

## Assignment 2 - Development Team Project: Coding Output

*Team:* The Red Team

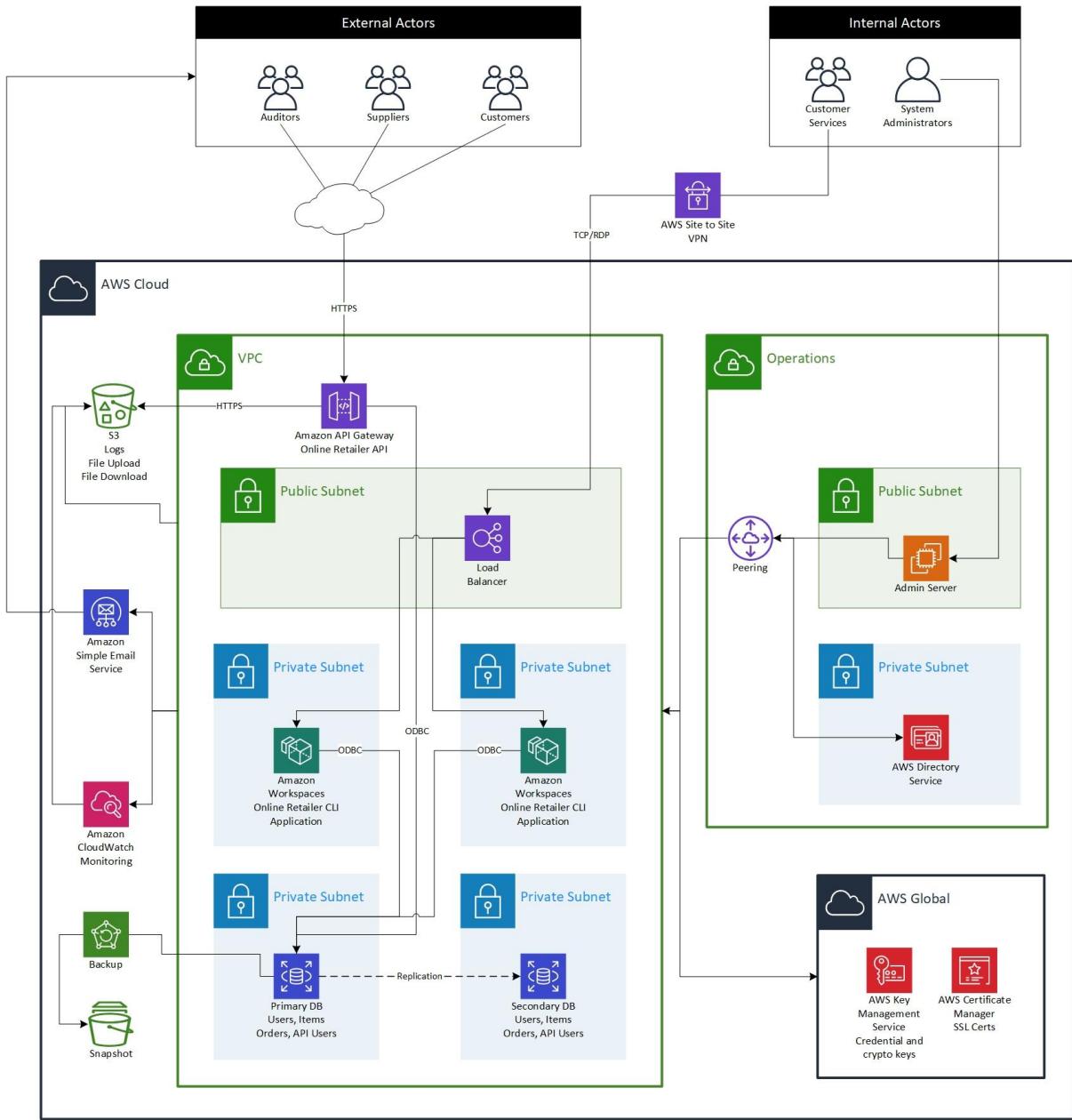
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*Word Count:* 1785

### **Application Description**

The application build consists of Python scripts that define classes containing downstream functions which allow all application functionalities (including CRUD, encryption and API functionality), JSON files to store data, scripts to access and run the API and store information on it, files that store log records, and scripts which set and store login and security keys. Application usage or the UI occurs via a terminal Command Line Interface (CLI) and allows a public individual to register themselves as a user or for an administrator to login (both by running ‘onlineretailer.py’) after setting an administrator key in the backend via running the ‘adminCreator.py’ script. Both the user and administrator roles are permissions limited. The auditor role cannot access the CLI, but rather accesses the API to view logs of access and system events via running the ‘server.py’ script.

The application is built with a microservice architecture. This means that each of the application’s code sets are encapsulated in their own methods and interact only with the necessary modules. Improving scalability, modifiability, testability and efficiency. The current version of the application is not network supported, it is locally accessed for the locally registered user. An administrator can access the application locally or via http or https if the optional SSL certification functionality is turned on.



^^^ Illustrated above is the structure of a proposed network supported version of the application running in AWS. By exposing backend applications through API gateways and load balancers to manage client based traffic and implementing various AWS components it would allow a secure and adaptable infrastructure and application stack.

## **Application Security Features**

Security measures implemented include, input sanitisation, data encryption, recurring authentication requirements, system action and event logging, password complexity requirements, data normalisation, role based access control, tagging inputs with user ID, manipulating store and user data via an API, review of the coding after linting and optional SSL certification functionality which is turn-'onable' or '-offable'.

Password encryption involves encrypting a password (which must meet specified complexity requirements) with a key that is then used downstream to decrypt the password when matching it to user input when it is retrieved. Encrypted login data is used to separate the access of differing types of users because the permissions accessible to them are associated with their specific type of account and authentication is required at key stages of use, not only the login stage. Additionally, data input sanitisation is built-in to the application functionality for when the user is prompted to provide input. All data retrieved or generated is formatted and deposited into JSON or .key files and this is even more so true for the logging data accessible to an auditor via the API. Furthermore, not just any data is retrieved, there are complexity requirements filtering user input. And, in more detail, the API built provides not only logs and records of system actions for an auditor to analyse, also it allows administrators to edit the item catalogue, order record and details for users accounts via http or https (if SSL certification is enabled).

Overall, the application's low attack surface is allowed because the application is accessible locally by a single terminal in which a user can only view their account and related data. Thus, the application is built based on an enclosed deployment and a limited usership model.

In accordance with the principles of agile and lean software development, the team perceived no need at this time, considering the style of the application usage and this being a first-time deployment, that the entire database should be encrypted. Furthermore, SSL

certification as it relates to accessing the API can be enabled or disabled as desired and this is ideal because it would be more likely for appropriate use of this program if the state of it was network deployable, which at this stage it is not.

### **Design vs. Actual Coding Output - Analysis**

The key differences between the design documentation and the actual coding output developed is as follows...

- A. Flask was replaced with FastAPI as the API technology or web framework utilised. This is because, although Flask is a lightweight and flexible microframework, FastAPI has a lower ‘ease of first time use’ barrier and more importantly, it provides the user with a user interface via http or https if SSL certification is turned on via the application back-end.
- B. The Mccabe linter was not utilised, instead Pylint and Flake8 were used

### **Application Data Structures**

Relational databases implemented in the application build...

1. JSON file containing the items available in the online retailer catalogue
2. JSON file containing the orders made by users
3. JSON file containing the locally registered secure user account
4. API database store containing the authorised auditor accounts
5. API database store containing the system actions and events log

## Application Run & Setting User Credentials

\*\*\*Visit the README.md file in the application source folder for more insight, especially regarding installation of the correct modules and tools.

*for administrators...*

Run ‘admincreator.py’.

Set the administrator key.

Run ‘onlineretailer.py’.

Logging in/registering a secure account >>

1. Administrators log in to their account by entering the unique administrator key that was set prior.

Accessing the main administrator menu >>

2. Administrators access the application menu where they can enter any prompted number to access the associated functionality.

```
[x] 
/usr/local/bin/python3 /Users/liamwillson/Desktop/Application/onlineretailer.py
○ liamwillson@Liams-MBP Application % /usr/local/bin/python3 /Users/liamwillson/Desktop/Application/onlineretailer.py

Welcome. It appears you have no account.
Input the following information to create an account...

Enter 1 to continue or 2 to exit (administrators input 'admin'): admin

-----
Admin authentication...
Input administrator key to continue: admin

-----
This is an ADMINISTRATOR account view. Please exit if not an administrator.

Administrator actions marked with '!!!'

1. Create an item in the shop catalogue !!!
2. View entire item catalogue
3. Search catalogue by item ID
4. Search catalogue by item name
5. Search catalogue by item price
6. Delete an item from the shop catalogue !!!

7. View all user's orders !!!
8. Search all user's orders by order ID !!!
9. Delete any user's order !!!

10. View all user's details !!!
11. Edit any user's details !!!
12. Delete any user's account !!!

13. Edit administrator key !!!
14. Exit

-----
Input the corresponding number to the option you wish to choose: █
```

*for users...*

Run ‘onlineretailer.py’.

Logging in/registering a secure account >>

1. Users register or log in to their account
  - If registering, the user enters a username and password, in addition to their personal details related to their account (personal and payment details).
  - If logging in, the user enters their unique username and password.

Accessing the main user menu >>

2. User accesses the application menu where they can enter any prompted number to access the associated functionality.

```
sktop/SSD_Team_Project-main/Application/onlineretailer.py

Welcome. It appears you have no account. Input the following information to create an account...
Enter 1 to continue or 2 to exit (administrators input 'admin'): 1

Firstly, set your login information...
Input a password: test
Input a username: test

Now, set your personal information...
Input your name (first and surname): test
Input your email address: test
Input your house number: test
Input your street: test
Input your town: test
Input your country: test
Input your postcode: test

Finally, set your payment information...
Input your bank name: test
Input your bank account name: test
Input your bank account BSB: test
Input your bank account number: test

Input your card name: test
Input your card number: test
Input your card expiry: test
Input your card cvc: test

User created.

_____

Registered user detected. Loading login prompt...
Enter 1 to continue or 2 to exit (administrators input 'admin'): 1

Login to your account...

Input your username: test
Input your password: test

_____

Welcome to the shop. Please explore the following options.

Your user ID is: test.fHXnmuoZkS
Your username is: test

1. View entire item catalogue
2. Search catalogue by item ID
3. Search catalogue by item name
4. Search catalogue by item price

5. Order an item
6. View your orders
7. Search your orders by order ID
8. Edit an order of yours
9. Delete an order of yours

10. View your user details
11. Edit your user details
12. Delete your user account

13. Exit

_____

Input the corresponding number to the option you wish to choose: █
```

## Application Functional Testing

### Security Measure

Fernet  
Cryptography  
Encryption  
for users & for  
administrators

### Functional Testing

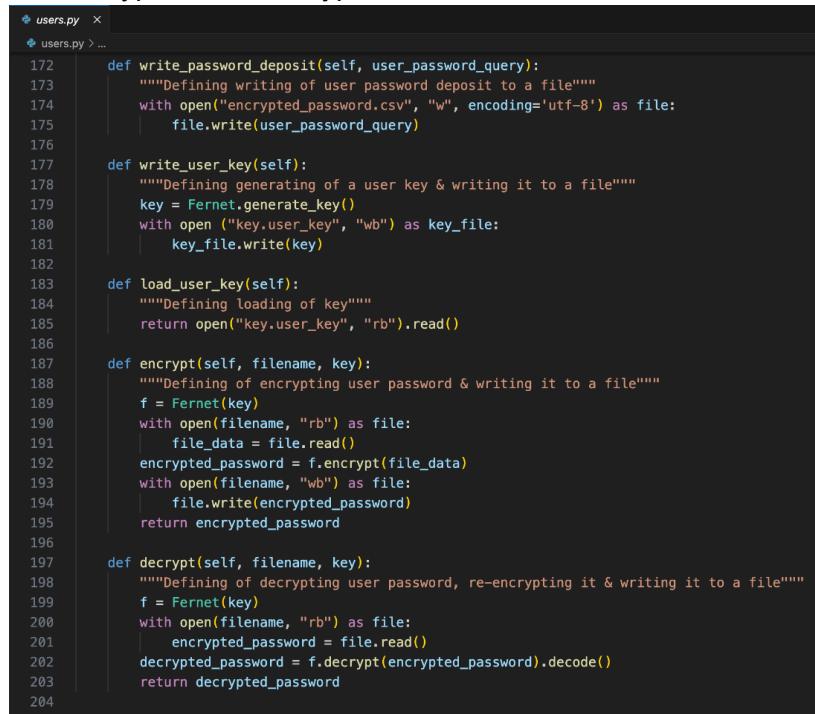
Fernet cryptography was used to encrypt a user's password when they set it during registering of their secure account and then it was used to decrypt it and compare it to the user's input when they entered their password to login to their secure account.

Retrieving input from the user to set a password, creating a deposit for the password, generating a Fernet encryption key and storing the key, and loading the key to use it to encrypt the password which is then written to the password deposit:



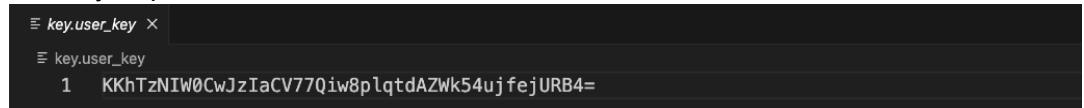
```
❸ onlineretailer.py ×
❸ onlineretailer.py > ...
24     #Setting a password, depositing it and encrypting it
25         i = 1
26         while i == 1:
27             user_password_query = input('Input a password (must be at least 8 characters): ')
28             if len(user_password_query) < 8 or len(user_password_query) > 30:
29                 print('Try again. Too short or too long.')
30             else:
31                 break
32         User.write_password_deposit(self, user_password_query)
33         User.write_user_key(self)
34         key = User.load_user_key(self)
35         User.encrypt(self, 'encrypted_password.csv', key)
```

The encryption and decryption functions defined:



```
❸ users.py ×
❸ users.py > ...
172     def write_password_deposit(self, user_password_query):
173         """Defining writing of user password deposit to a file"""
174         with open("encrypted_password.csv", "w", encoding='utf-8') as file:
175             file.write(user_password_query)
176
177     def write_user_key(self):
178         """Defining generating of a user key & writing it to a file"""
179         key = Fernet.generate_key()
180         with open ("key.user_key", "wb") as key_file:
181             key_file.write(key)
182
183     def load_user_key(self):
184         """Defining loading of key"""
185         return open("key.user_key", "rb").read()
186
187     def encrypt(self, filename, key):
188         """Defining of encrypting user password & writing it to a file"""
189         f = Fernet(key)
190         with open(filename, "rb") as file:
191             file_data = file.read()
192             encrypted_password = f.encrypt(file_data)
193             with open(filename, "wb") as file:
194                 file.write(encrypted_password)
195             return encrypted_password
196
197     def decrypt(self, filename, key):
198         """Defining of decrypting user password, re-encrypting it & writing it to a file"""
199         f = Fernet(key)
200         with open(filename, "rb") as file:
201             encrypted_password = file.read()
202             decrypted_password = f.decrypt(encrypted_password).decode()
203         return decrypted_password
204
```

The key deposit:



```
❸ key.user_key ×
❸ key.user_key
1   KKhtTzNIW0CwJzIaCV77Qiw8plqtdAZWk54ujfejURB4=
```

The encrypted password deposit:

```
encrypted_password.csv ×  
encrypted_password.csv  
1 gAAAAABlMSkVoJjLZVFBbmQ7T0QY8oWc-iq0XvPJFuIb0NX49cpsyTRlD8Kvz01_MKs0LSEmxczTClnldYzNjBVxaXdCreDQ4g==
```

Rejection of the login attempt if incorrect password inputted:

```
Registered user detected. Loading login prompt...  
Enter 1 to continue or 2 to exit (administrators input 'admin'): 1  
Login to your account...  
Input your username: testingtesting  
Input your password: incorrectpassword  
Incorrect entries. You exited...  
l Liamwillson@liams-mbp Application %
```

Acceptance of the login attempt if correct password inputted:

```
Registered user detected. Loading login prompt...  
Enter 1 to continue or 2 to exit (administrators input 'admin'): 1  
Login to your account...  
Input your username: testingtesting  
Input your password: testingtesting  
  
Welcome to the shop. Please explore the following options.  
Your user ID is: testingtesting.CqvdymrXZP  
Your username is: testingtesting  
1. View entire item catalogue  
2. Search catalogue by item ID  
3. Search catalogue by item name  
4. Search catalogue by item price  
5. Order an item  
6. View your orders  
7. Search your orders by order ID  
8. Edit an order of yours  
9. Delete an order of yours  
10. View your user details  
11. Edit your user details  
12. Delete your user account  
13. Exit  
  
Input the corresponding number to the option you wish to choose: %
```

*Note:* The combination of a correct username and password is required to login.

Backend Script To  
Set Administrator  
Key

An administrator is required to run in the backend the ‘adminCreator.py’ script to set the administrator key which is required to login as an administrator. The key is encrypted with Fernet cryptography and as described above, a key is generated which can decrypt the key when logging in.

### The ‘adminCreator.py’ script:

```
adminCreator.py > ...
1     """Importing necessary modules"""
2     ~
3     from admins import Admin
4
4     def main(self):
5         """Defining main program"""
6     #Defining administrator authentication, depositing it and encrypting it
7         admin_authenticator = input('Set the administrator key: ')
8         Admin.write_administrator_deposit(self, admin_authenticator)
9         Admin.write_admin_key(self)
10        key = Admin.load_admin_key(self)
11        Admin.encrypt(self, 'admin_key.csv', key)
12
13    #Run program
14    if __name__ == '__main__':
15        main(main)
16
```

If an administrator key does not yet exist and login is attempted:

```
Registered user detected. Loading login prompt...
Enter 1 to continue or 2 to exit (administrators input 'admin'): admin
Administrator access unavailable. You exited...
liamwillson@liams-mbp Application %
```

Setting the administrator key:

```
esktop/SSD_Team_Project-main 2/Application/adminCreator.py"
Set the administrator key: admin
liamwillson@liams-mbp Application %
```

### Input Sanitisation

When input is retrieved from the user, not just any input will be accepted.  
Inputs that require strings will accept strings and inputs that require integers will accept integers:

```
onlineretailer.py 2 > main
1     #Setting payment information for user account
2     ~
3     print('')
4     i = 1
5     while i == 1:
6         print('Finally, set your payment information...')
7         user_bank_name_query = input('Input your bank name: ')
8         user_bank_account_name_query = input('Input your bank account name: ')
9         user_bank_account_bsb_query = input('Input your bank account BSB: ')
10        user_bank_account_number_query = input('Input your bank account number: ')
11        print('')
12        user_card_name_query = input('Input your card name: ')
13        user_card_number_query = input('Input your card number: ')
14        user_card_expiry_query = input('Input your card expiry: ')
15        user_card_cvc_query = input('Input your card cvc: ')
16        if (user_bank_account_bsb_query.isdigit() is False or user_bank_account_number_query.isdigit() is False or
17            user_card_number_query.isdigit() is False or user_card_expiry_query.isdigit() is False or
18            user_card_cvc_query.isdigit() is False):
19            print('')
20            print('You entered characters in an input field that required digits only. Try again.')
21            print('')
22        else:
23            break
```

Setting a password requires a minimum and maximum character limit:

```
❸ onlineretailer.py 2 ✘
❹ onlineretailer.py > ⌂ main
25  #Setting a password, depositing it and encrypting it
26      i = 1
27      while i == 1:
28          user_password_query = input('Input a password (must be at least 8 characters): ')
29          if len(user_password_query) < 8 or len(user_password_query) > 30:
30              print('Try again. Too short or too long.')
31          else:
32              break
```

*Note:* These are examples of some of the input sanitisation measures implemented in the application.

## Data normalisation

When input is retrieved from users, in some cases it is normalised before it's deposited in storage or a database. For example, data inputted by the user is transformed to lowercase:

```
❸ onlineretailer.py 2 ✘
❹ onlineretailer.py > ⌂ main
232  #Requesting order information input from user
233      order_name_query = str(input('Input the name for the order: ')).lower()
234      order_item_query = str(input('Input the item you want to order: ')).lower()
235      order_quantity_query = str(input('Input the number of the item you want to order: ')).lower()
236      ~ order_delivery_type_query = str(input('Input P for pickup OR M for mail delivery: ')).lower()
237      print('')
238      abort_query = str(input("To execute order input '1' or to cancel '2': "))
239      if abort_query == str(1):
240          #Calling create_order function which commits inputted information to orders.json
241          Order.create_order(self, order_id_query=order_id_query,
242                             order_username_query=order_username_query,
243                             order_name_query=order_name_query, order_item_query=order_item_query,
244                             order_quantity_query=order_quantity_query,
245                             order_delivery_type_query=order_delivery_type_query)
246      user_menu(self)
```

## API:

Authentication &  
SSL Certification

This application is built with an API that allows an auditor or administrator to retrieve a log of system actions and events, retrieve the item catalogue, add an time to the item catalogue, update the quantity of an order submitted, delete an order submitted or upload a data file (e.g. a comprehensive item catalogue) to the application.

SSL certification can be enabled or disabled in the current version. If enabled, the API is accessed via https and SSL certification is required and if disabled, via http and SSL certification is not required.

SSL certification is enabled if 'SSL = 'TRUE" & 'SECURE = 'TRUE" or disabled if 'SSL = 'FALSE" & 'SECURE = 'FALSE":

```
❸ server.py ✘
❹ server.py > ...
1  """Importing necessary modules"""
2  import uvicorn
3
4  #Variables SSL
5  SSL = 'TRUE'
6  SECURE = 'TRUE'
7  HOST = 'localhost'
8  PORT = 8432
9  RELOAD = True
10 SSL_KEY_FILE = 'localhost+2-key.pem'
11 SSL_CERT_FILE = 'localhost+2.pem'
```

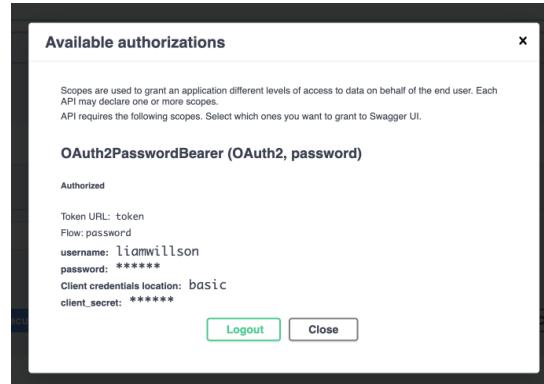
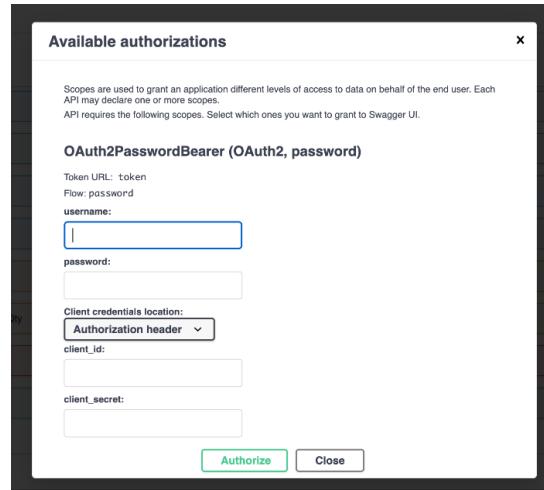
The API accessed via https:

FastAPI 0.1.0 OAS 3.1

/openapi.json

The screenshot shows the FastAPI Swagger UI interface. At the top right is an "Authorize" button with a lock icon. Below it, the "default" endpoint group is listed with various HTTP methods and their corresponding URLs. Some endpoints like "/token" and "/get-api-log" are highlighted in green, while others like "/add-item" and "/update-order-qty" are orange. A red highlight covers the "/delete-order" endpoint. The bottom section displays the "Schemas" for the API, listing "Body\_login\_token\_post", "Body\_upload\_upload\_file\_post", "HTTPValidationError", and "ValidationError". Each schema has an "Expand all" link next to it.

SSL certification enabled requires the auditor or administrator accessing the API to authenticate themselves:



## API: Application Actions

### Actions allowed by the API:

GET	/ Root	v
POST	/token Login	v
GET	/get-api-log Get Api Log	🔒 v
GET	/get-items Get Items	🔒 v
PUT	/add-item Add Items	🔒 v
PUT	/update-order-qty Update Order Qty	🔒 v
DELETE	/delete-order Delete Order	🔒 v
POST	/upload-file Upload	🔒 v

### Example of adding an item to the local 'items.json' via the API:

PUT /add-item Add Items

Adds items to the items json file

Parameters

Name	Description
item_id * required	007
item_name * required	Flower Seeds
item_price * required	50.00
item_description * required	Seeds that grow flowers.
item_stock * required	70

Responses

Curl

```
curl -X 'PUT' \
'http://localhost:8432/add-item?item_id=007&item_name=Flower%20Seeds&item_price=50.00&item_description=Seeds%20that%20grow%20flowers.&item_stock=70' \
-H 'accept: application/json'
```

Request URL

```
http://localhost:8432/add-item?item_id=007&item_name=Flower%20Seeds&item_price=50.00&item_description=Seeds%20that%20grow%20flowers.&item_stock=70
```

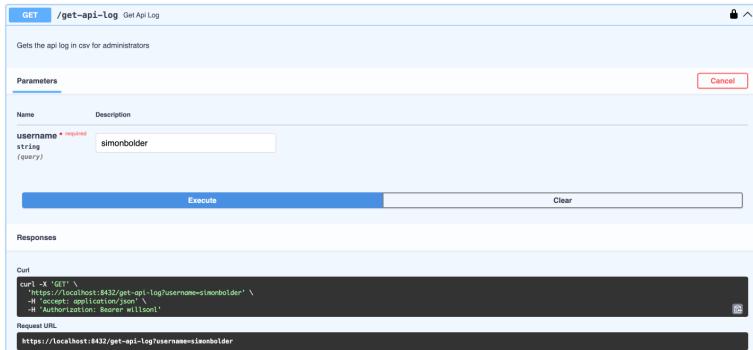
Server response

### Updated 'items.json':

```
{
  "items": [
    {
      "itemID": "test",
      "itemName": "test",
      "itemPrice": "test",
      "itemDescription": "test",
      "itemStock": "test"
    },
    {
      "itemID": "007",
      "itemName": "Flower Seeds",
      "itemPrice": "50.00",
      "itemDescription": "Seeds that grow flowers.",
      "itemStock": "70"
    }
  ]
}
```

## API: System Action & Event Logging

The API also allows auditors and administrators to view logs of system actions and events:



A screenshot of a REST API testing tool. The URL is /get-api-log. A parameter 'username' is set to 'simonboldr'. The tool shows the curl command and the JSON response.

```
Curl -X 'GET' -d 'username=simonboldr' "https://localhost:8432/get-api-log?username=simonboldr" -H 'Accept: application/json' -H 'Authorization: Bearer token'
```

Request URL: https://localhost:8432/get-api-log?username=simonboldr

## Password Complexity Requirements

When it is required for the user to set a password, they must meet password complexity requirements. The following illustrates a basic implementation of this:

```
❸ onlineretailer.py x
❹ onlineretailer.py > ...
24  #Setting a password, depositing it and encrypting it
25      i = 1
26      while i == 1:
27          user_password_query = input('Input a password (must be at least 8 characters): ')
28          if len(user_password_query) < 8 or len(user_password_query) > 30:
29              print('Try again. Too short or too long.')
30          else:
31              break
```

## Role Based Access Control

The roles defined by the application build are: public, user, administrator and auditor. The public can open the application and register to become a user. When the application is launched, there is a user menu and an administrator menu available depending on which user type has logged in. Either menu presents different options characterised by different levels of permission to the appropriate user type. Thus, there is role based access control available.

The user menu:

```
❸ onlineretailer.py x
❹ onlineretailer.py > ...
160  #Defining the user menu
161  def user_menu(self):
162      """Defining the user ID and username to present it in the user menu"""
163      for i in User.user_data['users']:
164          user_id_query = i['userID']
165          user_username_query = i['userUsername']
166      #Defining the user menu display
167      print(f'''
168      -----
169      Welcome to the shop. Please explore the following options.
170      | Your user ID is: {user_id_query}
171      | Your username is: {user_username_query}
172      |
173      1. View entire item catalogue
174      2. Search catalogue by item ID
175      3. Search catalogue by item name
176      4. Search catalogue by item price
177      5. Order an item
178      6. View your orders
179      7. Search your orders by order ID
180      8. Edit an order of yours
181      9. Delete an order of yours
182      10. View your user details
183      11. Edit your user details
184      12. Delete your user account
185      13. Exit
186      -----
187      ''')
188      #Offering the user menu choices
189      user_choice = str(input('Input the corresponding number to the option you wish to choose: '))
190
191
192
193
```

### The administrator menu:

```
 ❸ onlineretailer.py 2 ×
 ❸ onlineretailer.py > ...
491 def administrator_menu(self):
492     """Defining the administrator menu"""
493     print(' ')
494     print('-----')
495     #Defining administrator authentication
496     print('Admin authentication...')
497     admin_authenticator = str(input('Input administrator key to continue: '))
498     key = Admin.load_admin_key(self)
499     admin_verify = User.decrypt(self, "admin_key.csv", key)
500     if admin_authenticator == str(admin_verify):
501         pass
502     else:
503         print('')
504         print('Incorrect entries. You exited...')
505         sys.exit()
506     #Defining the administrator menu display
507     print('-----')
508
509 This is an ADMINISTRATOR account view. Please exit if not an administrator.
510
511     |   Administrator actions marked with '!!!'
512
513     1. Create an item in the shop catalogue !!!
514     2. View entire item catalogue
515     3. Search catalogue by item ID
516     4. Search catalogue by item name
517     5. Search catalogue by item price
518     6. Delete an item from the shop catalogue !!!
519
520     7. View all user's orders !!!
521     8. Search all user's orders by order ID !!!
522     9. Delete any user's order !!!
523
524     10. View all user's details !!!
525     11. Edit any user's details !!!
526     12. Delete any user's account !!!
527
528     13. Edit administrator key !!!
529
530     14. Exit
531
532     ''))
533 #Offering the user menu choices
534     user_choice = str(input('Input the corresponding number to the option you wish to choose: '))
```

### ID Tagging

Upon registering a secure account, a random user ID is allocated to the user. When the user creates and submits an order, their user ID is tagged to their order for tracking and identification purposes. The user ID is unchangeable neither by the user themselves or administrators and is a combination of the username and a random string.

### Generating the random user ID:

```
 ❸ onlineretailer.py 2 ×
 ❸ onlineretailer.py > ...
39     #Generating a user ID
40     user_id_source = string.ascii_letters
41     user_id_suffix = ''.join(random.choice(user_id_source) for i in range(10))
42     user_id_query = str(user_username_query) + '.' + str(user_id_suffix)
```

Tagging the user ID to an order when the user creates an order:

```
❸ onlineretailer.py 2 ×
❹ onlineretailer.py > ⚭ user_menu
228     #Defining the order ID and username to equal the user's
229     for i in User.user_data['users']:
230         order_id_query = i['userID']
231         order_username_query = i['userUsername']
232     #Requesting order information input from user
233     order_name_query = str(input('Input the name for the order: ')).lower()
234     order_item_query = str(input('Input the item you want to order: ')).lower()
235     ~
236     ~
237     order_quantity_query = str(input('Input the number of the item you want to order: ')).lower()
238     order_delivery_type_query = str(input('Input P for pickup OR M for mail delivery: ')).lower()
239     print('')
240     abort_query = str(input("To execute order input '1' or to cancel '2': "))
241     if abort_query == str(1):
242         #Calling create_order function which commits inputted information to orders.json
243         Order.create_order(self, order_id_query=order_id_query,
244                             order_username_query=order_username_query,
245                             order_name_query=order_name_query, order_item_query=order_item_query,
246                             order_quantity_query=order_quantity_query,
247                             order_delivery_type_query=order_delivery_type_query)
248     user_menu(self)
```

Implementation of  
only necessary  
and known  
libraries

Only necessary and known libraries have been imported to ensure that no unnecessary dependencies are created. This is the same consideration for importing classes from scripts to other scripts.

‘onlineretailer.py’ modules:

```
❸ onlineretailer.py 2 ×
❹ onlineretailer.py > ⚭ user_menu
1     """Importing necessary modules"""
2     import sys
3     import os
4     import random
5     import string
6     from inputtimeout import inputtimeout
7     from users import User
8     from admins import Admin
9     from items import Item
10    from orders import Order
11
```

‘system.py’ modules:

```
❸ system.py 2 ×
❹ system.py > ...
1     """https://www.geeksforgeeks.org/encrypt-and-decrypt-files-using-python/
2     https://regex-generator.olafneumann.org"""
3
4     #Importing necessary modules
5     import json
6     from datetime import datetime
7     import re
8     from cryptography.fernet import Fernet
9     import filelogging
10
```

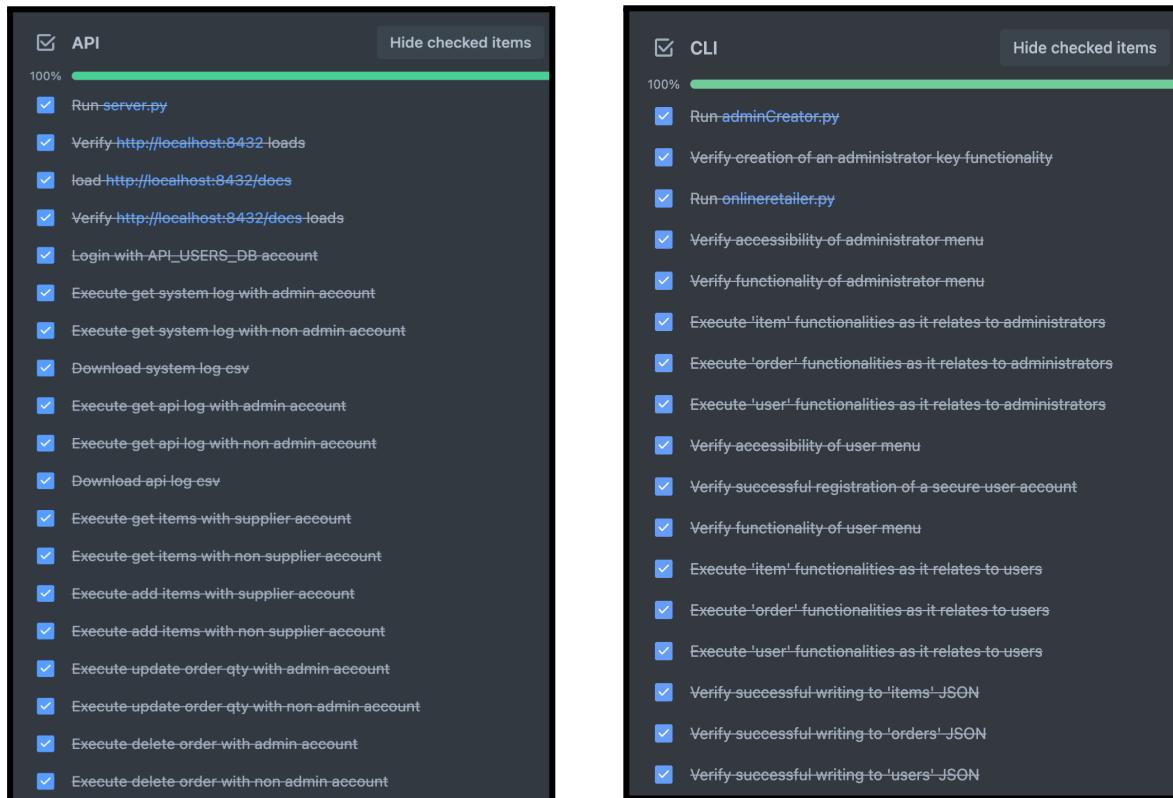
‘main.py’ modules:

```
main.py 9+ 
main.py > ...
1  '''Online Retailer API - written by team red as part of team project for SSD delivery using
2  tutorials and references from FASTAPI'''
3
4  # Importing necessary modules
5  import os
6  import json
7  from datetime import datetime
8  from typing import Union
9  from pydantic import BaseModel
10 from typing_extensions import Annotated
11 from fastapi import FastAPI
12 from fastapi.responses import FileResponse
13 from fastapi import Depends, FastAPI, HTTPException, status
14 from fastapi.security import OAuth2PasswordBearer, OAuth2PasswordRequestForm
15 from fastapi import File, UploadFile
16
```

## Trello

Trello was utilised as a collaborative tool that allowed the development team to employ the agile scrum development process. It was used to create tasks and assign them to cards that would then be pushed through the progressive stages of development. Access the development board via: <https://shorturl.at/IACQX>

The following evidences functional testing carried out for the application API and CLI and is illustrated on the development board linked above...



## OWASP (2021) Security Risk Considerations

Development sought to consider the security risks defined by OWASP (The Open Worldwide Application Security Project) (2021). Analysis of adherence to satisfying OWASP definitions:

<b><i>OWASP Web Application Security Risk</i></b>	<b><i>Application Implementations That Curtail The Risk</i></b>
A03:2021 - Injection	<ul style="list-style-type: none"><li>- Input sanitisation.</li></ul>
A07:2021 - Identification & Authentication Failures	<ul style="list-style-type: none"><li>- Password complexity requirements.</li><li>- Logging failed login attempts.</li></ul>
A02:2021 - Cryptographic Failures	<ul style="list-style-type: none"><li>- Cryptographic encryption of login information for users &amp; administrators using Fernet cryptography.</li><li>- Storage of encrypted hashed strings.</li></ul>
A01:2021 - Broken Access Control	<ul style="list-style-type: none"><li>- Robust roles and allocated permissions.</li><li>- No role inheritance.</li><li>- Separation of login portal and access of it dependent on role.</li></ul>
A05:2021 - Security Misconfiguration	<ul style="list-style-type: none"><li>- Implementation of only necessary, OWASP-approved and known libraries.</li><li>- Ensuring correct configuration of all technologies.</li></ul>
A06:2021 - Vulnerable & Outdated Components	<ul style="list-style-type: none"><li>- Implementation of a tool that checks for dependencies and security vulnerabilities.</li><li>- Usage and implementation of the latest version of all tools involved.</li></ul>
A09:2021 - Security Logging & Monitoring Failures	<ul style="list-style-type: none"><li>- Implementation of an effective and efficient API logging system.</li><li>- Storing log records in API database, which is protected by authentication requirements and optional SSL certificates.</li></ul>

## Application Security Testing

The system is prepared to particularly prevent 3 common types of attack: brute force attack (Luxemburk et al., 2021; OWASP, n.d.), denial of service attack (Humayun et al., 2020; OWASP, n.d.) and API injection (IEEE, 2022; OWASP, 2023).

### 1. API Injection Attack

- In order to prevent API Injection Attacks, the system features input sanitisation measures to ensure that the data inputted is only of a particular type when asked (such as inputs only accepting strings when asked or integers when asked). This security measure therefore prevents characters or strings that could inject harmful code into the system.
- The secure API file (called main.py) contains an “add-item” function that restricts authorised users to add items to the items.json file. This feature helps to prevent API injection attacks.
- In addition, an unsecure API file (called mainunsecure.py) has been created to show the security vulnerabilities of the Online Retailer API that can arise from API injection attacks. This file does not contain the security measures that are featured in the main.py file and therefore would represent an injection attack as it could inject unrestricted data into the json databases.

```
user_edit_choice = str(input('Input the corresponding number to the option you wish to choose:\n#Defining editing of user password function & exit option\nif user_edit_choice == str(1):\n    print('')\n    new_user_password = str(input('Input the new password: '))\n    User.edit_user(self, user_id_query=user_id_query, user_edit_choice=user_edit_choice,\n                  new_user_password=new_user_password, new_user_username="",\n                  new_user_name="", new_user_email_address="",\n                  new_user_house_number="", new_user_street="", new_user_town="",\n                  new_user_country="", new_user_postcode="", new_user_bank_name="",\n                  new_user_bank_account_name="", new_user_bank_account_bsb="",\n                  new_user_bank_account_number="", new_user_card_name="",\n                  new_user_card_number="" , new_user_card_expiry="",\n                  new_user_card_cvc="")\n    user_menu(self)\n#Defining editing of username function & exit option\nelif user_edit_choice == str(2):
```

<<<

This code demonstrates input sanitisation (here, ensuring that the inputted data is only string type).

```
@app.put("/add-item")\ndef add_items(token: Annotated[str, Depends(OAUTH2_SCHEME)], username: str,\n            item_id: str, item_name: str, item_price: str,\n            item_description: str, item_stock: str):\n    """Adds items to the items json file as a supplier"""\n    date_now = datetime.now()\n    date_str = date_now.strftime("%d/%m/%Y %H:%M:%S")\n    user_dict = API_USERS_DB.get(username)\n    user = UserInDB(**user_dict)\n    existing_items = []\n    if user.disabled is False:\n        if user.role == 'S':\n            for item in I_DATA['items']:\n                existing_items.append(item['itemID'])\n            if item_id in existing_items:\n                write_api_log('ADDITEMS', 'ERROR', date_str,\n                             'Item already exists in db - '\n                             + user.username , '409')\n                raise HTTPException(status_code=status.HTTP_409_CONFLICT,
```

<<<

The “add-item” function is limited only to authorised users and restricts users to add items to the items.json file.

## 2. Denial-of-Service (DoS) Attack

- The secure API file (called main.py) contains features that help to prevent Denial of Service (DoS) attacks. The “upload-file” function is limited only to authorised users and limits the file size and extension of the file. This would prevent a DoS attack.
- In addition, the unsecure API file (called mainunsecure.py) does not contain the security measures that are featured in the main.py file and therefore leaves the API vulnerable to a DoS attack.

```
@app.post("/upload-file")
async def upload(token: Annotated[str, Depends(OAUTH2_SCHEME)], username: str,
                 file: UploadFile = File(...)):
    """For customers to upload a file"""
    content_type = file.content_type
    cur_dir = os.getcwd() + '/uploads'
    date_now = datetime.now()
    date_str = date_now.strftime("%d/%m/%Y %H:%M:%S")
    user_dict = API_USERS_DB.get(username)
    user = UserInDB(**user_dict)
    if user.disabled is False:
        if user.role == 'C':
            if len(await file.read()) >= 1000:
                write_api_log('UPLOADFILE', 'ERROR', date_str,
                              'File is too large - ' + file.filename + ' - Size (KB) = ' +
                              str(file.size) + ' - ' +
                              user.username , '400')
                raise HTTPException(status_code=status.HTTP_400_BAD_REQUEST,
```

<<<

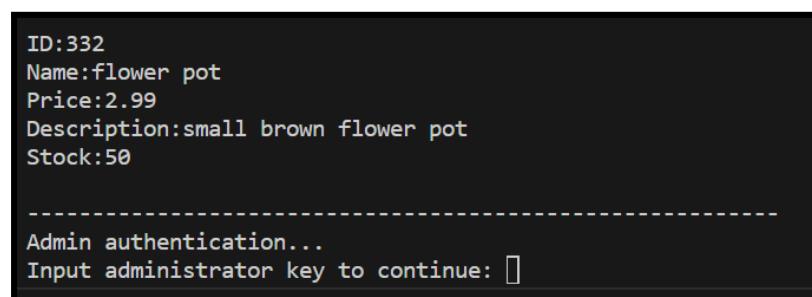
The “upload-file” function is limited only to authorised users and limits the file size to 1000KB.

## 3. Brute Force Attack

- The ‘onlineretailer.py’ contains features that help to prevent Brute Force Attacks including password complexity requirements, password encryption and administrator authentication.
- Password complexity requirements include making sure the minimum password length is 8 characters long as well as there being a 10 second time limit to input a password or else it will log you out.
- Administrator authentication requires the admin to authenticate themselves again if using CRUD functions - the system will prompt the admin to “Input administrator key to continue: ”
- These features can be turned off (commented out) which would make it more likely for Brute Force Attacks to occur.

```
#Setting a password, depositing it and encrypting it
    i = 1
    while i == 1:
        user_password_query = input('Input a password (must be at least 8 characters): ')
        if len(user_password_query) < 8 or len(user_password_query) > 30:
            print('Try again. Too short or too long.')
        else:
            break
    User.write_password_deposit(self, user_password_query)
    User.write_user_key(self)
    key = User.load_user_key(self)
    User.encrypt(self, 'encrypted_password.csv', key)
```

^^^ Code demonstrating the password complexity requirements (making sure the minimum password length is 8 characters long)



ID:332  
Name:flower pot  
Price:2.99  
Description:small brown flower pot  
Stock:50

-----  
Admin authentication...  
Input administrator key to continue: [ ]

<<<

Prompting an administrator to enter their admin key to continue...

## Application Linting

### *Pylint Linting*

The Pylint linter was used to identify stylistic, syntactical and programming errors and implement their solutions. Some examples of our Pylint linting...

‘users.py’ - Scored 3.22/10 before Pylint linting...

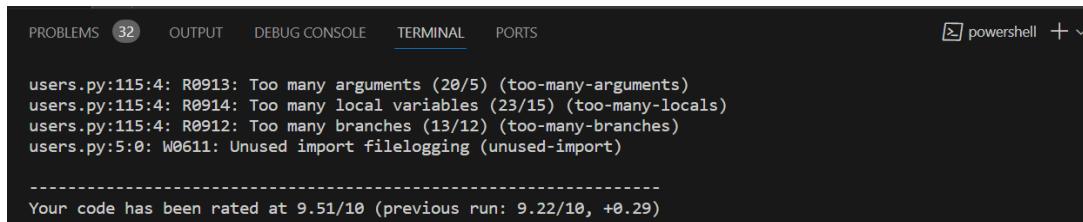


PROBLEMS 78 OUTPUT DEBUG CONSOLE TERMINAL PORTS powershell + ⌂

```
t-order)
users.py:4:0: C0411: standard import "import json" should be placed before "from cryptography.fernet import Fernet"
rt-order)
users.py:5:0: W0611: Unused import filelogging (unused-import)

-----
Your code has been rated at 3.22/10 (previous run: 3.22/10, +0.00)
```

then, ‘users.py’ - Scored 9.51/10 after Pylint linting...



PROBLEMS 32 OUTPUT DEBUG CONSOLE TERMINAL PORTS powershell + ⌂

```
users.py:115:4: R0913: Too many arguments (20/5) (too-many-arguments)
users.py:115:4: R0914: Too many local variables (23/15) (too-many-locals)
users.py:115:4: R0912: Too many branches (13/12) (too-many-branches)
users.py:5:0: W0611: Unused import filelogging (unused-import)

-----
Your code has been rated at 9.51/10 (previous run: 9.22/10, +0.29)
```

'onlineretailer.py' - Scored 5.82/10 before Pylint linting...

A screenshot of the VS Code interface showing the Terminal tab. The output window displays Pylint errors for the file 'onlineretailer.py'. The errors include:

```
der)
onlineretailer.py:9:0: C0411: standard import "import string" should be placed before "from users import User" (wrong-import-order)
-----
Your code has been rated at 5.82/10 (previous run: 5.82/10, +0.00)

PS C:\Users\Fergus Nugent\Documents\GitHub\SSD_Team_Project\Application> 
```

'onlineretailer.py' - Scored 9.03/10 after Pylint linting...

A screenshot of the VS Code interface showing the Terminal tab. The output window displays Pylint errors for the file 'onlineretailer.py' after it has been linted. The errors include:

```
onlineretailer.py:730:20: W0612: Unused variable 'new_user_card_name' (unused-variable)
onlineretailer.py:731:20: W0612: Unused variable 'new_user_card_number' (unused-variable)
onlineretailer.py:732:20: W0612: Unused variable 'new_user_card_expiry' (unused-variable)
onlineretailer.py:733:20: W0612: Unused variable 'new_user_card_cvc' (unused-variable)
-----
Your code has been rated at 9.03/10 (previous run: 7.97/10, +1.06)

PS C:\Users\Fergus Nugent\Documents\GitHub\SSD_Team_Project\Application> 
```

'items.py' - Scored 4.77/10 before Pylint linting...

A screenshot of the VS Code interface showing the Terminal tab. The output window displays Pylint errors for the file 'items.py' before it has been linted. The errors include:

```
-----
Your code has been rated at 4.77/10 (previous run: 4.77/10, +0.00)

PS C:\Users\Fergus Nugent\Documents\GitHub\SSD_Team_Project\Application> 
```

'items.py' - Scored 9.71/10 after Pylint linting...

A screenshot of the VS Code interface showing the Terminal tab. The output window displays Pylint errors for the file 'items.py' after it has been linted. The errors include:

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

-----
Your code has been rated at 9.71/10 (previous run: 9.57/10, +0.14)

● PS C:\Users\Fergus Nugent\Downloads\SSD_Team_Project-main\Application> pylint items.py
***** Module items
items.py:13:4: R0913: Too many arguments (6/5) (too-many-arguments)
items.py:98:14: W0631: Using possibly undefined loop variable 'i' (undefined-loop-variable)
-----
Your code has been rated at 9.71/10 (previous run: 9.71/10, +0.00)

PS C:\Users\Fergus Nugent\Downloads\SSD_Team_Project-main\Application> 
```

## Flake8 Linting

The Flake8 linter was used to prevent things like syntax errors, typos, bad formatting and incorrect styling. Some examples of our Flake8 linting...

'adminCreator.py' - before Flake8 linting...

A screenshot of the VS Code interface showing the Terminal tab. The output window displays Flake8 errors for the file 'adminCreator.py' before it has been linted. The errors include:

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

PS C:\Users\Fergus Nugent\Downloads\SSD_Team_Project-main\Application> flake8 admincreator.py
admincreator.py:4:1: E302 expected 2 blank lines, found 1
admincreator.py:6:1: E265 block comment should start with '# '
admincreator.py:13:1: E265 block comment should start with '# '
admincreator.py:14:1: E305 expected 2 blank lines after class or function definition, found 1
PS C:\Users\Fergus Nugent\Downloads\SSD_Team_Project-main\Application> 
```

'adminCreator.py' - after Flake8 linting...

```
PROBLEMS 3 OUTPUT DEBUG CONSOLE TERMINAL PORTS powershell  
PS C:\Users\Fergus Nugent\Downloads\SSD_Team_Project-main\Application> flake8 admincreator.py  
PS C:\Users\Fergus Nugent\Downloads\SSD_Team_Project-main\Application> []
```

'admins.py' - before Flake8 linting...

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS powershell + × ⓘ  
PS C:\Users\Fergus Nugent\Downloads\SSD_Team_Project-main\Application> flake8 admins.py  
admins.py:4:1: E302 expected 2 blank lines, found 1  
admins.py:14:18: E211 whitespace before '('  
admins.py:22:80: E501 line too long (89 > 79 characters)  
admins.py:32:80: E501 line too long (89 > 79 characters)
```

'admins.py' - after Flake8 linting...

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS powershell  
PS C:\Users\Fergus Nugent\Downloads\SSD_Team_Project-main\Application> flake8 admins.py  
PS C:\Users\Fergus Nugent\Downloads\SSD_Team_Project-main\Application> []
```

## Application GDPR Compliance, Due Diligence & Privacy Policy

The application has been developed according to the stipulations set out by the General Data Protection Regulation (GDPR) (General Data Regulation Protection, 2018), as data processing relates to:

1. Accessing the user data
2. Automated processing, erasure and data portability
3. Data integrity and confidentiality

Security measure implementation has been prioritised throughout the application development process in a best effort to protect user data. OWASP (2021) security risks have been mitigated appropriately.

Collected user data is for intended purpose only. No sharing with 3rd parties will occur. No exposure of the API externally or via network because it is accessed by http. Therefore, it is in our best confidence that the user data is only accessible to authorised members with appropriate and permitted access.

Although, processing of application data remains subject to:

1. Consent of the data subjects
2. Deployment of the application (i.e. commercialised or network deployed)

It is assumed that if this application was prepared for commercial deployment, then the application would be pushed through the correct legal process and the necessary documentation and policies would be written.

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