Homework #5

Due 10/01/2017

This homework consists of two parts, where the first (problems 1 to 4) is multiple-choice.

1. Via points are specified in order to:
   - Make the computed path smooth.
   - Be sure the path ends at the target frame in spite of errors.
   - Introduce temporal considerations into the trajectory generator.
   - Attempt to deal with constrains other than initial and final frame.

2. Third order polynomial are used since:
   - The trajectory between via points is constrained by four equalities.
   - Accelerations can only change linearly.
   - They are good approximations to smooth paths.
   - Desired velocities of the joints at the via points are known.

3. Linear functions as paths:
   - Can be used if no via points are specified.
   - Give rise to position discontinuities, unless parabolic blends are introduced.
   - Give rise to velocity discontinuities, unless parabolic blends are introduced.

4. One of the advantages of Joint over Cartesian space schemes is that:
   - They give rise to more intuitive motions.
   - They allow the use of via points between the initial and final targets.
   - They are easier to compute.
   - They simplify the design of straight motion in the workspace.

5. Let $\theta(0) = 5^\circ, \dot{\theta}(0) = 0, \theta(5) = 90^\circ, \dot{\theta}(5) = 0$. Design a linear path with parabolic blends meeting these specifications.

6. Supposed we add to the problem above the additional condition $\theta(2.5) = 40^\circ$. Compute a path using two appropriately combined third order polynomials. Sketch graphs of position, velocity, and acceleration.

7. For the robot in the figure, let $l_1 = l_2 = 20 cm, l_3 = 10 cm$. Suppose the pose of the end effector is $x(0) = 20cm, y(0) = 0, \varphi(0) = 0$, and $x(10) = 25cm, y(10) = 15, \varphi(10) = 90$. Calculate trajectories for the joint variables $\theta_1, \theta_2, \theta_3$. 