

# Aggregate Functions

CS 2550 Database Design 2022  
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## Definition

- ▶ Aggregate functions operate on an entire COLUMN's worth of values compared to the values in individual cells
- ▶ The column type must 'fit' the function
  - ▶ You can MIN a date or text
  - ▶ You can't AVG a text or a date

id	first_name	last_name	email	phone_number	hire_date	job_id	salary	commission_pct
1	Jeffrey	Deane	jeff@company.com	916.555.1234	2000-09-01	AD_ASST	3000	0
2	Neena	Kochhar	neena@company.com	916.555.2345	2001-01-01	ANALYST	4000	0
3	Lex	DeHaan	lex@company.com	916.555.3456	2001-02-01	SQL_DEV	4500	0
4	Alexander	Toh	alexto@company.com	916.555.4567	2001-03-01	REP_MAN	5000	0
5	Bruce	Smith	bruce@company.com	916.555.5678	2001-04-01	REP_MAN	6000	0
6	David	Turner	dturner@company.com	916.555.6789	2001-05-01	REP_MAN	7000	0
7	Vern	Clayton	vernc@company.com	916.555.7890	2001-06-01	REP_MAN	8000	0
8	Adam	Clayton	adamc@company.com	916.555.8901	2001-07-01	REP_MAN	9000	0
9	John	Abel	johna@company.com	916.555.9012	2001-08-01	REP_MAN	10000	0
10	Christina	Mavris	cmavris@company.com	916.555.0123	2001-09-01	HR_REP	11000	0
11	Jonathan	Abel	jabel@company.com	916.555.1234	2001-10-01	REP_MAN	12000	0
12	Walter	Tello	waltt@company.com	916.555.2345	2001-11-01	REP_MAN	13000	0
13	Renske	Law	renskel@company.com	916.555.3456	2001-12-01	REP_MAN	14000	0
14	Stephen	Stiles	stiles@company.com	916.555.4567	2002-01-01	REP_MAN	15000	0
15	Shelley	Gregg	shelleg@company.com	916.555.5678	2002-02-01	REP_MAN	16000	0
16	Dorel	Steece	dorel@company.com	916.555.6789	2002-03-01	REP_MAN	17000	0
17	Diana	Greenberg	dgreen@company.com	916.555.7890	2002-04-01	REP_MAN	18000	0
18	Anthony	Pollard	apollard@company.com	916.555.8901	2002-05-01	REP_MAN	19000	0
19	Ruth	Sims	rsims@company.com	916.555.9012	2002-06-01	REP_MAN	20000	0
20	Pat	Haas	pat@company.com	916.555.0123	2002-07-01	REP_MAN	21000	0
21	Timothy	Gietz	timothyg@company.com	916.555.1234	2002-08-01	REP_MAN	22000	0
22	David	Adams	dadams@company.com	916.555.2345	2002-09-01	REP_MAN	23000	0
23	Jessica	Wu	jessicaw@company.com	916.555.3456	2002-10-01	REP_MAN	24000	0
24	Greg	King	greg@company.com	916.555.4567	2002-11-01	REP_MAN	25000	0
25	Cheryl	Baer	cheryl@company.com	916.555.5678	2002-12-01	REP_MAN	26000	0
26	Pat	Abel	pabel@company.com	916.555.6789	2003-01-01	REP_MAN	27000	0
27	Timothy	Gietz	timothyg@company.com	916.555.7890	2003-02-01	REP_MAN	28000	0
28	David	Adams	dadams@company.com	916.555.8901	2003-03-01	REP_MAN	29000	0
29	Jessica	Wu	jessicaw@company.com	916.555.9012	2003-04-01	REP_MAN	30000	0
30	Greg	King	greg@company.com	916.555.0123	2003-05-01	REP_MAN	31000	0
31	Cheryl	Baer	cheryl@company.com	916.555.1234	2003-06-01	REP_MAN	32000	0
32	Pat	Abel	pabel@company.com	916.555.2345	2003-07-01	REP_MAN	33000	0
33	Timothy	Gietz	timothyg@company.com	916.555.3456	2003-08-01	REP_MAN	34000	0
34	David	Adams	dadams@company.com	916.555.4567	2003-09-01	REP_MAN	35000	0
35	Jessica	Wu	jessicaw@company.com	916.555.5678	2003-10-01	REP_MAN	36000	0
36	Greg	King	greg@company.com	916.555.6789	2003-11-01	REP_MAN	37000	0
37	Cheryl	Baer	cheryl@company.com	916.555.7890	2003-12-01	REP_MAN	38000	0
38	Pat	Abel	pabel@company.com	916.555.8901	2004-01-01	REP_MAN	39000	0
39	Timothy	Gietz	timothyg@company.com	916.555.9012	2004-02-01	REP_MAN	40000	0
40	David	Adams	dadams@company.com	916.555.0123	2004-03-01	REP_MAN	41000	0
41	Jessica	Wu	jessicaw@company.com	916.555.1234	2004-04-01	REP_MAN	42000	0
42	Greg	King	greg@company.com	916.555.2345	2004-05-01	REP_MAN	43000	0
43	Cheryl	Baer	cheryl@company.com	916.555.3456	2004-06-01	REP_MAN	44000	0
44	Pat	Abel	pabel@company.com	916.555.4567	2004-07-01	REP_MAN	45000	0
45	Timothy	Gietz	timothyg@company.com	916.555.5678	2004-08-01	REP_MAN	46000	0
46	David	Adams	dadams@company.com	916.555.6789	2004-09-01	REP_MAN	47000	0
47	Jessica	Wu	jessicaw@company.com	916.555.7890	2004-10-01	REP_MAN	48000	0
48	Greg	King	greg@company.com	916.555.8901	2004-11-01	REP_MAN	49000	0
49	Cheryl	Baer	cheryl@company.com	916.555.9012	2004-12-01	REP_MAN	50000	0
50	Pat	Abel	pabel@company.com	916.555.0123	2005-01-01	REP_MAN	51000	0
51	Timothy	Gietz	timothyg@company.com	916.555.1234	2005-02-01	REP_MAN	52000	0
52	David	Adams	dadams@company.com	916.555.2345	2005-03-01	REP_MAN	53000	0
53	Jessica	Wu	jessicaw@company.com	916.555.3456	2005-04-01	REP_MAN	54000	0
54	Greg	King	greg@company.com	916.555.4567	2005-05-01	REP_MAN	55000	0
55	Cheryl	Baer	cheryl@company.com	916.555.5678	2005-06-01	REP_MAN	56000	0
56	Pat	Abel	pabel@company.com	916.555.6789	2005-07-01	REP_MAN	57000	0
57	Timothy	Gietz	timothyg@company.com	916.555.7890	2005-08-01	REP_MAN	58000	0
58	David	Adams	dadams@company.com	916.555.8901	2005-09-01	REP_MAN	59000	0
59	Jessica	Wu	jessicaw@company.com	916.555.9012	2005-10-01	REP_MAN	60000	0
60	Greg	King	greg@company.com	916.555.0123	2005-11-01	REP_MAN	61000	0
61	Cheryl	Baer	cheryl@company.com	916.555.1234	2005-12-01	REP_MAN	62000	0
62	Pat	Abel	pabel@company.com	916.555.2345	2006-01-01	REP_MAN	63000	0
63	Timothy	Gietz	timothyg@company.com	916.555.3456	2006-02-01	REP_MAN	64000	0
64	David	Adams	dadams@company.com	916.555.4567	2006-03-01	REP_MAN	65000	0
65	Jessica	Wu	jessicaw@company.com	916.555.5678	2006-04-01	REP_MAN	66000	0
66	Greg	King	greg@company.com	916.555.6789	2006-05-01	REP_MAN	67000	0
67	Cheryl	Baer	cheryl@company.com	916.555.7890	2006-06-01	REP_MAN	68000	0
68	Pat	Abel	pabel@company.com	916.555.8901	2006-07-01	REP_MAN	69000	0
69	Timothy	Gietz	timothyg@company.com	916.555.9012	2006-08-01	REP_MAN	70000	0
70	David	Adams	dadams@company.com	916.555.0123	2006-09-01	REP_MAN	71000	0
71	Jessica	Wu	jessicaw@company.com	916.555.1234	2006-10-01	REP_MAN	72000	0
72	Greg	King	greg@company.com	916.555.2345	2006-11-01	REP_MAN	73000	0
73	Cheryl	Baer	cheryl@company.com	916.555.3456	2006-12-01	REP_MAN	74000	0
74	Pat	Abel	pabel@company.com	916.555.4567	2007-01-01	REP_MAN	75000	0
75	Timothy	Gietz	timothyg@company.com	916.555.5678	2007-02-01	REP_MAN	76000	0
76	David	Adams	dadams@company.com	916.555.6789	2007-03-01	REP_MAN	77000	0
77	Jessica	Wu	jessicaw@company.com	916.555.7890	2007-04-01	REP_MAN	78000	0
78	Greg	King	greg@company.com	916.555.8901	2007-05-01	REP_MAN	79000	0
79	Cheryl	Baer	cheryl@company.com	916.555.9012	2007-06-01	REP_MAN	80000	0
80	Pat	Abel	pabel@company.com	916.555.0123	2007-07-01	REP_MAN	81000	0
81	Timothy	Gietz	timothyg@company.com	916.555.1234	2007-08-01	REP_MAN	82000	0
82	David	Adams	dadams@company.com	916.555.2345	2007-09-01	REP_MAN	83000	0
83	Jessica	Wu	jessicaw@company.com	916.555.3456	2007-10-01	REP_MAN	84000	0
84	Greg	King	greg@company.com	916.555.4567	2007-11-01	REP_MAN	85000	0
85	Cheryl	Baer	cheryl@company.com	916.555.5678	2007-12-01	REP_MAN	86000	0
86	Pat	Abel	pabel@company.com	916.555.6789	2008-01-01	REP_MAN	87000	0
87	Timothy	Gietz	timothyg@company.com	916.555.7890	2008-02-01	REP_MAN	88000	0
88	David	Adams	dadams@company.com	916.555.8901	2008-03-01	REP_MAN	89000	0
89	Jessica	Wu	jessicaw@company.com	916.555.9012	2008-04-01	REP_MAN	90000	0
90	Greg	King	greg@company.com	916.555.0123	2008-05-01	REP_MAN	91000	0
91	Cheryl	Baer	cheryl@company.com	916.555.1234	2008-06-01	REP_MAN	92000	0
92	Pat	Abel	pabel@company.com	916.555.2345	2008-07-01	REP_MAN	93000	0
93	Timothy	Gietz	timothyg@company.com	916.555.3456	2008-08-01	REP_MAN	94000	0
94	David	Adams	dadams@company.com	916.555.4567	2008-09-01	REP_MAN	95000	0
95	Jessica	Wu	jessicaw@company.com	916.555.5678	2008-10-01	REP_MAN	96000	0
96	Greg	King	greg@company.com	916.555.6789	2008-11-01	REP_MAN	97000	0
97	Cheryl	Baer	cheryl@company.com	916.555.7890	2008-12-01	REP_MAN	98000	0
98	Pat	Abel	pabel@company.com	916.555.8901	2009-01-01	REP_MAN	99000	0
99	Timothy	Gietz	timothyg@company.com	916.555.9012	2009-02-01	REP_MAN	100000	0
100	David	Adams	dadams@company.com	916.555.0123	2009-03-01	REP_MAN	101000	0

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## Which functions?

- ▶ **COUNT**
  - ▶ The number of rows that match
- ▶ **AVG**
  - ▶ The mean average numeric value
- ▶ **MIN**
  - ▶ The smallest value specified
- ▶ **MAX**
  - ▶ The largest value specified
- ▶ **SUM**
  - ▶ The total of all values in the column

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### How?

- ▶ All the aggregate functions take a single parameter and return a single value
- ▶ AVG/MAX/MIN/SUM each take the column, the results of which are analyzed or operated on.
- ▶ COUNT takes **ONLY** the \* as its parameter as it returns the number of rows in the the query that are returned
  - ▶ On its own just rows in table
  - ▶ Especially useful with the GROUP BY clause for group counts

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### Extra Clauses

#### GROUP BY

- ▶ Required for ALL columns not linked to an aggregate function
- ▶ Columns separated by commas
- ▶ Order is not required but follow the SELECT clause
- ▶ Written after the FROM/WHERE clauses
- ▶ Executes **BEFORE** the WHERE and/or SELECT clauses

#### HAVING

- ▶ Optional
- ▶ Used to limit rows based on results of an aggregate function (like WHERE)
- ▶ Written after the GROUP BY clause
- ▶ Executes before the WHERE and/or SELECT clauses

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### When?

- ▶ If more columns than what the aggregate function is called on, the required GROUP BY clause is going to execute **AFTER** the FROM (of course) and **BEFORE** the WHERE/SELECT clauses since the coalesced column values need to be grouped together (lol)
- ▶ The optional HAVING clause also occurs **BEFORE** the WHERE/SELECT clauses since this is how the now coalesced results are then filtered before becoming available to the SELECT/WHERE clauses

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### Execution order

1. FROM
  - ▷ Pick the table(s)
2. GROUP BY
  - ▷ Identify and isolate based on column values
3. HAVING
  - ▷ Limit results based on result of aggregate
4. WHERE
  - ▷ Limit results based on other value(s)
5. SELECT
  - ▷ Pick the columns to display

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### Execution order of a query

```
4 SELECT
  section_id,
  COUNT(*) AS enroll_count
1 FROM
  enrollment
2 GROUP BY
  section_id
3 HAVING
  COUNT(*) > 4
5 ORDER BY
  COUNT(*),
  section_id
;
```

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### Demo Query

Worksheet    Query Builder

```
1 SELECT
2   section_id
3 FROM
4   enrollment;
```

Results

SECTION_ID
99
101
99
101
99
101

226 rows selected.

9

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### Limit query with DISTINCT

Distinct Query

```
Worksheet  Query Builder
6=SELECT DISTINCT
7  section_id
8 FROM
9  enrollment;
10
```

Distinct Results

SECTION_ID
102
100
147
117
123
92
150
138
91

64 rows selected.

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### Use Aggregate Function

Aggregate Query

```
Worksheet  Query Builder
11=SELECT
12  section_id,
13  COUNT(*) AS enroll_count
14 FROM
15  enrollment
16 GROUP BY
17  section_id;
18
```

Aggregate Results

SECTION_ID	ENROLL_COUNT
148	5
149	1
150	3
151	2
152	4
153	3
154	4
155	5
156	8

64 rows selected.

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