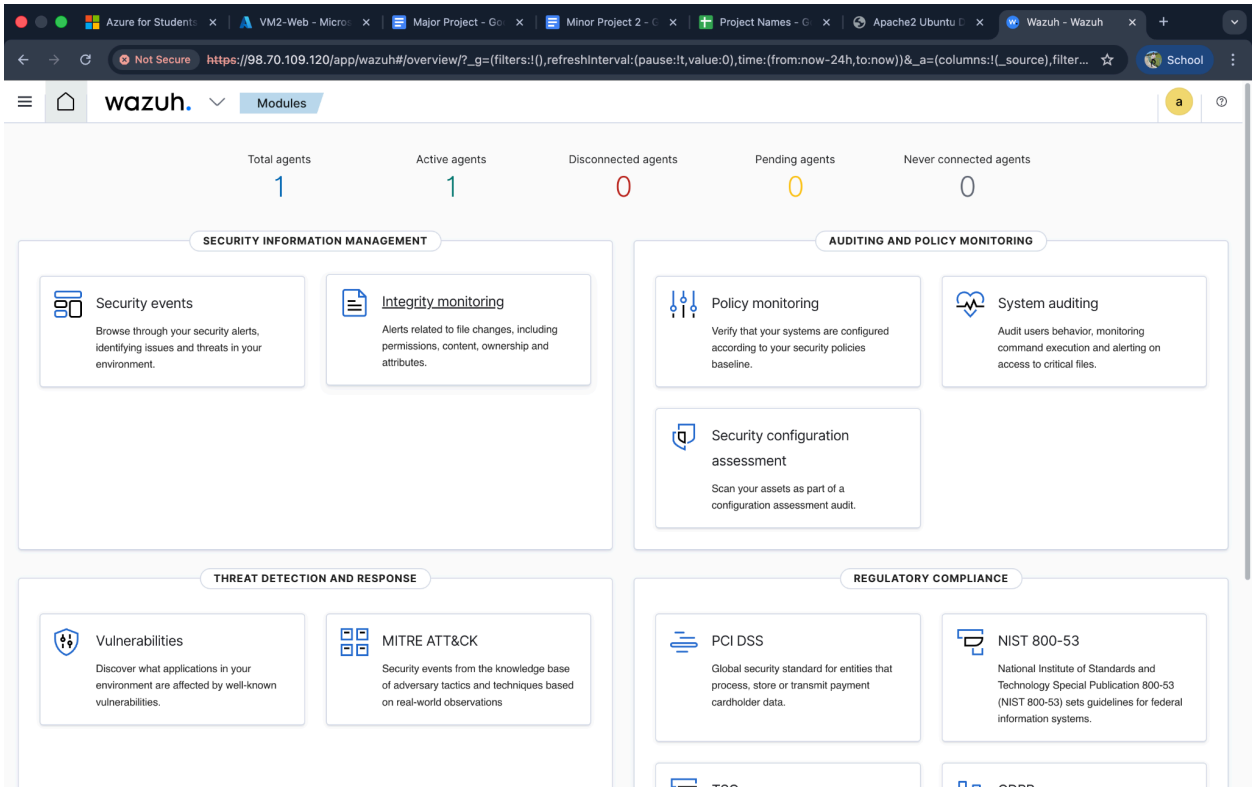
📘 PROJECT REPORT

Implementation of Cloud-Based SIEM Using Wazuh on Microsoft Azure

1. ABSTRACT

In modern cloud environments, continuous monitoring and real-time threat detection are essential to protect systems from cyber-attacks. This project focuses on the **design, deployment, and validation of a Security Information and Event Management (SIEM) solution using Wazuh on Microsoft Azure**.

The system collects logs from multiple virtual machines, analyzes them centrally, and detects suspicious activities such as **authentication failures, brute-force attempts, file integrity violations, and system anomalies**. The effectiveness of the SIEM solution is demonstrated through **attack simulations and real-time alert visualization** using the Wazuh Dashboard.



2. INTRODUCTION

Cloud computing has become the backbone of modern IT infrastructure. However, cloud systems are exposed to various cyber threats such as brute-force attacks, unauthorized access, and insider threats. Traditional security tools are insufficient to detect and correlate such attacks in real time.

A **Security Information and Event Management (SIEM)** system addresses this issue by:

1.Collecting logs from multiple sources
2.Correlating events
3.Detecting anomalies
4.Providing centralized monitoring and alerting
This project implements **Wazuh SIEM**, an open-source security monitoring platform, in a **Microsoft Azure cloud environment**.

4. SYSTEM ARCHITECTURE

4.1 Architecture Overview

The system is designed using a **three-tier architecture** deployed on Microsoft Azure:

1.VM3 – SIEM Server

→ Hosts Wazuh Manager, Wazuh Indexer, and Wazuh Dashboard

2.VM2 – Web Server

→ Public-facing Apache web server

→ Wazuh Agent installed

3.VM1 – Internal Server

→ Internal monitored system

→ Wazuh Agent installed

All virtual machines are deployed within a **custom Azure Virtual Network (VNet)** with **DMZ and Internal subnets**.

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Nexyra-VNet-1766496425710 | Overview

Deployment

Search

- Overview
- Inputs
- Outputs
- Template

Delete | Cancel | Redeploy | Download | Refresh

Deployment succeeded

Deployment 'Nexyra-VNet-1766496425710' to resource group 'Nexyra-Technologies' was successful.

Go to resource | Pin to dashboard

Your deployment is complete

Deployment name : Nexyra-VNet-1766496425710
Subscription : Azure for Students
Resource group : Nexyra-Technologies

Start time : 23/12/2025, 18:57:42
Correlation ID : 2c0e948c-f2e8-41e8-8fef-4e75a2b362f7

Deployment details

Next steps

Go to resource

Give feedback

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Cost management

Get notified to stay within your budget and prevent unexpected charges on your bill.

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Nexyra-VNet | Subnets

Virtual network

Check health of virtual network | Diagnose issues with this virtual network | Retrieve detailed routing information for troubleshooting

Search

- Overview
- Activity log
- Access control (IAM)
- Tags
- Diagnose and solve problems
- Resource visualizer
- Settings
  - Address space
  - Connected devices
  - Subnets
  - Bastion
  - DDoS protection
  - Firewall
  - Microsoft Defender for Cloud

Subnet | Refresh | Manage users | Delete | Export to CSV

Create subnets to segment the virtual network address space into smaller ranges for use by your applications. When you deploy resources into a subnet, Azure assigns the resource an IP address from the subnet.

Search subnets

Name	IPv4	IPv6	Available IPs	Delegated to	Security group	Route table
Internal-Subnet	10.0.1.0/24	-	249	-	-	-
DMZ-Subnet	10.0.2.0/24	-	250	-	-	-

Showing 2 subnets

Give feedback

Add or remove favorites by pressing Cmd+Shift+F

Switch to PowerShell | Restart | Manage files | New session | Editor | Web preview | Settings | Help

```
Your Cloud Shell session will be ephemeral so no files or system changes will persist beyond your current session.
deepak [ ~ ]$ sudo systemctl status apache2
sudo: The "no new privileges" flag is set, which prevents sudo from running as root.
sudo: If sudo is running in a container, you may need to adjust the container configuration to disable the flag.
deepak [ ~ ]$
```

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VM1-Internal
Virtual machine

Help me copy this VM in any region | Manage this VM with Azure CLI

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- Connect
- Networking
- Settings
- Availability + scale
- Security
- Backup + disaster recovery
- Operations
- Monitoring
- Automation
- Help

Connect | Start | Restart | Stop | Hibernate | Capture | Delete | Refresh | Open in mobile | Feedback | CLI / PS

Essentials JSON View

Resource group (move)	: Nexyra-Technologies	Operating system	: Linux (ubuntu 22.04)
Status	: Running	Size	: Standard B2ats v2 (2 vcpus, 1 GiB memory)
Location	: Central India	Primary NIC public IP	: 74.225.170.199
Subscription (move)	: Azure for Students		1 associated public IPs
Subscription ID	: f792c2f8-da86-4c66-b267-b1cb12113ecb	Virtual network/subnet	: Nexyra-VNet/Internal-Subnet
		DNS name	: Not configured
		Health state	: -
		Time created	: 23/12/2025, 15:40 UTC

Tags (edit) : Add tags

Properties | Monitoring | Capabilities (7) | Recommendations | Tutorials

Virtual machine

Computer name	VM1-Internal
Operating system	Linux (ubuntu 22.04)
VM generation	V2
VM architecture	x64
Agent status	Ready
Agent version	2.15.0.1
Hibernation	Disabled

Networking

Public IP address	74.225.170.199 (Network interface vm1-internal703)
	1 associated public IPs
Public IP address (IPv6)	-
Private IP address	10.0.1.4
Private IP address (IPv6)	-
Virtual network/subnet	Nexyra-VNet/Internal-Subnet
DNS name	Configure

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VM2-Web
Virtual machine

Help me copy this VM in any region | Manage this VM with Azure CLI

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- Backup + disaster recovery
- Operations
- Monitoring
- Automation
- Help

Connect | Start | Restart | Stop | Hibernate | Capture | Delete | Refresh | Open in mobile | Feedback | CLI / PS

Essentials JSON View

Resource group (move)	: Nexyra-Technologies	Operating system	: Linux (ubuntu 22.04)
Status	: Running	Size	: Standard B2ats v2 (2 vcpus, 1 GiB memory)
Location	: Central India	Primary NIC public IP	: 4.213.59.253
Subscription (move)	: Azure for Students		1 associated public IPs
Subscription ID	: f792c2f8-da86-4c66-b267-b1cb12113ecb	Virtual network/subnet	: Nexyra-VNet/DMZ-Subnet
		DNS name	: Not configured
		Health state	: -
		Time created	: 23/12/2025, 15:51 UTC

Tags (edit) : Add tags

Properties | Monitoring | Capabilities (7) | Recommendations | Tutorials

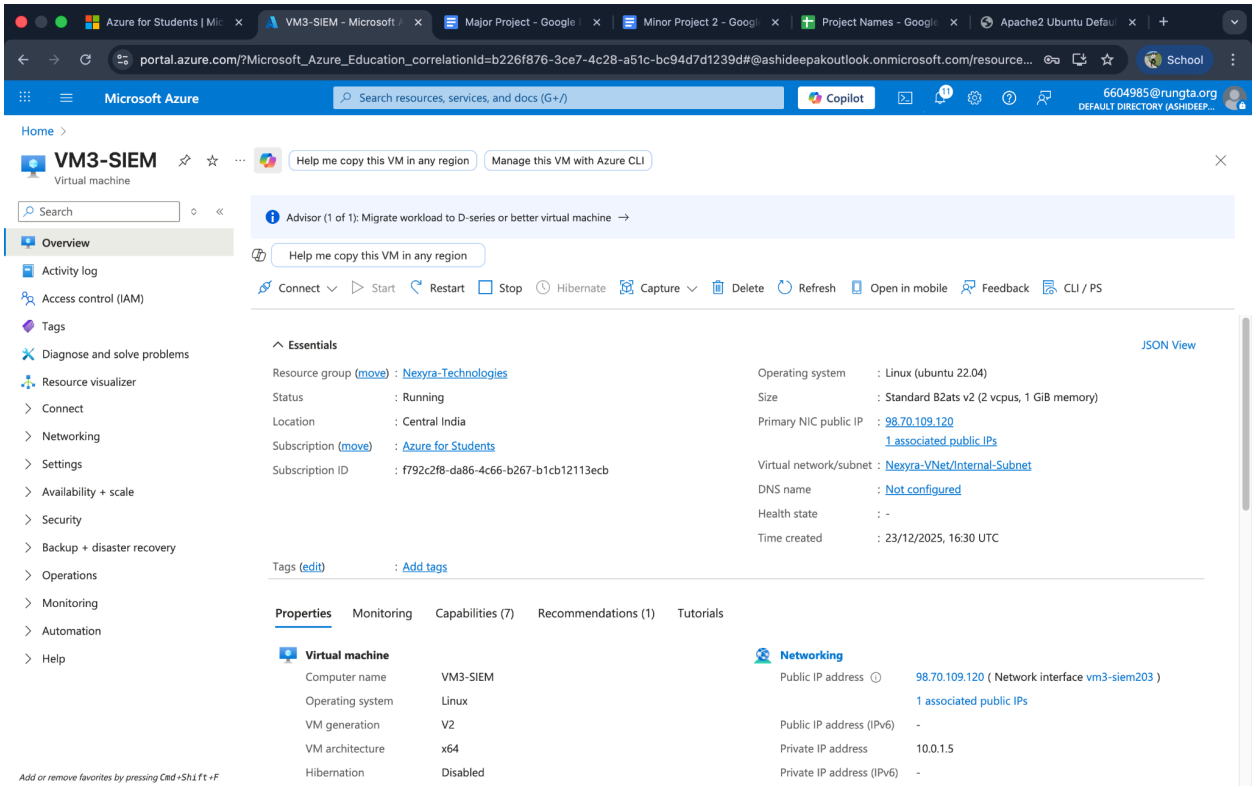
Virtual machine

Computer name	VM2-Web
Operating system	Linux (ubuntu 22.04)
VM generation	V2
VM architecture	x64
Agent status	Ready
Agent version	2.15.0.1
Hibernation	Disabled

Networking

Public IP address	4.213.59.253 (Network interface vm2-web117)
	1 associated public IPs
Public IP address (IPv6)	-
Private IP address	10.0.2.4
Private IP address (IPv6)	-
Virtual network/subnet	Nexyra-VNet/DMZ-Subnet
DNS name	Configure

Add or remove favorites by pressing Cmd+Shift+F



4.2 Architecture Flow

Attack Activity

↓

Wazuh Agent (VM2-Web / VM1-Internal)

↓

Wazuh Manager (VM3-SIEM)

↓

Wazuh Indexer (OpenSearch)

↓

Wazuh Dashboard (Visualization & Alerts)

5. TOOLS AND TECHNOLOGIES USED

Technology	Description
Microsoft Azure	Cloud platform
Ubuntu 22.04 LTS	Operating system
Wazuh SIEM	Security monitoring
Wazuh Agent	Log collection

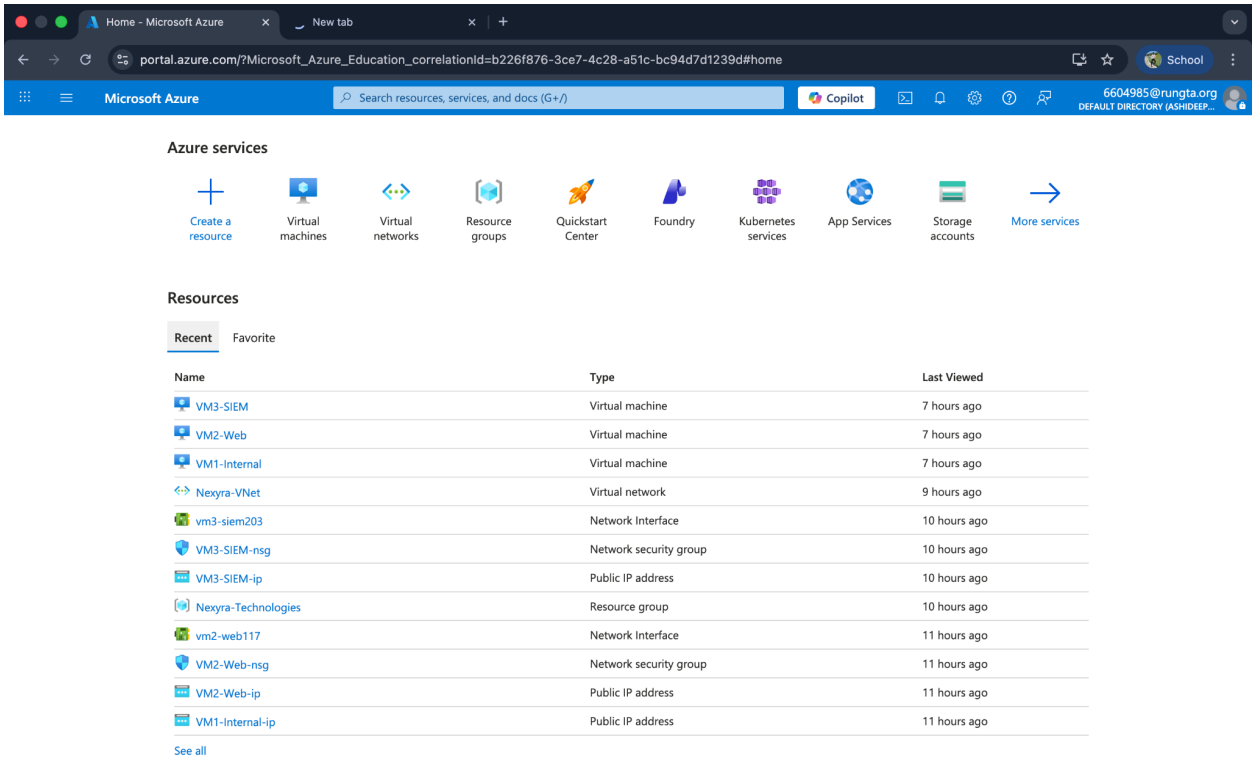
OpenSearch	**Log indexing**
Apache Web Server	**Target service**
SSH	**Secure remote access**
MITRE ATT&CK	**Threat classification**

6. IMPLEMENTATION DETAILS

6.1 Azure Infrastructure Setup

Three Ubuntu virtual machines were created using the Azure portal. Network Security Groups (NSGs) were configured to allow:

- **SSH (Port 22)**
- **HTTPS (Port 443)**
- **Wazuh Dashboard (Port 5601)**



6.2 Wazuh SIEM Installation

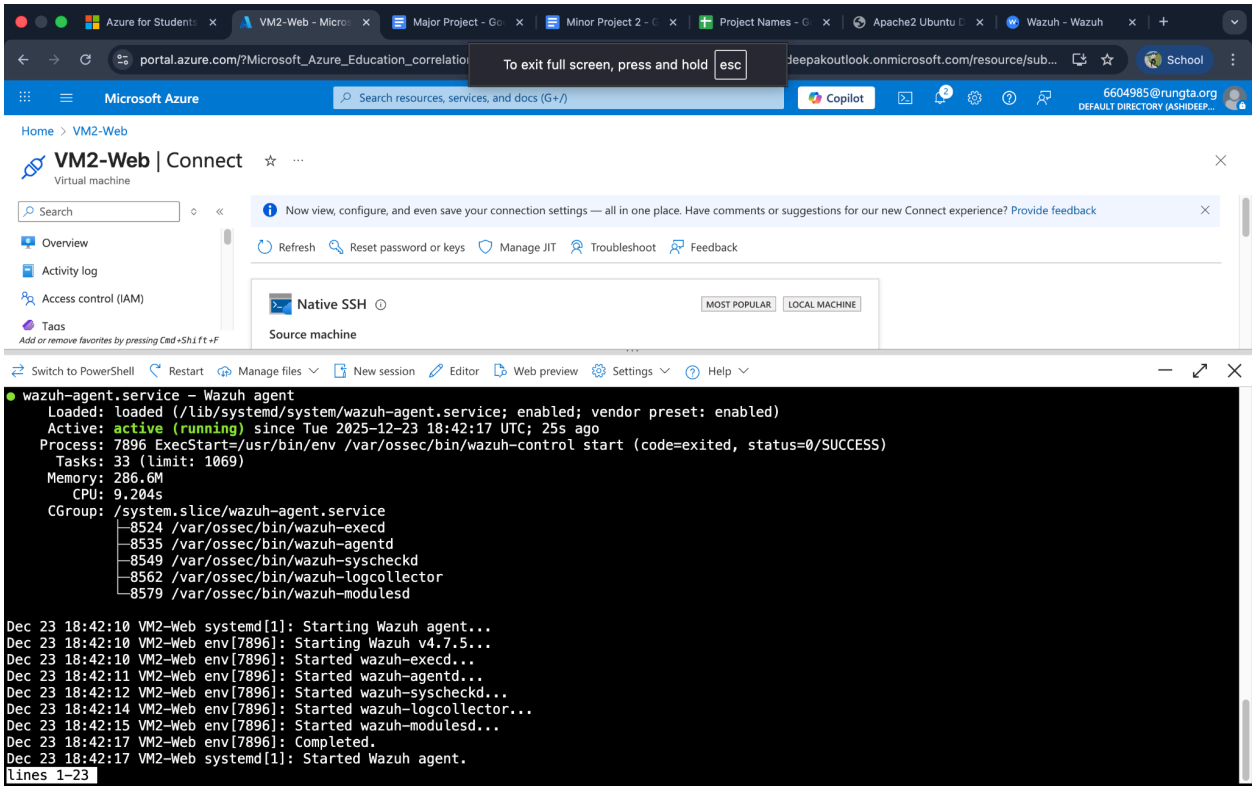
Wazuh was installed on VM3-SIEM using the official installation script. The installation included:

- **Wazuh Manager**
- **Wazuh Indexer**
- **Wazuh Dashboard**

All services were verified using `systemctl`.

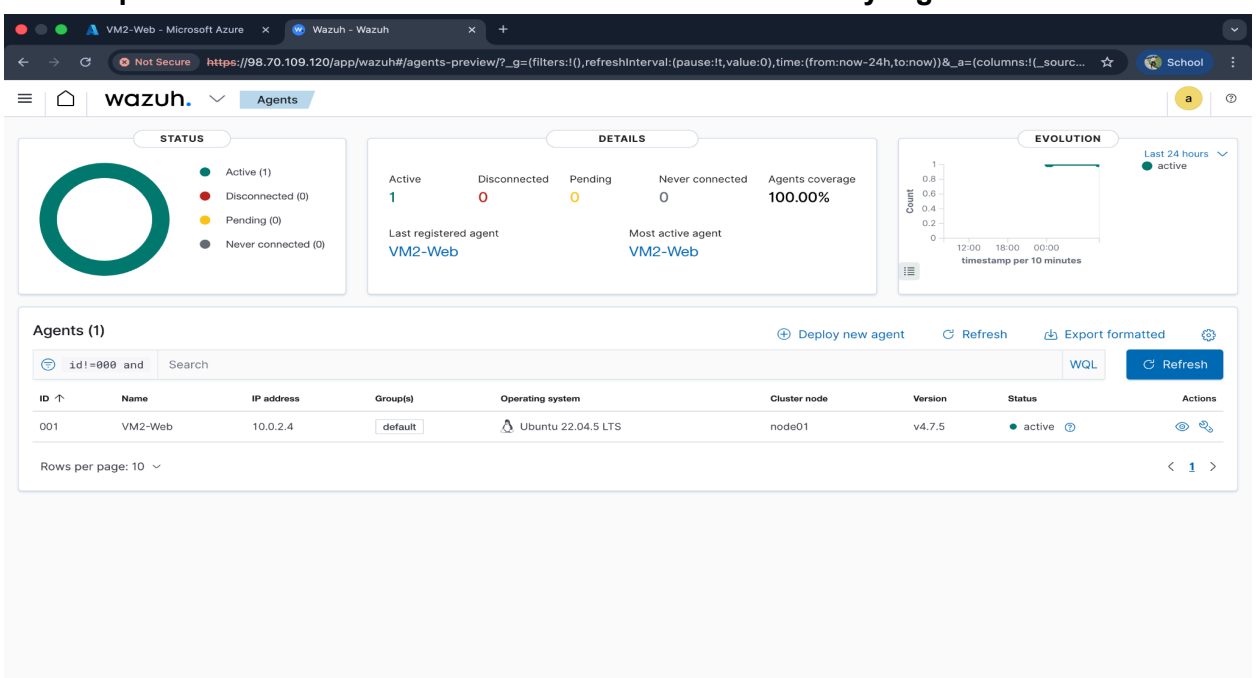
6.3 Agent Installation and Registration

Wazuh Agents were installed on VM2-Web and VM1-Internal. Each agent was configured with the private IP address of the SIEM server and successfully registered.



6.3 Agent Installation and Registration

Wazuh Agents were installed on VM2-Web and VM1-Internal. Each agent was configured with the private IP address of the SIEM server and successfully registered.



7. ATTACK SIMULATION

7.1 SSH Brute-Force Simulation

Multiple failed SSH login attempts were generated to simulate a brute-force attack. These attempts triggered authentication failure alerts.

Command - ssh fakeuser@localhost

```
2025/12/23 18:43:07 rootcheck: INFO: Ending rootcheck scan.
azureuser@VM2-Web:~$ ssh fakeuser@localhost
The authenticity of host 'localhost (127.0.0.1)' can't be established.
ED25519 key fingerprint is SHA256:W++AUy1DVjnhFwQld6OkQnOSaMAm5UVWwt1wkZr00Vs.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? ssh fakeuser@localhost
Please type 'yes', 'no' or the fingerprint:
Host key verification failed.
azureuser@VM2-Web:~$ ssh fakeuser@localhost
The authenticity of host 'localhost (127.0.0.1)' can't be established.
ED25519 key fingerprint is SHA256:W++AUy1DVjnhFwQld6OkQnOSaMAm5UVWwt1wkZr00Vs.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'localhost' (ED25519) to the list of known hosts.
fakeuser@localhost's password:
Permission denied, please try again.
fakeuser@localhost's password:
Permission denied, please try again.
fakeuser@localhost's password:
fakeuser@localhost: Permission denied (publickey,password).
azureuser@VM2-Web:~$
```

7.2 File Integrity Monitoring (FIM)

Unauthorized file creation and modification were performed to test file integrity monitoring.

sudo touch /etc/hacked_by_student
sudo echo "attack simulation" >> /etc/hacked_by_student

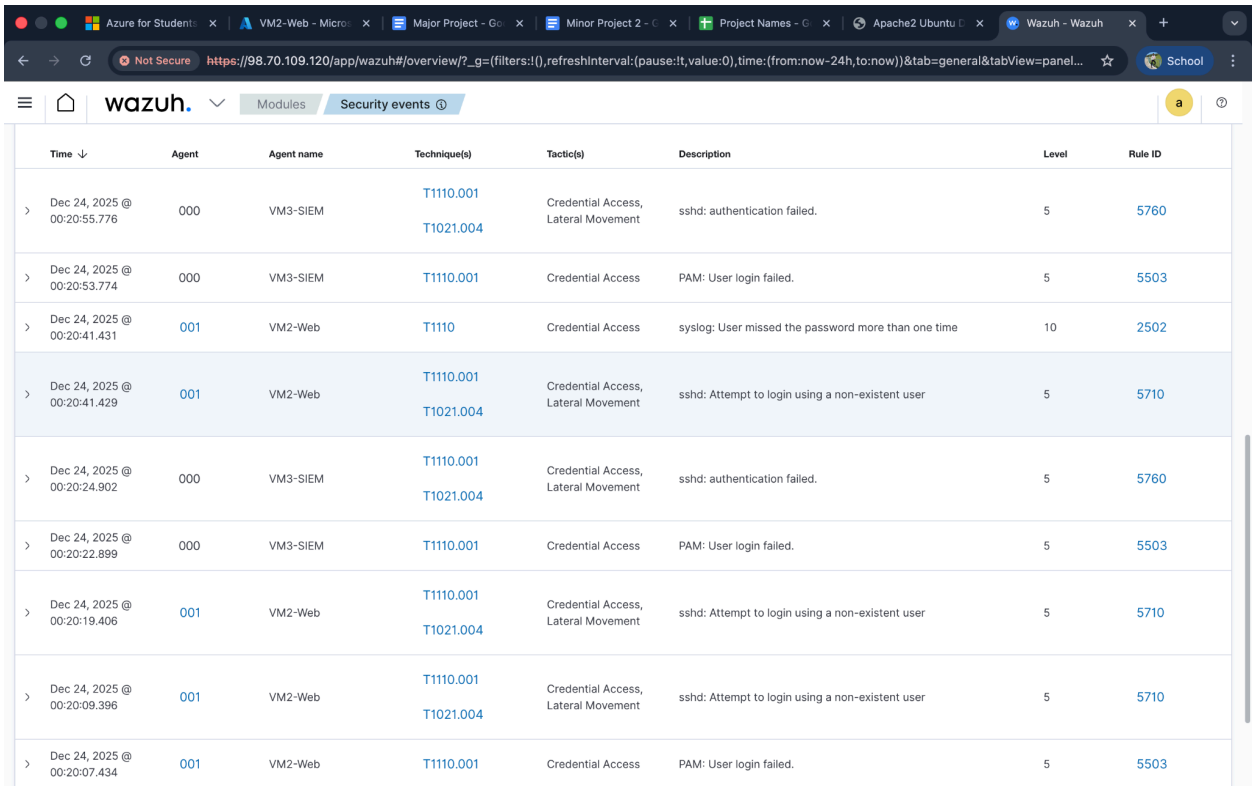
8. DETECTION AND MONITORING

All attack activities were successfully detected by Wazuh. Alerts were visible in:

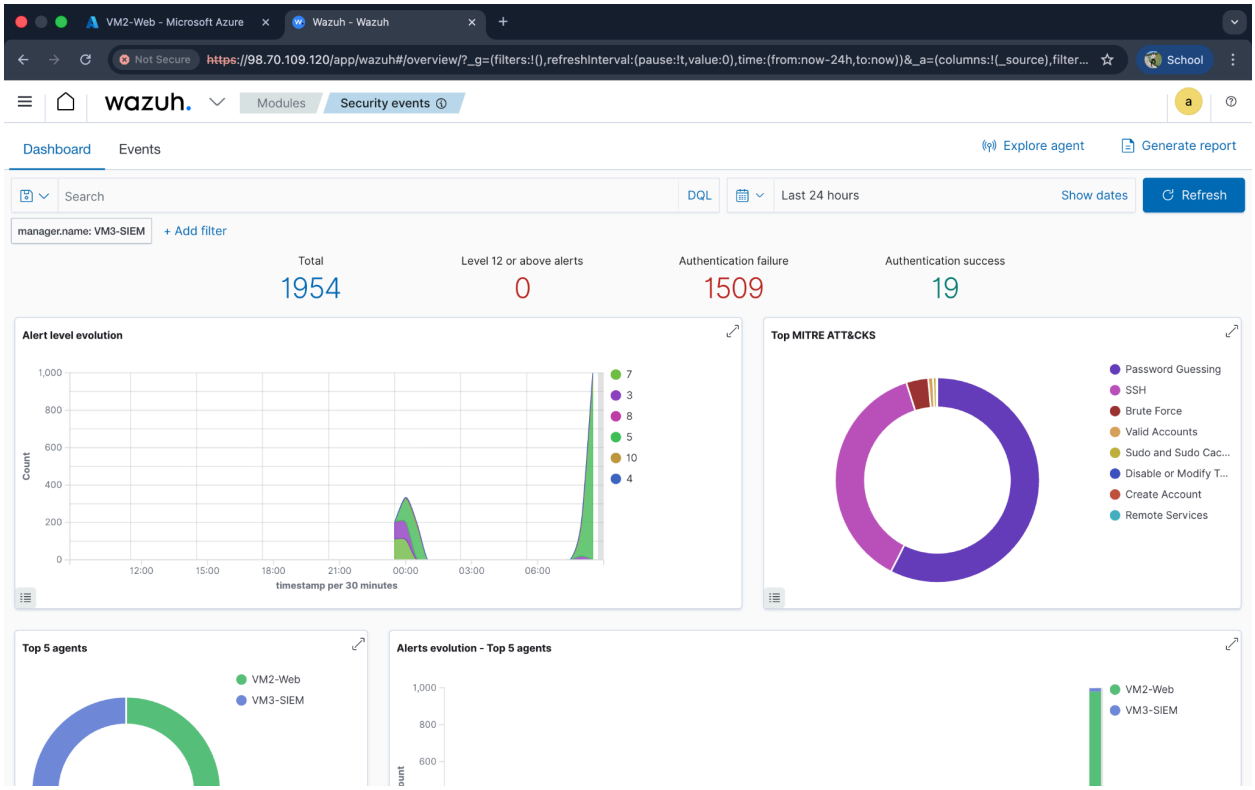
- Security Events
- Discover
- Integrity Monitoring

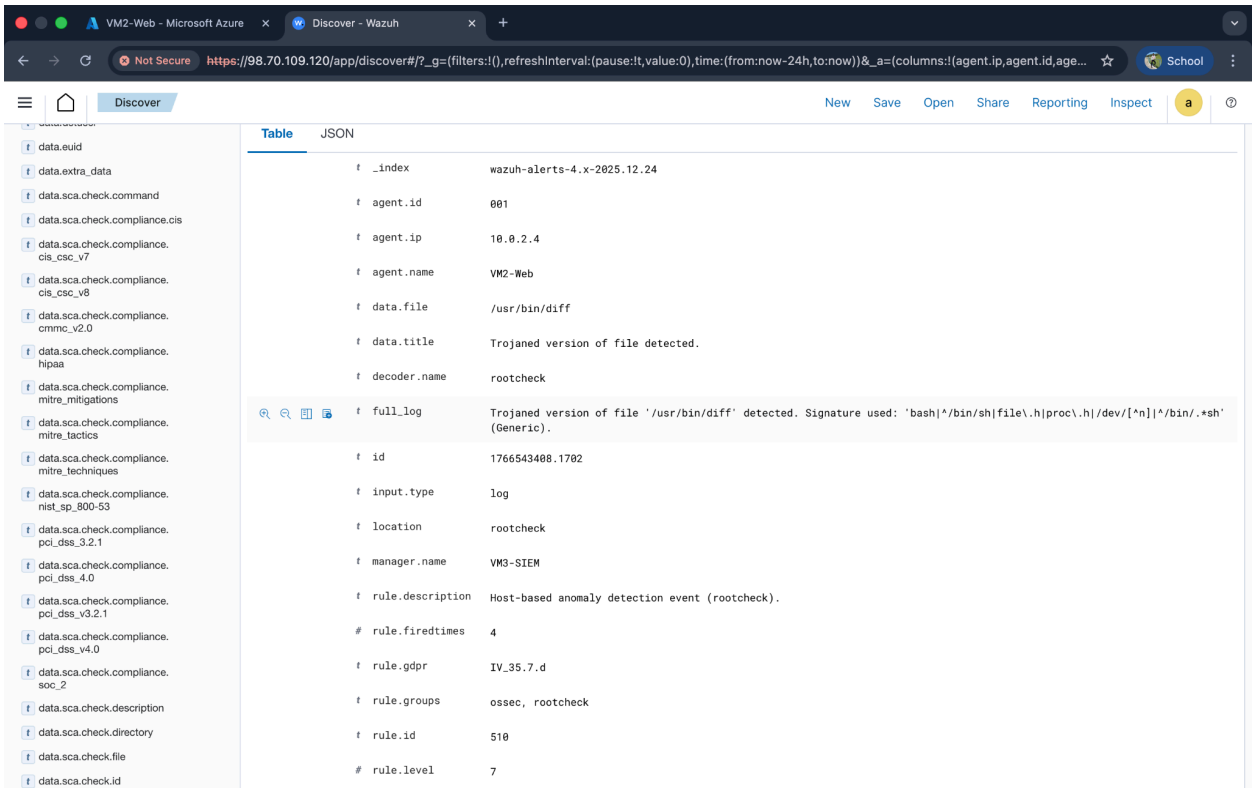
Detected events included:

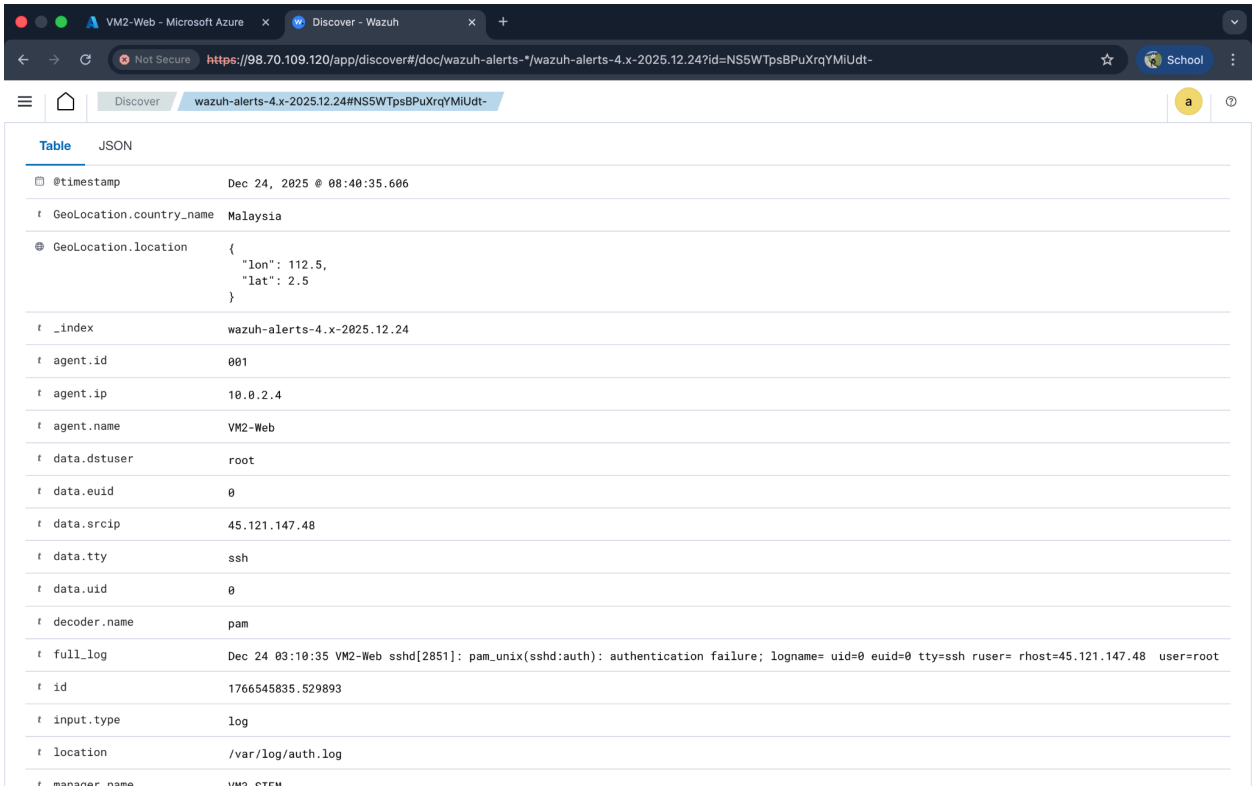
- Authentication failures
- SSH brute-force attempts
- Rootcheck alerts
- File integrity violations



Time	Agent	Agent name	Technique(s)	Tactic(s)	Description	Level	Rule ID
Dec 24, 2025 @ 00:20:55.776	000	VM3-SIEM	T1110.001 T1021.004	Credential Access, Lateral Movement	sshd: authentication failed.	5	5760
Dec 24, 2025 @ 00:20:53.774	000	VM3-SIEM	T1110.001	Credential Access	PAM: User login failed.	5	5503
Dec 24, 2025 @ 00:20:41.431	001	VM2-Web	T1110	Credential Access	syslog: User missed the password more than one time	10	2502
Dec 24, 2025 @ 00:20:41.429	001	VM2-Web	T1110.001 T1021.004	Credential Access, Lateral Movement	sshd: Attempt to login using a non-existent user	5	5710
Dec 24, 2025 @ 00:20:24.902	000	VM3-SIEM	T1110.001 T1021.004	Credential Access, Lateral Movement	sshd: authentication failed.	5	5760
Dec 24, 2025 @ 00:20:22.899	000	VM3-SIEM	T1110.001	Credential Access	PAM: User login failed.	5	5503
Dec 24, 2025 @ 00:20:19.406	001	VM2-Web	T1110.001 T1021.004	Credential Access, Lateral Movement	sshd: Attempt to login using a non-existent user	5	5710
Dec 24, 2025 @ 00:20:09.396	001	VM2-Web	T1110.001 T1021.004	Credential Access, Lateral Movement	sshd: Attempt to login using a non-existent user	5	5710
Dec 24, 2025 @ 00:20:07.434	001	VM2-Web	T1110.001	Credential Access	PAM: User login failed.	5	5503


VM2-Web - Microsoft Azure
Wazuh - Wazuh
Not Secure
https://98.70.109.120/app/wazuh#/overview/?_g=(filters:!(),refreshInterval:(pause:!t,value:0),time:(from:now-24h,to:now))&_a=(columns:!(_source),filter...
School
wazuh.
Modules
Security events
Dashboard
Events
Explore agent
Generate report
Search
DQL
Last 24 hours
Show dates
Refresh
manager.name: VM3-SIEM
+ Add filter
Total
1954
Level 12 or above alerts
0
Authentication failure
1509
Authentication success
19
Alert level evolution
Count
timestamp per 30 minutes
Top MITRE ATT&CKS
Password Guessing
SSH
Brute Force
Valid Accounts
Sudo and Sudo Cac...
Disable or Modify T...
Create Account
Remote Services
Top 5 agents
VM2-Web
VM3-SIEM
Alerts evolution - Top 5 agents


VM2-Web - Microsoft Azure
Discover - Wazuh
Not Secure
https://98.70.109.120/app/discover#/?_g=(filters:!(),refreshInterval:(pause:!t,value:0),time:(from:now-24h,to:now))&_a=(columns:!(agent.ip,agent.id,age...
School
Discover
New
Save
Open
Share
Reporting
Inspect
Table
JSON
data.euid
data.extra_data
data.sca.check.command
data.sca.check.compliance.cis
data.sca.check.compliance.cis_csc_v7
data.sca.check.compliance.cis_csc_v8
data.sca.check.compliance.cmmc_v2.0
data.sca.check.compliance.hipaa
data.sca.check.compliance.mitre_mitigations
data.sca.check.compliance.mitre_tactics
data.sca.check.compliance.mitre_techniques
data.sca.check.compliance.nist_sp_800-53
data.sca.check.compliance.pci_dss_3.2.1
data.sca.check.compliance.pci_dss_4.0
data.sca.check.compliance.pci_dss_v3.2.1
data.sca.check.compliance.pci_dss_v4.0
data.sca.check.compliance.soc_2
data.sca.check.description
data.sca.check.directory
data.sca.check.file
data.sca.check.id
_index wazuh-alerts-4.x-2025.12.24
agent.id 001
agent.ip 10.0.2.4
agent.name VM2-Web
data.file /usr/bin/diff
data.title Trojaned version of file detected.
decoder.name rootcheck
full_log Trojaned version of file '/usr/bin/diff' detected. Signature used: 'bash|^/bin/sh|file\.h|proc\.h|/dev/[^n]|^/bin/.*sh' (Generic).
id 1766543408.1702
input.type log
location rootcheck
manager.name VM3-SIEM
rule.description Host-based anomaly detection event (rootcheck).
rule.firedtimes 4
rule.gdpr IV_35.7.d
rule.groups ossec, rootcheck
rule.id 510
rule.level 7



9. RESULTS AND OBSERVATIONS

- Centralized monitoring was achieved
- Real-time alerts were generated
- Attack sources were identified with IP and geo-location
- SIEM effectively detected simulated attacks

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10. ADVANTAGES OF THE SYSTEM

- Real-time security monitoring
- Centralized log analysis
- Open-source and cost-effective
- Scalable cloud deployment
- MITRE-based threat classification

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11. LIMITATIONS

- Requires sufficient system resources
- Initial configuration complexity
- Manual alert tuning required

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12. FUTURE SCOPE

- Automated incident response
- Email/SMS alerting
- Integration with IDS tools (Suricata)
- Machine learning-based anomaly detection

---

13. CONCLUSION

This project successfully demonstrates a **cloud-based SIEM implementation using Wazuh on Microsoft Azure**. Through real attack simulations and alert analysis, the system proves its capability to monitor, detect, and analyze security threats in a modern cloud environment.

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14. REFERENCES

1. https://documentation.wazuh.com
2. https://learn.microsoft.com/azure
3. https://attack.mitre.org