Introducing PG-Schema

Schemas for Property Graphs

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Different ways to use schemas

No Schema

Flexible Schema

- rapid development in early stages
- schema comes with data
- **descriptive role:** tell users & systems what to expect in the data

Partial Schema

- advanced stages of development
- **prescriptive schema** over stable data
- **descriptive schema** for stable and evolving data

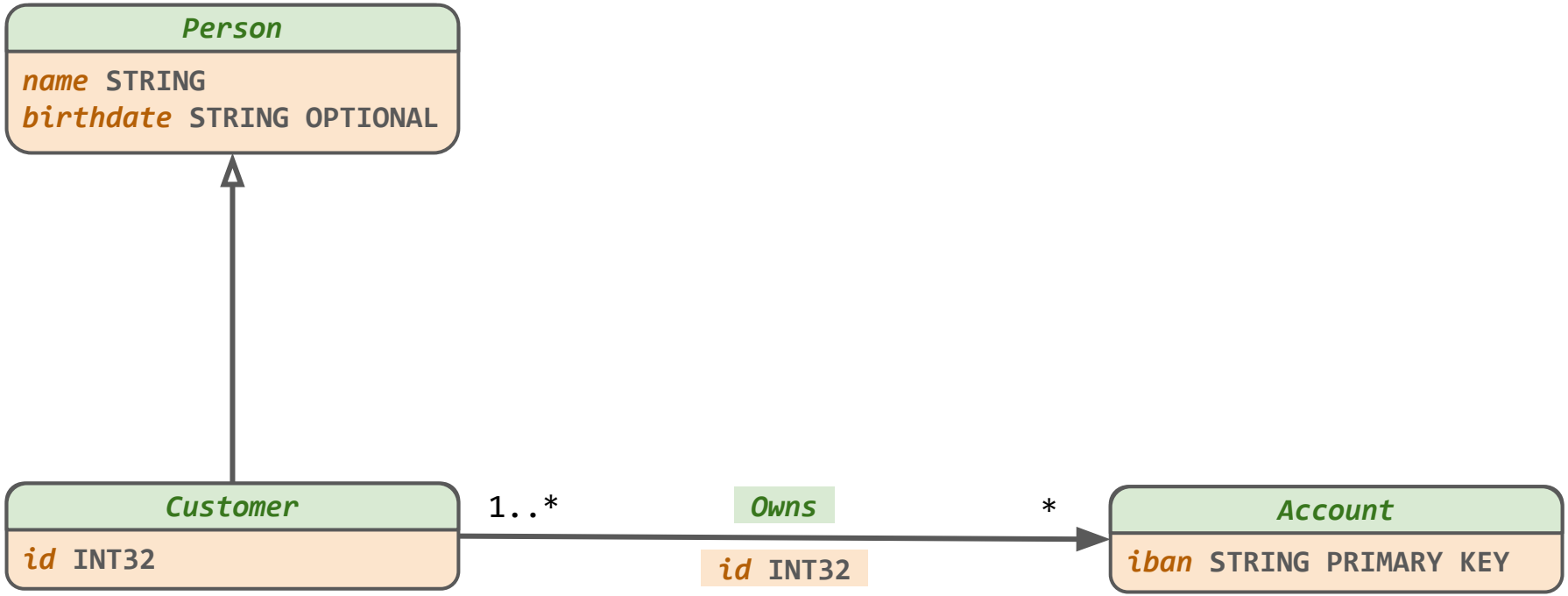
Schema First

- production settings of stable systems
- schema provided during setup
- **prescriptive role:** limit data modifications

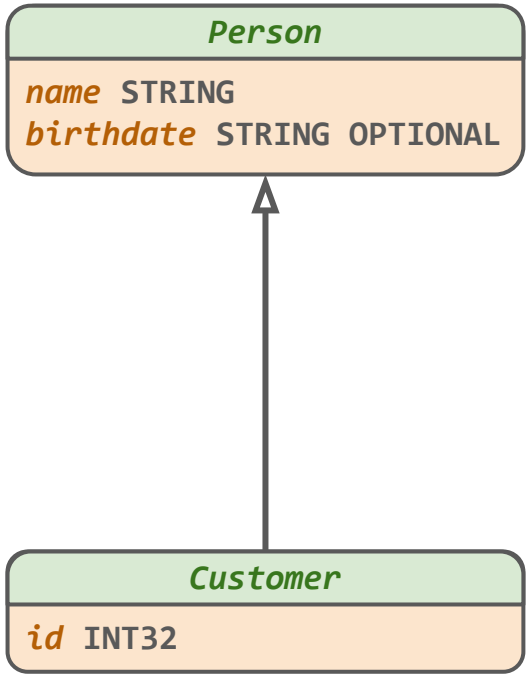
data exploration ● data visualisation ● query formulation
data transformations ● data integration
data curation ● query optimization

Ingredients of PG-Schema

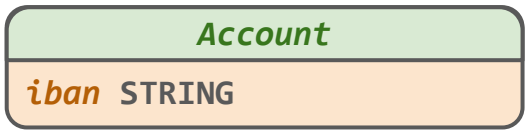
Example


Person
name STRING
birthdate STRING OPTIONAL
Customer
id INT32
1..*
Owns
id INT32
*
Account
iban STRING PRIMARY KEY

Node types

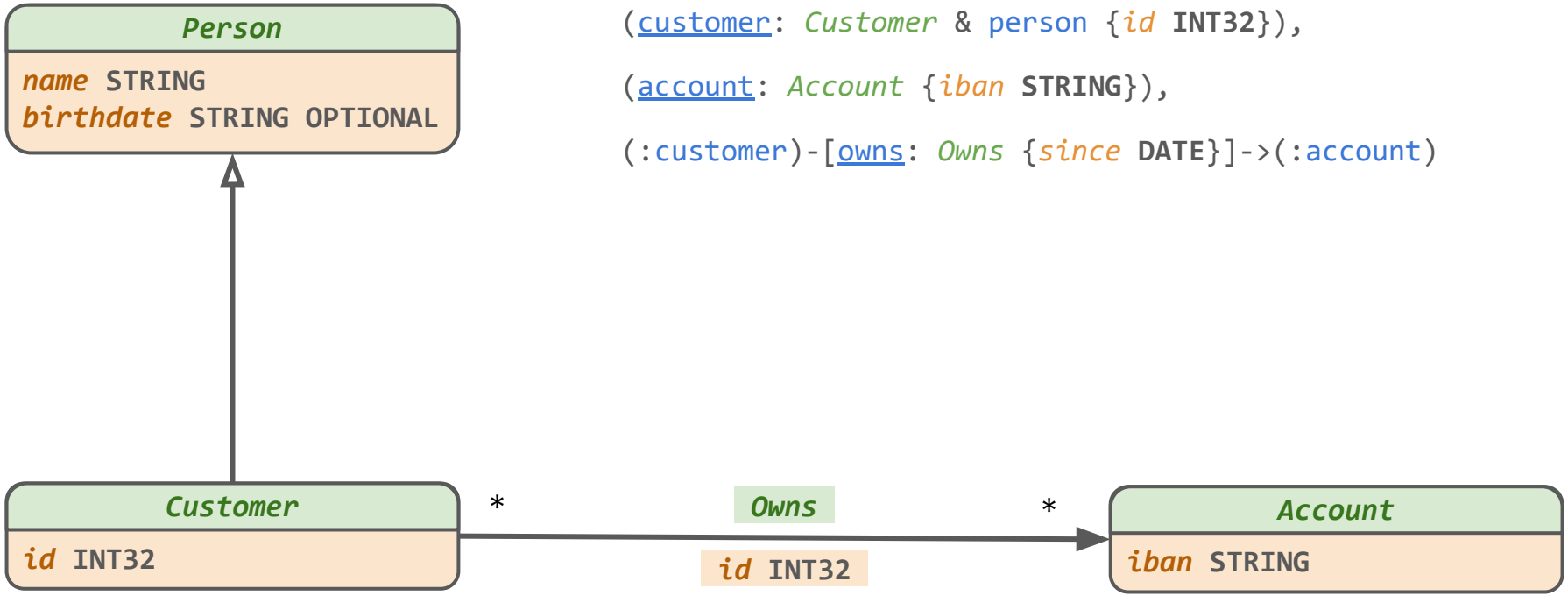



```
(person: Person {name STRING, OPTIONAL birthdate DATE}),
(customer: Customer & person {id INT32}),
(account: Account {iban STRING})
```

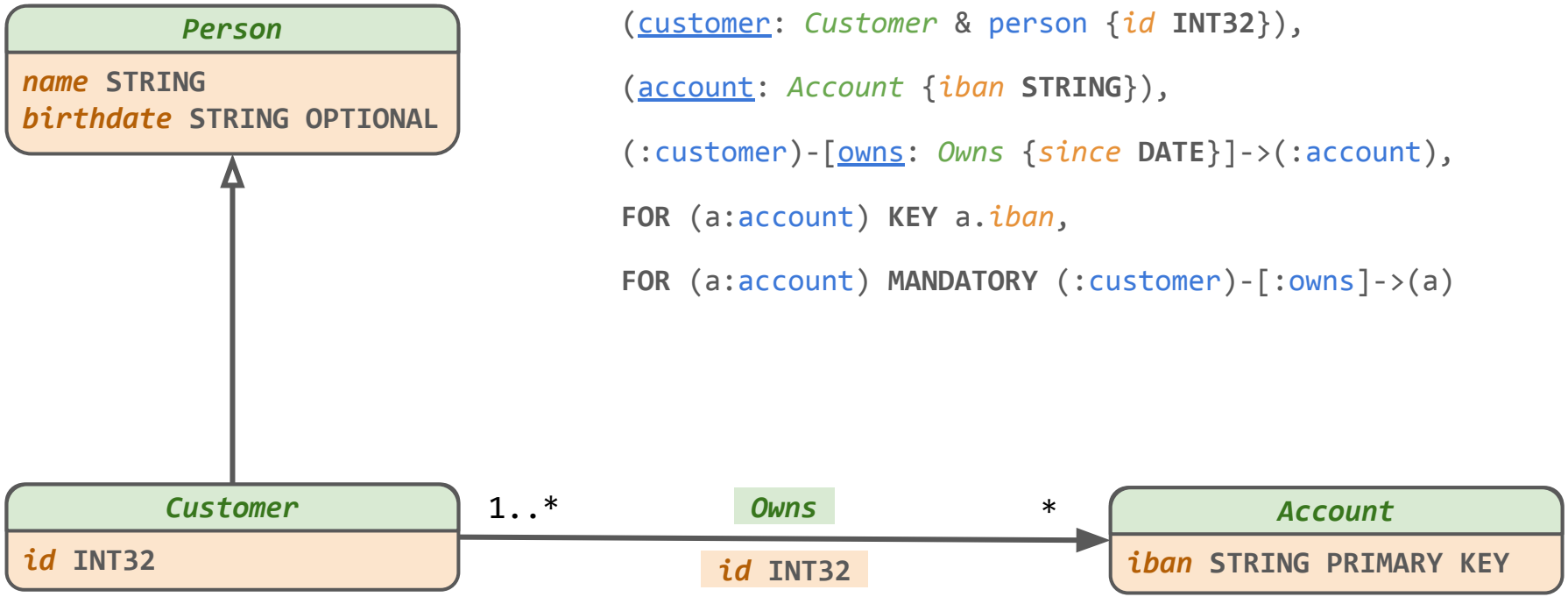


Edge types

```
(person: Person {name STRING, OPTIONAL birthdate DATE}),
(customer: Customer & person {id INT32}),
(account: Account {iban STRING}),
(:customer)-[owns: Owns {since DATE}]->(:account)
```



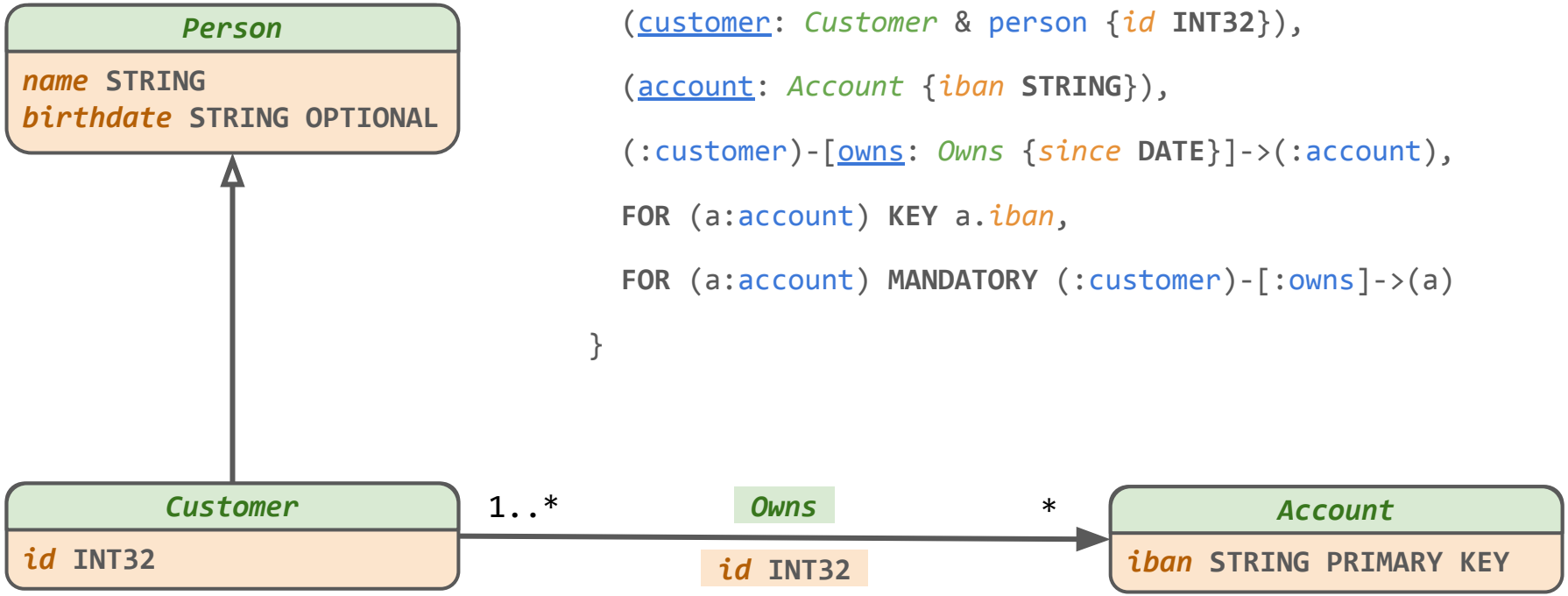
Constraints




```
(person: Person {name STRING, OPTIONAL birthdate DATE}),
(customer: Customer & person {id INT32}),
(account: Account {iban STRING}),
(:customer)-[owns: Owns {since DATE}]->(:account),
FOR (a:account) KEY a.iban,
FOR (a:account) MANDATORY (:customer)-[:owns]->(a)
```

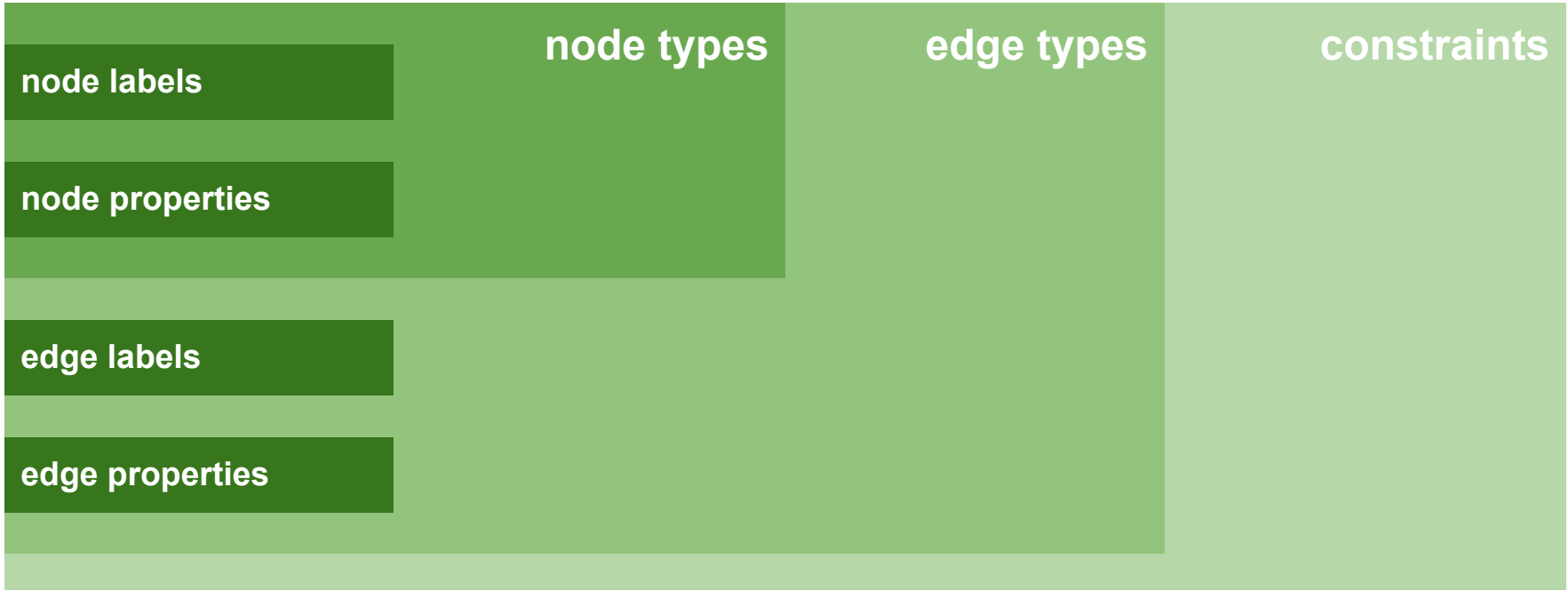
Complete PG-Schema

```
CREATE GRAPH TYPE customerGraph STRICT {
  (person: Person {name STRING, OPTIONAL birthdate DATE}),
  (customer: Customer & person {id INT32}),
  (account: Account {iban STRING}),
  (:customer)-[owns: Owns {since DATE}]->(:account),
  FOR (a:account) KEY a.iban,
  FOR (a:account) MANDATORY (:customer)-[:owns]->(a)
}
```



Superpowers of PG-Schema

Simplicity. One-way information flow



easy to understand, validate, and generate ● facilitates partial validation

Power. Compositionality

Union, intersection, and abstract types, for inheritance and more.

```
CREATE GRAPH TYPE customerGraph STRICT {
  (person: Person {name STRING, OPTIONAL birthdate DATE}),
  (company: Company {name STRING}),
  ABSTRACT (taxpayer: {taxPayerNumber STRING}),
  (customer: (person|company) & taxpayer & Customer {id INT32})
}
```

reusability ● conciseness ● modelling power

Versatility. Strict and loose schemas

STRICT schemas: elements must belong to at least one type and constraints must hold.

```
CREATE GRAPH TYPE customerGraph STRICT {
  (person: Person {name STRING, OPTIONAL birthdate DATE}),
  (customer: Customer & person {id INT32}),
  (account: Account {iban STRING}),
  (:customer)-[owns: Owns {since DATE}]->(:account),
  FOR (a:account) KEY a.iban,
  FOR (a:account) MANDATORY (:customer)-[:owns]->(a)
}
```

schema first ● partial schema ● flexible schema

Versatility. Strict and loose schemas

LOOSE schemas: elements may belong to zero types, but the constraints must hold.

```
CREATE GRAPH TYPE customerGraph LOOSE {
  (person: Person {name STRING, OPTIONAL birthdate DATE}),
  (customer: Customer & person {id INT32}),
  (account: Account {iban STRING}),
  (:customer)-[owns: Owns {since DATE}]->(:account),
  FOR (a:account) KEY a.iban,
  FOR (a:account) MANDATORY (:customer)-[:owns]->(a)
}
```

schema first ● partial schema ● flexible schema

Versatility. Closed and open types

CLOSED types (default) allow only explicitly mentioned or inherited labels and properties.

OPEN types allow arbitrary additional labels and properties.

```
CREATE GRAPH TYPE customerGraph STRICT {
  (person: Person OPEN {name STRING, OPTIONAL birthdate DATE}),
  (customer: Customer & person {id INT32, OPEN })
}
```

schema first ● partial schema ● flexible schema

Also in the paper

Also in the paper

- Systematic analysis of design requirements.
- Full grammar of PG-Schema (excluding PG-Keys).
- Formal semantics of PG-Schema (excluding PG-Keys).
- Detailed comparison with existing schema formalisms.
- Possible extensions.

Takeaway

For industry

- **PG-Schema is a simple, yet powerful and versatile schema language for property graphs, rooted in the experience of 30+ researchers, engineers, and standards contributors.**
- By implementing it in your system you will increase functionality to better support current and future customer demands.
- If full PG-Schema seems too much, talk to us about an adequate fragment.

For academia

- **The hard part of schema language design is striking the right balance between simplicity and power. Can we add negation or recursion?**
- Schema validation and basic schema generation is tractable, but practical maintenance algorithms are needed (incremental and batch setting).
- Powerful type compositions make visualizing schemas challenging.
- Graph data transformations and query optimization can build on PG-Schema.

Thank You