Assignment 1

(Deadline: Oct. 13. **Late submission will be considered as 0 point.**)

1. (30 points)
Consider a trajectory $\theta = \{x, y, z\}$ is given by $x = \cos 2\pi s, y = \sin 2\pi s, z = 2s, s \in [0,1]$, and its time scaling is $s(t) = \frac{1}{4}t + \frac{1}{8}t^2, t \in [0,2]$. Calculate $\ddot{\theta}$.

2. (30 points)
Via points with specified positions, velocities, and accelerations can be interpolated using fifth-order polynomials of time. For a fifth-order polynomial segment between via points j and $j+1$, of duration ΔT_j, with $\beta_j, \beta_{j+1}, \dot{\beta}_j, \dot{\beta}_{j+1}, \ddot{\beta}_j, \ddot{\beta}_{j+1}$ specified, solve for the coefficients of the fifth-order polynomial.

3. (40 points)
Consider a robot executing a motion of duration $T = 2$ s. Initially the robot follows a cubic time scaling. At $t = 1$ s, however, it switches to a fifth-order time scaling. This fifth-order time scaling, beginning at $t = 1$ s, should match the position, velocity, and acceleration of the cubic time scaling which is ending at that time, i.e., $s(1) = \frac{1}{2}, \dot{s}(1) = \frac{3}{4}, \ddot{s}(1) = 0$. Solve for the complete time scaling $s(t) : [0,2] \rightarrow [0,1]$.