Computational Science:
Computational Methods in Engineering

Meshgrids

What is the Desired Grid?

% DEFINE GRID
Nx = 7;
Ny = 5;
dx = 1;
dy = 1;
Calculate the Axis Vectors (\(xa & ya\))

\[
\begin{align*}
xa & = \[0.5:Nx-0.5\]*dx \\
ya & = \[0.5:Ny-0.5\]*dy
\end{align*}
\]

% DEFINE GRID
Nx = 7;
Ny = 5;
dx = 1;
dy = 1;

% AXIS VECTORS
xa = [0.5:Nx-0.5]*dx;
ya = [0.5:Ny-0.5]*dy;

Calculate the Meshgrid (\(X & Y\))

% DEFINE GRID
Nx = 7;
Ny = 5;
dx = 1;
dy = 1;

% AXIS VECTORS
xa = [0.5:Nx-0.5]*dx;
ya = [0.5:Ny-0.5]*dy;

% MESHGRID
[Y,X] = meshgrid(ya,xa);
### What is X?

<table>
<thead>
<tr>
<th>xa</th>
<th>0.5</th>
<th>1.5</th>
<th>2.5</th>
<th>3.5</th>
<th>4.5</th>
<th>5.5</th>
<th>6.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>0.5</td>
<td>1.5</td>
<td>2.5</td>
<td>3.5</td>
<td>4.5</td>
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</tr>
</tbody>
</table>

$\text{x axis}$

% DEFINE GRID
Nx = 7;
Ny = 5;
dx = 1;
dy = 1;

% AXIS VECTORS
xa = [0.5:Nx-0.5]*dx;
ya = [0.5:Ny-0.5]*dy;

% MESHGRID
[Y,X] = meshgrid(ya,xa);

X is an array the same size as the grid where the data in the array are the $x$ positions of each cell.

### What is Y?

<table>
<thead>
<tr>
<th>xa</th>
<th>0.5</th>
<th>1.5</th>
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<th>3.5</th>
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$\text{x axis}$

% DEFINE GRID
Nx = 7;
Ny = 5;
dx = 1;
dy = 1;

% AXIS VECTORS
xa = [0.5:Nx-0.5]*dx;
ya = [0.5:Ny-0.5]*dy;

% MESHGRID
[Y,X] = meshgrid(ya,xa);

Y is an array the same size as the grid where the data in the array are the $y$ positions of each cell.
Why is a Meshgrid Useful? (1 of 2)

% DEFINE GRID
Nx = 7;
Ny = 5;
dx = 1;
dy = 1;

% AXIS VECTORS
xa = [0.5:Nx-0.5]*dx;
ya = [0.5:Ny-0.5]*dy;

% MESHGRID
[Y,X] = meshgrid(ya,xa);

% RADIAL GRID
RSQ = X.^2 + Y.^2;

Why is a Meshgrid Useful? (2 of 2)

% DEFINE GRID
Nx = 7;
Ny = 5;
dx = 1;
dy = 1;

% AXIS VECTORS
xa = [0.5:Nx-0.5]*dx;
ya = [0.5:Ny-0.5]*dy;

% MESHGRID
[Y,X] = meshgrid(ya,xa);

% RADIAL GRID
RSQ = X.^2 + Y.^2;

% CREATE A CIRCLE
C = (RSQ <= r^2);
Linear Meshgrids

The Linear Meshgrid

Representative Geometries

Rectangles

Bars

Line Fills

Thick Lines

Radial Meshgrids

The Radial Meshgrid

Representative Geometries

Circles

Ellipses

Rings

% RADIAL MESHGRID
[Y,X] = meshgrid(ya,xa);
R = sqrt(X.^2 + Y.^2);
Azimuthal Meshgrids

The Azimuthal Meshgrid

\[ \theta = \text{atan2}(Y,X); \]

Representative Geometries

% AZIMUTHAL MESHGRID
[Y,X] = meshgrid(ya,xa);
THETA = atan2(Y,X);