Homework 1

8/10

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Computational Physics

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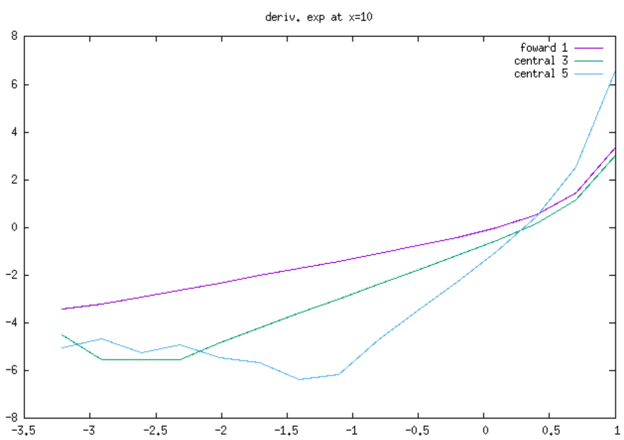
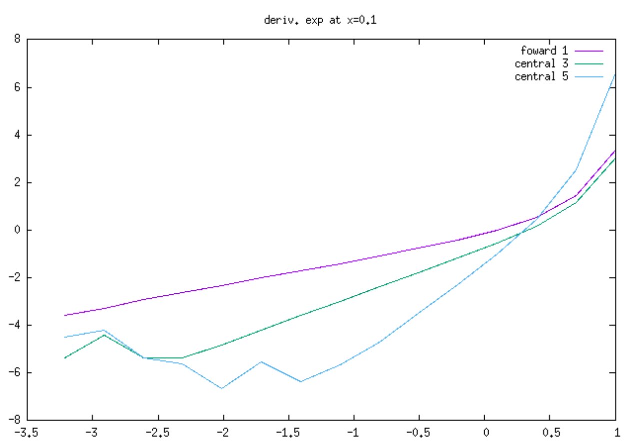
Problem 1. Below are plots of the first derivative of $cos(x)$ and $exp(x)$ using 2-point forward difference, 3-point central difference, and 5-point central difference at $x = 0.1, 10$. Out of these 3 methods 5-point central difference is the fastest to converge to the derivative

how do I see that?

What are axes?



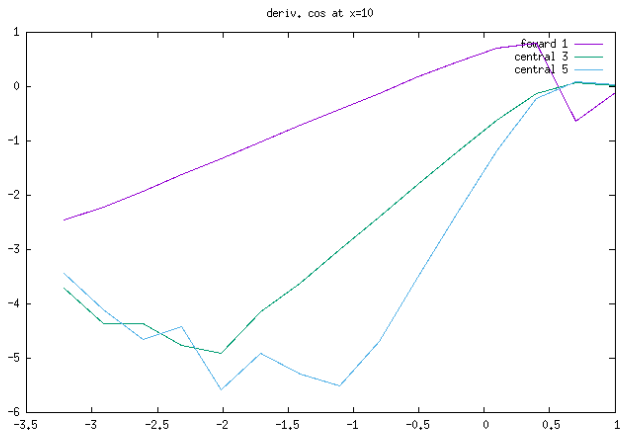
These don't look like my results from class, and no explanations of what going on.

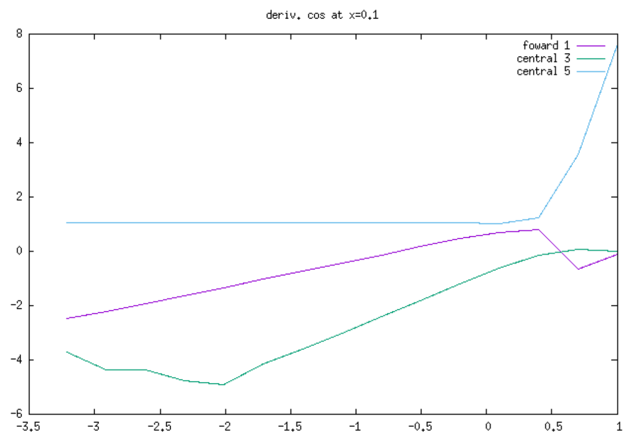


-1,5

Problem 2. Since the function is monotonic increasing, both trapezoid and midpoint produce the same error. We can see that Simpson's rule is the best of these integration methods with error reaching the precision value for a floating point number. After 10^6 bins, we see the

Axes!



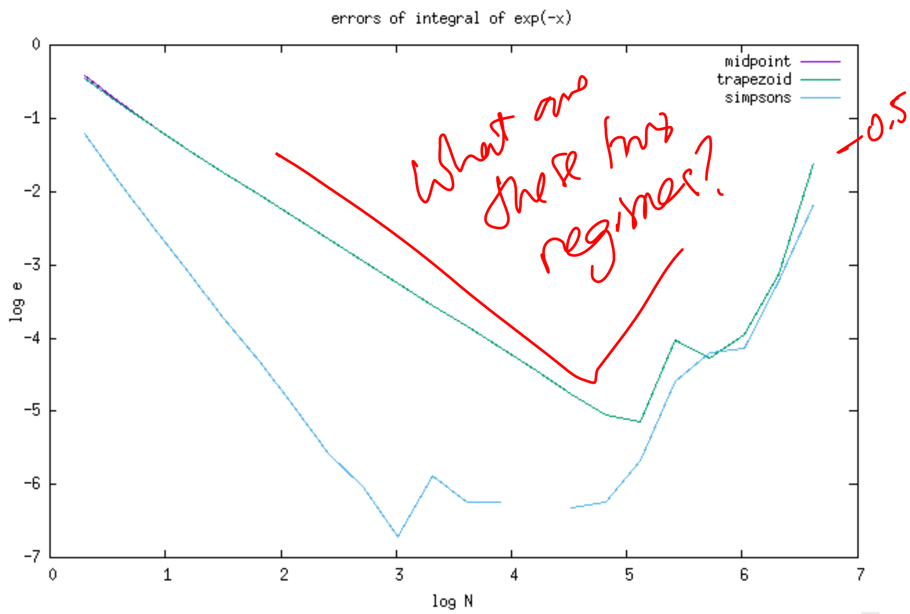


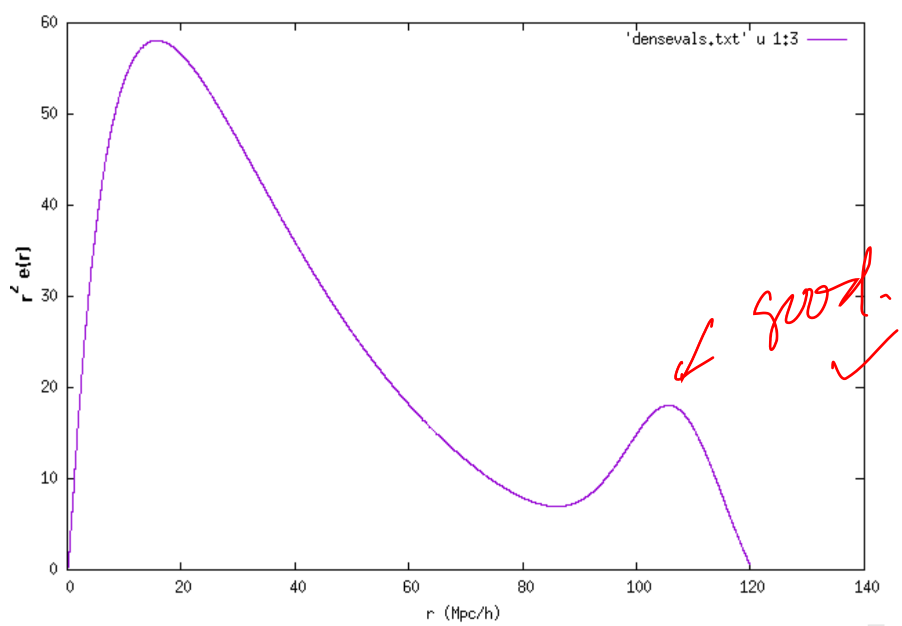
error appear to rise again but this is due to cancellation error when the method converges enough to the actual value.

Problem 3. To solve for the density fluctuations of the power spectrum, I used a cubic spline to interpolate the data from the input power file, then Simpson's rule to solve with $N = 100000$ bins in k

$$\xi(r) = \frac{1}{2\pi^2} \int k^2 P(k) \frac{sin(kr)}{kr} dk \tag{1}$$

The 2nd peak of this graph shows the baryon acoustic oscillations which occurs at around $r = 105$ Mpc/h with maximum $\xi(r) = 0.00161$.


errors of integral of exp(-x)
midpoint
trapezoid
simpsons
log e
log N
What are these two regimes?
-0.5


'densevals.txt' u 1:3
r^2 e(r)
r (Mpc/h)
good.