Assignment 4

1. Use the Lagrange multiplier technique to show that for $P(x_i)$ defined for discrete bins $\{i = 1, \ldots, M\}$, entropy is maximized when $P(x_i) = \frac{1}{N}$ for all i and the maximum value the entropy achieves is $logN$.

2. Problems from Bishop: 1.30 1.35, 1.39

3. Accelerating a Cart Consider the one-dimensional problem of accelerating a cart on a track, as shown in Figure 1. The problem is to pick a control law $u(t)$ that will get the cart as far as possible down the track at time T, but at the same time avoid costly accelerations.

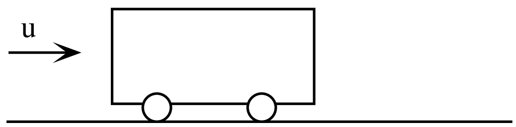

Figure 1: A cart on a one-dimensional track. The position on the track is given by $x(t)$. The cart is controlled by an acceleration $u(t)$.

The dynamic equation is

$$\ddot{x} = u(t)$$

with initial conditions

$$x(0) = 0$$
$$\dot{x}(0) = 0$$

The cost functional

$$J = x(T) - \frac{1}{2}\int_0^T u^2(t)dt$$

captures the desire to maximize the distance traveled in time T and at the same time penalize excessive accelerations.

Use the classical calculus of variations to solve for $u(t)$ analytically.

4. Check your answer to the previous problem by developing a MATLAB solution to this problem using DynamicProgramming.