The EKF Propogate function used is same as the one given in assignment -2.

Basic Formula used in Update Equations.

(i) With Distance only Measurement.

$$\hat{z} = \sqrt{(x-\hat{x})^2 + (y-\hat{y})^2}.$$

$$H = \left[\frac{(-x+\hat{x})}{\sqrt{(x-\hat{x})^2+(y-\hat{y})^2}} \quad \frac{(-y+\hat{y})}{\sqrt{(x-\hat{x})^2+(y-\hat{y})^2}} \quad 0 \right]$$

Based on number of landmarks H is stacked.

(ii) With Bearing only measurement.

$$\hat{z} = \tan^{-1}\left(\frac{\hat{y}-y}{\hat{x}-x}\right) - \phi$$

$$H = \left[\frac{-(\hat{y}-y)}{(x-\hat{x})^2+(y-\hat{y})^2} \quad \frac{+(\hat{x}-x)}{(\hat{x}-x)^2+(y-\hat{y})^2} \quad -1 \right]$$

Based on the number of landmarks H is stacked.

(iii) With both distance and bearing measurement.

$$\hat{z} = \sqrt{(x-\hat{x})^2 + (y-\hat{y})^2}$$

$$\hat{z}_1 = \tan^{-1}\left(\frac{\hat{y}-y}{\hat{x}-x}\right) - \phi$$

$$H = \left[\begin{array}{ccc} \dfrac{(-x+\hat{x})}{\sqrt{(x-\hat{x})^2+(y-\hat{y})^2}} & \dfrac{(-y+\hat{y})}{\sqrt{(x-\hat{x})^2+(y-\hat{y})^2}} & 0 \\[4mm] \dfrac{-(\hat{y}-y)}{\left(\sqrt{(x-\hat{x})^2+(y-\hat{y})^2}\right)^2} \cdot \dfrac{(\hat{x}-x)}{(x-\hat{x})^2+(y-\hat{y})^2} & & -1 \end{array} \right]$$

Based on the no. of landmarks H is stacked.

Here, $\begin{bmatrix} x \\ y \end{bmatrix} \rightarrow$ landmark position.

$\begin{bmatrix} \hat{x} \\ \hat{y} \end{bmatrix} \rightarrow$ Estimate got from propagation step.