

Class exercise 1

Calculate gradient and Laplacian for a given function **$h(\mathbf{x}, \mathbf{y})$** and make their plots

$$h(x, y) = \exp \left[-\left(\frac{x}{3}\right)^2 - \left(\frac{y}{2}\right)^2 \right]$$

Background

1. Gradient operator $\nabla \equiv \mathbf{i} \frac{\partial}{\partial x} + \mathbf{j} \frac{\partial}{\partial y} + \mathbf{k} \frac{\partial}{\partial z}$

2. Laplace operator $\nabla^2 \equiv \nabla \cdot \nabla = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}$

Matlab (or Octave) code

```
x = -6:1:6;
y = -5:1:5;

[X Y] = meshgrid(x,y);
h = exp( -(X/3).^2 -(Y/2).^2 );

% Gradient
dhdX = -(2/9)*X.*h;
dhdY = -(2/4)*Y.*h;

% Laplacian
d2hdx2 = -(2/9) + (2/9*X).^2.*h;
d2hdy2 = -(2/4) + (2/4*Y).^2.*h;
lapl = d2hdx2 + d2hdy2;
%lap2 = del2(h,1,1);

% plot Gradient vector
figure
contourf(X,Y,h);
colorbar
hold on
quiver(X,Y,dhdX,dhdY,'color','white');

% plot Laplacian
figure
mesh(X,Y,lapl);
colorbar
```