

# Database Administration

## Lecture 03: What is Metadata?

Coronel, Morris & Post

July 28, 2025

# Database Administration: What is Metadata?.



Content has been extracted from *Database Systems: Design, Implementation, and Management.*, 13th Edition, by Carlos Coronel & Steven Morris. Cengage Learning. 2018. and *Database Management Systems: Designing & Building Business Applications.*, 6th Edition, by Gerald Post. McGraw-Hill/Irwin. 2014.

Visit <https://www.cengage.com/c/database-systems-design-implementation-management-13e-coronel/9781337627900PF/> and <https://www.jerrypost.com/database/DBBookSummary.html>.

# Plan

What is Metadata?

Metadata Examples

Database Administration Tools

Understanding PostgreSQL System Catalogs

# Metadata

- Metadata is data about data. Data describing the properties or characteristics of the data: data types, size, domain, range, valid values, ...



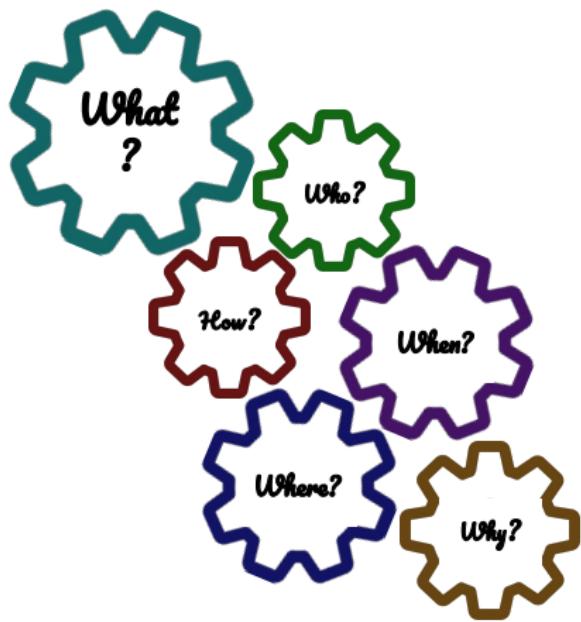
# Metadata

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# Plan

What is Metadata?

Metadata Examples

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# Photos



# Photo Metadata

File info X

File name  
twenty20\_6a15a8be-38e1-4ab7-a459-5470d1

Date taken  

November	29	2017
1	16	PM

Size  
8.9 MB

Dimensions  
4256 x 2832

twenty20\_6a15a8be-38e1-4ab7-a459-5470d0e29c82 Pro... X

General Security Details Previous Versions

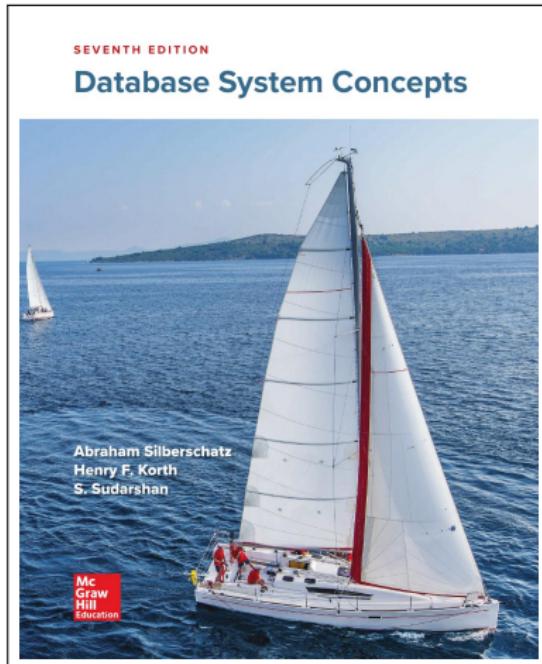
Property	Value
horizontal resolution	720 dpi
Vertical resolution	300 dpi
Bit depth	24
Compression	
Resolution unit	2
Color representation	sRGB
Compressed bits/pixel	

Camera

Camera maker	NIKON CORPORATION
Camera model	NIKON D700
F-stop	f/2.5
Exposure time	1/100 sec.
ISO speed	ISO-200
Exposure bias	0 step
Focal length	28 mm
Max aperture	1.6
Metering mode	Pattern
Subject distance	m -



# Books



# Book Metadata

Edit metadata - Database System Concepts - [8 of 97]

Title: Database System Concepts  
Title sort: Database System Concepts  
Author(s): Silberschatz, Abraham & Korth, Henry & Sudarshan, S.  
Number: 1.00

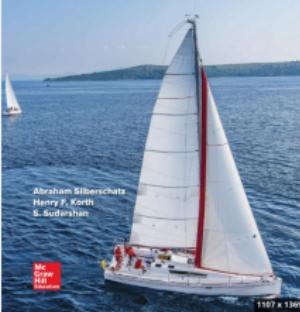
Change cover  
Browse Remove Trim borders  
Download cover Generate cover

Comments

What's New in the 7th Edition?

Extensive coverage of Big Data systems, from the user perspective (Chapter 10), as well as from an internal perspective (Chapters 20 through 23).  
Updates to all the internal chapters to reflect current-generation technology, such as solid-state disks.  
main-memory databases, multi-core systems, and parallel and distributed databases.  
Coverage of semi-structured data management using JSON, RDF, and Updated coverage of temporal data,  
data analytics, and advanced indexing techniques such as write-optimized indices.  
Reorganization and update of chapters to better support courses with a significant hands-on component, including  
use of current-generation application development tools and Big Data systems such as Apache Hadoop and Spark.  
New chapter on Blockchain Databases (Chapter 26) that introduces blockchain technology and its growing role in enterprise applications.

SEVENTH EDITION  
**Database System Concepts**



Abraham Silberschatz  
Henry F. Korth  
S. Sudarshan

McGraw-Hill Education

Billing: Not rated  
Tags: 7th Edition  
Jds: isbn:9780078022159  
Date: 26 Jan 2025  
Published: Mar 2019  
Publisher:  
Languages:

Download metadata

Normal view HTML source

0 Data files

Previous Next Cancel OK



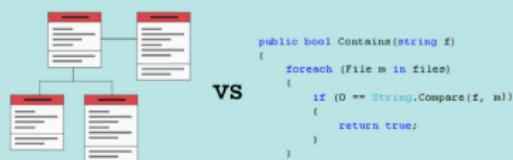
## Why It Is More Important to Document Database Than Application Code



Piotr Kononow

3rd August, 2017

Database Documentation · Software Development



We all know (I hope) how important it is to comment code we develop and maintain. We do it to make it easier to scan and understand it. To be able to test and modify it. For our colleagues and ourselves when we get back to it a few months later.

I want to make a case that documenting data structures (tables and columns) in our applications databases is **more important**, but even more overlooked than documentation of code. Here are a few reasons why I believe so.

Database goes beyond implementation project

More access points

More users

Users are more scattered:  
organizationally and geographically

And in time

# Blog Metadata

① 🔒 <https://dataedo.com/blog/why-it-is-more-important-to-document-database-than-application-code> ━ Metadata

Document  
Database Schema  
vs  
Application Code



## Why It Is More Important to Document Database Than Application Code

Piotr Kononow ⏰ 1 year ago

Database Documentation · Software Development · Why

Metadata

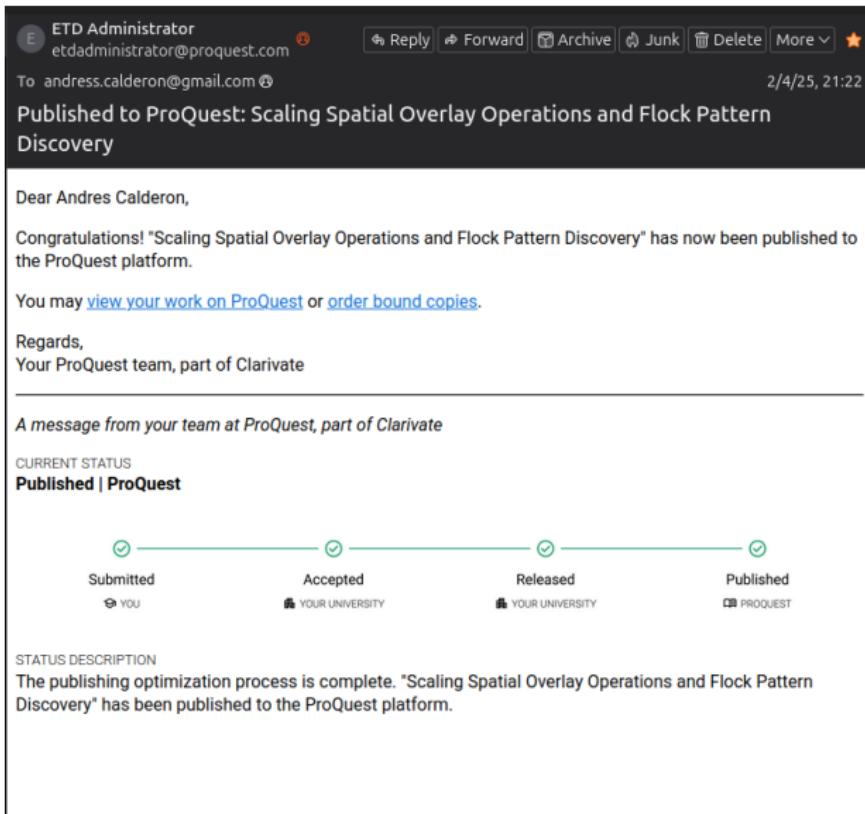
We all know (I hope) how important it is to comment code we develop and maintain. We do it to make it easier to scan and understand it. To be able to test and modify it. For our colleagues and ourselves when we get back to it a few months later.

Data

I want to make a case that documenting data structures (tables and columns) in our applications databases is **more important**, but even more overlooked than documentation of code. Here are a few reasons why I believe so.

<https://dataedo.com/kb/data-glossary/what-is-metadata>

# Emails

ETD Administrator  
etdadministor@proquest.com

To address.calderon@gmail.com 2/4/25, 21:22

Published to ProQuest: Scaling Spatial Overlay Operations and Flock Pattern Discovery

Dear Andres Calderon,

Congratulations! "Scaling Spatial Overlay Operations and Flock Pattern Discovery" has now been published to the ProQuest platform.

You may [view your work on ProQuest](#) or [order bound copies](#).

Regards,  
Your ProQuest team, part of Clarivate

---

A message from your team at ProQuest, part of Clarivate

CURRENT STATUS  
**Published | ProQuest**

Submitted → Accepted → Released → Published

Submitted: YOU → Accepted: YOUR UNIVERSITY → Released: YOUR UNIVERSITY → Published: PROQUEST

STATUS DESCRIPTION  
The publishing optimization process is complete. "Scaling Spatial Overlay Operations and Flock Pattern Discovery" has been published to the ProQuest platform.

# Email Metadata

13.09.2018 19:10

Dataedo Store <dataedo@dataedo.com>

Your Dataedo order 2018/718

Do  dataedo@dataedo.com

 Dataedo\_invoice\_2018-D-461.pdf 792 KB

 Dataedo

Thank you for choosing Dataedo. We are sure you will find it useful.  
You will find your keys below and invoice in attachment of this email.  
If you need any information or assistance respond to this email.

**Order details**

**Order #:** 2018/718  
**Order date:** 2018/09/13  
**Status:** Paid  
**Payment method:** PayPal

**Items**

Product	Price
Dataedo Pro - 1 Year Subscription	\$468
<b>Grand Total</b>	

**Your key**

**Dataedo Pro - 1 Year Subscription (1 user)**

```
ENJELJPJDJNLMBDHADENADODFHOMLJ1IHNFKRANKHJDEAPEOIIAACODBLGFBMOPHDNKGJNIPHMIDMBPFLELKKFMDNCMAHBPBCGGNCBMRPNHPLIKGMDCCNAMKRPJHGHNFHADBHEICKFDGEONIFCLJIMADANLENHLFDKBNFJUDIEGNLICJMUFFPMKMMIOGGAONNGKLNPBPHMDIMDBPFLELKKFMDNCMAHBPBCGGNCBMRPNHPLIKGMDCCNAMKRPJHGHN
```

**Properties**

**Settings**

Importance: Normal  
Sensitivity: Normal

**Security**

Encrypt message contents and attachments  
 Add digital signature to outgoing message  
 Request S/MIME receipt for this message  
 Do not AutoArchive this item

**Tracking options**

Request a delivery receipt for this message  
 Request a read receipt for this message

**Delivery options**

Have replies sent to:   
 Expires after:  None

**Contacts...**   
**Categories**

**Internet headers**

```
Received: from 124135.cloudwaysapps.com (104.131.29.249) (HELO cloudwaysapps.com) by server 1307517.home.pl (188.128.181.235) with SMTP (IdeaSmtpServer 0.83.148) id cde24d77096d7dec; Thu, 13 Sep 2018 19:10:22 +0200
Reply-To: <jm@dataedo.com>
From: 'Dataedo Store' <dataedo@dataedo.com>
```

**Data**

**Metadata**

# Documents

The screenshot shows a LibreOffice Writer document window. The title bar reads "Capítulo\_Núñez\_Calderón\_Díaz\_Sierra\_Vásquez.odt - LibreOffice Writer". The menu bar includes File, Edit, View, Insert, Format, Styles, Table, Form, Tools, Window, and Help. The toolbar below the menu bar contains icons for various document operations like opening, saving, and printing. The main content area displays the following text:

**Potencial de la Inteligencia Artificial en Teledetección para el Desarrollo Sostenible y la  
Gestión Ambiental**

Haydemar Núñez<sup>1</sup>, Andrés Calderón<sup>1</sup>, Nicolás Díaz<sup>1</sup>, Rocío Sierra<sup>1</sup>, David Vásquez<sup>2</sup>

<sup>1</sup>Departamento de Ingeniería de Sistemas y Computación. Universidad de los Andes.

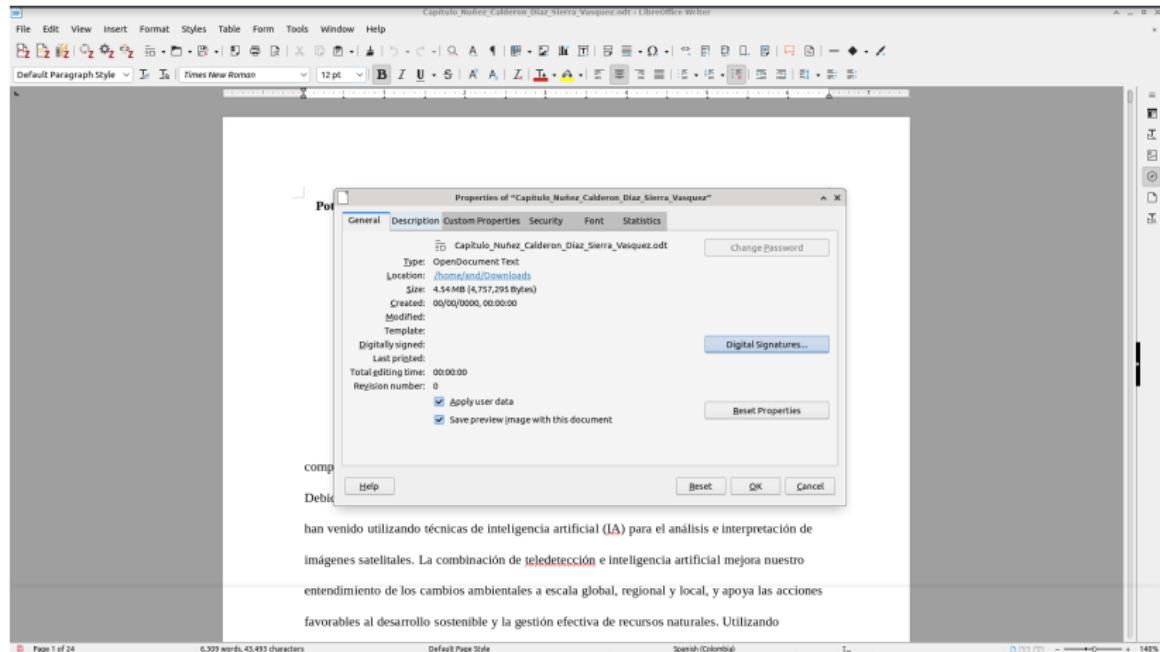
<sup>2</sup>Departamento de Ingeniería Química y Alimentos. Universidad de los Andes

<sup>2</sup>Department of Computer Science, University of California

La teledetección ha emergido como una valiosa herramienta para la observación y comprensión de nuestro entorno terrestre a través de la captura de datos con sensores remotos. Debido a la complejidad de los procesos relacionados con esta tecnología, en los últimos años se han venido utilizando técnicas de inteligencia artificial (IA) para el análisis e interpretación de imágenes satelitales. La combinación de teledetección e inteligencia artificial mejora nuestro entendimiento de los cambios ambientales a escala global, regional y local, y apoya las acciones favorables al desarrollo sostenible y la gestión efectiva de recursos naturales. Utilizando

Page 1 of 24 6,203 words, 43,493 characters Default Page Style Spanish (Colombia) 1- 142%

# Document Metadata



# Spreadsheets

Screenshot of a Google Sheets document titled "Diccionario\_Datos\_Niveles\_Variables\_MGN\_CNPV2018int.xlsb". The document contains a single sheet named "Atributos y variables nivel departamento".

The sheet has columns A through E. Column A is labeled "VARIABLE", column B is "TIPO", column C is "LONGITUD", column D is "DESCRIPCION", and column E is "Categoría original".

Rows 3 through 54 contain data entries. Row 3 is the header row. Row 4 contains the value "NOM" and the description "Código del departamento". Row 5 contains the value "MUNICIPIO" and the description "Nombre del departamento". Row 6 contains the value "CANTON" and the description "Nombre del municipio o distrito de departamento". Row 7 contains the value "PROVINCIA" and the description "Provincia en la que se encuentra el departamento. Distrito de coordinación plana (DCP). Ejemplo: Bogotá, Bogotá". Row 8 contains the value "LAPROV" and the description "Coordenadas de latitud y longitud del departamento". Row 9 contains the value "CONTRIB" and the description "Coordenadas de longitud vertical del departamento". Row 10 contains the value "UTMNE93S" and the description "Coordenadas de UTM NE 93 S". Row 11 contains the value "UTM93S" and the description "Coordenadas de UTM 93 S". Row 12 contains the value "UTM93N" and the description "Coordenadas de UTM 93 N". Row 13 contains the value "UTM93W" and the description "Coordenadas de UTM 93 W". Row 14 contains the value "UTM93E" and the description "Coordenadas de UTM 93 E". Row 15 contains the value "UTM93B" and the description "Coordenadas de UTM 93 B". Row 16 contains the value "UTM93A" and the description "Coordenadas de UTM 93 A". Row 17 contains the value "UTM93D" and the description "Coordenadas de UTM 93 D". Row 18 contains the value "UTM93C" and the description "Coordenadas de UTM 93 C". Row 19 contains the value "UTM93G" and the description "Coordenadas de UTM 93 G". Row 20 contains the value "UTM93H" and the description "Coordenadas de UTM 93 H". Row 21 contains the value "UTM93I" and the description "Coordenadas de UTM 93 I". Row 22 contains the value "UTM93J" and the description "Coordenadas de UTM 93 J". Row 23 contains the value "UTM93K" and the description "Coordenadas de UTM 93 K". Row 24 contains the value "UTM93L" and the description "Coordenadas de UTM 93 L". Row 25 contains the value "UTM93M" and the description "Coordenadas de UTM 93 M". Row 26 contains the value "UTM93N" and the description "Coordenadas de UTM 93 N". Row 27 contains the value "UTM93O" and the description "Coordenadas de UTM 93 O". Row 28 contains the value "UTM93P" and the description "Coordenadas de UTM 93 P". Row 29 contains the value "UTM93Q" and the description "Coordenadas de UTM 93 Q". Row 30 contains the value "UTM93R" and the description "Coordenadas de UTM 93 R". Row 31 contains the value "UTM93S" and the description "Coordenadas de UTM 93 S". Row 32 contains the value "UTM93T" and the description "Coordenadas de UTM 93 T". Row 33 contains the value "UTM93U" and the description "Coordenadas de UTM 93 U". Row 34 contains the value "UTM93V" and the description "Coordenadas de UTM 93 V". Row 35 contains the value "UTM93W" and the description "Coordenadas de UTM 93 W". Row 36 contains the value "UTM93X" and the description "Coordenadas de UTM 93 X". Row 37 contains the value "UTM93Y" and the description "Coordenadas de UTM 93 Y". Row 38 contains the value "UTM93Z" and the description "Coordenadas de UTM 93 Z". Row 39 contains the value "UTM93AA" and the description "Coordenadas de UTM 93 AA". Row 40 contains the value "UTM93AB" and the description "Coordenadas de UTM 93 AB". Row 41 contains the value "UTM93AC" and the description "Coordenadas de UTM 93 AC". Row 42 contains the value "UTM93AD" and the description "Coordenadas de UTM 93 AD". Row 43 contains the value "UTM93AE" and the description "Coordenadas de UTM 93 AE". Row 44 contains the value "UTM93AF" and the description "Coordenadas de UTM 93 AF". Row 45 contains the value "UTM93AG" and the description "Coordenadas de UTM 93 AG". Row 46 contains the value "UTM93AH" and the description "Coordenadas de UTM 93 AH". Row 47 contains the value "UTM93AI" and the description "Coordenadas de UTM 93 AI". Row 48 contains the value "UTM93AJ" and the description "Coordenadas de UTM 93 AJ". Row 49 contains the value "UTM93AK" and the description "Coordenadas de UTM 93 AK". Row 50 contains the value "UTM93AL" and the description "Coordenadas de UTM 93 AL". Row 51 contains the value "UTM93AM" and the description "Coordenadas de UTM 93 AM". Row 52 contains the value "UTM93AN" and the description "Coordenadas de UTM 93 AN". Row 53 contains the value "UTM93AO" and the description "Coordenadas de UTM 93 AO". Row 54 contains the value "UTM93AQ" and the description "Coordenadas de UTM 93 AQ".

A sidebar on the right shows a message from "Andres Calderon ..." at 6:57 PM Today: "Proviente del filtraje de datos".

At the bottom, there is a "Convert to table" button.

Below the sheet, there is a filter bar with dropdown menus for "Departamento", "Municipio", "Municipio Clase", "Sector rural", "Sección rural", "Zona Urbana", "Sector urbano", "Sección urbana", and "Manzana".

# Spreadsheets Metadata

Document details

Location: SHP\_MGN2018\_INTEGRD\_MPIO

Owner: me

Modified: 4:57PM by Andres Calderon Romero

Created: Sep 12, 2022

Diccionario\_Datos\_Niveles\_Variables\_MGN\_CNPV2018int

File Edit View Insert Format Data Tools Help

100% 103

Quattro... + B Z A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Categoría original

Atibutos y variables nivel departamento

DANE  
INSTITUTO NACIONAL DE ESTADÍSTICA Y CENSOS

VARIABLE TIPO DESCRIPCION Categoría original

1 DPTO\_CODIGO Text Código del Departamento

2 DPTO\_NOMBRE Text Nombre del departamento.

3 DPTO\_IMAGEN Long String Archivo de registro de la información del departamento.

4 DPTO\_SISTEMA Long String Archivo de sistema que contiene los datos de los departamentos.

5 DPTO\_REFERENCIA Long String Archivo de referencias de los departamentos.

6 LLEGADA Date Fecha de llegada al sistema del departamento.

7 LLEGADA\_ORIGEN Double Coordenadas de llegada anterior del departamento.

8 SITIOPROXIS Double Coordenadas de Encuentro CNPV 2018.

9 SITIOLB Double Coordenadas de encuentro que representan datos en sistemas distintos.

10 SITIOLBD Double Coordenadas de encuentro que representan datos en sistemas distintos.

11 UTMR\_1K Double Coordenadas de encuentro que representan datos en sistemas distintos.

12 UTMR\_10K Double Coordenadas de encuentro que representan datos en sistemas distintos.

13 UTMR\_1M Double Coordenadas de encuentro que representan datos en sistemas distintos. Bajo punto original.

14 UTMR\_10M Double Coordenadas de encuentro que representan datos en sistemas distintos. Bajo punto original.

15 UTMR\_100M Double Coordenadas de encuentro que representan datos en sistemas distintos. Bajo punto original.

16 UTMR\_1K0 Double Coordenadas de encuentro que representan datos en sistemas distintos.

17 UTMR\_1L0 Double Coordenadas de encuentro que representan datos en sistemas distintos.

18 UTMR\_1L00 Double Coordenadas de encuentro con uno decimal.

19 UTMR\_1L000 Double Coordenadas de encuentro con uno decimal.

20 UTMR\_1L0000 Double Coordenadas de encuentro con uno decimal.

21 UTMR\_1\_M Double Coordenadas de encuentro mises con uno decimal.

22 UTMR\_1\_1M Double Coordenadas de encuentro mises con uno decimal.

23 UTMR\_1\_10M Double Coordenadas de encuentro mises con uno decimal.

24 UTMR\_1\_100M Double Coordenadas de encuentro mises con uno decimal.

25 UTMR\_1\_1000M Double Coordenadas de encuentro mises con uno decimal.

26 UTMR\_1\_10000M Double Coordenadas de encuentro mises con uno decimal.

27 UTMR\_1\_100000M Double Coordenadas de encuentro mises con uno decimal.

28 UTMR\_1\_1000000M Double Coordenadas de encuentro mises con uno decimal.

29 UTMR\_1\_10000000M Double Coordenadas de encuentro mises con uno decimal.

30 UTMR\_1\_100000000M Double Coordenadas de encuentro mises con uno decimal.

31 UTMR\_1\_1000000000M Double Coordenadas de encuentro mises con uno decimal.

32 UTMR\_1\_10000000000M Double Coordenadas de encuentro mises con uno decimal.

33 UTMR\_1\_100000000000M Double Coordenadas de encuentro mises con uno decimal.

34 UTMR\_1\_1000000000000M Double Coordenadas de encuentro mises con uno decimal.

Convert to table

Departamento Municipio Municipio Clase Sector rural Sección rural Zona Urbana Sector urbano Sección urbana Manzana

# Code

main.py - Visual Studio Code

File Edit Selection View Go Run Terminal Help

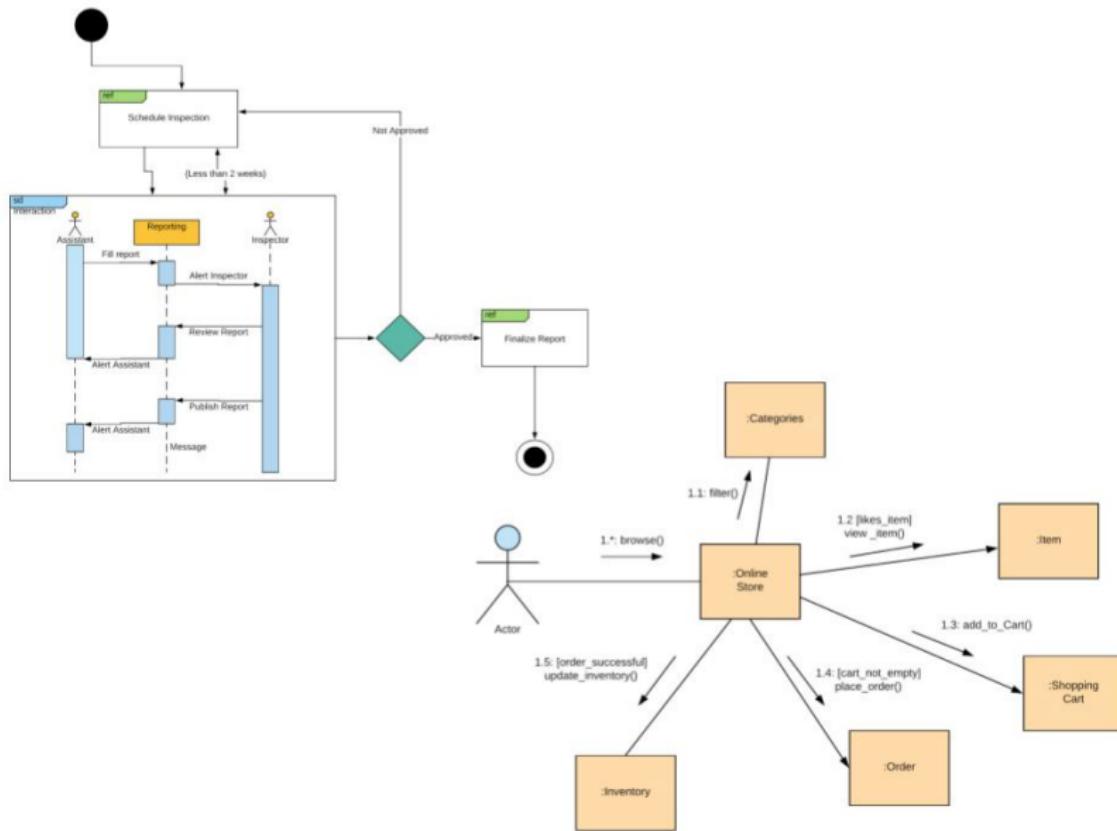
main.py

```
home > acald013 > MEGA > Work > PUJ > 2025-S1 > ADA > Labs > Lab0_report > main.py > ...
```

```
1  #!/usr/bin/env python3
2
3  import time # to get the current time...
4
5  # call the main functions...
6  from array_generator import generate_random_array
7  from insertion_sort import insertion_sort
8  from merge_sort import merge_sort
9
10 # number of runs for each size...
11 number_of_run = 5
12 # the array's sizes we want to evaluate...
13 sizes = [1000, 2000, 4000, 6000, 8000, 10000, 12500, 15000, 17500, 20000]
14
15 for n in range(1, number_of_run):
16     for size in sizes:
17         # generate a random array with the provided size...
18         array = generate_random_array(size)
19         # call insertion-sort and capture the execution time...
20         t0 = time.time()
21         insertion_sort(array)
22         insertion_time = time.time() - t0
23         print("{}\t{}\t{}".format("Insertion", size, insertion_time))
24         # call merge-sort and capture the execution time...
25         t0 = time.time()
26         merge_sort(array)
27         merge_time = time.time() - t0
28         print("{}\t{}\t{}".format("Merge", size, merge_time))
```

Ln 4, Col 1 Spaces: 4 UTF-8 ⓘ Python

# Code Metadata



# Databases

pgAdmin 4

File Object Tools Edit View Window Help

Welcome to pgAdmin 4! db: f1db.drivers f1db: scalar013@localhost

Query History

Query

```
1 SELECT * FROM f1db.drivers
2 ORDER BY driverid ASC
```

Scratch Pad

Data Output Messages Notifications

driverid	driverref	drivername	number	code	forename	surname	dob	nationality	url
1	hamilton	Lewis	44	HAM	Hamilton	Lewis	1985-07-07	British	<a href="http://en.wikipedia.org/wiki/Lewis_Hamilton">http://en.wikipedia.org/wiki/Lewis_Hamilton</a>
2	heidfeld	Nick	[null]	HEI	Heidfeld	Heidfeld	1977-05-10	German	<a href="http://en.wikipedia.org/wiki/Nick_Heidfeld">http://en.wikipedia.org/wiki/Nick_Heidfeld</a>
3	rosberg	Nico	6	ROS	Rosberg	Rosberg	1985-06-27	German	<a href="http://en.wikipedia.org/wiki/Nico_Rosberg">http://en.wikipedia.org/wiki/Nico_Rosberg</a>
4	alonso	Fernando	14	ALO	Alonso	Alonso	1981-07-29	Spanish	<a href="http://en.wikipedia.org/wiki/Fernando_Alonso">http://en.wikipedia.org/wiki/Fernando_Alonso</a>
5	kovalainen	Heikki	[null]	KOV	Kovalainen	Kovalainen	1985-10-19	Finnish	<a href="http://en.wikipedia.org/wiki/Heikki_Kovalainen">http://en.wikipedia.org/wiki/Heikki_Kovalainen</a>
6	nakajima	Kazuki	[null]	NAK	Nakajima	Nakajima	1985-07-11	Japanese	<a href="http://en.wikipedia.org/wiki/Kazuki_Nakajima">http://en.wikipedia.org/wiki/Kazuki_Nakajima</a>
7	boullier	Sebastien	[null]	BOU	Boullier	Boullier	1979-02-28	French	<a href="http://en.wikipedia.org/wiki/Sebastien_Boullier">http://en.wikipedia.org/wiki/Sebastien_Boullier</a>
8	rakkinen	Kimi	7	RAK	Räikkönen	Räikkönen	1979-10-17	French	<a href="http://en.wikipedia.org/wiki/Kimi_Räikkönen">http://en.wikipedia.org/wiki/Kimi_Räikkönen</a>
9	kubica	Robert	[null]	KUB	Kubica	Kubica	1984-12-07	Polish	<a href="http://en.wikipedia.org/wiki/Robert_Kubica">http://en.wikipedia.org/wiki/Robert_Kubica</a>
10	glock	Timo	[null]	GLO	Glock	Glock	1982-05-18	German	<a href="http://en.wikipedia.org/wiki/Timo_Glock">http://en.wikipedia.org/wiki/Timo_Glock</a>
11	sato	Takuma	[null]	SAT	Sato	Sato	1977-07-28	Japanese	<a href="http://en.wikipedia.org/wiki/Takuma_Sato">http://en.wikipedia.org/wiki/Takuma_Sato</a>
12	piquet_jr	Pepe	[null]	PIQ	Piquet Jr.	Piquet Jr.	1985-07-23	Brazilian	<a href="http://en.wikipedia.org/wiki/Pepe_Piquet_Jr.">http://en.wikipedia.org/wiki/Pepe_Piquet_Jr.</a>
13	massa	Felipe	19	MAS	Massa	Massa	1981-04-25	Brazilian	<a href="http://en.wikipedia.org/wiki/Felipe_Massa">http://en.wikipedia.org/wiki/Felipe_Massa</a>
14	coulthard	David	[null]	COU	Coulthard	Coulthard	1971-03-27	British	<a href="http://en.wikipedia.org/wiki/David_Coulthard">http://en.wikipedia.org/wiki/David_Coulthard</a>
15	trulli	Jarome	[null]	TRU	Trulli	Trulli	1974-07-13	Italian	<a href="http://en.wikipedia.org/wiki/Jarome_Trulli">http://en.wikipedia.org/wiki/Jarome_Trulli</a>
16	sutil	Adrián	99	SUT	Sutil	Sutil	1989-01-11	German	<a href="http://en.wikipedia.org/wiki/Adrián_Sutil">http://en.wikipedia.org/wiki/Adrián_Sutil</a>
17	webber	Mark	[null]	WEB	Webber	Webber	1976-08-27	Australian	<a href="http://en.wikipedia.org/wiki/Mark_Webber_(racing_driver)">http://en.wikipedia.org/wiki/Mark_Webber_(racing_driver)</a>
18	button	James	22	BUT	Button	Button	1980-07-19	British	<a href="http://en.wikipedia.org/wiki/James_Button">http://en.wikipedia.org/wiki/James_Button</a>
19	davidson	Anthony	[null]	DAV	Davidson	Davidson	1979-06-19	British	<a href="http://en.wikipedia.org/wiki/Anthony_Davidson">http://en.wikipedia.org/wiki/Anthony_Davidson</a>
20	vetel	Sebastian	5	VET	Vettel	Vettel	1987-07-03	German	<a href="http://en.wikipedia.org/wiki/Sebastian_Vettel">http://en.wikipedia.org/wiki/Sebastian_Vettel</a>
21	freschella	Giancarlo	[null]	FIS	Feschella	Feschella	1973-03-14	Italian	<a href="http://en.wikipedia.org/wiki/Giancarlo_Feschella">http://en.wikipedia.org/wiki/Giancarlo_Feschella</a>
22	barichello	Roberto	[null]	BAR	Barichello	Barichello	1972-09-23	Brazilian	<a href="http://en.wikipedia.org/wiki/Roberto_Barichello">http://en.wikipedia.org/wiki/Roberto_Barichello</a>
23	schumacher	Ralf	[null]	SOH	Schumacher	Schumacher	1975-06-30	German	<a href="http://en.wikipedia.org/wiki/Ralf_Schumacher">http://en.wikipedia.org/wiki/Ralf_Schumacher</a>
24	luzzi	Vitantonio	[null]	LUZ	Luzzi	Luzzi	1989-08-09	Italian	<a href="http://en.wikipedia.org/wiki/Vitantonio_Luzzi">http://en.wikipedia.org/wiki/Vitantonio_Luzzi</a>
25	wurz	Alexander	[null]	WUR	Wurz	Wurz	1974-06-15	Austrian	<a href="http://en.wikipedia.org/wiki/Alexander_Wurz">http://en.wikipedia.org/wiki/Alexander_Wurz</a>
26	rossi	Emerson	[null]	ROS	Rossi	Rossi	1983-01-14	Emerson	<a href="http://en.wikipedia.org/wiki/Emerson_Rossi">http://en.wikipedia.org/wiki/Emerson_Rossi</a>

Total rows: 861 Query complete 00:00:00.828

LF Ln 1, Col 1

# Databases

pgAdmin 4

File Object Tools Edit View Window Help

Welcome to pgAdmin 4! db.drivers@localhost

Query History

Query

```
1 SELECT * FROM f1db.drivers
2 ORDER BY driverid ASC
```

Scratch Pad

Data Output Messages Notifications

Showing rows: 1 to 861 Page No: 1 of 1 <> << >> >>

driverid	driverref	number	code	forename	surname	dateOfBirth	nationality	url
1	hamilton	44	HAM	Lewis	Hamilton	1985-07-07	British	<a href="http://en.wikipedia.org/wiki/Lewis_Hamilton">http://en.wikipedia.org/wiki/Lewis_Hamilton</a>
2	heidfeld	[null]	HEI	Nick	Heidfeld	1977-05-10	German	<a href="http://en.wikipedia.org/wiki/Nick_Heidfeld">http://en.wikipedia.org/wiki/Nick_Heidfeld</a>
3	rosberg	6	ROS	Nico	Rosberg	1985-06-27	German	<a href="http://en.wikipedia.org/wiki/Nico_Rosberg">http://en.wikipedia.org/wiki/Nico_Rosberg</a>
4	alonso	14	ALO	Fernando	Alonso	1981-07-29	Spanish	<a href="http://en.wikipedia.org/wiki/Fernando_Alonso">http://en.wikipedia.org/wiki/Fernando_Alonso</a>
5	kovalainen	[null]	KOV	Heikki	Kovalainen	1981-09-19	Finnish	<a href="http://en.wikipedia.org/wiki/Heikki_Kovalainen">http://en.wikipedia.org/wiki/Heikki_Kovalainen</a>
6	nakajima	[null]	NAK	Kazuki	Nakajima	1985-02-11	Japanese	<a href="http://en.wikipedia.org/wiki/Kazuki_Nakajima">http://en.wikipedia.org/wiki/Kazuki_Nakajima</a>
7	bottas	[null]	BOU	Sebastian	Bottas	1992-05-28	French	<a href="http://en.wikipedia.org/wiki/Sebastian_Bottas">http://en.wikipedia.org/wiki/Sebastian_Bottas</a>
8	rakkinen	7	RAI	Kimi	Räikkönen	1979-10-17	French	<a href="http://en.wikipedia.org/wiki/Kimi_Räikkönen">http://en.wikipedia.org/wiki/Kimi_Räikkönen</a>
9	kubica	88	KUB	Robert	Kubica	1984-06-06	Polish	<a href="http://en.wikipedia.org/wiki/Robert_Kubica">http://en.wikipedia.org/wiki/Robert_Kubica</a>
10	glock	[null]	GLO	Timo	Glock	1982-05-18	German	<a href="http://en.wikipedia.org/wiki/Timo_Glock">http://en.wikipedia.org/wiki/Timo_Glock</a>
11	sato	[null]	SAT	Takuma	Sato	1977-03-10	Japanese	<a href="http://en.wikipedia.org/wiki/Takuma_Sato">http://en.wikipedia.org/wiki/Takuma_Sato</a>
12	piquet_jr	[null]	PIQ	Nelson	Piquet Jr.	1971-03-23	Brazilian	<a href="http://en.wikipedia.org/wiki/Nelson_Piquet_Jr.">http://en.wikipedia.org/wiki/Nelson_Piquet_Jr.</a>
13	massa	19	MAS	Felipe	Massa	1980-04-25	Brazilian	<a href="http://en.wikipedia.org/wiki/Felipe_Massa">http://en.wikipedia.org/wiki/Felipe_Massa</a>
14	coulthard	[null]	COU	David	Coulthard	1971-04-27	British	<a href="http://en.wikipedia.org/wiki/David_Coulthard">http://en.wikipedia.org/wiki/David_Coulthard</a>
15	trulli	[null]	TRU	Jarome	Trulli	1981-07-12	Italian	<a href="http://en.wikipedia.org/wiki/Jarome_Trulli">http://en.wikipedia.org/wiki/Jarome_Trulli</a>
16	sutil	99	SUT	Adrián	Sutil	1983-07-06	Spanish	<a href="http://en.wikipedia.org/wiki/Adrián_Sutil">http://en.wikipedia.org/wiki/Adrián_Sutil</a>
17	webber	[null]	WEB	Mark	Webber	1978-09-27	Australian	<a href="http://en.wikipedia.org/wiki/Mark_Webber_(racing_driver)">http://en.wikipedia.org/wiki/Mark_Webber_(racing_driver)</a>
18	button	22	BUT	Jonas	Button	1980-07-19	British	<a href="http://en.wikipedia.org/wiki/Jonas_Button">http://en.wikipedia.org/wiki/Jonas_Button</a>
19	davidson	[null]	DAV	Anthony	Davidson	1979-06-19	British	<a href="http://en.wikipedia.org/wiki/Anthony_Davidson">http://en.wikipedia.org/wiki/Anthony_Davidson</a>
20	vetel	5	VET	Sebastian	Vettel	1987-07-03	German	<a href="http://en.wikipedia.org/wiki/Sebastian_Vettel">http://en.wikipedia.org/wiki/Sebastian_Vettel</a>
21	fisichella	[null]	FIS	Giandomenico	Fisichella	1979-03-14	Italian	<a href="http://en.wikipedia.org/wiki/Giandomenico_Fisichella">http://en.wikipedia.org/wiki/Giandomenico_Fisichella</a>
22	barichello	[null]	BAR	Roberto	Barichello	1972-09-23	Brazilian	<a href="http://en.wikipedia.org/wiki/Roberto_Barichello">http://en.wikipedia.org/wiki/Roberto_Barichello</a>
23	schumacher	[null]	SOH	Ralf	Schumacher	1975-06-30	German	<a href="http://en.wikipedia.org/wiki/Ralf_Schumacher">http://en.wikipedia.org/wiki/Ralf_Schumacher</a>
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25	wurz	[null]	WUR	Alexander	Wurz	1974-06-15	Austrian	<a href="http://en.wikipedia.org/wiki/Alexander_Wurz">http://en.wikipedia.org/wiki/Alexander_Wurz</a>
26	zemek	[null]	ZEM	Janek	Zemek	1983-01-14	Czech	<a href="http://en.wikipedia.org/wiki/Janek_Zemek">http://en.wikipedia.org/wiki/Janek_Zemek</a>

Total rows: 861 Query complete 00:00:00.828

LF Ln 1, Col 1

# Databases

The screenshot shows a database management system interface with the following sections:

- File, Edit, Tables, Columns, Databases, Relationships, Optimize Tables, Import, Export, Help**: Top navigation bar.
- drivers**: Database name in the top left.
- Tables**: Shows the `drivers` table with 861 rows and 10 columns: `driverid`, `driverref`, `number`, `code`, `forename`, `surname`, `dob`, `nationality`, and `url`. A query history panel on the left shows the following SQL:SELECT \* FROM f1db.drivers ORDER BY driverid ASC
- Columns**: Shows the structure of the `drivers` table with columns: `driverid` (serial), `driverref` (varchar 255), `number` (int), `code` (varchar), `forename` (varchar), `surname` (varchar), `dob` (date), `nationality` (varchar), and `url` (varchar).
- Indexes**: Shows two indexes: `idx_20402` (primary key) and `idx_20403`.
- Relationships**: Shows relationships with other tables: `driversdetails`, `qualifying`, `results`, and `sponsorships`.
- Data Output**: Shows the results of the query: Total rows: 861. Query complete 00:00:00.829.
- Messages**: No messages displayed.
- Notifications**: No notifications displayed.
- Page No: 1 of 1**: Page navigation at the bottom right.

# Metadata Characteristics<sup>1</sup>

- ▶ Metadata is information about an *object* or *resource* that describes *characteristics* of that object, such as content, quality, format, location, and access rights.

---

<sup>1</sup> Australian Research Data Commons

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# Plan

What is Metadata?

Metadata Examples

Database Administration Tools

Understanding PostgreSQL System Catalogs

# DBA Tools

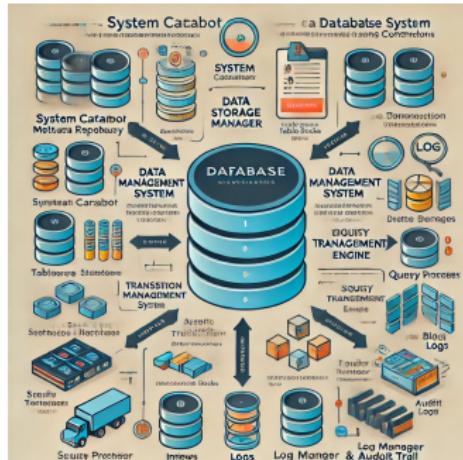
## The Data Dictionary (aka Metadata repository)

- ▶ Is a database administration tool.
- ▶ It is a type of metadata itself.
- ▶ Oracle defines it as a collection of tables with metadata.

### Definition

A data dictionary is a “*centralized repository of information about data such as meaning, relationships to other data, origin, usage, and format.*”

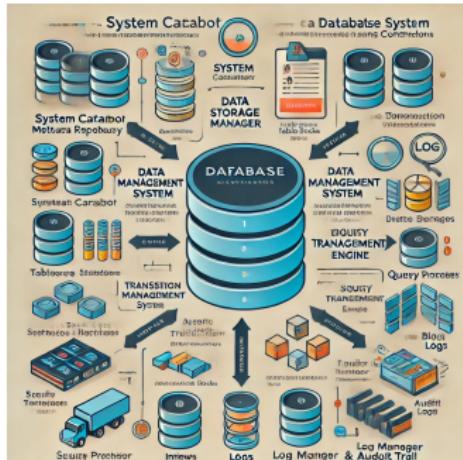
## Data Dictionary



DD stores information about database objects, including:

- ▶ Tables (names, columns, data types, constraints).

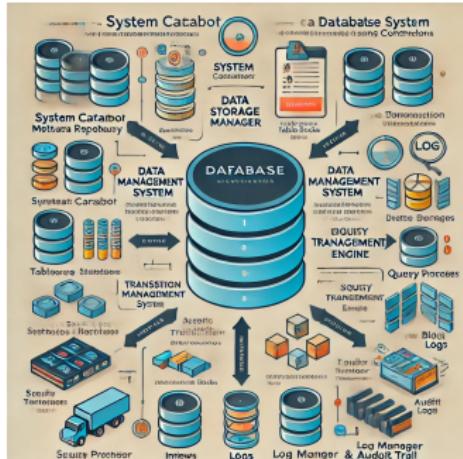
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DD stores information about database objects, including:

- ▶ Tables (names, columns, data types, constraints).
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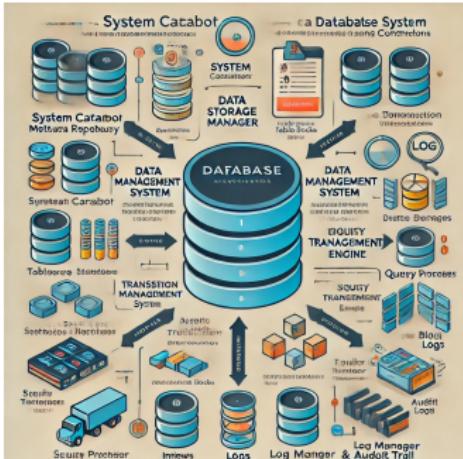
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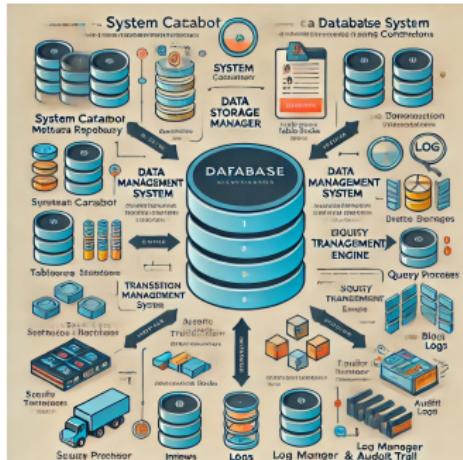
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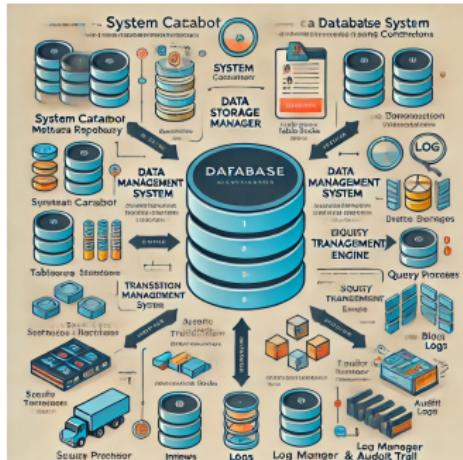
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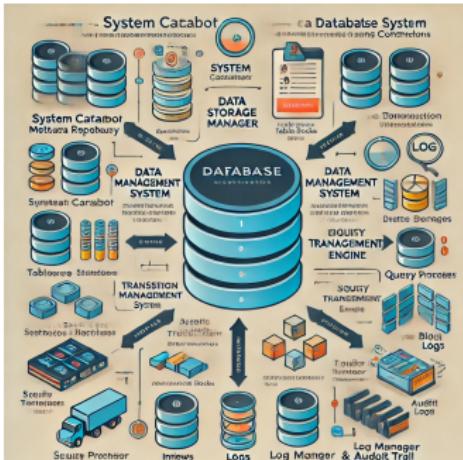
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  - ▶ Relationships & Dependencies (links between tables).
  - ▶ Audit & Logs (history of schema changes).

# Data Dictionary Types

## ► Integrated:

- ▶ With the DBMS. i.e., relational DBMSs include a built-in DD or system catalog that is frequently accessed and updated by the RDBMS.
- ▶ Tend to limit their metadata to the data managed by the DBMS.

# Data Dictionary Types

- ▶ **Integrated:**
  - ▶ With the DBMS. i.e., relational DBMSs include a built-in DD or system catalog that is frequently accessed and updated by the RDBMS.
  - ▶ Tend to limit their metadata to the data managed by the DBMS.
- ▶ **Standalone:**
  - ▶ Other DBMSs, especially older types, do not have a built-in data dictionary; instead, the DBA may use third-party standalone systems.
  - ▶ Usually more flexible and allow the DBA to describe and manage all of the organization's data, whether they are computerized or not.

# Data Dictionary Types

- ▶ **Active:** Automatically updated by the DBMS with every database access to keep its access information up to date.

# Data Dictionary Types

- ▶ **Active:** Automatically updated by the DBMS with every database access to keep its access information up to date.
- ▶ **Passive:** Not updated automatically and usually DBA requires running a batch process.

# Data Dictionary Function

- ▶ The DD main function is to store the description of all objects that interact with the database.
- ▶ Whatever the data dictionary's format, it provides database designers and end users with a much-improved ability to communicate.
- ▶ The DD is the tool that helps the DBA resolve data conflicts.

## Data Dictionary Content<sup>2</sup>

Although there is no standard format for the information stored in the DD, several features are common. DD typically stores descriptions of the following:

- ▶ Data elements that are defined in all tables of all databases.

---

<sup>2</sup>More info in “*Database Systems: Design, Implementation, & Management.*” 13<sup>th</sup> Ed. (Coronel & Morris, 2017). Section 16-7a.

## Data Dictionary Content<sup>2</sup>

Although there is no standard format for the information stored in the DD, several features are common. DD typically stores descriptions of the following:

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- ▶ Tables defined in all databases.

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# Plan

What is Metadata?

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Understanding PostgreSQL System Catalogs

# What are PostgreSQL System Catalogs?

- ▶ Internal tables where PostgreSQL stores schema metadata.
- ▶ Contain information about databases, tables, columns, and more.
- ▶ Essential for managing and querying database structure.

# Naming Conventions

- ▶ Catalog names start with `pg_`.
- ▶ Column prefixes often derived from catalog names:
  - ▶ `pg_database`: columns start with `dat_` (e.g., `datname`).
  - ▶ `pg_proc`: columns start with `pro_`.
  - ▶ `pg_namespace`: columns start with `nsp_`.
  - ▶ `pg_class`: columns start with `rel_` (stores information about tables and other objects with columns, referred to as “relations”).

# Retrieving Database Metadata

- ▶ pg\_database stores information about databases.
- ▶ To find the owner of a specific database:

```
1  SELECT
2      a.rolname AS 'Owner'
3  FROM
4      pg_database d
5  JOIN
6      pg_authid a
7  ON
8      a.oid = d.datdba
9  WHERE
10     datname = 'your_database_name';
```

- ▶ Replace `your_database_name` with the name of your database.

# Retrieving Table Metadata

- ▶ `pg_class` stores information about tables, indexes, and views.
- ▶ To list all ordinary tables:

---

```
SELECT
    relname
FROM
    pg_class
WHERE
    relkind = 'r';
```

---

- ▶ `relkind = 'r'` indicates ordinary tables.

# Retrieving Schema Metadata

- ▶ pg\_namespace stores information about schemas.
- ▶ To list all schema names:

---

```
SELECT
    nspname
FROM
    pg_namespace;
```

---

# Retrieving Index Metadata

- ▶ pg\_index and pg\_class store information about indexes.
- ▶ To find tables without indexes:

---

```
1   SELECT
2       c.oid::regclass AS table_name
3   FROM
4       pg_class c
5   WHERE
6       relkind = 'r' AND NOT EXISTS (
7           SELECT 1 FROM pg_index i WHERE i.indrelid = c.oid
8       );
```

---

# Retrieving Column Metadata

- ▶ `pg_attribute` stores information about table columns.
- ▶ To list column names and their data types:

---

```
1  SELECT
2      attname, atttypid::regtype
3  FROM
4      pg_attribute LIMIT 50;
```

---

- ▶ The `regtype` cast provides human-readable data types.

# Retrieving Function Metadata

- ▶ pg\_proc stores information about functions.
- ▶ To find functions that accept a **text** argument:

---

```
1   SELECT
2       oid::regprocedure
3   FROM
4       pg_proc
5   WHERE
6       'text'::regtype = ANY(proargtypes);
```

---

# Retrieving Size Information

- ▶ To get the size of tables:

```
1  SELECT
2      oid::regclass AS table_name,
3      pg_size.pretty(pg_table_size(oid)) AS size
4  FROM
5      pg_class
6  WHERE
7      relkind = 'r'
8  ORDER BY
9      pg_table_size(oid) DESC;
```

- ▶ `pg_size.pretty` formats sizes into readable units.

# End of Lecture 3.

TDT5FTOTTC



# Top 5 Fundamental Takeaways

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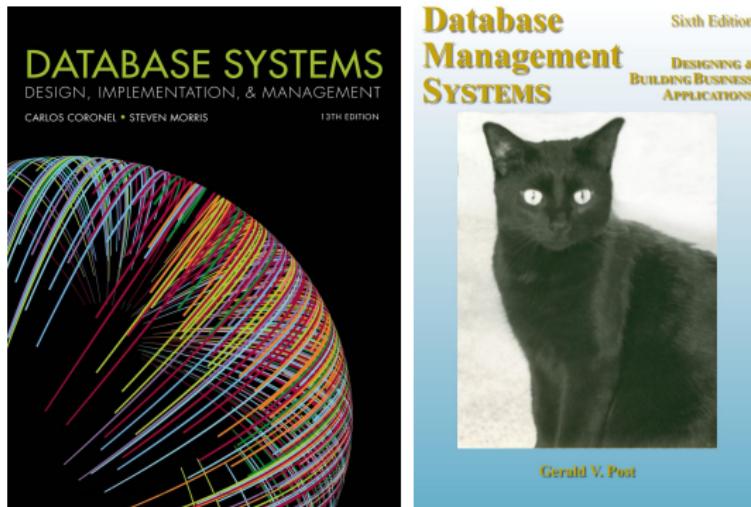
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# Database Administration: What is Metadata?



Content has been extracted from *Database Systems: Design, Implementation, and Management.*, 13th Edition, by Carlos Coronel & Steven Morris. Cengage Learning. 2018. and *Database Management Systems: Designing & Building Business Applications.*, 6th Edition, by Gerald Post. McGraw-Hill/Irwin. 2014.

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