

COMPSCI 105: Lecture #20 Indexing

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REVIEW OF SORTING

- Physically rearranges table to be in the desired order.
- As we've seen, sorting takes a long time.
- For N records:
 - $O(N^2)$ for bad sorting techniques,
 - $O(N \times \log_2(N))$ for good sorting techniques.
- Slow, but is advantageous for searching (binary search requires list be sorted).

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What if we need to see Table in several different orders?

- Option #1: Re-sort table each time a new view is needed.
 - Only one table, but...
 - ...takes lots of unnecessary time.
- Option #2: Make several copies of table, each sorted on a different field.
 - Many copies means lots of disk space used, and...
 - Adding/Deleting/Changing record in one means same change must be made to all (data consistency).
- Option #3: Use Indexes.

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INDEXING

- Indexes are additional hidden data structures associated with individual fields in a table.
- Indexes are maintained automatically by the database package.
- An index makes a table "look sorted" on the indexed field.
- Every field may have its own index.
- Indexes speed up both *searches* and *joins*.

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A Table without Indexing

PEOPLE

	ID	NAME
1	12345	Fred
2	72401	Joe
3	22222	Mary
4	54321	Sam
5	20202	Martha
6	11111	Bob
7	47904	Tom

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Tables without Indexes

- In a table without any indexes, data records may appear in any random order.
- A table might have its records in a sorted order without an index.
- Searching an unindexed table for matching records requires examining every record in the table. This is a linear search, which runs in $O(N)$ time for N records.

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Same Table Indexed on ID Field

PEOPLE

	ID	NAME
1	11111	Bob
2	12345	Fred
3	20202	Martha
4	22222	Mary
5	47904	Tom
6	54321	Sam
7	72401	Joe

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Table Indexed on ID Field

- The People table *apparently* is indexed on the ID field.
- People *might be* unindexed, but if it is indexed it would have to be on the ID field.
- Internally, People is still unsorted, but because there is an index on ID the database can show the table as if it was sorted by ID.

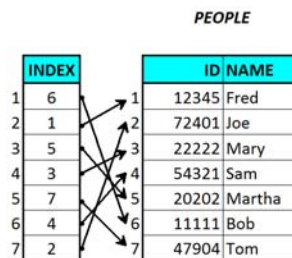
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Searching Indexed Tables

- Typically, indexed fields contain unique information (no duplicates).
- Such fields can be searched with binary search in $O(\log_2(N))$ time:
 - Check list item pointed to by middle *of index*,
 - Discard half *of index* not containing search term,
 - Repeat until item found or *index* becomes empty.

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Index on ID (not seen by user)



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Linear Search, Binary Search, Search with Indexing (Video).



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