Practice Assignment: SAT Example Depth First Search

Prepared by S. Baskaran

State Space

The start state is "11111".

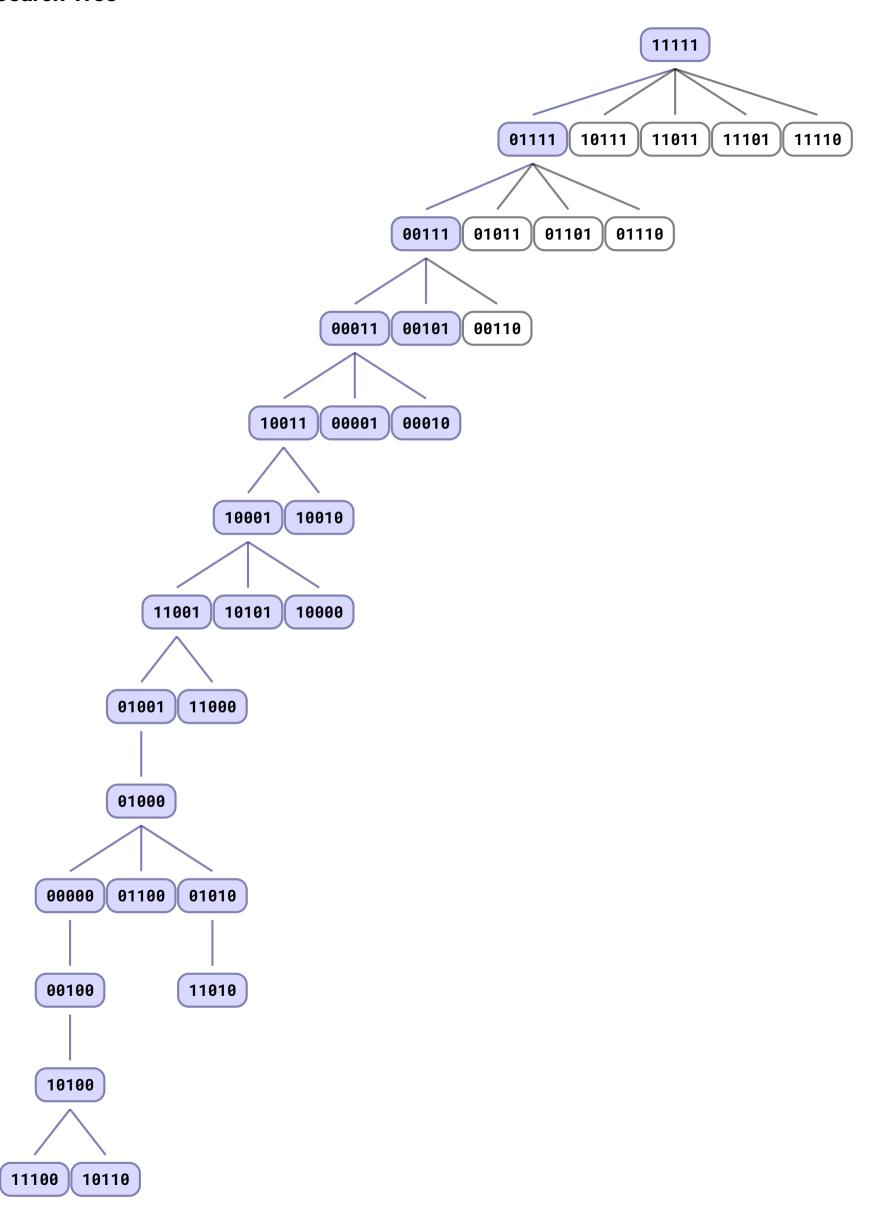
MoveGen is a one bit flip function.

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

 $F(abcde) = (a \lor \neg b) \land (\neg a \lor \neg c) \land (\neg a \lor \neg e) \land (b \lor \neg e) \land (\neg c \lor d) \land (c \lor e)$

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

Search Tree



Solution OPEN and CLOSED carry pairs: (NODE, PARENT) **OPEN** (11111, null):[] **CLOSED** 1. NODE 11111 (11111, null) close moveGen 01111:10111:11011:11101:11110:[] 01111:10111:11011:11101:11110:[] newNodes (01111, 11111):(10111, 11111):(11011, 11111):(11101, 11111): newPairs (11110, 11111):[] (01111, 11111):(10111, 11111):(11011, 11111):(11101, 11111): OPEN (11110, 11111):[] (11111, null):[] **CLOSED** 2. NODE 01111 (01111, 11111)close moveGen 11111:00111:01011:01101:01110:[] 00111:01011:01101:01110:[] newNodes (00111,01111):(01011,01111):(01101,01111):(01110,01111):[] newPairs (00111,01111):(01011,01111):(01101,01111):(01110,01111): **OPEN** (10111, 11111):(11011, 11111):(11101, 11111):(11110, 11111):[] (01111,11111):(11111,null):[] **CLOSED** 3. NODE 00111 (00111,01111)close 10111:01111:00011:00101:00110:[] moveGen 00011:00101:00110:[] newNodes (00011,00111):(00101,00111):(00110,00111):[] newPairs **OPEN** (00011,00111):(00101,00111):(00110,00111):(01011,01111): (01101, 01111):(01110, 01111):(10111, 11111):(11011, 11111): (11101, 11111):(11110, 11111):[] (00111,01111):(01111,11111):(11111,null):[] **CLOSED** 4. NODE 00011 close (00011,00111)10011:01011:00111:00001:00010:[] moveGen newNodes 10011:00001:00010:[] (10011,00011):(00001,00011):(00010,00011):[] newPairs **OPEN** (10011,00011):(00001,00011):(00010,00011):(00101,00111): (00110,00111):(01011,01111):(01101,01111):(01110,01111): (10111, 11111):(11011, 11111):(11101, 11111):(11110, 11111):[] (00011,00111):(00111,01111):(01111,11111):(11111,null):[] **CLOSED** 5. NODE 10011 close (10011,00011)moveGen 00011:11011:10111:10001:10010:[] 10001:10010:[] newNodes (10001, 10011):(10010, 10011):[] newPairs (10001, 10011):(10010, 10011):(00001, 00011):(00010, 00011): **OPEN** (00101,00111):(00110,00111):(01011,01111):(01101,01111): (01110,01111):(10111,11111):(11011,11111):(11101,11111): (11110, 11111):[] **CLOSED** (10011,00011):(00011,00111):(00111,01111):(01111,11111): (11111, null):[] 6. NODE 10001 (10001, 10011)close 00001:11001:10101:10011:10000:[] moveGen 11001:10101:10000:[] newNodes (11001, 10001):(10101, 10001):(10000, 10001):[] newPairs **OPEN** (11001, 10001):(10101, 10001):(10000, 10001):(10010, 10011): (00001,00011):(00010,00011):(00101,00111):(00110,00111): (01011, 01111):(01101, 01111):(01110, 01111):(10111, 11111): (11011, 11111):(11101, 11111):(11110, 11111):[] **CLOSED** (10001, 10011):(10011, 00011):(00011, 00111):(00111, 01111): (01111,11111):(11111,null):[] 7. NODE 11001 close (11001, 10001)01001:10001:11101:11011:11000:[] moveGen 01001:11000:[] newNodes (01001, 11001):(11000, 11001):[] newPairs (01001, 11001):(11000, 11001):(10101, 10001):(10000, 10001): **OPEN** (10010, 10011):(00001, 00011):(00010, 00011):(00101, 00111): (00110,00111):(01011,01111):(01101,01111):(01110,01111): (10111, 11111):(11011, 11111):(11101, 11111):(11110, 11111):[] (11001, 10001):(10001, 10011):(10011, 00011):(00011, 00111): **CLOSED** (00111,01111):(01111,11111):(11111,null):[] 8. **NODE** 01001 (01001, 11001)close 11001:00001:01101:01011:01000:[] moveGen 01000:[] newNodes (01000,01001):[] newPairs **OPEN** (01000,01001):(11000,11001):(10101,10001):(10000,10001): (10010, 10011):(00001, 00011):(00010, 00011):(00101, 00111): (00110,00111):(01011,01111):(01101,01111):(01110,01111): (10111, 11111):(11011, 11111):(11101, 11111):(11110, 11111):[] **CLOSED** (01001, 11001):(11001, 10001):(10001, 10011):(10011, 00011): (00011,00111):(00111,01111):(01111,11111):(11111,null):[] 9. NODE 01000 close (01000,01001)11000:00000:01100:01010:01001:[] moveGen newNodes 00000:01100:01010:[] newPairs (00000,01000):(01100,01000):(01010,01000):[] **OPEN** (00000,01000):(01100,01000):(01010,01000):(11000,11001): (10101, 10001):(10000, 10001):(10010, 10011):(00001, 00011): (00010,00011):(00101,00111):(00110,00111):(01011,01111): (01101, 01111):(01110, 01111):(10111, 11111):(11011, 11111): (11101, 11111):(11110, 11111):[] **CLOSED** (01000,01001):(01001,11001):(11001,10001):(10001,10011): (10011,00011):(00011,00111):(00111,01111):(01111,11111): (11111, null):[] 10. NODE 00000 close (00000,01000)10000:01000:00100:00010:00001:[] moveGen 00100:[] newNodes newPairs (00100,00000):[] (00100,00000):(01100,01000):(01010,01000):(11000,11001): **OPEN** (10101, 10001):(10000, 10001):(10010, 10011):(00001, 00011): (00010,00011):(00101,00111):(00110,00111):(01011,01111): (01101,01111):(01110,01111):(10111,11111):(11011,11111): (11101, 11111):(11110, 11111):[] (00000,01000):(01000,01001):(01001,11001):(11001,10001): **CLOSED** (10001, 10011):(10011, 00011):(00011, 00111):(00111, 01111): (01111,11111):(11111,null):[] 11. NODE 00100 close (00100,00000)moveGen 10100:01100:00000:00110:00101:[] newNodes 10100:[] newPairs (10100,00100):[] **OPEN** (10100,00100):(01100,01000):(01010,01000):(11000,11001): (10101, 10001):(10000, 10001):(10010, 10011):(00001, 00011): (00010,00011):(00101,00111):(00110,00111):(01011,01111): (01101, 01111):(01110, 01111):(10111, 11111):(11011, 11111): (11101, 11111):(11110, 11111):[] **CLOSED** (00100,00000):(00000,01000):(01000,01001):(01001,11001): (11001, 10001):(10001, 10011):(10011, 00011):(00011, 00111): (00111,01111):(01111,11111):(11111,null):[] 12. **NODE** 10100 close (10100,00100)00100:11100:10000:10110:10101:[] moveGen newNodes 11100:10110:[] (11100, 10100):(10110, 10100):[] newPairs **OPEN** (11100, 10100):(10110, 10100):(01100, 01000):(01010, 01000): (11000, 11001):(10101, 10001):(10000, 10001):(10010, 10011): (00001,00011):(00010,00011):(00101,00111):(00110,00111): (01011, 01111):(01101, 01111):(01110, 01111):(10111, 11111): (11011, 11111):(11101, 11111):(11110, 11111):[] **CLOSED** (10100,00100):(00100,00000):(00000,01000):(01000,01001): (01001, 11001):(11001, 10001):(10001, 10011):(10011, 00011): (00011,00111):(00111,01111):(01111,11111):(11111,null):[] 13. NODE 11100 close (11100, 10100)01100:10100:11000:11110:11101:[] moveGen [] newNodes newPairs [] **OPEN** (10110, 10100):(01100, 01000):(01010, 01000):(11000, 11001): (10101, 10001): (10000, 10001): (10010, 10011): (00001, 00011): (00010,00011):(00101,00111):(00110,00111):(01011,01111): (01101, 01111):(01110, 01111):(10111, 11111):(11011, 11111): (11101, 11111):(11110, 11111):[] **CLOSED** (11100, 10100):(10100, 00100):(00100, 00000):(00000, 01000): (01000,01001):(01001,11001):(11001,10001):(10001,10011): (10011,00011):(00011,00111):(00111,01111):(01111,11111): (11111, null):[] 14. NODE 10110 close (10110, 10100)moveGen 00110:11110:10010:10100:10111:[] [] newNodes newPairs **OPEN** (01100,01000):(01010,01000):(11000,11001):(10101,10001): (10000, 10001):(10010, 10011):(00001, 00011):(00010, 00011): (00101,00111):(00110,00111):(01011,01111):(01101,01111): (01110,01111):(10111,11111):(11011,11111):(11101,11111): (11110,11111):[] **CLOSED** (10110, 10100):(11100, 10100):(10100, 00100):(00100, 00000): (00000,01000):(01000,01001):(01001,11001):(11001,10001): (10001, 10011):(10011, 00011):(00011, 00111):(00111, 01111): (01111,11111):(11111,null):[] 15. NODE 01100 (01100,01000)close 11100:00100:01000:01110:01101:[] moveGen newNodes newPairs **OPEN** (01010,01000):(11000,11001):(10101,10001):(10000,10001): (10010, 10011):(00001, 00011):(00010, 00011):(00101, 00111): (00110,00111):(01011,01111):(01101,01111):(01110,01111): (10111, 11111):(11011, 11111):(11101, 11111):(11110, 11111):[] (01100,01000):(10110,10100):(11100,10100):(10100,00100): **CLOSED** (00100,00000):(00000,01000):(01000,01001):(01001,11001): (11001, 10001):(10001, 10011):(10011, 00011):(00011, 00111): (00111,01111):(01111,11111):(11111,null):[] 16. NODE 01010 close (01010,01000)11010:00010:01110:01000:01011:[] moveGen 11010:[] newNodes (11010,01010):[] newPairs **OPEN** (11010,01010):(11000,11001):(10101,10001):(10000,10001): (10010, 10011):(00001, 00011):(00010, 00011):(00101, 00111): (00110,00111):(01011,01111):(01101,01111):(01110,01111): (10111, 11111):(11011, 11111):(11101, 11111):(11110, 11111):[] (01010,01000):(01100,01000):(10110,10100):(11100,10100): CLOSED (10100,00100):(00100,00000):(00000,01000):(01000,01001): (01001, 11001):(11001, 10001):(10001, 10011):(10011, 00011): (00011,00111):(00111,01111):(01111,11111):(11111,null):[] 17. NODE 11010 close (11010,01010)01010:10010:11110:11000:11011:[] moveGen [] newNodes newPairs [] **OPEN** (11000, 11001):(10101, 10001):(10000, 10001):(10010, 10011): (00001,00011):(00010,00011):(00101,00111):(00110,00111): (01011, 01111):(01101, 01111):(01110, 01111):(10111, 11111): (11011, 11111):(11101, 11111):(11110, 11111):[] **CLOSED** (11010,01010):(01010,01000):(01100,01000):(10110,10100): (11100, 10100): (10100, 00100): (00100, 00000): (00000, 01000): (01000,01001):(01001,11001):(11001,10001):(10001,10011): (10011,00011):(00011,00111):(00111,01111):(01111,11111): (11111, null):[] 18. NODE 11000 close (11000, 11001)moveGen 01000:10000:11100:11010:11001:[] newNodes newPairs **OPEN** (10101, 10001): (10000, 10001): (10010, 10011): (00001, 00011): (00010,00011):(00101,00111):(00110,00111):(01011,01111): (01101, 01111):(01110, 01111):(10111, 11111):(11011, 11111): (11101, 11111):(11110, 11111):[] **CLOSED** (11000, 11001):(11010, 01010):(01010, 01000):(01100, 01000): (10110, 10100):(11100, 10100):(10100, 00100):(00100, 00000): (00000,01000):(01000,01001):(01001,11001):(11001,10001): (10001, 10011):(10011, 00011):(00011, 00111):(00111, 01111): (01111,11111):(11111,null):[] 19. **NODE** 10101 (10101, 10001)close 00101:11101:10001:10111:10100:[] moveGen newNodes [] newPairs **OPEN** (10000, 10001):(10010, 10011):(00001, 00011):(00010, 00011): (00101,00111):(00110,00111):(01011,01111):(01101,01111): (01110, 01111):(10111, 11111):(11011, 11111):(11101, 11111): (11110, 11111):[] **CLOSED** (10101, 10001):(11000, 11001):(11010, 01010):(01010, 01000): (01100,01000):(10110,10100):(11100,10100):(10100,00100): (00100,00000):(00000,01000):(01000,01001):(01001,11001): (11001, 10001):(10001, 10011):(10011, 00011):(00011, 00111): (00111,01111):(01111,11111):(11111,null):[] 20. NODE 10000 close (10000, 10001)moveGen 00000:11000:10100:10010:10001:[] [] newNodes [] newPairs **OPEN** (10010, 10011):(00001, 00011):(00010, 00011):(00101, 00111): (00110,00111):(01011,01111):(01101,01111):(01110,01111): (10111, 11111):(11011, 11111):(11101, 11111):(11110, 11111):[] (10000, 10001): (10101, 10001): (11000, 11001): (11010, 01010): **CLOSED** (01010,01000):(01100,01000):(10110,10100):(11100,10100): (10100,00100):(00100,00000):(00000,01000):(01000,01001): (01001, 11001):(11001, 10001):(10001, 10011):(10011, 00011): (00011,00111):(00111,01111):(01111,11111):(11111,null):[] 21. NODE 10010 close (10010, 10011)moveGen 00010:11010:10110:10000:10011:[] newNodes [] newPairs **OPEN** (00001,00011):(00010,00011):(00101,00111):(00110,00111): (01011, 01111):(01101, 01111):(01110, 01111):(10111, 11111): (11011, 11111):(11101, 11111):(11110, 11111):[] **CLOSED** (10010, 10011):(10000, 10001):(10101, 10001):(11000, 11001): (11010,01010):(01010,01000):(01100,01000):(10110,10100): (11100, 10100):(10100, 00100):(00100, 00000):(00000, 01000): (01000,01001):(01001,11001):(11001,10001):(10001,10011): (10011,00011):(00011,00111):(00111,01111):(01111,11111): (11111, null):[] 22. NODE 00001 close (00001,00011)10001:01001:00101:00011:00000:[] moveGen [] newNodes newPairs **OPEN** (00010,00011):(00101,00111):(00110,00111):(01011,01111): (01101, 01111):(01110, 01111):(10111, 11111):(11011, 11111): (11101, 11111):(11110, 11111):[] **CLOSED** (00001,00011):(10010,10011):(10000,10001):(10101,10001): (11000, 11001):(11010, 01010):(01010, 01000):(01100, 01000): (10110, 10100):(11100, 10100):(10100, 00100):(00100, 00000): (00000,01000):(01000,01001):(01001,11001):(11001,10001): (10001, 10011):(10011, 00011):(00011, 00111):(00111, 01111): (01111,11111):(11111,null):[] 23. NODE 00010 close (00010,00011)10010:01010:00110:00000:00011:[] moveGen [] newNodes newPairs **OPEN** (00101,00111):(00110,00111):(01011,01111):(01101,01111): (01110, 01111):(10111, 11111):(11011, 11111):(11101, 11111): (11110, 11111):[] **CLOSED** (00010,00011):(00001,00011):(10010,10011):(10000,10001): (10101, 10001):(11000, 11001):(11010, 01010):(01010, 01000): (01100,01000):(10110,10100):(11100,10100):(10100,00100): (00100,00000):(00000,01000):(01000,01001):(01001,11001): (11001, 10001):(10001, 10011):(10011, 00011):(00011, 00111): (00111,01111):(01111,11111):(11111,null):[] 24. NODE 00101 close (00101,00111)moveGen 10101:01101:00001:00111:00100:[] newNodes newPairs **OPEN** (00110,00111):(01011,01111):(01101,01111):(01110,01111): (10111, 11111):(11011, 11111):(11101, 11111):(11110, 11111):[] **CLOSED** (00101,00111):(00010,00011):(00001,00011):(10010,10011): (10000, 10001):(10101, 10001):(11000, 11001):(11010, 01010): (01010,01000):(01100,01000):(10110,10100):(11100,10100): (10100,00100):(00100,00000):(00000,01000):(01000,01001): (01001, 11001):(11001, 10001):(10001, 10011):(10011, 00011): (00011,00111):(00111,01111):(01111,11111):(11111,null):[] 25. NODE 00110 **GOAL** 00110 **OPEN** (00110,00111):(01011,01111):(01101,01111):(01110,01111): (10111, 11111):(11011, 11111):(11101, 11111):(11110, 11111):[] **CLOSED** (00101,00111):(00010,00011):(00001,00011):(10010,10011): (10000, 10001):(10101, 10001):(11000, 11001):(11010, 01010): (01010,01000):(01100,01000):(10110,10100):(11100,10100): (10100,00100):(00100,00000):(00000,01000):(01000,01001): (01001, 11001):(11001, 10001):(10001, 10011):(10011, 00011): (00011,00111):(00111,01111):(01111,11111):(11111,null):[] 11111:01111:00111:00110:[] **PATH**