Programming Assignment #1

DEADLINE: 2013-09-21 24:00

Assignment Title

- Implementation of a B+ tree index

Environment

- OS: Windows
- Language: Java

Constraints - Overall

- The B+ tree index should be stored in a single file (index file)
  - The file contains all the meta information for the index and also the index nodes
  - The internal organization of the file is not considered in grading
- The program should provide following functions:
  - **Search**
    - A single key search **AND** a range search
  - **Insertion of a key**
  - **Deletion of a key**
    - The deleted entry should be completely removed from the index and the file
- Assumption
  - Keys and pointers are all in the integer type
  - Duplicated keys are not allowed for insertions
  - The keys in a node are stored in an ASCENDING order
- **POLICY on COPY**
  - **DO NOT COPY someone else's program**
  - **DO NOT USE functions/methods/routines from existing code/library/programs in pre-implemented B+ tree indexes or any other similar tree-based indexes**
  - **All these actions are regarded as COPY and so will be handled accordingly**

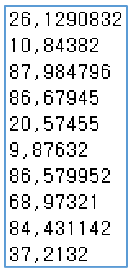
Constraints - Internal Structure

- Each node of a B+ tree index *should contain* the following data inside:
  - Non-leaf node
    - *m*: # of children
    - *p*: an array of *b* <*key*, *left_child_node*> pairs

        - *r*: a pointer to the rightmost child node
    - Leaf node
        - *m*: # of children
        - *p*: an array of *b* <*key*, *value*(or *pointer* to the value)> pairs
        - *r*: a pointer to the right sibling node

Constraints - Interface

- The program *should support **command-line interface***
- The following commands should be implemented:
    - **Data File Creation**
        - Command: *program* -c *index_file b*
            - *program*: name of the program (bptree)
            - *index_file*: name of a new index file
            - *b*: size of each node (max. # of child nodes)
        - This command creates a new index file containing an empty index with node size *b*
            - If the file already exists, it is overwrittten
        - Example
            - **java bptree -c index.dat 8**
    - **Insertion**
        - Command: *program* -i *index_file data_file*
            - *data_file*: name of the input data file that has a number of key-value pairs to be inserted
        - This command inserts all the key-value pairs inside the data_file into the index in the index_file
            - The insertion causes the modification of the index file
            - Insertions are performed in the same order of key-value pairs in the data file
        - The data file is provided as a .csv file (Comma Separated Values)
            - Each line of the data file contains a key-value pair
                - <key>,<value>₩n
            - Data file example (input.csv)



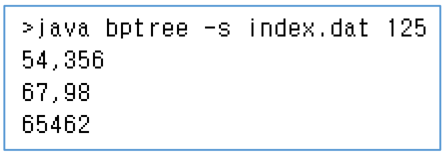
```
26,1290832
10,84382
87,984796
86,67945
20,57455
9,87632
86,579952
68,97321
84,431142
37,2132
```

        - Example

        - **java bptree -i index.dat input.csv**

- **Deletion**
    - Command: *program* -d *index_file data_file*
        - *data_file*: name of the input data file that has a number of keys to be deleted
    - This command deletes all the key-value pairs inside the input data file from the index
        - The deletion causes the modification of the index file
        - Deletions are performed in the same order of keys in the data file
    - The input data file is provided as a .csv file (Comma Separated Values)
        - Each line of the data file contains only a key value
            - <key>₩n
    - Example
        - **java bptree -d index.dat delete.csv**

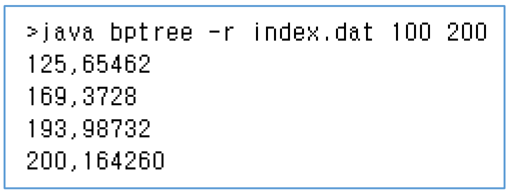
- **Single Key Search**
    - Command: *program* -s *index_file key*
        - *key*: key value to be searched
    - This command returns a value of a pointer to a record with the key
    - Output format
        - Print output to the *stdout*
        - While searching, the program prints each non-leaf node in the path that the search passes through
            - Print all the keys in the node in a single line
            - <key1>,<key2>,…,<key*m*>₩n
        - When the search reaches the leaf node having the search key, print the value matched with the search key
            - <value>₩n
            - <u>If not found, print 'NOT FOUND'</u>
    - Example
        - **java bptree -s index.dat 125**



```
>java bptree -s index.dat 125
54,356
67,98
65462
```

- **Ranged Search**
    - Command: *program* -r *index_file start_key end_key*
        - *start_key*: lower bound of the range search

        - *end_key*: upper bound of the ranged search
    - This command returns the values of pointers to records having the keys within the range provided
    - Output format
        - Print output to the *stdout*
        - Print all the key-value pairs with the key between *start_key* and *end_key* (including *start_key* and *end_key*)
            - <key1>,<value1>₩n<key2>,<value2>₩n...
        - Note that *start_key* and *end_key* may not be in the index
            - The program prints only the key-value pairs between them
    - Example
        - **java bptree -r index.dat 100 200**



```
>java bptree -r index.dat 100 200
125,65462
169,3728
193,98732
200,164260
```

How to turn in

1. Write your program
2. Write a document (.doc or .docx) that contains (in English):
    - Detailed explanations of your program/code with some screenshots
3. Zip the codes and the document
    - The filename should follow the format
        - ✓ Assignment01_<YOUR_STUDENT_NUMBER>.zip
        - ✓ Ex.) Assignment01_2010051924.zip
4. Submit it to the class community (http://portal.hanyang.ac.kr/)
    - **Until 2014-09-21 24:00**

- You can ask questions about the assignment via class community and/or e-mail
    - nowiz@dake.hanyang.ac.kr
- There will be penalties for the late submissions (-20% ~ -100%)
- **YOU WILL GET SERIOUS PENALTIES IF YOU DO COPY OR CHEAT**

Good luck!