

SQL Programming

SQL Processing Model

By this stage of the course, you've got some experience designing and writing SQL programs.

Along the way you've been grappling with the syntax of the language while developing your design intuitions and refining your coding skills.

What we're going to review in this lesson is an informal inquiry into how SQL programs are interpreted and executed by the computer.

This is our first look at the SQL Processing Model but it won't be our last.

In my opinion, this is one of the most important modules in the course, and when you master this lesson you will have laid the foundation for all future SQL learning. Understanding this model will help you understand some of the more complex features of SQL.

This Processing Model is simply that, a MODEL for you to use in better understanding how SQL works.

And although no single SQL implementation works in exactly this fashion, as a programmer, you can rely on them all to *behave* in this fashion.

How does SQL process the SQL statements that we write?

Perhaps it's Top to Bottom?

Without spending any time to reflect on this question, you might say that SQL processes the first clause, works its way to the next clause, and so on, until it has finished processing the entire program.

- 1st – SELECT
- 2nd – FROM
- 3rd - WHERE

Assuming we have a table named: MOVIE
that includes the following columns:

MID

TITLE

YR

GENRE

FORMAT

COST

MOVIE (base table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50

(as depicted here)

Can the query:

```
SELECT title, yr
```

```
FROM movies
```

be processed in a top-to-bottom fashion?

Can SQL *do* the SELECT clause,
and then *do* the FROM clause?

```
SELECT title, yr  
FROM movies
```

MOVIE (base table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50



TITLE	YR
STAR WARS	1971
ALIEN	1986
RAISING ARIZONA	1992

```
SELECT title, yr
FROM movies
```

MOVIE (base table)

MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50



TITLE	YR
STAR WARS	1971
ALIEN	1986
RAISING ARIZONA	1992

No, it cant.

SQL has no context for the columns that are listed in the SELECT clause without knowing which table(s) to use for those columns.

There might be a title column in a book table, a personnel table, or even a diplomat table.

Any reference to a column must be preceded by knowledge about the table that that column resides in.

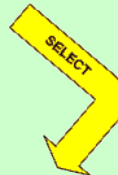
1st intuition: The FROM clause is processed first.

```
SELECT title, yr
FROM movies
```

MOVIE (base table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50



MOVIE (working table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50



(result table)	
TITLE	YR
STAR WARS	1971
ALIEN	1986
RAISING ARIZONA	1992

And in this regard you can think of the FROM clause as building a working copy of the base table.

This working copy will be the foundation for all subsequent working tables, up through the creation of the final result table.

Let's consider a more complex SQL program now. One with a WHERE clause.

The question we're faced with now is this: at what stage in the processing does the WHERE clause factor in?

Consider the query:

```
SELECT title, yr
FROM   movies
WHERE  yr > 1980
```

MOVIE (base table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50

Can the WHERE clause precede the FROM clause?

No. For the same reason that we saw with the SELECT clause. The named columns must be in reference to a table.

```
SELECT title, yr
FROM movies
WHERE yr > 1980
```

If we stand by our first intuition, namely that the FROM clause is processed first, then yes it does appear that the remainder of the clauses in the SQL program are processed in top to bottom order.

MOVIE (base table)

MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50



FROM

MOVIE (working table)

MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50



SELECT /
WHERE

(result table)

TITLE	YR
ALIEN	1986
RAISING ARIZONA	1992

```
SELECT title, yr
FROM movies
WHERE format = 'DVD'
```

But now consider this query:

```
SELECT title, yr
FROM movie
WHERE format = 'DVD'
```

Can the sequence of processing be:

```
FROM
SELECT
WHERE
```

MOVIE (base table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50

(result table)	
TITLE	YR
STAR WARS	1971
RAISING ARIZONA	1992

```
SELECT title, yr  
FROM movies  
WHERE format = 'DVD'
```

MOVIE (base table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50

(result table)	
TITLE	YR
STAR WARS	1971
RAISING ARIZONA	1992

No, it can't.

In this example, if the SELECT clause builds another intermediate working table, then when it's done, that table will have only the two columns: TITLE and YR. By the time SQL gets around to processing the WHERE clause, the column that it needs (ie format) won't be available.

So, in the more general case, it appears that the WHERE clause must precede the SELECT clause.

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```
SELECT title, yr
FROM movies
WHERE format = 'DVD'
```

MOVIE (base table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50

FROM

MOVIE (working table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50

WHERE

MOVIE (working table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50

SELECT

(result table)	
TITLE	YR
STAR WARS	1971
RAISING ARIZONA	1992

2d intuition: WHERE clause processing follows the FROM clause.

The FROM clause builds a working copy of the base table(s) that are referenced in the FROM clause.

The WHERE clause then creates another intermediate working table, but this table only includes the rows that pass the WHERE condition.

Then the SELECT clause builds the result table by including only the columns that are named in the SELECT clause.

The only other clause that we've studied is the ORDER BY clause, so let's fit that into the model.

Consider the query:

```
SELECT    title, yr
FROM      movie
WHERE     format = 'DVD'
ORDER BY  title
```

Can the ORDER BY clause precede the FROM clause?

MOVIE (base table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50

Can it follow the SELECT clause?

In this example it can.

So let's consider another form of the ORDER BY clause, and test our intuitions against that.

```
SELECT title, yr
FROM movies
WHERE format = 'DVD'
ORDER BY title
```

MOVIE (base table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50

FROM MOVIE (working table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50

WHERE MOVIE (working table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50

SELECT / ORDER BY (result table)	
TITLE	YR
RAISING ARIZONA	1992
STAR WARS	1971

Module 08: SQL Processing Model

```
SELECT yr
FROM movies
WHERE format = 'DVD'
ORDER BY title
```

MOVIE (base table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50

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Consider the query:

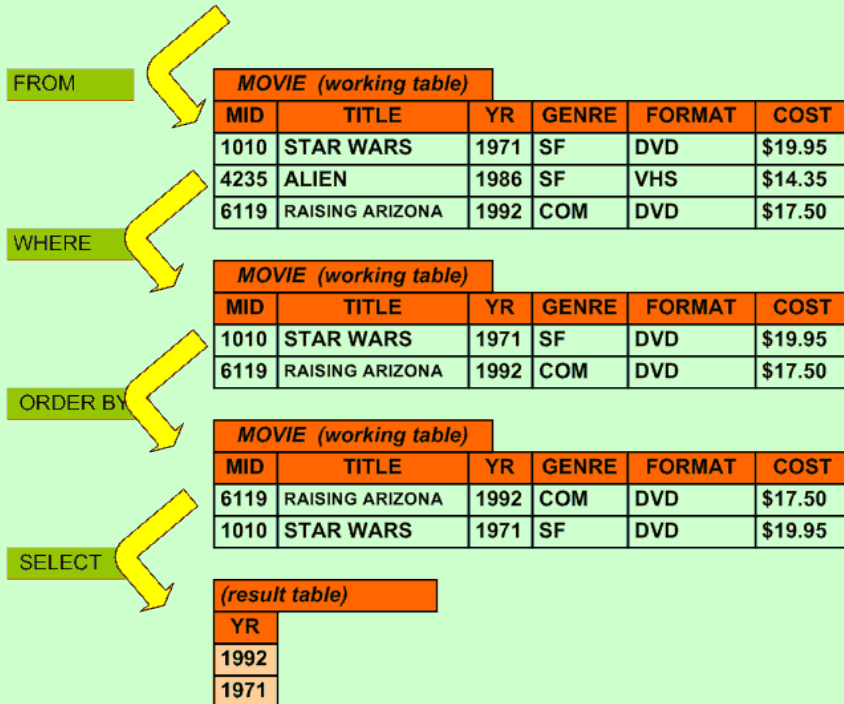
```
SELECT    yr
FROM      movie
WHERE     format = 'DVD'
ORDER BY  title
```

Can the ORDER BY clause still follow the SELECT clause?

(result table)	
YR	
1992	
1971	


```
SELECT yr
FROM movies
WHERE format = 'DVD'
ORDER BY title
```

MOVIE (base table)					
MID	TITLE	YR	GENRE	FORMAT	COST
1010	STAR WARS	1971	SF	DVD	\$19.95
4235	ALIEN	1986	SF	VHS	\$14.35
6119	RAISING ARIZONA	1992	COM	DVD	\$17.50



No it cannot, and once again, the data suggests that the SELECT clause is the last clause to be processed.

Recap:

Think of the SQL processing model as one in which SQL generates a number of intermediate working tables (or intermediary tables) on it's way to preparing the final result table.

In the sequencing of 'steps' the FROM clause is processed first. And we can think of the from clause as the part of the SQL statement that generates the first working table.

The WHERE clause is the next statement that is processed.

The WHERE clause tells SQL which rows in the table it should keep, and pass along to the next step.

In this regard, the WHERE clause is 'inclusionary', not 'exclusionary'.

Then, generally, everything else happens, with the SELECT clause being processed last.

Sort of ☺

Base table

Result table

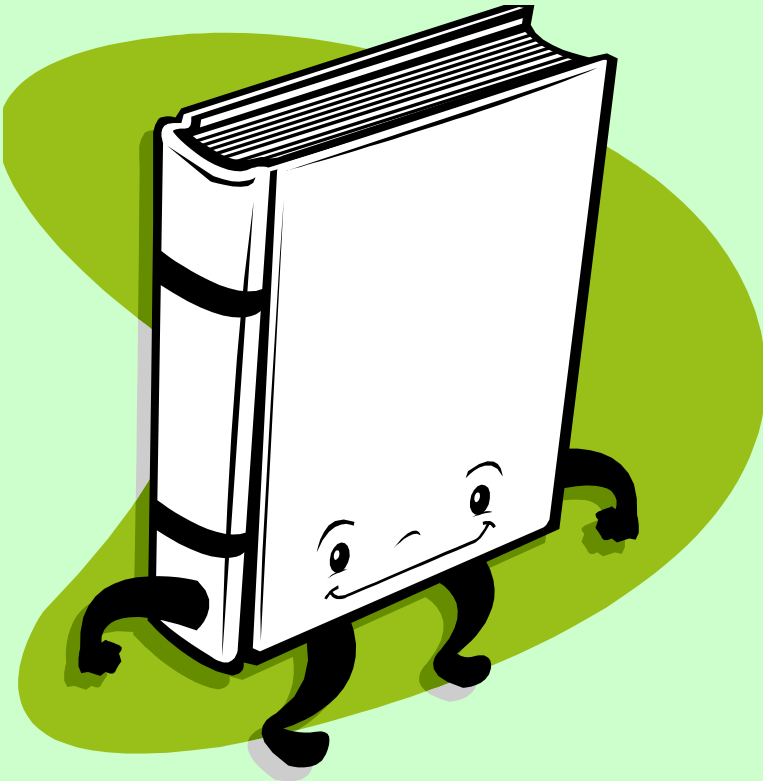
Working table, intermediate table

1st intuition

2nd intuition

3rd intuition

WHERE clause: inclusionary



Please drop me an email if you noticed any errors in this module. I'd also appreciate reading your comments, criticisms, and or suggestions as to how this module could be improved.

Thanks,

bil



That's All