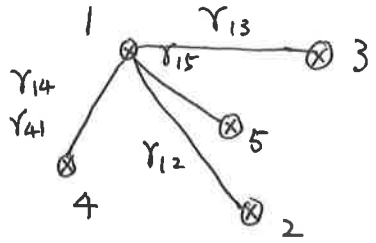
Construction of Distance Matrix.

Given 5 data points $\{(x_i, y_i)\}_{i=1}^{5}$. We have

$$X = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix}, \quad y = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \\ y_5 \end{bmatrix}$$



$$r_{ij} = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2}$$

$r_{ij} = r_{ji}$

$i, j = 1, 2, \cdots, 5$

$r_{ii} = 0$

Construct the distance matrix

$$DM = \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} & r_{15} \\ r_{21} & r_{22} & r_{23} & r_{24} & r_{25} \\ r_{31} & r_{32} & r_{33} & r_{34} & r_{35} \\ r_{41} & r_{42} & r_{43} & r_{44} & r_{45} \\ r_{51} & r_{52} & r_{53} & r_{54} & r_{55} \end{bmatrix}$$

Let $xa = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix} \cdot \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} x_1 & x_1 & x_1 & x_1 & x_1 \\ x_2 & x_2 & x_2 & x_2 & x_2 \\ x_3 & x_3 & x_3 & x_3 & x_3 \\ x_4 & x_4 & x_4 & x_4 & x_4 \\ x_5 & x_5 & x_5 & x_5 & x_5 \end{bmatrix}$

$= X * \text{ones}(1, 5)$

or $xa = \text{reshape}(X, 1, 5)$

$$Xb = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} * \begin{bmatrix} x_1 & x_2 & x_3 & x_4 & x_5 \end{bmatrix} = \begin{bmatrix} x_1 & x_2 & x_3 & x_4 & x_5 \\ x_1 & x_2 & x_3 & x_4 & x_5 \\ x_1 & x_2 & x_3 & x_4 & x_5 \\ x_1 & x_2 & x_3 & x_4 & x_5 \\ x_1 & x_2 & x_3 & x_4 & x_5 \end{bmatrix}$$

$= ones(5,1) * X'$

or $Xb = reshape(x, 5, 1)$

Similarly, $ya = y * ones(1,5)$ or $ya = reshape(y, 1, 5)$

$yb = ones(5,1) * y'$ or $yb = reshape(y, 5, 1)$

```
DM = sqrt((xa-xb).^2 + (ya-yb).^2);
```

Using 'for' loop

```
DM = zeros(5,5)
for i = 1 : 5
    for j = 1 : 5
        DM(i,j) = sqrt(x(i) - x(j)).^2 + (y(i) - y(j)).^2);
    end
end
```

```
DM = zeros(5,5)
for i = 1 : 5
    DM(i,:) = sqrt((x(i) - x').^2 + (y(i) - y').^2);
end
```