Pure pursuit

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1 Computing the target point

TODO

2 Computing the curvature

Circle going through the car and the target, tangent to the car direction.

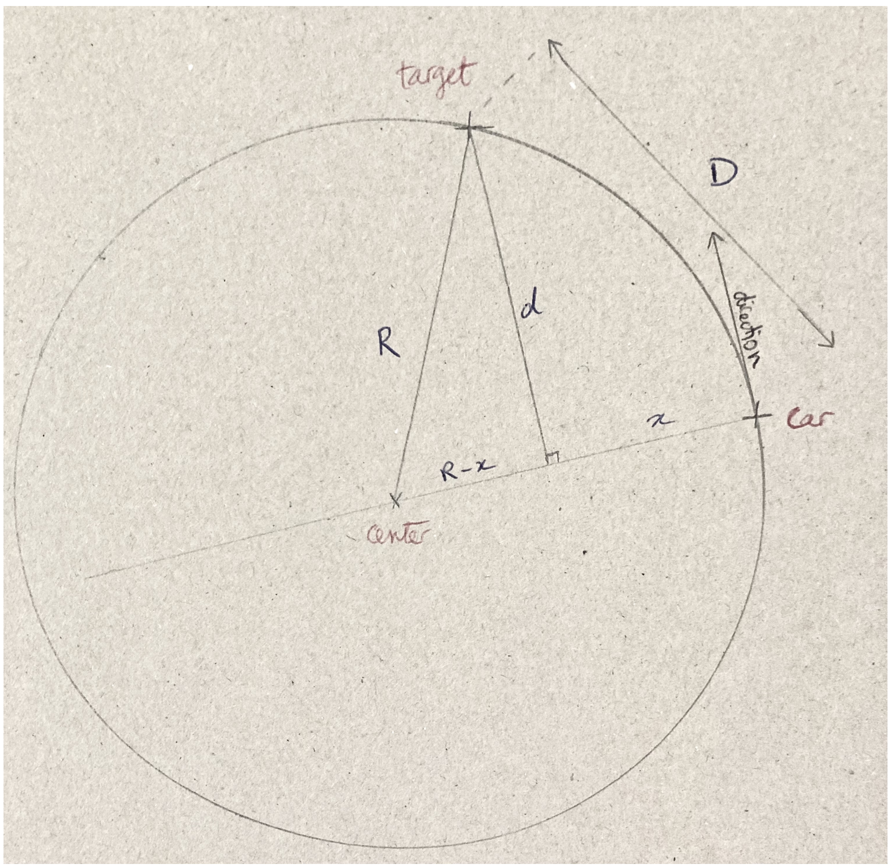

Figure 1: This frog was uploaded via the file-tree menu.

Goal: compute the radius R of the circle.

Using Pythagoras in the big triangle, we have:

$$
\begin{aligned}
R^2 &= d^2 + (R - x)^2 \\
R^2 &= d^2 + R^2 + x^2 - 2Rx \\
R &= \frac{d^2 + x^2}{2x}
\end{aligned} \tag{1}
$$

Using Pythagoras in the small triangle, we have:

$$
\begin{aligned}
D^2 &= d^2 + x^2 \\
x^2 &= D^2 - d^2
\end{aligned} \tag{2}
$$

We can plug it in the previous equation and get:

$$
\begin{aligned}
R &= \frac{d^2 + x^2}{2x} \\
R &= \frac{d^2 + D^2 - d^2}{2\sqrt{D^2 - d^2}} \\
R &= \frac{D^2}{2\sqrt{D^2 - d^2}}
\end{aligned} \tag{3}
$$

To compute d, we can use the formula for the distance between a point and a line defined by a point and a direction vector (here called `normal`, as the vector normal to the car direction):

$$
d = \|(\texttt{target} - \texttt{car}) - (\texttt{target} - \texttt{car}) \cdot \texttt{normal}\,\texttt{normal}\| \tag{4}
$$

We can plug it in the previous equation and finally get:

$$
R = \frac{D^2}{2\sqrt{D^2 - \|(\texttt{target} - \texttt{car}) - (\texttt{target} - \texttt{car}) \cdot \texttt{normal}\,\texttt{normal}\|^2}} \tag{5}
$$