SQL query

SELECT

c1,MIN(c2)

M

c1,MIN(c2)

P

GROUP BY

Pa

(c1,c2)

S

WHERE

DELTA

FROM

c2 <= 10

A

350 F + 150G + 300P

50 P

50 F

50 P

50 F

50 F

50 GP

50 P

100 GP

100 F

100 F

A

(c1,c2)

FROM

GROUP BY

P

M

DELTA

WHERE

c2 <= 10

c1,MIN(c2)

SELECT

S

c1,MIN(c2)

Pa

Reduced SQL pattern with (pre-) aggregation

|  |  |  |
| --- | --- | --- |
| rk | c3o | c3n |
| x1 | null | 5 |
| x2 | null | 7 |
| x3 | null | 8 |
| x4 | null | 5 |

|  |  |  |  |
| --- | --- | --- | --- |
| Rk | c1 | c2 | c3 |
| k1 | x1 | y1 | 5 |
| k2 | x1 | y1 | 12 |
| k3 | x2 | y2 | 7 |
| k4 | x3 | y2 | 8 |
| k5 | x4 | y3 | 5 |
| k6 | x4 | y3 | 21 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rk | c1o | c1n | c2o | c2n | c3o | c3n |
| k1 | null | x1 | null | y1 | null | 5 |
| k2 | null | x1 | null | y1 | null | 12 |
| k3 | null | x2 | null | y2 | null | 7 |
| k4 | null | x3 | null | y2 | null | 8 |
| k5 | null | x4 | null | y3 | null | 5 |
| k6 | null | x4 | null | y3 | null | 21 |

|  |  |  |
| --- | --- | --- |
| rk | c3o | c3n |
| x1\_k1 | null | 5 |
| x1\_k2 | null | 12 |
| x2\_k3 | null | 7 |
| x3\_k4 | null | 8 |
| x4\_k5 | null | 5 |
| x4\_k6 | null | 21 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Rk | c1o | c1n | c2o | c2n | c3o | c3n |
| k1 | null | x1 | null | y1 | null | 5 |
| k3 | null | x2 | null | y2 | null | 7 |
| k4 | null | x3 | null | y2 | null | 8 |
| k5 | null | x4 | null | y3 | null | 5 |

c3,MIN(c3)

d2 <= 10

(d1,d2)

Reorder

A

(c1,c2)

P

M

c2 <= 10

c1,MIN(c2)

S

c1,c2

Pa

Combine

A

Z1

c2 <= 10

Z2

(c1,c2)

A

Z2

c2 <= 10

c1,MIN(c2)

c1,MIN(c2)

M

Pa

P

(c1,c2)

S

Z1

Reorder

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Rk | c1o | c1n | c3o | c3n |
| k1 | null | x1 | null | 5 |
| k3 | null | x2 | null | 7 |
| k4 | null | x3 | null | 8 |
| k5 | null | x1 | null | 3 |

|  |  |  |  |
| --- | --- | --- | --- |
| Rk | c1 | c2 | c3 |
| k1 | x1 | y1 | 5 |
| k2 | x1 | y1 | 12 |
| k3 | x2 | y2 | 7 |
| k4 | x3 | y2 | 8 |
| k5 | x1 | y3 | 3 |
| k6 | x3 | y3 | 21 |

|  |  |  |
| --- | --- | --- |
| rk | c3o | c3n |
| x1\_k1 | null | 5 |
| x1\_k5 | null | 3 |
| x1 | null | 3 |
| x2\_k3 | null | 7 |
| x2 | null | 7 |
| x3\_k4 | null | 8 |
| x3 | null | 8 |

c3,MIN(c3)

d2 <= 10

150 F + 150G + 100P

100 F

50GP

50 F

100G/50P

A

Z1

(c1,c2)

c2 <= 10

Z2

1. FROM clause
2. WHERE clause
3. GROUP BY clause
4. HAVING clause
5. SELECT clause
6. ORDER BY clause

(c1,c2)

RJ

A B

FROM

c3,SUM(d2)

A

SUM(d2) <= 5

HAVING

SELECT

J

c2 <= 10

S

H

P

GROUP BY

WHERE

(c1,c2)

A

B

|  |  |
| --- | --- |
| PK | cs |
| y2 | 2 |

SUM(d2) <= 5

c3,SUM(d2)

|  |  |
| --- | --- |
| PK | cs |
| y1 | 6 |
| y2 | 2 |

|  |  |  |
| --- | --- | --- |
| rk | d1 | d2 |
| l1 | x1 | 3 |
| l2 | x2 | 2 |
| l3 | x2 | 15 |
| l4 | x3 | 17 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| rk | d1o | d1n | d2o | d2n |
| l1 | null | x1 | null | 3 |
| l2 | null | x2 | null | 2 |
| l3 | null | x2 | null | 18 |
| l4 | null | x3 | null | 17 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| rk | c1o | c1n | c2o | c2n | c3o | c3n |
| k1 | null | x1 | null | y1 | null | 10 |
| k2 | null | x1 | null | y1 | null | 12 |
| k3 | null | x2 | null | y2 | null | 9 |
| k4 | null | x2 | null | y2 | null | 8 |

|  |  |  |  |
| --- | --- | --- | --- |
| rk | c1 | c2 | c3 |
| k1 | x1 | y1 | 5 |
| k2 | x1 | y1 | 12 |
| k3 | x2 | y2 | 7 |
| k4 | x3 | y2 | 8 |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| rk | c1o | c1n | c2o | c2n | c3o | c3n | d1o | d1n | d2o | d2n |
| x1\_k1 | null | x1 | null | y1 | 5 | 10 |  |  |  |  |
| x1\_k2 | null | x1 | null | y1 | 12 | 12 |  |  |  |  |
| x1\_l1 |  |  |  |  |  |  | null | x1 | null | 3 |
| x2\_k3 | null | x2 | null | y2 | 7 | 9 |  |  |  |  |
| x2\_l2 |  |  |  |  |  |  | null | x2 | null | 2 |
| x2\_l3 |  |  |  |  |  |  | null | x2 | null | 18 |
| x3\_k4 | null | x3 | null | y2 | null | 8 |  |  |  |  |
| x3\_l4 |  |  |  |  |  |  | null | x3 | null | 17 |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| rk | c1o | c1n | c2o | c2n | c3o | c3n | d1o | d1n | d2o | d2n |
| k1\_l1 | null | x1 | null | y1 | null | 10 | null | x1 | null | 3 |
| k2\_l1 | null | x1 | null | y1 | null | 12 | null | x1 | null | 3 |
| k3\_l2 | null | x2 | null | y2 | null | 9 | null | x2 | null | 2 |
| k3\_l3 | null | x2 | null | y2 | null | 9 | null | x2 | null | 18 |
| k4\_l4 | null | x3 | null | y2 | null | 8 | null | x2 | null | 17 |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| rk | c1o | c1n | c2o | c2n | c3o | c3n | d1o | d1n | d2o | d2n |
| k1\_l1 | null | x1 | null | y1 | null | 10 | null | x1 | null | 3 |
| k2\_l1 | null | x1 | null | y1 | null | 12 | null | x1 | null | 3 |
| k3\_l2 | null | x2 | null | y2 | null | 9 | null | x2 | null | 2 |

c3,SUM(d2)

RJ

d2 <= 10

A B

(d1,d2)

(c1,c2,c3)

A B

c2 <= 10

c3,SUM(d2)

(c1,c2)

B

(c1,c2)

A

RJ

J

Se

S

H

P

SUM(d2) <= 5

c3,SUM(d2)

SUM(d2) <= 5

c3,SUM(d2)

H

A

A B

J

c3,SUM(d2)

c3,SUM(d2)

d2 <= 10

d2 <= 10

(c1,c2)

(c1,c2)

RJ

P

S

P

S

A

B

Z4

Z3

Z2

Z1

P

P

RJ

c2

d2

A B

S

c2 <= 10

(d1,d2)

B

(c1,c2,c3)

A

J

c2,SUM(d2)

A

H

SUM(d2) <= 5

RJ A B

(d2) d2

(c1,c2) c2 <= 10 c2

Z1

A

B

Z2

c2,SUM(d2) SUM(d2) <= 5

Z4

Z3

|  |  |
| --- | --- |
| PK | cs |
| y1 | 6 |

SUM(d2) <= 5

c3,SUM(d2)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| rk | c2o | c2n | d2o | d2n |
| x1\_k1 | null | y1 |  |  |
| x1\_k2 | null | y1 |  |  |
| x1\_l1 |  |  | null | 3 |
| x1\_k1\_l1 | null | y1 | null | 3 |
| x1\_k2\_l1 | null | y1 | null | 3 |
| x2\_k3 | null | y2 |  |  |
| x2\_l2 |  |  | null | 2 |
| x2\_k2\_l1 | null | y1 | null | 2 |
| x3\_k4 | null | y2 |  |  |

A B

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| rk | c1o | c1n | c2o | c2n |
| k1 | null | x1 | null | y1 |
| k2 | null | x1 | null | y1 |
| k3 | null | x2 | null | y2 |
| k4 | null | x2 | null | y2 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| rk | d1o | d1n | d2o | d2n |
| l1 | null | x1 | null | 3 |
| l2 | null | x2 | null | 2 |

(d2)

d2 <= 10

(c1,c2)

|  |  |  |
| --- | --- | --- |
| rk | d1 | d2 |
| l1 | x1 | 3 |
| l2 | x2 | 2 |
| l3 | x2 | 15 |
| l4 | x3 | 17 |

|  |  |  |  |
| --- | --- | --- | --- |
| Rk | c1 | c2 | c3 |
| k1 | x1 | y1 | 5 |
| k2 | x1 | y1 | 12 |
| k3 | x2 | y2 | 7 |
| k4 | x3 | y2 | 8 |

1. Reorder operations
2. Pipeline operations / Combine tables