March 19, 2000

Binary homework

Due Monday, March 27

1. Write 13 and 38 in binary. Compute in binary the sum and product of 13 and 38. Convert the results (the two binary answers) back to decimal. Are the answers correct? Show your work, please!

The following table may be useful.

$n =$	0	1	2	3	4	5	6	7	8	9	10	11	12
$2^n =$	1	2	4	8	16	32	64	128	256	512	1024	2048	4096

2. Consider this pattern of 0's and 1's: 111001 (three ones followed by two zeros followed by one one). Suppose that N is a number which when written in binary is some (unknown) number of repetitions of this pattern. For example, if N were three repetitions of the pattern (in binary, 111001111001111001*), the number N would be (in decimal) 237,177. Verify that no number produced in such a way can be a prime number.

Hint All you need to do is show that N can be written as a product of two other numbers – take advantage of the binary form. You do not need to do extensive computation, but you must give me some reasonable explanation of your assertion. I don't want only verification that the specific N above is not prime. I want you to explain why any N fitting the description above can't be prime. This is a problem which can be answered with a bit of thought more easily than with lots of computation.

3. Suppose that W is some really enormous number which when written in standard decimal form using a standard font size (like that used in this problem statement) has a length of **5 feet**. Give some reasonable over- and under-estimates for how long W would be when written in binary form using the same font size. Your answer need not be precise, but produce some estimates for the lengths together with a few sentences justifying them. I am more interested in your justification than I am in any specific quantitative answer!

* $\overbrace{111001}\overbrace{111001}\overbrace{111001}$