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Information Retrieval

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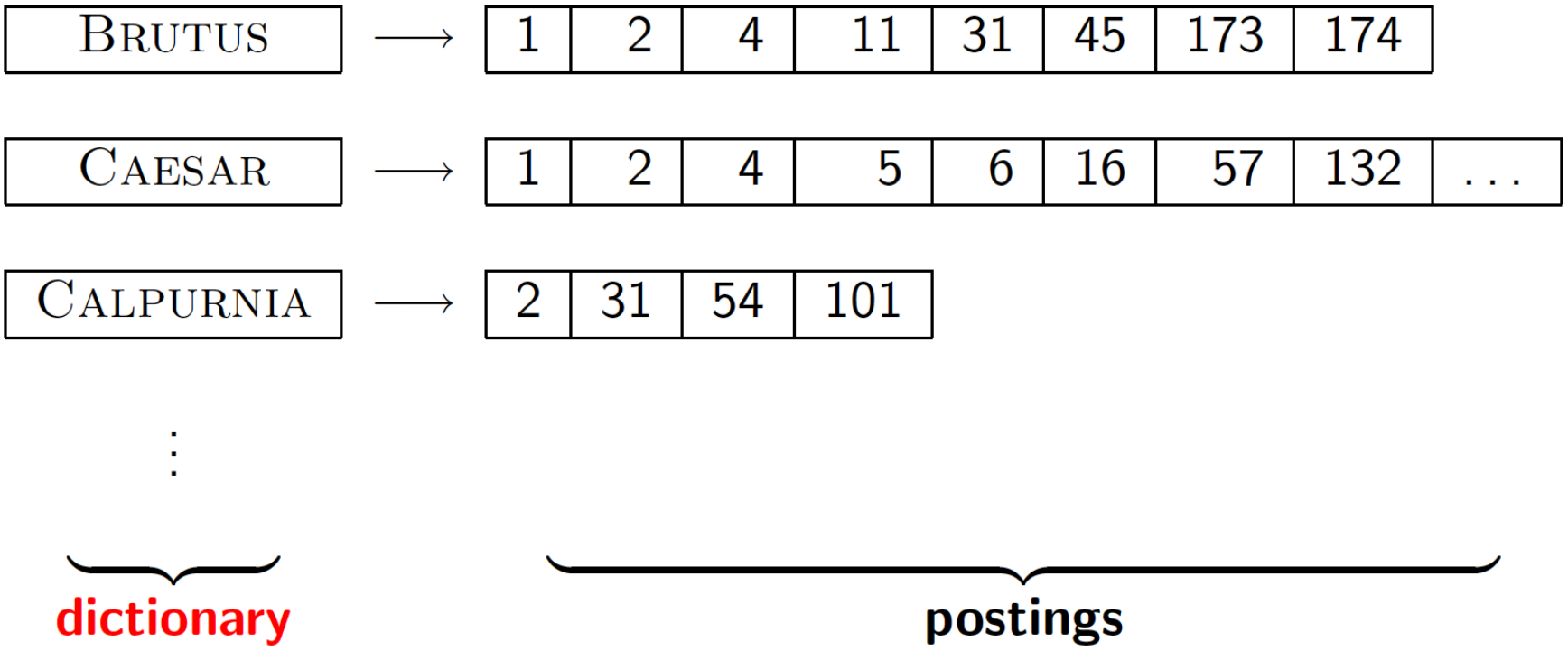
The study of mathematics, like the Nile, begins in minuteness but ends in magnificence.
Charles Caleb Colton.

The endless study of information retrieval, like the Taj Mahal, begins in magnificence and stays in magnificence.
Venkatesh Vinayakarao.

How to Store a Dictionary?



One (bad) Approach

- Store them all in a file.
- Go linearly (one by one) and compare.

Avg. no. of Comparisons $\propto$ No. of Words in Dictionary

Second (still bad) Approach

- Sort them.
- Do a binary search.

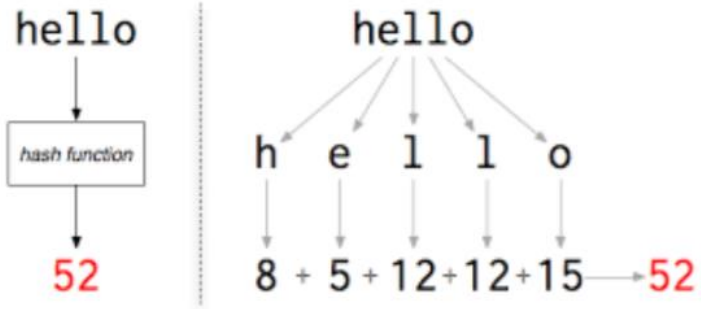
Avg. no. of Comparisons $\propto$ Log(No. of Words in Dictionary)

Can we do better?

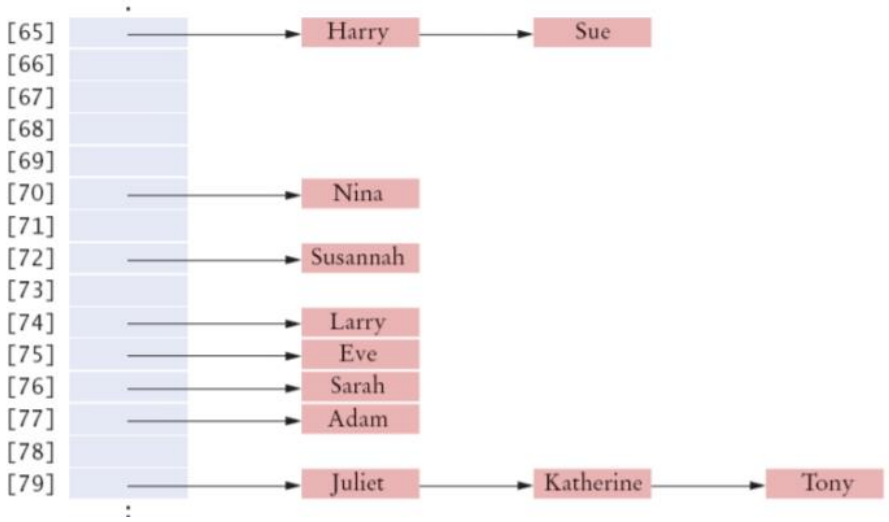
How can we store all dictionary words for a fast look up?

Hashing

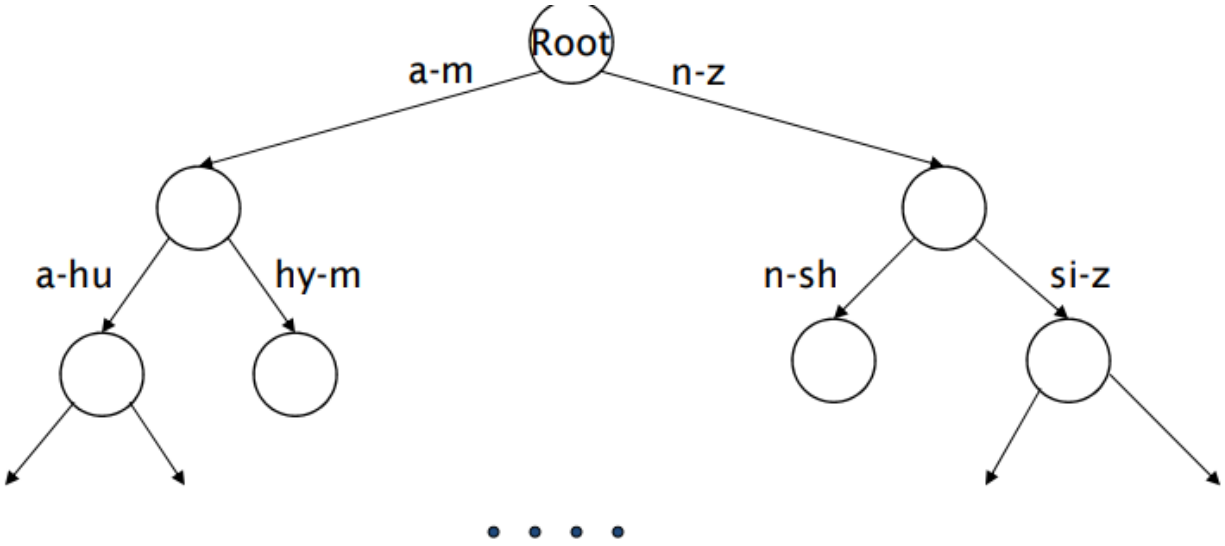
Simple hash function



Simple hash table



Binary Search Tree

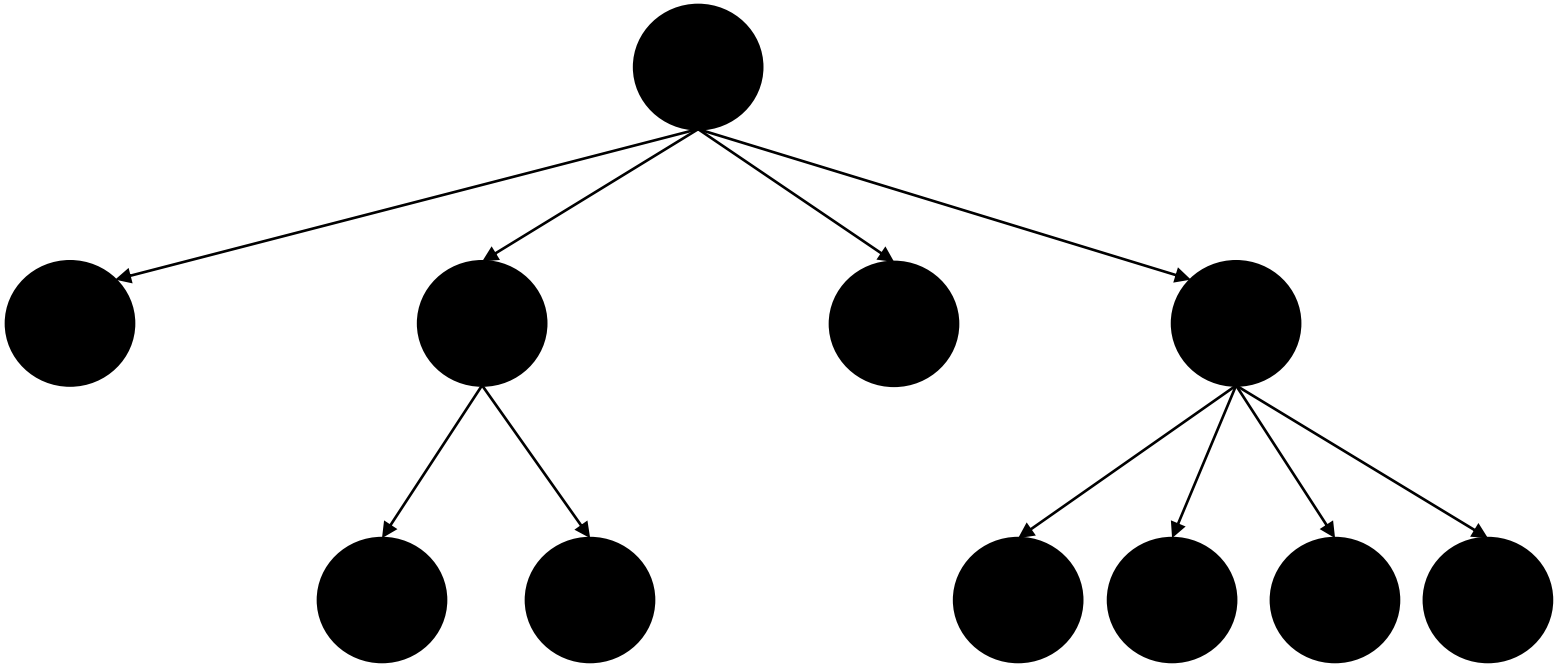


Dictionary terms are stored in the leaf nodes.

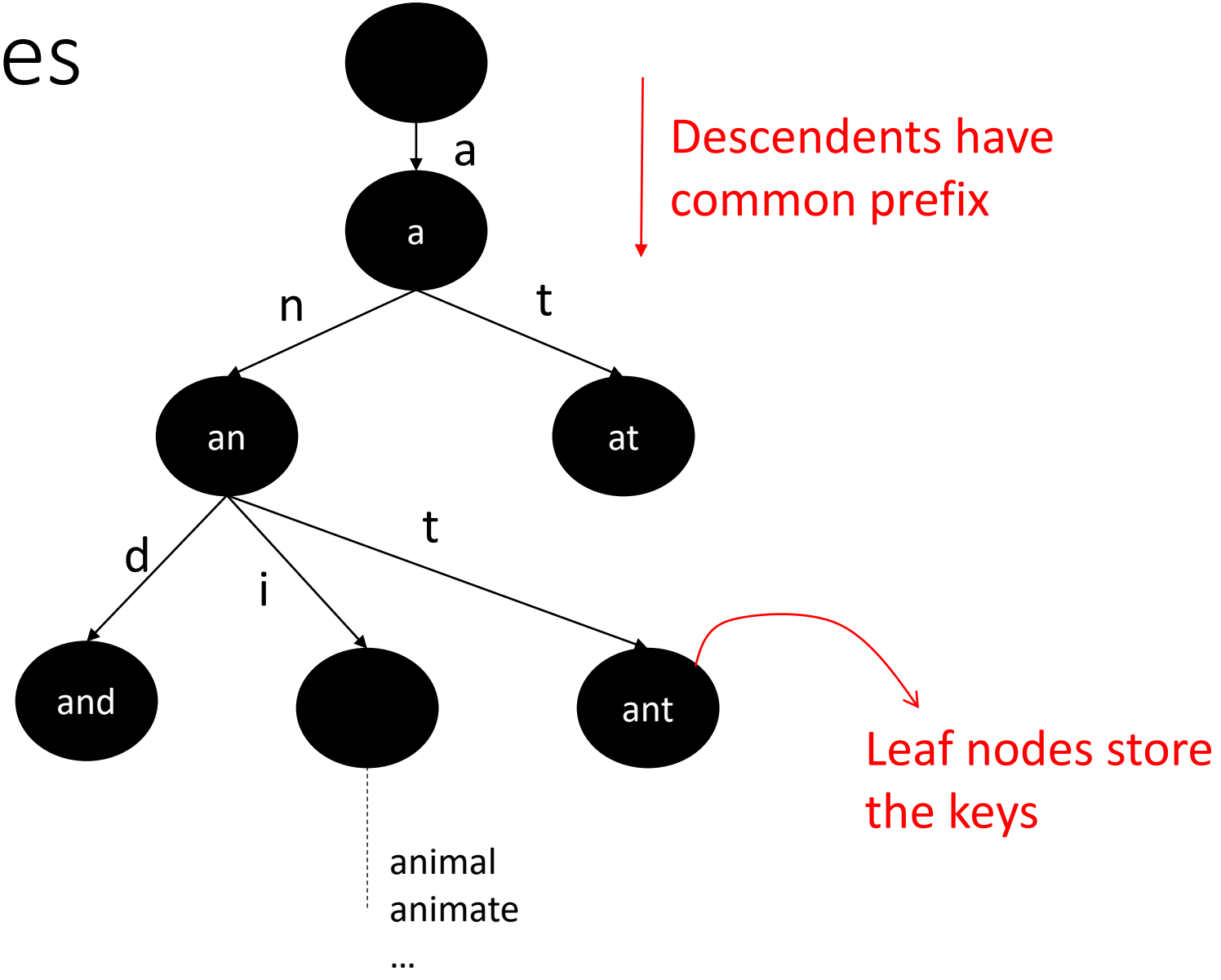
Balancing this tree is a concern. Can we do better?

B-Trees (Not Binary Trees)

- Nodes may have any number of children in the interval [a,b]



Tries


a
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Descendents have common prefix
Leaf nodes store the keys

Wild-card queries: *

- ***mon*:*** retrieve all words in range: ***mon ≤ w < moo***
- ****mon:*** find words ending in "mon": harder
  - Maintain an additional B-tree for terms *backwards.*

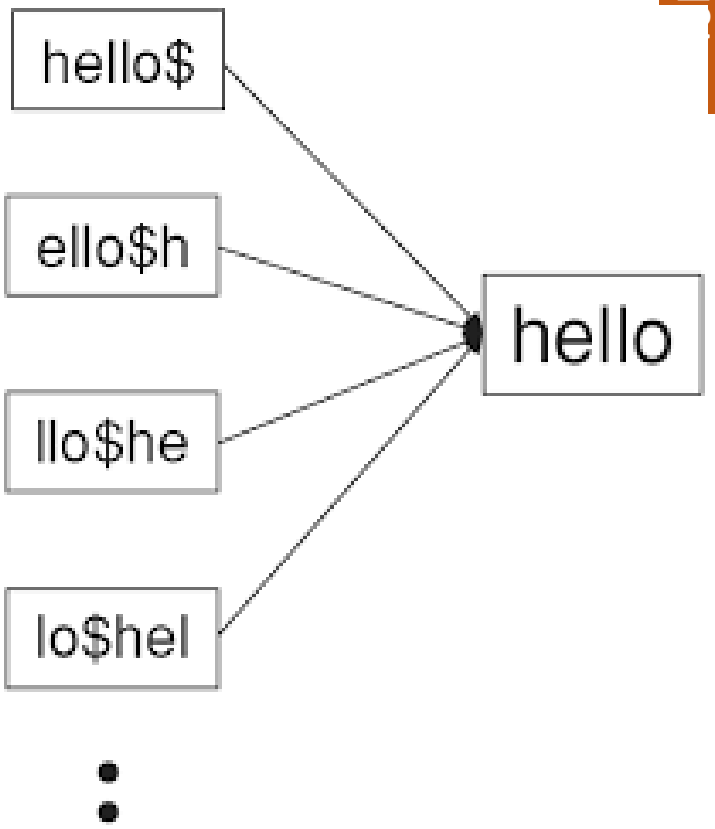
  Can retrieve all words in range: ***nom ≤ w < non****.*

B-trees handle *'s at the end of a query term

- How can we handle *'s in the middle of query term?
  - ***co*tion***
- We could look up ***co**** AND ****tion*** in a B-tree and intersect the two term sets
  - Expensive
- The solution: transform wild-card queries so that the *'s occur at the end
- This gives rise to the **Permuterm** Index.

How to Match he*lo?

- Rotate he*lo → he*lo$ → $he*lo → o$he*l → lo$he*
- Till * is at the end.
- Exercise: How will you match h*l*o?



Clue: Enumerate all matches for o$h*. Check if they contain l.

k-gram Index for Wildcard Queries

- k-gram is a sequence of k characters.
- 3-grams in “India” are Ind, ndi, dia.
- We add a $ to mark beginning and ending of the term.
- Therefore, “India” → {“$In”, “ndi”, “dia”, “ia$”}

Test Your Understanding

- Can we define a 3-gram conjunctive query for red*?
  - $re AND red does not match red*.
  - We need a postfiltering step to check the results for red*.

Thank You