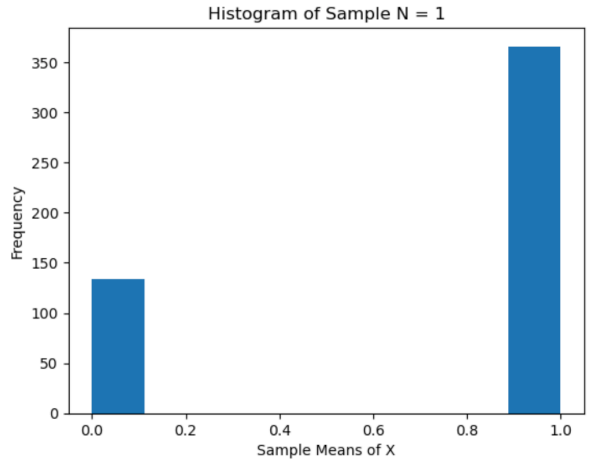
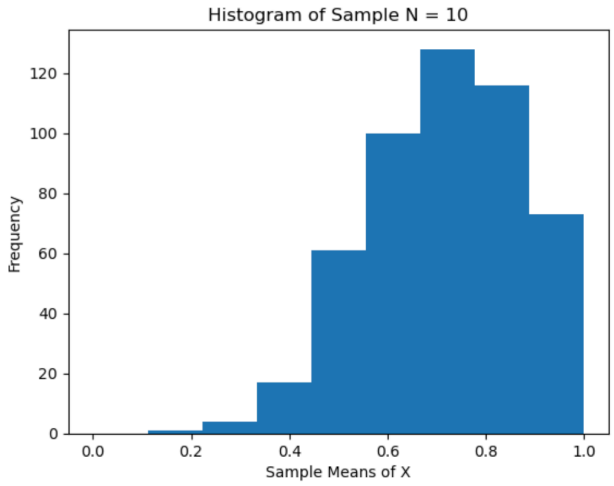
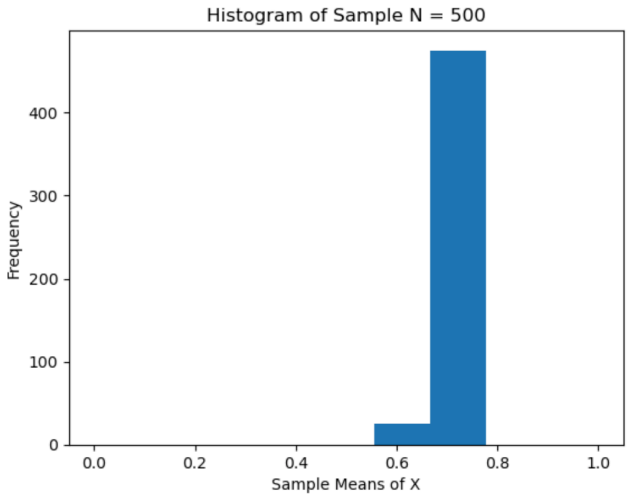
Q1

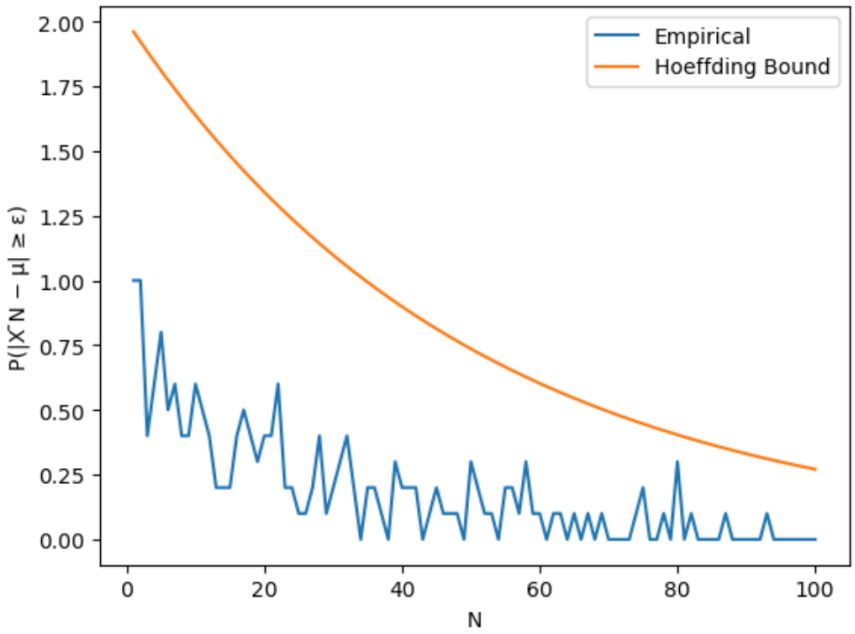
1.


Histogram of Sample N = 1
Frequency
Sample Means of X
0
50
100
150
200
250
300
350
0.0
0.2
0.4
0.6
0.8
1.0

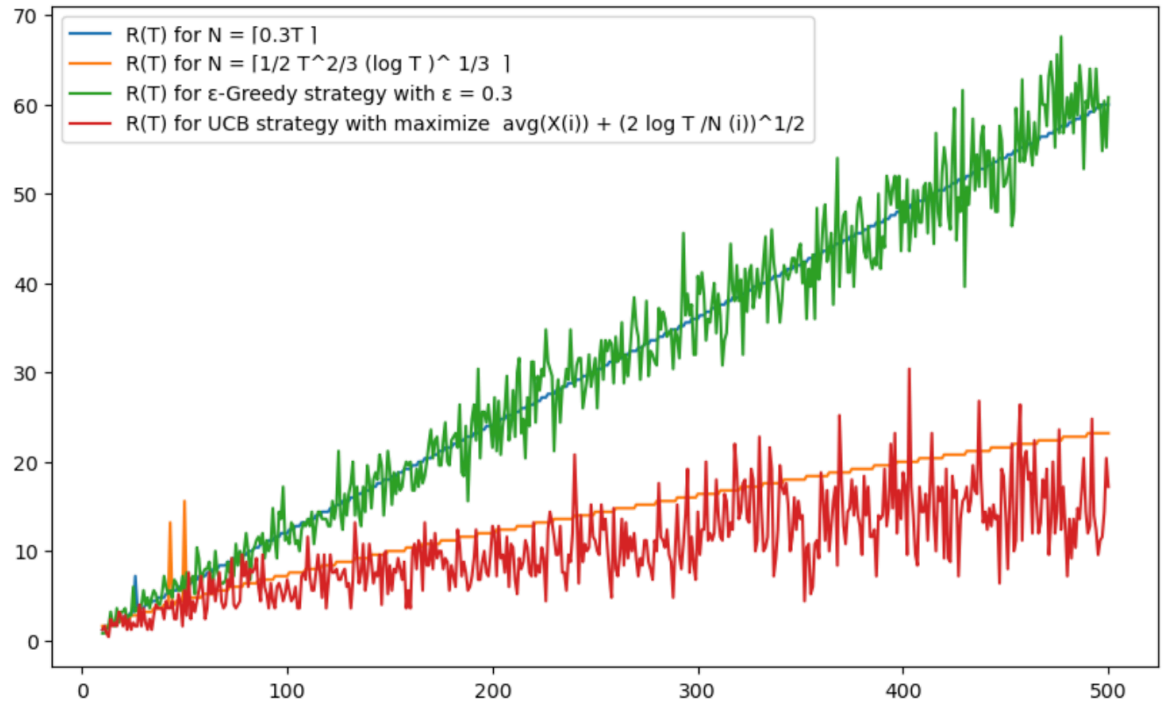

Histogram of Sample N = 10
Frequency
Sample Means of X
0
20
40
60
80
100
120
0.0
0.2
0.4
0.6
0.8
1.0


Histogram of Sample N = 500
Frequency
Sample Means of X
0
100
200
300
400
0.0
0.2
0.4
0.6
0.8
1.0

2.


Empirical
Hoeffding Bound
P(|X̄N − μ| ≥ ε)
N
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
0
20
40
60
80
100

Q2


R(T) for N = ⌈0.3T ⌉
R(T) for N = ⌈1/2 T^2/3 (log T)^ 1/3 ⌉
R(T) for ε-Greedy strategy with ε = 0.3
R(T) for UCB strategy with maximize avg(X(i)) + (2 log T /N (i))^1/2
70
60
50
40
30
20
10
0
0
100
200
300
400
500

Q3

1. Initial state:

_ _ _

_ X _

_ _ _

After 8 iterations:

_ _ _

_ X _

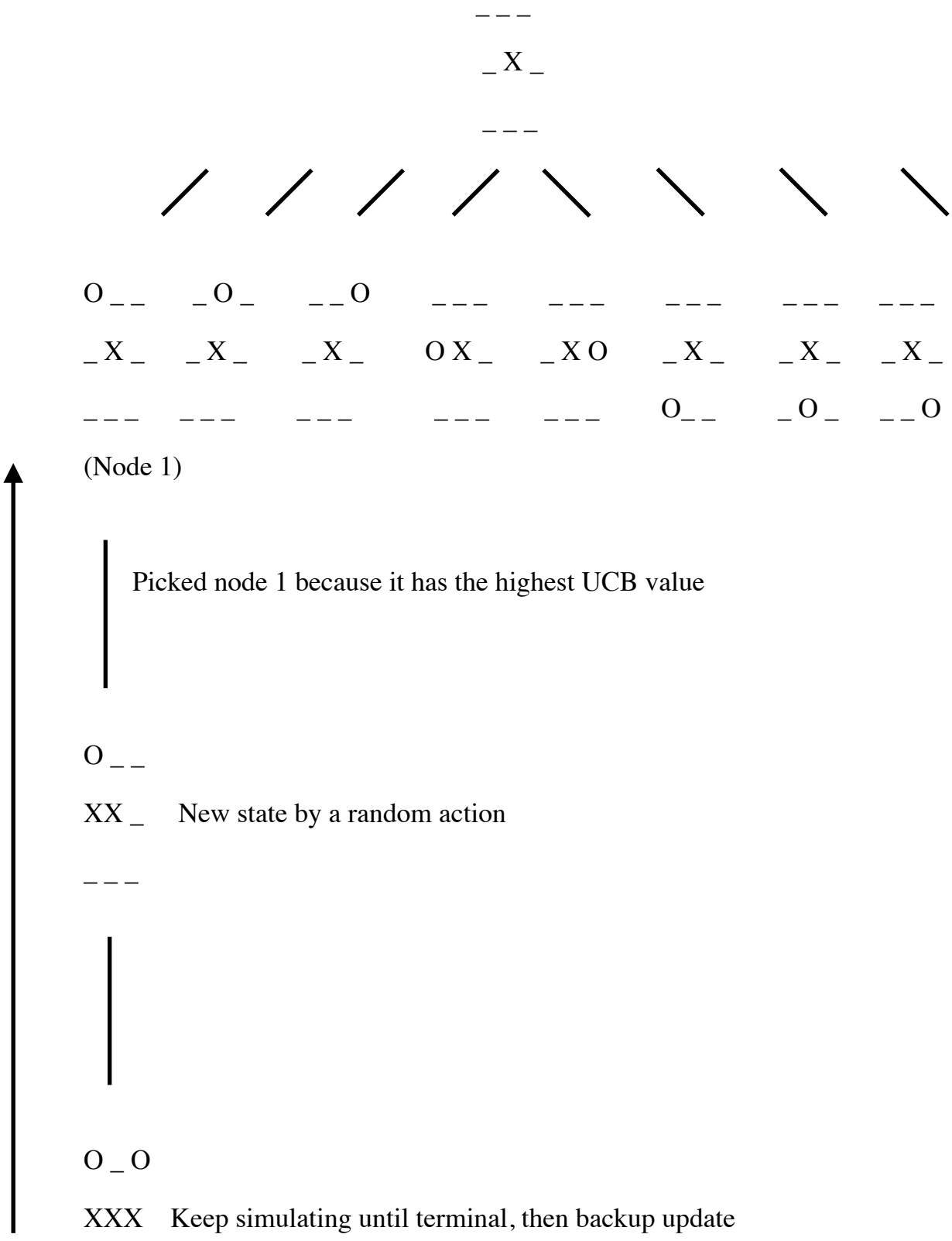
_ _ _

O _ _	_ O _	_ _ O	_ _ _	_ _ _	_ _ _	_ _ _	_ _ _
_ X _	_ X _	_ X _	O X _	_ X O	_ X _	_ X _	_ X _
_ _ _	_ _ _	_ _ _	_ _ _	_ _ _	O _ _	_ O _	_ _ O

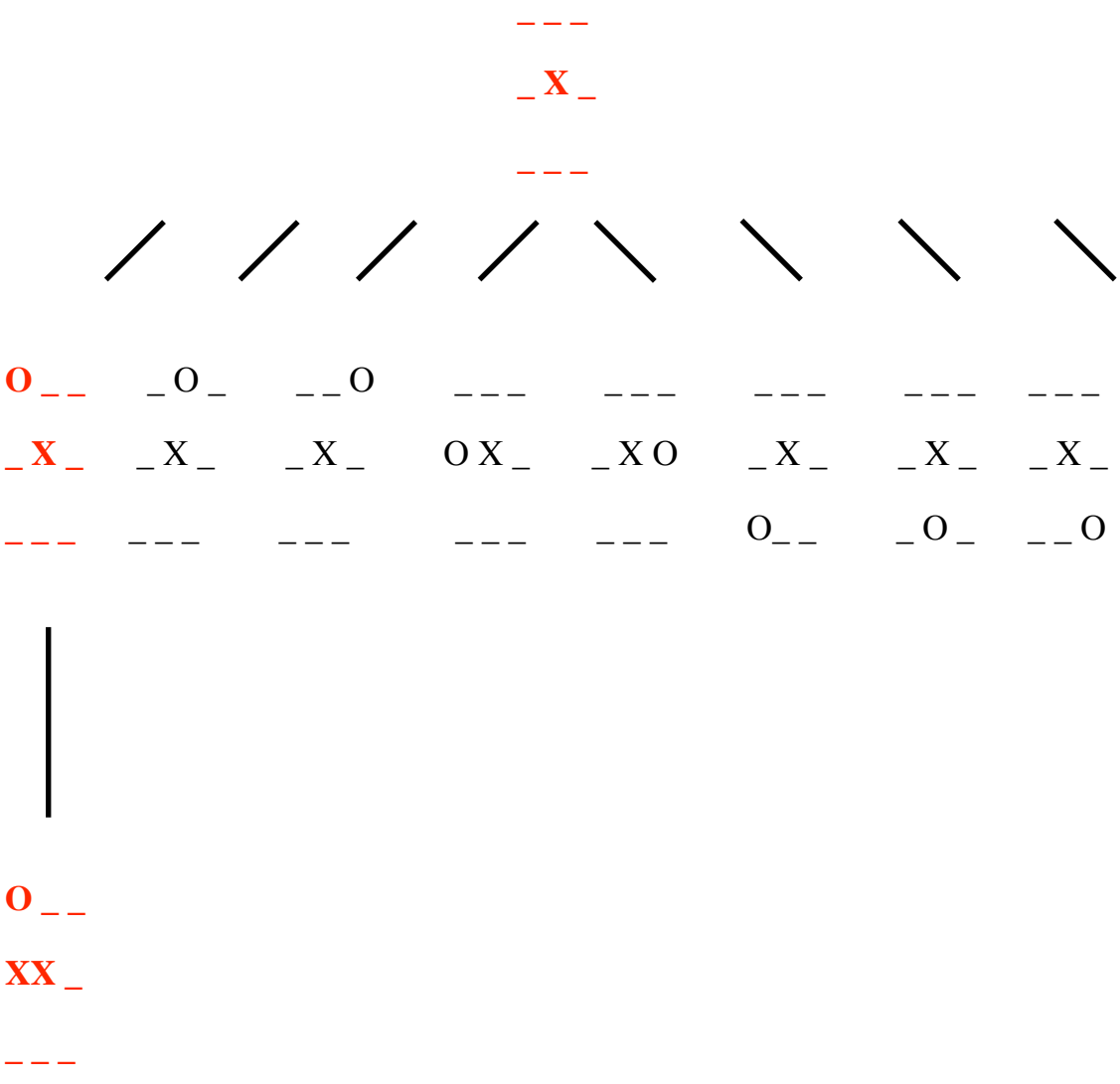
2.

a. Randomly choose a state that have the highest UCB value among these 8 states generated from the first 8 iteration

b.


_ _ _
_ X _
_ _ _
O _ _
_ O _
_ _ O
_ _ _
_ _ _
_ _ _
_ _ _
_ X _
_ X _
_ X _
O X _
_ X O
_ X _
_ X _
_ X _
_ _ _
_ _ _
_ _ _
_ _ _
_ _ _
O _ _
_ O _
_ _ O
(Node 1)
Picked node 1 because it has the highest UCB value
O _ _
XX _
New state by a random action
_ _ _
O _ O
XXX
Keep simulating until terminal, then backup update
_ _ _

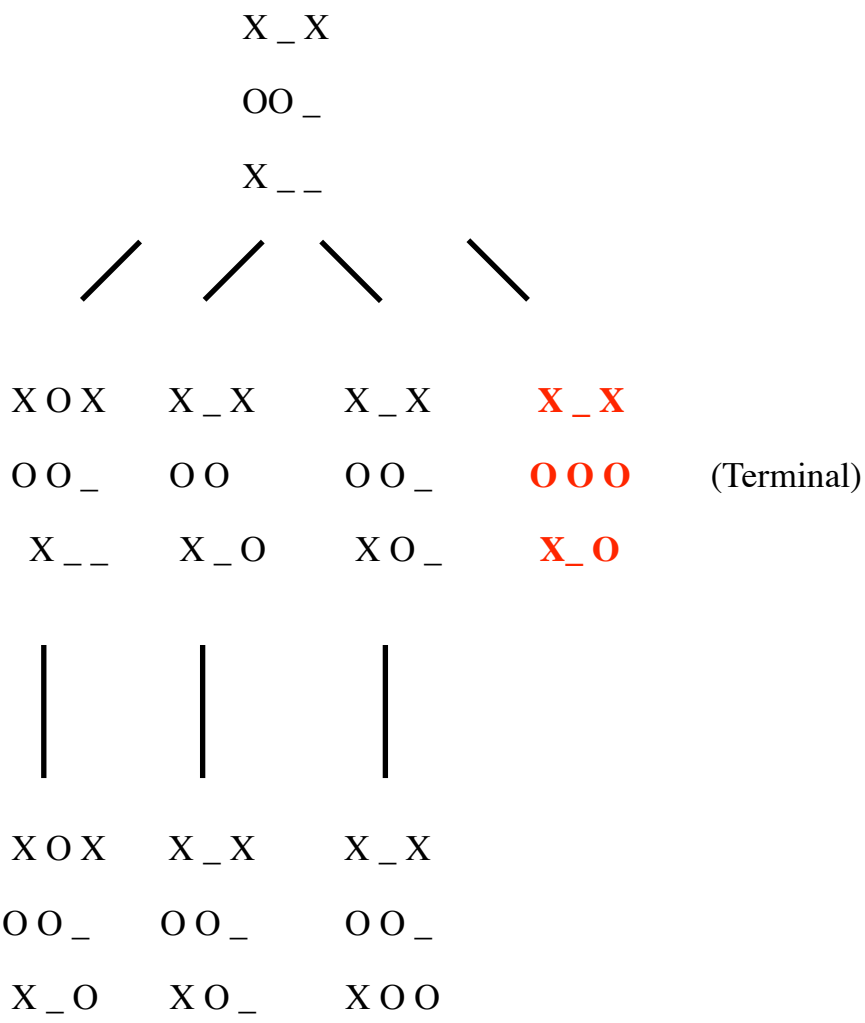
c.



The node in red. The root node only updates visit, the other two both update visit and UCB value

3.

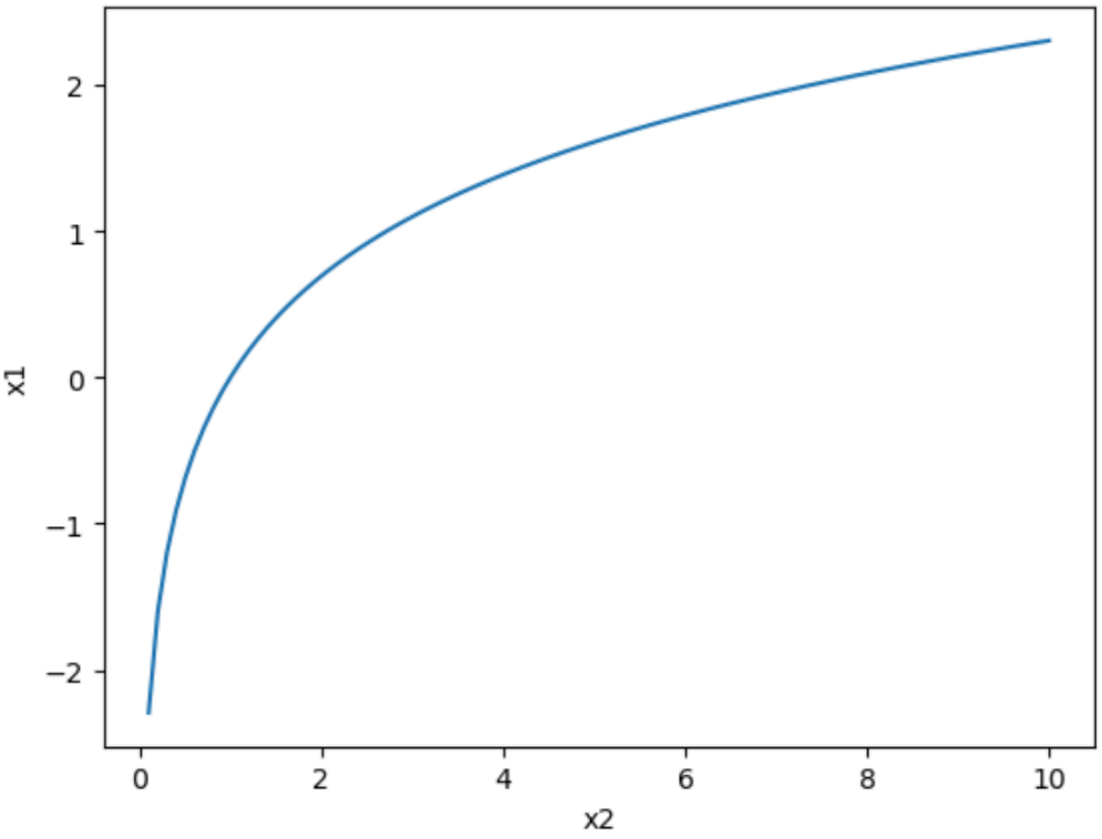
At most 7 nodes



At most 7 nodes. The red node will be visited twice. In the eighth iteration, the red node will be picked because of its high UCB value(due to it is a terminal node and winning state), but since it is terminal no node will be generated, so 7 at most.

Q4

1



When x2 = 2, x1 = 0.477, D1 = [0, 0.477(log(3)]

2.
x1= 0.6155375848385205, x2= 0.850651212532439
The branching operation occurs when I take a step size 0.1 to prune the next possible state

3. x1= 0.6155375848385205, x2= 0.850651212532439
X1 = 0, x2 =0

Because there are only two points with C1 and C2

4.
No solution

Q5

ϕ:$\neg(p2 \rightarrow(p3 \rightarrow(\neg p1 \wedge p2)))\rightarrow p1$

$= \neg(p2 \rightarrow(\neg p3 \vee (\neg p1 \wedge p2)))\rightarrow p1$

$= (\neg p2 \vee ((\neg p3 \vee \neg p1) \wedge(\neg p3 \vee p2)))\wedge \neg p1$

$= (\neg p2 \vee (\neg p3 \vee \neg p1) \wedge \neg p2 \vee (\neg p3 \vee p2))\wedge \neg p1$

$= (\neg p2 \vee (\neg p3 \vee \neg p1) \wedge \neg p2 \vee (\neg p3 \vee p2)) \wedge \neg p1$

$= ((\neg p2 \vee \neg p3 \vee \neg p1) \wedge (\neg p2 \vee \neg p3 \vee p2)) \wedge \neg p1$

$= (\neg p2 \vee \neg p3 \vee \neg p1)) \wedge \neg p1$

$= \neg p1$

DIMACS: p cnf 3 1

-1