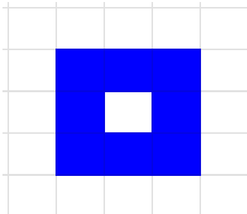
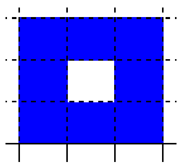
Owen Haedrich

Custom Polyomino Design

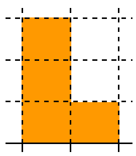
Donut: 8 filled cells surrounding a gap.



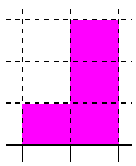
Fixed Piece Sequence



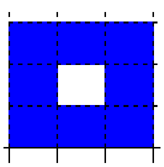
1. Donut



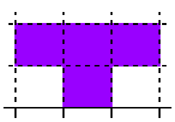
2. "L" tetromino



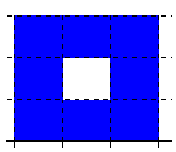
3. "J" tetromino



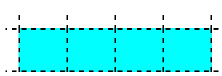
4. Donut



5. "T" tetromino



6. Donut



7. "I" tetromino

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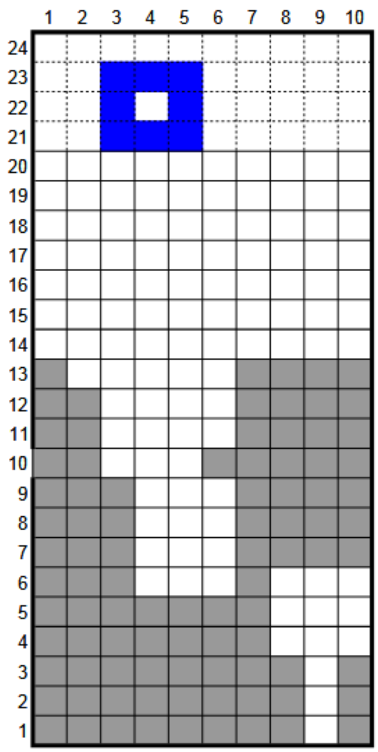
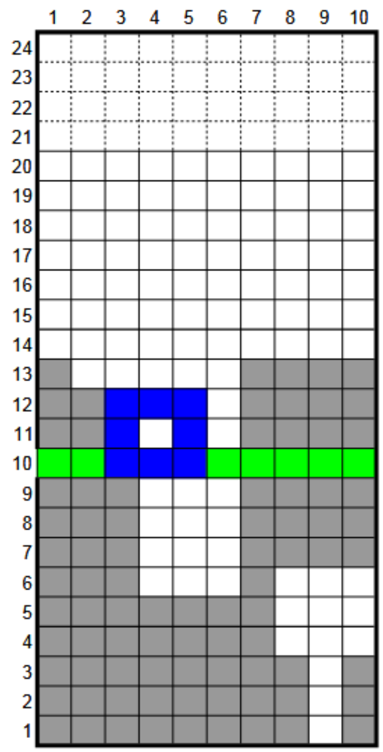
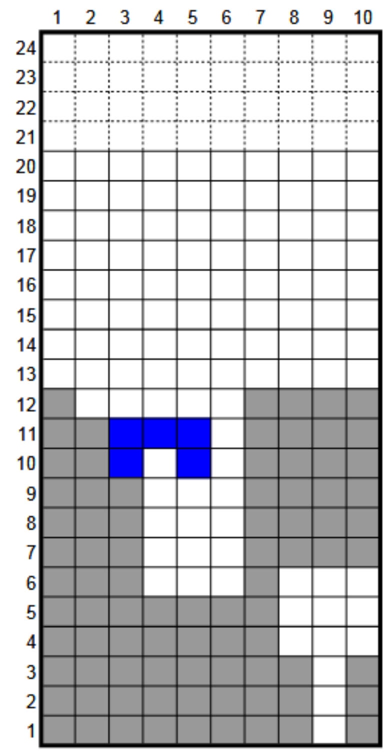
Board State Sequence

The board is confined to the standard 10x by 20y grid size. Grid spaces 21y-24y have been added to illustrate newly spawned pieces, they are not part of the play area.

Spawn Piece	Identify Cleared Lines (Highlighted in Green)	New State







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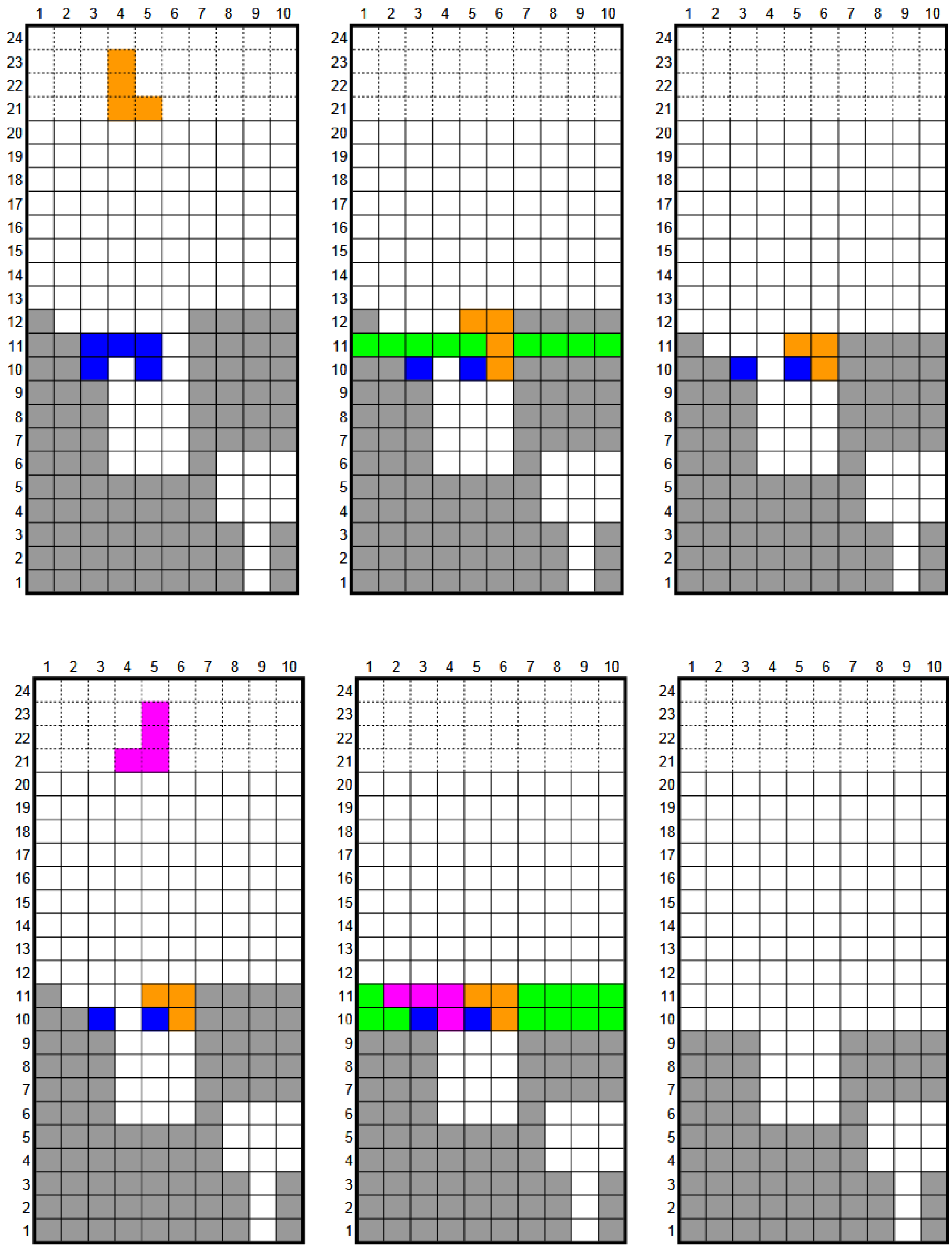

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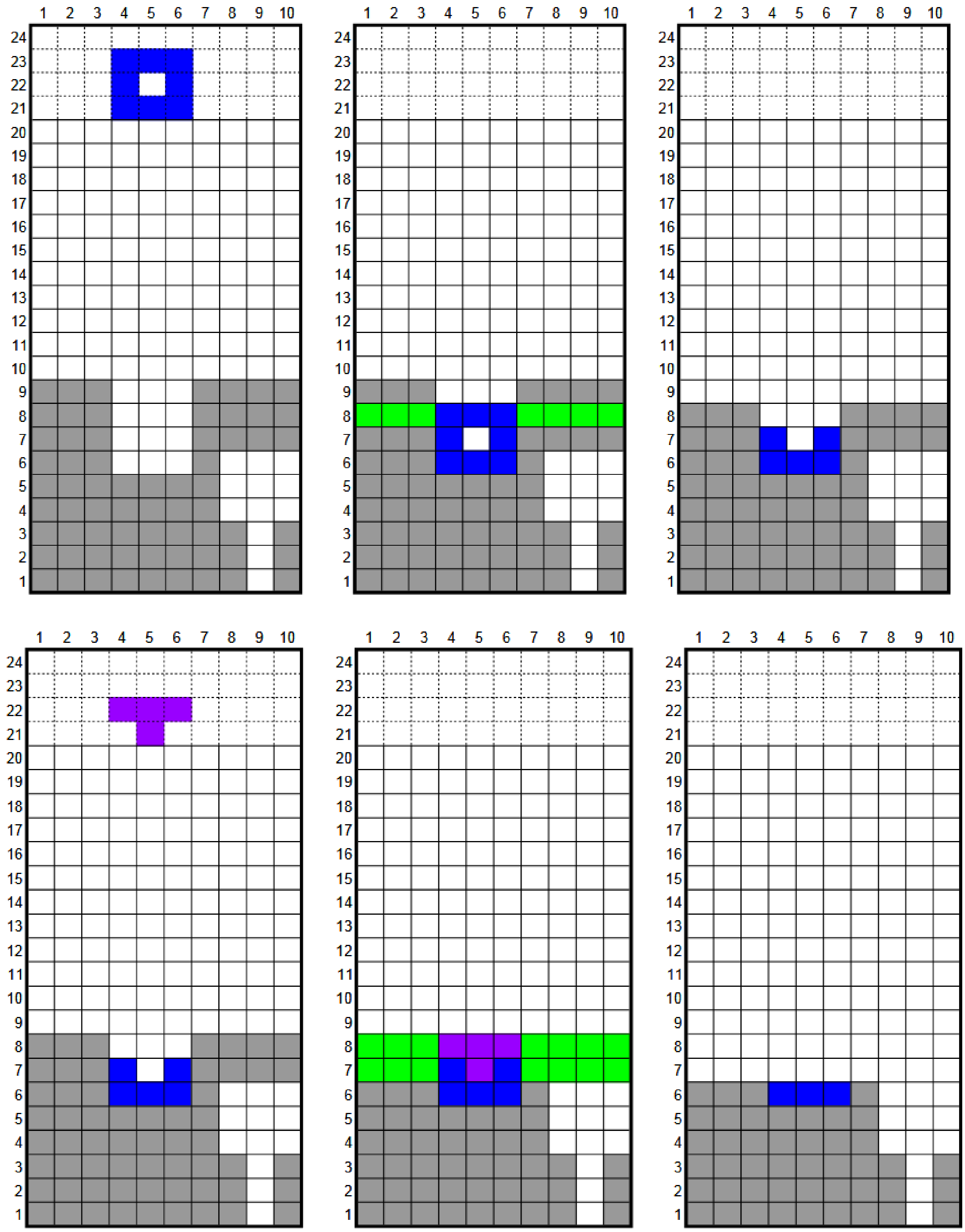

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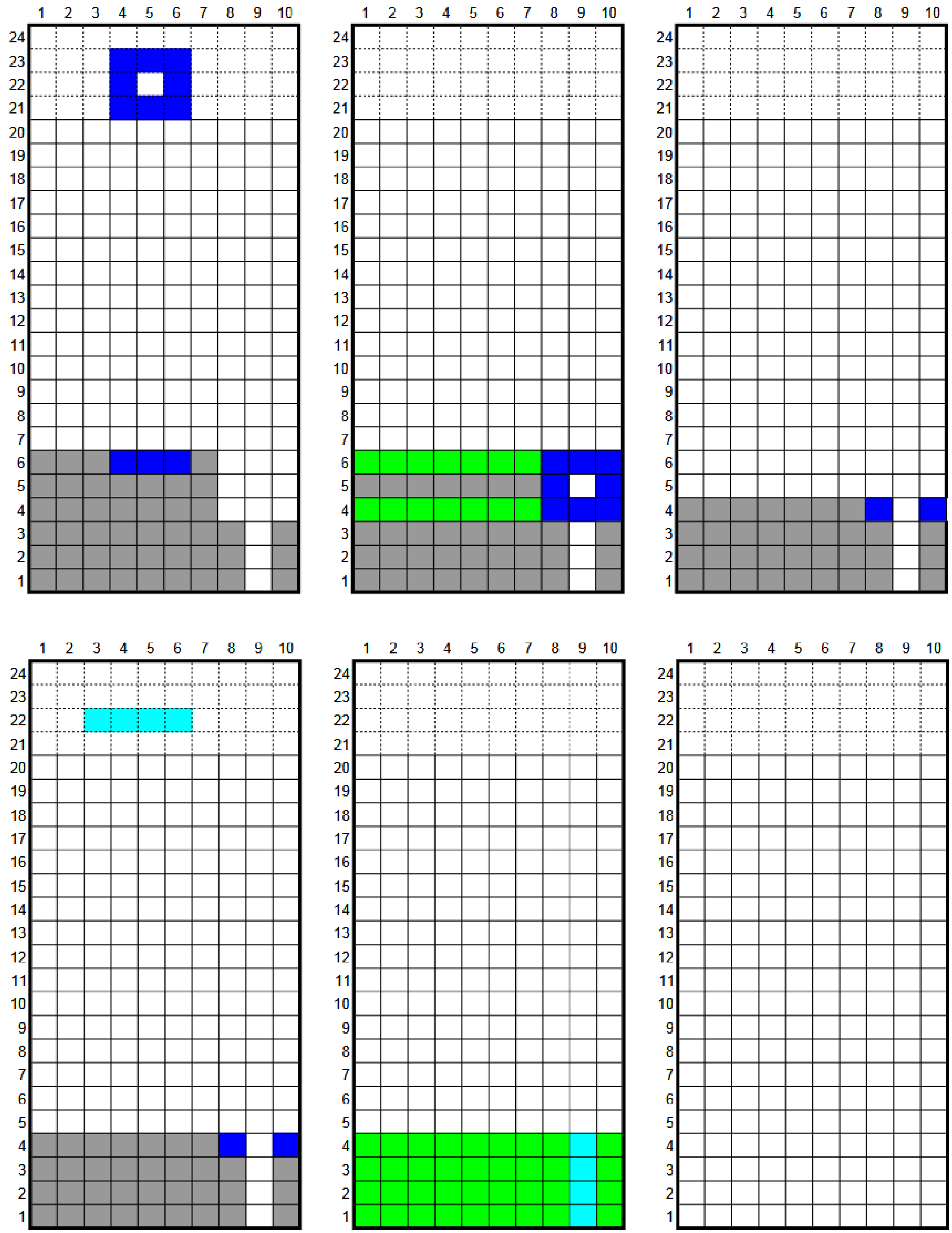

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Design Rationale

1. Properties of the Donut Polyomino

The Donut polyomino is an object with several interesting properties. The first and most obvious is its cell configuration: the Donut polyomino has 8 filled cells arranged in a ring around a gap cell in the centre. This creates a static relationship between the Donut and the rest of the pieces (the tetrominoes): it is the only piece with a gap. Additionally, because there are no objects in *Tetris* that can directly access an enclosed cell gap, the Donut has a challenge baked into its cell configuration.

Another interesting property is its symmetry: the Donut polyomino has just one orientation. This creates a relationship with the “O” tetromino, the only other piece with both vertical and horizontal symmetry. This property makes the piece predictable, yet inflexible: the rotation behaviour of the active piece has no impact on the Donut.

The final interesting property I will discuss is the cell count and size of the Donut polyomino, which creates relationships with both the tetrominoes and the board. The Donut has 4 outside edges, all 3 cells long. The Donut does not require an exceptional amount of space along any one edge, it matches the maximum length of many tetrominoes, namely the “S”, “Z”, “T”, “L” and “J”. However, the Donut takes up an exceptional area on the board because it has this length along both the x- and y-axes, and has double the cell count of a tetromino.

2. Relationships Between the Piece Sequence and the Board State

The chosen piece sequence has several interesting spatial and dynamic relationships with the board state in the envisioned play session. The first is roof-creation, which occurs after the bottom row of the Donut clears a line. This leaves an inverted “U” and blocks the next piece from falling directly into the area below. The subsequent pieces, the “L” and the “J”, could clear a line in the area below if the space was accessible, however they are forced to contend with the roof itself. The symmetry property of the Donut facilitates this relationship, because it avoids safer strategies from alternative orientations.

The next interesting relationship is found between the board and partially cleared pieces: the partial pieces contribute to a solvable board state. In the sequence, this can be seen where the player needs to use rotated “L” and “J” tetrominoes to the clear the roof left by the Donut: the “L” clears part of the Donut and leaves enough cells to set up the “J”. We also see partially cleared Donuts reveal straightforward setups for the next piece in the last 4 moves of the sequence. First, clearing the top row of a Donut creates space for a “T” tetromino, and later, clearing the top and bottom rows of a Donut reveals a Tetris as the final move of the sequence. These setups are made possible by the Donut's gapped cell configuration property.

The final interesting relationship I will discuss is the use of line drop downs to create a dynamic board state. This relationship between the board and piece objects is used with all the Donut pieces and with the "L" piece. This is an interesting relationship because it encourages the player to imagine future board states beyond simply examining subsections of the current board.

3. **Interesting Challenges Provided by the Board State**

I expect my board state to provide an interesting challenge for players for three main reasons. The first is found in an interesting property of the original puzzle board: the configuration of cells has large voids. I expect this to create a challenge by evoking uncertainty in the player before they place any pieces, which might inhibit their ability to use the hard-drop active piece behaviour due to time spent on analysis.

The next interesting challenge provided by the board state is in its relationship with the partially cleared pieces. The board state changes significantly between moves, and this is largely driven by the exceptional cell count property of the Donut. This creates a surprising sequence of clears throughout the puzzle. Particularly in the roof-clearing phase, where the player uses the rotation behaviour of the active "L" piece build up cells around the Donut while clearing its top row, revealing the gap cell and setting up a complete removal of the roof with the subsequent "J".

The final interesting challenge provided by the board state are the strategies required to clear the Donut polyomino. Since the line-clear and line-drop behaviours of the board prevent the Donut from being completely cleared upon first drop, they influence the player to consider the next state of the board and imagine how making the gap cell of the Donut accessible influences their next placement. A clear example is the 4 line clear setup, where the cell-gap-cell configuration left by the Donut fills out the top remaining line, and allows the player to completely clear the board. In this instance, the gap cell configuration and exceptional cell count properties of the Donut create a spatial relationship with that board and invoke the line-clearing and line-dropping behaviours in a way that's impossible with any single tetromino.