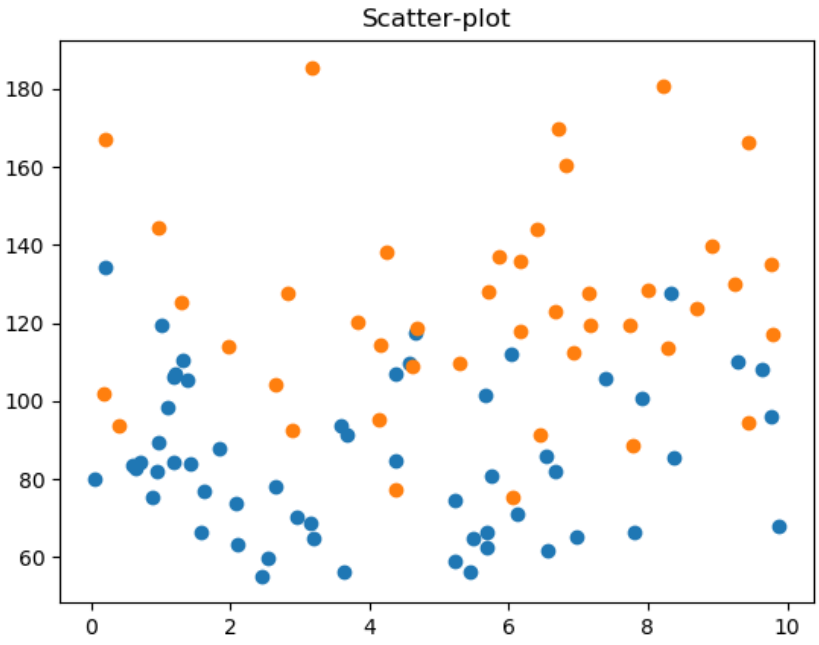
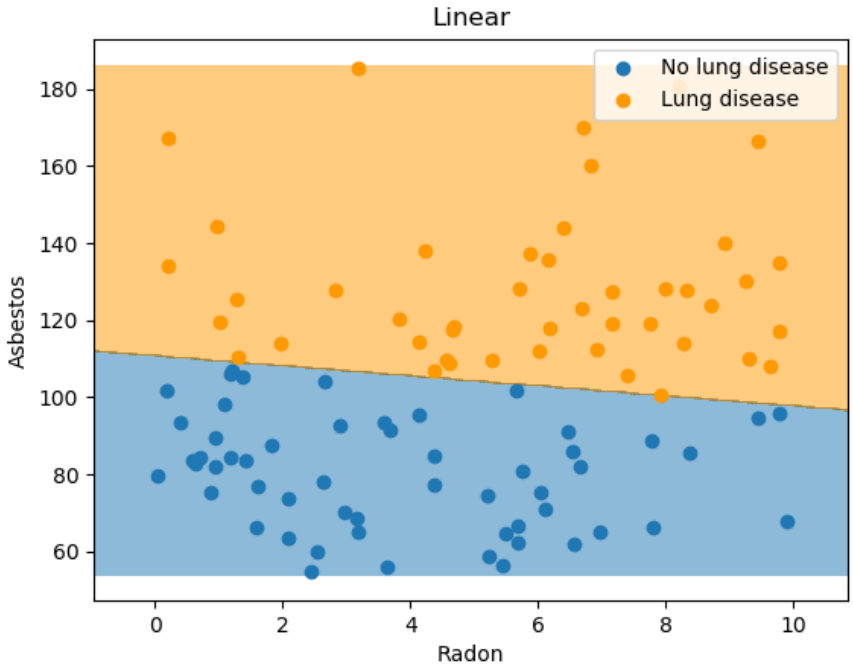
Esteban Aranda
CS 4342
04/29/21

Homework 5

(a).





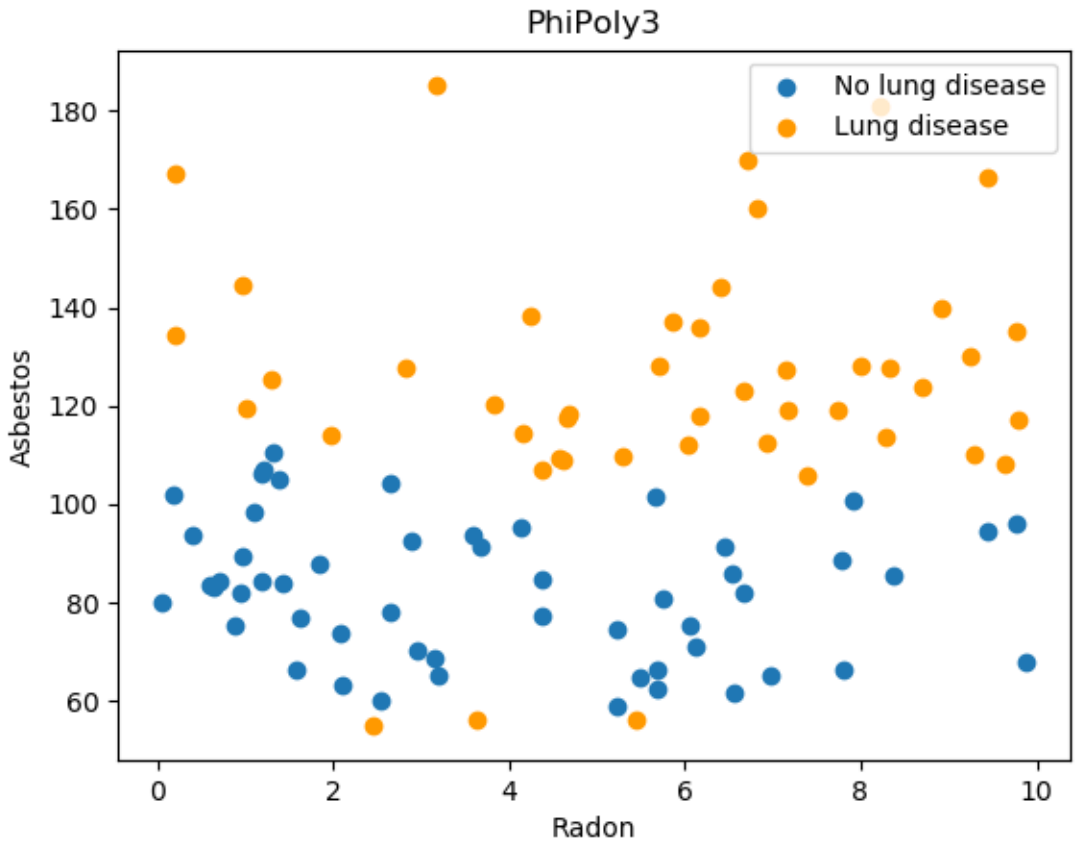
(b). $k_{poly3}(x, x') = (1 + x^T x')^3 = \varphi(x)^T \varphi(x')$

$k_{poly3}(x, x') = x^3 + 3x^2x' + 3x^2 + 3xx'^2 + 6xx' + 3x + x'^3 + 3x'^2 + 3x' + 1$

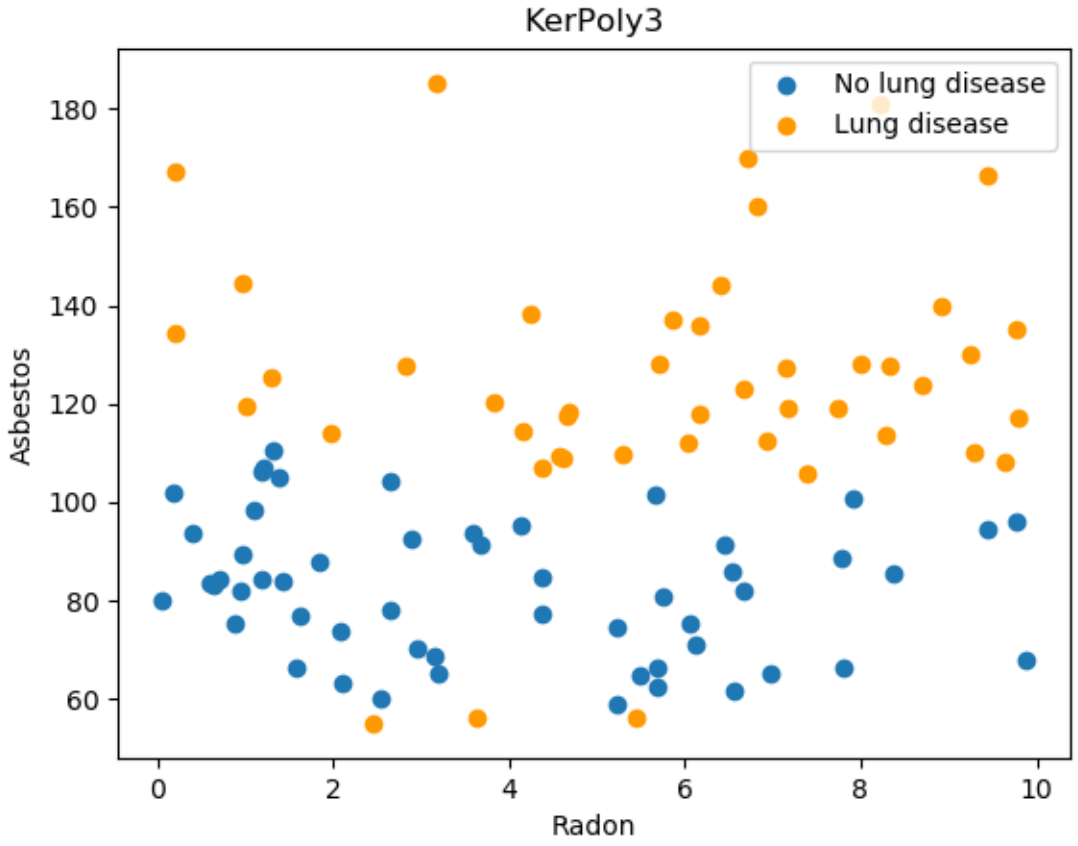
$x = [r\ a]^T$

$\varphi(x) =$

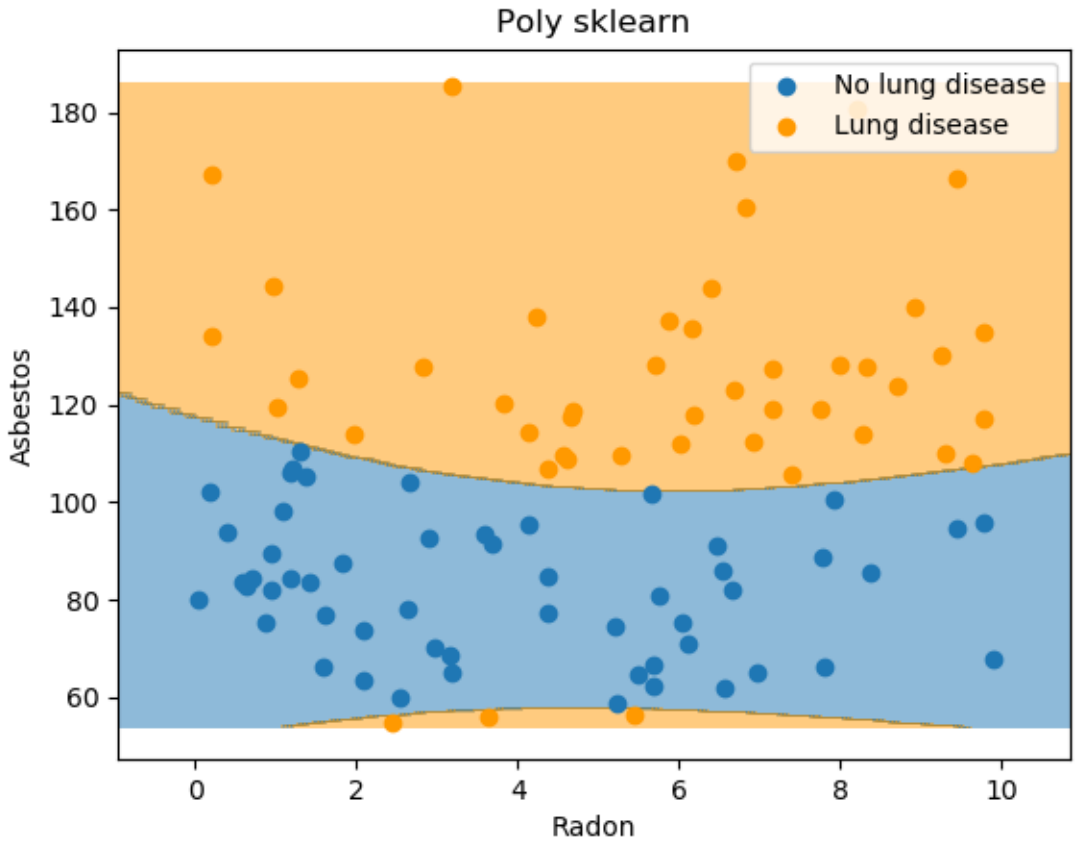
r^3
$\sqrt{3}r^2a$
$\sqrt{3}r^2$
$\sqrt{3}ra^2$
$\sqrt{6}ra$
$\sqrt{3}r$
a^3
$\sqrt{3}a^2$
$\sqrt{3}a$
1



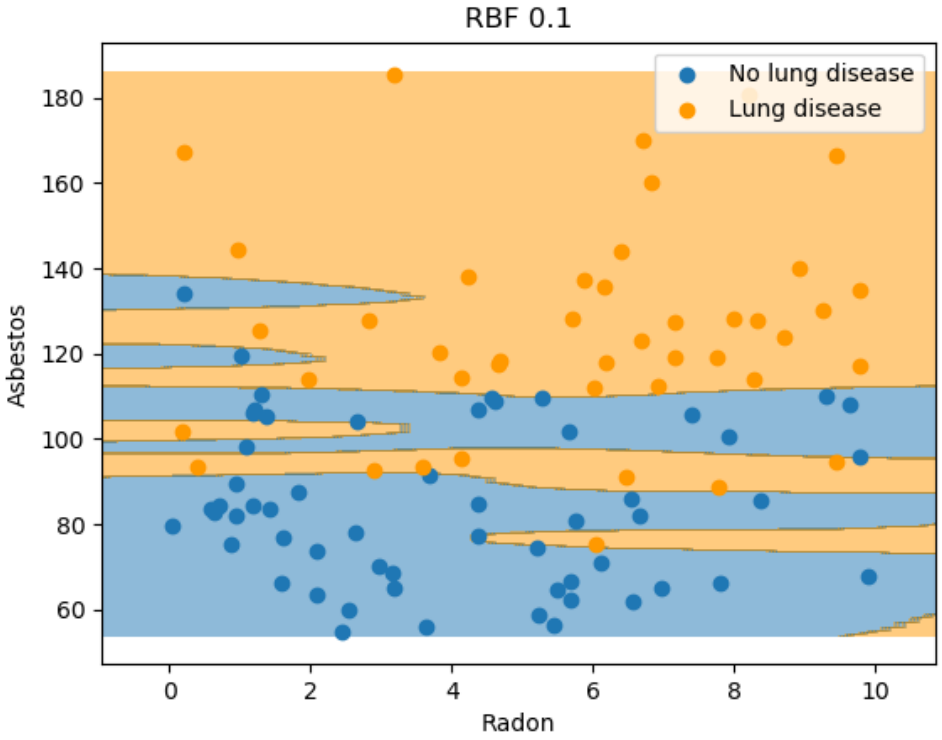
(c).

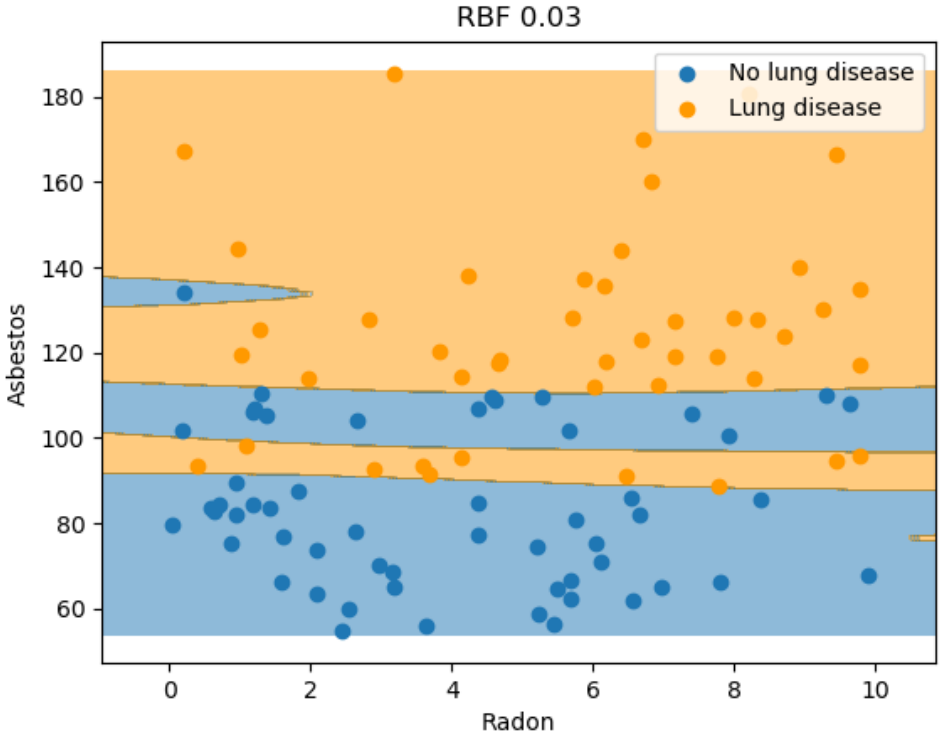

KerPoly3
No lung disease
Lung disease
Asbestos
Radon
180
160
140
120
100
80
60
0
2
4
6
8
10

(d).


Poly sklearn
No lung disease
Lung disease
Asbestos
Radon
180
160
140
120
100
80
60
0
2
4
6
8
10

(e).


RBF 0.1
No lung disease
Lung disease
Asbestos
Radon
180
160
140
120
100
80
60
0
2
4
6
8
10


RBF 0.03
No lung disease
Lung disease
Asbestos
Radon
180
160
140
120
100
80
60
0
2
4
6
8
10

The RBF with $\gamma = 0.1$ seems more likely to overfit because, as can be seen above, there are multiple cases where there are decision boundaries which only fit a single point of data, which is not the case for $\gamma = 0.03$. For example, this occurs for the data point at roughly (6, 80) which is classified as 'lung disease' in RBF 0.1 and as 'no lung disease' in RBF 0.03. If testing these two models on a bigger set of data, then RBF 0.1 will most likely have lower precision given that the model overfitted for that specific data point in the training set.