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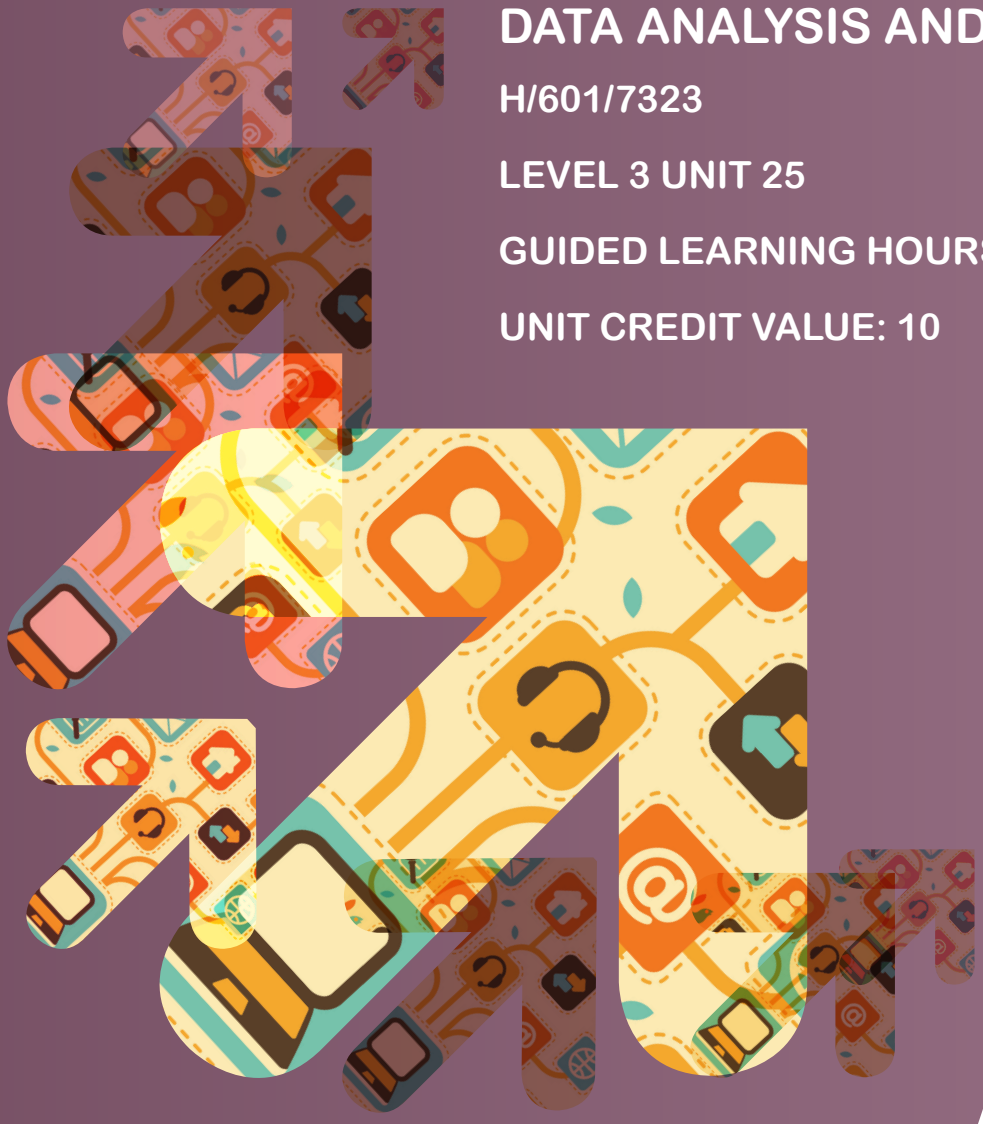
OCR LEVEL 3 CAMBRIDGE TECHNICAL

CERTIFICATE/DIPLOMA IN

IT



DATA ANALYSIS AND DESIGN

H/601/7323

LEVEL 3 UNIT 25

GUIDED LEARNING HOURS: 60

UNIT CREDIT VALUE: 10

OCR

DATA ANALYSIS AND DESIGN

H/601/7323

LEVEL 3

AIM AND PURPOSE OF THE UNIT

At the end of this unit learners will have a good understanding of different modelling methodologies and the associated advantages and disadvantages of each. They will have an understanding of logical data modelling and how to implement the logical data modelling concepts to produce a well structured and effective database system. Learners will be able to analyse requirements for a small business environment and design appropriate data models to meet the needs of the intended end user.

In order to achieve the aim, learners will be taught the following subject areas:

- modelling methodologies and the associated advantages and disadvantages for each method
- logical data modelling (LDM) to include the concepts, advantages, disadvantages, constraints and normalisation
- how to produce a logical data model for a given scenario/ business requirement taking into consideration user requirements, entity types and relationships, entity-relationship diagrams, relationship descriptions, constraints, purpose
- how to implement a logical data model
- testing strategy for testing the model to include the different test types.

It is expected that learners will already have a reasonable working knowledge of databases including the planning and implementation for given scenarios.

ASSESSMENT AND GRADING CRITERIA

Learning Outcome (LO) The learner will:	Pass The assessment criteria are the pass requirements for this unit. The learner can:	Merit To achieve a merit the evidence must show that, in addition to the pass criteria, the learner is able to:	Distinction To achieve a distinction the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
1 Know modelling methodologies	P1 describe the advantages and disadvantages of different database types		
	P2 describe different modelling methodologies	M1 explain the difference between conceptual, logical and physical data models	D1 compare benefits of different modelling technologies
2 Understand logical data modelling	P3 explain logical data modelling concepts		D2 compare advantages and disadvantages of using normalisation
3 Be able to produce logical data models	P4 produce a logical data model for a given requirement	M2 identify potential validation rules on a logical data model	
4 Be able to implement and test logical data models	P5 implement a logical data model		
	P6 test a logical data model	M3 describe the test strategy used for testing the data model	

TEACHING CONTENT

The unit content describes what has to be taught to ensure that learners are able to access the highest grade.

Anything which follows an i.e. details what must be taught as part of that area of content.

Anything which follows an e.g. is illustrative, it should be noted that where e.g. is used, learners must know and be able to apply relevant examples to their work though these do not need to be the same ones specified in the unit content.

LO1 Know modelling methodologies

- **database types and associated advantages and disadvantages**
- **flat file**
  - entities
  - attributes
- **relational**
  - entities
  - attributes
  - relationships
  - network
    - objects
    - relationships
  - hierarchical
    - trees
    - parents
    - children.
- **modelling methodologies and associated advantages and disadvantages**
  - bottom-up
  - top-down
  - Logical Data Modelling (LDM).
- **normalisation**
  - Object Orientated Analysis and Design (OOAD)
  - conceptual data model
  - physical data model.

Understand conceptual data modelling

- **identify highest-level relationships found between entities**
  - entities (describes the data)
  - relationships.

Extending conceptual models to logical models

- all entities and relationships between them
- all attributes for each entity
- the primary key for each entity
- foreign keys, (keys identifying the relationship between different entities).

The steps for designing a logical data model:

1. specify primary keys for all entities
2. find the relationships between different entities
3. find all attributes for each entity
4. resolve many-to-many relationships
5. normalisation.

LO2 Understand logical data modelling

- **concepts of Logical Data Modelling (LDM)**
  - entities
  - attributes
  - relationships
    - one-to-one (1:1)
    - one-to-many (1:M)
    - many-to-many (M:M).
- **entity relationship diagram (ER diagram)**
  - entity attribute relationship diagram (EAR diagram)
  - relationship conditions
    - mandatory
    - optional
- **primary keys**
- **foreign keys**
- **data dictionary**
- **advantages**
  - easy to understand
  - easy to visualise
  - structure method
  - standardisation of methods and notation
  - no data redundancy.
- **disadvantages**
  - can be difficult to modify
  - cannot always spot errors
  - can be time consuming.
- **constraints**
  - user requirements
  - operational platform
  - organisational requirements
  - domain
  - entity
  - referential.

- **normalisation advantages**
  - avoids data modification
  - greater flexibility
  - few null values
  - fewer inconsistencies
  - improved database security
  - improved storage efficiency
  - maximises the use of clustered indexes.
- **normalisation disadvantages**
  - can reduce database performance
  - maintenance overheads, (e.g. time consuming – the more entities the more normalisation required).

LO3 Be able to produce logical data models

Understand physical data modelling

- **represents how the model will be built within the database and shows the following:**
  - table structures
    - column name
    - column data type
    - column constraints
    - primary key
    - foreign key
  - relationships
  - physical considerations
  - physical data.
- **designed by:**
  - converting entities into tables
  - converting relationships into foreign keys
  - converting attributes to columns
  - modifying the physical data model based on constraints and requirements.

Understand the use of validation rules

- **validation rules help assure that data entry is reasonable and accurate**
  - uniqueness, (e.g. prevent duplication of entry)
  - set format, (e.g. dates to be entered in a certain way, postcodes etc.)
  - parameters – values entered to be between certain values.

LO4 Be able to implement and test logical data models

- **logical data model (LDM) content**
  - user requirements
    - data to be stored
    - outputs required
    - data validation rules
  - data dictionary
  - entity relationship diagram (ER diagram)
  - entity types
  - relationships descriptions
  - constraint list
  - entity attribute relationship diagram (EAR diagram)
  - purpose
    - easier to maintain
    - easier to make changes
    - standard programming notation.
- **test types**
  - integrity
  - entity
  - relationship
  - constraint
  - testing for errors
    - normal
    - erroneous
    - extreme
  - testing for usability
    - how quickly can someone learn how to use it? (Learnability)
    - how tolerant is it to user error? (Robustness)
    - how good is it in recovering from user error? (Recoverability)
    - how does it match the user's work practice? (Performance)
  - test strategy
    - prioritisation
    - test data
    - types of tests.

DELIVERY GUIDANCE

It is expected at this level that the learners will be able to work with relational databases consisting of several tables linked through relationships. Learners must however, be taught a variety of data analysis and data modelling techniques, including the methodologies and how to implement the structures.

Know modelling methodologies

Learners should be taught how to create a conceptual data model and that it contains purely the important entities and their relationships. They should then be taught how to extend the conceptual data model to the logical data model as per the teaching content.

Learners will need to be taught how to resolve many-to-many relationships (breaking them down into one-to-many relationships) and how to complete normalisation by going through the steps of First, Second and Third normalisation. This is a difficult process for learners to take on board and therefore it is suggested that they work through a number of activities where they have to normalise data.

Following on from this, learners should be taught about the physical data model as per the teaching content.

If they compare the conceptual model with the logical data model and with the physical data model, they will see that the main differences are as follows:

- entity names are now table names
- attributes are now field names
- data type for each field is specified. Data types can be different depending on the actual database being used.
- relationships are now foreign keys.

Tutors should provide learners with information relating to the different types of database e.g. relational, flat file, hierarchical and network and the advantages and disadvantages of each. Learners could be presented with case studies showing how the different database types are used. They could be presented with an example of a flat file database for a small company that has created a very simple database structure to store the names and addresses of their customers.

For a relational database, they could be given a scenario where a garage who sells new and second hand cars as well as offering car servicing, records information relating to their customers to include the details of their current vehicle, details of the service record etc. For the network type of database, the learners could be shown the layout of a Local Area Network (LAN) where the objects and relationships are clearly identifiable e.g. one printer (the object) could have a relationship with many PCs. For the hierarchical network the learner could be given a tree structure for a college where the sub trees are the staff members, students, courses and facilities. If the example contained a number of 'departmental' trees and it was identified that a member of staff worked for more than one department, they could see that for every department the member of staff worked in, they would have to be 'created'.

Learners could then have a group discussion about the different database types and consider the advantages and disadvantages of each.

As the main theme of this unit is the Logical Data Model (LDM), then the main focus for detailed delivery should be on this particular model. It is important however, that the learners have a good understanding of the different modelling methodologies. Learners could be asked to research the different modelling methodologies and produce a presentation to be delivered to the group on their findings. This should enable the learners to explain how the methodology works and what the advantages and disadvantages are of each type.

Understand logical data modelling

The learners will need to be fully conversant with Logical Data Modelling (LDM), including:

- what it contains
- how it works
- the advantages and disadvantages
- identifying constraints
- normalising data and the associated advantages and disadvantages.

It would assist learners if they were presented with a scenario e.g. a local estate agent wants to computerise their records for the properties they sell, the vendor details and potential buyers. They could then be asked to produce a conceptual data model (containing the entities and relationships) and create an Entity Relationship (ER) diagram. As a group they could discuss the choices they made and the reasons for their choices. Once the conceptual model has been agreed, they

could then go on to create the Entity Attribute Relationship (EAR) diagram. They should identify all entities and their relationships, if there are any Many to Many relationships they need to resolve these to produce One-to-Many relationships. Learners will need to identify the attributes associated with each entity and from this identify the Primary Key within an entity as well as the Foreign Keys which define the relationships between entities. The learners should discuss any constraints that have been identified and include the detail as part of their logical model.

It would be useful to the learner to see at this stage the importance of documenting their model. Give them examples of models where the documentation is sparse or incomplete and ask them to consider the problems that this may cause.

Learners should be given a number of flat file databases to practise the concept of normalisation. The only real way to learn this skill is through practical activities. Make sure that any notes that they are given keep the steps as simplistic as possible.

Once all the practical activities are complete, ask learners to review the work and consider the advantages and disadvantages associated with using the logical data model method as well as the advantages and disadvantages of normalisation. They can put together their ideas on a PowerPoint presentation to present to the rest of the group.

Be able to produce logical data models

Learners could be given a further scenario e.g. an office supplies company who use a flat file database system, where they apply the data modelling techniques that they have learnt from Learning Outcomes 1 and 2. They should be able to produce a relational database from the flat file system which will be more effective. They should be given additional guidance on the use of validation rules and why they are used as per the teaching content. Appropriate validation rules should be included within their modelling documentation.

Be able to implement and test logical data models

Learners need to implement a logical data model so that they can test it. It is advisable to use the ones that they have been designing e.g. the office supplies company model. It is important that the learners are taught about the importance of a good testing strategy. They should be guided on the different types of tests involved i.e. testing integrity, for errors, usability and how these tests would be conducted. Learners will probably need guidance on how to prioritise the tests they carry out and the importance of using a range of valid test data. Learners should be taught how to plan their tests and draw up a comprehensive test plan to include:

- date of test
- type of test
- what it is testing
- how it will be tested
- what test data will be used (if appropriate)
- what the anticipated result would be
- what the actual result of the test was
- any amendments/adjustments required
- re-testing where required.

SUGGESTED ASSESSMENT SCENARIOS AND TASK PLUS GUIDANCE ON ASSESSING THE SUGGESTED TASKS

Assessment Criterion P1

Learners could produce a report or presentation identifying the different types of databases e.g. flat file, relation, network, hierarchical, to include where they would be used and describing the advantages and disadvantages of each type.

Assessment Criteria P2, M1, D1

For P2, learners could produce a presentation or report identifying at least three of the model methodologies. One method must be logical data modelling (LDM). They need to include in the descriptions how each model is structured and their respective advantages and disadvantages. They should provide relevant examples to support their statements.

For merit criterion M1 learners must explain the differences between the conceptual model, logical model and physical model. Their explanations could be presented as a report or presentation supported by appropriate diagrams.

For distinction criterion D1 learners must compare the benefits of at least three model methodologies. Learners must refer to the data models that they identified for P2 and/or M1. This could be presented as an extension to their original report or presentation.

Assessment Criteria P3, D2

For P3, learners are required to explain the logical data modelling concepts and should be encouraged to use examples from a scenario to support their explanations. The evidence could be presented in the form of a report or presentation.

For distinction criterion D2 learners should compare the advantages and disadvantages of using normalisation. This could be in the form of a table, presentation or report.

Assessment Criteria P4, M2

For P4, learners could use the scenario as identified for assessment criteria P3/D2. They must develop a logical data model based on a given scenario. Their evidence must include Entity-Relationship and Entity-Attribute-Relationship diagrams. The evidence should be well structured showing the process that they have followed when developing a logical data model and be able to be used by anyone to produce the actual physical model. The documentation should clearly define the end user requirements as defined within the delivery guidance for Learning Outcome 3. This could be in the form of a report, presentation or table.

For merit criterion M2, learners must include relevant validation rules within their documentation to control the entry of data by an end user. The documentation could be in the format of a report, presentation or table.

Assessment Criterion P5

Learners must translate the logical data model from P4 into a physical data model i.e. constructing the real data structure. The evidence will be in the form of printouts of their data model etc screen prints showing the construction of the relationships etc, supported by their notes.

Assessment Criteria P6, M3

For P6, learners must devise an appropriate test strategy and test plan to test their model. The test plan must include the testing of integrity, testing of errors and testing of usability. The tests should be well thought out and relevant and include the headings identified in the section teaching content for Learning Outcome 4. There must be evidence presented of the actual test plan, the testing of the model via printouts and/or notes of the tests being carried out, the results and actions taken.

For merit criterion M3, learners must include a description of their test strategy; what have they selected to do and why. This could be in the form of a report or presentation.

SCENARIOS

Learners could be given a scenario to work from i.e. a DVD/ Game hire company wants to use an electronic database to store information relating to the DVDs and games they have for hire, customer details, details of films and games that are currently hired out etc. This particular scenario could be used to support their explanations of the logical data modelling concepts.

LINKS TO NOS

4.2 Data Analysis

4.5 Data Design

6.1 Information Management

CONTACT US

Staff at the OCR Customer Contact Centre are available to take your call between 8am and 5.30pm, Monday to Friday.
We're always delighted to answer questions and give advice.

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