Guided Interaction: Rethinking the Query-Result Paradigm

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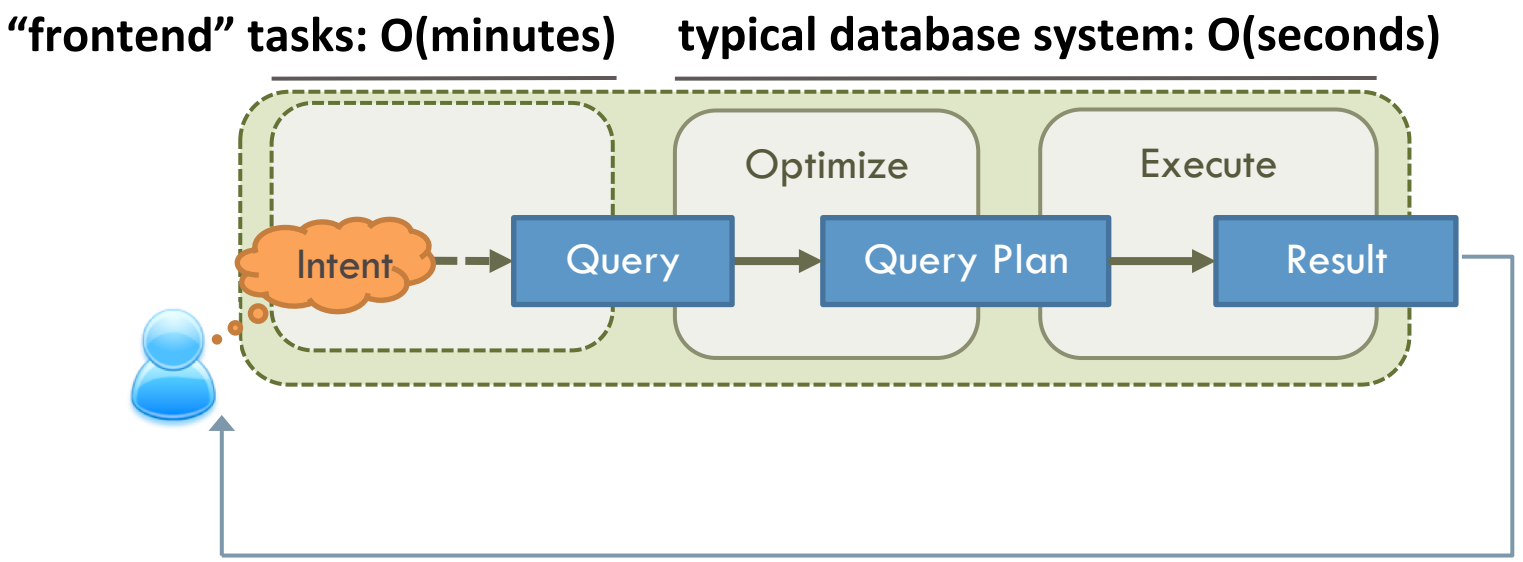
Overview



- Databases have become *really fast / efficient* in going from **query** to **result**
- But does that solve the *overall* ***user need***?

Outline

- Motivating Example
- Challenges
- Guided Interaction

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- **Motivating Example**
- Challenges
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Motivating Example

- **Alex** and **Bob** meet a Senior Manager
  - Forget name, need to look up contact info.
  - All they remember: manager of small group of senior researchers

Naïve user

Alex

Database Expert

Bob

Manager

Motivating Example: Naïve Alex

- Visits corporate social network website

1. Browses all the “advanced search” forms

2. Uses Faceted Search interface to naively query for everyone in the company

3. Realizes you can’t drill down by *seniority*
   - There isn’t a “*seniority*” field, but *age*…

4. Goes back to “Birthday Search” form
   - Figures out senior employees are ~50

5. Adds age range, drills further, finds person

Naïve user Alex

Motivating Example: Expert Bob

- Opens up SQL Console to employee DB

1. `SHOW TABLES; // reads…`
2. `DESC TABLES;  // reads more…`
3.
```
SELECT emp.project, COUNT(*) AS c, AVG(emp.age) AS a
FROM emp JOIN dept ON (emp.deptID = dept.ID)
GROUP BY emp.project ORDER BY c ASC, a DESC LIMIT 3
```
4.
```
SELECT emp.name,emp.cubicleID
FROM emp JOIN dept ON (emp.deptID = dept.ID)
WHERE dept.name='Research' AND
      emp.project='DatabasePrj' AND
      emp.designation='Manager'
```

Average age & count per group

Use “DatabasePrj” from prev query

Database Expert Bob

Motivating Example

- Both users spent more time constructing and issuing sub queries
- Issued redundant / wrong queries
- On standard server, most queries take < 1 min
  - Session takes several minutes – hour!
- Most time was spent in *constructing the right query*

Outline

- Motivating Example
- **Challenges**
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Outline

- Motivating Example

- **Challenges**
  - User's lack of Knowledge
  - Dependency of Information
  - Iterative and Incremental Querying
  - Imprecise User Query Intent

- Guided Interaction

Challenges

Lack of Knowledge

- Both users didn’t know about the
  - Schema
  - Data
- Naïve user Alex did not know about
  - Query Language

  either
- All 3 are needed to effectively issue queries
- Otherwise, most time is spent issuing trial-and-error queries to learn more about the DB

Challenges

Dependency of Information

3. Realizes you can't drill down by *seniority*
   - There isn't a "*seniority*" field, but *age*…
4. Goes back to "Birthday Search" form
   - Figures out senior employees are ~50

Naïve user
Alex

```
SELECT emp.project, COUNT(*) AS c, AVG(emp.age) AS a
FROM emp JOIN dept ON (emp.deptID = dept.ID)
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```

Average age & count per group

Database Expert Bob

Challenges

Dependency of Information

- Finding out what age “Senior” meant required a secondary query
- Cannot really write as a subquery
- Dependency exists between final query and intermediate query results

Challenges

Iterative & Incremental Querying

- Observation: Users construct queries by first executing smaller parts
  - Cognitive capacity of users is limited
- Query may be declarative, but users prefer iterative / incremental construction
- Leads to a lot of requerying

Challenges

Imprecise Query Intent

Average age & count per group

```
SELECT emp.project, COUNT(*) AS c, AVG(emp.age) AS a
FROM emp JOIN dept ON (emp.deptID = dept.ID)
GROUP BY emp.project ORDER BY c ASC, a DESC LIMIT 3
```

- DB Expert Bob was looking for some notion of "group" of small people

- Hard to translate imprecise intents unless we're aware of data
- Only solution is to execute and see if answer worked

Challenges

- Our example was a simple one
- Challenges become much harder with complex needs
  - n-way JOINs, Nested queries, complex aggregates…
- Any database use-case with a human in the loop will face these problems

Solutions so far

- Application-level
  - Slick UIs, customized to use case
- No principled approach to solving overall user needs
  - *Where are my standardized operators for overall data interaction?*
  - *Set of rules I can follow when building such a system?*
- Related work:
  - QBE, VizQL(Tableau), AQUA, CONTROL, Telegraph and more
  - Solve thin slices of the overall problem

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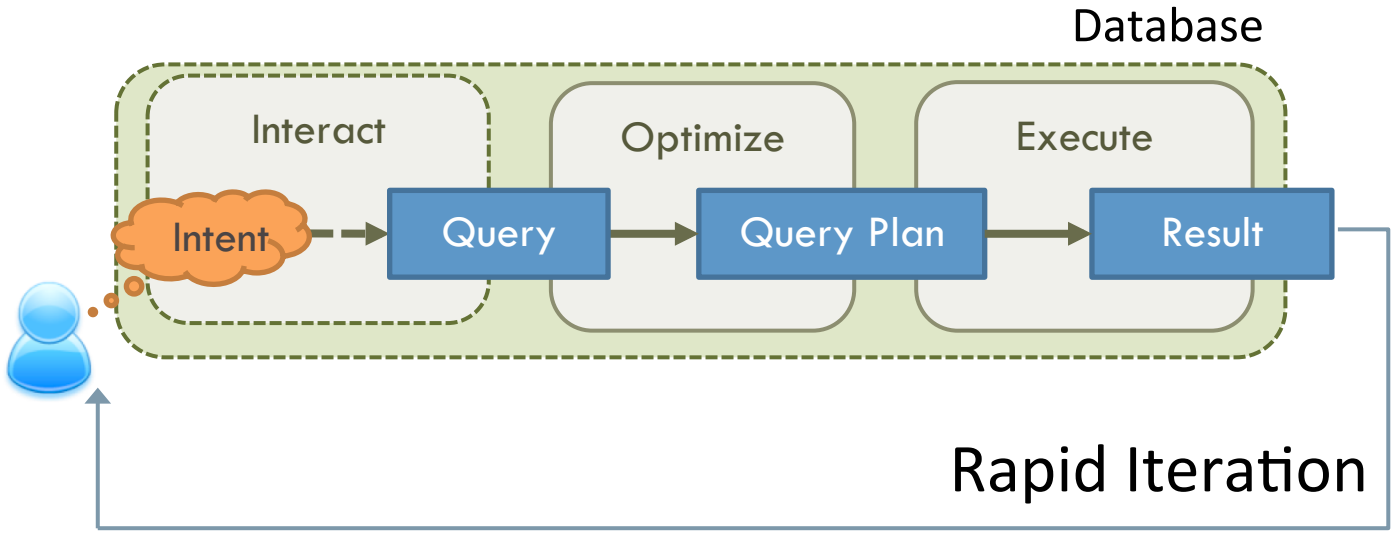
Guided Interaction

- Principled Approach to solving these problems
- More holistic thinking
- To be included *inside* database



Guided Interaction

- Set of 3 design principles
  - Enumeration
  - Insights
  - Responsiveness

- Database systems that
  keep these in mind
  can avoid the challenges discussed

Guided Interaction

Enumeration

- The database is responsible for effectively enumerating all possible valid interactions with the data.

- Removes burden of schema / data / language knowledge off the user

Guided Interaction

Enumeration: Example

- What does an enumeration-enabled query system look like?

- Important
  - *One* possible implementation
    - Focus on the concepts, not the idea!
  - Portray simple use case
    - Can have many, far more complex systems built using these principles

Guided Interaction

Enumeration: Example

- Consider SQL query interface
  - With Partial Query Completion

- Typing in **“em”** has exposed projection, join, and selection options.

Guided Interaction

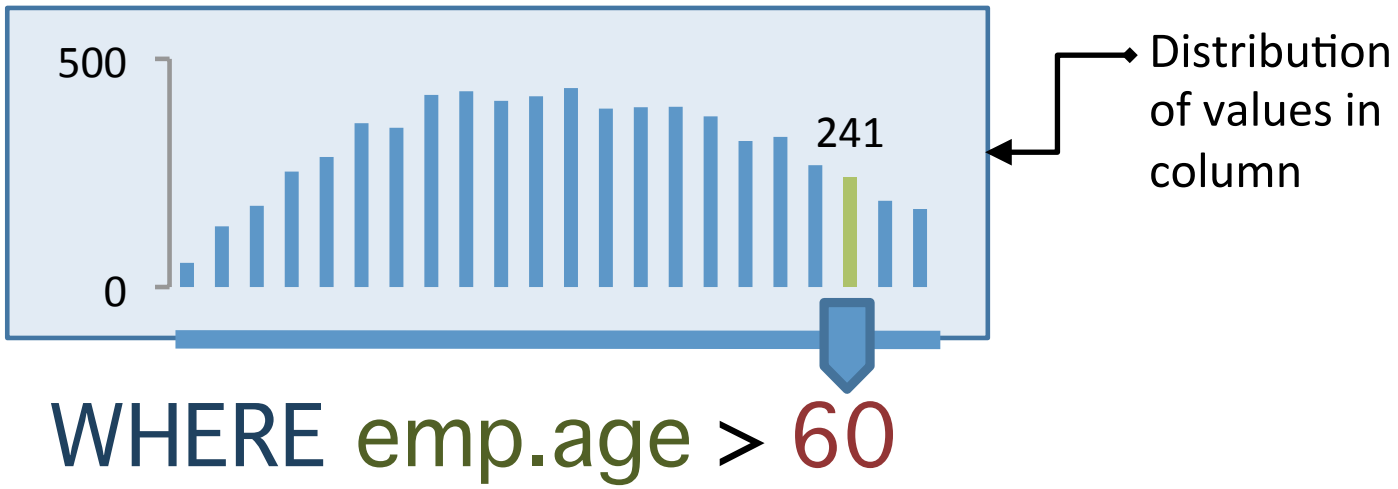
Insights

- The database must attempt to surface as many insights from the data as possible.

- Removes informational dependencies
- Aids expression of query intent
- Note: Should not overwhelm the user

Guided Interaction

Insights: Example



- Consider SQL interface with range / numeric value selection
- Visual / interactive feedback saves dependent query
- Does my DB let me build something like this?

Guided Interaction

Responsiveness

- All interactions must be instantaneous even if inaccurate.

- Fluid data interaction is key to getting insights
- Tradeoff accuracy for near-instantaneous responses (i.e. <100ms*)

* B. Bailey, J. Konstan, and J. Carlis. The effects of interruptions on task performance, annoyance, and anxiety in the user interface. In INTERACT, 2001.

Guided Interaction

Responsiveness: Example

- SQL query interface, Partial Query Completion
- Need to deliver results in <100ms

Summary

- Shortcomings in the Query-Result Model
  - Challenges
- Proposed Solution: **Guided Interaction**
  - Enumeration
  - Insights
  - Responsiveness
- Designing DBs that abide by these principles overcomes these shortcomings
  - Many fundamental building blocks already exist

Thanks! Questions?

Join me at the OSU Database Group!

http://arnab.org