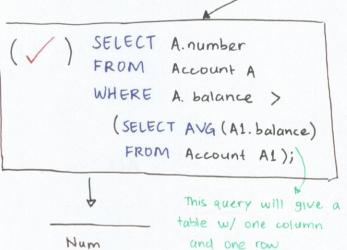
NESTED QUERIES

AGGREGATE RESULTS IN WHERE

Account

| Branch | CustID | Balance |
|-----------|--------|----------------------|
| London | L | 1330.00 |
| London | 2 | 1756.00 |
| Edinburgh | i | 450.00 |
| | London | London L London 2 |

QN: Accounts w/ a higher balance than the avg. of all accounts



A table w/ a single value.

SELECT A.number FROM Account A WHERE A. balance > AVG (SELECT A1. balance FROM Account A1) i

Aggregate for can only be used in SELECT and HAVING!

GENERAL SYNTAX

111

222

SELECT ... FROM ... WHERE term op (subquery);

Allowed as long as subquery returns a single value

SELECT FROM WHERE (term, ,..., term,) op (subquery);

as long as both subqueries

Allowed as long as subquery returns & a single row w/ n columns

(1,2,3) < (1,2,4) true (1,2,3) < (1,2,3) false

(1,3,1) < (1,4,3) true

(1,2,3) <= (1,2,3) true

The WHERE clause revisited

term := attribute | value

comparison :=

- **▶** (term, ..., term) **op** (term, ..., term) with **op** ∈ {=, <>, <, > <=, >=}
- ► term IS [NOT] NULL
- ► (term, ..., term) op ANY (query)
- ► (term, ..., term) op ALL (query)
- ► (term, ..., term) [NOT] IN (query)
- ► EXISTS (query)

condition :=

- comparison
- condition AND condition
- ► condition **OR** condition
- ► NOT condition

Comparisons between tuples

$$(A_1, \dots A_n) = (B_1, \dots, B_n) \iff A_1 = B_1 \wedge \dots \wedge A_n = B_n$$

$$(A_1, \dots A_n) \Leftrightarrow (B_1, \dots, B_n) \quad \iff \quad A_1 \neq B_1 \vee \dots \vee A_n \neq B_n$$

$$(A_1, A_2, A_3) < (B_1, B_2, B_3)$$
 (generalizes to n elements)

$$A_1 < B_1 \lor (A_1 = B_1 \land (A_2 < B_2 \lor (A_2 = B_2 \land A_3 < B_3)))$$

$$(A_1,A_2,A_3) <= (B_1,B_2,B_3) \qquad \text{(generalizes to n elements)}$$

$$\iff$$

$$A_1 < B_1 \lor \left(A_1 = B_1 \land \left(A_2 < B_2 \lor (A_2 = B_2 \land A_3 \leq B_3)\right)\right)$$

$$(A_{1}, A_{2}, A_{3}) < (B_{1}, B_{2}, B_{3}) \lor ((A_{1}, A_{2}, A_{3}) = (B_{1}, B_{2}, B_{3}))$$

ANY

- term, ..., term) op ANY (query)
- True if there exists a row r in the results of query such that
- → 3 < ANY ({1,2,3}) FALSE
 - 3 < ANY ([2,3,4]) TRUE

(term, ..., term) op F is true

 $\exists x : x \in \{2,3,4\} \land (3 < x)$

3 < ANY (1) - FALSE

No element in the empty set

ALL

- (term, ..., term) op ALL (query)
- True if for all rows \(\text{in the}\)
 results of query such that
 (term, ..., term) op \(\text{r} \) is true
- → 3 < ALL({5,4,63) TRUE
 - 3 < ALL ([4,3) 5]) FALSE

Ly ∀x: x ∈ {4,3,5} → (3<x)

- 3 < ALL ({ }) TRUE
 - Lo $\forall x: x \in \beta \rightarrow (3 < x)$ False

I.C. Customer: ID, Name, City Account: Num, Branch, CustID, Balance

→ QN: ID of customers from London who own an account

-> QN: Customers living in cities w/o a branch

SELECT C.id

FROM customer C

WHERE C. city = 'London'

AND C.id = ANY (SELECT A. custid FROM Account A);

SELECT *

FROM Customer C

WHERE C. city <> ALL (SELECT A. branch FROM Account A);