

Quantum Computing in Perspective

Miles Gould

@pozorvlak

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Bits and qubits

- ▶ Classical computing: bits

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 - ▶ $\{0, 1\}$

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- ▶ Classical computing: bits
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- ▶ Quantum computing: qubits

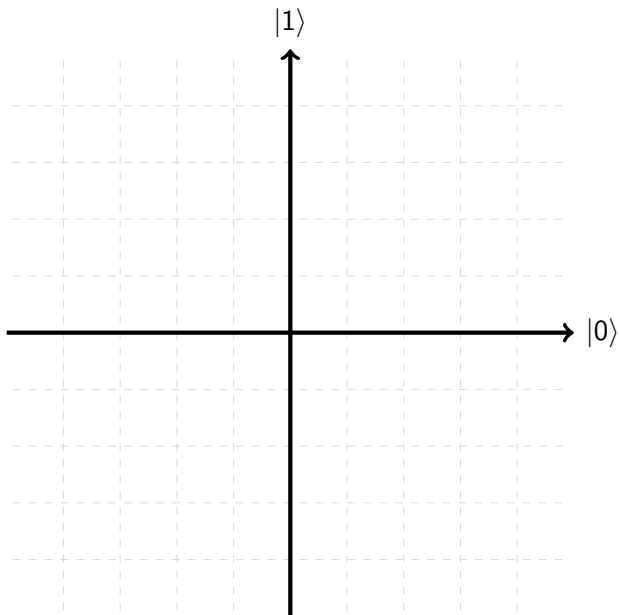
Bits and qubits

- ▶ Classical computing: bits
 - ▶ $\{0, 1\}$
- ▶ Quantum computing: qubits
 - ▶ After measurement: $\{0, 1\}$

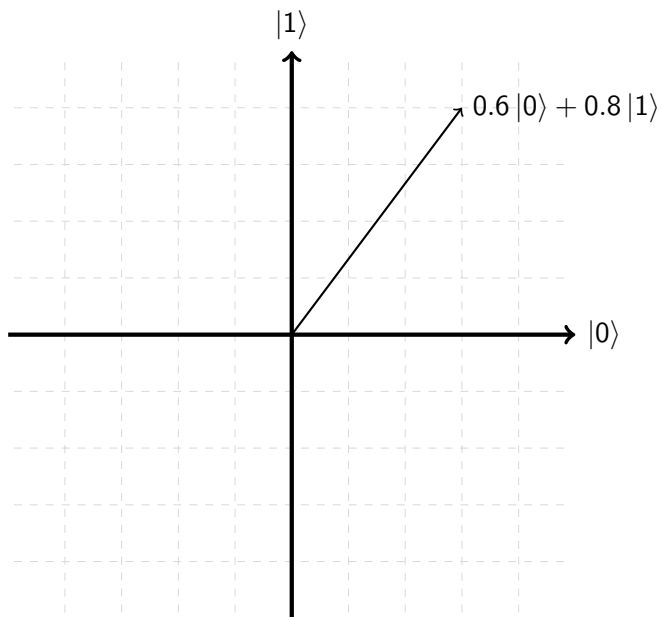
Bits and qubits

- ▶ Classical computing: bits
 - ▶ $\{0, 1\}$
- ▶ Quantum computing: qubits
 - ▶ After measurement: $\{0, 1\}$
 - ▶ Before measurement: ???

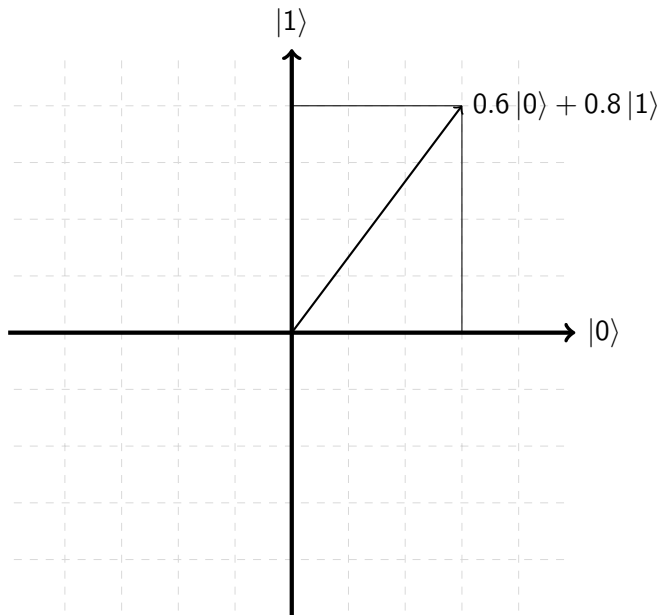
State space of a qubit



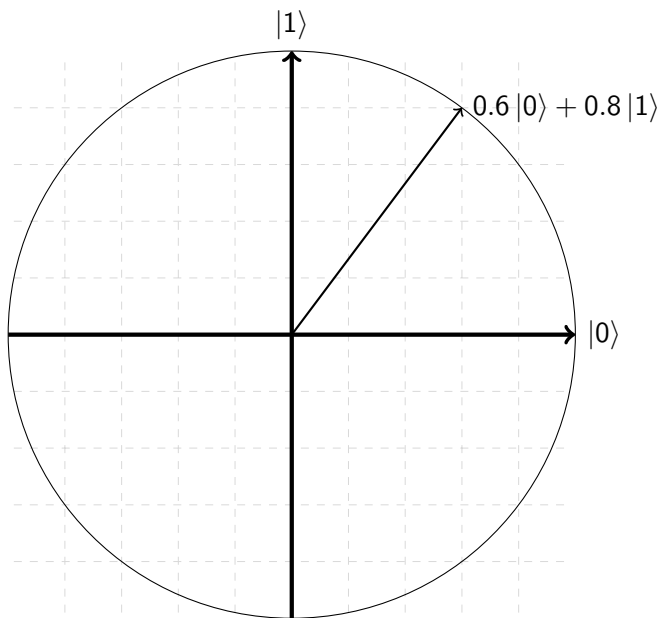
State space of a qubit



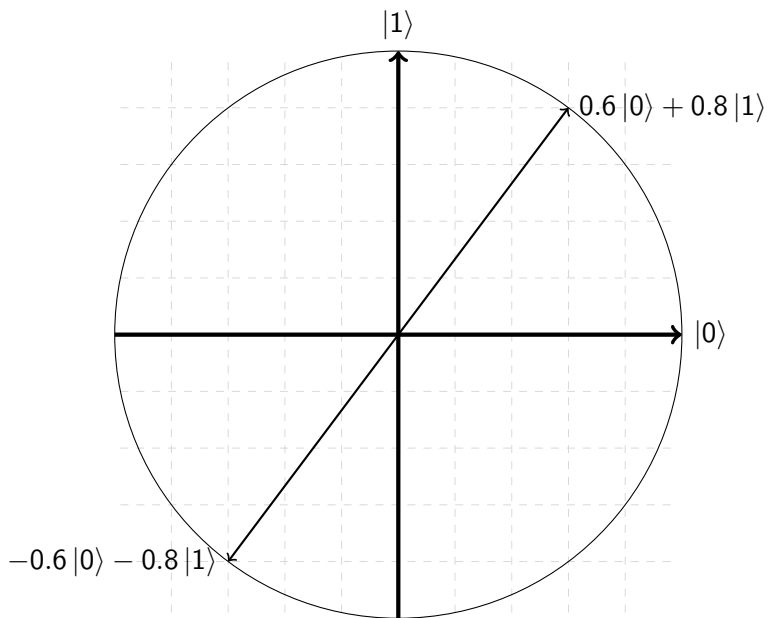
State space of a qubit



State space of a qubit

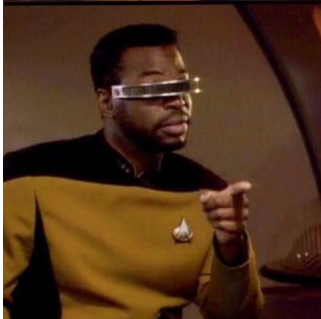


State space of a qubit



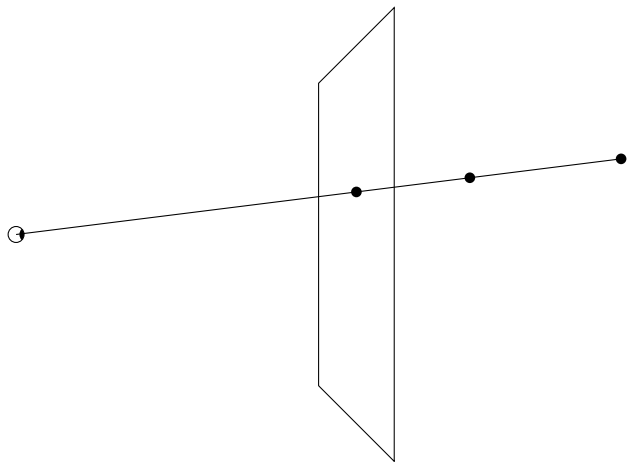


$$\{v \in \mathbb{C}^2 : |v| = 1\}$$

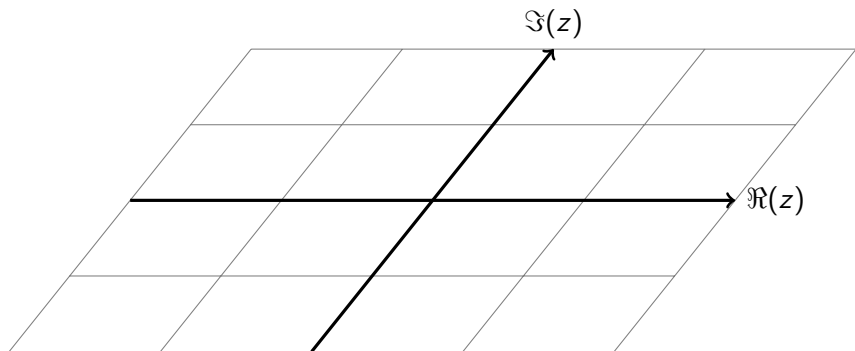


$$\frac{\mathbb{C}^2 - (0, 0)}{z \sim kz}$$

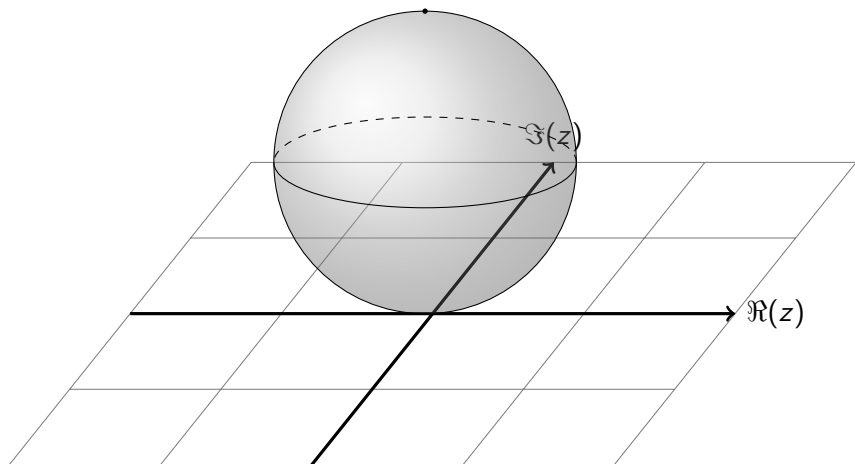
Projective space



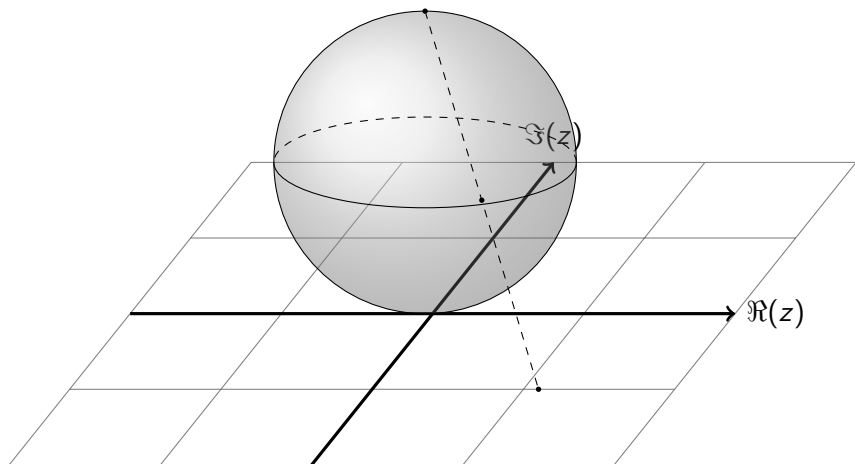
The Bloch sphere



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