Lecture 13

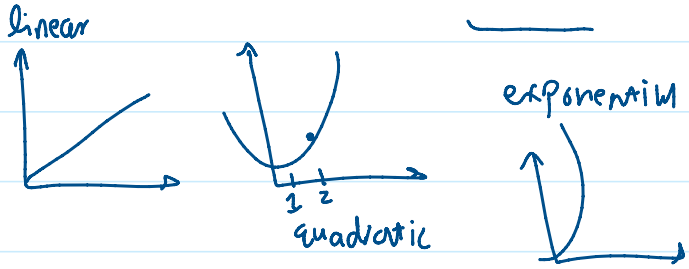
Sunday, October 13, 2024 9:38 AM

Chapter 7: Quantum Algorithms

Algorithm 1 vs Algorithm 2 search

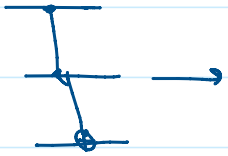
- Space Complexity → memory
- Time Complexity → CPU cycles

$O(n)$, $O(n^2)$, $O(2^n)$



- Two quantum algorithm complexity measures

  - Circuit Complexity: # of gates

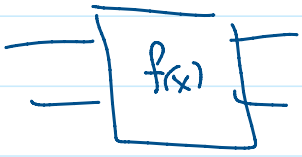


(CNOT, H, T gate, 82 H gate)

2 CNOT, 2H, 2T

- An efficient gate (or circuit) should have only polynomial # of universal gates
- Equivalent to space complexity in classical algorithms

- Query Complexity

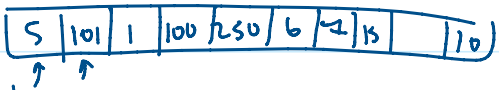


Oracle-based algorithms

- An oracle is a function $f(x)$
- In this context, query complexity is "# of times we query the oracle"
  ask / call

Example

- Searching for an item in an unsorted list



target = 10

Query complexity depends on "configuration" of the problem

- The query would be $f(x)$ where x is the target.
  the answer is 0 or 1

list is embedded →

$$f(x) = \begin{cases} 1 & \text{target is for} \\ 0 & \text{otherwise} \end{cases}$$