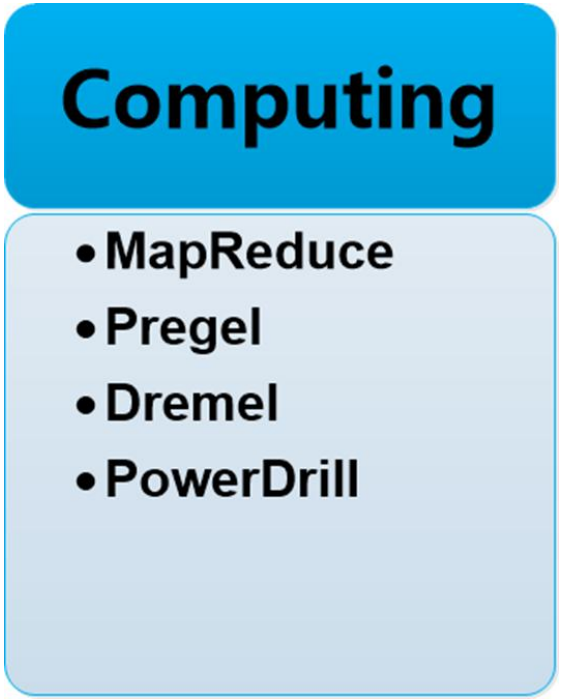
Lecture 17 Big Data Computing Architecture

Part II

- Computing Models
- Interactive Processing

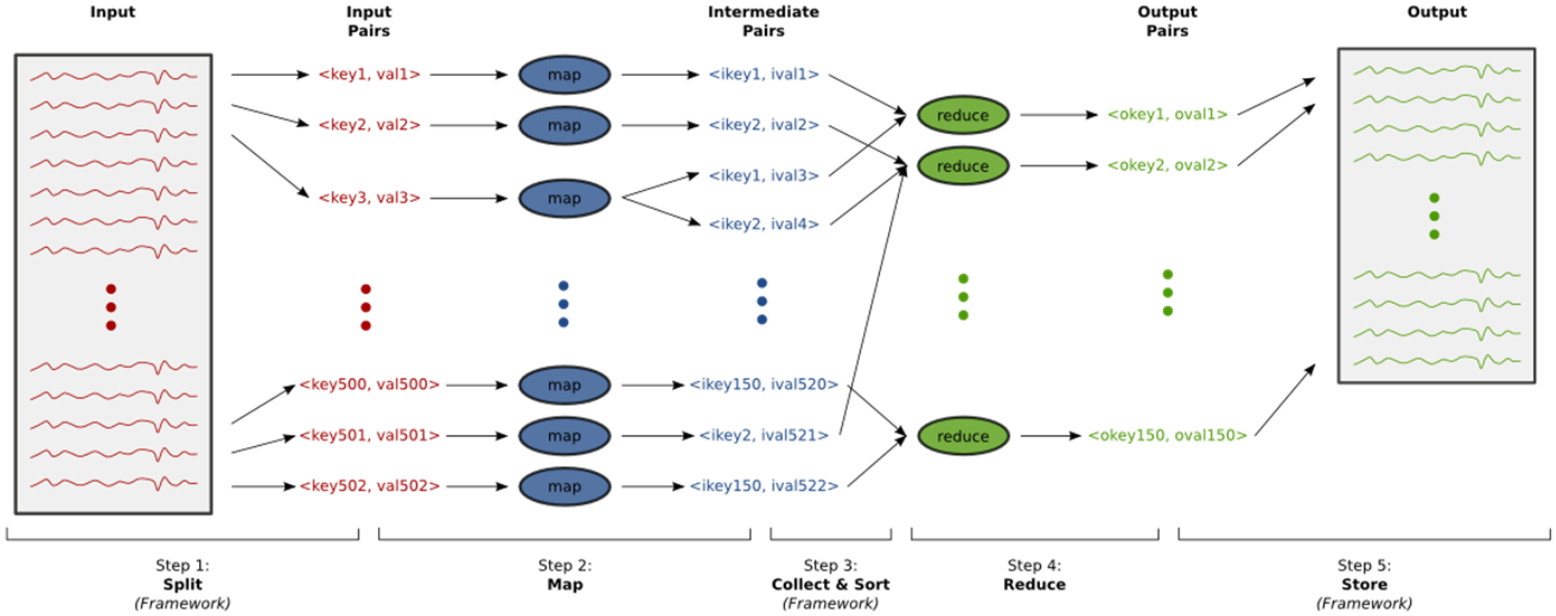
大数据计算架构

Google's computing architecture for big data processing



大数据计算架构

■ MapReduce　a parallel computational model　**并行计算模型**



大数据计算架构

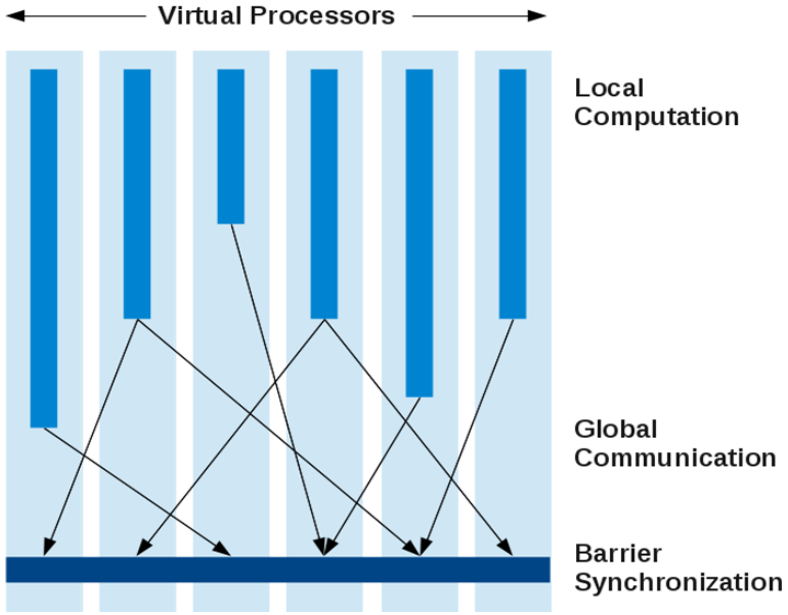
■ Google Pregel

大规模图处理

基于BSP模型的大规模图处理系统

- 图很复杂，但很多现实问题
  可用图来建模
- Google 20%数据由Pregel来处理
- 开源项目：Hama, Giraph

a BSP-based parallel graph computational model



大数据计算架构

■ Dremel

大数据交互式分析

Interactive Analysis of Web-Scale Datasets

Process 1PB, trillion records in 3 seconds

- Columnar storage format for nested data
  - Nested data model (Protocol Buffers)
- Tree architecture
- Interoperates with Google's data mgmt tools
  - In situ data access (GFS, Bigtable)
  - MapReduce pipelines
- SQL-like query language

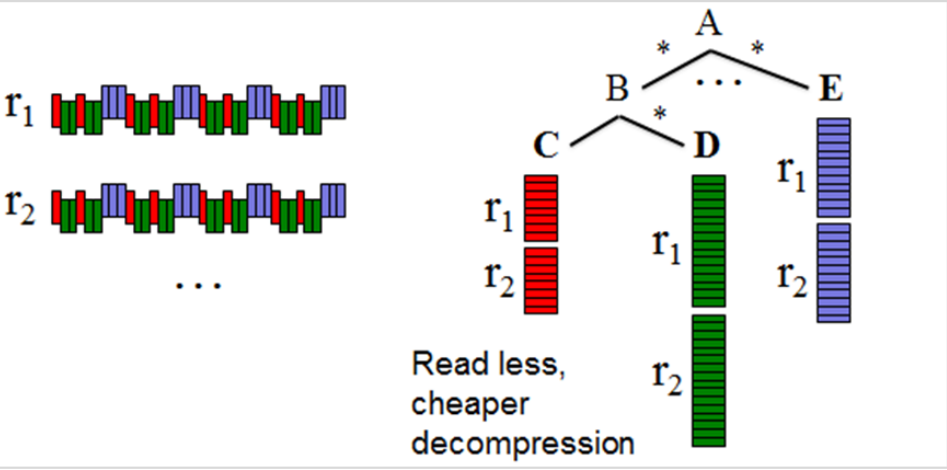
大数据计算架构

■ Dremel an interactive processing model

大数据交互式分析

➢ Columnar storage for nested data

```
message Document {
  required int64 DocId;
  optional group Links {
    repeated int64 Backward;
    repeated int64 Forward;
  }
  repeated group Name {
    repeated group Language {
      required string Code;
      optional string Country;
    }
    optional string Url;
  }
}
```



Challenge: preserve structure, reconstruct from a subset of fields

大数据计算架构

■ Apache Drill

大数据交互式分析

Interactive Analysis of Large-Scale Datasets

- ➢ Columnar storage format for nested data
  - Protocol Buffers, Avro
  - JSON, BSON
- ➢ SQL-like query language
  - DrQL
  - Mongo query language
- ➢ Tree architecture
- ➢ Interoperates with Hadoop data mgmt tools
  - In situ data access (HDFS, HBase)
  - MapReduce pipelines

- 2012: in incubation

[1] Apache Drill: http://incubator.apache.org/drill/

大数据计算架构

■ 小结 Summary on Computing Model

计算

- 及时性：分钟 -> 微秒 — Responsiveness: min. -> sec. -> ms
- 用户友好：并行编程 -> SQL语句 — Architecture: off-line + interactive
- 批处理和交互式互补，协同工作 — Interface: need to support SQL

批处理	交互式分析
• MapReduce • Pregel	• Dremel • PowerDrill

Interactive Processing Approach

- Data Model：Protocol Buffers, Avro, JSON
- Storage：Columnar stored structure
- Query：SQL，supporting Join operation
- Buffer：distributed buffer

Architectural Design on A New Interactive Processing Engine

- Application Domain
- Key Technology
- Architectural Design

Application Domain

- Online intelligent analysis for Internet E-commerce
- Network detection, control and resource alignment for Telecomm, Bank, Supply Chain, etc.
- Government's web-scale data analysis, pattern recognition, risk alert and management
- Big data-based, value-added data products and data services

大数据计算架构

Application 1：Online intelligent synthesis to Facebook data

- ✓ page hit ranking, ad viewing rate, etc.
- ✓ load distribution, peak load pattern
- ✓ geographic spread of visit statistics
- ✓ special data stats, most visited link
- ✓ bandwidth: 9GB/sec delay bound < 10 sec.

大数据计算架构

Application 2：Baidu news page hit and Ad data statistics

- ✓ Read syslog data
- ✓ Select two columns: _Url and _Res
- ✓ Code a function to extract _Site from _Url
- ✓ Compute news data and group by news site
- ✓ Do following two things for each news site:
- ✓ Count hit rate
- ✓ Calculate total number of Ads

■ 分析程序输入量

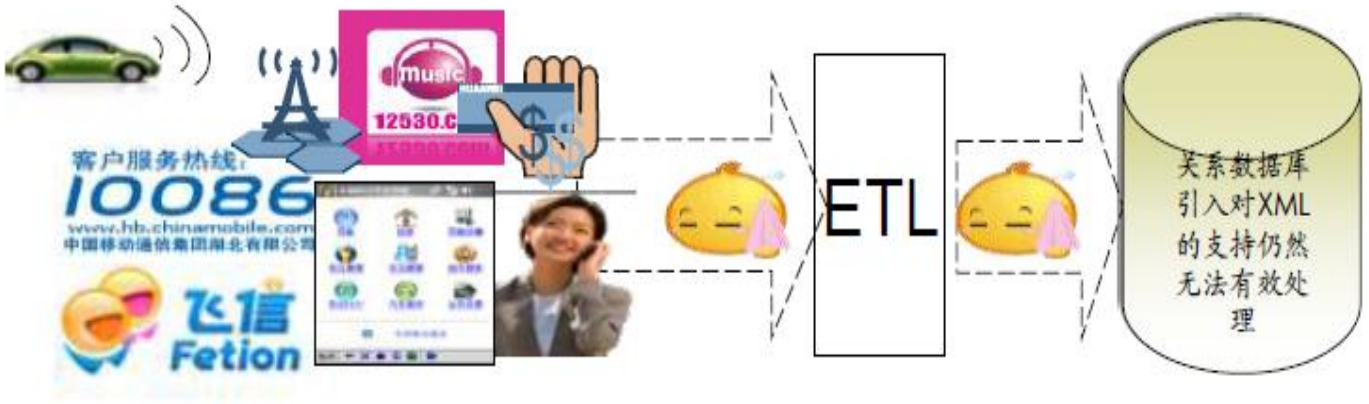
程序类型	占比
Web表单	24%
DQuery模式	43%
裸MapReduce	33%

} 67%

大数据计算架构

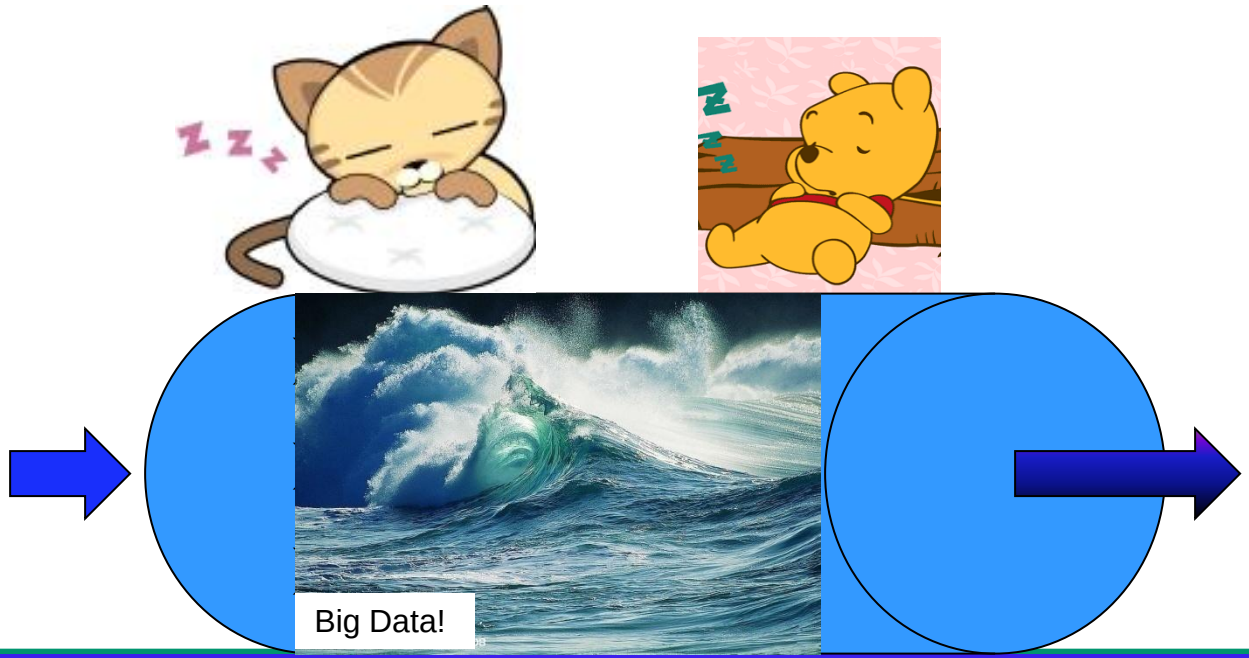
Application 3: Telecomm (China Mobile) Online Intelligent Business

- 传统数据仓库无法有效处理新型的业务数据
  - 公司在移动互联网和物联网上需要有新领域的突破，不同于传统通信业务分析特点，需要对内容等非结构化、大容量信息进行有效分析，传统的架构处理吃力 ；



大数据计算架构

Application 4：from Telecomm (Pipe Business) to Data Product/Service Business



- ✓ Telecomm only builds network (“Pipe”) for data transmission, but does nothing on the data
- ✓ E-business based on data network demands Telecomm to provide big data processing platform to better support their online intelligent analysis

大数据计算架构

Now we got something out of sea of data!

Interactive Processing Platform

HDFS/HBase/Hive/Zookeeper /HAMA

- ✓ On-time network data statistics and synthesis
- ✓ Value-added data product or big data-based functions/services
- ✓ Big data computing platform for E-business company that is better integrated with network
- ✓ Provide a complete solution for small business on data storage, process, and intelligent analysis

Key Considerations for Interactive Processing Engine

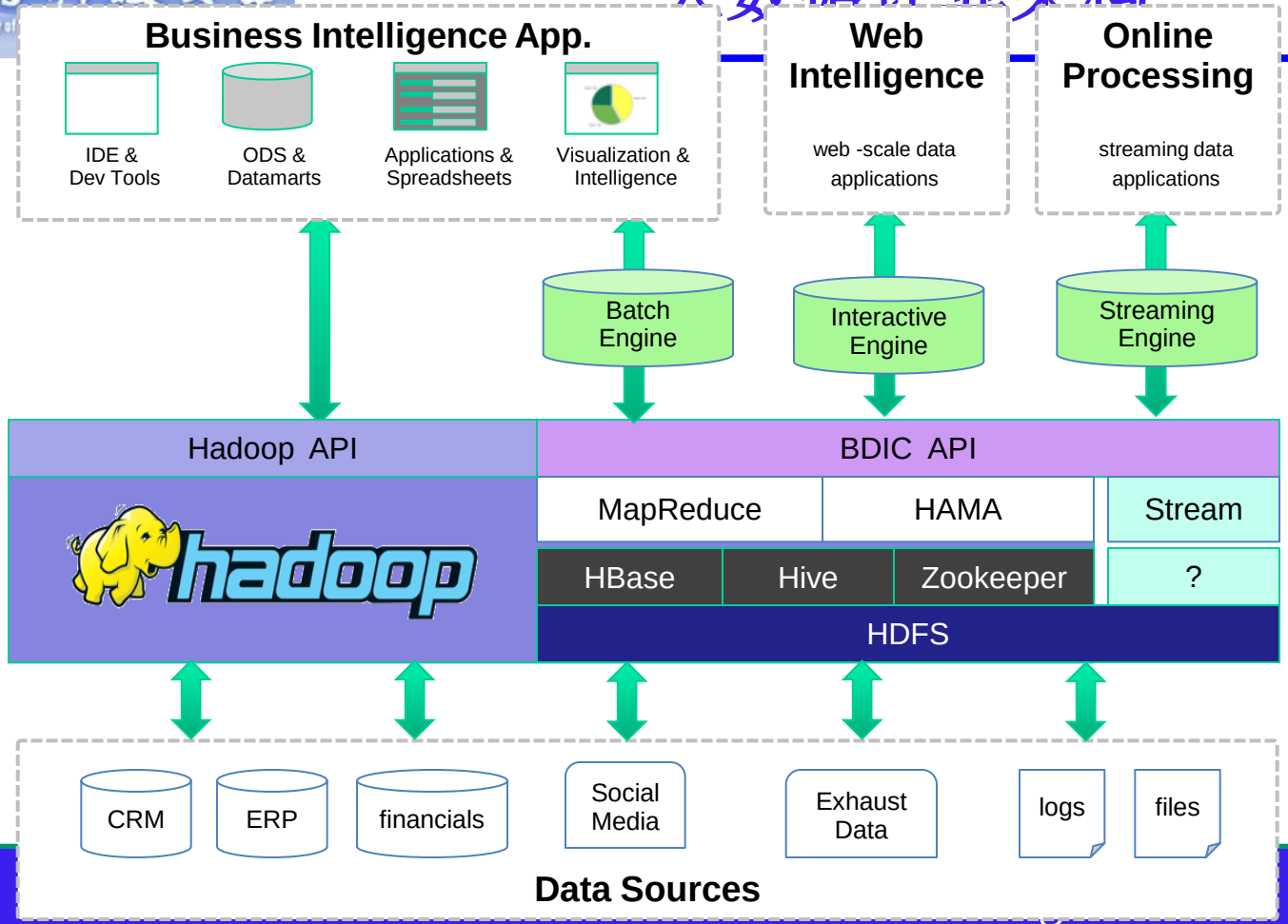
- To provide a on-time online big data processing platform to make up for the MapReduce computing model
- Based on Hadoop platform and use open source technology to compete with Google's Dremel and PowerDrill
- Key technical issues: data locality, columnar data structure, in-memory data processing

大数据计算架构

Google/Hadoop/BDIC Computing Architecture Comparison

Google	Hadoop	Interactive
Dremel/BigQuery	Drill/Cassandra	BDIC
MapReduce/Pregel	MapReduce	MapReduce/HAMA
Chubby	Zookeeper/Pig/Manhut	Zookeeper
BigTable/Spanner	HBase/Hive	HBase/Hive
GFS	HDFS	HDFS

大数据计算架构


Business Intelligence App.
IDE & Dev Tools
ODS & Datamarts
Applications & Spreadsheets
Visualization & Intelligence
Web Intelligence
web -scale data applications
Online Processing
streaming data applications
Batch Engine
Interactive Engine
Streaming Engine
Hadoop API
BDIC API
hadoop
MapReduce
HAMA
Stream
HBase
Hive
Zookeeper
?
HDFS
CRM
ERP
financials
Social Media
Exhaust Data
logs
files
Data Sources

Our hope!

- 1994, Yahoo! was born --- Internet door was open to people!
  1998, Google show up --- An IT Gig started from a search engine
  2004, Facebook born --- Social network in every person's life
  2012, Facebook IPO --- Gold mining in Internet world!
  2016~2020年？ --- Next is who?

- 2016 Slogan: No dream? you have no diff with a dead fish!

End of Lecture

谢谢！