Applications of Huffman tree

- to get an optimal set of codes for symbols $s_1, s_2, \cdots s_n$ which form a message
- the code for each symbol is a binary string - used for transmission of messages.

Ex:- If there are n symbols forming a message.

- To code each unique symbol using bit string
  - code each symbol using r-bit string where

$$2^{r-1} < n \leq 2^r$$

If a message is coded using 11 symbols say $s_1, s_2 \cdots s_{11}$

- No. of bits needed to code each symbol is 4 $\left[\because 2^3 < 11 \leq 2^4\right]$ (1)

Two Coding Schemes

1) Fixed length coding

Symbol	Binary Code
S_1	0000
S_2	0001
S_3	0010
S_4	0011
S_5	0100
S_6	0101
S_7	0110
S_8	0111
S_9	1000
S_{10}	1001
S_{11}	1010

~~Adv~~.

Disadvantage :=

This is efficient, only when the message encoded has all symbols with equal probabilities (equal no. of occurances)

2) Variable Length Coding / Huffman Coding

a) count the prob. of occurence of each symbol.

b) These probs are the weights of the symbols

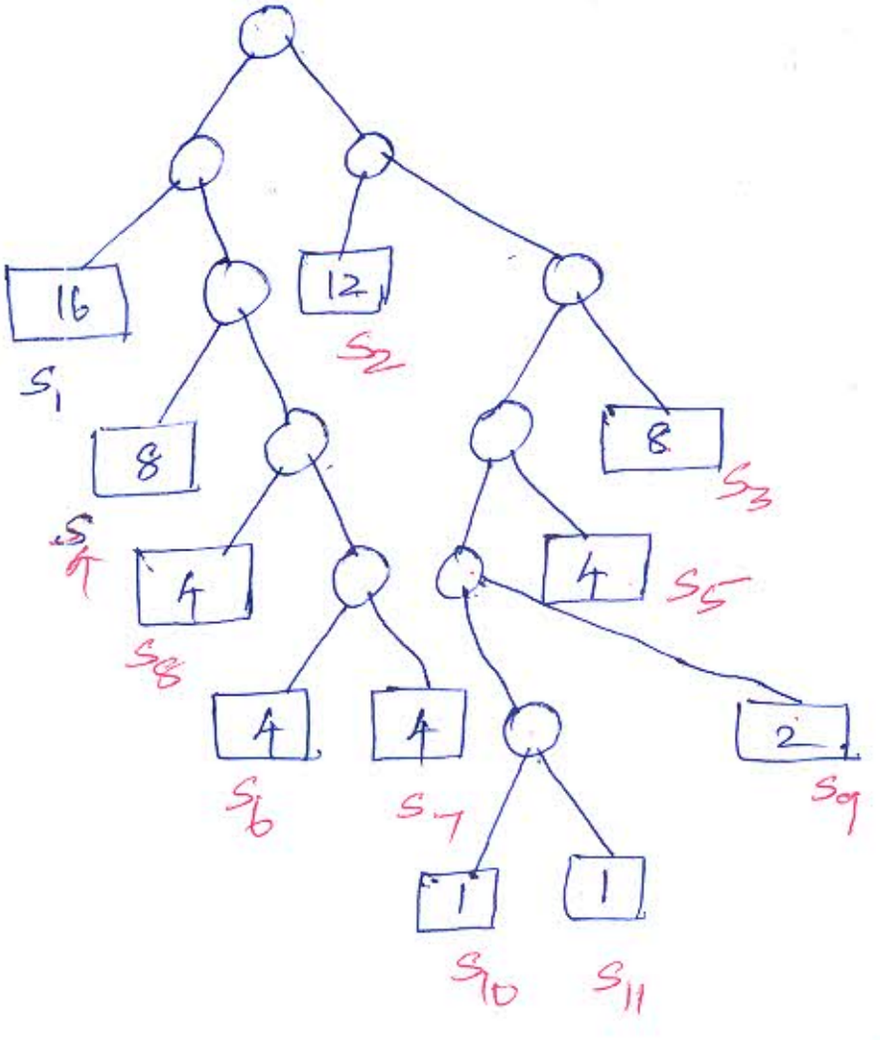
c) construct a huffman tree using these symbols as external nodes.

Ex: To make wts as integers, probs are multiplied by 64.

Symbol	Prob	weight	Code
S_1	1/4	16	00
S_2	3/16	12	10
S_3	1/8	8	111
S_4	1/8	8	010
S_5	1/16	4	1101
S_6	1/16	4	01110
S_7	1/16	4	0111
S_8	1/16	4	0110

Symbol	Prob	weight	Code
s_9	1/32	2	11001
s_{10}	1/64	1	110000
s_{11}	1/64	1	110001

d) Construct a Huffman tree with symbols as external nodes, using their weights.

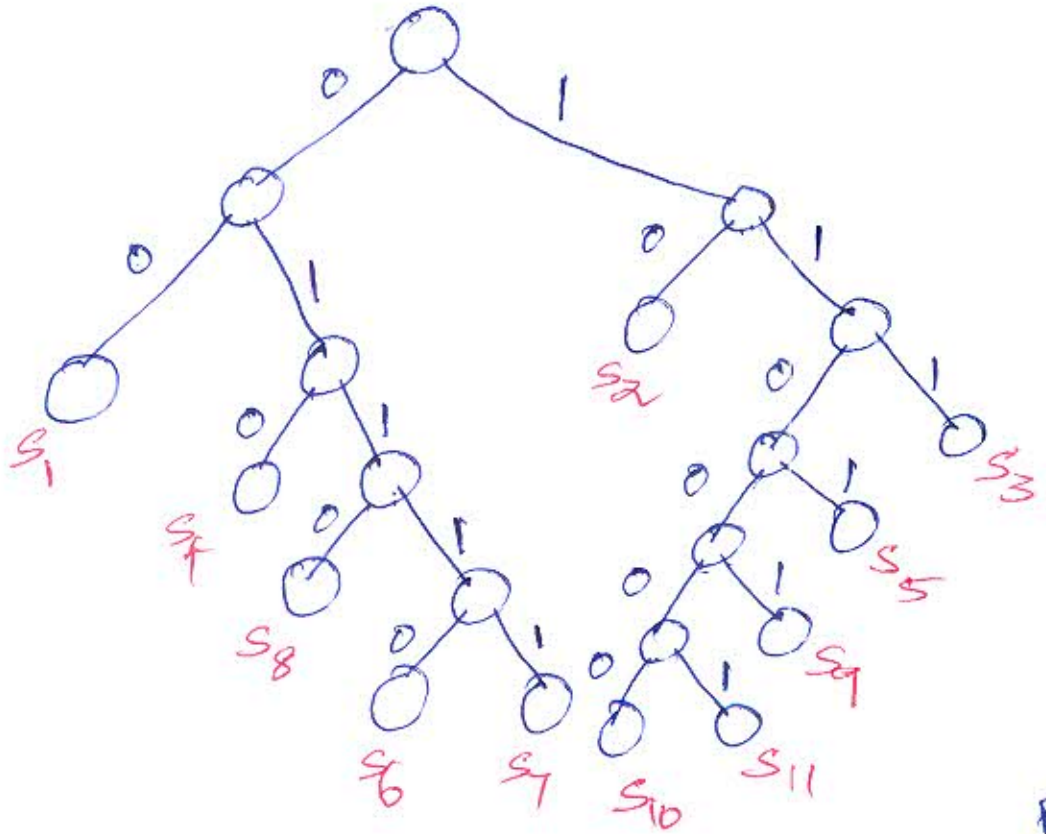


e) Huffman coding

1) Trace all the paths for each external node from the root node.

2) An edge is labeled as 0, if it is a left edge of a node. Else, it is labelled as 1.

3) Sequence of edges from root node to the leaf node is a binary string corresponding to the code of that symbol.



BITS PILANI, DUBAI CAMPUS

DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI

SECOND SEMESTER 2014 - 2015

COURSE : COMPUTER PROGRAMMING (CS F111)

COMPONENT : Tutorial# 6 **DATE** : 11/03/2015

Topics to be discussed:
- while loop
- for loop
- Examples

[**Note**: Students have already made flow charts for the following questions in Week 2. In this class, they will convert these to programs. Emphasis is on using while and for loops, interchangeably.]

Q1. Review of the topics, i.e. while and for loop.

Q2. Do the following (any two can be done in class):

a) WAP to find the sum of the cubes of first N natural numbers.

b) WAP to print the multiplication table of a given number.

c) WAP to find if a given number is prime.

Q3. Do the following by taking N as input. First attempt each question by assuming that we have a power operator with us, i.e. 2^a will give 2a. Now, assume that you do not have a power operator ... so to compute 2a repeated multiplications will be done.

a) WAP to find the sum of following series:

$$\sum_{a=0}^{n} \frac{1}{2^a}$$

b) Modify the above program (part a) to get the sum of following series:

$$\sum_{a=0}^{n} \frac{3+2a}{2^a}$$

c) Modify the above program (part b) to get the sum of following series:

$$\sum_{a=0}^{n} (-1)^a \frac{3+2a}{2^a}$$

*****END*****

Properties

1) It is an optimal set of binary code with minimum average length.

2) It has prefix property, no code appears as the prefix of other code.

3) Hence, doesn't need an end of character delimiter while decoding

Decoding

Scan the codes from the root till we reach a leaf node.

Ex:

Message: 0 0 1 1 1 1 1 0 0 1 0 1 0

Symbols: S_1 S_3 S_9 S_4

BITS PILANI, DUBAI CAMPUS

DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI

SECOND SEMESTER 2014 - 2015

COURSE : COMPUTER PROGRAMMING (CS F111)

COMPONENT : Tutorial# 6 **DATE** : 11/03/2015

Topics to be discussed:
- while loop
- for loop
- Examples

[**Note**: Students have already made flow charts for the following questions in Week 2. In this class, they will convert these to programs. Emphasis is on using while and for loops, interchangeably.]

Q1. Review of the topics, i.e. while and for loop.

Q2. Do the following (any two can be done in class):

a) WAP to find the sum of the cubes of first N natural numbers.

b) WAP to print the multiplication table of a given number.

c) WAP to find if a given number is prime.

Q3. Do the following by taking N as input. First attempt each question by assuming that we have a power operator with us, i.e. 2^a will give 2a. Now, assume that you do not have a power operator ... so to compute 2a repeated multiplications will be done.

a) WAP to find the sum of following series:

$$\sum_{a=0}^{n} \frac{1}{2^a}$$

b) Modify the above program (part a) to get the sum of following series:

$$\sum_{a=0}^{n} \frac{3+2a}{2^a}$$

c) Modify the above program (part b) to get the sum of following series:

$$\sum_{a=0}^{n} (-1)^a \frac{3+2a}{2^a}$$

*****END*****