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5/4/2022

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2. (15 points) Give three advantages to the use of floating point arithmetic. What are its chief disadvan-  
tages?

1. You can represent a wide variety of numbers, incredibly large and small numbers

2. You can represent numbers in between integers 0.00001 ect.

3. They can hold lots of precision

The main disadvantage is that digits will start to fall off with issues like catastrophic cancellation, can also have wonky errors when you start to have overflow issues.

3.) github link: <https://github.com/deltoro7/numerical_integration>

Output

midpoint

('Number\_intervals = ', 1, 'integral estimate = ', 0.725613288034858, 'error change % = ', 2.61721529770309)

('Number\_intervals = ', 10, 'integral estimate = ', 0.707288555144981, 'error change % = ', -2.59150857797278)

('Number\_intervals = ', 100, 'integral estimate = ', 0.707108598602370, 'error change % = ', -0.0254496983199101)

('Number\_intervals = ', 1000, 'integral estimate = ', 0.707106799360674, 'error change % = ', -0.000254451200795065)

('Number\_intervals = ', 10000, 'integral estimate = ', 0.707106781368289, 'error change % = ', -2.54450753946751e-6)

('Number\_intervals = ', 100000, 'integral estimate = ', 0.707106781188362, 'error change % = ', -2.54454208150160e-8)

now trap

('Number\_intervals = ', 1, 'integral estimate = ', 0.670379265333622, 'error change % = ', 5.19405510314800)

('Number\_intervals = ', 10, 'integral estimate = ', 0.7067432613016127, 'error change % = ', -5.14264562800130)

('Number\_intervals = ', 100, 'integral estimate = ', 0.7071031463577067, 'error change % = ', -0.0508954327223490)

('Number\_intervals = ', 1000, 'integral estimate = ', 0.7071067448382946, 'error change % = ', -0.000508902005141784)

('Number\_intervals = ', 10000, 'integral estimate = ', 0.7071067808230632, 'error change % = ', -5.08901478061746e-6)

('Number\_intervals = ', 100000, 'integral estimate = ', 0.7071067811829225, 'error change % = ', -5.08917836855073e-8)

now simpson

('Number\_intervals = ', 1, 'integral estimate = ', 0.707201947134446, 'error change % = ', 0.0134584974193822)

('Number\_intervals = ', 10, 'integral estimate = ', 0.707106930772577, 'error change % = ', -0.0134373427602386)

('Number\_intervals = ', 100, 'integral estimate = ', 0.707106781201495, 'error change % = ', -0.0000211525452024749)

('Number\_intervals = ', 1000, 'integral estimate = ', 0.707106781186549, 'error change % = ', -2.11368986972927e-9)

('Number\_intervals = ', 10000, 'integral estimate = ', 0.707106781186544, 'error change % = ', 2.66915717976242e-13)

('Number\_intervals = ', 100000, 'integral estimate = ', 0.707106781186500, 'error change % = ', 6.24896798556142e-12)

Output for sqrt(x)

midpoint

('Number\_intervals = ', 1, 'integral estimate = ', 703.527184975819, 'error change % = ', 5.63471245883166)

('Number\_intervals = ', 10, 'integral estimate = ', 667.229020770986, 'error change % = ', -5.45017480553045)

('Number\_intervals = ', 100, 'integral estimate = ', 666.018006088316, 'error change % = ', -0.181834036436919)

('Number\_intervals = ', 1000, 'integral estimate = ', 666.000183725072, 'error change % = ', -0.00267603051718873)

('Number\_intervals = ', 10000, 'integral estimate = ', 666.000001837683, 'error change % = ', -0.0000273104187822451)

('Number\_intervals = ', 100000, 'integral estimate = ', 666.000000018381, 'error change % = ', -2.73168355336596e-7)

now trap

('Number\_intervals = ', 1, 'integral estimate = ', 544.500000000000, 'error change % = ', 18.2432432432432)

('Number\_intervals = ', 10, 'integral estimate = ', 663.150739425359, 'error change % = ', -17.8154263401439)

('Number\_intervals = ', 100, 'integral estimate = ', 665.963676764804, 'error change % = ', -0.422362963880622)

('Number\_intervals = ', 1000, 'integral estimate = ', 665.999632512429, 'error change % = ', -0.00539876090467967)

('Number\_intervals = ', 10000, 'integral estimate = ', 665.999996324629, 'error change % = ', -0.0000546264565108394)

('Number\_intervals = ', 100000, 'integral estimate = ', 665.999999963255, 'error change % = ', -5.46340261253108e-7)

now simpson

('Number\_intervals = ', 1, 'integral estimate = ', 650.518123317213, 'error change % = ', 2.32460610852664)

('Number\_intervals = ', 10, 'integral estimate = ', 665.346942198482, 'error change % = ', -2.22654938157191)

('Number\_intervals = ', 100, 'integral estimate = ', 665.998787275455, 'error change % = ', -0.0978746361822714)

('Number\_intervals = ', 1000, 'integral estimate = ', 665.999999801871, 'error change % = ', -0.000182061023286513)

('Number\_intervals = ', 10000, 'integral estimate = ', 665.999999999984, 'error change % = ', -2.97466902628292e-8)

('Number\_intervals = ', 100000, 'integral estimate = ', 666.000000000000, 'error change % = ', -2.47516388432948e-12)

4. (15 points) State the right way to round reals to a fixed number of decimal places. Give two examples  
of the right way and the wrong way that is traditionally used.

The wrong way to Round reals is to do the simple way of rounding up at if the number preceding it is larger than 5 and leaving the digit the same if the number preceding it is smaller than 5. The right way to round a number is to randomly round up and to randomly round down ex. 1.525 rounds to 1.52, and 1.535 rounds to 1.54. The wrong way that is traditionally used is to round 1.525 to 1.53, this can cause issues with numbers to start migrating to higher and higher values.

5. (10 points) What are the main advantages of keeping code in a versioning system such as Mercurial or  
git?

The main advantages of keeping a code versioning system is that it makes it easier for reproducibility of

results. When errors occur in a new versions of code you can always revert to the previous version.

6. Github link:

<https://github.com/deltoro7/numerical_diff>

Output

(' value of h =', 1, 'estimate derivative = ', -0.3995864423053246)

(' value of h =', 1/10, 'estimate derivative = ', 10.929168703156988)

(' value of h =', 1/100, 'estimate derivative = ', 7.108782787238965)

(' value of h =', 1/1000, 'estimate derivative = ', 6.875900206259944)

(' value of h =', 1/10000, 'estimate derivative = ', 6.853515135116783)

(' value of h =', 1/100000, 'estimate derivative = ', 6.851285303666187)

(' value of h =', 1/1000000, 'estimate derivative = ', 6.8510624067208425)

(' value of h =', 1/10000000, 'estimate derivative = ', 6.851040121880203)

In [6]: