B Trees
**B-Trees**

A Search Structure for External Memory

- Binary trees are the method of choice for ordered dictionaries stored in main memory
- On external memory systems (disk), entire blocks (pages) are accessed at once
- We would like each node of our tree to fill a block of external memory
- Multiway search tree - Fan-out depends on block size (e.g., 100)
B-Trees

- B-Tree of order $m$:
  - The root is either a leaf or has between 2 and $m$ children
  - Each non-root node has between $\lceil m/2 \rceil$ to $m$ children (and one less keys)
  - All leaves are at the same level of the tree

- Example: B-tree of order 5
B Trees

Height

- Theorem: A B-tree of order \( m \) with \( n \) nodes has height at most \( (\lg n)/\gamma \), where \( \gamma = \lg m/2 \).
- Proof: With each level, fan-out is at least \( m/2 \). Number of nodes in a tree of height \( h \) is roughly \( n = \left(\frac{m}{2}\right)^h \). Solve for \( h \) as function of \( n \).