

TP Session: Differential Calculus with MATLAB

Department of Mathematics

Objectives of the Session

The main objectives of this session are:

- Understand the concepts of gradient, Jacobian, and Hessian.
- Learn how to compute derivatives symbolically in MATLAB.
- Develop skills in analyzing critical points and classifying them.
- Practice using MATLAB for symbolic and numerical computations.
- Visualize functions and their derivatives using MATLAB plotting tools.

Useful MATLAB Commands

Below is a list of essential MATLAB commands that will be used throughout the session:

- **Symbolic variables:**

```
syms x y
```

- **Defining a function:**

```
f = x^2*y + exp(x)*sin(y);
```

- **Gradient:**

```
gradient(f, [x,y])
```

- **Jacobian:**

```
F = [x^2+y, x*y, exp(y)];  
jacobian(F, [x,y])
```

- **Hessian:**

```
hessian(f, [x,y])
```

- Solving equations:

```
solve(gradient(f,[x,y])==0, [x,y])
```

- Plotting (2D and 3D):

```
fplot(f, [-5,5])      % 2D curve  
fsurf(f, [-3,3,-3,3]) % 3D surface  
fcontour(f, [-3,3,-3,3]) % Contour lines
```