18.310 Review Questions Exam 1

1. A Weighing: create a scheme for 12 coins one of which is heavy or light all coins must go on scale at least once, B what is max number of coins can be handled in this way without a good coin in k weighings
2. Sorting: describe heapsort in a few concise sentences. What are its advantages?
3. Median finding algorithm. Suppose N is gigantic and you pick out 10000 keys at random and find their medianwhat is the probability it is not rank between .2N/5 and 3N/5? (hint compute probability assuming it has rank exactly 2N/5 that half the others lie above it and half below it. Show that as you get further from the middle probabilities go down exponentially, so the answer is only a small factor larger than twice this.
4. Draw a diagram of the comparisons in Batchers algorithm on 16 keys.
5. Huffman and hu tucker Given a sequence of frequencies of words., find an optimal Huffman and Hu-Tucker code.
6. give an argument for n! having form (n/e)^n*W(n) were W(n) is 0(n).
7. What is the Weak Law of Large Numbers? Outline a proof
8. State and outline a proof of Shannons first (clear channel capacity) theorem
9. Describe : Lempel Ziv in your own words as concisely as possible.
10. State and Prove the Fundamental Theorem of Algebra for an arbitrary field.
11. Describe (apply?) a Test for primitivity of a polynomial
12. For a a primitive polynomial, of degree 3 show which powers of x obey which equations. Do the same for a primitive polynomial of degree 4.
13. Shannons second (noisy channel) theorem; describe and outline a proof
14. give a matrix code that encodes four bits and can correct one error show how to find it.
15. given a primitive polynomial p find p3
16. find up 3 table for the primitive polynomial given
17. if there are k errors prove relations between elementary symmetric functions for powers of terms at least k
18. write the error locator polynomial in terms of t's for up to 2 errors
19. describe how to test powers to see if there are errors in a 2 error correcting bch code
20. write relevant relations between elementary symmetric functions and power sum symmetric functions for a three error correcting code
21. how many message bits can a primitive polynomial of degree 10 handle. If you construct a 3 error correcting code, how many message bits can there be? If each bit has a probability .1/10000 of an error, what is the probability of there being 4 or more errors in a code on 1023 bits? What (roughly(is the probability that you will make a false decoding