🛡️ Azure-Based Multi-Layered DDoS Prevention System

This guide walks you step-by-step through building a **3-layer DDoS defense system** using **Azure services**, **Python (Flask + ML)**, and a **honeypot + CAPTCHA trap**. Built to work within **Azure's free/student tier**.

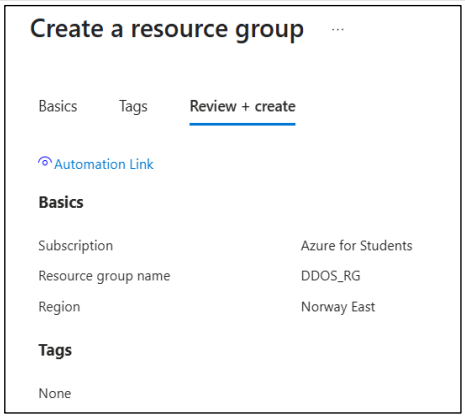
📁 Project Structure

```
|
|-Layer 1: Azure WAF (Application Gateway)
|- Layer 2: ML Anomaly Detection (Flask API)
|- Layer 3: Honeypot + reCAPTCHA
```

🔰 Layer 1: Web Application Firewall (WAF)

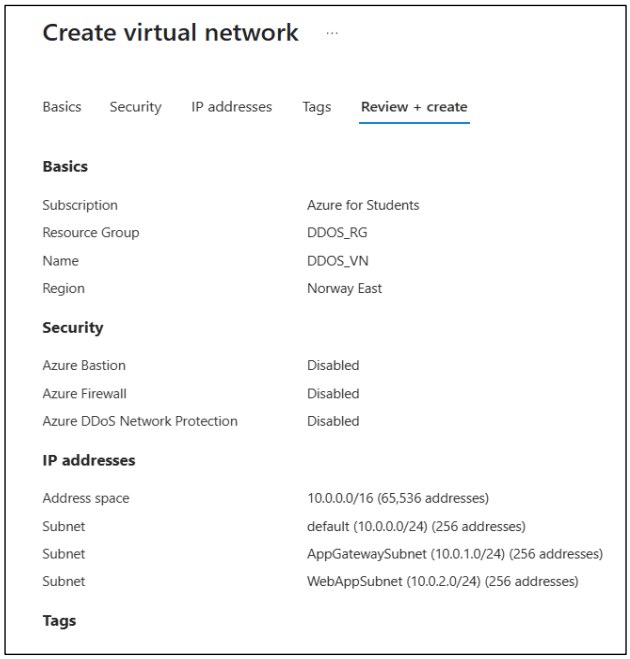
✅ Step 1: Create a Resource Group

1. Search: Resource Groups → + Create
2. Fill in details:
    - Name: DDoS-RG
    - Region: e.g., Norway East



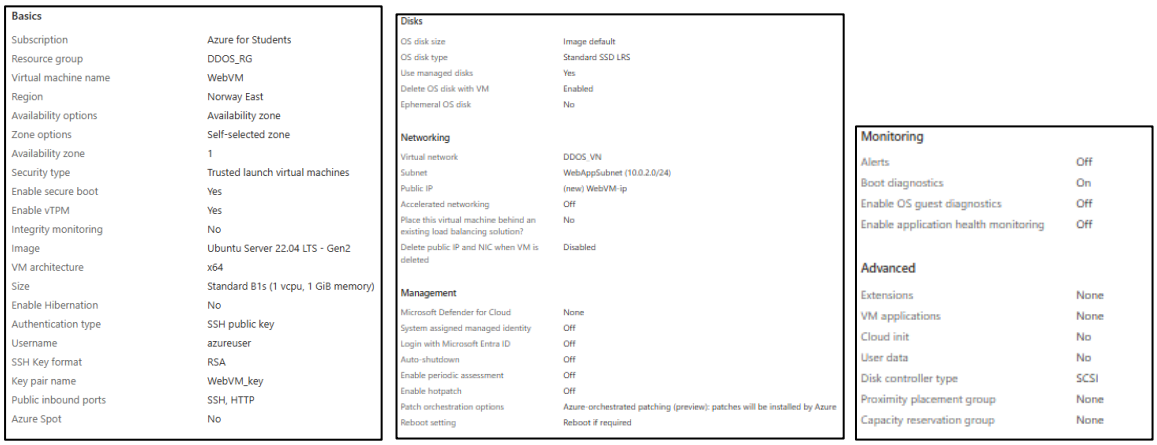
✅ **Step 2: Create a Virtual Network (VNet)**

1. Search: Virtual Networks → + Create
2. Fill:
    - Name: DDoS-VNet
    - Subnet 1: default
    - Address range: leave as default
3. Click Review + Create



✅ Step 3: Deploy Azure Virtual Machine

1. Search: Virtual Machines → + Create
2. Fill in:
    - VM Name: DDoS-VM
    - Region: same as above
    - Image: Ubuntu 22.04 LTS
    - Size: B1s (free)
    - Username: azureuser
    - Authentication: SSH or Password
3. Download the .pem file if SSH is chosen



Basics

Subscription	Azure for Students
Resource group	DDOS_RG
Virtual machine name	WebVM
Region	Norway East
Availability options	Availability zone
Zone options	Self-selected zone
Availability zone	1
Security type	Trusted launch virtual machines
Enable secure boot	Yes
Enable vTPM	Yes
Integrity monitoring	No
Image	Ubuntu Server 22.04 LTS - Gen2
VM architecture	x64
Size	Standard B1s (1 vcpu, 1 GiB memory)
Enable Hibernation	No
Authentication type	SSH public key
Username	azureuser
SSH Key format	RSA
Key pair name	WebVM_key
Public inbound ports	SSH, HTTP
Azure Spot	No

Disks

OS disk size	Image default
OS disk type	Standard SSD LRS
Use managed disks	Yes
Delete OS disk with VM	Enabled
Ephemeral OS disk	No

Networking

Virtual network	DDOS_VN
Subnet	WebAppSubnet (10.0.2.0/24)
Public IP	(new) WebVM-ip
Accelerated networking	Off
Place this virtual machine behind an existing load balancing solution?	No
Delete public IP and NIC when VM is deleted	Disabled

Management

Microsoft Defender for Cloud	None
System assigned managed identity	Off
Login with Microsoft Entra ID	Off
Auto-shutdown	Off
Enable periodic assessment	Off
Enable hotpatch	Off
Patch orchestration options	Azure-orchestrated patching (preview): patches will be installed by Azure
Reboot setting	Reboot if required

Monitoring

Alerts	Off
Boot diagnostics	On
Enable OS guest diagnostics	Off
Enable application health monitoring	Off

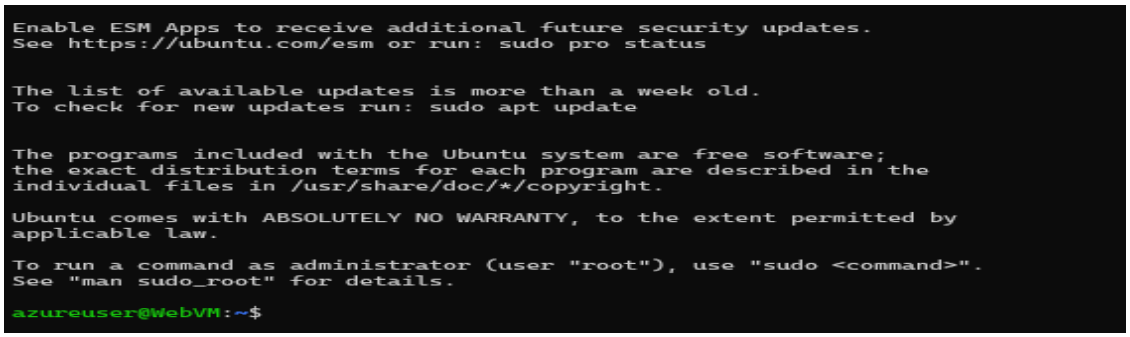
Advanced

Extensions	None
VM applications	None
Cloud init	No
User data	No
Disk controller type	SCSI
Proximity placement group	None
Capacity reservation group	None

✅ Step 4: Connect via SSH & Install Nginx

```
ssh -i path-to-key.pem azureuser@<VM_PUBLIC_IP>
sudo apt update && sudo apt install nginx -y
```

Verify by visiting:
http://<VM_PUBLIC_IP> → You should see the Nginx welcome page.



```
Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status


The list of available updates is more than a week old.
To check for new updates run: sudo apt update


The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

azureuser@WebVM:~$
```

✅ Step 5: Set Up Application Gateway + WAF

1. Search: Application Gateway → + Create
2. Choose:
    - Tier: WAF V2
    - Associate with previously created VNet and subnet
    - Create a public IP
3. Attach the backend VM IP to the App Gateway backend pool

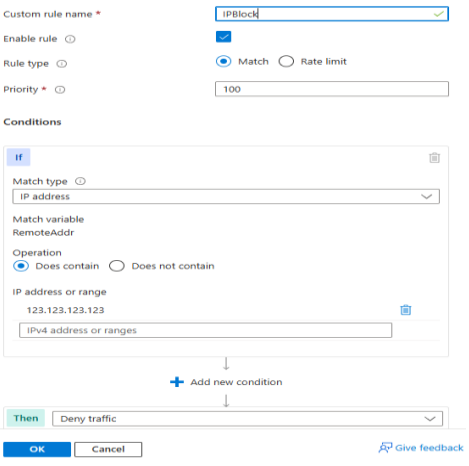
Basics	
Subscription	Azure for Students
Resource group	DDOS_RG
Name	DDoSAppGateway
Region	Norway East
Tier	WAF_v2
Enable autoscaling	Enabled
Minimum instance count	2
Maximum instance count	10
WAF status	Enabled
WAF mode	Detection
Availability zone	Zones 1, 2, 3
HTTP2	Enabled
Virtual network	DDOS_VN
Subnet	AppGatewaySubnet (10.0.1.0/24)
Web application firewall	(new) DDOS_WAF

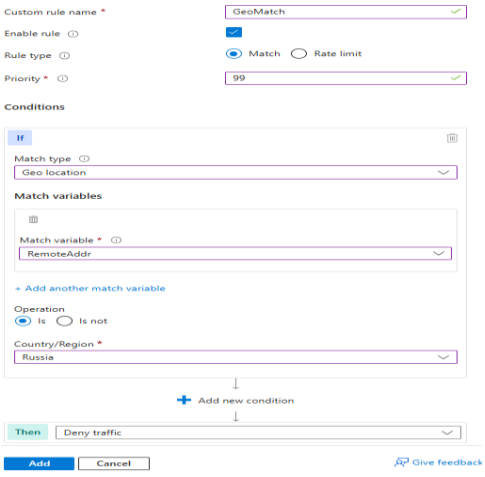
Frontends	
Public IPv4 address name	AppGatewayIP
SKU	Standard
Assignment	Static
Availability zone	ZoneRedundant

✅ Step 6: Configure WAF Policy

1. Search: WAF Policies
2. Select: DDOS_WAF
3. Enable OWASP Rule Set 3.2
4. Add **Custom Rules**:
    - **Block IP Rule**:
        - Rule Name: IPBlock
        - Match: RemoteAddr == <ip to block>
        - Action: Block
    - **Geo Block Rule**:
        - Match: GeoLocation == Russia
        - Action: Block

Click Save





✅ Layer 1 Complete

🧠 Layer 2: Machine Learning Detection API

✅ Step 1: Install Requirements (via SSH on VM)

```
sudo apt update
sudo apt install python3-pip git -y
pip3 install flask scikit-learn pandas numpy
```

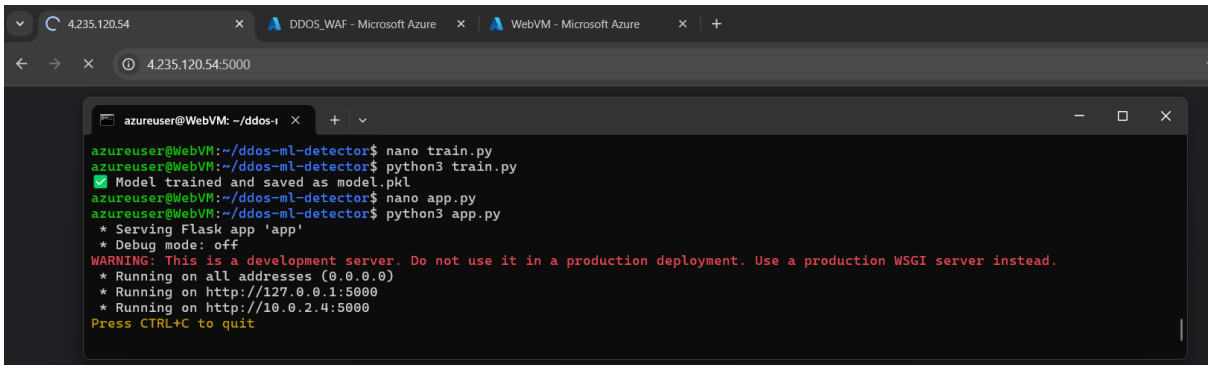
✅ Step 2: Build the ML Detector

```
mkdir ddos-ml-detector
cd ddos-ml-detector
nano train.py
```

Paste code from GitHub (ML model with RandomForest)

Then run:

```
python3 train.py
```



✅ Step 3: Create and Run Flask API

```
nano app.py
```

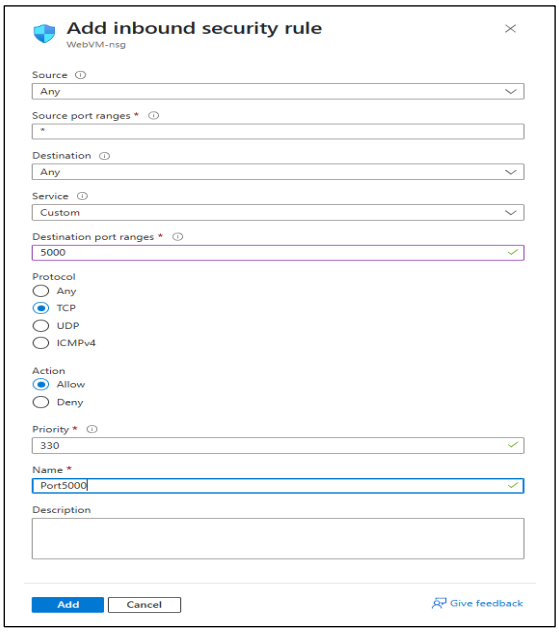
Paste code from GitHub (Flask endpoint using model.pkl)

Run it:

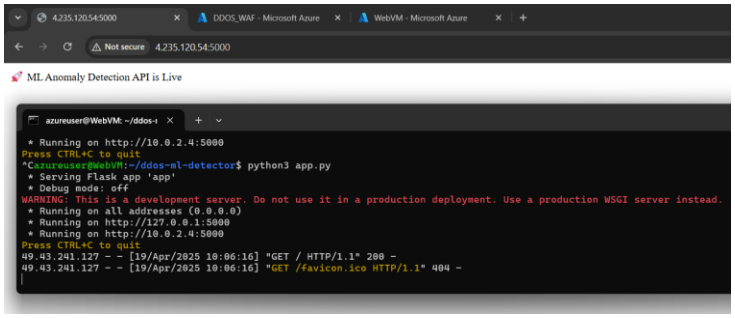
```
python3 app.py
```

✅ Step 4: Open Port 5000 in Azure

1. Go to VM > Networking > Inbound Rules
2. Add rule:
    - Port: 5000
    - Protocol: TCP
    - Source: Any



Restart app:
python3 app.py



✅ Layer 2 Complete

🎯 Layer 3: Honeypot + reCAPTCHA

✅ Step 1: SSH into the VM (same)

cd ~
mkdir honeypot
cd honeypot
pip3 install flask
nano honeypot.py

Paste honeypot code from GitHub.

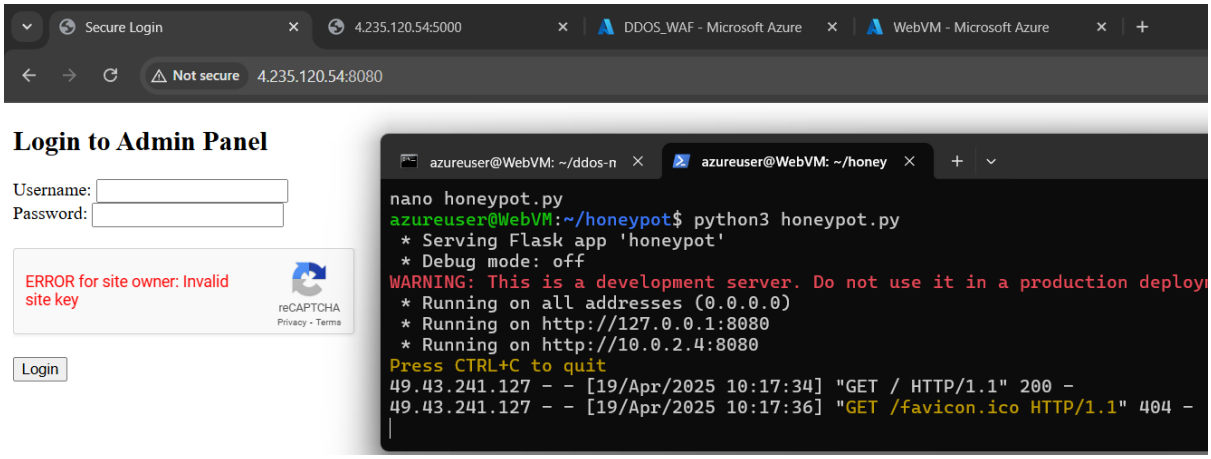
✅ Step 2: Run the Honeypot

python3 honeypot.py

✅ Step 3: Open Port 8080 (if used)

1. Go to VM > Networking
2. Add Inbound Rule for Port 8080

Now open http://<VM_IP>:8080



✅ Step 4: Setup reCAPTCHA

1. Go to: https://www.google.com/recaptcha/admin
2. Register your site:
   - Type: reCAPTCHA v2 (“I’m not a robot”)
   - Add your VM IP as a domain
3. Add your **site key** and **secret key** in HTML + Flask code

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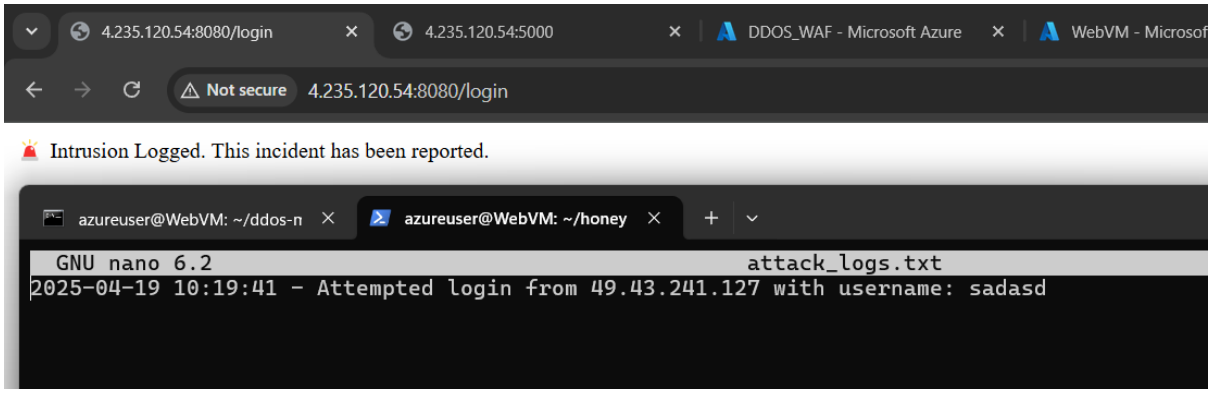
✅ Step 5: View Logs

cat honeypot/attack_logs.txt

You’ll see:
203.0.113.45 tried at 2025-04-19 19:32:22



✅ Layer 3 Complete

🧪 Testing Checklist

🔐 **Layer 1:**

- **IP Block Test**: Block mobile IP → visit site → should return **403**
- **Geo Block Test**: Connect VPN to Russia → visit → get **403**

🧠 **Layer 2:**

- Predict via curl → should return:

{"is_anomalous": true}

🕵️ **Layer 3:**

- Visit honeypot page → fake login → check attack_logs.txt
