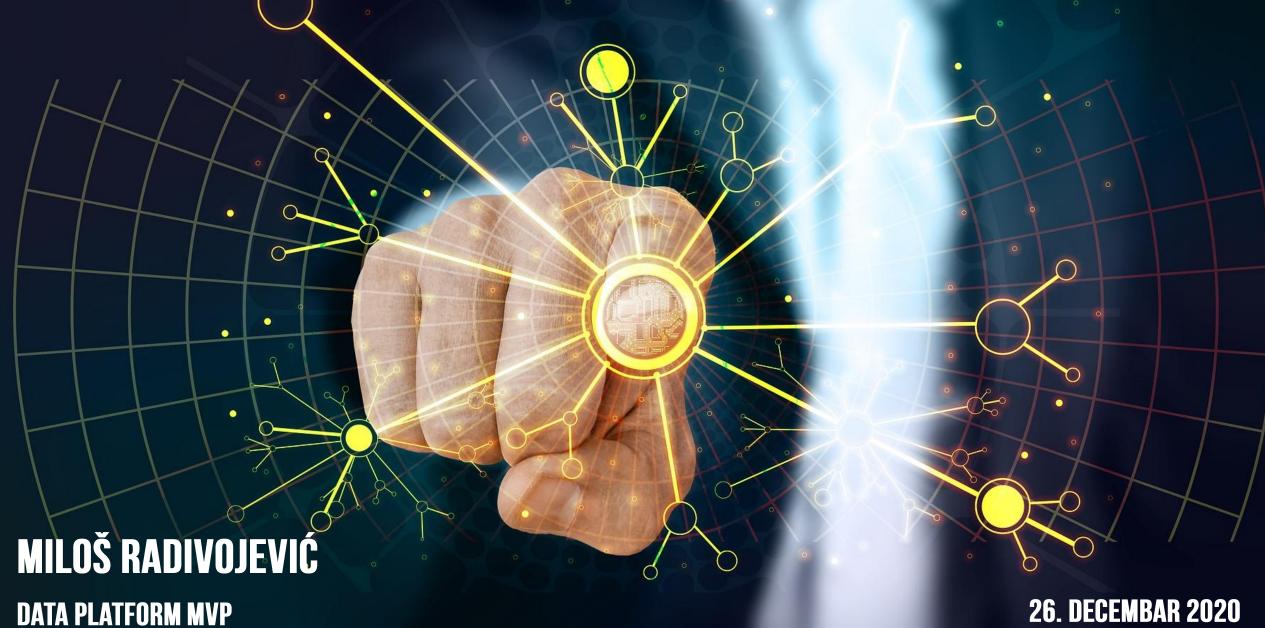
## INTELIGENTNO PROCESIRANJE U SQL SERVERU 2019



#### PROBLEMS WITH TABLE VARIABLES

```
DECLARE @t TABLE(id INT)
INSERT INTO @t SELECT message id FROM sys.messages;
SELECT * FROM @t;
 Query 2: Query cost (relative to the batch): 2%
 SELECT * FROM @t
                        1
                     Table Scan
                        [@t]
                    Cost: 100 %
 Cost: 0
                      1 (30940800%)
Actual Number of Rows
                      309408
```

309408

11 B

11 B

Number of Rows Read

Estimated Row Size

**Estimated Data Size** 

Estimated Number of Rows

- Unangemessene Operatoren im Ausführungsplan
- Unzureichende Speicherzuweisungen

#### PROBLEMS WITH TABLE VARIABLES

- Queries with table variables with many rows (> 10 KB) can have an inefficient plan
  - Inappropriate operators in the execution plan
  - Mostly nested loops join instead of hash join
- Insufficient memory allocations
- The number of rows is usually underestimated => less memory reserved for the query => tempdb spills

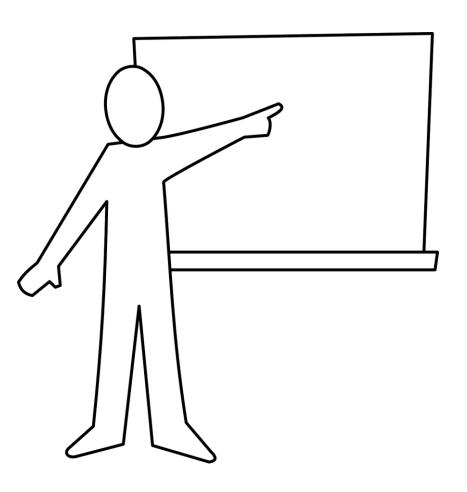
```
DECLARE @T AS TABLE (ProductID INT);
                                            to
INSERT INTO @T SELECT ProductID
                                             t<sub>1</sub>
FROM Production Product
                                                       SQL Server <=2017
WHERE ProductLine IS NOT NULL;

    Content of the table variable unknown at the compile time =>

                                                             cardinality 1
SELECT * FROM @T t
                                            t<sub>2</sub>
INNER JOIN Sales. Sales Order Detail od
ON t.ProductID = od.ProductID
                                                       SQL Server 2019
INNER JOIN Sales.SalesOrderHeader h
ON h.SalesOrderID = od.SalesOrderID

    Content of the table variable known at the compile time =>

ORDER BY od.UnitPrice DESC;
                                                             cardinality = actual number of rows
```



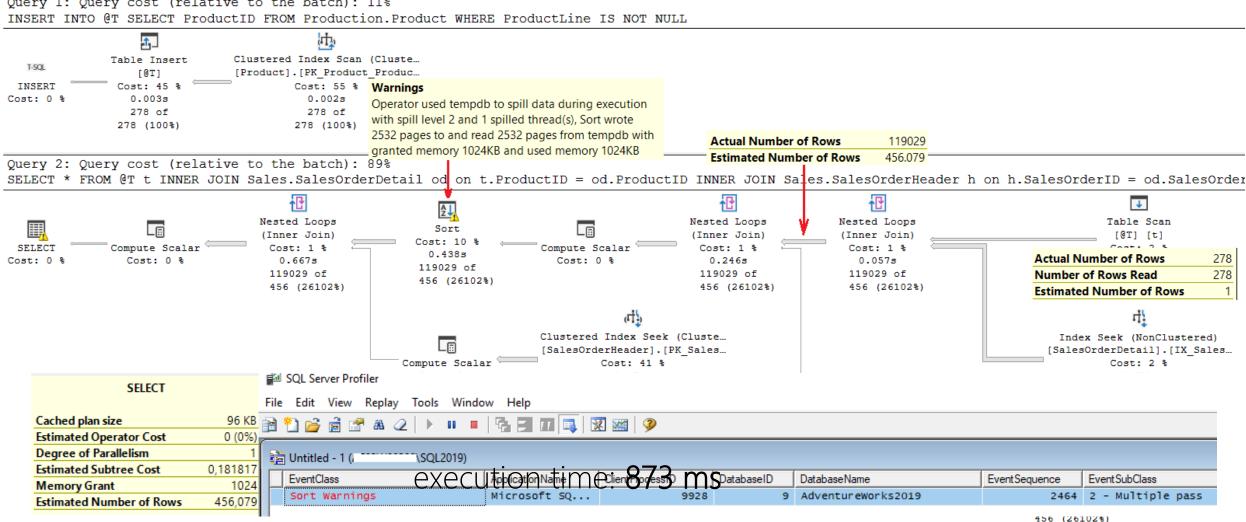
DEMO

DECLARE @T AS TABLE (ProductID INT);
INSERT INTO @T SELECT ProductID FROM Production.Product WHERE ProductLine IS NOT NULL;

SELECT \* FROM @T t
INNER JOIN Sales.SalesOrderDetail od on t.ProductID = od.ProductID
INNER JOIN Sales.SalesOrderHeader h on h.SalesOrderID = od.SalesOrderID
ORDER BY od.UnitPrice DESC;

Query 1: Query cost (relative to the batch): 11%

SQL Server 2017



```
DECLARE @T AS TABLE (ProductID INT);
                          INSERT INTO @T SELECT ProductID FROM Production. Product WHERE ProductLine IS NOT NULL;
                          SELECT * FROM @T t
                                                                                                                                                                                                                                                                                                                                              SOL Server 2019
                          INNER JOIN Sales.SalesOrderDetail od on t.ProductID = od.ProductID
                          INNER JOIN Sales.SalesOrderHeader h on h.SalesOrderID = od.SalesOrderID
                          ORDER BY od. UnitPrice DESC;
Query 2: Query cost (relative to the batch): 100%
SELECT * FROM @T t INNER JOIN Sales.SalesOrderDetail od on t.ProductID = od.ProductID INNER JOIN Sales.SalesOrderHeader h on h.SalesOrderID = od.SalesOrderDetail od on t.ProductID = od.ProductID = od.P
Missing Index (Impact 18.7112): CREATE NONCLUSTERED INDEX [<Name of Missing Index, sysname,>] ON [Sales].[SalesOrderDetail] ([ProductID]) INCLUDE ([CarrierTrackingNumber],[Orde...
                                    Parallelism
                                                                                                                 Hash Match
                                                                                                                                                                                                                                                     Parallelism
                                                                                                                                                                                                                                                                                                   Clustered Index Scan (Clustered)
                                                                                 Sort
                                                                                                                                                                                                                                                                                                 [SalesOrderHeader].[PK_SalesOrderHe...
                                (Gather Streams)
                                                                                                                (Inner Join)
                                                                                                                                                                                                                                             (Repartition Streams)
                                                                             Cost: 26 %
                                    Cost: 24 %
                                                                                                                 Cost: 16 %
                                                                                                                                                            Compute Scalar
                                                                                                                                                                                                     Compute Scalar
                                                                                                                                                                                                                                                      Cost: 3 %
                                                                                                                                                                                                                                                                                                                       Cost: 6 %
                                                                               0.1725
                                                                                                                                                                 Cost: 0 %
                                       0.2635
                                                                                                                    0.1085
                                                                                                                                                                                                        Cost: 0 %
                                                                                                                                                                                                                                                         0.016s
                                                                                                                                                                                                                                                                                                                         0.0125
                                                                             119029 of
                                     119029 of
                                                                                                                                                                                                                                                       31465 of
                                                                                                                                                                                                                                                                                                                       31465 of
                                                                                                                  119029 of
                                                                           126790 (93%)
                                                                                                                                                                                                                                                    31465 (100%)
                                                                                                                                                                                                                                                                                                                    31465 (100%)
                                  126790 (93%)
                                                                                                                126790 (93%)
                                                                                                                                                                                                                                                                                                                                  Actual Number of Rows
                                                                                                                                                                                                                                                                                                                                                                                            278
                                                                 Actual Number of Rows
                                                                                                                       119029
                                                                                                                                                                                                                                                                                                                                                                                            278
                                                                                                                                                                                                                                                                                                                                  Number of Rows Read
                                                                 Estimated Number of Rows
                                                                                                                       126790
                                                                                                                                                               Parallelism
                                                                                                                                                                                                            Hash Match
                                                                                                                                                                                                                                                         Parallelism
                                                                                                                                                                                                                                                                                                    Table Scan
                                                                                                                                                                                                                                                                                                                                                                                            278
                                                                                                                                                                                                                                                                                                                                  Estimated Number of Rows
                                                                                                                                                        (Repartition Streams)
                                                                                                                                                                                                           (Inner Join)
                                                                                                                                                                                                                                                  (Repartition Streams)
                                                                                                                                                                                                                                                                                                      [@T] [t]
                                                                                                                                                                                                                                                                                                                                                                                           11 B
                                                                                                                                                                                                                                                                                                                                  Estimated Row Size
                                                                                                                                                                 Cost: 5 %
                                                                                                                                                                                                             Cost: 4 %
                                                                                                                                                                                                                                                           Cost: 0 %
                                                                                                                                                                                                                                                                                                     Cost: 0 %
                                                                                                                                                                  0.0735
                                                                                                                                                                                                               0.0885
                                                                                                                                                                                                                                                              0.0015
                                                                                                                                                                                                                                                                                                       0.0005
                            SELECT
                                                                                                                                                                                                                                                                                                                                  Estimated Data Size
                                                                                                                                                                                                                                                                                                                                                                                        3058 B
                                                                                                                                                                119029 of
                                                                                                                                                                                                             119029 of
                                                                                                                                                                                                                                                              278 of
                                                                                                                                                                                                                                                                                                       278 of
                                                                                                                                                              126790 (93%)
                                                                                                                                                                                                           126790 (93%)
                                                                                                                                                                                                                                                           278 (100%)
                                                                                                                                                                                                                                                                                                    278 (100%)
```

Compute Scalar

Cost: 0 %

Compute Scalar

Cost: 0 %

execution time: 484 ms

SELECT

Cached plan size

Memory Grant

**Estimated Operator Cost** 

Estimated Subtree Cost

Estimated Number of Rows

Degree of Parallelism

208 KB

0 (0%)

9,32107

140864

126790

Cost: 0 %



Clustered Index Scan (Clustered)

[SalesOrderDetail].[PK\_SalesOrderDe

Cost: 10 %

0.0175

121317 of

121317 (100%)

Parallelism

(Repartition Streams)

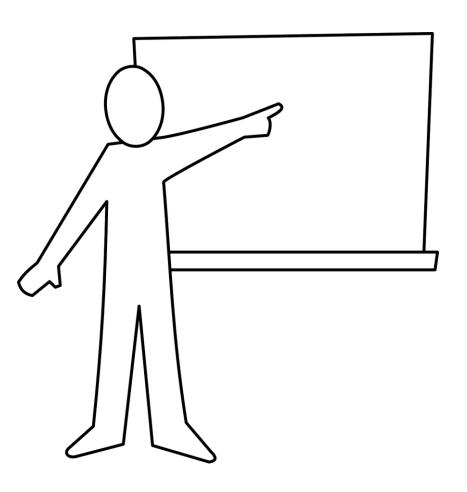
Cost: 4 %

0.0825

121317 of

121317 (100%)

- Improves plan quality and overall performance for queries referencing table variables
- Cardinality estimates are based on actual table variable row counts
- This accurate row count information will be used for optimizing downstream plan operations



DEMO

## CONCLUSION

- Designed to address cardinality issues caused by fixed estimation:
  - Nested Loop Joins where Hash Joins are more appropriate
  - Memory grant underestimation issues
- Better estimate for new queries, one can choose the behavior of table
- variables
  - Prone to Parameter Sniffing
  - •••

• •

Can break existing workarounds