>>> A crash course in SQL
>>> New Zealand Social Statistics Network

Daniel Fryer [†]

Nov, 2020

[†]daniel@vfryer.com

>>> Where are we now?

Day 2

1. Revision of day 1
2. Reading the docs
3. Aggregating
4. Big reveal and exercises

   Lunch!

5. Creating and editing tables
6. The Integrated Data Infrastructure
7. Putting it all together
8. Connecting and exporting

   Send me questions and give feedback

Page is hyperlinked: click a topic above to jump to it.

The Fourth Kahoot

>>> Revision of day 1 JOIN

Do Exercises Section 5.2.4

Click here to find the textbook.

>>> Where are we now?

Day 2

1. Revision of day 1
2. Reading the docs
3. Aggregating
4. Big reveal and exercises

   Lunch!

5. Creating and editing tables
6. The Integrated Data Infrastructure
7. Putting it all together
8. Connecting and exporting

   Send me questions and give feedback

Page is hyperlinked: click a topic above to jump to it.

>>> Reading the docs

* Quickly look something up when you forget syntax
* Learn new things while you browse and decipher
* Gain a deeper understanding
* It actually gets easy pretty quickly

>>> Reading the docs

* Quickly look something up when you forget syntax
* Learn new things while you browse and decipher
* Gain a deeper understanding
* It actually gets easy pretty quickly

Be brave, computers can sense fear

>>> Read the docs: FROM

The FROM clause is used to specify the table(s)
used in the SELECT statement (and others).

```
FROM {<table_source>} [,...n]
```

where

```
{<table_source>} ::= table_or_view_name [[AS] table_alias]
```

>>> Reading the docs: FROM

The Transact-SQL Syntax Conventions

```
FROM {<table_source>} [,...n]
```

>>> Reading the docs: FROM

The Transact-SQL Syntax Conventions

```
FROM {<table_source>} [,...n]
```

* { } curly braces group required items

>>> Reading the docs: FROM

The Transact-SQL Syntax Conventions

```
FROM {<table_source>} [,...n]
```

* { } curly braces group required items
* <label> placeholder for a block of syntax

>>> Reading the docs: FROM

The Transact-SQL Syntax Conventions

```
FROM {<table_source>} [,...n]
```

* { } curly braces group required items
* <label> placeholder for a block of syntax
* [,...n] means you can repeat with commas between

>>> Reading the docs: FROM

The Transact-SQL Syntax Conventions

```
FROM {<table_source>} [,...n]
```

* { } curly braces group required items
* <label> placeholder for a block of syntax
* [,...n] means you can repeat with commas between

```
FROM MyTable
```

>>> Reading the docs: FROM

The Transact-SQL Syntax Conventions

```
FROM {<table_source>} [,...n]
```

* { } curly braces group required items
* <label> placeholder for a block of syntax
* [,...n] means you can repeat with commas between

```
FROM MyTable, MyOtherTable
```

>>> Reading the docs: FROM

The Transact-SQL Syntax Conventions

```
FROM {<table_source>} [,...n]
```

where

```
<table_source> ::= table_or_view_name [[AS] table_alias]
```

* { } curly braces group required items
* <label> placeholder for a block of syntax
* [,...n] means you can repeat with commas between
* <label> ::= defining the placeholder

>>> Reading the docs: FROM

The Transact-SQL Syntax Conventions

```
FROM {<table_source>} [,...n]

 where

  <table_source> ::= table_or_view_name [[AS] table_alias]
```

* { } curly braces group required items
* <label> placeholder for a block of syntax
* [,...n] means you can repeat with commas between
* <label> ::= defining the placeholder

>>> Reading the docs: FROM

The Transact-SQL Syntax Conventions

```
FROM {<table_source>} [,...n]
```

where

```
<table_source> ::= table_or_view_name [[AS] table_alias]
```

* { } curly braces group required items
* <label> placeholder for a block of syntax
* [,...n] means you can repeat with commas between
* <label> ::= defining the placeholder
* [ ] square brackets indicate optional items

>>> Reading the docs: FROM

The Transact-SQL Syntax Conventions

```
FROM {<table_source>} [,...n]
```

where

```
<table_source> ::= table_or_view_name [[AS] table_alias]
```

* { } curly braces group required items
* <label> placeholder for a block of syntax
* [,...n] means you can repeat with commas between
* <label> ::= defining the placeholder
* [ ] square brackets indicate optional items

```
FROM MyTable M
```

>>> Reading the docs: FROM

The Transact-SQL Syntax Conventions

```
FROM {<table_source>} [,...n]
```

where

```
<table_source> ::= table_or_view_name [[AS] table_alias]
```

* { } curly braces group required items
* <label> placeholder for a block of syntax
* [,...n] means you can repeat with commas between
* <label> ::= defining the placeholder
* [ ] square brackets indicate optional items

```
FROM MyTable AS M
```

>>> Feeling confident?

Have a look at the T-SQL FROM documentation

>>> Feeling confident?

Have a look at the T-SQL FROM documentation

* It really is more of the same
* It gets easier very quickly with practice
* Google, StackExchange, etc
* Beginner tutorial
* Syntax guides and cheat sheets

>>> One more important syntax convention

* { } curly braces group required items
* <label> placeholder for a block of syntax
* [,...n] means you can repeat with commas between
* <label> ::= defining the placeholder
* [ ] square brackets indicate optional items
* | vertical bar indicates alternatives (OR)

>>> Group practice

```
<greeting> ::= {{Hello|Hi} [,...n] .}
               [Do you {love|hate} reading the docs?]
```

* { } curly braces group required items
* <label> placeholder for a block of syntax
* [,...n] means you can repeat with commas between
* <label> ::= defining the placeholder
* [ ] square brackets indicate optional items
* | vertical bar indicates alternatives (OR)

>>> Solution

* Hello.
* Hi.
* Hello. Do you love reading the docs?
* Hi. Do you love reading the docs?
* Hello, Hello, Hi, Hello, Hi, Hi.
* Hello, Hi, Hello, Hello. Do you love reading the docs?
* etc.

>>> Example from the docs (logical operator IN)

```
test_expression [ NOT ] IN ( subquery | expression [ ,...n ] )
```

Don't miss the round brackets!

>>> Example from the docs (logical operator IN)

```
test_expression [ NOT ] IN ( subquery | expression [ ,...n ] )
```

* test_expression IN (expression)

Don't miss the round brackets!
Example: 'red' IN ('red')

>>> Example from the docs (logical operator IN)

```
test_expression [ NOT ] IN ( subquery | expression [ ,...n ] )
```

* test_expression IN (expression)
* test_expression IN (subquery)

Don't miss the round brackets!
Example: FriendID IN (SELECT FriendID FROM Notes.Pets)

>>> Example from the docs (logical operator IN)

```
test_expression [ NOT ] IN ( subquery | expression [ ,...n ] )
```

* test_expression IN (expression)
* test_expression IN (subquery)
* test_expression NOT IN (expression)

Don't miss the round brackets!
Example: 'red' NOT IN ('red')

>>> Example from the docs (logical operator IN)

```
test_expression [ NOT ] IN ( subquery | expression [ ,...n ] )
```

* test_expression IN (expression)
* test_expression IN (subquery)
* test_expression NOT IN (expression)
* test_expression NOT IN (subquery)

Don't miss the round brackets!

Example: FriendID NOT IN (SELECT FriendID FROM Notes.Pets)

```
>>> Example from the docs (logical operator IN)


test_expression [ NOT ] IN ( subquery | expression [ ,...n ] )
```

* test_expression IN (expression)
* test_expression IN (subquery)
* test_expression NOT IN (expression)
* test_expression NOT IN (subquery)
* test_expression NOT IN (expression, expression, expression)

Don't miss the round brackets!
Example: 'red' IN ('red', 'blue', 'green')

>>> Exercises

Do Exercises Section 5.2.5

Click here to find the textbook.

>>> Where are we now?

Day 2

1. Revision of day 1
2. Reading the docs
3. Aggregating
4. Big reveal and exercises

   Lunch!

5. Creating and editing tables
6. The Integrated Data Infrastructure
7. Putting it all together
8. Connecting and exporting

   Send me questions and give feedback

Page is hyperlinked: click a topic above to jump to it.

>>> Aggregating queries

Aggregating queries collect the rows of a table into groups, and somehow return a single value for each group, or act on each group in some way.

We will cover:

1. GROUP BY clause
2. Aggregation functions
3. HAVING clause

The GROUP BY clause creates the groups. An aggregation function returns a single value or summary statistic for each group. The HAVING clause is used to choose groups (much like the WHERE clause chooses rows).

>>> SQL clause: GROUP BY

The GROUP BY clause groups the rows of a table according to the values of one or more columns. The easiest way to understand it is with a few examples.

We will look at the execution of this query:

```
SELECT P.friendID
FROM Notes.Pets P
GROUP BY P.friendID;
```

FROM Notes.Pets P

Pets			
PetID	PetName	PetDOB	FriendID
1	Chikin	24/09/2016	2
2	Cauchy	01/03/2012	3
3	Gauss	01/03/2012	3

GROUP BY P.FriendID

Pets			
PetID	PetName	PetDOB	FriendID
1	Chikin	24/09/2016	2
2	Cauchy	01/03/2012	3
3	Gauss	01/03/2012	3

GROUP BY P.FriendID

Unnamed			
PetID	PetName	PetDOB	FriendID
{2}	{Chikin}	{24/09/2016}	2
{2, 3}	{Cauchy, Gauss}	{01/03/2012, 01/03/2012}	3

```
SELECT P.FriendID
```

Unnamed			
PetID	PetName	PetDOB	FriendID
{2}	{Chikin}	{24/09/2016}	2
{2, 3}	{Cauchy, Gauss}	{01/03/2012, 01/03/2012}	3

>>> SQL clause: GROUP BY

result

Unnamed
FriendID
2
3

>>> Can we select any of the other columns?

SELECT ???

Unnamed			
PetID	PetName	PetDOB	FriendID
{2}	{Chikin}	{24/09/2016}	2
{2, 3}	{Cauchy, Gauss}	{01/03/2012, 01/03/2012}	3

SQL prevents it since it can't be sure that there is only one value in each entry.

>>> What will happen if we run this?

```
SELECT P.friendID, P.petDOB
FROM Notes.Pets P
GROUP BY P.friendID;
```

>>> Error

```
Msg 8120, Level 16, State 1, Line 1
Column 'Notes.Pets.PetDOB' is invalid in the select list
because it is not contained in either an aggregate function
or the GROUP BY clause.
```

>>> Error

```
Msg 8120, Level 16, State 1, Line 1
Column 'Notes.Pets.PetDOB' is invalid in the select list
because it is not contained in either an aggregate function
or the GROUP BY clause.
```

>>> This will fix the error

```
SELECT P.friendID, P.petDOB
FROM Notes.Pets P
GROUP BY P.friendID, P.petDOB;
```

```
GROUP BY P.FriendID, P.PetDOB
```

Pets			
PetID	PetName	PetDOB	FriendID
1	Chikin	24/09/2016	2
2	Cauchy	01/03/2012	3
3	Gauss	01/03/2012	3

```
GROUP BY P.FriendID, P.PetDOB
```

Unnamed			
PetID	PetName	PetDOB	FriendID
{2}	{Chikin}	24/09/2016	2
{2, 3}	{Cauchy, Gauss}	01/03/2012	3

>>> Group practice

Include the curly braces in your solutions

Letters		
A	B	Num
a	b	1
a	c	2
a	b	3
a	c	4

* GROUP BY B
* GROUP BY A
* GROUP BY A, B

>>> Solutions

* GROUP BY B

Unnamed		
A	B	Num
{a, a}	b	{1, 3}
{a, a}	c	{2, 4}

>>> Solutions

* GROUP BY B

Unnamed		
A	B	Num
{a, a}	b	{1, 3}
{a, a}	c	{2, 4}

* GROUP BY A

Unnamed		
A	B	Num
a	{b, c, b, c}	{1, 2, 3, 4}

>>> Solutions

* GROUP BY B

Unnamed		
A	B	Num
{a, a}	b	{1, 3}
{a, a}	c	{2, 4}

* GROUP BY A

Unnamed		
A	B	Num
a	{b, c, b, c}	{1, 2, 3, 4}

* GROUP BY A, B

Unnamed		
A	B	Num
a	b	{1, 3}
a	c	{2, 4}

>>> Aggregation functions

Aggregation functions are able to return a single value for each group. If you use an aggregation function, you can select a column that you haven't included in GROUP BY.

We will look at the execution of this query:

```
SELECT RP.gender, AVG(RP.age) AS AverageAge
FROM Notes.RandomPeople RP
GROUP BY RP.gender;
```

>>> Aggregation functions

Aggregation functions are able to return a single value for each group. If you use an aggregation function, you can select a column that you haven't included in GROUP BY.

We will look at the execution of this query:

```
SELECT RP.gender, AVG(RP.age) AS AverageAge
FROM Notes.RandomPeople RP
GROUP BY RP.gender;
```

Aggregation function

>>> Aggregation functions

Aggregation functions are able to return a single value for each group. If you use an aggregation function, you can select a column that you haven't included in GROUP BY.

We will look at the execution of this query:

```
SELECT RP.gender, AVG(RP.age) AS AverageAge
FROM Notes.RandomPeople RP
GROUP BY RP.gender;
```

Column name alias

>>> Aggregation function: AVG

```
FROM Notes.RandomPeople RP
```

RandomPeople		
Name	Gender	Age
Beyoncé	F	37
Laura Marling	F	28
Darren Hayes	M	46
Bret McKenzie	M	42
Jack Monroe	NB	30

>>> Aggregation function: AVG

GROUP BY RP.Gender

RandomPeople		
Name	Gender	Age
Beyoncé	F	37
Laura Marling	F	28
Darren Hayes	M	46
Bret McKenzie	M	42
Jack Monroe	NB	30

>>> Aggregation function: AVG

```
GROUP BY RP.Gender
```

Unnamed		
Name	Gender	Age
{Beyoncé, Laura Marling}	F	{37, 28}
{Darren Hayes, Bret McKenzie}	M	{46, 42}
{Jack Monroe}	NB	{30}

>>> Aggregation function: AVG

AVG(RP.Age)

Unnamed		
Name	Gender	(unnamed)
{Beyoncé, Laura Marling}	F	AVG({37,28})
{Darren Hayes, Bret McKenzie}	M	AVG({46,42})
{Jack Monroe}	NB	AVG({30})

>>> Aggregation function: AVG

AVG(RP.Age)

Unnamed		
Name	Gender	(unnamed)
{Beyoncé, Laura Marling}	F	32.5
{Darren Hayes, Bret McKenzie}	M	44
{Jack Monroe}	NB	30

>>> Aggregation function: AVG

```
SELECT RP.Gender, AVG(RP.Age) AS AverageAge
```

Unnamed		
Name	Gender	(unnamed)
{Beyoncé, Laura Marling}	F	32.5
{Darren Hayes, Bret McKenzie}	M	44
{Jack Monroe}	NB	30

>>> Aggregation function: AVG

result

Unnamed	
Gender	AverageAge
F	32.5
M	44
NB	30

We retrieved the average age for each gender in the table!

>>> What happens if we throw in a WHERE clause?

We will look at the execution of this query:

```
SELECT RP.gender, AVG(RP.age) AS AverageAge
FROM Notes.RandomPeople RP
WHERE RP.gender = 'F'
GROUP BY RP.gender;
```

>>> What happens if we throw in a WHERE clause?

FROM Notes.RandomPeople RP

RandomPeople		
Name	Gender	Age
Beyoncé	F	37
Laura Marling	F	28
Darren Hayes	M	46
Bret McKenzie	M	42
Jack Monroe	NB	30

>>> What happens if we throw in a WHERE clause?

```
WHERE RP.Gender = 'F'
```

RandomPeople		
Name	Gender	Age
Beyoncé	F	37
Laura Marling	F	28
Darren Hayes	M	46
Bret McKenzie	M	42
Jack Monroe	NB	30

>>> What happens if we throw in a WHERE clause?

```
GROUP BY RP.Gender
```

Unnamed		
Name	Gender	Age
{Beyoncé, Laura Marling}	F	{37, 28}

>>> What happens if we throw in a WHERE clause?

AVG(RP.Age)

Unnamed		
Name	Gender	(unnamed)
{Beyoncé, Laura Marling}	F	32.5

>>> What happens if we throw in a WHERE clause?

```
SELECT RP.Gender, AVG(RP.Age) AS AverageAge
```

Unnamed		
Name	Gender	(unnamed)
{Beyoncé, Laura Marling}	F	32.5

>>> What happens if we throw in a WHERE clause?

result

Unnamed	
Gender	AverageAge
F	32.5

We retrieved the average age for females in the table!

>>> Order of execution

1. FROM
2.
3.
4.
5.

>>> Order of execution

1. FROM
2. WHERE
3.
4.
5.

>>> Order of execution

1. FROM
2. WHERE
3. GROUP BY
4.
5.

>>> Order of execution

1. FROM
2. WHERE
3. GROUP BY
4. Aggregation
5.

>>> Order of execution

1. FROM
2. WHERE
3. GROUP BY
4. Aggregation
5. SELECT

>>> More aggregation functions

Function	Purpose
AVG	Average
STDEV	Sample standard deviation
STDEVP	Population standard deviation
VAR	Sample variance
VARP	Population variance
COUNT	Count number of rows
MIN	Minimum
MAX	Maximum
SUM	Sum

See the full list in the T-SQL docs

>>> More aggregation functions

Function	Purpose
AVG	Average
STDEV	Sample standard deviation
STDEVP	Population standard deviation
VAR	Sample variance
VARP	Population variance
COUNT	Count number of rows
MIN	Minimum
MAX	Maximum
SUM	Sum

See the full list in the T-SQL docs

>>> SQL clause: HAVING

The HAVING clause was created because WHERE is executed before GROUP BY. The HAVING clause is like WHERE, but it acts on groups.

We will look at the execution of this query:

```
SELECT RP.gender, AVG(RP.age) AS AverageAge
FROM Notes.RandomPeople RP
GROUP BY RP.gender
HAVING AVG(RP.age) > 40;
```

>>> SQL clause: HAVING

The HAVING clause was created because WHERE is executed before GROUP BY. The HAVING clause is like WHERE, but it acts on groups.

We will look at the execution of this query:

```
SELECT RP.gender, AVG(RP.age) AS AverageAge
FROM Notes.RandomPeople RP
GROUP BY RP.gender
HAVING AVG(RP.age) > 40;
```

Search condition with aggregation function

>>> SQL clause: HAVING

```
FROM Notes.RandomPeople RP
```

RandomPeople		
Name	Gender	Age
Beyoncé	F	37
Laura Marling	F	28
Darren Hayes	M	46
Bret McKenzie	M	42
Jack Monroe	NB	30

```
GROUP BY RP.Gender
```

Unnamed		
Name	Gender	Age
{Beyoncé, Laura Marling}	F	{37, 28}
{Darren Hayes, Bret McKenzie}	M	{46, 42}
{Jack Monroe}	NB	{30}

AVG(RP.Age)

Unnamed		
Name	Gender	(unnamed)
{Beyoncé, Laura Marling}	F	32.5
{Darren Hayes, Bret McKenzie}	M	44
{Jack Monroe}	NB	30

```
HAVING AVG(RP.Age) > 40
```

Unnamed		
Name	Gender	(unnamed)
{Beyoncé, Laura Marling}	F	32.5
{Darren Hayes, Bret McKenzie}	M	44
{Jack Monroe}	NB	30

```
SELECT RP.Gender, AVG(RP.Age) AS AverageAge
```

Unnamed		
Name	Gender	(unnamed)
{Darren Hayes, Bret McKenzie}	M	44

result

Unnamed	
Gender	AverageAge
M	44

>>> Order of execution

1. FROM
2.
3.
4.
5.
6.

>>> Order of execution

1. FROM
2. WHERE
3.
4.
5.
6.

>>> Order of execution

1. FROM
2. WHERE
3. GROUP BY
4.
5.
6.

>>> Order of execution

1. FROM
2. WHERE
3. GROUP BY
4. Aggregation
5.
6.

>>> Order of execution

1. FROM
2. WHERE
3. GROUP BY
4. Aggregation
5. HAVING
6.

>>> Order of execution

1. FROM
2. WHERE
3. GROUP BY
4. Aggregation
5. HAVING
6. SELECT

>>> Group practice

The aggregation function in the HAVING clause does not have to match the one in the SELECT clause.

```
SELECT RP.gender, STDEV(RP.age) AS AverageAge
FROM Notes.RandomPeople RP
GROUP BY RP.gender
HAVING AVG(RP.age) > 40;
```

Explain in words what the above query achieves.

>>> Solution

The query finds the sample standard deviation of the ages for each gender that has an average age greater than 40.

>>> Correlated subquery group exercise

```
SELECT Name
FROM RandomPeople RP
WHERE age > (SELECT AVG(age)
             FROM RandomPeople
             WHERE gender = RP.gender);
```

Two questions:

1. What does the query do?
2. Why don't we use HAVING?

>>> Correlated subquery group exercise

```
SELECT Name
FROM RandomPeople RP
WHERE age > (SELECT AVG(age)
             FROM RandomPeople
             WHERE gender = RP.gender);
```

Two questions:

1. What does the query do?
   Returns the name of every person whose age is greater than the average for their own gender.
2. Why don't we use HAVING?

>>> Correlated subquery group exercise

```
SELECT Name
FROM RandomPeople RP
WHERE age > (SELECT AVG(age)
             FROM RandomPeople
             WHERE gender = RP.gender);
```

Two questions:

1. What does the query do?
   Returns the name of every person whose age is greater than the average for their own gender.
2. Why don't we use HAVING?
   There is no aggregation function in the search condition.

>>> Correlated subquery group exercise

```
SELECT Name
FROM RandomPeople RP
WHERE age > (SELECT AVG(age)
             FROM RandomPeople
             WHERE gender = RP.gender);
```

Two questions:

1. What does the query do?
   Returns the name of every person whose age is greater than the average for their own gender.
2. Why don't we use HAVING?
   There is no aggregation function in the search condition.

We will come back to this during the exercises.

>>> The fifth Kahoot

Enjoy!

>>> Where are we now?

Day 2

1. Revision of day 1
2. Reading the docs
3. Aggregating
4. Big reveal and exercises

   Lunch!

5. Creating and editing tables
6. The Integrated Data Infrastructure
7. Putting it all together
8. Connecting and exporting

   Send me questions and give feedback

Page is hyperlinked: click a topic above to jump to it.

>>> A big reveal! SELECT

Retrieves rows from the database and enables the selection of one or many rows or columns from one or many tables in SQL Server. The full syntax of the SELECT statement is complex, but the main clauses can be summarized as:

[WITH { [XMLNAMESPACES ,] [<common_table_expression>] }]

SELECT *select_list* [INTO *new_table*]

[FROM *table_source*] [WHERE *search_condition*]

[GROUP BY *group_by_expression*]

[HAVING *search_condition*]

[ORDER BY *order_expression* [ASC | DESC]]

The UNION, EXCEPT, and INTERSECT operators can be used between queries to combine or compare their results into one result set.

>>> A big reveal! SELECT

Retrieves rows from the database and enables the selection of one or many rows or columns from one or many tables in SQL Server. The full syntax of the SELECT statement is complex, but the main clauses can be summarized as:

[WITH { [XMLNAMESPACES ,] [<common_table_expression>] }]

SELECT *select_list* [INTO *new_table*]

[FROM *table_source*] [WHERE *search_condition*]

[GROUP BY *group_by_expression*]

[HAVING *search_condition*]

[ORDER BY *order_expression* [ASC | DESC]]

The UNION, EXCEPT, and INTERSECT operators can be used between queries to combine or compare their results into one result set.

The others don't take so long to learn

>>> A big reveal! SELECT

Retrieves rows from the database and enables the selection of one or many rows or columns from one or many tables in SQL Server. The full syntax of the SELECT statement is complex, but the main clauses can be summarized as:

[WITH { [XMLNAMESPACES ,] [<common_table_expression>] }]

SELECT *select_list* [INTO *new_table*]

[FROM *table_source*] [WHERE *search_condition*]

[GROUP BY *group_by_expression*]

[HAVING *search_condition*]

[ORDER BY *order_expression* [ASC | DESC]]

The UNION, EXCEPT, and INTERSECT operators can be used between queries to combine or compare their results into one result set.

The others don't take so long to learn

>>> A big reveal! SELECT

Retrieves rows from the database and enables the selection of one or many rows or columns from one or many tables in SQL Server. The full syntax of the SELECT statement is complex, but the main clauses can be summarized as:

[WITH { [XMLNAMESPACES ,] [<common_table_expression>] }]

SELECT *select_list* [INTO *new_table*]

[FROM *table_source*] [WHERE *search_condition*]

[GROUP BY *group_by_expression*]

[HAVING *search_condition*]

[ORDER BY *order_expression* [ASC | DESC]]

The UNION, EXCEPT, and INTERSECT operators can be used between queries to combine or compare their results into one result set.

The others don't take so long to learn

>>> Group practice

Find the T-SQL documentation for ORDER BY (click here).
Figure out what it does, but try to keep it simple!

>>> Group practice

Find the T-SQL documentation for INTO (click here). Figure out what it does, but try to keep it simple!

>>> Group practice

Find the T-SQL documentation for UNION (click here). Figure out what it does, but try to keep it simple!

>>> Casting - aggregation warning!

Up to this point we have largely ignored data types. This can go on no longer. Arithmetic with integers always returns an integer (by rounding down).

$$\text{AVG}(\{1,2\}) = 1$$

So we need to use CAST in such cases.

>>> Casting - aggregation warning!

Up to this point we have largely ignored data types. This can go on no longer. Arithmetic with integers always returns an integer (by rounding down).

AVG({1,2}) = 1

So we need to use CAST in such cases. For example, in Notes.RandomPeople, the data type for Age is integer.

```
SELECT gender, AVG(age) AS AverageAge
FROM Notes.RandomPeople
GROUP BY gender;
```

Must be changed to:

```
SELECT gender, AVG(CAST(age AS Float)) AS AverageAge
FROM Notes.RandomPeople
GROUP BY gender;
```

>>> Exercises

Do Exercises Sections 5.2.6 and 5.2.7

Click here to find the textbook.

>>> The sixth Kahoot

Enjoy!

>>> Where are we now?

Day 2

1. Revision of day 1
2. Reading the docs
3. Aggregating
4. Big reveal and exercises

   Lunch!

5. Creating and editing tables
6. The Integrated Data Infrastructure
7. Putting it all together
8. Connecting and exporting

   Send me questions and give feedback

Page is hyperlinked: click a topic above to jump to it.

>>> We will learn to

* CREATE SCHEMA to store your tables

>>> We will learn to

* CREATE SCHEMA to store your tables
* CREATE VIEW to store a query like a table

>>> We will learn to

* CREATE SCHEMA to store your tables
* CREATE VIEW to store a query like a table
* SELECT INTO to store result in a table

>>> We will learn to

* CREATE SCHEMA to store your tables
* CREATE VIEW to store a query like a table
* SELECT INTO to store result in a table
* ALTER to add columns to a stored table

>>> We will learn to

* CREATE SCHEMA to store your tables
* CREATE VIEW to store a query like a table
* SELECT INTO to store result in a table
* ALTER to add columns to a stored table
* UPDATE to change the entries in a table

>>> We will learn to

* CREATE SCHEMA to store your tables
* CREATE VIEW to store a query like a table
* SELECT INTO to store result in a table
* ALTER to add columns to a stored table
* UPDATE to change the entries in a table
* INSERT INTO to create a whole record

>>> We will learn to

* CREATE SCHEMA to store your tables
* CREATE VIEW to store a query like a table
* SELECT INTO to store result in a table
* ALTER to add columns to a stored table
* UPDATE to change the entries in a table
* INSERT INTO to create a whole record
* CREATE TABLE to make one from scratch

>>> Clean up first

>>> CREATE SCHEMA to store your tables

```
CREATE SCHEMA MySchema;
GO
```

Use GO after every chunk of code that creates, updates, or deletes a table. It tells SQL Server to execute the code.

>>> CREATE VIEW to store a query like a table

Behaves like a table, but is a stored query.

```
CREATE OR ALTER VIEW MySchema.MyFriendsNames_view AS
SELECT firstName, lastName
FROM Notes.Friends;
GO
```

>>> CREATE VIEW to store a query like a table

Behaves like a table, but is a stored query.

```
CREATE OR ALTER VIEW MySchema.MyFriendsNames_view AS
SELECT firstName, lastName
FROM Notes.Friends;
GO
```

```
SELECT *
FROM MySchema.MyFriendsNames_view;
```

>>> SELECT INTO to store result in a table

Creates a table! Any SELECT result will be stored.

```
SELECT friendID, firstName, lastName
INTO MySchema.MyFriends
FROM Notes.Friends;
GO
```

>>> ALTER to add columns to a stored table

We can create a column to hold new or transformed data.

```
ALTER TABLE MySchema.MyFriends
ADD initials varchar(4);
GO
```

ALTER fills the column with NULLs for now.

>>> UPDATE to change the entries in a table

Now we can do this:

```
UPDATE MySchema.MyFriends
SET initials = CONCAT(
        SUBSTRING(firstName, 1, 1),
        SUBSTRING(lastName, 1, 1)
        )
WHERE firstName IS NOT NULL
AND lastName IS NOT NULL;
GO
```

See the SUBSTRING docs (click here)
and the CONCAT docs (click here)

>>> Note we could instead just alter the view

```
CREATE OR ALTER VIEW MySchema.MyFriendsNames_view AS
SELECT friendID, firstName, lastName,
  (CONCAT(SUBSTRING(firstName, 1, 1),
          SUBSTRING(lastName, 1, 1))
  ) AS initials
FROM Notes.Friends;
GO
```

```
SELECT *
FROM MySchema.MyFriendsNames_view;
```

>>> INSERT INTO to create a whole record

Hold on! What about NULL values in SUBSTRING and CONCAT

It's hard to tell. Let's experiment!

>>> INSERT INTO to create a whole record

Hold on! What about NULL values in SUBSTRING and CONCAT

It's hard to tell. Let's experiment!

```
INSERT INTO Notes.Friends
(friendID, firstName, lastName, favColour)
VALUES
(997, NULL, NULL, NULL),
(998, '', '', ''),
(999, 'NA', 'NA', 'NA');
GO
```

>>> INSERT INTO to create a whole record

Hold on! What about NULL values in SUBSTRING and CONCAT

It's hard to tell. Let's experiment!

```
INSERT INTO Notes.Friends
(friendID, firstName, lastName, favColour)
VALUES
(997, NULL, NULL, NULL),
(998, '', '', ''),
(999, 'NA', 'NA', 'NA');
GO
```

The view now changes!

```
SELECT *
FROM MySchema.MyFriendsNames_view;
```

>>> But our table doesn't change

```
SELECT *
FROM MySchema.MyFriends;
```

So a stored table is more static (which could be desired).

>>> But our table doesn't change

```
SELECT *
FROM MySchema.MyFriends;
```

So a stored table is more static (which could be desired).

```
INSERT INTO MySchema.MyFriends
(friendID, firstName, lastName)
SELECT friendID, firstName, lastName
FROM Notes.Friends
WHERE friendID > 995
GO
```

>>> The CASE clause

```
UPDATE MySchema.MyFriends
SET initials = (CASE
    WHEN (firstName IS NULL or lastName IS NULL) THEN 'none'
    WHEN (firstName = '' and lastName = '') THEN 'none'
    WHEN (firstName = 'NA' and lastName = 'NA') THEN 'none'
    ELSE (CONCAT(SUBSTRING(firstName, 1, 1),
                 SUBSTRING(lastName, 1, 1)))
    END);
GO
```

When using CASE in the SET clause,
or whenever updating a variable,
you need to be wary of the data type.

Note: CASE can also be used in SELECT.

>>> Error!

We avoided this by using VARCHAR(4)

```
Msg 2628, Level 16, State 1, Line 94
String or binary data would be truncated in table
'IDI_Sandpit.MySchema.MyFriends',
column 'initials'. Truncated value: 'no'.
```

>>> Cleaning up

```
DROP TABLE IF EXISTS MySchema.MyFriends;
DROP TABLE IF EXISTS MySchema.MyFriendsNames;
DROP VIEW IF EXISTS MySchema.MyFriendsNames_view;
DROP SCHEMA IF EXISTS MySchema;
DELETE FROM Notes.Friends WHERE Notes.Friends.friendID > 995;
GO
```

Inserting data is a great tool for testing and experimenting

>>> Many other functions

There are many other functions that allow you to change the values of entries before your select statement returns them.

* Full collection of them
* Mathematical functions (see ROUND, ABS, RAND)
* Date and time functions (see DAY, MONTH, YEAR, DATEDIFF)
* String functions (see CONCAT and SOUNDEX)

>>> CREATE TABLE to make one from scratch

```
CREATE TABLE MySchema.MyTable(
  pkey int not null ,
  var1 Float ,
  var2 varchar(50) ,
  var3 bit not null ,
  var4 char(1) ,
  initials int ,
  PRIMARY KEY (pkey) ,
  FOREIGN KEY (initials) REFERENCES MySchema.MyFriends (initials)
);
GO
```

>>> Error!

```
Msg 1776, Level 16, State 0, Line 1
There are no primary or candidate keys
in the referenced table 'MySchema.MyFriends'
that match the referencing column list in the foreign key …
```

>>> Solution?

Check the documentation (click here)

```
ALTER TABLE MySchema.MyFriends
ADD CONSTRAINT PK_MyFriends_initials
PRIMARY KEY (initials);
GO
```

Anything wrong with this?

>>> Better solution

Better!

```
CREATE TABLE MySchema.MyTable(
  pkey int not null ,
  var1 Float ,
  var2 varchar(50) ,
  var3 bit not null ,
  var4 char(1) ,
  friendID int ,
  PRIMARY KEY (pkey) ,
  FOREIGN KEY (friendID) REFERENCES MySchema.MyFriends (friendID)
);
GO
```

>>> Where are we now?

Day 2

1. Revision of day 1
2. Reading the docs
3. Aggregating
4. Big reveal and exercises

   Lunch!

5. Creating and editing tables
6. The Integrated Data Infrastructure
7. Putting it all together
8. Connecting and exporting

   Send me questions and give feedback

Page is hyperlinked: click a topic above to jump to it.

>>> What is the IDI?

A collection of databases and schemas containing deidentified administrative and survey data from people's interactions with many government departments.

The different government departments use different unique identifiers, so interactions have been linked to individuals probabilistically.

>>> What is the IDI?

A collection of databases and schemas containing deidentified administrative and survey data from people's interactions with many government departments.

The different government departments use different unique identifiers, so interactions have been linked to individuals probabilistically.

The schemas (sometimes called nodes) in the main database correspond mostly to different government departments. From a technical perspective, the probabilistic linking allows us to JOIN records between schemas.

>>> The spine

The spine is a derived dataset that we don't have access to. It is deemed by Stats NZ to be the most ideal for identifying an ever-resident population.

>>> The spine

The spine is a derived dataset that we don't have access to. It is deemed by Stats NZ to be the most ideal for identifying an ever-resident population.

Individuals in the spine are the only ones whose records are linked. All links are made "through the spine." There are 10 mil people in the spine, and 57 mil people in the IDI.

>>> The spine

The spine is a derived dataset that we don't have access to. It is deemed by Stats NZ to be the most ideal for identifying an ever-resident population.

Individuals in the spine are the only ones whose records are linked. All links are made "through the spine." There are 10 mil people in the spine, and 57 mil people in the IDI.

A good spine should include every person in the target population once and only once. It includes tax, births and visa data (not deidentified).

>>> The spine

The spine is a derived dataset that we don't have access to. It is deemed by Stats NZ to be the most ideal for identifying an ever-resident population.

Individuals in the spine are the only ones whose records are linked. All links are made "through the spine." There are 10 mil people in the spine, and 57 mil people in the IDI.

A good spine should include every person in the target population once and only once. It includes tax, births and visa data (not deidentified).

* Permanent residents
* Visas to reside, work or study
* People that live and work here without visas (e.g., Australians)

>>> More details at these website links

* Stats NZ prototype spine paper
* Stats NZ linking methodology paper
* VHIN spine explainer

>>> Probabilistic linking errors

Probabilistic linking produces a unique identifier, snz_uid.
The snz_uid can then act as a primary/foreign key pair.

* Just because two records/interactions are linked, doesn't mean they belong to the same individual.
  This is a false positive.

>>> Probabilistic linking errors

Probabilistic linking produces a unique identifier, snz_uid.
The snz_uid can then act as a primary/foreign key pair.

* Just because two records/interactions are linked, doesn't mean they belong to the same individual.
  This is a false positive.

* Just because two records/interactions are *not* linked, doesn't mean they *don't* belong to the same individual.
  This is a false negative.

>>> Probabilistic linking errors

Probabilistic linking produces a unique identifier, snz_uid.
The snz_uid can then act as a primary/foreign key pair.

* Just because two records/interactions are linked, doesn't mean they belong to the same individual.
  This is a false positive.

* Just because two records/interactions are *not* linked, doesn't mean they *don't* belong to the same individual.
  This is a false negative.

* Just because two records from different refreshes have the same snz_uid, definitely doesn't mean they have belong to the same individual.
  This is a silly mistake.

>>> Precision rate

The precision rate is the proportion of correct links, out of all links made. You can think of it as the probability that a randomly chosen link is correct. You can get the false positive rate from this as:

$$1 - (\text{precision rate}).$$

>>> Precision rate

The precision rate is the proportion of correct links, out of all links made. You can think of it as the probability that a randomly chosen link is correct. You can get the false positive rate from this as:

$$1 - (\text{precision rate}).$$

Stats NZ measures the precision rate, usually via clerical reviews of random samples of the links.

>>> Precision rate

The precision rate is the proportion of correct links, out of all links made. You can think of it as the probability that a randomly chosen link is correct. You can get the false positive rate from this as:

$$1 - (\text{precision rate}).$$

Stats NZ measures the precision rate, usually via clerical reviews of random samples of the links.

The priority of Stats NZ is to achieve a high precision rate. This involves a trade-off, with a *higher false negative rate*.

>>> Linkage bias

Linkage bias examines variables where the false negative rate is particularly high. For example, bias in year of birth is expected since older people have lived through longer periods of poor coverage, creating a linking bias. However, it is not easy to look at linked records versus records that didn't link, so estimating linkage bias is difficult.

>>> One-to-one relationship

When linkage is created between a schema and the spine, Stats NZ refers to it as a project.

"Each project ideally produces one-to-one links, where each record on one side links to at most one record on the other side. Duplicates are records which link to more than one record. How these are handled in the IDI depends on the projects."

>>> My favourite links

* Stats NZ paper - Use of the IDI
  "The first part of this report sets out to describe, from a researcher's point of view, what data is available, how it is structured, and the analytical platforms that are available".

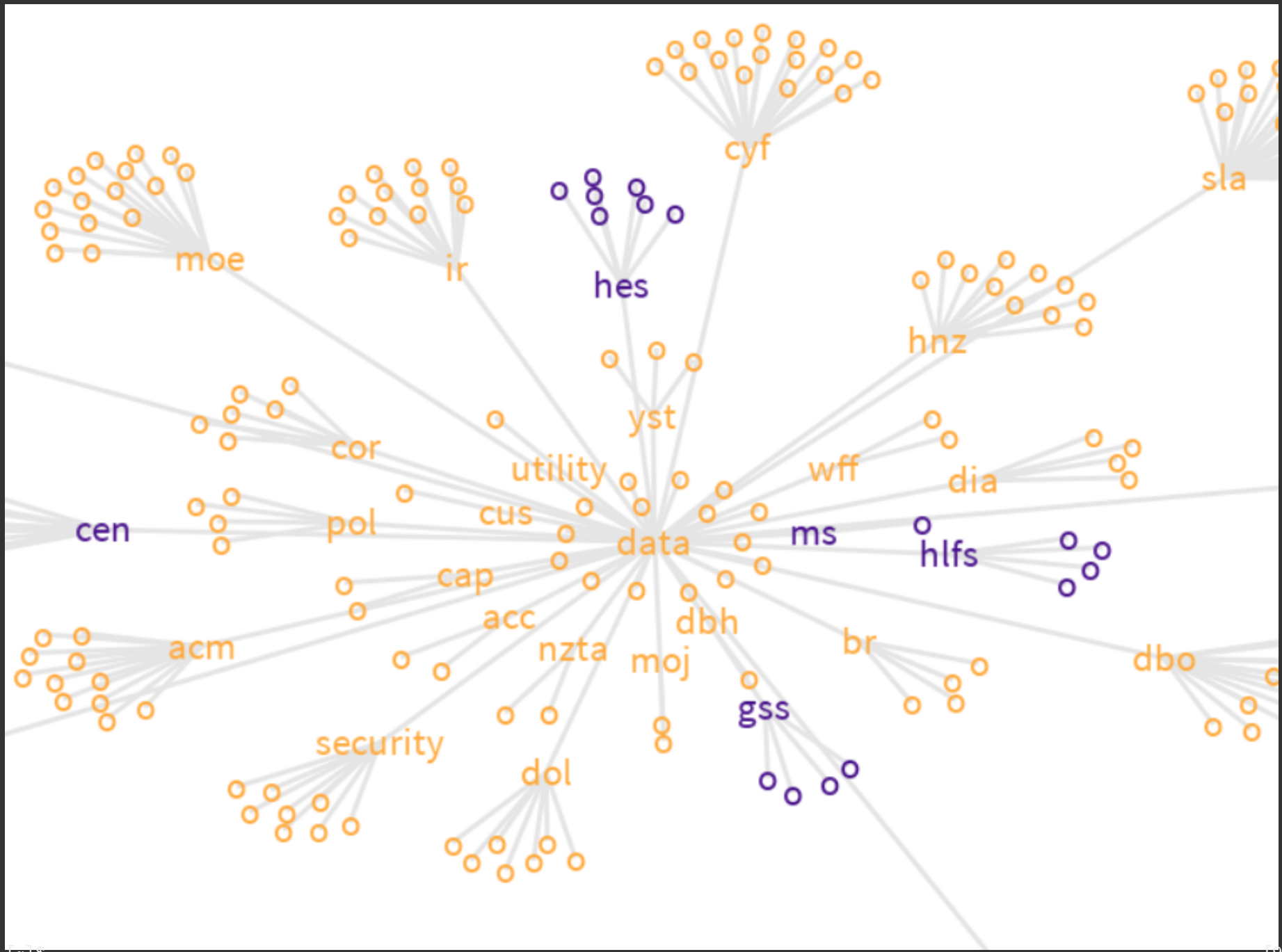
* VHIN guides to getting started
  Very beginner friendly.

* Data in the IDI
  Visual summary of available data as at September 2020.

* Current StatsNZ website
  Extensive and introductory material.

* Older StatsNZ website (may be moving soon)
  Contains data dictionaries.

>>> IDI_Clean schemas (some go off the page)



>>> Primary and foreign key pairs?

Well, yes and no

Let's look at some data dictionaries (click here)

>>> Primary and foreign key pairs?

Well, yes and no

Let's look at some data dictionaries (click here)

ACC Injury Claims Data: Serious Injury

* snz_uid
  Global, refreshed, not unique in table
* snz_acc_uid
* snz_acc_claim_uid

>>> Primary and foreign key pairs?

Well, yes and no

Let's look at some data dictionaries (click here)

ACC Injury Claims Data: Serious Injury

* snz_uid
  Global, refreshed, not unique in table
* snz_acc_uid
  Local, not refreshed, not unique in table
* snz_acc_claim_uid

>>> Primary and foreign key pairs?

Well, yes and no

Let's look at some data dictionaries (click here)

ACC Injury Claims Data: Serious Injury

* snz_uid
  Global, refreshed, not unique in table
* snz_acc_uid
  Local, not refreshed, not unique in table
* snz_acc_claim_uid
  Local, 'event ID', unique in table? maybe not.

>>> Primary and foreign key pairs?

Well, yes and no

Let's look at some data dictionaries (click here)

ACC Injury Claims Data: Serious Injury

* snz_uid
  Global, refreshed, not unique in table
* snz_acc_uid
  Local, not refreshed, not unique in table
* snz_acc_claim_uid
  Local, 'event ID', unique in table? maybe not.

The above 3 together form the primary key

>>> Identifying a primary / foreign key pair?

A foreign key is any column (or collection of columns) whose each entry is guaranteed to be equal to one, and only one, primary key entry in some other table that the foreign key is designated to 'point at'.

If the database administrator has not defined foreign keys, then you need to find natural relationships yourself. Then, write your own tests.

>>> An example to contemplate

Suppose the Houses table has a column PostCode,
but no column SuburbName.

Suppose the Suburbs table has two columns,
SuburbName and PostCode.

>>> An example to contemplate

Suppose the Houses table has a column PostCode,
but no column SuburbName.

Suppose the Suburbs table has two columns,
SuburbName and PostCode.

* Does each PostCode entry in Houses point at a unique PostCode entry in Suburbs? or, is the uniqueness violated, with some suburbs sharing the same post code?

* Can you determine which SuburbName from Suburbs corresponds to each PostCode entry in Houses? or, is there a risk that there is a PostCode entry in Houses that doesn't exist yet as an entry in Suburbs?

>>> An example to contemplate

Suppose the Houses table has a column PostCode,
but no column SuburbName.

Suppose the Suburbs table has two columns,
SuburbName and PostCode.

* Does each PostCode entry in Houses point at a unique PostCode entry in Suburbs? or, is the uniqueness violated, with some suburbs sharing the same post code?
* Can you determine which SuburbName from Suburbs corresponds to each PostCode entry in Houses? or, is there a risk that there is a PostCode entry in Houses that doesn't exist yet as an entry in Suburbs?

We will come back to this during the exercises.

>>> Where are we now?

Day 2

1. Revision of day 1
2. Reading the docs
3. Aggregating
4. Big reveal and exercises

   Lunch!

5. Creating and editing tables
6. The Integrated Data Infrastructure
7. Putting it all together
8. Connecting and exporting

   Send me questions and give feedback

Page is hyperlinked: click a topic above to jump to it.

>>> IDI Worksheet

To access the worksheet click here.

>>> IDI group exercise

Write a query (or two) that list(s) the snz_uid and birth year of all people who have registered a civil union with DIA and registered a serious injury with ACC.

>>> Solution

```
SELECT SI.snz_uid, CU.dia_civ_partnr1_birth_year_nbr
FROM DIA_Clean.Civil_unions CU,
     ACC_Clean.Serious_injury SI
WHERE CU.partner1_snz_uid = SI.snz_uid;
```

```
SELECT SI.snz_uid, CU.dia_civ_partnr2_birth_year_nbr
FROM DIA_Clean.Civil_unions CU,
     ACC_Clean.Serious_injury SI
WHERE CU.partner2_snz_uid = SI.snz_uid;
```

Do Exercises Section 5.2.8

Click here to find the textbook.

>>> Where are we now?

Day 2

1. Revision of day 1
2. Reading the docs
3. Aggregating
4. Big reveal and exercises

   Lunch!

5. Creating and editing tables
6. The Integrated Data Infrastructure
7. Putting it all together
8. Connecting and exporting

   Send me questions and give feedback

Page is hyperlinked: click a topic above to jump to it.

>>> Connect to SQL

This will be a walk-through from the notes, if we have time.