

Quantum Computation

CS 190 / 264

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Course Web Page:

www.ics.vci.edu/~irani/f18-/quantum.html

Course Overview:

What could we compute if we could build a large-scale quantum computer?

What do we expect we can't compute with a quantum computer?

First need to describe what a quantum computer is:

⇒ Model of Computation.

Will start with a brief introduction to the postulates of quantum mechanics.

Classical Computing: Turing Machine

Precise way to understand resources:

steps = computation time

tape cells = space used.

Extended Church-Turing Thesis

Any physically realizable computer can be efficiently simulated by a Turing Machine.

↓
polynomial overhead.

We will use Quantum Circuits as the model of quantum computation.

Complexity: # gates in the circuit.

Define complexity classes based on model of computation

Set of problems that can be solved with a particular limit on the resources

Resources scale with the size of the problem.

Complexity class example:

P = set of problems that can be solved on a classical computer in at most $P(n)$ steps.

n = # bits required to specify the input.

p is a fixed polynomial (e.g. $2x^2$ or $4x^3 - 7x$).

Will define BQP analogously for a quantum computer

↳ Set of problems "efficiently" solvable on a quantum computer.

What problems are in BQP?

What problems do we expect are not in BQP?

Are there problems in BQP that are not in P ?