Huffman codes

Huffman encoding is a lossless data compression algorithm that compresses data by assigning shorter codes to more frequent symbols and longer codes to less frequent ones. It is based on the frequency of a symbol's occurrence in the input data. This method is optimal because it produces the smallest possible average code length.

Steps in Huffman Encoding

- **Calculate the frequency** of each character in the input data.
- **Build a binary tree** from the frequency data.
- **Assign binary codes** to each character based on the tree's structure, ensuring that more frequent characters get shorter codes.

Example of Huffman Encoding

Let’s walk through an example step-by-step:

Step 1: Calculate Frequency

Suppose we want to encode the following string:

```
BACADAEAFABBAAAGAH
```

First, calculate the frequency of each character in the string:

Character	Frequency
A	7
B	3
C	1
D	1
E	1
F	1
G	2
H	1

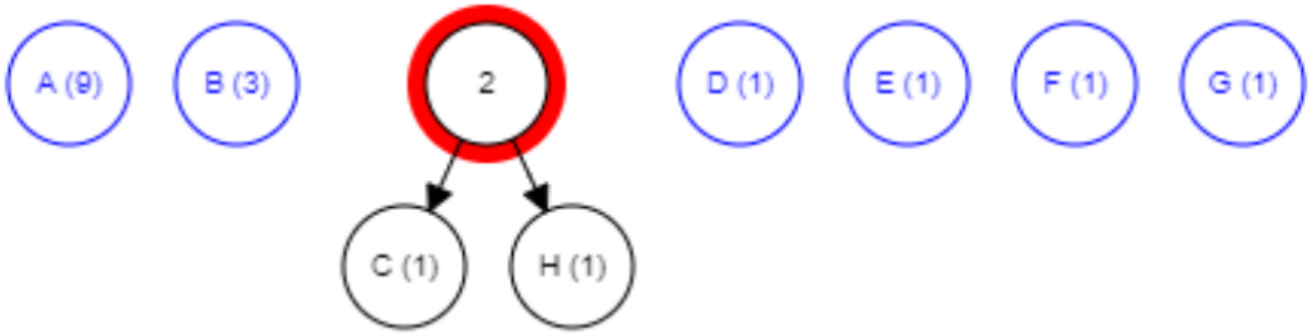
Step 2: Build the Huffman Tree

1.) Create a leaf node for each character and its frequency.

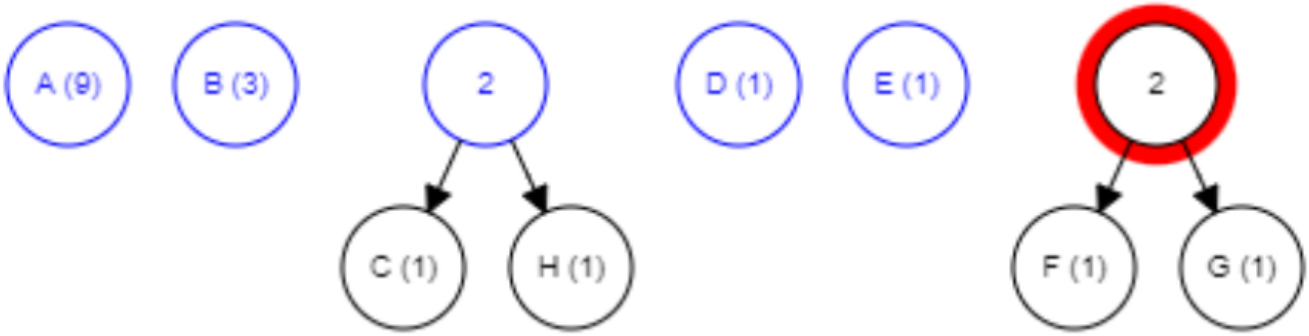
2.) **Merge the two nodes** with the lowest frequency. Create a new node with these two nodes as children, and the frequency of the new node is the sum of the two children's frequencies. Repeat this process until only one node (the root) remains.

Start with the frequencies:

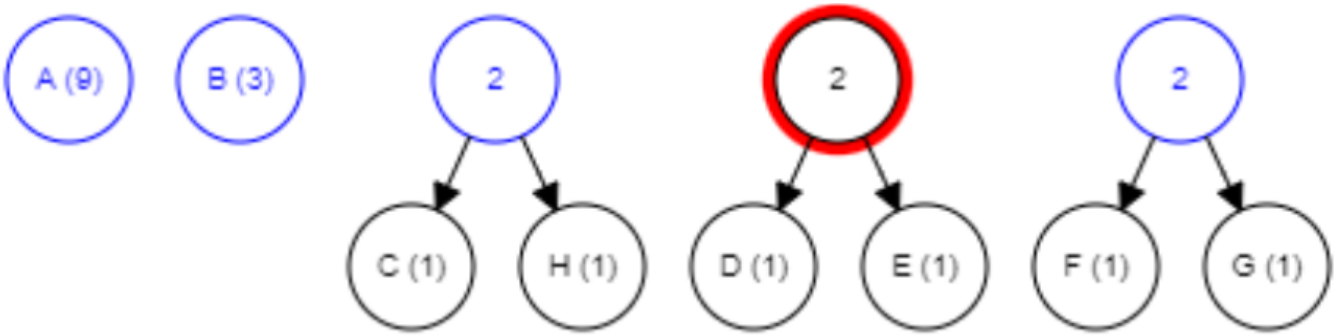
First, combine the two lowest frequency nodes. Let’s combine C and H (both have frequency 1):



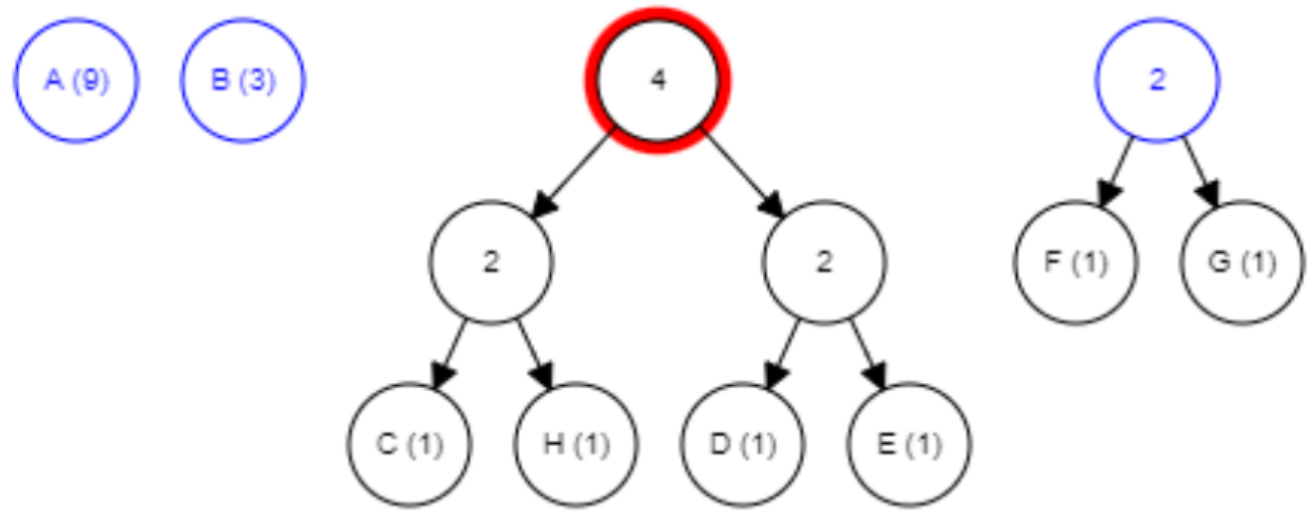
Combine the two lowest frequency nodes: F and G



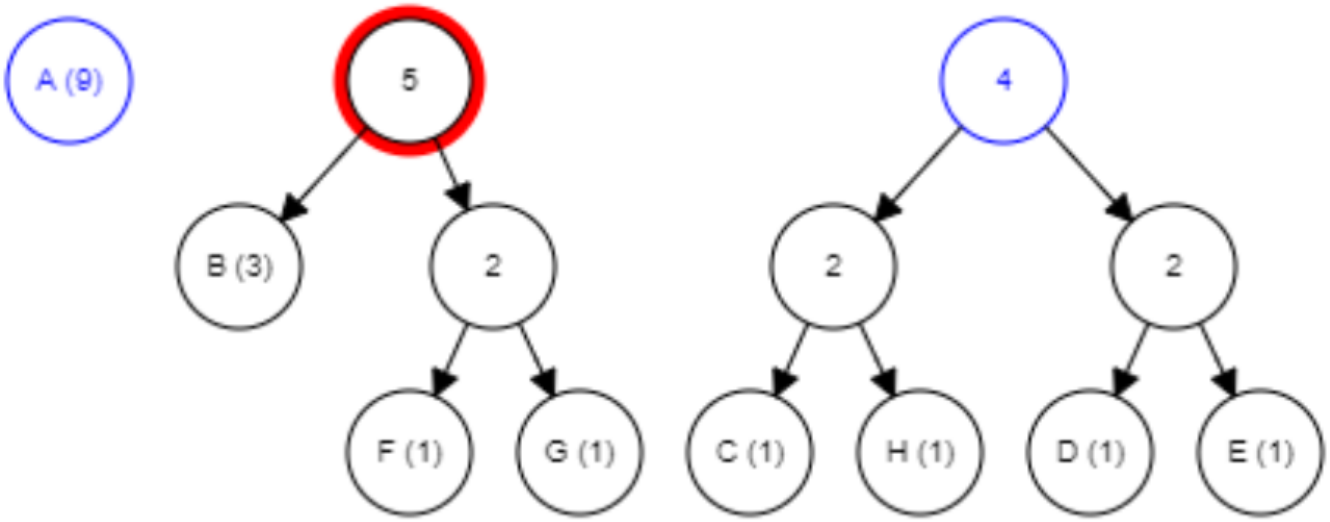
Combine the two lowest frequency nodes: D and E



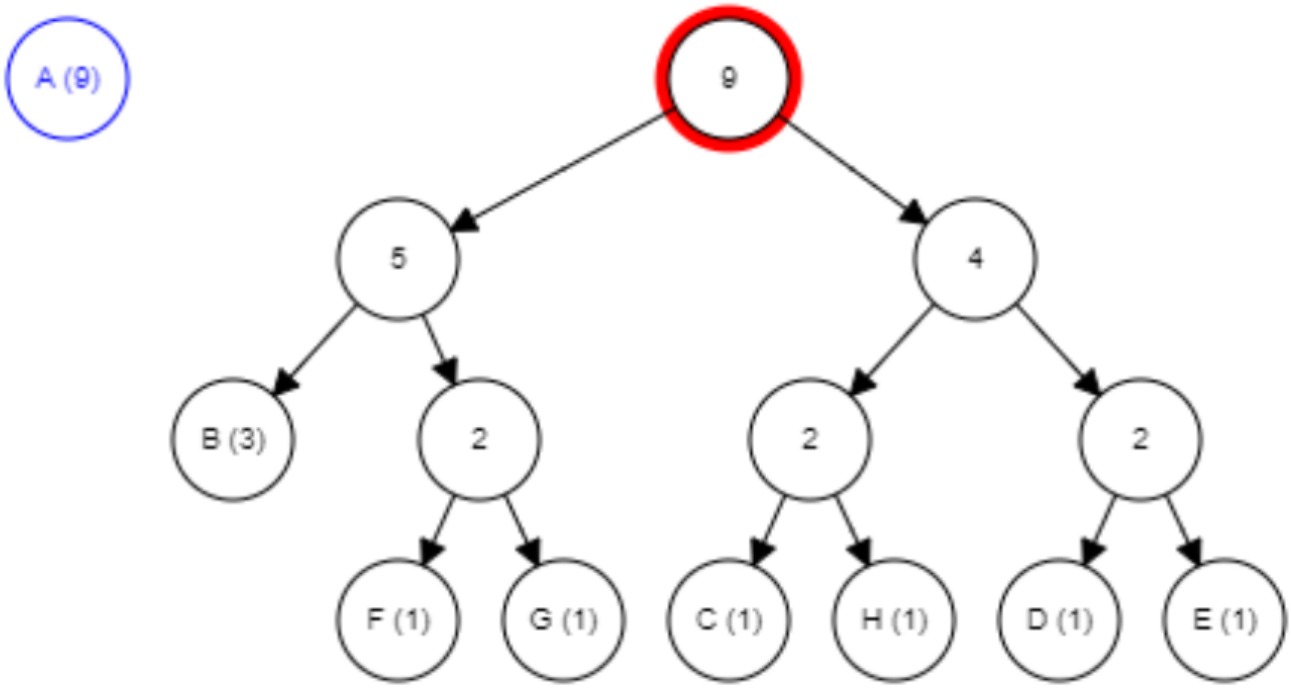
Merging two nodes:



Merging two nodes:



Merging two nodes:



Final tree: