PASS

SQL Server Execution Plans: From Zero to Hero!

Sergio Govoni

Goals

- This session is just a guideposts on mechanisms to try to move you in the right direction
- Good starting point to
  - Capture query execution plans
  - Understand which are the most important pieces of an execution plan
  - Learn where to go to see first!

Speaker Bio

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Agenda

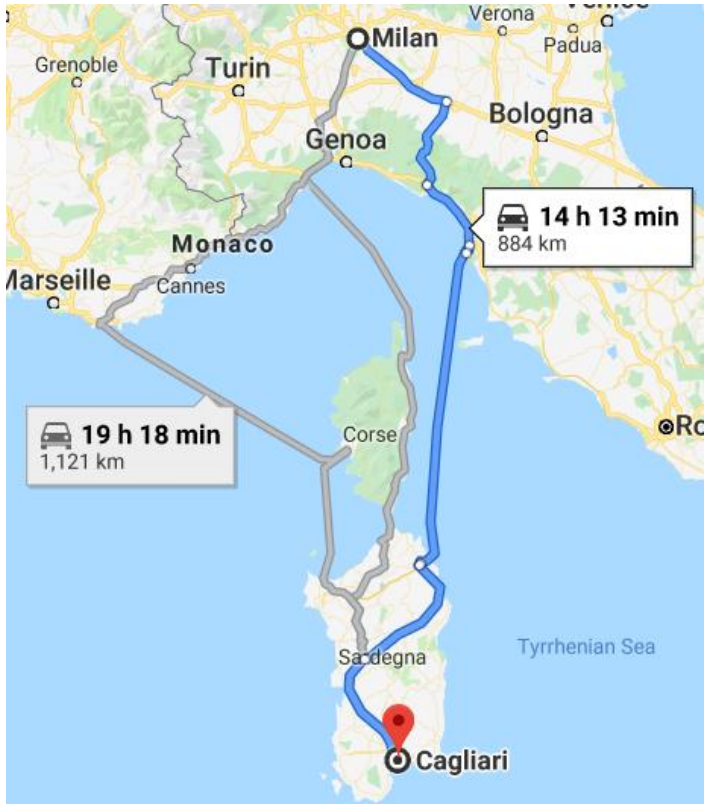
- Execution Plan
  - Fundamentals
  - Behind the scenes of a query
  - How to capture an execution plan
  - Logical and physical operators
  - The Execution Plan of an “Update” statement (I/U/D)
  - Warnings
  - “SARGable” Predicates
  - Index Scan VS Index Seek

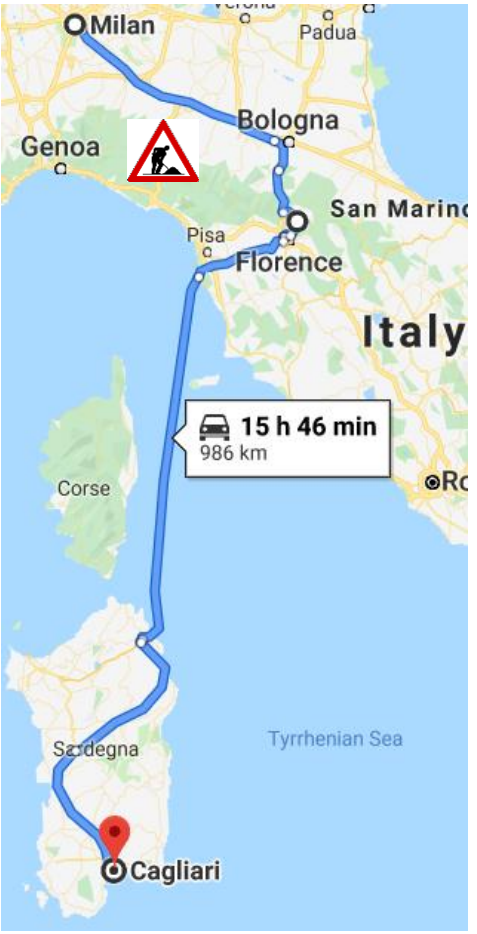
Execution Plans: Fundamentals

- Execution plan is generated by Query Optimizer
  - It helps us to answer the question: Why this query is so slow?
- It contains the instructions to execute a query
  - Table access order
  - Join operator
  - Indexes
- It defines the most efficient way to access data
- SQL Server stores the execution plans for reuse

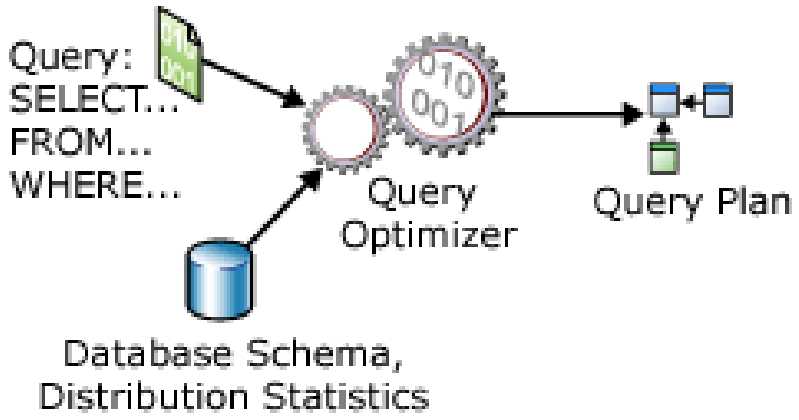
Execution Plans: Fundamentals

- Two types
  - Estimated Execution Plan
  - Actual Execution Plan
- Three formats
  - Graphical Plans
  - Text Plans (deprecated)
  - XML Plans
- Where you can find them?
  - SSMS, SQL Profiler, DMV
  - Extended Events, Query Store





Behind the scenes of a query

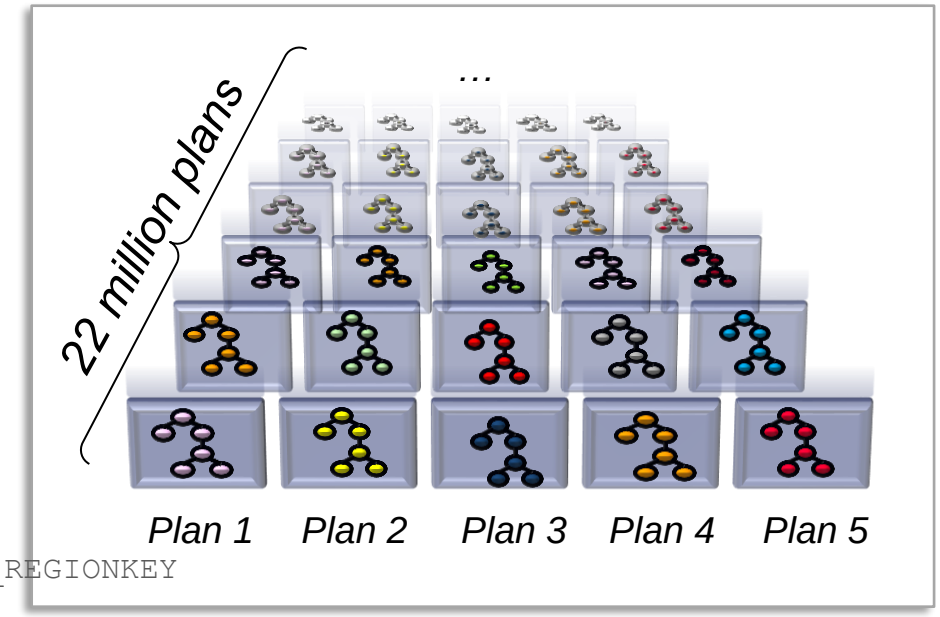


- Query Parsing
  - Logical operator tree
- Query Optimizer
  - It turns a query into an execution plan. T-SQL is a declarative language, developers are used to declare **what they want**, the Query Optimizer finds **how to implement** the request, physically
- Query Execution

Cost-based Plan

From David DeWitt keynote at PASS Summit - http://bit.ly/1emLOuj

```
Select o_year,
sum(case
 when nation = 'BRAZIL' then volume
 else 0
end) / sum(volume)
from
(
 select YEAR(O_ORDERDATE) as o_year,
  L_EXTENDEDPRICE * (1 - L_DISCOUNT) as volume,
  n2.N_NAME as nation
 from PART, SUPPLIER, LINEITEM, ORDERS, CUSTOMER, NATION n1,
 NATION n2, REGION
 where
    P_PARTKEY = L_PARTKEY and S_SUPPKEY = L_SUPPKEY
    and L_ORDERKEY = O_ORDERKEY and O_CUSTKEY = C_CUSTKEY
    and C_NATIONKEY = n1.N_NATIONKEY and n1.N_REGIONKEY = R_REGIONKEY
    and R_NAME = 'AMERICA' and S_NATIONKEY = n2.N_NATIONKEY
    and O_ORDERDATE between '1995-01-01' and '1996-12-31'
    and P_TYPE = 'ECONOMY ANODIZED STEEL'
    and S_ACCTBAL <= constant-1
    and L_EXTENDEDPRICE <= constant-2
) as all_nations
group by o_year  order by o_year
```



How to capture an Execution Plan

- Estimated plan
  - SET SHOWPLAN_TEXT (deprecated)
  - SET SHOWPLAN_ALL (deprecated)
  - SET SHOWPLAN XML
  - Display Estimated Execution Plan in SSMS
  - DMVs
    - sys.dm_exec_query_plan
    - sys.dm_exec_text_query_plan
  - SQL Server Query Store

How to capture an Execution Plan

- Actual plan
  - SET STATISTICS PROFILE (deprecated)
  - SET STATISTICS XML
  - Include Actual Execution Plan in SSMS

Demo

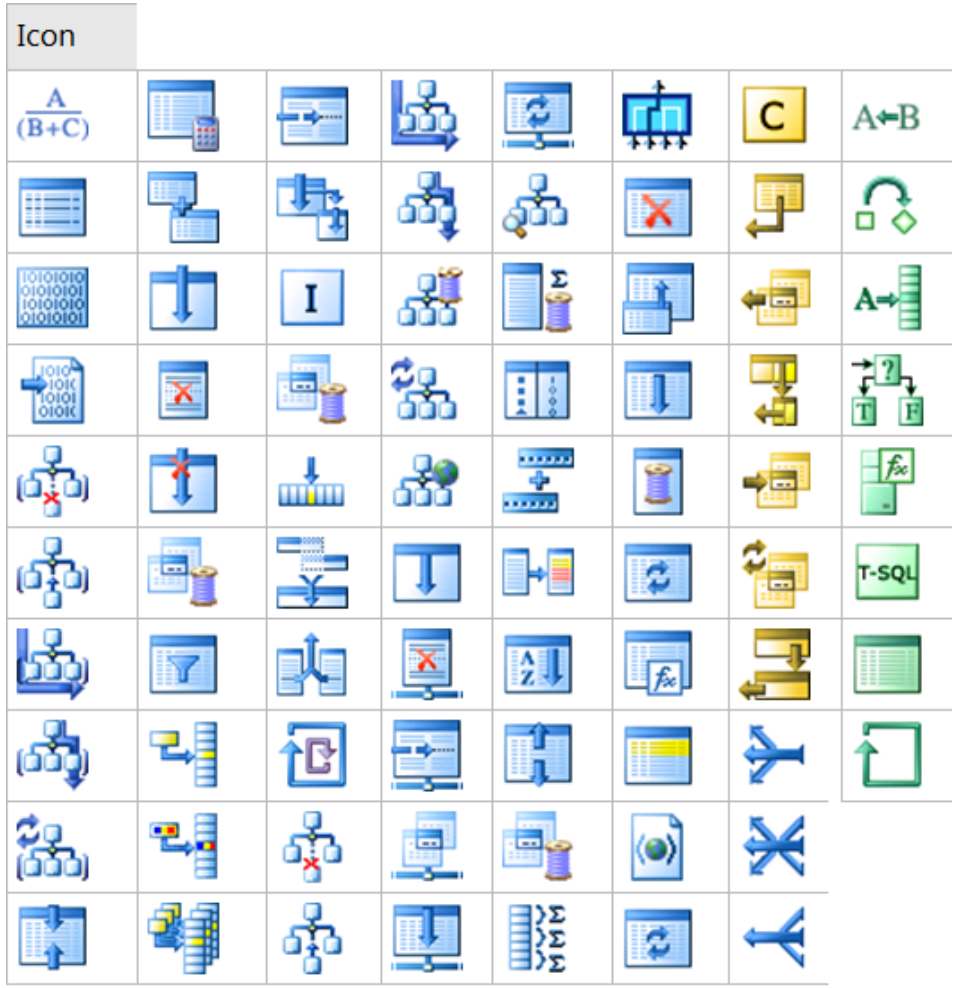
How to capture an execution plan

Logical and physical operators

The icon-based language

- Learning how to read execution plans is like learning a new icon-based language ☺
- More than 120 operators in SQL Server 2019
  - We will learn the most common/used ones
  - The complete list is available on Microsoft docs https://bit.ly/2Jrndei

The icon-based language



Icon-overlay when an operator is executed in parallel mode

Demo

Logical and physical operators

The Execution Plan of an “Update”

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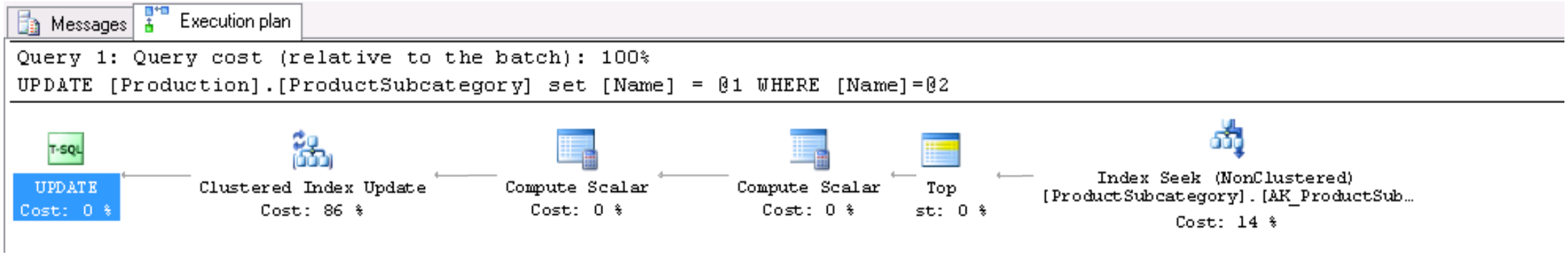

- Update (I/U/D/M) execution plan
  - Find rows to be update, check all constraints
- Some calculations
- Perform the update

Demo

The Execution Plan of an “Update”

Warnings

Warnings

- No statistics (ColumnsWithNoStatistics)
- No join predicate (NoJoinPredicate)
- Implicit conversions (PlanAffectingConvert)
- Sort on tempdb (SpillToTempDb)
- No matched indexes (UnmatchedIndexes)
- Wait (WaitWarningType)

- Check the showplanxml.xsd

Demo

Warnings

SARGable Predicates

SARGable Predicates

- Sargable is a strange term, it is an abbreviation of SARG which stands for **S**earch **ARG**ument
- Sargable means that the predicate can be evaluated/executed using an Index Seek
- Predicates

<expression><operator><expression>

<column><operator><expression>

SARGable Predicates

```
-- SARGable
WHERE StockItemID = 104
-- NON SARGable
WHERE StockItemID + 1 = 104

-- SARGable
WHERE StockItemName = 'DBA joke mug – it'
-- NON SARGable
WHERE UPPER(StockItemName) = UPPER('DBA joke mug - it')

-- ???
WHERE StockItemName LIKE 'DBA%'
```

Demo

SARGable Predicate

Index Scan vs Index Seek

Index Scan vs Index Seek

- Index scans are not necessarily bad
- Index seeks are not necessarily good
- It depends!!
- Pay attention to
  - Scans
  - Estimated number of executions
  - Number of executions

Demo

Index Scan vs Index Seek

Tools

- SentryOne Plan Explorer
  - Download: https://bit.ly/2oBSbVY
  - Post on UGISS: https://bit.ly/2UcYq27
  - Add-in available for SQL Server Management Studio and Azure Data Studio

Topics not covered in this session

- Optimization process
  - Search 0, Search 1, Search 2
  - Transformation rules
  - Trace Flags
- Intelligent Query Processing
- Parallelism
- How to force Query Optimizer
- Plan cache
- New Cardinality Estimator in SQL 2014+

Resources

- Books from Itzik Ben-Gan
  - https://bit.ly/2a0wIPv
  - https://bit.ly/2Jla3hN
  - https://bit.ly/29phxf8
- UGISS – User Group Italiano SQL Server
  - https://www.ugiss.org/
- UGISS channel on Vimeo
  - https://vimeo.com/ugiss
- SQL Saturday
  - http://sqlsaturday.com/

Resources

- eBook
  - SQL Server Execution Plans – by Grant Fritchey https://bit.ly/2OCMWPZ
- Videos
  - SQL Server Query Optimizer end-to-end

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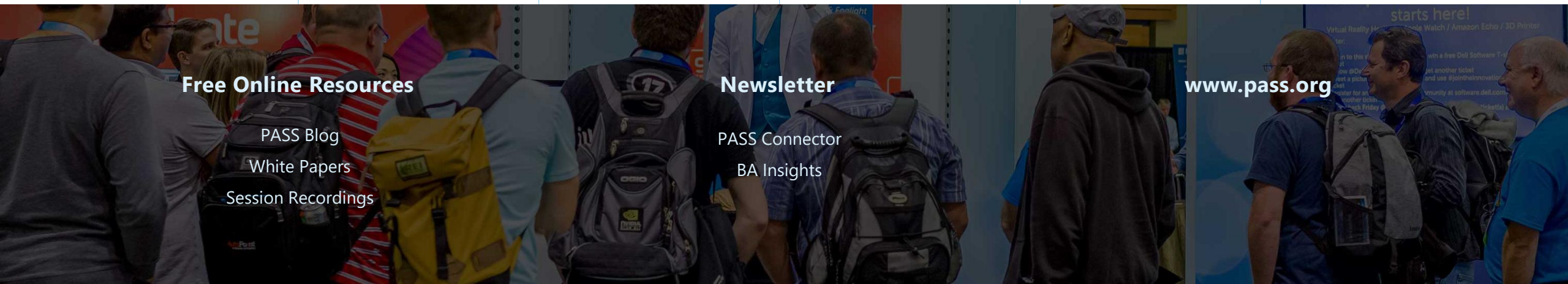

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