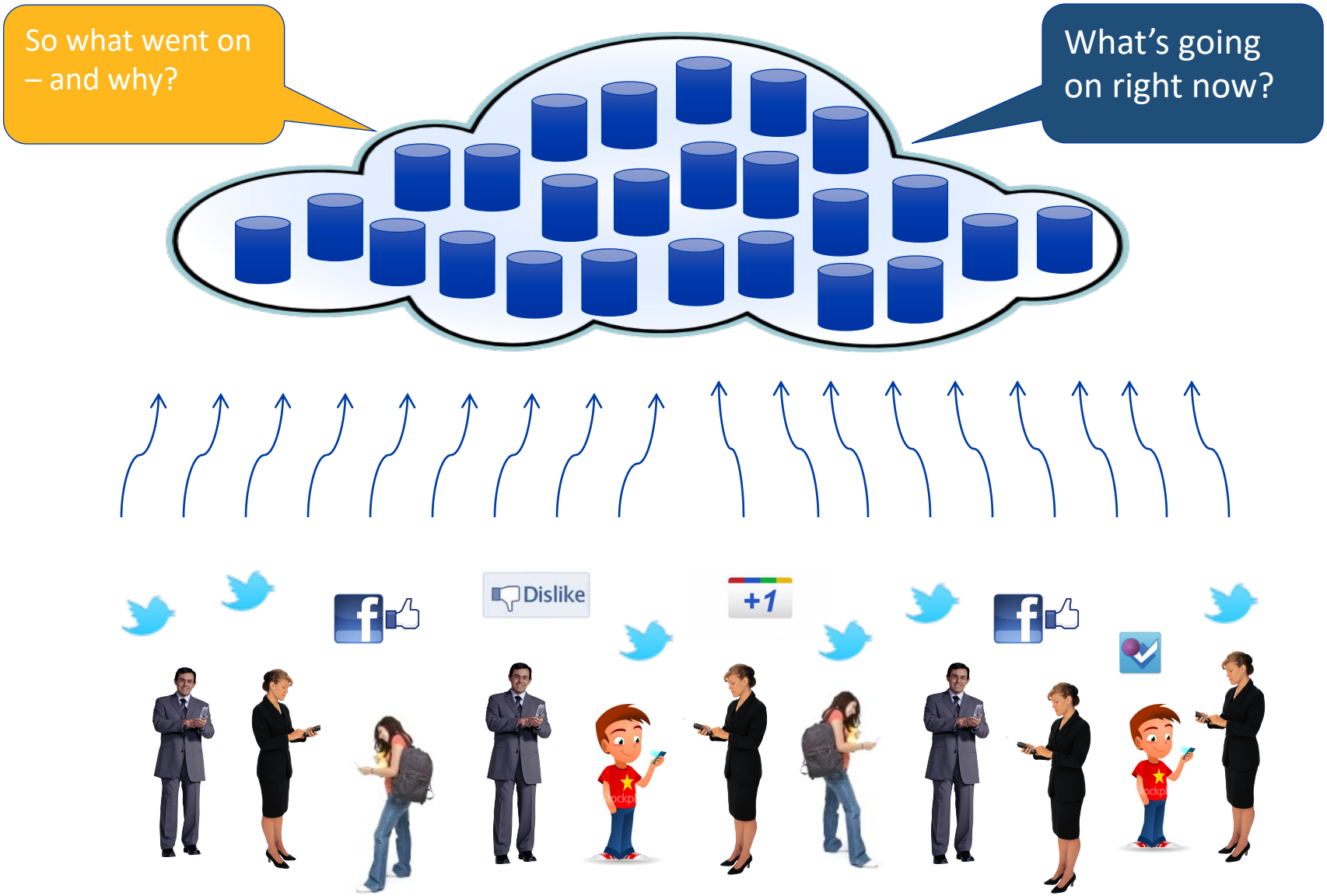
AsterixDB

A Scalable Open Source BDMS

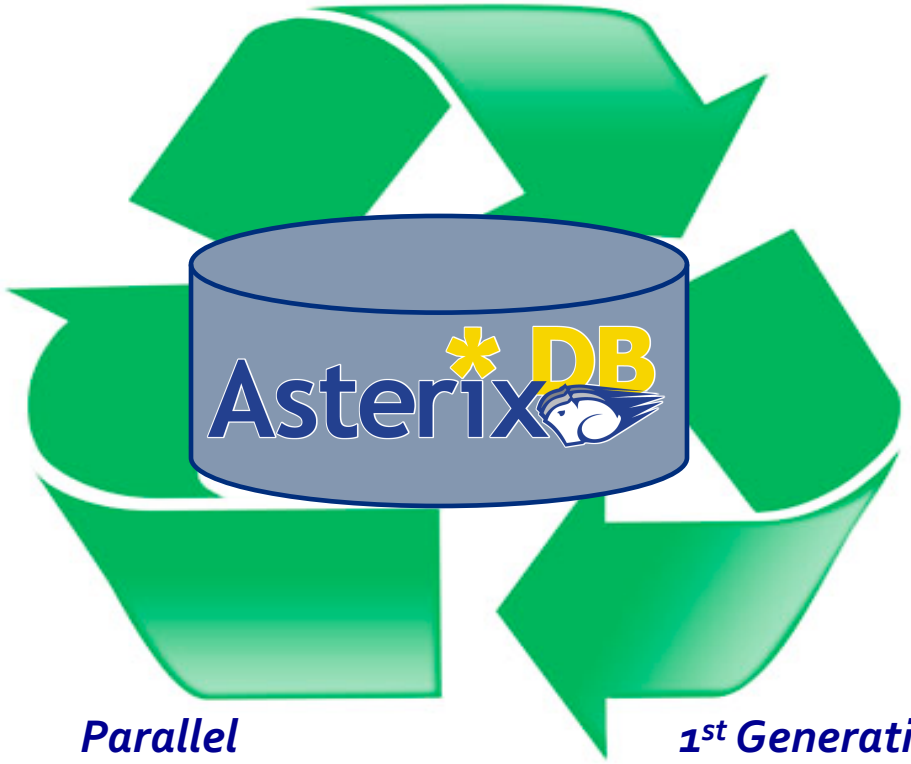
This presentation is based on slides made by Michael J. Carey, Chen Li, and Vassilis Tsotras

Big Data / Web Warehousing



Also: Today's Big Data Tangle

AsterixDB: "One Size Fits a Bunch"



BDMS Desiderata:

- Able to **manage** data
- **Flexible** data model
- Full **query** capability
- Continuous data **ingestion**
- Efficient and robust **parallel** runtime
- Cost **proportional** to task at hand
- Support "**Big Data** data types"

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ASTERIX Data Model (ADM)

```
CREATE DATAVERSE TinySocial;
USE TinySocial;

CREATE TYPE GleambookUserType AS {
   id: int,
   alias: string,
   name: string,
   userSince: datetime,
   friendIds: {{ int }},
   employment: [EmploymentType]
};
```

```
CREATE TYPE EmploymentType AS {
   organizationName: string,
   startDate: date,
   endDate: date?
};

CREATE DATASET GleambookUsers
                    (GleambookUserType)
PRIMARY KEY id;
```

Highlights include:

- JSON++ based data model
- Rich type support (spatial, temporal, …)
- Records, lists, bags
- ***Open vs. closed types***

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ASTERIX Data Model (ADM)

```
CREATE DATAVERSE TinySocial;
USE TinySocial;

CREATE TYPE GleambookUserType AS {
   id: int
};

CREATE TYPE GleambookMessageType AS {
      messageId: int,
      authorId: int,
      inResponseTo: int?,
      senderLocation: point?,
      message: string
   };

CREATE TYPE EmploymentType AS {
   organizationName: string,
   startDate: date,
   endDate: date?
};

CREATE DATASET GleambookUsers
                  (GleambookUserType)
PRIMARY KEY id;

CREATE DATASET GleambookMessages
                  (GleambookMessageType)
PRIMARY KEY messageId;
```

Ex: GleambookUsers Data

```
{"id”:1, "alias":"Margarita", "name":"MargaritaStoddard", "nickname":"Mags”,
  "userSince":datetime("2012-08-20T10:10:00"),  "friendIds":{{2,3,6,10}},
  "employment": [ {"organizationName":"Codetechno”, "startDate":date("2006-08-06")},
                        {"organizationName":"geomedia" ,     "startDate":date("2010-06-17"),
                                                                    "endDate":date("2010-01-26")} ],
  "gender":"F”
},

{"id":2, "alias":"Isbel”, "name":"IsbelDull", "nickname":"Izzy",
  "userSince":datetime("2011-01-22T10:10:00"),  "friendIds":{{1,4}},
  "employment": [ {"organizationName":"Hexviafind",  "startDate":date("2010-04-27")} ]
},

{"id":3, "alias":"Emory", "name":"EmoryUnk”,
  "userSince":datetime("2012-07-10T10:10:00"), "friendIds":{{1,5,8,9}},
  "employment": [ {"organizationName":"geomedia”,  "startDate":date("2010-06-17"),
                                                                "endDate":date("2010-01-26")} ]
},
          .....
```

Other DDL Features

```
CREATE INDEX gbUserSinceIdx ON GleambookUsers(userSince);
CREATE INDEX gbAuthorIdx ON GleambookMessages(authorId) TYPE BTREE;
CREATE INDEX gbSenderLocIndex ON GleambookMessages(senderLocation) TYPE RTREE;
CREATE INDEX gbMessageIdx ONGleambookMessages(message) TYPE KEYWORD;
//---------- and also ----------

CREATE TYPE AccessLogType AS CLOSED
   { ip: string, time: string, user: string, verb: string, `path`: string,  stat: int32, size: int32 };
CREATE EXTERNAL DATASET AccessLog(AccessLogType) USING localfs
   (("path"="localhost:///Users/mikejcarey/extdemo/accesses.txt"),
     ("format"="delimited-text"), ("delimiter"="|"));

CREATE FEED myMsgFeed USING socket_adapter
    (("sockets"="127.0.0.1:10001"), ("address-type"="IP"),
     ("type-name"="GleambookMessageType"), ("format"="adm"));
CONNECT FEED myMsgFeed TO DATASET GleambookMessages;
START FEED myMsgFeed;
```

External data highlights:

- Equal opportunity access
- Feeds to “keep everything!”
- Ingestion, *not* streams

ASTERIX Queries (SQL++)

- *Q1:* List the user names and messages sent by Gleambook social network users with less than 3 friends:

```
SELECT user.name AS uname,
            (SELECT VALUE msg.message
             FROM GleambookMessages msg
             WHERE msg.authorId = user.id) AS messages
FROM GleambookUsers user
WHERE COLL_COUNT(user.friendIds) < 3;
```

```
{ "uname": "NilaMilliron", "messages": [  ] }
{ "uname": "WoodrowNehling", "messages": [ " love acast its 3G is good:)" ] }
{ "uname": "IsbelDull", "messages": [ " like product-y the plan is amazing", " like
  product-z its platform is mind-blowing" ] }
...
```

SQL++ *(cont.)*

- *Q2:* Identify active users (last 30 days) and group and count them by their numbers of friends:

```
WITH endTime AS current_datetime(),
     startTime AS endTime - duration("P30D")
SELECT nf AS numFriends, COUNT(user) AS activeUsers
FROM GleambookUsers user
LET nf = COLL_COUNT(user.friendIds)
WHERE SOME logrec IN AccessLog SATIS
     user.alias = logrec.user
     AND datetime(logrec.time) >= startTime
     AND datetime(logrec.time) <= endTime
GROUP BY nf;
```

```
{ "numFriends": 2, "activeUsers": 1 }
{ "numFriends": 4, "activeUsers": 2 }
 . . .
```

***SQL++ highlights*:**

- Born at UCSD (Yannis P.)
- Many features (see docs)
- Spatial & text predicates
- Set-similarity matching

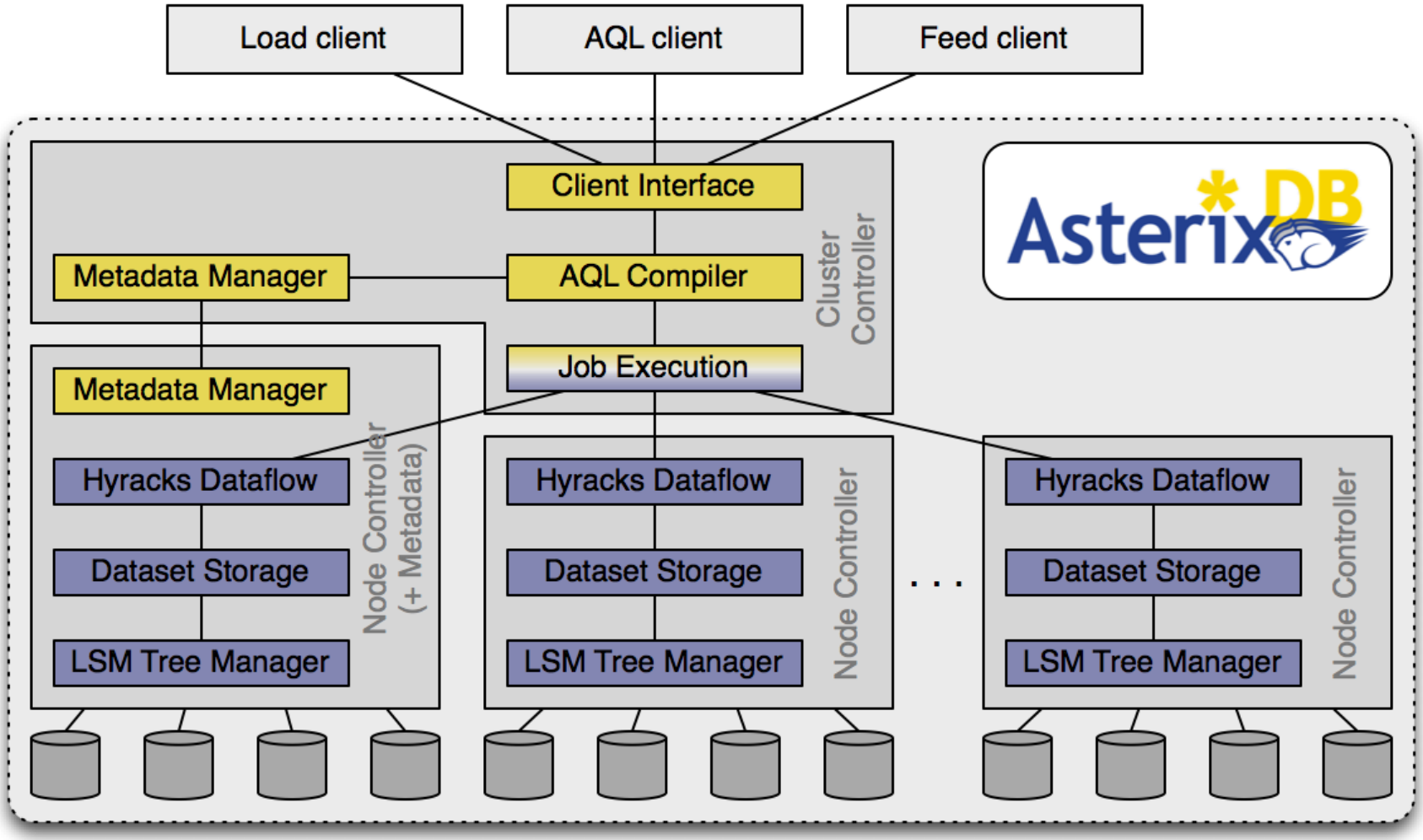
Updates and Transactions

- *Q3:* Add a new user to Gleambook.com:

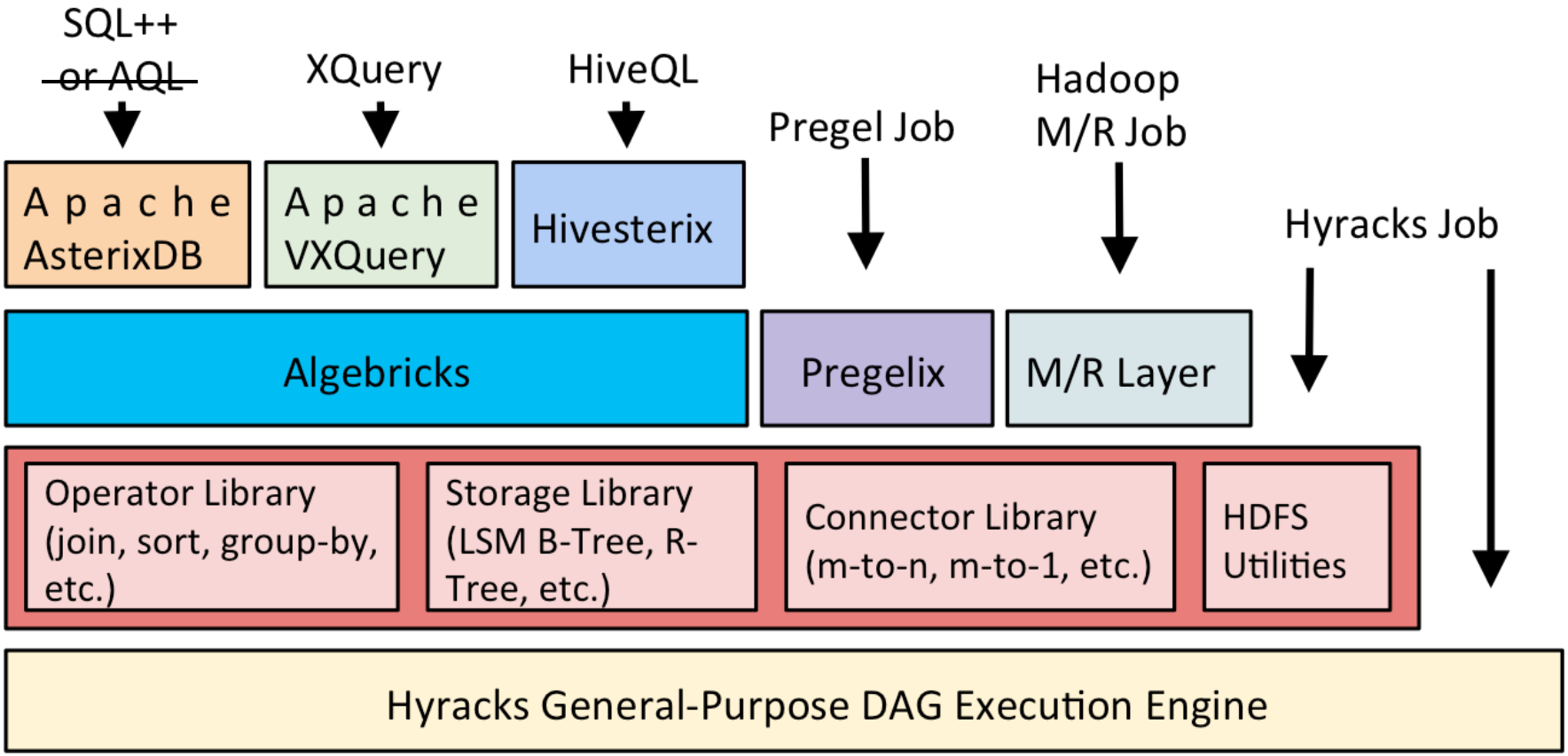
```
UPSERT INTO GleambookUsers (
{"id":667,"alias":"dfrump",
 "name":"DonaldFrump",
  "nickname":"Frumpkin",
  "userSince":datetime("2017-01-
    01T00:00:00"),
  "friendIds":{{ }},
  "employment":[{"organizationName":"USA",
  "startDate":date("2017-01-20")}],
  "gender":"M"}
);
```

- Key-value store-like transactions (w/record-level atomicity)
- Insert, delete, and upsert ops; index-consistent
- 2PL concurrency
- WAL no-steal, no-force with LSM shadowing

AsterixDB System Overview



Software Stack



Hyracks Dataflow Runtime

- Partitioned-parallel platform for data-intensive computing
- Job = dataflow DAG of operators and connectors
  - Operators consume and produce ***partitions*** of data
  - Connectors ***route*** (repartition) data between operators
- Hyracks *vs.* the "competition"
  - Based on time-tested parallel database principles
  - *vs.* Hadoop MR: More flexible model and less "pessimistic"
  - *vs.* newer SQL-on-Hadoop runtimes: Emphasis on out-of-core execution and adherence to memory budgets
  - Fast job activation, data pipelining, binary format, state-of-the-art DB style operators (hash-based, indexed, ...)
- Early test at Yahoo! Labs on 180 nodes (1440 cores, 720 disks)

Hyracks *(cont.)*

Query

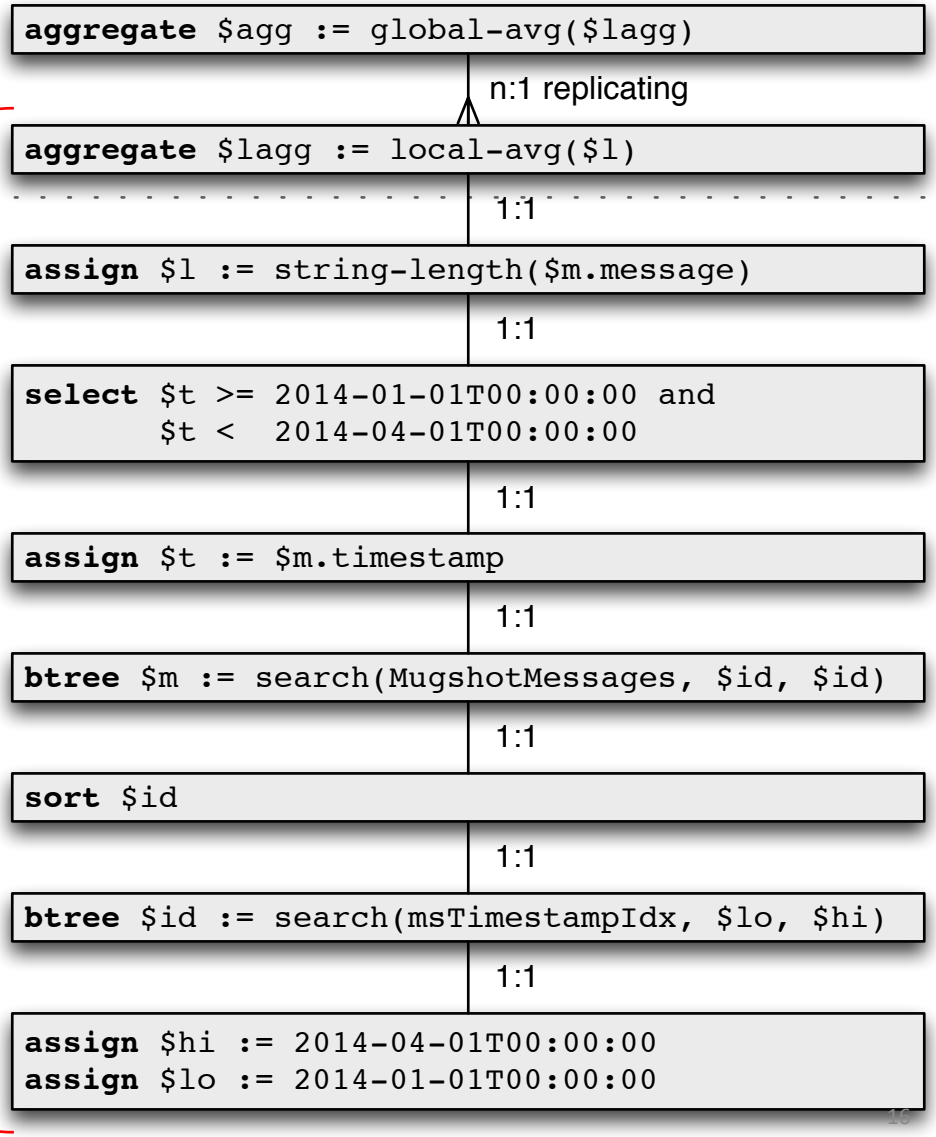
```
use dataverse TinySocial

avg (
 for $m in dataset MugshotMessages
 where $m.timestamp >=
     datetime("2014-01-01T00:00:00")
  and $m.timestamp <
     datetime("2014-04-01T00:00:00")
 return string-length($m.message)
)}
```

Select Options | Clear Query | Run

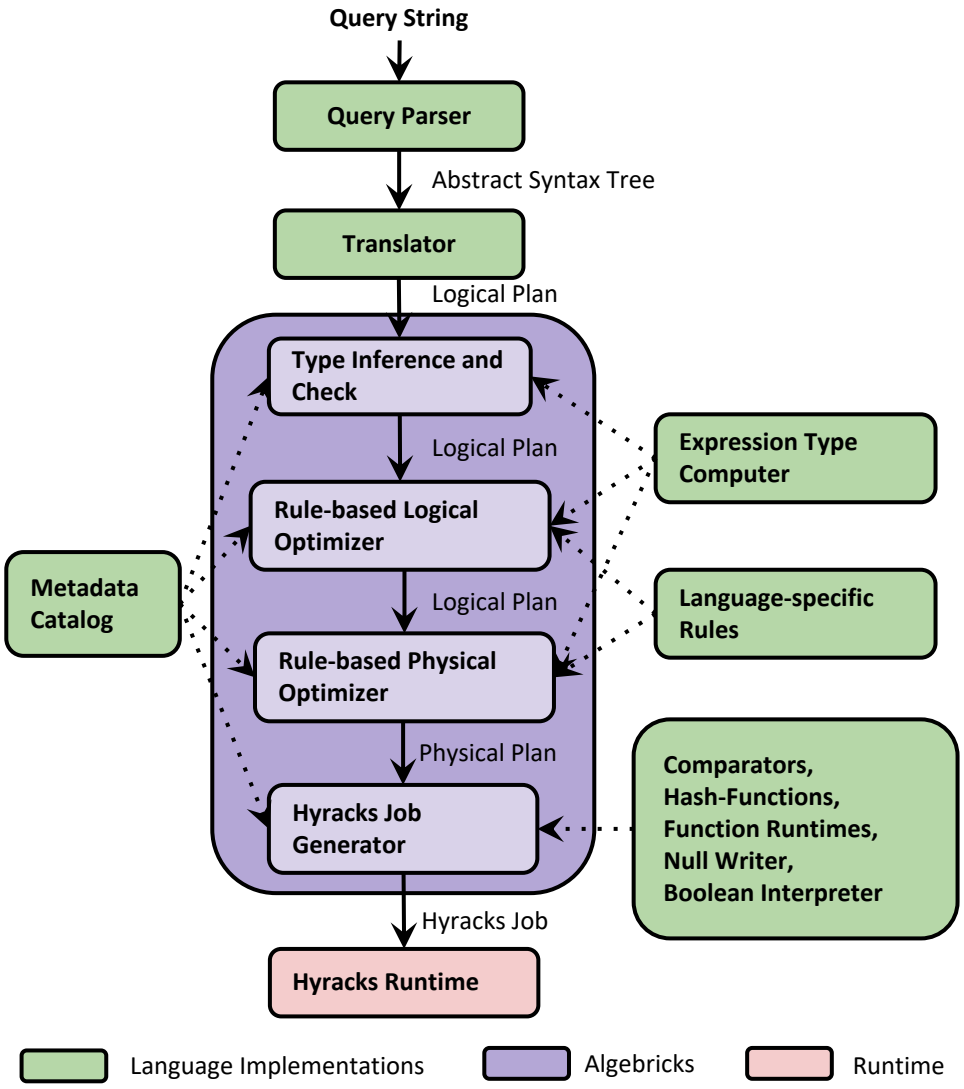
- [ ] Print parsed expressions
- [ ] Print rewritten expressions
- [ ] Print logical plan
- [ ] Print optimized logical plan
- [x] Print Hyracks job
- [x] Execute query

Algebricks

Partitioned Parallelism!



Algebricks Query Compiler Framework



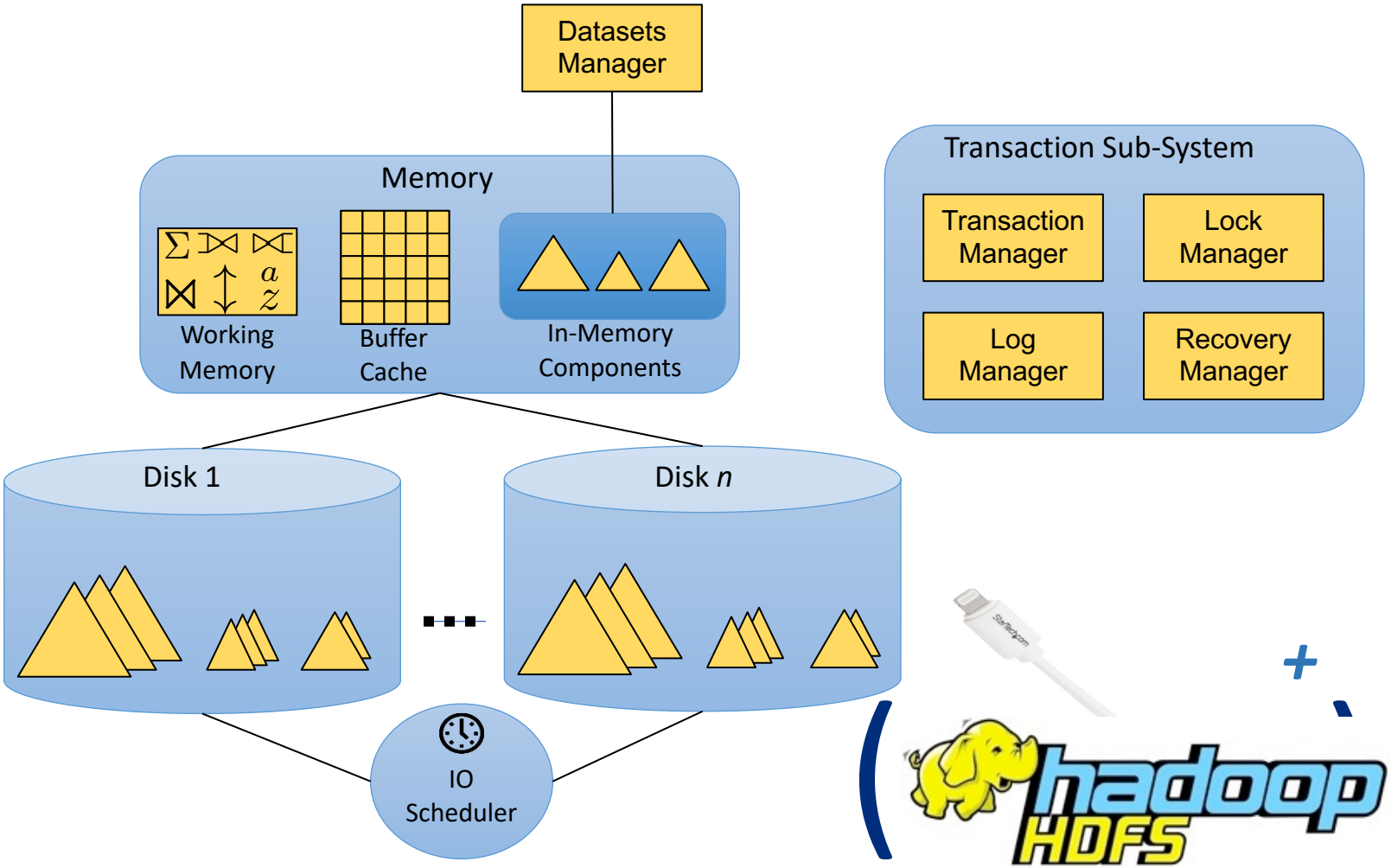
Algebricks

- Logical Operators
- Logical Expressions
- Metadata Interface
- Model-Neutral Logical Rewrite Rules
- Physical Operators
- Model-Neutral Physical Rewrite Rules
- Hyracks Job Generator

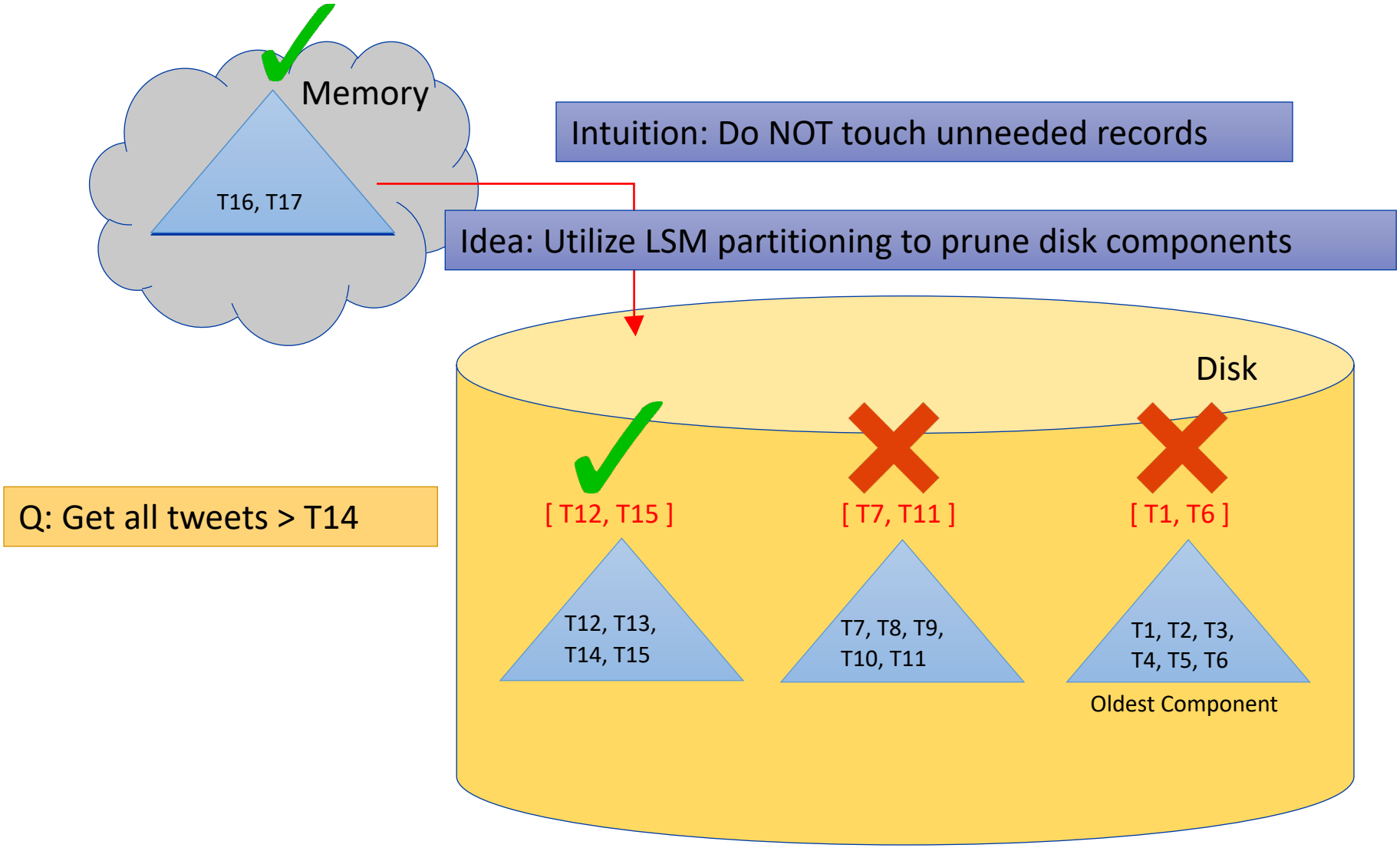
Target Query Language

- Query Parser (AST)
- AST Translator
- Metadata Catalog
- Expression Type Computer
- Logical Rewrite Rules
- Physical Rewrite Rules
- Language Specifics

Native Storage Management

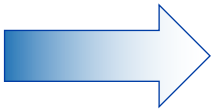


LSM-Based Filters



Transaction Support

- Key-value store-like transaction semantics
  - Entity-level transactions (by key) within “transactors”
  - Atomic insert, delete, and upsert (including indexing)
  - Concurrency control (based on entity-level locking)
  - Crash recovery (based on no-steal logging + shadowing)
  - Backup and restore support (just in case... ☺)
- Expected use of AsterixDB is to model, capture, and ***track*** the “state of the world” (not to ***be*** it)...



SELECT ... FROM Weather W...
// return current conditions by city

(Long serializable reads)

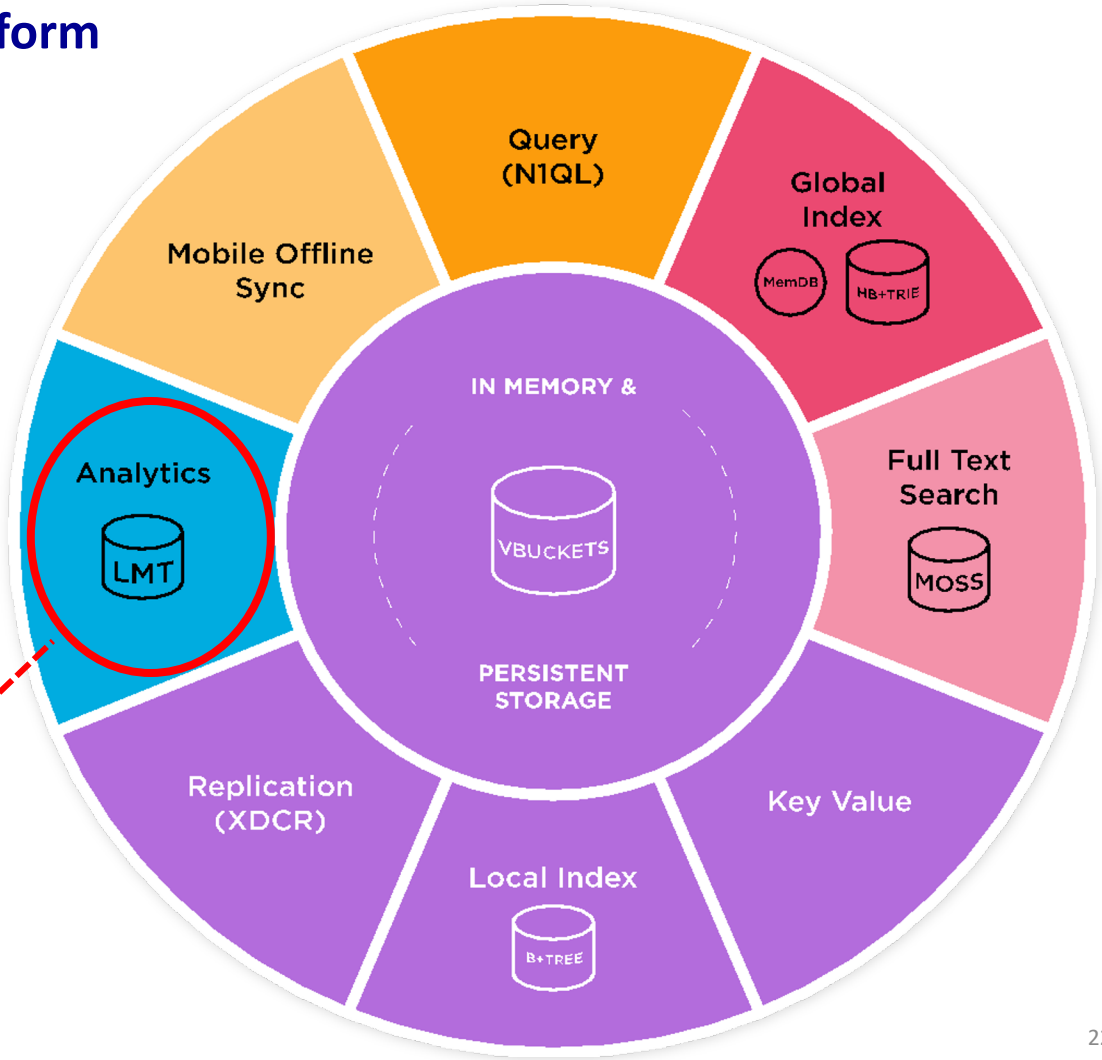
Example AsterixDB Use Cases

- Potential use case areas include
  - Behavioral science
  - Cell phone event analytics
  - Social data analytics
  - Public health
  - Cluster management log analytics
  - Power usage monitoring
  - IoT data storage and querying
  - ….

Commercial Use: Big Data Analytics

Couchbase Data Platform

- ✓ Service-Centric Clustered Data System
  - ✓ Multi-process Architecture
  - ✓ Dynamic Distribution of Facilities
  - ✓ Cluster Map Distribution
  - ✓ Automatic Failover
  - ✓ Enterprise Monitoring/Management
  - ✓ Security
- ✓ Offline Mobile Data Integration
- ✓ Streaming REST API
- ✓ SQL-like Query Engine for JSON
- ✓ Clustered* Global Indexes
- ✓ Lowest Latency Key-Value API
- ✓ Active-Active Inter-DC Replication
- ✓ Local Aggregate Indexes
- ✓ Full-Text Search*
- ✓ **Operational Analytics (currently *DP*)**



For More Information

- Asterix project UCI/UCR research home
  - http://asterix.ics.uci.edu/
- Apache AsterixDB home
  - http://asterixdb.apache.org/
- SQL++ Primer
  - http://asterixdb.apache.org/docs/0.9.4.1/sqlpp/primer-sqlpp.html