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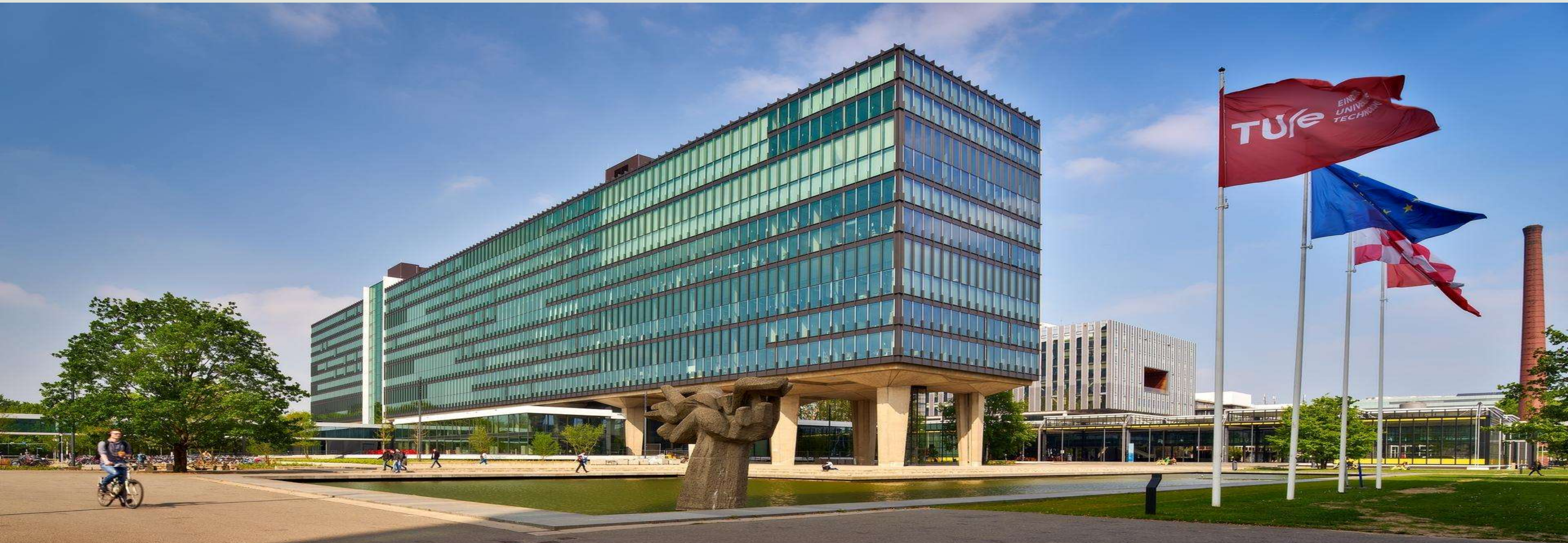

Linked Data Council's Business Intelligence and Interactive Benchmark from GSQL to GQL

Ryan Meghoe -Web Science

TigerGraph

2017

AIM : Fast DBM for graphs

Language : GSQL

SCOPE

Bi workload (20)

Interactive workload (26)

GQL parser: pattern match evaluation test

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LDBC

Business Intelligence

- OLAP
- multi-hop/path/subgraph queries
- inserts

Interactive Workload

- OLTP
- 2 hop/3hop queries
- inserts and deletes

Property Graphs & GQL

- Property Graphs terminology
- GQL

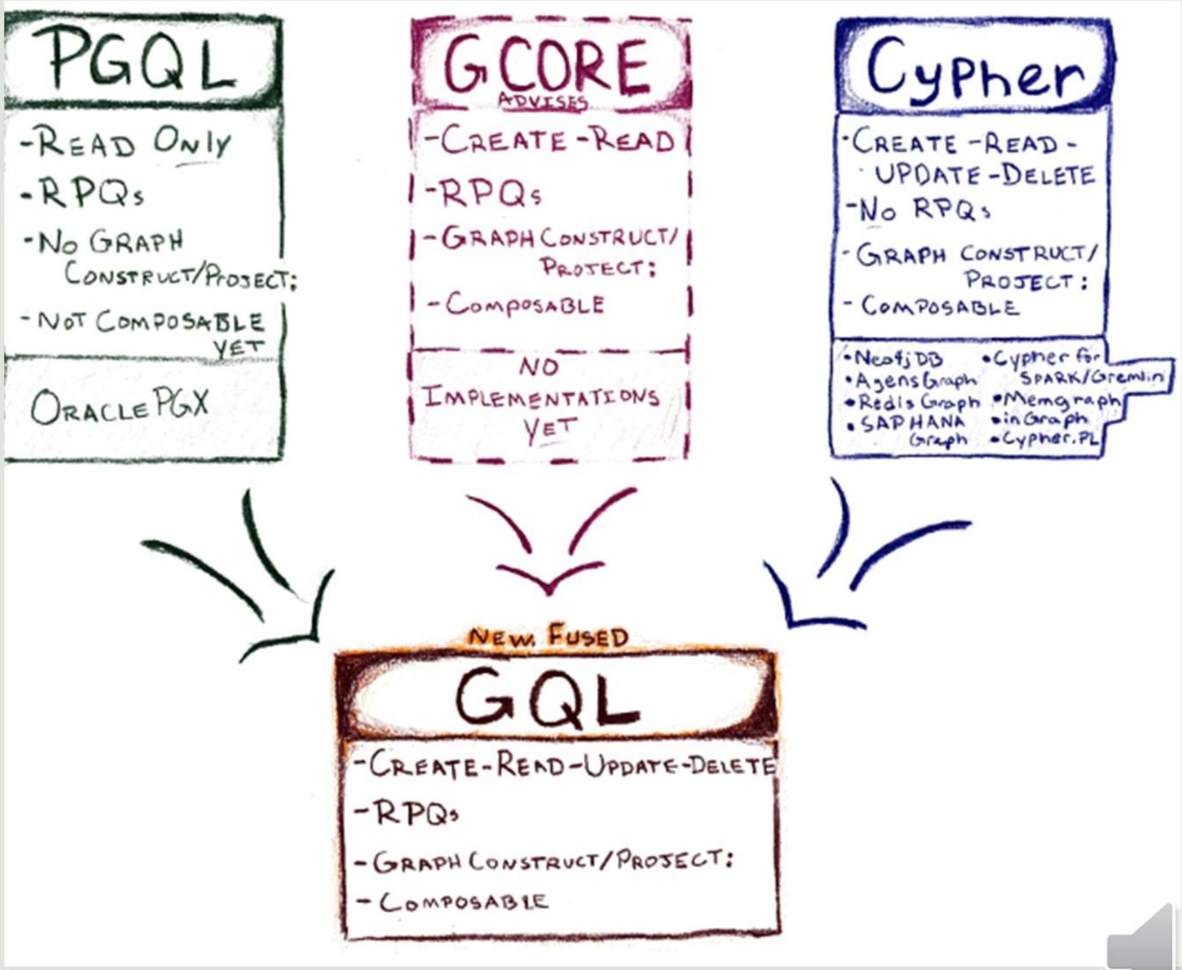
GQL

Standard

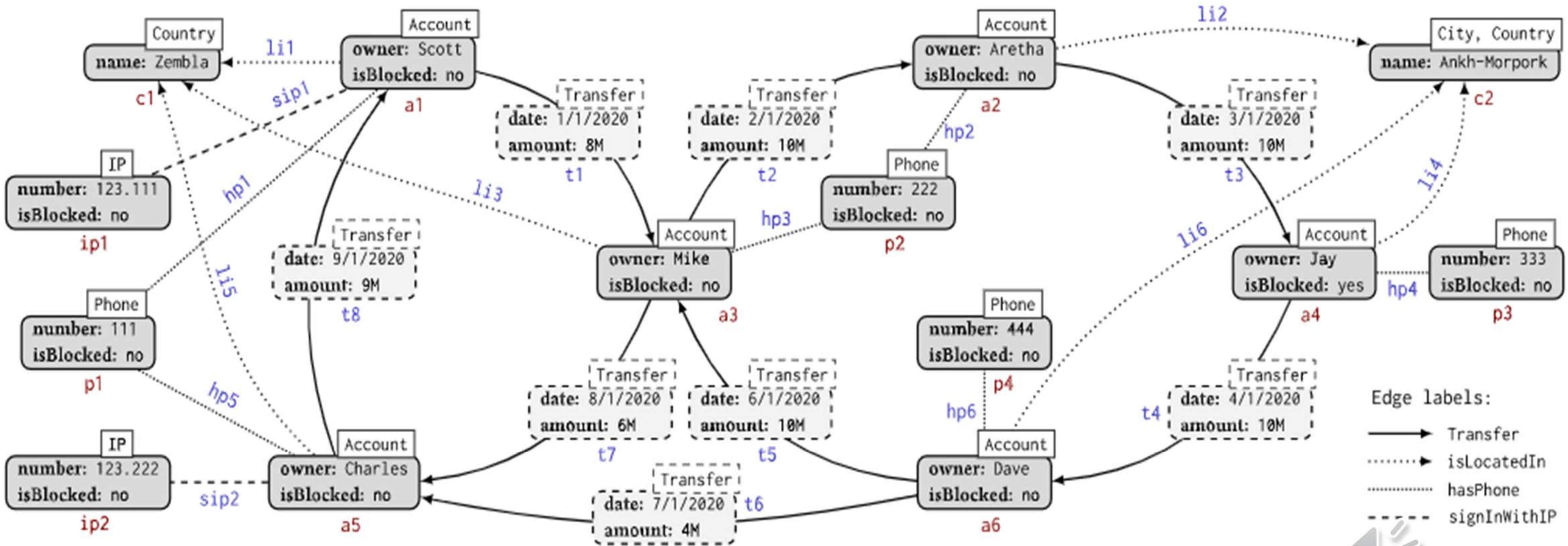
Property graphs

RPQ

ISO Standard :Final Delivery -> 2024



Property Graphs



Property Graphs

$$G = (N, E, rho, \lambda, \sigma)$$

1. N , E
2. ρ : E ->$(N \times N)$
3 . **λ** :$(N \cup E)$ SET+(L)
4. σ : $(N \cup E) \times P$ SET+(V)

Node Pattern

χ and is a triple of (a,L,P) :

- $a \in A \cup \{nil\}$ is an optional name.
- $L \subset \emptyset \cup \{L1,...,Ln\}$, which is finite
- P can be nil or (m,n) where $m,n \in N \cup \{nil\}$

Relationship Pattern

$\rho = (d,a,L,P,I)$

direction: d ∈ {→,→,−}

- name: a ∈ A ∪ {nil}
- empty finite set : L ⊂ ∅ ∪ {L1,...,Ln}
- P can be an empty finite set of key-value pairs, in the form (k,v);

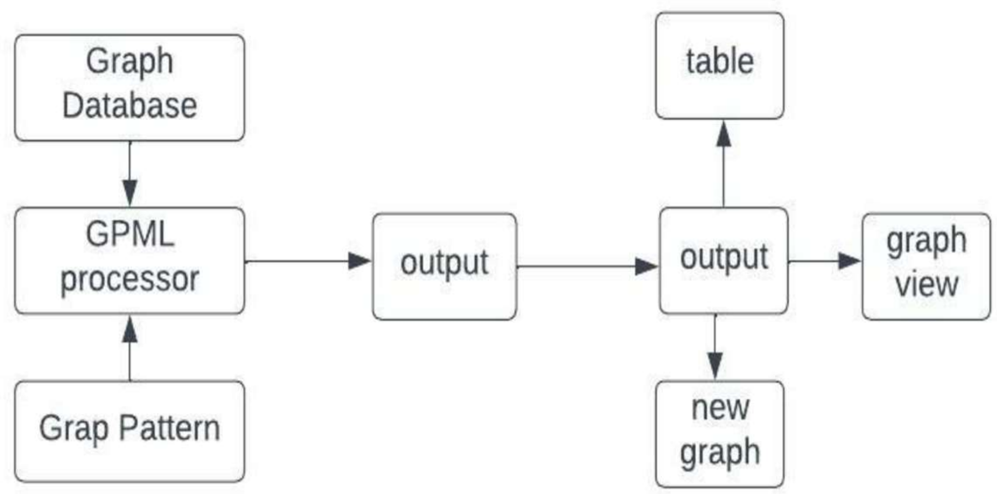
k,∈ κ, v,∈, ν

- I can be nil or (m,n) where m,n ∈ N ∪ {nil}

Data-Model

GQL values

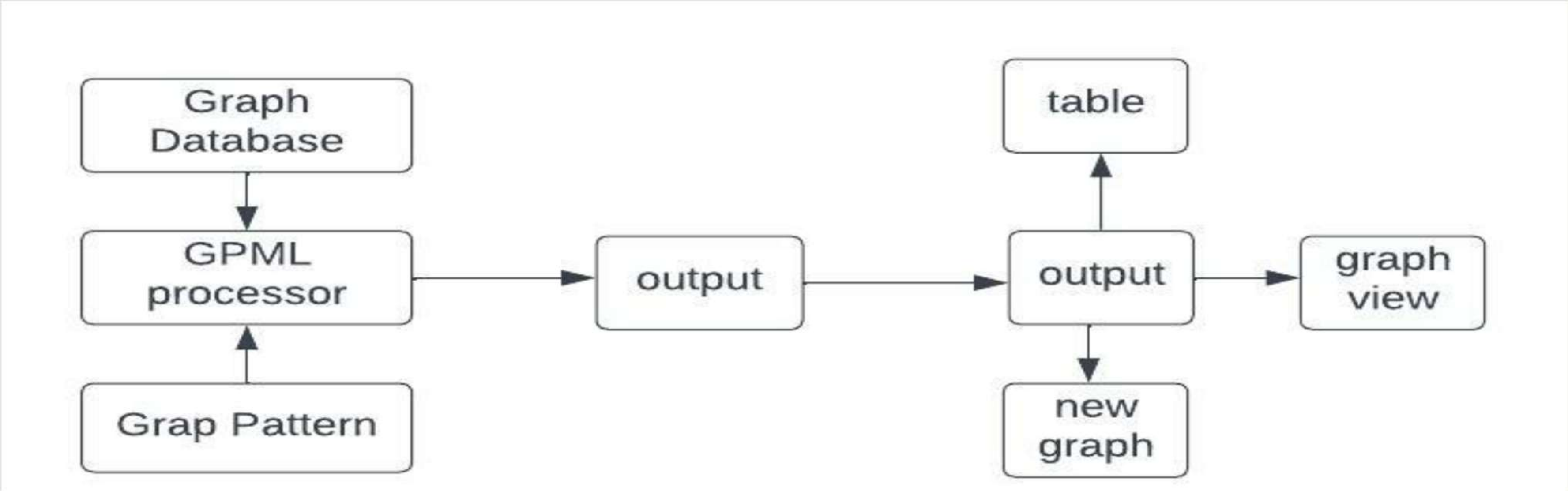
- Base types
- Node and Edge indentifiers
- (Multiset)Set(Vn...Vm)
- Map()
- Paths



Pattern Matching

- Match Pattern Relationship
- Path Pattern Union & Multiset Alternation
- Restrictors & Selectors

Pattern Matching for GPML



Relationship Pattern

MATCH *pattern*

<-[specification]- left directed

<~[specification]~ left undirected

-[specification]-> right directed

~[specification]~> right undirected

~-[specification]~ undirected

Path patterns
UNION and Multiset Alternation

MATCH *pattern_1* | pattern 2

MATCH *pattern_1* |+| pattern 2

Restrictors

TRAIL ACYCLIC SIMPLE

Selectors

ANY vs ANY K

ANY SHORTEST vs ALL SHORTEST vs SHORTEST K vs SHORTEST K GROUP

Quantifiers

{m,n} between m and n repetitions

{m,}

*

+

Ensuring path Termination:

MATCH Type-selector Type-restrictor
......remaining query..

- GQL Syntax
- Demo

GQL features and Syntax

$$\textbf{query} ::= \text{query expr (query conjunction query expr)*}$$

$$\textbf{query conjunction} ::= \text{set operator} \mid \text{OTHERWISE}$$

$$\text{query expr} ::= \text{focused query expr} \mid \text{ambient query expr}$$

$$\textbf{focused query expr} ::= \text{(FROM a match clause+)+ return statement a} \in A$$

$$ambientqueryexpr ::= matchclause + returnstatement$$

$$\textbf{return statement} ::= RETURN setquantifier?(*|returnlist)$$

$$\textbf{set operator} ::= unionoperator|othersetoperator$$

$$\textbf{union operator} ::= UNION(setquantifier|MAX)?$$

$$\textbf{other set operator} ::= (EXCEPT|INTERSECT)setquantifier?$$

$$\textbf{set quantifier} ::= DISTINCT|ALL$$

$$\textbf{return list} ::= returnitem(,returnitem)*$$

GSQL	GQL
CREATE OR REPLACE DISTRIBUTED QUERY bi7(STRING tag) SYNTAX v2 {	-
TYPEDEF TUPLE <STRING relatedTagName, UINT replyCount> RESULT;	-
HeapAccum<RESULT>(100, replyCount DESC, relatedTagName ASC) @@result;	-GROUP BY ORDER BY
SumAccum<UINT> @count;	- COUNT

GSQL breakdown to GSQL

```
 tagWithName = SELECT t FROM Tag:t
WHERE t.name == tag;
```

Pattern match 1

```
 replies = SELECT c FROM tagWithName -
(<HAS_TAG.<REPLY_OF)- Comment:c;
```

Pattern match 2

```
repliesWithTag =
   SELECT r
   FROM tagWithName -(<HAS_TAG)- replies:r;
```

Pattern match 3

```
  PRINT @@result as result;
}
```

-

GSQL	GQL
repliesWithoutTag = replies MINUS repliesWithTag;	- EXCEPT ALL
tmp = SELECT t FROM repliesWithoutTag:r -(HAS_TAG>)- Tag:t ACCUM t.@count += 1 POST-ACCUM @@result += RESULT(t.name, t.@count);	- - Return

Final GQL QUERY

```
FROM BI
MATCH  (tag:Tag {name:$tagname} )<-[:HAS_TAG]-(m:Message),
          (m)<-[:REPLY_OF]-(c:Comment)-[:HAS_TAG]->(rTag:Tag)
RETURN rTag.name AS  rTag_name,
     count(*) AS count

EXCEPT ALL

FROM BI
MATCH  (c1:Comment)~[:HAS_TAG]~(tag1:Tag)
Return rTag_name
```

- DEMO
- Limitation(s)
- Future Research

Limitations

VIEWS -> Tables

Graph-> Binding Table -> Subgraph projection -> View-Table

Functions , Predicates

Brief Demo

Future Work

- TLP
- Views and Subgraphs
- Extension of the GQL parser to support those
- Path termination

Thank You

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Bibliography

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