Trajectory Planning Questions

1. The equation $q(t) = a_0 + a_1 t$ defines a line. Solve for the coefficients a_0 and a_1 that satisfy the initial and final position constraints of $q(t_0) = q_0$ and $q(t_f) = q_f$.

2. We discussed using linear algebra to solve for the coefficients of the cubic polynomial that satisfies the specified conditions. Will there always be a solution? If no, when does it fail?

$$\begin{bmatrix} q_0 \\ v_0 \\ q_f \\ v_f \end{bmatrix} = \begin{bmatrix} 1 & t_0 & {t_0}^2 & {t_0}^3 \\ 0 & 1 & 2t_0 & 3{t_0}^2 \\ 1 & t_f & {t_f}^2 & {t_f}^3 \\ 0 & 1 & 2t_f & 3{t_f}^2 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \\ a_3 \end{bmatrix}$$

3. For which of the five trajectory types can q leave the interval between q_0 and q_f for the time span $t_0 \leq t \leq t_f$? Explain.

4. Why would one ever use a line or a cubic polynomial instead of a quintic polynomial?

5. How does the idea of sequencing low-order polynomials such as cubics through multiple via points relate to LSPB and Bang-Bang trajectories?

6. Set up the equations to solve for all the coefficients of a general LSPB given initial time t_0, final time t_f, initial position q_0, final position q_f, initial velocity v_0, final velocity v_f, and blend duration t_b (duration of starting parabola and ending parabola). Here are the equations for the three curves: $q(t) = b_0 + b_1 t + b_2 t^2$ $q(t) = a_0 + a_1 t$ $q(t) = c_0 + c_1 t + c_2 t^2$