TU856/3
INTRODUCTION TO DEVOPS

LAB 3 – VAGRANT

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PAULINA CZARNOTA C21365726

LINK TO THE REPOSITORY

https://github.com/PaulinaCzarnota/devops-lab-3

STEP 1: SETTING UP VAGRANT AND THE VIRTUAL MACHINE (VM)

1.1 Initialize a Vagrant Project

Navigate to the project directory and run:

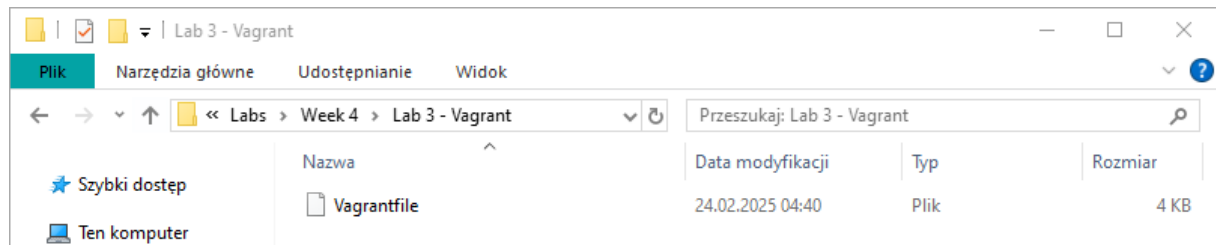### 1.2 Start the Virtual Machine

1.3 Connect to the VM

Once the VM is running, connect via SSH:

```
C:\Users\35389\Desktop\TU856 Modules\YEAR 3\Year 3 - Semester 2\Introduction to DevOps - Eoin Rogers\Labs\Week 4\Lab 3 - Vagrant>vagrant ssh
Linux bookworm 6.1.0-29-amd64 #1 SMP PREEMPT_DYNAMIC Debian 6.1.123-1 (2025-01-02) x86_64

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

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
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individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
vagrant@bookworm:~$
```

STEP 2: INSTALLING DEPENDENCIES

Inside the VM, update the package list and install required dependencies:

```
vagrant@bookworm:~$ sudo apt update
Get:1 https://deb.debian.org/debian bookworm InRelease [151 kB]
Get:2 https://security.debian.org/debian-security bookworm-security InRelease [48.0 kB]
Get:3 https://deb.debian.org/debian bookworm-updates InRelease [55.4 kB]
Get:4 https://deb.debian.org/debian bookworm-backports InRelease [59.0 kB]
Get:5 https://security.debian.org/debian-security bookworm-security/main Sources [146 kB]
Get:6 https://security.debian.org/debian-security bookworm-security/main amd64 Packages [246 kB]
Get:7 https://security.debian.org/debian-security bookworm-security/main Translation-en [146 kB]
Get:8 https://deb.debian.org/debian bookworm/main Sources [9496 kB]
Get:9 https://deb.debian.org/debian bookworm/main amd64 Packages [8792 kB]
Get:10 https://deb.debian.org/debian bookworm/main Translation-en [6109 kB]
Get:11 https://deb.debian.org/debian bookworm-updates/main Sources [16.2 kB]
Get:12 https://deb.debian.org/debian bookworm-updates/main amd64 Packages [13.5 kB]
Get:13 https://deb.debian.org/debian bookworm-updates/main Translation-en [16.0 kB]
Get:14 https://deb.debian.org/debian bookworm-backports/main Sources [323 kB]
Get:15 https://deb.debian.org/debian bookworm-backports/main amd64 Packages [283 kB]
Get:16 https://deb.debian.org/debian bookworm-backports/main Translation-en [236 kB]
Fetched 26.1 MB in 14s (1918 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
9 packages can be upgraded. Run 'apt list --upgradable' to see them.
```

```
vagrant@bookworm:~$ sudo apt install -y python3 python3-venv python3-pip git nano vim curl
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
python3 is already the newest version (3.11.2-1+b1).
python3 set to manually installed.
nano is already the newest version (7.2-1+deb12u1).
The following additional packages will be installed:
  binutils binutils-common binutils-x86-64-linux-gnu build-essential cpp cpp-12 dirmngr dpkg-dev fakeroot
  fontconfig-config fonts-dejavu-core g++ g++-12 gcc gcc-12 git-man gnupg gnupg-l10n gnupg-utils gpg gpg-agent
  gpg-wks-client gpg-wks-server gpgconf gpgsm javascript-common libabsl20220623 libalgorithm-diff-perl
  libalgorithm-diff-xs-perl libalgorithm-merge-perl libaom3 libasan8 libassuan0 libatomic1 libavif15 libbinutils
  libc-dev-bin libc-devtools libc6-dev libcc1-0 libcrypt-dev libctf-nobfd0 libctf0 libcurl4 libdav1d6 libde265-0
  libdeflate0 libdpkg-perl liberror-perl libexpat1-dev libfakeroot libfile-fcntllock-perl libfontconfig1 libgav1-1
  libgcc-12-dev libgd3 libgomp1 libgpm2 libgprofng0 libheif1 libisl23 libitm1 libjbig0 libjpeg62-turbo libjs-jquery
  libjs-sphinxdoc libjs-underscore libksba8 liblerc4 liblsan0 libmpc3 libmpfr6 libnpth0 libnsl-dev libpython3-dev
  libpython3.11 libpython3.11-dev libquadmath0 librav1e0 libsodium23 libstdc++-12-dev libsvtav1enc1 libtiff6
  libtirpc-dev libtsan2 libubsan1 libwebp7 libx11-6 libx11-data libx265-199 libxau6 libxcb1 libxdmcp6 libxpm4
  libyuv0 linux-libc-dev make manpages-dev patch pinentry-curses python3-dev python3-distutils python3-lib2to3
  python3-pip-whl python3-setuptools python3-setuptools-whl python3-wheel python3.11-dev python3.11-venv
  rpcsvc-proto vim-runtime zlib1g-dev
Suggested packages:
  binutils-doc cpp-doc gcc-12-locales cpp-12-doc dbus-user-session pinentry-gnome3 tor debian-keyring g++-multilib
  g++-12-multilib gcc-12-doc gcc-multilib autoconf automake libtool flex bison gdb gcc-doc gcc-12-multilib
  git-daemon-run | git-daemon-sysvinit git-doc git-email git-gui gitk gitweb git-cvs git-mediawiki git-svn
  parcimonie xloadimage scdaemon apache2 | lighttpd | httpd glibc-doc bzr libgd-tools gpm libstdc++-12-doc make-doc
  ed diffutils-doc pinentry-doc python-setuptools-doc ctags vim-doc vim-scripts
The following NEW packages will be installed:
  binutils binutils-common binutils-x86-64-linux-gnu build-essential cpp cpp-12 curl dirmngr dpkg-dev fakeroot
  fontconfig-config fonts-dejavu-core g++ g++-12 gcc gcc-12 git git-man gnupg gnupg-l10n gnupg-utils gpg gpg-agent
  gpg-wks-client gpg-wks-server gpgconf gpgsm javascript-common libabsl20220623 libalgorithm-diff-perl
  libalgorithm-diff-xs-perl libalgorithm-merge-perl libaom3 libasan8 libassuan0 libatomic1 libavif15 libbinutils
  libc-dev-bin libc-devtools libc6-dev libcc1-0 libcrypt-dev libctf-nobfd0 libctf0 libcurl4 libdav1d6 libde265-0
  libdeflate0 libdpkg-perl liberror-perl libexpat1-dev libfakeroot libfile-fcntllock-perl libfontconfig1 libgav1-1
  libgcc-12-dev libgd3 libgomp1 libgpm2 libgprofng0 libheif1 libisl23 libitm1 libjbig0 libjpeg62-turbo libjs-jquery
  libjs-sphinxdoc libjs-underscore libksba8 liblerc4 liblsan0 libmpc3 libmpfr6 libnpth0 libnsl-dev libpython3-dev
  libpython3.11 libpython3.11-dev libquadmath0 librav1e0 libsodium23 libstdc++-12-dev libsvtav1enc1 libtiff6
  libtirpc-dev libtsan2 libubsan1 libwebp7 libx11-6 libx11-data libx265-199 libxau6 libxcb1 libxdmcp6 libxpm4
  libyuv0 linux-libc-dev make manpages-dev patch pinentry-curses python3-dev python3-distutils python3-lib2to3
  python3-pip python3-pip-whl python3-setuptools python3-setuptools-whl python3-venv python3-wheel python3.11-dev
  python3.11-venv rpcsvc-proto vim vim-runtime zlib1g-dev
0 upgraded, 117 newly installed, 0 to remove and 9 not upgraded.
```

Verify installations:

```
vagrant@bookworm:~$ python3 --version
Python 3.11.2
vagrant@bookworm:~$ pip3 --version
pip 23.0.1 from /usr/lib/python3/dist-packages/pip (python 3.11)
vagrant@bookworm:~$
```

STEP 3: CREATING FLASK VIRTUAL ENVIRONMENT

3.1 Create and Activate Virtual Environment

```
vagrant@bookworm:~$ python3 -m venv flask_venv
vagrant@bookworm:~$ source flask_venv/bin/activate
(flask_venv) vagrant@bookworm:~$
```

3.2 Install Flask

```
(flask_venv) vagrant@bookworm:~$ pip install Flask
Collecting Flask
  Downloading flask-3.1.0-py3-none-any.whl (102 kB)
                                      ━━━━━━━ 103.0/103.0 kB 1.6 MB/s eta 0:00:00
Collecting Werkzeug>=3.1
  Downloading werkzeug-3.1.3-py3-none-any.whl (224 kB)
                                      ━━━━━━━ 224.5/224.5 kB 2.6 MB/s eta 0:00:00
Collecting Jinja2>=3.1.2
  Downloading jinja2-3.1.5-py3-none-any.whl (134 kB)
                                      ━━━━━━━ 134.6/134.6 kB 2.4 MB/s eta 0:00:00
Collecting itsdangerous>=2.2
  Downloading itsdangerous-2.2.0-py3-none-any.whl (16 kB)
Collecting click>=8.1.3
  Downloading click-8.1.8-py3-none-any.whl (98 kB)
                                      ━━━━━━━ 98.2/98.2 kB 2.7 MB/s eta 0:00:00
Collecting blinker>=1.9
  Downloading blinker-1.9.0-py3-none-any.whl (8.5 kB)
Collecting MarkupSafe>=2.0
  Downloading MarkupSafe-3.0.2-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (23 kB)
Installing collected packages: MarkupSafe, itsdangerous, click, blinker, Werkzeug, Jinja2, Flask
Successfully installed Flask-3.1.0 Jinja2-3.1.5 MarkupSafe-3.0.2 Werkzeug-3.1.3 blinker-1.9.0 click-8.1.8 itsdangerous-2.2.0
(flask_venv) vagrant@bookworm:~$
```

STEP 4: CREATING THE FLASK WEB APPLICATION

Create a file named hello.py and add the following code:

```
(flask_venv) vagrant@bookworm:~$ nano hello.py
```

File Location: /home/vagrant/hello.py.

```
GNU nano 7.2                                                                    hello.py *
from flask import Flask

app = Flask(__name__)

@app.route('/')
def hello():
    return '<p>Hello, World! <a href="/about">About</a></p>'

@app.route('/about')
def about():
    return '<p>This is a Flask web app running in a Linux VM.</p>'

if __name__ == "__main__":
    app.run(host="0.0.0.0", port=5000)
```

STEP 5: RUNNING AND TESTING FLASK

5.1 Start Flask

```
(flask_venv) vagrant@bookworm:~$ flask --app hello run --host=0.0.0.0
 * Serving Flask app 'hello'
 * Debug mode: off
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
 * Running on all addresses (0.0.0.0)
 * Running on http://127.0.0.1:5000
 * Running on http://10.0.2.15:5000
Press CTRL+C to quit
```

5.2 Test the Web App

Open another terminal and SSH into the VM:

Run a test request:

First Terminal:

STEP 6: AUTOMATING DEPLOYMENT WITH VAGRANTFILE

Modify Vagrantfile to automate the setup:

STEP 7: TESTING AUTOMATED DEPLOYMENT

7.1 Reprovision the VM

```
(flask_venv) vagrant@bookworm:~$ exit
logout

C:\Users\35389\Desktop\TU856 Modules\YEAR 3\Year 3 - Semester 2\Introduction to DevOps - Eoin Rogers\Labs\Week 4\Lab 3 - Vagrant>
```
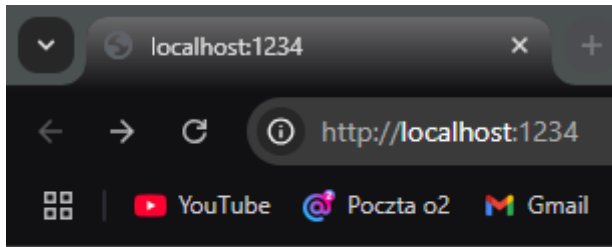
```
C:\Users\35389\Desktop\TU856 Modules\YEAR 3\Year 3 - Semester 2\Introduction to DevOps - Eoin Rogers\Labs\Week 4\Lab 3 - Vagrant>vagrant reload --provision
==> default: Attempting graceful shutdown of VM...
==> default: Checking if box 'debian/bookworm64' version '12.20250126.1' is up to date...
==> default: Clearing any previously set forwarded ports...
==> default: Fixed port collision for 22 => 2222. Now on port 2209.
==> default: Clearing any previously set network interfaces...
==> default: Preparing network interfaces based on configuration...
    default: Adapter 1: nat
==> default: Forwarding ports...
    default: 5000 (guest) => 1234 (host) (adapter 1)
    default: 22 (guest) => 2209 (host) (adapter 1)
==> default: Booting VM...
==> default: Waiting for machine to boot. This may take a few minutes...
    default: SSH address: 127.0.0.1:2209
    default: SSH username: vagrant
    default: SSH auth method: private key
==> default: Machine booted and ready!
==> default: Checking for guest additions in VM...
    default: The guest additions on this VM do not match the installed version of
    default: VirtualBox! In most cases this is fine, but in rare cases it can
    default: prevent things such as shared folders from working properly. If you see
    default: shared folder errors, please make sure the guest additions within the
    default: virtual machine match the version of VirtualBox you have installed on
    default: your host and reload your VM.
    default:
    default: Guest Additions Version: 6.0.0 r127566
    default: VirtualBox Version: 7.1
==> default: Mounting shared folders...
    default: C:/Users/35389/Desktop/TU856 Modules/YEAR 3/Year 3 - Semester 2/Introduction to DevOps - Eoin Rogers/Labs/Week 4/Lab 3 - Vagrant => /vagrant
==> default: Running provisioner: shell...
    default: Running: inline script
    default:
    default: WARNING: apt does not have a stable CLI interface. Use with caution in scripts.
    default:
    default: Hit:1 https://security.debian.org/debian-security bookworm-security InRelease
    default: Hit:2 https://deb.debian.org/debian bookworm InRelease
    default: Hit:3 https://deb.debian.org/debian bookworm-updates InRelease
    default: Hit:4 https://deb.debian.org/debian bookworm-backports InRelease
    default: Reading package lists...
    default: Building dependency tree...
    default: Reading state information...
    default: 9 packages can be upgraded. Run 'apt list --upgradable' to see them.
    default:
    default: WARNING: apt does not have a stable CLI interface. Use with caution in scripts.
    default:
    default: Reading package lists...
    default: Building dependency tree...
    default: Reading state information...
    default: python3 is already the newest version (3.11.2-1+b1).
    default: python3-venv is already the newest version (3.11.2-1+b1).
    default: python3-pip is already the newest version (23.0.1+dfsg-1).
    default: git is already the newest version (1:2.39.5-0+deb12u2).
    default: nano is already the newest version (7.2-1+deb12u1).
    default: vim is already the newest version (2:9.0.1378-2).
    default: curl is already the newest version (7.88.1-10+deb12u8).
    default: 0 upgraded, 0 newly installed, 0 to remove and 9 not upgraded.
    default: Requirement already satisfied: Flask in ./flask_venv/lib/python3.11/site-packages (3.1.0)
    default: Requirement already satisfied: Werkzeug>=3.1 in ./flask_venv/lib/python3.11/site-packages (from Flask) (3.1.3)
    default: Requirement already satisfied: Jinja2>=3.1.2 in ./flask_venv/lib/python3.11/site-packages (from Flask) (3.1.5)
    default: Requirement already satisfied: itsdangerous>=2.2 in ./flask_venv/lib/python3.11/site-packages (from Flask) (2.2.0)
    default: Requirement already satisfied: click>=8.1.3 in ./flask_venv/lib/python3.11/site-packages (from Flask) (8.1.8)
    default: Requirement already satisfied: blinker>=1.9 in ./flask_venv/lib/python3.11/site-packages (from Flask) (1.9.0)
    default: Requirement already satisfied: MarkupSafe>=2.0 in ./flask_venv/lib/python3.11/site-packages (from Jinja2>=3.1.2->Flask) (3.0.2)
==> default: Running provisioner: file...
```

7.2 Verify Flask is Running

```
vagrant@bookworm:~$ ps aux | grep flask
vagrant     1004  0.0  0.3   3876  1820 pts/0    S+   05:24   0:00 grep flask
```
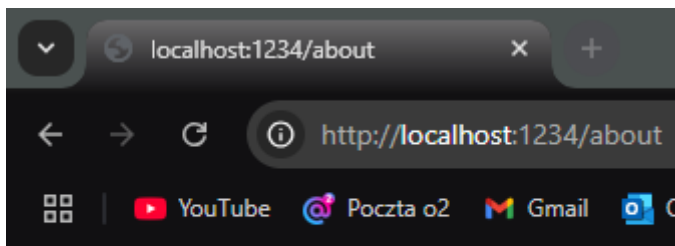
STEP 8: ACCESSING WEB APP FROM HOST MACHINE

http://localhost:1234 → Displays "Hello, World!" with link to /about.

http://localhost:1234/about → Displays "This is a Flask web app running in a Linux VM."

STEP 9: SHUTTING DOWN AND DESTROYING THE VM

9.1 Exit and Shutdown

9.2 Destroy VM