HW#2 Hybrid Control Systems

(1) Following the maximum principle shown in section 3.5 (page 65) of the text obtain the optimal control for

$$\dot{x} = x + u \quad , \quad x(0) = 5$$

$$0 \leq u(t) \leq 2$$

$$\text{maximize} \quad \int_0^2 (2x - 3u - \alpha u^2)\, dt$$

for the following 2 cases

(a) $\alpha = 0$

(b) $\alpha = 1$

---

(2) Draw the phase plane plot for the system of example 3.2.2 using the matlab software pplane.m and ppsolve.m.

---

(3) Show the steps for solving:

$$\text{Minimize} \quad \frac{1}{2}\int_0^{10} \left\{ [x_1 \;\; x_2]\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + [u_1 \;\; u_2]\begin{bmatrix} u_1 \\ u_2 \end{bmatrix} \right\} dt$$

subject to

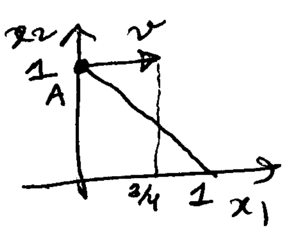
$$\dot{x}_1 = -2x_1 + u_1 + u_2$$

$$\dot{x}_2 = -3x_2 + 3u_1 - 2u_2$$

$$x_1(0) = 5 \quad , \quad x_2(0) = 7$$

$$x_1 + 5x_2 \geq 0$$

---

(4) 

Derive $\pi(x, v)$ for $x = (0,1)$ and for the vector shown in the figure.

(5) Show all the modes of

$$\dot{x}_1 = -x_1^2 + u$$

$$\dot{x}_2 = -x_1 - x_2 + u$$

$$y = x_1 + x_2$$

$$0 \leq y \perp u \geq 0$$