

# **Configuration Manual**

MSc Research Project Master of Science in Cloud Computing

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#### **MSc Project Submission Sheet**

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Lecturer:			
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# **Configuration Manual**

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## **1** Introduction

This manual provides detailed guidelines for setting up, executing, and evaluating experiments for benchmarking the performance of AWS EC2 and Azure VM platforms using TensorFlow for deep learning tasks. The evaluation focuses on the following metrics:

- CPU utilization
- Memory consumption
- Disk I/O performance
- Training time
- Cost efficiency
- Model accuracy

This study involves training the GoogleNet model on both platforms with identical configurations to ensure fair comparisons. The results of this study aim to aid researchers and practitioners in selecting the optimal platform for their machine learning workloads.

# 2 System Requirements

### 2.1 Hardware Requirements

- **CPU**: Minimum 8 cores
- Memory: At least 32 GB RAM
- Storage: High-throughput SSD storage
- **Internet**: High-speed connection for accessing cloud platforms

#### 2.2 Software Requirements

- **Operating System**: Windows Server 2022 or equivalent
- Programming Language: Python 3.9 or higher
- **Deep Learning Framework**: TensorFlow 2.12
- Monitoring Tools: AWS CloudWatch and Azure Monitor

• Version Control: Git for tracking code changes

#### 2.3 Dataset

- Dataset Name: Stanford University Elbow X-ray Dataset
- Dataset Size: Approximately 4300 images
- **Task:** Binary classification (Positive/Negative)

#### 2.4 Preprocessing Techniques:

- Image Resizing: Convert images to 224x224 pixels using OpenCV.
- Normalization: Scale pixel values to the range [0, 1].
- Augmentation: Apply rotation, zoom, shear, and flips using TensorFlow's ImageDataGenerator.

## 3. Cloud Platform Setup

### 3.1 AWS EC2 Setup

1. First create an AWS account and sign in to the AWS Console and go to the EC2 Dashboard to create a EC2 first click on launch instance as shown in the figure.



Figure 1: EC2 Dashboard to launch instance.

2. Launch an Ec2 instance with the following

- a. Instance Type: t3.2xlarge
- b. Operating System: Windows\_Server-2022-English-Full-Base
- c. Attached Storage: Elastic Block Store (EBS)
- 3. Create a new key pair with the following options as shown in the figure and save the private key to establish the connection to your instance once the instance is created.

xrayelbow	
he name can include up to 255 ASCII characters	. It can't include leading or trailing spaces.
Key pair type	
• RSA RSA encrypted private and public key pair	C ED25519 ED25519 encrypted private and public key pair
Private key file format	
.pem For use with OpenSSH	
<ul> <li>.ppk</li> <li>For use with PuTTY</li> </ul>	
	ey in a secure and accessible location on er to connect to your instance. Learn

Figure 2: Key pair creation options.

- 4. Once all this is completed click on launch instance for the instance to be created.
- 5. Configure Monitoring:
  - a. Enable AWS CloudWatch.
  - b. Create custom alarms for CPU utilization >90%.
- 6. Next install the required software in EC2 instance to train our model
- Python Setup:
  - Python 3.9 was installed on AWS instance using the following terminal command:
  - py --version
  - The necessary libraries were installed using pip:
  - o py -m pip install tensorflow opency-python scikit-learn matplotlib seaborn
- TensorFlow Setup:
  - py -m pip install tensorflow==2.12.0

• To verify TensorFlow installation, the following code was run in the Python shell: print("TensorFlow version:", tf.\_\_version\_\_)

### 3.2 Azure VM Setup

1. First create an Azure account and sign in to the Azure Console and go to the VM Dashboard to create a VM click on create a new VM option as shown in the figure.

Home >							
Virtual machines ☆ … Default Directory (2412himashreemsgmail.onmicrosoft.com)							
$+$ Create $\lor$ $\rightleftharpoons$ Switch	to classic 🕓 Re	eservations $\checkmark$	🐯 Manage view	$\sim$			
Filter for any field	Subscription e	quals <b>all</b>	Type equals <b>all</b>				
Chouing 1 to 1 of 1 records							

Figure3: VM Console to create new VM rd D8 v3 Virtual Machine:

- 2. Create a Standard\_D8\_v3 Virtual Machine:
  - a. vCPUs: 8
  - b. Memory: 32 GB
  - c. Operating System: 2022-datacenter-azure-edition
- 3. Attach Premium SSD LRS for data storage.

When creating the VM choose the following options s shown in figure and create a new resource group as well Once this is done create the username and password to connect to the vm as well in the same console.

Help me create a low cost VM	Help me create a VM optimized for high availability Help me choose the right VM size	
Project details		
Select the subscription to manage deplo your resources.	oyed resources and costs. Use resource groups like folders to organize and manage all	
Subscription *	Azure subscription 1 V	
Resource group * ()	(New) Resource group	
	Create new	
Instance details		
	A resource group is a container that holds related resources for an Azure solution.	
Virtual machine name * 🛈		
Region * 💿	Name *	
Availability options ()	ML	
Ananability options	OK Cancel	
Zone options ③	Choose up to 3 availability zones, one VM per zone	
	Choose up to 5 availability zones, one vivi per zone	
Project details		
Select the subscription to manage deploy	yed resources and costs. Use resource groups like folders to organize and manage all	
your resources.		
Subscription * ()	Azure subscription 1	
Resource group * 🕕	(New) FinalThesis_group	
	Create new	
Instance details		
Virtual machine name * ③	FinalThesis 🗸	
Region * 🕕	(US) West US 2 V	
Availability options 🕕	Availability zone	
	Self-selected zone	
Zone options ①	Choose up to 3 availability zones, one VM per zone	
	<ul> <li>Azure-selected zone (Preview)</li> </ul>	
	Let Azure assign the best zone for your needs	
Availability zone * 💿	Zone 3	
Availability zone - 🕓	You can now select multiple zones. Selecting multiple zones will create one VM	
	per zone. Learn more C*	
Security type 💿	Trusted launch virtual machines	
	Configure security features	
Image * 🕕	Windows Server 2022 Datacenter: Azure Edition - x64 Gen2  See all images   Configure VM generation	
VM architecture ①	() Arm64	
	● x64	
	Arm64 is not supported with the selected image.	
Run with Azure Spot discount 🕕		
size * 💿	Standard_D8s_v3 - 8 vcpus, 32 GiB memory (US\$548.96/month) ①	
	See all sizes	

Figure 4: New VM creation options

- 4. Install Software:
  - a. Python 3.9 and TensorFlow using pip through "pip install tensorflow" command
- 5. Configure Monitoring:
  - a. Use Azure Monitor for tracking metrics.
  - b. Set up alerts for high CPU utilization.

### 4. Model Training

1. The dataset for this project is uploaded in the following link http://surl.li/mfafyp You can download this and keep it in your local.

- 2. Once the required software is installed in both Azure and AWS Copy the dataset from your local and paste it in the directories of the respective platforms.
- 3. Once all the dependencies are all installed Run the model.py python file to train the model The code created is based on the googlenet algorithm.

### 5. Monitoring During Training

- 1. Create own Custom Dashboards in both AWS CloudWatch and Azure Monitor
- 2. Use AWS CloudWatch to track CPU utilization, memory usage, and disk read write operations.
- 3. Use Azure Monitor to log similar metrics.
- 4. Configure alerts for resource thresholds (e.g., CPU >90%).

CloudWatch > EC2		
EC2 🏠 Cross account unavailable		1h 3h 12h 1d 1w Custom 🗊 🖸 🔻 💈
EC2  Filter by resource group	(info	Actions V Add to dashboard
▲ In alarm (0) ○ ○ Insufficient data (0) ○ ○ OK (0)		
CPU Utilization: Average	DiskReadBytes: Average         I           bytes         1           0.5         0           13.00         13.30         14.00         14.30         15.00         15.30           0.6x36x0737z82c843         0.6x36x0737z82c843         0.5x36x0735x845x00         0.5x36x0735x845x00	DiskReadOps: Average Count 1 0.5 0 13:00 13:30 14:00 14:30 15:00 15:3
DiskWriteBytes: Average bytes 1 0.5 1 1.500 15:30 14:00 14:30 15:00 15:30 0-04a5ea0757x82463d 0-04a5ea0220408284 (mx-floxd9-observabilityworkshop-73d48356735a4 0-07e498:ts8e8c5aaf4	DiskWriteOps: Average         E           Count         1         0.5         0         1         0.5         0         1         0.5         0         1         0.5         0         1         0.5         0         1         0.5         0         1         0.5         0         1         5.00         15.30         15.30         15.30         15.30         15.30         0         15.30         0         0.57/35/26/35/25         0         0         1         0.57/35/26/35/25 (a)         0         0         1         0         1         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0         0         0         0 <td>Networkin: Average Bytes 1.684 552 2.5% 1.300 15.30 14:00 14:30 15:00 15:30 6.064540075736246535 (ans.cloud9-observabilityworkshop-7364835673564b709 6.07694865ebec5aal4</td>	Networkin: Average Bytes 1.684 552 2.5% 1.300 15.30 14:00 14:30 15:00 15:30 6.064540075736246535 (ans.cloud9-observabilityworkshop-7364835673564b709 6.07694865ebec5aal4
NetworkOut: Average Bytes 441M 2.21M 17.2k 15.00 15.30 14.00 14.30 15.00 15.30 0-boaster/35/28/265d 0-boaster/35/28/265d 0-boaster/35/28/265d 0-boaster/35/28/265d	NetworkPacketsIn: Average         E           Count	NetworkPacketsOut: Average Count 4.206 2.144 7.56 1.300 1.300 1.300 1.300 1.400 1.430 1.500 1.5

Figure 5: AWS custom monitoring dashboard

MLModel-dashboard	Save	Preview	Cancel					
+ Add tiles								
You can resize, move, edit tiles, or add tiles to your da	ashboard.							
Get access to an improved dashboard experience	and new mobile prese	nce. Try it now						$\times$
Avg Percentage CPU for MLModel				Sum Disk Read Bytes for MLModel				
_100%				_1008				
80%				806				
60%				608				
40%				408				
20%				208				
0% 6 AM 12 PM	6 PM			6 AM	12 PM	6 PM		
6 AM 12 PM	6 PM			6 AM	12 PM	6 PM		UIC+05
Percentage CPU (Avg), mlmodel				Disk Read Bytes (Sum), mlmodel				
Percentage CPO (Avg), mimodel				Disk Read Bytes (Sum), mimodel				
Avg Disk Write Bytes for MLModel			Avg Di	k Write Bytes, Avg Disk Read Operations/Sec, and	Avg Disk Write By	ytes and Avg Disk Read O	: perations/Sec fo	or MLModel
1008			1006	,	1008			
808			808		808			
608			608		608			

Figure 6: Azure Custom Monitoring dashboard

Once the dashboards are created, we can get the data from training the model which is used in this project to evaluate the performance of both the Cloud platforms and compare.