Fragmentasi pada MySQL Menggunakan Partisi Horizontal

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Deskripsi server

- Sistem operasi : Linux Mint 18.3 Cinnamon 64-bit
- Versi MySQL : 5.7.23
- RAM : 4 GB
- CPU : 4 cores

Implementasi Partisi 1: Sakila Dataset

Deskripsi dataset

- Dataset terdiri dari 23 tabel.

- Masing-masing tabel memiliki jumlah baris data sebagai berikut

TABLE_NAME	TABLE_ROWS
payment	16049
rental	16045
film_actor	5462
inventory	4581
film_text	1000

TABLE_NAME	TABLE_ROWS
film_category	1000
film	1000
address	603
city	600
customer	599
actor	200
country	109
category	16
language	6
store	2
staff	2
staff_list	NULL
actor_info	NULL
sales_by_store	NULL
film_list	NULL
sales_by_film_category	NULL
customer_list	NULL
nicer_but_slower_film_list	NULL

Proses pembuatan partisi

Step 1 - Pemilihan tabel yang akan dipartisi.

Berdasarkan distribusi data yang terdapat dalam tabel pada database tersebut kita dapat melakukan partisi pada tabel yang mempunyai data paling banyak untuk mempersingkat waktu query, yaitu **payment** dan **rental**.

Step 2 - Daftar tabel yang akan dipartisi

- Table **payment**

  - Partisi menggunakan metode `HASH`, dimana MySQL akan menyimpan berdasarkan `payment_id` pada tabel `payment`. Pada kasus ini, tabel akan dipartisi menjadi 7 bagian, maka MySQL akan menyimpan data berdasarkan `payment_id` modulus 7 pada setiap partisinya.
  - Nama dari partisi-partisinya adalah :
    1. p0, untuk data dengan `payment_id` mod 7 = 0
    2. p1, untuk data dengan `payment_id` mod 7 = 1
    3. p2, untuk data dengan `payment_id` mod 7 = 2

4. p3, untuk data dengan `payment_id` mod 7 = 3
5. p4, untuk data dengan `payment_id` mod 7 = 4
6. p5, untuk data dengan `payment_id` mod 7 = 5
7. p6, untuk data dengan `payment_id` mod 7 = 6

- Table **rental**

  - Predikat yang akan digunakan yaitu berdasarkan kolom `rental_date` dengan ketentuan partisi dibagi berdasarkan bulannya.
  - Partisi menggunakan metode `RANGE` untuk setiap bulan.
  - Berdasarkan predikat di atas, maka tabel `rental` akan terbagi menjadi 12 bagian.
  - Nama dari partisi-partisinya adalah :
    1. p01, untuk data dengan `rental_date` = 1
    2. p02, untuk data dengan `rental_date` = 2
    3. p03, untuk data dengan `rental_date` = 3
    4. p04, untuk data dengan `rental_date` = 4
    5. p05, untuk data dengan `rental_date` = 5
    6. p06, untuk data dengan `rental_date` = 6
    7. p07, untuk data dengan `rental_date` = 7
    8. p08, untuk data dengan `rental_date` = 8
    9. p09, untuk data dengan `rental_date` = 9
    10. p10, untuk data dengan `rental_date` = 10
    11. p11, untuk data dengan `rental_date` = 11
    12. p12, untuk data dengan `rental_date` = 12

Implementasi Partisi

- Script SQL untuk membuat partisi table `payment` dengan metode `HASH`

```
CREATE TABLE payment (
payment_id SMALLINT UNSIGNED NOT NULL AUTO_INCREMENT,
customer_id SMALLINT UNSIGNED NOT NULL,
staff_id TINYINT UNSIGNED NOT NULL,
rental_id INT DEFAULT NULL,
amount DECIMAL(5,2) NOT NULL,
payment_date DATETIME NOT NULL,
last_update TIMESTAMP DEFAULT CURRENT_TIMESTAMP ON UPDATE
CURRENT_TIMESTAMP,
PRIMARY KEY  (payment_id),
UNIQUE KEY `payment_id` (`payment_id`),
KEY idx_fk_staff_id (staff_id),
KEY idx_fk_customer_id (customer_id)
-- CONSTRAINT fk_payment_rental FOREIGN KEY (rental_id) REFERENCES
rental (rental_id) ON DELETE SET NULL ON UPDATE CASCADE,
-- CONSTRAINT fk_payment_customer FOREIGN KEY (customer_id) REFERENCES
customer (customer_id) ON DELETE RESTRICT ON UPDATE CASCADE,
-- CONSTRAINT fk_payment_staff FOREIGN KEY (staff_id) REFERENCES staff
(staff_id) ON DELETE RESTRICT ON UPDATE CASCADE
)ENGINE=InnoDB DEFAULT CHARSET=utf8;
ALTER TABLE payment
```

```
            PARTITION BY HASH(payment_id)
            PARTITIONS 7;
```

- Script SQL untuk membuat partisi table `payment` dengan metode `HASH`

```
CREATE TABLE rental (
rental_id INT NOT NULL AUTO_INCREMENT,
rental_date DATETIME NOT NULL,
inventory_id MEDIUMINT UNSIGNED NOT NULL,
customer_id SMALLINT UNSIGNED NOT NULL,
return_date DATETIME DEFAULT NULL,
staff_id TINYINT UNSIGNED NOT NULL,
last_update TIMESTAMP NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE
CURRENT_TIMESTAMP,
PRIMARY KEY (rental_id, rental_date),
UNIQUE KEY  (rental_date,inventory_id,customer_id),
KEY idx_fk_inventory_id (inventory_id),
KEY idx_fk_customer_id (customer_id),
KEY idx_fk_staff_id (staff_id)
-- CONSTRAINT fk_rental_staff FOREIGN KEY (staff_id) REFERENCES staff
(staff_id) ON DELETE RESTRICT ON UPDATE CASCADE,
-- CONSTRAINT fk_rental_inventory FOREIGN KEY (inventory_id)
REFERENCES inventory (inventory_id) ON DELETE RESTRICT ON UPDATE
CASCADE,
-- CONSTRAINT fk_rental_customer FOREIGN KEY (customer_id) REFERENCES
customer (customer_id) ON DELETE RESTRICT ON UPDATE CASCADE
)ENGINE=InnoDB DEFAULT CHARSET=utf8;
ALTER TABLE rental
PARTITION BY RANGE (MONTH(rental_date))
(
    PARTITION p01 VALUES LESS THAN (02) ENGINE = InnoDB,
    PARTITION p02 VALUES LESS THAN (03) ENGINE = InnoDB,
    PARTITION p03 VALUES LESS THAN (04) ENGINE = InnoDB,
    PARTITION p04 VALUES LESS THAN (05) ENGINE = InnoDB,
    PARTITION p05 VALUES LESS THAN (06) ENGINE = InnoDB,
    PARTITION p06 VALUES LESS THAN (07) ENGINE = InnoDB,
    PARTITION p07 VALUES LESS THAN (08) ENGINE = InnoDB,
    PARTITION p08 VALUES LESS THAN (09) ENGINE = InnoDB,
    PARTITION p09 VALUES LESS THAN (10) ENGINE = InnoDB,
    PARTITION p10 VALUES LESS THAN (11) ENGINE = InnoDB,
    PARTITION p11 VALUES LESS THAN (12) ENGINE = InnoDB,
    PARTITION p12 VALUES LESS THAN (13) ENGINE = InnoDB
);
```

Catatan :

Ketika melakukan partisi pada sebuah tabel, tidak dapat menggunakan `FOREIGN KEY`, maka deklarasi `FOREIGN KEY` pada waktu membuat table tidak dieksekusi.

> `PRIMARY KEY` harus tetap tercantum pada setiap tabel partisi. Jika partisi yang dilakukan tidak menggunakan `PRIMARY KEY` tabel tersebut, atribut (kolom) yang dijadikan parameter untuk predikat harus menjadi `PRIMARY KEY` tabel tersebut.

Benchmarking

Table payment

Step 1 - Periksa tabel yang dipartisi menggunakan query `EXPLAIN`.

`EXPLAIN SELECT COUNT(*) FROM payment\G`

```
mysql> explain select count(*) from payment\G
*********************** 1. row ***************************
          id: 1
  select type: SIMPLE
        table: payment
   partitions: p0,p1,p2,p3,p4,p5,p6
         type: index
possible keys: NULL
          key: idx fk staff id
      key len: 1
          ref: NULL
         rows: 16080
     filtered: 100.00
        Extra: Using index
1 row in set, 1 warning (0,00 sec)
```

Step 2 - Lakukan verifikasi partisi dengan pengujian menggunakan query `INSERT`.

```
-- insert data to PARTITION p6
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16050, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16057, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16064, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16071, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16078, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16085, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16092, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16099, "599",
```

```
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16106, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16113, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");

       -- insert data to PARTITION p5
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16056, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16063, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16070, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16077, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16084, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16091, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16098, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16105, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16112, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16119, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");

       -- insert data to PARTITION p4
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16055, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16062, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16069, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
       `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16076, "599",
       "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
       INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
```

```
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16083, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16090, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16097, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16104, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16111, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16118, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");

    -- insert data to PARTITION p3
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16054, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16061, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16068, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16075, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16082, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16089, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16096, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16103, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16110, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16117, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");

    -- insert data to PARTITION p2
    INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
    `rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16053, "599",
    "1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
```

```sql
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16060, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16067, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16074, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16081, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16088, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16095, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16102, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16109, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16116, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");

-- insert data to PARTITION p1
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16052, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16059, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16066, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16073, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16080, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16087, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16094, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16101, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
```

```
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16108, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16115, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");

-- insert data to PARTITION p0
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16051, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16058, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16065, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16072, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16079, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16086, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16093, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16100, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16107, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
INSERT INTO `payment` (`payment_id`, `customer_id`, `staff_id`,
`rental_id`, `amount`, `payment_date`, `last_update`) VALUES (16114, "599",
"1", "14599", "4.99", "2005-08-21 17:43:42", "2006-02-15 22:24:12");
```

Step 3 - Periksa dengan menggunakan query select

```
-- menjalankan query ke tabel partisi data yang benar
SELECT * FROM payment PARTITION (p6) WHERE payment_id = 16057;

-- menjalankan query ke tabel partisi data yang salah
SELECT * FROM payment PARTITION (p5) WHERE payment_id = 16057;
```

```
mysql> SELECT * FROM payment PARTITION (p6) WHERE payment id = 16057;
+------------+-------------+----------+-----------+--------+---------------------+---------------------+
| payment id | customer id | staff id | rental id | amount | payment date        | last update         |
+------------+-------------+----------+-----------+--------+---------------------+---------------------+
|      16057 |         599 |        1 |     14599 |   4.99 | 2018-09-28 02:15:59 | 2006-02-15 22:24:12 |
+------------+-------------+----------+-----------+--------+---------------------+---------------------+
1 row in set (0,00 sec)

mysql> mysql> SELECT * FROM payment PARTITION (p5) WHERE payment id = 16057;
Empty set (0,00 sec)

mysql>
```

Tabel rental

Step 1 - Periksa tabel yang dipartisi menggunakan query EXPLAIN.

EXPLAIN SELECT COUNT(*) FROM rental\G

```
mysql> explain select count(*) from rental\G
*********************** 1. row ***********************
           id: 1
  select type: SIMPLE
        table: rental
   partitions: p01,p02,p03,p04,p05,p06,p07,p08,p09,p10,p11,p12,
         type: index
possible keys: NULL
          key: idx fk staff id
      key len: 1
          ref: NULL
         rows: 16044
     filtered: 100.00
        Extra: Using index
1 row in set, 1 warning (0,00 sec)
```

Step 2 - Tambahkan UNNIQUE INDEX untuk payment_date sebagai PRIMARY KEY yang digunakan dalam tabel-tabel partisi.

```
ALTER TABLE `sakila`.`rental`
DROP INDEX `rental_date` ,
ADD UNIQUE INDEX `rental_date` (`rental_id` ASC, `rental_date` ASC,
`inventory_id` ASC, `customer_id` ASC);
```

Step 3 - Lakukan verifikasi partisi dengan pengujian menggunakan query INSERT.

```
-- insert data to PARTITION p01
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16050,
"2018-01-1 15:16:04", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16057,
"2018-01-1 15:16:04", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16064,
"2018-01-1 15:16:05", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
```

```
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16071,
     "2018-01-1 15:16:06", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16078,
     "2018-01-1 15:16:07", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16085,
     "2018-01-1 15:16:08", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16092,
     "2018-01-1 15:16:09", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16099,
     "2018-01-1 15:16:10", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16106,
     "2018-01-1 15:16:11", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16113,
     "2018-01-1 15:16:12", "4472", "374", \N, "2", "2018-09-15 21:30:53");

     -- insert data to PARTITION p02
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16056,
     "2018-02-18 15:16:03", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16063,
     "2018-02-18 15:16:04", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16070,
     "2018-02-18 15:16:05", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16077,
     "2018-02-18 15:16:06", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16084,
     "2018-02-18 15:16:07", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16091,
     "2018-02-18 15:16:08", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16098,
     "2018-02-18 15:16:09", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16105,
     "2018-02-18 15:16:10", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16112,
     "2018-02-18 15:16:11", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16119,
     "2018-02-18 15:16:12", "4472", "374", \N, "2", "2018-09-15 21:30:53");

     -- insert data to PARTITION p03
```

```
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16055,
"2018-03-18 15:16:03", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16062,
"2018-03-18 15:16:04", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16069,
"2018-03-18 15:16:05", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16076,
"2018-03-18 15:16:06", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16083,
"2018-03-18 15:16:07", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16090,
"2018-03-18 15:16:08", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16097,
"2018-03-18 15:16:09", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16104,
"2018-03-18 15:16:10", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16111,
"2018-03-18 15:16:11", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16118,
"2018-03-18 15:16:12", "4472", "374", \N, "2", "2018-09-15 21:30:53");

-- insert data to PARTITION p04
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16054,
"2018-04-18 15:16:03", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16061,
"2018-04-18 15:16:04", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16068,
"2018-04-18 15:16:05", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16075,
"2018-04-18 15:16:06", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16082,
"2018-04-18 15:16:07", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16089,
"2018-04-18 15:16:08", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16096,
"2018-04-18 15:16:09", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
```

```
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16103,
     "2018-04-18 15:16:10", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16110,
     "2018-04-18 15:16:11", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16117,
     "2018-04-18 15:16:12", "4472", "374", \N, "2", "2018-09-15 21:30:53");

     -- insert data to PARTITION p05
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16053,
     "2018-05-18 15:16:03", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16060,
     "2018-05-18 15:16:04", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16067,
     "2018-05-18 15:16:05", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16074,
     "2018-05-18 15:16:06", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16081,
     "2018-05-18 15:16:07", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16088,
     "2018-05-18 15:16:08", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16095,
     "2018-05-18 15:16:09", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16102,
     "2018-05-18 15:16:10", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16109,
     "2018-05-18 15:16:11", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16116,
     "2018-05-18 15:16:12", "4472", "374", \N, "2", "2018-09-15 21:30:53");

     -- insert data to PARTITION p06
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16052,
     "2018-06-18 15:16:03", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16059,
     "2018-06-18 15:16:04", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16066,
     "2018-06-18 15:16:05", "4472", "374", \N, "2", "2018-09-15 21:30:53");
     INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
     `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16073,
     "2018-06-18 15:16:06", "4472", "374", \N, "2", "2018-09-15 21:30:53");
```

```
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16080,
"2018-06-18 15:16:07", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16087,
"2018-06-18 15:16:08", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16094,
"2018-06-18 15:16:09", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16101,
"2018-06-18 15:16:10", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16108,
"2018-06-18 15:16:11", "4472", "374", \N, "2", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16115,
"2018-06-18 15:16:12", "4472", "374", \N, "2", "2018-09-15 21:30:53");

-- insert data to PARTITION p07
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16051,
"2018-07-18 15:16:03", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16058,
"2018-07-18 15:16:04", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16065,
"2018-07-18 15:16:05", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16072,
"2018-07-18 15:16:06", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16079,
"2018-07-18 15:16:07", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16086,
"2018-07-18 15:16:08", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16093,
"2018-07-18 15:16:09", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16100,
"2018-07-18 15:16:10", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16107,
"2018-07-18 15:16:11", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16114,
"2018-07-18 15:16:12", "14599", "374", \N, "1", "2018-09-15 21:30:53");

-- insert data to PARTITION p08
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16120,
```

```sql
                "2018-08-18 15:16:03", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16121,
"2018-08-18 15:16:04", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16122,
"2018-08-18 15:16:05", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16123,
"2018-08-18 15:16:06", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16124,
"2018-08-18 15:16:07", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16125,
"2018-08-18 15:16:08", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16126,
"2018-08-18 15:16:09", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16127,
"2018-08-18 15:16:10", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16128,
"2018-08-18 15:16:11", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16129,
"2018-08-18 15:16:12", "14599", "374", \N, "1", "2018-09-15 21:30:53");

-- insert data to PARTITION p09
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16130,
"2018-09-18 15:16:03", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16131,
"2018-09-18 15:16:04", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16132,
"2018-09-18 15:16:05", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16133,
"2018-09-18 15:16:06", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16134,
"2018-09-18 15:16:07", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16135,
"2018-09-18 15:16:08", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16136,
"2018-09-18 15:16:09", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16137,
"2018-09-18 15:16:10", "14599", "374", \N, "1", "2018-09-15 21:30:53");
```

```
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16138,
"2018-09-18 15:16:11", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16139,
"2018-09-18 15:16:12", "14599", "374", \N, "1", "2018-09-15 21:30:53");

-- insert data to PARTITION p10
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16140,
"2018-10-18 15:16:03", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16141,
"2018-10-18 15:16:04", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16142,
"2018-10-18 15:16:05", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16143,
"2018-10-18 15:16:06", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16144,
"2018-10-18 15:16:07", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16145,
"2018-10-18 15:16:08", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16146,
"2018-10-18 15:16:09", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16147,
"2018-10-18 15:16:10", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16148,
"2018-10-18 15:16:11", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16149,
"2018-10-18 15:16:12", "14599", "374", \N, "1", "2018-09-15 21:30:53");

-- insert data to PARTITION p11
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16150,
"2018-11-18 15:16:03", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16151,
"2018-11-18 15:16:04", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16152,
"2018-11-18 15:16:05", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16153,
"2018-11-18 15:16:06", "14599", "374", \N, "1", "2018-09-15 21:30:53");
INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
`customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16154,
```

```
   "2018-11-18 15:16:07", "14599", "374", \N, "1", "2018-09-15 21:30:53");
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16155,
   "2018-11-18 15:16:08", "14599", "374", \N, "1", "2018-09-15 21:30:53");
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16156,
   "2018-11-18 15:16:09", "14599", "374", \N, "1", "2018-09-15 21:30:53");
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16157,
   "2018-11-18 15:16:10", "14599", "374", \N, "1", "2018-09-15 21:30:53");
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16158,
   "2018-11-18 15:16:11", "14599", "374", \N, "1", "2018-09-15 21:30:53");
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16159,
   "2018-11-18 15:16:12", "14599", "374", \N, "1", "2018-09-15 21:30:53");

   -- insert data to PARTITION p12
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16160,
   "2018-12-18 15:16:03", "14599", "374", \N, "1", "2018-09-15 21:30:53");
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16161,
   "2018-12-18 15:16:04", "14599", "374", \N, "1", "2018-09-15 21:30:53");
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16162,
   "2018-12-18 15:16:05", "14599", "374", \N, "1", "2018-09-15 21:30:53");
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16163,
   "2018-12-18 15:16:06", "14599", "374", \N, "1", "2018-09-15 21:30:53");
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16164,
   "2018-12-18 15:16:07", "14599", "374", \N, "1", "2018-09-15 21:30:53");
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16165,
   "2018-12-18 15:16:08", "14599", "374", \N, "1", "2018-09-15 21:30:53");
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16166,
   "2018-12-18 15:16:09", "14599", "374", \N, "1", "2018-09-15 21:30:53");
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16167,
   "2018-12-18 15:16:10", "14599", "374", \N, "1", "2018-09-15 21:30:53");
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16168,
   "2018-12-18 15:16:11", "14599", "374", \N, "1", "2018-09-15 21:30:53");
   INSERT INTO `rental` (`rental_id`, `rental_date`, `inventory_id`,
   `customer_id`, `return_date`, `staff_id`, `last_update`) VALUES (16169,
   "2018-12-18 15:16:12", "14599", "374", \N, "1", "2018-09-15 21:30:53");
```

Step 3 - Periksa dengan menggunakan query select

```
-- menjalankan query ke tabel partisi data yang benar
SELECT * FROM rental PARTITION (p03) WHERE rental_date = '2018-03-18
15:16:05';

-- menjalankan query ke tabel partisi data yang salah
SELECT * FROM rental PARTITION (p07) WHERE rental_date = '2018-03-18
15:16:05';
```

```
mysql> SELECT * FROM rental PARTITION (p03) WHERE rental_date = '2018-03-18 15:16:05';
+-----------+---------------------+--------------+-------------+-------------+----------+---------------------+
| rental_id | rental_date         | inventory_id | customer_id | return_date | staff_id | last_update         |
+-----------+---------------------+--------------+-------------+-------------+----------+---------------------+
|     16069 | 2018-03-18 15:16:05 |         4472 |         374 | NULL        |        2 | 2018-09-15 21:30:53 |
+-----------+---------------------+--------------+-------------+-------------+----------+---------------------+
1 row in set (0,01 sec)

mysql> SELECT * FROM rental PARTITION (p07) WHERE rental_date = '2018-03-18 15:16:05';
Empty set (0,00 sec)
```

Implementasi Partisi 2: Measures Dataset

Deskripsi dataset

- Dataset terdiri dari 2 tabel.

- Masing-masing tabel memiliki jumlah baris data sebagai berikut

TABLE_NAME	TABLE_ROWS
partitioned_measures	1837729
measures	1837238

- Dataset bisa didapatkan melalui Measures Dataset.

Import dataset

Step 1 - Import Measures dataset ke MySQL Database.

```
# Create a database for dataset
echo "CREATE DATABASE `database-name`" | mysql -u[username] -p
***insert MySQL password***

# Import the dataset
mysql -u[username] -p < sample_1_8_M_rows_data.sql
***insert MySQL password***
```

[username], password = username dan password yang digunakan pada MySQL Database.

Benchmarking

SELECT Query

- Hapus index pada tabel untuk melihat performa asli dari query yang dieksekusi.

```
ALTER TABLE `vertabelo`.`measures`
DROP INDEX `measure_timestamp` ;

ALTER TABLE `vertabelo`.`partitioned_measures`
DROP INDEX `measure_timestamp` ;
```

- Query `SELECT` untuk tabel tanpa pertisi.

```
SELECT SQL_NO_CACHE
    COUNT(*)
FROM
    vertabelo.measures
WHERE
    measure_timestamp >= '2016-01-01'
        AND DAYOFWEEK(measure_timestamp) = 1;
```

- Query `SELECT` untuk tabel dengan partisi.

```
SELECT SQL_NO_CACHE
    COUNT(*)
FROM
    vertabelo.partitioned_measures
WHERE
    measure_timestamp >= '2016-01-01'
        AND DAYOFWEEK(measure_timestamp) = 1;
```

- Hasil Query

No	Tabel tanpa Partisi (detik)	Tabel dengan Partisi (detik)
1.	2,49	1,01
2.	0,76	0,42
3.	0,76	0,42
4.	0,75	0,41
5.	0,75	0,41
6.	0,76	0,41
7.	0,75	0,42
8.	0,75	0,42

No	Tabel tanpa Partisi (detik)	Tabel dengan Partisi (detik)
9.	0,76	0,43
10.	0,76	0,41
Rata-rata	0,93	0,48

BIG DELETE Query

- Tambahkan kembali index yang telah dihapus sebelumnya untuk mengeksekusi query BIG DELETE.

```
ALTER TABLE `vertabelo`.`measures`
ADD INDEX `index1` (`measure_timestamp` ASC);
ALTER TABLE `vertabelo`.`partitioned_measures`
ADD INDEX `index1` (`measure_timestamp` ASC);
```

- Query BIG DELETE untuk tabel tanpa partisi.

```
DELETE
FROM vertabelo.measures
WHERE  measure_timestamp < '2015-01-01';
```

- Query BIG DELETE untuk tabel tanpa partisi.

```
ALTER TABLE vertabelo.partitioned_measures
DROP PARTITION to_delete_logs ;
```

- Hasil Query

No	Tabel tanpa Partisi (detik)	Tabel dengan Partisi (detik)
1.	1,69	0,98
2.	1,74	1,86
3.	2,97	0,43
4.	0,78	0,47
5.	1,51	1,22
6.	0,44	0,39
7.	1,34	0,51
8.	1,26	0,84
9.	0,46	0,41

No	Tabel tanpa Partisi (detik)	Tabel dengan Partisi (detik)
10.	0,58	0,46
Rata-rata	1,24	0,76

Kesimpulan

Pertimbangan untuk menentukan predikat untuk *Horizontal Partition* pada sebuah tabel salah satunya dapat dilihat dari banyaknya data yang terdapat dalam tabel tersebut. Maksimalkan fungsi dari *Horizantal Partition* untuk meminimalkan waktu eksekusi query yang sesuai dengan kebutuhan. Ketika membuat partisi pada tabel, perlu memperhatikan syarat-syarat fragmentasi diantaranya :

- **Tidak diperbolehkan** penggunaan `FOREIGN KEY`.
- Penggunaan `UNIQUE` dan `PRIMARY KEY` pada tabel.
- Metode pembagian yang digunakan pada masing-masing fungsi `PARTITION` (`KEY`, `HASH`, `RANGE`, dan `LIST`).
- Buktikan proses fragmentasi telah benar dengan pembuktian kondisi **Completeness**, **Reconstruction**, dan **Disjointness**.
- dsb.