EE105 HW4 Solution

1. **Perceptron Model Calculation (Hand Calculation)**

   $$Weighted\ Sum = w_1x_1 + w_2x_2 + w_3x_3 = 3.5 > 0$$

   So the output is 1.

2. **Activation Functions (Hand Calculation)**

   $$Weighted\ Sum = w_1x_1 = z = 2.5$$

   Sigmoid: $\frac{1}{1+e^{-z}} \approx 0.924$

   Relu: $\max(0, z) = 2.5$

   Tanh: $\frac{e^z - e^{-z}}{e^z + e^{-z}} = 0.9866$

3. **Design a Neural Network Topology (Conceptual)**

   1. Input Layer

   Number of inputs: 3

   Input 1: Weather forecast

   Input 2: Tickets available

   Input 3: Friends attending

   2. Hidden Layer (optional)

   Number of neurons: 2 (can be more)

   Weights: Each neuron connects to all 3 inputs (total of 6 weights + 2 biases, depends on # of neurons)

   Activation function: ReLU (your choice)

   3. Output Layer

   Number of outputs: 1

   Purpose: Binary classification (Attend = 1, Not Attend = 0)

   Activation Function: Sigmoid — outputs a value between 0 and 1 (your choice)

   Decision Rule:

   If output ≥ 0.5 → Attend (1)

   If output < 0.5 → Don't Attend (0)

4. **Smallest Neural Network for MNIST Classification (Python Implementation)**

   Typically, a hidden layer with 128 neurons is often the smallest that can reliably achieve ~92% accuracy on MNIST. We accept all reasonable choices of neuron networks.