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% Liam Fruzyna
% MATH 4540
% Assignment 3

format long

% 5.2 9c) Calculate the approximation error of the composite trapezoid rule for
% h = b-a, h/2^1,, h/2^2, ..., h/2^8 and plot.

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

trapezoid(f, 8, 0, 1);

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

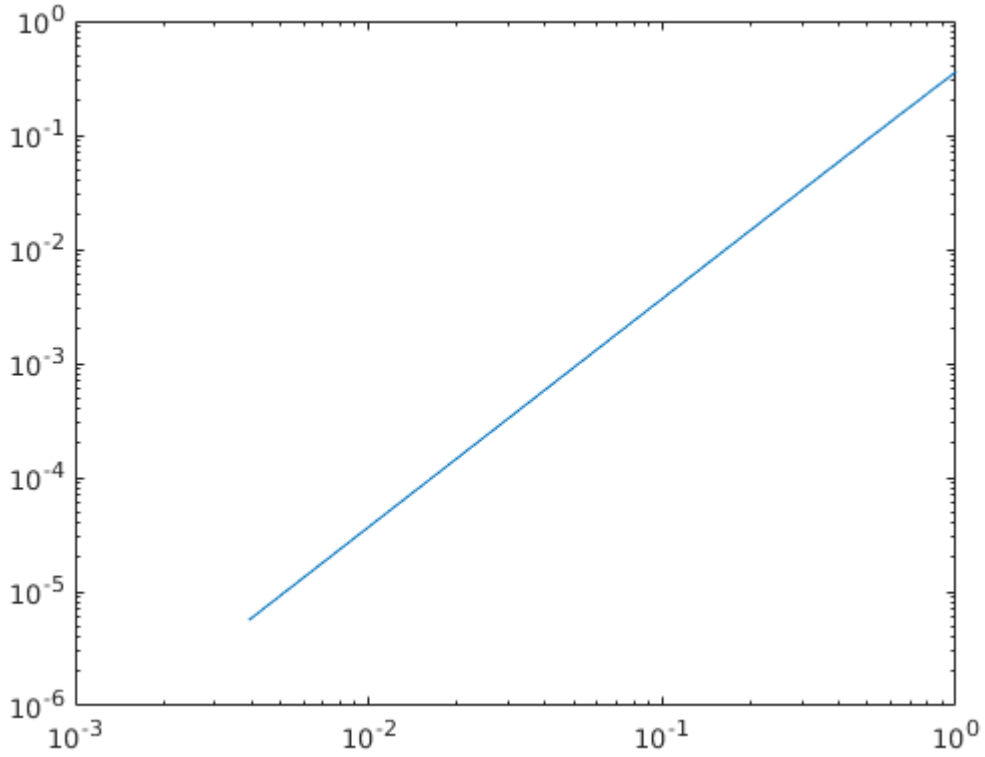
    results = zeros(1, n);
    errors = zeros(1, n);
    hs = zeros(1, n);

    for p=0:n
        x0 = a;
        x1 = b;
        result = 0;
        m = 2^p;
        h = (x1 - x0) / m;
        for i=1:m
            x1 = x0 + h;
            y0 = f(x0);
            y1 = f(x1);
            result = result + (h / 2) * (y0 + y1);
            x0 = x1;
        end
        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 = 0.361946052273981