LDBC Social Network Benchmark

Interactive Workload

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LDBC

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- And Special Thanks to many others that have contributed so far

Summary of SNB-Interactive

- Simple but challenging interactive queries on top of a social network site
  - Interactive queries
  - Flexible: Declarative and API based systems
  - Systems of different scales
  - Latency and throughput are both important
  - Easy to adopt
- All software and docs at https://github.com/ldbc
  - LDBC Datagen
  - LDBC Driver
  - Validation Sets
  - Specification

LDBC SNB Datagen

- Generates a realistic social network with the Facebook degree distribution (persons, groups, posts, likes, etc.)
  - Correlated graph → Similar people have a larger probability to connected, correlated attributes, etc.
  - Non-uniform/Spiky activity volume
  - Scalable (Apache Hadoop based)
  - Deterministic → Allows a fair comparison between SUTs and reproducibility of benchmark executions

LDBC SNB Datagen

- Scale Factors
  - 1,3,10,30,100,300,1000
  - Based on the size of the dataset on dist in CSV format

SF	Relations	Persons	Messages	Activity	Size
SF1	20M	11K	3M	3 years	1GB
SF10	200M	73K	30M	3 years	10GB
SF100	2000M	499K	300M	3 years	100GB
SF1000	20000M	3600K	3000M	3 years	1000GB

* approximate numbers

LDBC SNB Datagen

- 90% of the network is output as CSV to be bulk loaded
- The rest 10% is output as update streams
  - This guarantees the properties of the network are preserved
- Substitution parameters for each complex read query type
  - Parameter binding to reduce variability between queries

LDBC SNB Interactive queries

- 14 Complex reads
  - Interactive yet complex
  - target choke-points
  - Explores the neighborhood of a starting node or path between a pair of nodes
  - Example:
    - Query 6: Given a **start Person** and some Tag, find the other Tags that occur together with this Tag on Posts that were created by start Person’s friends and friends of friends

LDBC SNB Interactive queries

- 7 Short reads
  - balance read/write ratio of workload (70/30)
  - represent queries to populate the website
  - mimic user behavior around the social network
  - Example:
    - Given a start Person, retrieve their first name, last name, birthday, IP address, browser, and city of residence
    - Given a start Person, retrieve all of their friends, and the date at which they became friends
- 8 Update queries
  - Add content produced by the users, do not remove

LDBC Workload Driver

- Responsible of generating the Workload = Stream of operations
  - scheduled start time (real time)
  - type (e.g. ComplexQuery1)
  - parameters (e.g. Person ID)

LDBC Workload Driver

- Updates
  - substitution parameters read from datagen update streams
  - time stamps ("simulation time") read from datagen update streams
- Complex Reads
  - substitution parameters read from datagen files
  - scheduled start times assigned by driver as multiples of update frequency
    - Not all the queries are the same complexity (d, d^2 and d^3. d = average degree)
    - We want all the queries to take about the same time (this is vendor dependant)

LDBC Workload Driver - Example

- **Query mix for SF10**

Query	Frequency
Q1	26
Q2	37
Q3	106
Q4	36
Q5	72
Q6	316
Q7	48
Q8	9
Q9	384
Q10	37
Q11	20
Q12	44
Q13	19
Q14	49

- **Query mix for SF300**

Query	Frequency
Q1	26
Q2	37
Q3	142
Q4	46
Q5	84
Q6	580
Q7	32
Q8	3
Q9	705
Q10	44
Q11	24
Q12	44
Q13	19
Q14	49

LDBC Workload Driver

- Short Reads
  - Split into two groups: "person centric" & "message centric"
  - after each Complex Read/Update, a sequence of Short Reads is executed
    - a sequence appoximates walk through network
    - at each step there is a probability of taking another step, which decreases at each step
    - steps consist of either all "person centric" or all "message centric" operations
      - e.g., (person centric operations)->(flip coin)->(message centric operations)->(flip coin)...
  - mimics user "following links"/Facebook-stalking :-)
  - substitution parameters taken from results of recent Complex Reads and Short reads

LDBC Workload Driver - Execution

- Driver schedules operations as close to their scheduled start times as possible
  - Experiments show the driver can achieve rates of hundreds of operations per second
- "Time Compression Ratio" used to configure target throughput
- Number of worker threads configurable
- Given a vendor implementation & workload, driver generates validation datasets
- Official validation datasets are provided by the LDBC SNB
  - https://github.com/ldbc/ldbc_snb_interactive_validation

LDBC Workload Driver - Rules

- Benchmark executions must meet the following rules to be valid:
  - queries must pass validation datasets
  - at most 5% of the queries actual start time can be one second greater than scheduled start time
  - must comprise at least 2 hours of simulation time
  - at any point, the test machine is disconnected and those commited must be persistent
- Performance metrics are:
  - latencies for each query
  - throughput
  - throughput/cost
  - a global benchmark score including loading time

Conclusions

- SNB Interactive on top of synthetic Social Network data
- 3 Types of queries:
  - Complex Reads
  - Short Reads
  - Updates
- The driver builds a query wich mimics a user behavior
- Both latency and throughput are important. Persistence is mandatory
- All software is open source. We are open for contributions!

Progress

- Mainly focused on polishing and easing adoption

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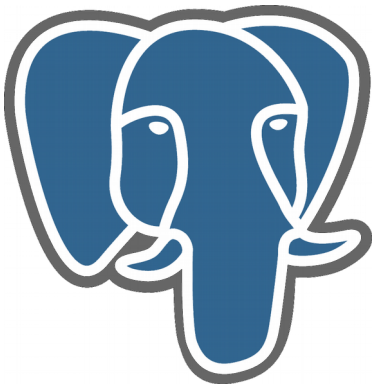
  - We have set up an Amazon S3 bucket with datasets
    - ldbc-snb
    - East coast region
  - From SF1 to SF1000 in CSV, CSVMergeForeign and TTL Formats
  - Set up as “Requester Pays”
    - cheap, about 0.03$ per GB
    - Datasets are compressed (about 1/3 ratio)
    - Downloading SF1000 its about 10$

Progress

- Mainly focused on polishing and easing adoption
  - We have created a Postgres compliant JDBC driver with all Interactive and BI query implementations.
    - https://github.com/ldbc/ldbc_snb_implementations
  - Fully validated
  - The goal is to serve as the base implementation for SQL systems



Progress

- Mainly focused on polishing and easing adoption
  - Extended the LDBC driver with new requested features from vendors
    - Adjustable number of update threads
    - Skipable update stream starting point

Progress

- Mainly focused on polishing and easing adoption
  - Improved query formulation, consistent with BI queries
    - Added “limit” and “sort” sections
  - Removed unnecessery stuff that was outdated or duplicated from the github pages (from 106 to 39 pages)

Progress

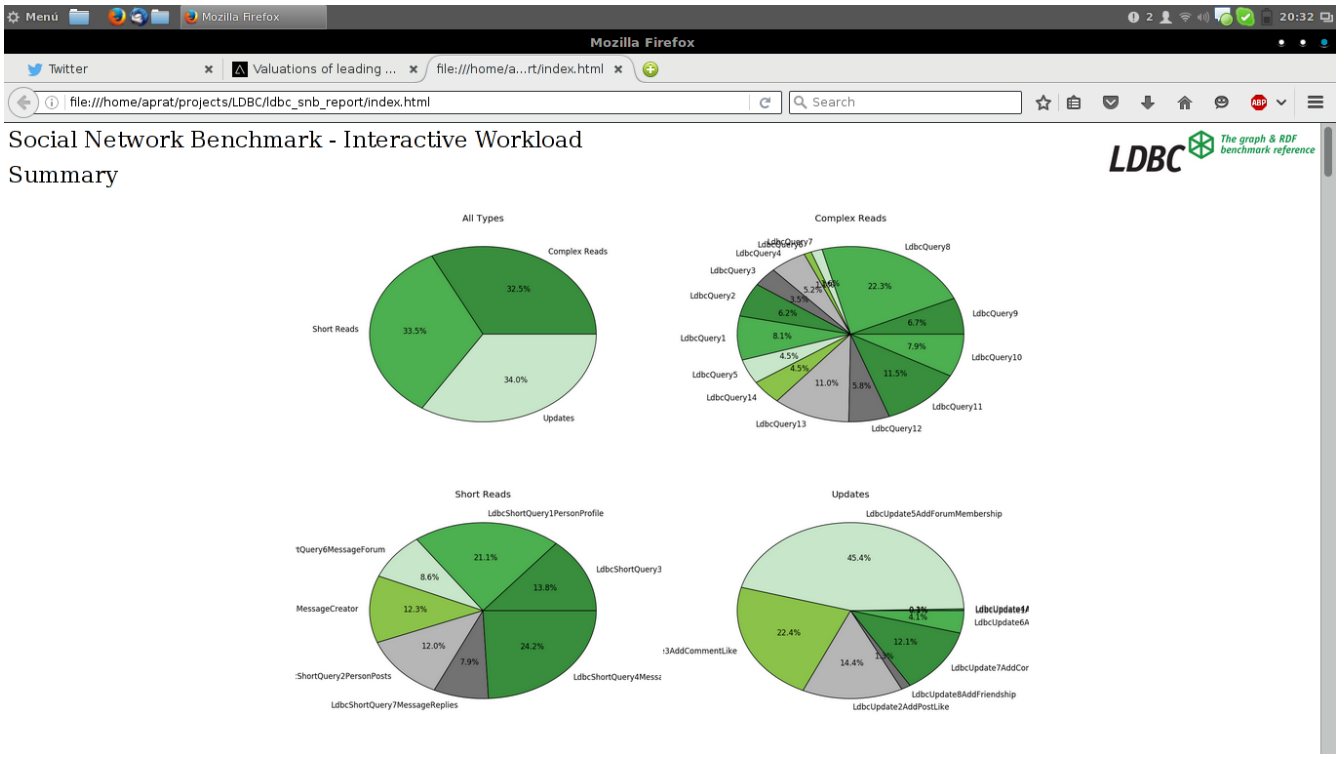
- Mainly focused on polishing and easing adoption
  - New version of the data generator (v0.2.6) with new features:
    - Added data integrity tests
    - Improved performance and scalability
    - Added more configuration options to override the generation process:
      - Custom string/date formatting
      - Custom message text generation
      - Custom knows edge weight computation
    - Bug fixing (thanks to testing!)
  - See github.com/ldbc/ldbc_snb_datagen/releases/tag/v0.2.6 for a full list of changes

Current and future Work

- Towards 1.0 version
  - Missing the pricing cost model.
    - Waiting for LDBC Bylaws to be approved
  - Preparing new audited results
    - Neo4j and Sparksee are ready to be audited

Current and future Work

- Working on a reporting tool to visualize the data output by the driver
  - Just prototyping stages



Conclusions

- LDBC SNB Interactive Workload models the use of a social network site by its users
  - Complex Reads, Short Reads, Updates
- Targets systems at different scales and kinds
- Actively hearing the community, please send Feedback!
  - We are mainly working on easing the adoption
- Preparing version 1.0 with new audited results, to be sent to the Board of Directors for approval

Thank you