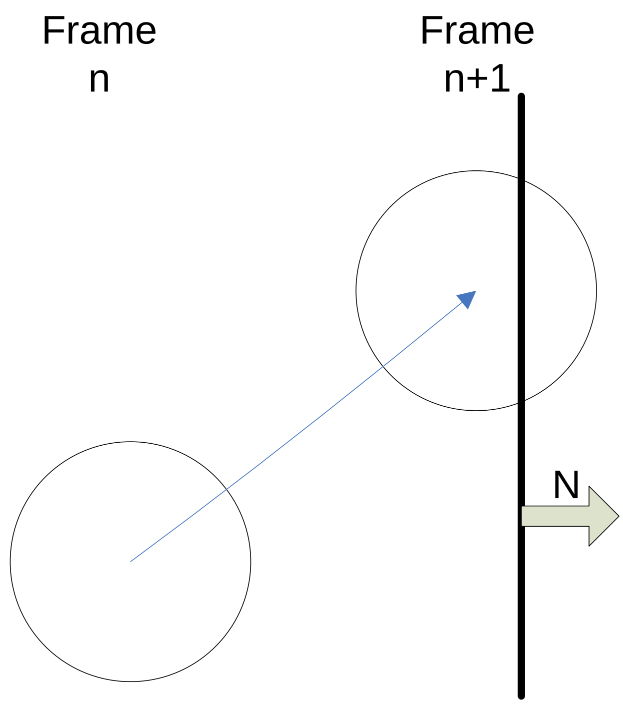
Lecture 17

Animated Circle vs Line Segment

CS230
Game Implementation Techniques

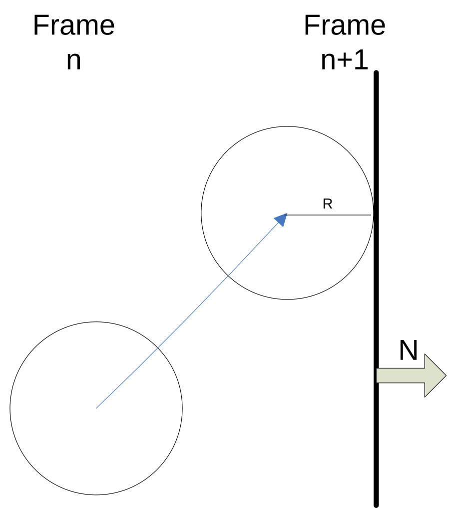
1.1. Circle-Line collision

- Checking if a circle collided with a line is similar to the point-line collision check.
- It is not enough to just check if the center of the circle is colliding with the line:



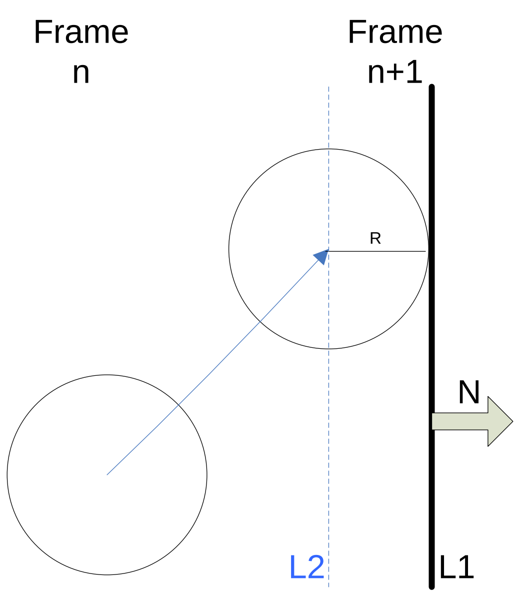
The circle is colliding with the line, although its center didn't collide yet

- As you can see in the figure above, the center of the circle didn't collide with the line yet, but obviously, the circle is colliding with it.
- Logically, the circle will collide with the line if the distance separating its center from the line is equal to the radius.



The circle collides with the line when the distance between its center and the line is equal to the radius

- This means that the circle collides with the line, when its center collides with a second line parallel to the original one, but with an offset equal to the radius.



The circle collides with the line when its center collides with a line parallel to it but offsetted by the radius

- Now the problem comes down to checking for collision between the center of the circle and the offset line.
- Recall that the equation of a line is: $\vec{N}$.P = D
- $\vec{N}$: Normal of the line
- P: Any point belonging to the line.
- D: The constant term in the normal line equation.
- Check the previous section to see how the normal line equation is computed.
- In order to know if a point is on the line, its coordinates should satisfy the line's equation.
- If $\vec{N}$.P – D = 0 → The point is on the line.
- If $\vec{N}$.P – D > 0 → The point is on the side the normal is pointing to.
- If $\vec{N}$.P – D < 0 → The point is on the side not pointed to by the normal.
- Basically, the value that you get when you are replacing "P" with a point's coordinates is the distance separating it from the line, assuming the normal $\vec{N}$ is normalized.
- Therefore, we should normalize the line's normal <u>before</u> computing its normal line equation in case we want to use it to determine the distance separating it from a certain point.
- Now the normal line equation would be $\widehat{N}$.P = D where $\widehat{N}$ is the unit vector of $\vec{N}$
    - "D" is different now because it was computed using the normalized normal
- Using this information, if we replace any point from L2 in L1's equation, we will get:
    - A negative value, because L2 is on the side not pointed to by the normal.
    - The value itself is R (the radius of the circle)
    - Therefore, the result of replacing the coordinates of any point on L2 in L1's is: -Radius
- $\widehat{N}.P_{L2}$ - D = –R where P_{L2} is a point on L2
- $\widehat{N}.P_{L2}$ - D + R = 0 represents now the equation of L2.
    - $\widehat{N}$: The unit vector of L1's normal. L1 and L2 are parallel, therefore their normals are parallel too.
    - P_{L2}: Any point on L2
    - D: The constant of L1's normal line equation.
    - R: The radius of the circle
    - (In other words, "-D + R" is the constant of L2's normal line equation)
- Finally, all what we have to do now in order to check if the circle collides with the line L1, is check if the center of the circle collides with the line L2
    - We can use the previous Point-Line collision check

