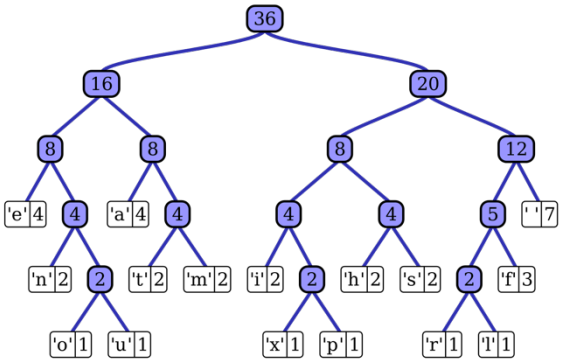
# Huffman agacı ve kodlama

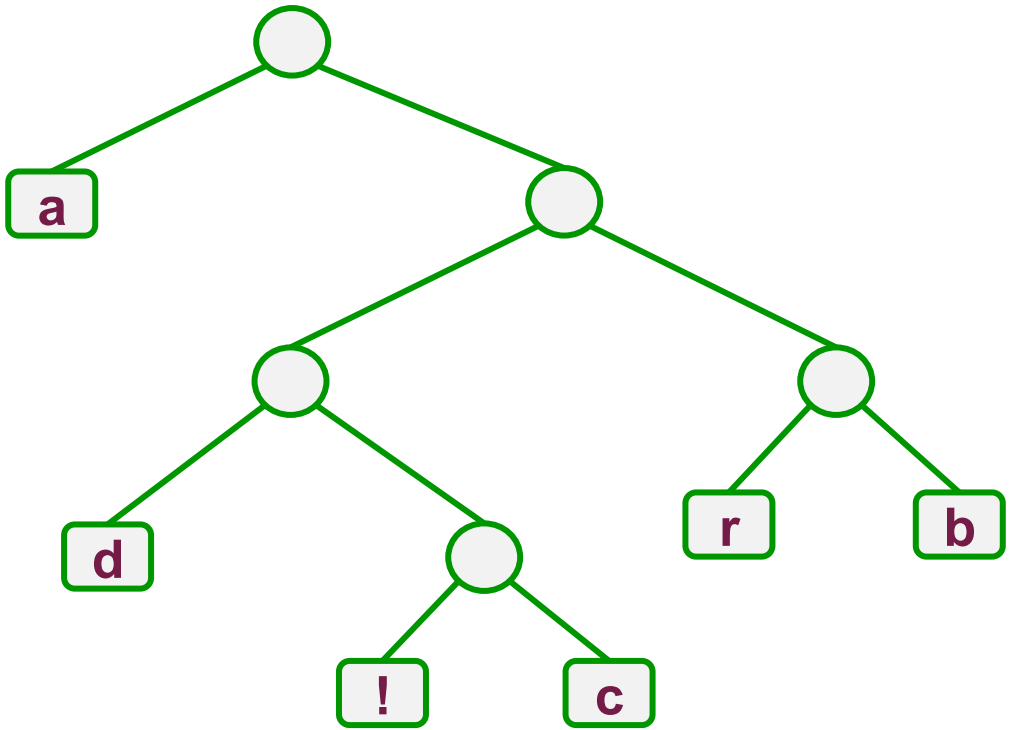



| color | freq. | bit code |
|---|---|---|
| | 14 | 0 |
| | 6 | 10 |
| | 3 | 110 |
| | 2 | 111 |


Suhap SAHIN

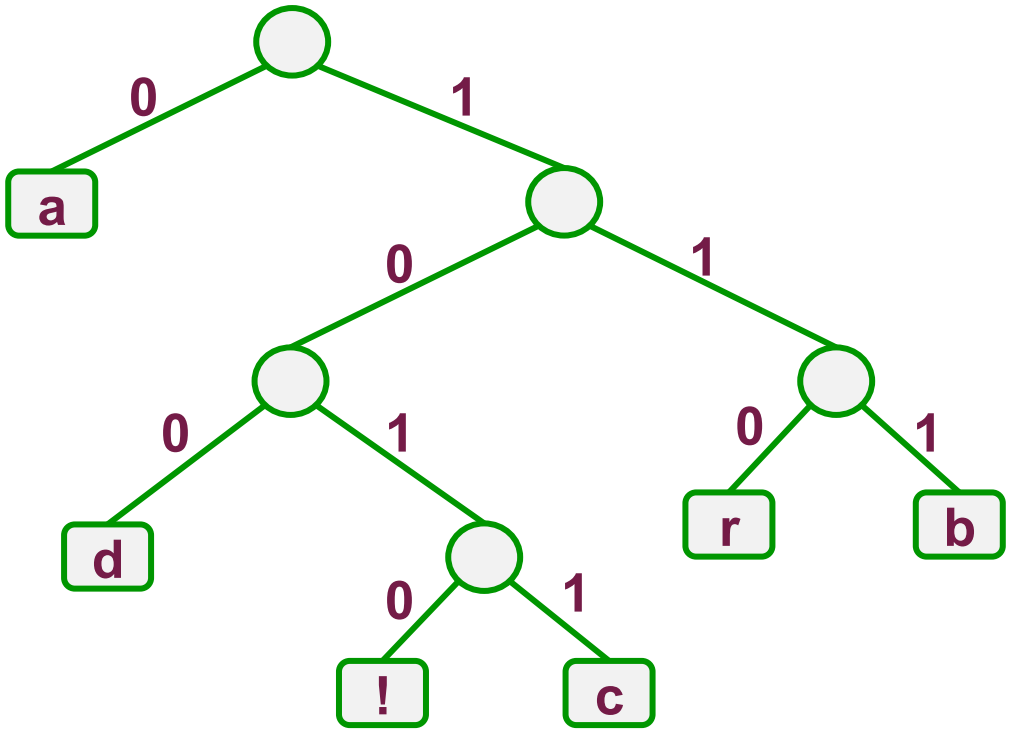
Onur GÖK

# Huffman Kodlama



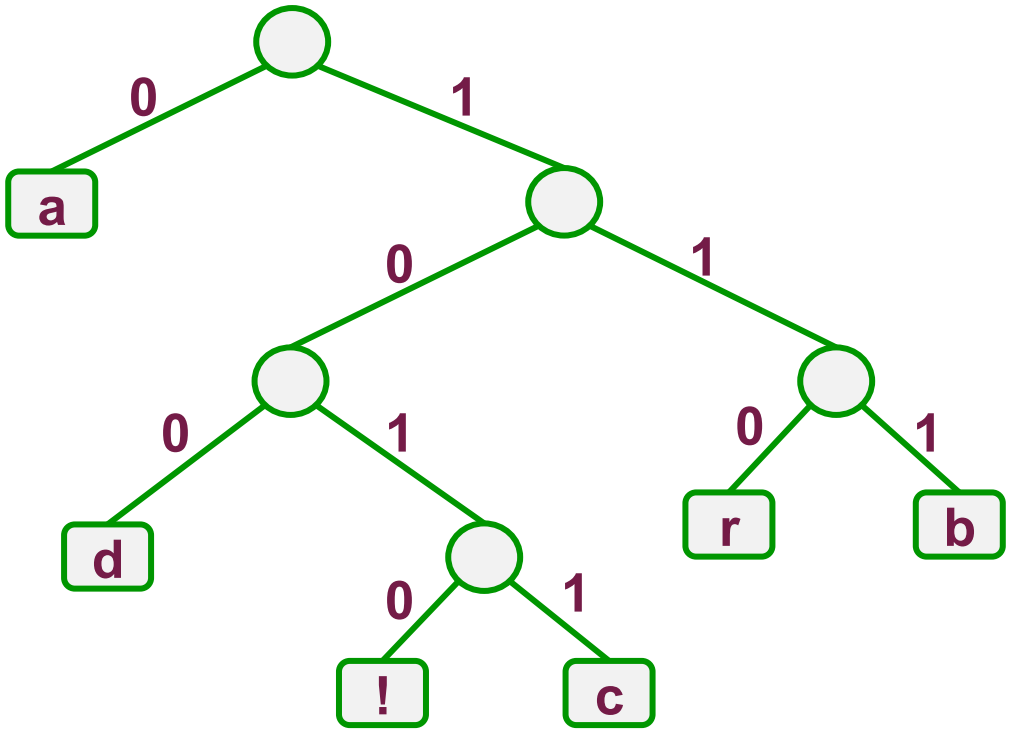

| karakter | kodlama |
|---|---|
| a | 0 |
| b | 111 |
| c | 1011 |
| d | 100 |
| r | 110 |
| ! | 1010 |

# Huffman Kodlama



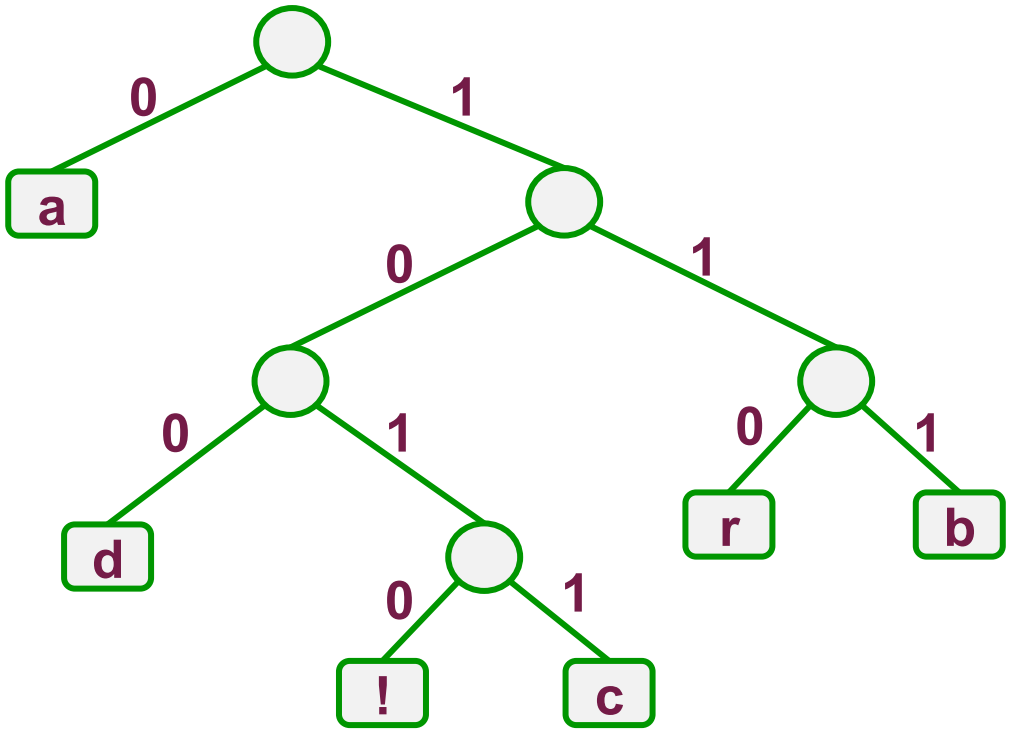

| karakter | kodlama |
|---|---|
| a | 0 |
| b | 111 |
| c | 1011 |
| d | 100 |
| r | 110 |
| ! | 1010 |

# Huffman Kodlama



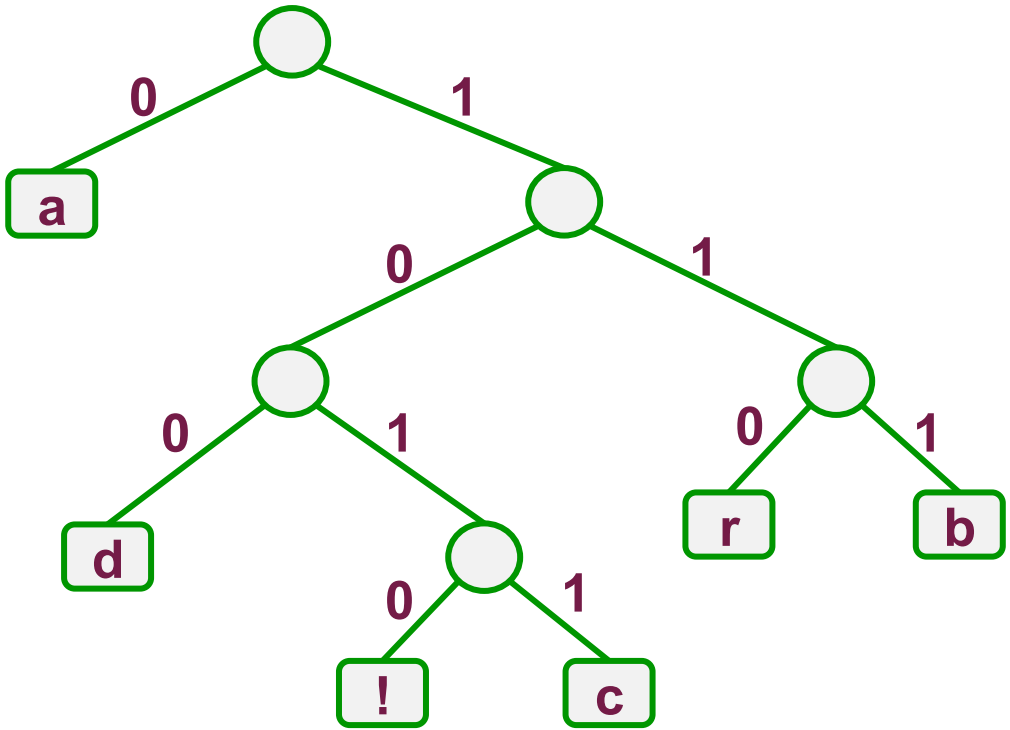

| karakter | kodlama |
|---|---|
| a | 0 |
| b | 111 |
| c | 1011 |
| d | 100 |
| r | 110 |
| ! | 1010 |

# Huffman Kodlama



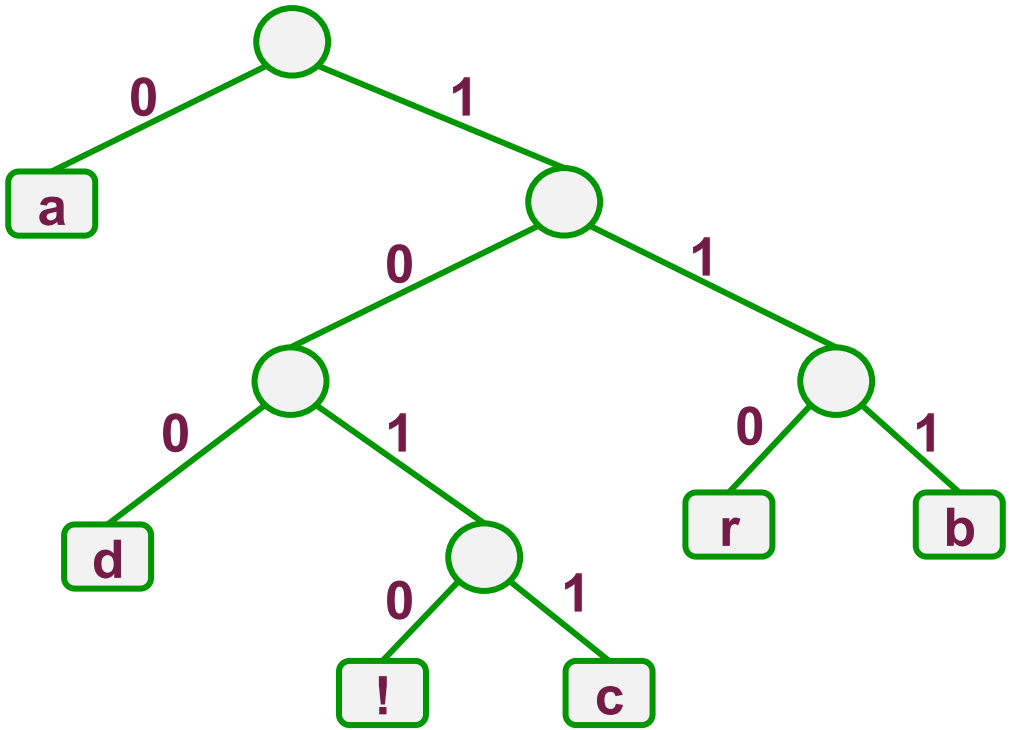

| karakter | kodlama |
|---|---|
| a | 0 |
| b | 111 |
| c | 1011 |
| d | 100 |
| r | 110 |
| ! | 1010 |

# Huffman Kodlama



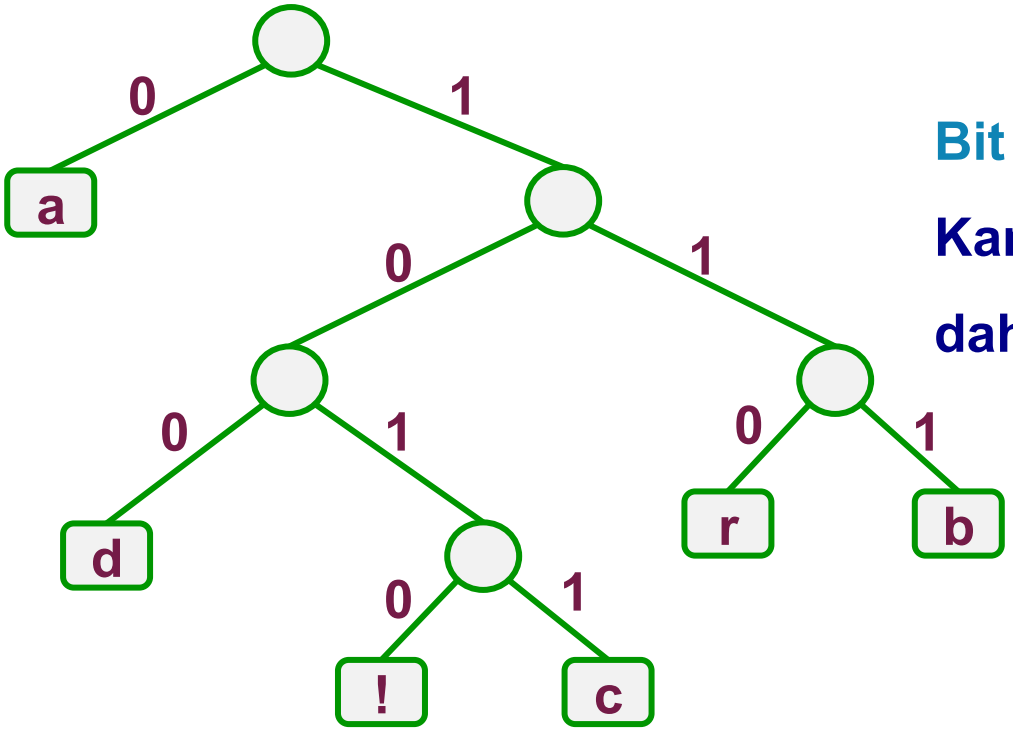

| karakter | kodlama |
|---|---|
| a | 0 |
| b | 111 |
| c | 1011 |
| d | 100 |
| r | 110 |
| ! | 1010 |

# Huffman Kodlama




| karakter | kodlama |
|---|---|
| a | 0 |
| b | 111 |
| c | 1011 |
| d | 100 |
| r | 110 |
| ! | 1010 |

# Huffman Kodlama



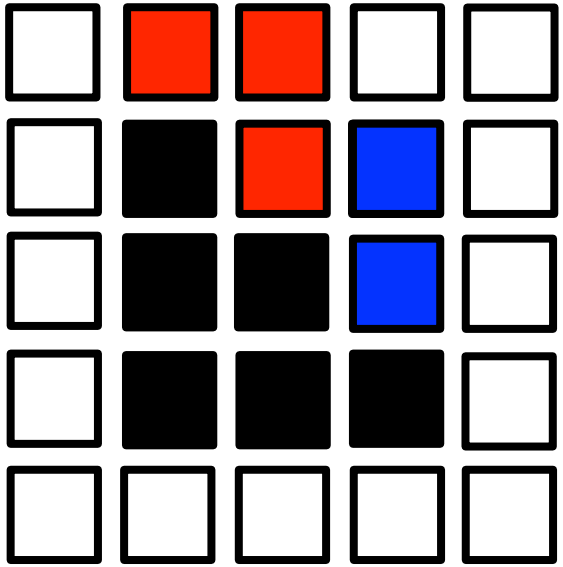

**Bit düzeyinde sıkıstırma**

**Karakterleri frekansına göre**

**daha az bit degeriyle tutmak**

# Huffman Kodlama

**istatiksel olarak kodlama yapılır**



| renk | tekrar | kod | maliyet | maliyet |
|---|---|---|---|---|
| | 14 | 0 | 14 | 42 |
| | 6 | 10 | 12 | 18 |
| | 3 | 110 | 9 | 6 |
| | 2 | 111 | 6 | 6 |

# Frekans bulma

CERACECCERCERACECECRCE

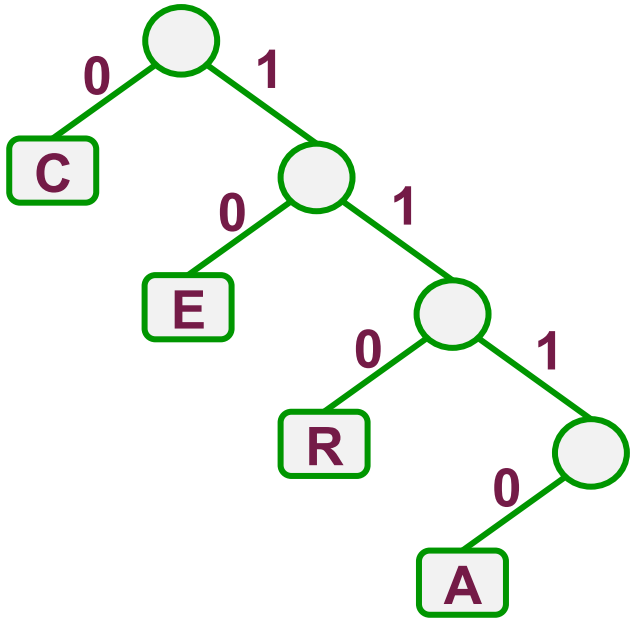
CCECE

| Karakterler | C | E | R | A |
|---|---|---|---|---|
| Frekanslar | 12 | 9 | 4 | 2 |

# Agaç Olusturma

CERACECCERCERACECECRCECCECE

| Karakterler | C | E | R | A |
|---|---|---|---|---|
| Frekanslari | 12 | 9 | 4 | 2 |



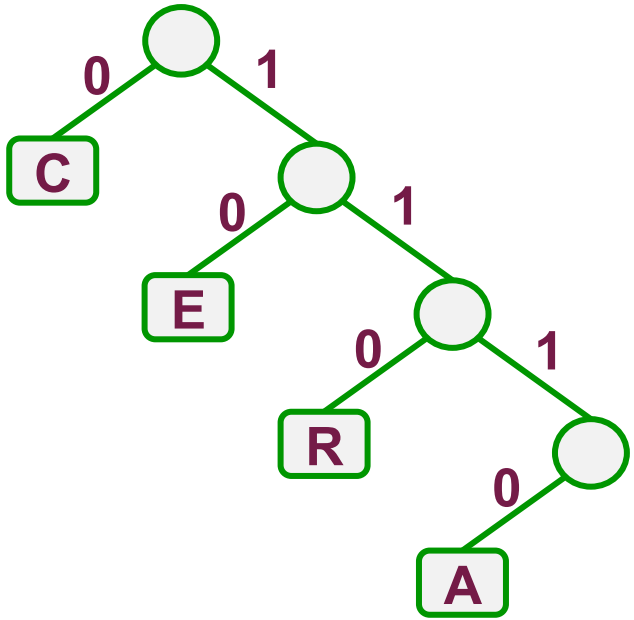
# Kodlama

C E R A C E CC E R C E R A C E C E C R

C E CC E C E

0101101110010001011001011011100100100110010001 0010

| Karakterler | C | E | R | A |
|---|---|---|---|---|
| Frekanslari | 12 | 9 | 4 | 2 |




| | |
|---|---|
| C | 0 |
| E | 10 |
| R | 110 |
| A | 111 |
| | 0 |

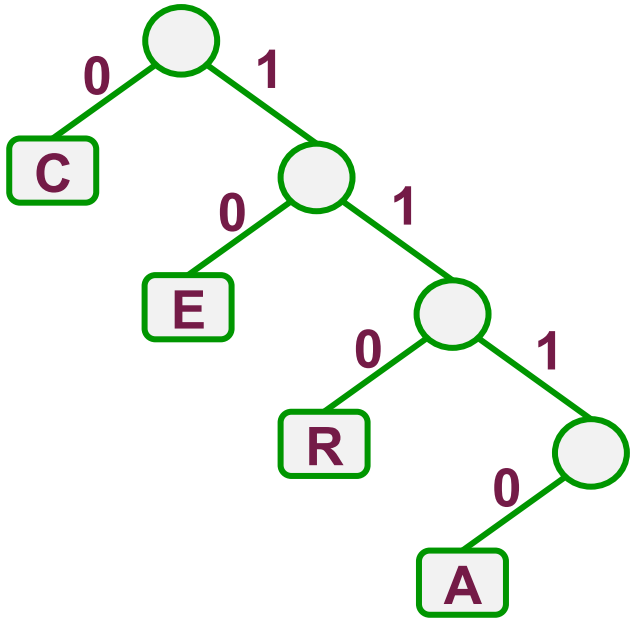
# Metin Olusturma

C E R A C E CC E R C E R A C E C E C R

C E CC E C E

0101101110010001011001011011100100100110010001 0010

| Karakterler | C | E | R | A |
|---|---|---|---|---|
| Frekanslari | 12 | 9 | 4 | 2 |




| | |
|---|---|
| C | 0 |
| E | 10 |
| R | 110 |
| A | 111<br>0 |

# Örn: Frekans Bulma

| Karakter | t | s | o | n | l | e | a |
|---|---|---|---|---|---|---|---|
| Frekans | 53 | 22 | 18 | 45 | 13 | 65 | 45 |

# Örn: Agac olusturma


**Kuyruk iki veya daha fazla dügüm içeriyorsa:**

| Karakter | t | s | o | n | l | e | a |
|---|---|---|---|---|---|---|---|
| Frekans | 53 | 22 | 18 | 45 | 13 | 65 | 45 |

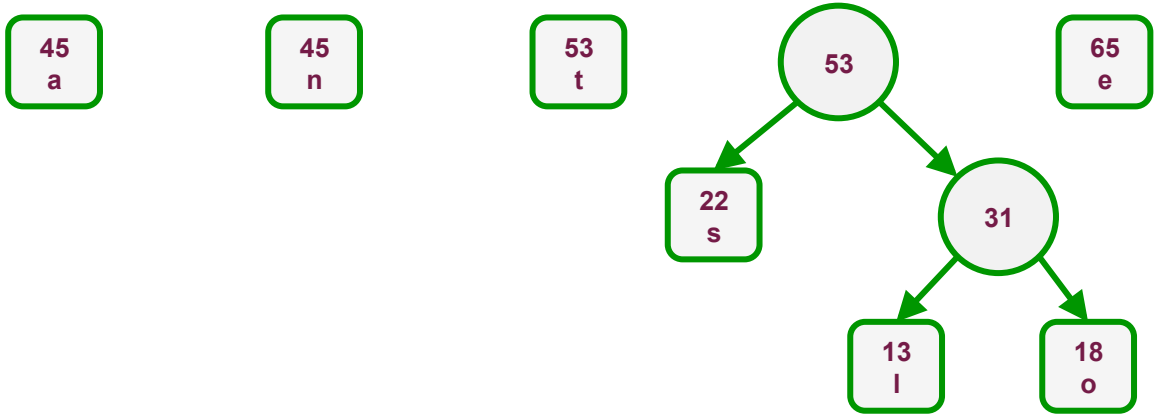
# Örn: Agac olusturma


**Kuyruk iki veya daha fazla dügüm içeriyorsa:**

- Yeni dügüm olustur
- Kuyruktaki ilk dügümü al, yeni dügüm sol çocuk yap
- Kuyruktaki ikinci dügümü al, yeni dügüm sag çocuk yap
- Yeni dügümün degerini çocukların karakter toplamı yap
- Yeni dügümün kuyruktaki yerini bul yerlestir.

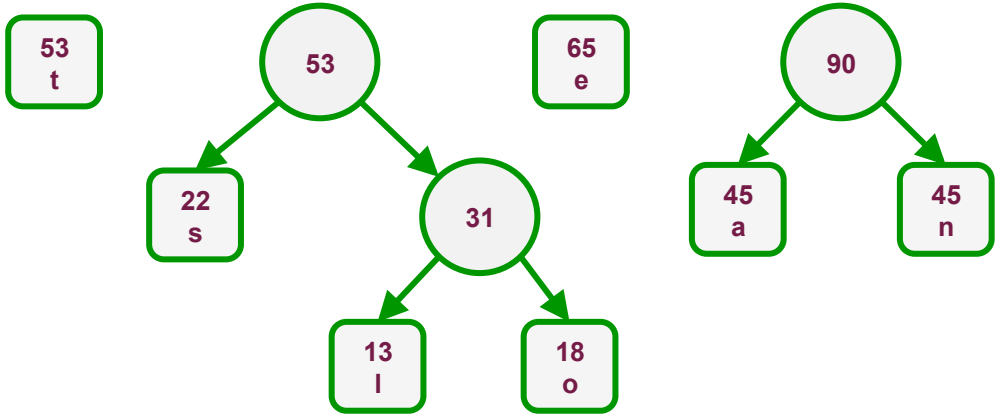
| Karakter | t | s | o | n | l | e | a |
|---|---|---|---|---|---|---|---|
| Frekans | 53 | 22 | 18 | 45 | 13 | 65 | 45 |

# Örn: Agac olusturma



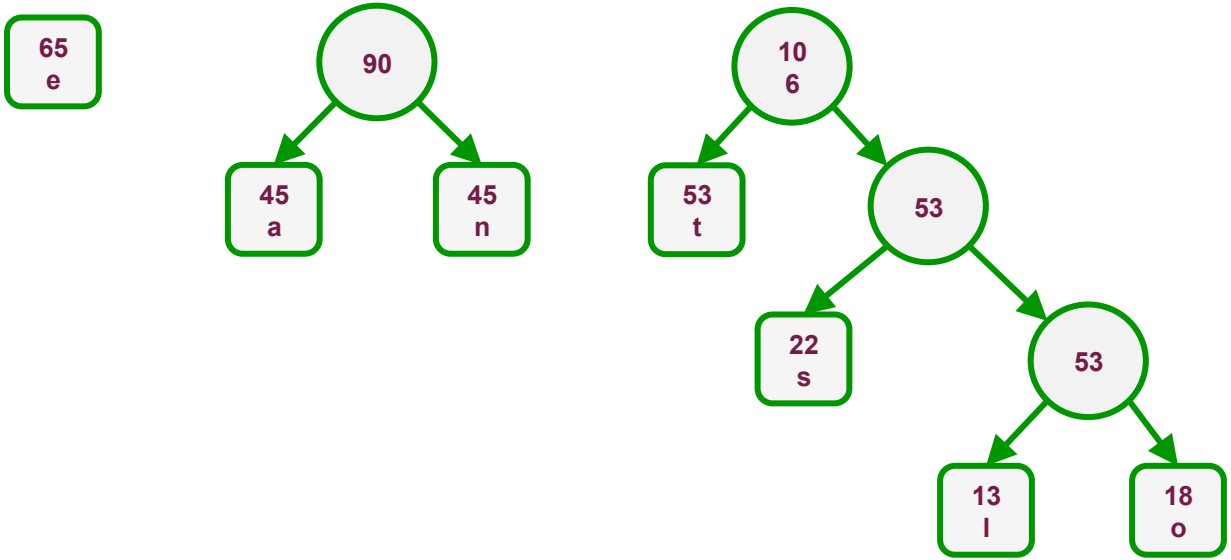

| Karakter | t | s | o | n | l | e | a |
|---|---|---|---|---|---|---|---|
| Frekans | 53 | 22 | 18 | 45 | 13 | 65 | 45 |

# Örn: Agac olusturma



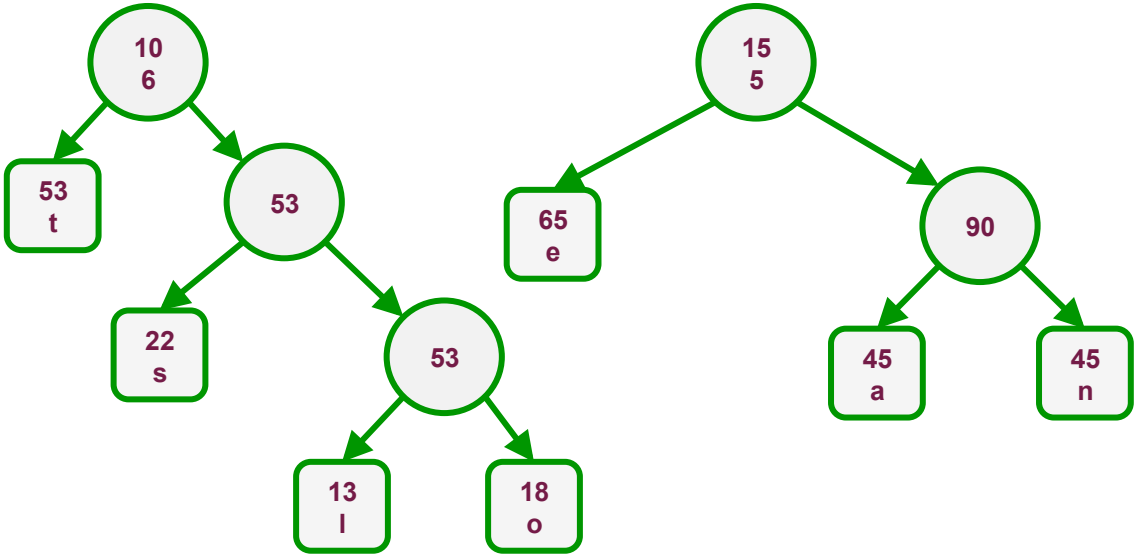

| Karakter | t | s | o | n | l | e | a |
|---|---|---|---|---|---|---|---|
| Frekans | 53 | 22 | 18 | 45 | 13 | 65 | 45 |

# Örn: Agac olusturma



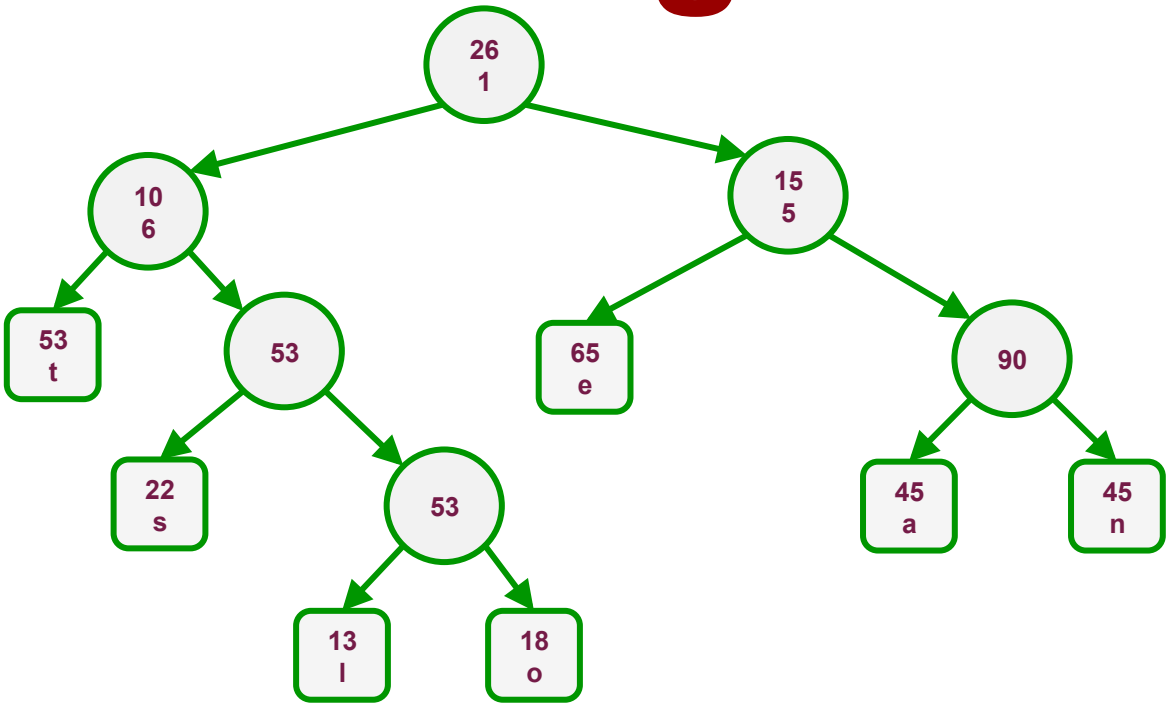

| Karakter | t | s | o | n | l | e | a |
|---|---|---|---|---|---|---|---|
| Frekans | 53 | 22 | 18 | 45 | 13 | 65 | 45 |

# Örn: Agac olusturma



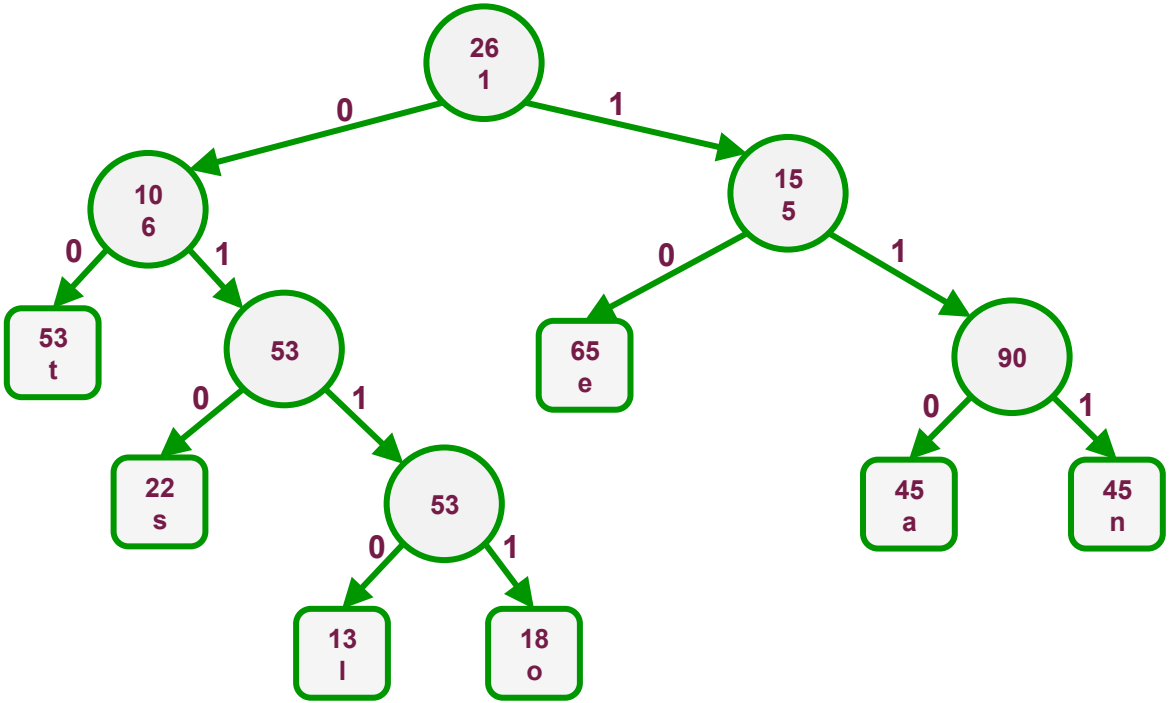

| Karakter | t | s | o | n | l | e | a |
|---|---|---|---|---|---|---|---|
| Frekans | 53 | 22 | 18 | 45 | 13 | 65 | 45 |

# Örn: Agac olusturma




| Karakter | t | s | o | n | l | e | a |
|---|---|---|---|---|---|---|---|
| Frekans | 53 | 22 | 18 | 45 | 13 | 65 | 45 |

# Örn: Kodlama




| Karakter | t | s | o | n | l | e | a |
|---|---|---|---|---|---|---|---|
| Huffman Kodu | 00 | 010 | 011<br>1 | 111 | 0110 | 10 | 110 |

# Metin Olusturma

| Karakter | t | s | o | n | l | e | a |
|---|---|---|---|---|---|---|---|
| Frekans | 53 | 22 | 18 | 45 | 13 | 65 | 45 |

Frekans * Bit sayisi :

(53+22+18+45+13+65+45) *8

= 261 * 8

= 2088

| Decimal | Hex | Char | Decimal | Hex | Char | Decimal | Hex | Char | Decimal | Hex | Char |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | [NULL] | 32 | 20 | [SPACE] | 64 | 40 | @ | 96 | 60 | ` |
| 1 | 1 | [START OF HEADING] | 33 | 21 | ! | 65 | 41 | A | 97 | 61 | a |
| 2 | 2 | [START OF TEXT] | 34 | 22 | " | 66 | 42 | B | 98 | 62 | b |
| 3 | 3 | [END OF TEXT] | 35 | 23 | # | 67 | 43 | C | 99 | 63 | c |
| 4 | 4 | [END OF TRANSMISSION] | 36 | 24 | $ | 68 | 44 | D | 100 | 64 | d |
| 5 | 5 | [ENQUIRY] | 37 | 25 | % | 69 | 45 | E | 101 | 65 | e |
| 6 | 6 | [ACKNOWLEDGE] | 38 | 26 | & | 70 | 46 | F | 102 | 66 | f |
| 7 | 7 | [BELL] | 39 | 27 | ' | 71 | 47 | G | 103 | 67 | g |
| 8 | 8 | [BACKSPACE] | 40 | 28 | ( | 72 | 48 | H | 104 | 68 | h |
| 9 | 9 | [HORIZONTAL TAB] | 41 | 29 | ) | 73 | 49 | I | 105 | 69 | i |
| 10 | A | [LINE FEED] | 42 | 2A | * | 74 | 4A | J | 106 | 6A | j |
| 11 | B | [VERTICAL TAB] | 43 | 2B | + | 75 | 4B | K | 107 | 6B | k |
| 12 | C | [FORM FEED] | 44 | 2C | , | 76 | 4C | L | 108 | 6C | l |
| 13 | D | [CARRIAGE RETURN] | 45 | 2D | - | 77 | 4D | M | 109 | 6D | m |
| 14 | E | [SHIFT OUT] | 46 | 2E | . | 78 | 4E | N | 110 | 6E | n |
| 15 | F | [SHIFT IN] | 47 | 2F | / | 79 | 4F | O | 111 | 6F | o |
| 16 | 10 | [DATA LINK ESCAPE] | 48 | 30 | 0 | 80 | 50 | P | 112 | 70 | p |
| 17 | 11 | [DEVICE CONTROL 1] | 49 | 31 | 1 | 81 | 51 | Q | 113 | 71 | q |
| 18 | 12 | [DEVICE CONTROL 2] | 50 | 32 | 2 | 82 | 52 | R | 114 | 72 | r |
| 19 | 13 | [DEVICE CONTROL 3] | 51 | 33 | 3 | 83 | 53 | S | 115 | 73 | s |
| 20 | 14 | [DEVICE CONTROL 4] | 52 | 34 | 4 | 84 | 54 | T | 116 | 74 | t |
| 21 | 15 | [NEGATIVE ACKNOWLEDGE] | 53 | 35 | 5 | 85 | 55 | U | 117 | 75 | u |
| 22 | 16 | [SYNCHRONOUS IDLE] | 54 | 36 | 6 | 86 | 56 | V | 118 | 76 | v |
| 23 | 17 | [ENG OF TRANS. BLOCK] | 55 | 37 | 7 | 87 | 57 | W | 119 | 77 | w |
| 24 | 18 | [CANCEL] | 56 | 38 | 8 | 88 | 58 | X | 120 | 78 | x |
| 25 | 19 | [END OF MEDIUM] | 57 | 39 | 9 | 89 | 59 | Y | 121 | 79 | y |
| 26 | 1A | [SUBSTITUTE] | 58 | 3A | : | 90 | 5A | Z | 122 | 7A | z |
| 27 | 1B | [ESCAPE] | 59 | 3B | ; | 91 | 5B | [ | 123 | 7B | { |
| 28 | 1C | [FILE SEPARATOR] | 60 | 3C | < | 92 | 5C | \ | 124 | 7C | \| |
| 29 | 1D | [GROUP SEPARATOR] | 61 | 3D | = | 93 | 5D | ] | 125 | 7D | } |
| 30 | 1E | [RECORD SEPARATOR] | 62 | 3E | > | 94 | 5E | ^ | 126 | 7E | ~ |
| 31 | 1F | [UNIT SEPARATOR] | 63 | 3F | ? | 95 | 5F | _ | 127 | 7F | [DEL] |

# Metin Olusturma

| Karakter | t | s | o | n | l | e | a |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

# Metin Olusturma

| Karakter | t | s | o | n | l | e | a |
|---|---|---|---|---|---|---|---|
| Huffman Kodu | 00 | 010 | 0111 | 111 | 0110 | 10 | 110 |

# Metin Olusturma

| Karakter | t | s | o | n | l | e | a |
|---|---|---|---|---|---|---|---|
| Huffman Kodu | 00 | 010 | 0111 | 111 | 0110 | 10 | 110 |
| Bit Sayısı | 2 | 3 | 4 | 3 | 4 | 2 | 3 |

# Metin Olusturma

| Karakter | t | s | o | n | l | e | a |
|---|---|---|---|---|---|---|---|
| Huffman Kodu | 00 | 010 | 0111 | 111 | 0110 | 10 | 110 |
| Bit Sayısı | 2 | 3 | 4 | 3 | 4 | 2 | 3 |
| Frekans | 53 | 22 | 18 | 45 | 13 | 65 | 45 |

# Metin Olusturma

| Karakter | t | s | o | n | l | e | a |
|---|---|---|---|---|---|---|---|
| Huffman Kodu | 00 | 010 | 0111 | 111 | 0110 | 10 | 110 |
| Bit Sayısı | 2 | 3 | 4 | 3 | 4 | 2 | 3 |
| Frekans | 53 | 22 | 18 | 45 | 13 | 65 | 45 |
| Frekans * Bit Sayısı | 106 | 66 | 72 | 135 | 52 | 130 | 135 |
| Toplam | | | | 696 | | | |

# Metin Olusturma

| | |
|---|---|
| t | 00 |
| s | 010 |
| o | 0111 |
| n | 111 |
| l | 0110 |
| e | 10 |
| a | 110 |

**Sıkıstırılmıs dosyadaki bit sayısı**
**= kac_bit + hangi_karakterler + toplam_kod + sıkıstırılmıs_metin**
**= 3 + (7*8) + 21 + 696**
**= 776**

**Sıkıstırma oranı**
**= normal metin bit sayısı / kodlanmıs metin bit saıysı**

**= 2088 / 776**
**= 2.69**

**sıkıstırılmıs metin, gerçek metin %37'si kadardır.**
**100 / 2.69 = 37%**

# Metin Olusturma

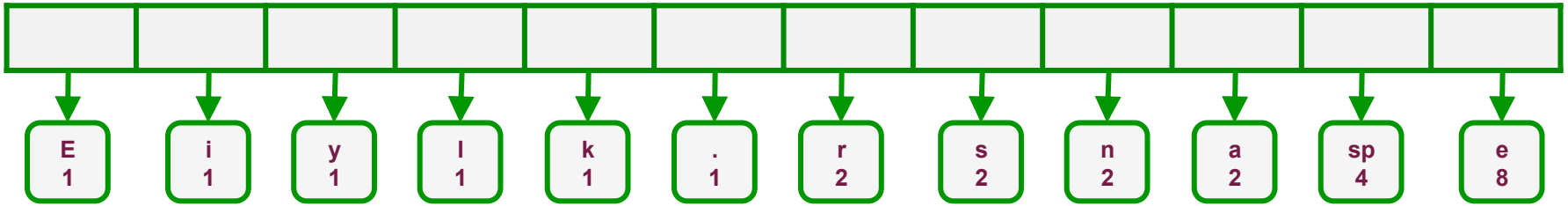
| Karakter | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| Huffman Kodu | 0 | 101 | 100 | 111 | 110 | 1100 |

**Decode:** 11000100110

11000100110 face

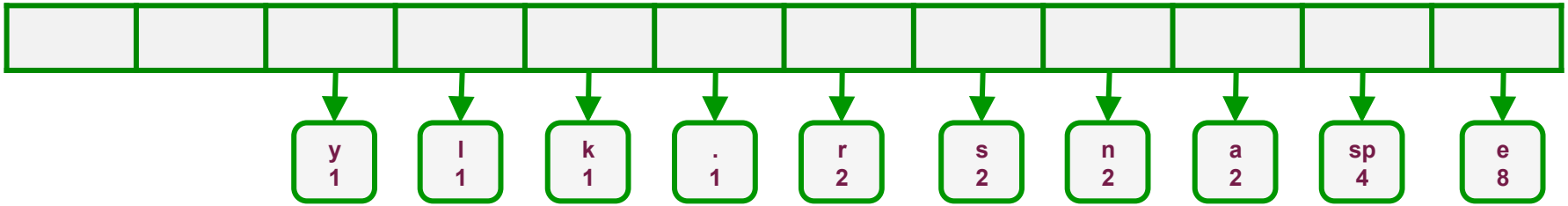
11000100110 eaac e

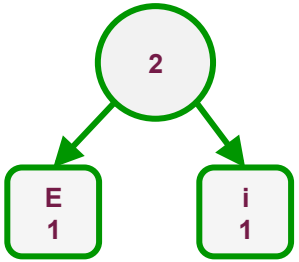
# Statik Huffman Kodlama




**“Eerie eyes seen near lake.”**

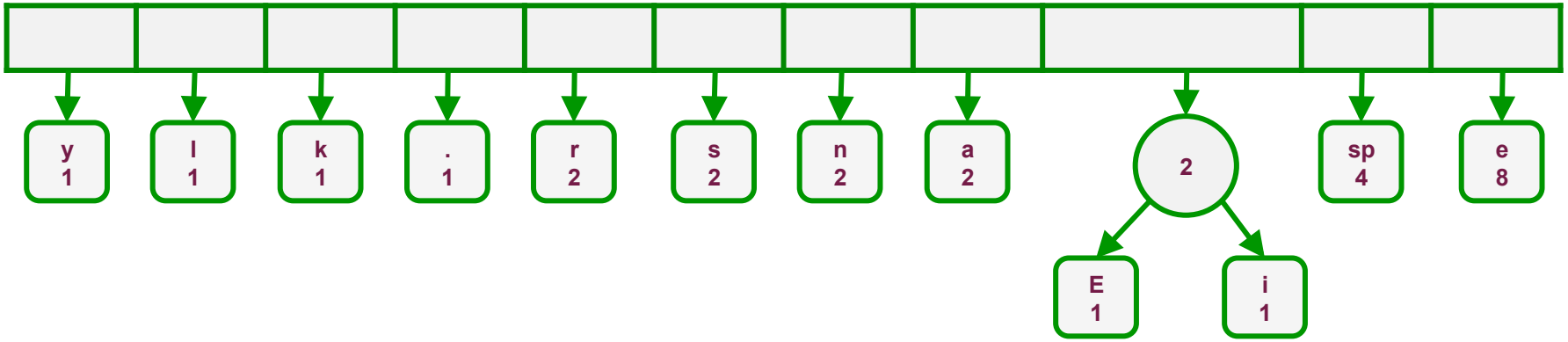
# Statik Huffman Kodlama



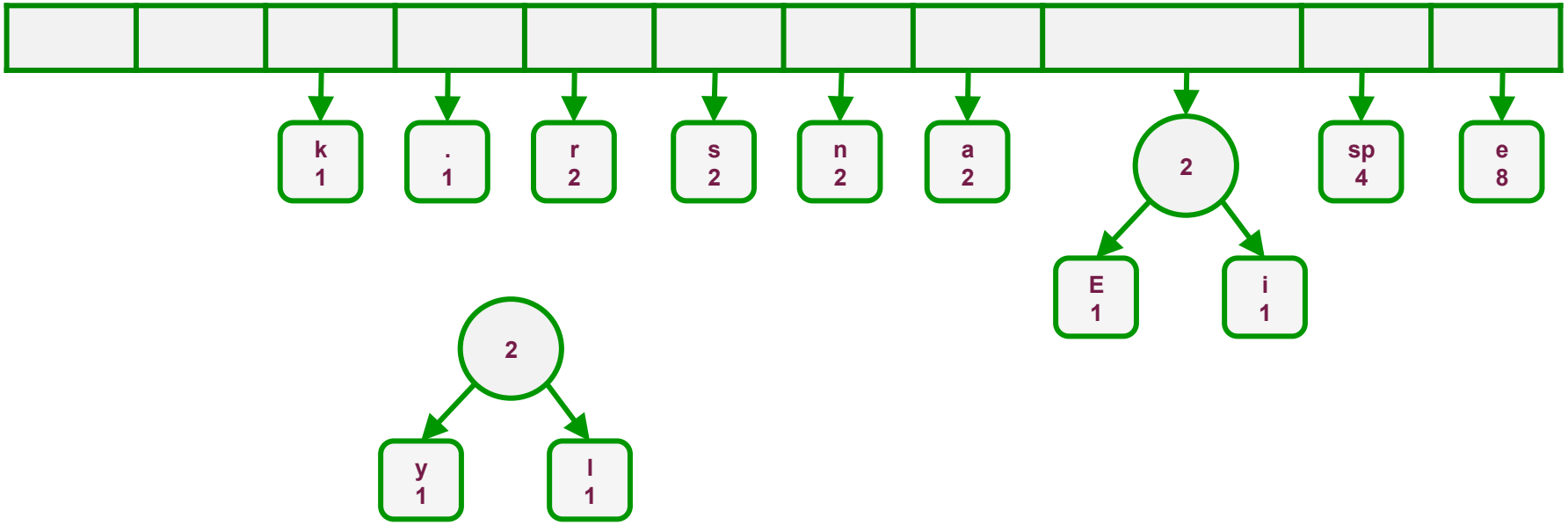

**“Eerie eyes seen near lake.”**

# Statik Huffman Kodlama



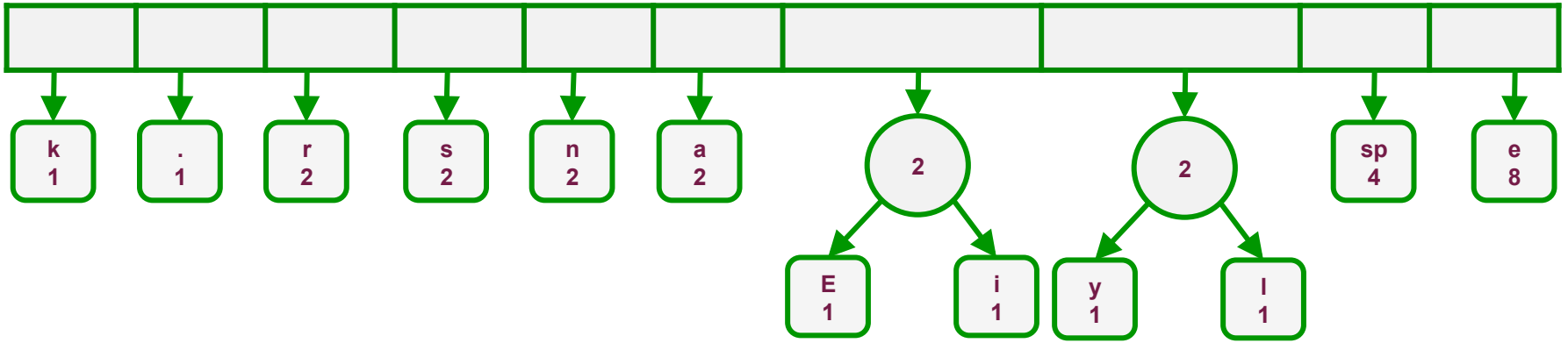

**“Eerie eyes seen near lake.”**

# Statik Huffman Kodlama



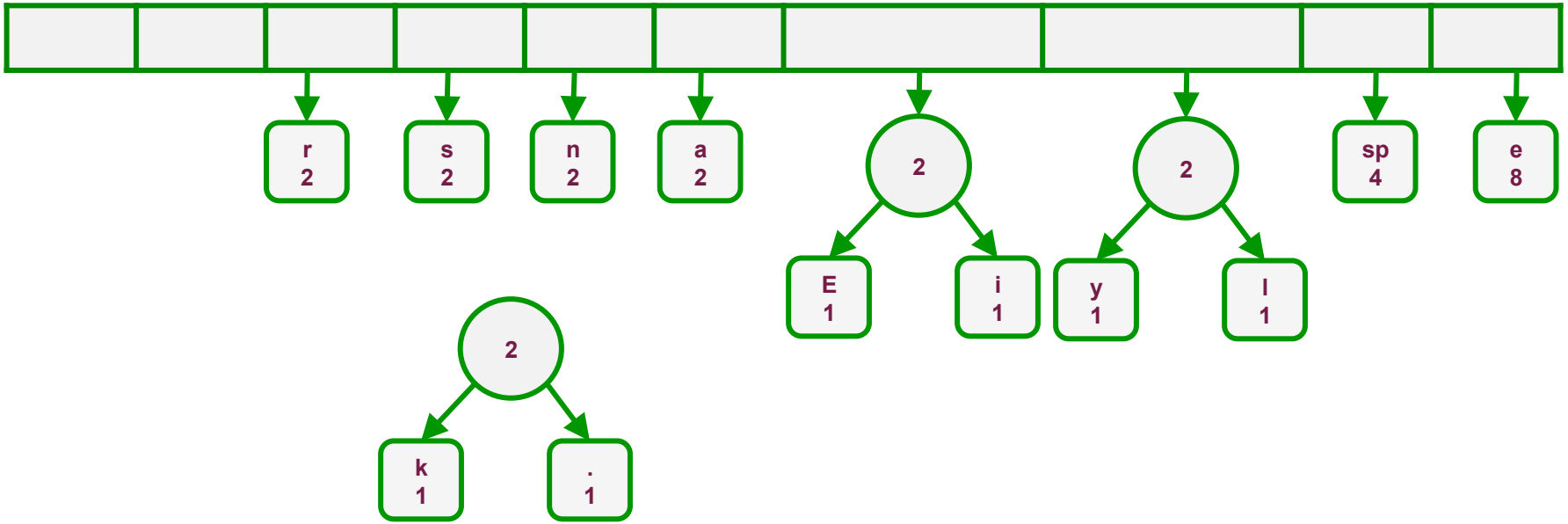

**“Eerie eyes seen near lake.”**

# Statik Huffman Kodlama



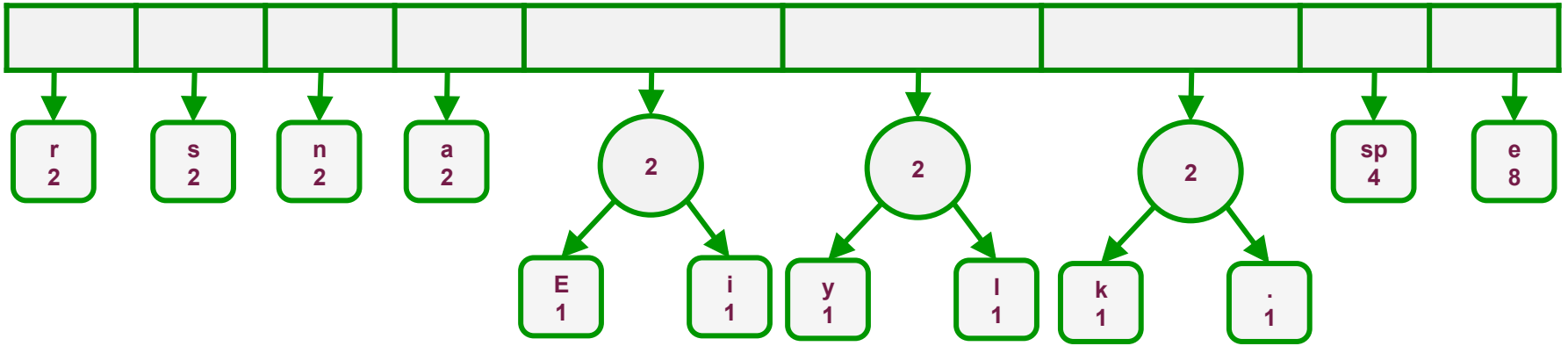

**“Eerie eyes seen near lake.”**

# Statik Huffman Kodlama



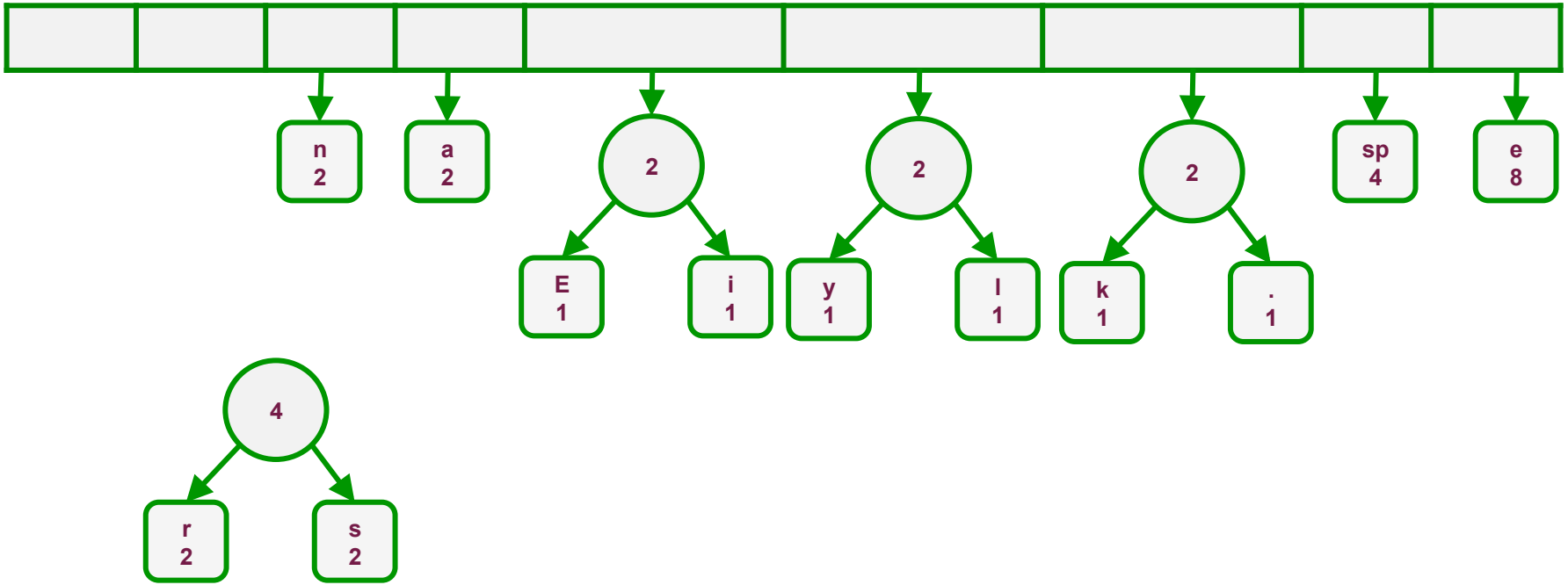

**“Eerie eyes seen near lake.”**

# Statik Huffman Kodlama




**“Eerie eyes seen near lake.”**

# Statik Huffman Kodlama

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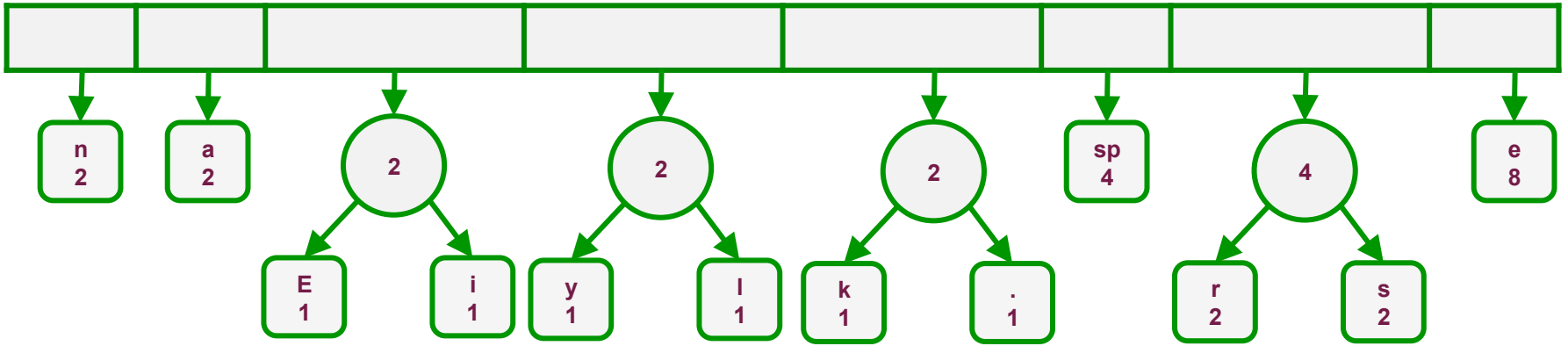


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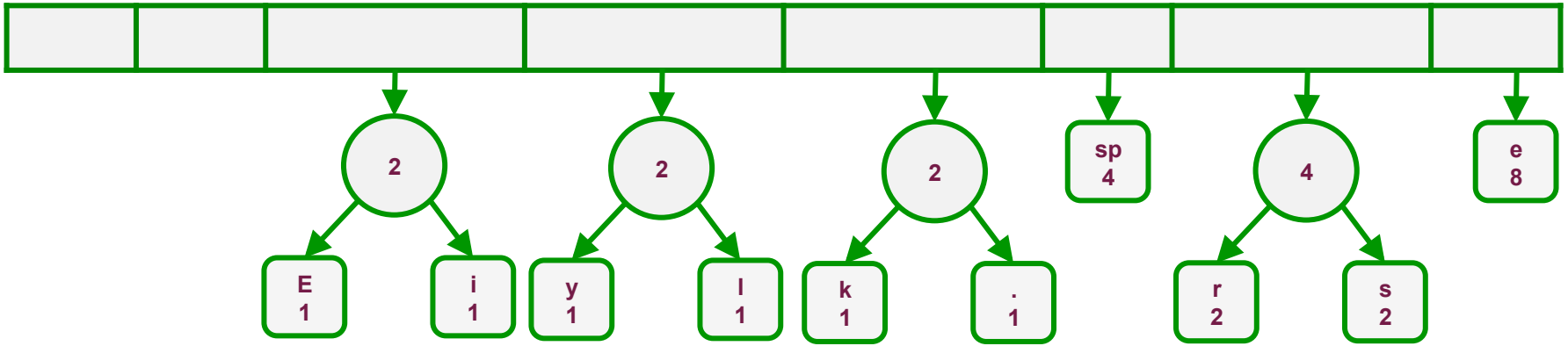


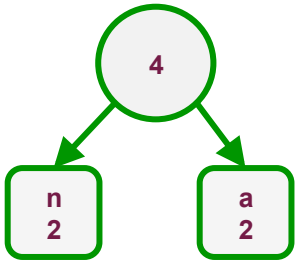


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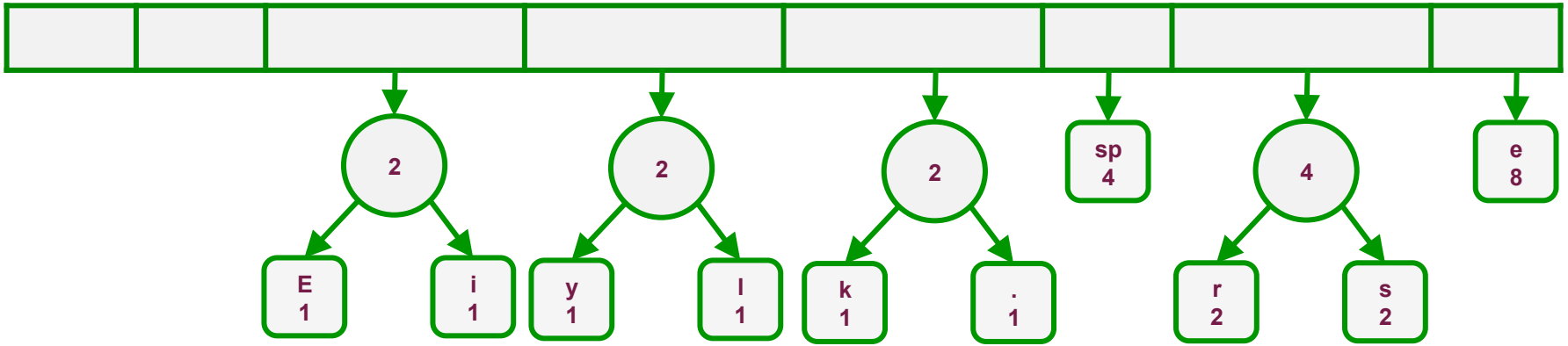


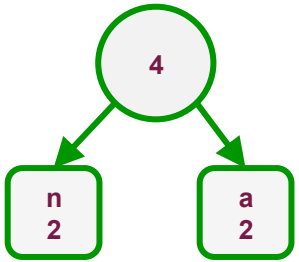


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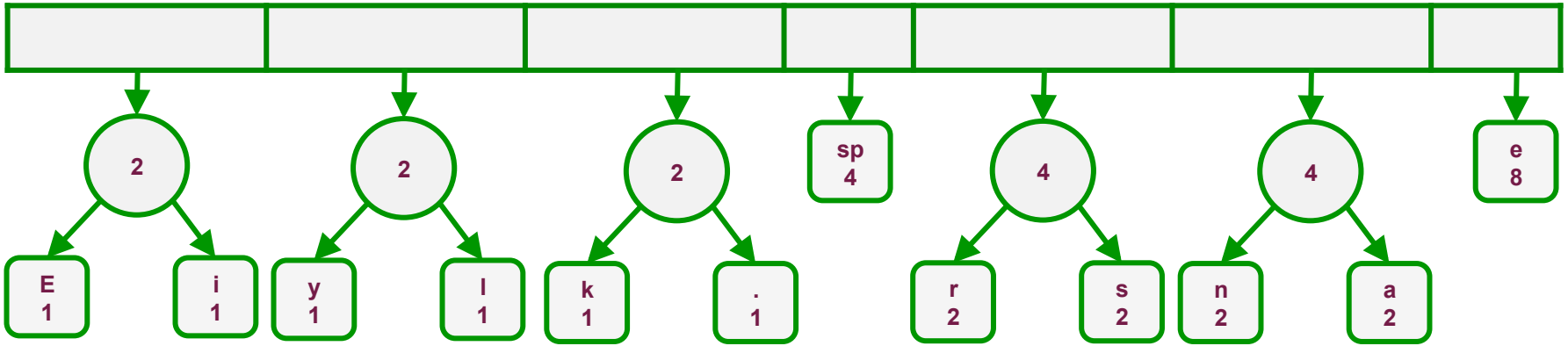


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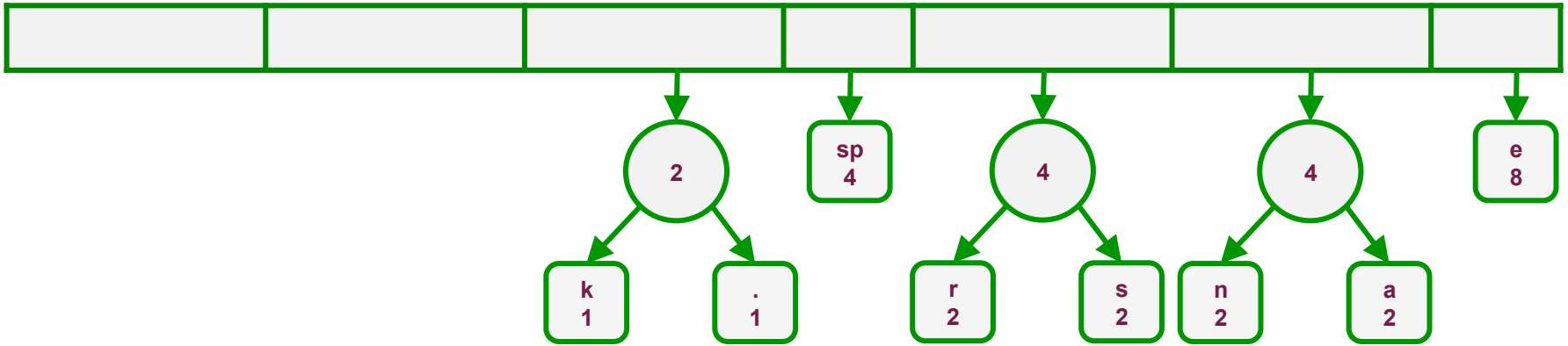


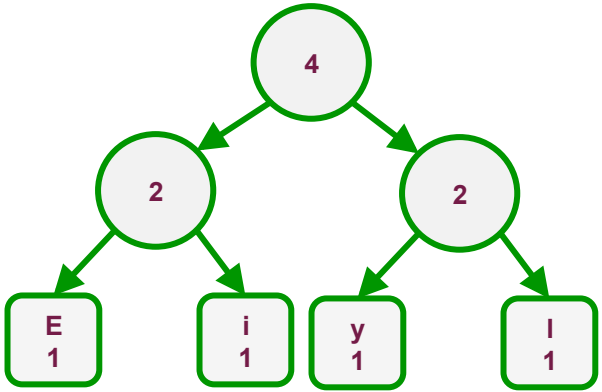


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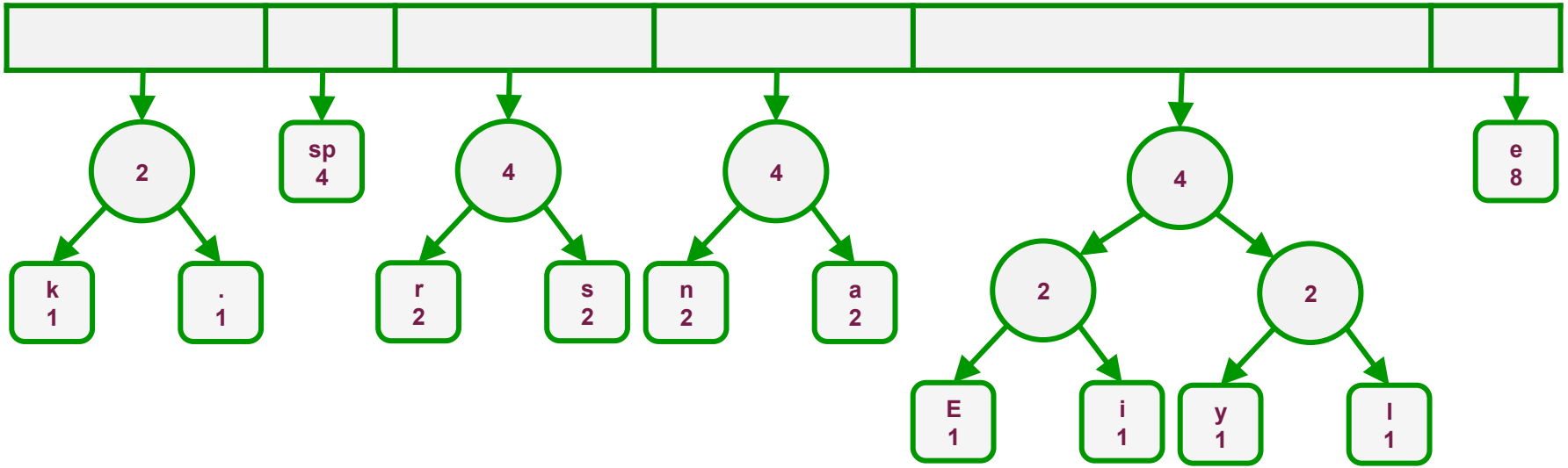


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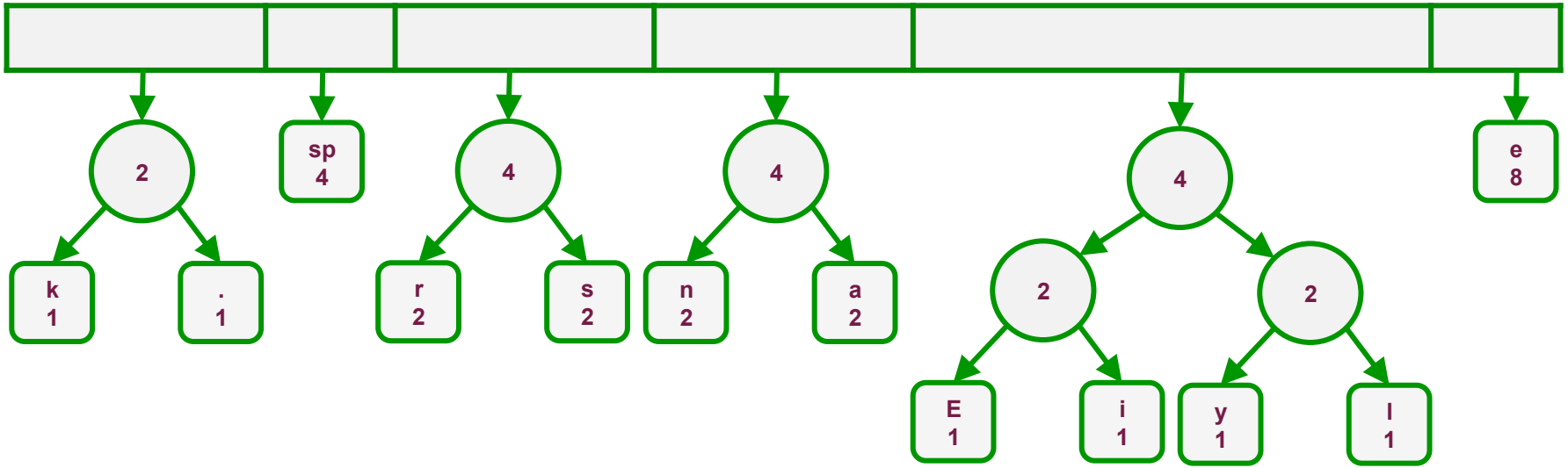


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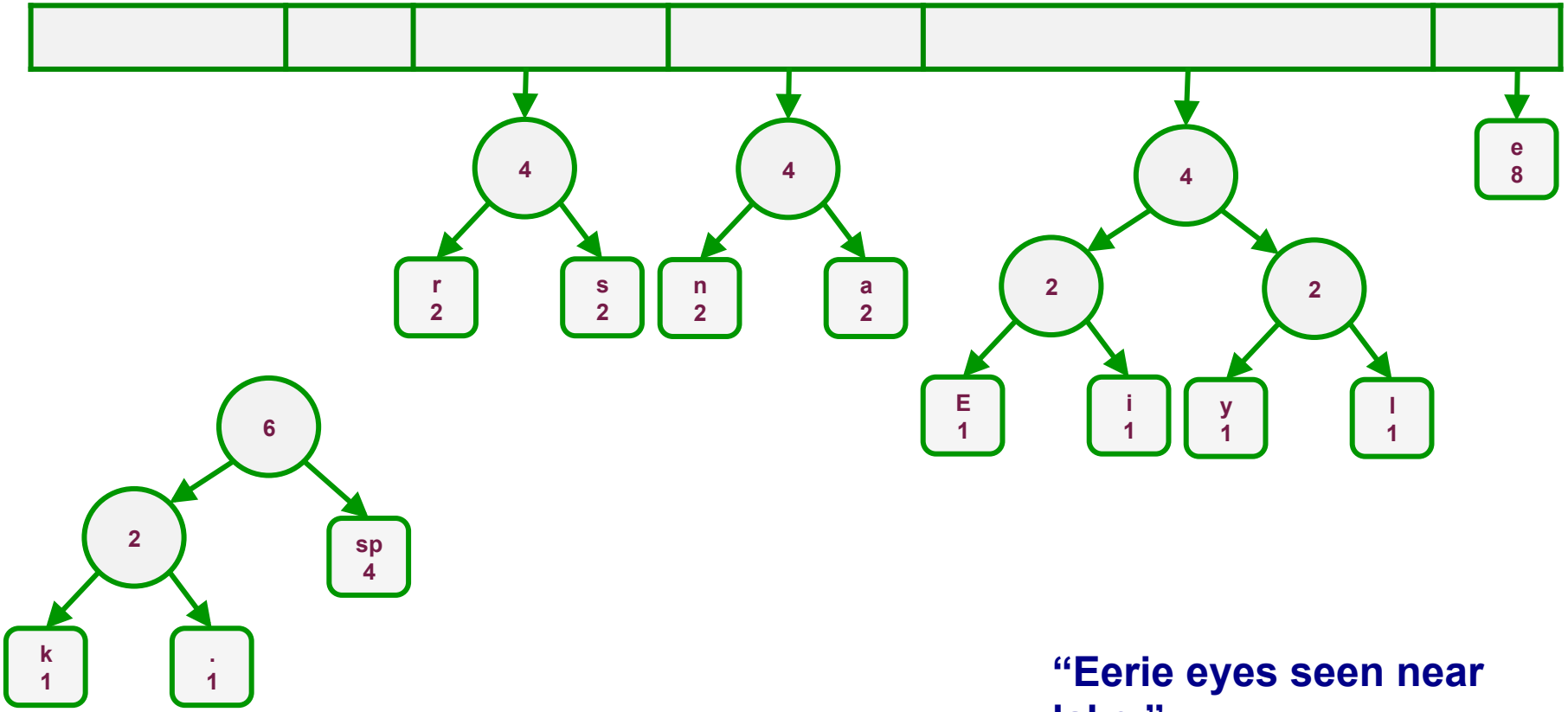


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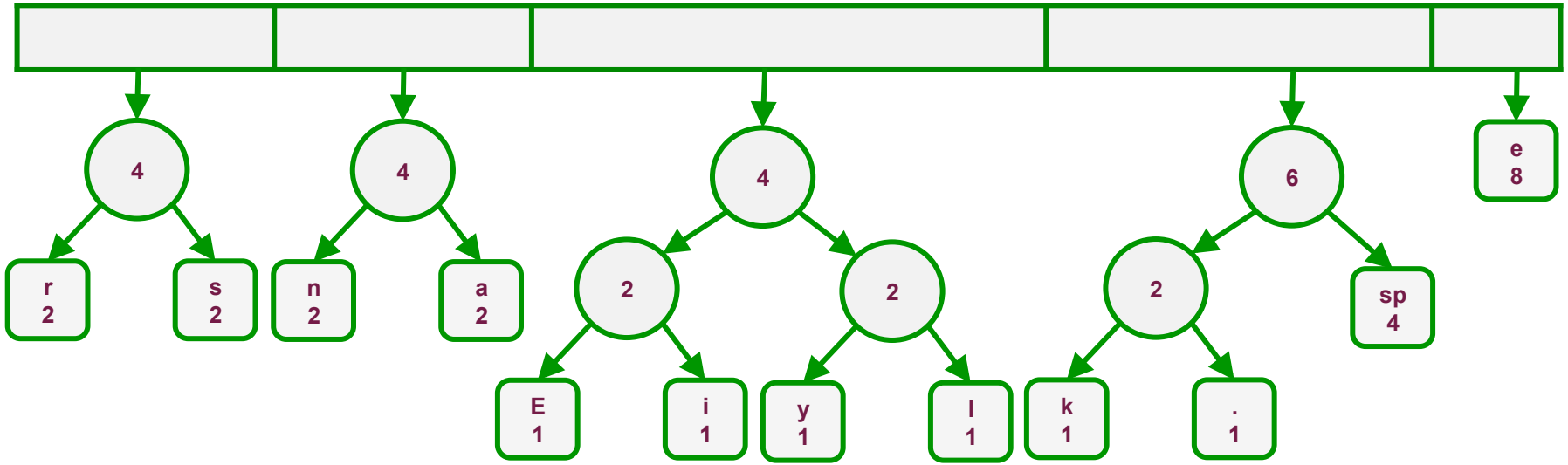


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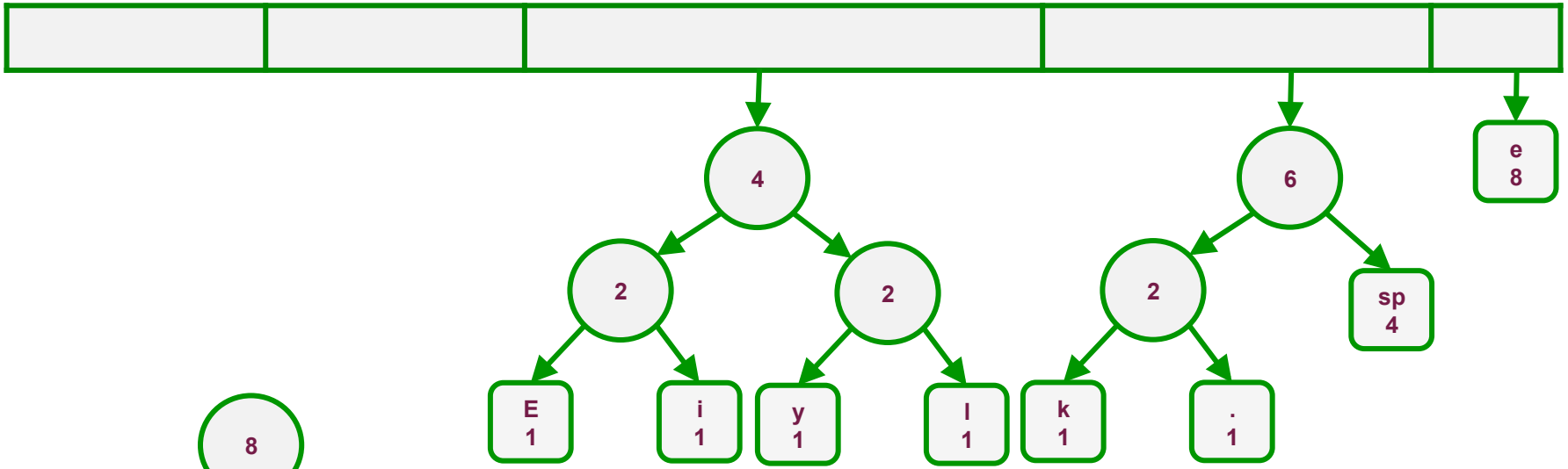


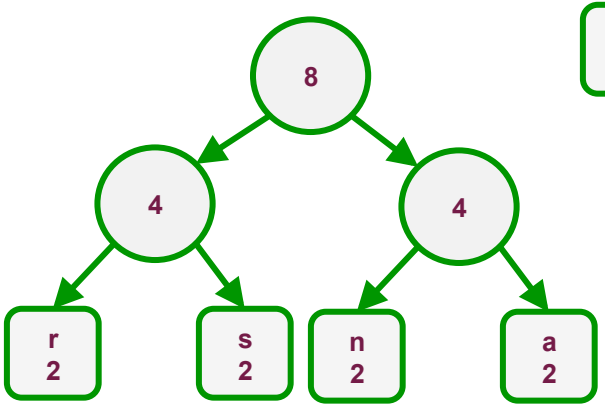


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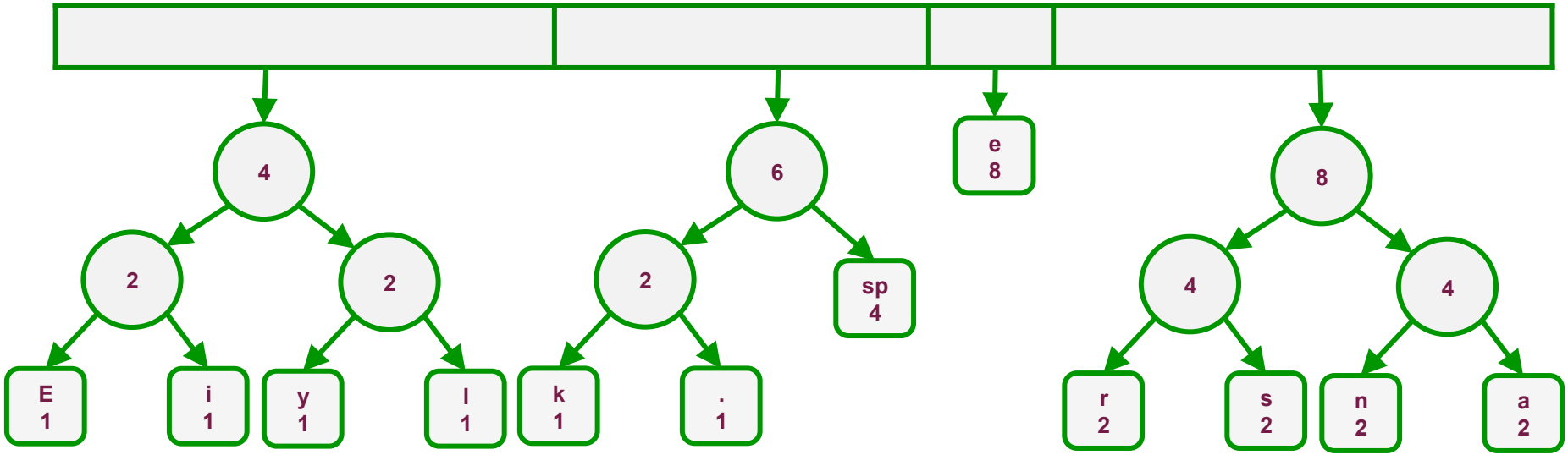


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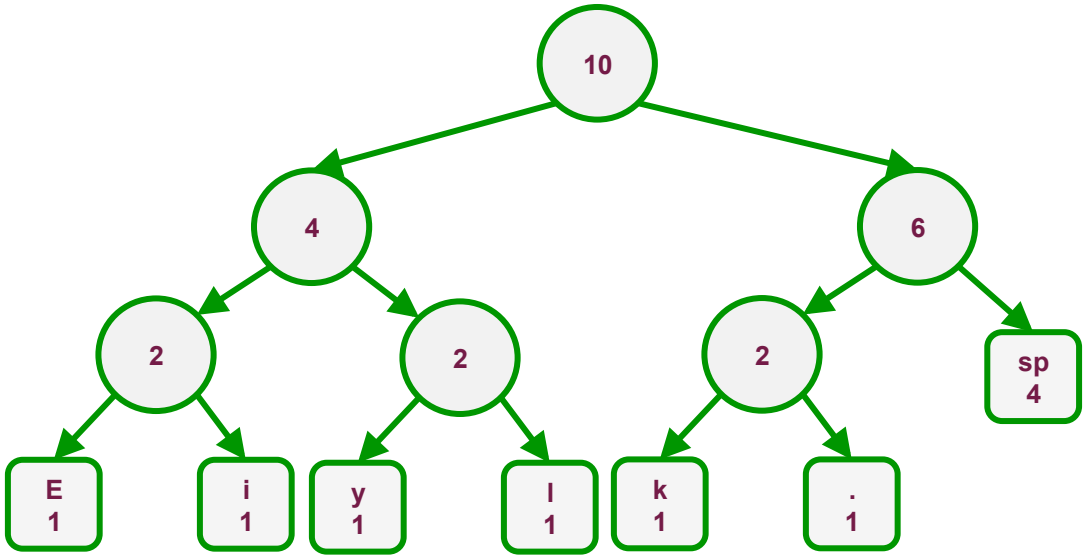


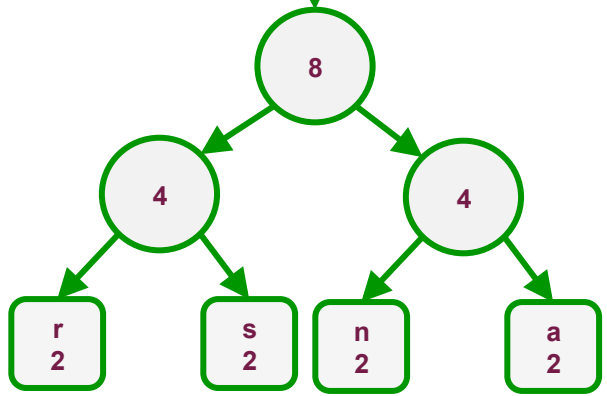


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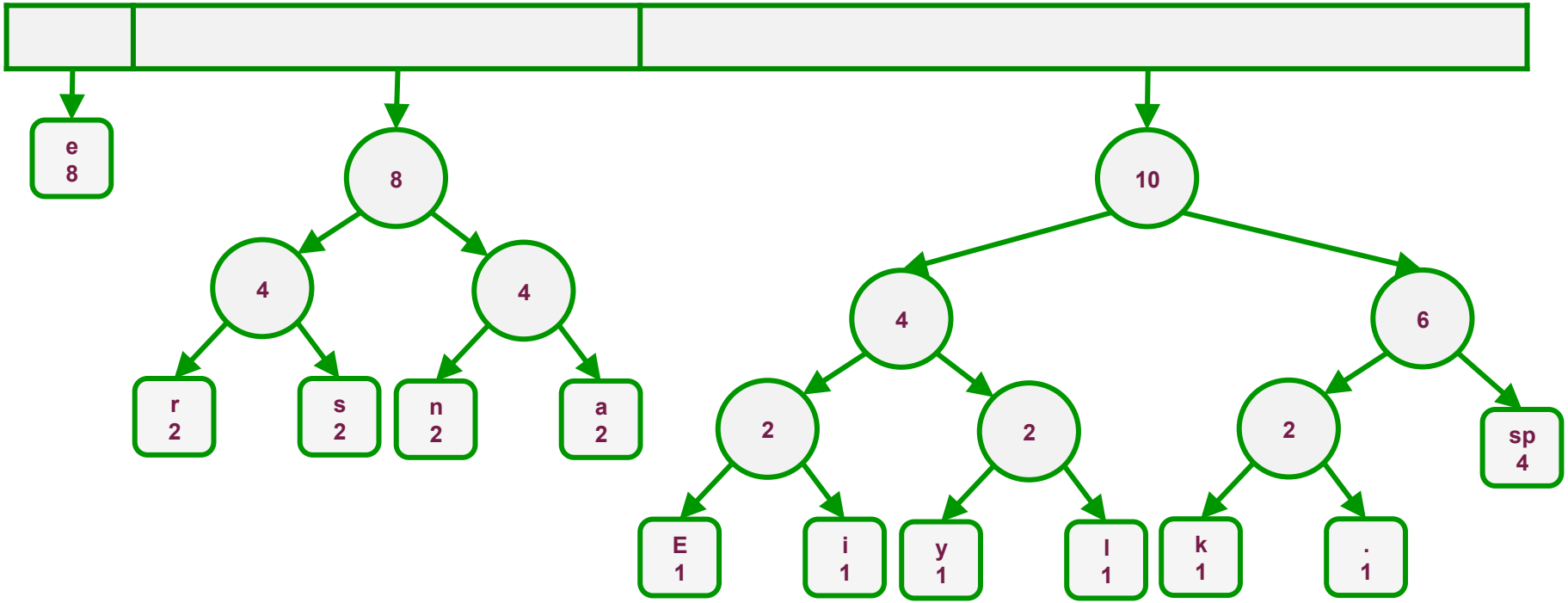


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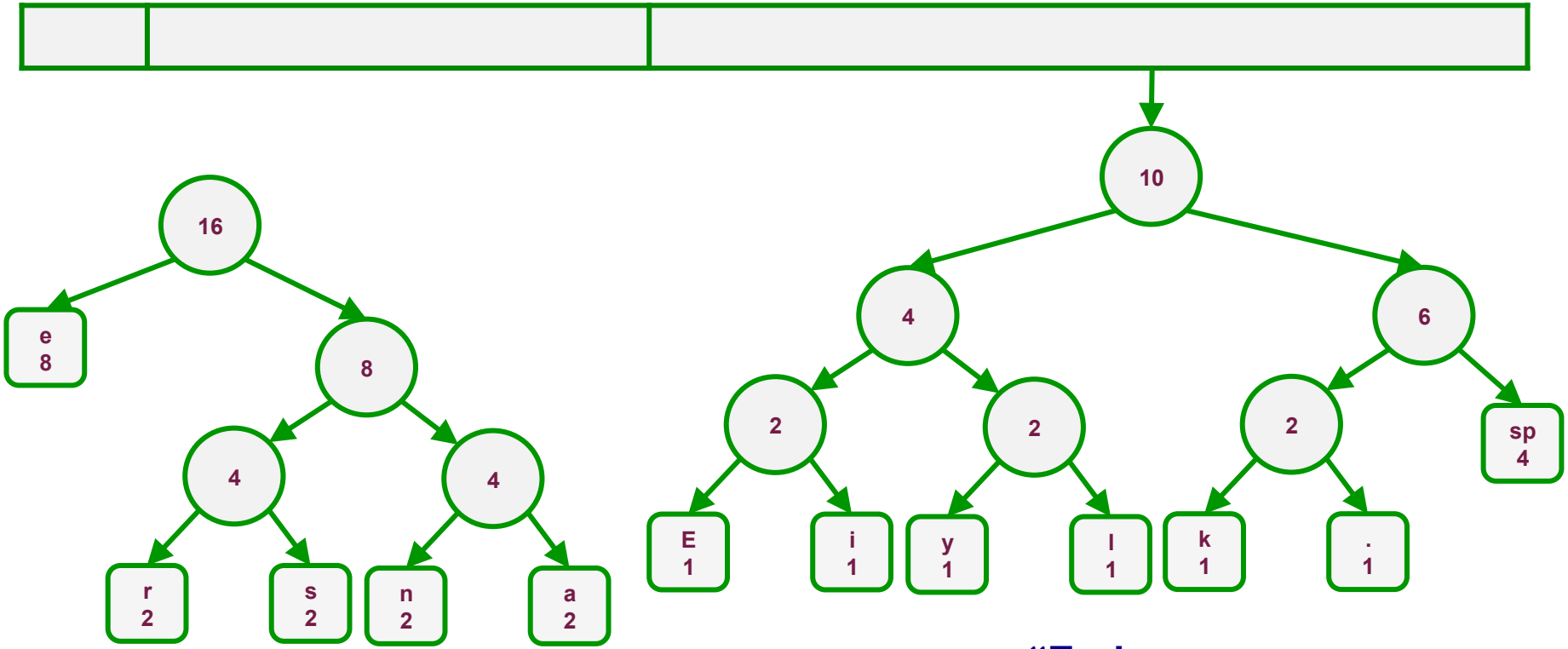


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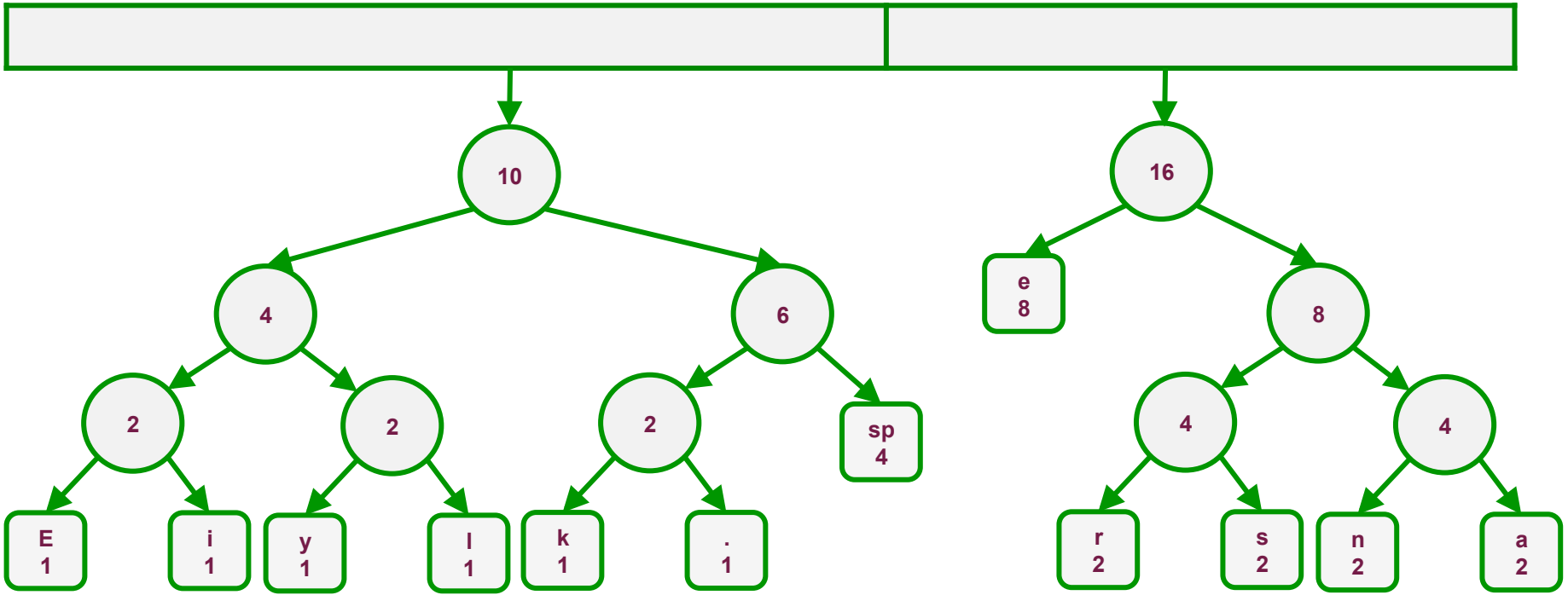


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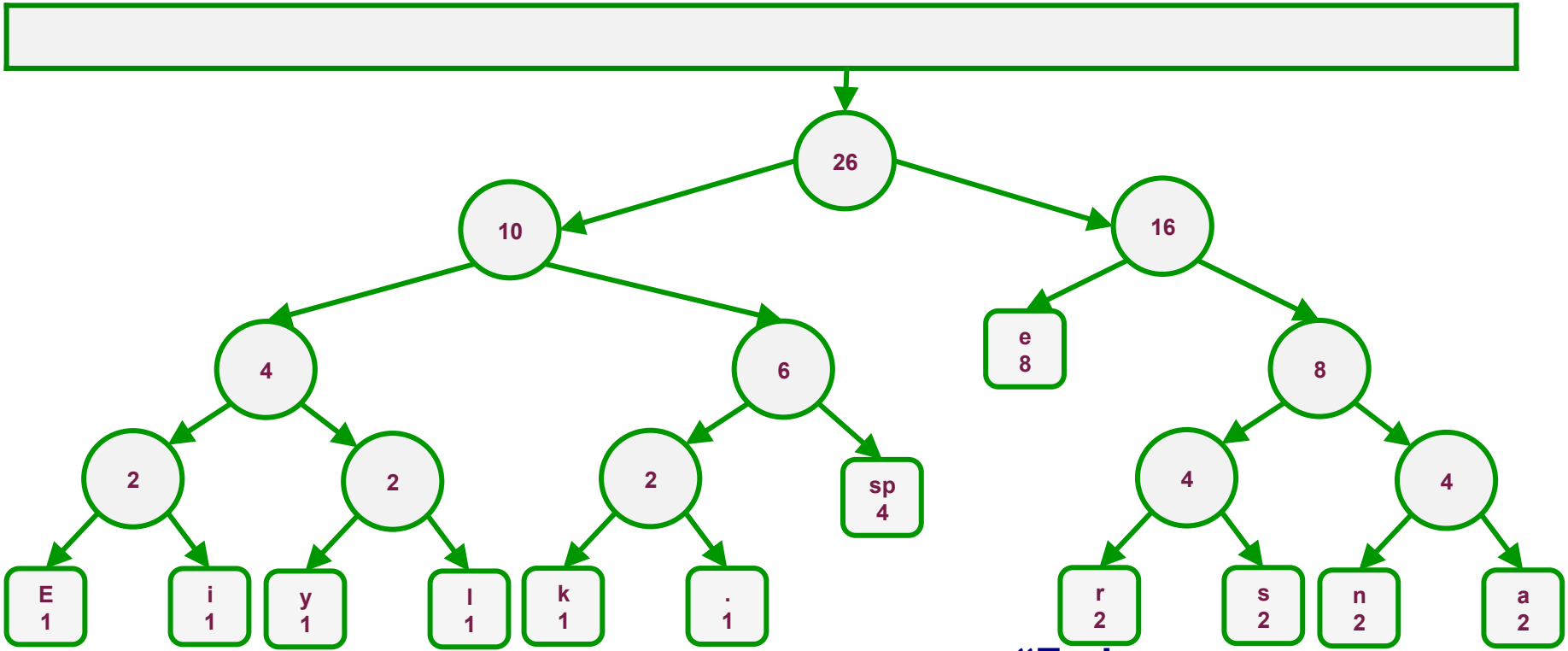


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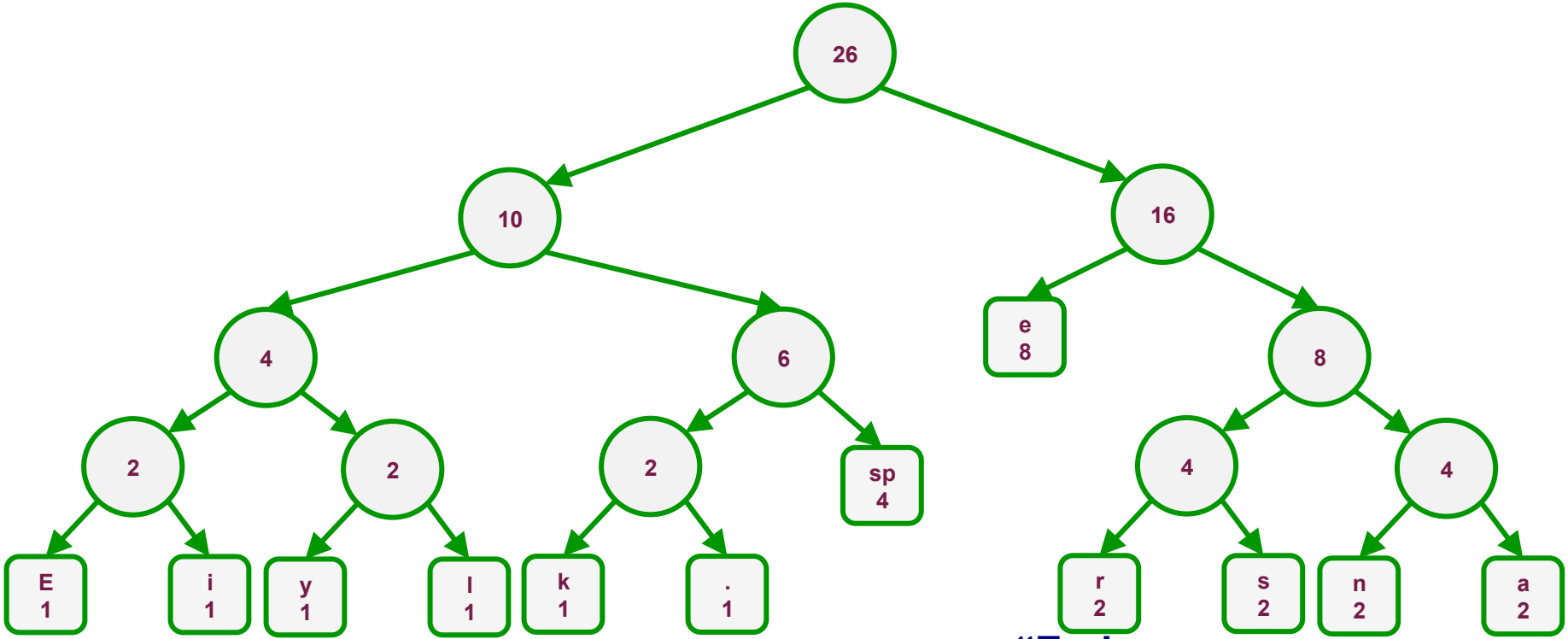


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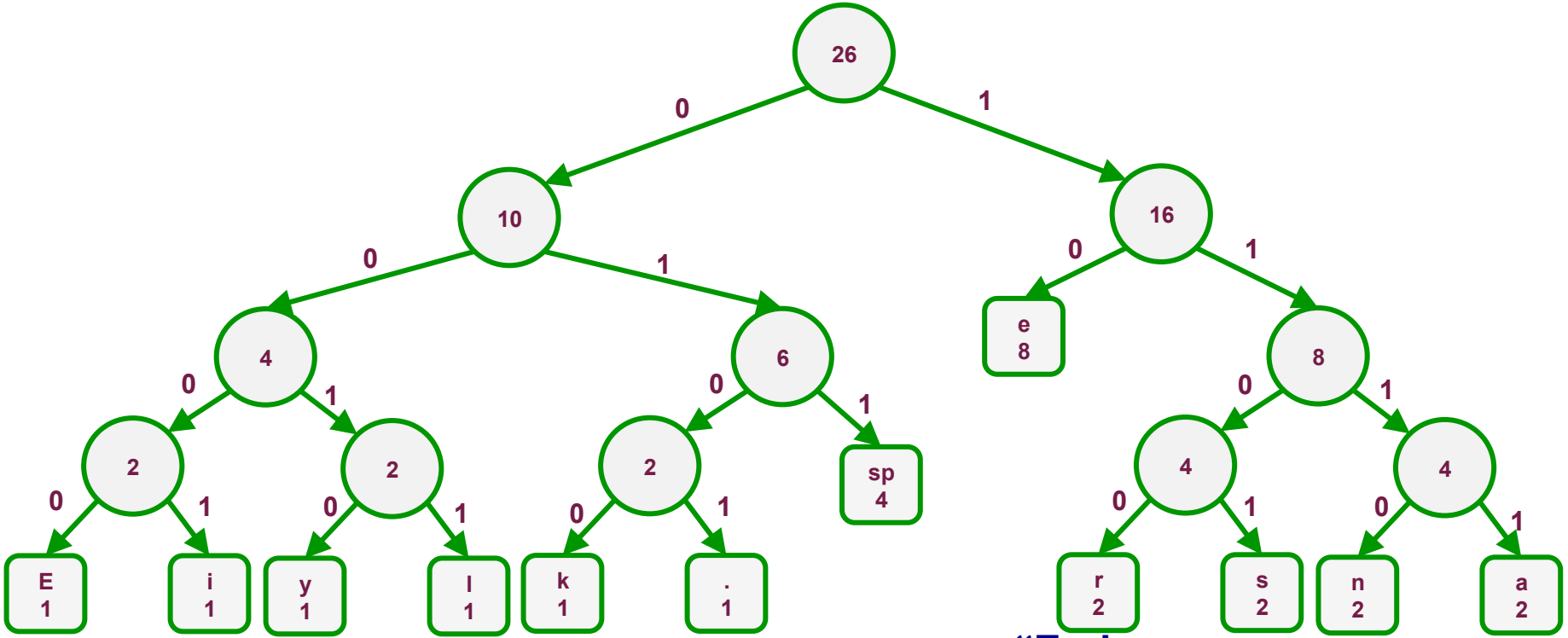


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# Statik Huffman Kodlama

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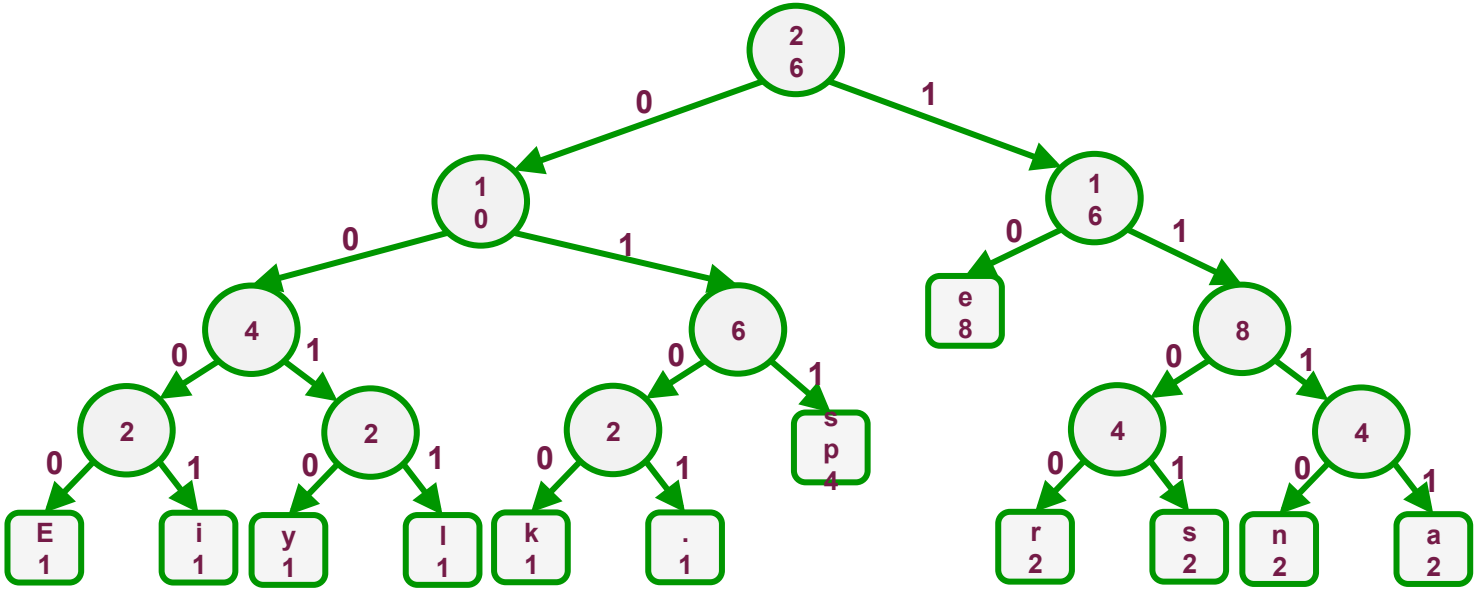


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| Karakter | Kod |
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| E | 0000 |
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| y | 0010 |
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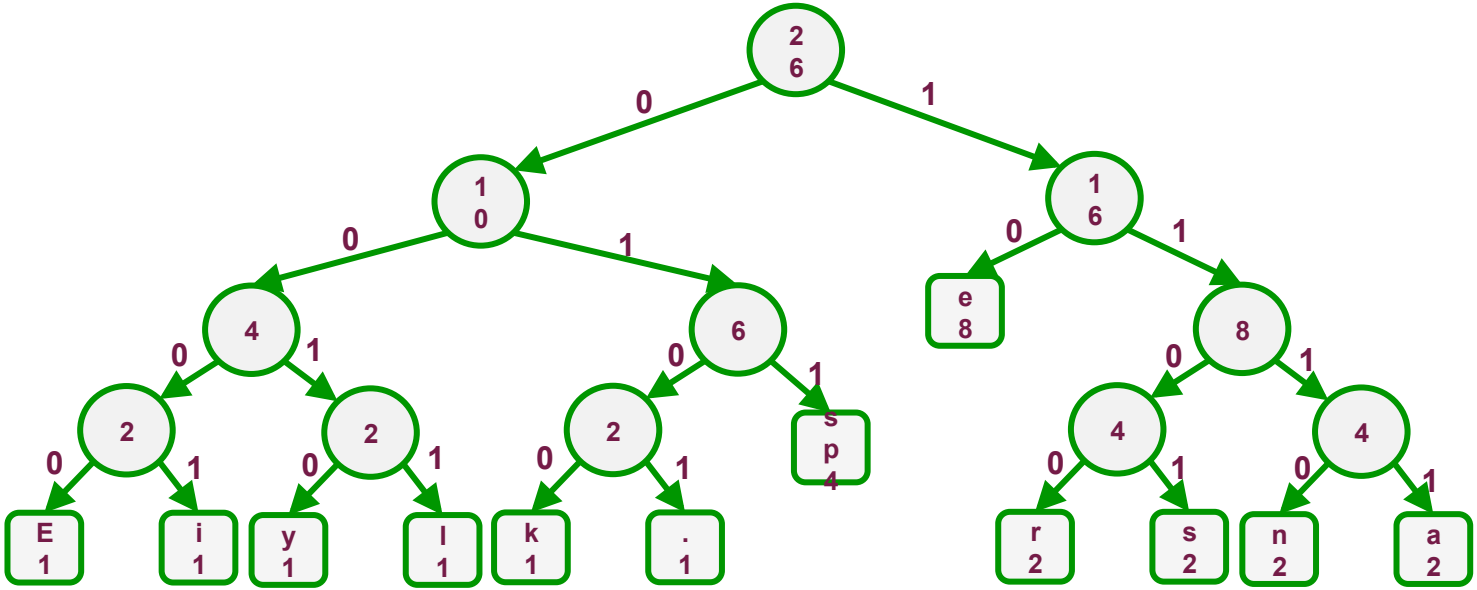


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# Sorular