UNIVERSIDADE FEDERAL FLUMINENSE - UFF

Avaliação Continuada 1

Estudos sobre índices

João Pedro de Almeida dos Santos

NITERÓI/RJ

2023

- ## Consulta 1

Qual o total de crimes por tipo e por segmento das ruas do distrito de IGUATEMI durante o ano de 2016?

```
SELECT s.id as segment, SUM(total_feminicide) as total_feminicide,
       SUM(total_homicide) as total_homicide,
       SUM(total_felony_murder) as total_felony_murder,
       SUM(total_bodily_harm) as total_bodily_harm,
       SUM(total_theft_cellphone) as total_theft_cellphone,
       SUM(total_armed_robbery_cellphone) as total_armed_robbery_cellphone,
       SUM(total_theft_auto) as total_theft_auto,
       SUM(total_armed_robbery_auto) as total_armed_robbery_auto, year
  FROM no_index001."crime" c, no_index001."time" t, no_index001."segment" s,
       no_index001."vertice" v, no_index001."district" d
 WHERE c.time_id = t.id
   AND t.year = 2016
   AND c.segment_id = s.id
   AND s.start_vertice_id = v.id
   AND v.district_id = d.id
   AND d.name = 'IGUATEMI'
   GROUP BY s.id, year;
```

Obs: Para as consultas realizadas com uso de índice, apenas a cláusula FROM será alterada, retirando o prefixo “no_” ao nome do esquema, como no exemplo a seguir:

```
SELECT s.id as segment, SUM(total_feminicide) as total_feminicide,
       SUM(total_homicide) as total_homicide,
       SUM(total_felony_murder) as total_felony_murder,
       SUM(total_bodily_harm) as total_bodily_harm,
       SUM(total_theft_cellphone) as total_theft_cellphone,
       SUM(total_armed_robbery_cellphone) as total_armed_robbery_cellphone,
       SUM(total_theft_auto) as total_theft_auto,
       SUM(total_armed_robbery_auto) as total_armed_robbery_auto, year
  FROM index001."crime" c, index001."time" t, index001."segment" s,
       index001."vertice" v, index001."district" d
 WHERE c.time_id = t.id
   AND t.year = 2016
   AND c.segment_id = s.id
   AND s.start_vertice_id = v.id
   AND v.district_id = d.id
   AND d.name = 'IGUATEMI'
   GROUP BY s.id, year;
```

Nas consultas seguintes ocorrerá a mesma alteração no nome dos esquemas, porém, não será apresentada uma captura de tela mostrando essa alteração.

Para obtenção das métricas de tempo serão utilizados em conjunto os comandos EXPLAIN e ANALYZE no SGBD pgAdmin 4.

Utilizando os comandos EXPLAIN e ANALYZE temos os seguintes resultados:

- Sem índice:

```
Planning Time: 1.951 ms
Execution Time: 632.850 ms
```

- Com índice:

```
Planning Time: 3.279 ms
Execution Time: 0.096 ms
```

• Consulta 2

Qual o total de crimes por tipo e por segmento das ruas do distrito de IGUATEMI entre 2006 e 2016?

```
SELECT s.id as segment, SUM(total_feminicide) as total_feminicide,
       SUM(total_homicide) as total_homicide,
       SUM(total_felony_murder) as total_felony_murder,
       SUM(total_bodily_harm) as total_bodily_harm,
       SUM(total_theft_cellphone) as total_theft_cellphone,
       SUM(total_armed_robbery_cellphone) as total_armed_robbery_cellphone,
       SUM(total_theft_auto) as total_theft_auto,
       SUM(total_armed_robbery_auto) as total_armed_robbery_auto, year

  FROM no_index001."crime" c, no_index001."time" t, no_index001."segment" s,
       no_index001."vertice" v, no_index001."district" d
 WHERE c.time_id = t.id
   AND t.year BETWEEN 2006 AND 2016
   AND c.segment_id = s.id
   AND s.start_vertice_id = v.id
   AND v.district_id = d.id
   AND d.name = 'IGUATEMI'
   GROUP BY s.id, year;
```

Utilizando os comandos EXPLAIN e ANALYZE temos os seguintes resultados:

- Sem índice:

```
Planning Time: 0.296 ms
Execution Time: 609.421 ms
```

- Com índice:

```
Planning Time: 0.435 ms
Execution Time: 0.124 ms
```

- ## Consulta 3

Qual o total de ocorrências de Roubo de Celular e roubo de carro no bairro de SANTA EFIGÊNIA em 2015?

```
SELECT s.id as segment,
       SUM(total_theft_cellphone + total_armed_robbery_cellphone) as total_theft_cellphone,
       SUM(total_theft_auto + total_armed_robbery_auto) as total_theft_auto, t.year
  FROM no_index001."crime" c, no_index001."time" t, no_index001."segment" s,
       no_index001."vertice" v, no_index001."neighborhood" n
 WHERE c.time_id = t.id
   AND t.year = 2015
   AND c.segment_id = s.id
   AND s.start_vertice_id = v.id
   AND v.neighborhood_id = n.id
   AND n.name = 'Santa Efig�nia'
   GROUP BY s.id, year;
```

Utilizando os comandos EXPLAIN e ANALYZE temos os seguintes resultados:

- Sem índice:

```
Planning Time: 0.868 ms
Execution Time: 576.578 ms
```

- Com índice:

```
Planning Time: 0.857 ms
Execution Time: 0.127 ms
```

- ## Consulta 4

Qual o total de crimes por tipo em vias de mão única da cidade durante o ano de 2012?

```
SELECT oneway, SUM(total_feminicide) as total_feminicide,
       SUM(total_homicide) as total_homicide,
       SUM(total_felony_murder) as total_felony_murder,
       SUM(total_bodily_harm) as total_bodily_harm,
       SUM(total_theft_cellphone) as total_theft_cellphone,
       SUM(total_armed_robbery_cellphone) as total_armed_robbery_cellphone,
       SUM(total_theft_auto) as total_theft_auto,
       SUM(total_armed_robbery_auto) as total_armed_robbery_auto, year
  FROM no_index001."crime" c, no_index001."time" t, no_index001."segment" s
 WHERE c.time_id = t.id
   AND t.year = 2012
   AND c.segment_id = s.id
   AND s.oneway = 'yes'
   GROUP BY year, oneway;
```

Utilizando os comandos EXPLAIN e ANALYZE temos os seguintes resultados:

- Sem índice:

```
Planning Time: 0.171 ms
Execution Time: 676.851 ms
```

- Com índice:

```
Planning Time: 0.170 ms
Execution Time: 0.049 ms
```

● Consulta 5

Qual o total de roubos de carro e celular em todos os segmentos durante o ano de 2017?

```
SELECT s.id as segment,
       SUM(total_theft_cellphone + total_armed_robbery_cellphone) as total_theft_cellphone,
       SUM(total_theft_auto + total_armed_robbery_auto) as total_theft_auto, t.year
  FROM no_index001."crime" c, no_index001."time" t, no_index001."segment" s
 WHERE c.time_id = t.id
   AND t.year = 2017
   AND c.segment_id = s.id
   GROUP BY s.id, year;
```

Utilizando os comandos EXPLAIN e ANALYZE temos os seguintes resultados:

- Sem índice:

```
Planning Time: 0.180 ms
Execution Time: 1082.261 ms
```

- Com índice:

```
Planning Time: 0.250 ms
Execution Time: 0.065 ms
```

● Consulta 6

Quais os IDs de segmentos que possuíam o maior índice criminal (soma de ocorrências de todos os tipos de crimes), durante o mês de Novembro de 2010?

```
SELECT MAX(soma_crimes) as max_soma_crimes
  FROM ( SELECT s.id as segment,
                SUM(total_feminicide + total_homicide + total_felony_murder +
                    total_bodily_harm + total_theft_cellphone +
                    total_armed_robbery_cellphone + total_theft_auto +
                    total_armed_robbery_auto) as soma_crimes
```

```
          FROM no_index001."crime" c, no_index001."time" t, no_index001."segment" s
         WHERE c.time_id = t.id
           AND t.year = 2010
           AND t.month = 11
           AND c.segment_id = s.id
        GROUP BY s.id
);
```

Utilizando os comandos EXPLAIN e ANALYZE temos os seguintes resultados:

- Sem índice:

```
Planning Time: 0.206 ms
Execution Time: 564.829 ms
```

- Com índice:

```
Planning Time: 0.215 ms
Execution Time: 0.064 ms
```

• Consulta 7

Quais os IDs dos segmentos que possuíam o maior índice criminal (soma de ocorrências de todos os tipos de crimes) durante os finais de semana do ano de 2018?

```
SELECT MAX(soma_crimes) as max_soma_crimes
  FROM ( SELECT s.id as segment,
                SUM(total_feminicide + total_homicide + total_felony_murder +
                    total_bodily_harm + total_theft_cellphone +
                    total_armed_robbery_cellphone + total_theft_auto +
                    total_armed_robbery_auto) as soma_crimes
           FROM no_index001."crime" c, no_index001."time" t, no_index001."segment" s
          WHERE c.time_id = t.id
            AND t.year = 2018
            AND (t.weekday = 'friday' OR t.weekday = 'saturday' OR t.weekday = 'sunday')
            AND c.segment_id = s.id
         GROUP BY s.id
);
```

Utilizando os comandos EXPLAIN e ANALYZE temos os seguintes resultados:

- Sem índice:

```
Planning Time: 0.313 ms
Execution Time: 685.745 ms
```

- Com índice:

```
Planning Time: 0.192 ms
Execution Time: 0.080 ms
```

- **Índices Criados**

```
/* Índices de Match Exato */
CREATE INDEX idx_ano_hash
ON index001."time"
USING hash(year);

CREATE INDEX idx_mes
ON index001."time"
USING hash(month);

CREATE INDEX idx_weekday
ON index001."time"
USING hash(weekday);

CREATE INDEX idx_cidade
ON index001."district"
USING hash(name);

CREATE INDEX idx_vizinhanca
ON index001."neighborhood"
USING hash(name);

CREATE INDEX idx_oneway
ON index001."segment"
USING hash(oneway);

/* Índices de Intervalo de Valores */
CREATE INDEX idx_ano_btree
ON index001."time"
USING btree(year);

/* Índice para chaves estrangeiras (sempre na tabela que referencia) */
CREATE INDEX idx_segment_id
on index001."crime"
USING hash(segment_id);

CREATE INDEX idx_time_id
on index001."crime"
USING hash(time_id);

CREATE INDEX idx_district_id
on index001."vertice"
USING hash(district_id);
```

```
CREATE INDEX idx_neighborhood_id
on index001."vertice"
USING hash(neighborhood_id);

CREATE INDEX idx_start_vertice_id
ON index001."segment"
USING hash(start_vertice_id);
```