Dutch Belgian DataBase Day – v2006

A Database Armada

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Data explosion

- World Wide Web
- Digital Libraries
- SkyServer

✓ Computation and storage exhaustive

Current line of defence

- Huge monolithic clusters
- GRIDs
- P2P overlay networks

Why it isn't sufficient

- Need for autonomous servers (co-operation)
- Need for divergent query answering (when is it done?)

✓ Current solutions don't cover both

The idea of Armada

- Don't use a central server
- Track lineage information to give directions

✓ We call it *Armada*

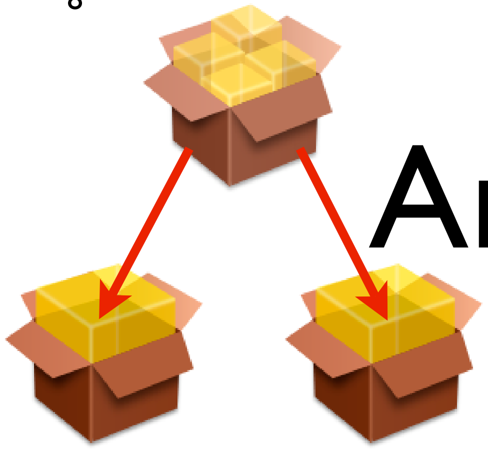
Armada

- A reference model for an evolving database system
- Transparent distribution in SQL

Meta data

- Distribute all to all
- Keep it central

✓ Armada is somewhere in the middle



Armada: chunking

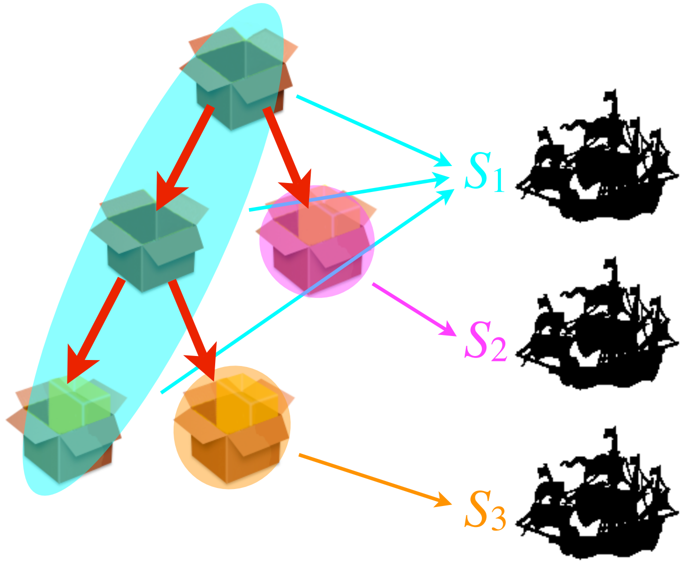
- Chunking is the process of fragmenting a box with data
- The *chunk operation* takes one box, and produces new ones

$$T_o = \qquad\qquad . [\,\%, S_1\,]{:}B_o\,; \begin{cases} [\,f\;, S_1\,]{:}B_1 \\ [\,f', S_2\,]{:}B_2 \end{cases}$$

$$T_1 = [\,\%, S_1\,]{:}B_o\,.\,[\,f\;, S_1\,]{:}B_1\,;$$

$$T_2 = [\,\%, S_1\,]{:}B_o\,.\,[\,f', S_2\,]{:}B_2\,;$$

Armada: evolving



- Chunking upon need
- New sites can host boxes to help out
- Old (empty) boxes stay around for routing

Boxes keep meta-data about their predecessor and successors. This allows to redirect an arbitrary client with an arbitrary query in the right direction.

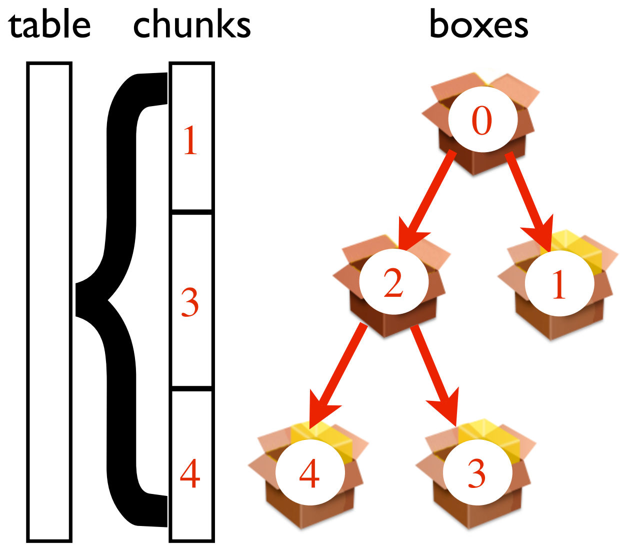
Armada properties

- Sites or ships, are considered autonomous
- No full replication, no full meta-data replication, no central server

✓ Meta-data (= lineage) distribution

Armada in a database

- Active boxes hold data
- All chunks together form a full table
- Take the *union* of all chunks



SQL

- Each Armada starts at a single site, as a single table:

```
CREATE TABLE treasures (
    bag    int,
    coins  bigint,
    origin varchar(64),
    CONSTRAINT t_b_pkey PRIMARY KEY (bag)
);
```

Chunking

- Creation of two new tables, representing the boxes
- Inclusion of a check for the chunk function

```
CREATE TABLE treasures_BX (
    bag    int,
    coins  bigint,
    origin varchar(64),
    CONSTRAINT BX_b_pkey PRIMARY KEY (bag),
    CONSTRAINT BX_b_check CHECK (treasures_F1(bag))
);
```

Moving

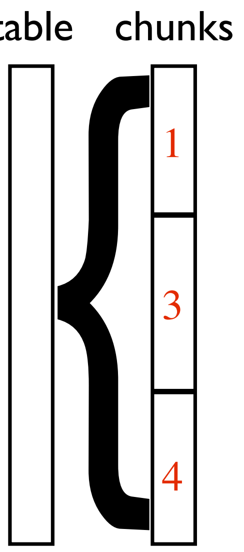
- “move” the data from the old to the new tables

```
INSERT INTO treasures_BX
    SELECT bag, coins, origin
        FROM treasures
        WHERE treasures_F1(bag);

DROP TABLE treasures;
```

Recording lineage

- Encode the lineage information into SQL views



```
CREATE VIEW treasures AS
    SELECT bag, coins, origin
        FROM (
            SELECT bag, coins, origin
                FROM treasures_B1
            UNION
            SELECT bag, coins, origin
                FROM treasures_B2
        ) AS treasures;
```

Getting answers

- Clients not aware of Armada
- "Just a query" on the original table
- Execution through views

```
SELECT *
    FROM treasures;
```

```
SELECT *
   FROM (
       SELECT bag, coins, origin
           FROM treasures_B1
       UNION
       SELECT bag, coins, origin
           FROM treasures_B2
   ) AS treasures;
```

Client particulars

- Centre of each operation
- Communication flow between client and servers
- No “chaining” or “recursion” at the server side
- Servers don’t play a client role

Execution revisited

- Servers won't "execute" the views
- Clients get "query plan" instead
- Query plan consists of sub queries and their relations

Query plans

- Look like the views
- Contain sub queries
- Explain how the sub queries must be glued together

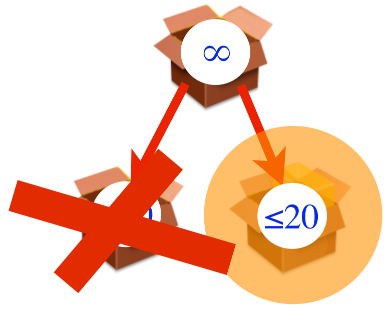
Total execution

- Client executes all sub queries from plan
- Client glues together (trivial with `UNIONs`)

- All boxes are consulted :(

Chunk functions help

- Query selection predicate
- Chunk function coverage



```
SELECT *
   FROM (
       SELECT bag, coins, origin
           FROM treasures_B1
       ~~UNION~~
       ~~SELECT bag, coins, origin~~
           ~~FROM treasures_B2~~
   ) AS treasures
   WHERE bag < 12;
```

```
SELECT *
   FROM treasures
   WHERE bag < 12;
```

Armada is

- Lineage based de-centralised system
- Autonomous servers
- Client centric

Questions?

Armada

MonetDB