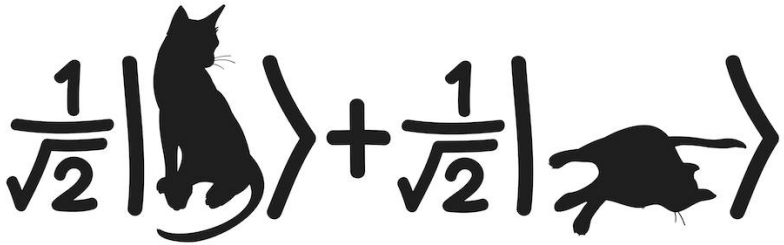
Quantum Mechanics & Quantum Computation

Umesh V. Vazirani
University of California, Berkeley



Lecture 5: Quantum Gates

Taking Stock

Organizing Principles

- Kanban approach to math formalism.

$$(\alpha_0|0\rangle + \alpha_1|1\rangle) \otimes (\beta_0|0\rangle + \beta_1|1\rangle) = \alpha_0\beta_0|00\rangle + \alpha_0\beta_1|01\rangle + \cdots$$

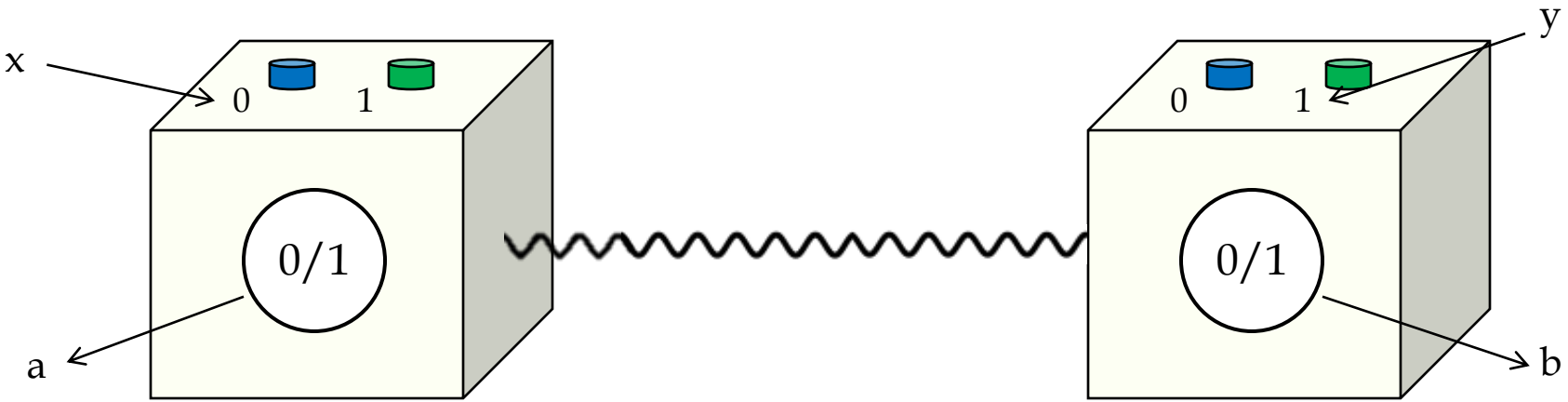
Measurements – operator

- Emphasize counter-intuitive aspects of QM.

Survey

- Level of lectures – easy/hard?
- In-video quizzes – are they helpful? Easier/harder?
- Level of homework questions – easy/hard?
- Did you attempt the optional assignments? Would you like more optional questions?
- Linear algebra preparation – do you want a review?
- Would you like to see some discussion of how some of the lecture topics relate to current research questions?

Bell's Experiment Setup



- Two boxes are very far apart.
- If both inputs are 1, want output bits to be different
  Otherwise, want outputs of the two boxes to be the same.

Boxes described by local hidden variables ➔ succeed with prob ≤ ¾ = .75

Boxes share a Bell state ➔ can succeed with prob as high as .85

Certifying Randomness

- Construct a physical random generator whose output can be certified to be random.

- Can use the Bell experiment to certify quantum randomness:

Succeed with probability close to 85% ➔ a, b random bits!

http://arxiv.org/pdf/0911.3427v3.pdf

http://arxiv.org/pdf/1111.6054v1.pdf