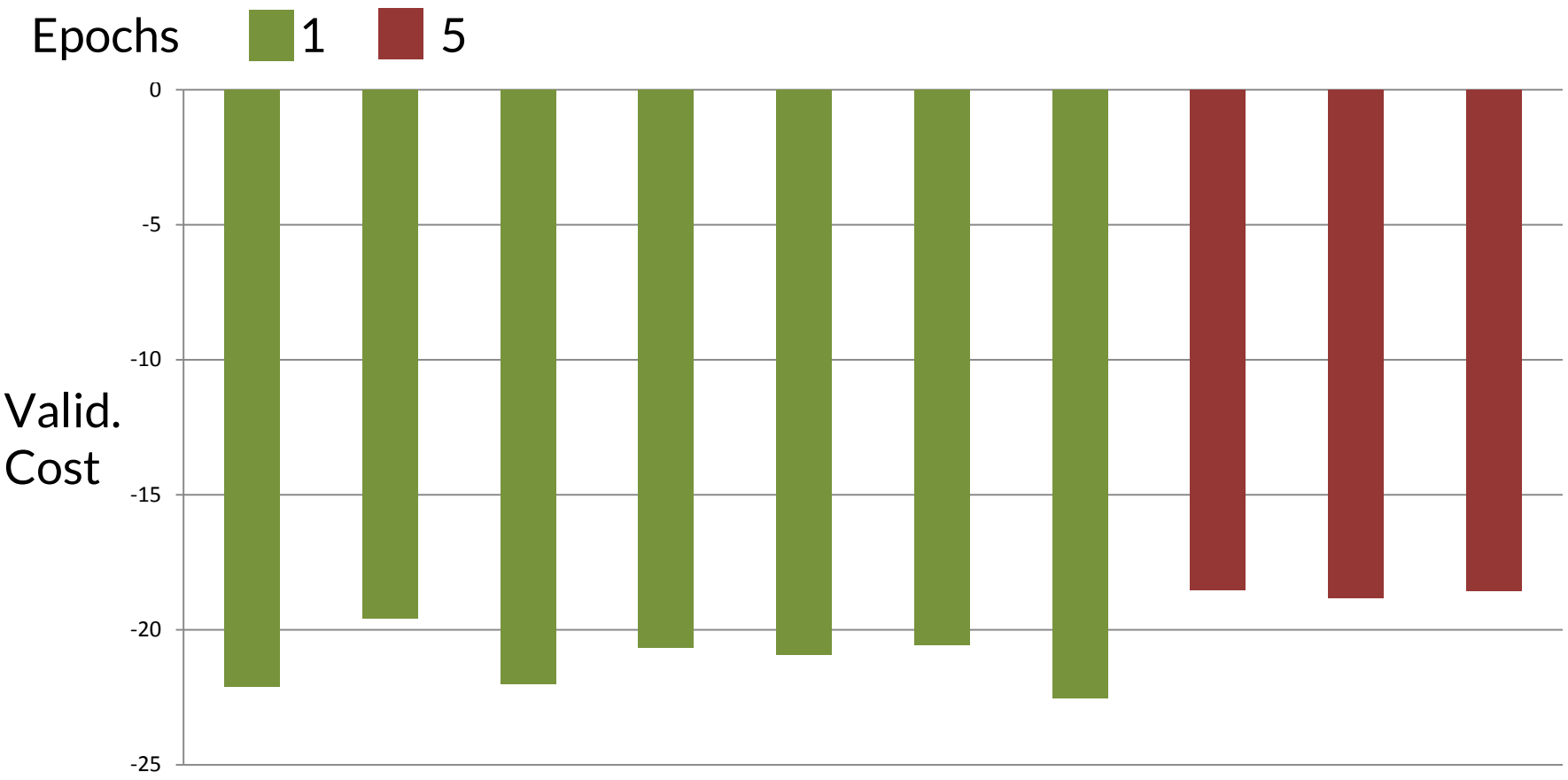
EXPERIMENT RESULTS RBM



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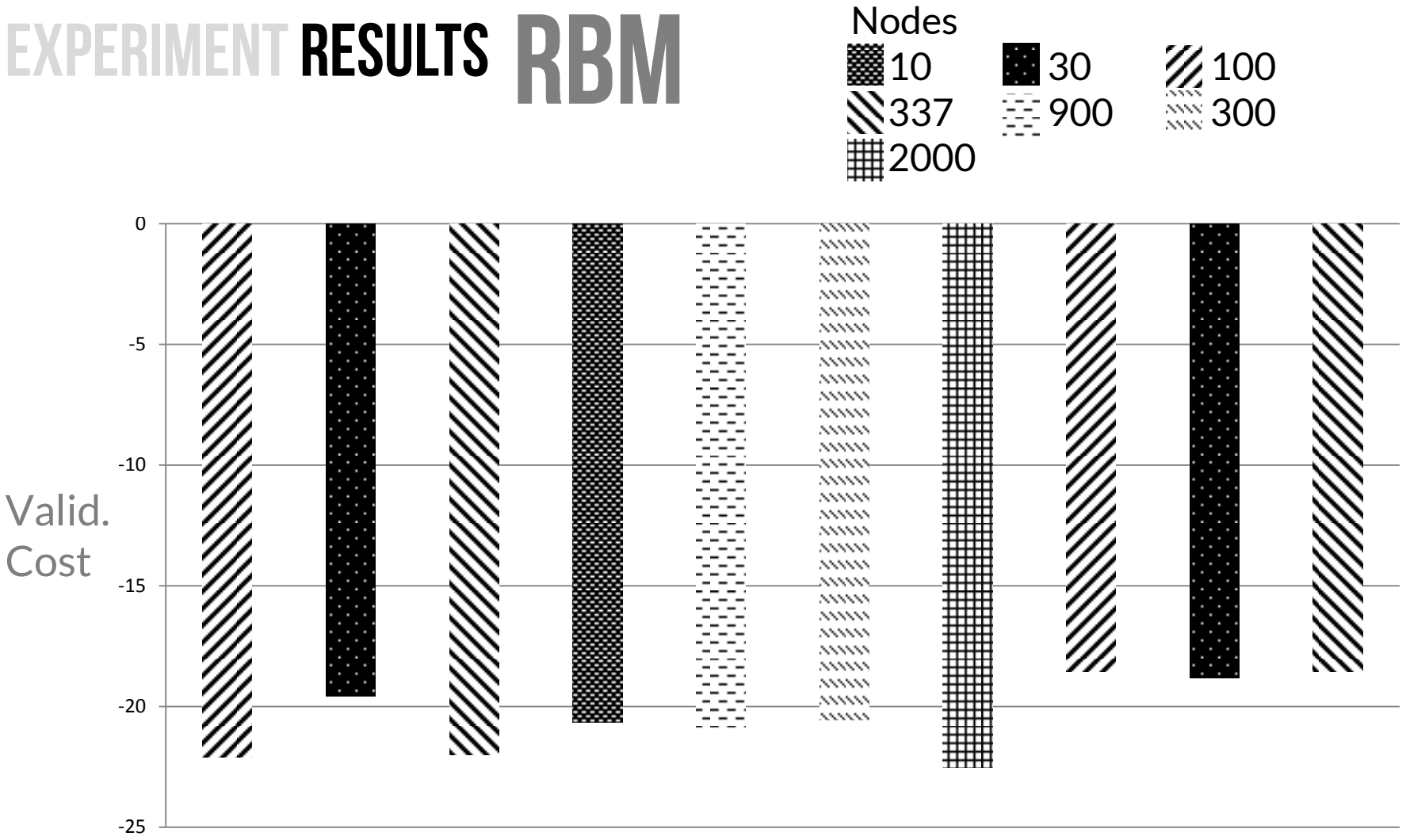

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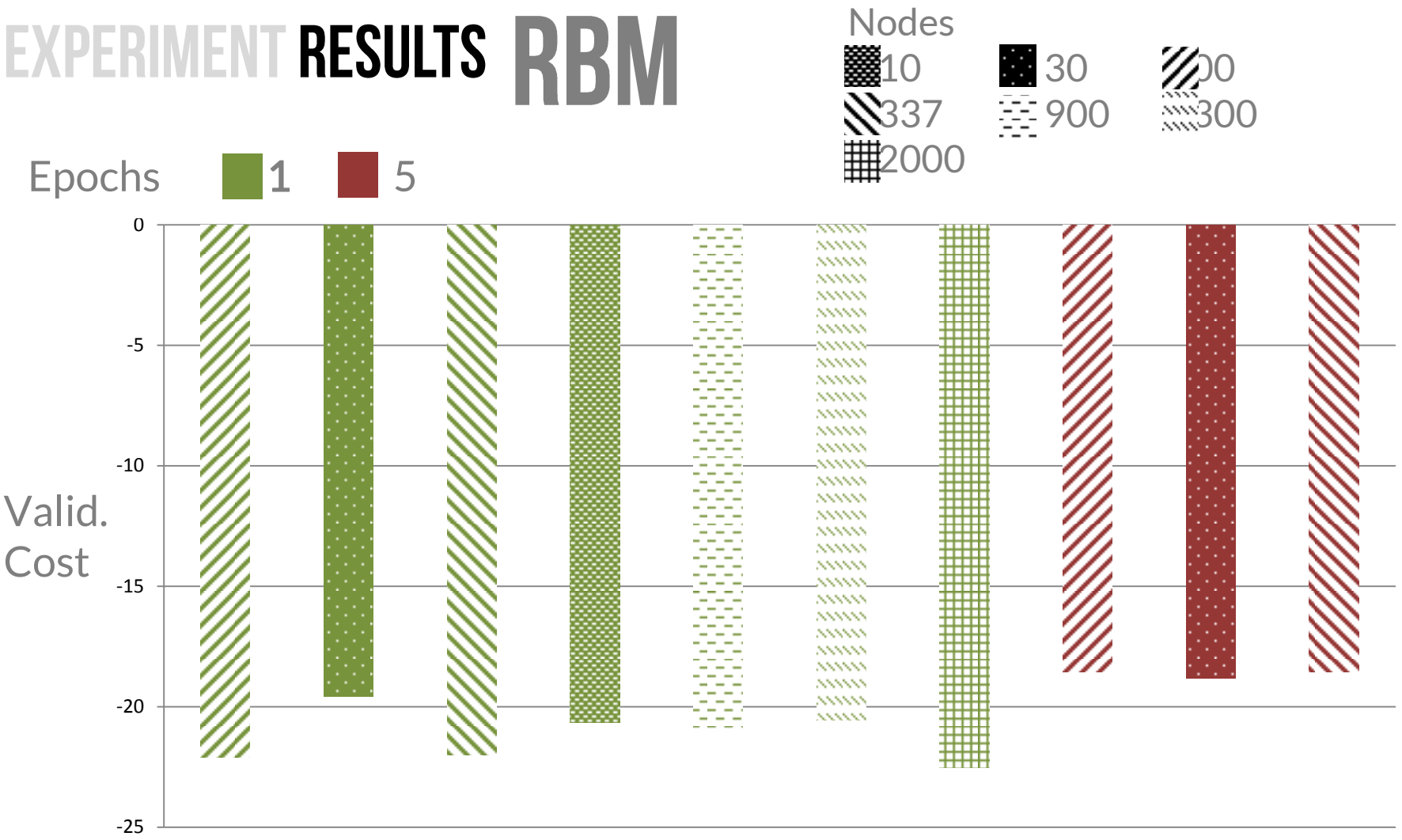

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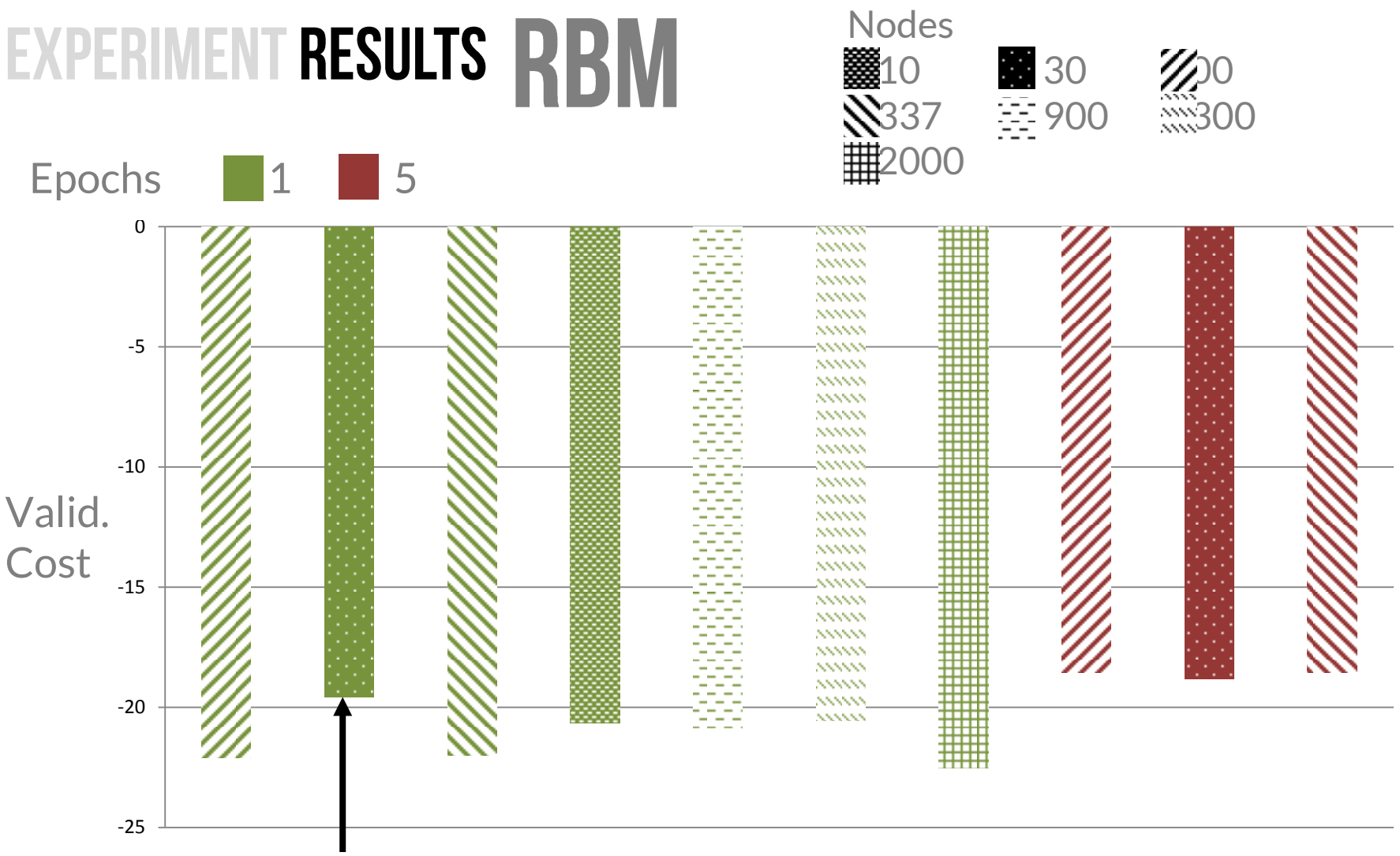

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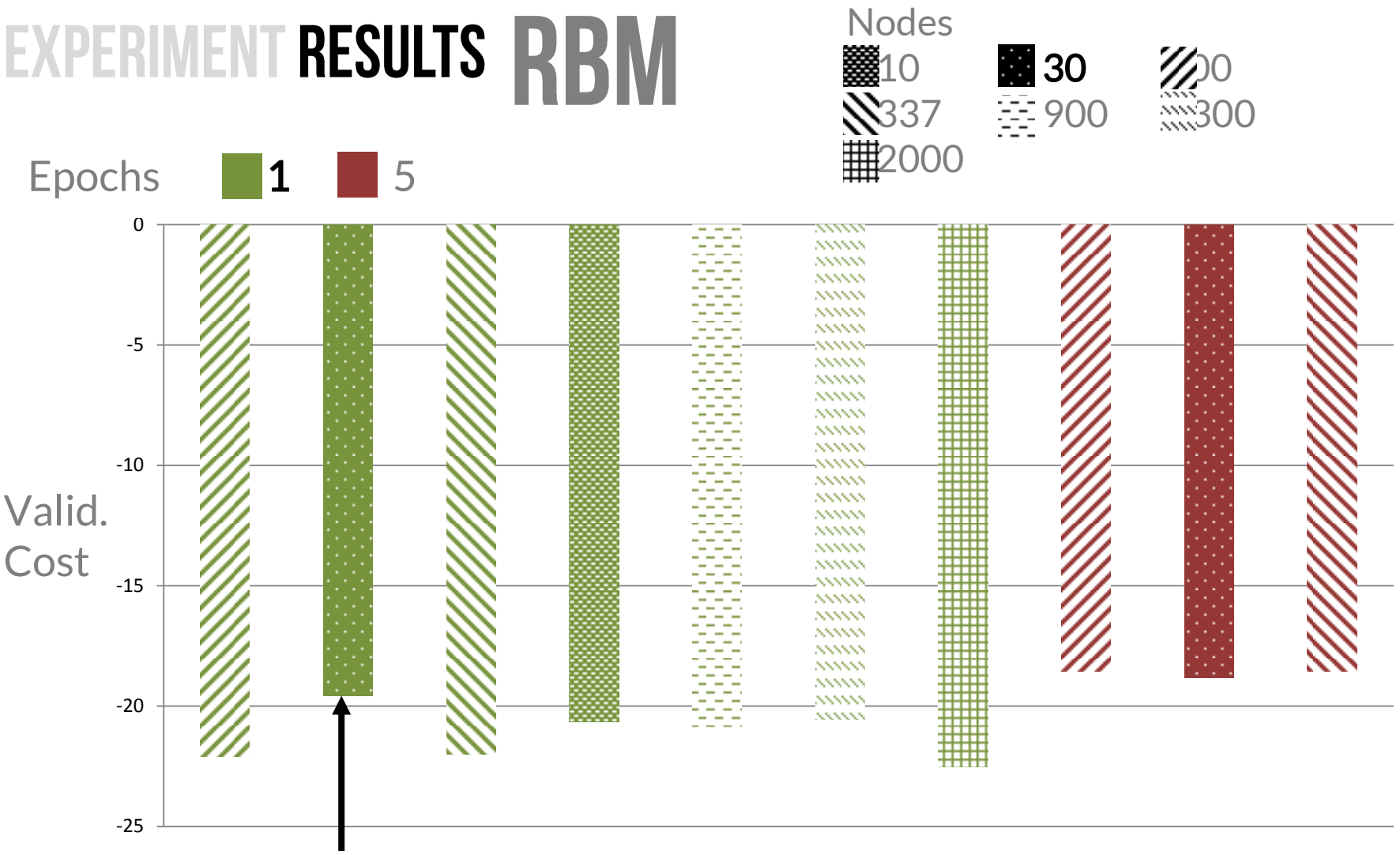

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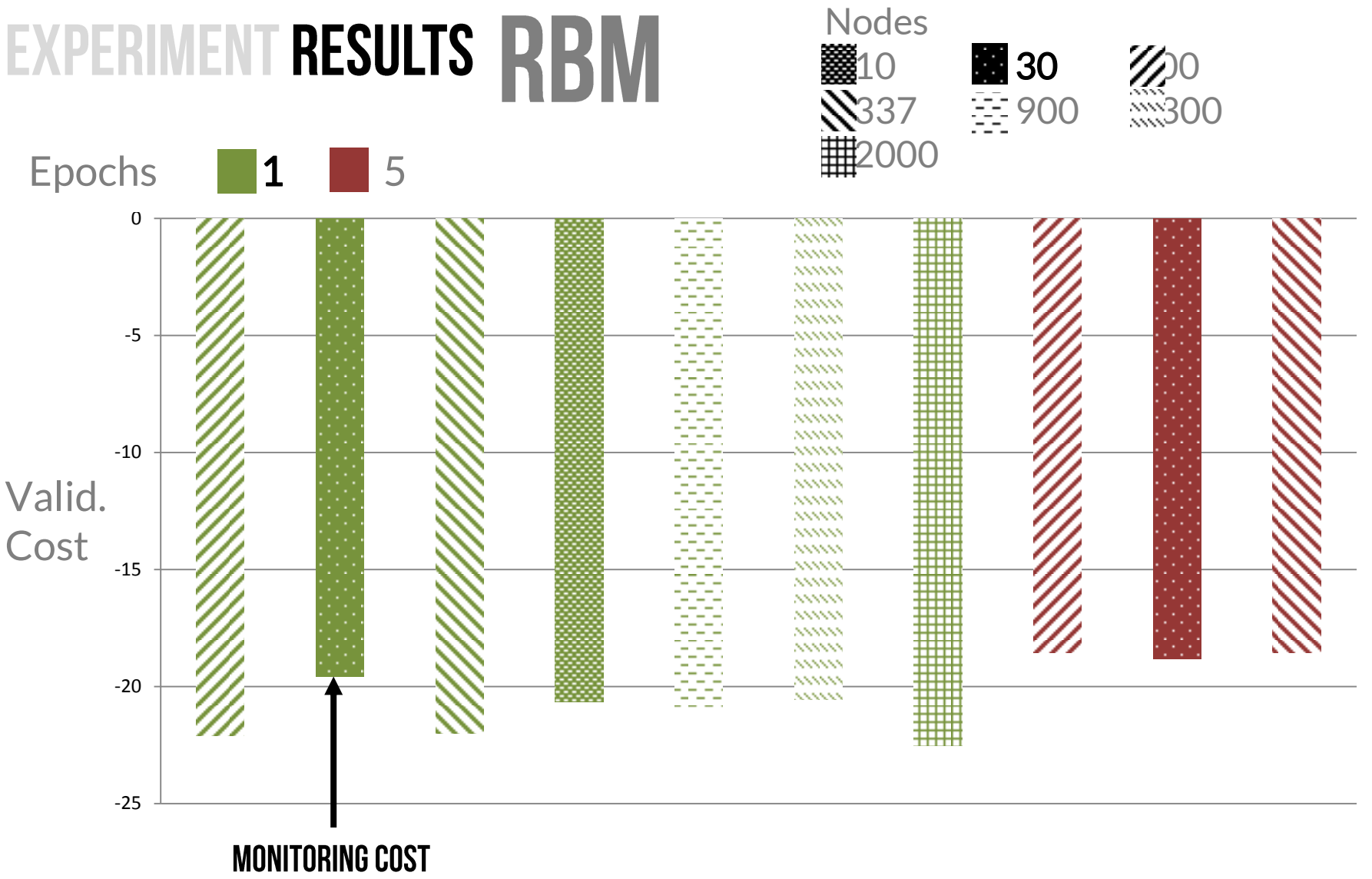
EXPERIMENT RESULTS RBM



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EXPERIMENT

MLP

To Choose:

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

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EXPERIMENT

MLP

To Choose:

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

The Grid:

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

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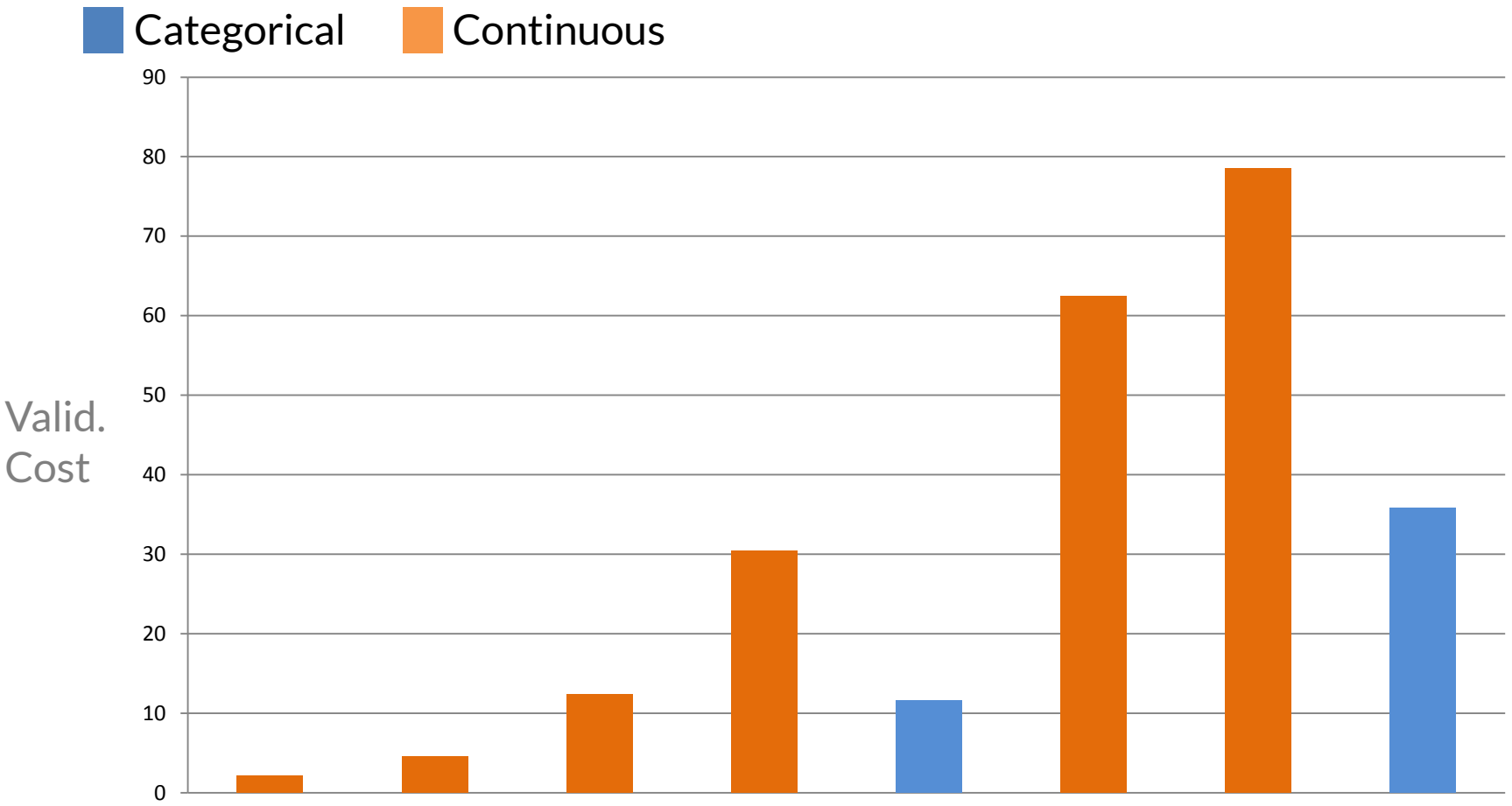
EXPERIMENT RESULTS MLP



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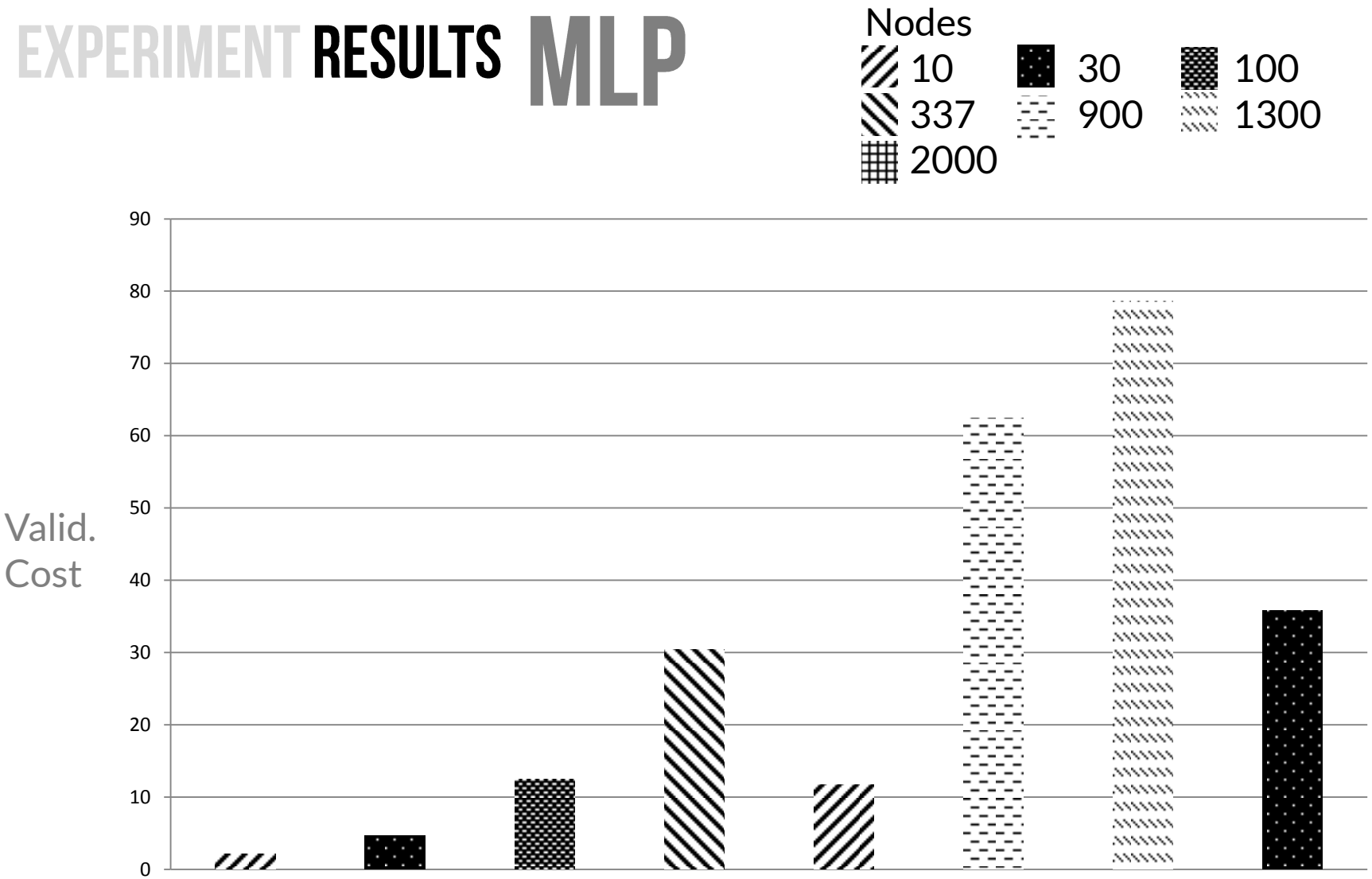
EXPERIMENT RESULTS MLP



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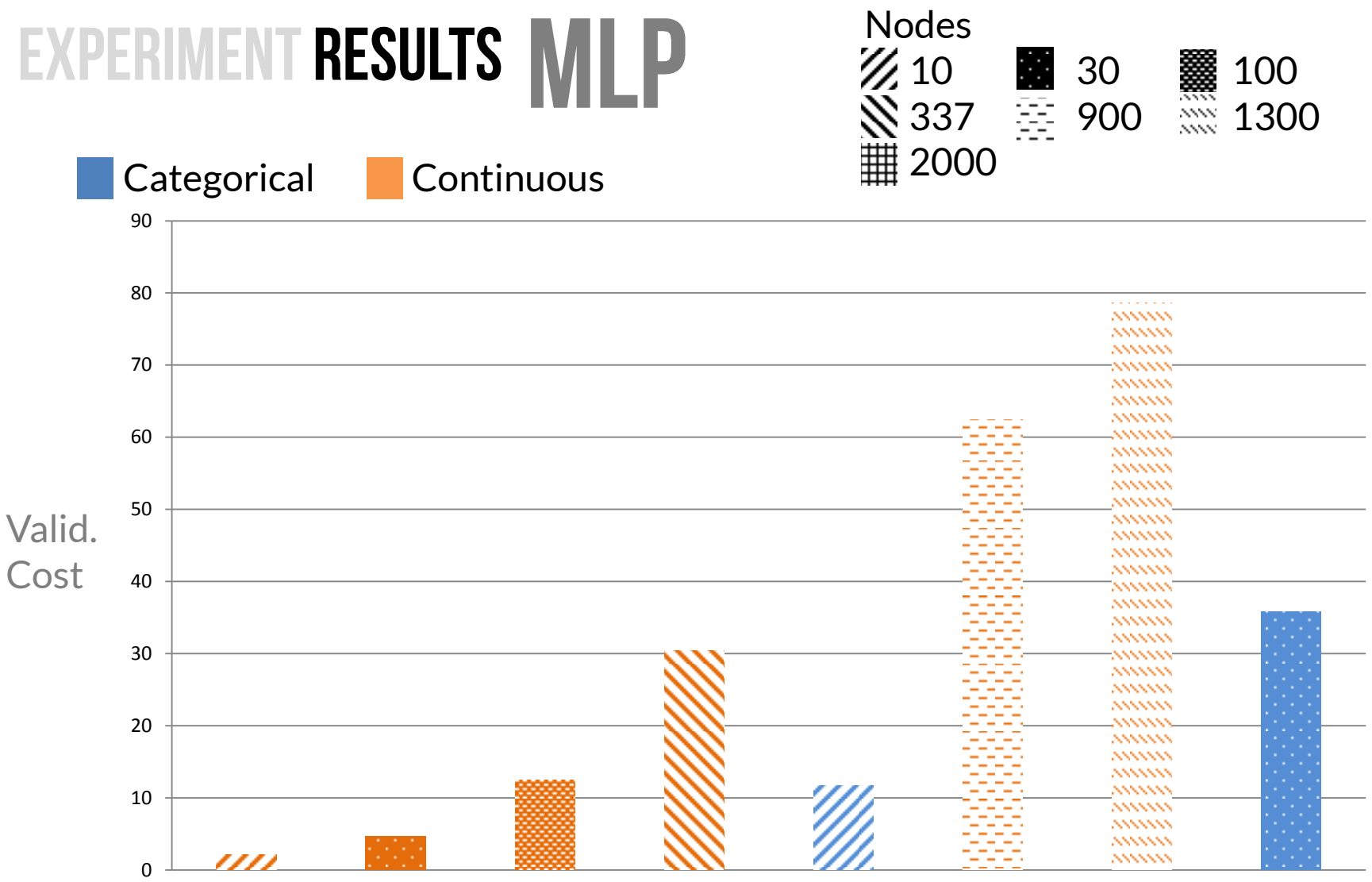
EXPERIMENT RESULTS MLP



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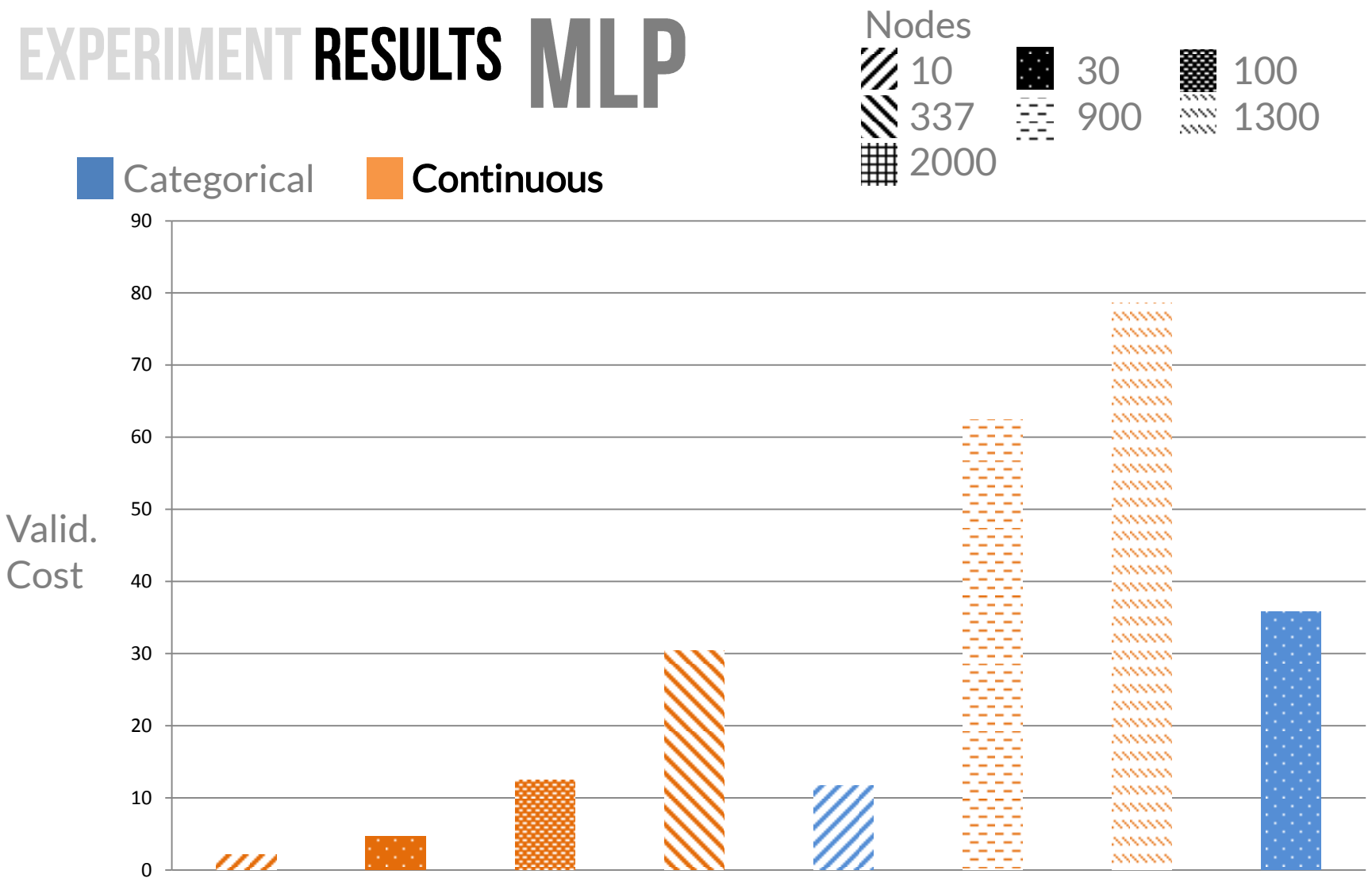
EXPERIMENT RESULTS MLP



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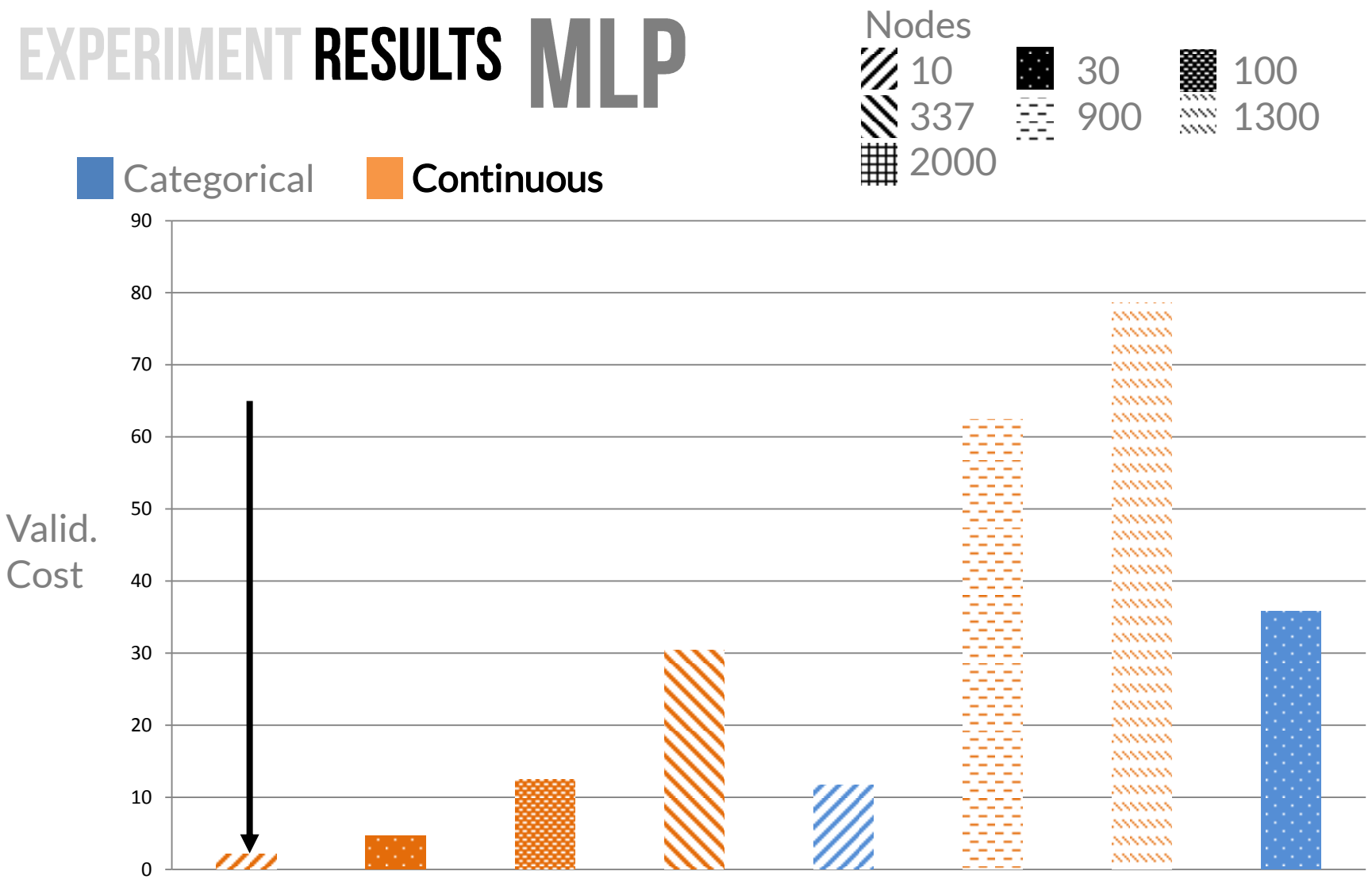
EXPERIMENT RESULTS MLP



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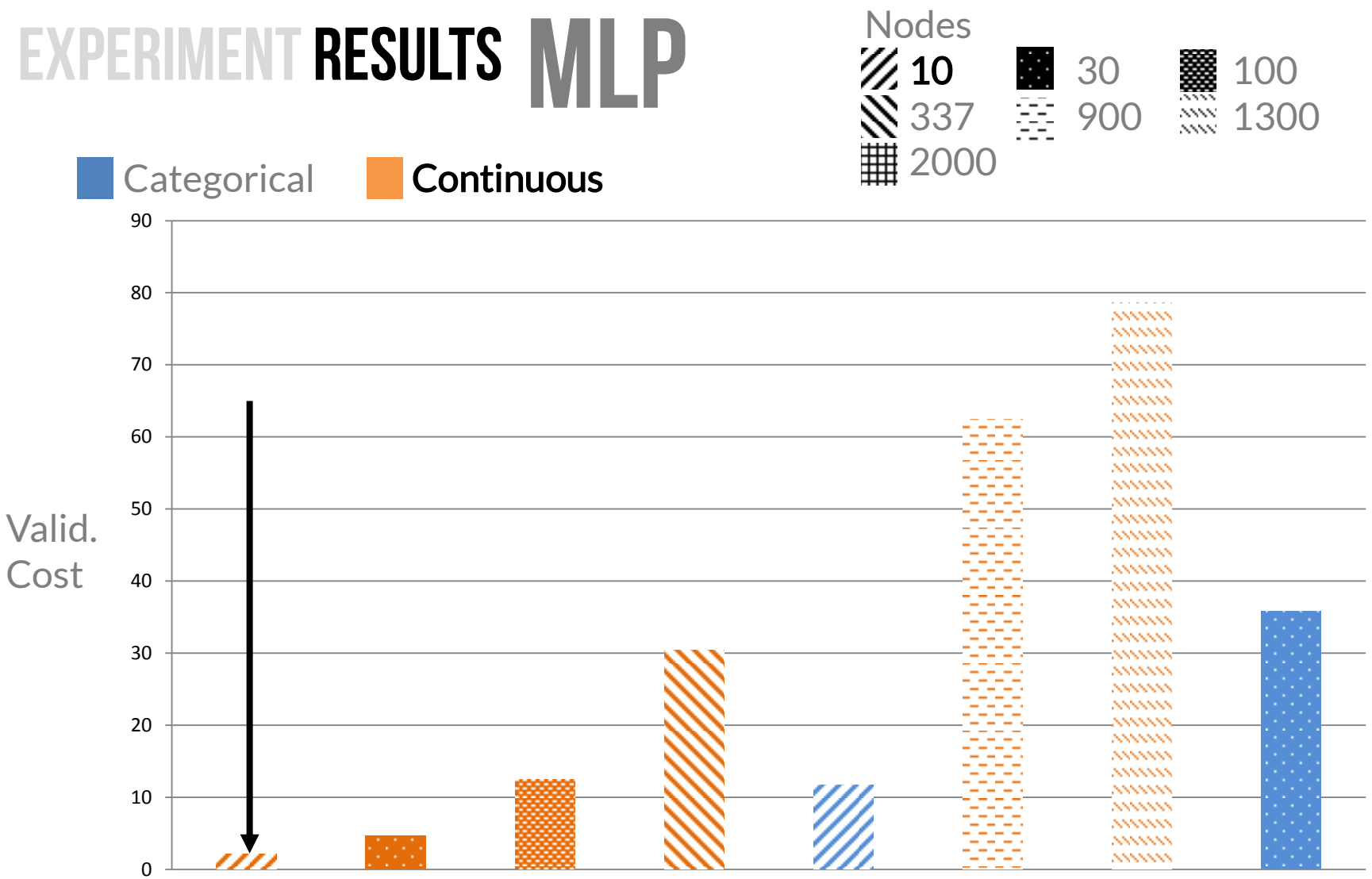
EXPERIMENT RESULTS MLP



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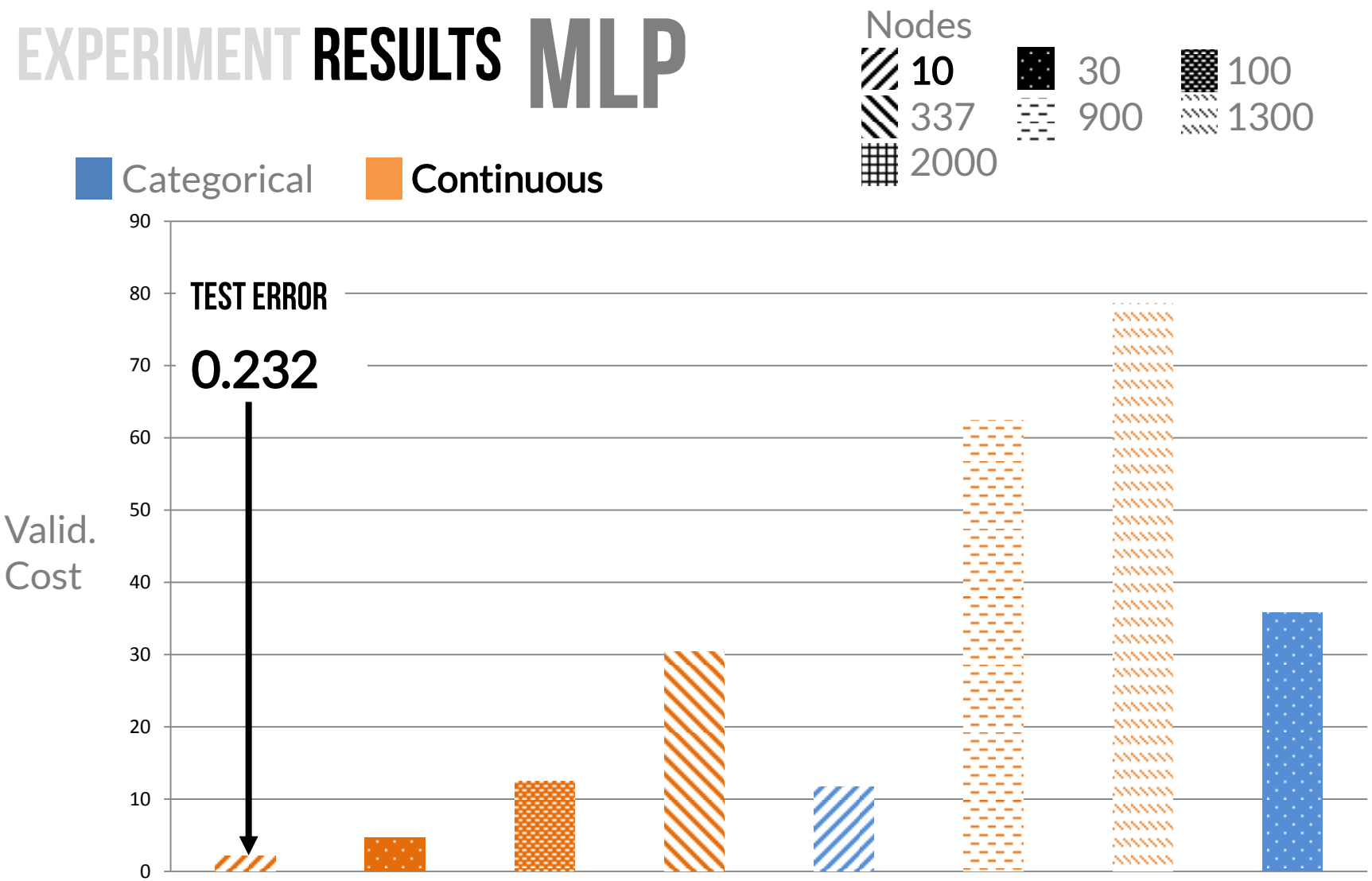
EXPERIMENT RESULTS MLP



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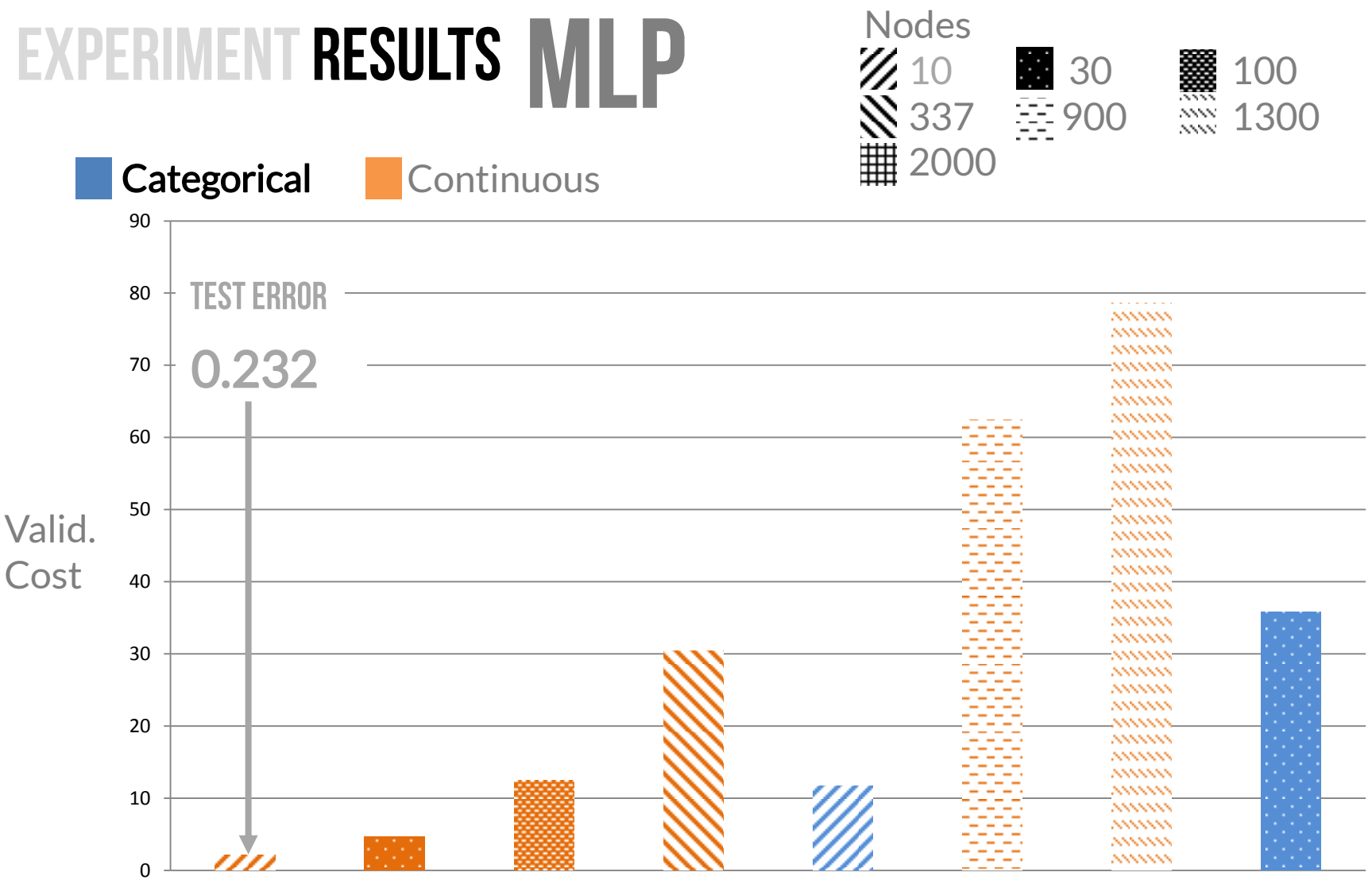
EXPERIMENT RESULTS MLP



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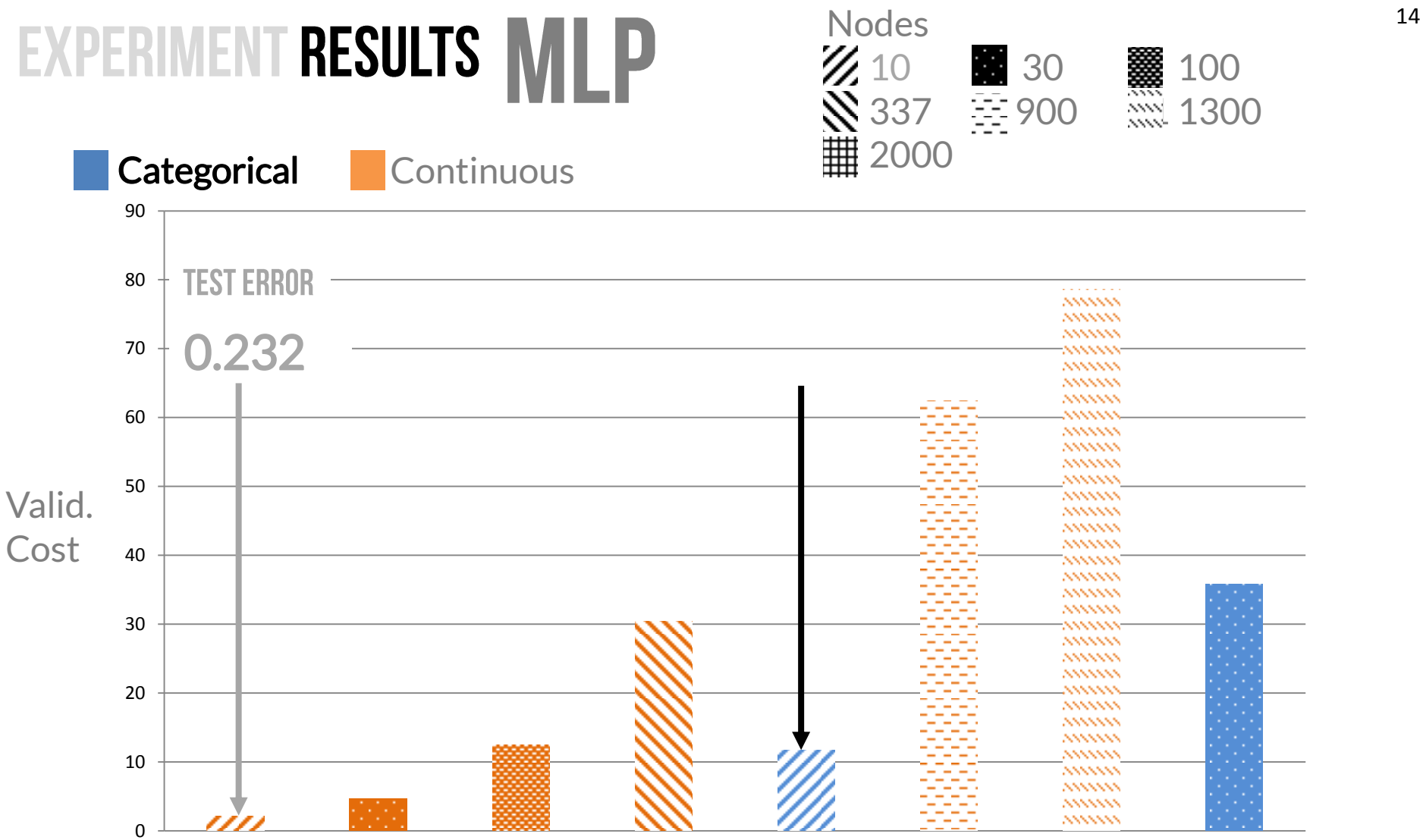

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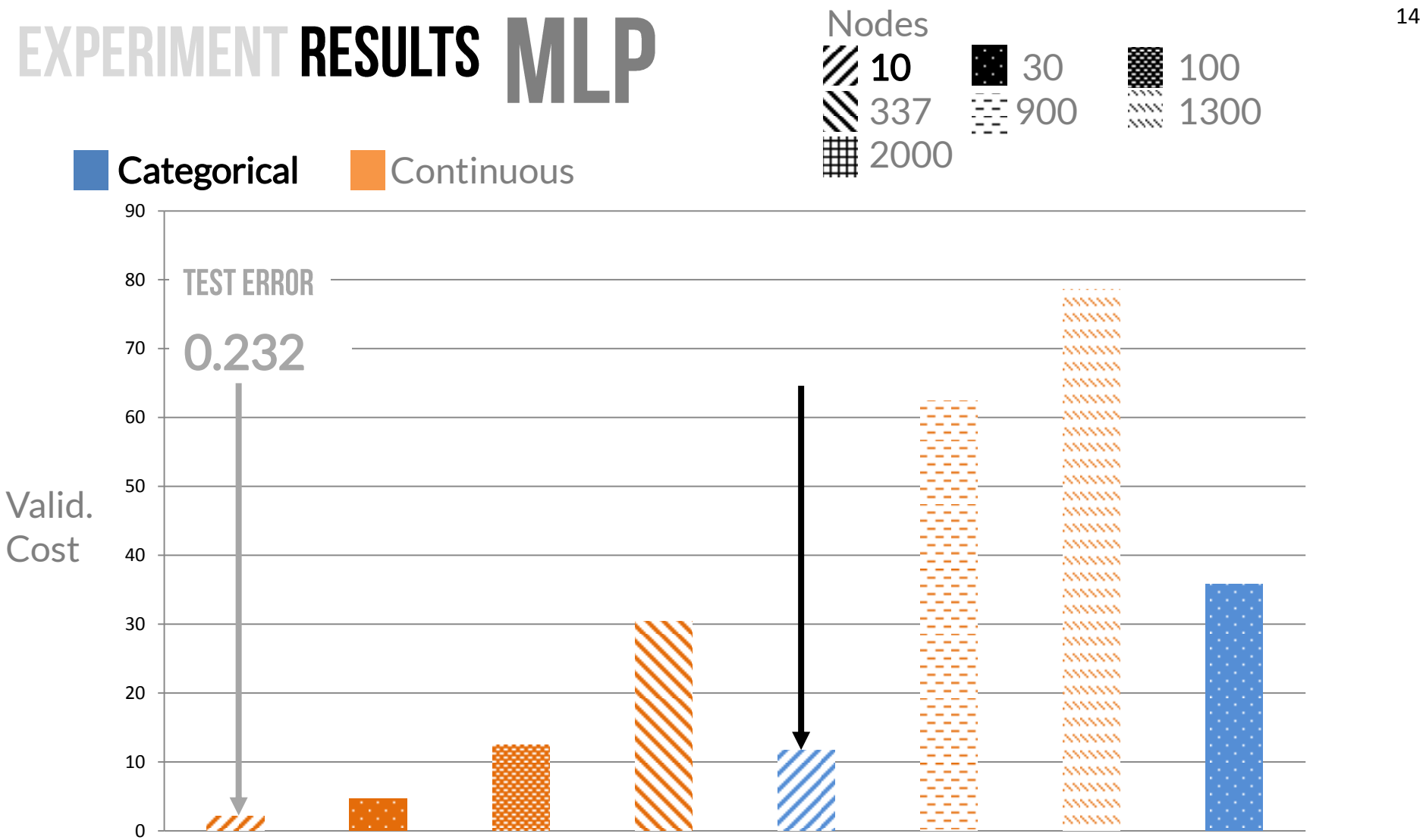
EXPERIMENT RESULTS MLP



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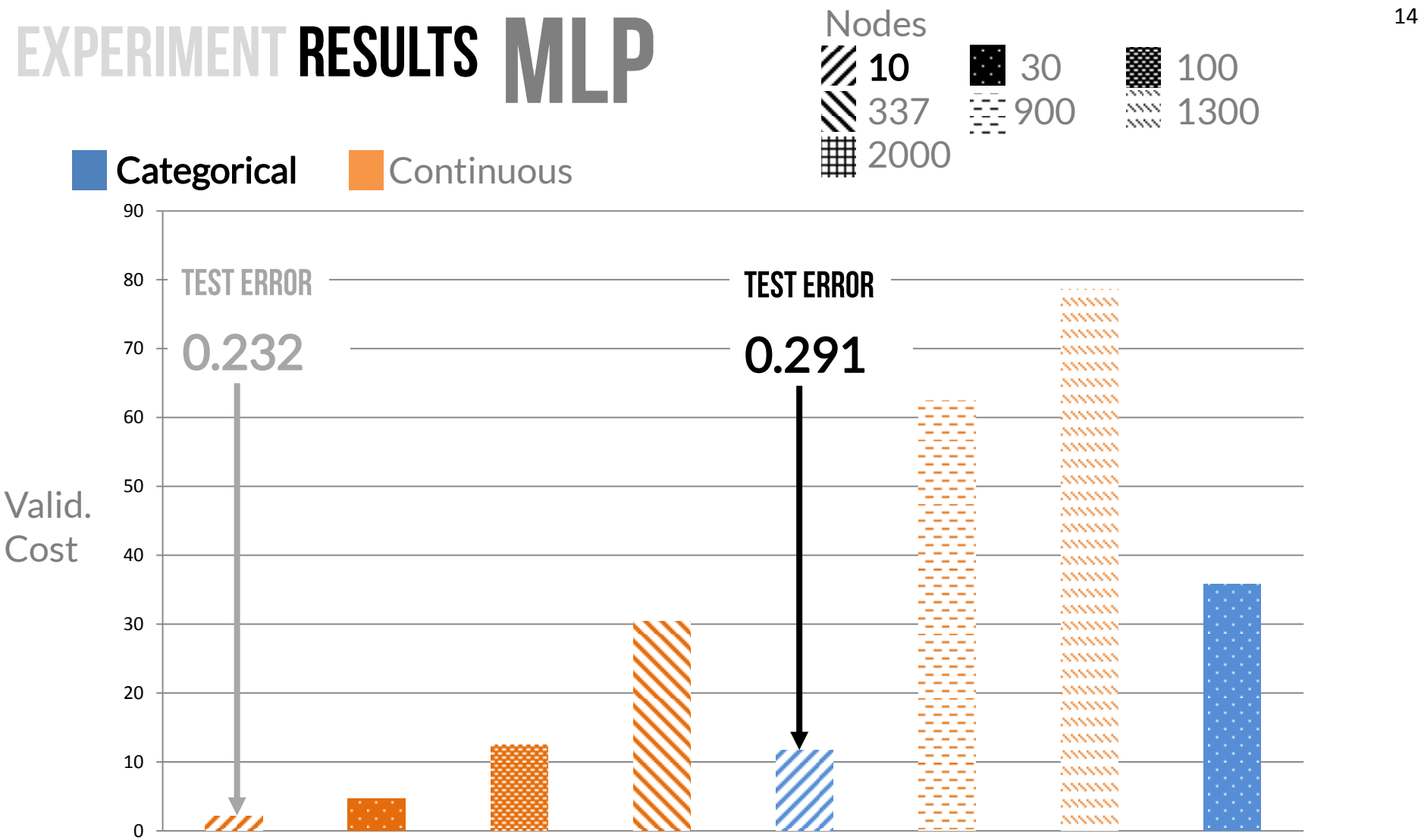
EXPERIMENT RESULTS MLP



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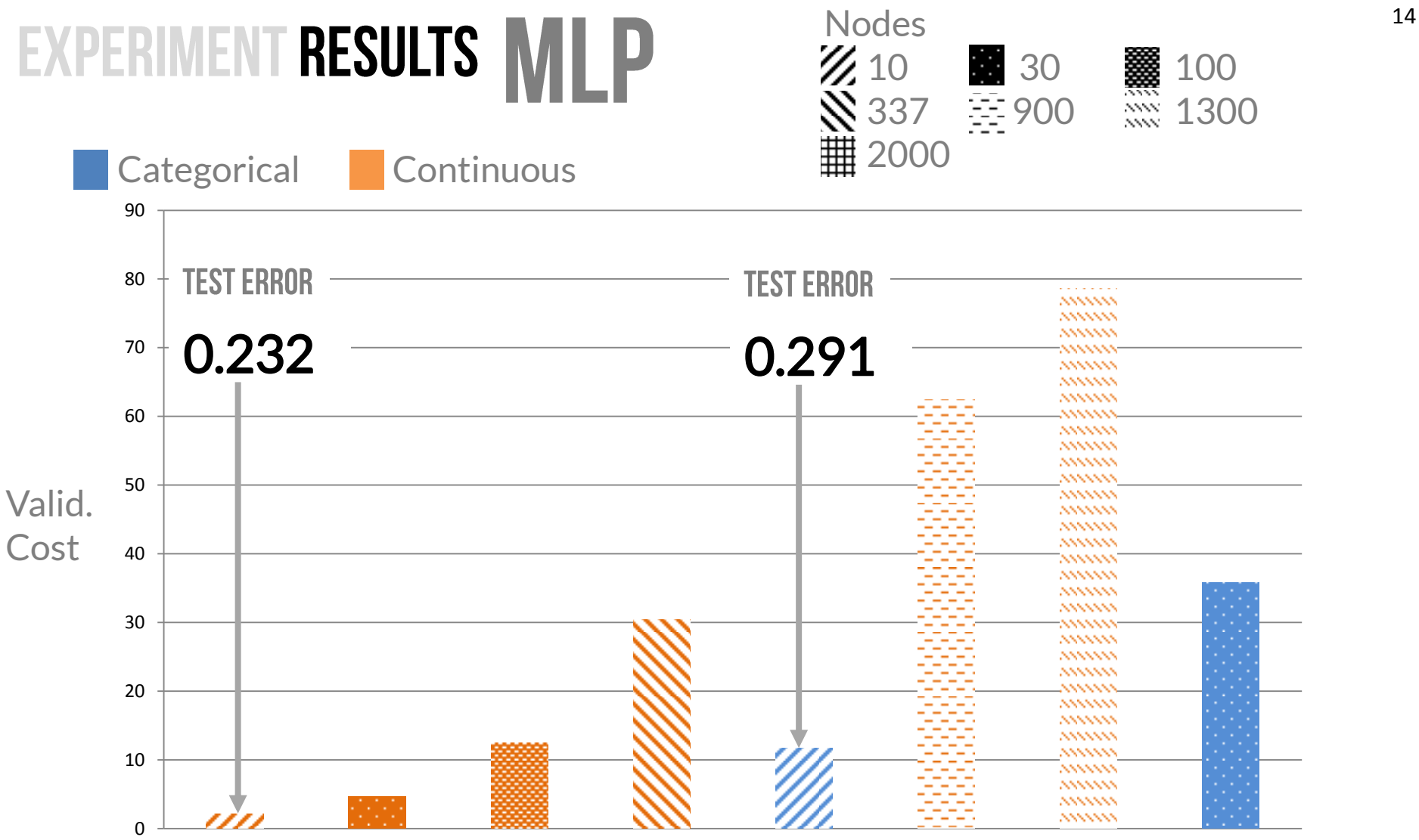
EXPERIMENT RESULTS MLP



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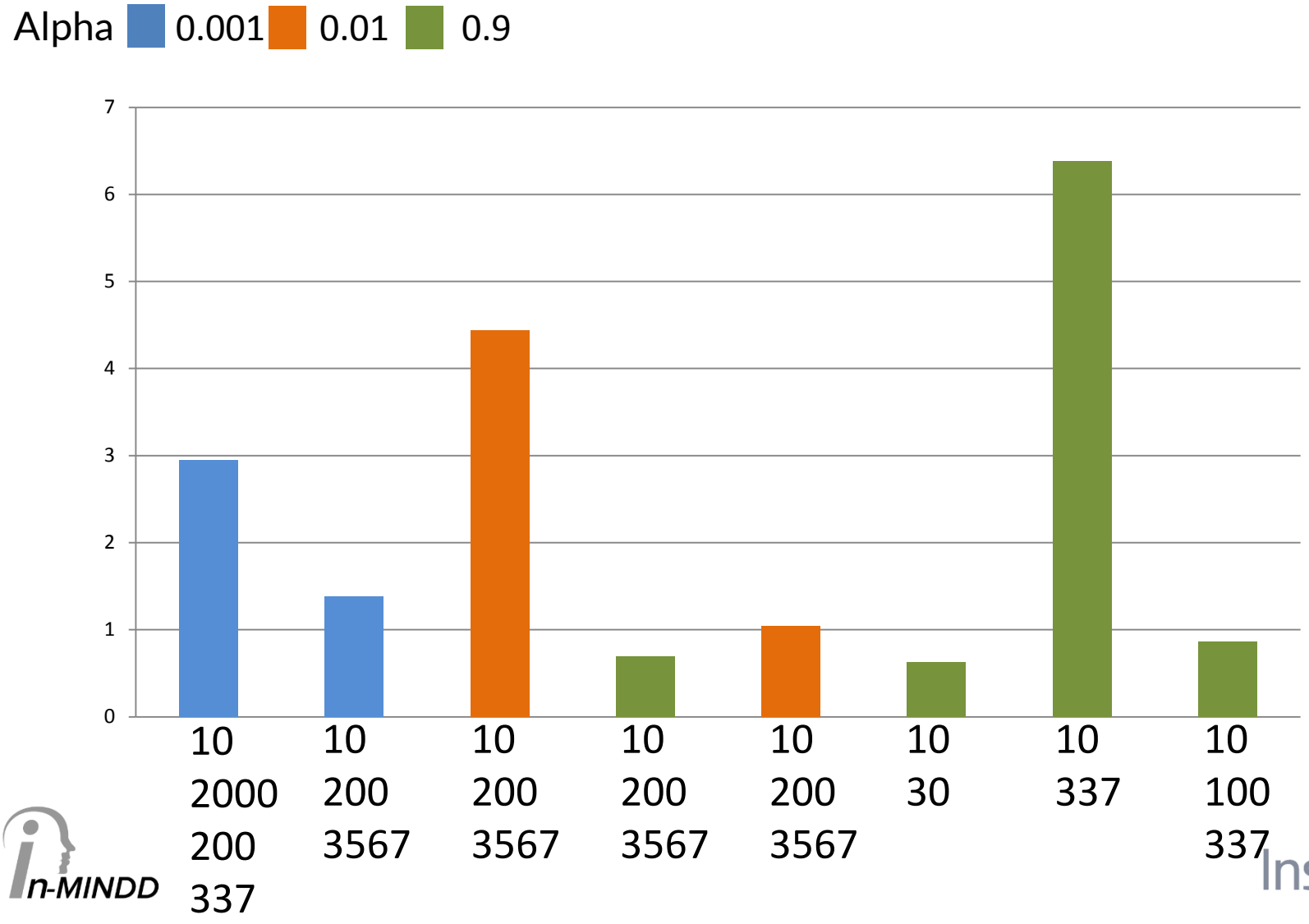
EXPERIMENT RESULTS DBN

Lambda @ 0.03



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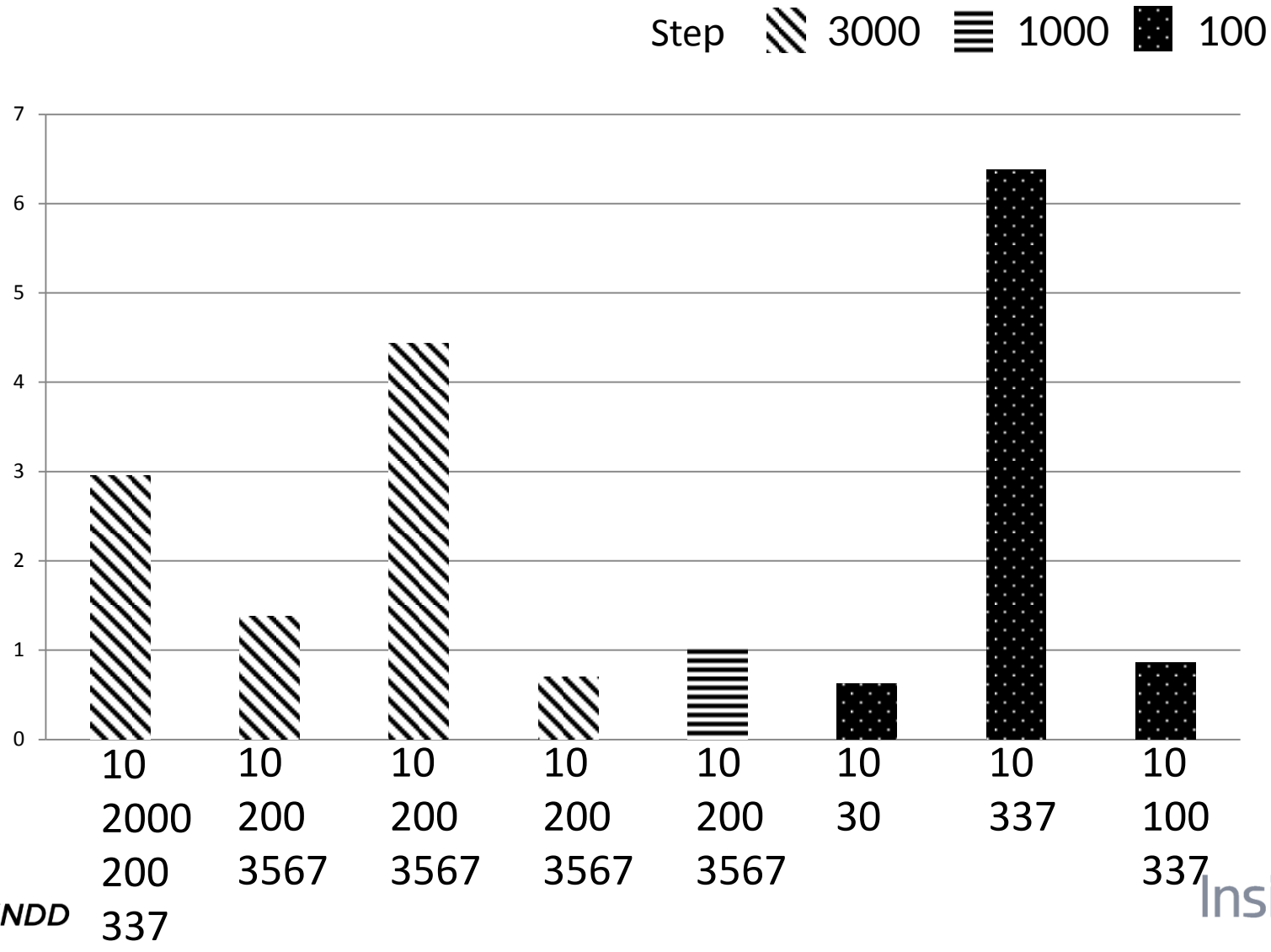
EXPERIMENT RESULTS DBN

Lambda @ 0.03



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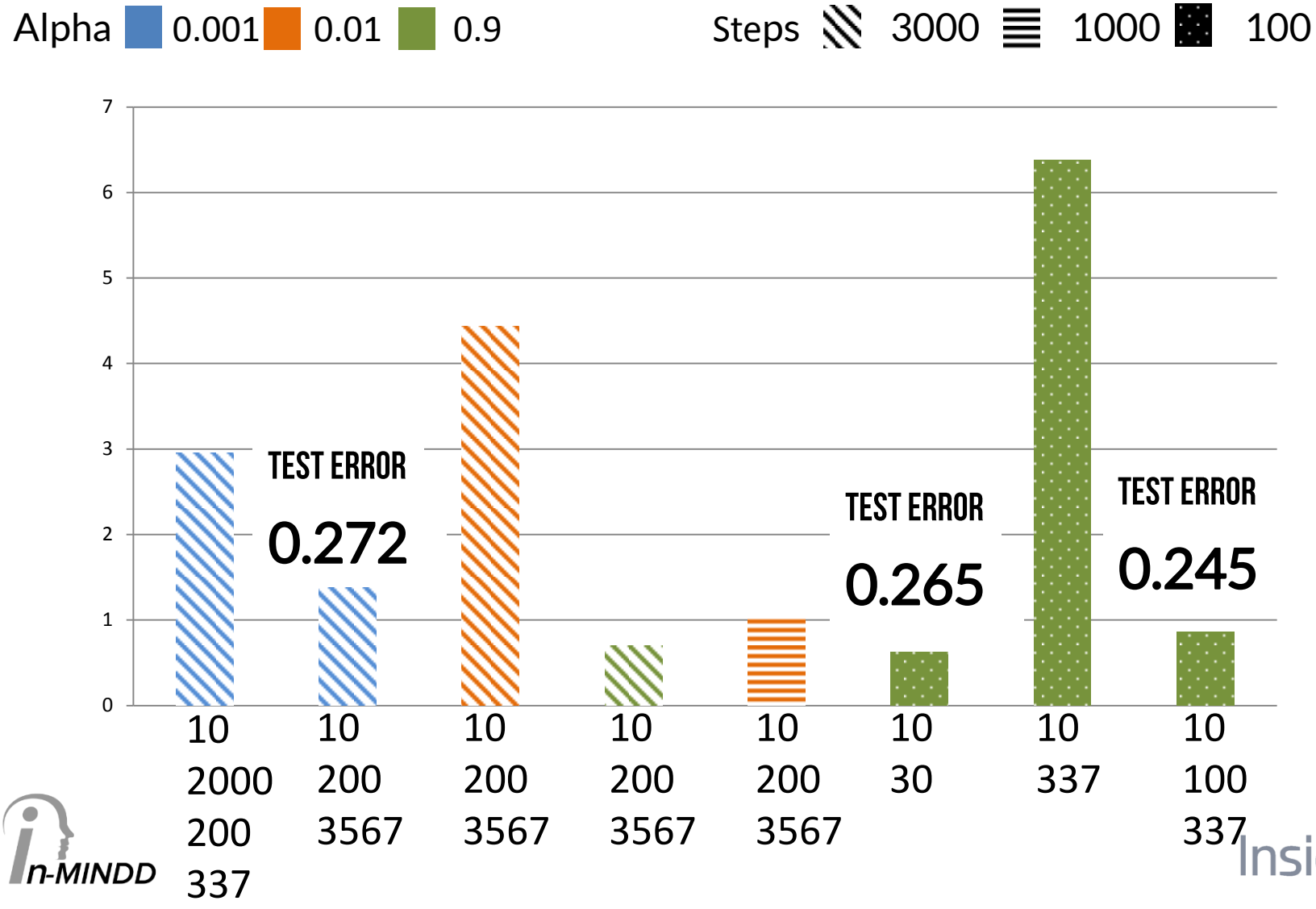
EXPERIMENT RESULTS DBN

Lambda @ 0.03



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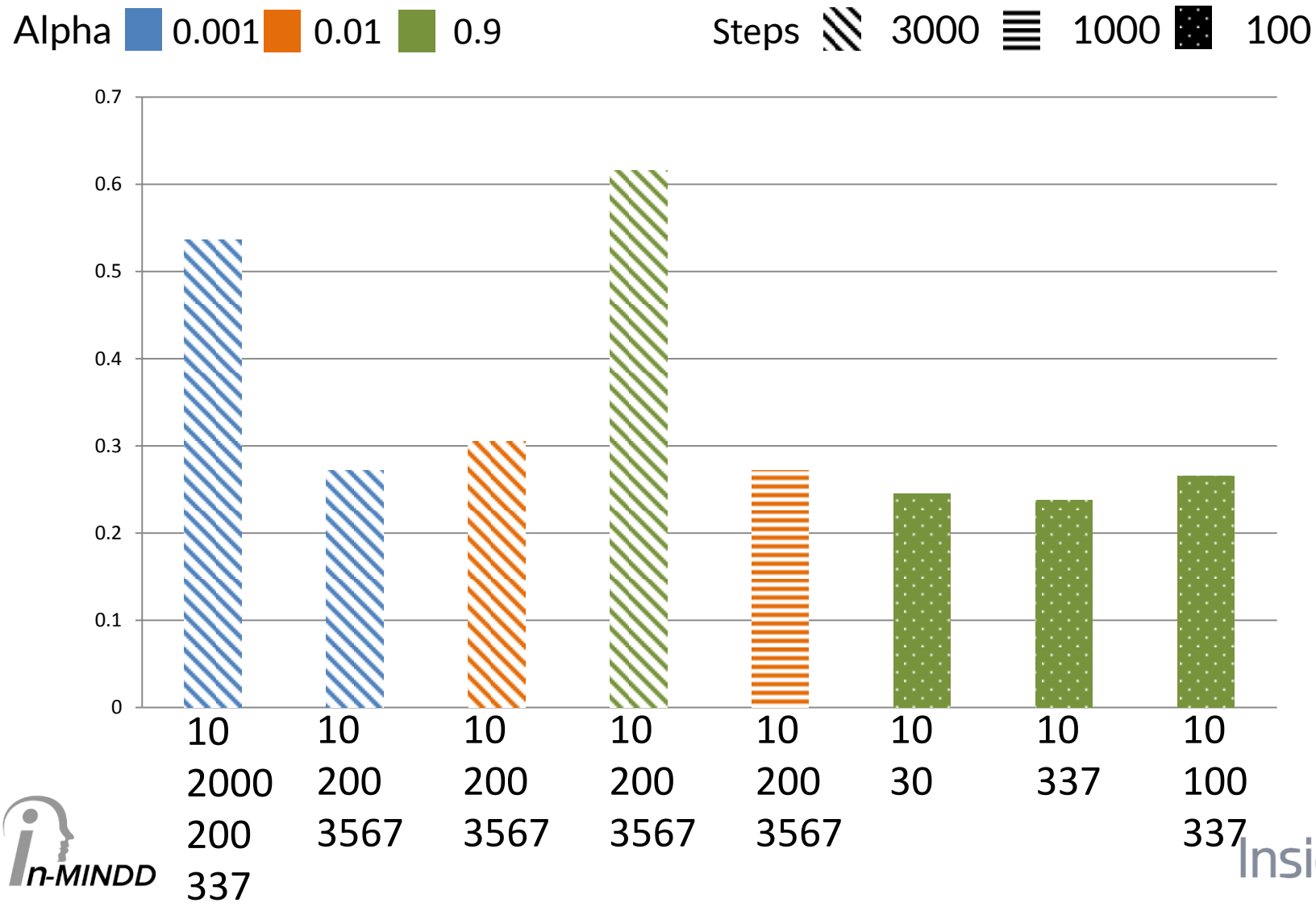
EXPERIMENT RESULTS DBN

Lambda @ 0.03



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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

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EXPERIMENTS CONCLUSIONS

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

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QUESTIONS?

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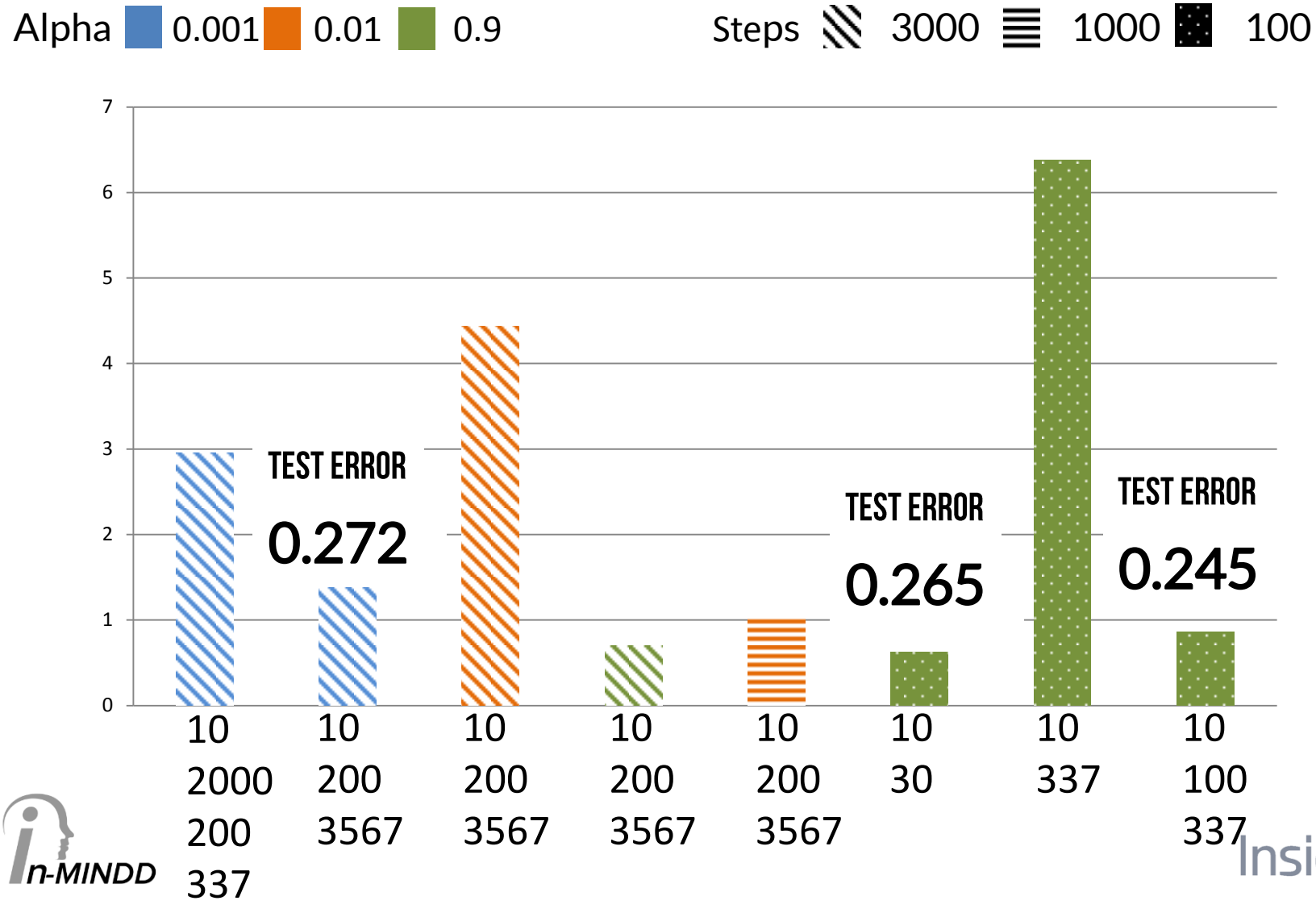
EXPERIMENT RESULTS DBN

Lambda @ 0.03



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