

# MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Department of Electrical Engineering and Computer Science  
Department of Mechanical Engineering

6A32 / 2A29

Information and Entropy

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Homework 6

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## Problem 1

One hundred students took an exam in an Information and Entropy seminar. Your task is to take all their grades and compress them using Huffman encoding using only the symbols { 1 2 3 4 5 } which correspond to the letter grades { A B C D F } respectively. Using MATLAB, execute the following lines to retrieve the grades.

```
rand('state',100);           % Reset random number generator.  
grades = raylrnd(1,1,100);   % Rayleigh random numbers  
grades = ceil(grades/max(grades)*5); % Normalize to F = 5
```

The command, `tabulate` will assist you in the following questions. Remember to use `log2` for the correct logarithm.

- a) Derive the binary digit representations for each letter grade.
- b) What is the theoretical number of bits per symbol? How many bits would theoretically be needed to encode all the grades?
- c) If the grades were to be encoded using the binary digit representations from part a, how many bits would be needed?
- d) Modify the binary digit representations from part a so that a bitstream can be uniquely decoded forwards and backwards. This new representation need not be efficient.