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Aggregates

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❖ Aggregates

Aggregates reduce a collection of values into a single result.

Examples: `count(Tuples)`, `sum(Numbers)`,
`max(AnyOrderedType)`

The action of an aggregate function can be viewed as:

```
State = initial state
for each item T {
    # update State to include T
    State = updateState(State, T)
}
return makeFinal(State)
```

❖ Aggregates (cont)

Aggregates are commonly used with **GROUP BY**.

In that context, they "summarise" each group.

Example:

R				select a,sum(b),count(*)		
a b c				from R group by a		
-----+-----+-----						
1 2 x						
1 3 y						
2 2 z						
2 1 a						
2 3 b						

a sum count				
-----+-----+-----				
1 5 2				
2 6 3				

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group by essentially puts your results into different buckets, all with the same value for the grouping attribute (which is attribute a above). The aggregates then work within the groups, not across them. That's why sum is 5 for blue and 6 for red, similarly with count being 2 and 3.

❖ User-defined Aggregates

SQL standard does not specify user-defined aggregates.

But PostgreSQL provides a mechanism for defining them.

To define a new aggregate, first need to supply:

- *BaseType* ... type of input values
- *StateType* ... type of intermediate states
- state mapping function: $sfunc(state, value) \rightarrow newState$
- [optionally] an initial state value (defaults to null)
- [optionally] final function: $ffunc(state) \rightarrow result$

❖ User-defined Aggregates (cont)

New aggregates defined using **CREATE AGGREGATE** statement:

```
CREATE AGGREGATE AggName(BaseType) (  
    sfunc      = UpdateStateFunction,  
    stype      = StateType,  
    optional { initcond = InitialValue,  
              finalfunc = MakeFinalFunction,  
              sortop    = OrderingOperator  
    );
```

- **initcond** (type *StateType*) is optional; defaults to **NULL**
- **finalfunc** is optional; defaults to identity function
- **sortop** is optional; needed for min/max-type aggregates

❖ User-defined Aggregates (cont)

Example: defining the **count** aggregate (roughly)

```
create aggregate myCount(anyelement) (  
    stype      = int,      -- the accumulator type  
    initcond   = 0,        -- initial accumulator value  
    sfunc      = oneMore   -- increment function  
);  
  
create function  
    oneMore(sum int, x anyelement) returns int  
as $$  
begin return sum + 1; end;  
$$ language plpgsql;
```

❖ User-defined Aggregates (cont)

Example: **sum2** sums two columns of integers

```
create type IntPair as (x int, y int);
```

```
create function
```

```
    addPair(sum int, p IntPair) returns int  
as $$
```

```
begin return sum + p.x + p.y; end;
```

```
$$ language plpgsql;
```

```
create aggregate sum2(IntPair) (  
    stype      = int,  
    initcond   = 0,  
    sfunc      = addPair  
);
```

❖ User-defined Aggregates (cont)

PostgreSQL has many aggregates (e.g. **sum**, **count**, ...)

But it doesn't have a product aggregate.

Implement a **prod** aggregate that

- computes the product of values in a column of numeric data

Usage:

```
select prod(*) from iota(5);
prod
-----
120
```


❖ User-defined Aggregates (cont)

Example: product aggregate

```
create function
    mult(soFar numeric, next numeric) returns numeric
as $$
begin return soFar * next; end;
$$ language plpgsql;

create aggregate prod(numeric) (
    stype      = numeric,
    initcond   = 1,
    sfunc      = mult
);
```

❖ User-defined Aggregates (cont)

Define a **concat** aggregate that

- takes a column of string values
- returns a comma-separated string of values

Example:

```
select count(*), concat(name) from Employee;
```

```
-- returns e.g.
```

count	concat
4	John,Jane,David,Phil

❖ User-defined Aggregates (cont)

Example: string concatenation aggregate

```
create function
    join(s1 text, s2 text) returns text
as $$
begin
    if (s1 = '') then
        return s2;
    else
        return s1 || ',' || s2;
    end if;
end;
$$ language plpgsql;

create aggregate concat(text) (
    stype      = text,
    initcond   = '',
    sfunc      = join
);
```

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