Schrodinger's frog

Team: QuAndes
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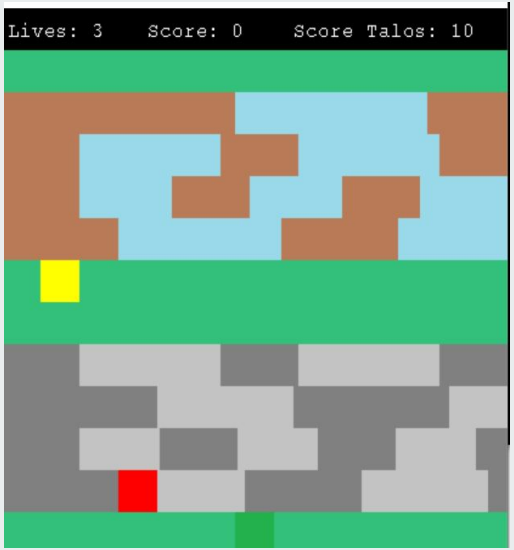
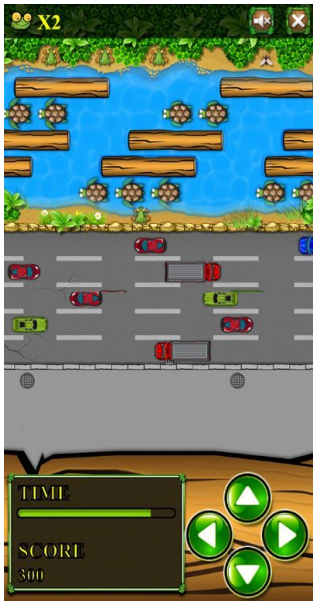
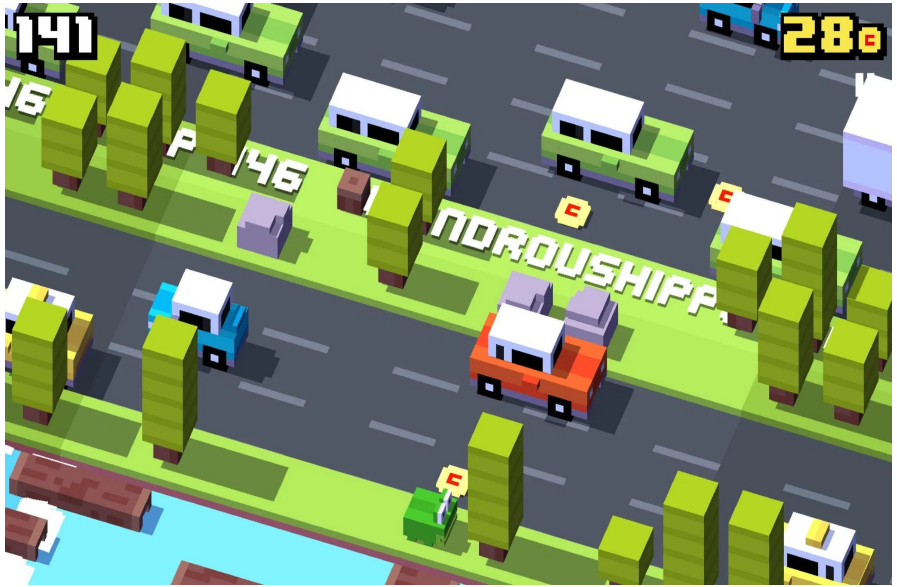


Using NISQ devices for games

- We can use variational algorithms such as QAOA and VQE to solve particular problems within the game.
- It can be hard to make a (not boring) educational game that exposes ideas in QM, such as tunneling and superposition and even entanglement

Jumper Frog / Crossy Road



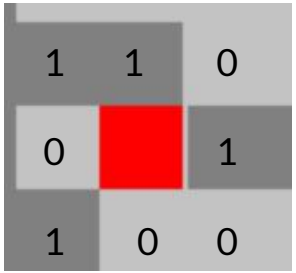


Goals

- Implement the QAOA circuit to solve a quadratic programming problem.
- Implement gates to some qubits and use this to introduce an element of uncertainty in the game.
- Make a fun game that anyone without quantum computing knowledge could play and enjoy.

QAOA: Talos

- The bot will move depending on a reward function that depends on the 8 cells around it.



Optimize c(up)*up + c(down)*down + c(right)*right + c(left)*left + c(stay)*stay

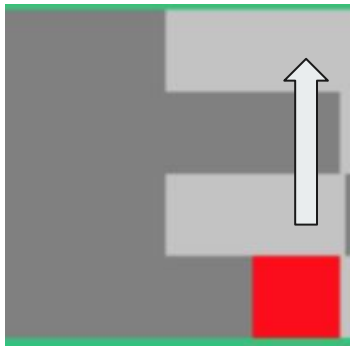
subject to up+down+right+left+stay=1

This can be translated to a QUBO problem and solved by QAOA

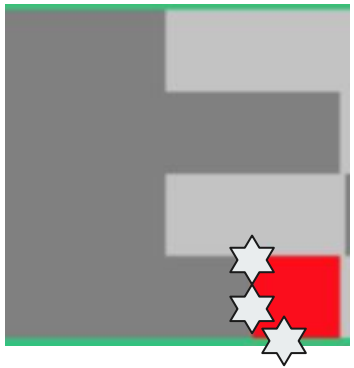
Uncertainty: Quantum superpowers

Implement quantum superpowers using Hadamard gate

Quantum tunnelling



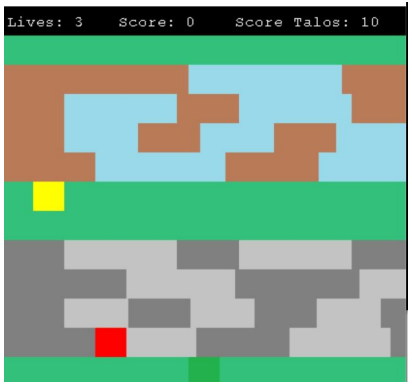
Quantum crash

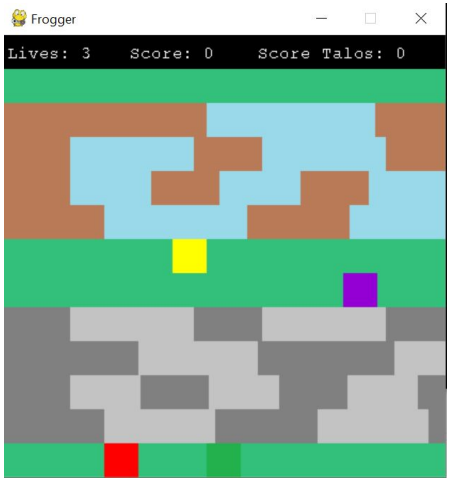


Things we were able to do:

- Implement QAOA for the red frog (opponent)
- Modify a version of frogger written by Ricardo Lima*

  by adding superpowers based on quantum states and including Talos.





*https://github.com/rhrlima/frogger


Frogger
ves: 3 Score: 10 Score Talos: 0
MADE IN
ANIMOTICA

Things to do in the future

- We want to improve the user interaction—for example, adding Talos as an optional bot and allowing different difficulties.This can be achieved with adequate cost functions for every difficulty
- Change and improve the graphical aspects of the game, such as adding an image to the frogs and the quantum powers.
- Due to our inexpertise, we were only able to implement the QAOA circuit of Talos on the qasm_simulator. We would love to implement this circuit on the IonQ backend in the future (we could implement the superpowers on both Ionq and Qasm backends).
- We did not have time to fix a classical method that could make the bot correctly move. We would like to make it work.
- Implement a new game mode with entanglement