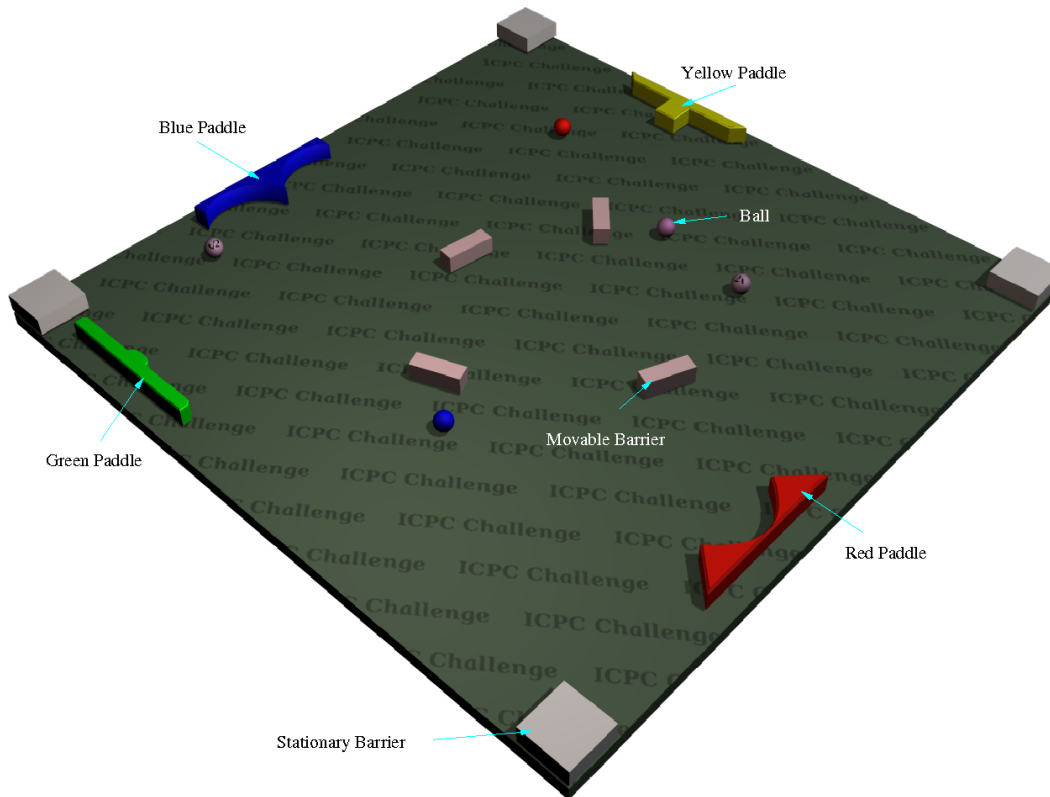


# Problem: QuadraPong (sample problem)

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QuadraPong is played by four concurrent players on a field like the following. Each player owns an edge of the field and controls a paddle that moves along a line near that edge. Balls of various colors roll around the field, and, in general, players attempt to keep them from rolling off their edge.



## Paddle Shape

At the start of the game, players submit a desired paddle shape. The paddle shape is an arbitrary, two-dimensional, simple polygon that is confined to a standard-sized bounding rectangle. Players can specialize their play strategy to match their chosen paddle geometry.

## Paddle Control and Behavior

Players affect the game applying a desired amount of force, either to the left or the right in order to move the paddle along the edge of the field. All paddles have the same mass, regardless of their shape.

Paddle motion is frictionless but a speed limit is enforced. After the speed limit is reached, acceleration in the direction of motion has no effect. If velocity is not cancelled out by force in the opposite direction, the paddle will continue to move indefinitely, bouncing off the stationary barriers at the corners of the field.

Collisions between the paddle and other movable objects affect the velocity of the other object but not the paddle. The field is designed so that two paddles can't collide.

## Balls

Periodically, balls are introduced into the field. They start at a randomly-selected location near the middle of the field, and with a random, non-zero velocity. Ball motion is frictionless. Balls bounce elastically off paddles, barriers and other balls. Balls come in seven types, all of which behave the same but differ in how they are scored.

## Movable Barriers

The field is populated with a small number of movable barriers. Barriers start at predictable locations on the field and can be moved by hitting them with other movable objects. Barriers have much more mass than a ball and exhibit a lot of friction with the playing field, so hitting a barrier with a ball will have only a small effect on the barrier's position. With some effort, players can use balls to position one or more barriers to give themselves an advantage.

## Scoring

Scoring is determined by what types of balls are permitted to fall off a player's edge of the field. The player who permits a ball to fall off their edge is called the *victim*, and the player who last hit the ball is called the *attacker*.

- Ordinary Ball : Ordinary balls are the most common in the game. Here, all players other than the victim receive a small number of points, and the attacker receives an additional point bonus. If there is no attacker or if the attacker is the same as the player, the attacker's point bonus is uniformly distributed to all other players.
- Colored Ball : Colored balls come in four types, one for each player. These balls encourage players to let some balls to roll off their own edge or to be selective in where they send a ball when they get a chance to hit it. For a colored ball, if the victim matches the ball color, then the victim is awarded points. Otherwise, the ball is scored the same way as an ordinary ball.
- Score Multiplier Ball : Score multiplier balls come in two types, a double score ball and a half score ball. Like colored balls, these encourage players to be selective in what they do with a ball that's heading toward their edge. These balls do not award any points themselves. Instead, they alter the scoring of a ball that has already left the field. A double score ball doubles the effect of the last ball to roll off the victim's edge and a half score ball cuts it in half. For example, if a blue ball rolls off the blue player's edge, a subsequent double score ball will award the blue player twice the number of points for that ball. If an ordinary ball rolls off the blue player's edge, a subsequent half score ball will award all other players half the points they would normally have received for that ball. Multiple score multiplier balls have a multiplicative affect. If a blue ball rolls off the blue player's edge, three subsequent double score balls and one half score ball will award the blue player four times the number of points for the blue ball.

Each game runs for a particular amount of time. Afterward, players are ranked based on their total score.