# Seminar problems in computation

## Models of computation

1) Design a Turing machine to recognise the language B = {w#w-1 | w ∈ {0, 1,2}\* }. That is, the language of strings of 2s, 1s and 0s followed by the # and then the reverse of the string. So “210#012” should be accepted, but “210#210” should be rejected. You can adapt the machine in the slides.

## Complexity

2) Consider the following code.

void f(m){ // where m is a 2d matrix with fixed rows and columns  
 for d in 0..m.rows(){  
 if m[d][d]==0{  
 int i=row\_index\_with\_highest\_value\_in\_column(m,d,d+1);  
 if m[i][d]!=0{  
 swap\_rows(m,d,i);  
 } else {continue;}  
 }   
 f=m[d][d];  
 for i in 0..m[d].cols(){ m[d][i]/=f;}  
 for i in d+1..m.rows(){  
 f=-m[i][d];  
 for k in d..m[i].cols(){ m[i][k]+=m[d][k]\*f; }  
 }   
 }  
}

Please estimate the time complexity T(r,c)=… for this procedure.

Please give the order of complexity (O) of T(r,c)

* ***r*** is the number of rows
* ***c*** is the number of columns
* You may assume that the procedure “swap\_rows” has time 3
* You may assume that the procedure “row\_index\_with\_highest\_value\_in\_column**”** being the maximum of a list has linear time cost (n) in the number of elements it must search through.

## Algorithms

3) Given a set of 2d data points it is always possible to plot a polynomial function through them all. For instance [(1,5),(7,10),(-5,1),(-6,-6)] can be fitted by

Y=6.74 - 1.6097x-0.198x2+0.071x3

Can you find an algorithm to find these equations in general for any set of points? Discuss the time complexity.

## Probability

4) The probability of catching Lyme disease after one day of hiking in the Cuyamaca mountains are estimated at less than 1 in 10000. You feel bad after a day of hike in the Cuyamacas and decide to take a Lyme disease test. The test is positive. The test specifications say that in an experiment with 1000 patients with Lyme disease, 990 tested positive. Moreover. When the same test was performed with 1000 patients without Lyme disease, 200 tested positive. What are the chances that you have caught Lyme disease?