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Computer science

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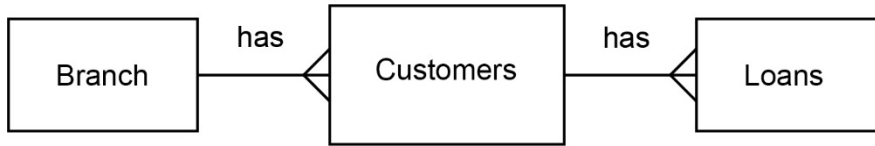International Baccalaureate
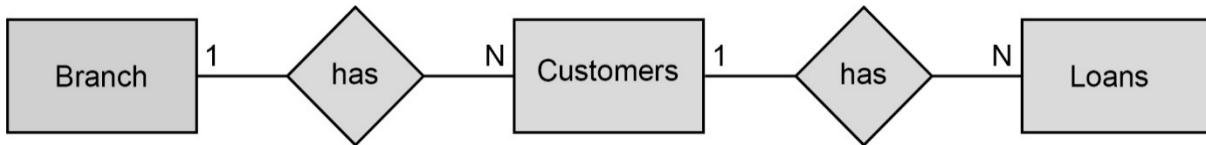Baccalauréat International
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Option A — Databases

1. (a)

OR

Bank, Customers and Loan correctly positioned;
for EACH 1 to n relationship / for "has customers" and "has loans" (accept words
to this effect); **[2]**

(b)

Loan_ID	Customer_ID	Amount	Type
RD050789	987887982	430 000 000	Venture
RG903540	124567552	231 900 000	Venture
XY348801	648782904	800 000	Home

Award [1] for any two correct rows, [2] for all three rows correct. **[2]**

(c) *Award up to [4 max].*

Answers may include:

Step 1: From the table CUSTOMERS,ACCOUNTS;
Step 2: Choose Family_name attribute;
Step 3: For a condition of the Customer_ID matching in both the CUSTOMERS
and ACCOUNTS table;
Step 4: And also satisfying the condition of the Balance > 300 000;

SELECT CUSTOMERS.Family_name, ACCOUNTS_Balance
FROM CUSTOMERS INNER JOIN ACCOUNTS
ON CUSTOMERS.Customer_ID = ACCOUNTS,Customer_ID
WHERE ACCOUNTS.Balance > 300 000

Award [1] for identifying the FamilyName
Award [1] for checking that Customer_ID matches..
Award [1] for identifying the use of both CUSTOMERS and ACCOUNTS.
Award [1] for balance check of greater than 300 000.

Note: *SQL is not required* **[4]**

(d)   *Award up to **[3 max]***.
        Access control;
        this means that different users will have different levels of access to the *Galaxy Bank* database;
        Therefore customers will only be able to access the information that they require to carry out their transactions;
        Whereas other users such as the DBA will have access to more of the database;
        Ensuring that the sensitive information within the *Galaxy Bank* database is secure from unauthorized access, editing *etc*.;   **[3]**

        Note: do not accept responses pertaining to how access rights are granted.

(e)   *Award up to **[3 max]***.
        Row locking prevents two or more database users from updating the same data at the same time;
        When a row is locked it means that another database session cannot update that data until the lock is released (which unlocks the data and allows other database users to update that data;
        If the database as a whole is locked, then only one database session can apply any updates; Locks are done using statements;   **[3]**

2.   (a)   *Award up to [2 max].*
Insertion;
Deletion;
Modification;
Lost update;   **[2]**

(b)   *Award [1] for each method of recovery followed by [1] for brief explanation up to a maximum of [2].*
Mark as [2] and [2]

Do not accept generic back up responses. It must be DBMS related.

System log;
In the event of a disk crash (any catastrophic failure);
The recovery method recovers a past copy of the database;
Backed up to archival storage and reconstructs a more current state by redoing the operations of committed transactions, up to the time of failure.

Deferred Update;
To support ABORT and machine failure scenarios;
While a transaction runs, no changes made by that transaction are recorded in the Database;
On a commit, new data is recorded in a log file and flushed to the disk;
New data is then recorded in the database itself;
On abort, do not do anything (the database has not been changed);
On a system restart after a system failure, REDO the log;
Data on disk is not updated until after a transaction commits fully;   **[4]**

(c)   *Award up to [3 max].*
Authorizing/managing access to the database;
Coordinating and monitoring its use;
Capacity planning;
Routine backups to safeguard from data loss during crash;
Tried and tested strategies to recover the database after any crash;
reinstallation/overwrite of data; // Do not accept installation of new software alone
Manage security;   **[3]**

(d)   *Award up to [3 max].*
Important sensitive information like personal details such as names, social security;
Number and addresses should be separated;
A unique identifier should be assigned to each customer;
This identifier is then used to access the booking details in the *ShowTime*;   **[3]**

Note: *No generic access rights issues like authorisation should be accepted.*
Do not accept Encryption as it is a general point and not specific to DBMS.

3.   (a)   *Award up to [3 max].*
Normalization leads to a reduction in the chance of data redundancy occurring;
Because each item of data only occurs on one location in the database;
Therefore this can reduce the possibility of update anomalies occurring;
More efficient use of memory;

Normalization reduces the likelihood of update anomalies occurring;
Because each item of data only occurs on one location in the database;
Therefore if the data is edited there is no chance that the data may exist in its
original form anywhere else in the database;

Normalization leads to smaller tables with less information in each row;
This leads to a reduction of input/output transfers;
Which means that the likelihood of CPU activities being suspended are
reduced/the CPU is able to work at full capacity;

Note: Do not award marks between clusters.   **[3]**

(b)   Use a text field for the School_phone_no with a length of 9 characters
(*Accept limit check*);
Use an input mask such as 000000000 to ensure only numbers can be entered;
Use a validation rule to ensure the first three entries can only be "065"   **[3]**
Accept format check;

(c)   *Award up to [2 max].*
Some values are not atomic in the **Student_Choice** and **School_phone_no**
fields/attributes;
repeat rows for students with multiple choices / phone numbers with one choice
per row;
Each record must have a unique key;

For **Student_Choice** have three columns, Stud_Choice1, Stud_Choice2 and
Stud_Choice3, with null values (or default values set to "none") as appropriate or
two columns for **School_phone_no**;   **[2]**

(d)   *Award up to **[8 max]**.*

Alternative 1
For a three table solution:

Student table
*Award **[1]** for <u>primary key</u>: student_ID // Do not accept other suggestions for the primary key.*
*Award **[1]** for attributes relating to student eg   First_Name*
*   Family_Name*
*   Date_of_birth*

Note: *do not penalize additional attributes such as Student_choice.*

School table
*Award **[1]** for <u>primary key</u>. Either school_Name **or** user defined key such as SchoolID // Do not accept a composite key.*
*Award **[1]** for attributes relating to school such as: School(School_Name)*
*   School_Post_code,*
*   School_phone_no.*

Note: *do not penalize additional attributes such as Student_choice.*

Student choice Table/Instrument table
*Award **[1]** for <u>primary key</u>. Either user-defined **or** a composite key.*
*Award **[1]** for attributes relating to choice such as Student_choice/Instrument choice.*

*Award **[1]** for each foreign key up to a maximum of **[2 max]**.*

Alternative 2
For a four table solution

Student table
Award [1] for <u>primary key</u>: student_ID // Do not accept other primary keys
Award [1] for attributes relating to student eg   First_Name
Family_Name
Date_of_birth

Note: do not penalize additional attributes such as Student_choice.

School table
*Award [1] for <u>primary key</u>. Either school_Name **or** user defined key such as SchoolID // Do not accept a composite key*
Award [1] for attributes relating to school such as: School(School_Name)
School_Post_code
School_phone_no

Note: do not penalize for additional second School_Phone_no field.

Student choice Table/Instrument table
*Award [1] for <u>primary key</u>. Either Lesson_ID **or** Instrument_ID // Do not accept a composite key.*
Award [1] for attributes relating to choice such as Student_choice/Instrument choice.

Details Table/Lessons Table
Award [1] for <u>primary key</u>. Any ID or composite.
Award [1] for the correct foreign key in this table.

Note: This is the only table in which marks can be awarded for the use of a composite [primary] key.

(e)   2NF allows non-prime attributes to be functionally dependent on non-prime attributes which means there are transitive dependencies at 2NF;
While 3NF allows non-prime attributes to be functionally dependent only on the primary / super key and is already in 2NF;
Therefore it is not possible for update anomalies to occur when a database is in 3NF;   **[3]**

4. (a) *Award up to [2 max].*
Deviation detection is a statistical technique;
Appropriate marketing of product;
Which is used to detect outlying data that does not fit the assumed model;
Therefore it can be used to predict the trends and patterns of demand for certain
consumer goods in the future; **[2]**

(b) *Award up to [3 max].*
To speed query execution, which can be especially important in data warehouses
used by Singalytics;
May effectively be used in data warehouses as they contain pre-joined tables that
package data for common uses;
If the data is all present in a single table, there will be no need for joins, hence the
selects can be done very quickly;
A single table with all the required data allows much more efficient index usage;
If there is heavy read load and when the application is read intensive;
If the columns are indexed properly, then results can be filtered and sorted by
utilizing the same index; **[3]**

(c) *Award up to [3 max].*
To retrieve all the required data from the source system with as little resources as
possible;
Designed in a way that it does not affect the source system;
In terms or performance/ response time/ locking;
Makes it accessible for processing on the data;
Ensuring that historical data being extracted can be read by the current systems;
Ensuring the different data formats being extracted can all be converted or
scrubbed to become readable by the system and able to be formatted;
Ensuring that the data is relevant to what the user wishes to extract and utilise; **[3]**

(d) *Award up to [2 max].*
The content in the data warehouse is only valid for a time period;
Because the data undergoes changes dynamically;
A data warehouse's focus on change over time is time variant; **[2]**

(e) *Award up to [4 max].*

Award [2 max] for the explanation and [2 max] for the example(s).

Associations:
Correlate the presence;
of a set of items with another range of values for another set of variables;
Breaks up data sets by variables such as gender, location, age;
It may be used to detect patterns independently from the geographic region,
females buy more dark colour trousers than males;

Examples:
when a female retail shopper buys a cotton shirt, she is likely to buy a stole.
Associations of the type Full arm formal shirts => Dark colour trousers; Full arm
formal shirts => cufflinks may produce enough confidence and support to be valid
association rules of interest;
If the application area has a natural classification of the item sets into hierarchies,
discovering associations within the hierarchies is of no particular interest;
Specifically its associations across hierarchies;

Note: *For generic responses award [2 max].* **[4]**

(f)   *Award up to **[6 max]**.*

*Award **[3 max]** for the feature(s) and **[3 max]** for supporting explanation/examples.*

Features:
Enhanced modelling capabilities;
Extensibility/support new data types;
Object DBMS stores more complex data and relationships;
Improved performance;
Reusability;
Eliminates need for user defined keys;
Eliminates need for Joins;

Examples:
Inheritance property, we can re-use the attributes (size, fabric) and functionalities;
It reduces the cost of maintaining the same data multiple times;
All this information is encapsulated and, there is no fear being misused by other objects. If we need any new feature we can easily add new class inherited from parent class and that adds new features;
Reduces the overhead and maintenance costs;
So it becomes more flexible if any changes and apparel business changes with fashion needs;
Codes are re-used because of the inheritance feature;   **[6]**

Option B — Modelling and simulation

5. (a) *Award [4 max]:*
Award [1] for each fully correct row indicating variable name, type, and values
(no marks for incomplete information, but do allow abbreviated strings)

eg

Variable	Data type	Range of values
IType	String in (accept Char)	{f,l,m}
IBrand	Integer in	{1,2,3}
ICond	String in (accept integers variants)	{vg,g,nr}
IVol	Integer (accept float variant)	Between 1 and 2000

Note: *If a full column is missing, then award [1] for each correct column (for a max of [2]).* **[4]**

(b) (i) *Award [4 max]:*
Award [1]: correct initialisation of Initvalue.
Award [1]: correct calculation of Temp.
Award [1]: correct comparison of Temp with 90.
Award [1]: correct return/output.

```
proc Decide(Item, Vol)
Var Temp
if Item = f then Initvalue = 100
   else if Item = l then Initvalue = 30
      else if Item = m then Initvalue = 80;
endif
if Vol >= 500 then Temp = 0.7 * Initvalue    // accept <,>
   else if Vol =< 30 then Temp = 1.2 * Initvalue
      else Temp = Initvalue;
endif
if Temp > 90 then
   return "Reject"              // accept any 2 reasonable outputs
   else return "Accept";
endif
```
[4]

(ii) Any item of furniture with a volume < 500 dm³;
Any musical instrument with a volume ≤ 30 dm³;

Example answers:
A piece of furniture with volume of 400 dm³;
A piece of furniture with volume < 30 dm³;
A flute with volume of 1 dm³; **[2]**

(c) *Award [2 max]:*
Award [2] for completely correct answer (only the left or right-hand side needs to be shown).
Award [1] for correctly writing just 4 factors from the left-hand side.

5 * 80 * 3 * 3 * (80/100) = $2880

Alternative expression for the left-hand side:
5 * (Item.IType.Initvalue) * (Item.IType.IBrand) *
(Item.IVol.Percentage) * (Item.ICond.Multiplier)   **[2]**

(d) *Award up to [4 max].*
Award [1] for some layout design.
Award [1] for each of the following elements:
  - correct formula for Itype
  - correct formula for Ivol
  - correct formula for Icond
  - correct formula for Selling Price.

Example for [4]:

	A	B	C
1	Itype	m	=IF(B1="f",100,IF(B1="l",30,IF(B1="m",80)))
2	Ibrand	3	=B2
3	Ivol	96	=IF(B3>=500,5,IF(B3>=30,3,1))
4	Icond	nr	=IF(B4="vg",3,IF(B4="g",2,IF(B4="nr",0.8)))
5			
6	Selling Price	=5*C1*C2*C3*C4	
7			

Example for [1]:

	A	B	C
1	Itype	m	80
2	Ibrand	3	3
3	Ivol	96	3
4	Icond	nr	0.8
5			
6	Selling Price	2880	
7			

Example for [2]:
Award [1] for the general layout.
Award [1] for detail (Vlookup table, explanations).   **[4]**

(e) *Award [3 max]:*
Type consistency, *eg* currency, integer, floating
Range consistency, depending on the decision procedure,
Value at the limits given by the specification (*eg* < or =<)

Accept any testing that relates to
  - *normal data // **Note:** an example will get this mark*
  - *extreme data,*
  - *abnormal data.*

Note: *Answers must be more specific than alpha/beta testing, dry-run, etc.*   **[2]**

6. (a) *Award [4 max]:*
Award [1] for identifying a problem, [1] for an elaboration.
Mark as [2] and [2].

There is no evidence that there are two knives to slice the bread roll;
so one of them could already be delayed;

There could be need of the same fillings;
meaning that the two bread rolls will be prepared with a slight delay;

One fork/spoon falls down and will need to be washed;
there must be a policy on who will wash it;

One ingredient is finished and needs replenishment;
there must be a policy on who collects the new bowl;

There can be concurrent access to the cash register
there must be a policy on who goes first;

No evidence that both persons have space/paper to wrap simultaneously on the table;
There must be a policy on who goes first;

Accept other reasonable answers.   **[4]**

(b) *Award [3 max]:*

Split the job in two separate sections;
one guy handles all the food, the other guy takes order, wraps, handles money;
to minimize possible clashes on resources;

Grouping similar tasks together:
Slice several bread rolls / stockpile bread rolls;
To be filled on demand;

Note: *do not award marks for answers related to serving*   **[3]**

(c) *Award [3 max]:*
A model is a / an accurate representation (either physical or digital) of a real-world entity;
A simulation is an algorithm/method of implementing a model;
By changing the various parameters/variables of the model;
In order to investigate its subsequent behaviour;   **[3]**

(d) *Award [3 max]:*
The number of utensils;
Washing times;
Time spent arranging the food on a plate;
The amount / quantity of ingredients
The number of customers/orders waiting
The number of servings for the dish they are currently preparing;

Accept other reasonable answers.
Accept application answers – option to include/exclude ingredients   **[3]**

(e) *Award **[6 max]***
*Mark as **[3]** and **[3]***.

The objective of reducing turn-around time,
May lead to hastily prepared dishes,
Which may be lacking in quality.

Trying to cook a batch of orders in 10 minutes,
May require the pans to be used for multiple dishes,
Impacting the unique taste of these dishes.

More appliances might need to be switched on, in case of large orders demand;
For example, an oven, which take time to heat up;
Causing some dishes to be undercooked;

The number of customers/orders;
May be too high;
To be dealt with in 10 minutes;

Being in charge of preparing a full dish, gives job satisfaction;
Lack of satisfaction may lead to loss of interest in the job;
affecting the quality of the cooking;   **[6]**

7.   (a)   (i)   *Award **[2 max]**.*
                *Award **[1]** for each of the **two** requested elements that provide input.*

                Accept any ATD sensor explicitly stated by name.
                Accept: speedometer, fuel gauge, brake pads, human pushing a button.
                Do not accept: temp regulation unit (or any unit that is integrated in ECU).
                If in doubt, please contact your Team Leader.   **[2]**

         (ii) *Award **[2 max]**.*
                May depend on the car maker and patents may be involved;
                For example, internal communications protocols across different systems
                may not be revealed;

                Different vehicles have different uses;
                it doesn't make sense to have the same firmware for different requirements;

                Different models operate at different parameters,
                Requiring different algorithms;

                Different Countries may have different regulations;
                Therefore country-specific ECUs for the same model/type of car;   **[2]**

   (b)   *Award **[4 max]** for one example with explanations.*

         Example answers:
         The quantity and/or direction of diffusion of CO_2 and fine particulates can be
         mapped using colour plots;
         Over the whole duration of the test in a 3D space;
         Choosing a colour in an intuitive way;
         To show how the density evolves over time;

         Examples:
         Plotting 3D points for CO_2 with vectors x,y,z ; // can be given BOD
         Where x = time;
         y = density of CO_2;
         z = temperature;

         Note: *do not accept generic answers that describe the process of 'rendering'.*   **[4]**

8. (a) *Award [4 max]*:
        Uses a (training) set of <u>input data and known response</u> values;
        To <u>compare the model's output</u> with actual values from the past which will give an
        error in the estimate;
        The model is then <u>changed</u> in order to minimize this error;
        This <u>process is iterated</u> until a sufficiently accurate model is produced;
        Which can then be <u>used to make predictions</u>/classifications;   **[4]**

    (b) *Award [2 max]*.
        Award [1] for evidence of multiplication between layers.
        Award [1] for fully correct expression / answer.

        60 * 36 + 36 * 6 + 6 * 1 = 2382   **[2]**

9. (a) *Award [4 max]*.
        Cluster analysis will attempt to <u>group</u> together images;
        Into groups that <u>have certain similarities</u>;
        This will be achieved by <u>looking at characteristics</u>;
        <u>Such as</u> the presence of horizontal/vertical lines/windows/spires *etc*.   **[4]**

    (b) *Award [6 max]*:
        Award [2] + [2] + [2].

        Award [2] for a description of GA, such as:
        GA uses a <u>fitness function</u> (based on stored data);
        to validate/discard the "adequacy" of some detected features;

        Award [2] for one reason for appropriateness with amplification.
        The features in images have been extracted in previous processing;
        And can be represented in a suitable way to be used with genetic algorithms;

        Award [2] for one reason against appropriateness with amplification
        One has to decide which features shall drive the recognition process;
        Choosing the wrong feature may lead to incorrect results;

        If the GA merges similar features to build broad classes;
        Then the recognition may not be precise enough;

        If the GA focuses on several small details taken in isolation;
        A limited number of features may be recognised;   **[6]**

10. *Award [4 max]*.
    Mark as [2] and [2].
    Not all text can be translated literally;
    Humans can bend the rules to make produce sense in the target language;

    Machine translators can only use the data that has been programmed into them;
    Cannot translate anything outside their knowledge base, *eg* obscure/new words/phrases;

    Knowing which tone/register to use depends upon experience;
    That machine learning algorithms do not yet have;

    There are several 1000 different languages;
    Linking all of them all is too big a task;   **[4]**

Option C — Web science

11. (a) *Award up to **[2 max]**.*

*Award **[1 max]** for Internet and **[1 max]** for WWW.*

Internet is a network of (networks of) computers that can communicate one with each other;
To exchange/access information through the WWW;

The WWW is a way to access/share/exchange information using software applications;
Using the Internet as a physical medium;

Internet allows the transmission of data;
That constitute the information that applications on the WWW may want to share/access/exchange;

The WWW provides, through hyperlinks, a level of connectivity of resources (logical connectivity);
Which can be physically sparse, but connected in a network in the Internet; **[2]**

(b) *Award up to **[4 max]**:*

*Award **[1]** for defining the term "standards" and award **[1]** for a development up to **[2 max]**;*

*Award **[1]** for defining the term "protocol(s)" and award **[1]** for a development up to **[2 max]**;*

Standards are applied by the browser;
For interpreting the HTML (XML);
So that the all information will appear, and also (more or less) as expected;

Protocols are used;
To build up the communication at different levels of the architecture;
All browsers will rely upon the same internet protocols (TCP/IP);
That is essential for interoperability in transmission/communication;
So that the IP address is retrieved (via the DNS server); **[4]**

*Award **[2 max]** for a generic response.*

(c) *Award up to **[2 max]**:*
HTTPS <u>authenticates</u> the web site;
HTTPS <u>encrypts</u> the data that need to be transferred; **[2]**

(d)   *Award up to **[3 max]**:*
The bank needs to store all passwords in its server, including the credentials given to the users;
So that the comparison with the individual's entry happens in the bank with the local database;
To the purpose of guaranteeing security;
And to possibly perform other operations (tracking log-ins or transactions);

The bank cannot send out password to be processed on the client's side;
This will not be a guarantee for security for the bank/it may introduce vulnerabilities/sensitive data cannot be sent out in the public domain;
Hence the comparison with the individual's entry must happen in the bank with the local database;

Note: *Do not award marks between clusters.*   **[3]**

(e)   *Award up to **[3 max]**:*
XML is used to create/organize the data on the internal database;
By clicking the virtual button a script is run that transforms the information on the database into the print-out form;
Stylesheet in <u>XSLT</u> transforms XML into an output form;
The script contains instructions on how to access the database (which fields are relevant) and how to present the information for the final form for the printer;

By clicking the virtual button a script is run;
Which uses XML to retrieve/select the required data from the internal database/server;
Which is displayed using XSLT into an appropriate output form (on the screen);
The script also contains instructions for the correct printout of data;

Note: *Do not award marks between clusters.*   **[3]**

12. (a) *Award up to [3 max].*

Note: An expansion from the technical/computational perspective only (not sociological one) is expected about aspects of the chosen method of online interaction.

Aspects that can gain credit:
Editing, permissions layer, ownership, tracking of updates, security (open to vandalism/non-monitored contributors), open source (interoperability).

Software for wikis provides <u>collaborative</u> editing sharing of information of content, directly from the browser;
<u>Updates are usually tracked</u> in wikis (also to be removed afterwards) as they come from different authors / usually non-moderated / added content can also be removed later on (also by others);
The evolution of a wiki is more immediate and spontaneous because updates are immediately visible;
The wiki can easily be vandalized with incorrect/unauthoritative information, but it can also be quickly amended/corrected if this is realized quickly;   **[3]**

   (b) (i) *Award up to [1 max].*
It specifies how to access the resource/show the path/contains domain name, with the ftp protocol;   **[1]**

      (ii) *Award up to [3 max]:*
It sends a GET/PHP request to the server tri-events.cc;
To execute en/general-info (index.php);
And the result of this execution is made available to the client /browser (with ftp);
(It specifies to use the ftp protocol to send the request and to return the resource;)

Note: Do not accept DNS.   **[3]**

   (c) *Award up to [4 max].*
Lossy compression results in files of smaller size;
It may be needed for video <u>streaming</u> because the server provides execution through scripting;
And guaranteeing streaming without interruptions is a priority;
It may be a choice for <u>downloading</u> video for local execution to manage outgoing traffic on popular servers/increases the speed (using smaller files);   **[4]**

(d) *Award up to **[4 max]**.*

Award **[1 max]** for identifying a technology that is needed award up to **[3 max]** for an extension describing how the technology is used and interacts with other components.

Example 1:
An interactive web page that has an <u>auto-refresh/automatic update extension</u>;
So that every N seconds a script is executed to reload the page;
The web page is linked to an underlined database/data source
OR interrogates specific databases/news databanks;
That are distributed and collectively provide regular updates;
And they can be displayed back using the script;

Example 2:
A dynamic web page equipped with a <u>RSS feed</u>;
That collects/aggregates news from sources that cover that live event;
The feed is in form of an update in XML;
Therefore, it can be used to feed an underlining (distributed) database or the web page/uses syndication/can be immediately interpreted by the browser;
And it can then be processed by some script to be displayed back in the original web page; **[4]**

13. (a) (i) *Award up to **[3 max]**:*

*Award **[1]** for showing understanding of the need **of each** of the following: GPS, mapping software, underlying distributed information.*

The GPS of the device gives its current location (coordinates);

Coordinates sent out through the Internet (with 3G/4G/5G/Wifi/using the specific features of the mobile device OS);

Coordinates are linked to map software (*eg* Googlemaps) to retrieve current's device position and neighbourhood information (using thematic databases);

And integrated with further annotations (relative to museums) that can be provided by third-party services;
    OR by information incrementally gathered from users;
    OR by further databases (GIS services);
    OR by interrogating an (incremental) database accessible from the server where the app has been downloaded from, for its first installation; **[3]**

(ii) *Award up to [2 max]*.

Award [1] for identifying a feature and award [1] for reasonable expansion of the feature up to [2 max].

Example 1:
The <u>design of the front-end</u> (the user interface) with the specific mobile device;
So that the commands are specific (and built-in) within the device, to support interactive use;
(With the effect that the app can be used across a range of devices and mobile operating systems;)

Example 2:
To <u>personalize the app with a "history"</u> on the client's side, after the first use of the application;
So that only the new information added in the database (underlying sources used by the app) can be fetched by the client's script; **[2]**

(b) (i) *Award up to [2 max]*.
Number of hits;
Popularity of linking pages;
Amount of links to the same page departing from the source page;
Trustworthiness of the linking domain;
Relevance of content between source and target page;
Time to download;
…(there are others). **[2]**

(ii) *Award up to [5 max]*.
Old information is more likely to be retrieved by web crawlers;
But this requires time to crawl;
But this interferes with the response time for the current search;
And it may even be penalised by policies in search engines;
Without returning currently relevant information;
Example of old information are old or broken links/orphan pages/old text masked by comments in the HTML code, and it can be revised from time to time;
Cleanly written code allows for a more efficient search process;
Which facilitates correct indexing;

Note: *Award [2 max] for a generic response.* **[5]**

(c) *Award up to [4 max]*.
In P2P all machines can interchangeably be client as well as server (no division of client-server);
Data and services can be replicated across sites, and be retrieved from them;
Services are virtualized/reside on virtual machines;

Therefore, if one node is unavailable the service can still be provided by resorting to other nodes;
OR
System updates can be made while not interrupting the provision of the service
OR
The failure of a node does not imply the failure of the entire network **[4]**

14. (a) *Award up to [2 max]:*
Nodes represent URLs/web site/web pages;
Each edge represents a direct link from one URLs/web sites/web pages to another;
It is a small scale representation of some specific network of 16 nodes that can be part of the WWW;   **[2]**

(b) (i) *Award up to [2 max].*
Award [1] any two correct.
Award [2] all correct.

13, 9, 10, 14   **[2]**

(ii) *Award up to [1 max].*
Expected: exactly these three nodes, in any order

11, 12, 8   **[1]**

(iii) *Award up to [1 max].*
As it can reach and be reached by every other element in SCC;
OR
Because it is reachable from the IN and it reaches the OUT;   **[1]**

(iv) *Award up to [1 max].*
Because it doesn't reach the SCC;   **[1]**

(c) *Award up to [3 max]*:
Starts from a set of seeds (initial nodes);
Visits the web pages, makes a copy of them/indexes/finds all the links on web pages;
Follows the links/hyperlinks;
Returns a list of URL, usually ordered under some criteria;
eg to determine the "weight" of a node.   **[3]**

(d) *Award up to [4 max].*

Award [1 max] for an initial statement and award up to [1 max] for an expansion/development up to [2 max];

Mark as 2 and 2.

The site might have been protected by a login;
And the crawler cannot go deeper than the surface / cannot access the deep web;

The crawler is unable to access multimedia items;
and it analyses only text;

The sites containing these documentaries/interviews are still new;
and their presence on the web is not mature;

Page may contain a robots.txt file;
that prevents it from getting indexed;   **[4]**

(e)   *Award up to [6 max].*
Collective intelligence refers to the <u>large</u> amount of knowledge/information that exists on the WWW;
In areas such as blogs, wikis, forums (accept any suitable example);
Text based searches are based on specific words/terms;
Without considering the context / meaning that they are used in;
Therefore a lot of irrelevant data would be retrieved / a lot of relevant data would be missed;
The semantic web implies a different/standard way of representing data (audio/video/pictures);
That allows the representation of knowledge (rather than data);
So that more relevant information can be retrieved/collective intelligence can be utilized;
And analysed directly by computers/machines;
However, this doesn't necessarily mean that all of the information retrieved is valid;
As anyone can post on the web / not all information is correct/some might be biased;   **[6]**

Option D — Object-oriented programming

15. (a) `public`;
Allows access to variables from outside of the class/unlimited access;

`protected`;
Allows access to variable from within the package (project) in which they are created/subclasses;

`final`;
Prevents variables from being modified;

`static`;
Refers to variables that act on the class as a whole (and not on individual objects);

Note:
- *Accept at most one example pertaining to methods.*
- *Do not accept two examples pertaining to the same modifier.* **[4]**

(b) The OOP feature shown in the constructors (accept the 2 signatures) is overloading (accept polymorphism);
The constructor methods have a different number / type of parameters / different parameters;
The method calling the constructor / compiler will determine which of these methods is selected;
By matching up with the parameters; **[4]**

(c) Silver; **[1]**

(d) Through the use of the (appropriate) array index / appropriate code description;

Example:
`Individual object = allVisits[individual object's location]` **[1]**

(e) `public` boolean isGold()
```
{
    return (statusNow.equals("Gold"); // allows =
}
```

Award marks as follows:
Signature;
Correct comparison (allow use of `getStatusNow()`);
Return (that matches the signature – allow FT);

Note:
- *Allow the equivalent use of IF/THEN statements.*
- *Do not accept parameters to be passed.*
- *Do not allow the use of* `totalPoints`*.* **[3]**

16. (a) *Award **[1]** for three compartments, **[1]** for correct + and −, and **[1]** for correct contents.*

```
Visits
− hotelCode: String
− days: int
+ Visits(String, int)
+ getDays():int
```

***Note**:*
- *allow variations in the format, but must use + / −*
- *accept additional getters/setters, but the given content must be present.* **[3]**

(b) (i) m102; **[1]**

(ii) 0; **[1]**

(iii) 6; **[1]**

(c) <u>*Example 1:*</u>
```
public int calculateTotalPoints()
{
  int totalPoints = 0;
  for (int x = 0; x < y; x++)
  {
    totalPoints = totalPoints + allVisits[x].getDays();
  }
  totalPoints = totalPoints * 1000 + bonusPoints;
  return totalPoints;
}
```

*Award marks for **correctly** including the following:*
Signature + matching return;
Loop through the number of visits (y); // *do not allow length statements;*
Any use of `allVisits` array;
Correct update of `totalPoints` (with or without bonusPoints);
Inclusion of bonus points <u>outside</u> of the loop (or if the loop is absent);

<u>*Example 2:*</u>
```
public int calculateTotalPoints()
{
  int totalDays = 0;
    for (int x = 0; x < y; x++)
    {
      totalDays = totalDays + allVisits[x].getDays();
    }
    totalPoints = totalDays * 1000 + bonusPoints;
    return totalPoints;
}
```
[5]

(d)
```java
public int daysMissing()
{
    int pointsNeeded = 0;
    int points;

    // convert present status to minimum number of days
    if (statusNow.equals("Silver"))      // allow = or use of
                                         // isSilver()
        pointsNeeded = 10000;
    else if (statusNow.equals("Gold"))   // allow = or use of
                                         // isGold()
        pointsNeeded = 50000;
    points = pointsNeeded - calculateTotalPoints();
    if (points > 0)  // might be negative
    {
        return points/1000;
    }
    else
    {
        return 0;
    }
}
```

Award marks for correctly including the following:
Signature + return of an integer;
All required declaration (initialization if needed);
Conversion to points/days for all 3 statuses *// bronze can be the default;*
Calculation of points missing (allow `getTotalPoints()` or the variable
`totalPoints` for `calculateTotalPoints()`);
Convert to days (divide by 1000) *// allow if the conversion has already taken place;*
Returning calculated number; *// allow even if negative or if incorrect or without an
if else clause;*
Returning 0 *// when the points needed would have been negative / when
required points have already been gained;*   **[7]**

(e)   A generic class / Status / Point / Bronze class can be used as a superclass;
       Sub-classes can then be created (2 or 3) for the individual statuses;
       Containing elements specific to them / overriding superclass methods;
       And inheriting methods/variables required by all status levels from the
       superclass;

       *Do not award more than **[2]** for a generic response.*   **[4]**

(f)   (In the Points class) `statusNow = statusNextYear`;
       `bonusPoints` set to 0 (accept reset `bonusPoints`);
       `totalPoints` set to 0 (accept reset `totalPoints`);
       variable y (that counts the visits) needs to be set to 0;
       `statusNextYear = Bronze` (accept reset `statusNextYear`);

       Note: *Do not accept "array `allVisits` reinitialised to empty".*   **[3 max]**

17.   *Award up to **[7 max]**. Note there are 9 marking points.*

An array of objects / 2 parallel arrays would be created / any other appropriate
structure; // *Do not allow 2D array;*
Containing hotel codes and number of days;
Repeat/loop for each object in the `allVisits` array;
- Inspect the hotel ids and days stayed / find a matching hotel;
- Update the array(s); // *see first note below*
- By increasing the number of days (for the specific hotel);
Sort / search / look for / find; // *see first note below;*
The object / hotel code with the largest number of days;
Find the name of the hotel using the hotel code / Hotel class;   **[7 max]**

Note:
- *mps can be awarded even if the wrong values are being updated or searched for
(eg stays instead of days).*
- *For mp 7 only allow the use of "look for" and "find" if accompanied by a suitable
description.*

18. (a)   *Example 1:*
The link list will enable space to be allocated dynamically/will only take up the
space required;
Because the number of customers is unknown / customers may join or leave the
loyalty scheme during the year;

Example 2:
Customers / objects / nodes can be easily added or deleted;
so customers may join or leave the loyalty scheme during the year;   **[2]**

(b)
```
public ArrayList goldMails()
{
  ArrayList al = new ArrayList(); // Allow use of <String> identifier
  int s = allCustomers.size();
  int x = 0;
    while(!(allPoints[x] == null)) // Allow(allPoints[x]!=null)
  {
    if (allPoints[x].isGold())
    {
      String a = allPoints[x].getMemberId();
      for (int y = 0; y < s; y++)
      {
        String b = allCustomers.get(y).getMemberId();
        if (a.equals(b))  // allow =
          al.add(allCustomers.get(y).getEmail());
      }
    }
    x = x + 1
  }
  return al;
}
```

Award marks as follows:
Declaring a new `ArrayList` (with or without the String identifier);
Looping through the `allPoints` array;
Testing for "Gold";
Loping through the `allCustomers` linked list (using the size or an iterator);
Correct check for identical ids;
Adding the email to the `ArrayList`;
Returning the arraylist;   **[6 max]**

Note:
- *Do not allow any methods that are not part of the LinkedList or ArrayList
  library classes – eg the length function for the linked list is invalid.*
- *Do not penalize more than once for omitting the "gets".*
- *Allow the for loop:* `for (Customer currCust : allCustomers).`
- *Allow for loop instead of a while loop.*

19. (a)   The method calls itself;
              With a changing parameter;
              There is a base (terminating) case;   **[2 max]**

      (b)

parameter passed to method	output
3	3
2	2
1	1
0	
	1
	2
	3

Award marks as follows:
Outputting 6 values;
Correct parameter list
First 3 output numbers correct;
Last 3 output numbers correct;   **[4]**

      (c)   An infinite loop / program will never end/terminate;
            Will eventually cause the program to crash;
            As it runs out of memory for the parameters stored / Stack overflow;
            As the base case is never reached;   **[3 max]**

      (d)   Comments can be added;
            Use of meaningful names;
            <u>Correct</u> indentation;
            Relationships/dependencies shown between class (UML) diagrams;   **[3]**