Quantum Information and Computing Notes

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1 Lecture 1

- Serial - Parallel in Classical Computing using many processors
- History of QC
  Feynman : capturing probabilistic nature of QM
  Shor : factorising big composite number using QC - no classical algorithm to solven polynomial time

- Inherent parallelism in QC as all bits are linear combinations
- *Entanglement*
- Moore's Law - Number density of transistors doubles every two months
  inter transistor distance decreases - *Miniaturization*
  as you get smaller quantum effects get more significant
  Heat produced by one component affects other
  Heat produced $\propto$ volume but Removing Heat $\propto$ surface
- Landaur's Principle - Every physically irreversible process (most classical) n bits of information increases entropy by $nk_b \log 2$
- Reversible classical gates - *collecting garbage?*
- Complexity of problem - dependence of time and memory on length of input
  polynomial,log,constant time - easy problems
  2^n - hard problem

2 Postulates of Quantum Mechanics :-

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3 Qubits

16/4

- cbit - 0/1
- qbit - 2D Hilbert space, $|0\rangle, |1\rangle$
  choose orthonormal states $\langle 0|1\rangle = \langle 1|0\rangle = 0$ and $\langle 0|0\rangle = \langle 1|1\rangle = 1$
  Any linear combination is valid - $|\psi\rangle = c_0 |0\rangle + c_1 |1\rangle | c_1, c_2 \in \mathbb{C}$
  Matrix representation - ([23])

$\frac{\gamma}{\pi}$ $k1$