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% Liam Fruzyna
% MATH 4540
% Assignment 3

format long

% 5.2 10c) Calculate the approximation error of the composite Simpson's rule for
% h = b-a, h/2^1,, h/2^2, ..., h/2^8 and plot.

format long

f = @(x) x * exp(x);

simpsons(f, 8, 0, 1);

function[result] = simpsons(f, n, a, b)
    syms x;
    real = int(f(x), 0, 1);

    results = zeros(1, n);
    errors = zeros(1, n);
    hs = zeros(1, n);

    for p=0:n
        x0 = a;
        x2 = b;
        m = 2^p;
        h = (x2 - x0) / m;

        even = 0;
        for i=1:m/2-1
            x = x0 + 2 * i * h;
            even = even + f(x);
        end

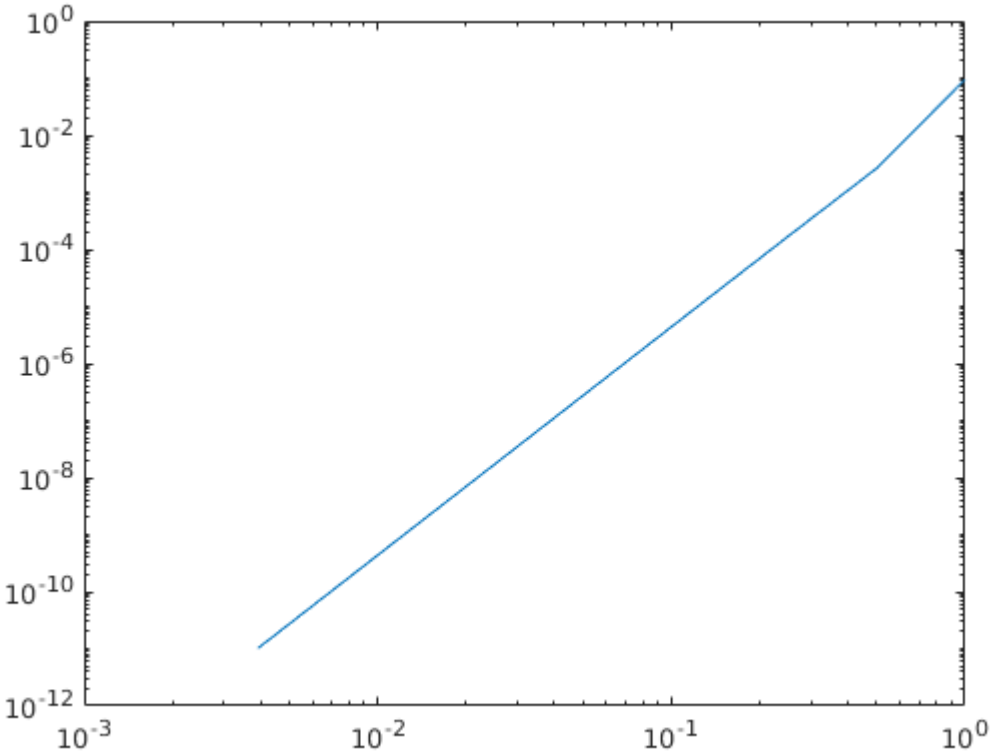
        odd = 0;
        for i=1:m/2
            x = x0 + (2 * i - 1) * h;
            odd = odd + f(x);
        end

        result = (h / 3) * (f(x0) + f(x2) + 2 * even + 4 * odd);
        hs(p+1) = h;
        results(p+1) = result;
        errors(p+1) = double(abs(real - result));
    end

    disp(results);
    disp(errors);
    loglog(hs, errors);
```

```
    slope = (errors(n) - errors(1)) / (hs(n) - hs(1))
end
```

Results



slope = 0.094645474789168