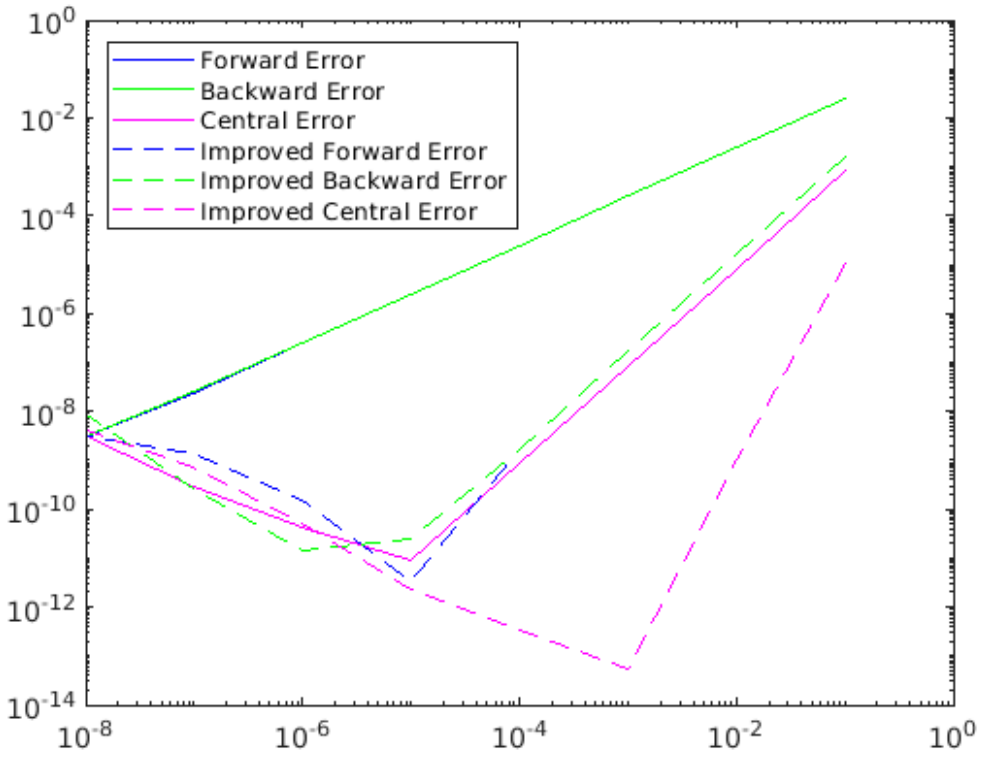
```
% Matlab script to calculate numerical derivative of arctan(x)
a = 1;
trueVal = 1/(1 + a.^2);
h = 10.^[-1:-1:-8];
% Forward diff.
fwdDiff = (f(a + h) - f(a))./h;
errFwd = abs(trueVal - fwdDiff);
disp(['Error in forward diff.: ', num2str(errFwd)]);
% Backward diff.
bckDiff = (f(a) - f(a - h))./h;
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');
% Function for arctan(x)
function fx = f(x)
  fx = atan(x);
end
```

```
Error in forward diff.: 0.024169   0.0024917  0.00024992  2.4999e-05
   2.5e-06  2.5006e-07  2.4133e-08  3.0387e-09
Error in backward diff.: 0.025831   0.0025083  0.00025008  2.5001e-05
    2.5e-06  2.4998e-07  2.4717e-08  3.0387e-09
Error in central diff.: 0.00083082  8.3331e-06  8.3333e-08  8.3317e-10
  8.8267e-12  4.1133e-11  2.9193e-10  3.0387e-09
Error in improved forward diff.: 0.0016374  1.6663e-05  1.6667e-07
 1.6665e-09  3.2756e-12  1.5216e-10  1.4022e-09  3.0387e-09
Error in improved backward diff.: 0.0016249  1.6663e-05  1.6667e-07
 1.6682e-09   2.448e-11  1.4378e-11  2.6318e-10  8.5899e-09
Error in improved central diff.: 1.0176e-05  1.0002e-09  5.5955e-14
 3.3268e-13  2.3505e-12  5.0385e-11  7.5453e-10  3.9639e-09
```



Published with MATLAB® R2020b