EE 121 - Introduction to Digital Communications
Homework 5 Solutions

March 8, 2008

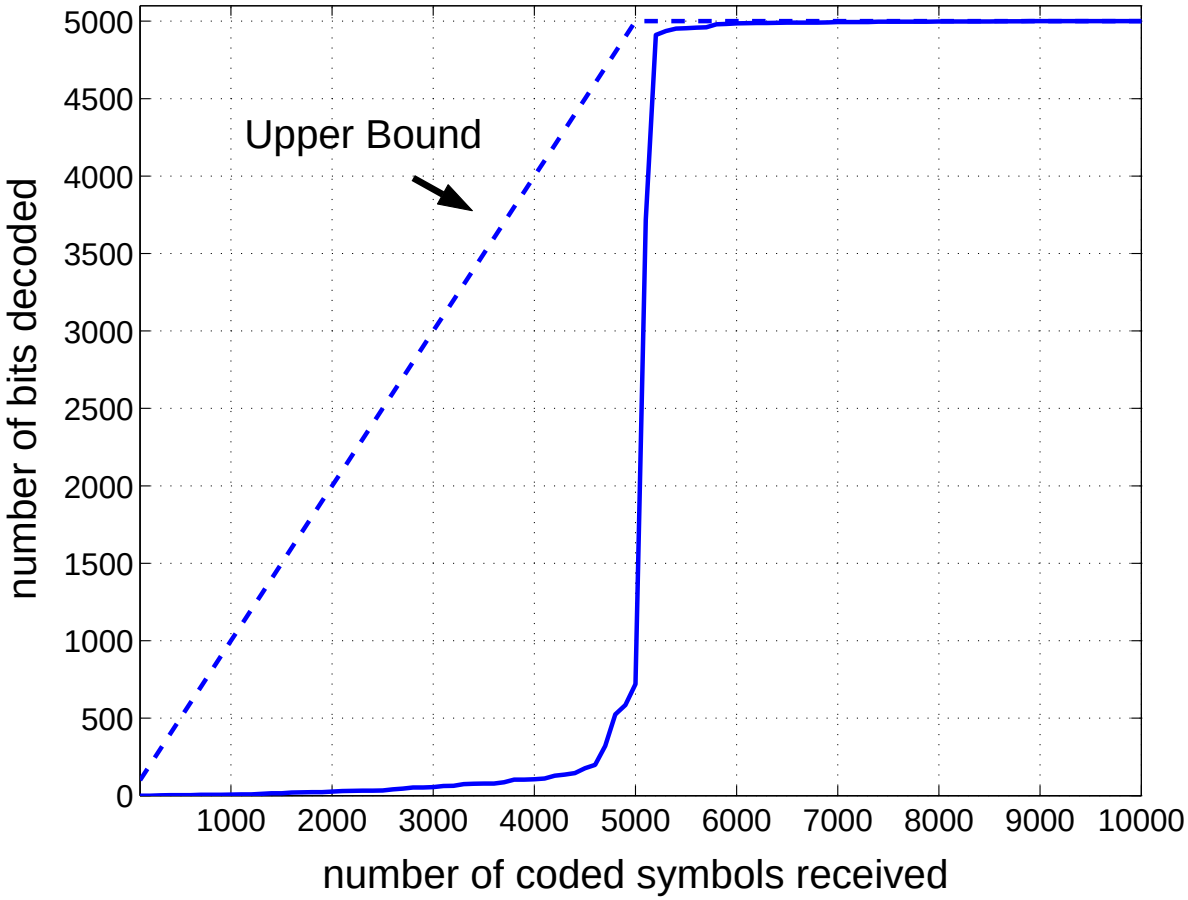
1 (a) A simple and efficient way of storing the data is in an $N \times (D+1)$ matrix. The first entry of the ith row stores the number of data bits used in the generation of the ith coded symbol. The remaining D entries of the ith row store the indices of the data bits that are added together modulo two, to form the ith coded symbol.

(b) See sample code.

(c) Typically 0 data bits can be decoded given only 100 coded symbols. In order to be able to decode at least one bit, we require a seed, that is a coded symbol formed from only one data bit. The expected number of such coded symbols is about 0.8 ($100\Omega_1$). The maximum possible number of bits that can be decoded from the 100 symbols is 100. This upper bound is very loose.

(d) Typically only a few data bits, if any, can be decoded given 200 coded symbols. Now the average number of seeds is 1.6, but the problem becomes finding another coded symbol that connects to the same seed symbol. The upper bound is now 200, but is still very loose.

(e) See code and the graph below (note the code takes many hours to run). There is a sharp transition at around $N = 5000$. The overhead needed to decode the 5000 data bits is very low when N is slightly larger than 5000. When N is much larger than 5000, this overhead becomes significant. As the graph below suggests, many additional symbols are typically required before the last few data bits can be decoded. Often in practice, an outer code is used (typically a simple block code) to circumvent this.


Upper Bound
number of bits decoded
number of coded symbols received
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000