The Analyst's Guide To:

Identifying and Fixing Performance Anti-Patterns

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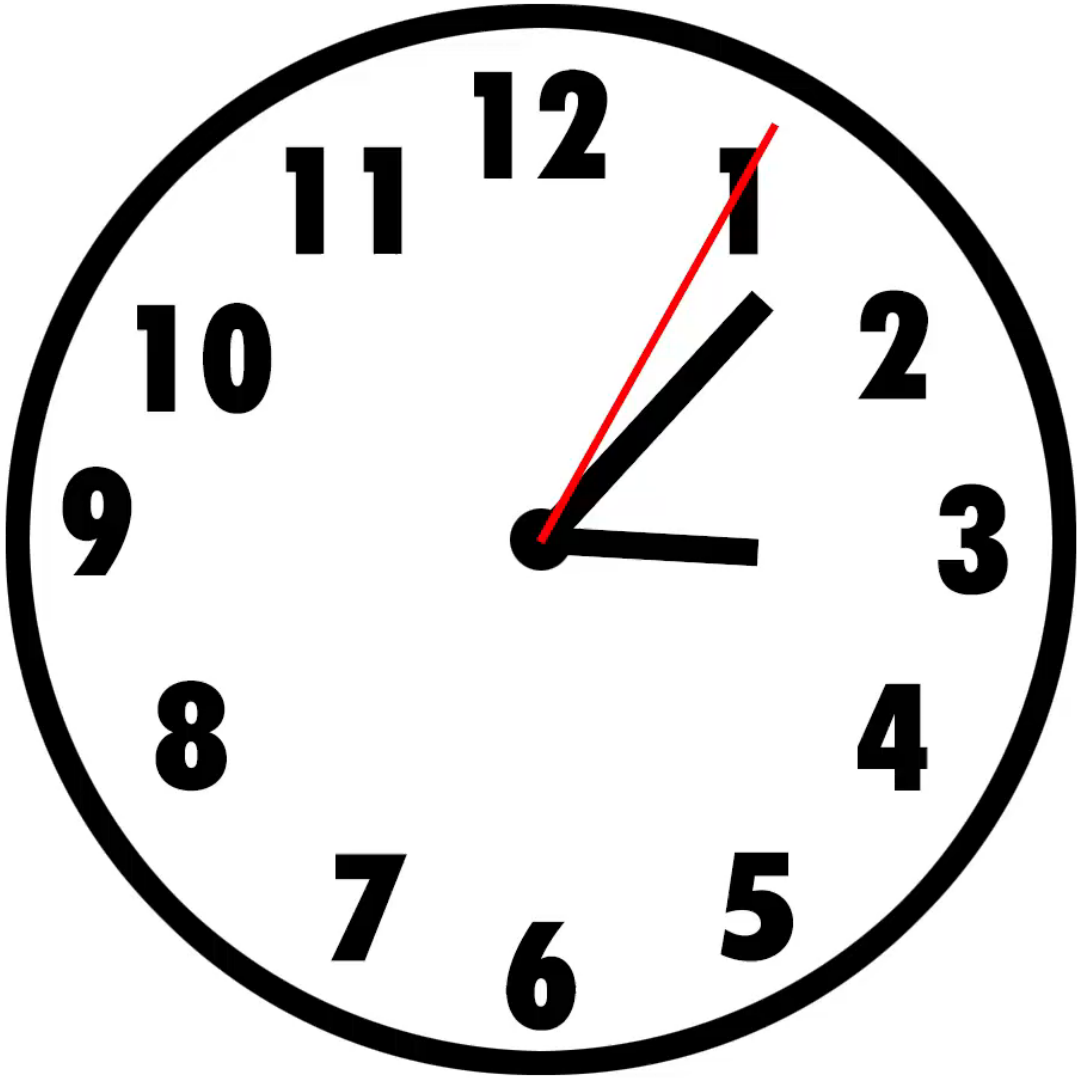
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Patterns

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Anti-Patterns

Chris Maluszynski / MOMENT

5 Performance Anti-Patterns

(and how to fix them)

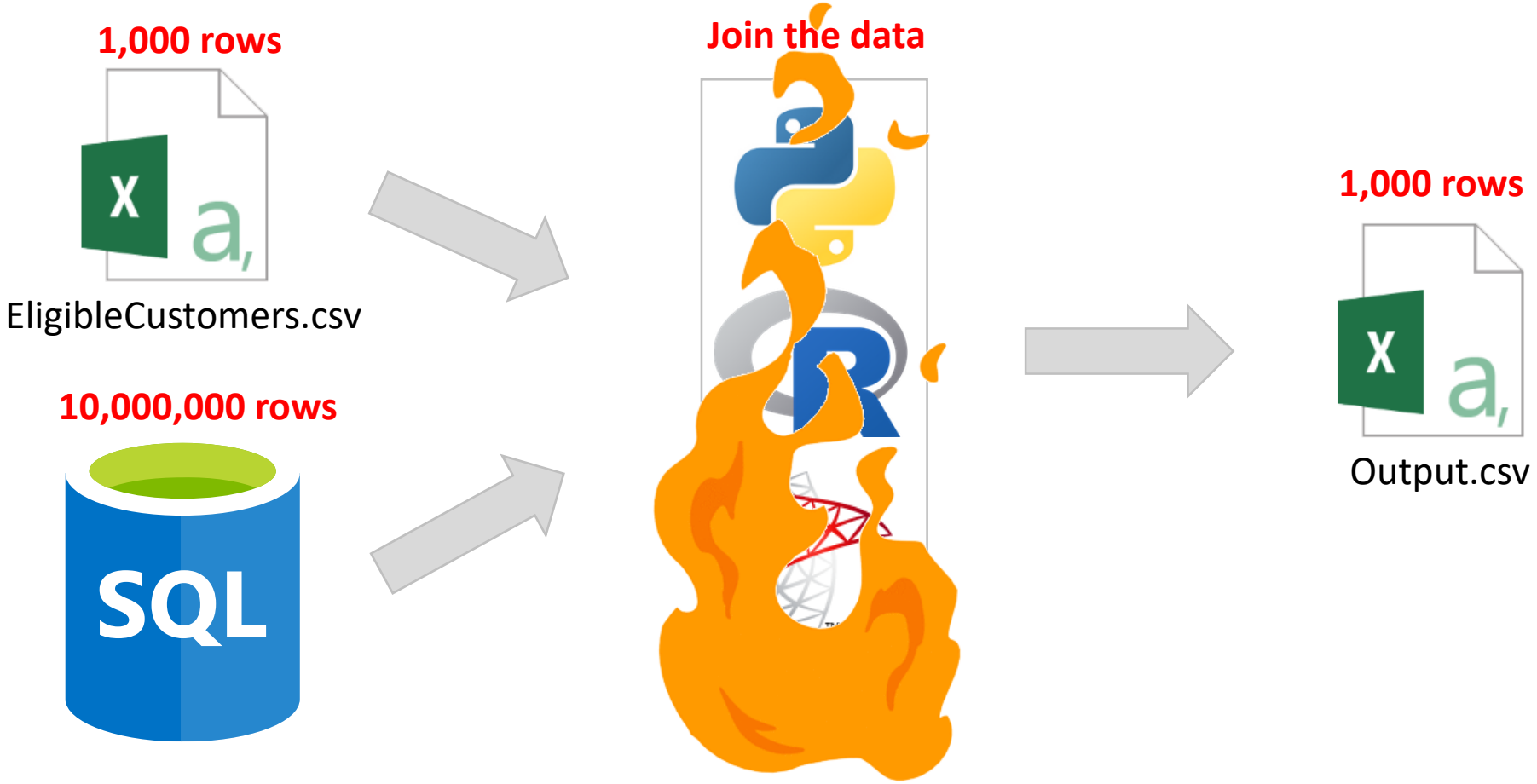
Anti-Pattern #1: Downloading Data

Move the smaller data

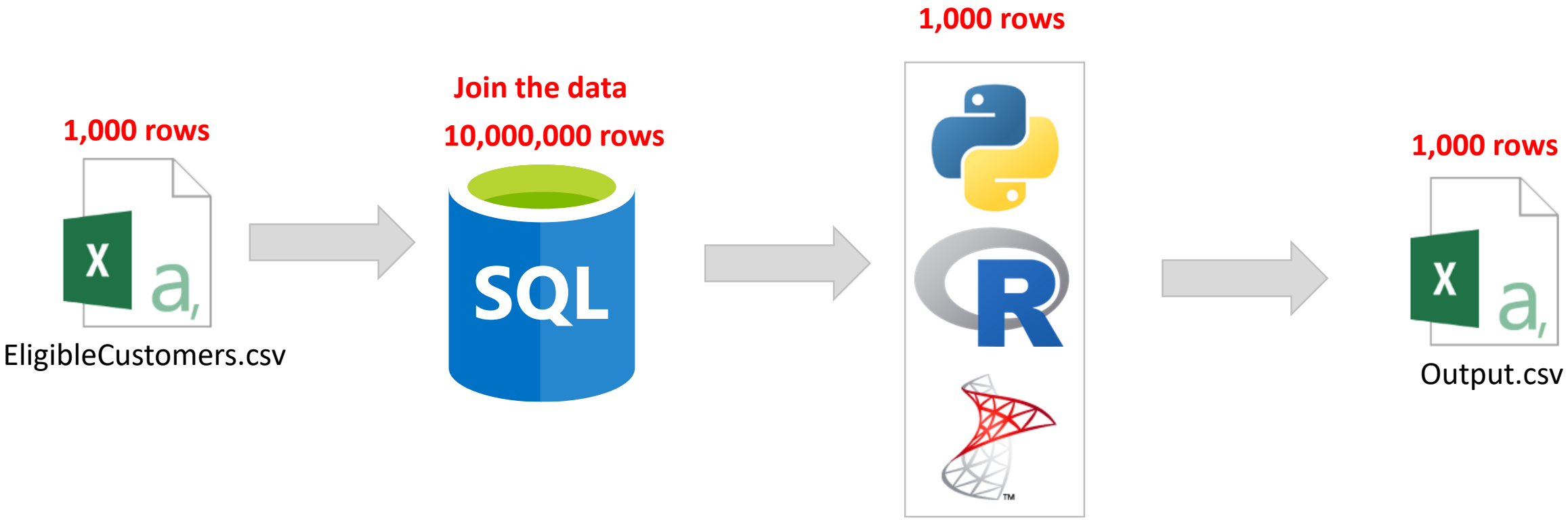
EligibleCustomers.csv


```
SELECT
    ...
FROM
    dbo.Customers
WHERE
    Id IN (1,2,3,...)
```

Move the smaller data



Move the smaller data



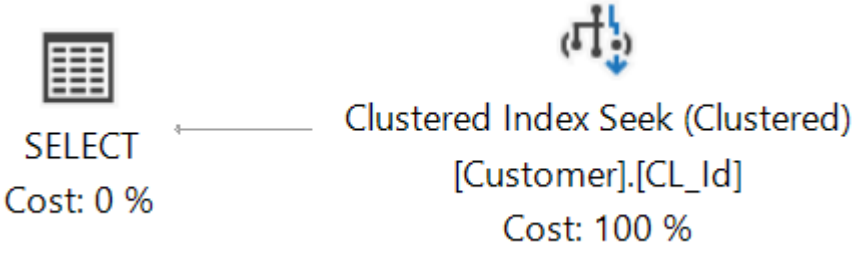
Move the smaller data

```
CREATE TABLE ##EligibleCustomers;
-- bulk insert OR use your tool of choice
BULK INSERT ##EligibleCustomers FROM 'C:\EligibleCustomers.csv'

CREATE CLUSTERED INDEX CL_Id
    ON ##EligibleCustomers (Id);
CREATE NONCLUSTERED INDEX IX_PurchaseDate
    ON ##EligibleCustomers(PurchaseDate) INCLUDE (FullName);

SELECT
    ...
FROM
    dbo.Customers c
    INNER JOIN ##EligibleCustomers ec
        ON c.Id = ec.Id
```

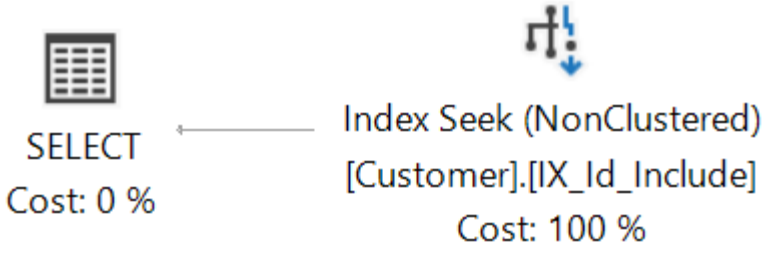
Anti-Pattern #2: Preventing Index Use

SELECT *

```sql
SELECT
    *
FROM
    dbo.Customer
WHERE
    Id = 123
```

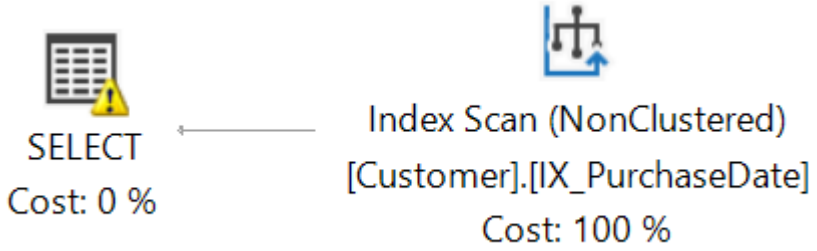



```sql
SELECT
    Id,
    PurchaseDate
FROM
    dbo.Customer
WHERE
    Id = 123
```

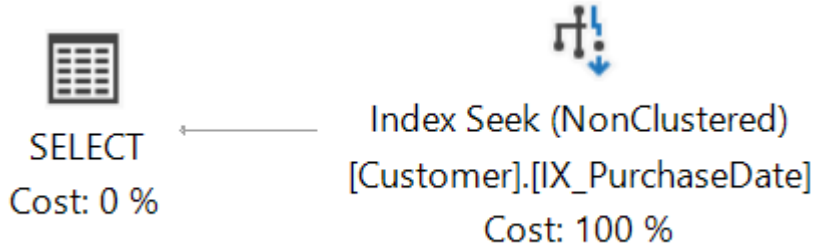


Converting Data on Read

```sql
SELECT
    ...
FROM
    dbo.Customer
WHERE
    CAST(PurchaseDate AS CHAR(10)) = '2019-01-01'
```

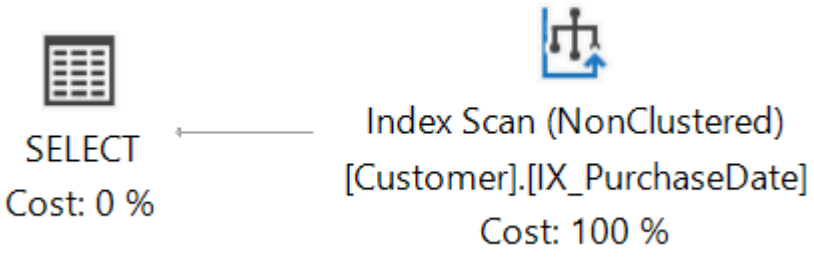



```sql
SELECT
    ...
FROM
    dbo.Customer
WHERE
    PurchaseDate = CAST('2019-01-01' AS DATETIME2)
```

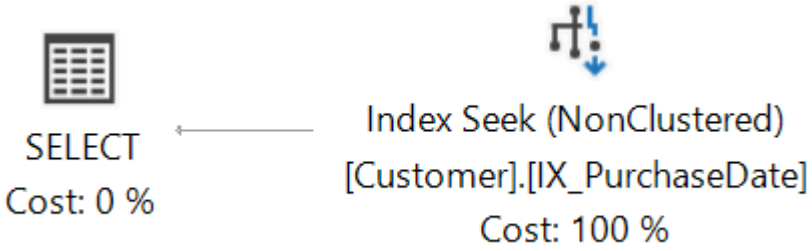


Scalar Functions

```sql
SELECT
    FullName,Id
FROM
    dbo.Customer
WHERE
    DATEADD(day,30,PurchaseDate) >= GETDATE()
```



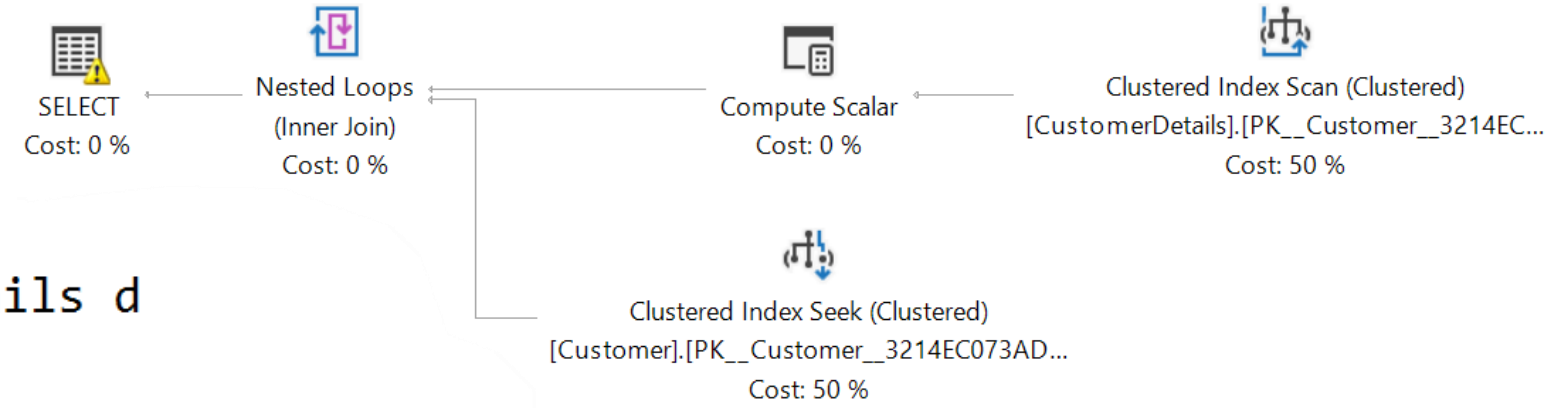

```sql
SELECT
    FullName,Id
FROM
    dbo.Customer
WHERE
    PurchaseDate >= DATEADD(day,-30,GETDATE())
```

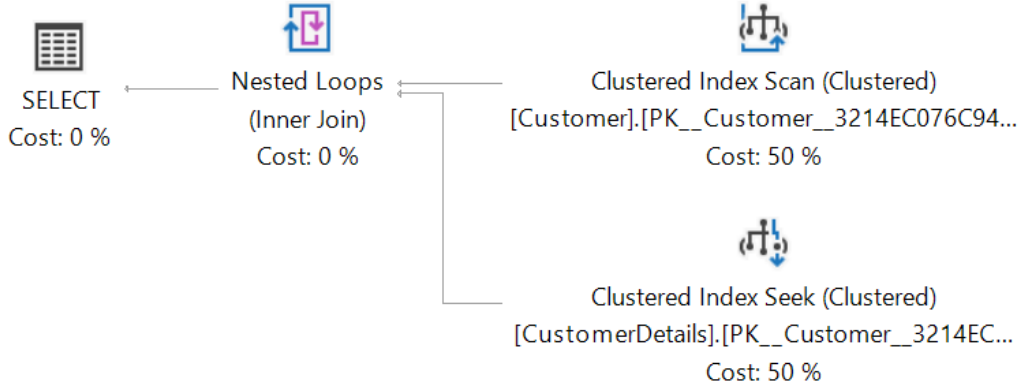


Implicit Conversions

```
CREATE TABLE dbo.Customer (Id int PRIMARY KEY...
CREATE TABLE dbo.CustomerDetails (Id int PRIMARY KEY... (...
```

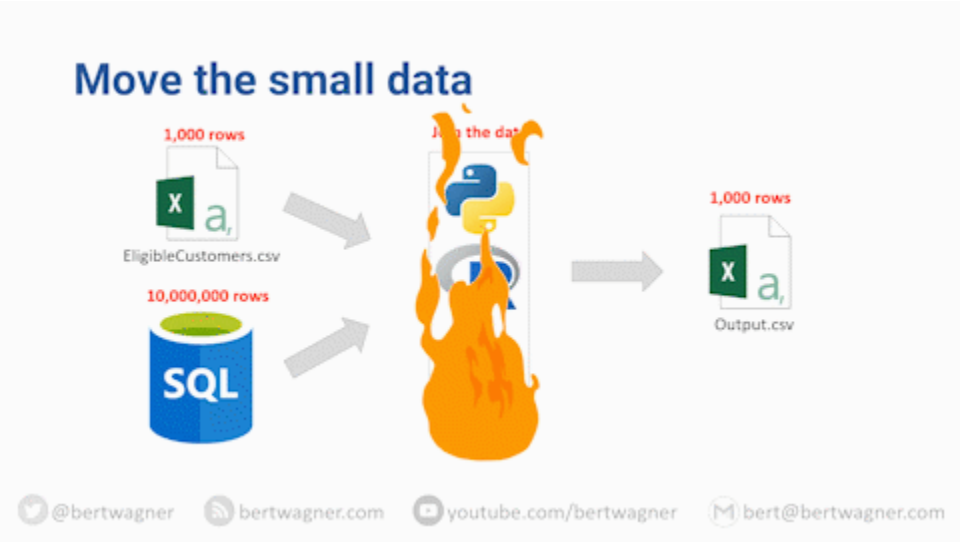
```
SELECT
    ...
FROM
    dbo.Customer c
    INNER JOIN dbo.CustomerDetails d
        ON c.Id = d.Id
```

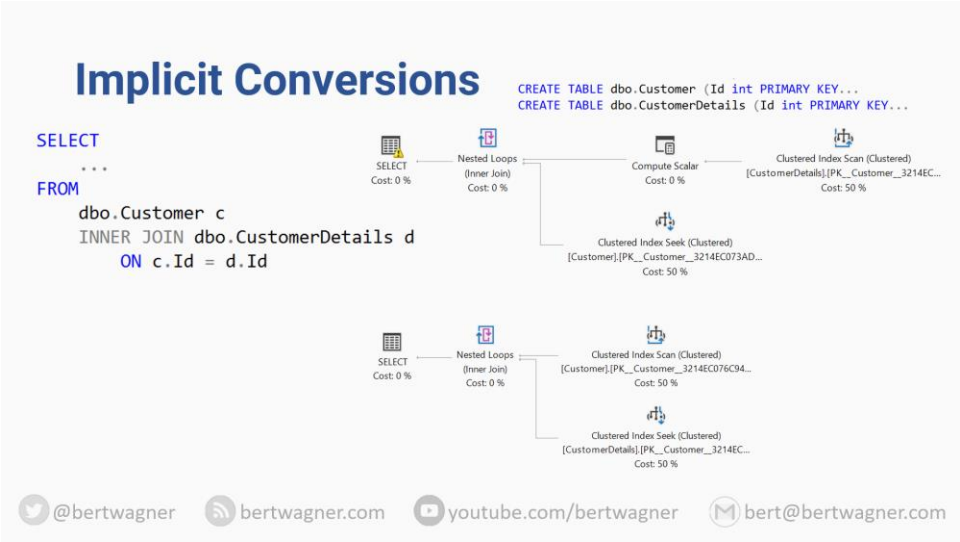




Anti-Pattern #3: Using The Wrong Tool

Joining





Join data where it makes sense to do so:

- Do you need to move a lot of data?
- Are indexes available?
- Do you need to convert datatypes?

Filtering

```sql
SELECT
    ...
FROM
    dbo.Orders
WHERE
    PurchaseDate = '2019-01-01'
```

Index Seek (NonClustered)
[Orders].[IX_PurchaseDate_Includes]

```
for (int i = 0; i < table.Rows.Count; i++)
{
    if (table.Rows[i]["PurchaseDate"].ToString() == "2019-01-01")
    {
        output.Rows.Add(table.Rows[i]);
    }
}
```

Rows returned: **5,000**
Rows read: **5,000**

Rows returned: **5,000**
Rows read: **10,000,000**

Aggregating

```
table = ReadInDataFromDatabase();

var total = table.AsEnumerable()
    .Sum(x => x.Field<int>("Total") );

var average = table.AsEnumerable()
    .Average(x => x.Field<int>("Total") );
```

```
SELECT
    SUM(Total) AS OrderTotal,
    AVG(Total) AS OrderAverage,
    ...
FROM
    dbo.Orders
```

Columnstore Index Scan (NonClustered)

[Orders].[NCC_Total]

Window and Analytical Functions

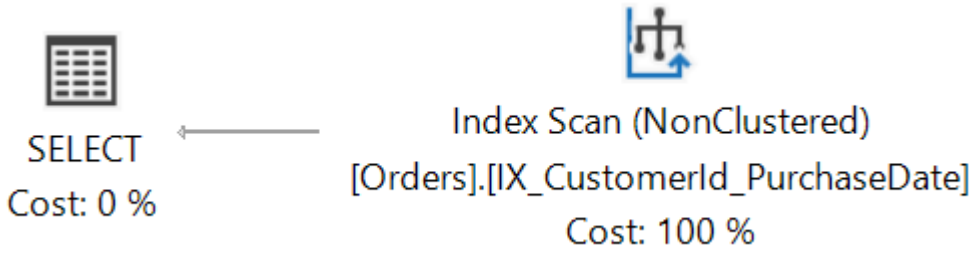
```sql
SELECT
  CustomerId,
  Total,
  SUM(Total) OVER (
    PARTITION BY CustomerId
    ORDER BY PurchaseDate
    ) AS RunningTotal,
  LEAD(Total) OVER (...) AS NextValue,
  LAST_VALUE(Total) OVER (
    ...
    ROWS BETWEEN UNBOUNDED PRECEDING
    AND UNBOUNDED FOLLOWING) AS LastValue
FROM
  dbo.Orders
```

	CustomerId	Total	RunningTotal	NextValue	LastValue
1	1	5	5	8	6
2	1	8	13	3	6
3	1	3	16	6	6
4	1	6	22	NULL	6
5	2	5	5	5	1
6	2	5	10	1	1
7	2	1	11	NULL	1
8	3	2	2	8	2
9	3	8	10	9	2
10	3	9	19	5	2
11	3	5	24	4	2
12	3	4	28	2	2
13	3	2	30	NULL	2

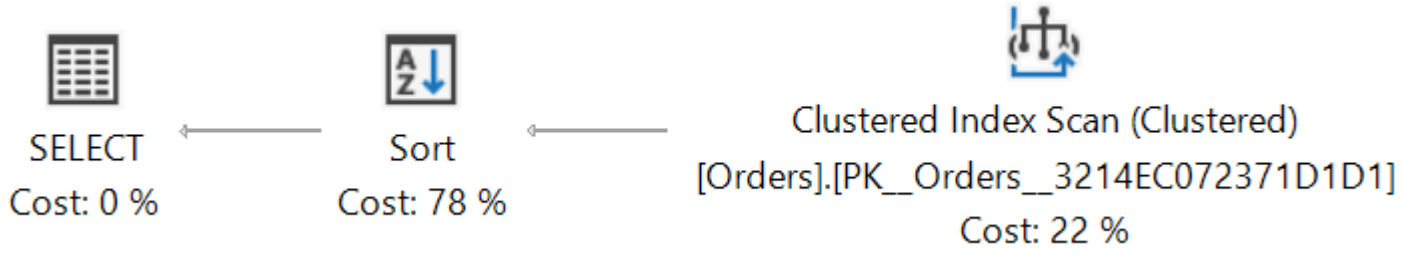
Sorting*

```sql
SELECT
  CustomerId,
  PurchaseDate,
  Total
FROM
  dbo.Orders
ORDER BY
  CustomerId,
  PurchaseDate
```

Might already be sorted if index exists:



Might have to sort if no index found:



Common Table Expressions (CTEs)

```sql
SELECT
    ...
FROM
    dbo.Customers c
    LEFT JOIN dbo.Orders o
        ON c.Id = o.CustomerId
    INNER JOIN  (
    SELECT ...
    FROM dbo.OrderDetails
    WHERE OrderType = 'Online') d
        ON o.Id = d.OrderId
WHERE
    o.PurchaseDate >= DATEADD(month,-1,GETDATE())
    AND c.JoinDate >= DATEADD(day,-365,GETDATE())
```

```sql
WITH NewCustomers AS (
    SELECT ...
    FROM dbo.Customers
    WHERE c.JoinDate >= DATEADD(day,-365,GETDATE())
), RecentPurchases AS (
    SELECT ...
    FROM dbo.Orders
    WHERE PurchaseDate >= DATEADD(month,-1,GETDATE())
), OnlineOrdersOnly AS (
    SELECT ...
    FROM RecentPurchases o
    INNER JOIN dbo.OrderDetails d
        ON o.Id = d.OrderId
    WHERE d.OrderType = 'Online'
)
SELECT ...
FROM NewCustomers c
INNER JOIN OnlineOrdersOnly o
    ON c.Id = o.CustomerId
```

Anti-Pattern #4: Looping

Cursors and WHILE

```
DECLARE @Id int

DECLARE OrderCursor CURSOR
    FOR SELECT Id FROM ##Orders
OPEN OrderCursor
WHILE @@FETCH_STATUS = 0
BEGIN
    FETCH NEXT FROM OrderCursor INTO @Id;
    SELECT * FROM OrderDetails WHERE OrderId = @Id
END
CLOSE OrderCursor;
DEALLOCATE OrderCursor;
```

```
SELECT
    ...
FROM
    dbo.Orders o
    INNER JOIN dbo.OrderDetails d
        ON o.Id = d.OrderId
```

Eager Lazy Loading

```
DataTable table = GetOrders();
for (int i = 0; i < table.Rows.Count; i++)
{
    var orderId = Convert.ToInt32(table.Rows[i]["Id"]);
    DataTable dt = GetOrderDetails(orderId);
}
```

```
SELECT
    ...
FROM
    dbo.Orders o
    INNER JOIN dbo.OrderDetails d
        ON o.Id = d.OrderId
```

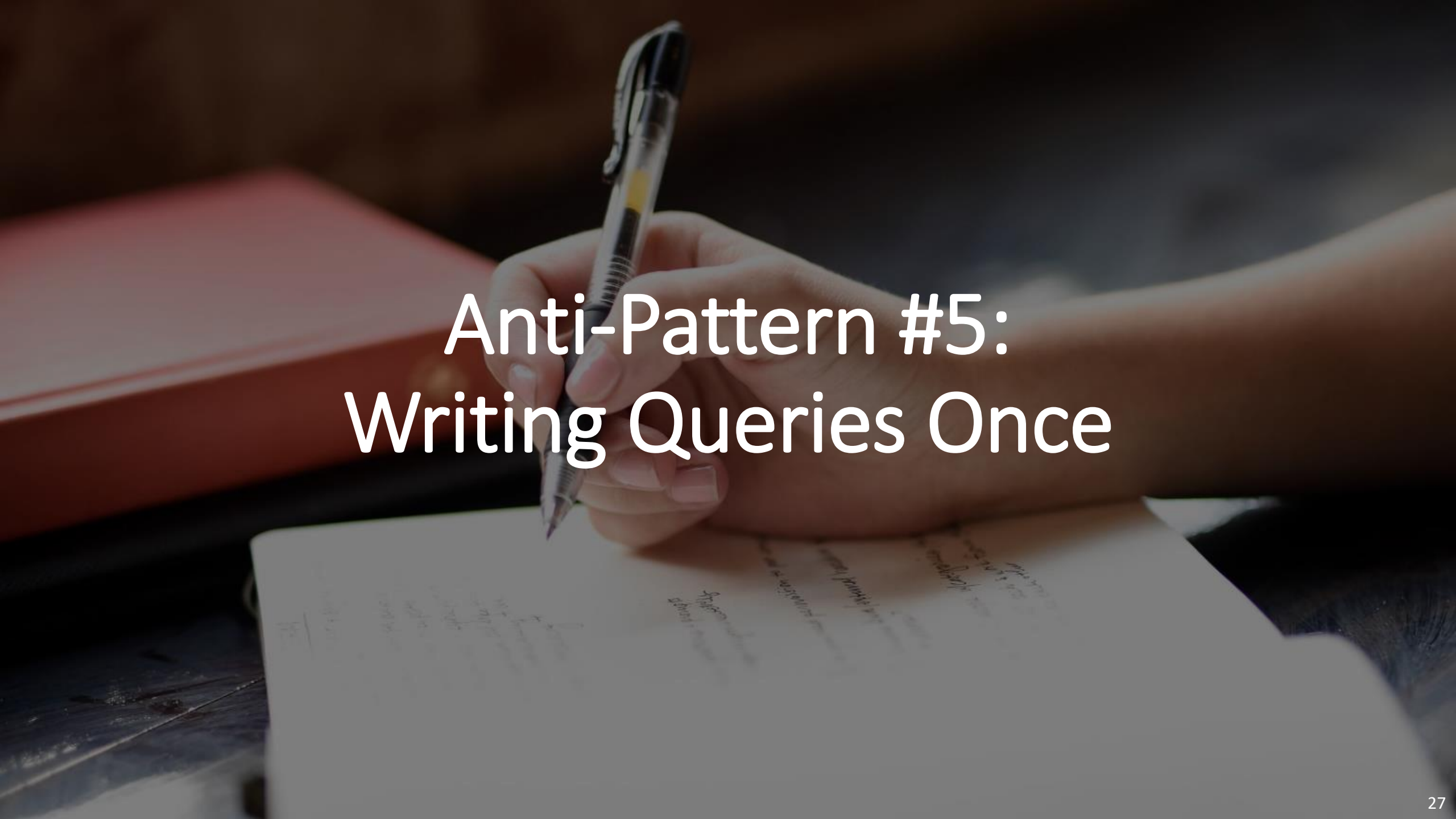
Correlated Subqueries

```sql
SELECT
    o.Id,
    (SELECT AVG(Total)
        FROM ##OrderDetails
        WHERE OrderId = o.Id
        ) AS CombinedTotal
FROM
    ##Orders o
```

```
Table '##OrderDetails'. Scan count 6, logical reads 12...
Table '##Orders'. Scan count 1, logical reads 1...
```

```sql
SELECT
    o.Id,
    a.AverageTotal
FROM
    ##Orders o
    INNER JOIN (
        SELECT AVG(Total) AS AverageTotal,
        OrderId
        FROM ##OrderDetails
        GROUP BY OrderId) a
            ON o.Id = a.OrderId
```

```
Table '##OrderDetails'. Scan count 1, logical reads 2...
Table '##Orders'. Scan count 1, logical reads 1...
```



Anti-Pattern #5: Writing Queries Once

DISTINCT vs GROUP BY

```sql
SELECT DISTINCT
    Col1,
    Col2
FROM
    dbo.Table1
```

```sql
SELECT
    Col1,
    Col2
FROM
    dbo.Table1
GROUP BY
    Col1,
    Col2
```

OR vs UNION ALL

```sql
SELECT
    ...
FROM
    dbo.Table1
WHERE
    Col1 = 'A'
    OR Col2 = 'A'
```

```sql
SELECT
    ...
FROM
    dbo.Table1
WHERE
    Col1 = 'A'
UNION ALL
SELECT
    ...
FROM
    dbo.Table1
WHERE
    Col2 = 'A'
```

NOT IN vs NOT EXISTS

```sql
SELECT
    Col1,
    Col2
FROM
    dbo.Table1 t1
WHERE
    Col1 NOT IN (
        SELECT Col1
        FROM dbo.Table2 t2
    )
```

```sql
SELECT
    Col1,
    Col2
FROM
    dbo.Table1 t1
WHERE
    NOT EXISTS (
        SELECT 1/0
        FROM dbo.Table2 t2
        WHERE t1.Col1 = t2.Col1
    )
```

JOINS vs JOINS

```sql
SELECT
    ...
FROM
    dbo.Table1 t1
    INNER JOIN dbo.Table2 t2
        ON t1.Col1 = t2.Col1
```

```sql
SELECT
    ...
FROM
    dbo.Table1 t1
    LEFT JOIN dbo.Table2 t2
        ON t1.Col1 = t2.Col1
WHERE
    t2.Col1 IS NOT NULL
```

Correlated Subqueries vs JOINS

```sql
SELECT
    Col1,
    (SELECT
        Col2
    FROM
        dbo.Table2 t2
    WHERE
        t1.Col1 = t2.Col1
    ) AS Col2
FROM
    dbo.Table1 t1
```

```sql
SELECT
    t1.Col1,
    t2.Col2
FROM
    dbo.Table1 t1
    LEFT JOIN dbo.Table2 t2
        ON t1.Col1 = t2.Col1
```

Forcing Join Order

```sql
SELECT
    ...
FROM
    dbo.Table1 t1
    INNER JOIN dbo.Table2 t2
        ON t1.Col1 = t2.Col1
    INNER JOIN dbo. Table3 t3
        ON t2.Col2 = t3.Col2
```

```sql
SELECT
    ...
FROM
    dbo.Table1 t1
    INNER JOIN dbo.Table2 t2
        ON t1.Col1 = t2.Col1
    INNER JOIN (
    -- More rows than your query
    -- will ever return
        SELECT TOP 2147483647
            ...
        FROM dbo. Table3
        ) t3
        ON t2.Col2 = t3.Col2
```

Break up giant queries

```sql
WITH InitialData AS (
    ...
), FilteredData AS (
    ...
), JoinedData AS (
    ...
)
SELECT ...
FROM JoinedData
```

```sql
WITH InitialData AS (
    ...
), FilteredData AS (
    ...
)
SELECT * INTO #FilteredData FROM FilteredData;
CREATE CLUSTERED INDEX ON #FilteredData (Col1, Col2);

WITH JoinedData AS (
    SELECT ... FROM #FilteredData
    ...
)
SELECT ...
FROM JoinedData
```

Review

1. Move smaller data to where the larger data exists
2. Allow index use
3. Use the right tools for the job
4. Think in sets instead of looping
5. Rewrite your queries

Thank you!

SQL WITH BERT

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Appendix

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  - https://docs.microsoft.com/en-us/sql/relational-databases/indexes/columnstore-indexes-query-performance?view=sql-server-2017
  - http://www.nikoport.com/columnstore/
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  - https://docs.microsoft.com/en-us/sql/t-sql/queries/select-over-clause-transact-sql?view=sql-server-2017
  - https://docs.microsoft.com/en-us/sql/t-sql/functions/analytic-functions-transact-sql?view=sql-server-2017
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  - https://dba.stackexchange.com/a/158429/168918
- 28
  - https://sqlperformance.com/2017/01/t-sql-queries/surprises-assumptions-group-by-distinct
- 29
  - https://bertwagner.com/2018/02/20/or-vs-union-all-is-one-better-for-performance/
- 30
  - https://sqlperformance.com/2012/12/t-sql-queries/left-anti-semi-join
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  - https://bertwagner.com/2017/11/21/does-the-join-order-of-my-tables-matter/
  - https://sqlbits.com/Sessions/Event14/Query_Tuning_Mastery_Clash_of_the_Row_Goals