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 characteristics would you attribute to a web application, as opposed to a 'static' website?   [1]
  A.   Browser-based user interface
  B.   Client-side scripts
  C.   Dynamic content
  B.   HTTP requests

Question 2   This question has one correct answer

Which of these is another term for the type of data structure stored by key-value databases?   [1]
  A.   One-dimensional array
  B.   Index table
  C.   List
  D.   Dictionary

Question 3   This question has one correct answer

Which of the following is executed on the CLIENT-side?   [1]
  A.   Python
  B.   SQL
  C.   JavaScript
  D.   PHP

Question 4   This question has one correct answer

What kind of HTTP request is typically made when a user clicks a text hyperlink on a web page?   [1]
  A.   GET
  B.   POST
  C.   None. HTTP requests are only made when a user submits a form.
  D.   None. The request is made by the server, not the client.

Question 5   This question has one correct answer

In SQL, what type of constraint says that a particular field in a table uniquely
identifies each row in the table?   [1]
  A.   Unique
  B.   Foreign key
  C.   Not null
  D.   Primary key

Question 6   This question has one correct answer

In SQL, what type of constraint says that a field in one table should refer to a
primary key field in another table?   [1]
  A.   Primary key
  B.   Foreign key
  C.   Candidate key
  D.   Super key

Question 7   This question has one correct answer

A junction table can be used to resolve what kind of association between entities
in a relational database?   [1]
  A.   One-to-One
  B.   Many-to-One
  C.   Many-to-Many
  D.   Zero-to-Many

Question 8   This question has one correct answer

Which of the following is a database operation referred to in the CRUD acronym?   [1]
  A.   Reset
  B.   Revert
  C.   Rollback
  D.   Read

Question 9   This question has one correct answer

A MySQL database administrator wants to grant a user called 'admin' read and
write privileges on all tables in a single database called 'faceblob'. Which of the
following SQL statements might achieve this?   [1]
  A.   GRANT ALL ON 'faceblob'.* TO 'admin'@'localhost';
  B.   GRANT ALL ON *.'faceblob' TO 'admin'@'localhost';
  C.   GRANT * ON 'faceblob'.* TO 'admin'@'localhost';
  D.   GRANT ALL ON *.* TO 'admin'@'localhost';

Question 10   This question has one correct answer

In the MySQL DBMS, what effect does setting the `AUTOCOMMIT` boolean to false
have?   [1]
  A. Prevents the next SQL statement being treated as a transaction and
      committed implicitly
  B. Undoes transactions that have not already been committed to the
      database
  C. None. The default InnoDB storage engine already has `AUTOCOMMIT` false
      by default
  D. Signals every SQL statement should be treated as a transaction and
      committed implicitly

Question 11   This question has one correct answer

Generally speaking, which of the following is a relational database better suited
to?   [1]
  A. Distributing data across many servers
  B. Identifying patterns/relationships in big data (data mining)
  C. Analytical type queries affecting a whole data set
 D. Transaction type queries affecting whole records

Question 12   This question has one correct answer

Which of the following statements is generally true and supports your answer to
the previous question?   [1]
  A. Analytical types of query rarely affect the whole data set
  B. In a relational database, data tends to be serialized by column
  C. In a relational database, data tends to be serialized by row
  D. Table joins can be just as efficient on a sharded (distributed) relational
      database

Question 13   This question has one correct answer

The figure below shows the first 5 tables in an Entity Relationship (ER) diagram for a football game review application. According to the diagram, how many columns will the Game table have?   [1]
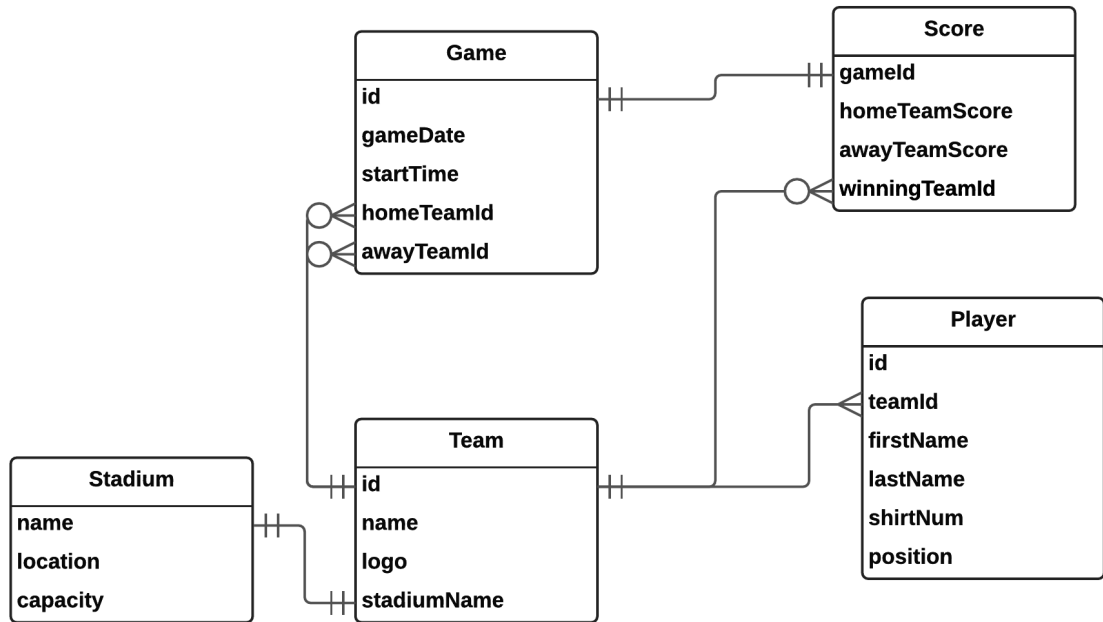
   A.   4
   B.   5
   C.   6
   D.   It's impossible to tell

Question 14   This question has one correct answer

Looking again at the ER diagram from question 13, what kind of logical association is there between Player and Team?   [1]
   A.   One-to-Many
   B.   Many-to-One
   C.   Many-to-Many
   D.   Zero-to-Many

Question 15   This question has one correct answer

It could be said that the Score table fails to meet 3rd normal form. Why might this be?   [1]
   A.   There is a one-to-one association between Score and Game
   B.   There are 2 foreign keys defined in the table
   C.   The winningTeamId field is not independent of all other fields in the table
   D.   The Score table should be integrated with the Game table

Question 16   This question has one correct answer

It has been indicated in the diagram that a One-to-One association exists between Stadium and Team. How could this type of relationship be implemented in a MySQL database?   [1]
  A. By applying the `NOT NULL` constraint to the 'stadiumName' field in Team, and making it a `FOREIGN KEY` referencing the `PRIMARY KEY` ('name') in the Stadium table
  B. It's not possible to model this kind of association directly
  C. By applying `UNIQUE` and `NOT NULL` constraints to the 'stadiumName' field in Team, and making it a `FOREIGN KEY` referencing the `PRIMARY KEY` ('name') in the Stadium table
  D. By applying the `UNIQUE` constraint to the 'name' field in Stadium, and making it a `FOREIGN KEY` referencing the `PRIMARY KEY` ('stadiumName') in the Team table

Question 17   This question has one correct answer

What is the 'L' in the LAMP acronym a type of?   [1]
  A. Server-side scripting language
  B. Database Management System
  C. Web server
  D. Operating system

Question 18   This question has one correct answer

In the MySQL database management system, what kind of statement would allow you to change the structure of an existing table?   [1]
  A. `ALTER TABLE`
  B. `UPDATE TABLE`
  C. `DROP TABLE`
  D. None. It is not possible to change the structure of a table after its creation

Question 19   This question has one correct answer

In SQL, a function that performs a calculation on a set of values and returns a single value is known as what?   [1]
  A. Aggregate function
  B. Cluster function
  C. Composite function
  D. Mathematical function

Question 20   This question has one correct answer

Which of the following is NOT an example of the type of function mentioned in
Question 19?   [1]
  A. COUNT()
  B. AVG()
  C. MAX()
  D. RAND()

Question 21   This question has one correct answer

What is the correct way to invoke the 'save' method of the object 'Data'?   [1]
  A. $Data()->save
  B. save->$Data
  C. $Data->save()
  D. $Data->save

Question 22   This question has one correct answer

What PHP function needs to be called on every page that uses sessions?   [1]
  A. session_start()
  B. session_get()
  C. sessions_name()
  D. get_session()

Question 23   This question has one correct answer

If a cookie is set at 10am on Monday using the following function, when will it
expire?

`setcookie("TestCookie", $value, time()+86400);`   [1]

  A. Monday 11am
  B. Monday 10pm
  C. Tuesday 10am
  D. Monday 10am in one week's time

Question 24   This question has one correct answer

Which of these statements would correctly print the day?   [1]
  A. `print "<p>Today is $weekday['today'].</p>"`
  B. `print "<p>Today is {$weekday['today']}.</p>";`
  C. `print "<p>Today is $weekday{[today']}.</p>"`
  D. `print '<p>Today is "$weekday["today"].</p>'`

Question 25   This question has one correct answer

The following statement will set $cur_page to the page number passed in a GET request, or default to page number 1. What character should replace X?   [1]

```
$cur_page=isset($_GET['pagenumber']) X $_GET['pagenumber'] :  1 ;
```

   A.   &

   B.   %

   C.   —

   D.   ?

Question 26   This question has one correct answer

Which of the following will correctly append $string_two to $string_one?   [1]

   A. $string_one . $string_two

   B. $string_one =+ $string_two

   C. $string_one .= $string_two

   D. $string_one .. $string_two

Question 27   This question has one correct answer

If you use the following autoload function, what filename should the class DataTable have?

```
function _autoload ($class)  require($class . '_class.php');
```
[1]

   A.   DataTable_class.php

   B.   datatable.php

   C.   datatable_class.php

   D. $DataTable.php

Question 28   This question has one correct answer

Which set of permissions for the upload directory would make it possible for a PHP upload script to save a file there, the server if the server is running as the process 'nobody'?   [1]

  i. -rwxrwxr-x root nobody

  ii. -r-xr-xr-x nobody nobody

 iii. -r-xrwxr-x nobody root

 iv. -rwxrwxr-x nobody root

   A.   i & ii

   B.   i & iv

   C.   ii & iv

   D.   ii & iii

Question 29   This question has one correct answer

Given the following PDO statements, which are being used to check login credentials, what should be passed as $data? [1]

```
$sql = "SELECT email FROM admin WHERE email = ? AND password = SHA1(?)";
$statement = $db->prepare( $sql );
$statement->execute( $data );
```

A. $data = "$email, $password";
B. $data = array($email, $password);
C. $data = $email . $password
D. $data = $email + $password

Question 30   This question has one correct answer

If you have written a class called OpenFile to open and read a file. Which of the following is needed in the class definition to allow you to pass a filename to a new instance of the object? [1]
A. property declaration
B. destructor function
C. constructor function
D. method declaration

Question 31   This question has one correct answer

In a certain MVC (Model View Controller) application, the following code is used in index.php to select a controller. If the navigation has been clicked, it makes a GET request that includes the selected page name. Otherwise the page defaults to 'blog'. What should replace X in the last line of the code? [1]

```
$navigation = isset( $_GET['page'] );
if ( $navigation ) {
    $contrl = $_GET['page'];
} else {
    $contrl = "blog";
}
include_once "controllers/admin/X.php";
```

A. $page
B. $default
C. $contrl
D. $blog

Question 32   This question has one correct answer

Would the structure of the relationship between Model, View and Controller in an
MVC website best be described as: [1]
  A.   three layers
  B.   a triangle
  C.   linear
  D.   merged

Question 33   This question has one correct answer

If you want to create a new class called NewTable based on an existing Table class,
which adds a new method called updateTable, what should appear in place of X
and Y below?   [1]

```
class NewTable X Table {
    public Y updateTable () {
        // more code here
    }
```

  A.   inherits, construct
  B.   overrides, method
  C.   abstracts, variable
  D.   extends, function

Question 34   This question has one correct answer

When scraping web pages for images, you end up with many image URLs of the
form

```
http://www.thedomain.com/thepage/image_name.jpg
```

Which two PHP functions could be combined to extract the image name from
each URL?   [1]
  A.   explode, end
  B.   strpos, explode
  C.   strlen, end
  D.   strlen, explode

Question 35   This question has one correct answer

When using XPath to search a scraped page which has been loaded in to a DOM-
Document, what does the following query return?   [1]

`$xpath->query("//h2")`

   A.   the first instance of `<h2>`
   B.   all instances of `<h2>`
   C.   all instances of `<h2>` that are children of `<h1>`
   D.   all instances of `<h2>` that are not children of `<h1>`

Question 36   This question has one correct answer

How can PHP help map a set of latitude / longitude points stored in a database?   [1]
   A.   Querying the database for points and creating an array to pass to a
       Javascript library
   B.   Querying the database for points and placing them on to a map
   C.   Using an AJAX request to query the database
   D.   Using an AJAX request to query a Javascript library

Question 37   This question has one correct answer

What is the role of Network Address Translation (NAT)?   [1]
   A.   To enable many computers to connect to the internet using a single
       routable IP addess.
   B.   To enable the networks that make up the internet to connect globally.
   C.   To map the conversion between IP and TCP/IP protocols
   D.   To allow multiple HTTP connections to the same server

Question 38   This question has one correct answer

What other numbers combine with IP addresses to specify a TCP socket?   [1]
   A.   Time To Live (TTL)
   B.   packet size
   C.   process numbers
   D.   port numbers

Question 39   This question has one correct answer

Which of the following is not a network protocol   [1]
   A.   FTP
   B.   DDOS
   C.   UDP
   D.   SSH

Question 40   This question has one correct answer

A hash function is used to safely store passwords. What does it do?   [1]
  A.   Maps every character in a password to a random character.
  B.   Maps every character in a password to a hexadecimal number.
  C.   Maps the password to a string of fixed size.
  D.   Maps the password to a uuencoded version.

Part B

Question 41

You are the back-end developer working on the Football Game Review application shown in the ER diagram accompanying Question 13.

The app is to be implemented using the MySQL Database Management System (DBMS).

You have been given the following functional specifications for the app:

- Any user can search past and future games by location, player, team and date range
- Any user can view the final score of any past game
- Any user can register an account
- A registered user can log in
- A logged in user can review a match
- A review may include images and embedded media (i.e. video clips uploaded on another platform such as youtube or vimeo)
- A logged in user can comment on a review

i. Extend the ER diagram to accommodate any missing functionality. You should indicate in your diagram where any constraints will be applied, and what MySQL data type will be used by each field. You do not need to redraw the existing tables in full, but you should indicate if a field in a new table is related to a field in an existing table. [10]

ii. Referring to your proposed schema, write one or more SQL statements to return the following details about past and future matches:
   - Date and start time
   - Stadium name and location
   - Home and away team names

[8]

iii. Another developer tells you the game scores should be stored in the Game table, rather than in Score. What do you tell them? [2]

Question 42

You have started a new job working as the lead developer for a growing online learning platform. The software is currently written in PHP and uses the MySQL Database Management System (DBMS).

i. Another developer in your team suggests that MongoDB would offer a more 'scalable' back-end solution than MySQL.

What type of database is MongoDB, and why do you think they consider it a more 'scalable' solution than MySQL? [4]

ii. You have agreed to port the current MySQL back-end over to MongoDB.

The table below provides a snapshot of the User table with some example data.

How might this data be represented in MongoDB? [6]

id	username	password	email	date_registered	is_admin
1	jon001	Du9CX8uy	jon@hotmule.com	'2015-02-01'	0
2	sue012	F76hgJui	sue@jmail.com	'2016-03-23'	1

iii. Upon inspection of the current back-end and middleware, you notice a couple of security concerns that could pose a threat to user data. Suggest what these might be and how they could be remedied in the short-term. [4]

iv. The application middleware has been written in PHP. Unfortunately, the application has been written in such a way that it requires almost entirely rewriting in order for it to work with a MongoDB back-end.

Suggest ways in which the application could have been written to minimise the need for rewriting code when porting between 2 different back-ends.

For full marks you should explain how and why any techniques or principles you've identified are beneficial. [6]

Question 43

You want to scrape data from a government website that compares how well different schools are doing.

  i. You are going to store the results of your scraping in a mysql database called 'school_data' on localhost, using MySQL user account 'scraper' with password 'test'. Write the PHP code necessary to create a new PDO connection to the database. [6]

  ii. In order to use the PHP cURL library to scrape the page, you define the following function

```
1 function curlGet($url) {
2 $ch = curl_init();
3 curl_setopt($ch, CURLOPT_RETURNTRANSFER, TRUE);
4 curl_setopt($ch, CURLOPT_URL, $url);
5 $results = curl_exec($ch);
6 curl_close($ch);
7 return $results;
8 }
```

Explain the role of the statements on lines 2 to 5. [3]

  iii. You store the results of your scraping in a new DOMDocument object:

```
$dom = new DOMDocument();
```

```
$dom->loadHTML($results);
```

What does this do? [2]

  iv. Assume that the DOMDocument from part (b) above has been made navigable using XPath in the following

```
$xpath = new DOMXPath($dom); // Instantiating new XPath DOM object
```

You can now use XPath queries to select parts of the scraped page content. Information about the schools is presented on the page as unordered list items in a list with the class 'school-results-listing'. In other words, data for each school is an `<li>` element in a list which is defined by

```
<ul class="school-results-listing">
```

What XPath query would select all the elements containing data about a school? [3]

  v. Each list element contains a variety of data about the school, including a link inside `<h3>` tags in the following form:

```
<h3>
<a  href="/school/110182">The Castle School</a>
</h3>
```

How would you use a combination of xpath and a regular expression to extract the ID number of each school from these links?   [6]

Question 44

An important part of web development is understanding the different ways messages and content are exchanged between clients and servers.

i. How are cookies related to HTTP headers? [2]

ii. Draw a diagram to show the interactions between a client (browser) and a server running PHP when

a cookie is set

a cookies value is changed

a cookie is deleted

and write the PHP statements necessary to carry out each of the above steps. [6]

iii. What is an AJAX request (i.e. one that uses XMLHttpRequest())? [2]

iv. In the following code, what is the number NNN and what does it represent?

```
function alertContents() {
var xhttp = new XMLHttpRequest();
xhttp.onreadystatechange = function() {
if (this.readyState == 4 && this.status == NNN ) {
alert(httpRequest.responseText);
} else {
alert('There was a problem with the request.');

}
};
xhttp.open("GET", "ajax_info.txt", true);
xhttp.send();
}
```

[2]

v. Sessions are another way to store information so it persists across HTTP connections, and are often used for user authentication.

One way to implement this in object oriented PHP is to have an AdminTable class (to access stored user data) and an AdminUser class.

The login process uses the AdminTable to check that the user has given the correct username and password.

The AdminUser class is used on each page to check whether the user is logged in.

Write code (or pseudocode) for both of these, with comments explaining the functionality. As a minimum, the classes should have the methods AdminTable->checkCredentials() and AdminUser->isLoggedIn(). [8]