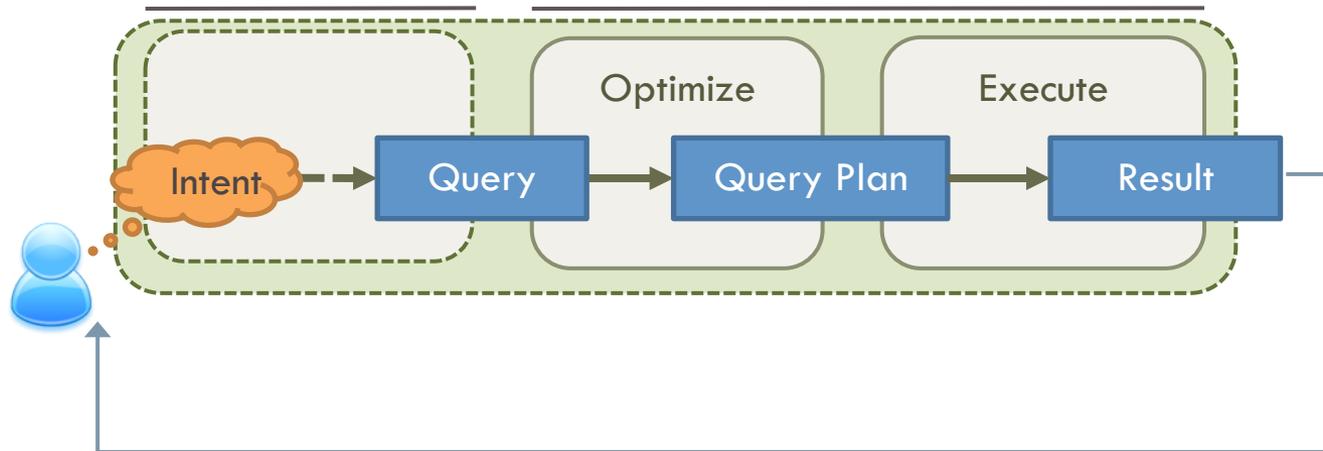


# Guided Interaction: Rethinking the Query-Result Paradigm

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# Overview

“frontend” tasks:  $O(\text{minutes})$       typical database system:  $O(\text{seconds})$



- 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

- **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..`

Average age & count per group

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'`

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**
- Guided Interaction

# 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 Languageeither
- 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



Naïve user  
Alex

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```
SELECT emp.project, COUNT(*) AS c, AVG(emp.age) AS a
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GROUP BY emp.project ORDER BY c ASC, a DESC LIMIT 3
```

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

# 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

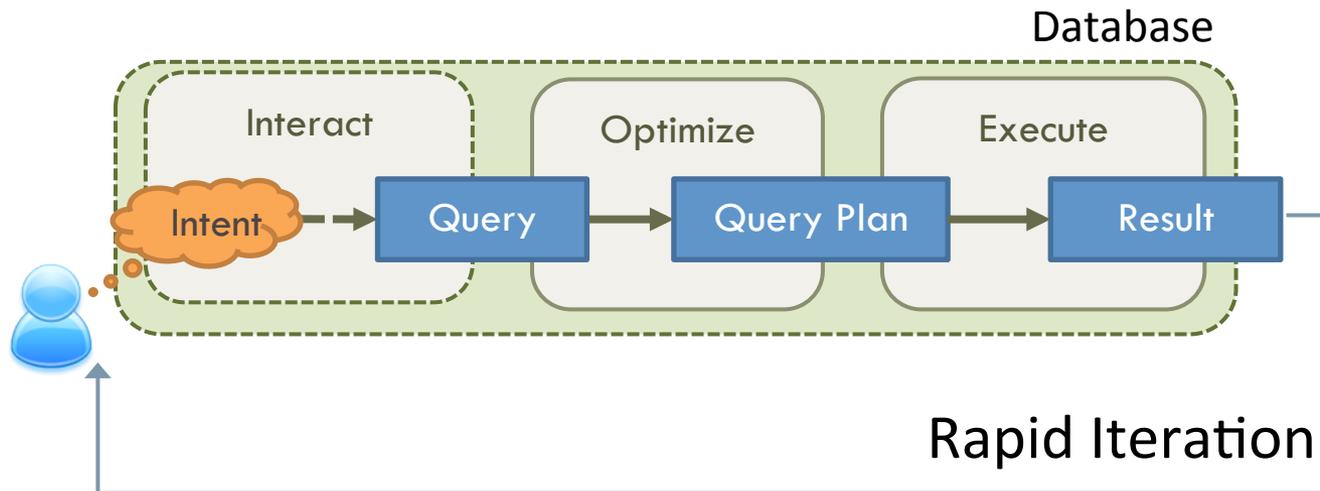
- Application-level
  - Slick UIs, customized to use case
- No principled approach to solving overall user needs
  - *Where are my **standardized operators** for overall data interaction?*
  - ***Set of rules** I can follow when building such a system?*
- Related work:
  - QBE, VizQL(Tableau), AQUA,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

# Outline

- Motivating Example
- Challenges
- **Guided Interaction**

# 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

# 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

# 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

# Enumeration: Example

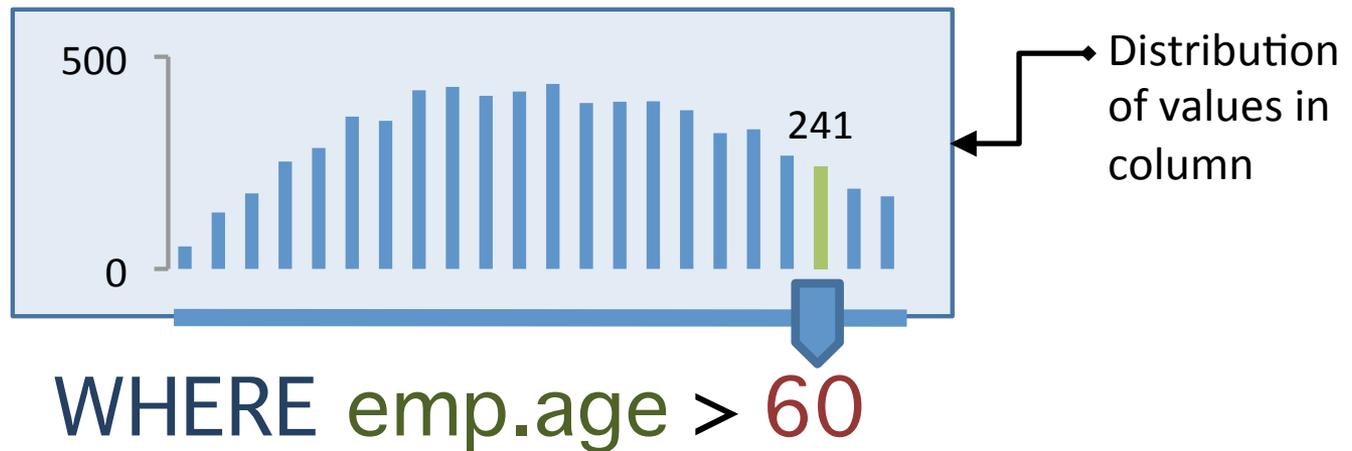


- Consider SQL query interface
  - With Partial Query Completion
- Typing in “**em**” has exposed projection, join, and selection options.

# 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

# 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?

# 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.  $<100\text{ms}^*$ )

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

# 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>