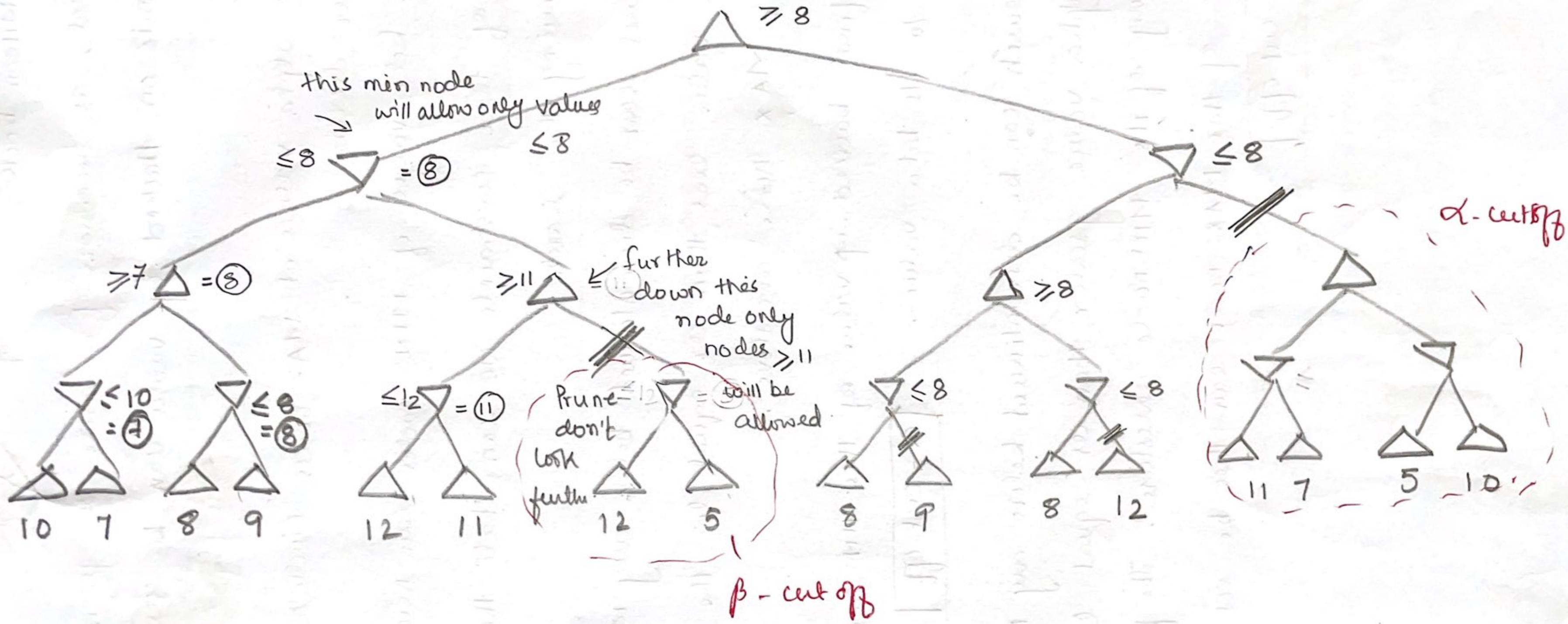
α - values = lower bound

β - value = upper bound.



Roll No.	(B.Tech./MTech./Ph.D.)	Name:

Problem: Consider the problem of **maximizing** the function $f(x) = x^2, 0 \leq x \leq 31$.

Simulated annealing

Given initial temperature, T = 1000

A solution is represented with a 5-bit string.

The initial State (or solution) is 10011 ($x = 19$ and $f(x) = 361$).

A neighbouring state is obtained just by flipping a bit randomly.

Candidate state 1: 11011 ($x = 27$ and $f(x) = 729$)

Compute $\triangle E = 361 - 729 = -368$

$\triangle E \leq 0$ accept the state

Candidate state 2: 01011 ($x = 11$ and $f(x) = 121$)

Compute $\triangle E = 729 - 121 = 608$

Compute the acceptance probability with T = 1000

$$\exp\left(\frac{-\triangle E}{T}\right) = \exp\left(\frac{-608}{1000}\right) = 0.544$$

Try computing the acceptance probability with T = 100

$$\exp\left(\frac{-\Delta E}{T}\right) = \exp\left(\frac{-608}{100}\right) = 0.002$$

Genetic algorithm

Initial Population

$f_i / \sum f_i$

String no.	Initial popln.	X value	f(x)	Selec. Prob.	Selection	
1	01101	13	169	0.144	1	String 1 Selected once
2	11000	24	576	0.492	2	twice
3	01000	8	64	0.054	0	not selected
4	10011	19	361	0.308	1	Selected once.

Given: Mating pool : 2-1, 4-3

Crossover site : 4 4 2 2

Selected population	New population	
0110|1	01100	$\longrightarrow$ 12
1100|0	11001	$\longrightarrow$ 25
11|000	11011	$\longrightarrow$ 27
10|011	10000	$\longrightarrow$ 16

Cross over site

Roll No.	(B.Tech./MTech./Ph.D.)	Name:

1. Consider the candy examples as discussed in the class. Show the calculations for the first iteration of EM. [5 marks]

<u>Learning of parameter θ</u>

E-Step

$$\boxed{\hat{N}(\mathrm{Bag}=1) = \sum_{j=1}^{N} P(Bag = 1 | flavor_j, wrapper_j, hole_j)}$$

M-step

$$\theta_1 = \frac{\hat{N}(Bag = 1)}{N}$$

* Solution is available in the book.

2. Consider a single Boolean random variable Y (the 'classification'). Let the prior probability P(Y = true) be π. Let's try to find π, given a training set $D = (y_1, \ldots, y_N)$ with N independent samples of Y. Furthermore, suppose p of the N are positive and n of the N are negative. [5 marks]

(a) Write down an expression for the likelihood of D (i.e. the probability of seeing this particular sequence of examples, given a fixed value of π) in terms of π, p and n.

(b) By differentiating the log likelihood L, find the value of π that maximizes the likelihood.

$P(Y = \text{true}) = \pi$

$P(Y = \text{false}) = (1 - \pi)$

p = # positive samples

n = # negative samples

Probability of data is $\pi^p (1-\pi)^n$

Log likelihood = $L = p \log \pi + n \log (1 - \pi)$

setting the derivative to 0.

$$\frac{\partial L}{\partial \pi} = \frac{p}{\pi} - \frac{n}{1-\pi} = 0$$

so, ML value is $\pi = p/(p+n)$ which is the proportion of positive examples in the data.