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Resource Lists

LM Data Structures, Algorithms, and Databases

Immersive Reader

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1. Data structure & algorithms, Part 1 (3 weeks) 3. Databases, Part 2 (3 weeks)

2. Databases, Part 1 (2 weeks + consolidation week)

4. Data structure & algorithms, Part 2 (2 weeks) The module is assessed during this semester by three class tests/Quiz (week 4, week 7 and week 10), which collectively make up 20% of your module mark, while the other 80% is determined by your performance in the exam in the May-June 2025 exam period.

There are many excellent books on Data Structures, Algorithms, and Databases. Please see our resource list.

Recommended Books

Topic List

This module consists of Four Blocks.

In Block I: Data structure & algorithms, we will learn about the basic concepts of data structure and algorithms (e.g. pre-conditions & post conditions), as well as searching and the tree structure.

implementing queries. In Block 3: Databases, We will learn techniques for database design, including conceptual design (called entity-relationship modelling) and logical design (extracting tables from the models, and eliminating redundancies) Finally, in Block 4: Data structure & algorithms, we will learn about the graph structure, sorting algorithms and hashtable.

In Block 2: Databases, We will learn the database query language SQL and the theoretical framework of relational algebra, which is used in

Each Block consists of individual topics, which you can see in the table below. Each topic spans multiple lectures, which run in every week of this semester (please see your timetable). Notes for each topic, and recordings of each lecture, will be made available as the module progreses. These

notes and lectures will cover everything you need for the exam.

Activity plan/Learning objectives Additional Resources Topic

Block 1: Data structure & algorithms • Module overview. 1. Introduction • Principles of algorithms and data structures design. **Edgbaston:** • Understand the Linear Search. Lecture Notes [PPT

↓] Video [<u>Lectuer1</u> ⇒] • Search algorithms on unsorted 2. Binary Search and Merge Sort Review Quiz and sorted arrays. • Understand the Merge Sort. **Edgbaston: Lecture Notes**

 Week1_Lecture2 [PPT ↓] **Tutorial:** Videos Exercise Sheet 01 ↓ Week1_Lecture2 ⇒ Exercise Sheet 01 (Solution ↓ • Week1_Lecture3 □→ Tutorial 1 Recording □→ Code $[\underline{zip} \downarrow]$ Exercise Sheet 01 (Tutorial).pdf ↓ **Dubai: Lecture Notes** Week 01 Annotated PDF ↓ Videos [<u>Dubai Week 01</u> □] Code [$\underline{\text{Zip}} \downarrow$] • Understand the problem of 3. Tree Structure inserting and deleting elements. **Edgbaston:** • Understand the Tree data structure. • Terminologies. Videos [Week2_Lecture1 ➡] • Types of Trees. • Representation of the Tree structure. • Understand how to search for 4. Binary Search Tree (BST) Review Quiz an element in BST. • Understand how to insert an **Tutorial: Edgbaston:** element in BST. Lecture Notes [PPT

↓] Exercise Sheet 02 ↓ • Understand how to delete an element in BST. Tutorial 2 Recording □⇒ Videos: Week2_Lecture2 ⇒ Week2 Lecture3 ⇒ updated] Code [$\underline{\text{Zip}} \downarrow$]

Exercise Sheet 02 (Tutorial) ↓ [Answer to Q5] Exercise Sheet 02 (Solution)

↓ [Answer to Q5] updated] Dubai: Lecture Notes Week 02 PPT ↓ Week 02 Annotated PDF ↓ Videos [<u>Dubai Week 02</u> ⊟] Code [<u>Zip</u> <u>↓</u>] • Problem of imbalanced BST. 5. Adelson-Velsky and Landis (AVL) Tree Review Quiz • Balance of a node and AVL **Edgbaston:** property. • The best and the worst case of **Tutorial: Lecture Notes** AVL Tree. • Algorithms for AVL trees Week3_Lecture1 [PPT ↓] Exercise Sheet 03 ↓ Search Week3_Lecture2&3 (Updated)[PPT ↓] <u>Tutorial 3 Recording</u> ⊟ Insertion Videos Deletion Exercise Sheet 03 (Tutorial).pdf ↓ Week3 Lecture1 ⇒ Exercise Sheet 03 (Solution) ↓ Week3_Lecture2 ⇒ Week3_Lecture3 ⇒ Code [$\underline{\text{Zip}} \downarrow$]

Block 2: Databases (Weeks 4-6) 1. Databases and SQL Lecture Handout 1: SQL ↓ **Edgbaston:** <u>Unassessed Exercise Sheet 1</u> ↓ Introduction to databases • Introduction to SQL query • <u>Solutions (28 Feb, 12:00 GMT)</u> <u>↓</u> **Lecture Notes** language Grouping queries

Aggregate operators

Sample Solution (Class Test 1)

Tutorial:

Lecture Handout 2: Relational algebra ↓

Unassessed Exercise Sheet 2 ↓

<u>Unassessed Exercise Sheet 3</u> ↓

Solutions for Part A ↓

Solutions

Dubai:

Lecture Notes

Code [$\underline{\text{Zip}} \downarrow$]

Week 03 PPT ↓

Class Test 1 in Week 4

Week5, Lecture 1 [PPT

↓]

• Week4, Lecture 1 (unavailable)

• Week4, Lecture 2 ⇒

• Week5, Lecture 1 ⇒

2. Relational algebra

• Week 5, Lecture 3 [PPT ↓]

• Week 5, Lecture 2 ⇒

• Week 5, Lecture 3 ⇒

Edgbaston:

Videos

Dubai:

Lecture Notes

Videos

Videos

• Week 8, Lecture 1 ⇒

<u>LectureAnnotations</u> ↓

Videos

Videos

Dubai:

Videos

Videos

Videos

(80%).

Assessments

supplementary exam period.

Lecture Notes

• Week 10, Lecture 1 ⇒

Week 11a PPT ↓

covers MST)

• Week 10, Lecture 2 → (This is a previously recorded

• Week 10, Lecture 3 → (The first part of this video

• Week 10, Lecture 3 → (The second part of this video

covers an overview of the HashTable)

• Week 11, Lecture 1 ⇒

video, but the content is still current)

Week 8, Tutorial ⇒

• Week 7, Lecture 1 [PPT ↓]

• Week 7, Lecture 2 [PPT ↓]

• Lecture 1, part 2 (Tuesday) □

• Lecture 1, part 1 (missing recording)

Worksheet (Data structure) \downarrow

Lecture Notes

Dubai:

Week 03 Annotated PDF ↓

Videos [Dubai Week 03 □]

• Using queries as temporary <u>Tutorial 4 recording</u> ⊟ tables Lecture Notes Week 04 PPT ↓ <u>Lecture Handout on SQL</u> <u>↓</u> <u>LecturesSQLCommands.txt</u> ↓ Videos <u>Dubai Week 04 Recording</u> ⇒ • Install the PostgreSQL server PostgreSQL installation PostgreSQL installation instructions (videos) on your home computer • Create the sample database • for Linux • Go through the handout for for Windows (Alternative link ⇒) working with the database for Mac • Continue by attempting the exercises. Our sample database Unassessed Exercise Sheet 1 ↓ • <u>postgres.zip</u> ↓ • the <u>README.txt</u> <u>↓</u> file (included in zip) Handout on working with the database

• Introduction to relations

• Procedures for operators

• Efficiency considerations

Relational operators

Tutorial: Dubai: <u>Tutorial 5 recording</u> ⊟ Lecture Notes Tutorial 5 (Annotation) ↓ • Week 05 PPT ↓ • <u>LectureSQLCommands05.txt</u> <u>↓</u> • <u>Lecture Handout 2</u> <u>↓</u> Videos <u>Dubai Week 05 Recording</u> ⇒ Week 6: Consolidation Week **Edgbaston:** No new learning objectives, just catch-up. Videos Attempt Practice Quiz • Lecture 1 (Review of class test 1) □→ • <u>Lecture 2 (PostgreSQL exercises)</u> ⇒ Cotinue Exercise Sheet 1 ↓ • Lecture 3 (SQL, relational algebra) When finished,

Worksheet (Database) ↓ Videos <u>Dubai Week 06 Recording</u> ⇒ Class Test 2 in Week 7 Sample questions and solutions ↓ Block 3: Database design (Weeks 7-9) 1. Entity-Relationship modelling Handout 3: Entity-Relationship modelling ↓ Basic Quiz **Edgbaston:** Entities Relationships

• Basic designs

Weak entities

Hierarchies

Attempt Exercise Sheet 2 ↓

• Week 8, tutorial **Tutorial:** Tutorial 7 Recording □⇒ Dubai: Tutorial 7 (Annotation).pdf ↓ Lecture Notes Week 07 PPT ↓ Videos <u>Dubai Week 07 Recording</u> ⊟ 2. Logical design Handout 4: Logical Design ↓ • Extracting tables from ER **Edgbaston:** Review quiz models See Part B of <u>Unassessed Exercise Sheet 3</u> ↓ Lecture Notes • Attempt Logical design quiz Solutions for Part B ↓

• Week 8, Lecture 3 ⇒ Dubai: **Tutorial:** Lecture Notes Week 08 PPT ↓ Tutorial 8 Recording ⊟ Videos <u>Dubai Week 08 Recording</u> ⇒ Tutorial 8 (Annotation).pdf ↓ 3. Normalisation Handout 5: Design theory ↓ • Functional dependencies and **Edgbaston:** redundancy Lecture Notes Unassessed Exercise Sheet 4 ↓ • Boyce-Codd Normal Form • Normalisation procedure Week9, tutorial [<u>hand work</u> <u>↓</u>] Videos • Week 9, Lecture 1 ⇒ • Week 9, Tutorial ⊟ Dubai: **Lecture Notes** Week 09a PPT ↓ (Normalisation)

Handout 6: Designing for Performance ↓ 4. Physical design **Edgbaston:** • Database storage on disk drives Lecture Notes Feedback Form - Block 3 ⇒ • Optimisation techniques **Videos** Dubai: Lecture Notes Week 09b PPT ↓ (Physical Design) Videos <u>Dubai Week 09b Recording</u> ⇒ (Physical Design) Class Test 3 in Week 10 Block 4: Data structure & algorithms 1. Graph Structure and Algorithms Review Quiz • Basic concepts and Exercise Sheet Week10 ↓ **Edgbaston:** representations. • Shortest paths.

• Minimal spanning trees (MST).

Review Quiz

• Basic concepts. 2. Hashtable • Hash functions. • Collisions handling. **Edgbaston:**

• Week 11, Lecture 2 - Part 1 ⇒ Dubai: Lecture Notes Videos 3. Sorting Algorithms Review Quiz Quicksort **Edgbaston:** • Heapsort Lecture Notes [PPT

↓] Exercise Sheet_Week11 ↓ Videos • Week 11, Lecture 2 - Part 2 ⇒ • Week 11, Lecture 3 ⇒ Dubai: **Lecture Notes**

• Class Test 2: An online Quiz test on 05/03/2025. It covers the contents in Block 2. • Class Test 3: A paper based test on 26/03/2025. It covers the contents in Block 3. Masters students must get a 50% or higher average mark to pass the module, while Year in Computer Science students must get a 40% or higher average mark. In the unfortunate case that you do not achieve this, there will be one chance to resit the module, by exam only, in the August 2025

This module is assessed by three 60-minute class tests during this semester (20%) and a two-hour exam in the May-June 2025 main exam period

Examination The examination carries 80% module credit.

The examination is a two-hour paper. The examination will take place in the Main Examination Period in May/June.

• Class Test 1: A paper based test on 12/02/2025. It covers the contents in Block 1.

The School of Computer Science maintains an archive of past exam papers. Microsoft Teams Page

We have set up a Microsoft Teams page for the module, which you can join by clicking here. On this page, you can talk to other students on the module and ask each other questions in order to support each other's learning. We also

recommend that you use this page to form study groups in order to study the module content as a group, which should make learning both more enjoyable and more effective. The module team will also be present on the page, and will also try to answer questions, but please note that the Teams page should not be used as a substitute for tutorials, Q&A sessions or office hours.

Office Hours Office Hours are weekly timeslots that you can visit a member of staff's office in order to ask them any questions you have (about any part of the module). Please feel free to attend office hours as you see fit.

• Jizheng: Monday afternoon between 13:00 and 15:00 (CS Building, Room 112). • Uday: Monday afternoon 13:00 and 15:00 during weeks 4-9 (CS Building, Room 210) • Ahmad: Monday 6:00-7:00pm and Wednesday 4:00-5:00pm (UAE Time) By appointment Zoom link →

Contact Information There are also many places that you can go to get help or ask questions. If you need to get in touch you could:

• Email the relevant Education Support Office (ug-cs@contacts.bham.ac.uk) or msc-cs@contacts.bham.ac.uk). If your are experiencing personal difficulties, have questions relating to extensions or more general study challenges, you might like to contact the CS Welfare Team (cswelfare@contacts.bham.ac.uk) or the Dubai Welfare Team (dubaiwellbeing@contacts.bham.ac.uk).

Previous

• Meet or email a member of the module teaching team.

Overview Assignments This module is a compulsory module for MSc Computer Science and Year in Computer Science. It is offered in the Edgbaston campus as well as the Grades Dubai campus, and contains 4 teaching blocks: Panopto