CS122 Using Relational Databases and SQL
Subqueries and Set Operations

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Query Results

- Query results are either a table or a value*
  - E.g. `select * from products` or `select count(*) from products`
- *Query results can be used in places where a table/value can be used*

** A value can also be considered as a table with only one row and one column*

Subquery Example 1

- Find the most expensive products

```
select * from products where price =
        ( select max(price) from products );
```

Subquery Example 2

- List the ID's of the products sold on 2011/9/1

```
select d.product_id from order_details d,
        (select * from orders
                where date_ordered = '2011-09-01') as o
        where d.order_id = o.id;
```

Subquery Example 3

- List the ID's of the products sold on 2011/9/1

```
select product_id from order_details
        where order_id in
        (select id from orders
                where date_ordered = '2011-09-01');
```

About IN

- Checks whether a value is in a set of values
- Only works on single column
- Returns `NULL` if
  - The value is `NULL`, or
  - No match found and there's a `NULL` in the set

More Subquery Examples

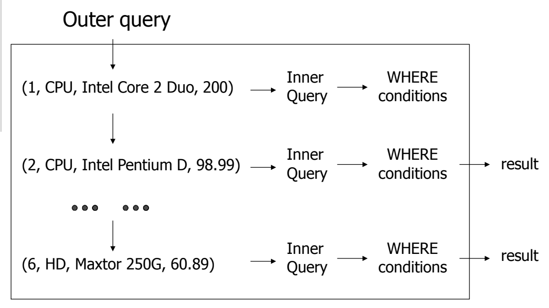
- Find the CPU products that are cheaper than Intel Pentium D
- Find the products that have never been ordered
  - NOT IN

Correlated Subquery

- The inner query uses column(s) from the outer query
  - E.g. find the products that are cheaper than the average price of their category

```
select * from products p where p.price <
        ( select avg(price) from products
                where category = p.category );
```

How Correlated Subqueries Work



Correlated Subquery Using EXISTS

- Find the customers who have ordered from our store before

```
select * from customers c where exists
        ( select * from orders
                where customer_id = c.id);
```

About EXISTS

- A unary operator
- Returns `true` if the subquery returns at least one row
- NOT EXISTS

ANY and ALL

- Find the CPU products that are more expensive than all HD products
- Find the HD products that are more expensive than at least one CPU product

Can we write these queries without using ANY or ALL??

Set Operations

- Union
  - {1,2,3} ∪ {4,5,6} = {1,2,3,4,5,6}
- Intersect
  - {1,2,3} ∩ {2,3,4} = {2,3}
- Difference
  - {1,2,3} – {2,3,4} = {1}

Set Operations in Database - UNION

vendors

vendor	zip
Intel	91111
AMD	92222
Seagate	83333
MAXTOR	74444

customers

customer	zip
John	91111
Jane	91111
Tom	92222

- List all the zip codes from both `vendors` and `customers` table

About UNION

- Combine result tables of `SELECT` statements
- The result tables must have the same number of columns
- The corresponding columns must have the same (or at least "compatible") type
- Duplicates in union results
  - `UNION` – automatically remove duplicates
  - `UNION ALL` – keep duplicates

INTERSECT and DIFFERENCE

- Same syntax as UNION
- MySQL does not support INTERSECT and DIFFERENCE
- *So how we implement intersection and difference without INTERSECT and DIFFERENCE??*

Summary

- Syntax
  - Subquery (regular and correlated)
  - IN, EXISTS, ANY, ALL
- A different way of thinking (vs. Joins)