

Quantum Mechanics & Quantum Computation



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Lecture 4: Bell Inequalities

Research: Certifiable Randomness

CHSH Game



Input

x

y

Output

a

b

Condition

if $x=y=1$ then $a \neq b$
else $a=b$.

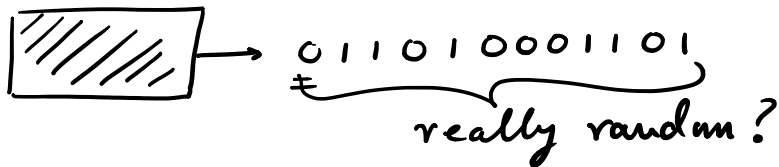
x	y	a	b
0	0	0	0
0	1 [✓]	0	0
1	0	0	0
1	1 [✓]	0	0

Classical $\leq \underline{\underline{.75}}$

Quantum: $\cos^2 \frac{\pi}{8} \sim \underline{\underline{.85}}$

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>

Nature

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