

```
phase=# vacuum analyze;  
VACUUM
```

```
phase=# explain analyze select name from movie where imdb_score < 2;  
QUERY PLAN
```

```
-----  
Bitmap Heap Scan on movie (cost=4553.45..20391.36 rows=242713 width=11) (actual time=46.620..79.088 rows=248942 loops=1)  
  Recheck Cond: (imdb_score < '2'::numeric)  
  Heap Blocks: exact=7354  
  -> Bitmap Index Scan on movie_imdb_score_index (cost=0.00..4492.77 rows=242713 width=0) (actual time=45.502..45.502 rows=248942 loops=1)  
    Index Cond: (imdb_score < '2'::numeric)  
Planning Time: 0.374 ms  
Execution Time: 84.804 ms  
(7 rows)
```

```
phase=# explain analyze select name from movie where imdb_score between 1.5 and 4.5;  
QUERY PLAN
```

```
-----  
Seq Scan on movie (cost=0.00..27804.00 rows=756071 width=11) (actual time=16.230..167.947 rows=751917 loops=1)  
  Filter: ((imdb_score >= 1.5) AND (imdb_score <= 4.5))  
  Rows Removed by Filter: 248083  
Planning Time: 0.267 ms  
Execution Time: 184.642 ms  
(5 rows)
```

```
phase=# explain analyze select name from movie where year between 1900 and 1990;  
QUERY PLAN
```

```
-----  
Seq Scan on movie (cost=0.00..27804.00 rows=900286 width=11) (actual time=15.389..102.996 rows=901172 loops=1)  
  Filter: ((year >= 1900) AND (year <= 1990))  
  Rows Removed by Filter: 98828  
Planning Time: 0.361 ms  
Execution Time: 123.340 ms  
(5 rows)
```

```
phase=# explain analyze select name from movie where year between 1990 and 1995;  
QUERY PLAN
```

```
-----  
Bitmap Heap Scan on movie (cost=820.64..14520.56 rows=59728 width=11) (actual time=7.566..23.649 rows=59142 loops=1)  
  Recheck Cond: ((year >= 1990) AND (year <= 1995))  
  Heap Blocks: exact=7351  
  -> Bitmap Index Scan on movie_year_index (cost=0.00..805.70 rows=59728 width=0) (actual time=6.244..6.244 rows=59142 loops=1)  
    Index Cond: ((year >= 1990) AND (year <= 1995))  
Planning Time: 0.210 ms  
Execution Time: 25.513 ms  
(7 rows)
```

```
phase=# explain analyze select * from movie where pc_id < 50;  
QUERY PLAN
```

```
-----  
Bitmap Heap Scan on movie (cost=1083.20..15027.16 rows=91197 width=29) (actual time=8.089..25.322 rows=88293 loops=1)  
  Recheck Cond: (pc_id < 50)  
  Heap Blocks: exact=7354  
  -> Bitmap Index Scan on movie_pc_id_index (cost=0.00..1060.40 rows=91197 width=0) (actual time=6.879..6.879 rows=88293 loops=1)  
    Index Cond: (pc_id < 50)  
Planning Time: 0.234 ms  
Execution Time: 27.893 ms  
(7 rows)
```

```
phase=# explain analyze select * from movie where pc_id > 20000;  
QUERY PLAN
```

```
-----  
Bitmap Heap Scan on movie (cost=912.10..14676.86 rows=76861 width=29) (actual time=9.523..25.359 rows=75620 loops=1)  
  Recheck Cond: (pc_id > 20000)  
  Heap Blocks: exact=7354  
  -> Bitmap Index Scan on movie_pc_id_index (cost=0.00..892.88 rows=76861 width=0) (actual time=8.311..8.312 rows=75620 loops=1)  
    Index Cond: (pc_id > 20000)  
Planning Time: 0.223 ms  
Execution Time: 27.554 ms  
(7 rows)
```

```
phaseb=# vacuum analyze;
VACUUM
```

```
phaseb=# explain analyze
select a.name, m.name
from actor a, movie m, casting c
where (a.a_id, m.m_id)=(c.a_id, c.m_id) and a.a_id<50;
```

QUERY PLAN

```
-----
Gather (cost=1007.41..23546.42 rows=640 width=27) (actual time=12.865..268.585 rows=18648 loops=1)
  Workers Planned: 2
  Workers Launched: 2
  -> Nested Loop (cost=7.41..22482.42 rows=267 width=27) (actual time=16.042..174.273 rows=6216 loops=3)
    -> Nested Loop (cost=6.99..22360.12 rows=267 width=20) (actual time=15.985..42.961 rows=6216 loops=3)
      -> Parallel Seq Scan on actor a (cost=0.00..5384.50 rows=20 width=20) (actual time=15.870..15.896 rows=16 loops=3)
        Filter: (a_id < 50)
        Rows Removed by Filter: 99984
      -> Bitmap Heap Scan on casting c (cost=6.99..845.48 rows=330 width=8) (actual time=0.086..1.605 rows=381 loops=49)
        Recheck Cond: (a_id = a.a_id)
        Heap Blocks: exact=10190
        -> Bitmap Index Scan on casting_a_id_index (cost=0.00..6.90 rows=330 width=0) (actual time=0.042..0.042 rows=381 loops=49)
          Index Cond: (a_id = a.a_id)
    -> Index Scan using movie_m_id_index on movie m (cost=0.42..0.46 rows=1 width=15) (actual time=0.021..0.021 rows=1 loops=18648)
      Index Cond: (m_id = c.m_id)
Planning Time: 4.788 ms
Execution Time: 269.387 ms
(17 rows)
```

```
phaseb=# explain analyze
select a.name, c.m_id
from actor a, casting c
where a.a_id=c.a_id and c.m_id<50;
```

QUERY PLAN

```
-----
Nested Loop (cost=0.85..1591.93 rows=200 width=20) (actual time=1.338..9.434 rows=196 loops=1)
  -> Index Only Scan using casting_pkey on casting c (cost=0.43..7.93 rows=200 width=8) (actual time=0.980..1.102 rows=196 loops=1)
    Index Cond: (m_id < 50)
    Heap Fetches: 0
  -> Index Scan using actor_a_id_index on actor a (cost=0.42..7.92 rows=1 width=20) (actual time=0.040..0.040 rows=1 loops=196)
    Index Cond: (a_id = c.a_id)
Planning Time: 0.848 ms
Execution Time: 9.529 ms
(8 rows)
```

```
phaseb=# explain analyze
select m.name, p.name
from movie m, production_company p
where m.pc_id=p.pc_id and m.imdb_score<1.5;
```

QUERY PLAN

```
-----
Hash Join (cost=6017.86..22305.18 rows=124185 width=22) (actual time=67.947..183.994 rows=123792 loops=1)
  Hash Cond: (m.pc_id = p.pc_id)
  -> Bitmap Heap Scan on movie m (cost=2330.86..16687.17 rows=124185 width=15) (actual time=11.687..96.199 rows=123792 loops=1)
    Recheck Cond: (imdb_score < 1.5)
    Heap Blocks: exact=7354
    -> Bitmap Index Scan on movie_imdb_score_index (cost=0.00..2299.81 rows=124185 width=0) (actual time=10.867..10.867 rows=123792 loops=1)
      Index Cond: (imdb_score < 1.5)
  -> Hash (cost=2296.00..2296.00 rows=80000 width=15) (actual time=55.920..55.921 rows=80000 loops=1)
    Buckets: 131072 Batches: 2 Memory Usage: 2908kB
    -> Seq Scan on production_company p (cost=0.00..2296.00 rows=80000 width=15) (actual time=8.343..26.182 rows=80000 loops=1)
Planning Time: 3.146 ms
Execution Time: 186.879 ms
(12 rows)
```

```
phaseb=# explain analyze
select m.name, p.name
from movie m, production_company p
where m.pc_id=p.pc_id and m.year between 1950 and 2000;
```

QUERY PLAN

```
-----
Hash Join (cost=10657.32..37818.37 rows=509843 width=22) (actual time=47.940..216.543 rows=503970 loops=1)
  Hash Cond: (m.pc_id = p.pc_id)
  -> Bitmap Heap Scan on movie m (cost=6970.32..27421.96 rows=509843 width=15) (actual time=17.089..79.089 rows=503970 loops=1)
    Recheck Cond: ((year >= 1950) AND (year <= 2000))
    Heap Blocks: exact=7354
    -> Bitmap Index Scan on movie_year_index (cost=0.00..6842.86 rows=509843 width=0) (actual time=16.205..16.206 rows=503970 loops=1)
      Index Cond: ((year >= 1950) AND (year <= 2000))
  -> Hash (cost=2296.00..2296.00 rows=80000 width=15) (actual time=30.533..30.534 rows=80000 loops=1)
    Buckets: 131072 Batches: 2 Memory Usage: 2908kB
    -> Seq Scan on production_company p (cost=0.00..2296.00 rows=80000 width=15) (actual time=1.380..11.221 rows=80000 loops=1)
Planning Time: 5.885 ms
Execution Time: 227.327 ms
(12 rows)
```