

COSC2406/2407 Database Systems

Assignment Project Exam Help

Course Introduction

<https://eduassistpro.github.io>

Room : 14.11.04

Online Consultation via Collaborate Ultra (no appointment)

Thursdays

Email : xiangmin.zhou@rmit.edu.au

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Course Overview

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Nga

RMIT University acknowledges the Kulin Nation
Custodians of the land on which the University stands.
respectfully recognises Elders both past and present. RMIT also
acknowledges the Traditional Custodians of lands across Australia
where it conducts its business, their Elders, Ancestors, cultures and
heritage.

Emergency Procedure Information

Before starting our session today, RMIT wishes to make you aware of the Emergency Procedures that are in place for your safety. Please look around and familiarize yourself with the emergency exits in this room and *do this for each new venue in which you attend classes.* Evacuation plans are located in all corridors.

- In the event of an emergency, please leave the building in an orderly fashion to the assembly area indicated on the evacuation map, located in the foyer of this building. *Do not use lifts*
 - Please also obey any instructions provided by fire wardens, by staff in attendance, by RMIT Security or by emergency services. Once the evacuation has been completed, you will be advised when it is safe to return to the building.
 - RMIT thanks you for your cooperation.
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- Databases are still a hot field.
- DB uns
- If yo

write code on almost anything else.

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Pre-requisite Courses, Assumed Knowledge and Capabilities

- Fundamental knowledge of relational database concepts, including relational modeling and design, relational algebra, SQL, and Conceptual modelling, equivalent to ISYS1055/1057 Database Concepts.

- Ext kno <https://eduassistpro.github.io>

COSC1285/2123 Algorithms and An

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Warning: If you have NOT passed both Data

Algorithms and Analysis (or the equivalent else

studies) then you should WITHDRAW from this course **NOW!**

The assignment work in this course assumes knowledge of database concepts and will require advanced programming skills to implement complex data structures and algorithms.

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Important dates for course change in Semester 1, 2021 are:

- 8 March, 2021 - last day to add a course/s.

- 31 M

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can

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- 15 M

Last day to allocate or adjust classes (by 5pm

- 30 April 2021 - last day to drop course/s without a (fail grade). Financial penalty still applies.

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After completing COSC2406/2407 you should be able to:

- Explain the implementation of the internals of database systems
- Ev
- An
- and recovery
- Design and implement significant so

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Lecture Topic

- ① Introduction to course. Structured, semi-structured & unstructured data
- ② Disks and files
- ③ Files, pages and records
- ④ File o
- ⑤ Tre
- ⑥ Has
- ⑦ Index construction and sorting
- ⑧ Query evaluation
- ⑨ Query optimisation
- ⑩ Transactions, concurrency and recovery
- ⑪ Information retrieval
- ⑫ Revision and review

Classes each week

- lectorials start in week 1

- tutorials and laboratory classes start in week 2

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- 1 hour online Lectorial

- 1 ho

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you

- 1 hour Laboratory class (sign up using the onl

- 1 hour online consultation.

- *myTimetable*

<https://mytimetable.rmit.edu.au/even/student>

- If you have problems with your timetable, contact RMIT Connect

<https://rmit.service-now.com/connect/> online, by phone.

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From Week 2 onwards we will be using Linux machines in the Amazon AWS cloud as our main teaching environment

- Every machine will have a unique IP address
 - You will be responsible for securely managing your machine
 - Keys MUST NOT be shared between people
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Assessment Tasks:

- Weekly tasks - Formative weekly online exercises (15%) to be completed by 11:59pm on Tuesday in weeks 3 to 10 (6 of 8 best results will be counted for final marks.)
- Assignment 1 (20%).
 - on a linux VM you will evaluate and compare alternative

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- Assignment 2 (45%):
 - building on your solution to Assignment 1, critically analyse and report on the index systems
 - released in week 6
 - final submission due 11.59pm on Sunday 23 May 2021
 - demo and code walkthrough in week 12
- Assignment 3 (take-home 24 hour exercise in Week 14) (20%) covering all aspects of the course

Academic integrity – avoiding plagiarism

The following resources are available online:

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- *Study skills and plagiarism resource booklet* – advice for those beginning a program of study at the School of Computer Science and I

- Available <https://eduassistpro.github.io/>
- *Academic integrity workshop slides*

<http://www1.rmit.edu.au/browse;ID=1000>

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Read more about academic integrity here:

<https://www.rmit.edu.au/students/student-essentials/rights-and-responsibilities/academic-integrity>

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- See someone immediately if you have any difficulties that may prevent you from completing the course

- Be aware of RMIT special consideration process:

htt

ials/

ass

mission

- Let t

assignment or other assessable material (

sympathetic if given warning—expect a c

contact us a day or two before the due date)

- Give us feedback about tutors/lab assista
tutorials and lectures

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Available through canvas: <https://rmit.instructure.com/>

- Learning Resources
 - Readings for each week

A preliminary version of the complete course notes prepared prior to the start of the semester

-

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- Assessment Tasks (to appear) - Formative exercises available each Friday (starting assignment specifications)
- Announcements
- Discussion Forum - be sure to read these forums regularly and ask questions and contribute to the discussion (but do not post solutions to assessment tasks).
- Actions from student surveys (to appear)

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- Weekly (pre-lecture) reading material will be available online, you should read this before attempting the weekly formative weekly online exercises
- The following textbooks covers many of the topics in this course:

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The Complete Book, Prentice Hall, 2008 (2nd edition).

- R. Elmasri and S.B. Navathe, *Data Base Systems*, 8th edition.
- P.J. Sadeagle and M. Fowler, *NoSQL Database Systems: Emerging World of Polygot Persistence*.
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- References will be given to each of these books, though we will be mostly following Ramakrishnan and Gehrke.

- **Lecturer** (Xiangmin Zhou)

Building 14, Level 11, Room 04

- Consultation: 10:20-11.20am Thursdays

- email: xiangmin.zhou@rmit.edu.au

- **RM**

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- **Phone** 9925 5000 (Monday to Thursday
10am-5pm)

- Visit Building 10, Level 4

- **College Academic Student Services** (
the student lifecycle

- Building 10, Level 9

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- Online <https://rmit.service-now.com/serviceandsupport/>, if you have a problem with your AWS Linux VM make sure you include in the Subject field:

"C

- Call 4.3 <https://eduassistpro.github.io>
 - Visit a walk up support area on campus, incl
 - Swanston library Building 10 Level 6 - Monday to Friday 6.00 pm
 - Swanston Academic Building (SAB) - B to Friday 8.00 am to 8.00 pm
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Does it sometimes feel like you're
the only girl in your classes?

We know what that's like!

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and
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d

interested in all t

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email RMITSWITCH@gmail.co

All female and genderqueer students including international,
domestic, undergrad and postgrad students are welcome to join!

Material in this lecture series is collected from various sources, including:

- Lec Will (E
- Ad

Ramakrishna and Santha Sumanaseka

- Supplementary material from: Raghu Ramakrishna and Johannes Gehrke.
- Input from other staff.

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COSC2406/2407 Database Systems

NoSQL databases

Structured, semi-structured and unstructured data

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Lecture 1

Reference: Pramod J. Sadalage and Martin Fowler,

NoSQL: A Brief Guide to the Emerging World of Polygot Persistence,

Addison-Wesley, 2013. Chapters 1, 2, 3, and 9.



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Many different data models for database systems, including:

- network
- hier
- rela
- ded
- nested relational
- object-oriented

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From the 1980s, relational data model became t

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- Persistence: Database systems are all about managing persistence and using a relational database makes it easy to get at and manage small bits of persistent data within large amount of per
 - Co tra <https://eduassistpro.github.io>
 - Integration: allows multiple application pr the same data
 - Standard model: (well mostly standard) d language (SQL)
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Impedance Mismatch

Impedance mismatch refers to difference between

- relational model
- in-memory record structures

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With rise of web services - integration and interoperability shifts from database to web services (“service oriented architecture”), and from SQL to HT

- integratio
mul
- application database - database access
application (integrity can be maintained by)

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With clusters relational databases:

- not designed to run on clusters, even though some products such as Oracle
- but consider using clusters
- e.g. <https://eduassistpro.github.io/>

Alternative to use clusters to deal with large volume traffic:

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- e.g. Amazon and Google

Big Data (3 key Vs):

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- Volume — amount of data
- Velocity — new data/bandwidth required

- Var

Other Vs:

- Val (causation)
- Veracity — how to assess accuracy of (say)
- Value — from a business perspective what
- Visibility — technology to make data from di
visible

<http://rob-livingstone.com/2013/06/big-data-or-black-hole/>

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NoSQL has no single definition or data model

- NoSQL = "not only SQL" (one common interpretation)
- ref
- tec

Two main
database

- scale of data requires clusters
- reduce effort mapping between database
data structures

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Polyglot Persistence:

- rela
- can
- typ

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- Key-value Store
- Column-family Store
- Graph Store

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Used in Document Stores, Key-value Stores, and Column-family Store

- rela
 - tabl
 - agg
- complex structure
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JSON example, from page 16, Sadalage and Fowler:

```
// in custo
{
  "id": 1,
  "name": "Martin",
  "billingAddress": [{"city": "Chicago"}]
```

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Aggregate-oriented data models

JSON example continued, from page 16, Sadalage and Fowler:

```
//in orders
[
  {
    "id": 99,
    "customerId": 1,
    "orderI
      {
        "prod
        "price": 32.45,
        "productName": "NoSQL Distilled"
      }
    ],
  ...
}
```

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Consequences (See Section 2.1.2)

- rela
- agg
- but d
- but do support atomic consistency of a singl

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Use ID to get to aggregate data, but can also query and index content of aggregate.

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Use Cases:

- eve
- con
- web analytics
- e-commerce applications

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When not to use:

- complex transactions spanning different structures
- queries against varying aggregate structures

Pairs of keys (usually strings) and values (which can be strings or primitives such as integers).

Access to aggregate value is via key, but content of aggregate is "opaque" to database.

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Use Cas

- stor
- use
- shopping carts

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When not to use:

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- relationships among data
- multi operation transactions
- query by data
- set operations

Column-family stores

Can store tabular data (especially sparse tables), e.g. Google Bigtable, Apache HBase, Cassandra.

A Bigtable cluster serves a set of tables, which are sparse, distributed persistent data with dimensions:

- Rows (unit of “transaction” consistency)
- Columns
- Time unit
- Tim

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Use Cases:

- event logging
- content management systems, blogging
- webcounters

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When not to use:

- ACID transactions
- aggregate functions

- Support data represented as graph (e.g. social networking)
- SPARQL
- e.g. IBM RDF GraphStore

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See Seci

Use Cas

- con

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- routing, dispatch, location-based service
- recommender systems

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When not to use:

- when need to update many items
- large scale

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NoSQL databases are schemaless

- dat
- eas
- but s

access the data

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Compare terminology of MongoDB (with Oracle)

- MongoDB instance (= database instance)
- dat
- coll
- doc
- _id (=rowid)
- DBPerf (=,dir)

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- Pramod J. Sadalage and Martin Fowler, *NoSQL: A Brief Guide to the* 2011
- No <https://eduassistpro.github.io>
- Chang et al. “Bigtable: A distributed storage system for structured data”, *ACM Transactions on Computer Systems*, June 2008.

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