Big Data and the Cloud Phenomenon

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How much information is there?

- Almost everything is recorded digitally.
- Most bytes are never seen by humans.
- Data summarization, trend detection, anomaly detection are key technologies.

See Mike Lesk:

See Lyman & Varian:
How much information
http://www.sims.berkeley.edu/research/projects/how-much-info/
Patterns

- AMBIENT DATA -> SHOEBOX PATTERN
BIG DATA IS A DISRUPTIVE SHIFT

- DRIVES NEW OPPORTUNITIES AND NEW DESIGN PATTERNS
- AMBIENT DATA -> SHOEBOX PATTERN
GARTNER: "WAIT, WHAT? WHAT DID WE JUST SEE?"

ONE YEAR OF ADSENSE CLICKSTREAM DATA:
COOKED DOWN WITH MAP-REDUCE, 50X: 20 TB
VERTIPQA SERVER SCALE-OUT, 33X: 600 GB
VERTIPQA IN-MEMORY STORE, 40X: 15 GB
PROCESS IN EXCEL: 300 B ROWS

GARTNER: “WAIT, WHAT? WHAT DID WE JUST SEE?”
THE COST OF 1 PB

COST OF DATA ENTRY FOR 1 PB:

MANUAL DATA ENTRY: $1/kB
1 PB = $1 TRILLION

COST OF SERVERS FOR 1 PB:

33 COMMODITY SERVERS @ $3,000
1 PB = $100,000

$1 TRILLION : $100,000 = 10^7
FOR EACH SEARCH THEY SEND OUT DATA
THEY ALSO COLLECT DATA ABOUT THE SEARCH AND THE USER
THEY SAVE MORE DATA THAN THEY SEND BACK

BING IS AN INFORMATION MACHINE,
CREATING DATA FOR THEIR CUSTOMERS –
THE ADVERTISERS
CREATING DATA FOR THEIR USERS –
BETTER RELEVANCE AND RANKING ANSWERS
PETABYTES PER DAY
BIG DATA IS A DISRUPTIVE SHIFT

- DRIVES NEW OPPORTUNITIES AND NEW DESIGN PATTERNS
- AMBIENT DATA -> SHOEBOX PATTERN
EXAMPLE: THE DIGITAL SHOEBOX PATTERN

“RETAIN ALL POTENTIALLY VALUABLE AMBIENT DATA FOR SUBSEQUENT ANALYSIS”
“WE WANT TO ANALYZE LINKS FOR PAGE RANKS. LET'S CRAWL THE WEB AND COLLECT LINKS, AND MAKE A DIRECTED GRAPH.”
A CULTURE OF SCARCITY
A CULTURE OF ABUNDANCE
DIGITAL SHOEBOX PATTERN

LOGICAL MODELING

AMBIENT DATA

DATA ACQUISITION

PHYSICAL MODELING

LOAD

TUNE

ANSWER

QUESTION

THE WEB: TIMESTAMP URL HTML

EXTRACT

DIGITAL SHOEBOX

ALL DATA
NO MODELING
NATURAL SCHEMA

QUESTION

NEW QUESTION
When is this pattern appropriate?

\[
\left( \frac{\text{perceivedLatentValue}}{\text{time}} \right) > \left( \frac{\text{cost(dataAquisition)}}{\text{time}} + \frac{\text{cost(dataStorage)}}{\text{time}} \right)
\]
BIG DATA IS A DISRUPTIVE SHIFT

• DRIVES NEW OPPORTUNITIES AND NEW DESIGN PATTERNS
• AMBIENT DATA -> SHOEBOX PATTERN
• CONSTRUCTING DATA FROM DATA -> CORPUS PATTERN

WHEN IS THIS APPROPRIATE?
1. PERF IS CRITICAL
2. STORAGE COST IS OK
3. STALE DATA IS OK
“WE’LL OPTIMIZE THE DATABASE FOR THIS DUAL USE”

WHEN IS THIS APPROPRIATE?
1. PERF IS CRITICAL
2. STORAGE COST IS OK
3. STALE DATA IS OK
MAP- SHUFFLE- REDUCE PATTERN

DATA | MAP | REDUCE | DATA | MAP | REDUCE | DATA | MAP | REDUCE | DATA | MAP | REDUCE

WHEN IS THIS APPROPRIATE?
1. EASILY PARALLELIZABLE
2. VERY LARGE SCALE
3. BATCH!
BIG DATA IS A DISRUPTIVE SHIFT

• DRIVES NEW OPPORTUNITIES AND NEW DESIGN PATTERNS

• AMBIENT DATA
  -> SHOEBOX PATTERN

• CONSTRUCTING DATA FROM DATA
  -> CORPUS PATTERN

• MANY COPIES OF THE SAME DATA
  -> REPLICATION PATTERN
SQL AZURE REPLICATION PATTERN

PARTITIONS FOR SCALE

1. NO TRANSACTIONS ACROSS PARTITIONS
2. AUTOMATIC RECOVERY ON NODE FAILURE
SQL AZURE REPLICATION PATTERN

When is this appropriate?
1. App needs consistency
2. Read and write loads similar

The application sees all the effect of its transactions as they occurred in chronological order.
1. No transactions across partitions
Consistency. The application sees the effect of other transactions with invalid chronological order.

- WRITE
- REPLICATE
- WAIT FOR QUORUM
- RETURN
- READ FROM REPLICA

1. NO TRANSACTIONS ACROSS PARTITIONS
2. ATOMIC TRANSACTIONS WITHIN A PARTITION
3. NO READ CONSISTENCY ACROSS PARTITIONS
4. EVENTUAL CONSISTENCY

- SQL Always ON (HADRON) with Readable Secondaries

- WHEN IS THIS APPROPRIATE?
  1. READ FOCUSED LOAD
  2. PERF IS CRITICAL
  3. WEAK CONSISTENCY OK
ALLOWS TUNING READ PERF BY ALLOCATING RESOURCES TO HOT PARTITIONS
CHOOSE DESIGN PATTERN

• READ/WRITE LOADS
• SCALE REQUIREMENTS
• PERF REQUIREMENTS
• TOLERANCE FOR WEAK CONSISTENCY
• TOLERANCE FOR STALENESS
• BATCH OR LIVE
• AD HOC OR PRODUCTION
“WE HAVE BEEN SUCCESSFUL AS A DATABASE COMPANY FOR SO LONG, PEOPLE DON’T RECOGNIZE THIS IS A NEW ERA.”
WE HAVE THE TECHNOLOGY
WE HAVE THE DATA

DO WE HAVE THE IMAGINATION?