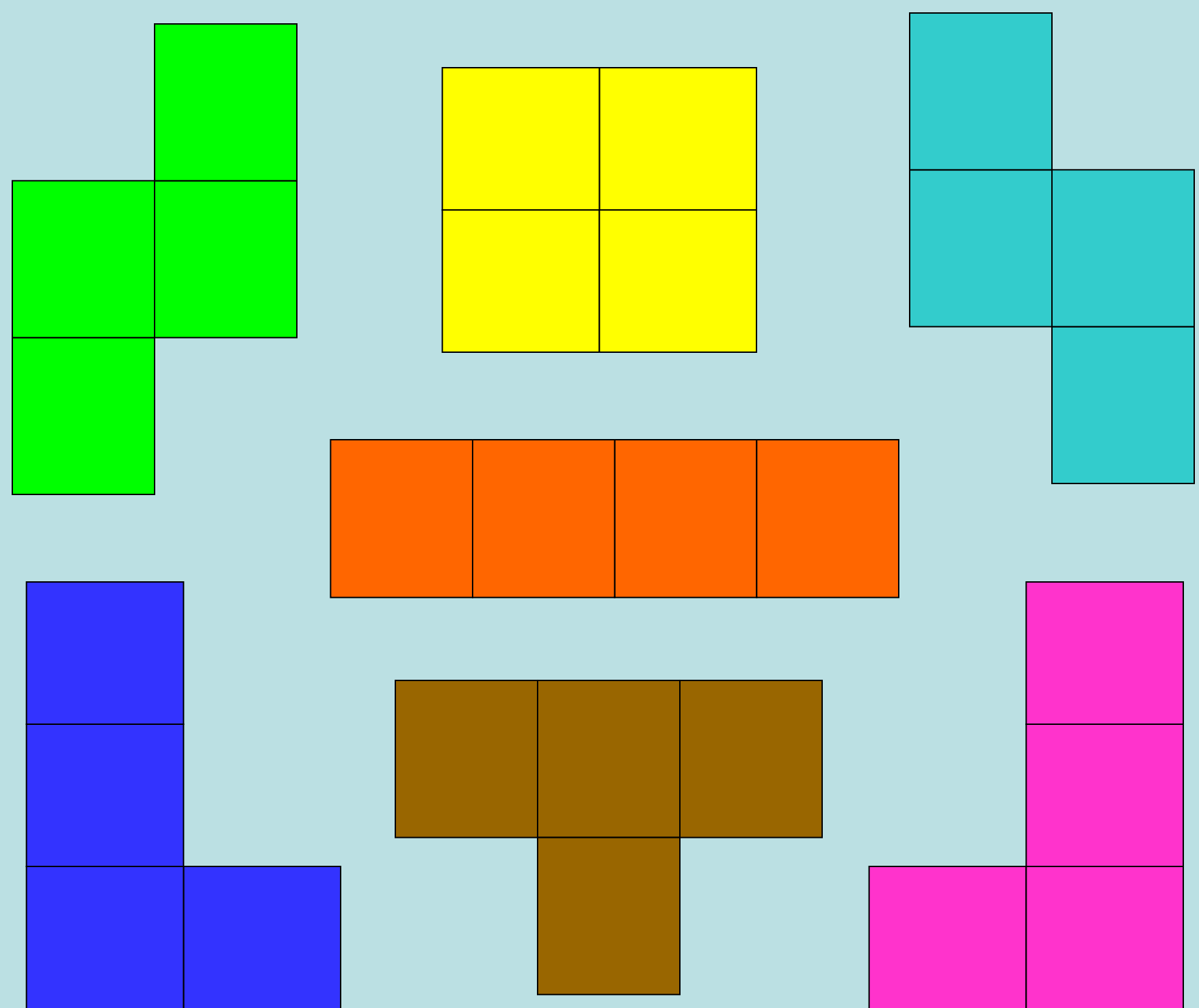


2 Player Tetris is PSPACE-Hard

Lev Reyzin, Yale University

The Tetrominoes



The Rules of 2 Player Tetris (2PT)

Played on two m by n grids, one for each player

Tetrominoes fall from the top of each player's grid

Players manipulate the tetrominoes until they are placed

Any full rows disappear from that player's board and the rest of the rows "fall" downward

When a player clears a row, "penalty blocks" appear at the bottom of his opponent's board.

A player wins when his opponents board fills to the top

FORMULA-GAME

TQBF is complete for PSPACE

A simple reduction from TQBF shows FORMULA-GAME is PSPACE-Hard

FORMULA-GAME is a game played on a quantified boolean formula in prenex normal form

$$\phi = \exists x_1 \forall x_2 \exists x_3 \dots \forall x_k [\psi]$$

Players E (and A, respectively) set values for variables bound to the existential (and universal) quantifiers in the order they appear in. Player E (and A) tries to make the formula true (and false). It is PSPACE hard to tell who has a winning strategy

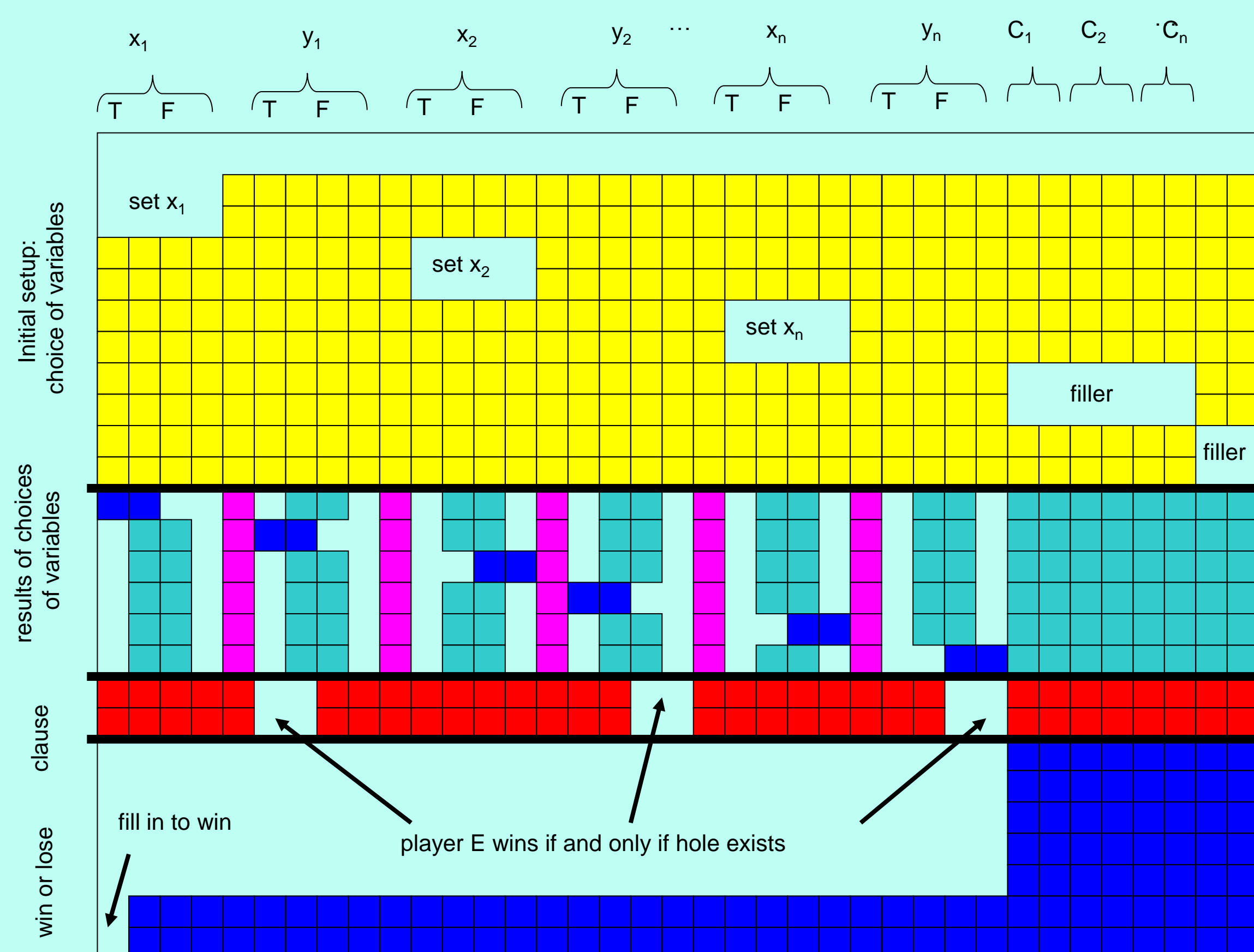
The Reduction

We reduce FORMULA-GAME to 2PT by showing how we can make 2PT game play out any FORMULA-GAME by the widgets below

This reduction holds for most reasonable assumptions of timing and rule variants

Our reduction uses arbitrary functions for penalty blocks, but can be extended to traditional penalty block functions (like having penalty block lines be one fewer than the number of lines cleared)

Player E's Widget



Player A's Widget

