FAQ about this code.

1. Why are we dividing by *c* and not *a*?

In the standard quadratic formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

The term *a* typically represents the coefficient of the quadratic term x^2.

However, in this code, the equation being solved is different from a traditional quadratic equation. Here, the variables *a*, *b*, *c*, and *d* in the code come from a specific physics-based problem, not a direct

$$ax^2 + bx + c = 0$$

equation. The values represent different quantities in the interception problem, specifically velocities and distances. Let's review them in the context of the physics:

- *a = Vector3.Dot(v, v) - s * s;* represents the relative speed of the enemy and bullet squared, compared to the bullet's speed squared.
- *b = Vector3.Dot(p, v);* represents the dot product of the distance vector *p* and the velocity vector *v*, indicating how aligned the enemy's movement is with the direction to the shooter.
- *c = Vector3.Dot(p, p);* is the squared distance between the shooter and the enemy.
- *d = b * b - a * c;* is the discriminant, calculated similarly to the quadratic discriminant *b^2 - 4ac*, but tailored to this specific problem.

In this specific scenario, the equation being solved is a modified version of the quadratic equation but in terms of time, distance, and speed. The division by *c* in the terms:

$$t1 = \frac{-b - \sqrt{d}}{c}, \quad t2 = \frac{-b + \sqrt{d}}{c}$$

is due to the problem setup. The *c* here represents a scaling factor for the quadratic terms, where *c* is associated with the distance squared between the shooter and the target. This is why *c* is being used instead of the traditional *a* in the standard quadratic formula. The calculation reflects solving for the time *t* at which the projectile intersects the moving enemy, rather than solving a general quadratic equation.

2. Why are we returning *t * p + v*?

After calculating the valid time *t* for intercepting the target, the expression:

t * *p* + *v*

represents the predicted position of the enemy at time *t*, relative to the shooter.

- *t* * *p* calculates how much the relative position *p* (difference between enemy and shooter positions) changes over time *t*.
- + *v* adds the velocity *v* of the enemy to account for the movement of the enemy during that time.

This vector essentially tells the shooter where to aim the projectile, taking into account both the current position of the enemy (*p*) and their future position based on their velocity (*v*).

Thus, this combination:

t * *p* + *v*

is the calculated future position (or trajectory) where the shooter must aim to intercept the enemy, given that the bullet takes *t* time to reach the target.

Summary:

1. Dividing by *c*: The division by *c* is due to the specific problem setup, where *c* represents the squared distance between the shooter and the enemy, and this modifies the terms of the quadratic equation being solved.

2. Returning *t* * *p* + *v*: This calculates the predicted future position of the enemy after time *t*, where *t* is the time it will take for the projectile to intercept the moving enemy. The vector returned represents the direction and magnitude needed to successfully hit the moving target.