

*Mathscapes*  
January 2026

**Title**

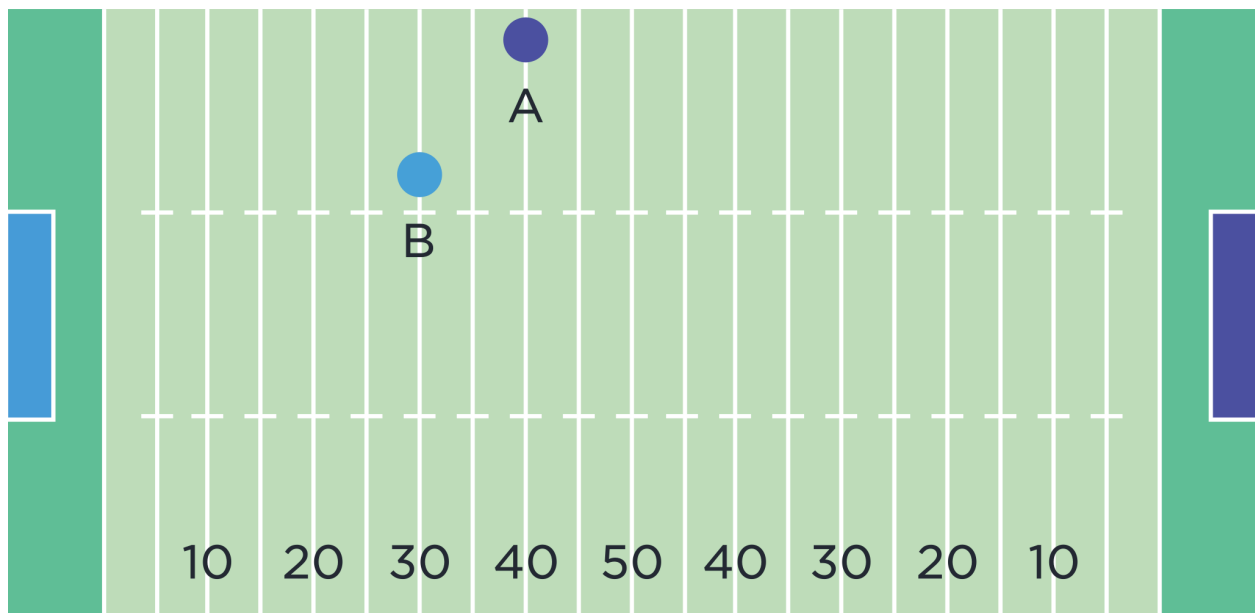
Football Theory

**Real world event**

College football finals in January, gearing up for Superbowl at the start of February

**Problem**

Person A just caught the football! There is only one defender (Person B) between A and the end zone. Assume both players are equally fast, and very agile, and that if Person B reaches Person A, then the tackle is definitely successful.



What direction should Person A start running in?

What is the farthest-left yard line that Person A can definitely reach, no matter what strategy Person B uses? How and why?

What is the farthest-right yard line that Person B can ensure Person A never crosses, no matter what strategy Person A uses? How and why?

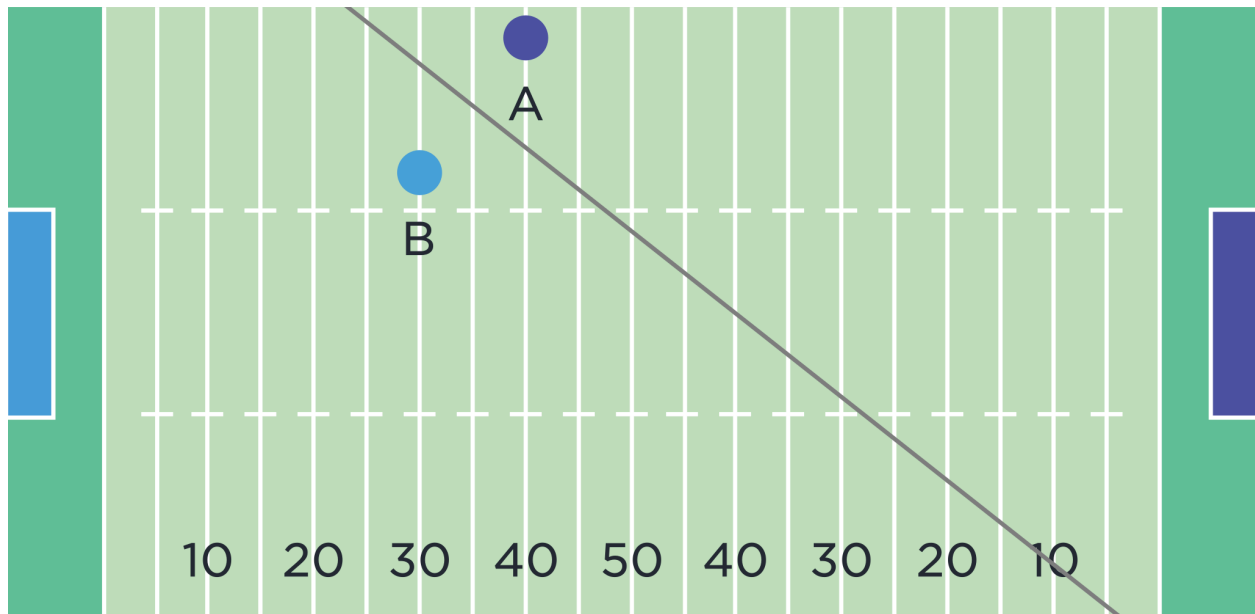


How would you figure out the answer in general, if Person A and Person B started at different positions?

This is a real-world example of Game Theory. There is a huge space of possible strategies for each player to consider.

## Solution

The key to this problem is a classical Geometry concept: the *perpendicular bisector*. That is the line that passes halfway between A and B, and which is perpendicular to the line through A and B.



It splits the field into two parts. Crucially, all points on A's side of the bisector are closer to A than to B, and all points on B's side are closer to B than to A.

In particular, if A runs in a straight line towards any point on A's side of the bisector, A will get there first, no matter what B does.

So, A can safely reach the intersection of the gray line and the sideline, around the 27-yard line, no matter what B does.

But B has a simple strategy to prevent A from ever crossing the gray line, no matter what A does: B could just think of the gray line like a mirror, and copy A's moves, just mirrored across the gray line. B's objective is to make sure that at every moment, A's position and B's position are symmetric across the gray line. Then, the moment A touches the gray line, B would be right at that spot, catching A and ending the play.

Therefore, B can ensure that no matter what A does, A does not get past the 27-yard line.

So, A should just run directly toward the intersection of the perpendicular bisector and the sideline. And B should just mirror A's moves, and end up running directly toward that same intersection.

In general, if A and B started at different positions, then the solution would still be determined by the perpendicular bisector. If the perpendicular bisector was such that A's side included any part of the end zone, then A would be able to reach that point of the end zone by running directly at it, without getting stopped by B.

This strategy is actually practical, and you don't need pen, paper, or tools to use it. You can use it in the heat of action. It's easy to eyeball the perpendicular bisector between you and another person (or object). Try it out. Just look at the point halfway between the two of you, and then imagine a line that runs through that point, perpendicular to the line between the two of you. You can visualize it in a split second.

Fun fact: there is an article about this strategy, which shows that in a game between Army and Air Force in 1994, there was an opportunity to score which perhaps was missed because the player didn't know this fact.

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