MA/CS 109 Second CS Homework

Due Thursday 11/16 @ 3:30pm in lecture

Problem 1

Suppose you use the RLE109 algorithm, as defined in lecture last week (lecture slides may be found here: http://www.cs.bu.edu/fac/snyder/cs109/Home.html). Encode the following messages into binary in uncompressed or compressed form as indicated.

- A_FED into uncompressed form:
- AAADEEEE into compressed form:
- AAAAAAAAAAAAAAAADD into compressed form:

Problem 2

Again, using the RLE109 algorithm, decode the following messages:

- 010110011011
- 000001000011001100

Problem 3

In lecture we discussed how a code such a LRE109 could make a binary "message" shorter (hopefully!) or longer (hopefully not!). It could also change the encoding but leave it at the same length.

A. Give an example of a message that is unchanged in length after encoding by the LRE109 method (hint: some part of the message will get longer and the other part will get shorter, balancing out in the end to the same number of bits as the original).

B. What is the best possible compression ratio (i.e., the smallest ratio (# bits after compression)/(#bits before compression)) you could expect to get for any message using the LRE109 compression algorithm? Give an example of a message that has this optimal compression ratio. (Hint: Consider a message that involves multiple occurrences of only a single letter.)

Problem 4

Using the following Huffman Code from lecture on Wednesday 10/29:

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A   0
B   10
C   11
```

give the binary encoding of the following message:

ABCCAAB

and then decode the following message:

1010110100010111011.

Problem 5

Suppose our alphabet is A, B, C, D, with probabilities as follows: A = .5, B = .3, C = .1, and D = .1. Along the same lines as the presentation in lecture on Friday, construct the Huffman Tree and the resulting Huffman Code, and then encode the message "BADDAD". Show all work. Finally, calculate the average number of bits that this code would use for messages that have these probabilities, and give the corresponding compression ratio.