Ay190 – Worksheet 09
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# 1

The goal is to solve the linear system of equations:

$$Ax = b \tag{1}$$

for $nxn$ matrices $A$ and $nx1$ vectors $b$. I write a fanciful code that checks that each matrix $A$ is square and of same dimension as the vector $b$. I find the determinant, which is nonzero in every case. Thus these matrices can be solved.For matrices LSE4_m and LSE5_m I find the natural log of the determinant because attempting to calculate the determinant itself encounters overflow error.

The dimensions and determinants are available for any of the LSEs in ws9.py.

| | LSE1 | LSE2 | LSE3 | LSE4 | LSE5 |
|---|---|---|---|---|---|
| Det Sign | 1 | -1 | -1 | -1 | 1 |
| Det Natural Log | -4.53358731971 | 77.1114857221 | 226.07016741 | 1930.40191136 | 4563.75910742 |
| Matrix Dim | 10 | 100 | 200 | 1000 | 2000 |

# 2

I use the code available at `http://shiftycow.net/gauss-elimination-functions-in-python-and-matlab/`. Note this code does not pivot the matrices. It takes as an input an $n\,x\,n+1$ matrix whose $n+1$th column is the vector $b$. Code is available at ws9b1.py. I use time.clock to time the evaluation.

| | LSE1 | LSE2 | LSE3 | LSE4 | LSE5 |
|---|---|---|---|---|---|
| time (s) | 0.0 | 0.08 | 0.3 | 21.42 | 173.52 |

# 3

I used scipy.linalg to solve the system of equations using time.clock to time the results as above. Code is avaialable at ws9c.py.

| | LSE1 | LSE2 | LSE3 | LSE4 | LSE5 |
|---|---|---|---|---|---|
| time (s) | 0.0 | 0.0 | 0.1 | 0.24 | 1.78 |

Clearly scipy.linalg runs much faster (by two orders for the last three matrices), but we again see exponential growth in run time. Double the array dimension increases evaluation time by 9 and not 4 as we would expect for an evaluation of time order $n^2$.