EXAMINATION PREPARATION TEST

"DOING IT TO CHANGE THE WORLD TOGETHER"

COMPUTER SCIENCE 6023/1

NOVEMBER 2024 PREPARATION

ADDITIONAL MATERIAL

Answer paper

TIME 3HOURS

INSTRUCTIONS

ANSWER ALL QUESTIONS

"DON'T REGRET TOMMOROW"

@Sir Timu

Contact: 0778423856

1. (a) In a particular computer system, real numbers are stored using floating-point representation

   with:

- 8 bits for the mantissa
- 8 bits for the exponent
- two's complement form for both mantissa and exponent

  Calculate the floating point representation of + 3.5 in this system. Show your working.[3]

  Solution:

  3.5 has to be converted into binary. First number 3 has to be converted as a normal denary to

  binary conversion, which gives: 3 = 11

  3 written in inclusive of sign bit 3 = 011

  Now 0.5 has to be converted to binary. 0.5 x 2 = 1

  3.5 = 11.1

  So the number becomes 011.1

  Sign bit

  011.10000

  0 1 1 . 1 0 0 0 0

  (decimal moved 2 places right after sign bit)

  So the exponent is 2 so Mantissa and exponent would be

  01110000 00000010

  Sign bit Mantissa Exponent

(b) In a computer system, real numbers are stored using floating-point representation with:

8 bits for the mantissa, followed by 8 bits for the exponent

- Two's complement form is used for both mantissa and exponent.
- A real number is stored as the following two bytes:

  Mantissa Exponent

  0 0 1 0 1 0 0 0 0 0 0 0 0 0 1 1

  Calculate the denary value of this number. Show your working[3]

Solution: sign bit

As Exponent 0 0 0 0 0 0 1 1 = 3 denary

Now Mantissa = 0 0 1 0 1 0 0 0

Decimal is actually after the sign bit

So decimal would be 0.0101000

As exponent is 3 so decimal will move three places to right 0 . 0 1 0 1 0 0 0

Place Values 0.5 0.25 0.125 0.0625

8 4 2 1 . ½ ¼ 1/8 1/16

0 0 1 0 . 1 0 0 0

2 . 5 (Calculated as per place values)

(c) Find the decimal number represented by:

[4]

Now we first solve the Exponent

Place Value = -8 4 2 1

1 1 1 0

Exponent = -2

Now solving Mentissa which is:

1 0 1 1 0 0 0 0

We know decimal lies after sign bit so number becomes

1 . 0 1 1 0 0 0 0

Whenever we have –ve exponent with -ve mantissa, we first solve exponent and then TAKE Two's Compliment of Mentissa (Keeping the sign of number intact)

1 . 0 1 1 0 0 0 0

Now take 1's compliment

Carry 1 1 1 1

0 . 1 0 0 1 1 1 1

Now 2's Compliment Add 1 + 1

0 . 1 0 1 0 0 0 0

Now because our exponent was -2 we have to shift decimal two places LEFT

0 0 0 . 1 0 1 0 0 0

Place values 1 0.5 0.25 0.125 0.0625 0.03125

Number becomes - (0 . 0 0 1 0 1 0 0 0)

Keeping sign in mind, our number was –ve so we kkep the sign intact

Denary number is - (0.125+0.03125) = - 0.15325

2. (a)

A student writes a program to output numbers using the following code:

```
X ← 0.0
FOR i ← 0 TO 1000
   X ← X + 0.1
   OUTPUT X
ENDFOR
```

The student is surprised to see that the program outputs the following sequence:

0.0 0.1 0.2 0.2999999 0.3999999 .....

Explain why this output has occurred.

[3]

Solution:

Any one of the below mentioned answers:

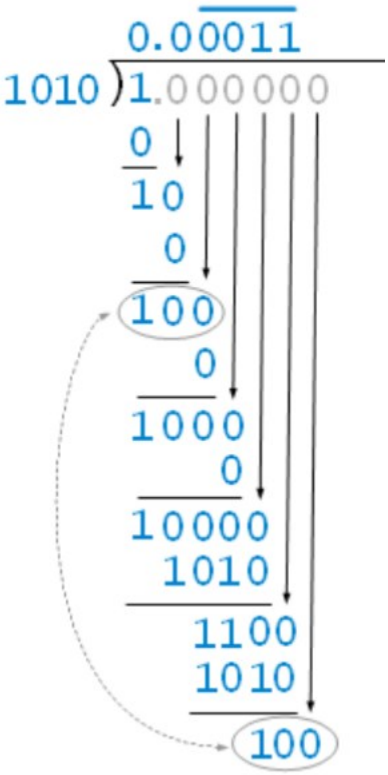
o cannot be represented exactly in binary

o 0.1 represented here by a value just less than 0.1

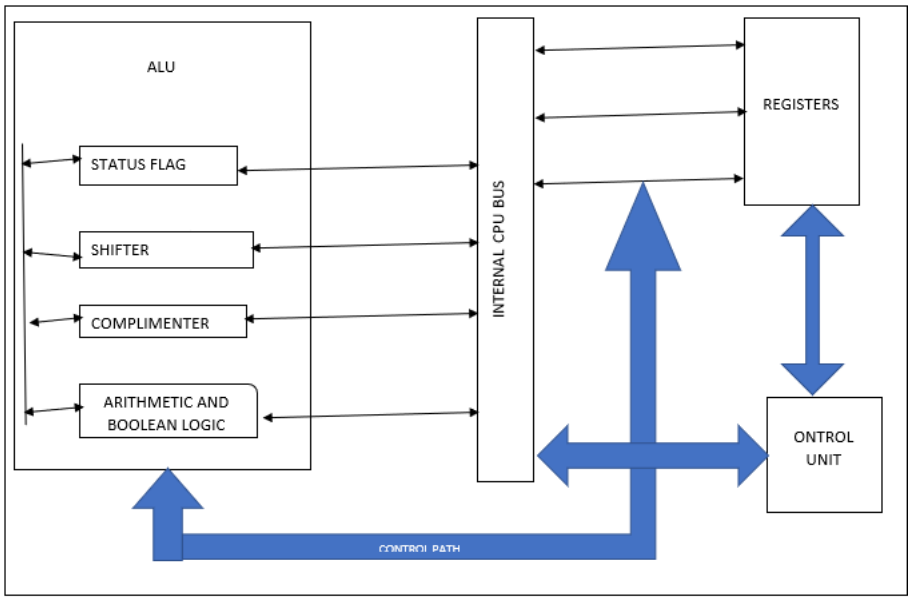
o the loop keeps adding this approximate value to counter

o until all accumulated small differences become significant enough to be seen

b) Find the value of 1/1010 [2]



3. (a) Draw the diagram to show the processor components [4]



(b) Compare the RISC and CISC processors [4]

CISC features	RISC features
Many instruction formats are possible	Uses fewer instruction formats/sets
There are more addressing modes	Uses fewer addressing modes
Makes use of multi-cycle instructions	Makes use of single-cycle instructions
Instructions can be of a variable length	Instructions are of a fixed length
Longer execution time for instructions	Faster execution time for instructions
Decoding of instructions is more complex	Makes use of general multi-purpose registers
It is more difficult to make pipelining work	Easier to make pipelining function correctly
The design emphasis is on the hardware	The design emphasis is on the software
Uses the memory unit to allow complex instructions to be carried out	Processor chips require fewer transistors

(c)Explain with aid of a diagram the vectored interrupt mechanism, giving examples [3]

4. (a) Define parallel processing [1]

Parallel processing – operation which allows a process

to be split up and for each part to be executed by a

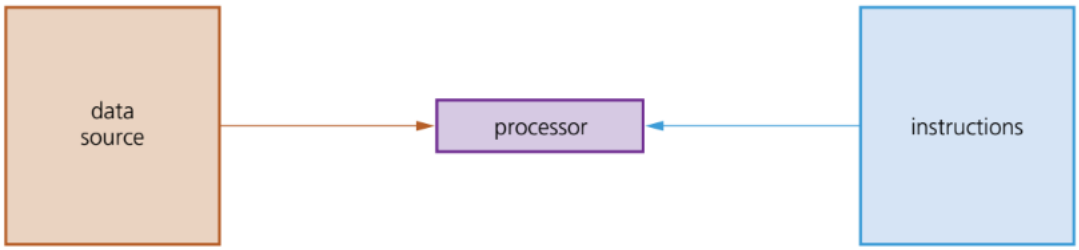
different processor at the same time.

(b) With aid of a diagram for each case explain:

I. SISD

SISD (single instruction single data)

SISD (single instruction single data) uses a single processor that can handle a single instruction and which also uses one data source at a time. Each task is processed in a sequential order. Since there is a single processor, this architecture does not allow for parallel processing. It is most commonly found in applications such as early personal computers.



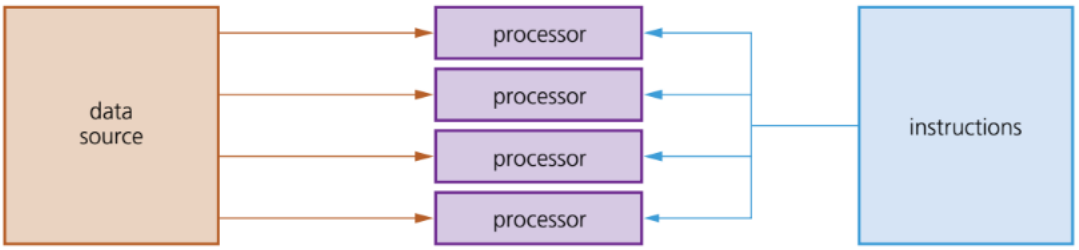
II. SIMD

SIMD (single instruction multiple data)

SIMD (single instruction multiple data) uses many processors. Each processor executes the same instruction but uses different data inputs – they are all doing the same calculations but on different data at the same time.

SIMD are often referred to as array processors; they have a particular application in graphics cards. For example, suppose the brightness of an image made up of 4000 pixels needs to be increased. Since SIMD can work on many data items at the same time, 4000 small processors (one per pixel) can each alter the brightness of each pixel by the same amount at the same time. This means the whole of the image will have its brightness increased consistently.

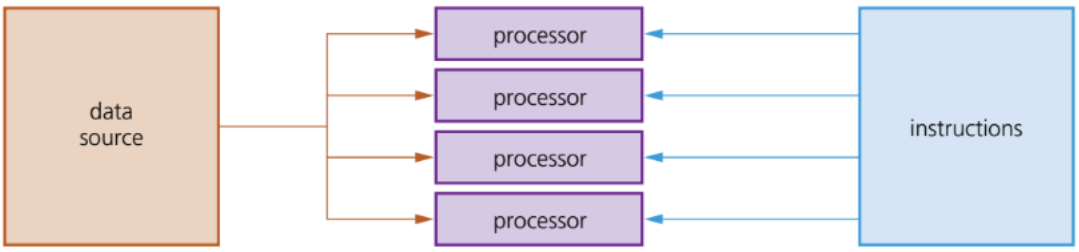
Other applications include sound sampling – or any application where a large number of items need to be altered by the same amount (since each processor is doing the same calculation on each data item).



III. MISD

MISD (multiple instruction single data)

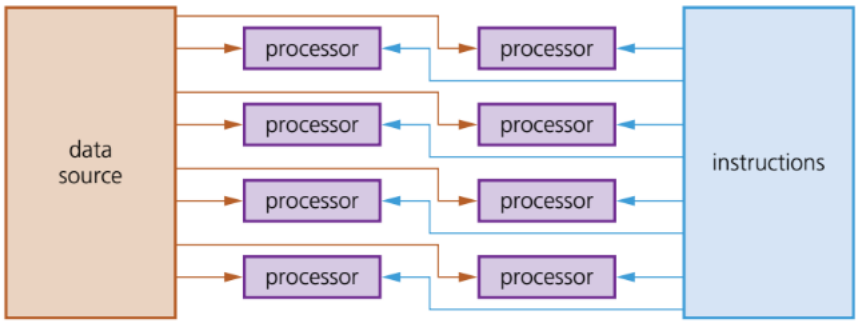
MISD (multiple instruction single data) uses several processors. Each processor uses different instructions but uses the same shared data source. MISD is not a commonly used architecture (MIMD tends to be used instead). However, the American Space Shuttle flight control system did make use of MISD processors.



IV. MIMD [3]

MIMD (multiple instruction multiple data)

MIMD (multiple instruction multiple data) uses multiple processors. Each one can take its instructions independently, and each processor can use data from a separate data source (the data source may be a single memory unit which has been suitably partitioned). The MIMD architecture is used in multicore systems (for example, by super computers or in the architecture of multi-core chips).



(c) State and explain 5 special purpose registers found in the Von Neumann Architecture [2]

Program Counter (PC)

- Contains the address of the next instruction to be fetched/executed
- PC holds address of next instruction
- this register is automatically incremented so that it always holds the memory address of the next instruction
- Keeps track of whereabouts of the next program in the memory.
- After one instruction has been carried out, the PC will be able to tell the processor the whereabouts of the next instruction.
- The PC is also called the Sequence Control Register (SCR) as it controls the sequence in which instructions are executed.
- During program execution, the PC:

• stores the address of the next instruction to be executed

• Its content is automatically incremented after the address is read, or

• Its content is altered to specific address if instruction is a jump instruction

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Memory address register (MAR)

• Hold the memory address that contains either the next piece of data or an instruction that is to be used.

• It holds the address of a memory location from which data will be read from or written to.

• Specifies the address for the next read or write

• This is where the address that was read from the PC is sent.

Memory Data Register (MDR) also called Memory buffer register (MBR)

• Used to store data which has been read from or is ready to write to memory.

• It acts like a buffer and holds anything that is copied from the memory ready for the processor to use it

• It contains data written into memory or receives data read from memory

Current instruction register (CIR)

- it holds the instruction that is to be executed

- Contains both the operator and operand of the current instruction - For example the instruction MOVE 100,#13

- "MOVE" is the operator, and "100" and "#13" are the operands.

- It stores an instruction while it is being decoded/executed/carried out

- Its contents change when an instruction from memory has been placed in MDR, and then it is copied from MDR to CIR.

The Status Register (SR).

- This contains status bits which reflect on the results of an instruction. For example, if there is an error in the operation (such as an overflow) this will be recorded in the status register. The Status Registers also store data about interrupts

Index register

• It is a register used for modifying operand addresses during program execution,

• Used in performing vector/array operations.

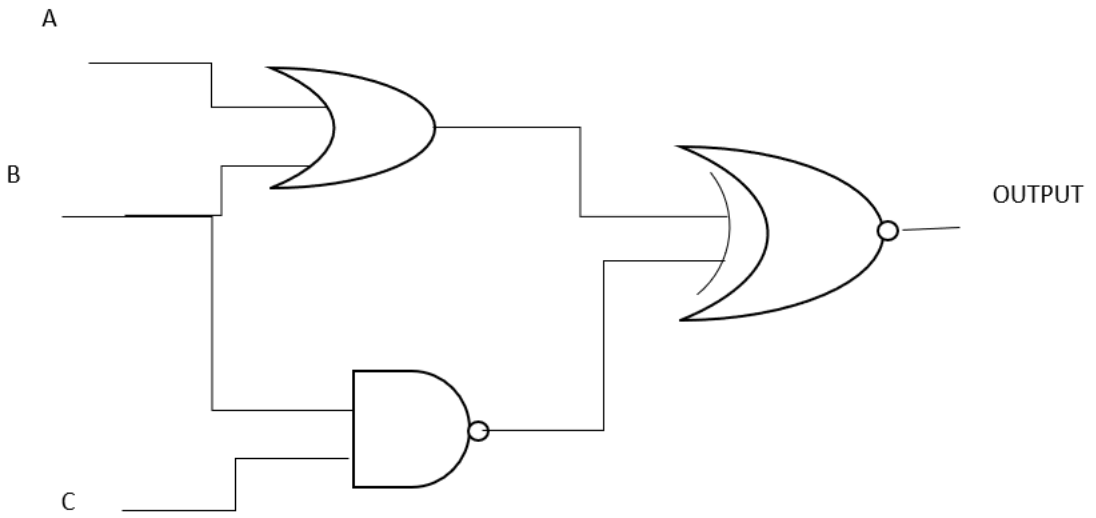
• Used for indirect addressing where an immediate constant (i.e. which is part of the instruction itself) is added to the contents of the index register to form the address to the actual operand or data

General Purpose Registers Accumulator

(d) Explain 3 function of the ALU and 5 functions of the control unit [2]

(e) Draw the logic gate and complete the truth table for:

((A+B) .C) (C.B)' [2]



A	B	C	A+B	(B.C)'	OUTPUT
0	0	0	0	1	0
0	0	1	0	1	0
0	1	0	1	1	1
0	1	1	1	0	0
1	0	0	1	1	1
1	0	1	1	1	1
1	1	0	1	1	1
1	1	1	1	0	0

5. (a)Define:

   I. Multiplexing [1]

   II. Virtual circuits [1]

   (b) The above are found in which layer of the OS model [1]

   (c) Explain how data integrity can be improved in the Transport layer [1]

   (d) Complete the table below

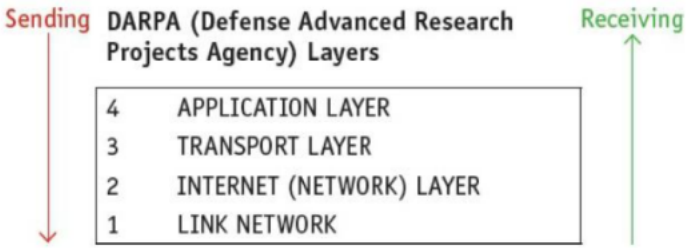
LAYER	**PROTOCOL**	**FUNCTION**
1, Physical		
2, Data link		
3,Network/internet		
4,Transport		
5,Apllication		

[4]

(e) With aid of a diagram explain the TCP/IP protocols [3]

TCP/IP protocols

This is the four-layer structure for TCP/IP protocols:



TCP (Transmission Control Protocol)

If an application is running on an end-system where a 'message' is to be sent to a different end

system the application will be controlled by an application layer protocol as described above.

The protocol will transmit the user data to the transport layer.

The TCP protocol operating in the transport layer now has to take responsibility for ensuring

the safe delivery of the 'message' to the receiver.

The TCP protocol creates sufficient packets to hold all of the data.

Each packet consists of a header plus the user data.

IP (Internet Protocol)

The function of the network layer, and in particular of the IP, is to ensure correct routing

over the Internet.

IP protocol takes the packet received from the transport layer and adds a further header.

The header contains the IP addresses of both the sender and the receiver.

The IP packet, which is usually called a 'datagram', is sent to the data-link layer and

therefore to a different protocol suite. The data-link layer assembles datagrams into 'frames'. Once the IP packet has been sent to

the datalink layer, IP has no further duty.

IP will have no knowledge of whether or not it reached its destination. If IP receives a

packet which contains an acknowledgement of a previously sent packet, it will simply pass

the packet on to TCP with no awareness of the content.

IP address

Every device on the internet has a unique IP address. The IP address is included in a

data packet. IP addresses are either 32-bit or 128-bit numbers. The address is broken down into four 8-bit numbers (each is called an octet). Each octet can represent a number between 0 and 255 and is separated by a full stop, eg 192.168.0.12.

To find your IP address you can use the ipconfig command line tool.

Home and small business routers often incorporate a basic dynamic host configuration protocol (DHCP) server which assigns IP addresses to devices on a network.

Application-layer protocols associated with TCP/IP

There are very many application-layer protocols. This discussion considers some that are used most

FTP (File Transfer Protocol)

FTP is used to transfer large files. It is often used for organising files on a web server for a website. You can have private access to an area on an FTP server where you can upload your files. You can then give another user access to download the documents that you have shared.

 FTP or File Transfer Protocol is an extensively used for downloading. It uses TCP/IP for transmission of data.

 FTP allows the transfer of files over the internet between two computers.

 It follows a client-server relationship i.e. users(client) have to log in using a username and password before being able to download files from or upload files to the server.

 FTP is weak in terms of security and does not have any encryption. Therefore SSH or SSL protocols are used with it to provide additional security.

FTP Server: central computer stores files that are to be downloaded

FTP Command: user can send action/instruction (or by example, e.g. change directory) that are carried out on server

FTP Client: A computer that requests a file from FTP server is called FTP client.

Anonymous: allows user to access files user does not need to identify themselves to Server.

HTTP (Hyper Text Transfer Protocol)

HTTP transfers web pages from web servers to the client. All web page addresses start with http. An https address is a secure web address which has been encrypted. An

https address is used for sites holding bank details and secure information.

 HTTP is a protocol used to transfer data across internet. It is a set of rules which must be followed while transferring data such as files, image, sound, videos etc on the World Wide Web.

 It is also based on a client-server relationship i.e. when a user opens the web browser and types in or clicks on a Uniform Resource Locater (URL), the request is sent and URL is converted into an IP address which is used to locate the server.

 The server contains text, images etc in HTML format or PDF or in original formats.

 HTTP daemon is the program which acts upon the requests from clients and sends the requested file to them.

 HTTPS is Hyper Text Transfer Protocol Secure when data is encrypted and send with security.

6. (a) Describe Routing Information Protocol (RIP) [3]

   (b) Describe Open Shortest Path First (OSPF) Routing protocol [4]

   (b) summarizes what happens when a user requests a web page from a Website with reference to Domain Name System (DNS) [2]

   The usertypes URL into their browser. HTTP(s) transmits the request from the application layer to the transport layer (TCP).

   The TCP creates data packets and sends them to the destination port(s).

   The DNS server stores a database of URLs and matching IP addresses.

   The DNS server uses the domain name typed into the browser to look up the IP address of the appropriate website.

   The server TCP sends back an acknowledgement.

   Once communication has been established, the web server sends the web page back in HTML format to the browser. The browser interprets the page and displays it or sends the data in the correct format to the media player.

7. (a) Identify 5 risks to computer system [3]

   (b) Suggest measures to mitigate these risks in (a) above [2]

   (c) Identify any five sources of vulnerabilities [2]

   (d) Identify and Explain any 5 risk management techniques [3]

8. (a) Define the following terms

I. Recursion

II. Winding

III. Unwinding

IV. Base case

V. General case

As they are related to recursion [2]

(b) Write an Algorithm using pseudocode that will calculate compound interest [2]

(c) Dry run the Following Algorithm For n=6

```
FUNCTION      Factorial[ Byval n : INTEGER]
    DECLARE Result : INTEGER
  IF n=0          THEN
      Result=1
    ELSE
      Result=Factorial(n-1)*n
  END IF
 RETURN Result
END FUNCTION
```

CALL NUMBER	Function call	n	Result	Return
1	Factorial(6)	6	Factorial(5)*6	
2	Factorial(5)	5	Factorial(4)*5	
3	Factorial(4)	4	Factorial(3)*4	
4	Factorial(3)	3	Factorial(2)*3	
5	Factorial(2)	2	Factorial(1)*2	
6	Factorial(1)	1	Factorial(0) *1	
7	Factorial(0)	0	1	1
6	Factorial(1)	1	1	1
5	Factorial(2)	2	2	2
4	Factorial(3)	3	6	6
3	Factorial(4)	4	24	24
2	Factorial(5)	5	120	120
1	Factorial(6)	6	720	720

[2]

(d) The following Data was Sorted using In-Order Algorithm

3 7 9 12 15 21 99

Construct the binary tree [2]

(e) Write an Algorithm to perform Quick sort [1]

(f) Using your algorithm above sort the array below

12 8 1 9 13 67 [1]

9. (a)Explain why the table below is not in 1NF [2]

Student ID	First Name	Second Name	Date Of Birth	Subject Name	Subject Teacher	Class ID	Location	Teacher Name	Licence Number	Address	Teacher Date Of Birth
S1276	Noor	Baig	09/22/2010	Maths, History, Geography	Mr Yee, Miss Wu, Mr Khan	7A	Floor 2 Room 3	Mr Khan	37952	School House 1	03/27/1985
S1277	Ahmad	Sayed	06/11/2010	Maths, Science, Geography	Mr Yee, Miss Yo, Mr Khan	7B	Floor 2 Room 4	Miss Malik	68943	School House 2	12/14/1988
S1299	Tahir	Hassan	01/30/2011	Maths, Science, History	Mr Yee, Miss Yo, Miss Wu	7A	Floor 2 Room 3	Mr Khan	37952	School House 1	03/27/1985

(b) Normalise the table to 2NF (3)

First normal form (1NF)

The un-normalised School database can be represented as follows.

STUDENT(StudentID, FirstName, SecondName, DateOfBirth, SubjectName,

SubjectTeacher, SubjectName, SubjectTeacher, SubjectName, SubjectTeacher,

ClassID, Location, TeacherName, LicenceNumber, Address, TeacherDateOfBirth).

STUDENT is the table name; the attributes are listed in order and the primary

key is underlined.

The student's subjects and the subject teacher are the repeating attributes.

For the database to be in first normal form, these need to be removed to a

separate table and linked to the original table with a foreign key. The School database can now be represented in 1NF as follows.

STUDENT(StudentID, FirstName, SecondName, DateOfBirth, ClassID, Location,

TeacherName, LicenceNumber, Address, TeacherDateOfBirth).

STUDENTSUBJECT(StudentID, SubjectName, SubjectTeacher).

The primary key for the STUDENTSUBJECT table is a composite key formed

from the two attributes StudentID and SubjectName; the attribute StudentID

is also a foreign key that links to the STUDENT table.

Student ID	First Name	Second Name	Date Of Birth	Class ID	Location	Teacher Name	Licence Number	Address	Teacher Date Of Birth
S1276	Noor	Baig	09/22/2010	7A	Floor 2 Room 3	Mr Khan	37952	School House 1	03/27/1985
S1277	Ahmad	Sayed	06/11/2010	7B	Floor 2 Room 4	Miss Malik	68943	School House 2	12/14/1988
S1299	Tahir	Hassan	01/30/2011	7A	Floor 2 Room 3	Mr Khan	37952	School House 1	03/27/1985

Student ID	Subject Name	Subject Teacher
S1276	Maths	Mr Yee
S1276	History	Miss Wu
S1276	Geography	Mr Khan
S1277	Maths	Mr Yee
S1277	Science	Miss Yo
S1277	Geography	Mr Khan
S1299	Maths	Mr Yee
S1299	Science	Miss Yo
S1299	History	Miss Wu

▲ **Table 8.9** School database in 1NF

Second normal form (2NF)

There are now two tables; in the STUDENTSUBJECT table the primary key is a composite key and the SubjectTeacher is only dependent on the SubjectName part of the primary key. This is a partial dependence and needs to be removed by introducing a third table, SUBJECT. The School database can now be represented in 2NF as follows.

STUDENT(StudentID, FirstName, SecondName, DateOfBirth, ClassID, Location, TeacherName, LicenceNumber, Address, TeacherDateOfBirth)

STUDENTSUBJECT(StudentID, SubjectName)

SUBJECT(SubjectName, SubjectTeacher)

Student ID	First Name	Second Name	Date Of Birth	Class ID	Location	Teacher Name	Licence Number	Address	Teacher Date Of Birth
S1276	Noor	Baig	09/22/2010	7A	Floor 2 Room 3	Mr Khan	37952	School House 1	03/27/1985
S1277	Ahmad	Sayed	06/11/2010	7B	Floor 2 Room 4	Miss Malik	68943	School House 2	12/14/1988
S1299	Tahir	Hassan	01/30/2011	7A	Floor 2 Room 3	Mr Khan	37952	School House 1	03/27/1985

Student ID	Subject Name
S1276	Maths
S1276	History
S1276	Geography
S1277	Maths
S1277	Science
S1277	Geography
S1299	Maths
S1299	Science
S1299	History

Subject Name	Subject Teacher
Maths	Mr Yee
History	Miss Wu
Geography	Mr Khan
Science	Miss Yo

▲ **Table 8.10** School database in 2NF

(c) Describe how a DBMS overcomes the limitations of a file-based approach to the storage and retrieval of data. [2]

(d) A school stores a large amount of data. This includes student attendance, qualification, and contact details. The school's software uses a file-based approach to store this data.

A.) The school is considering changing to a DBMS.

I. State what DBMS stands for. [1]

II. Describe two ways in which the Database Administrator (DBA) could use the DBMS software to ensure the security of the student data. [1]

III. A feature of the DBMS software is a query processor. Describe how the school secretary could use this software. [1]

IV. The DBMS has replaced software that used a file-based approach with a relational database. Describe how using a relational database has overcome the previous problems associated with a file-based approach. [1]

10. (a)describe the role of Intellectual Property Rights [5]

(b) evaluate the importance of e- Business [5]

THE END GOOD LUCK!!!

MARKING SCHEME TO BE RELEASED TOMMOROW AFTERNOON

SUNDAY 10 NOV 2024.

FOR ANY QUERIES REGARDING THIS QUESTION PAPER PLEASE

CONTACT: 0775423556

ONLINE SERMINAR TOMMORROW FROM 2PM TO 8:30pm

FASCILITATOR: CHIBY

: Last super Creator

SECURE YOUR PLACE TODAY "Don't wait for tomorrow tell a friend to tell a friend"

COST: $2 us

ACCOUNT : 0771100799 Tino Chiby

Revision for the last super and Some techniques to unlock your potential will be covered tomorrow

MAIN EXPECTED TOPICS

1. **BINARY TREE**
2. **Quick sort**
3. **Binary search**
4. **Recursion**
5. **Processor Architecture**
6. **BINARY REPRESENTATION OF FLOATING POINT**
7. **Routing protocols**

……

AND MANY OTHER TOPICS WILL BE COVERED IN DETAIL TOMMOROW

"REACHING OUT TO THE WORLD WHERE EVER YOU ARE"

To secure your place kindly pay and forward your message to @chiby so that we can add you in the seminar group.

John 1:11 "He came for his own, but his own did not receive him"