

HW3

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1 Answers

- (a) derivative of $x(x-1)$ at $x=1$ using definition with $\delta = 0.01$ is 1.0100000000000001; derivative of $x(x-1)$ at $x=1$ analytically is 1. The difference is -0.0100000000000009; (b) for different δ : [0.01, 0.0001, 1e-06, 1e-08, 1e-10, 1e-12, 1e-14], the difference between actual value is [1.00000000e-02 9.99999999e-05 9.99917733e-07 3.92252875e-09 8.28403710e-08 8.89005833e-05 -7.99277837e-04]. At first when the δ is decreasing, the difference starts to decrease, however at about 1e-10, the difference starts to increase. This may due to the fact that the precision of the computer is limited, and so when the δ is too small, there may be rounding error occurs.
- the figure 1 below shows the time for 5 different sizes of matrix multiplication using explicit method, namely, size [10,30,100,300,1000]. clearly, the time is proportional to the cube of the size. Using `dot()` method, the computational time is drastically reduced. The exact time for each size when using explicit method is: [5.72919846e-04 1.44171715e-02 4.97361898e-01 1.34161708e+01 5.05462780e+02]; the time for each size when using `dot()` is: [2.09808350e-05 1.69277191e-05 2.12907791e-04 1.58119202e-03 2.74429321e-02].

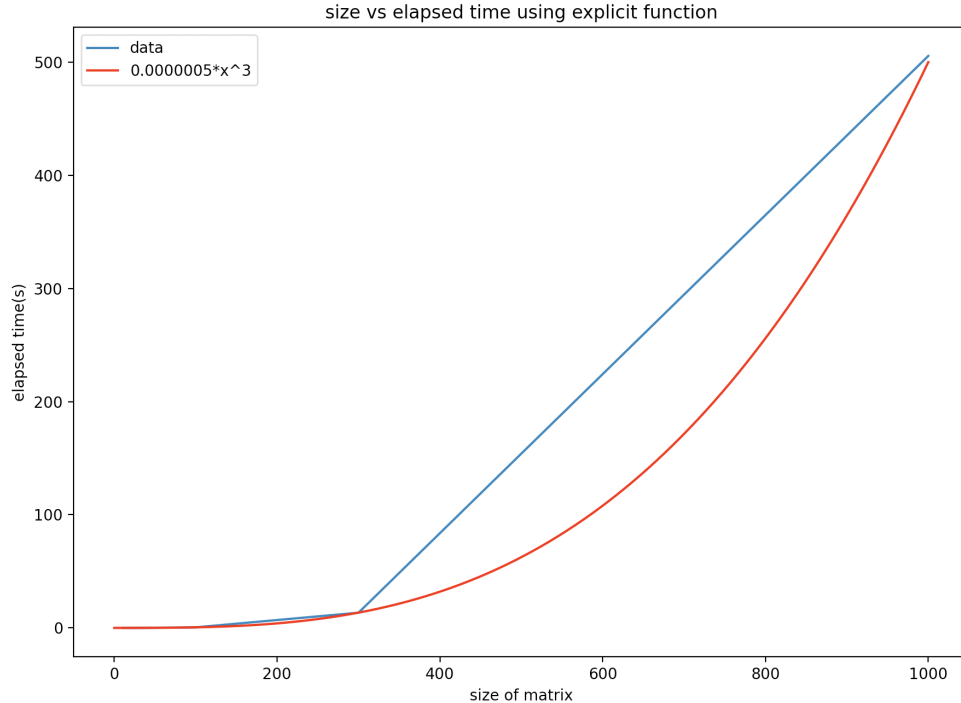


Figure 1: Computation time using explicit method in blue, function $y = 0.0000005x^3$ in red

- See figure 2 below.
- See figure 3, using nonuniform distribution to re-scale the time distribution.

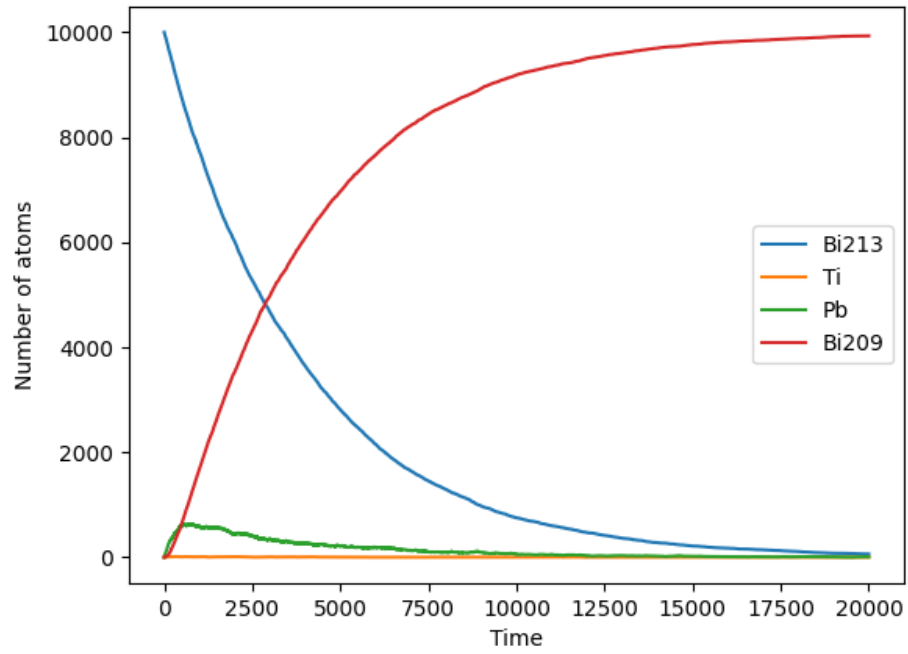


Figure 2: Radioactive decay chain, numbers of atoms for each element as function of time

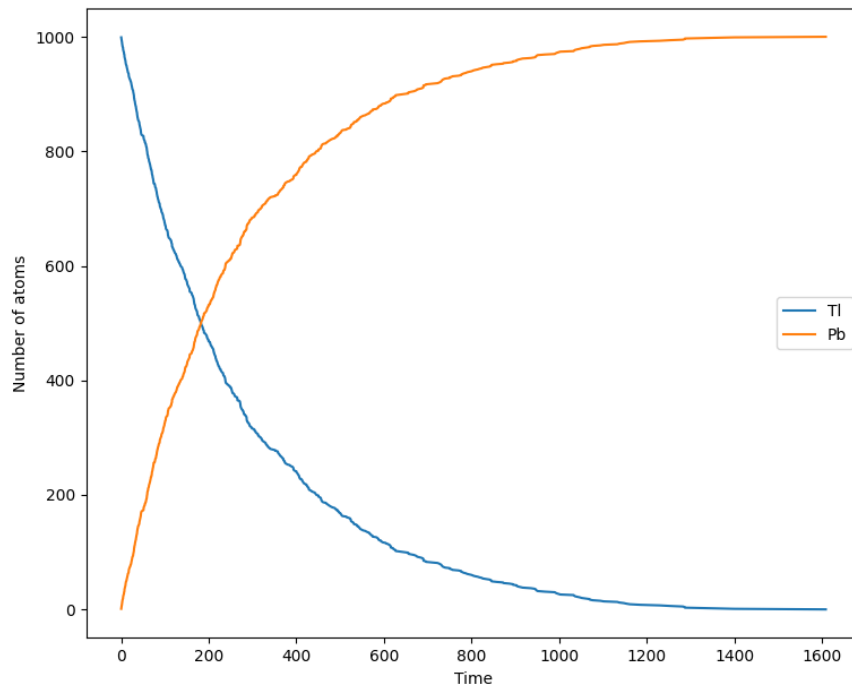


Figure 3: Radioactive decay simulation using faster nonuniform distribution method, numbers of atoms for each element as function of time

2 Github

Github Account: robertXi6