Data compression

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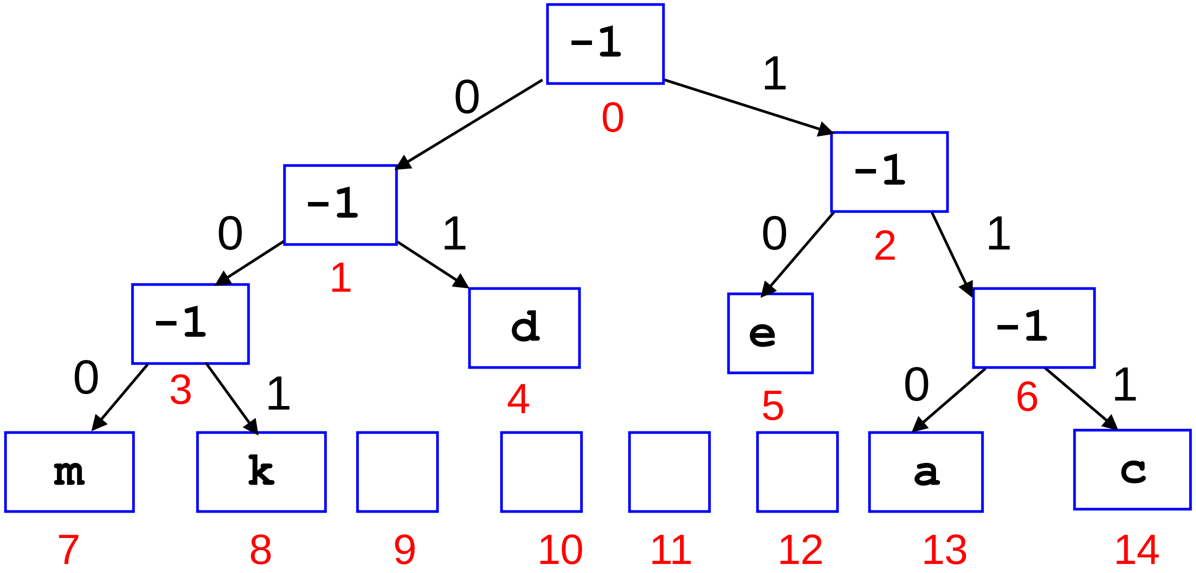
File Compression

- The Huffman Code can be used to compress a file.
- The compressed file may be organized as the following

HM	Huffman Tree	Size	Data …

  - HM is the prefix code of the compressed file
  - Huffman Tree is an array representation of the Huffman tree generated for the coding data
  - Size specifies the compressed data’s size in number of bits
  - Data contains the bits of compressed data

Array representation of the Huffman Tree



All the leaf nodes in the Huffman tree are labeled as characters

15	-1	-1	-1	-1	d	e	-1	m	k					a	c

The array's size = (2^0 + 2^1 + … + 2$^{n)}$ where n is the tree's maximal level
The children of node i are at 2i+1 and 2i+2
The parent of node i is at (i-1)/2

Implementation

- Giving a data structure as the following to represent the Huffman tree in array

```
typedef struct {
    int size;
    int * nodes;
} HuffmanTreeArray;
```

- Write a function to convert a Huffman tree in the array format
  - HuffmanTreeArray tree2array(HuffmanTree);

Quiz 1

- Rewrite the functions in the previous lab in order to compress files using the Huffman code.
- The program should be used to compress files in a command line mode as below
  - $ compress in_file [out_file]

- The following functions need to be implemented
  - HuffmanTree makeHuffman (FILE * in);
  - void createHuffmanTable(HuffmanTree htree, Coding* htable);
  - HuffmanTreeArray tree2array(HuffmanTree);
  - void compressFile(FILE* in, FILE *out);

Decoding the File

- Firstly, check the prefix “HM” of the file
- Read tree in the array representation
- Once receiver has tree it scans incoming bit stream
    - Data is bit based versus byte based
- Scanning algorithm
    - Set cursor at the root of the tree
    - If the current node has value -1, read new bit
        - 0 ⇒ move cursor to the left child
        - 1 ⇒ move cursor to the right child
    - Otherwise, get the new character at the node, move the cursor to the root.

Quiz 2

- Write a program to decompress files compressed as in Quiz 1
- Use the command line mode to decompress files
  - $ decompress compressed_file [out_file]