

Algorithm Engineering

10/2/23

Q1

Sampling algorithm with $n=10, m=2$

J	1	2	3	4	5	6	7	8	9	10
S	a	b	c	d	e	f	g	h	i	l
P	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	1	.1	$\frac{1}{2}$	1	.1	1
formula	$\frac{1}{5}$	$\frac{2}{9}$	$\frac{2}{8}$	$\frac{2}{7}$	$\frac{2}{6}$	$\frac{2}{5}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	//

sampled

the condition to be checked is $p < \frac{m-s}{n-j+1}$

position

So the selected elements are f and i

• Sampling algorithm with n unknown and $m=2$.

J	1	2	3	4	5	6	7	8	9	10
S	a	b	c	d	e	f	g	h	i	l
h	//	//	1	3	4	2	1	5	4	6

enters

enters

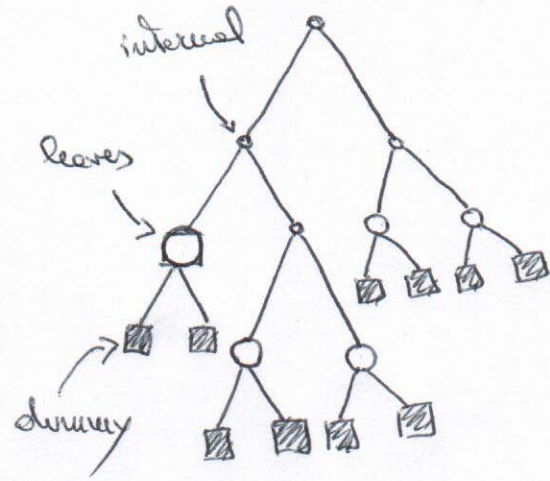
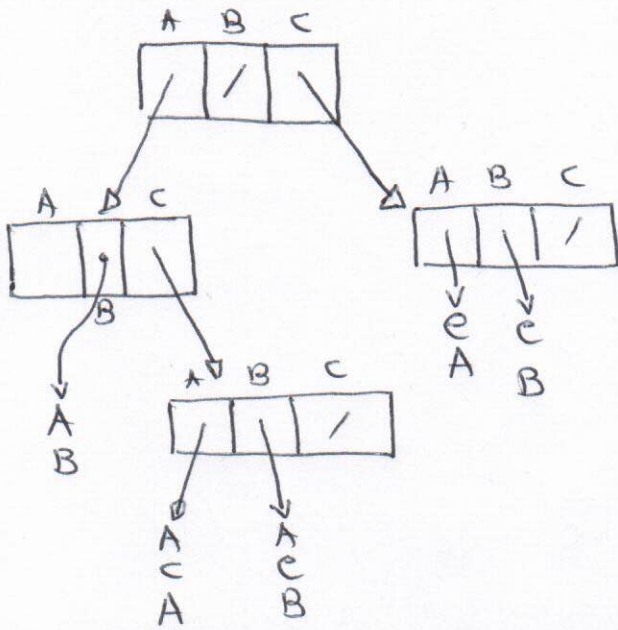
enters

$R = \begin{matrix} 1 & 2 \\ \boxed{a} & \boxed{b} \end{matrix}$ initial state

$R = \begin{matrix} \boxed{g} & \boxed{f} \end{matrix}$ final state

Q2

Build the uncompacted tree for S'



$B = 111110011000000000$
 ← 19 bits →

gives that the tree consists
 of 4 internal nodes, 5 leaves
 and thus $n = 9$

check-path-len(B)

left = 0, ~~return left;~~

i = 1;

while (B[i] == 1) do

left++;

i = rank₁(2 * i);

i = select₁(i)

end-while;

~~return left;~~

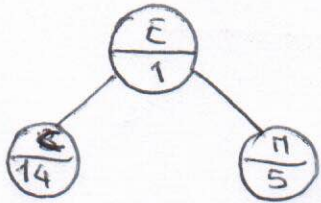
~~return left;~~

computes the length
 of the leftmost path

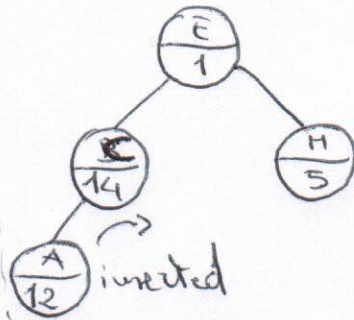
Q3

Build a heap by inserting the sequence:

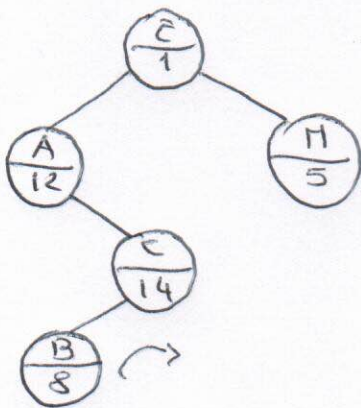
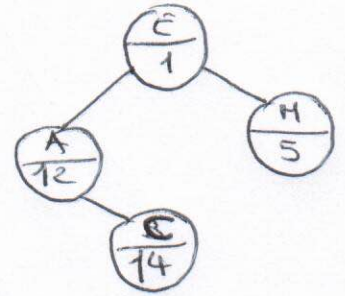
$\langle E, 1 \rangle \langle C, 14 \rangle \langle H, 5 \rangle \langle A, 12 \rangle \langle B, 8 \rangle$



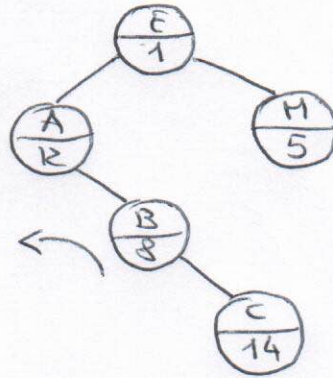
after 3 insertions



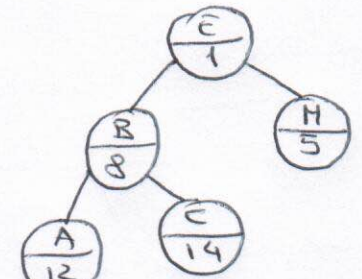
right rotation



right rotation



left rotation



011111

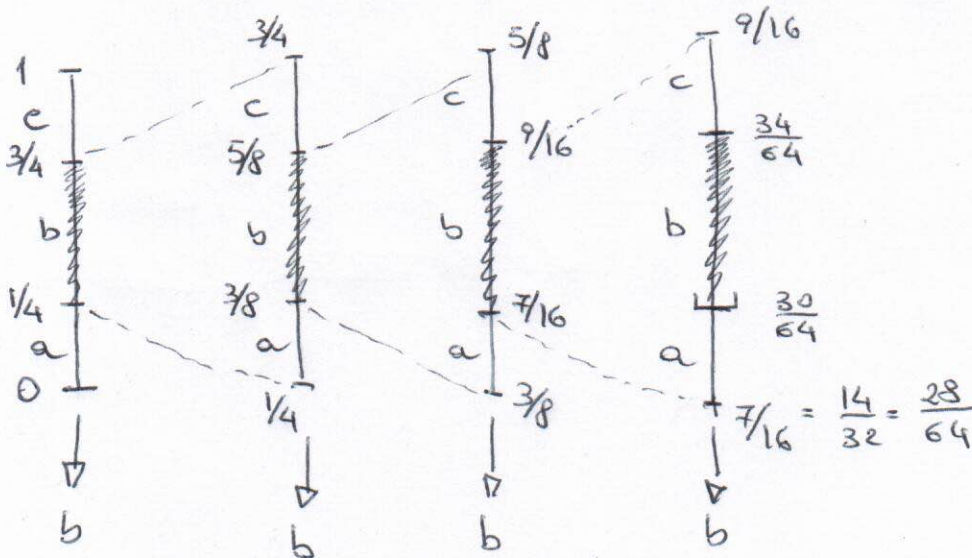
Q4

Decompress via Arithmetic coding: $\langle 4, \text{~~011111~~ \rangle}$

$011111 \Rightarrow \frac{31}{32}$

$\frac{1}{4} \frac{1}{8} \frac{1}{16} \frac{1}{32} \frac{1}{64}$

$P[a] = P[c] = 1/4$
 $P[b] = 1/2$



T = bbbb