## Overview [Lab work and Homework]

As discussed in the lecture we will start off in the module by presenting you with an opportunity to get setup with some of the basic tooling which will be used for the module. In this lab we will introduce some of our basic **tech stack** and begin exploring some basic use of the various elements of this tech stack.

Many of the exercises below are intended to prompt both **thinking** and **discussion**, don’t just be satisfied with a **surface level of understanding** talk to your tutors in class and share your thoughts and ideas with us!

This tutorial makes use of the XAMPP software package, we recommend using a [portable version](https://sourceforge.net/projects/xampp/files/XAMPP%20Windows/8.2.4/xampp-portable-windows-x64-8.2.4-0-VS16.zip/download) of this software package The lab tutorial forms both the lab work and homework for the week 5 activities.

**Objectives**

* Analyse and dissect existing sample entity relationship diagrams to understand the planning / design information they convey to the Engineering team.
* Produce SQL statements which would be capable of putting example records into the tables represented within the design found in a given ERD.
* Explain the purpose of some basic SQL statements used to implement a database system.
* Produce an entity relationship diagram which conveys information about the structure of an existing database system.[[1]](#footnote-1)

## Additional information: Tracking your learning progress.

To help track your progress early in the module, we will be using a little system in these first few weeks to **help you track your understanding so far**. This will give you an opportunity to show how you are getting on with understanding the material each week during the early stages of the module so we can **better guide you** through **developing your knowledge and understanding**. When attempting your answer also be honest and discuss with **us when you needed to do some additional background research**[[2]](#footnote-2), and **show us where you got your information from**[[3]](#footnote-3).

**Progress checker**

The progress checker is included at the end of our various exercises to allow you to keep a record of your learning, giving you an opportunity to quickly show us your progress and discuss in class during the following week. It also encourages you to keep a record of this progress to help you to reflect on your developing skills and understanding during the module.

Example “Progress checker”

Please select the answer you feel **best describes your level of understanding** for **each exercise** (an example progress checker can be seen in **figure 1**.

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| --- | --- |
| **Now let’s check how well you have understood so far! 😊** | |
| How did you find attempting this exercise? | Choose one (**X**) |
| Grinning Face I’m **very confident** that I have understood and completed this task successfully | **X** |
| Slightly Smiling Face I’m **fairly confident** that I have understood and completed this task successfully |  |
| Thinking Face I think I’m **getting there** but I need to **work on understanding this a little more** |  |
| Grinning Face with Sweat I **got a bit stuck** and I will need to **work on understanding this a lot more** |  |

Figure 1 An example 'progress checker'

**Food for thought**

The “Food for thought” messages boxes provide some prompts for you to work on deepening your understanding as you progress through the labs a good Computer Scientist / Data Scientist / Software Engineer recognises the value of picking apart the tools and concepts they are learning about to deepen their understanding. Fundamentally, we aim for this module to not just be about you “Developing Database-backed Web Applications” but about refining your approach to problem solving in Software Development, to help you become a more well-rounded Engineer 😊

To help this process along we will use the “Food for thought” message boxes to provide some suggested starting points to investigate various aspects of what you are doing in the labs further, moving you away from approaching development as simply **“remembering ‘recipes’ from a cookbook”** to **“understanding what tools/techniques/concepts to apply”**, **“when to apply them”**, **“how to apply them”** and **“why we tend to apply them in a particular way”**



Figure 2 The Swedish Chef (By Disney.com, Fair use, https://en.wikipedia.org/w/index.php?curid=40291413)

Think about it like this: developers are a bit like chefs, we don’t just memorise and follow a bunch of “recipes” (example programs) from someone else’s “cookbook” (tutorial / documentation / example code) we are experienced enough to understand **how** those recipes work and **why** they work so we can use that understanding to develop our own recipes and serve up our own tasty dishes to our customers (our own software applications)

Example “Food for thought”

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| CookiesThinkingIdea**Food for thought** |
| Let’s deepen our understanding by thinking a little deeper about this exercise and discussing our thoughts in class. |
| We will have a sample prompt to think about / experiment with some aspect of the lab in this bit usually. |

**Be an active learner. Help us help you to grow.**

As well as recording your progress with the lab work **so far**[[4]](#footnote-4) and discussing with us during the following week, please make sure you tell us **in class**[[5]](#footnote-5) about any aspects of the current week’s work you are particularly struggling to understand. From what we have seen **so far** based on your progress at Level 4 many of you are still working your way up from the **lower levels** in your **understanding of programming / software development**. To turn you into an effective **Software Engineer** / **Software Developer** we need you to **work with us** to move away from those **basic**, **lower levels of understanding**, which will require **you** to work on **actively developing your skills** (with our guidance along the way 😊) to reach those **higher levels**[[6]](#footnote-6).

We want you to move from:

* **Memorising** recipes / definitions

By

* **Understanding** the tools, techniques and concepts underpinning our examples / exercises

Then working on

* **Applying** these tools, techniques, and concepts. Experimenting with them to gain deeper understanding.

So that you can eventually

* **Create** your own original software solutions through an informed approach to planning, designing, and implementing software.
* **Analyse** the different approaches (e.g tools, techniques and concepts) that could be applied to help solve a problem and how best to use them.
* **Evaluate** your approach (and others) to help develop your better judgment when creating software.

A diagram of a diagram of a diagram

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Figure 3 The different levels of learning, to discuss in class (ThoughtCo, 2019)

# Week 4 – Designing Databases part 1

Before attempting the below lab exercises ensure that you have set up an XAMPP instance capable of running the Apache web server and MySQL on the device you are using, work with your lab tutor to familiarise yourself with this process – they will likely demo this process as part of the introductory lab talk.

You may find the following documentation available online useful for your exploration and interpretation of Entity Relationship Diagrams

* [Article] [Visual Paradigm: What is Entity Relationship Diagram (ERD)?](https://www.visual-paradigm.com/guide/data-modeling/what-is-entity-relationship-diagram/)
  + To bolster your understanding of what information is contained within an ERD.
* [Article] [Visual Paradigm: What is Data Modeling?](https://www.visual-paradigm.com/guide/data-modeling/what-is-data-modeling/)
  + To bolster your understanding of why we would use data modelling techniques such as entity relationship modelling in Software Engineering projects.
* [Article] [Work with entity relationship table shapes in draw.io](https://www.drawio.com/blog/entity-relationship-tables)
  + This will be useful for providing some software capable of drawing out your design diagrams for various ERDs.
* [[Video] Entity Relationship Diagram (ERD) Tutorial – Part 1](https://www.youtube.com/watch?v=QpdhBUYk7Kk)
* [[Video] Entity Relationship Diagram (ERD) Tutorial – Part 2](https://www.youtube.com/watch?v=-CuY5ADwn24)
* [[Video] Database Keys Made Easy – Primary, Foreign, Candidate, Surrogate, & Many More](https://www.youtube.com/watch?v=8wUUMOKAK-c)
* [[Video] Create Entity Relationship Diagrams (ERD) with draw.io](https://www.youtube.com/watch?v=JYZPdU5F2iM)

Note: The diagrams below were created using Visual Paradigm Community Edition. However, equivalent Crows Feet notation ERDs can be created using the Software at [draw.io](https://draw.io).

## Exercise 1

Please answer the below questions based on the following entity relationship diagram:

Diagram

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Figure 4 Example ERD 1

1. Is this kind of ERD a logical, conceptual, or physical ERD model of a database system? Justify your answer.
2. What are the entities that are represented within this system design?
3. What attributes are represented within this system design?
4. Write out some [INSERT INTO](https://www.w3schools.com/sql/sql_insert.asp) statements in SQL which would insert some example tuples/records into Customer, Customer\_Movie, Movie and Producer (aim for at least 2 records for each) – you do not need to create the database beforehand! Just think about what records you would like to add and what SQL code you could write to insert those records.
5. What benefits might storing the FirstName and LastName of the customer as separate items provide?
6. Why might it be better to use a date datatype for the Customer’s data of birth rather than a TEXT, VARCHAR or String datatype?
7. What issues might occur with storing a value from 1 to 5 for a star rating in the form of a single character be?
8. What is the meaning of the key symbol next to ‘MovieID’ on Customer\_Movie?
9. What is the meaning of the key symbol next to ‘CustomerID’ on Customer\_Movie?
10. Why are Customer and Movie not connected directly to each other? What benefit does Customer\_Movie provide?
11. What cardinality of relationship exists between Customer and Customer\_Movie? What do you think this relationship represents?
12. What kind of software system do you believe this partial database design might be targeted towards?

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| CookiesThinkingIdea**Food for thought** |
| Let’s deepen our understanding by thinking a little deeper about this exercise and discussing our thoughts in class. |
| What limitations does this current database design present about the kind of software system which it could underpin? Think about the kind of data that would be able to be represented within the system based on the entities, attributes and relationships present. |

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| **My solution** Idea |
| Record your notes about how you attempted to answer the question / solve the exercise in this section (just edit the text box 😉) |

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| **Now let’s check how well you have understood so far! 😊** | |
| How did you find attempting this exercise? | Choose one (**X**) |
| Grinning Face I’m **very confident** that I have understood and completed this task successfully |  |
| Slightly Smiling Face I’m **fairly confident** that I have understood and completed this task successfully |  |
| Thinking Face I think I’m **getting there** but I need to **work on understanding this a little more** |  |
| Grinning Face with Sweat I **got a bit stuck** and I will need to **work on understanding this a lot more** |  |

## Exercise 2

Please answer the below questions based on the following entity relationship diagram:

**A screenshot of a computer

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Figure 4 Example ERD 2

1. Is this kind of ERD a logical, conceptual, or physical ERD model of a database system? Justify your answer.
2. What are the entities that are represented within this system design?
3. What attributes are represented within this system design?
4. Write out some [INSERT INTO](https://www.w3schools.com/sql/sql_insert.asp) statements in SQL which would insert some example tuples/records into Customer, Order, Order\_Product, Employee, and Product (aim for at least 2 records for each) – you do not need to create the database beforehand! Just think about what records you would like to add and what SQL code you could write to insert those records.
5. What is the meaning of the key symbol next to ‘ID’ on Customer?
6. What is the meaning of the ‘salesRepEmployeeNum’ on Customer?
7. What kind of relationship cardinality is there between Customer and Order? Why might this be?
8. Why are Product and Order not connected directly to each other, what benefit does Order\_Product provide?
9. What is the meaning of Productlineid on Product?
10. What kind of software system do you believe this partial database design might be targeted towards?

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| CookiesThinkingIdea**Food for thought** |
| Let’s deepen our understanding by thinking a little deeper about this exercise and discussing our thoughts in class. |
| What limitations does this current database design present about the kind of software system which it could underpin? Think about the kind of data that would be able to be represented within the system based on the entities, attributes and relationships present. |

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| **My solution** Idea |
| Record your notes about how you attempted to answer the question / solve the exercise in this section (just edit the text box 😉) |

|  |  |
| --- | --- |
| **Now let’s check how well you have understood so far! 😊** | |
| How did you find attempting this exercise? | Choose one (**X**) |
| Grinning Face I’m **very confident** that I have understood and completed this task successfully |  |
| Slightly Smiling Face I’m **fairly confident** that I have understood and completed this task successfully |  |
| Thinking Face I think I’m **getting there** but I need to **work on understanding this a little more** |  |
| Grinning Face with Sweat I **got a bit stuck** and I will need to **work on understanding this a lot more** |  |

## Exercise 3

Please answer the below questions based on the following entity relationship diagram:

A diagram of a work flow

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Figure 4 Example ERD 3

1. Is this kind of ERD a logical, conceptual, or physical ERD model of a database system? Justify your answer.
2. What are the entities that are represented within this system design?
3. What attributes are represented within this system design?
4. Why are Students not directly connected to Module, what purpose does Module\_Student serve?
5. Write out some [INSERT INTO](https://www.w3schools.com/sql/sql_insert.asp) statements in SQL which would insert some example tuples/records into Student, Module\_Student, Module, Department and Instructor (aim for at least 2 records for each) – you do not need to create the database beforehand! Just think about what records you would like to add and what SQL code you could write to insert those records.
6. Which SQL DDL statement would allow you to create the data structure which will be used to store Student data?
7. Which SQL DDL statement would allow you to create the data structure which will be used to store Module\_Student data?
8. What kind of software system do you believe this partial database design might be targeted towards? What limitations does the current design present?

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| CookiesThinkingIdea**Food for thought** |
| Let’s deepen our understanding by thinking a little deeper about this exercise and discussing our thoughts in class. |
| What limitations does this current database design present about the kind of software system which it could underpin? Think about the kind of data that would be able to be represented within the system based on the entities, attributes and relationships present. |

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| **My solution** Idea |
| Record your notes about how you attempted to answer the question / solve the exercise in this section (just edit the text box 😉) |

|  |  |
| --- | --- |
| **Now let’s check how well you have understood so far! 😊** | |
| How did you find attempting this exercise? | Choose one (**X**) |
| Grinning Face I’m **very confident** that I have understood and completed this task successfully |  |
| Slightly Smiling Face I’m **fairly confident** that I have understood and completed this task successfully |  |
| Thinking Face I think I’m **getting there** but I need to **work on understanding this a little more** |  |
| Grinning Face with Sweat I **got a bit stuck** and I will need to **work on understanding this a lot more** |  |

## Exercise 4

The sample database found on Moodle in Week 3 ([mysqlsampledatabase](https://moodle.bcu.ac.uk/mod/resource/view.php?id=7729923)) contains a SQL script called “mysqlsampledatabase.sql”, read through the script, and answer the following questions:

1. What statement is used to create the database within the script?
2. What is the name of the database created within the script?
3. Which statement does the SQL script use to select the database it will run further queries on?
4. Which block of SQL code produces the `customers` table? Explain the SQL code by picking it apart.
5. Which statement is used to put some example records into the `customers` table?
6. Using draw.io or some equivalent diagramming software, draw a diagram which represents just the `customers` table
7. Which block of SQL code produces the `employees` table? Explain the SQL code by picking it apart.
8. Using draw.io or some equivalent diagramming software, draw a diagram which represents just the `employees` table
9. Which statement is used to put some example records into the `employees` table?
10. Which block of SQL code produces the `offices` table? Explain the SQL code by picking it apart.
11. Using draw.io or some equivalent diagramming software, draw a diagram which represents just the `offices` table
12. Which statement is used to put some example records into the `offices` table?
13. Using draw.io or some equivalent diagramming software, draw a diagram containing the `customers`, `employees` and `offices` entities
14. Modify the above diagram to establish the relationship between these entities, transforming it from a diagram that just displays those entities on their own to one that shows entities and their relationships between each other (and ERD)

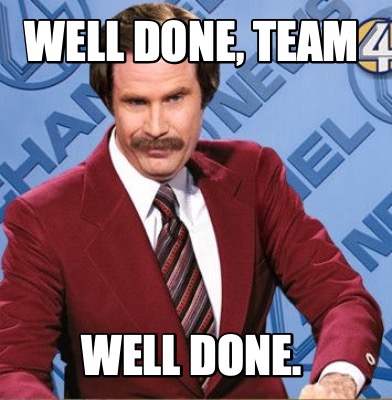
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| CookiesThinkingIdea**Food for thought** |
| Let’s deepen our understanding by thinking a little deeper about this exercise and discussing our thoughts in class. |
| In the previous exercises we asked you to pick apart some example ERD **designs** and think about what information they are conveying and what practical software systems could be built from them. In this exercise we have a sample database implementation, and we are asking you to pick this apart before thinking about an equivalent ERD design which would represent that implementation.  Why would we ask you to focus on solving these ERD problems in either direction? Namely what benefits could understanding the following give you in real world scenarios:   * Going from an abstracted Design to Implementation details? * Going from Implementation details to an abstracted Design? |

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| **My solution** Idea |
| Record your notes about how you attempted to answer the question / solve the exercise in this section (just edit the text box 😉) |

|  |  |
| --- | --- |
| **Now let’s check how well you have understood so far! 😊** | |
| How did you find attempting this exercise? | Choose one (**X**) |
| Grinning Face I’m **very confident** that I have understood and completed this task successfully |  |
| Slightly Smiling Face I’m **fairly confident** that I have understood and completed this task successfully |  |
| Thinking Face I think I’m **getting there** but I need to **work on understanding this a little more** |  |
| Grinning Face with Sweat I **got a bit stuck** and I will need to **work on understanding this a lot more** |  |

# Additional Notes

**Extension task**



Finished early? Excellent! J

Use this opportunity to discuss with your lab tutor what you have understood so far and ask them to assign some tasks that you could attempt to further refine your skills and knowledge.

1. This is related to a concept in Engineering called [“Reverse Engineering”](https://en.wikipedia.org/wiki/Reverse_engineering) the process of trying to recreate a design for a system which is as close as possible to the original by understanding how an implementation of that system works [↑](#footnote-ref-1)
2. So we can keep track of whether the answer is primarily derived through your own existing understanding, or based on reviewing the work of someone else – this is not a negative at all when you are starting to learn a new tool or concept! Experienced developers started building their knowledge from somewhere, but you want to clearly reflect on how you are building those skills and knowledge and where you are getting it from [↑](#footnote-ref-2)
3. Referencing is very important, but a simple url, etc is fine for the lab content [↑](#footnote-ref-3)
4. If you need to work on it further then please show us what you have done so far and then continue to work on it further, this allows us to ‘temperature check’ your progress as a group. [↑](#footnote-ref-4)
5. The earlier you tell us, the better 😉 Get our attention and discuss what you need help with so we can advise you [↑](#footnote-ref-5)
6. That’s where the **fun** stuff (and the **money)** is when it comes to Software Development 😉 [↑](#footnote-ref-6)