SQL $\rightarrow$ RA $\rightarrow$ Optimized RA $\rightarrow$ Set of possible plans $\rightarrow$ One plan

- Plan compiler
- Cost based optimizer

apply always good ops whenever possible

(pattern + reduce)

FB user $\n\rightarrow$ friend of $\rightarrow$ FB user
BNLS

1 PHS
Tp TS
SMS
2 PHS

INLS

Any other Join algo

Constructing One possible plan

INLS

R S

INLS

S MS

R S

1 PHS
T
S MJ

R S
Time Taken - minimize

$\rightarrow$ # of IOs

$\rightarrow$ CPU Time

Memory Required - upper bound
Measuring IO

Output is free (already allocated to next operator)

Only relevant for this operator

Input is free (already allocated by prior operator)

Statistics of interest:
- Pages of data in a table IR
- Index Stats -> depth of tree
- How many records returned 10R
Algorithms

- File Scan
- Index Scan

Projection (map)
Selection (filter)
Union

Sort
- InMem
- External

BNLJ
1-PHJ
1-PTJ
2-PHJ
SMJ
INLJ

Distinct

Access Paths
File Scan \((R)\)

\(|R|\)

Index Scan \((I)\)

\(\text{Tree}\)

\(|I|\text{ of } I0S: \text{ depth of tree } + 10c |R|\)
Sort(R) (with B pages of buffer)

# of I/Os: $\log_B (1R/2) \cdot 2 \cdot |R|

BNLJ($x$) (with B pages of buffer for each R,S)

for block R in R:
  for block S in S:
    for r in block R:
      for s in block S:
        emit R x S

If First pass:
  write out block S

# of I/Os:

$|R| + \frac{|R|}{B} \cdot |S| + |S|

$ = \frac{|R|}{B} \cdot |S|

\[(|R| - 1) \cdot |S| + |S|\]