CSE 512: Distributed and Parallel Data Systems

Lecture 18

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Teaching Evaluation

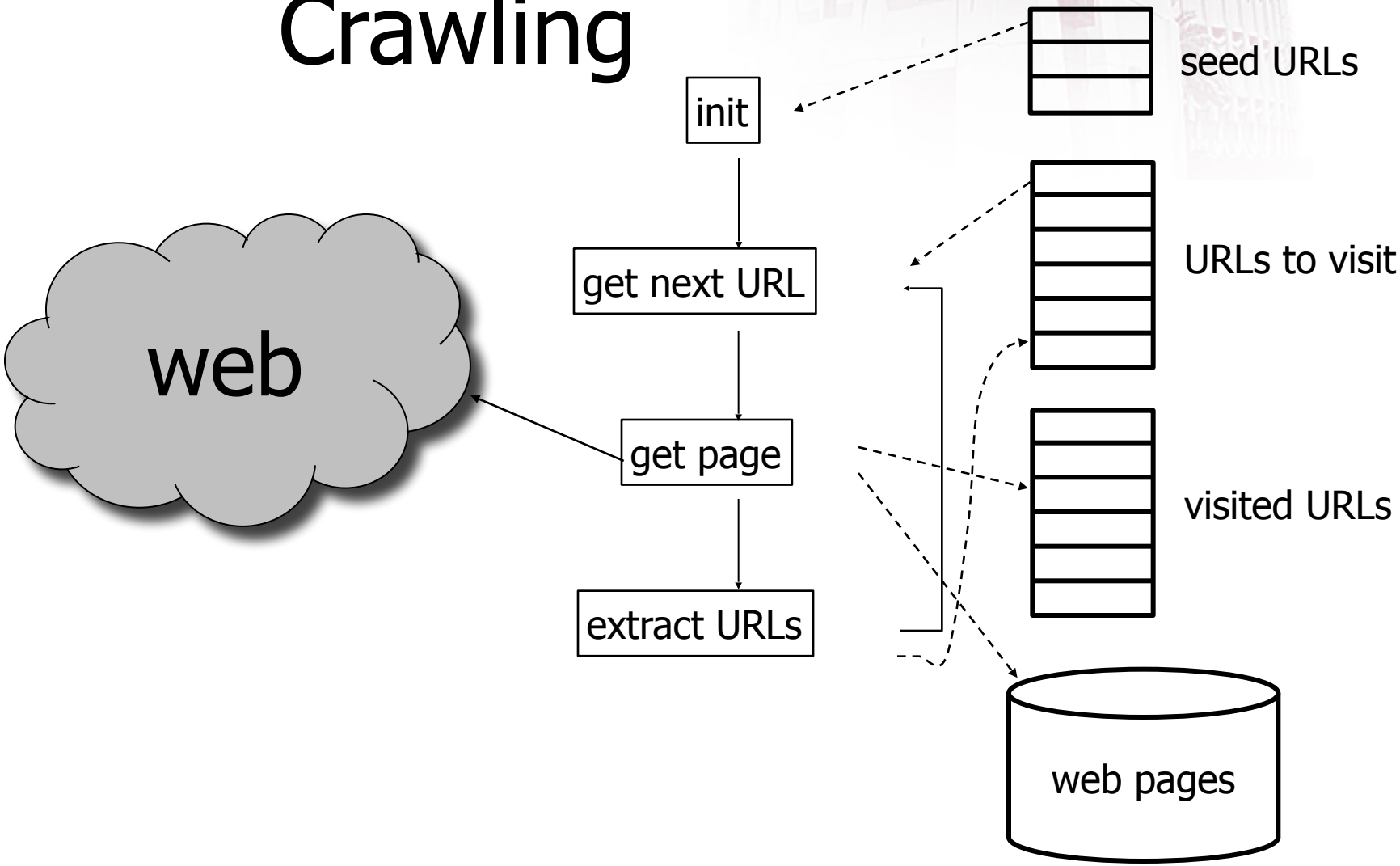
https://fultonapps.asu.edu/eval/

Google Search I'm Feeling Lucky

Web Search Engine

- Crawling
- Indexing
- Computing ranking features
- Serving queries

Crawling


seed URLs
init
URLs to visit
web
get next URL
get page
visited URLs
extract URLs
web pages

Issues

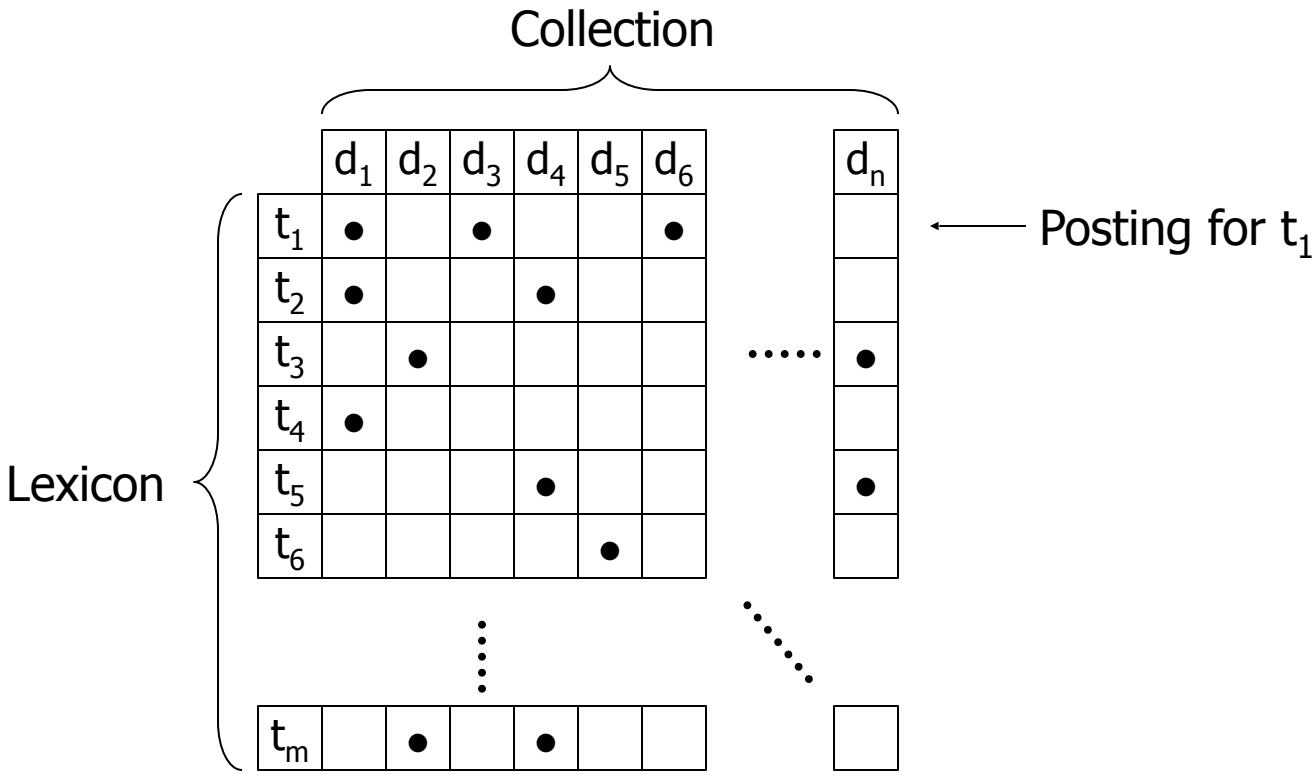
- Scope and freshness
  - Not enough space/time to crawl "all" pages
  - Page importance, quality, and update frequency
  - Site mirrors and (near) duplicate pages
  - Dynamic content and crawler traps
- Load at visited web sites
  - Rules in robots.txt
  - Limit number of visits per day
  - Limit depth of crawl

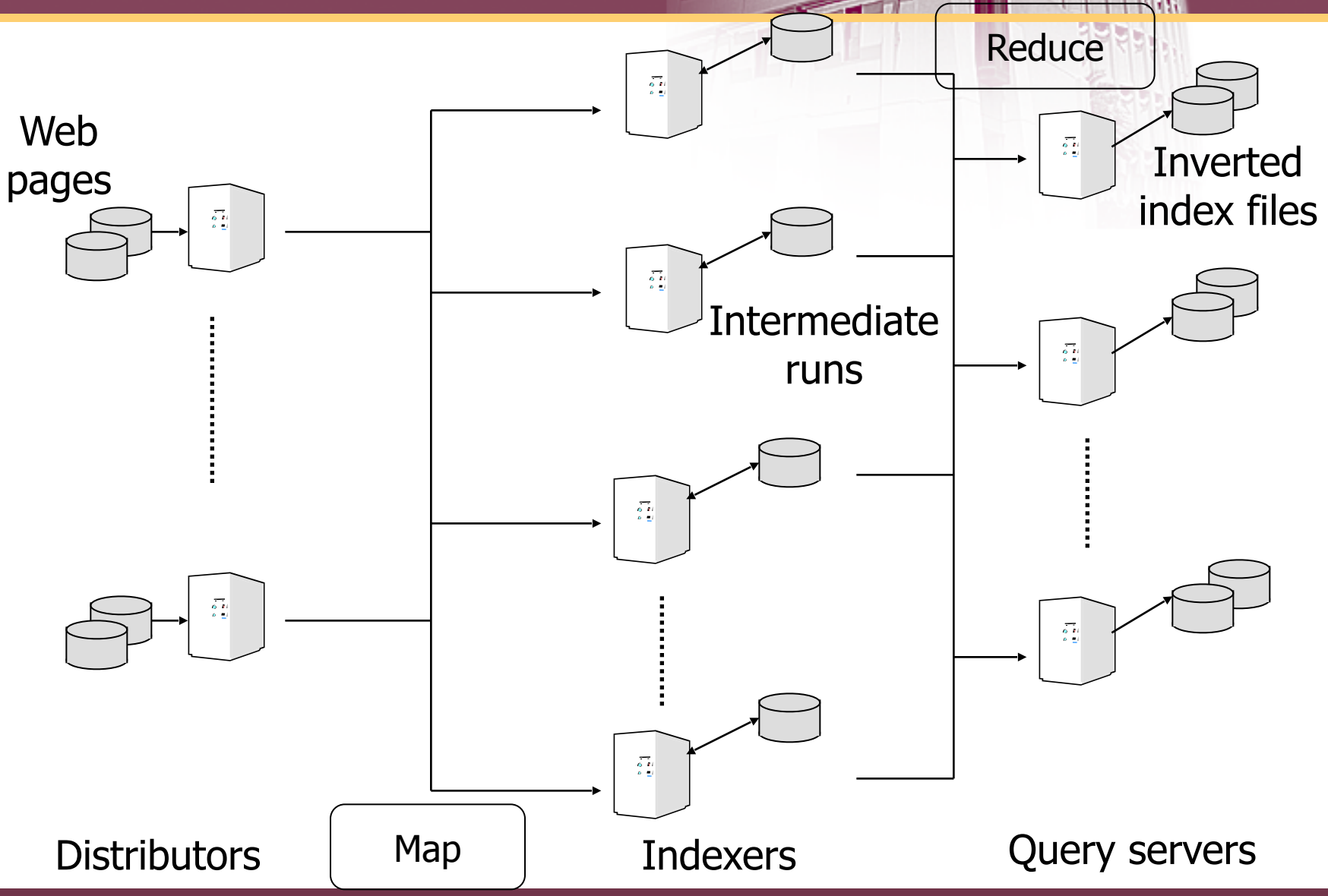
Issues

- Load at crawler
  - Variance of fetch latency/bandwidth
  - Parallelization and scalability
    - Multiple agents
    - Partitioning URL lists
    - Communication between agents
    - Recovering from agent failure

Indexing

- Build term-document index

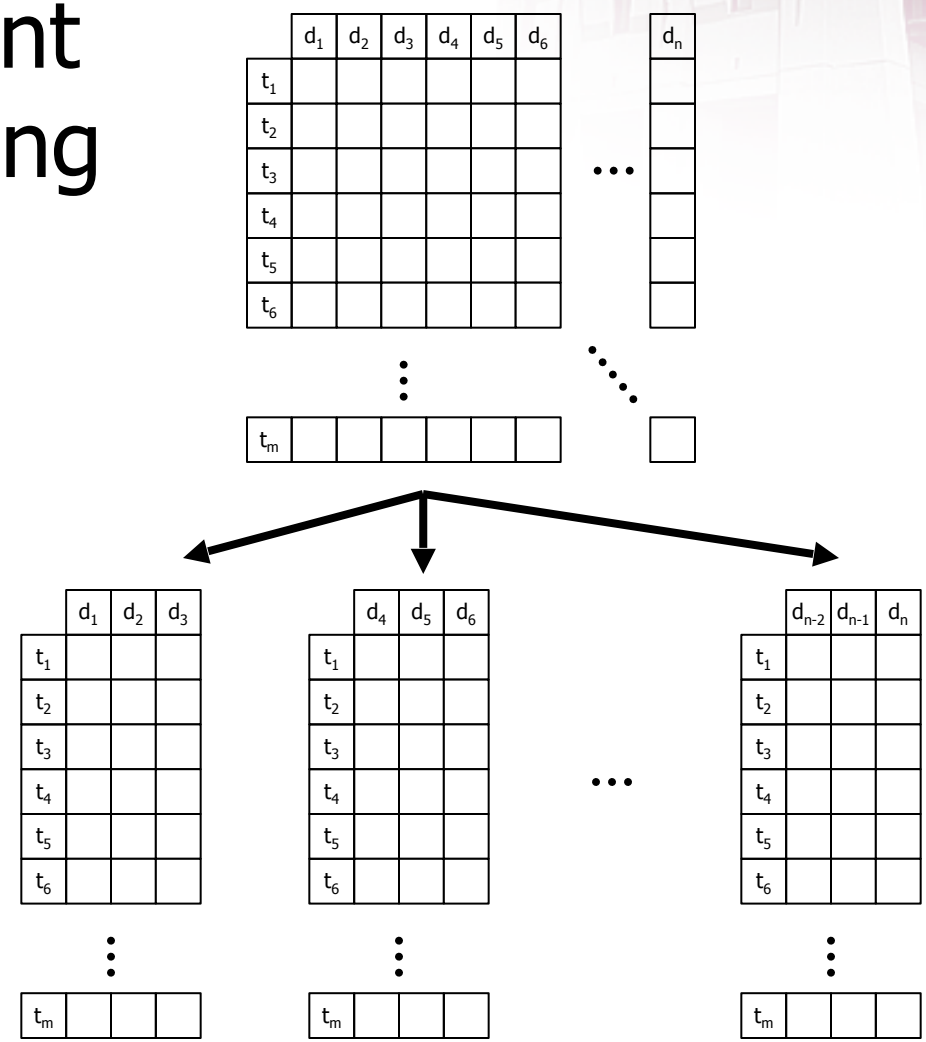



Reduce
Web pages
Inverted index files
Intermediate runs
Distributors
Map
Indexers
Query servers

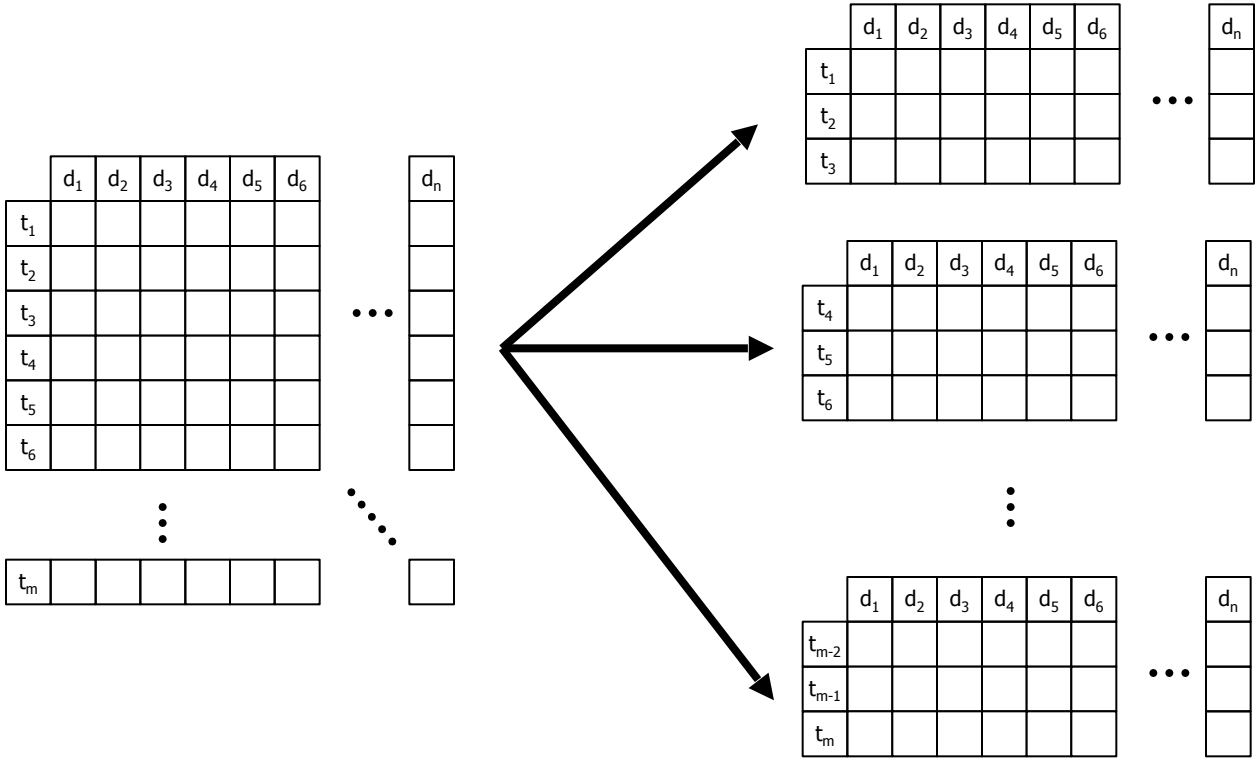
Issues

- Index partitioning
  - Efficient query processing
    - Query routing
    - Result retrieval

Document Partitioning



Term Partitioning



Document Partitioning

- Split the collection of documents
- Advantages
  - Easy to add new documents
  - Load balanced
  - High processing throughput
- Disadvantages
  - Communication with all query servers

Term Partitioning

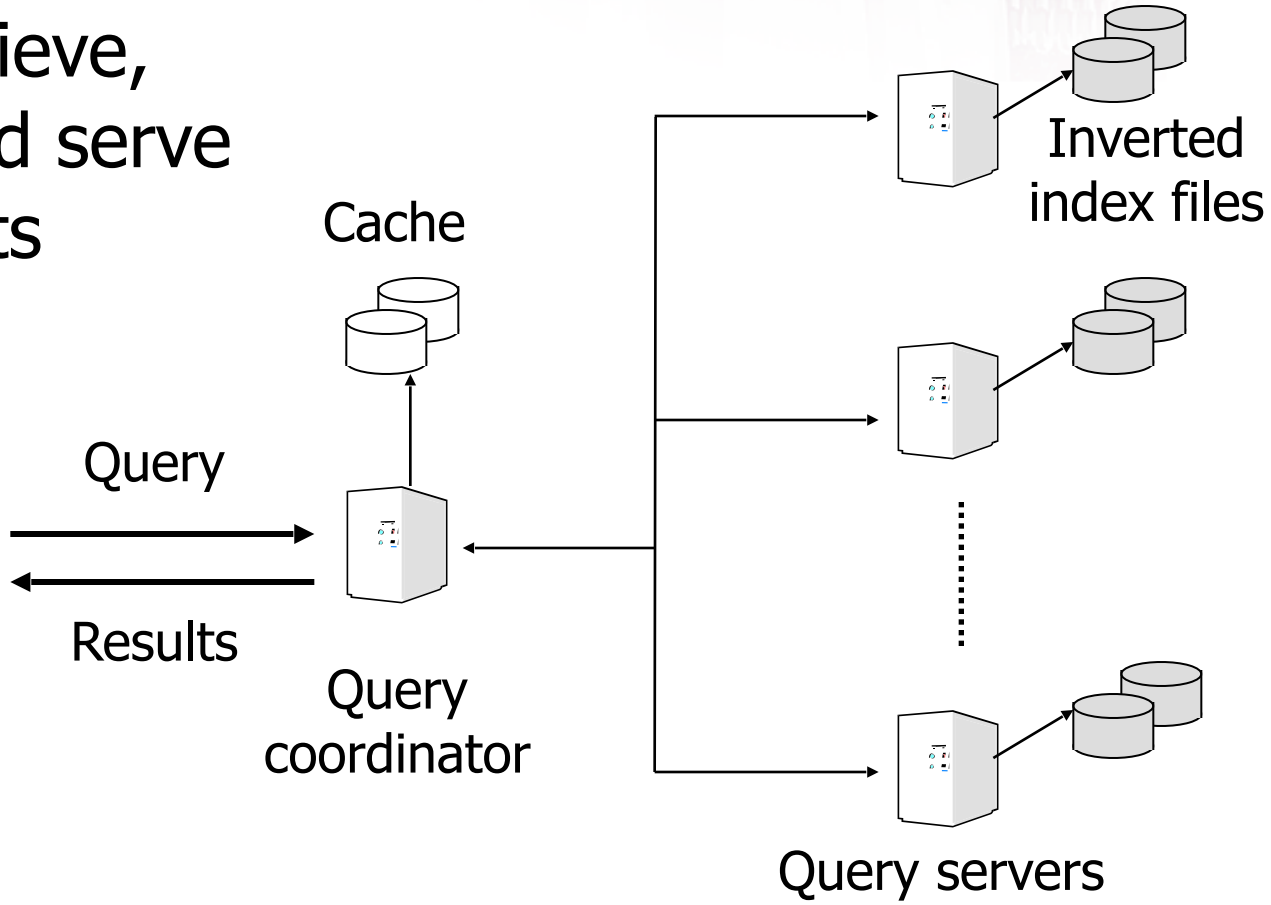
- Split the lexicon
- Advantages
  - Reduced communication with query servers
- Disadvantages
  - More processing before partitioning
  - Adding new documents is hard
  - Load balancing is hard
  - Processing throughput limited by query length

Ranking Feature Computation

- Parallel/distributed computation tasks
  - Text/language processing
  - Document classification/clustering
  - Web graph analysis

Query Processing

- Locate, retrieve, process, and serve query results



Architecture

- Multiple sites connected by WAN
  - Site = coordinator + servers + cache
- Partitioning
  - Parallel processing
  - Distributed storage of data
  - E.g., index partitioning
- Replication
  - Availability
  - Throughput
  - Response time

Wrap-Up

What we Covered

- Database Systems
- Distributed Systems
- Data Fragmentation (Partitioning)
- Distributed Query Processing and Optimization
- Distributed Transaction Processing

What we Covered

- Replicated Data Management
- Reliable Data Management
- Parallel Database Systems
- Data Management in MapReduce Systems
- NoSQL Data Management System

Take-Away Message

- Distributed and Parallel Data Systems are very hot these days
  - Major Internet companies require such skills
- I have tried to give you the abstract concept and also expose you to new technologies
- No one size (database system) fits all