3SAT FINAL PROJECT

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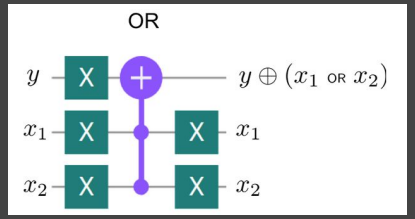
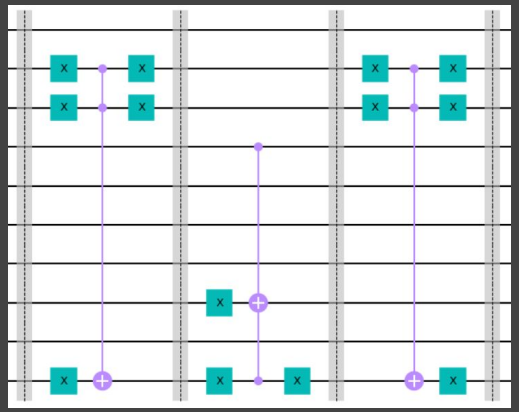




01 QUANTUM ORACLE

- 3-SAT refresher:
  - Boolean expressions such as “(x0 or !x1 or x2) and (!x2 or x1 or !x0) and (x1 or x0 or !x2)”
  - Does a 3-SAT expression have solutions? NP-complete
  - Grover’s Algorithm can find them faster
- Turning 3-SAT expression into quantum oracle
  - Implemented with OR gates and Multi-AND gates
  - How to minimize auxiliary bits?
    - Reuse them by uncomputing parts of circuit
    - Need to reuse all auxiliary bits with Grover’s Algorithm

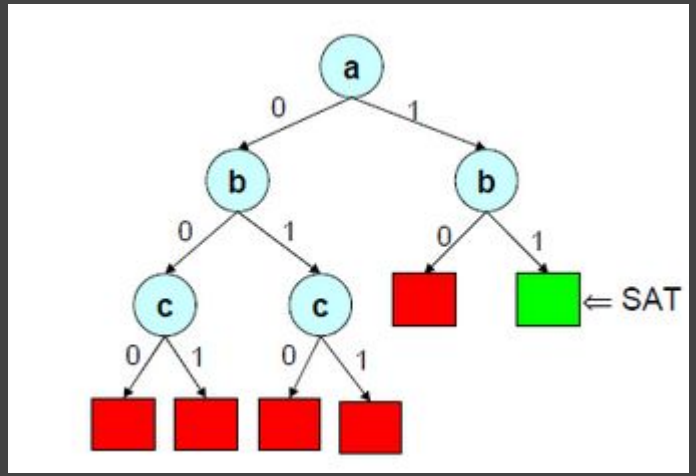
02 NO. SOLUTIONS

Is the formula is satisfiable? *

If so, we can use brute force to find the number of solutions

Many ways...we keep a set of all possible interpretations

If not, return unsatisfiable

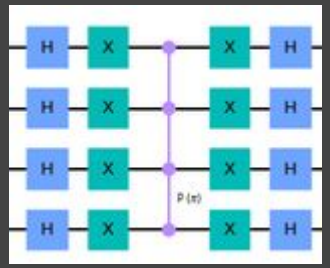


* run a basic version of the DPLL algo to find out

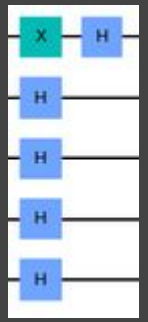
```
for seq in itertools.product([True,False], repeat=n):
    # present a possible interpretation
    a = set(zip(literals, seq))
```

03 GROVER'S ALGORITHM

initialize qc ——> Q.CIRCUIT ——>



initialize qc2 ——>



$$r = \lfloor \pi * \sqrt{\frac{2^{literals}}{classical\ sols}}\ /4 \rfloor$$

——>

qc

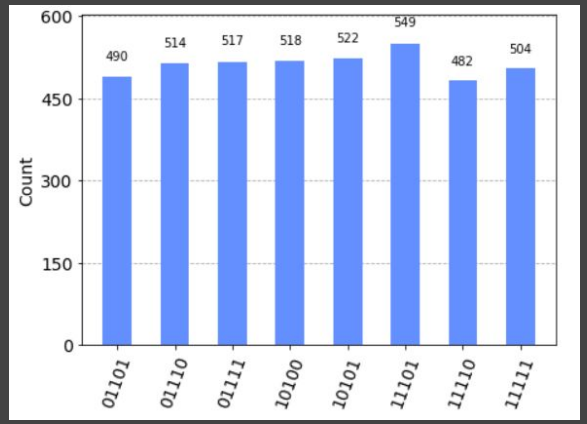
getting the solutions:

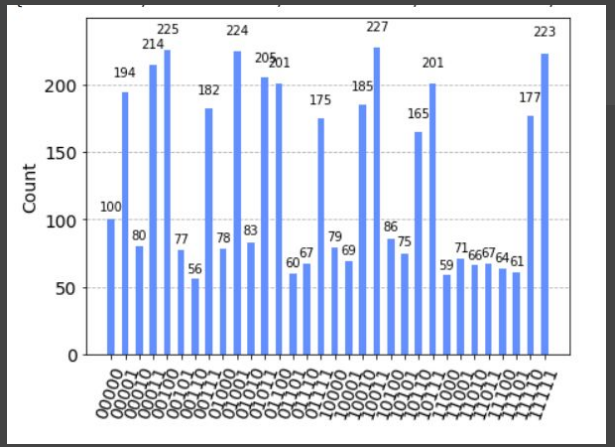
```
for i in range(solutions[0]):
  max = -1
  maxStr = ""
  for res in counts:
    if(counts[res]>max):
      max=counts[res]
      maxStr = res
  counts[maxStr] = 0
  sols.append(maxStr)

solutions[1].sort()
sols.sort()
```

04 EXPERIMENTAL RESULTS

DEMO!





Thanks for listening!