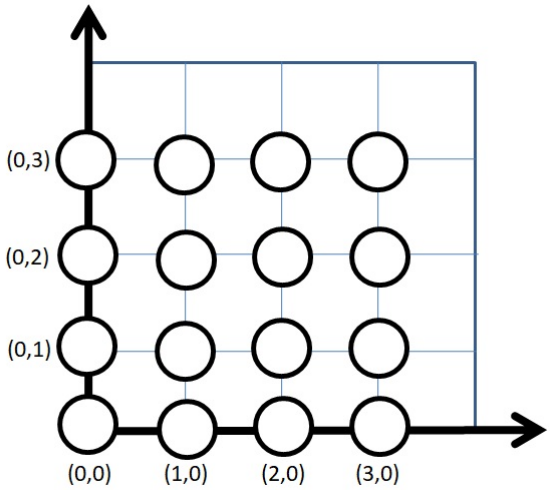
INDIAN INSTITUTE OF TECHNOLOGY PATNA

PH103 : Physics
Tutorial 3

1. Temperature in a region is given by the scalar field functions given below
   a. T(x,y) = x + y
   b. T(x,y) = $x^2 + y^2$.
   Indicate values of the function in the first quadrant of the scalar field points (inside the circle) provided (figure below). Also plot the vector field for $\vec{\nabla}T$ for both the functions for same data points. Try to correlate between scalar and vector field map.



2. The height of a certain hill(in m) is given by

$$h(x, y) = 10(2xy - 3x^2 - 4y^2 - 18x + 28y + 12)$$

   where y is the distance(in m) north, x the distance east from an origin fixed at the valley of hill

   (a) Where is the top of the hill located?
   (b) How high is the hill?
   (c) How steep is the slope at a point 1 mile north and one mile east from the valley? In what direction is the slope steepest, at that point?

3. Given a vector $\vec{r} = r\hat{e_r}$, verify $\int_V \vec{\nabla} \cdot \vec{r} dV = \int_S \vec{r}.ds$, for a sphere of radius R. What do you physically infer from this?

4. A vector field originating from inside of a hollow cylinder of radius a and length L is given as $\vec{A} = \rho\hat{e_\rho} + \sin\phi\hat{e_\phi} + \hat{e_z}$. Verify $\int_V \vec{\nabla} \cdot \vec{A}dV = \int_S \vec{A}.ds$.