1 Introduction

The Postgres query planner does not necessarily return a good plan even with interesting orders. As mentioned in the CORDS paper, one reason is the estimated number of rows returned by a scan or join can be way off [1] due to the independence assumption falling apart.

For instance, if there are many clauses that are dependant on each other, the optimizer might estimate one row because of the independence assumption of AND clauses. As a result, the optimizer might perform a nested loop join because the single row fits in memory. An example where clause could be looking for rows belonging to a particular city in a province in a country on a continent. None of the values are independent and as a result their individual probabilities should not be multiplied.

As a result, this prototype was created to explore the possibility of a database user manually manipulating the plan, or changing the estimates of the number of rows returned from a base or joined relation. The primary use case is for queries that are expected to take hours or days to complete. Additionally, this tool can be used for queries that are expected to be used many times. If used in other settings, then the time spent having the user optimize the query may significantly exceed the time saved in query processing.

2 Features

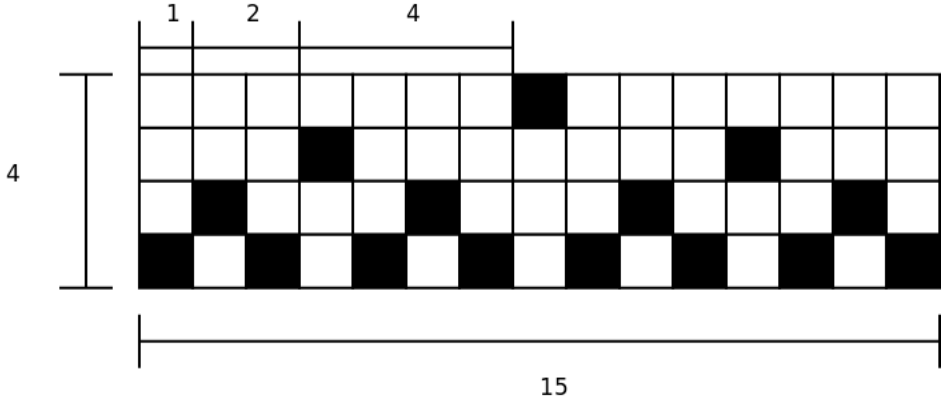
The prototype begins by displaying the plan that the optimizer initially computes. The UI can display any number of levels of joins. From that UI, you can change which join algorithm should be applied on the two relations. Lastly, the UI also allows you to modify the estimated number of rows for each relation and then the query planner searches for a new plan using the new estimates.

3 How it Works

The most complicated components of this project are summarized here. A lot of other challenges encountered are not included here to keep the report brief.

3.1 UI

The UI was built using GTK+. The most complicated component of the UI is the display of the plan. This was solved by applying a table GUI abstraction, where a plan node widget can be placed at any row and column of the table. A tree structure can be simulated in the table. The following diagram illustrates how the formula was derived.



The 0th row is the top most row of the table. The 0th column is the left most column of the table. Given the above convention, we can compute the position of all the nodes using the following recursive

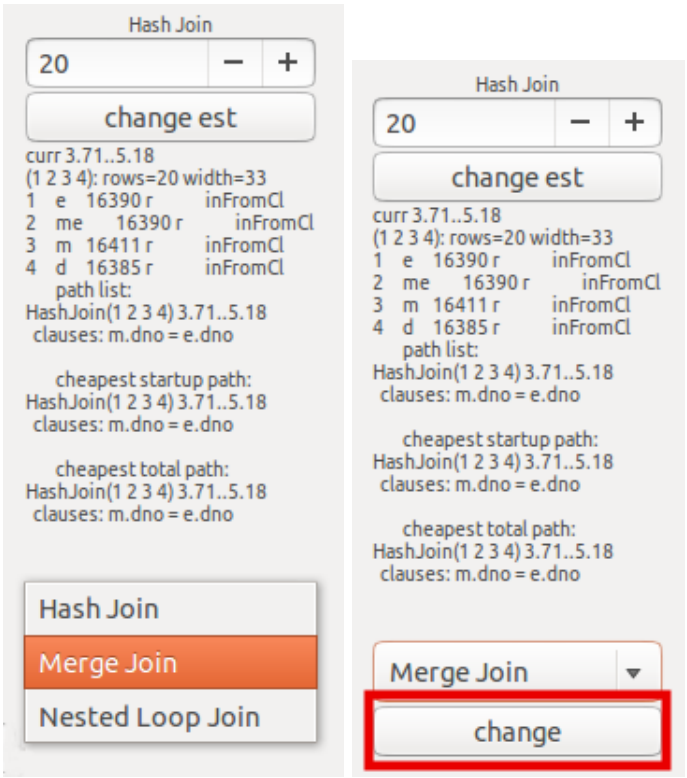
formulae

$$
\begin{aligned}
row_{root} &= 0 \\
column_{root} &= 2^{TreeHeight-1} - 1 \\
row_{child} &= row_{parent} + 1 && \text{for both left and right children} \\
column_{child} &= column_{parent} - 2^{height_{parent}-2} && \text{for the left child} \\
column_{child} &= column_{parent} + 2^{height_{parent}-2} && \text{for the right child}
\end{aligned}
$$

This can generalize to n-ary trees if needed. First, determine the max number of branches, then rederive the above formulas with n instead of two.

3.2 Changing Joins

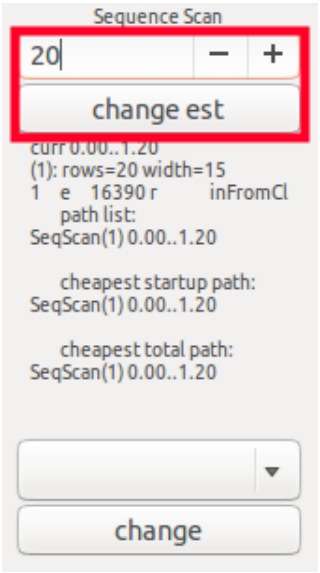
The prototype wraps the plan tree data structure returned by query planner inside its own tree so that each node of the tree has pointers to any important GUI widgets that the user may have manipulated. When the user changes the join on the GUI, we recursively rebuild the path upwards starting from the node that was changed. This updates the costs all the way up. The user can select one of the joins populated in the drop down list and hit the change button to replace the join with the one selected. A screenshot is provided below.



3.3 Changing a Relation's Rows Estimates

The prototype adds a hashtable to the PlannerInfo struct. The hashtable is a map from relids belonging to the relation accumulated so far in the tree to the overridden estimated number of rows. If the hashtable does not contain an entry for the given relids, then the estimate for that relation has not been

overridden. Where ever the estimated number of rows was accessed in costsize.c, a lookup to the hashtable to check if it has been overridden prepended. Additionally, the following functions also check for overridden estimates: *set_baserel_size_estimates, set_joinrel_size_estimates, and get_parameterized_joinrel_size*. Lastly, the user changes the estimated number of rows by changing the textbox provided inside the GUI widget representing that relation and then hits . A screenshot below is provided for reference.



4 Future Work

Firstly, in order to focus on the functionality of this prototype, the GUI runs on the database process, This avoided having to implement a communication protocol between the database and client and figuring out how to serialize that data. Secondly, there is no way to manipulate the structure of the tree. Thirdly, the user cannot change which scan should be performed on a base relation. Fourthly, only one path-key is considered for the merge join. A variety of options should be presented to the user selecting merge join. Lastly, there is absolutely no validation to assist the user when he creates something that does not make sense.

5 Acknowledgements

I would like to thank José Calvo for recommending that I place the GUI directly on the database server so that I would not have to figure out how to serialize data between the server and client.

References

[1] Ihab F. Ilyas, Volker Markl, Peter Haas, Paul Brown, and Ashraf Aboulnaga. Cords: Automatic discovery of correlations and soft functional dependencies. In *Proceedings of the 2004 ACM SIGMOD International Conference on Management of Data*, SIGMOD '04, pages 647–658, New York, NY, USA, 2004. ACM.