CSCI317 Database Performance Tuning

Index Selection Guidelines

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Index Selection Guidelines

Outline

To use index or not to use index ?

Efficiency of indexing

A wise choice of an index key

Cluster index versus non-cluster index

Hash index versus B*-tree index

Balancing the costs of index maintenance

To use an index or not to use an index ?

Main principle

- Do not build index unless some query (including the query components of updates and deletions) benefit from it

Selectivity of an attribute A in a relational table T is defined as a result of a query

Selectivity of attribute A

```
SELECT COUNT(DISTINCT A) / COUNT(*)
FROM T;
```

Selectivity of an attribute is a number in a range (0, 1]

Primary key and candidate key have the highest selectivity equal to 1

Selectivity of a set of attributes (A, B, ...) is computed in the same way a selectivity of a single attribute

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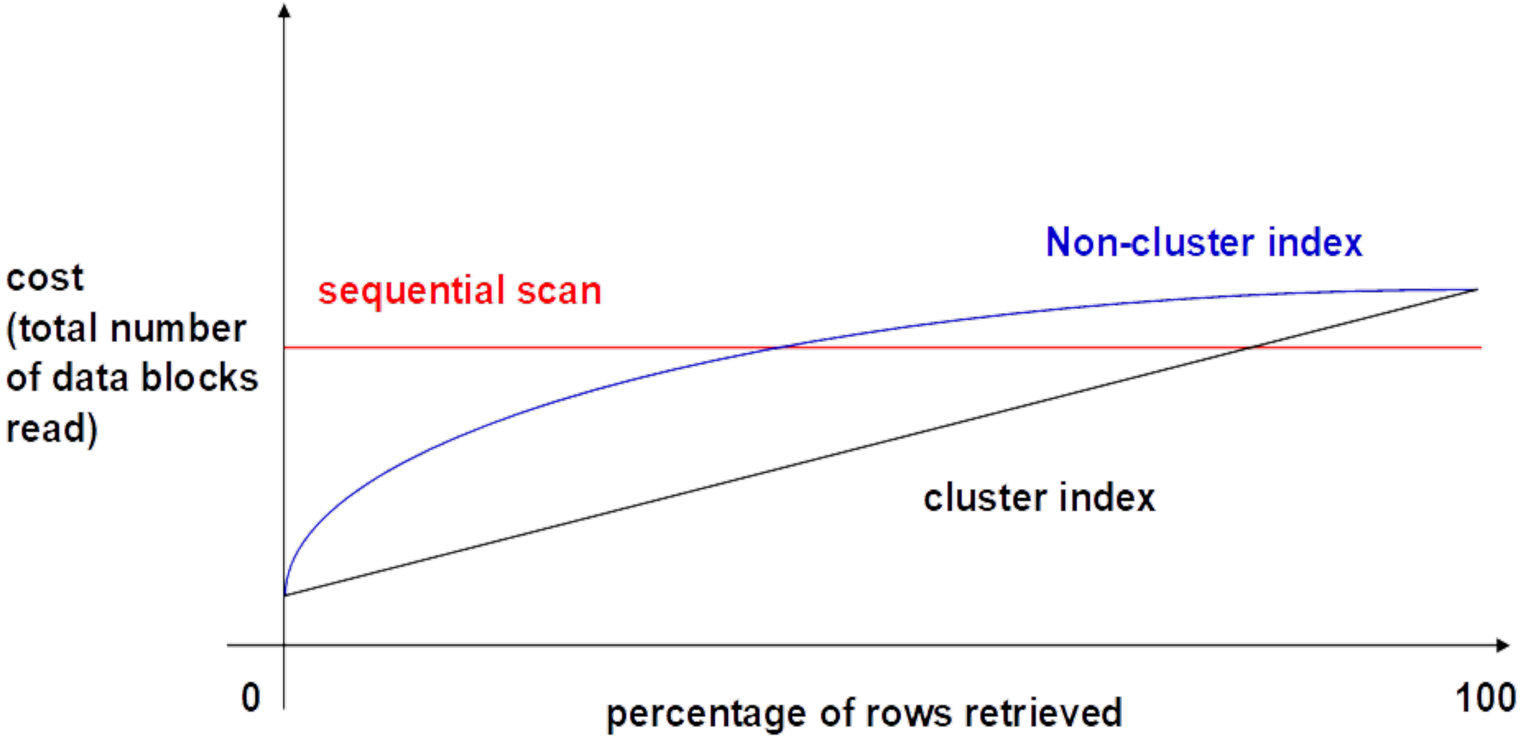
Efficiency of indexing



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An exact-match selection condition such as `attribute=value` suggests that we should consider an index on `attribute` when selectivity of `attribute` is high

If `attribute` is frequently updated or new values are added and old values are deleted then it should be B-Tree based index (majority of the cases)

If `attribute` does not change frequently then we should consider hash-based index

If a relational table that includes `attribute` changes frequently then we must use non-cluster based index

If a relational table that includes `attribute` has very infrequent changes then cluster based index is a good option

A wise choice of an index key

A range selection condition such as `attribute>value` means that we must use B-Tree based index on attribute

If a relational table that includes `attribute` changes frequently then we must use non-cluster based index

If a relational table that includes `attribute` has very infrequent changes then cluster based index is a good option

A wise choice of an index key

Index with a `composite key` should be considered when `WHERE` clause includes a condition on more than one attribute and a condition is a conjunction (`AND`) of elementary terms

For example a query like

Benefits from a composite index key

```
SELECT *
FROM EMPLOYEE
WHERE fname = 'James' AND lname = 'Bond';
```

benefits of from a composite key index `(fname, lname)`

An order of attributes in a composite key index is very important

For example a query like

May benefit from a composite index key

```
SELECT *
FROM EMPLOYEE
WHERE lname = 'Bond';
```

benefits of from a composite key index `(lname, fname)`

A wise choice of an index key

It is always worth to consider an index that allows for index only processing of a query, for example a query like

Index only processing of a query

```
SELECT fname, lname
FROM EMPLOYEE
```

does not need access to a relational table `EMPLOYEE` and entire processing can be done on a composite key index `(lname, fname)`

Another example of index only processing of a query

Index only processing of a query

```
SELECT city
FROM EMPLOYEE
WHERE city LIKE 'A%';
```

does not need access to a relational table `EMPLOYEE` and entire processing can be done on a single attribute index `(city)`

A wise choice of an index key

An index can be used for aggregation, sorting, and grouping, for example, query like

Horizontal traversal of an index

```
SELECT COUNT(*)
FROM EMPLOYEE;
```

does not need access to a relational table `EMPLOYEE` and entire processing can be done on an index on primary key

For example, a query like

Horizontal traversal of an index

```
SELECT *
FROM EMPLOYEE
ORDER BY lname
```

does not need to sort a relational table `EMPLOYEE` and sorting can be replaced with horizontal traversal through leaf level of a composite key index `(lname, fname)`

A wise choice of an index key

An index can be used for aggregation, sorting, and grouping, for example, a query like

Horizontal traversal of an index

```
SELECT lname, COUNT(*)
FROM EMPLOYEE
GROUP BY lname;
```

does not need to group a relational table `EMPLOYEE` over `lname` and entire processing can be done by a horizontal scan through leaf level of a composite key index `(lname, fname)`

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Cluster index versus non-cluster index

Clustering has a very positive impact on performance of query processing

Clustering has a very negative impact on performance on insert/update /delete operations

Range queries are likely to benefit from clustering

If an index enables index-only query computation strategy then such index does not need to be cluster index

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Hash index versus B*-Tree index

B*-Tree index is preferable when a table is frequently updated

Only B*-Tree index can be used for range queries

Hash index is preferable for equality queries on read-only relational table

Hash index better supports hash-based implementation of join operation

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Balancing the costs of index maintenance

If index maintenance slows down important `UPDATE`/`DELETE`/`INSERT` operations - drop an index

Index may speed up `UPDATE`/`DELETE`/`INSERT` operations when their computation involves query processing

References

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