

A Quantum Valentine’s Day

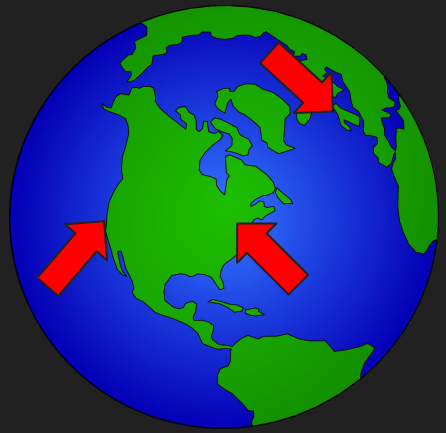
A fun adventure through the very first quantum Valentine’s Day dating mini-game.



Team InterQonnected

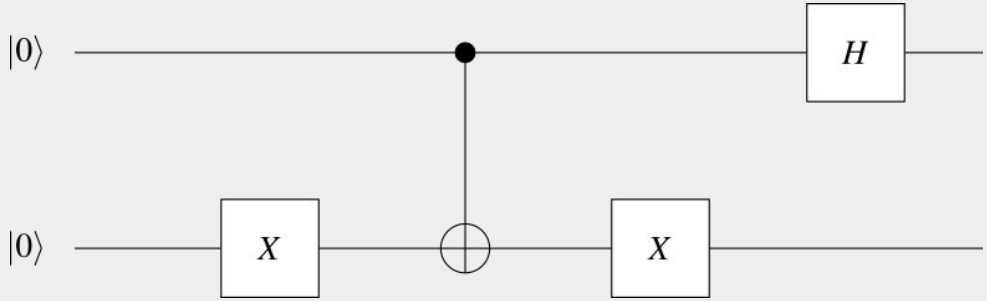
Andy Schang, Akimasa Ihara, Tyler King, Anish Shanbhag

Berkeley
UNIVERSITY OF CALIFORNIA



General Idea

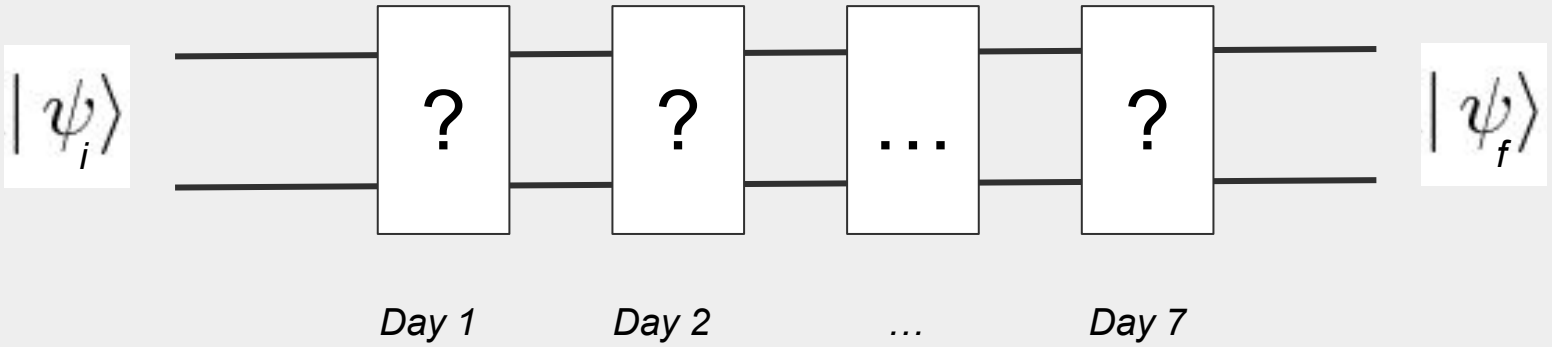
- Incorporate a quantum computing challenge game with a Valentine's Day theme



or

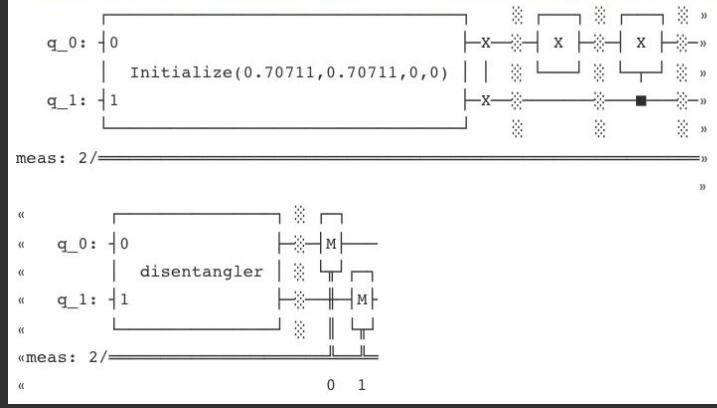
Gameplay

- Random initial, target state
- Get to target state in 7 days (turns) or less



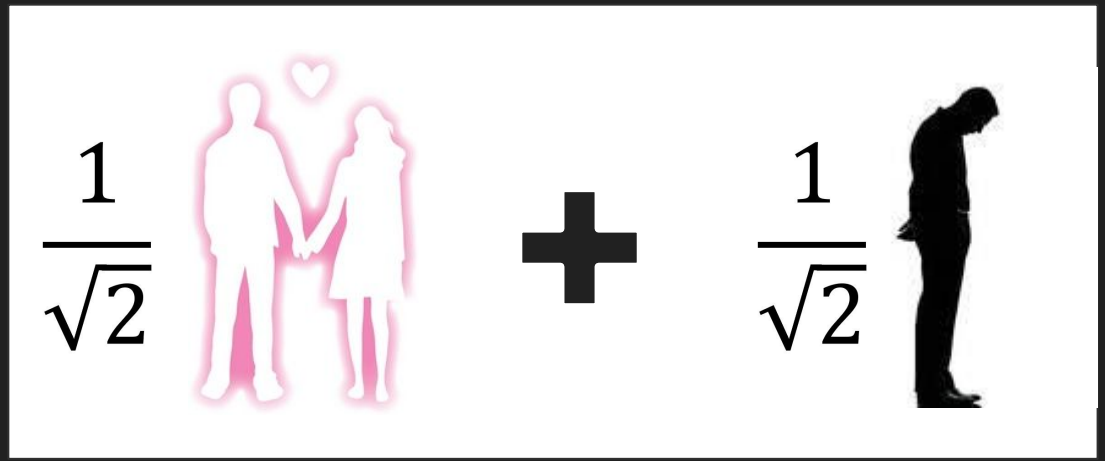
Winning Screen:

```
.....She said yes!! You officially have a valentine right in time for Valentine's Day
Congratulations on winning! Below is the circuit you produced - we hope your love will develop into something as beautiful as this.
```



Quantum Aspect

- Manipulating quantum circuits with Various gates
  - X, Z, CNOT, H, SWAP
- IonQ simulator + IonQ quantum computer



Classical Aspect

- General framework
- User Interface

"You went to a movie with your crush, they even bought you popcorn!"

"You got your crush's number!"

"Your crush waved at you and you waved ba- oh wait... she was waving at the person behind you."

"Your crush unfollowed you on instagram :("

"Your crush ignored you at a gathering."

"A friend tells you that your crush likes you."

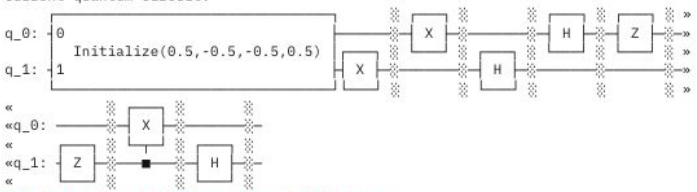
"Your crush winked at you!",

"You tripped and fell and ... your crush laughed at you."

Machine Learning Model

- The game also has a versus mode in which you can compete against another secret admirer of your crush
- Get to the target vector before they do, or you'll lose out on the golden opportunity to ask your crush out!
- We used the deep Q reinforcement learning algorithm to train a neural network to play the game
- After only around an hour of training (about 40,000 training games), the opponent takes only 5 gates to finish the game
- Interestingly, however, our model was only able to solve around 30% of any game even within 20 moves - but when it did, it almost never took more than 6-7 moves
- There may be some games that are unsolvable within a short amount of moves


Demo

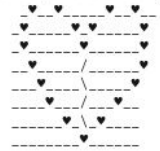


A friend tells you that your crush likes you.

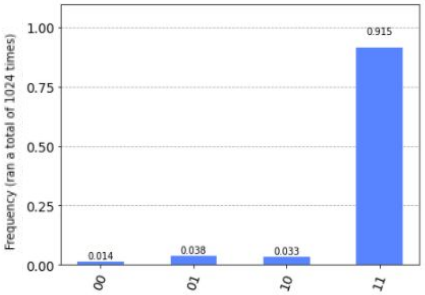
Time is up! You asked your crush out and are waiting for your their response. It feels like an eternity waiting for the response... (the real quantum computer just has long queue times)

(Here, we are measuring your statevector and seeing how many times it becomes measured in the target statevector basis (win - 80% success rate). We measure in the target statevector basis by applying a gate that would take the target statevector to the Z basis and measure in the Z basis - so a success will be a 00 measured.)

Uh oh, looks like you have no valentine this year because you've been rejected... better luck next time, never give up!



Below is your histogram for future reference. Many other fish out there!



The histogram is different from what you would expect from the final statevector since we have effectively switched the measurement basis to the target statevector basis.

Conclusions

- Extremely happy to have had the chance to participate in this hackathon.
- Thanks to Microsoft, IonQ, and all who sponsored and organized this event!