Introduction to Modern Application Development Dr. Gaurav Raina Department of Computer Science and Engineering Indian Institute of Technology, Madras

Module - P9 Lecture - 17 Introduction to SQL

Hi all. Welcome to Module - P9. In this module, we will be getting an introduction to what SQL is, and doing some quick exercises with SQL.

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Contents	
Objective:	
 Understand what SQL is DML queries: Create, Read, Update, Delete data DDL queries: Create tables, delete tables, add columns Fetching data from multiple tables in one query Making aggregation queries 	
Introduction to Modern Application Development	Dr Gaurav Raina (IIT Madras), Tanmai Gopal (Hasura)
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Main objective is to understand what SQL is and what kind of queries we can do with it, and we will make several different kinds of queries.

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 We understood why we need a database We understood basic data modelling concepts We got some basic familiarity with using a DBMS and manage console 	ging a database via a popular DBMS
Introduction to Modern Academics Development	Dr Gunne Reins (HT Midyns) Tawwei Genel (Humen)
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To recap what we have understood so far. We know why we need a database. We have also understood some basic data modeling concepts. We have gotten some basic familiarity with using a DBMS, and also managing a database.

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This is what the architecture look like. We had a browser; using the browser, we went to

a webapp, which was db.imad.hasura.app.io, which is serving an application called Adminer. Now this application was a PHP webapp, which was talking to the Postgres DBMS; taking results from the Postgres DBMS, and sending it back to us.



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If we look at how Adminer which is the webapp is communicating with Postgres, Adminer is a webapp which is actually a client and the DBMS is the server. So, the Adminer client makes a request to the DBMS server and the DBMS server returns the response the Adminer client. This communication happens over a different network protocol, which is not http.

For Postgres, in fact, it is call the Postgres protocol. It is the protocol on top of the TCP protocol, like how http is a protocol on top of the TCP protocol. Adminer sends an SQL query to the Postgres DBMS; and the Postgres DBMS responds to the results. So, the language in which the webapp is making queries to the DBMS is SQL. This is similar to how when we make http request. We make http request that have a particular format, for example, we make a get request to the URL, our request contains the URL, it contains the path, it contains headers, and it contains a body. Similarly, the request that is sent from the Adminer to the DBMS contains SQL.

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SQL	
1. A special purpose programming language	
2. Mostly a declarative language	
a. Specify what data you want, not the process of how to e	xtract data
3. Can be used to manipulate data content in a schema	
 DML: Data Manipulation Language 	CREATE TABLE "LINK" (
Can be used to manipulate the schema itself	"id" serial NOT NULL, "name" text NOT NULL
 DOL: Data Definition Language 	31
	UPDATE "user" SET
DEGET 3x10 "user" ('username', 'name', 'enal3') SELECT * FROM 1	user" LINET Se: "name" = "tannad",
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Now, what is SQL? Now SQL is a special purpose language; it is a declarative language; it is not a procedural language. So, with SQL, we can specify what we want to do, as a result and we can declare our action, but we do not need to describe how the action needs to be done. We will understand what this means in a little bit, and you will get sense of this.

The two quick definitions that are important; SQL is both DML and DDL. DDM is a data manipulation language; so it is the language to manipulate data meaning to select, insert, update, or delete data. A DDL is a data definition language, which means a language to define the schema or the structure in which the data is stored, and to change that structure in which data is stored. So, SQL allows us to do both; it allow us to for example, in this box, insert a value into a table or select the value from a table, but it also allows us to create a table.

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1.	Login to our database via a web UI (adminer)	
2.	Make DML queries	
	 Select data from tables 	
	b. Insert data into tables	
	 Update a set of rows in tables 	
	 Delete a set of rows in tables Relati data from an dicia tables 	
	Select data iron multiple tables Accessorie data	
2	Make DDL queries	
·*	a Craste a table	
	 b. Dros a table 	

So, let us quickly try this out.

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	Server localhost:5432	
	Usemame coco98	
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	Database cocco98	
	Go to your database console.	
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	password ssh-coco98-75666	
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I head to my IMAD console; go to the database console.

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Let us look at the article table. So, we have 4 articles in the article table.

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I am going to open this in a separate tab. So, the SQL command window I will open in a separate tab. And now instead of using the UI to select this data let us try it use the SQL to select the data. So, I will say select star from article and let see what it does.

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This selects the 4 articles that we have. So, let read this SQL query we are saying select

which is an SQL keywords. So, we are seeing select star which represents all columns. So, select all the columns from which again it is an SQL keyword from the table article.

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I can make this query a little better, and I can change select id coma title from the articles. So, we will just select two columns from the article.

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And try to I can select also only the title. So, each of this is a SQL query that we made and it returns the results. Though as you can see the results that I returned by an SQL query resembles a table and is exactly the same at a logical level is exactly the same as a table. So, the output is also in a tabular format.

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Let us try to now make an insert request. So, this is what an insert request looks like. I will say insert into and then I will give you the table names, so table name article. I then have to give the columns that I am inserting I have to name the columns that I am trying to insert into. Let us check out what the columns are. So, the columns are id, title, content, author id and category – so id, title, content, author id, and category.

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And I am inserting into this article table the values, and now I am going to list out all the values of this particular row. So, I am going to create a new id, let say 99, the title of my article is article 99. The content is also article 99. The author id is 1 which is in integer, and the category is say a personal. And once I execute this query you can see that I am inserting into the article table.

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And let us refresh this to see, if they are insert has gone through we can see that a new row has been created.

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Now, the interesting thing is that we actually do not need to insert an id value. So, because the id is set to auto increment, so I can remove the id column and I can remove the id value from here.

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Let us I inserting again and you can see that another article has been created, but it has been given the id 9, because that is what a last auto incrementing number was at.

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Let us now look at a different request let say let us look at and update a request. Let us do update article, set category equal to work, where title equal to article 99. In this query,

I am trying to update the article table; in the article table, I am trying to set the value of category to work and I want this to happen for all the rows in the article table only where a particular condition is met, which is where the title should be equal to 99. Otherwise, the article should not be updated.

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Let us try to execute this query see that it says query executed two rows affected because I had two rows of the same title.

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Now, if I look at the old data it says the category is personal,

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If I refresh this, you can see that the article is changed to work.

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I can now also issue a delete request. Let us do delete from article where title equal to article 99.

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select user	edit 6 article-three	this is my third article	1	personal	
	Save Edit Clone	Delete		rt	

So, again is has two rows affecting first look at this and you can see that both those rows are gone now. In fact, every single action that you can do on this UI on top of the

database is actually done an SQL command. So, an easy way to see that it is actually by looking at this particular part of the Adminer console which shows us the SQL query.

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For example, if I added this and changed the category to work, you can see that the item has been updated.

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You can click on the SQL command; you will see the SQL command that the web app is issuing to the d b to the DBMS right. So, you can learn SQL basics just by making requests here.

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For example, if you want to select by a particular values, so let say I want to select where id less than 10, and id greater than 4, right, let say we make this query.

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You get two values and you can see the SQL statement that is going to make this query, so that is the SQL statement. Let us now look at a slightly different kind of query let us look at a query where we can fetch information from multiple tables in this same request and that is a very common use case.

For example, if you look at the article table, if I fetch data from the article table I will only get id, title, content, author id and category, but suppose I also want the authors name how will I make that query. I do not want to make making two quarries is a bad idea; I do not want to make query to the article table and then make a query to the author table and fetch that information. Because if the data set is large, for example, if you imagine a few 1000 articles I would have to make one query to fetch the 1000 articles and then, I would have to make potentially up to a 1000 more queries to fetch the author information for each author. But I want to fetch all of that information in one short, and so let see where that query looks like.

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Here I can say select a star from article comma user, where article dot author id is equal to user dot id. Note that is important to used the double quotes around the user table name because user is a special keyword in Postgres, and so it is important to add the double quotes here. So, if you say select star from. So, I am saying select all the columns from both these tables where article dot author id is equal to user dot id.

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And so if you execute this, you will get all the author information here as well right. So, getting author id 1, you are getting user name, name, and email. And so, now you can choose what columns you want. For example, you want article dot id article dot title and then I want the user dot user name user dot name.

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And if these are the columns that you want you can make a query, and you can just get those 4 columns. This is how you can fetch from multiple tables in the same short. Now, this is a very simple example and what we will actually doing here is something called a joint. So, this is a shortcut for doing something called a join. Joints allow you to fetch from multiple tables across several conditions.

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Let us now look at another important kind of query. Let us go back to our article table let us clear these conditions, now the cross arrow. So, we have 4 articles. Now in these 4 articles, I want to make a query to fetch the number of the articles written by each author. So, I want to, so in this case the result that I want to be author id 1 has it one article has written three articles and author id two has written one article. So, the information that I want to fetch is how many article are written by each author.

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Let us look at what that SQL query looks like. So, I can say select author id and count of star from the article table and group by author id.

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So, you can see that we have got the results. Let us read this SQL quickly, we are saying select the column author id and count of star and we will understand this is in bit. From

the table article, but instead of just fetching all the data from the table article taking the data from the table article and group it by a particular columns value. So, group it by the values of author id.

And if you look it author id, they are only two values. So, it groups it for the value one and groups it for the value two; once you group a particular table, the only column that you can select is by performing what is called an aggregation on it. So, here we performed a count aggregation to get the number of articles that are written by this particular author. So, these queries are called aggregations or group by queries. And group by queries can be used to perform a lot of complex analytics on the data that is stored in your database.

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Let us now look at something very different. Let us now actually create a table by using SQL. And what will do in this case is that we will actually just here Adminers, so we will go to create a table and we will say create a table called SQL test. Give it a column called id, now, which is in integer, and a column called name which is a text right and save this.

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If you look at the create command, you will see what the SQL is and so let us copy paste this SQL. I am put into a command window right and let us change this to some other name SQL test 2.

And if we done this query, so let us redo these queries, these queries say - create a table and the table name with the following column. So, create table SQL test 2 with a column id and name; the id column is an integer column and null values are not allowed inside this column. The name column is a text column and no null values are allowed inside this column.

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If you click on execute, you will see that another table has been created. Similarly we can drop these tables or rather we can delete these tables and the way to delete these tables is called a drop.

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Let us do a drop table SQL underscore test. You can see that the table has disappeared.

Let us draw the SQL test 2 and it struck. So, this SQL statement deletes tables this is called dropping the table. So, in SQL you would typically refer to dropping deleting a table as a drop, you delete a data base you can also delete an entire data base by doing a drop data base, but when you in, but when you a delete a row the SQL command is called a delete not a drop.

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1. 2.	Login to our database via a web UI (adminer) Make DML queries a. Select data from tables b. Insert data into tables c. Update a set of rows in tables d. Delete a set of rows in tables	
3.	e. Select data from multiple tables f. Aggregate data Make DDL queries a. Create a table b. Drop a table	
htroducti	on to Modern Application Development ● Matt ♥ Pressure as ● 11 @ An	Dr Gaurae Raina (IIT Madrae), Tanmai Gopal (Masara)

This is just a super fast introduction to what SQL is and what the power of SQL is. I did not go into any syntax to explain to you on what the SQL language is and what the syntax of language is, but the idea was just to go there few fundamentals of what the power of SQL is. (Refer Slide Time: 15:09)



I would encourage those of you interested in the back end development side of things, in interested in databases to definitely learn SQL. SQL is almost one of the prerequisites for doing complex analytics and for analyzing databases and managing databases.

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Key takeaways				
 Every single action we did so far via the UI, is actually execute SQL is amazingly powerful! SQL is a standard way of talking to relational databases Many other databases also support SQL even though they are 	ed via an SQL command e not relational databases			
Introduction to Modern Application Development	Dr Guarav Raina (IIT Madras), Tanmai Gopal (Hasura)			

The important things you will remember after this from this module are number one

what the SQL syntax looks like, and that the SQL language is extremely powerful and every single thing that we do via the UI on Adminer is actually happening via an UI SQL command. The index is that you make, indexes that you delete, the primary keys that you make, when you change a type of a column, when you insert data or search for data in a particular way all of those are SQL commands.

SQL is standard way of talking to relational databases and in fact, Postgres my SQL, oracle, my MySQL server, psi base all of them are respect to the SQL standard. And each of these databases differ a little bit in the particular version of SQL or the particular syntax of SQL they use, but the core language is the same across all these databases. A lot of other data bases which are not relational databases also support SQL.

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Up next are several quick theory modules on thinking about performance in databases especially touching on indexes, security, backup, recovery, and introduction to transactions in ACID, which are very important for financial applications or e commerce applications, and introduction to views, analytics. We will also look at the difference between NoSQL and SQL systems. And then finally, look at how we can scale a database or how databases are scaled vertically and horizontally.