Component 1 | 1.3.2| Databases

Specification & learning objectives

	A Level	Specification point description
	1.3.2a	Relational database, flat file, primary key, foreign key, secondary key, entity relationship modelling, normalisation and indexing
	1.3.2b	Methods of capturing, selecting, managing and exchanging data
	1.3.2c	Normalisation to 3NF
	1.3.2d	SQL - Interpret and modify
	1.3.2e	Referential Integrity
	1.3.2f	Transaction processing, ACID (Atomicity, Consistency, Isolation, Durability), record locking and redundancy

Resources

PG Online textbook page ref: 82-109

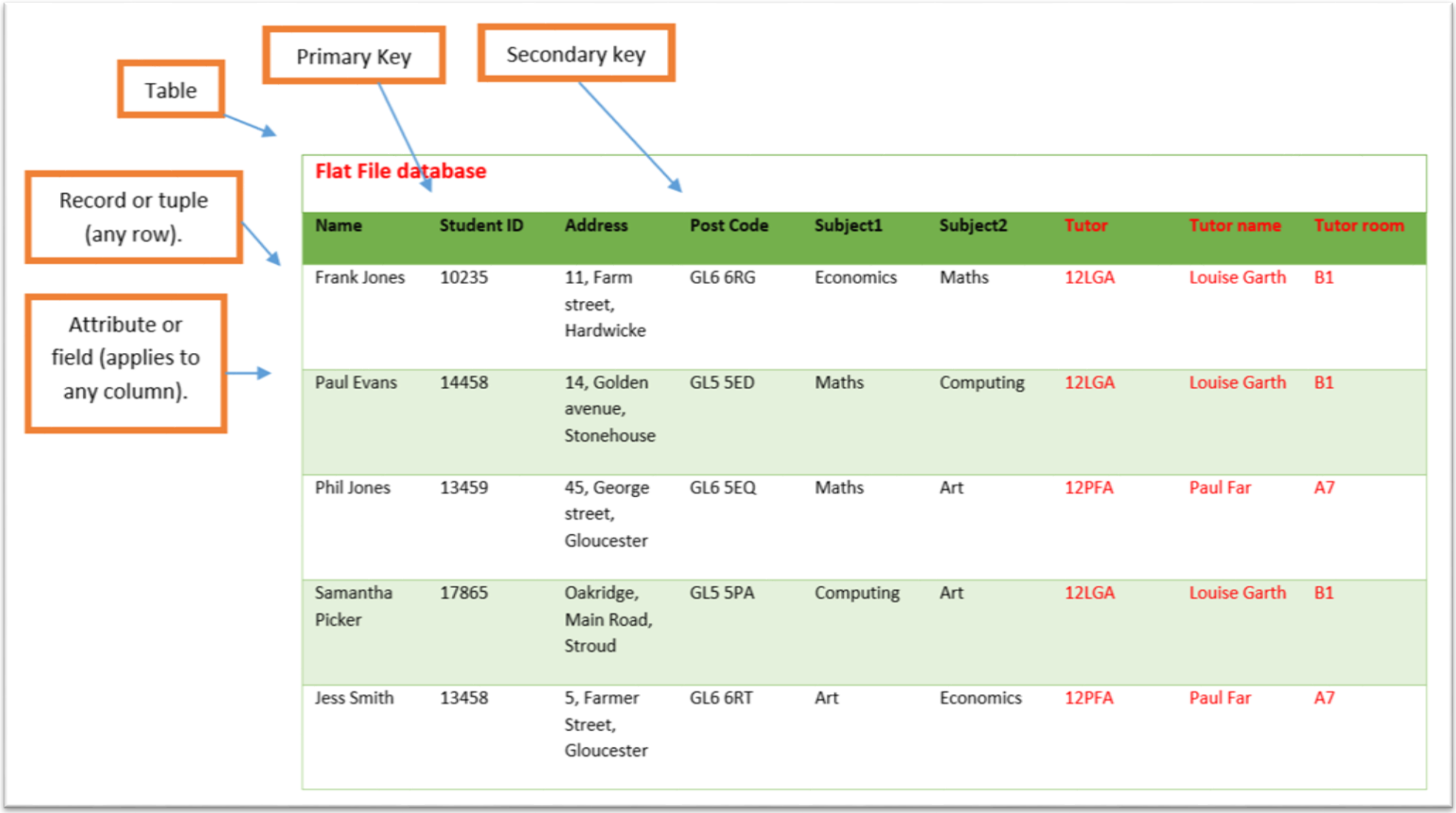
Hodder textbook page ref: 183-200

CraignDave videos for SLR 10

Key question: What are the key terms associated with databases?

Relational database: The data is stored in sensible groups, and a separate table is made for each group. A relationship can be made between them.
Flat file: All of your data is stored in one big table, it is a standard database.
Primary key: A primary key is a key in a relational database which is unique for each record, it is a unique identifier.
Foreign key: A column that references a column of another table.
Concatenated Primary key:
Secondary key: A secondary key is a key that is indexed for faster searches. A table can more than one secondary key however.
ERM: Entity relationship modelling is a way of representing the relationships between entities.
Normalisation: Database normalisation is the process of organising the columns and tables of a relationship database to minimise data redundancy.
Indexing: Indexing is the process of entering information from historical records into an online, searchable database.

Key question: What are the key terms associated with databases?



Flat File database

Name	Student ID	Address	Post Code	Subject1	Subject2	Tutor	Tutor name	Tutor room
Frank Jones	10235	11, Farm street, Hardwicke	GL6 6RG	Economics	Maths	12LGA	Louise Garth	B1
Paul Evans	14458	14, Golden avenue, Stonehouse	GL5 5ED	Maths	Computing	12LGA	Louise Garth	B1
Phil Jones	13459	45, George street, Gloucester	GL6 5EQ	Maths	Art	12PFA	Paul Far	A7
Samantha Picker	17865	Oakridge, Main Road, Stroud	GL5 5PA	Computing	Art	12LGA	Louise Garth	B1
Jess Smith	13458	5, Farmer Street, Gloucester	GL6 6RT	Art	Economics	12PFA	Paul Far	A7

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Key question: How can data be captured and exchanged for databases?

Capture	Explanation
Online form	An online form can be used for entering a clients personal details, for instance when on a website and signing up for something you will have to fill in your details. This is an online form and is a way of capturing data that is to be stored in a database. Data can also be managed such as changing your personal details if for instance you want to change your email. It is quick and easy and data redundancy or error is minimal.
OCR	OCR or optical character recognition is used consistently as a way of entering data from printed paper data sheets; this could include bank statements or receipts. OCR reads data from a sheet such as a receipt and inputs the values or text into a form which can be understood by a computer. And because it can be understood by a computer it can be input into a database and is therefore a method of capturing data.
Barcodes	A barcode is an optical machine readable symbol. Barcodes are found on pretty much everything bought from a shop and provides a product with its identification, for instance when buying a product the cashier will scan the barcode and the computer will flash up with the product information and price. This is a method of exchanging data because not only does it tell the cashier about the product it also tells the business through the computer that a product has been bought. Barcodes can be read by a barcode scanner which is an electronic device that can read and output barcodes to a computer.

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Key question: How can data be captured and exchanged for databases?

Capture	Explanation
PDA	PDA or personal digital assistant is a personal device such as a mobile phone which functions as a personal information manager. They are synchronized with a desktop or server based database and allow integration with SQL databases that are stored on the device. A PDA therefore provides the capturing for the data stored however it is responsible for all the methods.
SQL	SQL or structured query language is a method for managing data within a relational database management system, it can be used to query data within a database and then the data can be managed.
DBMS	DBMS or a data management system is an application for creating and managing databases, Microsoft Access is an example of a DBMS. DBMS' can be used to capture and manage data.
CSV	CSV or comma separated values is a file which can be used to store data for a database, to manage and change data for the database you just have to edit the CSV file.
XML	XML is a form of database that allows data to be specified and occasionally stored, the data can be queried changed and exported.

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Key question: What is the purpose of normalisation?

This flat file database below can be made more efficient, the columns tutor, tutor name and tutor name make the database inefficient because data is repeated.

Normalisation

Table

Primary Key

Secondary key

Record or tuple (any row).

Attribute or field (applies to any column).

Flat File database

Name	Student ID	Address	Post Code	Subject1	Subject2	Tutor	Tutor name	Tutor room
Frank Jones	10235	11, Farm street, Hardwicke	GL6 6RG	Economics	Maths	12LGA	Louise Garth	B1
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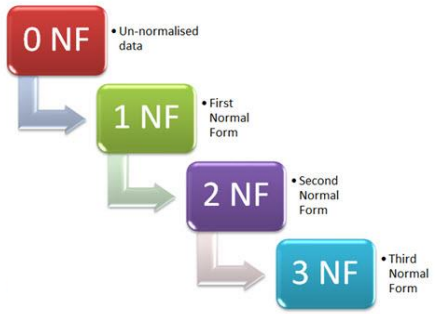
Tutor	Tutor name	Tutor room
12LGA	Louise Garth	B1
12PFA	Paul Far	A7

A relational database can be introduced in order to reduce the amount of data in the original database. For instance the tutor name is repeated as is the tutor room – this is unnecessary so another table can be created called tutor.



The table would be representative of the one above. And the columns tutor name and tutor room in the original database can be removed, this process is called normalisation.

Key question: How do you use the main keywords in SQL to create, return and delete data in a database?

Some SQL commands
CREATE TABLE - create an empty table
DROP - delete a table or even a complete database
INSERT - insert a row into a table
UPDATE - alter data in a row
SELECT - retrieve data from the database, more than one table can be accessed in the query.
WHERE sets up one or more conditions to filter the query
AND allows more than one condition to be included
FROM identifies the table to be used

Key question: What are the considerations in transaction processing?

In order to change a database in some way, there needs to be a specific chunk of work (operations) carried successfully.
This set of operations in called a database transaction.

A **database transaction** is an indivisible set of operations that needs to complete successfully in order to update one or more databases in some way.

A transaction can only have two outcomes:
1.The transaction succeeds
2.The transaction fails
A partially-successful transaction that fails to complete properly should be detected by the system and effectively cancelled so that the database is in exactly the same state as it was as if the transaction never happened.

Key question: What are the considerations in transaction processing?

A transaction changes the state of a database and there are only four basic operations. You can memorise this with the acronym **CRUD.**

Action	SQL equivalent
CREATE	INSERT or CREATE
READ	SELECT
UPDATE	UPDATE
DELETE	DELETE, DROP

A database management system must ensure that transactions must have the following features:

- **A**tomicity
- **C**onsistency
- **I**solation
- **D**urability

Consistency means that a transaction must ensure that all the database rules are still being followed. For example a transaction might try to update an integer-only field with a string - this breaks a rule and so the transaction is not allowed to happen.4
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Key question: What are the considerations in transaction processing?

The **'Atomic'** bit reflects the idea that a successful transaction has a minimum number of steps and every step must succeed before the database is permanently changed by the transaction. It ensures data integrity.

A database management system must ensure that transactions must have the following features:

- **A**tomicity
- **C**onsistency
- **I**solation
- **D**urability

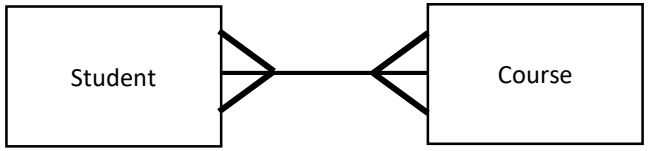
Consistency means that a transaction must ensure that all the database rules are still being followed. For example a transaction might try to update an integer-only field with a string - this breaks a rule and so the transaction is not allowed to happen.

Isolation means that no other transaction can interfere with the data being handled by the current transaction until it has completed its update. An isolated transaction cannot be interfered with while underway.

Durability means that whatever transaction has taken place, the update must remain in place even if there is a system failure. In practice, this means that a successful transaction updates the database stored in secondary memory i.e. on a hard drive.

Typical exam questions

A new database is being designed for a school to keep track of students who join for A level studies and the courses they take. The structure it plans to use is:



1. Identify **one** reason why this table structure is not suitable. **[1]**

2. Draw a new version of the above table structure to solve the problem. **[3]**

3. The Course table has the following fields: CourseID, CourseName, LecturerInitials, LecturerName. Describe what is meant by the term primary key and suggest which fields, if any would be suitable. **[3]**

4. Write an SQL statement to extract the CourseName and LecturerInitials from the Course table for all courses taught by Lecturer “Jake Bidmead”. The results should be ordered by CourseID in ascending order. **[3]**

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Target: Overall grade:

Minimum expectations & learning outcomes

☐	Terms 114-133 from your A Level Key Terminology should be included and formatted.
☐	You must include an annotated table that demonstrates your understanding of the terms associated with a database including field, record, primary key, foreign key, secondary key & index.
☐	You must include Entity Relationship Diagrams (ERDs) which clearly shows a database design being taken from a flat file to 3NF with supporting annotations to explain what is happening at each normal form.
☐	You must include several annotated examples of SQL statements.
☐	You must include a clear breakdown of the acronym ACID.
☐	You must include examples of common data capture and exchange formats including OCR, OMR, CSV, XML & JSON.
☐	Answer the exam questions.

Feedback

Breadth	Depth	Presentation	Understanding
☐ All	☐ Analysed	☐ Excellent	☐ Excellent
☐ Most	☐ Explained	☐ Good	☐ Good
☐ Some	☐ Described	☐ Fair	☐ Fair
☐ Few	☐ Identified	☐ Poor	☐ Poor

Comment & action required

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Reflection & Revision checklist

Confidence	Clarification
☹ 😐 ☺	Candidates need to understand what is meant by a database.
☹ 😐 ☺	Candidates should be familiar with basic database terminology such as fields, records and tables.
☹ 😐 ☺	Candidates should know the difference between a flat file and a relational database and be able to explain the benefits and limitations of each approach.
☹ 😐 ☺	Candidates should have experience of setting up and using both a flat file, and relational database.
☹ 😐 ☺	Candidates should know what is meant by a primary key, foreign key and secondary key and how each are used in a database.
☹ 😐 ☺	Candidates should be able produce and follow Entity Relationship (ER) diagrams which include 1:1, 1:M and M:M relationships.
☹ 😐 ☺	Candidates should be able to identify how tables should be linked.
☹ 😐 ☺	Candidates need to have an awareness of a range of methods for capturing data (such as forms, OCR, OMR and sensors) selecting data (such as Query By Example and SQL), managing data (such as changing data by manipulating it – e.g. arithmetic functions, adding, editing, deleting the data) and exchanging data (with common formats such as CSV, JSON and XML). Candidates won't be specifically asked about any one of these methods but may be asked to discuss/justify suitable methods as part of a more open question.
☹ 😐 ☺	Candidates need to have an understanding of the need to interrogate data within a database.
☹ 😐 ☺	Candidates should understand the purpose of indexing in a database and the benefits of using indexing to optimise the searching for data.
☹ 😐 ☺	Candidates need to have experience of a range of methods for capturing data (such as forms – what do they collect, what do they look like – data mining, where does the data come from, how is it collected and analysed), selecting data (such as how to produce QBEs – adding fields, tables, criteria, sorting – selecting through Boolean expressions – AND, OR, NOT), managing data (such as changing data by manipulating it – e.g. arithmetic functions – adding, editing, deleting the data) and exchanging data (such as methods of transferring data – electronic i.e. memory stick, e-mail, and non-electronic e.g. paper based – appropriate formats for the transfer of data and communication mediums to transfer data – such as the structure, is it in a table or a list).(such as forms, data mining), selecting data (such as producing QBEs, selecting through Boolean expressions), managing data (such as manipulation, adding, editing, deleting) and exchanging data (such as methods of transferring data, appropriate formats for the transfer of data and communication mediums to transfer data).
☹ 😐 ☺	Candidates should have experience of using SQL to edit and modify data in a database. They should understand the need for SQL as a standard language.
☹ 😐 ☺	Candidates should be able write and follow scripts using the SQL commands listed in appendix 5d.
☹ 😐 ☺	Candidates need to understand what is meant by referential integrity, and why this is desirable in a database.

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Reflection & Revision checklist

Confidence	Clarification
☹ 😐 ☺	Candidates should understand what is meant by transaction processing, and scenarios where transaction processing takes place.
☹ 😐 ☺	Candidates should understand the problems that arise from transaction processing, and how these can be overcome.
☹ 😐 ☺	Candidates should understand the ACID rules for transaction processing, and why databases should be built to these standards.
☹ 😐 ☺	Candidates should understand how record locking prevents the overriding of data and understand how record locking takes place.