

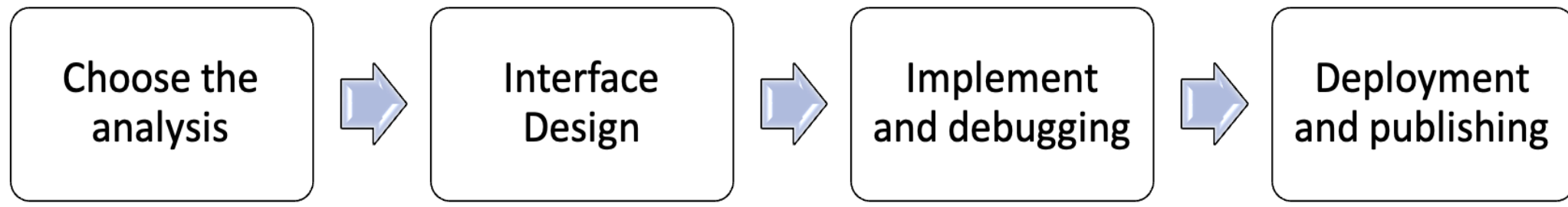


# Learned Interactive Visualization Interfaces

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## Building Interactive Visualization Interfaces is Hard 😞

Four steps to build an interfaces:



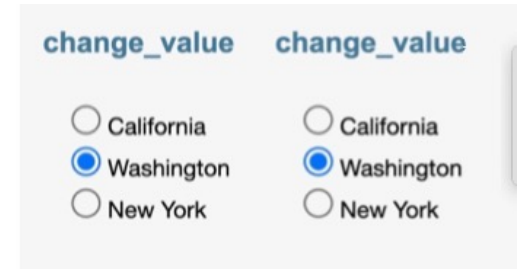
Interface goodness:

Which visualization? Which interaction? How to layout?

The first system that can automatically learn good interactive visualization interfaces from example analyses.

## Existing Tools

- Visualization recommendation tools: Only Static Visualization.

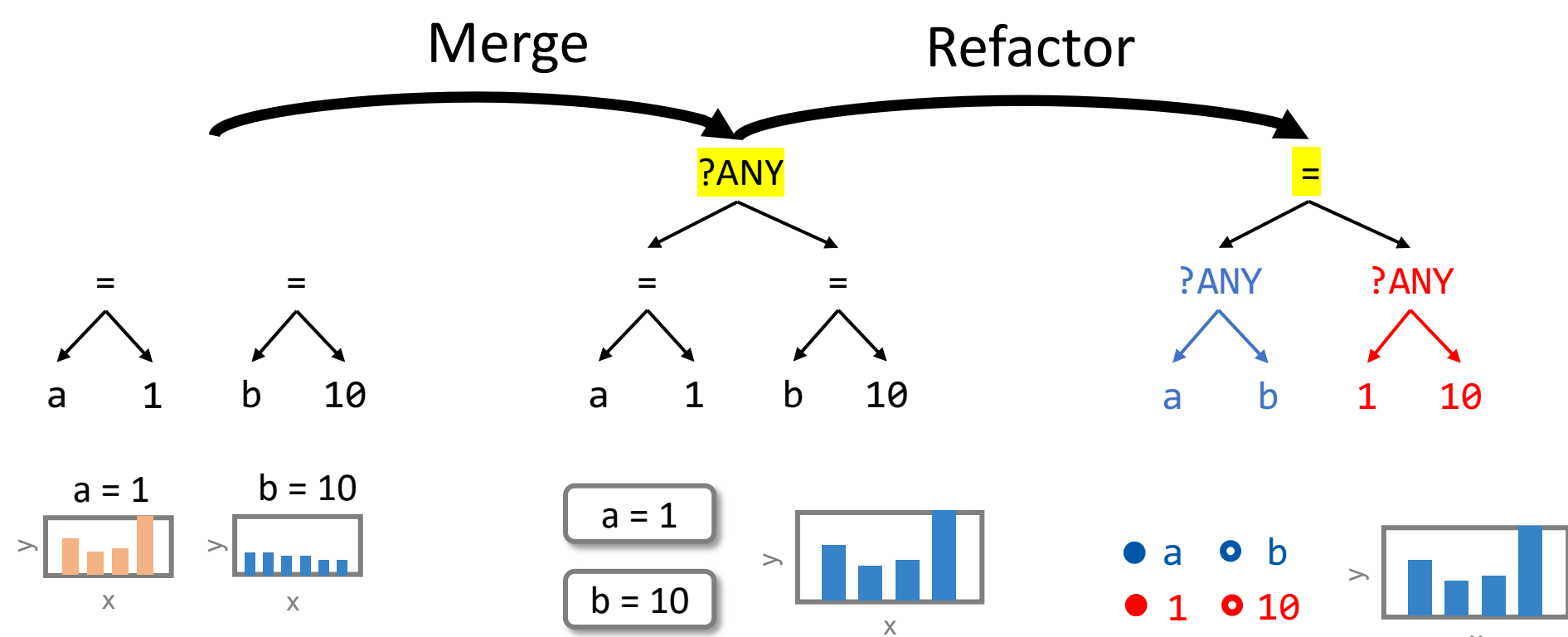


- Our prior work – PI: Only a list of widgets
- Dashboard builders limited in analysis complexity and require design effort and sometimes programming.

## Difftree Represents Interface Analyses

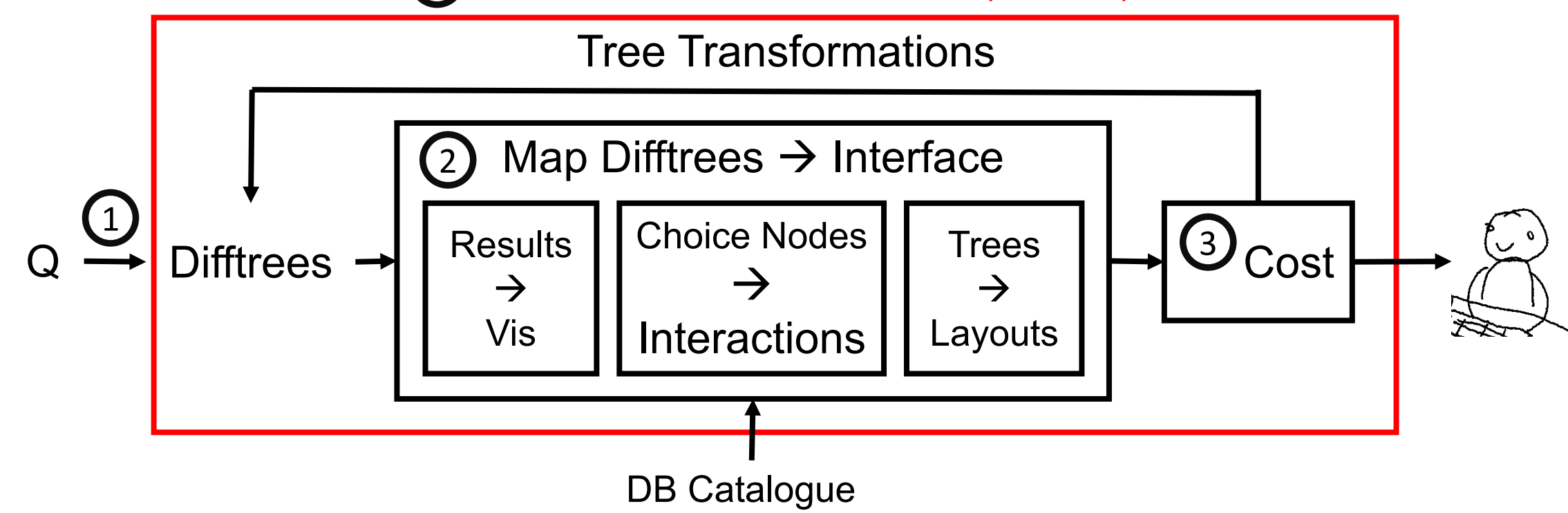
Difftree extends SQL with choice nodes.

- Choice nodes model analyses difference.
- Transformation rules can transform one tree to others.



## System Overview

### ④ Monte Carlo Tree Search (MCTS)



- 1) Parse into Difftrees.
- 2) Map the Difftrees to a candidate interface:
  - a. Each Difftree result is rendered by a visualization,
  - b. Each choice node is parameterized by an interaction,
  - c. The Difftree structure maps to the layout
- 3) Estimate candidate interface cost; returns if good otherwise transforms it.
- 4) The MCTS algorithm efficiently explores the huge search space.

## PI2: SQL Analyses to Interfaces

PI2 help generate interfaces in Jupyter notebooks.

## NL2INTERFACE: Natural Language Queries to Interfaces

NL2INTERFACE uses LLM to transform natural language queries to Difftree representation and generate interfaces.

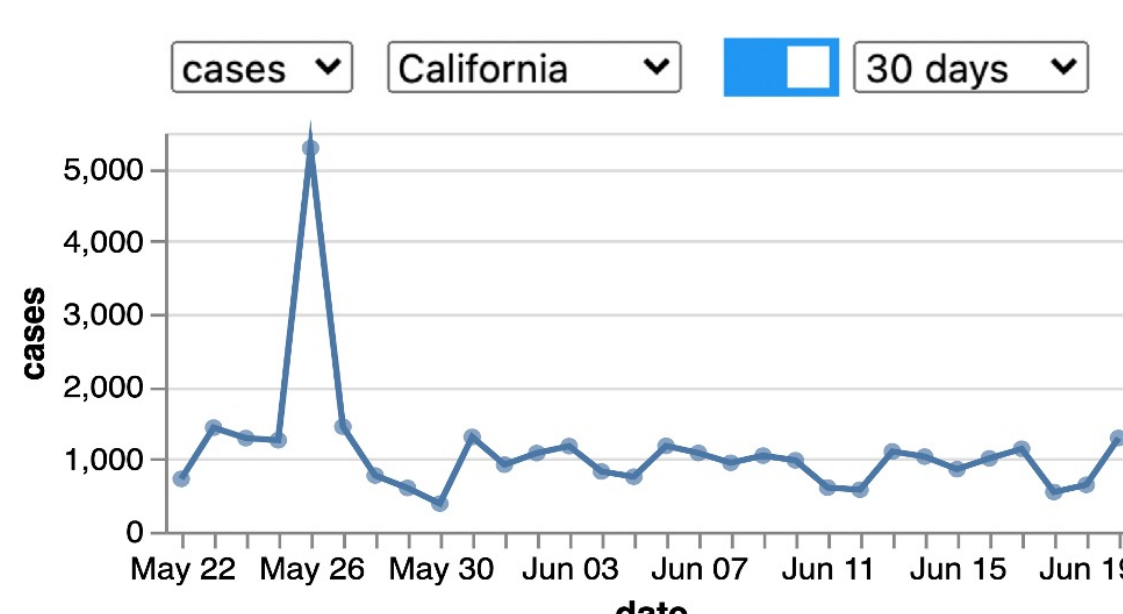
An example of linked visualization interface:

## User Study: How do learned interfaces compare with manual design?

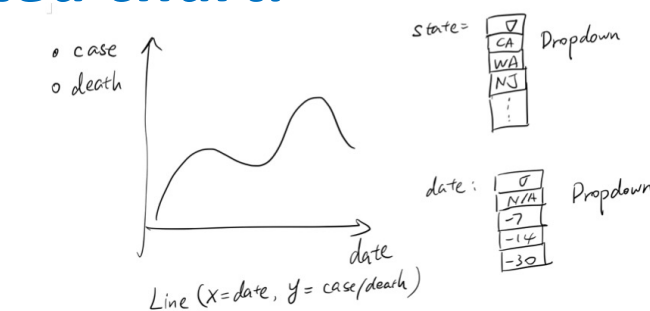
Takeaways: Users can understand and use learned interfaces, and they found them comparable or better than their own manual design.

```
Q1 SELECT date, cases FROM covid WHERE state='CA'
Q2 ..WHERE state='WA' and date>date(today(), '-30 days')
Q3 ..WHERE state='CA' and date>date(today(), '-7 days')
Q4 SELECT date, deaths FROM covid WHERE state='CA'
Q5 ..WHERE state='NY'
Q6 ..WHERE state='WA' and date>date(today(), '-14 days')
Q7 ..WHERE state='WA' and date>date(today(), '-7 days')
Q8 ..WHERE state='NY' and date>date(today(), '-7 days')
```

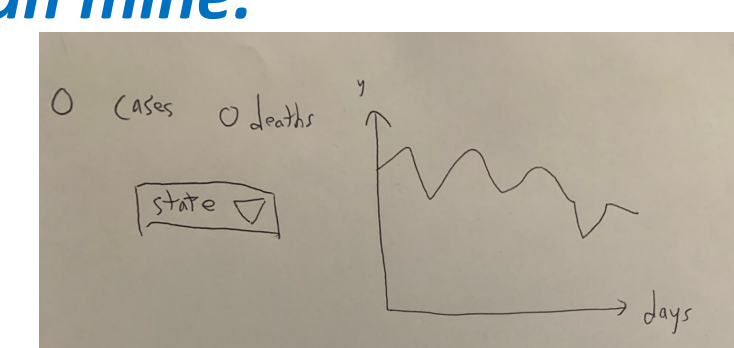
### PI2 learned interfaces



U4: "mine is basically same as the auto generated chart."



U2: "I miss the date changes. PI2 is a better design than mine."



## References

[1] Chen, Yiru, Jeffrey Tao, and Eugene Wu. "DIG: The Data Interface Grammar." *Proceedings of the Workshop on Human-In-the-Loop Data Analytics*. 2023.  
 [2] Chen, Yiru, and Eugene Wu. "PI2: End-to-end interactive visualization interface generation from queries." *Proceedings of the 2022 International Conference on Management of Data*. 2022.  
 [3] Chen, Yiru, et al. "NL2INTERFACE: Interactive Visualization Interface Generation from Natural Language Queries." *In IEEE Visualization Conference NLVIZ Workshop 2022*.