

Assignment 3

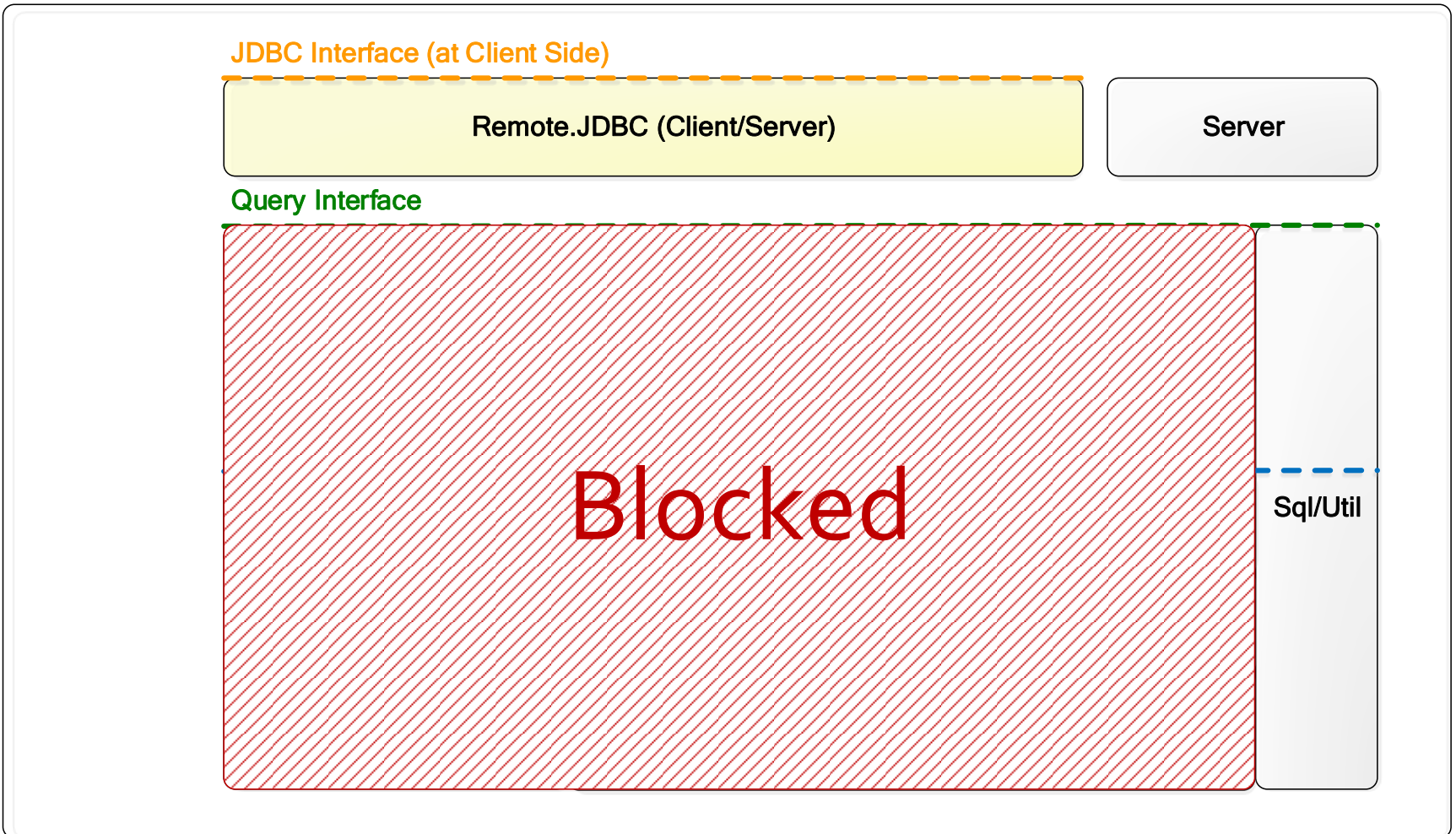
Databases Systems

DataLab, CS, NTHU

Spring, 2021

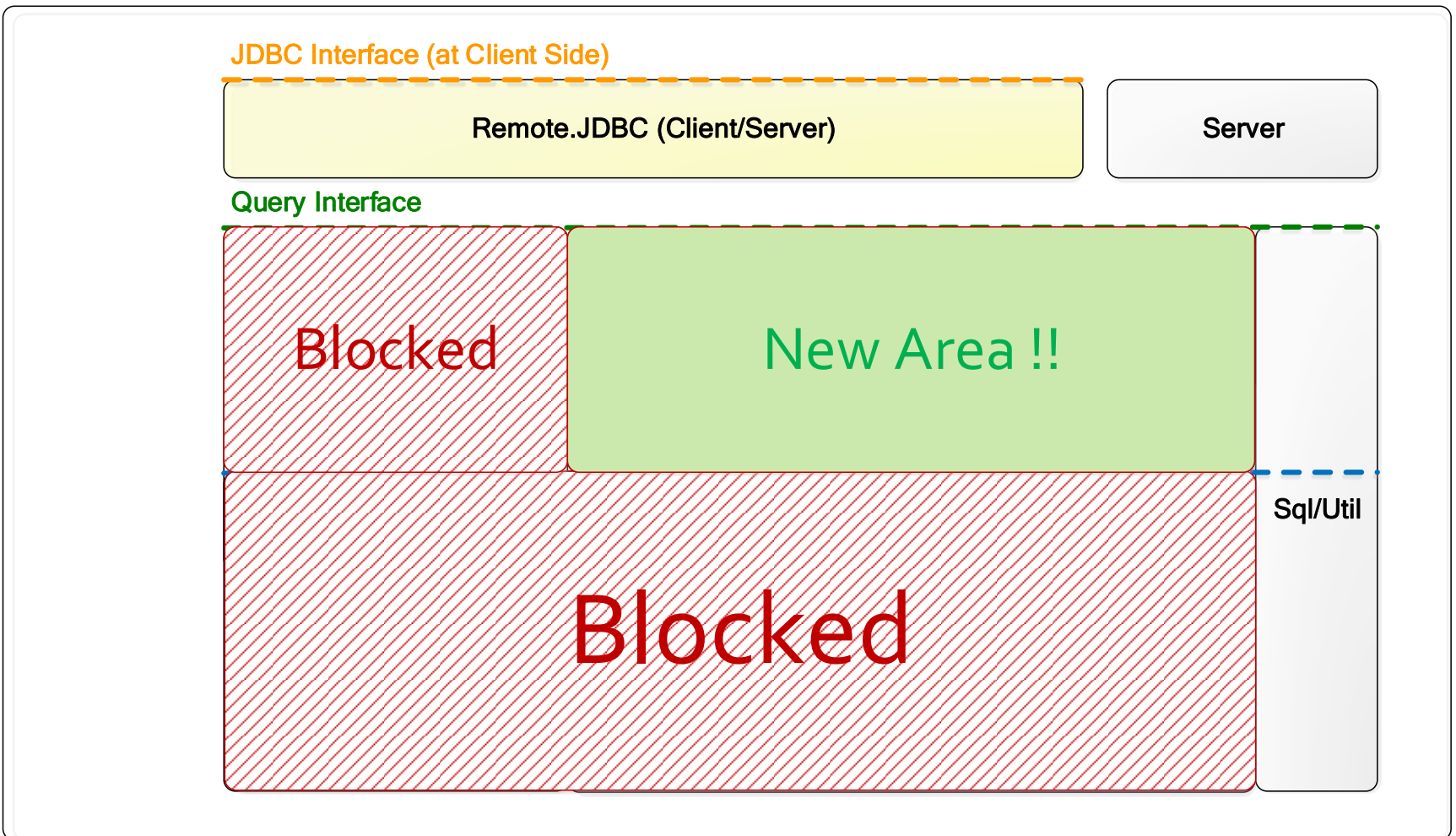
Last Time

VanillaDB



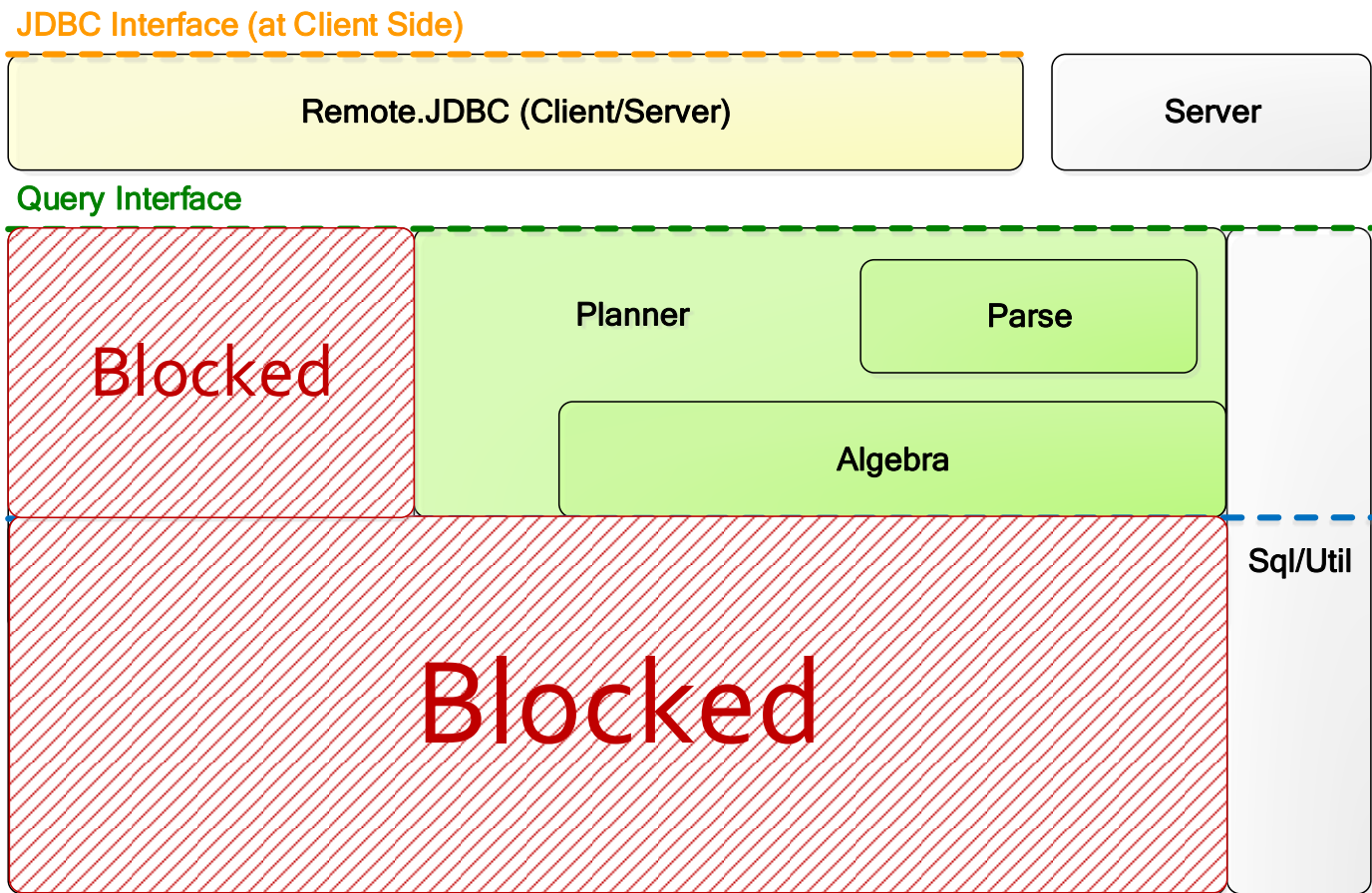
This Time

VanillaDB



This Time

VanillaDB



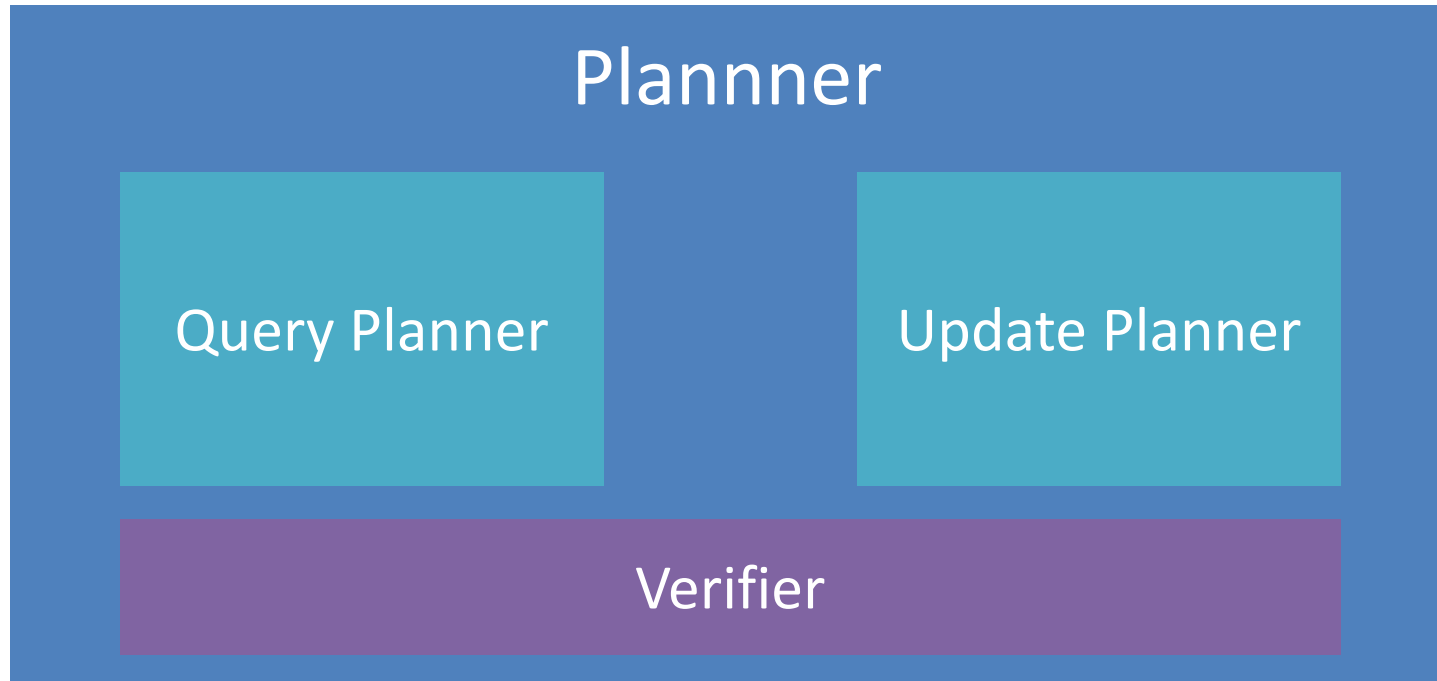
Outline

- Query package
 - Parse package
 - Algebra package
 - Planner package

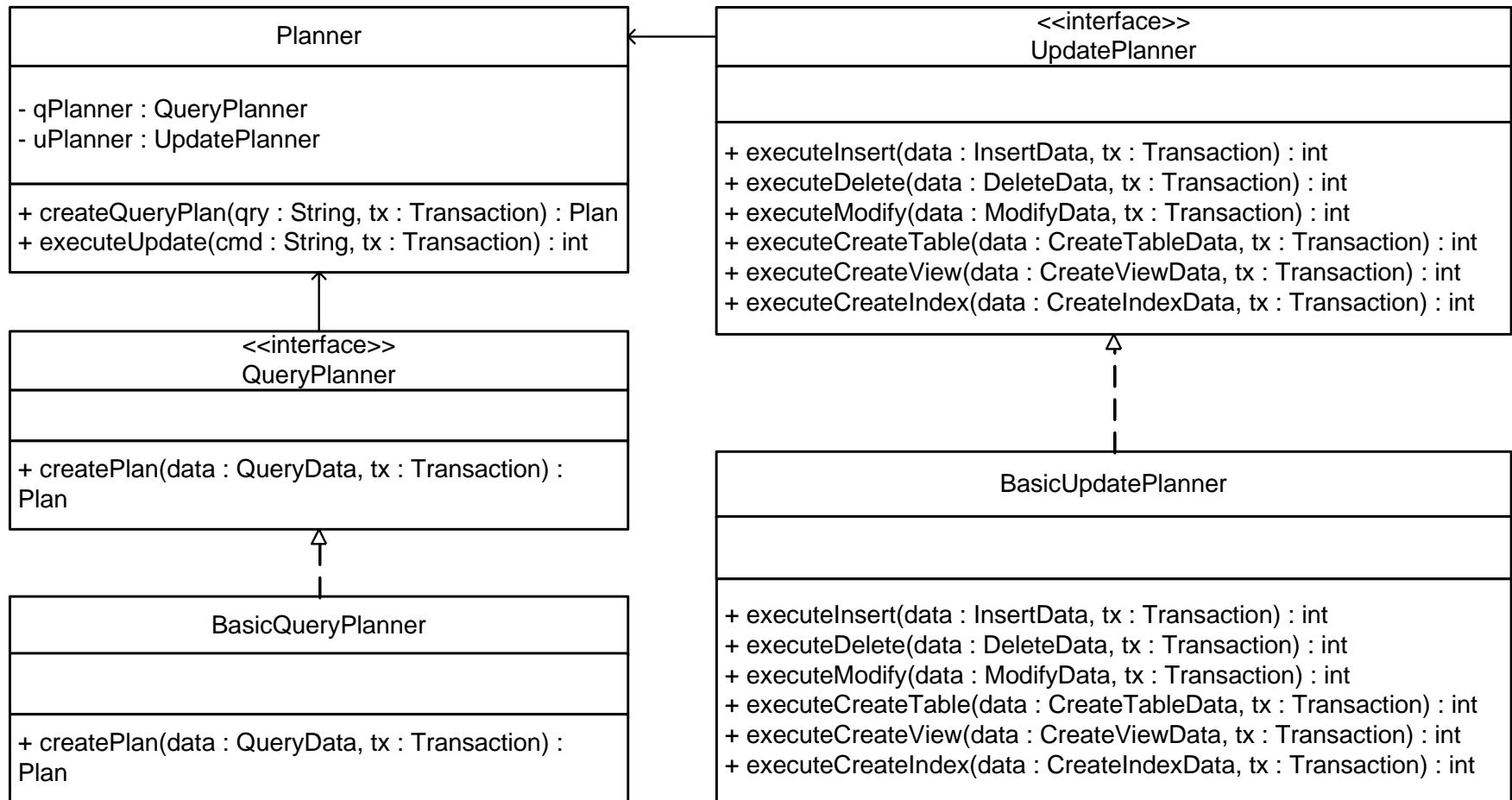
Planner

- The one puts all these together
 1. Accepts a query
 2. Creates a parser to parse the query
 3. Verifies all parameters are reasonable
 4. Generates a plan tree according to the query

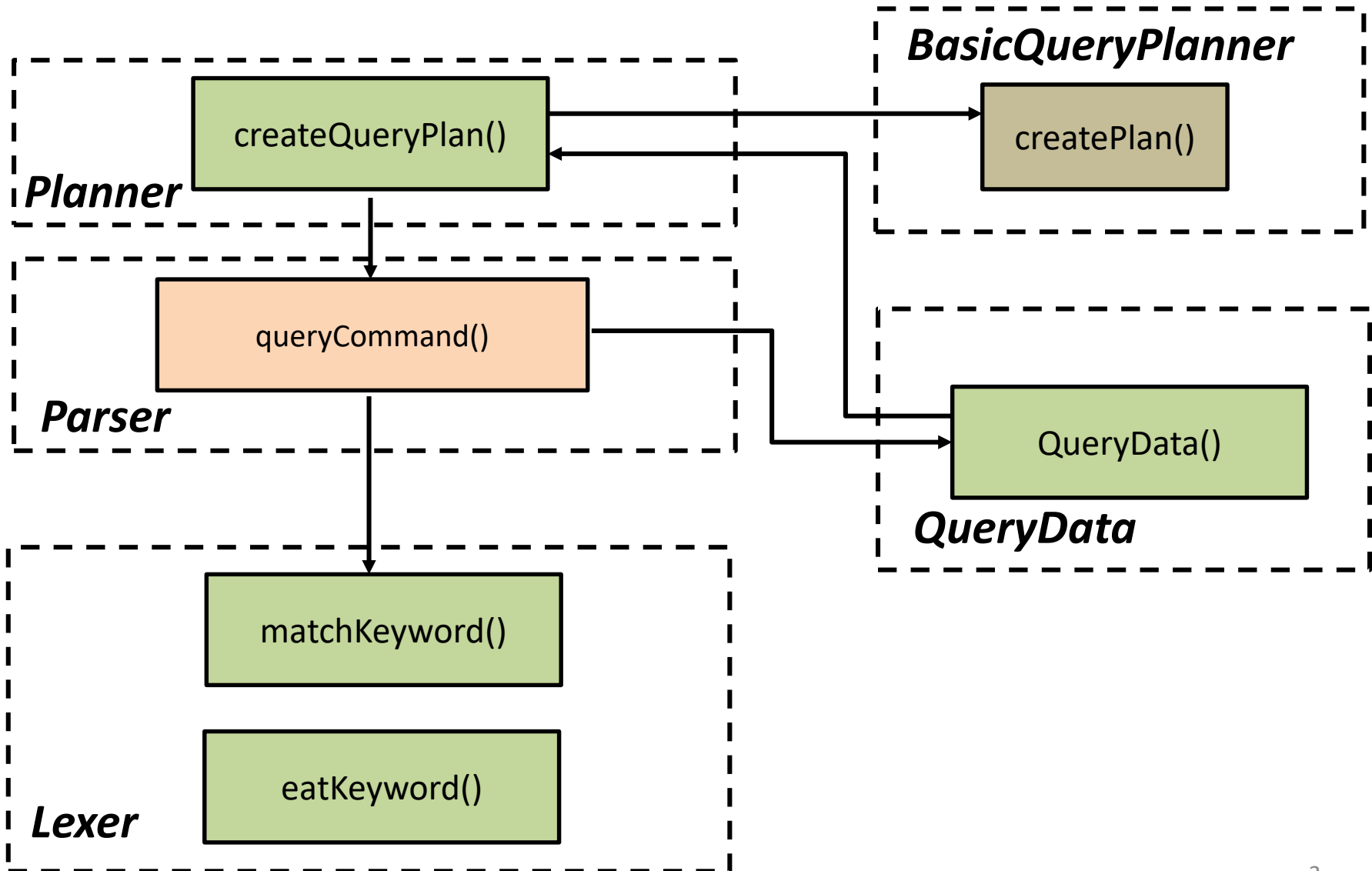
planner Package



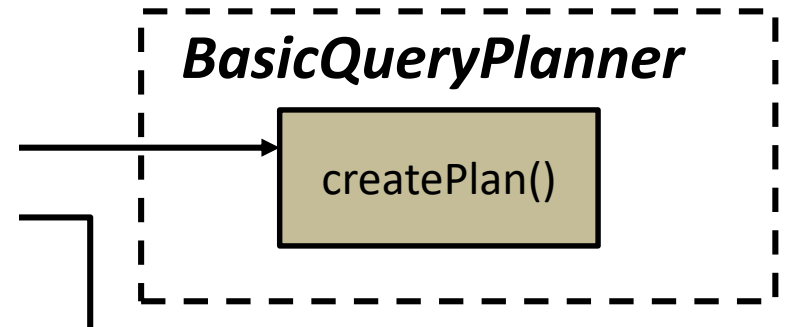
Basic Implementation



Overview



BasicQueryPlanner

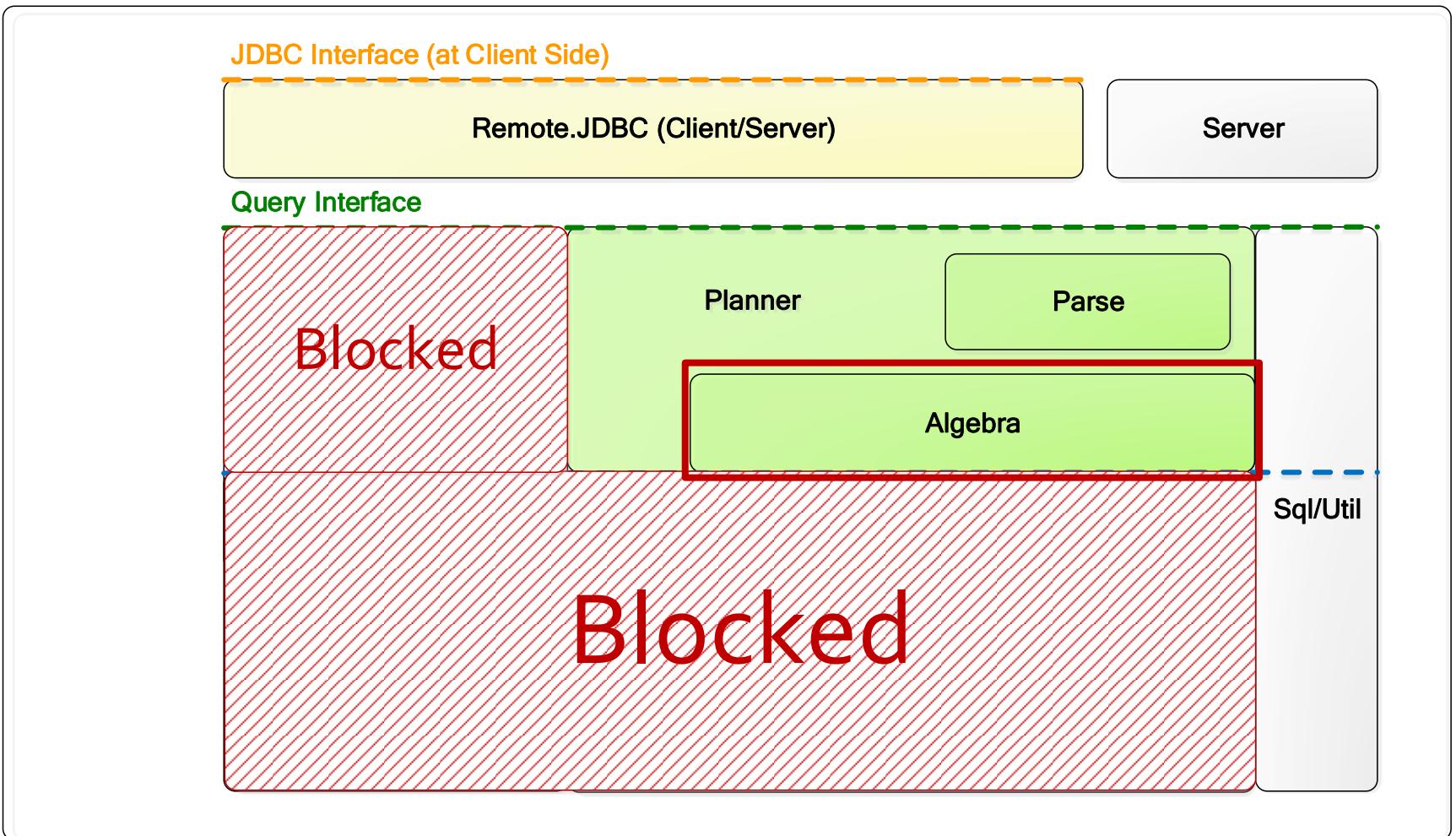


BasicQueryPlanner

```
public class BasicQueryPlanner implements QueryPlanner {  
  
    /**  
     * Creates a query plan as follows. It first takes the product of all tables  
     * and views; it then selects on the predicate; and finally it projects on  
     * the field list.  
     */  
    @Override  
    public Plan createPlan(QueryData data, Transaction tx) {  
        // Step 1: Create a plan for each mentioned table or view  
        List<Plan> plans = new ArrayList<Plan>();  
        for (String tblname : data.tables()) {  
            String viewdef = VanillaDb.catalogMgr().getViewDef(tblname, tx);  
            if (viewdef != null)  
                plans.add(VanillaDb.newPlanner().createQueryPlan(viewdef, tx));  
            else  
                plans.add(new TablePlan(tblname, tx));  
        }  
        // Step 2: Create the product of all table plans  
        Plan p = plans.remove(0);  
        for (Plan nextplan : plans)  
            p = new ProductPlan(p, nextplan);  
        // Step 3: Add a selection plan for the predicate  
        p = new SelectPlan(p, data.pred());  
        // Step 4: Add a group-by plan if specified  
        if (data.groupFields() != null) {  
            p = new GroupByPlan(p, data.groupFields(), data.aggregationFn(), tx);  
        }  
        // Step 5: Project onto the specified fields  
        p = new ProjectPlan(p, data.projectFields());  
        // Step 6: Add a sort plan if specified  
        if (data.sortFields() != null)  
            p = new SortPlan(p, data.sortFields(), data.sortDirections(), tx);  
  
        return p;  
    }  
}
```

Where Are We ?

VanillaDB



algebra Package

```
graph LR; A[Plan Classes] --- B[Scan Classes]; A --- C[Materialize Package]; B --- C;
```

Plan
Classes

Scan
Classes

Materialize
Package

Plan & Scan

<<interface>> Plan
+ open() : Scan + blocksAccessed() : long + schema() : Schema + histogram() : Histogram + recordsOutput() : long

<<interface>> Scan
+ beforeFirst() + next() : boolean + close() + hasField(fldname : String) : boolean

Using a Query Plan

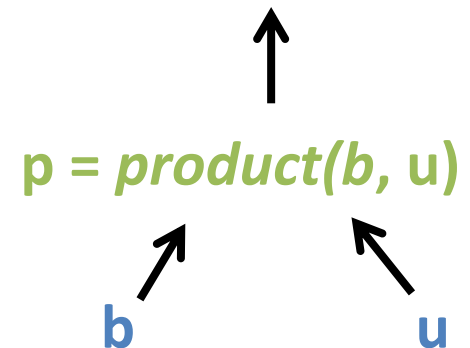
```
VanillaDb.init("studentdb");  
Transaction tx = VanillaDb.txMgr().newTransaction(  
    Connection.TRANSACTION_SERIALIZABLE, true);
```

```
Plan pb = new TablePlan("b", tx);  
Plan pu = new TablePlan("u", tx);  
Plan pp = new ProductPlan(pb, pu);  
Predicate pred = new Predicate("...");  
Plan sp = new SelectPlan(pp, pred);
```

```
sp.blockAccessed(); // estimate #blocks accessed
```

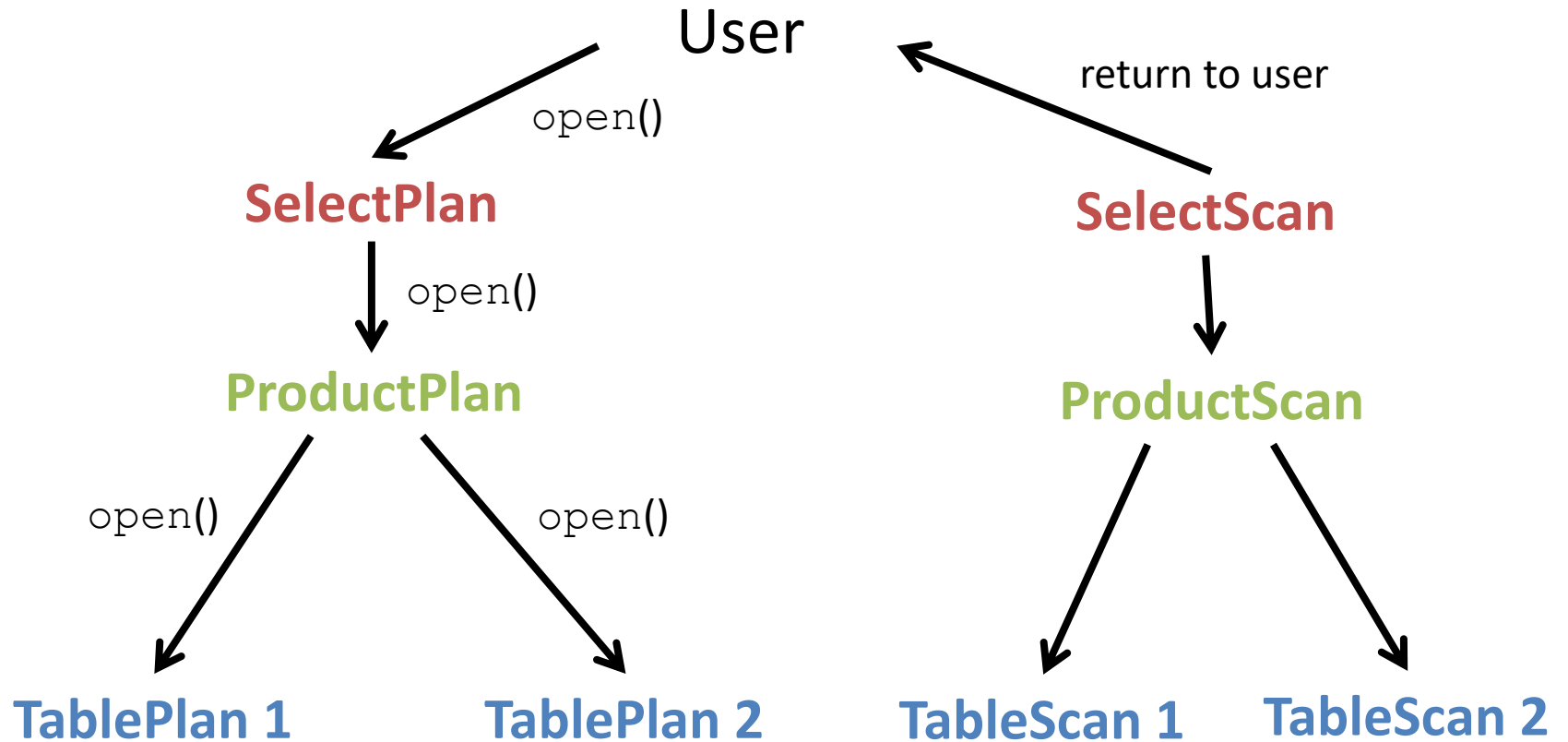
```
// open corresponding scan only if sp has low cost  
Scan s = sp.open();  
s.beforeFirst();  
while (s.next())  
    s.getVal("bid");  
s.close();
```

select(p, where...)



What Happened When We Called `open ()` ?

open ()



How Do Scans Work ?

Example

project(s, select blog_id)



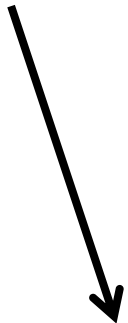
beforeFirst()

**select(p, where name = 'Picachu'
and author_id = user_id)**



beforeFirst()

product(b, u)



beforeFirst()

b

blog_id	url	created	author_id
33981	...	2009/10/31	729
33982	...	2012/11/15	730
41770	...	2012/10/20	729

u

user_id	name	balance
729	Steven Sinofsky	10,235
730	Picachu	NULL

```
SELECT blog_id FROM b, u
WHERE name = "Picachu"
AND author_id = user_id;
```

Example

project(s, select blog_id)



beforeFirst()

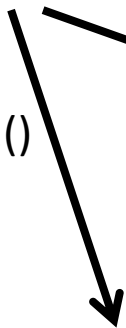
**select(p, where name = 'Picachu'
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beforeFirst()

product(b, u)

next()



beforeFirst()



b

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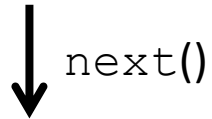
u

user_id	name	balance
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```
SELECT blog_id FROM b, u
WHERE name = "Picachu"
AND author_id = user_id;
```

Example

project(s, select blog_id)



select(p, where name = 'Picachu'
and author_id = user_id)



product(b, u)

blog_id	url	created	author_id	user_id	name	balance
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next()

b

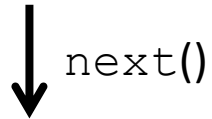
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Example

project(s, select blog_id)



select(p, where name = 'Picachu'
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product(b, u)

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b

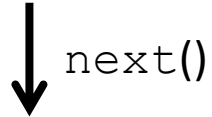
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Example

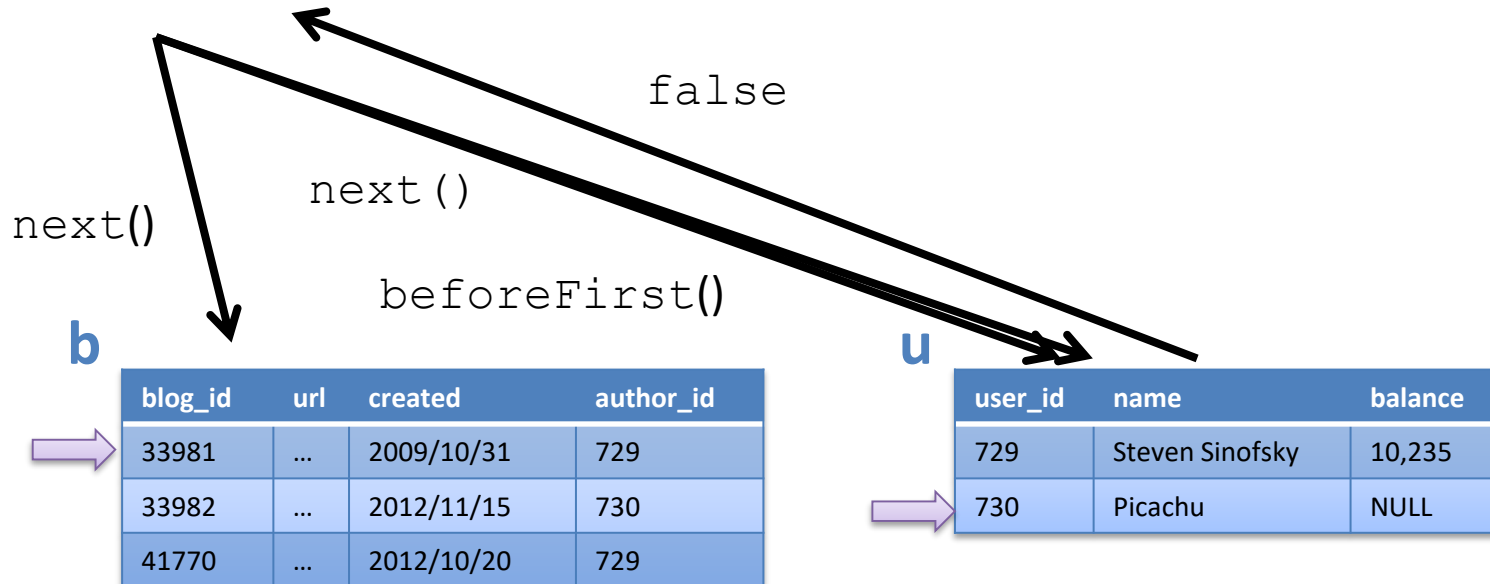
project(s, select blog_id)



**select(p, where name = 'Picachu'
and author_id = user_id)**

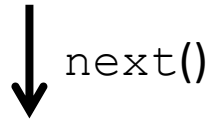


product(b, u)



Example

project(s, select blog_id)



select(p, where name = 'Picachu'
and author_id = user_id)



product(b, u)

blog_id	url	created	author_id	user_id	name	balance
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next()

b

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user_id	name	balance
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Example

project(s, select blog_id)

blog_id
33982

next()

blog_id	url	created	author_id	user_id	name	balance
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**select(p, where name = 'Picachu'
and author_id = user_id)**

next()



product(b, u)

blog_id	url	created	author_id	user_id	name	balance
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next()

b

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Example

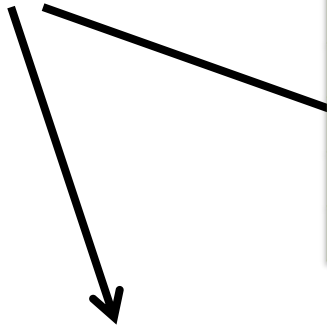
project(s, select...)



select(p, where
name = 'Picachu')



product(b, u)



blog_id
33982



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41770	...	2012/10/20	729	730	Picachu	NULL

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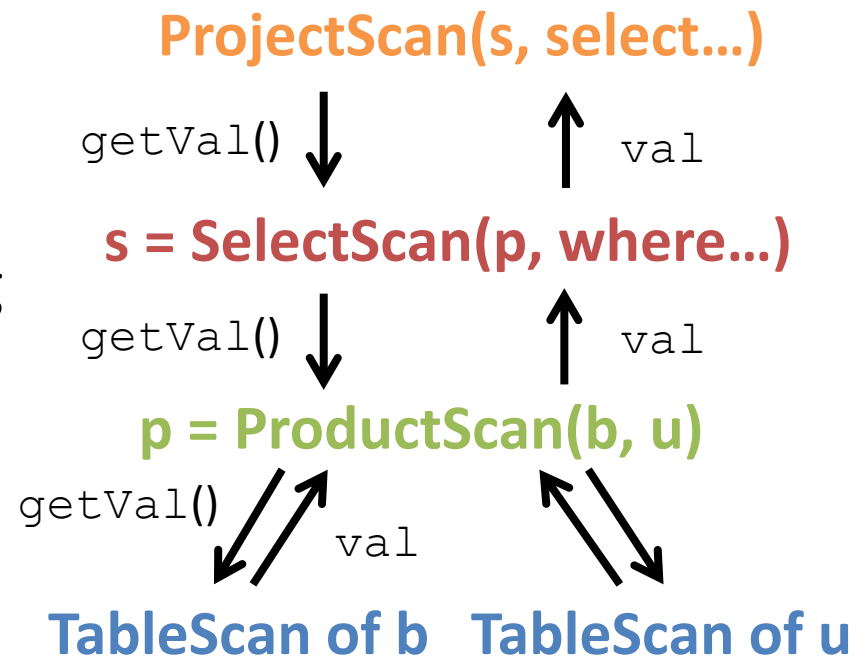
u

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Pipelined Scanning

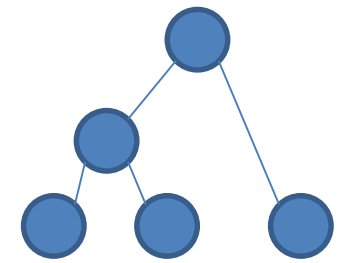
- The above operators implement **pipelined scanning**
 - Calling a method of a node results in recursively calling the same methods of child nodes on-the-fly
 - Records are computed one at a time as needed --- no intermediate records are saved



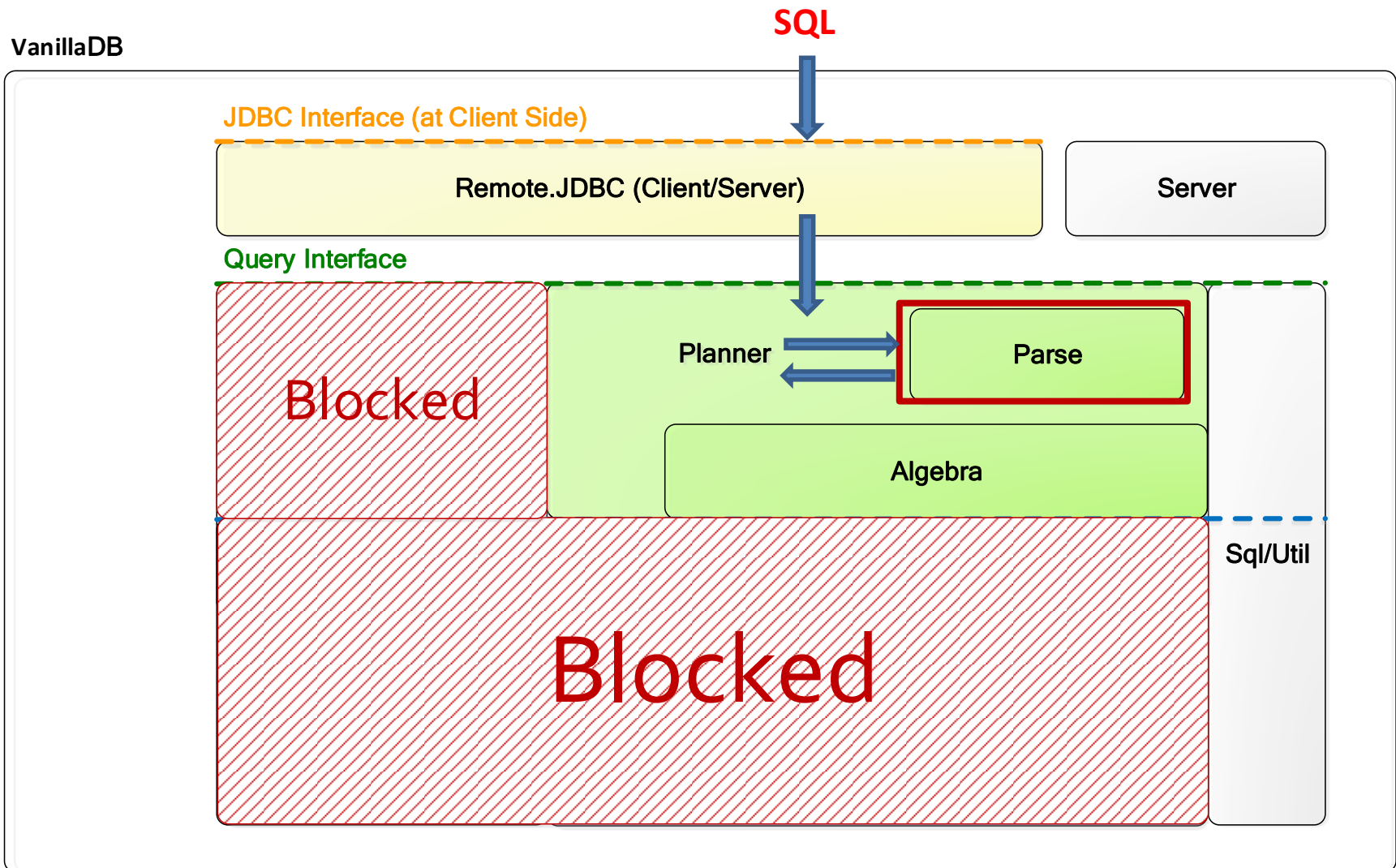
Pipelined vs. Materialized

- Despite its simplicity, pipelined scanning is inefficient in some cases
 - E.g., when implementing `SortScan` (for `ORDER BY`)
 - It needs to iterate all children to find the next record
- For such cases, we use ***materialized scanning***
 - Intermediate records are materialized to a temp table (file)
 - E.g., the `SortScan` can use an external sorting algorithm to sort all records at once, save them, and return each record upon `next()` is called
- Pipelined or materialized?
 - Saving in scanning cost vs. materialization overhead

Where Are We ?



VanillaDB



Two Steps of Parsing A SQL

- Lexer
 - Tokenizing
 - Identifying keywords, IDs, values, delimiters
- Parser
 - Checking syntax
 - Identifying the action and the parameters

Overview

