

# MATH 3341 — Fall 2019

## Lab 11: MATLAB Integration Routines & Gauss Quadrature

Download `Math.3341.Lab.11.zip`, unzip it by following the Windows Instructions on WyoCourses. Change the current working directory of MATLAB to the unzipped folder, and type `edit lab_11_script` in the Command Window.

### 1 BUILT-IN INTEGRATION FUNCTIONS

- (a) Use both `polyint` and `integral` to evaluate  $\int_{-1}^3 (x^2 - 2x + 1) dx$ .
- (1) Define the lower bound `a` and upper bound `b`.
  - (2) Define the polynomial `P` as  $p(x) = x^2 - 2x + 1$ .
  - (3) Integrate  $p(x) = x^2 - 2x + 1$  using `polyint` and store the result to `pI`.
  - (4) By fundamental theorem of calculus, evaluate the integral `pI` on  $[a, b]$  using `polyval` and store the result to `pI_value`.
  - (5) Define the anonymous function `f` by  $f(x) = x^2 - 2x + 1$ , and then use `integral` to evaluate  $\int_{-1}^3 (x^2 - 2x + 1) dx$  and store it to `I`.
- (b) Evaluate the previous integral again, now using `trapz` and `cumtrapz`.
- (c) Use `integral2` to evaluate  $\int_{-\pi}^{-3\pi/2} \int_0^{2\pi} (y \sin x + x \cos y) dy dx$ .
- (d) Use `integral3` to evaluate  $\int_0^1 \int_{x^2}^x \int_{x-y}^{x+y} y dz dy dx$ .

### 2 GAUSS QUADRATURE

- (a) Implement Gauss quadrature using  $n$  Gauss nodes, which is given by Equation (2.1), in the function file `gauss_quad.m`.

$$\int_{-1}^1 f(x) dx \approx \sum_{i=1}^n w_i f(x_i). \quad (2.1)$$

- (b) Use `gauss_quad` to evaluate the integral

$$\int_1^{1.6} \frac{2x}{x^2 - 4} dx,$$

with  $n = 1, 2, \dots, 15$  Gauss nodes.

Note: `legendre_pair.m` is provided to calculate  $x_i$  and  $w_i$ . Use `help legendre_pair` to check the usage.

At last, call `diary('lab_11_output.txt')`, run the scripts `lab_11_script.m`, then call `diary off`. You will upload the script files `lab_11_script.m`, `lab_11_output.txt`, and `gauss_quad.m` to Overleaf. Then recompile, and submit the generated .pdf file on WyoCourses.