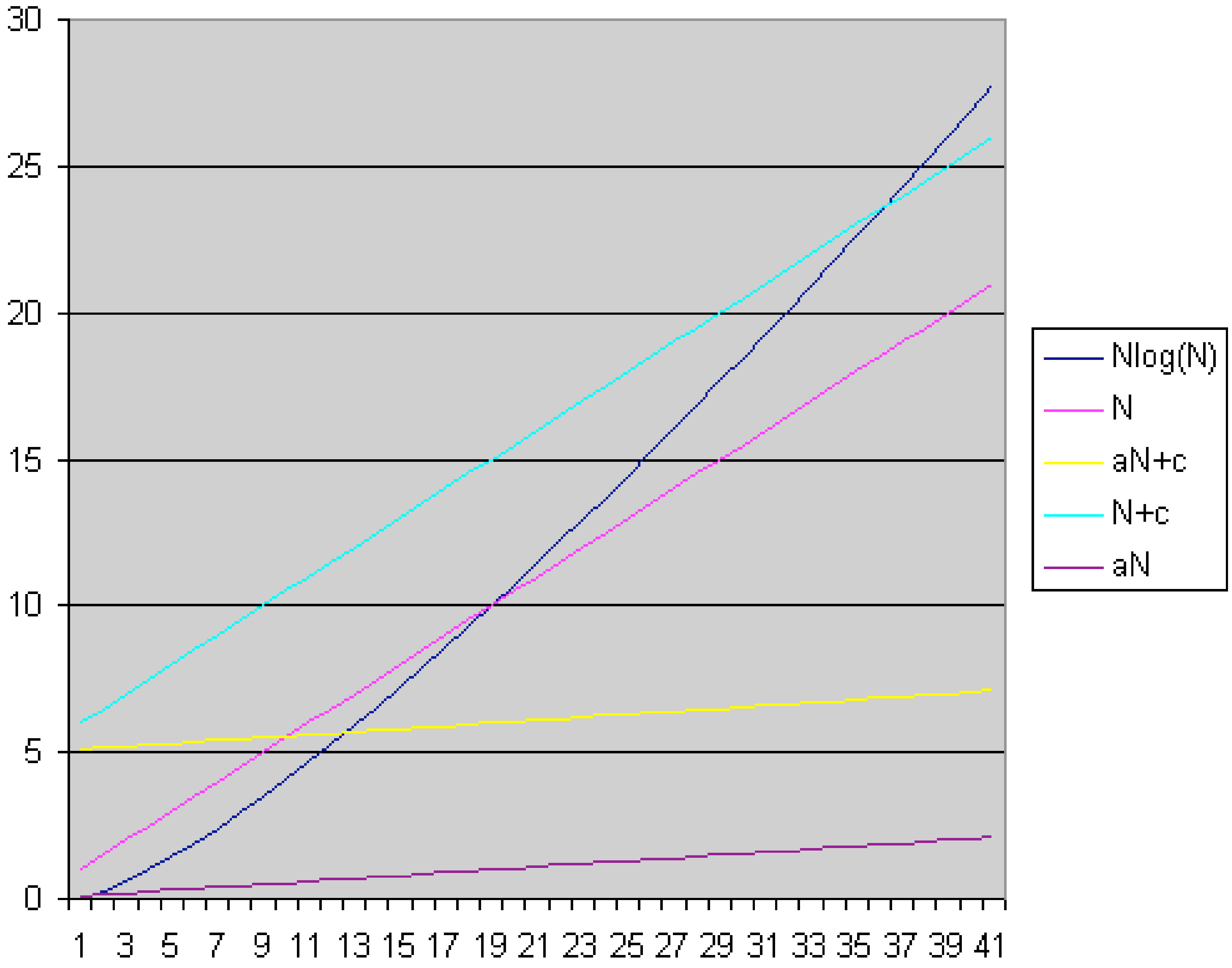
Single-Pass In-Memory Indexing

Large Scale Indexing

- Key decision in block merge indexing is block size
- In practice, spidering often interlaced with indexing
- Spidering bottlenecked by WAN speed and other factors

Single-Pass In-Memory Indexing



Overview

- Introduction
- Hardware
- BSBI - Block sort-based indexing
- SPIMI - Single Pass in-memory indexing
- Distributed indexing
- Dynamic indexing
- Miscellaneous topics

Distributed Indexing

- Web-scale indexing
  - Must use a distributed computing cluster
  - “Cloud computing”
- Individual machines are fault-prone
  - They slow down unpredictably or fail
    - Automatic maintenance
    - Software bugs
    - Transient network conditions
    - A truck crashing into the pole outside
    - Hardware fatigue and then failure

Distributed Indexing - Architecture

- The design of Google's indexing as of 2004

Distributed Indexing - Architecture

- Use two classes of parallel tasks
  - Parsing
  - Inverting
- Corpus is split broken into splits
  - Each split is a subset of documents
  - analogous to distributed crawling
- Master assigns a split to an idle machine
  - Parser will read a document and output (t,d) pairs
  - Inverter will sort and write postings

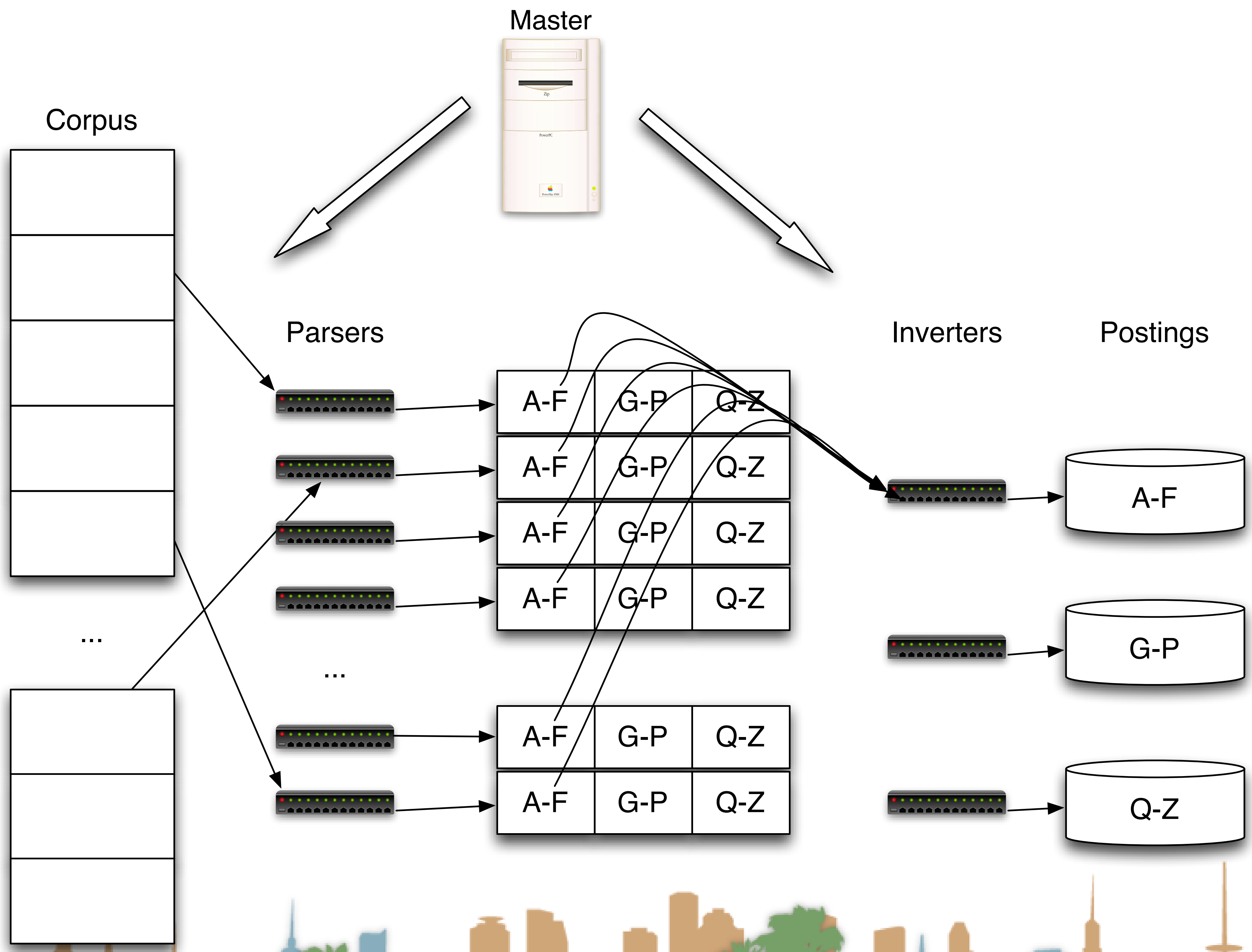
Distributed Indexing - Architecture

- Use an instance of MapReduce
  - An general architecture for distributed computing
  - Manages interactions among clusters of
    - cheap commodity compute servers
    - aka nodes
  - Uses Key-Value pairs as primary object of computation

Distributed Indexing - Architecture

- Use an instance of MapReduce
  - There is a map phase
    - This takes splits and makes key-value pairs
    - this is the “parse” phase of BSBI and SPIMI
  - The map phase writes intermediate files
    - Results are bucketed into R buckets
  - There is a reduce phase
    - This is the “invert” phase of BSBI and SPIMI
    - There are R inverters

Distributed Indexing - Architecture



Distributed Indexing - Architecture

- Parsers and Inverters are not separate machines
  - They are both assigned from a pool
  - It is separate software
- Intermediate files are stored on a local disk
  - Part of the "invert" task is to talk to the parser machine and get the data. (master coordinates)
- MapReduce has different architectures for different data manipulation tasks besides this one.

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Dynamic Indexing

- Documents come in over time
  - Postings need to be updated for terms already in dictionary
  - New terms need to get added to dictionary
- Documents go away
  - Get deleted, etc.

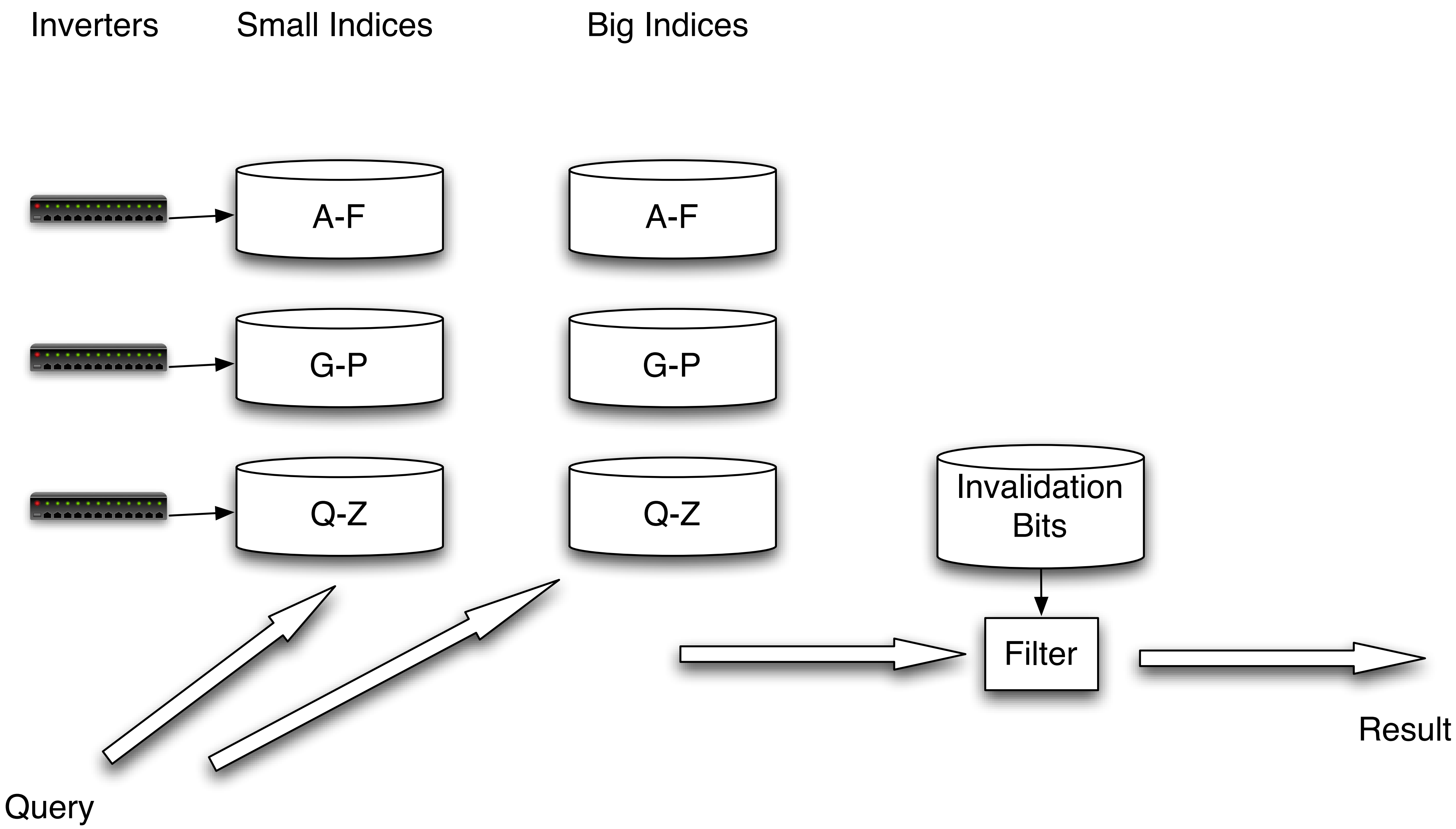
Dynamic Indexing

- Overview of solution
  - Maintain your “big” main index on disk
    - (or distributed disk)
  - Continuous crawling creates “small” indices in memory
  - Search queries are applied to both
    - Results merged

Dynamic Indexing

- Overview of solution
  - Document deletions
    - Invalidation bit for deleted documents
    - Just like contextual filtering,
      - results are filtered to remove invalidated docs
      - according to bit vector.
  - Periodically merge “small” index into “big” index.

Dynamic Indexing



Dynamic Indexing

- Issues with big *and* small indexes
  - Corpus wide statistics are hard to maintain
    - Typical solution is to ignore small indices when computing stats
  - Frequent merges required
  - Poor performance during merge
    - unless well engineered
  - Logarithmic merging

End of Chapter 4

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Got to about slide 17 of cons.pdf
And image cons18.eps or so

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