UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

Department of Computing

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IS52027C
Data, Networks and the Web

Duration: 3 hours

Date and time:

This paper is in two parts: part A and part B. You should answer ALL questions from part A and THREE questions from part B. Part A carries 40 marks, and each question from part B carries 20 marks. The marks for each part of a question are indicated at the end of the part in [.] brackets.

There are 100 marks available on this paper.

No calculators should be used.

THIS PAPER MUST NOT BE REMOVED
FROM THE EXAMINATION ROOM

Part A

Multiple choice

Question 1   This question has one correct answer

Which of the following, sent in a response header, would let the client of a web server know that their request had been fulfilled?   [1]
  A. `HTTP/1.1 202 Accepted`
  B. `GET /Protocols/HTTP/HTTP2.html HTTP/1.1`
  C. `HTTP/1.1 200 OK`
  B. `HTTP/1.1 404 Not Found`

Question 2   This question has one correct answer

Which sequence of words most accurately completes the following?   [1]

> In a _____ website, the source code for the website comes from files stored on the server which do not change. In a _____ web application, the source code is generated on the fly using _____ scripts.

  A. static, dynamic, server-side
  B. dynamic, data-driven, client-side
  C. normal, data-backed, dynamic
  D. dynamic, three-tier, CGI

Question 3   This question has one correct answer

What is Common Gateway Interface?   [1]
  A. Standard protocol providing full-duplex communication channels over a single TCP connection
  B. Standard protocol used by web servers to execute programs as if they were command-line applications
  C. Standard protocol used to facilitate a network conversation through which applications can exchange data
  D. Application protocol for distributed, collaborative, and hypermedia information systems

Question 4   This question has one correct answer

Which of the following is **NOT** a valid justification for making an HTTP request using the POST method?   [1]
  A. The size of the data being sent with the request exceeds 2048 characters
  B. The data being sent with the request is sensitive
  C. The data being sent with the request describes the information the client wants from the server
  D. The request will result in a destructive action being performed on the database

Question 5   This question has one correct answer

Which of the following is a cryptographic network protocol that will allow a user to run a remote terminal session securely? [1]
  A. Git
  B. Transport Layer Security
  C. Secure Sockets Layer
  D. Secure Shell

Question 6   This question has one correct answer

In what way might applying a `FOREIGN KEY` constraint to a field in a relational database help to ensure the integrity of the data it contains? [1]
  A. It forces a dependency between the foreign key field and a primary key field in another table. This has the effect of restricting or constraining the values it can contain.
  B. It means the data cannot be accessed without performing a table join. This makes it harder for a malicious user to inject erroneous data.
  C. It forces a dependency between two primary key fields. This effectively prohibits there being duplicate values.
  D. It establishes a many-to-one relationship between two entities in the database. This serves to increase data redundancy.

Question 7   This question has one correct answer

Which of the following is a standard data interchange format consisting of key-value and array data types? [1]
  A. XML
  B. FieldStorage
  C. BSON
  D. JSON

Question 8   This question has one correct answer

Which of the following is **NOT** a characteristic of the MongoDB database management system? [1]
  A. The ability to create Replica Sets
  B. The ability to perform ACID compliant transactions spanning multiple documents
  C. The data has no fixed schema
  D. The ability to perform sharding of data across multiple servers

Question 9   This question has one correct answer

What are the main implications regarding your answer to question 8? [1]
  A. There is no need to allocate space for empty fields in a Mongo database
  B. High levels of data redundancy and availability can be achieved
  C. Operations affecting multiple documents allow the possibility that inconsistencies may be introduced
  D. Performance is maintained as the amount of data increases

Question 10   This question has one correct answer

Which of these SQL statements is most similar to the following MongoDB query?   [1]

```
db.collection.find( { qty: { $gt: 4 } } )
```

   A.   SELECT * FROM Table WHERE Table.qty > 4;
   B.   SELECT Table.field FROM Table WHERE Table.qty > 4;
   C.   SELECT * FROM Table WHERE qty.gt == 4;
   D.   SELECT field FROM Table WHERE qty < 4;

Question 11   This question has one correct answer

Which attribute of an HTML input element is typically used to reference the form data after the form is submitted?   [1]
   A.   for
   B.   name
   C.   type
   D.   value

Question 12   This question has one correct answer

Which of these terms best describes the act of exploiting security vulnerabilities in web appplications in order to execute client-side scripts on other users' computers?   [1]
   A.   Cross-origin requests
   B.   Cross-site scripting
   C.   Code injection
   D.   Phishing

Question 13   This question has one correct answer

The figure below shows the first 5 tables in an Entity Relationship (ER) diagram for an online shoe store. According to the diagram, which of the following tables serves as a junction table?   [1]
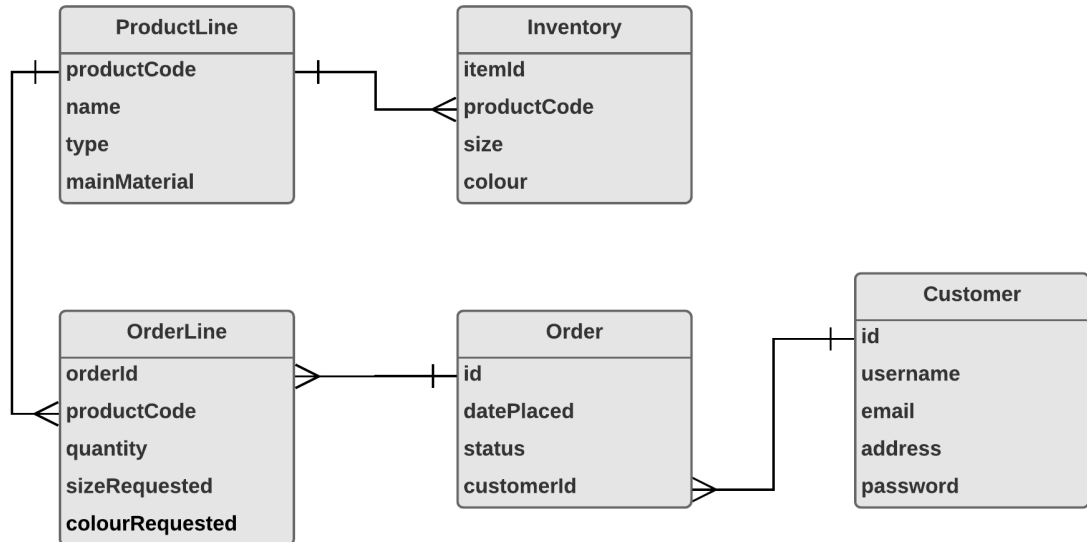
A.   ProductLine
B.   Order
C.   OrderLine
D.   Inventory

Question 14   This question has one correct answer

Referring to the same ER diagram from Question 13, what kind of association has been modelled between the Order and OrderLine tables?   [1]
A.   Zero-to-Many
B.   One-to-Many
C.   Many-to-Many
D.   These two tables are not related

Question 15   This question has one correct answer

Which of the following is **NOT** a direct justification for Separation of Concerns?   [1]
A.   Maximising code reuse
B.   Inreased portability
C.   Enhanced data security
D.   Reduced development time

Question 16   This question has one correct answer

When implementing the database depicted in the ER diagram from Question 13, how could the backend developer model a one-to-many association between Inventory and ProductLine?   [1]
  A.   By applying the `NOT NULL` constraint to the 'productCode' field in Inventory and making it a `FOREIGN KEY` referencing the `PRIMARY KEY` ('productCode') in the ProductLine table
  B.   It's not possible to model this kind of association directly
  C.   By applying `UNIQUE` and `NOT NULL` constraints to the 'productCode' field in Inventory, and making it a `FOREIGN KEY` referencing the `PRIMARY KEY` ('productCode') in the ProductLine table
  D.   By applying the `UNIQUE` constraint to the 'name' field in ProductLine, and making it a `FOREIGN KEY` referencing the `PRIMARY KEY` ('productCode') in the Inventory table

Question 17   This question has one correct answer

What effect might an expired SSL certificate have on the end-user of a web-based application?   [1]
  A.   The browser might warn them that the site is not trusted
  B.   They will be unable to access the site
  C.   They may be exposed to other users' data
  D.   The browser will prompt them to renew the certificate

Question 18   This question has one correct answer

In order to protect the integrity of data held in a database, which of the following should generally be considered?   [1]
  A.   Possibility of unauthorised access
  B.   Possibility of unexpected hardware failure
  C.   Possibility of human error
  D.   All of the above

Question 19   This question has one correct answer

In relational database management systems, what type of function operates on values from multiple rows in order to return a single value of higher significance?   [1]
  A.   Aggregate function
  B.   Join
  C.   Composite function
  D.   Pipeline operator

Question 20   This question has one correct answer

What name is given to some random data that is used as an additional input to a
one-way cryptographic function?   [1]
   A.   seed
   B.   bcrypt
   C.   salt
   D.   hash key

Question 21   This question has one correct answer

How does adding some random data to a password before hashing make it more
secure?   [1]
   A.   It increases the length of the cryptographic key
   B.   It makes the password longer
   C.   It protects it from rainbow tables
   D.   It increases the strength of the cryptographic algorithm

Question 22   This question has one correct answer

At which layer of the Internet Protocol Stack does HTTP operate?   [1]
   A.   link layer
   B.   internet layer
   C.   transport layer
   D.   application layer

Question 23   This question has one correct answer

The internet connections between processes on the client and on the server are
known as sockets. A connection is defined by a combination of the IP addresses
of both computers with what?   [1]
   A.   the port numbers
   B.   the URLs of both computers
   C.   the start and end times of the connection
   D.   the software running at each end of the connection

Question 24   This question has one correct answer

The difference between the GET and POST methods of HTTP can be charac-
terised in the following way: [1]
   A.   GET is the request, POST is the response
   B.   GET can't be cached, POST can be cached
   C.   GET is secure, POST is insecure
   D.   GET requests data, POST submits data

Question 25   This question has one correct answer

Routes in Flask are defined using statements like @app.route('/'), which comes
before the function that generates the response. This statement is known as: [1]
  A.   A class
  B.   A generator
  C.   A URL
  D.   A decorator

Question 26   This question has one correct answer

In which part of the HTTP conversation is a cookie passed between the client and
the server?   [1]
  A.   in the HTML
  B.   in the headers
  C.   in the URL
  D.   in an API

Question 27   This question has one correct answer

When a Flask view returns a string (e.g. return "hello, world!"), what will the
app to do turn it into a valid communication with the client (e.g. browser)?   [1]
  A.   convert it to "`<p>hello, world!</p>`"
  B.   serialise it
  C.   create a response object
  D.   hash it

Question 28   This question has one correct answer

In the context of the Flask framework, which of the following is **not** a commonly
used term?   [1]
  A.   Route
  B.   Endpoint
  C.   Breakpoint
  D.   View

Question 29   This question has one correct answer

If we want to create our page in Jinja using some common page elements that are
already in a template called base.html, we use the following statement at the top
of the new page template: [1]
  A.   inherits base.html
  B.   adapts base.html
  C.   absorbs base.html
  D.   extends base.html

Question 30   This question has one correct answer

If we want Flask to process a form submitted by a web page, the route should include: [1]
A.   methods = [POST]
B.   methods = [FORM]
C.   request.args
D.   a cookie

Question 31   This question has one correct answer

What general processing should we apply to any content returned by a web form?   [1]
A.   sanitise, validate
B.   convert to unicode
C.   hash, validate
D.   add to a session

Question 32   This question has one correct answer

When making a call from a web app to a database, the results are usually returned in an object which we can iterate over (e.g. to get the full set of results). This object is generally known as: [1]
A.   a commit object
B.   a mysql query
C.   a collection
D.   a database cursor

Question 33   This question has one correct answer

The Flask-SQLAlchemy extension enables us to work with data objects instead of using SQL queries. What does ORM stand for?   [1]
A.   Ordered-Results Matrix
B.   Object-Results Matrix
C.   Object-Relational Mapping
D.   Object-Row Manipulation

Question 34   This question has one correct answer

The Python function json.dumps serialises an object to JSON format, suitable for an API response. Flask's jsonify function adds to this by: [1]
A.   colour-coding the different parts of the JSON
B.   returning a Response object with the application/json mimetype
C.   converting the JSON into a Python dictionary
D.   converting the HTML in to JSON format

Question 35   This question has one correct answer

Of the four main HTTP methods used by APIs, two are GET and POST. The other two are: [1]
- A.   curl and wget
- B.   PUSH and POP
- C.   PLACE and REPLACE
- D.   PUT and DELETE

Question 36   This question has one correct answer

Flask uses Blueprints to: [1]
- A.   organise the application into distinct components
- B.   replace Python classes
- C.   set up APIs
- D.   make forms more secure

Question 37   This question has one correct answer

We can add a variable part to a URL in Flask, which is then passed to the view function as a variable. For a set of user pages for each username, this would take the form: [1]
- A.   `/?user=username`
- B.   `request.method='username'`
- C.   `('username')`
- D.   `d- @app.route('/user/<username>')`

Question 38   This question has one correct answer

A web application which allows you to create, edit and delete content can be said to implent the CRUD operations, where C stands for Create and D for delete. What to R & U stand for?   [1]
- A.   Read, Update
- B.   Reverse, Undo
- C.   Redirect, Update
- D.   Revise, Update

Question 39   This question has one correct answer

An app running on Flask's built in server is normally only visible locally, as the pages are served at `http://127.0.0.1:5000/`. What host setting makes the server publically available?   [1]
- A.   `host=192.168.0.1`
- B.   `host=*.*.*.*`
- C.   `host=''`
- D.   `host=0.0.0.0`

Question 40   This question has one correct answer

Python classes contain a constructor function (which in a web app, for example, might be used to initiate the database connection). These constructor functions have the form: [1]
   A.   def __name__ = __main__
   B.   def __init__(self)
   C.   def set(self)
   D.   class Construct

Part B

Question 41

You are a fullstack developer responsible for implementing the Shoe Shop application, for which you were given an ER diagram in Question 13.

  i. What database management system will you use for this application and why? [6]

 ii. The following table contains a random sample of some initial stock data for the Shoe Shop. Write the queries you would use to insert this data in a database. If applicable, include the queries you would need to run before being able to insert the data. Your answer should be consistent with your answer to part i).

productCode	name	type	mainMaterial	size	colour
12345	Tammy	boot	synthetic	6	black
12345	Tammy	boot	synthetic	4	brown

[10]

iii. Write one or more queries to retrieve the itemId's and colours of any boots named 'Tammy' which are currently in stock. [4]

Question 42

You are a middleware developer for a company which make web-based software for estate agencies.

The backend of the application has been developed in MySQL, and the middleware is written in Python.

i. The company expect to be able to sell their software to many estate agencies without needing to customise the middleware. However, they do need to be able to customise the frontend according to each agency's brand and style. What could you do as the middleware developer to facilitate this? [6]

ii. One of the company's clients has complained that users of their website have been receiving annoying popups. The popups have appeared on a part of the website which allows registered users to post reviews about the agency.

Explain how this might have happened, and what could be done to prevent it happening in the future. [6]

iii. Several of the agencies have requested a new feature be added to the application which will allow a registered user to save their search preferences.

Describe how this new feature will work and, where applicable, what changes you will make to the middleware in order to implement it. You may also describe the changes you would require a backend developer makes to an existing database.

You are free to make your own assumptions about the existing architecture of the application and its current database. [8]

Question 43

You are building a 'to do' list app using Flask.

i. Here is your first version of the script, with a single view that shows all the 'to do' items stored in your database.

```
from flask import Flask
from flask import render_template

class DBHelper:

    def __init__(self):
            self.db = pymysql.connect(host='localhost',
                user='user',
                passwd='password',
                db='database'))

    def get_all_to_do(self):
            query = "select * from to_do order by created_at desc;"
            with self.db.cursor() as cursor:
                cursor.execute(query)
                return cursor.fetchall()

app = Flask(__name__)

@app.route('/')
def index():
    to_do = db.get_all_to_do()
    return render_template("index.html", to_do=to_do)
```

Explain what the following lines do: [6]

```
from flask import Flask
app = Flask(__name__)
@app.route('/')
def index():
to_dos = db.get_all_to_dos()
return render_template("index.html", to_dos=to_dos)
```

ii. You have included a new view which adds a new 'to do' item submitted via a form, using a new call to the database which inserts the data. The view is shown below; what are the mistakes in the code?

```
@app.route('/add_to_do')
def add_twit():
    db.add_twit(request.form['to_do'])
    return redirect(url_for('/'))
```

[2]

iii. You decide to add user authentication to your app so users can log in to add 'to do' items. You will create this using the basic Flask framework i.e. without using any extensions.

Assuming there is a database method db_check_username_password(username, password) which returns True if there is a match for the user credentials, write suitable views for logging in and out. [6]

iv. How might this be improved by using the Flask-Login extension? How is this extension implemented and how does it achieve these improvements? Illustrate your answer with code snippets where relevant. [6]

Question 44

You have created a website where people can add and view music reviews.

i. Your index page displays the music reviews using a Jinja template. A link to the 'vote' view for each review is also provided (the review_id is passed to the 'vote' function). The template HTML for the main block in the page is shown below:

```
{% AAA "base.html" %}

{% BBB body %}

{% for review in reviews %}

<div class="row">
  <div class="col-md-2">CC1 review.username CC2</div>
  <div class="col-md-4">CC1 review.text CC2</div>
  <div class="col-md-3"><a href="{{ DDD('vote', review_id=review.review_id)
                                   }}">vote</a></div>
</div>
{% EEE %}

{% FFF %}
```

What words or symbols should replace the following: [6]
- AAA
- BBB
- CC1
- CC2
- DDD
- EEE
- FFF

ii. The use of templates by Flask is an example of a principle of programming known as 'Separation of Concerns'. What does this mean and why is it useful? [2]

iii. You decide to provide API access to the reviews so that people can make use of them on other websites or in offline analysis. Describe the characteristic of an API; how to they work, and how are they related to core web programming concepts such as CRUD and RESTful? [4]

iv. Assuming you are using a MySQL database backend with a database method db_get_reviews that selects all reviews and returns cursor.fetchall(), write a view to provide API access to these results. The API should provide access to all reviews and to reviews by a particular author. [4]

v. Describe how you would provide an API using a Flask extension. Include key parts of your code and comments to highlight key features. (You can assume the use of an ORM like Flask-SQLAlchemy if necessary). [4]