Advanced Database Project

Final Phase

Team 16

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Submitted to:

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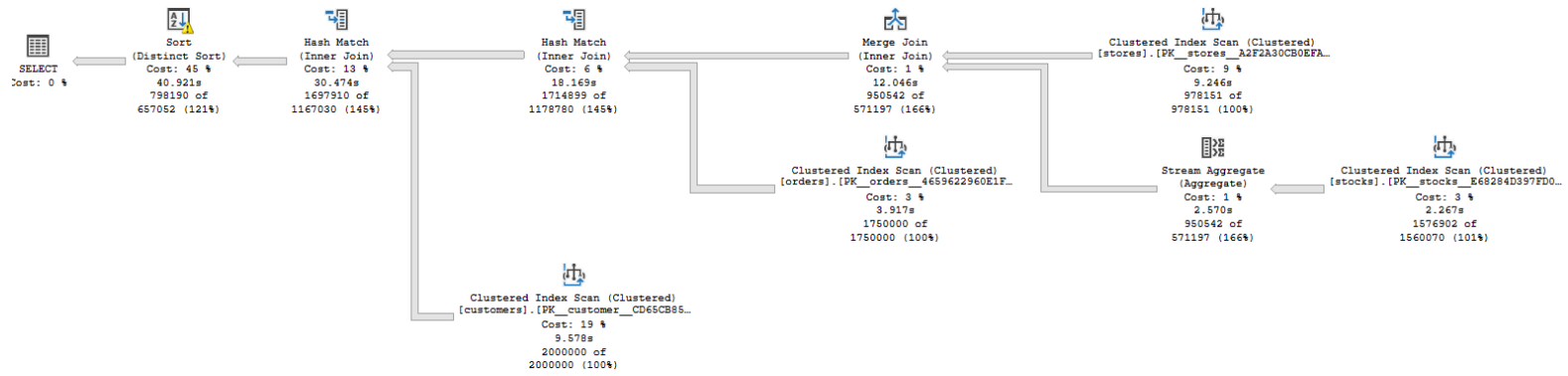
SQL Query #1

```sql
SELECT DISTINCT
       c.first_name,
       c.last_name
FROM
       sales.orders AS o,
       sales.customers AS c
WHERE
       o.customer_id = c.customer_id
       AND o.store_id IN (
       SELECT
              sto.store_id
       FROM
              sales.stores AS sto
WHERE
          sto.store_id IN ( SELECT stc.store_id FROM production.stocks AS stc
                            WHERE stc.quantity > 1000 ))
```

Execution Plan Diagram



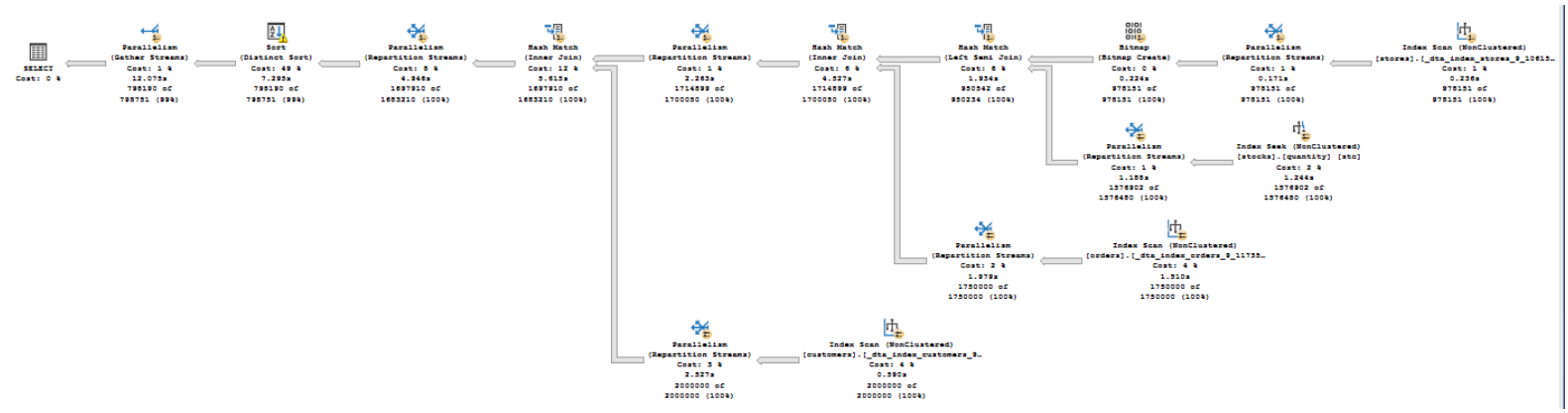
Some Analysis

Rows	StmtText	NodeId	Parent	PhysicalOp	LogicalOp	Argument	TotalSubtreeCost	Parallel
798190	SELECTDISTINCT c.first_name,c.last_nameFROMSales.orders AS o ,sales.customers AS c'	1	0				238.8167	False
798190	|--Sort(DISTINCT ORDER BY:([c].[first_name] ASC, [c].[last_name] ASC))	2	1	Sort	Distinct Sort	DISTINCT ORDER BY:([c].[first_name] ASC, [c].[last_name] ASC)	238.8167	False
1697910	|--Hash Match(Inner Join, HASH:([o].[customer_id])=([c].[customer_id]), RESIDUAL:(	4	2	Hash Match	Inner Join	HASH:([o].[customer_id])=([c].[customer_id]), RESIDUAL:([stor	130.845	False
1714899	|--Hash Match(Inner Join, HASH:([stc].[store_id])=([o].[store_id]))	6	4	Hash Match	Inner Join	HASH:([stc].[store_id])=([o].[store_id])	55.42873	False
950542	| |--Merge Join(Inner Join, MERGE:([sto].[store_id])=([stc].[store_id]), RESIDUAL	7	6	Merge Join	Inner Join	MERGE:([sto].[store_id])=([stc].[store_id]), RESIDUAL:([store].[	33.39322	False
978151	| | |--Clustered Index Scan(OBJECT:([store].[sales].[stores].[PK__stores__A2F2	8	7	Clustered Index Scan	Clustered Index Scan	OBJECT:([store].[sales].[stores].[PK__stores__A2F2A30CB0EFA4	20.97406	False
950542	| | |--Stream Aggregate(GROUP BY:([stc].[store_id]))	9	7	Stream Aggregate	Aggregate	GROUP BY:([stc].[store_id])	9.102805	False
1576902	| | |--Clustered Index Scan(OBJECT:([store].[production].[stocks].[PK__stocl	10	9	Clustered Index Scan	Clustered Index Scan	OBJECT:([store].[production].[stocks].[PK__stocks__E68284D39	7.197171	False
1750000	| |--Clustered Index Scan(OBJECT:([store].[sales].[orders].[PK__orders__465962	11	6	Clustered Index Scan	Clustered Index Scan	OBJECT:([store].[sales].[orders].[PK__orders__4659622960E1F0	7.539393	False
2000000	|--Clustered Index Scan(OBJECT:([store].[sales].[customers].[PK__customer__CD	12	4	Clustered Index Scan	Clustered Index Scan	OBJECT:([store].[sales].[customers].[PK__customer__CD65CB8	44.59291	False

SQL Query #1 Optimization

```
SELECT
		DISTINCT c.first_name,c.last_name
FROM
	sales.orders AS o INNER JOIN sales.customers AS c on   o.customer_id =
c.customer_id
WHERE
o.store_id IN (
	SELECT
		sto.store_id
	FROM
		sales.stores AS sto
WHERE
	sto.store_id IN ( SELECT stc.store_id FROM production.stocks AS stc
			WHERE stc.quantity > 1000 ))
```

Exection Plan Diagram



Some Analysis

Rows	StmtText	NodeId	Parent	PhysicalOp	LogicalOp	Argument	TotalSubtreeCost	Parallel
798190	SELECT DISTINCT c.first_name,c.last_name FROM sales.orders AS o INNER JOIN sales.cu	1	0				164.1221	False
798190	|--Parallelism(Gather Streams)	2	1	Parallelism	Gather Streams		164.1221	True
798190	|--Sort(DISTINCT ORDER BY:([c].[first_name] ASC, [c].[last_name] ASC))	3	2	Sort	Distinct Sort	DISTINCT ORDER BY:([c].[first_name] ASC, [c].[last_name] ASC)	162.7942	True
1697910	|--Parallelism(Repartition Streams, Hash Partitioning, PARTITION COLUMNS:([c	4	3	Parallelism	Repartition Streams	PARTITION COLUMNS:([c].[first_name], [c].[last_name])	82.89161	True
1697910	|--Hash Match(Inner Join, HASH:([o].[customer_id])=([c].[customer_id]), RES	5	4	Hash Match	Inner Join	HASH:([o].[customer_id])=([c].[customer_id]), RESIDUAL:([new_store].[sales].[custom	69.05932	True
1714899	|--Parallelism(Repartition Streams, Hash Partitioning, PARTITION COLUMN	6	5	Parallelism	Repartition Streams	PARTITION COLUMNS:([o].[customer_id])	38.04844	True
1714899	|--Hash Match(Inner Join, HASH:([sto].[store_id])=([o].[store_id]))	7	6	Hash Match	Inner Join	HASH:([sto].[store_id])=([o].[store_id])	35.98306	True
950542	|--Hash Match(Left Semi Join, HASH:([sto].[store_id])=([stc].[store_i	8	7	Hash Match	Left Semi Join	HASH:([sto].[store_id])=([stc].[store_id])	17.1488	True
978151	|--Bitmap(HASH:([sto].[store_id]), DEFINE:([Bitmap1004]))	9	8	Bitmap	Bitmap Create	HASH:([sto].[store_id])	2.63793	True
978151	|--Parallelism(Repartition Streams, Hash Partitioning, PARTITI	10	9	Parallelism	Repartition Streams	PARTITION COLUMNS:([sto].[store_id])	2.63793	True
978151	|--Index Scan(OBJECT:([new_store].[sales].[stores].[_dta_in	11	10	Index Scan	Index Scan	OBJECT:([new_store].[sales].[stores].[_dta_index_stores_9_1061578820__K1] AS [sto])	1.437483	True
1576902	|--Parallelism(Repartition Streams, Hash Partitioning, PARTITION	12	8	Parallelism	Repartition Streams	PARTITION COLUMNS:([stc].[store_id])	5.390551	True
1576902	|--Index Seek(OBJECT:([new_store].[production].[stocks].[qua	13	12	Index Seek	Index Seek	OBJECT:([new_store].[production].[stocks].[quantity] AS [stc]), SEEK:([stc].[quantity] >	3.47323	True
1750000	|--Parallelism(Repartition Streams, Hash Partitioning, PARTITION CO	14	7	Parallelism	Repartition Streams	PARTITION COLUMNS:([o].[store_id])	8.878751	True
1750000	|--Index Scan(OBJECT:([new_store].[sales].[orders].[_dta_index_c	15	14	Index Scan	Index Scan	OBJECT:([new_store].[sales].[orders].[_dta_index_orders_9_1173579219__K2_K7_1_3_	6.089407	True
2000000	|--Parallelism(Repartition Streams, Hash Partitioning, PARTITION COLUMN	16	5	Parallelism	Repartition Streams	PARTITION COLUMNS:([c].[customer_id])	10.77584	True
2000000	|--Index Scan(OBJECT:([new_store].[sales].[customers].[_dta_index_cu	17	16	Index Scan	Index Scan	OBJECT:([new_store].[sales].[customers].[_dta_index_customers_9_1029578706__K1_	6.212092	True

What did we make to optimize?

[1] Query Optimization

- Make inner join on customer_id

[2] Adding Indexes

Index In	Columns	Sort Order
orders	Customer_id	ASC
	Store_id	ASC
stocks	quantity	ASC

[3] Parallel Execution

- The system has decided that it could benefit from performing some of the processing in parallel.
- It shouldn't be a cause for concern - generally - and the "duplicate" rows will be eliminated by the later (Gather Streams) operation.

NoSql Query #1

```
db.getCollection("dbo.ordcuststorstoc").aggregate([{
    $match: {
        quantity: {
            $gt: 1000
        },
        first_name: {
            $exists: true
        },
        last_name: {
            $exists: true
        }
    }
}, {
    $group: {
        _id: {
            first_name: "$first_name",
            last_name: "$last_name"
        }
    }
}, {
    $project: {
        first_name: "$_id.first_name",
        last_name: "$id.last_name"
    }
}, {
    $sort: {
        _id: - 1
    }
}], {
    "allowDiskUse": true
})
```

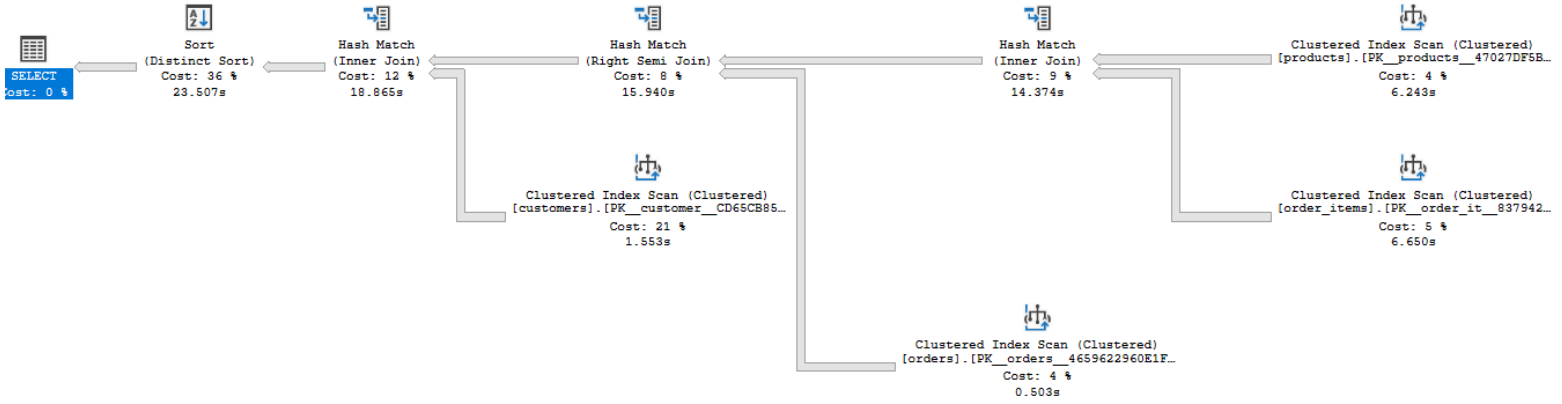
Time Analysis Query #1

Type	Time
SQL (Not Optimized)	00:48.472
Sql (Optimized)	00:22.594
NoSQL	00:67.676

SQL Query #2

```
SELECT
	DISTINCT c.first_name,
	c.last_name
FROM
	sales.orders AS o,
	sales.customers AS c
WHERE
	c.customer_id = o.customer_id
	AND o.shipped_date > '1970-08-11'
	AND o.order_id IN (
	SELECT
		oi.order_id
	FROM
		sales.order_items AS oi
	WHERE
	oi.discount > 10
	AND oi.product_id IN ( SELECT p.product_id FROM production.products AS p WHERE
	p.model_year > 1950 ));
```

Execution Plan Diagram



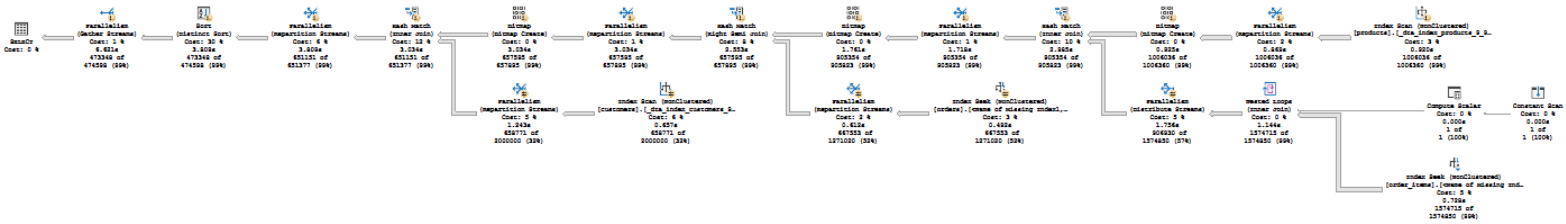
Some Analysis

Rows	StmtText	NodeId	Parent	PhysicalOp	LogicalOp	Argument	TotalSubtreeCost	Parallel
473348	SELECT DISTINCT c.first_name, c.last_name FROM sales.orders AS o, sales.customers AS	1	0				211.2786	False
473348	|--Sort(DISTINCT ORDER BY:([c].[first_name] ASC, [c].[last_name] ASC))	2	1	Sort	Distinct Sort	DISTINCT ORDER BY:([c].[first_name] ASC, [c].[last_name] ASC)	211.2786	False
651151	|--Hash Match(Inner Join, HASH:([o].[customer_id])=([c].[customer_id]), RESIDUA	3	2	Hash Match	Inner Join	HASH:([o].[customer_id])=([c].[customer_id]), RESIDUAL:([store].[sales].[customers].	135.9496	False
657595	|--Hash Match(Right Semi Join, HASH:([oi].[order_id])=([o].[order_id]))	4	3	Hash Match	Right Semi Join	HASH:([oi].[order_id])=([o].[order_id])	65.59115	False
905354	| |--Hash Match(Inner Join, HASH:([p].[product_id])=([oi].[product_id]))	6	4	Hash Match	Inner Join	HASH:([p].[product_id])=([oi].[product_id])	40.18327	False
1006036	| | |--Clustered Index Scan(OBJECT:([store].[production].[products].[PK__p	7	6	Clustered Index Scan	Clustered Index Scan	OBJECT:([store].[production].[products].[PK__products__47027DF5B1341017] AS [p]),	9.39643	False
1574715	| | |--Clustered Index Scan(OBJECT:([store].[sales].[order_items].[PK__orde	8	6	Clustered Index Scan	Clustered Index Scan	OBJECT:([store].[sales].[order_items].[PK__order_it__837942D42157409F] AS [oi]), WI	11.24458	False
1270917	| |--Clustered Index Scan(OBJECT:([store].[sales].[orders].[PK__orders__4659	9	4	Clustered Index Scan	Clustered Index Scan	OBJECT:([store].[sales].[orders].[PK__orders__4659622960E1F0CB] AS [o]), WHERE:([st	7.539393	False
2000000	|--Clustered Index Scan(OBJECT:([store].[sales].[customers].[PK__customer__	10	3	Clustered Index Scan	Clustered Index Scan	OBJECT:([store].[sales].[customers].[PK__customer__CD65CB8567E6237E] AS [c])	44.59291	False

SQL Query #2 Optimization

```
SELECT
	DISTINCT c.first_name,
	c.last_name
FROM
	( SELECT so.order_id, so.customer_id FROM sales.orders AS so WHERE
so.shipped_date > '1970-08-11' ) AS o
	INNER JOIN sales.customers AS c ON c.customer_id = o.customer_id
WHERE
	o.order_id IN (
	SELECT
		oi.order_id
	FROM
		sales.order_items AS oi
	WHERE
	oi.discount > 10
	AND oi.product_id IN ( SELECT p.product_id FROM production.products AS p WHERE
	p.model_year > 1950 ))
```

Exection Plan Diagram



Some Analysis

Rows	StmtText	NodeId	Parent	PhysicalOp	LogicalOp	Argument	TotalSubtreeCost	Parallel
473348	SELECT DISTINCT c.first_name, c.last_name FROM (SELECT	1	0				95.97579	False
473348	|--Parallelism(Gather Streams)	2	1	Parallelism	Gather Streams		95.97579	True
473348	|--Sort(DISTINCT ORDER BY:([c].[first_name] ASC, [c].	3	2	Sort	Distinct Sort	DISTINCT ORDER BY:([c].[first_name] ASC, [c].[last_name] ASC)	95.17524	True
651151	|--Parallelism(Repartition Streams, Hash Partition	4	3	Parallelism	Repartition Streams	PARTITION COLUMNS:([c].[first_name], [c].[last_name])	66.29818	True
651151	|--Hash Match(Inner Join, HASH:([so].[customer	5	4	Hash Match	Inner Join	HASH:([so].[customer_id])=([c].[customer_id]), RESIDUAL:([new_	60.92782	True
657595	|--Bitmap(HASH:([so].[customer_id]), DEFINE	6	5	Bitmap	Bitmap Create	HASH:([so].[customer_id])	38.30396	True
657595	|--Parallelism(Repartition Streams, Hash P	7	6	Parallelism	Repartition Streams	PARTITION COLUMNS:([so].[customer_id])	38.30396	True
657595	|--Hash Match(Right Semi Join, HASH:([	8	7	Hash Match	Right Semi Join	HASH:([oi].[order_id])=([so].[order_id])	37.48721	True
905354	|--Bitmap(HASH:([oi].[order_id]), DEF	9	8	Bitmap	Bitmap Create	HASH:([oi].[order_id])	24.92697	True
905354	|--Parallelism(Repartition Streams	11	9	Parallelism	Repartition Streams	PARTITION COLUMNS:([oi].[order_id])	24.92697	True
905354	|--Hash Match(Inner Join, HASH	12	11	Hash Match	Inner Join	HASH:([p].[product_id])=([oi].[product_id])	23.81318	True
1006036	|--Bitmap(HASH:([p].[product	13	12	Bitmap	Bitmap Create	HASH:([p].[product_id])	4.54513	True
1006036	|--Parallelism(Repartition	14	13	Parallelism	Repartition Streams	PARTITION COLUMNS:([p].[product_id])	4.54513	True
1006036	|--Index Scan(OBJECT:([	15	14	Index Scan	Index Scan	OBJECT:([new_store].[production].[products].[_dta_index_produ	2.890889	True
906930	|--Parallelism(Distribute Stre	16	12	Parallelism	Distribute Streams	PARTITION COLUMNS:([oi].[product_id]), WHERE:(PROBE([Bitma	10.04797	True
1574715	|--Nested Loops(Inner Join	17	16	Nested Loops	Inner Join	OUTER REFERENCES:([Expr1005], [Expr1006], [Expr1004])	5.050431	False
1	|--Compute Scalar(DEFIN	18	17	Compute Scalar	Compute Scalar	DEFINE:(([Expr1005],[Expr1006],[Expr1004])=GetRangeWithMism	0	False
1	|--Constant Scan	19	18	Constant Scan	Constant Scan		0	False
1574715	|--Index Seek(OBJECT:([	20	17	Index Seek	Index Seek	OBJECT:([new_store].[sales].[order_items].[<Name of Missing In	5.050431	False
667553	|--Parallelism(Repartition Streams, H	21	8	Parallelism	Repartition Streams	PARTITION COLUMNS:([so].[order_id])	4.715209	True
667553	|--Index Seek(OBJECT:([new_store	22	21	Index Seek	Index Seek	OBJECT:([new_store].[sales].[orders].[<Name of Missing Index1,	2.681522	True
658771	|--Parallelism(Repartition Streams, Hash Part	23	5	Parallelism	Repartition Streams	PARTITION COLUMNS:([c].[customer_id])	10.77584	True
658771	|--Index Scan(OBJECT:([new_store].[sales]	24	23	Index Scan	Index Scan	OBJECT:([new_store].[sales].[customers].[_dta_index_customer	6.212092	True

What did we make to optimize?

[1] Query Optimization

- Select first on the order.shipped_date and return only the columns needed later
- Make inner join on customer_id of order and customer table

[2] Adding Indexes

Index In	Columns	Sort Order
products	protduct_id	ASC
	model_year	ASC
order_items	discount	ASC
orders	shipped_date	ASC

[3] Parallel Execution

- The system has decided that it could benefit from performing some of the processing in parallel.
- It shouldn't be a cause for concern - generally - and the "duplicate" rows will be eliminated by the later (Gather Streams) operation.

NoSql Query #2

```
db.getCollection("dbo.ordcusitempro").aggregate([{
    $match: {
        model_year: {
            $gt: 1950
        },
                        shipped_date: {
            $gt: new ISODate('1970-08-11')
        },
                        discount: {
            $gt: 10
        },
        first_name: {
            $exists: true
        },
        last_name: {
            $exists: true
        }
    }
}, {
    $group: {
        _id: {
            first_name: "$first_name",
            last_name: "$last_name"
        }
    }
}, {
```

```
    $project: {
        first_name: "$_id.first_name",
        last_name: "$id.last_name"
    }
}, {
    $sort: {
        _id:  - 1
    }
}], {
    "allowDiskUse": true
})
```

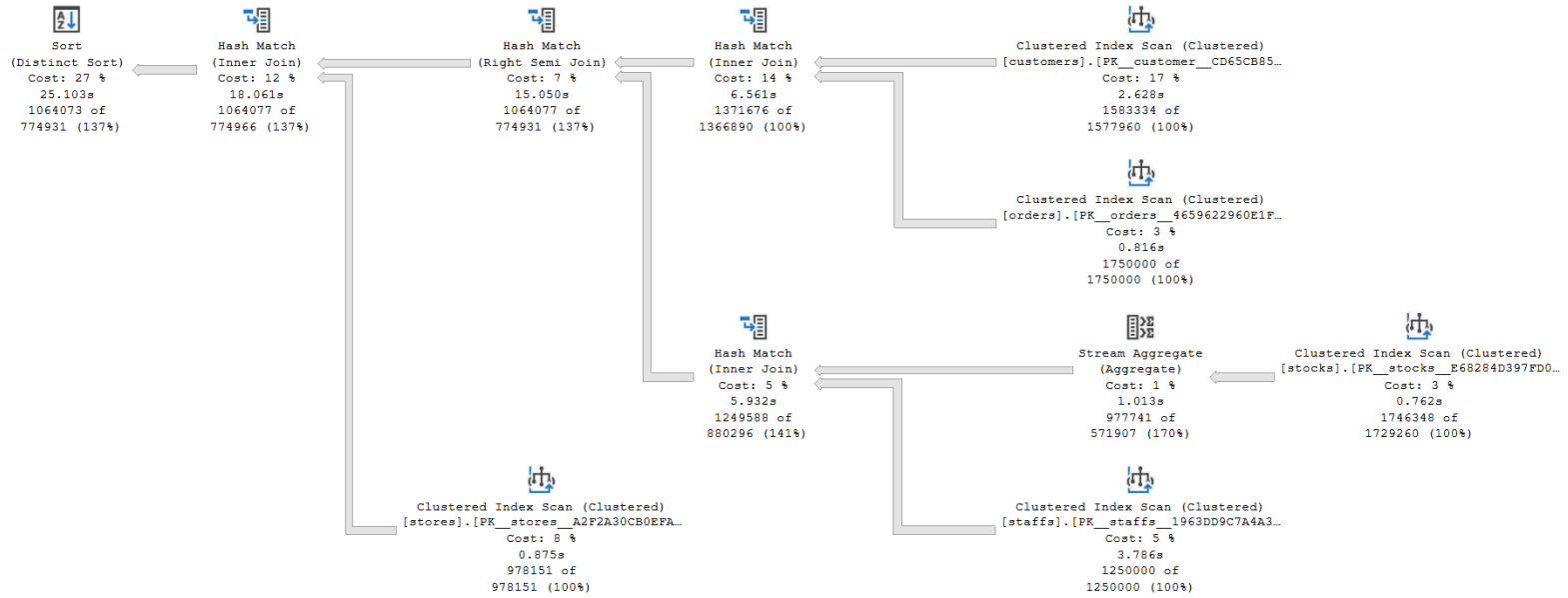
Time Analysis Query #2

Type	Time
SQL (Not Optimized)	00:32.914
Sql (Optimized)	00:14.589
NoSQL	00:58.487

SQL Query #3

```
SELECT
	DISTINCT s.first_name,
	s.last_name,
	sto.store_name
FROM
	sales.staffs AS s,
	sales.stores AS sto
WHERE
	s.store_id = sto.store_id
	AND sto.store_id IN ( SELECT st.store_id FROM production.stocks AS st
WHERE st.quantity > 20 )
	AND s.staff_id IN (
	SELECT
		o.staff_id
	FROM
		sales.orders AS o
	WHERE
	o.staff_id = s.staff_id
	AND o.customer_id IN ( SELECT c.customer_id FROM sales.customers AS c WHERE
	c.zip_code > '2000' ))
```

Execution Plan Diagram



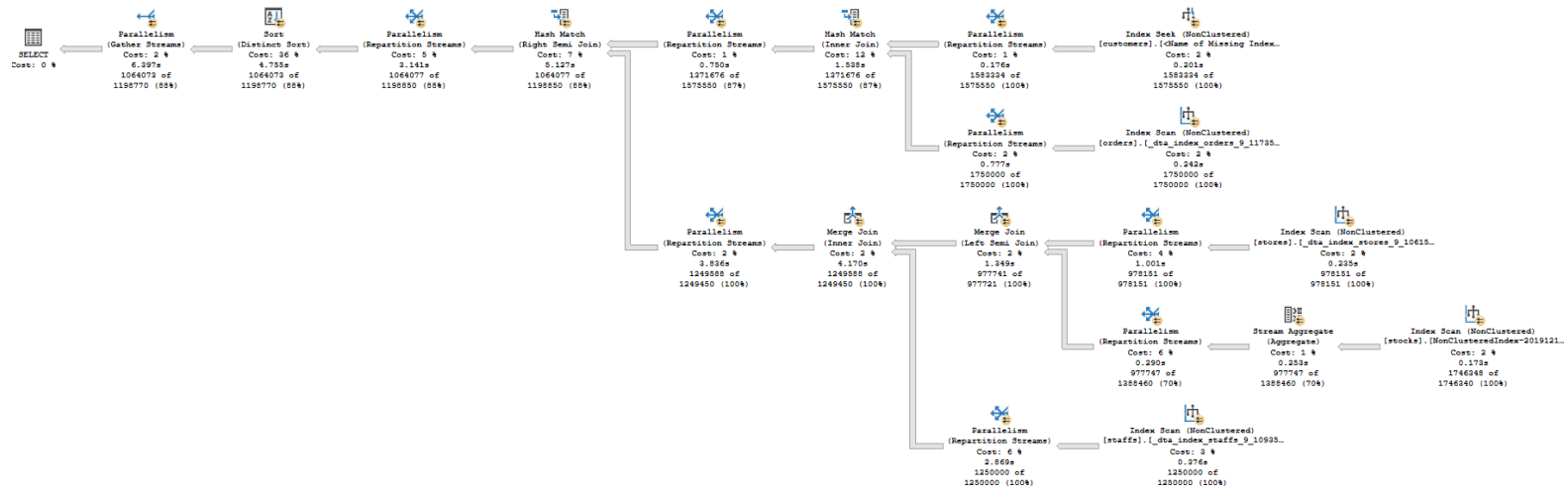
Some Analysis

Rows	StmtText	NodeId	Parent	PhysicalOp	LogicalOp	Argument	TotalSubtreeCost	Parallel
1064073	SELECT DISTINCT s.first_name, s.last_name, sto.store_name FROM	1	0				261.471	False
1064073	|--Sort(DISTINCT ORDER BY:([s].[first_name] ASC, [s].[last_nam	2	1	Sort	Distinct Sort	DISTINCT ORDER BY:([s].[first_name] ASC, [s].[last_name] A	261.471	False
1064077	|--Hash Match(Inner Join, HASH:([st].[store_id])=([sto].[stor	4	2	Hash Match	Inner Join	HASH:([st].[store_id])=([sto].[store_id])	191.8728	False
1064077	|--Hash Match(Right Semi Join, HASH:([o].[staff_id])=([s].[	5	4	Hash Match	Right Semi Join	HASH:([o].[staff_id])=([s].[staff_id]), RESIDUAL:([store].[sale	139.2443	False
1371676	| |--Hash Match(Inner Join, HASH:([c].[customer_id])=([c	7	5	Hash Match	Inner Join	HASH:([c].[customer_id])=([o].[customer_id]), RESIDUAL:([s	88.02207	False
1583334	| | |--Clustered Index Scan(OBJECT:([store].[sales].[cus	8	7	Clustered Index Scan	Clustered Index Scan	OBJECT:([store].[sales].[customers].[PK__customer__CD65C	44.59291	False
1750000	| | |--Clustered Index Scan(OBJECT:([store].[sales].[orc	9	7	Clustered Index Scan	Clustered Index Scan	OBJECT:([store].[sales].[orders].[PK__orders__4659622960E	7.539393	False
1249588	| |--Hash Match(Inner Join, HASH:([st].[store_id])=([s].[s	10	5	Hash Match	Inner Join	HASH:([st].[store_id])=([s].[store_id])	33.21813	False
977741	| |--Stream Aggregate(GROUP BY:([st].[store_id]))	11	10	Stream Aggregate	Aggregate	GROUP BY:([st].[store_id])	9.187757	False
1746348	| | |--Clustered Index Scan(OBJECT:([store].[product	12	11	Clustered Index Scan	Clustered Index Scan	OBJECT:([store].[production].[stocks].[PK__stocks__E68284[	7.197171	False
1250000	| |--Clustered Index Scan(OBJECT:([store].[sales].[staf	13	10	Clustered Index Scan	Clustered Index Scan	OBJECT:([store].[sales].[staffs].[PK__staffs__1963DD9C7A4A	12.04347	False
978151	|--Clustered Index Scan(OBJECT:([store].[sales].[stores].[P	14	4	Clustered Index Scan	Clustered Index Scan	OBJECT:([store].[sales].[stores].[PK__stores__A2F2A30CB0E	20.97406	False

SQL Query #3 Optimization

```
SELECT DISTINCT
	s.first_name,
	s.last_name,
	sto.store_name
FROM
	sales.staffs AS s
	INNER JOIN sales.stores AS sto ON sto.store_id = s.store_id
WHERE
	sto.store_id IN ( SELECT st.store_id FROM production.stocks AS st WHERE
st.quantity > 20 )
	AND s.staff_id IN (
	SELECT
		o.staff_id
	FROM
		sales.orders AS o
	WHERE o.customer_id IN ( SELECT c.customer_id FROM sales.customers AS c
					WHERE c.zip_code > '2000' ))
```

Exection Plan Diagram



Some Analysis

Rows	StmtText	NodeId	Parent	PhysicalOp	LogicalOp	Argument	TotalSubtreeCost	Parallel
1064073	SELECT DISTINCT [first_name],[last_name],[sto.store_name FROM[Sale	1	0				156.2407	False
1064073	|--Parallelism(Gather Streams)	2	1	Parallelism	Gather Streams		156.2407	True
1064073	|--Sort(DISTINCT ORDER BY:([s].[first_name] ASC, [s].[last_name]	3	2	Sort	Distinct Sort	DISTINCT ORDER BY:([s].[first_name] ASC, [s].[last_name] ASC, [sto].[	153.5176	True
1064077	|--Parallelism(Repartition Streams, Hash Partitioning, PARTITIO	4	3	Parallelism	Repartition Streams	PARTITION COLUMNS:([s].[first_name], [s].[last_name], [sto].[store_	97.95304	True
1064077	|--Hash Match(Right Semi Join, HASH:([o].[staff_id])=([s].[sta	5	4	Hash Match	Right Semi Join	HASH:([o].[staff_id])=([s].[staff_id])	89.58683	True
1371676	|--Parallelism(Repartition Streams, Hash Partitioning, PAR	7	5	Parallelism	Repartition Streams	PARTITION COLUMNS:([o].[staff_id])	32.50592	True
1371676	|--Hash Match(Inner Join, HASH:([c].[customer_id])=([c	8	7	Hash Match	Inner Join	HASH:([c].[customer_id])=([o].[customer_id]), RESIDUAL:([new_store	30.58972	True
1583334	|--Parallelism(Repartition Streams, Hash Partitioning	9	8	Parallelism	Repartition Streams	PARTITION COLUMNS:([c].[customer_id])	5.513364	True
1583334	|--Index Seek(OBJECT:([new_store].[sales].[custo	10	9	Index Seek	Index Seek	OBJECT:([new_store].[sales].[customers].[<Name of Missing Index, sy	3.597162	True
1750000	|--Parallelism(Repartition Streams, Hash Partitioning	11	8	Parallelism	Repartition Streams	PARTITION COLUMNS:([o].[customer_id])	6.643196	True
1750000	|--Index Scan(OBJECT:([new_store].[sales].[order	12	11	Index Scan	Index Scan	OBJECT:([new_store].[sales].[orders].[_dta_index_orders_9_1173579	3.853852	True
1249588	|--Parallelism(Repartition Streams, Hash Partitioning, PAR	13	5	Parallelism	Repartition Streams	PARTITION COLUMNS:([s].[staff_id])	45.60593	True
1249588	|--Merge Join(Inner Join, MERGE:([sto].[store_id])=([s].	14	13	Merge Join	Inner Join	MERGE:([sto].[store_id])=([s].[store_id]), RESIDUAL:([new_store].[sal	41.96824	True
977741	|--Merge Join(Left Semi Join, MERGE:([sto].[store_id	15	14	Merge Join	Left Semi Join	MERGE:([sto].[store_id])=([st].[store_id]), RESIDUAL:([new_store].[sa	25.37505	True
978151	|--Parallelism(Repartition Streams, Hash Partition	16	15	Parallelism	Repartition Streams	PARTITION COLUMNS:([sto].[store_id]), ORDER BY:([sto].[store_id] AS	9.147228	True
978151	|--Index Scan(OBJECT:([new_store].[sales].[sto	17	16	Index Scan	Index Scan	OBJECT:([new_store].[sales].[stores].[_dta_index_stores_9_10615788	2.448594	True
977747	|--Parallelism(Repartition Streams, Hash Partition	18	15	Parallelism	Repartition Streams	PARTITION COLUMNS:([st].[store_id]), ORDER BY:([st].[store_id] ASC)	13.69118	True
977747	|--Stream Aggregate(GROUP BY:([st].[store_id])	19	18	Stream Aggregate	Aggregate	GROUP BY:([st].[store_id])	5.056811	True
1746348	|--Index Scan(OBJECT:([new_store].[producti	20	19	Index Scan	Index Scan	OBJECT:([new_store].[production].[stocks].[NonClusteredIndex-2019	3.853111	True
1250000	|--Parallelism(Repartition Streams, Hash Partitioning	21	14	Parallelism	Repartition Streams	PARTITION COLUMNS:([s].[store_id]), ORDER BY:([s].[store_id] ASC)	14.1888	True
1250000	|--Index Scan(OBJECT:([new_store].[sales].[staffs]	22	21	Index Scan	Index Scan	OBJECT:([new_store].[sales].[staffs].[_dta_index_staffs_9_109357893	4.515148	True

What did we make to optimize?

[1] Query Optimization

- Make inner join on store_id of staff and store table

[2] Adding Indexes

Index In	Columns	Sort Order
staff	staff_id	ASC
	store_id	ASC
stocks	quantity	ASC
	store_id	ASC
orders	customer_id	ASC
	statff_id	ASC
customers	zip_code	ASC

[3] Parallel Execution

- The system has decided that it could benefit from performing some of the processing in parallel.
- It shouldn't be a cause for concern - generally - and the "duplicate" rows will be eliminated by the later (Gather Streams) operation.

NoSql Query #3

```
db.getCollection("dbo.stafstostocordcus").aggregate([{
    $match: {
        quantity: {
            $gt: 20
        },
        zip_code: {
            $gt: "2000"
        },
        store_name: {
            $exists: true
        },
        s_first_name: {
            $exists: true
        },
        s_last_name: {
            $exists: true
        }
    }
}, {
    $group: {
        _id: {
            store_name: "$store_name",
            s_first_name: "$s_first_name",
            s_last_name: "$s_last_name"
        }
    }
}, {
    $project: {
        store_name: "$_id.store_name",
        s_first_name: "$_id.s_first_name",
        s_last_name: "$id.s_last_name"
    }
}, {
    $sort: {
        _id: - 1
    }
}], {
    "allowDiskUse": true
})
```

Time Analysis Query #3

Type	Time
SQL (Not Optimized)	00:32.914
Sql (Optimized)	00:18.985
NoSQL	00:89.435