Q-CTRL
CHALLENGE SUMMARY

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This is my attempt on the Q-CTRL challenge, instructions are found here `https://docs.q-ctrl.com/boulder-opal/application-notes/q-ctrl-qchack-challenge`.

Some of the resources that helped me understand what is really happening are:

- `https://en.wikipedia.org/wiki/Qubit#Physical_implementations`
- `https://en.wikipedia.org/wiki/Electromagnetic_pulse#Non-nuclear_electromagnetic_pulse_(NNEMP)`
- Pulse optimization for error-robust control on cloud-based hardware. `https://www.youtube.com/watch?v=ZemwL5mKNXM`

Before this I was thinking of qubits as being unitary vectors in a 2-dimensional complex space, that is, linear combinations of $|0\rangle$ and $|1\rangle$ with complex coefficients with norm 1. Hence, I was thinking of qubits as points in a 4-dimensional sphere. So, most of the time I had to rely on my intuition from only having real coefficients and a 2-dimensional sphere. But what I didn't know is that we can remove another degree of freedom by getting rid of the global phase. So qbits can be thought of a slice of the 4-sphere: a 3-sphere. The standard representation of qbits in this way is called a Poincare-Bloch sphere.

Unfortunately I did not have enough time to understand all what was needed to finish the challenge. I did manage to get a second pulse for the Hadamard gate which I call $H2$. I followed the jupyter notes and all changes are made there. It seems that $H2$ has a standard error marginally better than that of the H provided.

```
H estimated probability of getting 1 is 0.4609375
H estimate standard error:  0.015577243301708272
H2 estimated probability of getting 1 is 0.490234375
H2 estimate standard error:  0.015622019483489914
```

Date: 11th April 2021.