IMPROVING OPTIMALITY AND SPEED OF GREEDY GROUP RECURSION ALGORITHM

Florin Dobrian [1] **Oleg Puzyrko White** [1]

ABSTRACT

Recently (Liu et al., 2025) has presented efficient algorithm - Greedy Group Recursion (GGR) - for reordering the rows and the fields within each row of an input table to maximize key-value (KV) cache reuse when performing LLM serving. In this paper, we propose several adjustments to GGR algorithm that can improve optimality of the solution and reduce its execution time.

1 INTRODUCTION

There has been growing research on LLM inference optimization. In particular, recent work (Liu et al., 2025; Cheng et al., 2025) presents solutions to optimize relational data analytics workloads for offline LLM inference. It proposes Greedy Group Recursion (GGR), an approximate algorithm that leverages functional dependencies (such as primary and foreign key relationships from the data schema) and table statistics, which are readily available in many databases and analytics systems, to reduce the search space.

The GGR algorithm is defined by a specification in Algorithm 1.

Algorithm 1 Greedy Group Recursion (GGR)

Input: Table T, Functional Dependency FD
Output: Prefix Hit Count S, Reordered List of Tuples L

function HITCOUNT(v, c, T, FD)
  $R_v \leftarrow \{i \mid T[i, c] = v\}$
  inferred_cols $\leftarrow \{c' \mid (c, c') \in FD\}$
  inferred_vals $\leftarrow \{T[R_v[0], c'] \mid c' \in$ inferred_cols$\}$
  tot_len $= \text{len}(v)^2 + \sum_{c' \in \text{inferred\_cols}} \left(\frac{\sum_{r \in R_v} \text{len}(T[r, c'])}{|R_v|} \right)^2$
  return tot_len $\times$ $(|R_v| - 1)$,[c] + inferred_cols, inferred_vals
end function

function GGR(T, FD)
  if $|T|_{rows} = 1$ **then**
    return 0, [T[1]]
  end if
  if $|T|_{cols} = 1$ **then**
    $S \leftarrow \sum_{v \in \text{distinct}(T[,1])}$ HITCOUNT$(v, 1, T)$
    Return $S, sort([T[i] \mid i \in 1 \dots |T|_{rows}])$
  end if
  $max\_HC, b\_v, b\_c, b\_cols, b\_vals \leftarrow -1$, None, None, [], []
  for $c \in$ columns(T), $v \in$ distinct(T[, c]) **do**
    $HC, cols, vals \leftarrow$ HITCOUNT(v, c, T, FD)
    if $HC > max\_HC$ **then**
      $max\_HC, b\_v, b\_c, b\_cols, b\_vals = HC, v, c, cols, vals$
    end if
  end for
  $R\_v \leftarrow \{i \mid T[i, b\_c] = b\_v\}$
  $A\_HC, L\_A \leftarrow$ GGR(T[rows $\setminus R\_v$, cols], FD)
  $B\_HC, L\_B \leftarrow$ GGR($T[R\_v$, cols $\setminus b\_cols]$, FD)
  $C\_HC, \_ \leftarrow$ HITCOUNT(b_v, b_c, T, FD)
  $S \leftarrow A\_HC + B\_HC + C\_HC$
  $L \leftarrow [[b\_v] + b\_vals + L\_B[i] \mid i \in 1 \dots |R\_v|] + L\_A$
  return S, L
end function

return GGR(T, FD)

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[1]Data Analytics Group. Corresponding author: Oleg P. White <oleg.p.white@gmail.com>.