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Back to Indexes, the original culprit !

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Takeaways…

- How does the optimizer decide which index to use?
- Optimizer's choice of the physical join operator
- Database Tuning Advisor. When? Why? How?
- Getting rid of redundant indexes !

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Image Source: http://www.jeffcubos.com/2011/10/18/load-em-up/

Agenda

- Demo: Indexing Scenario 1
- Optimizer’s choice of Physical Join Operator
- Indexing Scenario 2
- Demo: Good Design vs Better Design
- The Optimizer’s choice of Indexes
- Demo: Indexing Scenario 3
- How, When & Why did the Indexes become culprits?
- Demo: Clean up act !
- Summary / Call to Action

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Indexing Scenario 1

Optimizer's choice of Physical Join Operator

- NESTED LOOP JOIN
  - when the outer input is small and the inner input has an index on the join key
  - No restriction on operators; Inputs need not be sorted
- MERGE JOIN:
  - Medium to large inputs
  - Requires equality operator & inputs must be sorted on join predicate
- HASH JOIN:
  - Large inputs
  - Requires equality operator; Inputs need not be sorted

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Indexing Scenario 2

```
SELECT C.ContactID, C.FirstName, C.EmailPromotion
FROM Person.Contact2 AS C
WHERE C.FirstName LIKE N'L%'               ←  4.3 % (872)
        AND C.EmailPromotion = 1           ←  25.2 % (5044)
        AND C.ContactID < 10000            ←  50.04 % (9994)
OPTION (MAXDOP 1)

--returns 77 out of 19972 records
```

Indexing Scenario 2

```
SELECT C.ContactID, C.FirstName, C.EmailPromotion
FROM Person.Contact2 AS C
WHERE C.FirstName LIKE 'L%'           ←     4.3 % (872)
        AND C.EmailPromotion = 1      ←     25.2 % (5044)
        AND C.ContactID < 10000       ←     50.04 % (9994)
OPTION (MAXDOP 1)
-------------------------------------------------------------------------------------------
-- Option 1
CREATE INDEX ContactComposite4
ON Person.Contact2(FirstName, EmailPromotion)
-- Option 2
CREATE INDEX ContactComposite5
ON Person.Contact2(EmailPromotion, FirstName)
```

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Good Design vs Better Design

The Optimizer's choice of Indexes

- Common advice (as it is):
  - Most selective column should be the first column
    - Does it mean you add the primary key as the leading column of all your indexes?
- SQL maintains HISTOGRAM only for the first column of the index
- Additionally, DENSITY is maintained for all the columns in left-based subset mechanism
- Common advice (as it should be):
  - Most selective column should be the first column when all other column predicates use the equality operator

The Optimizer’s choice of Indexes

- Single column index:
  - True:
    - FirstName LIKE 'L%'
    - EmailPromotion = 1
    - ContactID < 10000
  - False:
    - FirstName LIKE ‘%L'
    - ABS(EmailPromotion) = 1
    - ContactID + 1 < 10000

The Optimizer’s choice of Indexes

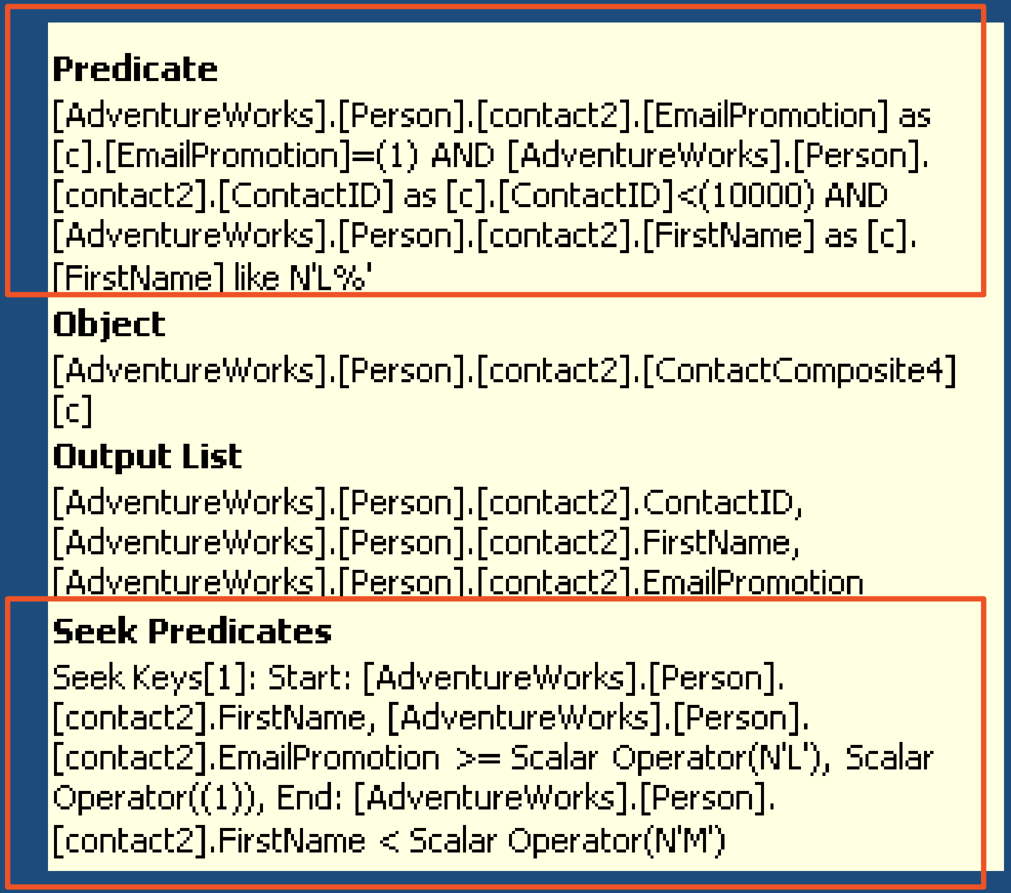
- Multi-column index:
  - The index can be used to seek on the second column if there is an equality predicate on the first column
  - True:
    - FirstName = ‘L‘ AND EmailPromotion = 1
  - Partially True:
    - FirstName LIKE ‘L%‘ AND EmailPromotion = 1
  - False
    - FirstName LIKE ‘%L‘ AND EmailPromotion = 1

The Optimizer’s choice of Indexes

- Multi-column index:
  - The index can be used to seek on the second column if there is an equality predicate on the first column
  - True:
    - FirstName = ‘L‘ AND EmailPromotion = 1
  - Partially True:
    - FirstName LIKE ‘L%‘ AND EmailPromotion = 1
  - False
    - FirstName LIKE ‘%L‘ AND EmailPromotion = 1

The Optimizer's choice of Indexes

Multi-column index: Our scenario



Predicate

[AdventureWorks].[Person].[contact2].[EmailPromotion] as [c].[EmailPromotion]=(1) AND [AdventureWorks].[Person].[contact2].[ContactID] as [c].[ContactID]<(10000) AND [AdventureWorks].[Person].[contact2].[FirstName] as [c].[FirstName] like N'L%'

Object

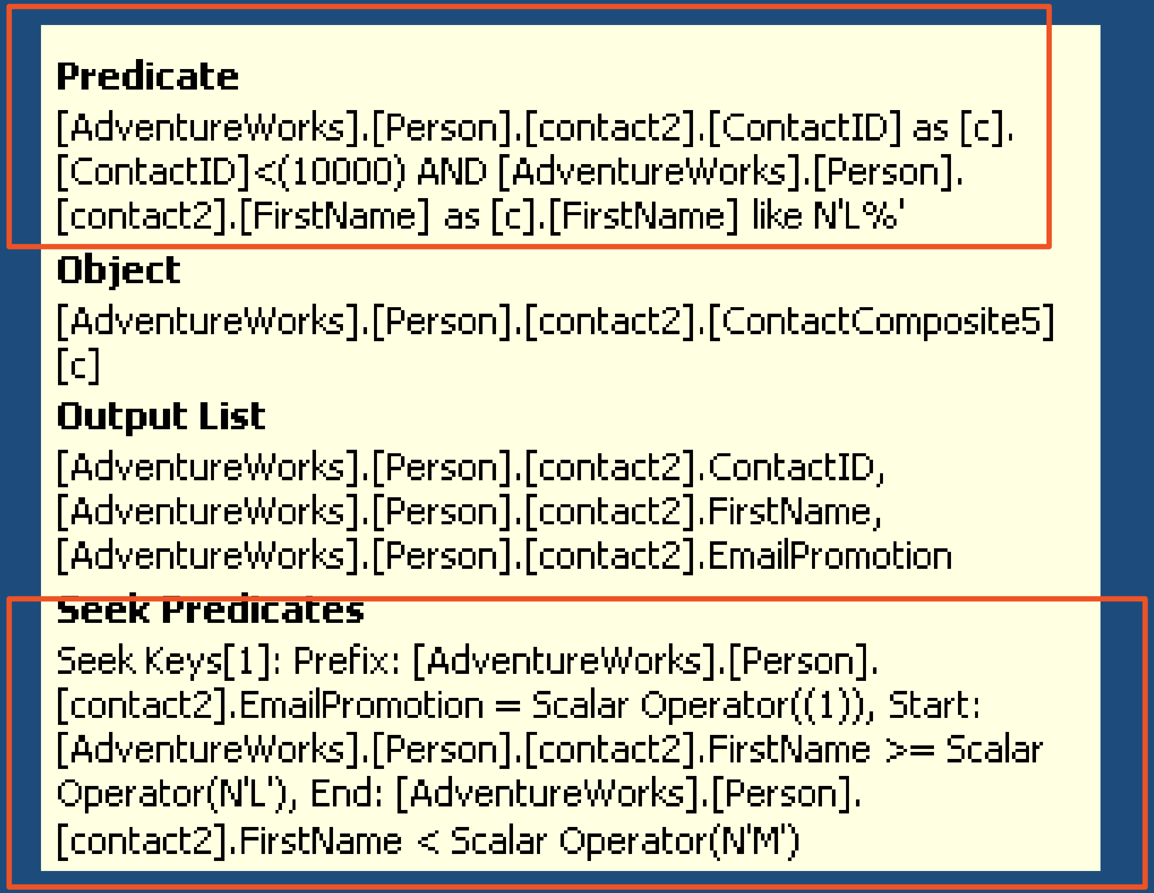
[AdventureWorks].[Person].[contact2].[ContactComposite4] [c]

Output List

[AdventureWorks].[Person].[contact2].ContactID, [AdventureWorks].[Person].[contact2].FirstName, [AdventureWorks].[Person].[contact2].EmailPromotion

Seek Predicates

Seek Keys[1]: Start: [AdventureWorks].[Person].[contact2].FirstName, [AdventureWorks].[Person].[contact2].EmailPromotion >= Scalar Operator(N'L'), Scalar Operator((1)), End: [AdventureWorks].[Person].[contact2].FirstName < Scalar Operator(N'M')



Predicate

[AdventureWorks].[Person].[contact2].[ContactID] as [c].[ContactID]<(10000) AND [AdventureWorks].[Person].[contact2].[FirstName] as [c].[FirstName] like N'L%'

Object

[AdventureWorks].[Person].[contact2].[ContactComposite5] [c]

Output List

[AdventureWorks].[Person].[contact2].ContactID, [AdventureWorks].[Person].[contact2].FirstName, [AdventureWorks].[Person].[contact2].EmailPromotion

Seek Predicates

Seek Keys[1]: Prefix: [AdventureWorks].[Person].[contact2].EmailPromotion = Scalar Operator((1)), Start: [AdventureWorks].[Person].[contact2].FirstName >= Scalar Operator(N'L'), End: [AdventureWorks].[Person].[contact2].FirstName < Scalar Operator(N'M')

and the DTA ???

Image source: http://www.gamerreaction.tv/2011/04/erring-on-the-easy-side/frustrated/

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Indexing Scenario 3

How, When & Why did the indexes become culprits?

- Too many Non-Clustered indexes?
- Did you strike a right balance between SELECT & UPDATE performance?
- Can you get rid of some redundant indexes?

Image source: http://onlinewebfun.com/1835/truckload/

How, When & Why did the indexes become culprits?

```
SELECT C.ContactID, C.FirstName, C.EmailPromotion
FROM Person.Contact2 AS C
WHERE C.FirstName LIKE 'L%'
        AND C.EmailPromotion = 1
        AND C.ContactID < 10000
OPTION (MAXDOP 1)
```

```
CREATE INDEX ContactComposite5
ON Person.Contact2(EmailPromotion,
FirstName)
```

```
SELECT C.ContactID, C.FirstName, C.EmailPromotion
FROM Person.Contact2 AS C
WHERE C.FirstName = 'LANE'
        AND C.EmailPromotion =< 1
        AND C.ContactID < 10000
OPTION (MAXDOP 1)
```

```
CREATE INDEX ContactComposite4
ON Person.Contact2(firstname,
EmailPromotion)
```

```
SELECT c2.FirstName
FROM person.Contact2 AS c2
INNER JOIN
person.contact3 c3
ON C2.FirstName = c3.FirstName
ORDER BY C3.FirstName
```

```
CREATE INDEX C2FirstName
ON Person.Contact2(firstname)
```

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Clean up act !

Summary / Call to Action

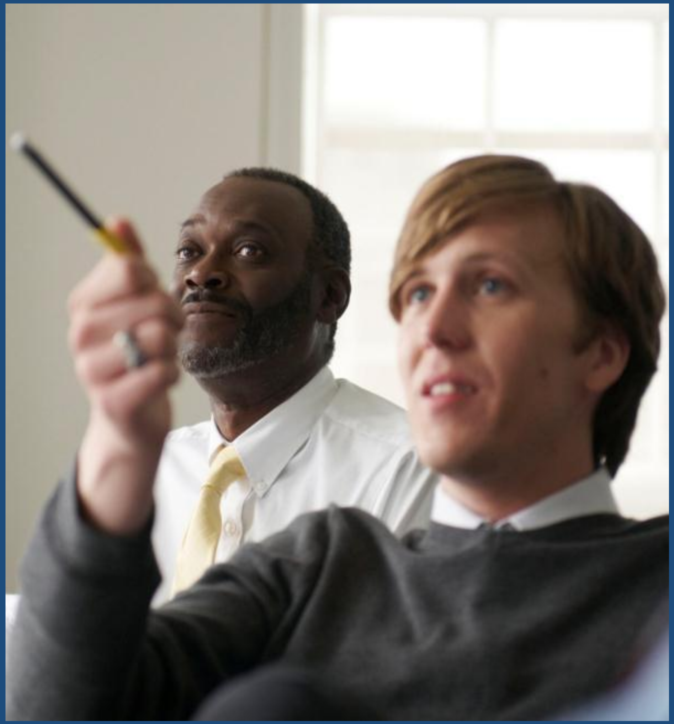
- Browse this recording once again ☺
- Try out the code snippets yourself
- Review your indexing strategies
- Implement the knowledge
- Try out various combinations in your ‘test environment’

Takeaways…

- How does the optimizer decide which index to use?
- Optimizer's choice of the physical join operator
- Database Tuning Advisor. When? Why? How?
- Monitor, Monitor, Monitor !

Complete an evaluation on CommNet and enter to win!

Track Resources



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Thank you all !

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