2014

User Manual

QUANTUM TIC TAC TOE

CS 101 PROJECT

The rules of quantum tic-tac-toe attempt to capture several phenomena of quantum systems.
These phenomena are:

1. Superposition,
2. Entanglement and
3. Collapse.

- Superposition is the ability of quantum objects to be in two places at once.

- Entanglement is the phenomenon where distant parts of a quantum system display correlations that cannot be explained by either timelike causality or common cause.

- Collapse is the phenomenon where the quantum states of a system are reduced to classical states. Collapses occur when a measurement happens, but the mathematics of the current formulation of quantum mechanics is silent on the measurement process. Many of the interpretations of quantum mechanics derive from different efforts to deal with the measurement problem.

How to Play.....???

Quantum tic-tac-toe captures the three quantum phenomena discussed above by modifying one basic rule of classical tic-tac-toe: the number of marks allowed in each square. Additional rules specify when and how a set of marks "collapses" into classical moves.

The initial game interface is a grid as shown(fig.1)

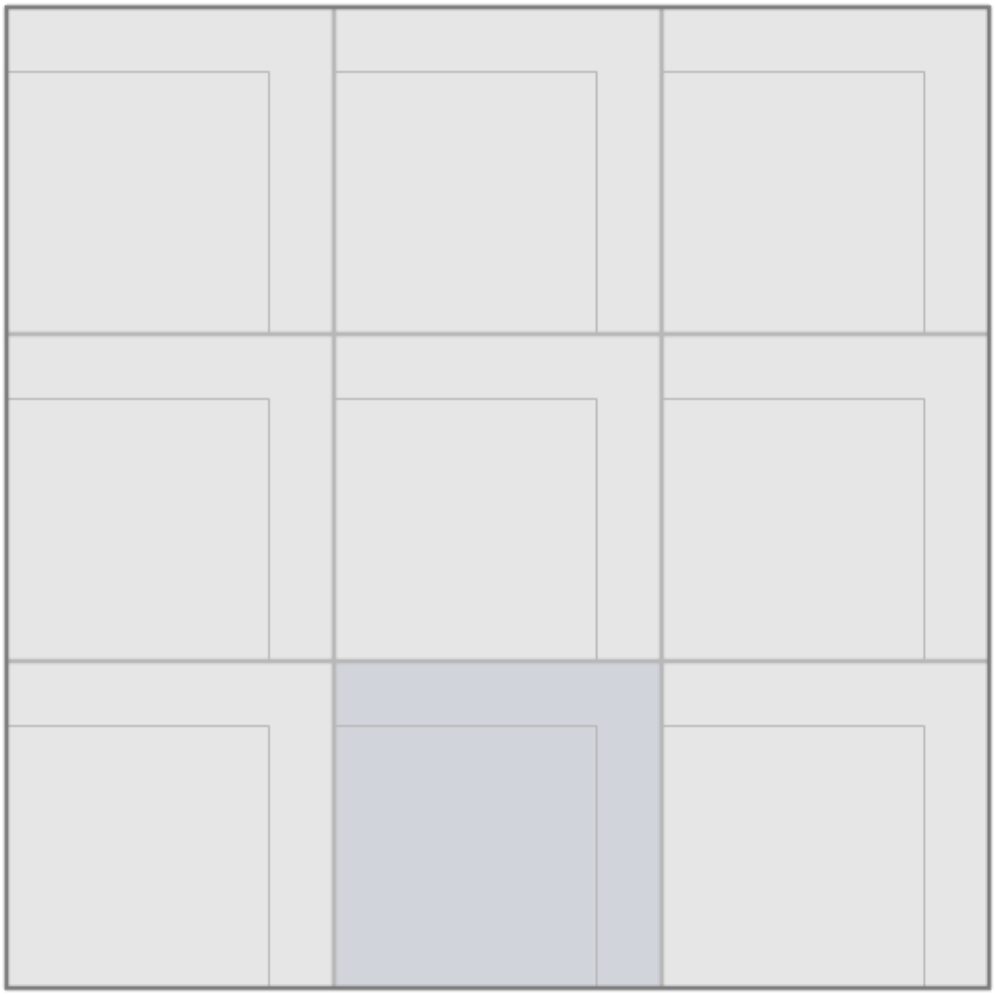

Fig.1

The first player to play is assigned green colour and the second one blue. (In the illustrations the first player is represented in red.)

On each move, the current player selects two **distinct** squares**(the same pair should not be selected in the next move by the same player but can be selected by the other player)** , instead of one, and one of the spaces in each of the square he selects is highlighted to his colour in which the player's move number is embedded(fig.2).

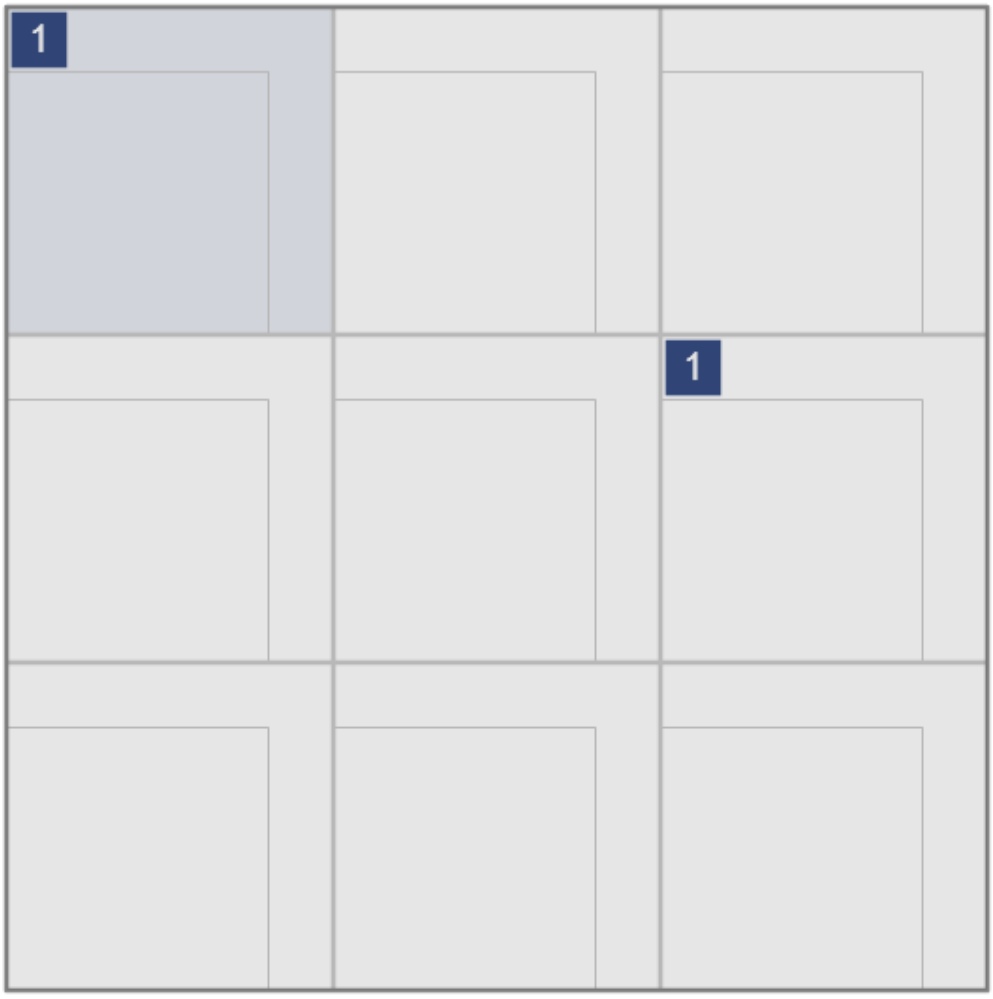

Fig.2

For example, player 1's first move might be to place in both the upper left and lower right squares. The two squares thus marked are called ***entangled***. During the game, there may be as many as eight highlighted spaces in a single square (if the square is entangled with all eight other squares).

The phenomenon of collapse is captured by specifying

that a **"cyclic entanglement"** or a **“loop formation”** causes a **"measurement".** A *cyclic entanglement* is a cycle in the entanglement graph; for example, if

- square 1 is entangled via move X1 with square 4, and
- square 8 is in turn entangled via move O1 with square 1 and
- square 4 is entangled via move X2 with square 8,

(here ,for the sake of simplicity **X=green ,O=blue** and the subscript indicates overall turn number)

then these three squares form a cyclic entanglement.

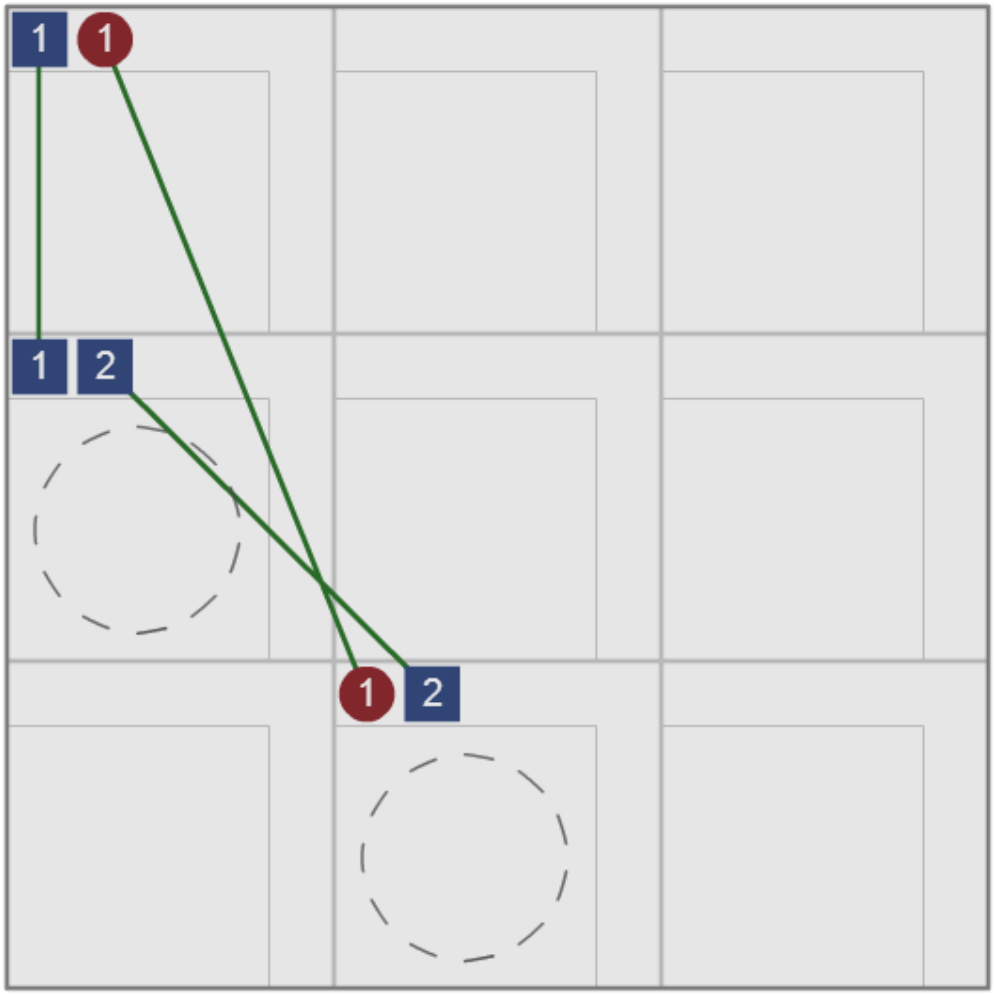

Fig.3

At the end of the turn on which the cyclic entanglement was created, the player whose turn it is — that is, the player who created the cycle — chooses one of two ways to "measure" the cycle and thus cause all the entangled squares to "collapse" into classical tic-tac-toe moves. In the preceding example, since player 1 created the cycle, player 1 decides how to "measure" it.

Player 1's two options are:

1. X2 collapses into square 4. This forces O1 to collapse into square 8 and X1 to collapse into square 1.(fig.4)

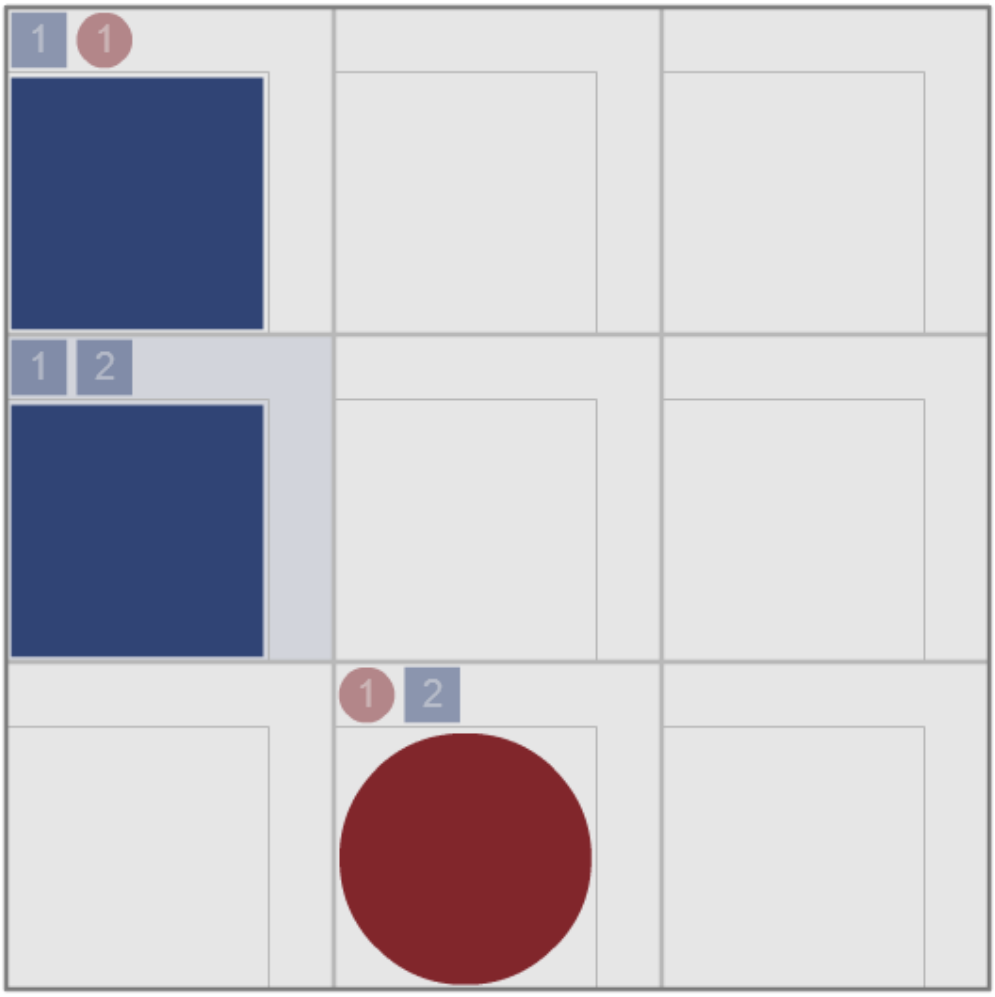

Fig.4

2. X2 collapses into square 8. This forces O1 to collapse into square 1 and X1 to collapse into square 4.(fig.5)

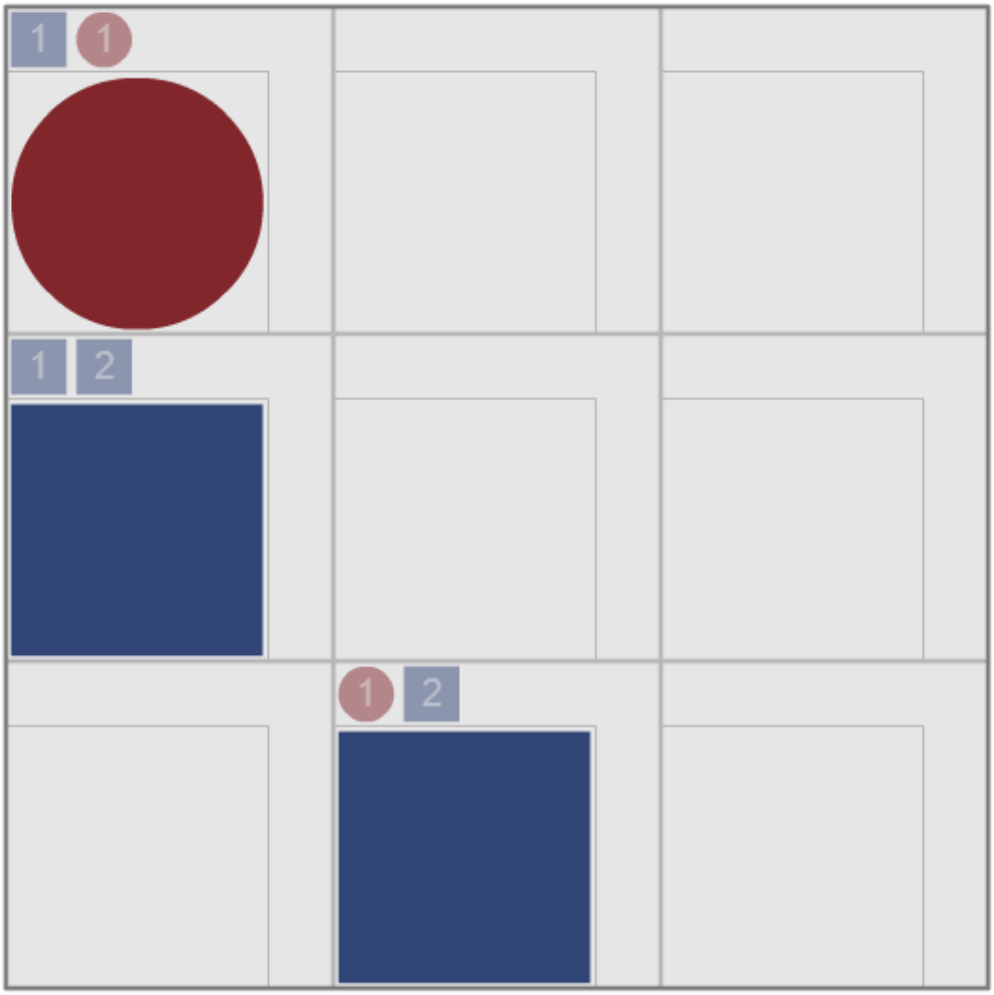

Fig.5

Any other chains of entanglements hanging off the cycle would also collapse at this time. (Note that it is impossible for two or more cyclic entanglements to be created in a single turn.)

When a move collapses into a single square, that square is permanently marked (in larger print) with the colour of

the collapsed move — a *classical mark*. A square containing a classical mark is fixed for the rest of the game; no more small highlighted spaces may be placed in it.

The first player to achieve a tic-tac-toe (three in a row horizontally, vertically, or diagonally) consisting entirely of *classical marks* is declared the winner.

Note:

The above figures are just for illustration. The actual program defers from the above figures but the basic game concept is retained.

Image Courtesy:

http://countergram.com/qtic

USER MANUAL: CLASSIC TIC TAC TOE

Players alternate placing Xs and Os on the board until either (a) one player has three in a row, horizontally, vertically or diagonally; or (b) all nine squares are filled.

If a player is able to draw three Xs or three Os in a row, that player wins.

If all nine squares are filled and neither player has three in a row, the game is a draw.

In our game we have replaced X with a square and O with a circle.