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ДИСЦИПЛИНА:

Распределенные системы

# Лабораторная работа 2. Проектирование и реализация простой клиент-серверной системы. HTTP, веб-серверы и веб-сервисы

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**Цель работы:** изучить методы отправки и анализа HTTP-запросов с использованием инструментов telnet и curl, настройку и анализ работы HTTP-сервера nginx, а также изучить концепции REST и RESTful API.

## Ход работы:

### 1.1 Установка telnet и curl

```
devops@devopsvm:~$ sudo apt-get install telnet curl
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
telnet is already the newest version (0.17+2.5-3ubuntu4).
The following additional packages will be installed:
  libcurl3t64-gnutls libcurl4t64
The following packages will be upgraded:
  curl libcurl3t64-gnutls libcurl4t64
3 upgraded, 0 newly installed, 0 to remove and 214 not upgraded.
Need to get 900 kB of archives.
After this operation, 0 B of additional disk space will be used.
Do you want to continue? [Y/n] Y
Get:1 http://ru.archive.ubuntu.com/ubuntu noble-updates/main amd64 curl amd64 8.5.0-2ubuntu10.4 [227 kB]
Get:2 http://ru.archive.ubuntu.com/ubuntu noble-updates/main amd64 libcurl4t64 amd64 8.5.0-2ubuntu10.4 [
341 kB]
Get:3 http://ru.archive.ubuntu.com/ubuntu noble-updates/main amd64 libcurl3t64-gnutls amd64 8.5.0-2ubunt
u10.4 [333 kB]
Fetched 900 kB in 7s (136 kB/s)
(Reading database ... 194276 files and directories currently installed.)
Preparing to unpack .../curl_8.5.0-2ubuntu10.4_amd64.deb ...
Unpacking curl (8.5.0-2ubuntu10.4) over (8.5.0-2ubuntu10.3) ...
Preparing to unpack .../libcurl4t64_8.5.0-2ubuntu10.4_amd64.deb ...
Unpacking libcurl4t64:amd64 (8.5.0-2ubuntu10.4) over (8.5.0-2ubuntu10.3) ...
Preparing to unpack .../libcurl3t64-gnutls_8.5.0-2ubuntu10.4_amd64.deb ...
Unpacking libcurl3t64-gnutls:amd64 (8.5.0-2ubuntu10.4) over (8.5.0-2ubuntu10.3) ...
Setting up libcurl4t64:amd64 (8.5.0-2ubuntu10.4) ...
Setting up libcurl3t64-gnutls:amd64 (8.5.0-2ubuntu10.4) ...
Setting up curl (8.5.0-2ubuntu10.4) ...
Processing triggers for man-db (2.12.0-4build2) ...
Processing triggers for libc-bin (2.39-0ubuntu8.3) ...
```

### 1.2 HTTP запрос в lenta.ru

```
devops@devopsvm:~$ sudo telnet lenta.ru 80
Trying 81.19.72.34...
Connected to lenta.ru.
Escape character is '^]'.
'
HTTP/1.1 400 Bad Request
Server: nginx
Date: Sat, 05 Oct 2024 08:49:59 GMT
Content-Type: text/html
Content-Length: 150
Connection: close

<html>
<head><title>400 Bad Request</title></head>
<body>
<center><h1>400 Bad Request</h1></center>
<hr><center>nginx</center>
</body>
</html>
```

```
devops@devopsvm:~$ curl -v https://lenta.ru/
* Host lenta.ru:443 was resolved.
* IPv6: 64:ff9b::5113:4821, 64:ff9b::5113:4820, 64:ff9b::5113:4822
* IPv4: 81.19.72.32, 81.19.72.34, 81.19.72.33
*   Trying 81.19.72.32:443...
* Connected to lenta.ru (81.19.72.32) port 443
* ALPN: curl offers h2,http/1.1
* TLSv1.3 (OUT), TLS handshake, Client hello (1):
*  CAfile: /etc/ssl/certs/ca-certificates.crt
*  CApath: /etc/ssl/certs
* TLSv1.3 (IN), TLS handshake, Server hello (2):
* TLSv1.2 (IN), TLS handshake, Certificate (11):
* TLSv1.2 (IN), TLS handshake, Server key exchange (12):
* TLSv1.2 (IN), TLS handshake, Server finished (14):
* TLSv1.2 (OUT), TLS handshake, Client key exchange (16):
* TLSv1.2 (OUT), TLS change cipher, Change cipher spec (1):
* TLSv1.2 (OUT), TLS handshake, Finished (20):
* TLSv1.2 (IN), TLS handshake, Finished (20):
* SSL connection using TLSv1.2 / ECDHE-ECDSA-AES128-GCM-SHA256 / X25519 / id-ecPublicKey
* ALPN: server accepted http/1.1
* Server certificate:
*  subject: CN=*.lenta.ru
*  start date: Jan 18 08:27:56 2024 GMT
*  expire date: Feb 18 08:27:55 2025 GMT
*  subjectAltName: host "lenta.ru" matched cert's "lenta.ru"
*  issuer: C=BE; O=GlobalSign nv-sa; CN=GlobalSign GCC R3 DV TLS CA 2020
*  SSL certificate verify ok.
*   Certificate level 0: Public key type EC/prime256v1 (256/128 Bits/secBits), signed using sha256WithRSAEncryption
*   Certificate level 1: Public key type RSA (2048/112 Bits/secBits), signed using sha256WithRSAEncryption
*   Certificate level 2: Public key type RSA (2048/112 Bits/secBits), signed using sha256WithRSAEncryption
* using HTTP/1.x
> GET / HTTP/1.1
> Host: lenta.ru
> User-Agent: curl/8.5.0
> Accept: */*
>
< HTTP/1.1 200 OK
< Server: nginx
< Date: Sat, 05 Oct 2024 08:55:49 GMT
```

## 1.3 Установка nginx

```
devops@devopsvm:~$ sudo apt-get install nginx
[sudo] password for devops:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  nginx-common
Suggested packages:
  fcgiwrap nginx-doc
The following packages will be upgraded:
  nginx nginx-common
2 upgraded, 0 newly installed, 0 to remove and 212 not upgraded.
Need to get 552 kB of archives.
After this operation, 0 B of additional disk space will be used.
Do you want to continue? [Y/n] Y
Get:1 http://ru.archive.ubuntu.com/ubuntu noble-updates/main amd64 nginx amd64 1.24.0-2ubuntu7.1 [521 kB]
Get:2 http://ru.archive.ubuntu.com/ubuntu noble-updates/main amd64 nginx-common all 1.24.0-2ubuntu7.1 [31.2 kB]
Fetched 552 kB in 1s (736 kB/s)
Preconfiguring packages ...
(Reading database ... 194276 files and directories currently installed.)
Preparing to unpack .../nginx_1.24.0-2ubuntu7.1_amd64.deb ...
Unpacking nginx (1.24.0-2ubuntu7.1) over (1.24.0-2ubuntu7) ...
Preparing to unpack .../nginx-common_1.24.0-2ubuntu7.1_all.deb ...
Unpacking nginx-common (1.24.0-2ubuntu7.1) over (1.24.0-2ubuntu7) ...
Setting up nginx (1.24.0-2ubuntu7.1) ...
 * Upgrading binary nginx
Setting up nginx-common (1.24.0-2ubuntu7.1) ...
Processing triggers for ufw (0.36.2-6) ...
Processing triggers for man-db (2.12.0-4build2) ...
```

## Настройка

```
devops@devopsvm:~$ sudo systemctl start nginx
devops@devopsvm:~$ sudo systemctl enable nginx
Synchronizing state of nginx.service with SysV service script with /usr/lib/systemd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable nginx
devops@devopsvm:~$
```

1.4 Проверка статуса работы nginx

```
devops@devopsvm:~$ sudo systemctl status nginx
● nginx.service - A high performance web server and a reverse proxy server
     Loaded: loaded (/usr/lib/systemd/system/nginx.service; enabled; preset: enabled)
     Active: active (running) since Sat 2024-10-05 12:02:25 MSK; 1min 49s ago
       Docs: man:nginx(8)
   Main PID: 3258 (nginx)
      Tasks: 3 (limit: 3445)
     Memory: 2.4M (peak: 2.8M)
        CPU: 26ms
     CGroup: /system.slice/nginx.service
             ├─3258 "nginx: master process /usr/sbin/nginx -g daemon on; master_process on;"
             ├─3259 "nginx: worker process"
             └─3260 "nginx: worker process"

Oct 05 12:02:25 devopsvm systemd[1]: Starting nginx.service - A high performance web server and a reverse proxy server...
Oct 05 12:02:25 devopsvm systemd[1]: Started nginx.service - A high performance web server and a reverse proxy server.
```

1.5 Был открыт конфигурационный файл nginx для редактирования с помощью команды

sudo nano /etc/nginx/sites-available/default

1.6 Настройка виртуального хоста для обработки запросов к локальному сайту

```
  GNU nano 7.2
server {
 listen 80;
 server_name localhost;
 location / {
 root /var/www/html;
 index index.html index.htm;
 }
 location /api/ {
 proxy_pass http://127.0.0.1:5000/;
 proxy_set_header Host $host;
 proxy_set_header X-Real-IP $remote_addr;
 proxy_set_header X-Forwarded-For $proxy_add_x_forwarded_for;
 proxy_set_header X-Forwarded-Proto $scheme;
 }
}
```

1.7 Перезапуск nginx

```
devops@devopsvm:~$ sudo systemctl restart nginx
devops@devopsvm:~$
```

2.1 Установка Python

```
devops@devopsvm:~$ sudo apt-get install python3 python3-pip
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
python3 is already the newest version (3.12.3-0ubuntu2).
python3 set to manually installed.
python3-pip is already the newest version (24.0+dfsg-1ubuntu1).
0 upgraded, 0 newly installed, 0 to remove and 212 not upgraded.
devops@devopsvm:~$
```

2.2 Установка пакета Virtuallenv

```
devops@devopsvm:~$ sudo apt-get install python3-venv
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
python3-venv is already the newest version (3.12.3-0ubuntu2).
0 upgraded, 0 newly installed, 0 to remove and 212 not upgraded.
```

2.3 Создание новой виртуальной среды Python

```
devops@devopsvm:~$ ~python3 -m venv testenv
Command '~python3' not found, did you mean:
  command 'python3' from deb python3 (3.12.3-0ubuntu2)
  command 'bpython3' from deb bpython (0.24-1)
  command 'ipython3' from deb ipython3 (8.14.0-2)
Try: sudo apt install <deb name>
```

2.4 Активация виртуальной среды

```
devops@devopsvm:~$ source testenv/bin/activate
(testenv) devops@devopsvm:~$
```

2.5 Установка flask

```
(testenv) devops@devopsvm:~$ pip install flask
Collecting flask
  Downloading flask-3.0.3-py3-none-any.whl.metadata (3.2 kB)
Collecting Werkzeug>=3.0.0 (from flask)
  Downloading werkzeug-3.0.4-py3-none-any.whl.metadata (3.7 kB)
Collecting Jinja2>=3.1.2 (from flask)
  Downloading jinja2-3.1.4-py3-none-any.whl.metadata (2.6 kB)
Collecting itsdangerous>=2.1.2 (from flask)
  Downloading itsdangerous-2.2.0-py3-none-any.whl.metadata (1.9 kB)
Collecting click>=8.1.3 (from flask)
  Downloading click-8.1.7-py3-none-any.whl.metadata (3.0 kB)
Collecting blinker>=1.6.2 (from flask)
  Downloading blinker-1.8.2-py3-none-any.whl.metadata (1.6 kB)
Collecting MarkupSafe>=2.0 (from Jinja2>=3.1.2->flask)
  Downloading MarkupSafe-2.1.5-cp312-cp312-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (3.0 kB)
Downloading flask-3.0.3-py3-none-any.whl (101 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 101.7/101.7 kB 598.7 kB/s eta 0:00:00
Downloading blinker-1.8.2-py3-none-any.whl (9.5 kB)
Downloading click-8.1.7-py3-none-any.whl (97 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 97.9/97.9 kB 2.5 MB/s eta 0:00:00
Downloading itsdangerous-2.2.0-py3-none-any.whl (16 kB)
Downloading jinja2-3.1.4-py3-none-any.whl (133 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 133.3/133.3 kB 2.8 MB/s eta 0:00:00
Downloading werkzeug-3.0.4-py3-none-any.whl (227 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 227.6/227.6 kB 4.2 MB/s eta 0:00:00
Downloading MarkupSafe-2.1.5-cp312-cp312-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (28 kB)
Installing collected packages: MarkupSafe, itsdangerous, click, blinker, Werkzeug, Jinja2, flask
Successfully installed Jinja2-3.1.4 MarkupSafe-2.1.5 Werkzeug-3.0.4 blinker-1.8.2 click-8.1.7 flask-3.0.3 itsdangerous-2.2.0
```

2.6 Проверка версии flask

```
(testenv) devops@devopsvm:~$ flask --version
Python 3.12.3
Flask 3.0.3
Werkzeug 3.0.4
```

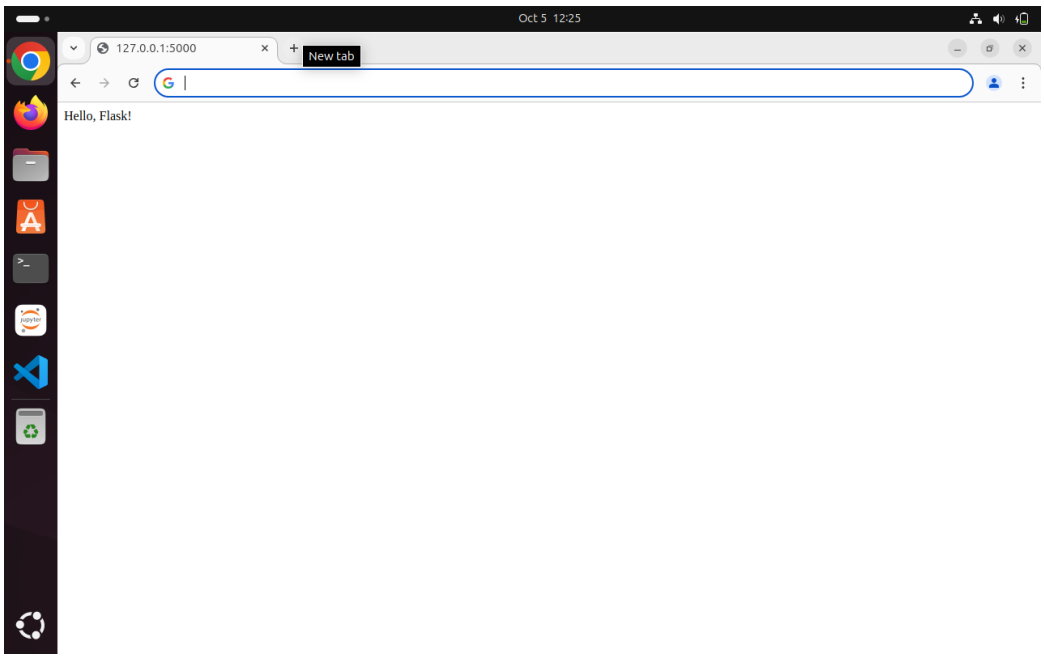
3.1-3.2 Был создан файл flasktest.py и написан следующий код для приветствия в приложение:

```
  GNU nano 7.2
import flask
app = flask.Flask(__name__)
@app.route('/')
def hello_world():
 return 'Hello, Flask!'
if __name__ == '__main__':
 app.run()
```

Запуск программы

```
(testenv) devops@devopsvm:~$ python3 flasktest.py
 * Serving Flask app 'flasktest'
 * Debug mode: off
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI
 * Running on http://127.0.0.1:5000
Press CTRL+C to quit
127.0.0.1 - - [05/Oct/2024 12:22:03] "GET / HTTP/1.1" 200 -
127.0.0.1 - - [05/Oct/2024 12:22:03] "GET /favicon.ico HTTP/1.1" 404 -
```

3.3 Проверка работы приложения flask 127.0.0.1:5000




Остановка процесса

```
(testenv) devops@devopsvm:~$ fuser -k 5000/tcp
(testenv) devops@devopsvm:~$
```

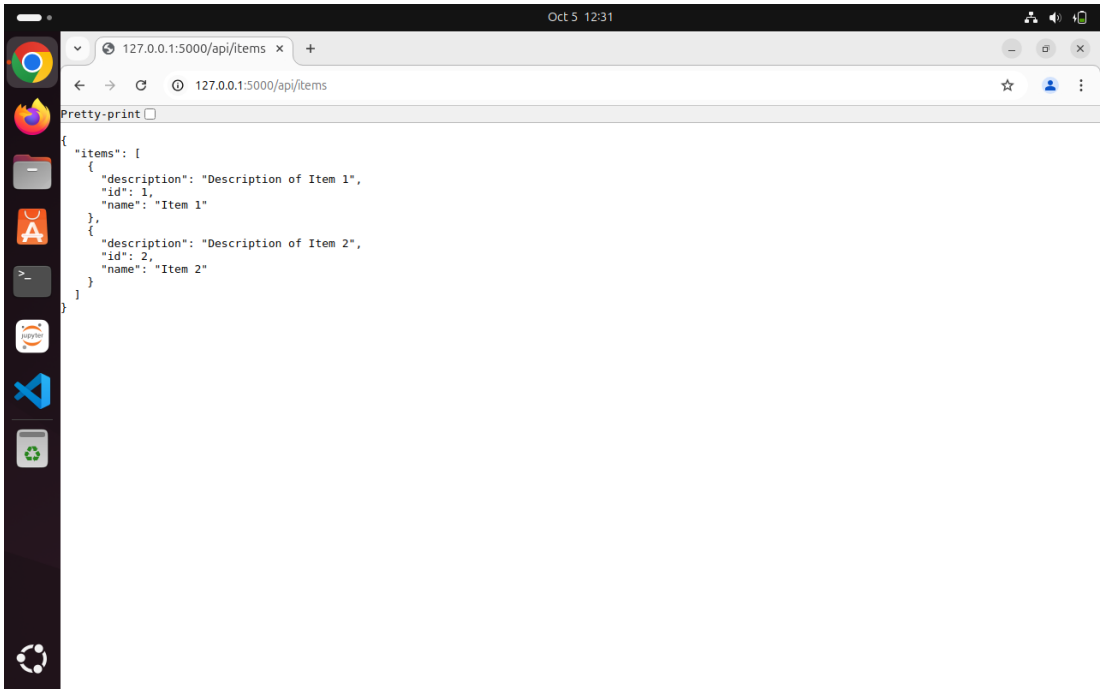
4.1 Создание простого Flask API.

```
  GNU nano 7.2                                        app.py
from flask import Flask, jsonify, request
app = Flask(__name__)
# Пример ресурсов
data = {
 "items": [
 {"id": 1, "name": "Item 1", "description": "Description of Item 1"},
 {"id": 2, "name": "Item 2", "description": "Description of Item 2"},
 ]
}
@app.route('/api/items', methods=['GET'])
def get_items():
 return jsonify(data)
@app.route('/api/items/<int:item_id>', methods=['GET'])
def get_item(item_id):
 item = next((item for item in data['items'] if item['id'] == item_id), None)
 if item:
  return jsonify(item)
 return jsonify({"error": "Item not found"}), 404
@app.route('/api/items', methods=['POST'])
def create_item():
 new_item = request.json
 data['items'].append(new_item)
 return jsonify(new_item), 201
if __name__ == '__main__':
 app.run(debug=True)
```

4.2 Запуск на порту 5000

```
(testenv) devops@devopsvm:~$ python3 app.py
 * Serving Flask app 'app'
 * Debug mode: on
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI s
erver instead.
 * Running on http://127.0.0.1:5000
Press CTRL+C to quit
 * Restarting with stat
 * Debugger is active!
 * Debugger PIN: 615-008-951
```

4.3 Проверка




5.1 В новом терминале был использован curl для взаимодействия с API через nginx

```
devops@devopsvm:~$ curl http://localhost:5000/api/items
{
  "items": [
    {
      "description": "Description of Item 1",
      "id": 1,
      "name": "Item 1"
    },
    {
      "description": "Description of Item 2",
      "id": 2,
      "name": "Item 2"
    }
  ]
}
devops@devopsvm:~$
```

Получение конкретного элемента

```
devops@devopsvm:~$ curl http://localhost:5000/api/items/1
{
  "description": "Description of Item 1",
  "id": 1,
  "name": "Item 1"
}
devops@devopsvm:~$
```

Создание нового элемента

```
(testenv) devops@devopsvm:~$ curl -X POST -H "Content-Type: application/json" -d '{"id":3,"name":"Item 3","description":"Description of Item 3"}' http://localhost:5000/api/items
{
  "description": "Description of Item 3",
  "id": 3,
  "name": "Item 3"
}
(testenv) devops@devopsvm:~$
```

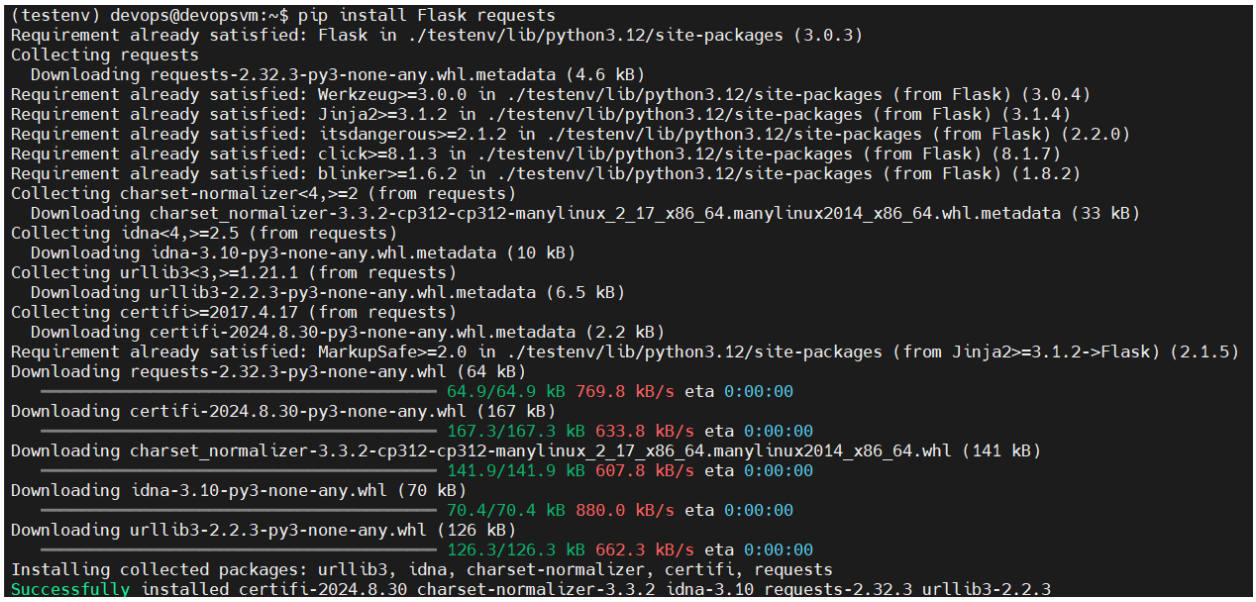
Индивидуальное задание

Создать конфигурацию nginx и REST API, которая будет взаимодействовать с указанным сайтом или API.

**5. Создание API для получения курса валют с cbr.ru.**

Ход работы:

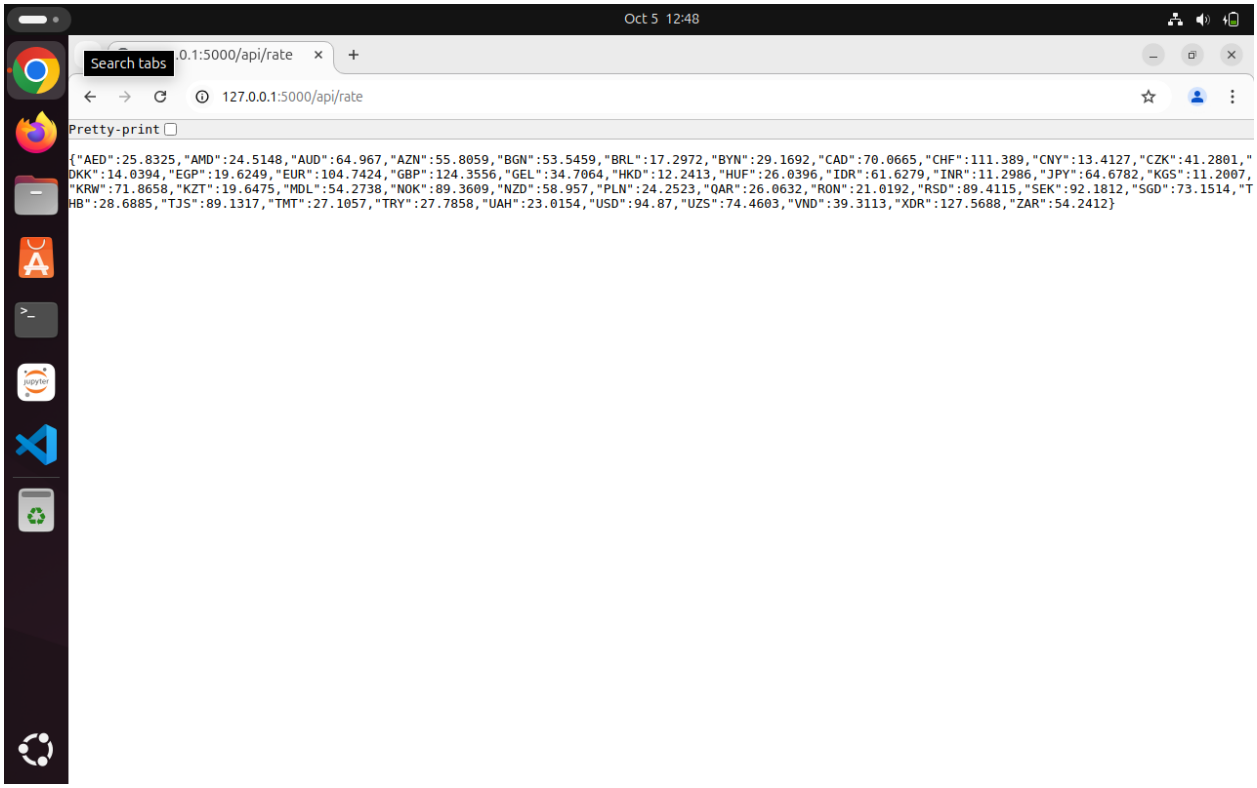
Установка модуля requests



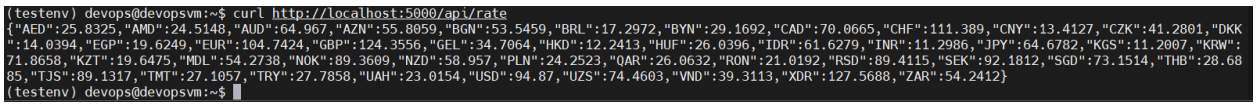

Был создан файл app1.py со следующим кодом

```
  GNU nano 7.2
from flask import Flask, jsonify
import requests
from xml.etree import ElementTree as ET

app = Flask(__name__)

@app.route('/api/rate', methods=['GET'])
def get_exchange_rate():
    url = "https://www.cbr.ru/scripts/XML_daily.asp"
    response = requests.get(url)

    if response.status_code == 200:
        root = ET.fromstring(response.content)
        rates = {}
        for child in root.findall('Valute'):
            char_code = child.find('CharCode').text
            value = float(child.find('Value').text.replace(',', '.'))
            rates[char_code] = value
        return jsonify(rates)
    else:
        return jsonify({'error': 'Failed to retrieve data'}), 500

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

Проверка




С помощью curl вернем json с курсами валют




Вывод: были изучены методы отправки и анализа HTTP-запросов с использованием инструментов telnet и curl, были проведены настройка и анализ работы HTTP-сервера nginx. Также были изучены концепции REST и RESTful API. Было выполнено индивидуальное задание на закрепление вышеперечисленных знаний.