## Additional Combinatorial Games

**Multi Nim.** Suppose that a positive integer $k$ has been agreed upon. Play begins with several piles of sticks. The number of sticks in each pile may vary from pile to pile. A move is made by removing one or more sticks from no more than $k$ piles. The player to take the last stick wins. When $k = 1$, this is Nim.

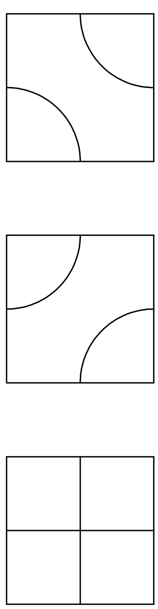
**Piles.** Play begins with a single pile of stones. A move is made by dividing a pile of stones into two smaller piles. The first player who is unable to do this loses.

**Adjacent Litton.** Play begins on an empty $n \times n$ board. A move is made by placing pieces on empty squares of the board. All the pieces placed on a given turn must be in the same column or row, and they must all be adjacent. The player who fills the board wins.

**MAL.** (meaning Misère Adjacent Litton) Play begins on an empty $n \times n$ board. A move is made by placing pieces on empty squares of the board. All the pieces placed on a given turn must be in the same column or row, and they must all be adjacent. The player who fills the board loses.

**Wiggle.** To prepare for play, an $m \times n$ rectangle is drawn, divided into $mn$ unit squares. In her first move, Alice draws in the top leftmost square one of the patterns displayed below in (a). This begins a (wiggling) curve that starts at the center of the top of this square. On each successive move, this curve is to be continued. The player whose move takes the curve back to the boundary of the big rectangle loses. Note that the drawing on each unit square depicts pieces of two separate curves. In the case of the piece whose curves cross, making a +, one curve runs from left to right while the other runs from top to bottom. These curves are considered to cross without touching, which is to say you cannot make a turn in the middle of the square to change directions. In (b) a completed game is depicted. The small numbers on the corners of the squares indicate the order in which the squares were played in. Alice lost on her fifth move.

(a)



(b)