Data Administration in Information Systems

Welcome

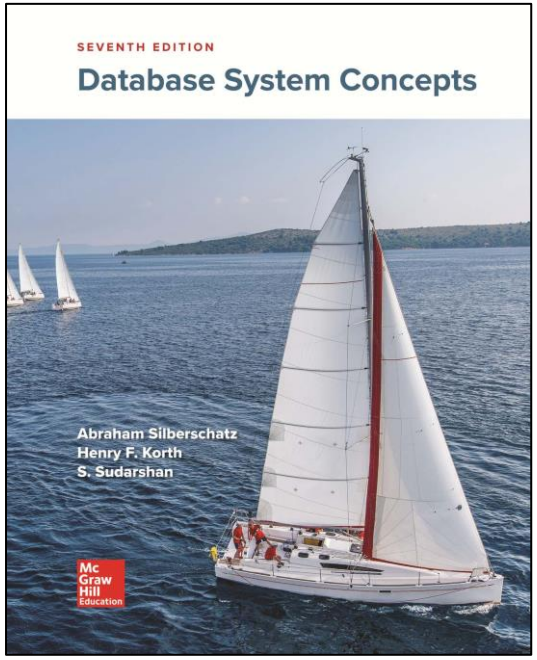
What this course is about

- Database optimization ≈ “making queries run faster”
  - how data is stored and retrieved from disk
  - which indexes exist to provide faster access to data
  - which algorithms does the database use to answer queries
  - how the order of operations affects performance
  - how to run multiple transactions in parallel
  - what to do when multiple transactions want to access the same data
  - what to do when the system crashes in the middle of transactions
  - how to redesign a database for performance
  - how to rewrite queries for performance
  - what are the best indexes for performance
  - how to optimize transactions for performance
  - understanding the impact of hardware and the operating system
  - monitoring database performance and troubleshooting

Supporting material / bibliography

- Books
  - Silberschatz et al, *Database System Concepts*, McGraw-Hill, 2020
  - Ramakrishnan et al, *Database Management Systems*, McGraw-Hill, 2003
  - Shasha et al, *Database Tuning*, Morgan Kaufmann, 2003

65%



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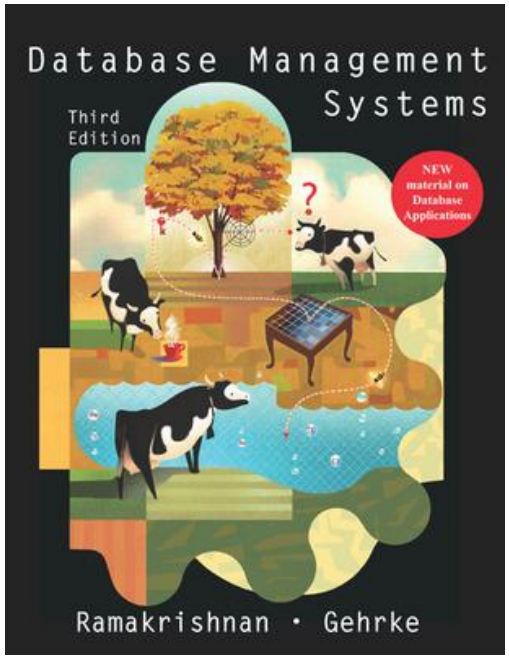

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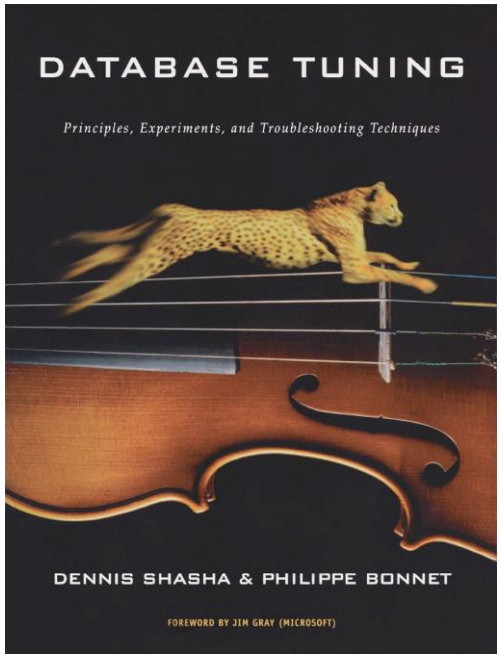


Practice / software / VM

- We will be practicing with the following software:
  - Microsoft SQL Server 2019 Developer Edition
  - SQL Server Management Studio
  - Database Engine Tuning Advisor
  - SQL Server Profiler
  - AdventureWorks database

- The software is provided as a virtual machine:
  - Oracle VirtualBox 7.0
    - works on Windows, Linux, Mac
    - should work on the new Mac processors too
  - Pre-configured with 8 GB of RAM and 4 CPU cores
    - assumes you have at least 16 GB of RAM and 8 CPU cores
    - if this is not the case, change the VM configuration

Labs

- There are 12 labs
- Each lab is a step-by-step tutorial to be done on the VM

- To begin each lab:
  1. Launch the virtual machine (VM)
  2. Open the Web browser (Edge)
  3. The browser will redirect you to the lab

- At the end of each lab:
  1. Collect the request screenshot (full screen)
  2. Submit the screenshot on Fénix (until Friday)

Labs

Lab01.pdf

https://groups.tecnico.ulisboa.pt/adsi-meic/Lab01.pdf

4 of 4 | Page view | Read aloud | Add text | Draw | Highlight | Erase

```
SELECT m.Name AS Model,
       d.Description AS Description,
       c.Name AS Culture
FROM Production.ProductModel AS m,
     Production.ProductDescription AS d,
     Production.Culture AS c,
     Production.ProductModelProductDescriptionCulture AS mdc
WHERE mdc.ProductModelID = m.ProductModelID
  AND mdc.ProductDescriptionID = d.ProductDescriptionID
  AND mdc.CultureID = c.CultureID
  AND mdc.ProductModelID = 1;

SET STATISTICS IO ON;
SET STATISTICS TIME ON;
```

35. Switch to the **Messages** tab and note the following:
    - The command **SET STATISTICS IO ON** has turned on statistics about the amount of disk activity generated by the query.
    - The command **SET STATISTICS TIME ON** has turned on statistics about the time it took parse, compile, and execute the query.

36. In the toolbar, press the button **Include Actual Execution Plan** (the button will remain pressed).
    Note: If you cannot find it in the toolbar, the same option is available in the Query menu.

37. Now **Execute** the query again, and a new tab will appear next to **Results** and **Messages**.

38. Switch to the **Execution Plan** tab and inspect the sequence of operations that the system performed to answer the query.

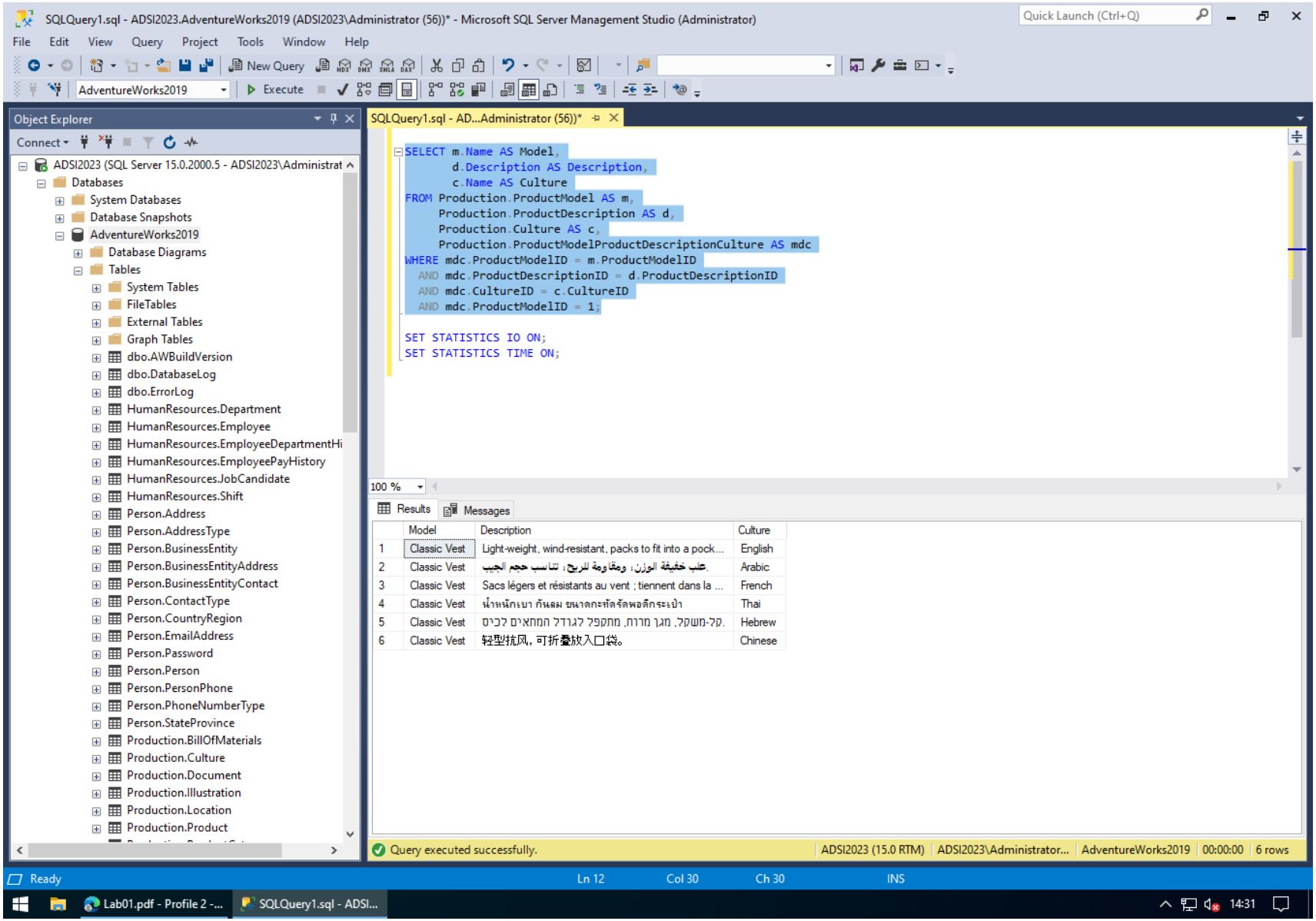
39. Take a few minutes to understand the correspondence between these operations and the SQL query. Namely, identify the tables and join operations in this execution plan.

Take a screenshot of your work and submit it in Fénix for lab credit.

IST/DEI Page 4 of 4

Lab01.pdf - Profile 2 -... | SQLQuery1.sql - ADSI... | 14:28

Labs


SQLQuery1.sql - ADSI2023.AdventureWorks2019 (ADSI2023\Administrator (56))* - Microsoft SQL Server Management Studio (Administrator)
Quick Launch (Ctrl+Q)
File Edit View Query Project Tools Window Help
New Query
AdventureWorks2019
Execute
Object Explorer
Connect
ADSI2023 (SQL Server 15.0.2000.5 - ADSI2023\Administrat
Databases
System Databases
Database Snapshots
AdventureWorks2019
Database Diagrams
Tables
System Tables
FileTables
External Tables
Graph Tables
dbo.AWBuildVersion
dbo.DatabaseLog
dbo.ErrorLog
HumanResources.Department
HumanResources.Employee
HumanResources.EmployeeDepartmentHi
HumanResources.EmployeePayHistory
HumanResources.JobCandidate
HumanResources.Shift
Person.Address
Person.AddressType
Person.BusinessEntity
Person.BusinessEntityAddress
Person.BusinessEntityContact
Person.ContactType
Person.CountryRegion
Person.EmailAddress
Person.Password
Person.Person
Person.PersonPhone
Person.PhoneNumberType
Person.StateProvince
Production.BillOfMaterials
Production.Culture
Production.Document
Production.Illustration
Production.Location
Production.Product
SQLQuery1.sql - AD...Administrator (56))*
SELECT m.Name AS Model,
d.Description AS Description,
c.Name AS Culture
FROM Production.ProductModel AS m,
Production.ProductDescription AS d,
Production.Culture AS c,
Production.ProductModelProductDescriptionCulture AS mdc
WHERE mdc.ProductModelID = m.ProductModelID
AND mdc.ProductDescriptionID = d.ProductDescriptionID
AND mdc.CultureID = c.CultureID
AND mdc.ProductModelID = 1;
SET STATISTICS IO ON;
SET STATISTICS TIME ON;
100 %
Results
Messages
Model Description Culture
1 Classic Vest Light-weight, wind-resistant, packs to fit into a pock... English
2 Classic Vest خفيفة الوزن، ومقاومة للريح، تناسب حجم الجيب. Arabic
3 Classic Vest Sacs légers et résistants au vent ; tiennent dans la ... French
4 Classic Vest น้ำหนักเบา กันลม ขนาดกะทัดรัดพอดีกระเป๋า Thai
5 Classic Vest קל-משקל, מגן מרוח, מתקפל לגודל המתאים לכיס. Hebrew
6 Classic Vest 轻型抗风，可折叠放入口袋。 Chinese
Query executed successfully.
ADSI2023 (15.0 RTM) ADSI2023\Administrator... AdventureWorks2019 00:00:00 6 rows
Ready
Ln 12 Col 30 Ch 30 INS
Lab01.pdf - Profile 2 -...
SQLQuery1.sql - ADSI...
14:31

Labs

TÉCNICO LISBOA

Data and Information Systems Management

PT / EN

Monday ↓ Friday ↓

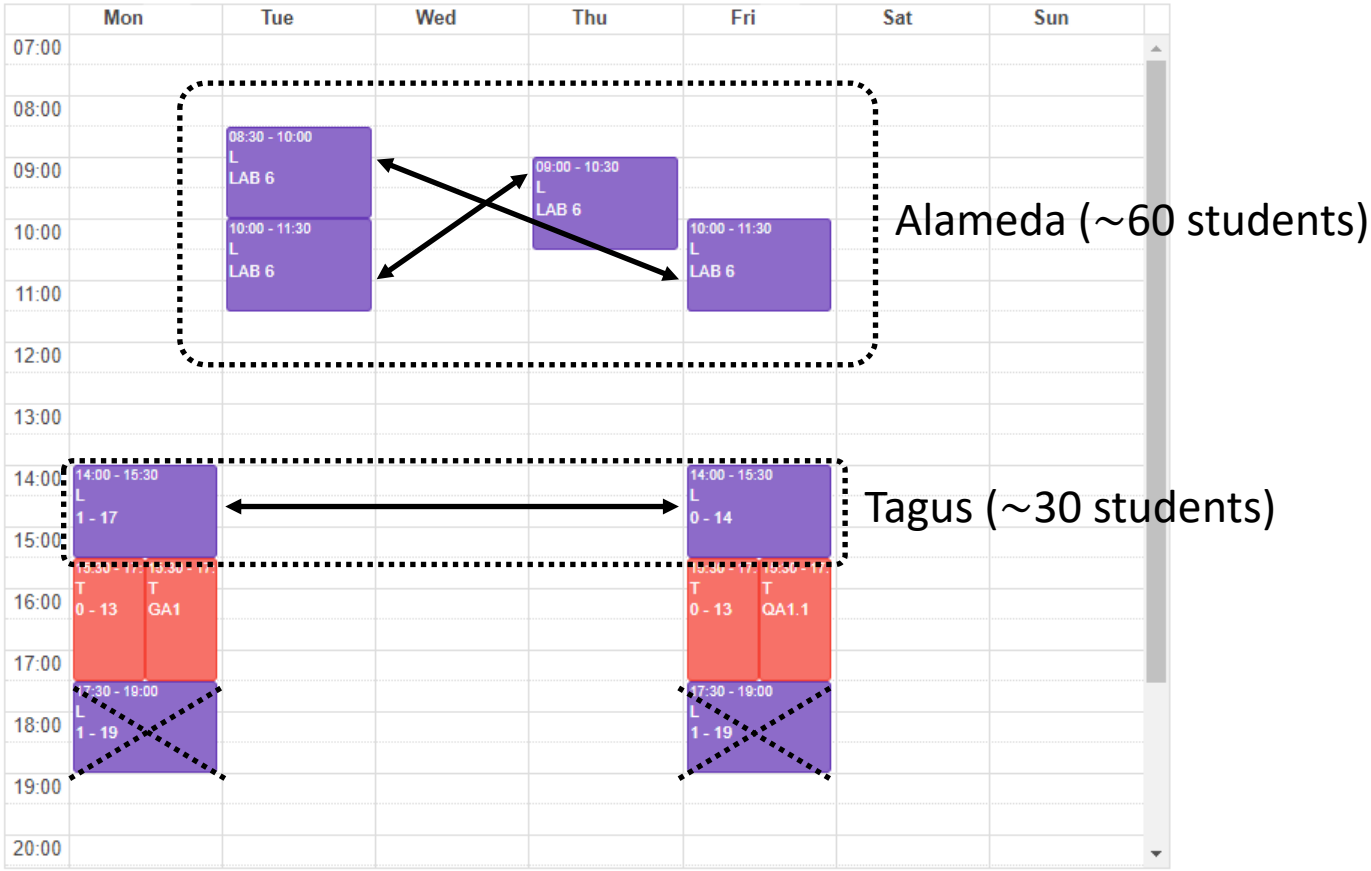
Evaluations

Projects	Beginning	End
Project: Lab 1	20/02/2023 00:00	24/02/2023 23:59
Project: Lab 2	27/02/2023 00:00	03/03/2023 23:59
Project: Lab 3	27/02/2023 00:01	03/03/2023 23:59
Project: Lab 4	06/03/2023 00:00	10/03/2023 23:59
Project: Lab 5	06/03/2023 00:01	10/03/2023 23:59
Project: Lab 6	13/03/2023 00:00	17/03/2023 23:59
Project: Lab 7	13/03/2023 00:01	17/03/2023 23:59
Project: Lab 8	20/03/2023 00:00	24/03/2023 23:59
Project: Lab 9	20/03/2023 00:01	24/03/2023 23:59
Project: Lab 10	27/03/2023 00:00	31/03/2023 23:59
Project: Lab 11	27/03/2023 00:01	31/03/2023 23:59
Project: Lab 12	10/04/2023 00:00	14/04/2023 23:59
Project: Project	10/04/2023 00:01	14/04/2023 23:59

- Initial Page
- Groups
- Evaluations
- Bibliographic References
- Schedule
- Evaluation Methods
- Objectives
- Planning
- Syllabus
- Shifts
- Announcements
- Summaries
- Prerequisites
- Laboratorial Component
- Programming and Computing Component

Groups / shifts

- Labs and project to be done in groups of 2 students
- Group registration opens right after this lecture
- When registering the group, choose a shift



Project / evaluation

- Project consists in set of tasks/challenges similar to labs
  - but using a larger database (2 GB)
  - project will be published around labs 5/6 (~5 weeks before deadline)

- Final grade:

  15% Labs + 35% Project + 50% Exam

  - Labs: submit proof of work in Fénix (weekly)
  - Project: submit report in Fénix
  - Exam: minimum grade 8.0 (without rounding)

Teaching staff

- Diogo R. Ferreira
  - Senior lecturer / professor
- Leonardo Alexandre
  - Teaching assistant @ Alameda
- Daniel Gonçalves
  - Teaching assistant @ Alameda
- Miguel G. Silva
  - Teaching assistant @ Tagus




How to reach us

- Slack workspace
  - Sign up with your e-mail address **@tecnico.ulisboa.pt**