**Gen 575 Spring 2024**

**Problem Set 1**

*Due by 11:59 pm Apr-17-2023 to beliveau [at] uw.edu*

**Name:**

**Problem 1 (10 points)**

* 1. **(5 points)** You were reviewing the lecture 1 slides (as one does), and understandably couldn’t stop yourself from reading up on how the Kibble Balance mentioned on *slide 6* works. In your own words, describe below in a few sentences what the Kibble Balance is designed to do and how it achieves this. A high-level description is sufficient. Be sure to point out any force transduction or energy transfer occurring:
  2. **(5 points)** You couldn’t help but noticing the “Acoustic Resonator” on *slide 10* of the lecture 1 slides as well, and of course had to investigate further. Your google dot com search led you to <https://www.nist.gov/programs-projects/acoustic-thermometry>. In your own words, describe below in a few sentences what the Acoustic Resonator is designed to do and how it achieves this. A high-level description is sufficient. Be sure to point out any force transduction or energy transfer occurring:

**Problem 2 (15 points)**

You had so much fun playing the guessing games in class that you decided to make your own version of it to unveil at your next social gathering. You decide to come up with your own guessing game to unveil at your next social gathering. In your game, the goal is to guess a number between 1 and 75. Your game has the following structure:

|  |  |  |
| --- | --- | --- |
| **Guess** | **Example** | **Reveal** |
| Value | “Is it 33?” | “Yes” OR “No” |
| Multiple of 7 | “Is it a multiple of 7?” | “Yes” OR “No” |
| Prime | “Is it prime?” | “Yes” OR “No” |
| Cube | “Is it a cube?” | “Yes” OR “No” |

**2.1 (5 points)** Calculate the Information Entropy *H* of your game. Show your work:

**2.2 (10 points)** Calculate the Information gain *I* for each outcome of each guess listed in the table above. Show your work:

**Problem 3 (25 points)**

The accompanying *2024.fake.scores.xlsx* contains your “fake scores” from class and true labels for your deepfake guessing game.

**3.1 (10 points)** Populate the 14 confusion matrices below using the indicated decision boundaries with the data from *2024.fake.scores.xlsx*. R = real, F = Fake

|  |  |  |
| --- | --- | --- |
| *If fake score >-1, fake*  Team Jerky | **Actual R** | **Actual F** |
| **Predicted R** |  |  |
| **Predicted F** |  |  |

|  |  |  |
| --- | --- | --- |
| *If fake score >0, fake*  Team Jerky | **Actual R** | **Actual F** |
| **Predicted R** |  |  |
| **Predicted F** |  |  |

|  |  |  |
| --- | --- | --- |
| *If fake score >1, fake*  Team Jerky | **Actual R** | **Actual F** |
| **Predicted R** |  |  |
| **Predicted F** |  |  |

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| --- | --- | --- |
| *If fake score >2, fake*  Team Jerky | **Actual R** | **Actual F** |
| **Predicted R** |  |  |
| **Predicted F** |  |  |

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| --- | --- | --- |
| *If fake score >3, fake*  Team Jerky | **Actual R** | **Actual F** |
| **Predicted R** |  |  |
| **Predicted F** |  |  |

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| --- | --- | --- |
| *If fake score >4, fake*  Team Jerky | **Actual R** | **Actual F** |
| **Predicted R** |  |  |
| **Predicted F** |  |  |

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| --- | --- | --- |
| *If fake score >5, fake*  Team Jerky | **Actual R** | **Actual F** |
| **Predicted R** |  |  |
| **Predicted F** |  |  |

|  |  |  |
| --- | --- | --- |
| *If fake score >-1, fake*  Team ROC’ing Curves | **Actual R** | **Actual F** |
| **Predicted R** |  |  |
| **Predicted F** |  |  |

|  |  |  |
| --- | --- | --- |
| *If fake score >0, fake*  Team ROC’ing Curves | **Actual R** | **Actual F** |
| **Predicted R** |  |  |
| **Predicted F** |  |  |

|  |  |  |
| --- | --- | --- |
| *If fake score >1, fake*  Team ROC’ing Curves | **Actual R** | **Actual F** |
| **Predicted R** |  |  |
| **Predicted F** |  |  |

|  |  |  |
| --- | --- | --- |
| *If fake score >2, fake*  Team ROC’ing Curves | **Actual R** | **Actual F** |
| **Predicted R** |  |  |
| **Predicted F** |  |  |

|  |  |  |
| --- | --- | --- |
| *If fake score >3, fake*  Team ROC’ing Curves | **Actual R** | **Actual F** |
| **Predicted R** |  |  |
| **Predicted F** |  |  |

|  |  |  |
| --- | --- | --- |
| *If fake score >4, fake*  Team ROC’ing Curves | **Actual R** | **Actual F** |
| **Predicted R** |  |  |
| **Predicted F** |  |  |

|  |  |  |
| --- | --- | --- |
| *If fake score >5, fake*  Team ROC’ing Curves | **Actual R** | **Actual F** |
| **Predicted R** |  |  |
| **Predicted F** |  |  |

**3.2 (15 Points)** Generate a ROC curve using the data from 3.1. Using any reasonable method of your choosing, compute/estimate the area under the curve (AUC) for the *Fake Score* classifiers of the two teams. Which was more performant (i.e., had a higher AUC?). How does the AUCs of the two teams compare to random guesses? Show your work: