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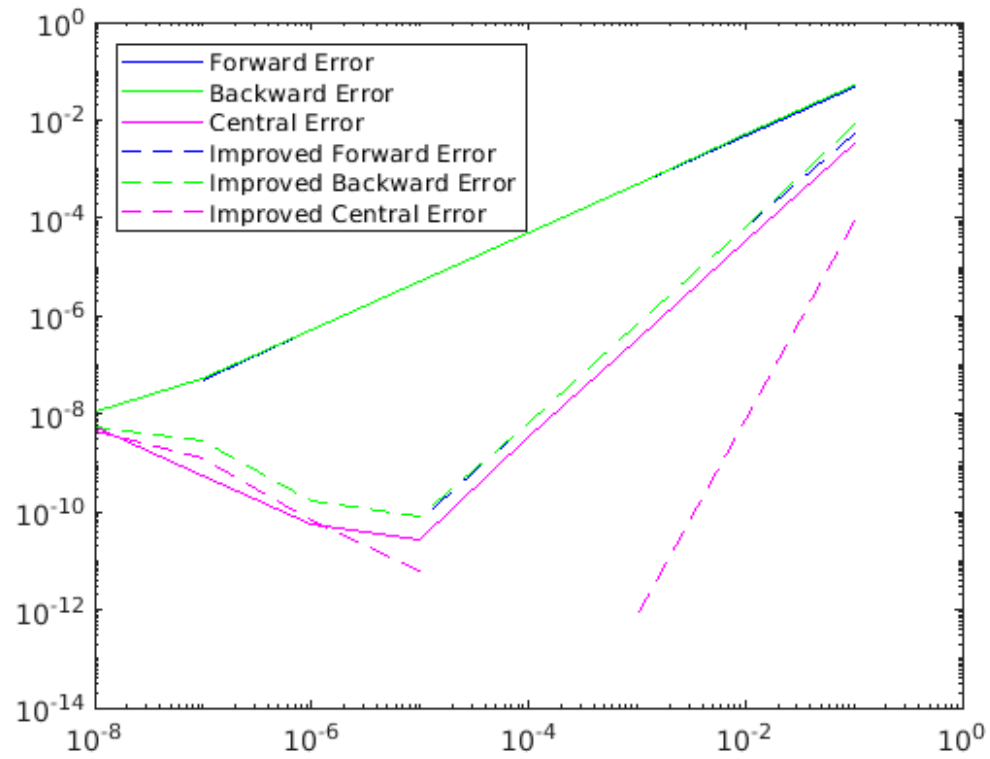
% Q2 (ii)

% Matlab script to calculate
% first order numerical differentiation of 2-x+ln(x) at x=1
a = 1;
trueVal = 0;
h = 10.^[-1:-1:-8];
% Forward diff.
fwdDiff = (f(a + h) - f(a))./h;
errFwd = abs(trueVal - fwdDiff);
disp(['Error in forward diff.: ', num2str(errFwd)]);
% Backward diff.
bckDiff = (f(a) - f(a - h))./h;
errBck = abs(trueVal - bckDiff);
disp(['Error in backward diff.: ', num2str(errBck)]);
% Central diff.
cntrDiff = (f(a + h) - f(a - h))./(2.*h);
errCntr = abs(trueVal - cntrDiff);
disp(['Error in central diff.: ', num2str(errCntr)]);
% Improved Forward diff.
iFwdDiff = (-f(a + 2*h) + 4*f(a + h) - 3*f(a))./(2.*h);
errIFwd = abs(trueVal - iFwdDiff);
disp(['Error in improved forward diff.: ', num2str(errIFwd)]);
% Improved Backward diff.
iBckDiff = (3*f(a) - 4*f(a - h) + f(a - 2*h))./(2.*h);
errIBck = abs(trueVal - iBckDiff);
disp(['Error in improved backward diff.: ', num2str(errIBck)]);
% Improved Central diff.
iCntrDiff = (-f(a + 2*h) + 8*f(a + h) - 8*f(a - h) + f(a - 2*h))./(
12.*h);
errICntr = abs(trueVal - iCntrDiff);
disp(['Error in improved central diff.: ', num2str(errICntr)]);
% Plots
loglog(h, errFwd, '-b', h, errBck, '-g', h, errCntr, '-m');
hold on;
loglog(h, errIFwd, '--b', h, errIBck, '--g', h, errICntr, '--m');
legend('Forward Error', 'Backward Error', 'Central Error', 'Improved
Forward Error', 'Improved Backward Error', 'Improved Central
Error', 'Location', 'northwest');
hold on;
% Function 2-x+ln(x)
function fx = f(x)
    fx = 2 - x + log(x);
end

Error in forward diff.: 0.046898    0.0049669    0.00049967    4.9997e-05
                    5e-06    5.0004e-07    4.996e-08    0
Error in backward diff.: 0.053605    0.0050336    0.00050033    5.0003e-05
                    5e-06    4.9993e-07    5.107e-08    1.1102e-08
Error in central diff.: 0.0033535    3.3335e-05    3.3333e-07    3.3334e-09
                    2.7756e-11    5.5511e-11    5.5511e-10    5.5511e-09
Error in improved forward diff.: 0.0054042    6.5194e-05    6.6517e-07
                    6.6658e-09    6.6613e-11    0    0    0

```

Error in improved backward diff.: 0.0085074 6.8195e-05 6.6817e-07
6.668e-09 8.3267e-11 1.6653e-10 2.7756e-09 5.5511e-09
Error in improved central diff.: 8.2954e-05 8.0029e-09 7.5865e-13
0 6.4763e-12 6.4763e-11 1.2027e-09 4.6259e-09



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