Computation, Information, and Intelligence (ENGRI/CS/INFO/COGST 172), Spring 2007
2/21/07: **Lecture 14 aid — B-trees; the vector-space model**

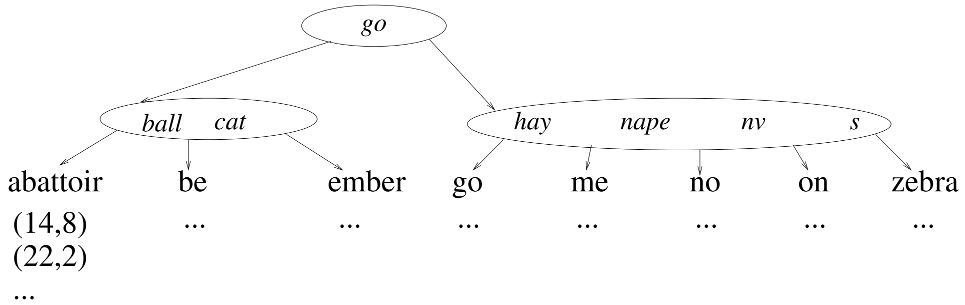
Topics: more on B-trees; retrieval based on the vector-space model, allowing the incorporation of more information regarding term frequencies.

Follow-ups to last time: If you query Google for "how tall is mount everest", you receive a specialized response:

> Mount Everest — Elevation: 8,850 M (29,035 feet) Ranked 1st
> According to http://copernicus.subdomain.de/Mount_Everest - More sources ⟩⟩

But what if you query Google for "how tall is greek peak"?[1] Nothing doing.

I. Example B-tree Remember that the index is stored (in sorted order, left to right) in the leaves.



This tree is of order $t = 2$ because the root contains between 1 and $2 \cdot 2$ keys inclusive, and the other internal nodes contain between 2 and $2 \cdot 2$ (inclusive) keys. See previous lecture aid for definitions.

II. B-tree search (*See that you understand from the definitions given on lecture aid from last time why this procedure works.*) Suppose we want to know which documents contain the term w. Begin at the left-hand side of the root. Move rightwards among the (sorted) keys until you either *first* hit a key $k \neq w$ such that k alphabetically follows w or you hit the right end of the node; then, follow the child that you are "at". Repeat until you hit a leaf.

III. Example data Let the vocabulary W be w_1: cat; w_2: dog; w_3: news.

A three-document corpus: d: "cat news" d': "news cat news cat news" d'': "cat dog news dog news"

Query q: "cat dog"

IV. Normalized term-frequency vectors Let the terms be $w_1, w_2, \ldots, w_m$. Define the *term-document frequency* $\text{freq}(w_i \in d)$ as the number of times w_i occurs in d. We then set the document vector $\overrightarrow{d}$ for document d as follows:

$$\overrightarrow{d} = \left(\frac{\text{freq}(w_1 \in d)}{N(d)}, \frac{\text{freq}(w_2 \in d)}{N(d)}, \ldots, \frac{\text{freq}(w_m \in d)}{N(d)} \right)$$

where $N(d) = \sqrt{\sum_{i=1}^{m} \text{freq}(w_i \in d)^2}$ is the *length-normalization factor*.

[1] 2100 feet.