Huffman Coding

The Basic Algorithm

- Huffman coding is a form of statistical coding
- Not all characters occur with the same frequency!
- Yet all characters are allocated the same amount of space
  - 1 char = 1 byte, be it e or X

The Basic Algorithm of Huffman Coding

1. Scan text to be compressed and tally occurrence of all characters.
2. Sort or prioritize characters based on number of occurrences in text.
3. Build Huffman code tree based on prioritized list.
4. Perform a traversal of tree to determine all code words.
5. Scan text again and create new file using the Huffman codes.

Building a Tree

Scan the original text

- Consider the following short text:

Eerie eyes seen near lake.

- Count up the occurrences of all characters in the text

Building a Tree

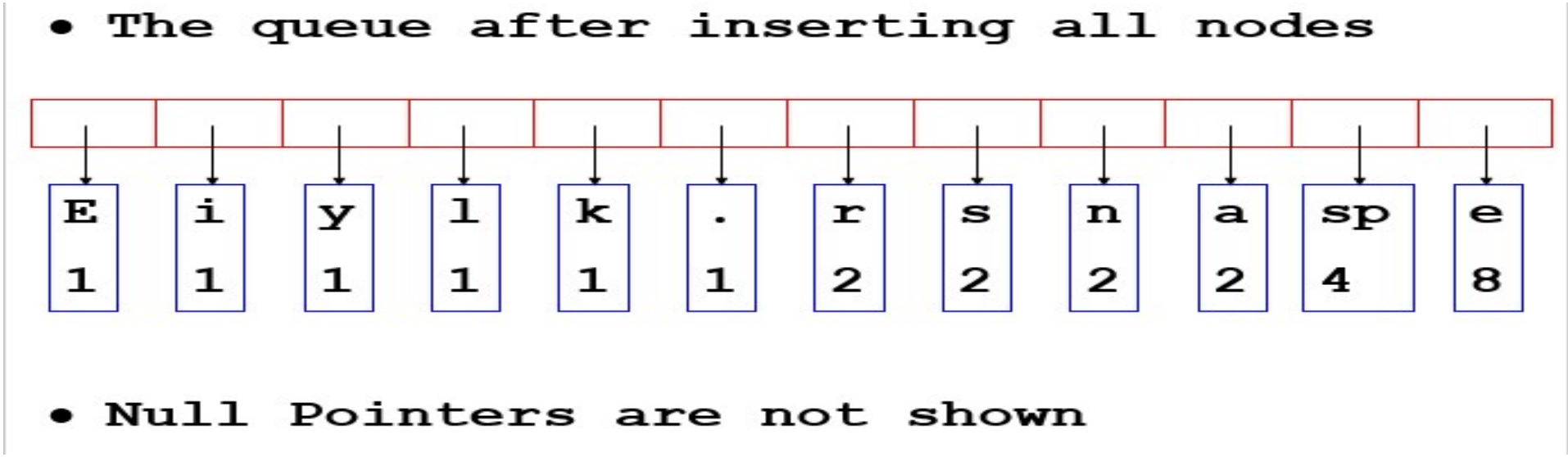
Scan the original text

Eerie eyes seen near lake.

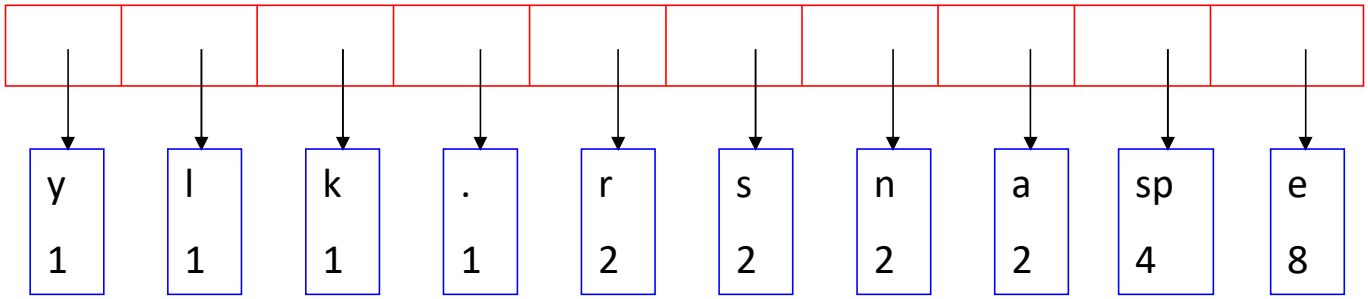
- What is the frequency of each character in the text?

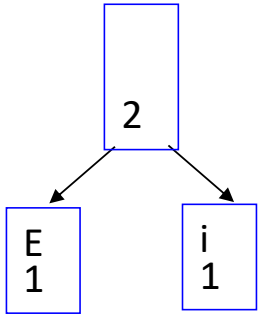
Char	Freq.	Char	Freq.	Char	Freq.
E	1	y	1	k	1
e	8	s	2	.	1
r	2	n	2		
i	1	a	2		
space	4	l	1		

- Place nodes in a priority queue
  - The lower the occurrence, the higher the priority in the queue

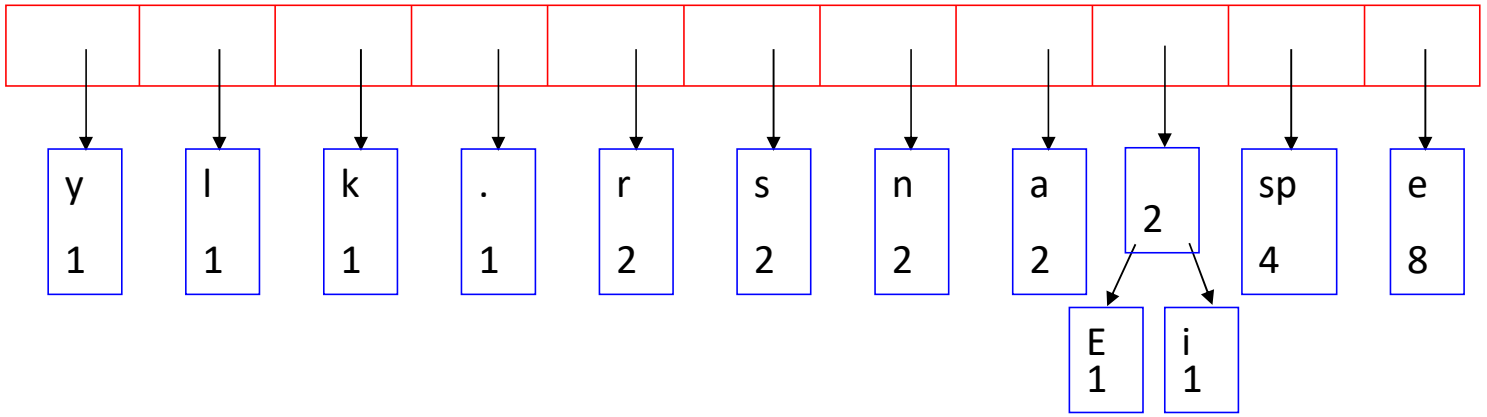


Building a Tree

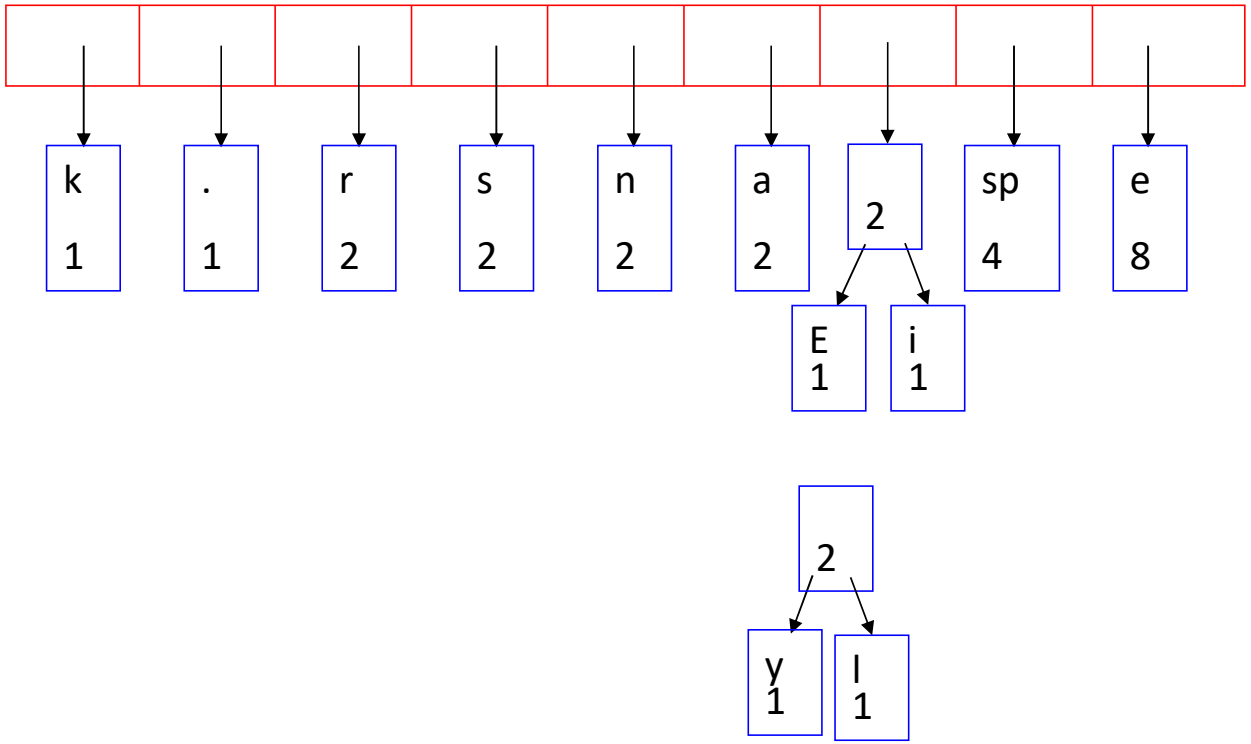




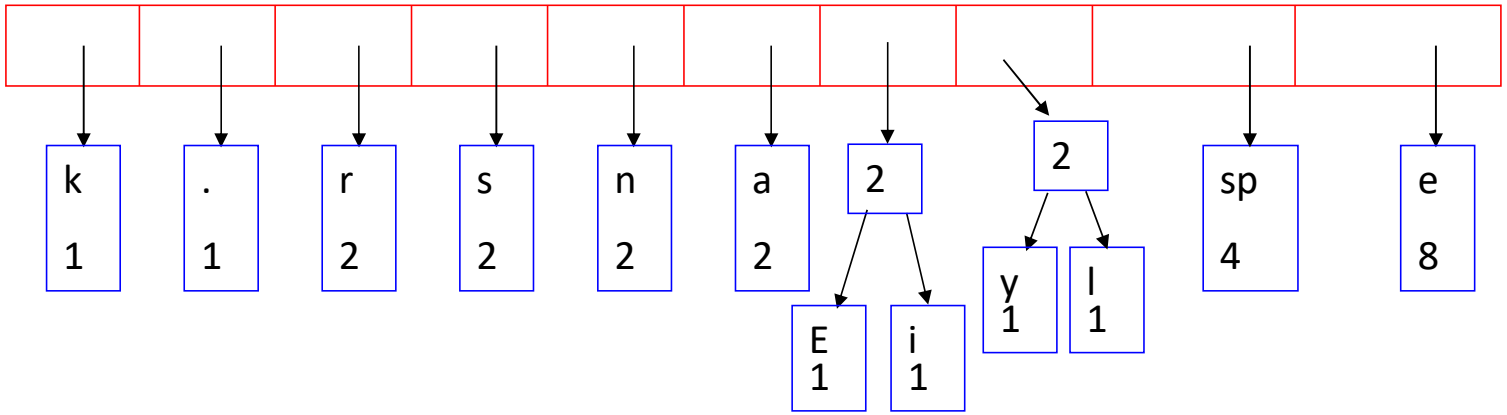
Building a Tree



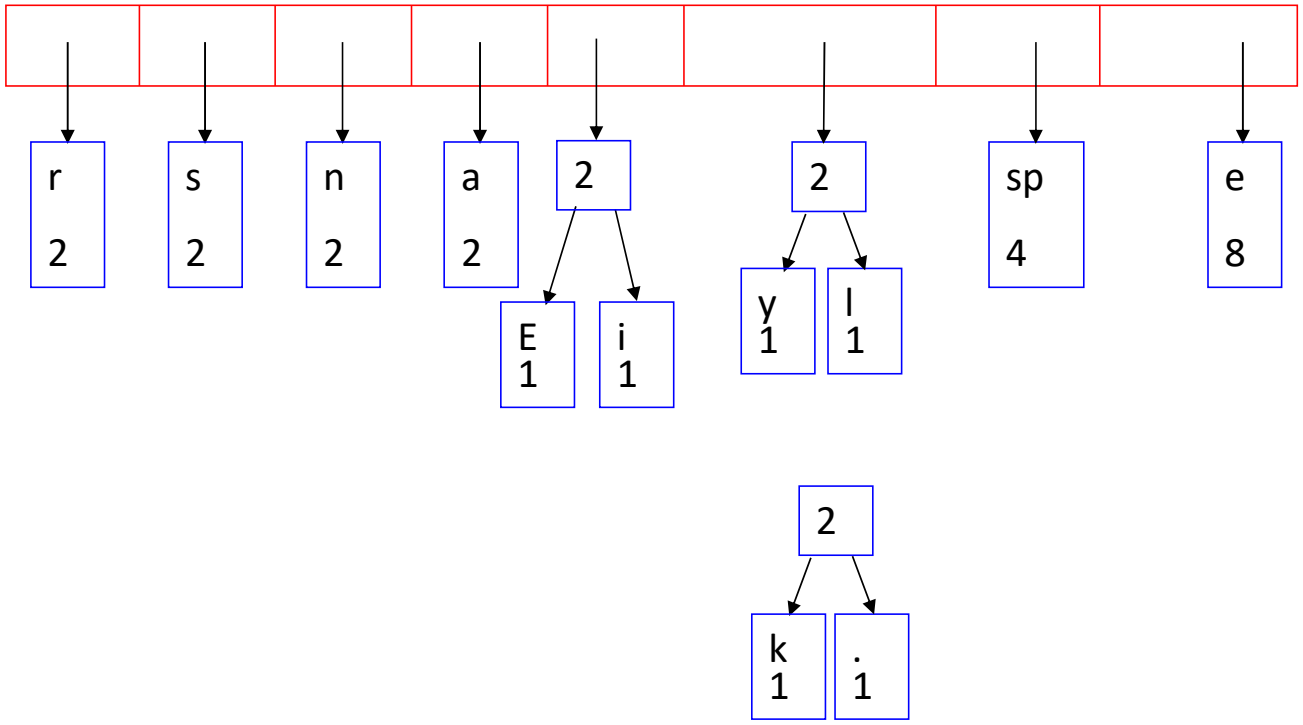
Building a Tree



Building a Tree



Building a Tree



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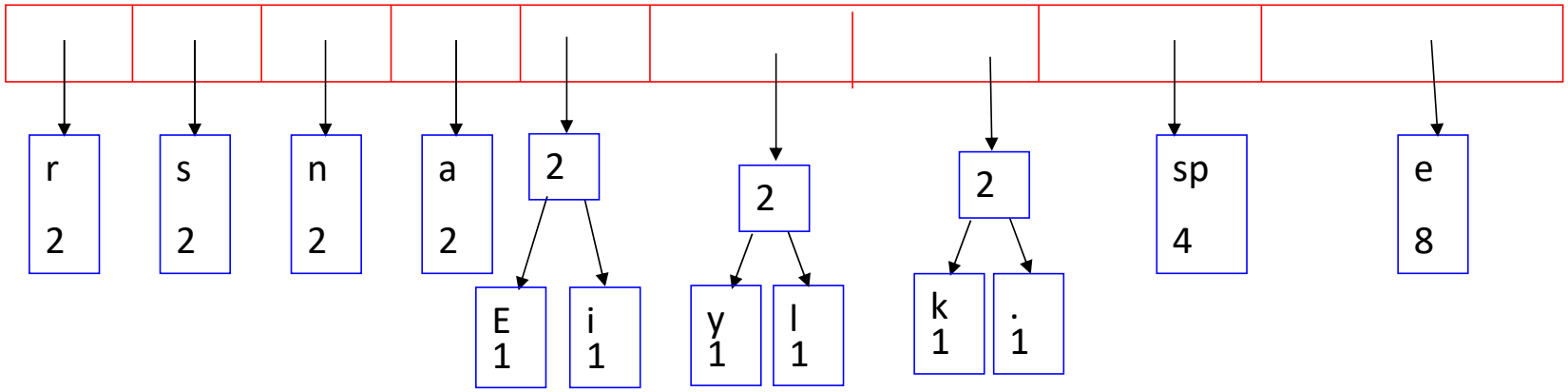

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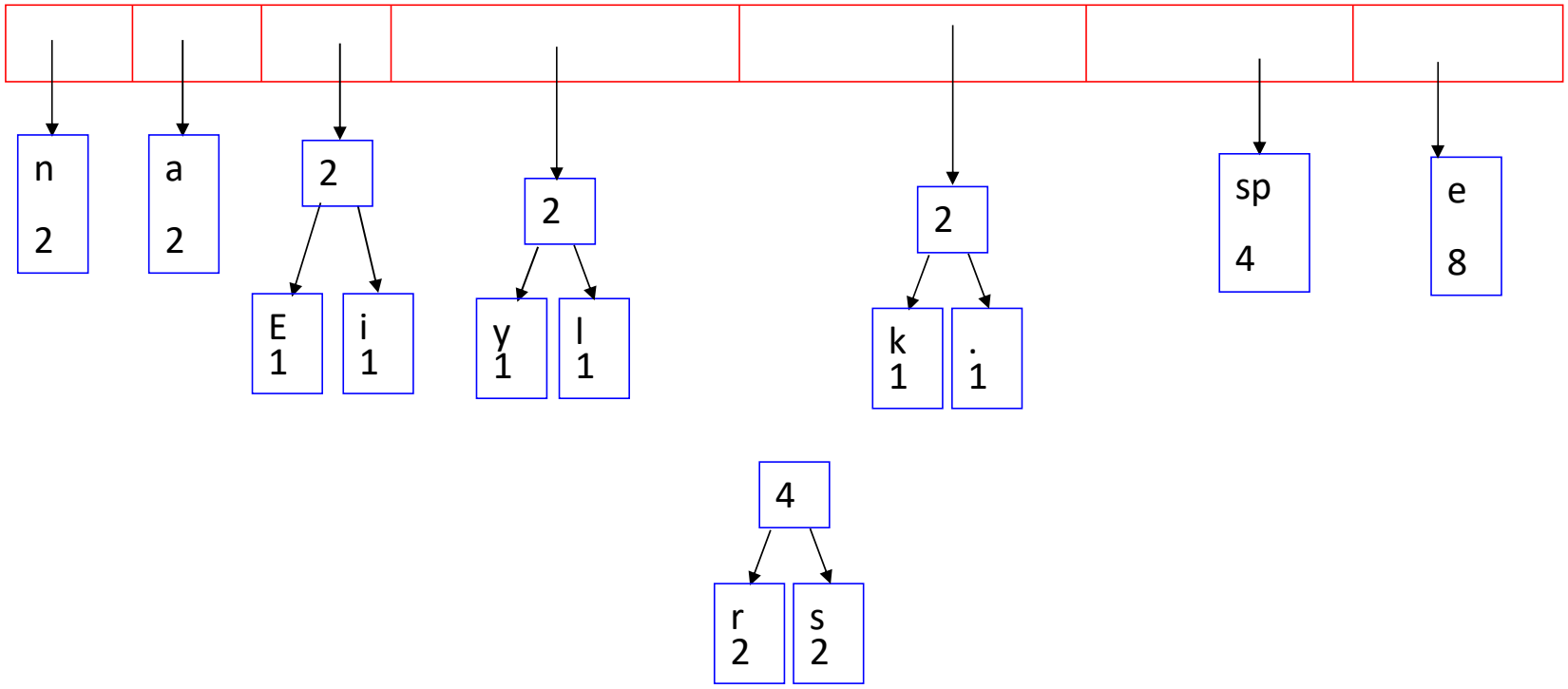

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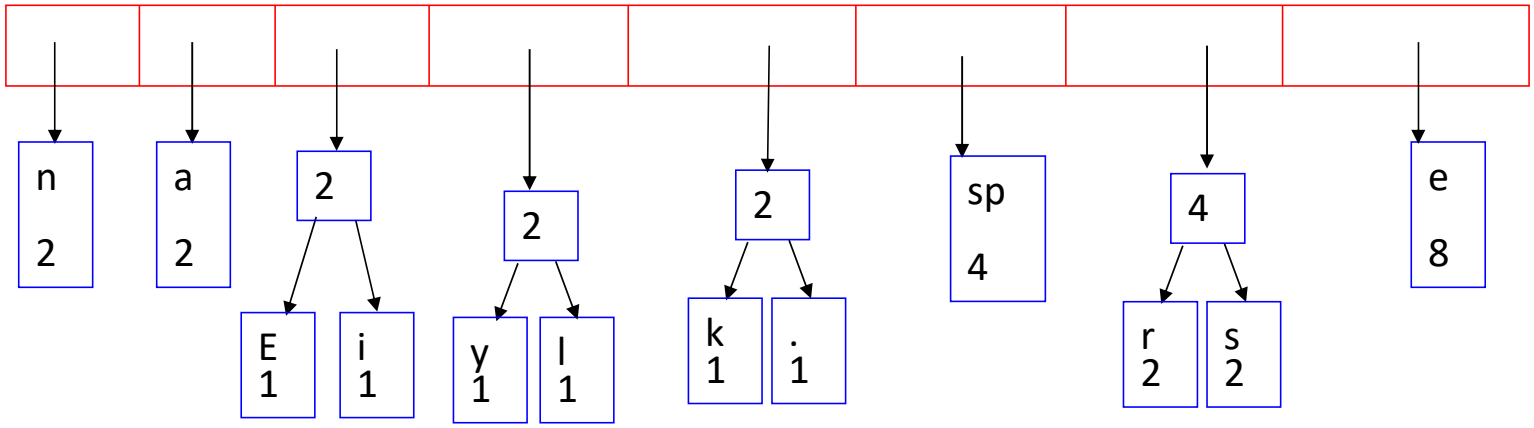

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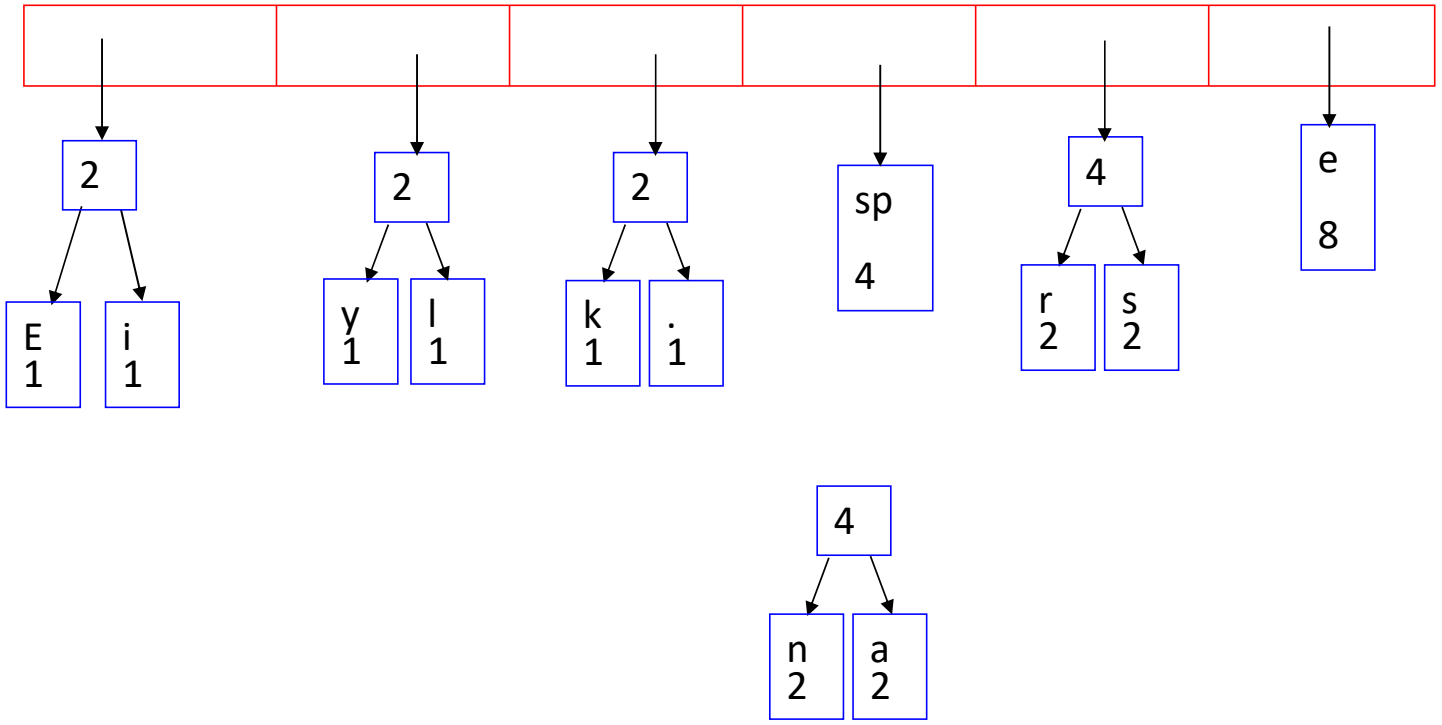

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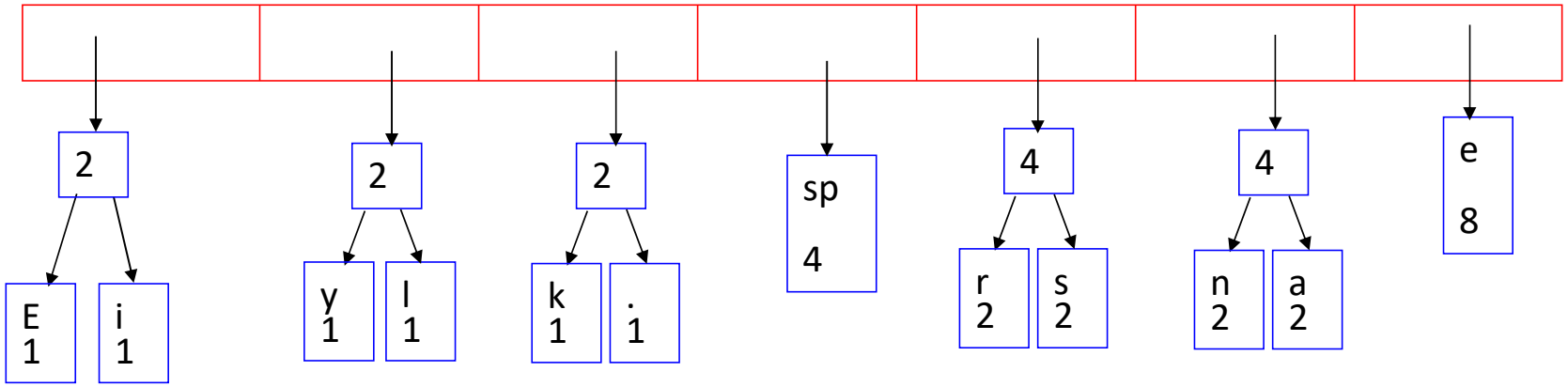
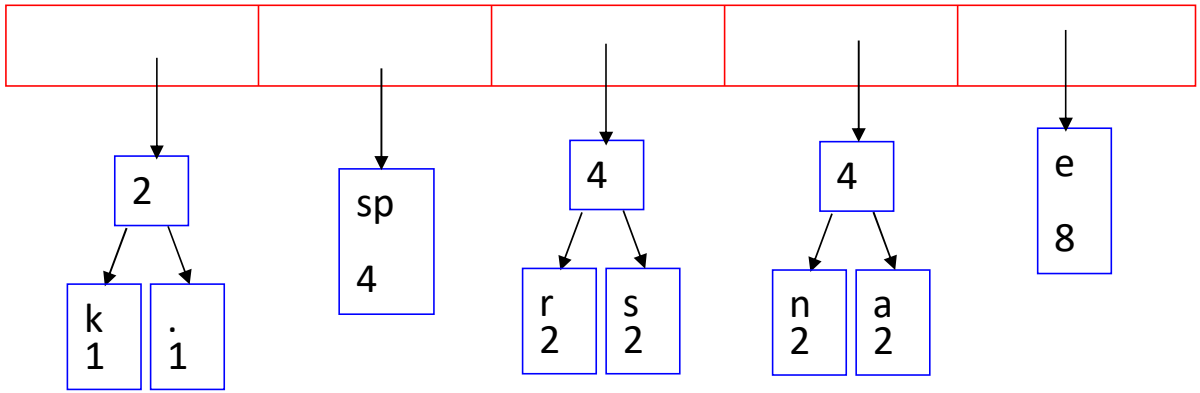
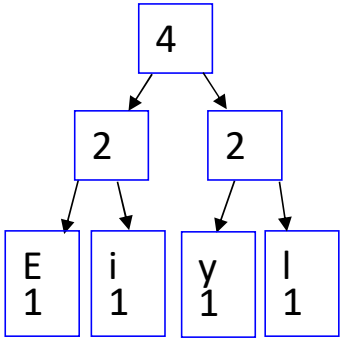


Building a Tree





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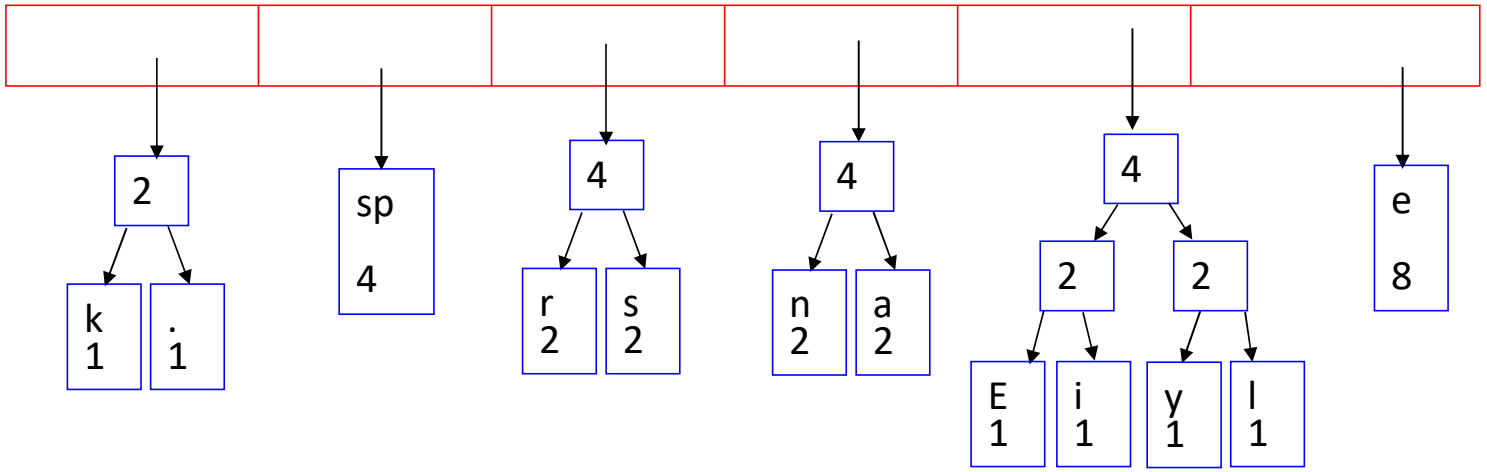

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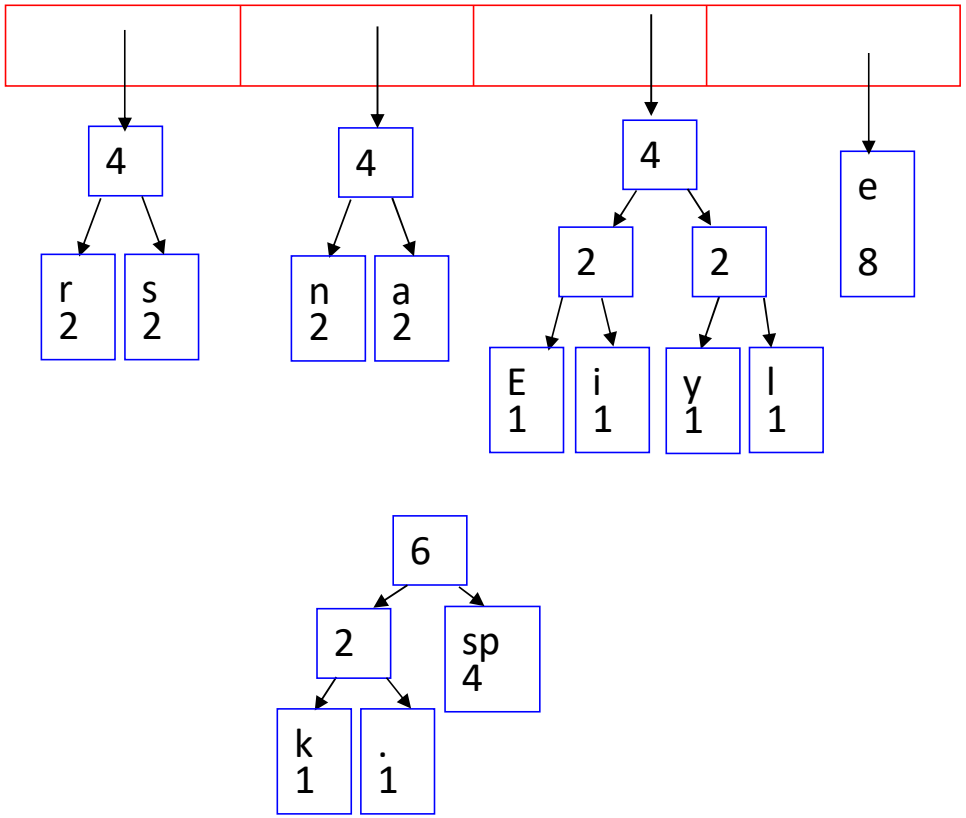
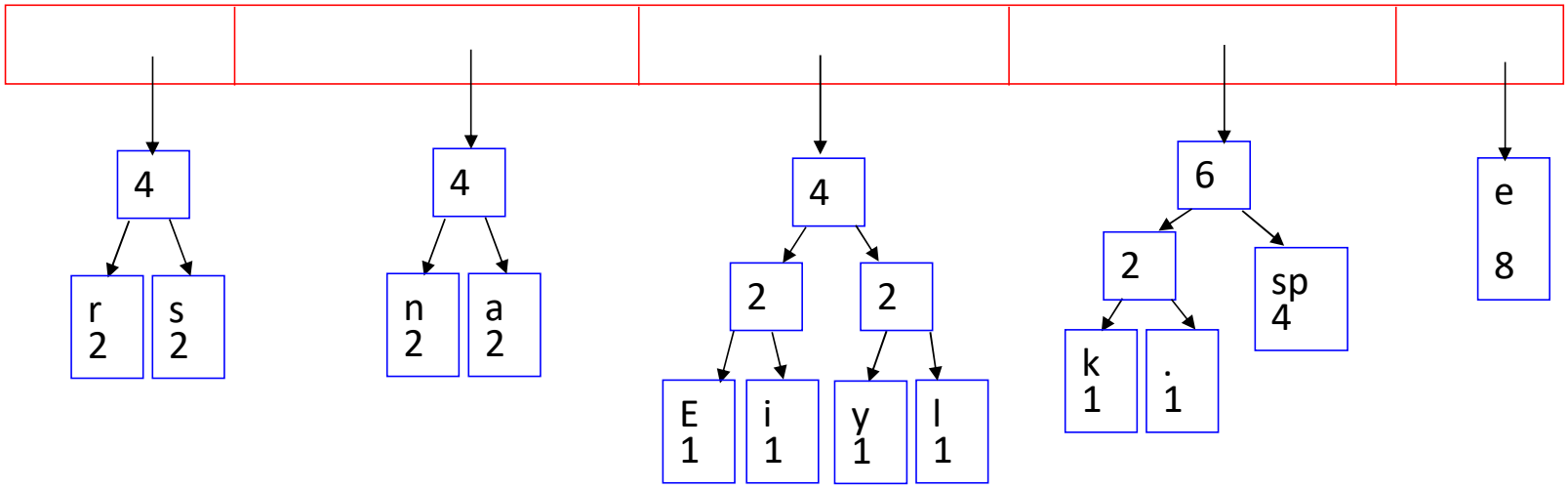
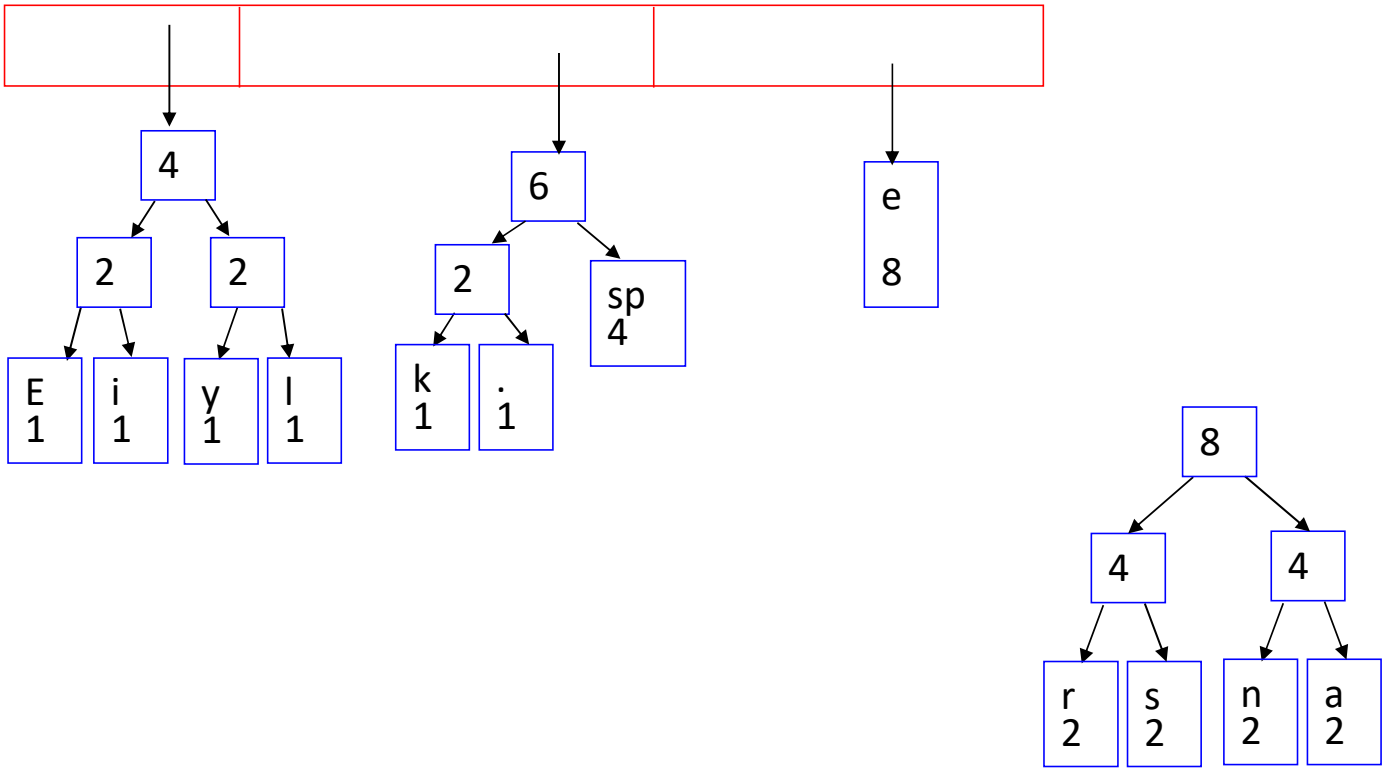


Building a Tree



What is happening to the characters with a low number of occurrences?

Building a Tree



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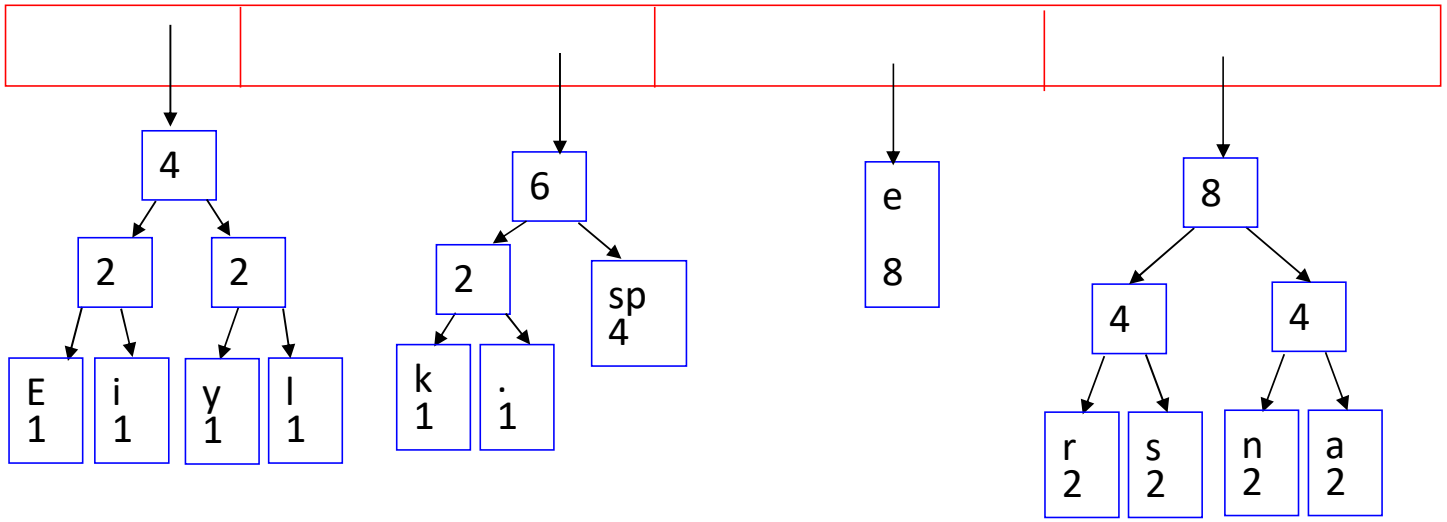

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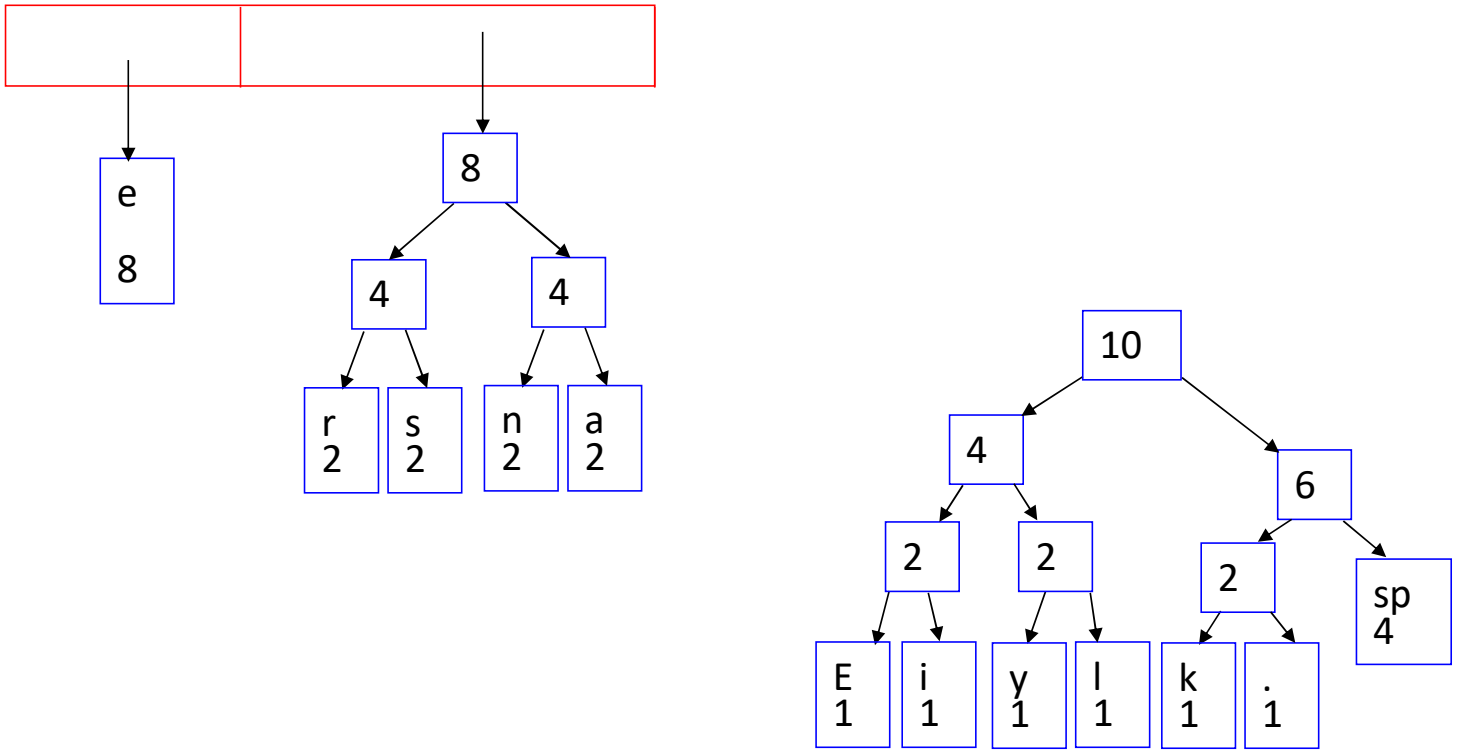

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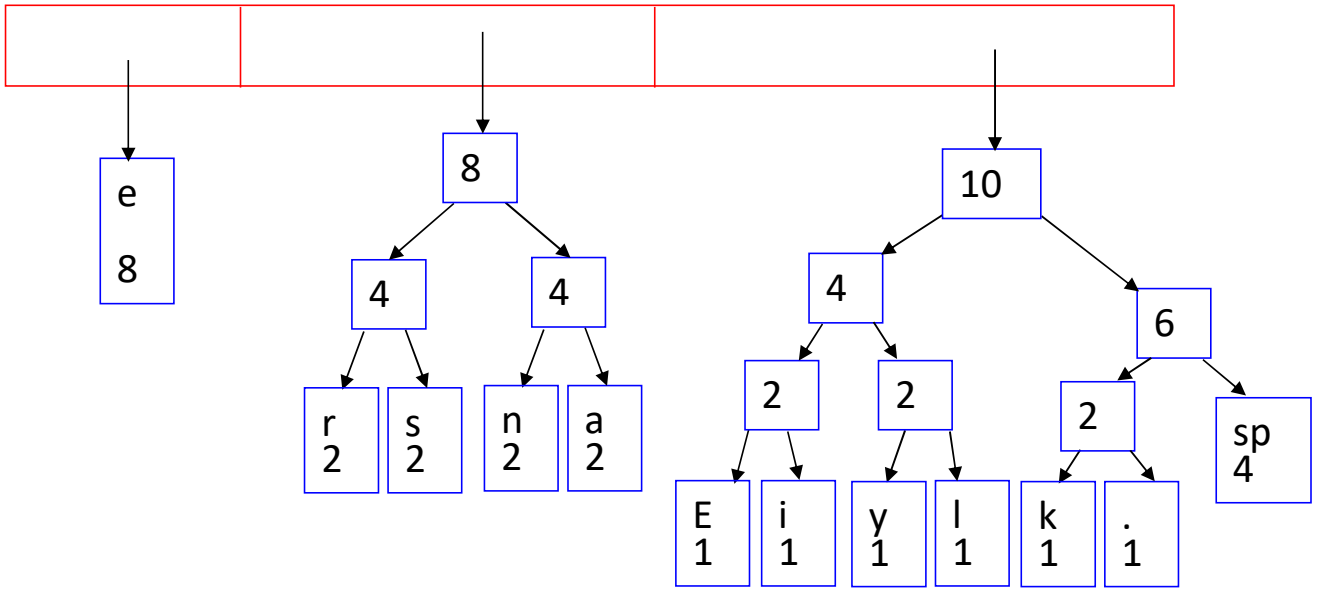
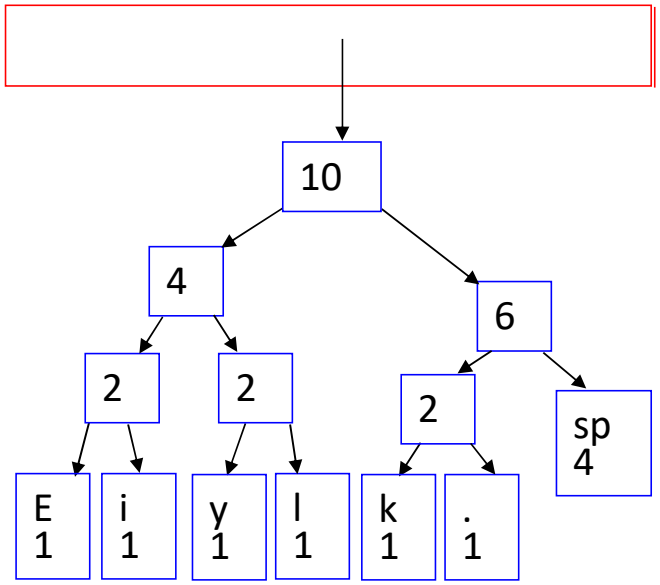
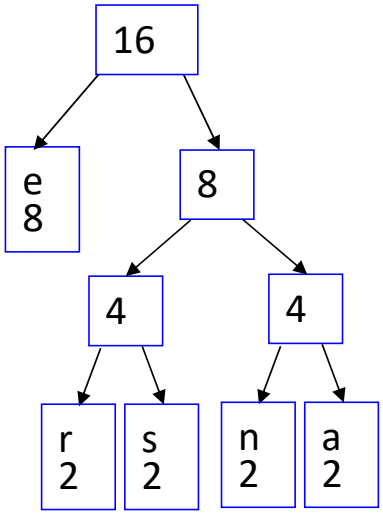


Building a Tree





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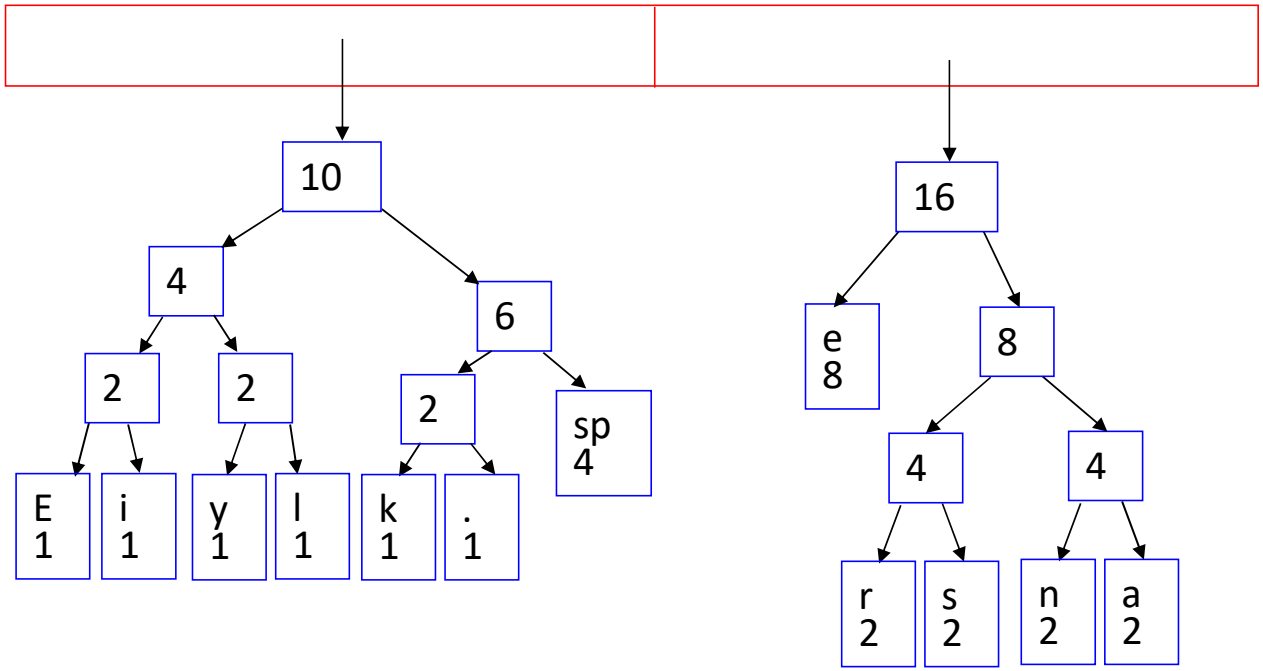

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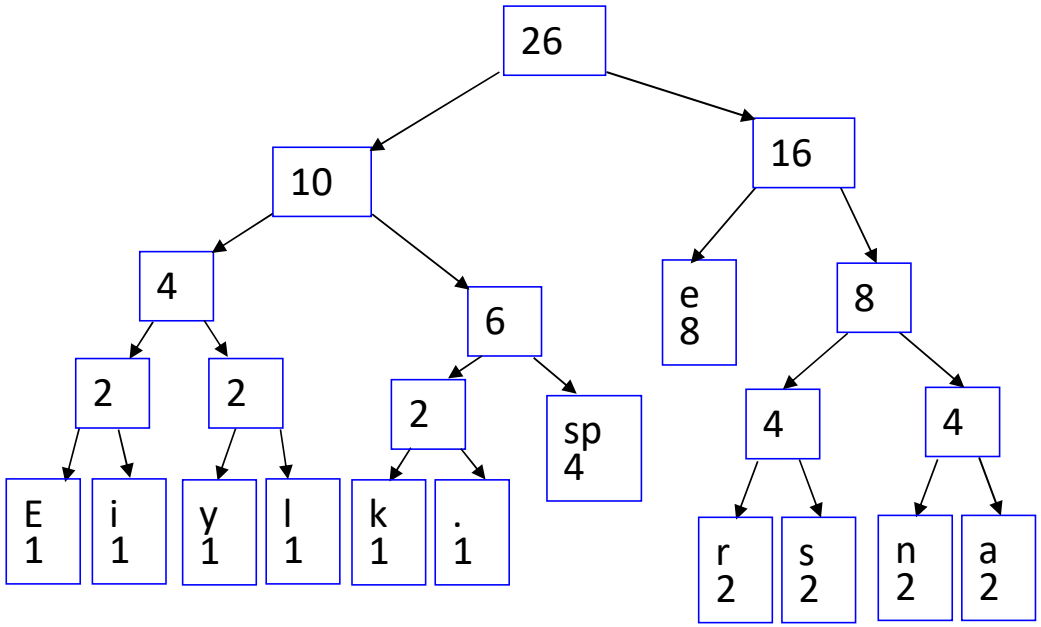

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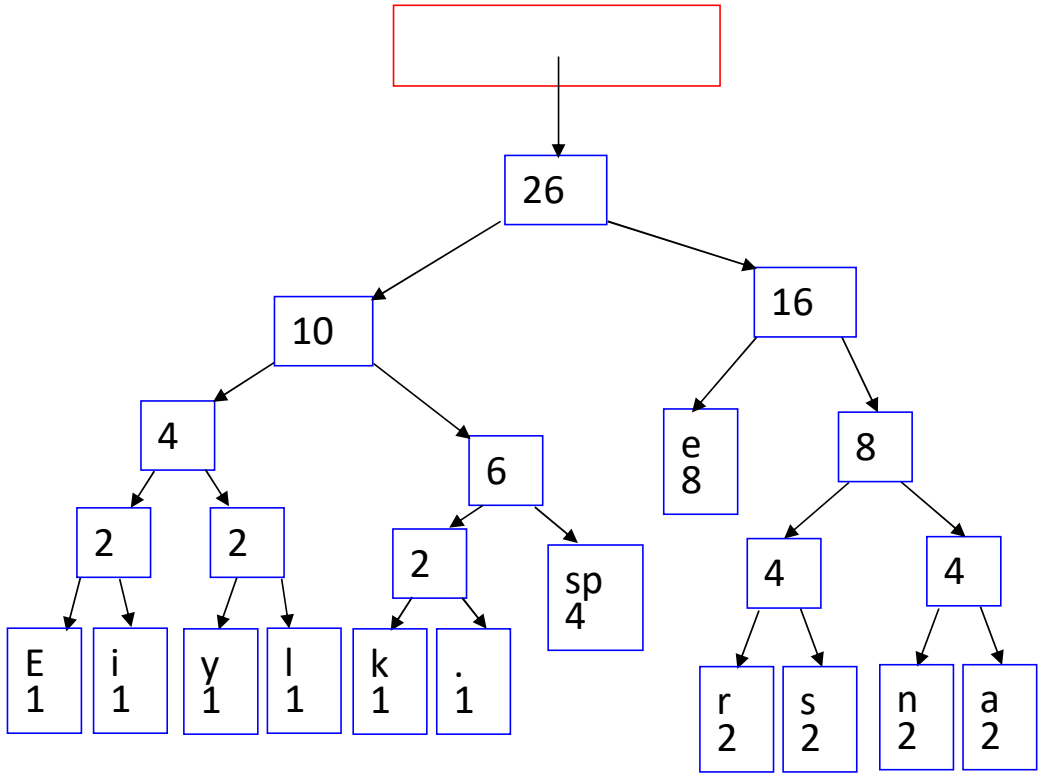


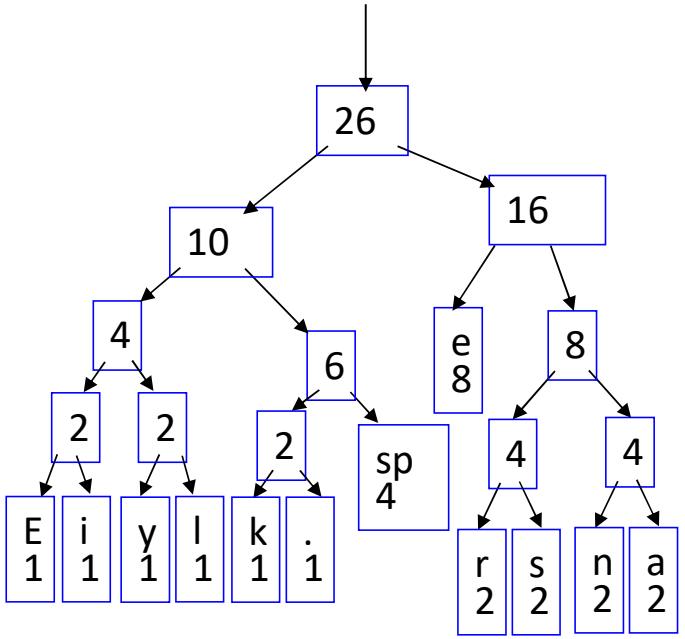
After enqueueing this node there is only one node left in priority queue.

Building a Tree

Dequeue the single node left in the queue.

This tree contains the new code words for each character.

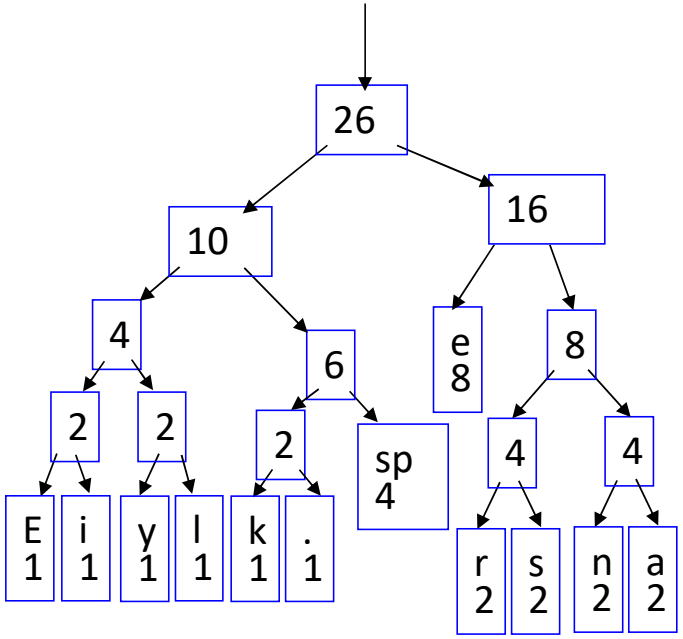
Frequency of root node should equal number of characters in text.



Eerie eyes seen near lake. 26 characters

Encoding the File
Traverse Tree for Codes

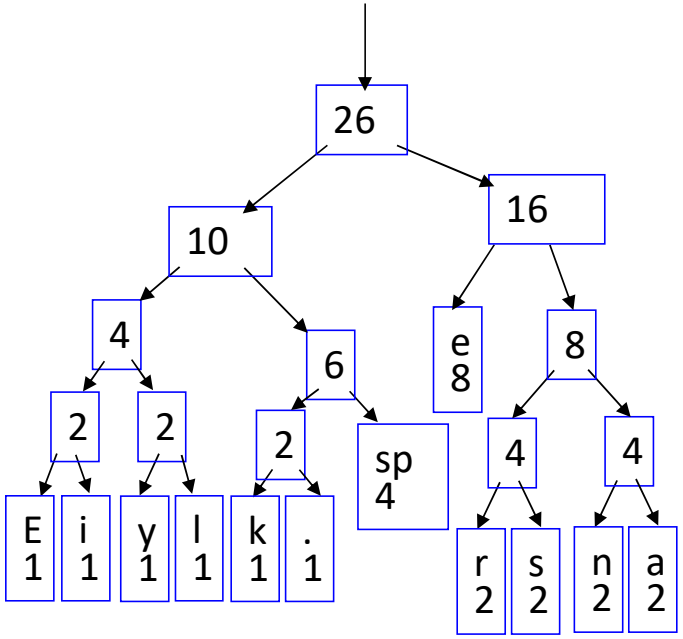
- Perform a traversal of the tree to obtain new code words
- Going left is a 0 going right is a 1
- code word is only completed when a leaf node is reached



Encoding the File

Traverse Tree for Codes

Char	Code
E	0000
i	0001
y	0010
l	0011
k	0100
.	0101
space	011
e	10
r	1100
s	1101
n	1110
a	1111



Encoding the File

- Rescan text and encode file using new code words

Eerie eyes seen near lake.

```
00001011000001100111000101011011010011111101011111110001100111111010010010 1
```

Char	Code
E	0000
i	0001
y	0010
l	0011
k	0100
.	0101
space	011
e	10
r	1100
s	1101
n	1110
a	1111

- **Why is there no need for a separator character?**

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