

Database Administration: What is Metadata?

Lecture 03: Metadata

et al.

10 de febrero de 2025

Database Administration: DBA Tools.



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, ...



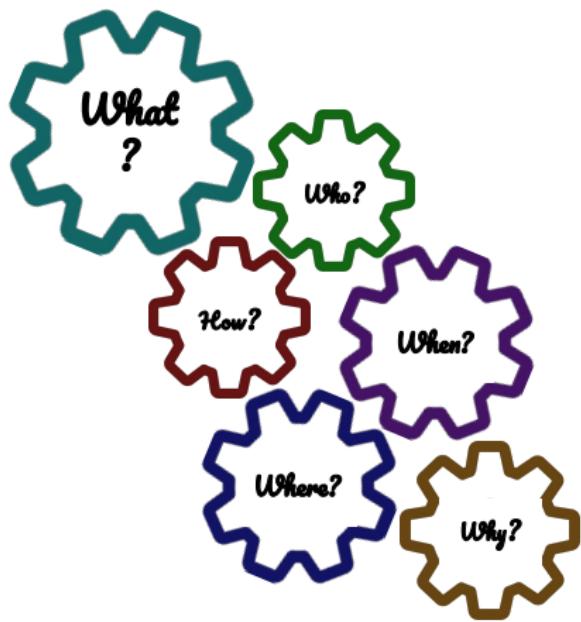
Metadata

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Plan

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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

SEVENTH EDITION

Database System Concepts



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

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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



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

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0 Data files

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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

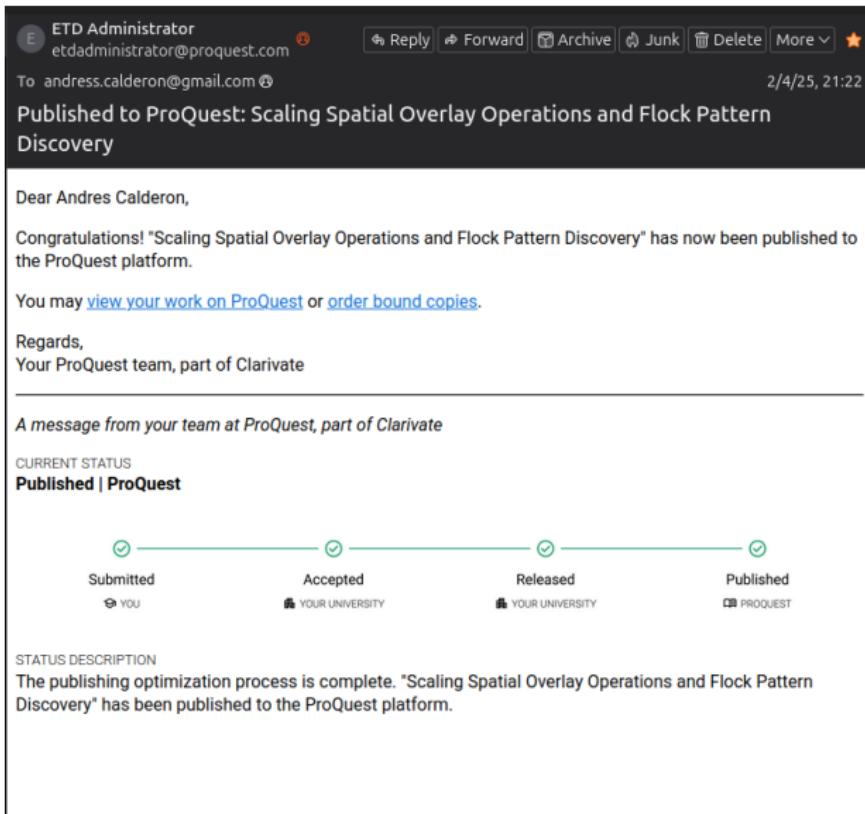
We all know (I hope) how important it is to comment code we develop and maintain. We do it to make it easier to scan and understand it. To be able to test and modify it. For our colleagues and ourselves when we get back to it a few months later.

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
etdadministrator@proquest.com

To andress.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

The screenshot illustrates the analysis of an email message regarding its data and metadata.

Data: The main content of the email includes the recipient's name ('Dataedo Store <dataedo@dataedo.com>'), the subject ('Your Dataedo order 2018/718'), and an attachment ('Dataedo_invoice_2018-D-461.pdf' - 792 KB). The body of the email expresses gratitude for choosing Dataedo and provides order details.

Order details:

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

Items:

Product	Price
Dataedo Pro - 1 Year Subscription	\$468
Grand Total	

Your key:

Dataedo Pro - 1 Year Subscription (1 user)

```
ENJELJPJDJNLMBDHADENADODPHOMLJ1  
LHNFKRANKHJDEAPEOIIAACODBLGFBMOPHD  
NKGJNIPHMIDMBPFLELKKFMDNCMAHBP  
BCGGNCBMMJPNHPLIKGMDCCNAMKRPJHGHN  
FHADBHEICKFDGEONIFCLJIMADANLENHL  
PDKBNFJUDIEGNLICJUJFFPMKMMI0GGA00  
NKGJNIPHMIDMBPFLELKKFMDNCMAHBP  
BCGGNCBMMJPNHPLIKGMDCCNAMKRPJHGHN
```

Properties Dialog (Metadata):

Settings:

- Importance: Normal
- Sensitivity: Normal

Security:

- Encrypt message contents and attachments
- Add digital signature to outgoing message
- Request S/MIME receipt for this message

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 12:00 AM

Internet headers:

```
Received: from 124135.cloudwaysapps.com (104.131.29.249) (HELO  
cloudwaysapps.com)  
by server1307517.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>
```

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 Núñez¹, Andrés Calderón¹, Nicolás Díaz¹, Rocío Sierra¹, David Vásquez²

'Departamento de Ingeniería de Sistemas y Computación. Universidad de los Andes.

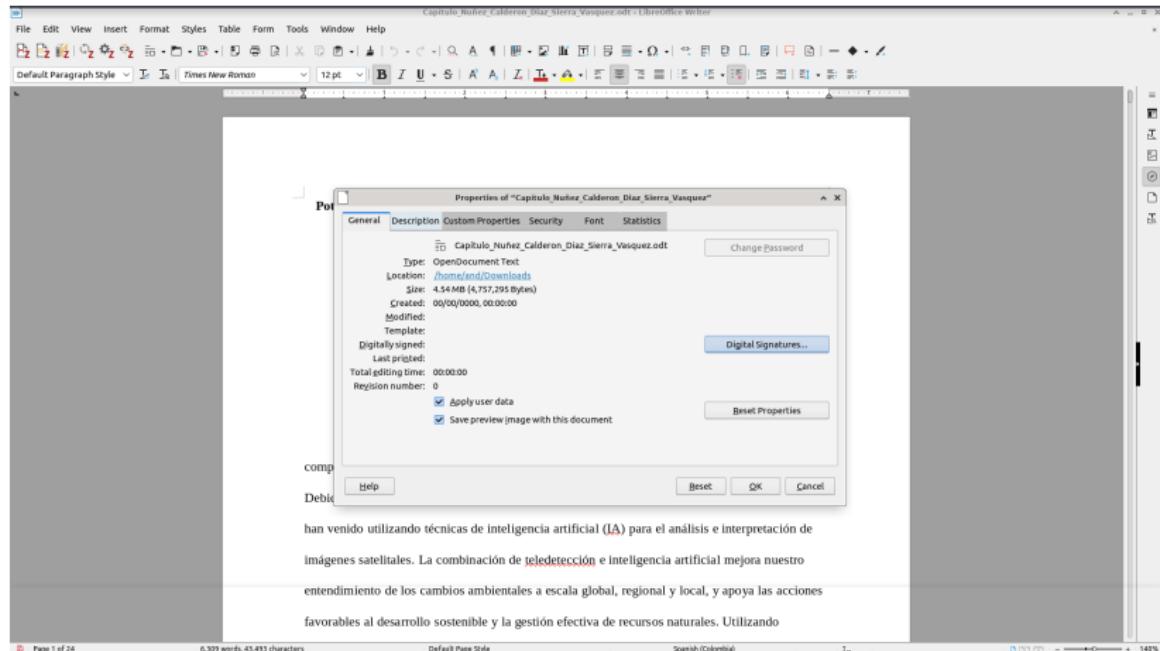
^Departamento de Ingeniería Química y Alimentos. Universidad de los Andes

^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, 45,493 characters Default Page Style Spanish (Colombia) 1- 148%

Document Metadata



Spreadsheets

Screenshot of a Google Sheets document titled "Diccionario_Datos_Niveles_Variables_MGN_CNPV2018int.xlsx". The sheet is titled "Atributos y variables nivel departamento".

The table contains the following data:

3	VARIABLE	TIPO	LONGITUD	DESCRIPCION	Categoría original
4	SP01_CODIGO	Text	1	Código del departamento.	
5	SP02_CODNAME	Text	100	Nombre del departamento.	
6	SP03_ID	Text	10	Código identificador del departamento.	
7	SP04_PAIS	Text	100	País del Departamento en su forma definitiva. Diversos de los países: MÉXICO, Colombia, Ecuador.	
8	SP05_PISO	Double	10	Coordenadas de latitud y longitud del departamento.	
9	SP06_CANTIDAD	Double	10	Coordenadas de longitud oriente del departamento.	
10	UTM93NOMINA	Double	10	Coordenadas de latitud y longitud en UTM93.	
11	UTM93EAST	Double	10	Coordenadas de latitud y longitud en UTM93 Eje este.	
12	UTM93NORTH	Double	10	Coordenadas de latitud y longitud en UTM93 Eje norte.	
13	UTM93LNGRAVE	Double	10	Coordenadas de latitud y longitud en UTM93 Eje longitud.	
14	UTM93ELEVACION	Double	10	Altitud en metros sobre el nivel del mar en UTM93.	
15	UTM93PROYECTO	Double	10	Coordenadas de latitud y longitud en UTM93 Proyecto.	
16	UTM93NOMINA2	Double	10	Coordenadas de latitud y longitud en UTM93 Nominativa.	
17	UTM93EAST2	Double	10	Coordenadas de latitud y longitud en UTM93 Eje este2.	
18	UTM93NORTH2	Double	10	Coordenadas de latitud y longitud en UTM93 Eje norte2.	
19	UTM93LNGRAVE2	Double	10	Coordenadas de latitud y longitud en UTM93 Eje longitud2.	
20	UTM93ELEVACION2	Double	10	Altitud en metros sobre el nivel del mar en UTM932.	
21	UTM93PROYECTO2	Double	10	Coordenadas de latitud y longitud en UTM93 Proyecto2.	
22	UTM93NOMINA3	Double	10	Coordenadas de latitud y longitud en UTM93 Nominativa3.	
23	UTM93EAST3	Double	10	Coordenadas de latitud y longitud en UTM93 Eje este3.	
24	UTM93NORTH3	Double	10	Coordenadas de latitud y longitud en UTM93 Eje norte3.	
25	UTM93LNGRAVE3	Double	10	Coordenadas de latitud y longitud en UTM93 Eje longitud3.	
26	UTM93ELEVACION3	Double	10	Altitud en metros sobre el nivel del mar en UTM933.	
27	UTM93PROYECTO3	Double	10	Coordenadas de latitud y longitud en UTM93 Proyecto3.	
28	UTM93NOMINA4	Double	10	Coordenadas de latitud y longitud en UTM93 Nominativa4.	
29	UTM93EAST4	Double	10	Coordenadas de latitud y longitud en UTM93 Eje este4.	
30	UTM93NORTH4	Double	10	Coordenadas de latitud y longitud en UTM93 Eje norte4.	
31	UTM93LNGRAVE4	Double	10	Coordenadas de latitud y longitud en UTM93 Eje longitud4.	
32	UTM93ELEVACION4	Double	10	Altitud en metros sobre el nivel del mar en UTM934.	
33	UTM93PROYECTO4	Double	10	Coordenadas de latitud y longitud en UTM93 Proyecto4.	
34	UTM93NOMINA5	Double	10	Coordenadas de latitud y longitud en UTM93 Nominativa5.	
35	UTM93EAST5	Double	10	Coordenadas de latitud y longitud en UTM93 Eje este5.	
36	UTM93NORTH5	Double	10	Coordenadas de latitud y longitud en UTM93 Eje norte5.	
37	UTM93LNGRAVE5	Double	10	Coordenadas de latitud y longitud en UTM93 Eje longitud5.	
38	UTM93ELEVACION5	Double	10	Altitud en metros sobre el nivel del mar en UTM935.	
39	UTM93PROYECTO5	Double	10	Coordenadas de latitud y longitud en UTM93 Proyecto5.	

Bottom right corner of the table: + Convert to table

Bottom navigation bar: + Departamento • Municipio • Municipio Clase • Sector rural • Sección rural • Zona Urbana • Sector urbano • Sección urbana • Manzana •

Right sidebar: Andres Calderon ... 6:57 PM Today. Provieno del flujo de datos.

Spreadsheets Metadata

Screenshot of a Google Sheets document titled "Diccionario_Datos_Niveles_Variables_MGN_CNPV2018int". The sheet contains a table of variables and their descriptions, with a modal window showing document details.

Document details

- Location: SHP_MGN2018_INTGRD_MP10
- Owner: me
- Modified: 4:57PM by Andres Calderon Romero
- Created: Sep 12, 2022

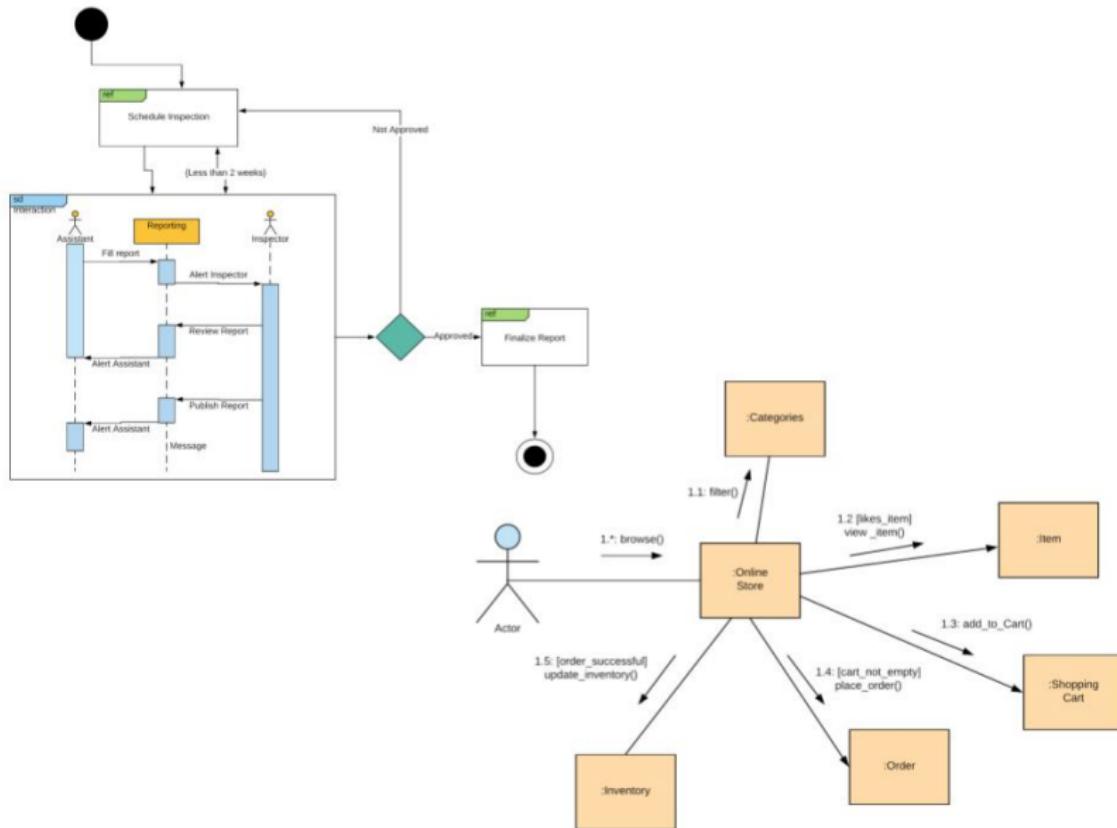
3 VARIABLE	TIPO	LARGOR	DESCRIPCION	Categoría original
4 DPTO_CODIGO	Text	3	Código del departamento	
5 DPTO_NOMBRE	Text	100	Nombre del departamento	
6 DPTO_INICIO	Long Integer	Alto de la vigencia de la información del departamento		
7 DPTO_FIN	Long Integer	Baja de la vigencia de la información del departamento		
8 LLEGADA	Double	Porcentaje de señales emitidas de los condensadores planos MAC301, Colombia, Segundo		
9 LLEGADAS	Double	Porcentaje de llegadas emitidas de los condensadores planos MAC301, Colombia, Segundo		
10 CONDICIONES	Double	Condición de llegada emitida del departamento		
11 SITIOPROX	Double	Centrado de Encuesta CNPV 2018		
12 SITIOL_R	Double	Centrado de encuesta que responde tiene un domicilio estable		
13 SITIOL_RD	Double	Centrado de encuesta que responde vive en un domicilio estable		
14 UTMR_3M	Double	Centrado de encuesta que responde vive en un domicilio fijo	Segundo Indigena	
15 UTMR_3M_R	Double	Centrado de encuesta que responde vive en un domicilio fijo Segundo Indigena	Segundo Indigena	
16 UTMR_3M_RD	Double	Centrado de encuesta que responde vive en un domicilio fijo Segundo Indigena	Segundo Indigena	
17 UTMR_3R	Double	Centrado de encuesta que responde vive en una vivienda propia		
18 UTMR_3R_R	Double	Centrado de encuesta que responde vive en una vivienda propia		
19 UTMR_3R_RD	Double	Centrado de encuesta que responde vive en una vivienda propia		
20 UTMR_3L	Double	Centro de encuesta vive con otra persona		
21 UTMR_3L_R	Double	Centro de encuesta vive con otra persona		
22 UTMR_3L_RD	Double	Centro de encuesta vive con otra persona estable		
23 UTMR_3M_R	Double	Centro de encuesta vive con otra persona estable		
24 UTMR_3M_RD	Double	Centro de encuesta vive con otra persona estable		
25 UTMR_3R_R	Double	Centro de encuesta vive con otra persona estable		
26 UTMR_3R_RD	Double	Centro de encuesta vive con otra persona estable		
27 UTMR_3L_X	Double	Centro de encuesta no reside en el hogar		
28 UTMR_3L_X_R	Double	Centro de encuesta no reside en el hogar		
29 UTMR_3L_X_RD	Double	Centro de encuesta no reside en el hogar		
30 UTMR_3R_X	Double	Centro de encuesta no reside en el hogar		
31 UTMR_3R_X_R	Double	Centro de encuesta no reside en el hogar		
32 UTMR_3R_X_RD	Double	Centro de encuesta no reside en el hogar		
33 UTMR_3R_X_RRD	Double	Centro de encuesta no reside en el hogar		
34 UTMR_3R_X_RRD	Double	Centro de encuesta no reside en el hogar		

Code

The screenshot shows a Visual Studio Code window titled "main.py - Visual Studio Code". The file menu includes File, Edit, Selection, View, Go, Run, Terminal, and Help. The code editor displays a Python script named "main.py". The script imports time, array_generator, insertion_sort, and merge_sort. It defines a list of sizes and a loop to run each size 5 times, measuring the execution time for both insertion sort and merge sort.

```
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))
```

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	http://en.wikipedia.org/wiki/Lewis_Hamilton
2	heidfeld	Nick	[null]	HEI	Heidfeld	Heidfeld	1977-05-10	German	http://en.wikipedia.org/wiki/Nick_Heidfeld
3	rosberg	Nico	6	ROS	Rosberg	Rosberg	1985-06-27	German	http://en.wikipedia.org/wiki/Nico_Rosberg
4	alonso	Fernando	14	ALO	Alonso	Alonso	1981-07-29	Spanish	http://en.wikipedia.org/wiki/Fernando_Alonso
5	kovalainen	Heikki	[null]	KOV	Kovalainen	Kovalainen	1985-10-19	Finnish	http://en.wikipedia.org/wiki/Heikki_Kovalainen
6	nakajima	Kazuki	[null]	NAK	Nakajima	Nakajima	1985-07-11	Japanese	http://en.wikipedia.org/wiki/Kazuki_Nakajima
7	boullier	Sebastien	[null]	BOU	Boullier	Boullier	1979-02-28	French	http://en.wikipedia.org/wiki/Sebastien_Boullier
8	rakkinen	Kimi	7	RAK	Räikkönen	Räikkönen	1979-10-17	French	http://en.wikipedia.org/wiki/Kimi_Räikkönen
9	kubica	Robert	88	KUB	Kubica	Kubica	1984-12-07	Polish	http://en.wikipedia.org/wiki/Robert_Kubica
10	glock	Timo	[null]	GLO	Glock	Glock	1982-05-18	German	http://en.wikipedia.org/wiki/Timo_Glock
11	sato	Takuma	[null]	SAT	Sato	Sato	1977-07-28	Japanese	http://en.wikipedia.org/wiki/Takuma_Sato
12	piquet_jr	Pepe	[null]	PIQ	Piquet Jr.	Piquet Jr.	1985-07-23	Brazilian	http://en.wikipedia.org/wiki/Pepe_Piquet_Jr.
13	massa	Felipe	19	MAS	Massa	Massa	1981-04-25	Brazilian	http://en.wikipedia.org/wiki/Felipe_Massa
14	coulthard	David	[null]	COU	Coulthard	Coulthard	1971-03-27	British	http://en.wikipedia.org/wiki/David_Coulthard
15	trulli	Jarome	[null]	TRU	Trulli	Trulli	1974-07-13	Italian	http://en.wikipedia.org/wiki/Jarome_Trulli
16	sutil	Adrián	99	SUT	Sutil	Sutil	1989-01-11	German	http://en.wikipedia.org/wiki/Adrián_Sutil
17	webber	Mark	[null]	WEB	Webber	Webber	1976-08-27	Australian	http://en.wikipedia.org/wiki/Mark_Webber_(racing_driver)
18	button	Jameson	22	BUT	Button	Button	1980-07-19	British	http://en.wikipedia.org/wiki/Jameson_Button
19	davidson	Anthony	[null]	DAV	Davidson	Davidson	1979-06-19	British	http://en.wikipedia.org/wiki/Anthony_Davidson
20	vetel	Sebastian	5	VET	Vettel	Vettel	1987-07-03	German	http://en.wikipedia.org/wiki/Sebastian_Vettel
21	freschella	Giancarlo	[null]	FIS	Feschella	Feschella	1973-03-14	Italian	http://en.wikipedia.org/wiki/Giancarlo_Feschella
22	barichello	Roberto	[null]	BAR	Barichello	Barichello	1972-09-23	Brazilian	http://en.wikipedia.org/wiki/Roberto_Barichello
23	nath_schumacher	Ralf	[null]	SOH	Schumacher	Schumacher	1975-06-30	German	http://en.wikipedia.org/wiki/Ralf_Schumacher
24	luzzi	Vitantonio	[null]	LUZ	Luzzi	Luzzi	1989-08-09	Italian	http://en.wikipedia.org/wiki/Vitantonio_Luzzi
25	wurz	Alexander	[null]	WUR	Wurz	Wurz	1974-06-15	Austrian	http://en.wikipedia.org/wiki/Alexander_Wurz
26	zemek	Janek	[null]	ZEM	Zemek	Zemek	1983-01-14	Czech	http://en.wikipedia.org/wiki/Janek_Zemek

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	http://en.wikipedia.org/wiki/Lewis_Hamilton
2	heidfeld	[null]	HEI	Nick	Heidfeld	1977-05-10	German	http://en.wikipedia.org/wiki/Nick_Heidfeld
3	rosberg	6	ROS	Nico	Rosberg	1985-06-27	German	http://en.wikipedia.org/wiki/Nico_Rosberg
4	alonso	14	ALO	Fernando	Alonso	1981-07-29	Spanish	http://en.wikipedia.org/wiki/Fernando_Alonso
5	kovalainen	[null]	KOV	Heikki	Kovalainen	1981-09-19	Finnish	http://en.wikipedia.org/wiki/Heikki_Kovalainen
6	nakajima	[null]	NAK	Kazuki	Nakajima	1985-02-11	Japanese	http://en.wikipedia.org/wiki/Kazuki_Nakajima
7	bottas	[null]	BOU	Sebastian	Bottas	1992-05-28	French	http://en.wikipedia.org/wiki/Sebastian_Bottas
8	rakkinen	7	RAI	Kimi	Räikkönen	1979-10-17	French	http://en.wikipedia.org/wiki/Kimi_Räikkönen
9	kubica	88	KUB	Robert	Kubica	1984-06-06	Polish	http://en.wikipedia.org/wiki/Robert_Kubica
10	glock	[null]	GLO	Timo	Glock	1982-05-18	German	http://en.wikipedia.org/wiki/Timo_Glock
11	sato	[null]	SAT	Takuma	Sato	1977-03-20	Japanese	http://en.wikipedia.org/wiki/Takuma_Sato
12	piquet_jr	[null]	PIQ	Nelson	Piquet Jr.	1971-03-23	Brazilian	http://en.wikipedia.org/wiki/Nelson_Piquet_Jr.
13	massa	19	MAS	Felipe	Massa	1980-04-25	Brazilian	http://en.wikipedia.org/wiki/Felipe_Massa
14	coulthard	[null]	COU	David	Coulthard	1971-04-27	British	http://en.wikipedia.org/wiki/David_Coulthard
15	trulli	[null]	TRU	Jarome	Trulli	1981-01-12	Italian	http://en.wikipedia.org/wiki/Jarome_Trulli
16	sutil	99	SUT	Adrián	Sutil	1983-07-06	Spanish	http://en.wikipedia.org/wiki/Adrián_Sutil
17	webber	[null]	WEB	Mark	Webber	1978-09-27	Australian	http://en.wikipedia.org/wiki/Mark_Webber_(racing_driver)
18	button	22	BUT	Jonas	Button	1980-07-19	British	http://en.wikipedia.org/wiki/Jonas_Button
19	davidson	[null]	DAV	Anthony	Davidson	1979-06-19	British	http://en.wikipedia.org/wiki/Anthony_Davidson
20	vetel	5	VET	Sebastian	Vettel	1987-07-03	German	http://en.wikipedia.org/wiki/Sebastian_Vettel
21	freschella	[null]	FIS	Giampiero	Freschella	1979-01-14	Italian	http://en.wikipedia.org/wiki/Giampiero_Freschella
22	barichello	[null]	BAR	Roberto	Barichello	1972-09-23	Brazilian	http://en.wikipedia.org/wiki/Roberto_Barichello
23	schumacher	[null]	SOH	Ralf	Schumacher	1975-06-30	German	http://en.wikipedia.org/wiki/Ralf_Schumacher
24	luzzi	[null]	LUZ	Vitantonio	Luzi	1980-08-05	Italian	http://en.wikipedia.org/wiki/Vitantonio_Luzi
25	wurz	[null]	WUR	Alexander	Wurz	1974-06-15	Austrian	http://en.wikipedia.org/wiki/Alexander_Wurz
26	rossi	[null]	ROS	Gianni	Rossi	1983-01-14	Emirati	http://en.wikipedia.org/wiki/Gianni_Rossi

Total rows: 861 | Query complete 00:00:00.828 | LF | Ln 1, Col 1

Databases

Screenshot of a database management system interface showing the "drivers" table.

File Edit Tables Databases Relationships Optimize Tables Importers Reports

drivers

Columns

Related entities Constraints Comments

Column	Type	Size	Nulls	Auto	Default	Comments
driverid	serial	20	✓		current_drivers_driverid_seq.nextval	driverid
driverref	varchar	255			~character varying	
number	int	10	✓		null	
code	varchar	3	✓		null	
forename	varchar	255			~character varying	
surname	varchar	255			~character varying	
dob	date	20	✓		null	
nationality	varchar	255	✓		null	
url	varchar	255			~character varying	

Showing 1 out of 2 entries

Data Output

Messages

Notifications

driverid **driverref** **number** **code** **forename** **surname** **dob** **nationality** **url**

1	hamilton							
2	leclerc							
3	rosberg							
4	alonso							
5	kovalainen							
6	nakajima							
7	button							
8	rakkinen							
9	kubica							
10	glock							
11	sato							
12	pepper Jr							
13	massa							
14	coulthard							
15	trulli							
16	sutil							
17	webber							
18	button							
19	davidson							
20	vetter							
21	frechella							
22	barriello							
23	nat_schumacher							
24	izquierdo							
25	wurz							
26	ernst							

Total rows: 861 Query complete 00:00:00.829

Indexes

Constraint Name

Table **Type** **Sort** **Deferrable**

pk_driverid primary **None** **Asc** **driverid**

ix_driverid_wt unique **Must be unique** **Asc** **wt**

Showing 1 out of 2 entries

Relationships

Close relationships within degree of separation

One Uniquely Two Uniquely

driverdetails -> driver

- 1. **driverdetails**
 - 1. **driver**
- 2. **driverdetails**
 - 2. **driver**

qualifying -> driver

- 1. **qualifying**
 - 1. **driver**
- 2. **qualifying**
 - 2. **driver**

driver -> results

- 1. **driver**
 - 1. **results**
- 2. **driver**
 - 2. **results**

results -> driver

- 1. **results**
 - 1. **driver**
- 2. **results**
 - 2. **driver**

spinnings -> driver

- 1. **spinnings**
 - 1. **driver**
- 2. **spinnings**
 - 2. **driver**

Showing 1 out of 2 entries

Page No: 1 of 1 << >> <<< >>>

LF Ln 1, Col 1

Generated by SlickEdit

Generated by Altinity A.I.

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.

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

¹ Australian Research Data Commons

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Plan

What is Metadata?

Metadata Examples

Database Administration Tools

Understanding PostgreSQL System Catalogs

DBA Tools

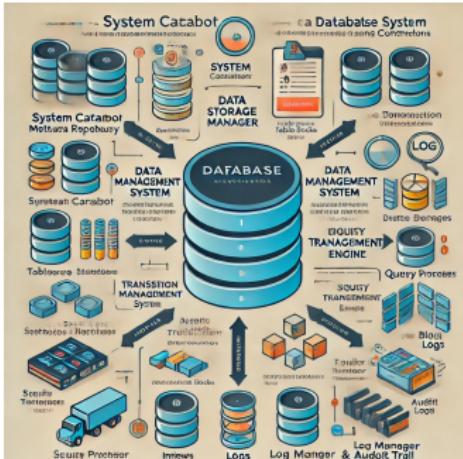
The Data Dictionary (aka Metadata repository)

- ▶ 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).
 - ▶ Indexes (primary keys, foreign keys).
 - ▶ Views (virtual tables).
 - ▶ Users & Permissions (who can access what).
 - ▶ Storage Structures (tablespaces, partitions).
 - ▶ Relationships & Dependencies (links between tables).
 - ▶ Audit & Logs (history of schema changes).

Data Dictionary Types

- ▶ **Integrated:** Included with the DBMS. i.e., relational DBMSs include a built-in DD or system catalog that is frequently accessed and updated by the RDBMS.
- ▶ **Standalone:** Other DBMSs, especially older types, do not have a built-in data dictionary; instead, the DBA may use third-party standalone systems.

Data Dictionary Types

- ▶ **Integrated:** Tend to limit their metadata to the data managed by the DBMS.
- ▶ **Standalone:** 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.
- ▶ **Passive:** Not updated automatically and usually DBA requires running a batch process.

Data Dictionary Function

- ▶ The DD's 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 Content²

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.

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

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Plan

What is Metadata?

Metadata Examples

Database Administration Tools

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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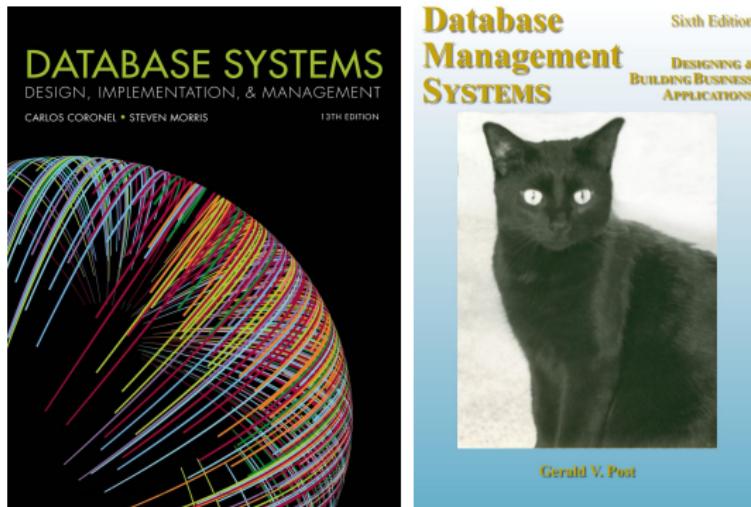
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Database Administration: DBA Tools.



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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