Computer Exercise 5.1.2

The following program will use the same integral approximation algorithm from exercise 5.1.2 for two functions and compare the approximations (for 100 iterations) with known actual values. The corresponding approximations, actual values, and errors will be displayed.

a) $\int_0^{\pi} \sin(x)dx = 2$

```
%initiate function
f = @(x) sin(x);

%initiate parameters
n = 100;
a = 0;
b = pi;

%known actual value
actual = 2;

%execute algorithm
I1 = Trapezoid_Uniform(f, a, b, n);

%display approximation
fprintf('integral approximation = %12.12f, acutal = %12.12f, error = %8.8e', I1, ...
    actual, abs(actual - I1))
```

```
integral approximation = 1.999835503887, acutal = 2.000000000000, error = 1.64496113e-04
```

b) $\int_0^{\pi} e^x dx = e - 1$

```
%initiate function
f = @(x) exp(x);

%initiate parameters
n = 100;
a = 0;
b = 1;

%known actual value
actual = exp(1)-1;

%execute algorithm
I2 = Trapezoid_Uniform(f, a, b, n);

%display approximation
fprintf('integral approximation = %12.12f, acutal = %12.12f, error = %8.8e', I2, ...
    actual, abs(actual - I2))
```

```
integral approximation = 1.718296147450, acutal = 1.718281828459, error = 1.43189914e-05
```

The approximations are pretty decent for a relatively simple integral approximation method.

```
function I = Trapezoid_Uniform(f, a, b, n)
    h = ((b-a)/n);
    sum = (1/2)*(f(a) + f(b));
    for k = 1:(n-1)
        xk = a + k*h;
        sum = sum + f(xk);
    end
    I = h*sum;
end
```