

Lecture SAT Example
Breadth First Search
Prepared by S. Baskaran

State Space

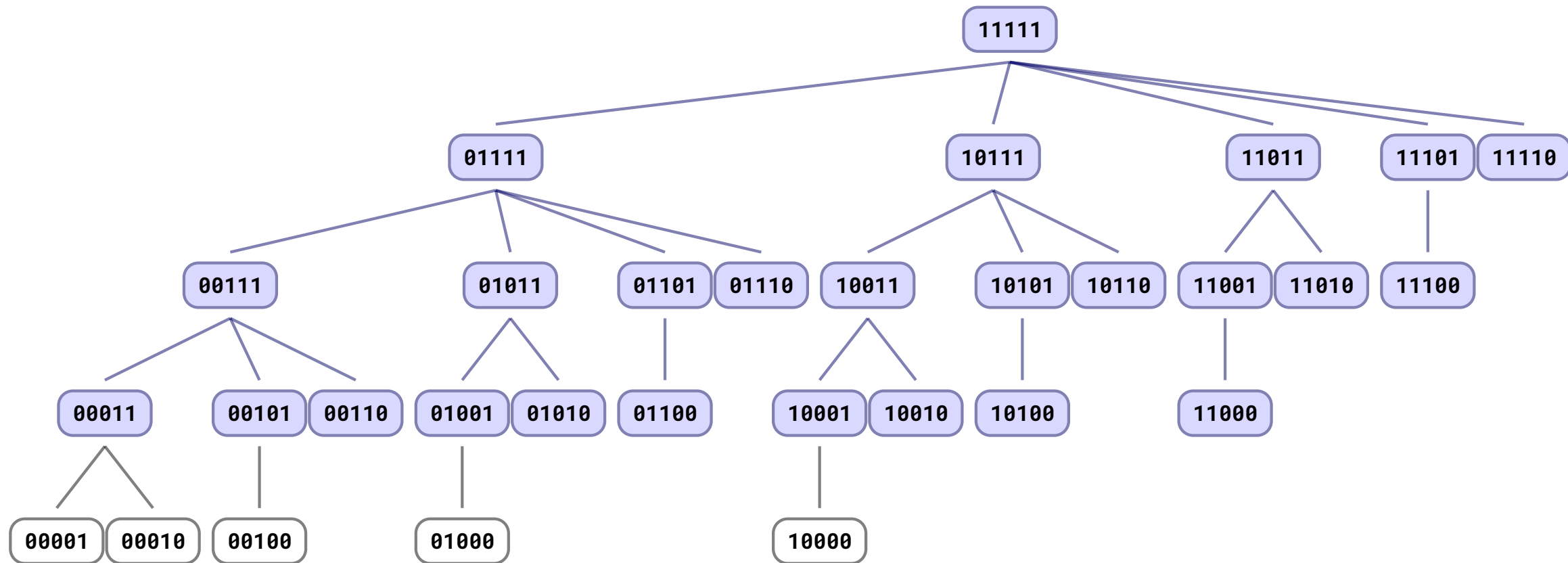
The start state is “11111”.

MoveGen is a one bit flip function.
It flips the bits from left to right, one bit at a time, and accordingly returns the neighbours.

$$F(abcde) = (b \vee \neg c) \wedge (c \vee \neg d) \wedge (\neg b) \wedge (\neg a \vee \neg e) \wedge (e \vee \neg c) \wedge (\neg c \vee \neg d)$$

S.No.	abcde	h(F)	eval(F)	eval					
				$(b \vee \neg c)$	$(c \vee \neg d)$	$(\neg b)$	$(\neg a \vee \neg e)$	$(e \vee \neg c)$	$(\neg c \vee \neg d)$
1	00000	6	1	1	1	1	1	1	1
2	00001	6	1	1	1	1	1	1	1
3	00010	5	0	1	0	1	1	1	1
4	00011	5	0	1	0	1	1	1	1
5	00100	4	0	0	1	1	1	0	1
6	00101	5	0	0	1	1	1	1	1
7	00110	3	0	0	1	1	1	0	0
8	00111	4	0	0	1	1	1	1	0
9	01000	5	0	1	1	0	1	1	1
10	01001	5	0	1	1	0	1	1	1
11	01010	4	0	1	0	0	1	1	1
12	01011	4	0	1	0	0	1	1	1
13	01100	4	0	1	1	0	1	0	1
14	01101	5	0	1	1	0	1	1	1
15	01110	3	0	1	1	0	1	0	0
16	01111	4	0	1	1	0	1	1	0
17	10000	6	1	1	1	1	1	1	1
18	10001	5	0	1	1	1	0	1	1
19	10010	5	0	1	0	1	1	1	1
20	10011	4	0	1	0	1	0	1	1
21	10100	4	0	0	1	1	1	0	1
22	10101	4	0	0	1	1	0	1	1
23	10110	3	0	0	1	1	1	0	0
24	10111	3	0	0	1	1	0	1	0
25	11000	5	0	1	1	0	1	1	1
26	11001	4	0	1	1	0	0	1	1
27	11010	4	0	1	0	0	1	1	1
28	11011	3	0	1	0	0	0	1	1
29	11100	4	0	1	1	0	1	0	1
30	11101	4	0	1	1	0	0	1	1
31	11110	3	0	1	1	0	1	0	0
32	11111	3	0	1	1	0	0	1	0

Search Tree



Solution

OPEN and CLOSED carry pairs: (NODE,PARENT)

OPEN	(11111,null):[]
CLOSED	[]
1.	
NODE	11111
close	(11111,null)
moveGen	01111:10111:10111:10101:11110:[]
newNodes	01111:10111:10111:11101:11110:[]
newPairs	(01111,11111):(10111,11111):(11011,11111):(11011,11111):(11110,11111):[]
OPEN	(01111,11111):(10111,11111):(11011,11111):(11011,11111):(11110,11111):[]
CLOSED	(11111,null):[]
2.	
NODE	01111
close	(01111,11111)
moveGen	11111:00111:01011:01101:01110:[]
newNodes	00111:01011:01101:01110:[]
newPairs	(00111,01111):(01011,01111):(01101,01111):(01110,01111):[]
OPEN	(10111,11111):(11011,11111):(11101,11111):(11110,11111):(00111,01111):(01011,01111):(01101,01111):(01110,01111):[]
CLOSED	(01111,11111):(11111,null):[]
3.	
NODE	10111
close	(10111,11111)
moveGen	00111:11111:10011:10101:10110:[]
newNodes	10011:10101:10110:[]
newPairs	(10011,10111):(10101,10111):(10110,10111):[]
OPEN	(11011,11111):(11101,11111):(11110,11111):(00111,01111):(01011,01111):(01110,01111):(10011,10111):(10110,10111):[]
CLOSED	(10111,11111):(01111,null):[]
4.	
NODE	11011
close	(11011,11111)
moveGen	01011:10011:11111:11101:11010:[]
newNodes	11001:11010:[]
newPairs	(11001,11011):(11010,11011):[]
OPEN	(11101,11111):(11110,11111):(00111,01111):(01011,01111):(01101,01111):(01110,01111):(10011,10111):(11010,11011):[]
CLOSED	(11011,11111):(01111,11111):(01111,null):[]
5.	
NODE	11101
close	(11101,11111)
moveGen	01101:10101:11001:11111:11100:[]
newNodes	11100:[]
newPairs	(11100,11101):[]
OPEN	(11110,11111):(00111,01111):(01011,01111):(01101,01111):(01110,01111):(10011,10111):(10101,10111):(11010,11011):[]
CLOSED	(11101,11111):(11011,11111):(01111,11111):(01111,null):[]
6.	
NODE	11110
close	(11110,11111)
moveGen	01110:10110:11010:11100:11111:[]
newNodes	[]
newPairs	[]
OPEN	(00111,01111):(01011,01111):(01101,01111):(01110,01111):(10011,10111):(10101,10111):(11010,11011):[]
CLOSED	(11110,11111):(11101,11111):(11011,11111):(01111,11111):(01111,null):[]
7.	
NODE	00111
close	(00111,01111)
moveGen	10111:00111:00011:00101:00110:[]
newNodes	00011:00101:00110:[]
newPairs	(00011,00111):(00101,00111):(00110,00111):[]
OPEN	(01011,01111):(01101,01111):(01110,01111):(10011,10111):(10101,10111):(11010,10111):(11001,00111):(00110,00111):[]
CLOSED	(00111,01111):(11110,11111):(11101,11111):(01111,null):[]
8.	
NODE	01011
close	(01011,01111)
moveGen	11011:00011:00111:01001:01010:[]
newNodes	01001:01010:[]
newPairs	(01001,01011):(01010,01011):[]
OPEN	(01101,01111):(01110,01111):(10011,10111):(10101,10111):(10110,10111):(10011,10111):(11010,11011):(00011,00111):(01001,01011):(01010,01011):[]
CLOSED	(01011,01111):(00111,01111):(11110,11111):(11101,11111):(01111,null):[]
9.	
NODE	01101
close	(01101,01111)
moveGen	11101:00101:01001:01111:01100:[]
newNodes	01100:[]
newPairs	(01100,01101):[]
OPEN	(01110,01111):(10011,10111):(10101,10111):(10110,10111):(11001,00111):(11010,10111):(00011,00111):(00110,00111):(01010,01011):[]
CLOSED	(01101,01111):(01011,01111):(00111,01111):(11110,11111):(01111,null):[]
10.	
NODE	01110
close	(01110,01111)
moveGen	11110:00110:01010:01100:01111:[]
newNodes	[]
newPairs	[]
OPEN	(10011,10111):(10101,10111):(10110,10111):(11001,00111):(10110,00111):(11010,00111):(00011,00111):(00110,00111):(01010,01011):[]
CLOSED	(01110,01111):(01101,01111):(01011,01111):(00111,01111):(01111,null):[]
11.	
NODE	10011
close	(10011,10111)
moveGen	00011:10111:10111:10001:10010:[]
newNodes	10001:10010:[]
newPairs	(10001,10011):(10010,10011):[]
OPEN	(10101,10111):(10110,10111):(11001,10111):(10110,10111):(11001,00111):(00110,00111):(01001,01011):(00110,00111):(10001,10011):[]
CLOSED	(10011,10111):(01110,01111):(11101,11111):(01111,null):[]
12.	
NODE	10101
close	(10101,10111)
moveGen	00101:11101:10001:10111:10100:[]
newNodes	10100:[]
newPairs	(10100,10101):[]
OPEN	(10110,10111):(11001,10111):(10101,10111):(10110,10111):(11100,11101):(00011,00111):(00110,00111):(01010,01011):(10100,10011):[]
CLOSED	(10101,10111):(00111,01111):(01110,11111):(01111,null):[]
13.	
NODE	10110
close	(10110,01111)
moveGen	00110:11110:10010:10100:10111:[]
newNodes	[]
newPairs	[]
OPEN	(11001,11011):(10101,10111):(11100,11101):(00011,00111):(00101,00111):(01010,01011):(10001,10011):(10010,10011):[]
CLOSED	(10110,10111):(10101,10111):(10011,10111):(01111,null):[]
14.	
NODE	11001
close	(11001,10111)
moveGen	01001:10001:11101:11011:11000:[]
newNodes	11000:[]
newPairs	(11000,11001):[]
OPEN	(11010,11011):(11100,11101):(00011,00111):(00101,00111):(00110,00111):(01010,01011):(10010,10011):(10001,10011):[]
CLOSED	(11001,11011):(10110,10111):(10101,10111):(10011,null):[]
15.	
NODE	11010
close	(11010,10111)
moveGen	00101:10101:11110:11000:11011:[]
newNodes	[]
newPairs	[]
OPEN	(11100,11101):(00011,00111):(00101,00111):(00110,00111):(00101,01011):(01100,01011):(10001,10011):(10010,10011):[]
CLOSED	(11010,11011):(11001,10111):(10110,10111):(01011,01111):(00111,01111):(11110,11111):(11101,11111):(01111,null):[]
16.	
NODE	11100
close	(11100,11101)
moveGen	01100:10100:11000:11110:11101:[]
newNodes	[]
newPairs	[]
OPEN	(00011,00111):(00101,00111):(00110,00111):(01001,01011):(01010,01011):(01100,01011):(10001,10011):(10010,10011):[]
CLOSED	(11100,11101):(10101,10111):(11001,10111):(01111,null):[]
17.	
NODE	00011
close	(00011,00111)
moveGen	10011:01011:00111:00001:00010:[]
newNodes	00001:00010:[]
newPairs	(00001,00011):(00010,00011):[]
OPEN	(00101,00111):(00110,00111):(00101,01011):(01010,01011):(01001,01011):(01100,01011):(10001,10011):(10010,10011):[]
CLOSED	(00011,00111):(00110,00111):(01110,11111):(01111,null):[]
18.	
NODE	00101
close	(00101,00111)
moveGen	10101:01101:00001:00111:00100:[]
newNodes	00100:[]
newPairs	(00100,00101):[]
OPEN	(00110,00111):(01001,01011):(01010,01011):(01100,01011):(10001,10011):(10010,10011):(00001,00011):(00100,00101):[]
CLOSED	(00101,00111):(00011,00111):(11100,11101):(01111,null):[]
19.	
NODE	00110
close	(00110,00111)
moveGen	10110:01110:00010:00100:00111:[]
newNodes	[]
newPairs	[]
OPEN	(01001,01011):(01010,01011):(01100,01011):(10001,00111):(10010,10011):(00001,00011):(00010,00101):[]
CLOSED	(00110,00111):(00101,00111):(00011,00111):(11100,11101):(01011,01111):(10101,10111):(01011,01111):(01111,null):[]
20.	
NODE	01001
close	(01001,01011)
moveGen	11001:00001:01101:01011:01000:[]
newNodes	01000:[]
newPairs	(01000,01001):[]
OPEN	(01010,01011):(01100,01011):(10001,00111):(10010,00111):(10100,10101):(00001,00011):(00010,00101):[]
CLOSED	(01001,01011):(00110,00111):(00101,00111):(00111,null):[]
21.	
NODE	01010
close	(01010,01011)
moveGen	11010:00010:01110:01000:01011:[]
newNodes	[]
newPairs	[]
OPEN	(01100,01011):(10001,10011):(10010,10011):(10100,10101):(10000,01001):(01000,01001):[]
CLOSED	(01010,01011):(01001,01011):(00110,00111):(00101,00111):(00111,null):[]
22.	
NODE	01100
close	(01100,01101)
moveGen	11100:00100:01000:01110:01101:[]
newNodes	[]
newPairs	[]
OPEN	(10001,10011):(10010,10011):(10100,10101):(11000,11001):(00001,00011):(00010,00101):[]
CLOSED	(01100,01101):(01010,01011):(01001,01011):(00110,00111):(00101,00111):(00011,00111):(11100,11101):(01101,01111):(01110,11111):(01111,null):[]
23.	
NODE	10001
close	(10001,10011)
moveGen	00001:11001:01011:10011:10000:[]
newNodes	10000:[]
newPairs	(10000,10001):[]
OPEN	(10010,10011):(10100,10101):(11000,11001):(00001,00011):(00010,00101):[]
CLOSED	(10001,10011):(01100,01101):(01010,01011):(01001,01011):(00110,00111):(00101,00111):(11100,11101):(01011,01111):(01011,01111):(01111,null):[]
24.	
NODE	10010
close	(10010,10011)
moveGen	00010:11010:01110:10000:10011:[]
newNodes	[]
newPairs	[]
OPEN	(10100,10101):(11000,11001):(00001,00011):(00010,00101):[]
CLOSED	(10010,10011):(10001,10011):(01100,01101):(01010,01011):(01010,01011):(01001,01011):(11100,11101):(01011,01111):(01011,01111):(01111,null):[]
25.	
NODE	10100
close	(10100,10101)
moveGen	00100:11100:10000:10110:10101:[]
newNodes	[]
newPairs	[]
OPEN	(11000,11001):(00001,00011):(00010,00101):(00100,00101):[]
CLOSED	(10100,10101):(10010,10011):(10001,10011):(00100,00101):(00100,01001):[]
26.	
NODE	11000
close	(11000,11001)
moveGen	01000:10000:11100:11010:11001:[]
newNodes	[]
newPairs	[]
OPEN	(00001,00011):(00010,00011):(00100,00101):(01000,01001):[]
CLOSED	(11000,11001):(10100,10101):(10010,10011):(10001,10011):(00100,00101):(00100,00101):(00011,00011):(00110,00111):(01010,01011):(01110,11111):(01111,null):[]
27.	
NODE	00001
GOAL	00001
OPEN	(00001,00011):(00010,00011):(00100,00101):(01000,01001):[]
CLOSED	(11000,11001):(10100,10101):(10010,10011):(10001,10011):(00100,00101):(00100,00101):(00011,00011):(00110,00111):(01010,01011):(01110,11111):(01111,null):[]
PATH	11111:01111:00111:00011:00001:[]