

CS2035b Data Analysis and Visualization - Lab 7

General Lab Instructions to Help Labs Run Smoothly

- Read through the lab instructions **before** coming to the lab.
- Do any required pre-lab preparation.
- Bring a **printed** copy of the lab instructions to the lab.

Overview and Preparation

This (and all subsequent) labs will be using MatLab 2016b as installed in the Health Sciences 14 or 16 general computing labs. You must attend this lab in HSB14 or HSB16 in order to get assistance from the TA. Attendance will be taken. You can use your UWO login/password to login to these machines. Lab submission is to be done via Owl. Remember, labs are worth 10% of the total grade for this course (there are 11 labs in total, you must do 8 to receive full marks).

Upon completion of this lab, you should have done the following in the MatLab environment:

- Created a script file, `script_lab07.m`, containing the MatLab code to run the code for all the symbolic computations required for this lab.
- Created another file, `diary_lab07.txt` which saves the output from running the script file as a diary file. Note that some image files may also be created (i.e. `2Dfct.jpg`).
- Zipped these files from into `lab07.zip` and submitted this single file via owl by 11:55pm on the first Sunday following the lab.

Exercise: Symbolic Arithmetic

- For this exercise, we will perform some symbolic arithmetic. You need to Look at the lecture 15 notes.

Differentiation

1. Consider $f(x, y) = \exp(x^2 + y^3)$.
2. Differentiate $f(x, y)$ with with respect to x and y and with respect to x and then y and finally with respect y and then x .
3. Evaluate these 4 derivatives at $x = 2$ and $y = 3$. Note that for the 1D derivatives you will still get a function in terms of the other variable. For double derivatives you should get numbers.

Integration

1. Consider $f(x, y) = \exp(x^2 + y^2)$.
2. Integrate $f(x, y)$ with respect to x and y (1D integrations) and then with respect to x and then y and finally with respect y and then x .
3. Evaluate these 3 integrals for limits $xmin = -2$ and $xmax = 2$ and $ymin = -3$ and $ymax = 3$ where appropriate.
4. Verify these 2D results using the numerical integration function `integral2`. Figure 1 shows a plot of this surface.
5. Use:

```
[X,Y]=meshgrid(xmin:0.1:xmax,ymin:0.1:ymax);  
Z=exp(X.^2+Y.^2);  
surf(X,Y,Z);  
title('f=exp(x^2+y^2)');  
print 2Dfct.jpg -djpeg
```

to make the plot and:

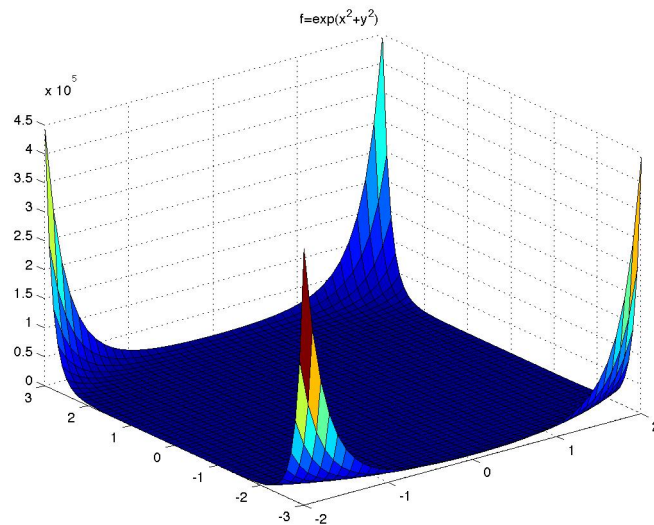


Figure 1: 2D plot of $f(x, y) = e^{x^2+y^2}$ between $xmin = -2$ and $xmax = 2$ and $ymin = -3$ and $ymax = 3$.

```
fun=@(X,Y) exp(X.^2+Y.^2);
fprintf('The value of the integral using integral2: %f\n',...
        integral2(fun,xmin,xmax,ymin,ymax));
```

to generate the integral value.

Linear Algebra

1. Consider the following system of equation $Ax = B$, where A , B and x are given symbolically as:

$$A = \begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix}, \quad B = \begin{pmatrix} b1 \\ b2 \\ b3 \end{pmatrix} \quad \text{and} \quad x = \begin{pmatrix} x1 \\ x2 \\ x3 \end{pmatrix}.$$

2. Using $AI=\text{inv}(A)$ what is the symbolic inverse of A .
3. The unknowns x can be solved as $x = A^{-1}B$ and $\mathbf{x}=A\backslash B$. What are the symbolic values of x for each solution. What are the symbolic differences for these 2 solutions. Are the solutions the same?

4. What is the symbolic condition number of A , $\text{cond}(A)$.

Polynomials

1. Consider the polynomial $P(x) = x^5 - 2 * x^4 - 28 * x^3 + 38 * x^2 + 171 * x - 180$. Solve for the roots of this polynomial.
2. Consider the polynomial $P(x) = x^4 + 29 * x^2 + 100$. Solve for the roots of this polynomial.