Jiaming Lai
A53314574

Assignment #1

Problem 1: Convolution as Linea Map

Solution

(a) Obviously the size of matrice T must be $(N+1) \times (N+1)$. Let $T_{i1}, T_{i2}, \ldots, T_{i(N+1)}$ be the i-th row of matrice T. Since $y = Tx$, we can get

$$v(i-1) = \sum_{j=1}^{N+1} T_{ij} u(j-1) = T_{i1}u(0) + T_{i2}u(1) + \ldots + T_{i(N+1)}u(N) \tag{1}$$

Accoring to the convolution function,

$$v(i-1) = \sum_{k=-\infty}^{+\infty} h(k)u(i-1-k) = \sum_{k=(i-1-N)}^{i-1} h(k)u(i-1-k) \tag{2}$$

Comparing function (1) and function (2), it is easy to conclude that

$$T_{ij} = h(i-j),\ where\ 1 \leq i \leq (N+1),\ 1 \leq j \leq (N+1)$$

So the matrice is a matrice where each element could be represented as $T_{ij} = h(i-j),\ where\ 1 \leq i \leq (N+1),\ 1 \leq j \leq (N+1)$.

(b) The structure of matrice T could be described as follow:

$$T_{i,j} = T_{i+1,j+1}$$

Problem 2: Adjacency graph

Solution

Problem 3: Vector Spaces of Polynomials

Solution

Problem 4: Symmetric and Hermitian matrices

Solution

Problem 5: Properties of Vector Spaces

Solution

Problem 6: Linear Independence

Solution

Problem 7: Finding Basis

Solution