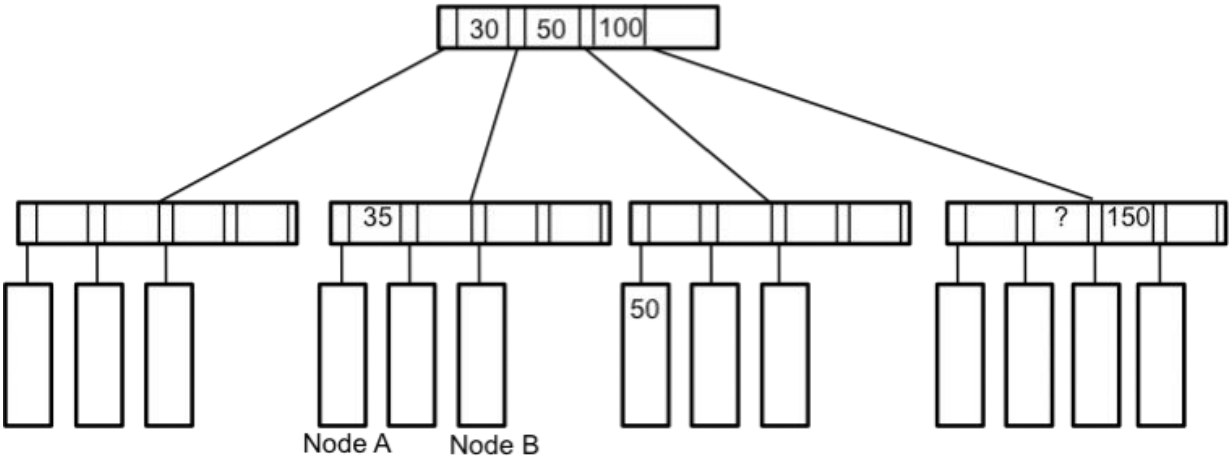
Written Assignment 3
100 pts
Due November 9, 2018 before 11:59PM

Submission Guidelines
Submit all your solutions in the form of a PDF file to Canvas. You can either **type them up** or **write on papers and scan/take picture them.** If you choose the latter, please make sure that your hand writing is **clear and readable**. Name your file as **W3_YourCaseID_YourLastName.pdf**.

1. Consider B-tree below, with M = L = 5 (i.e., each leaf node can hold up to 5 values). Assume that each key is **unique positive integer** (no duplicate keys)**.** Using the partially shown nodes' state below, what are the possible ranges of values residing in the leaf nodes A, B, and in the range boundary denoted with "?" ? Please explain the results. **(10 pts result, 10 pts explanation)**



2. Answer the following questions and explain why:
   a. Consider a B-tree with M = 5, height = 2. What is the **minimum number** of keys stored in this B-tree? **(10 pts)**
   b. Consider a B-tree with M = 4, and the number of keys is 15. What is the **maximum number** of nodes that store a key/keys? **(10 pts)**

3. Assume we build a binary max-on-top heap from keys 10, 12, 1, 14, 6, 5, 8, 15, 3, 9, 7, 4, 11, 13, 2.
   a. Show the result of building this heap by inserting the above keys one at a time in the order given (from left to right), into an initially empty binary heap. Please show key steps and short illustrations if necessary. **(10 pts)**
   b. Show the heap from problem (a) above after executing three **deleteMaximum** operations on this heap. Show each step. **(10 pts)**

4. Use the same input stream of Q3, write a program to output the **median** using heap structure. The **median** is the value separating the higher half from the lower half of a data sample. For example, the median of input is 8. **(20 pts)**

5. Use the same input stream of Q3, implement HeapSort in ascending order **(20 pts)**.