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Quantum Algorithms: Quiz 1 2021-02-04

Name: MADHU PEDURI

1. What does it mean for a predicate P on domain X to be *decidable*?

→ A predicate P $A^* \rightarrow \{0,1\}$ is decidable if there exists a turing machine M such that

$$\phi : P(x) = \varphi_M$$

→ If the function of Predicate, δ, is Computable, then such predicate is Decidable.

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Quantum Algorithms: Quiz 2 2021-02-11

Name: MADHU PEDURI

1. Define the class NP.

A predicate L belongs to class NP, if there exists a Non deterministic TM that computes L in Polynomial time

$$L(x) = \exists y \left((|y| < q(|x|)) \wedge R(x,y) \right)$$

or

$R(x,y)$ is a predicate $\in P$ having two variables) what is $q(\,)$?

$L(x) = 1 \Rightarrow$ there exists a Computational Path that gives yes in Poly(n).

$L(x) = 0 \rightarrow$ there is no such property

or

there is no Path of any length that gives 'yes'

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Quantum Algorithms: Quiz 3 2021-02-18

Name: MADHU PEDURI

1. Define the complexity class BPP.

A predicate L belongs to class BPP if there exists a Probabilistic TM M and P, a polynomial function.
for an input string x, it gives answer in P(|x|) steps (Polynomial time)
such that

$L(x) = 1$ M gives yes with probability $\geq (1-\varepsilon)$

$L(x) = 0$ M gives No with Probability $\geq 1-\varepsilon$

where ε is the admissable error

$0 < \varepsilon < 1/2$

error in book

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Quantum Algorithms: Quiz 4 2021-02-25

Name: MADHU PEDURI

1. State Fermat's Little Theorem.

If a, p are coprime then p prime
for an integer $a \in \mathbb{Z}$ $a \neq 0$; $p \neq 0$

$$a^{p-1} \equiv 1 \pmod{p}$$

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Quantum Algorithms: Quiz 5 2021-03-04

Name: Madhu peduri

1. Let $\mathcal{B} = \{|0\rangle, |1\rangle, |2\rangle\}$ be an ordered basis for the vector space $\mathbb{V}$. Let $\varphi = |0\rangle\langle 0| - 2|1\rangle\langle 2|$ be a linear transformation. Find the matrix for φ relative to the basis $\mathcal{B}$, $(\varphi)_{\mathcal{B}\to\mathcal{B}}$.

$$\varphi = \begin{pmatrix} 1/2 & 2/3 \\ 1 & -1/3 \end{pmatrix} \quad X$$

why 2/3 ?

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Quantum Algorithms: Quiz 6 2021-03-11

Name: MADHU PEDURI

1. Show that if $U^{-1} = U^{\dagger}$ then U preserves the bracket. That is, if $U|\alpha\rangle = |\gamma\rangle$ and $U|\beta\rangle = |\delta\rangle$ then $\langle\alpha \mid \beta\rangle = \langle\gamma \mid \delta\rangle$.

$$U|\alpha\rangle = |\gamma\rangle$$

$$U|\beta\rangle = |\delta\rangle$$

$$\langle\alpha|\beta\rangle = \langle\alpha||\beta\rangle$$

$$= \langle\gamma|U^{\dagger}U|\delta\rangle$$

$$= \langle\gamma|I|\delta\rangle$$

$$= \langle\gamma||\delta\rangle \quad (\because U^{\dagger}U^{-1} = I)$$

$$= \langle\gamma|\delta\rangle$$

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Quantum Algorithms: Quiz 7 2021-03-25

Name: MADHU PEDURI

1. Let U be a unitary matrix. Using the definition of the operator norm, show that $\|U\| = 1$.

Definition of operator norm

$$\|X\| = \sup_{\|\alpha\| \neq 0} \frac{\|X|\alpha\rangle\|}{\|\alpha\|}$$

$$= \sup_{\|\alpha\| \neq 0} \frac{\|U|\alpha\rangle\|}{\|\alpha\|}$$

= Unitary matrix (operator) Preserve geometry of the Vector ✓

$$\|U\| := \frac{\|\alpha\|}{\|\alpha\|} = 1$$

$\because$ ~~$\|U|\alpha\rangle = \|\alpha\|$~~

$\because \|U|\alpha\rangle\| = \|\alpha\|$

R'

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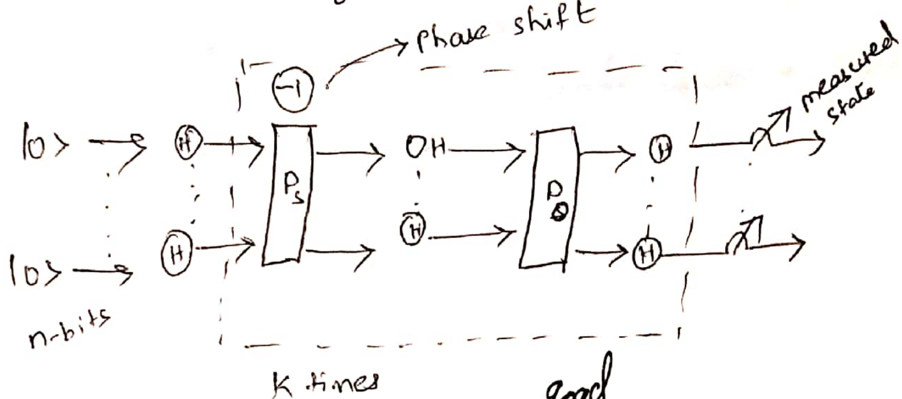
Quantum Algorithms: Quiz 8 2021-04-01

Name: MADHU PEDURI

1. Draw the circuit for Grover's algorithm

$$G = -I \circ H^{\otimes n} \circ D_0 \circ H^{\otimes n} \circ D_s$$



good

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Quantum Algorithms: Quiz 9 2021-04-08

Name: MADHU PEDURI

1. Let $\mathbb{A}$ be a subspace of the vector space $\mathbb{V}$ and let $|\alpha\rangle \in V$. Define Π_α and $\Pi_{\mathbf{A}}$.

$\cancel{\Pi_{\alpha}} = \cancel{|\alpha\rangle\langle\alpha|}$

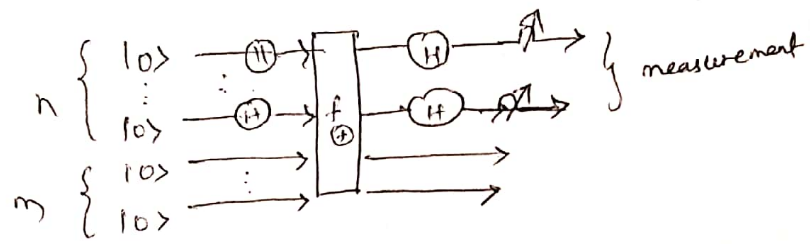
$\Pi_{\alpha} = \underbrace{|\alpha\rangle}\otimes \underbrace{B^{n-m}}$ vector tensor a space?

$\Pi_A = \sum_k \Pi_{\alpha_k}$

Quantum Algorithms: Quiz 10 4/4 2021-04-15

Name: MADHU PEDURI

1. Draw the circuit that solves Simon's Problem. Be sure to indicate on which qubits measurement is performed.



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Name: MADHU PEDURI

1. Draw the eigenvalue approximation circuit for unitary U with eigenvector $|\alpha\rangle$.

$$U|\alpha_k\rangle = d_k|\alpha_k\rangle$$