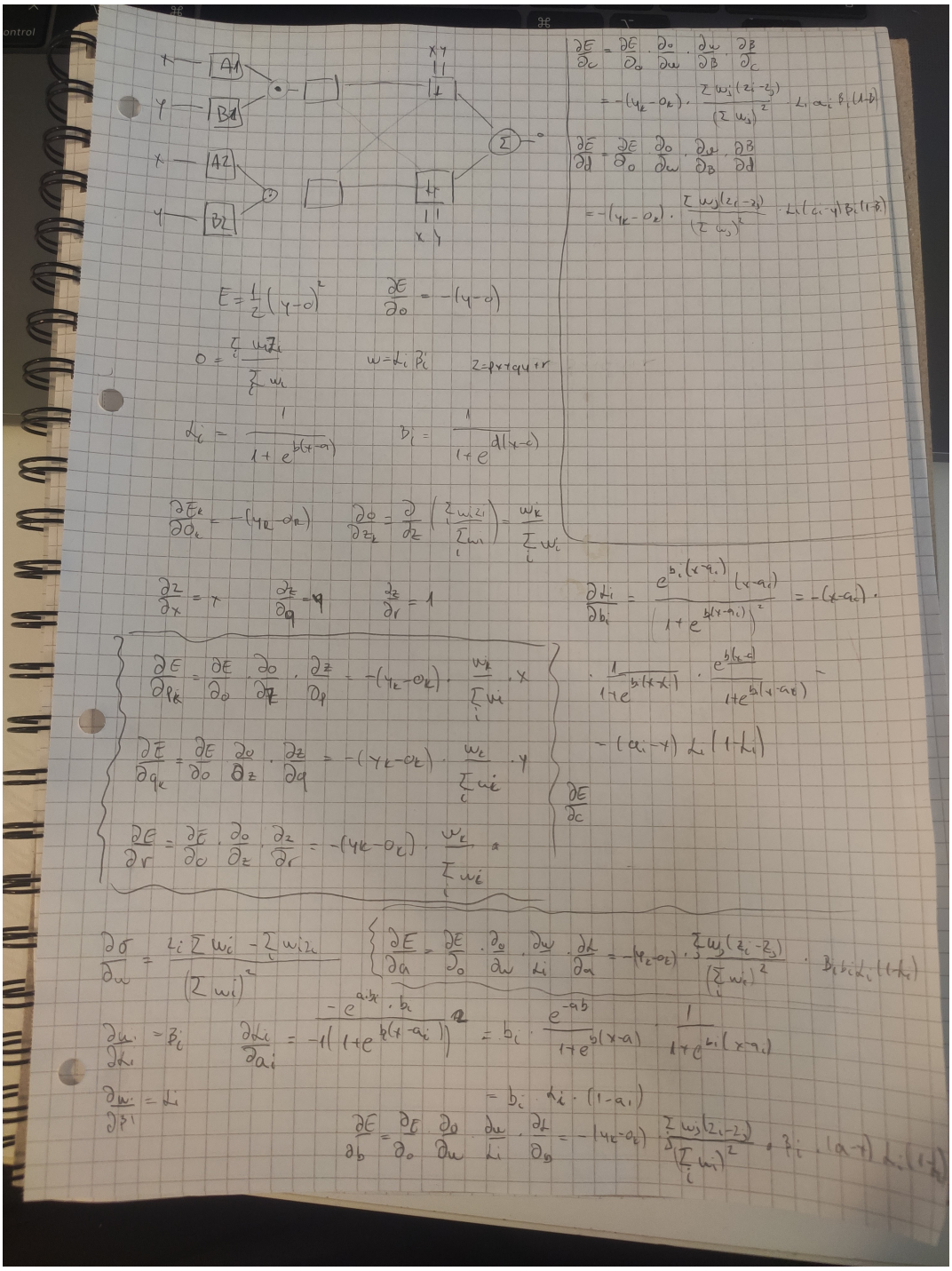
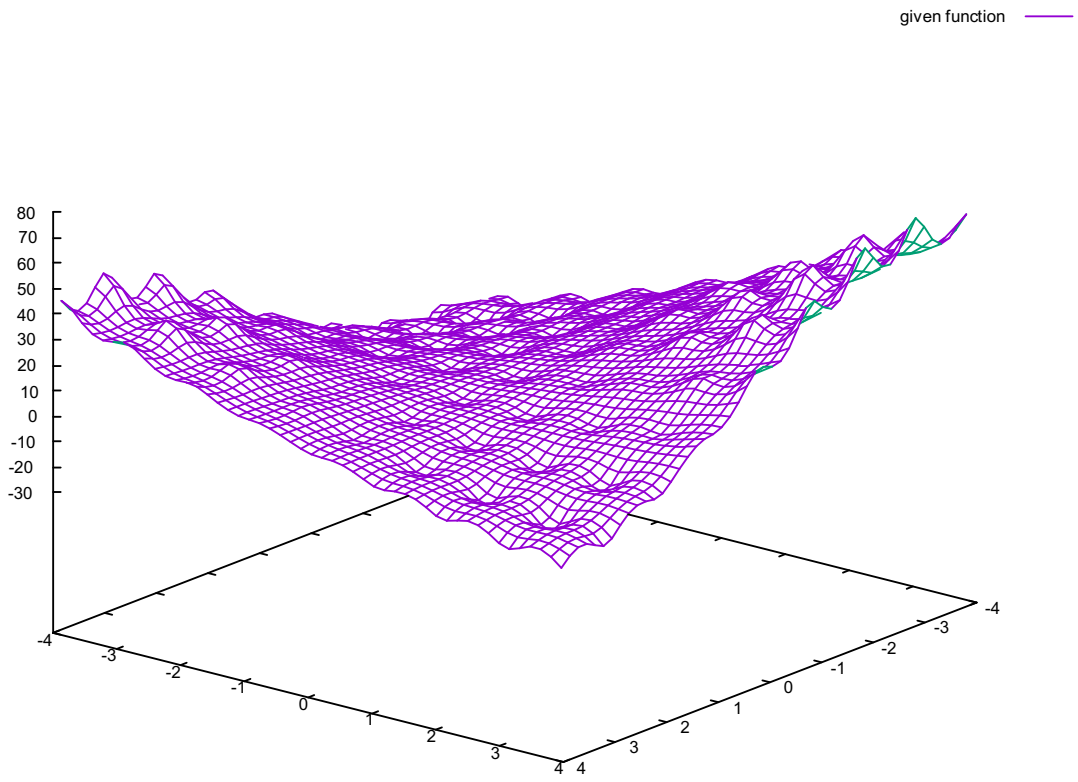
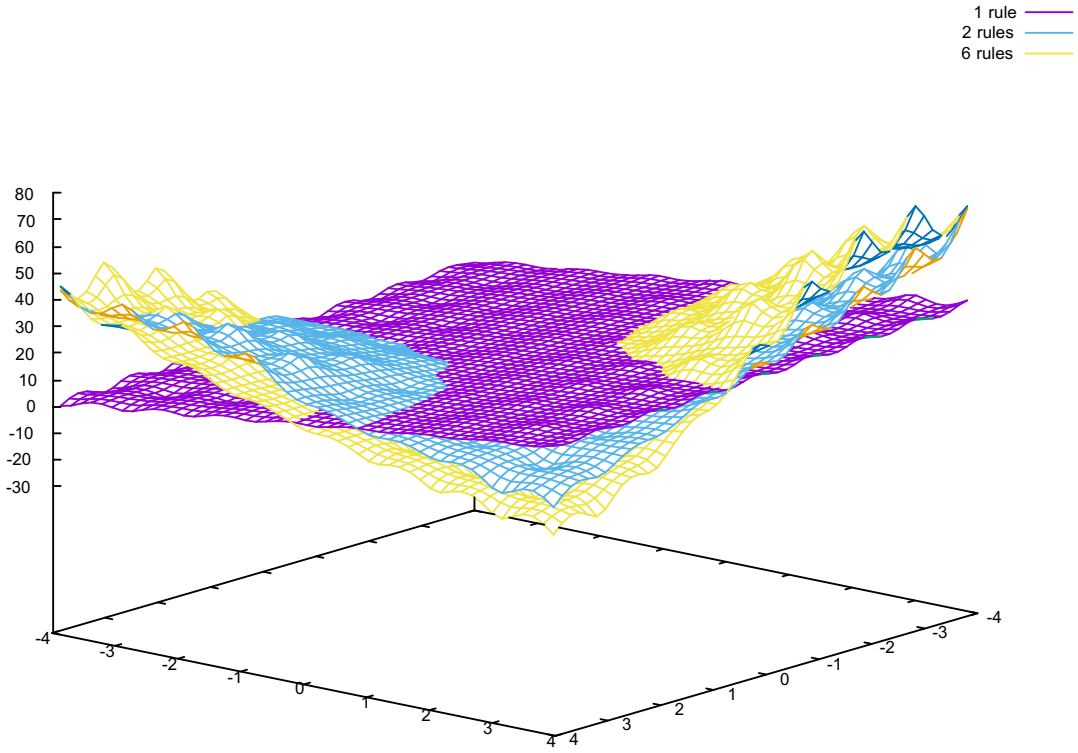
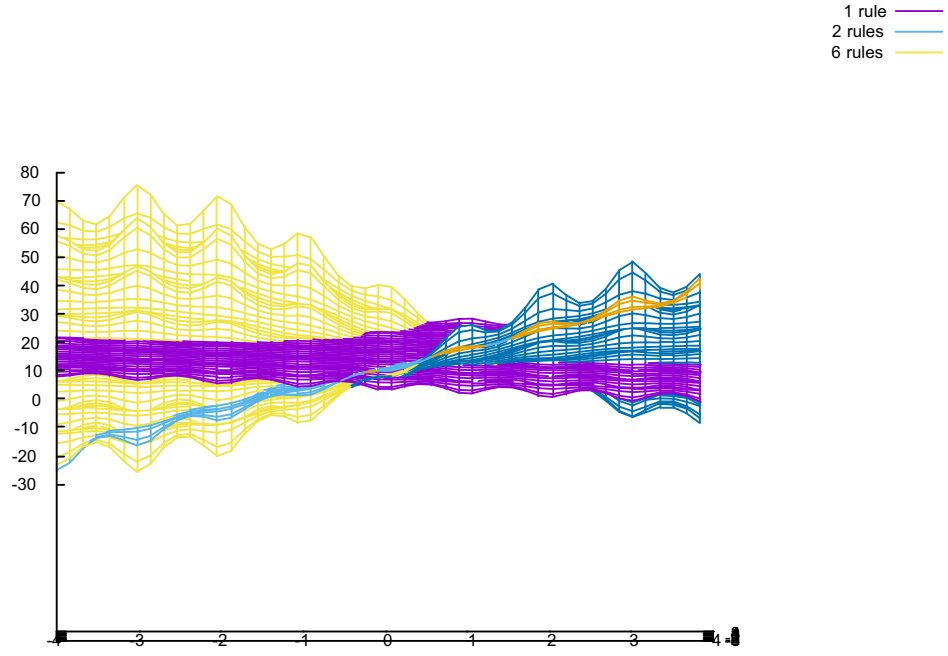

x
y
A1
B1
A2
B2
xy
Σ
x y
$E = \frac{1}{2}(y-o)^2$
$\frac{\partial E}{\partial o} = -(y-o)$
$o = \frac{\sum_i w_i z_i}{\sum_i w_i}$
$w = \alpha_i \beta_i$
$z = px + qy + r$
$\alpha_i = \frac{1}{1+e^{b(x-a)}}$
$\beta_i = \frac{1}{1+e^{d(y-c)}}$
$\frac{\partial E_k}{\partial o_k} = -(y_k - o_k)$
$\frac{\partial o}{\partial z_k} = \frac{\partial}{\partial z}\left(\frac{\sum_i w_i z_i}{\sum_i w_i}\right) = \frac{w_k}{\sum_i w_i}$
$\frac{\partial z}{\partial x} = p$
$\frac{\partial z}{\partial q} = q$
$\frac{\partial z}{\partial r} = 1$
$\frac{\partial E}{\partial p_k} = \frac{\partial E}{\partial o}\cdot\frac{\partial o}{\partial z}\cdot\frac{\partial z}{\partial p} = -(y_k - o_k)\cdot\frac{w_k}{\sum_i w_i}\cdot x$
$\frac{\partial E}{\partial q_k} = \frac{\partial E}{\partial o}\cdot\frac{\partial o}{\partial z}\cdot\frac{\partial z}{\partial q} = -(y_k - o_k)\cdot\frac{w_k}{\sum_i w_i}\cdot y$
$\frac{\partial E}{\partial r} = \frac{\partial E}{\partial o}\cdot\frac{\partial o}{\partial z}\cdot\frac{\partial z}{\partial r} = -(y_k - o_k)\cdot\frac{w_k}{\sum_i w_i}\cdot 1$
$\frac{\partial E}{\partial c}$
$\frac{\partial \alpha_i}{\partial b_i} = \frac{e^{b_i(x-a_i)}(x-a_i)}{(1+e^{b(x-a_i)})^2} = -(x-a_i)\cdot\frac{1}{1+e^{b(x-a_i)}}\cdot\frac{e^{b(x-a_i)}}{1+e^{b(x-a_i)}}$
$= (a_i - x)\,\alpha_i(1-\alpha_i)$
$\frac{\partial o}{\partial w} = \frac{\alpha_i\sum w_i - \sum w_i z_i}{(\sum w_i)^2}$
$\frac{\partial E}{\partial a} = \frac{\partial E}{\partial o}\cdot\frac{\partial o}{\partial w}\cdot\frac{\partial w}{\partial \alpha_i}\cdot\frac{\partial \alpha_i}{\partial a} = -(y_k - o_k)\cdot\frac{\sum_j w_j(z_i - z_j)}{(\sum_i w_i)^2}\cdot\beta_i b_i \alpha_i(1-\alpha_i)$
$\frac{\partial w_i}{\partial \alpha_i} = \beta_i$
$\frac{\partial \alpha_i}{\partial a_i} = -1\left(1+e^{b(x-a_i)}\right)^{-2}\cdot(-e^{a_i x}\cdot b_i) = b_i\cdot\frac{e^{-ab}}{1+e^{b(x-a)}}\cdot\frac{1}{1+e^{b_i(x-a_i)}}$
$= b_i\cdot\alpha_i\cdot(1-\alpha_i)$
$\frac{\partial w_i}{\partial \beta_i} = \alpha_i$
$\frac{\partial E}{\partial b} = \frac{\partial E}{\partial o}\cdot\frac{\partial o}{\partial w}\cdot\frac{\partial w}{\partial \alpha_i}\cdot\frac{\partial \alpha}{\partial b} = -(y_k - o_k)\cdot\frac{\sum_j w_j(z_i - z_j)}{(\sum_i w_i)^2}\cdot\beta_i\cdot(a-x)\,\alpha_i(1-\alpha_i)$

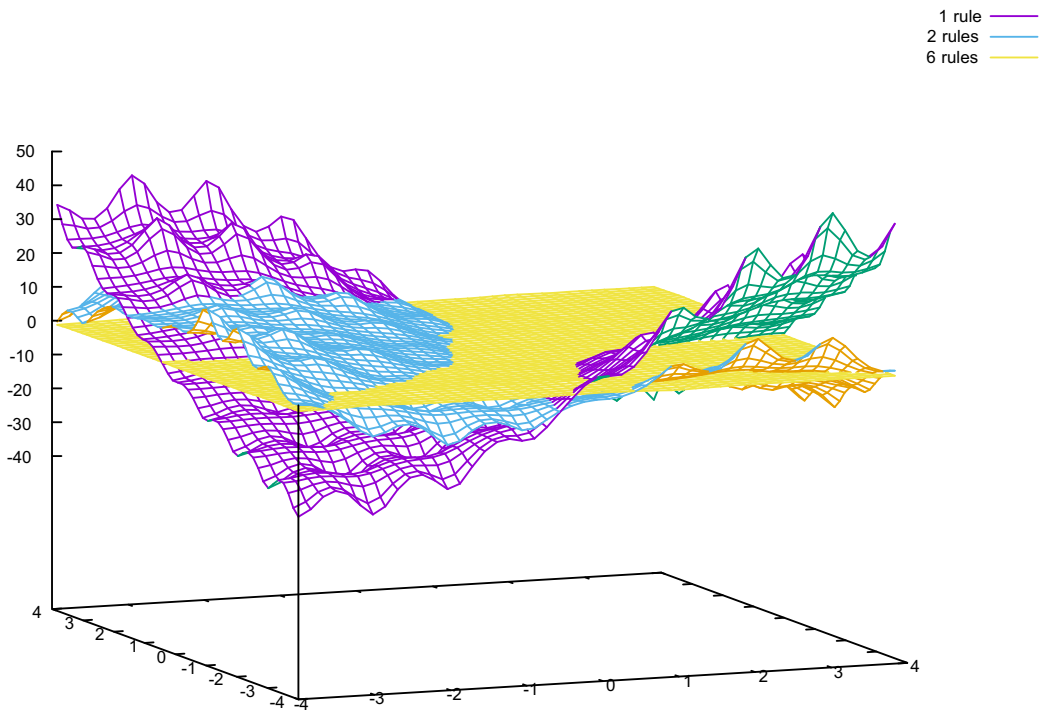
TASK 3

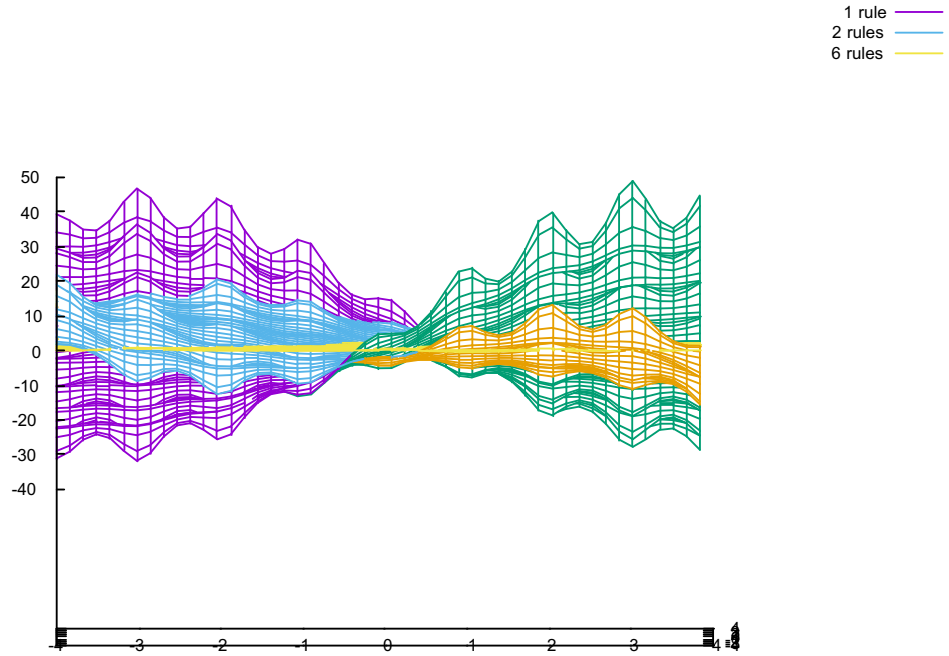

given function
80
70
60
50
40
30
20
10
0
-10
-20
-30
-4
-3
-2
-1
0
1
2
3
4
-4
-3
-2
-1
0
1
2
3
4

TASK 4

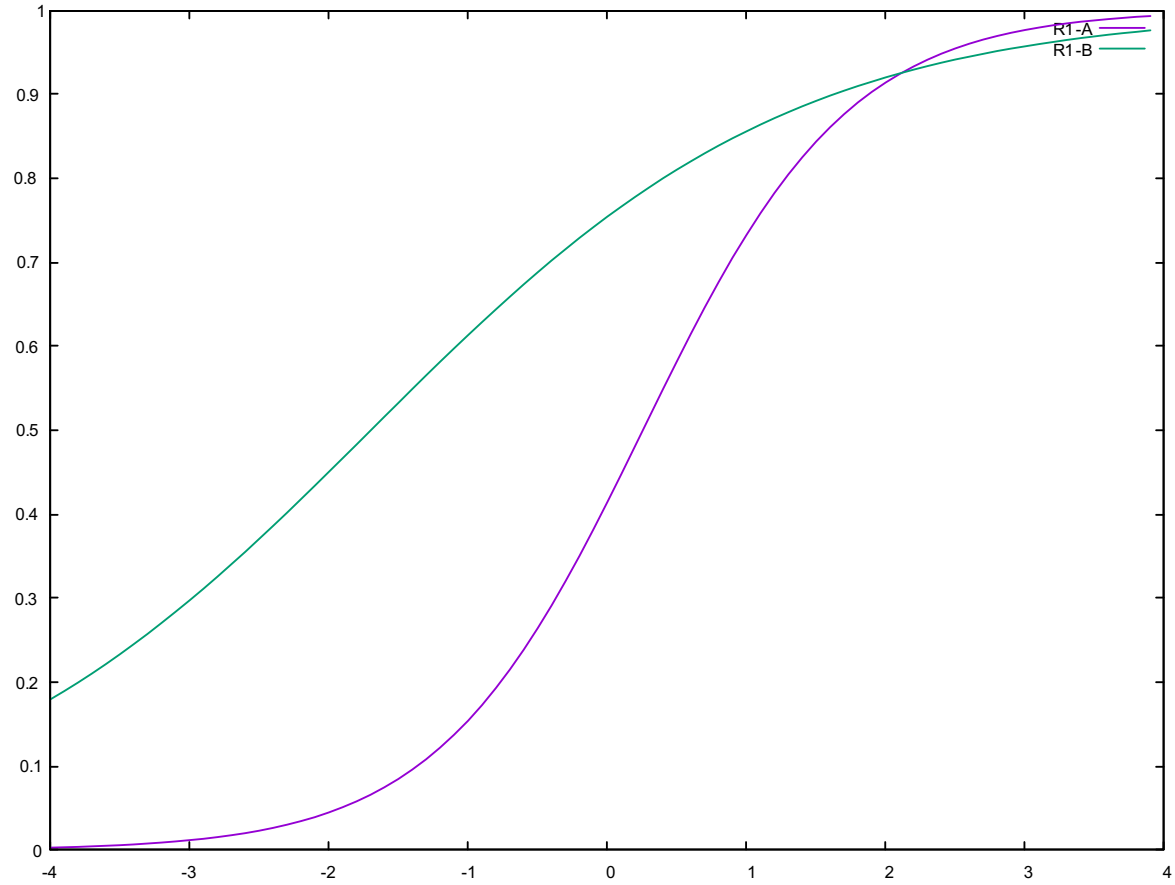

1 rule
2 rules
6 rules
80
70
60
50
40
30
20
10
0
-10
-20
-30
-4
-3
-2
-1
0
1
2
3
4

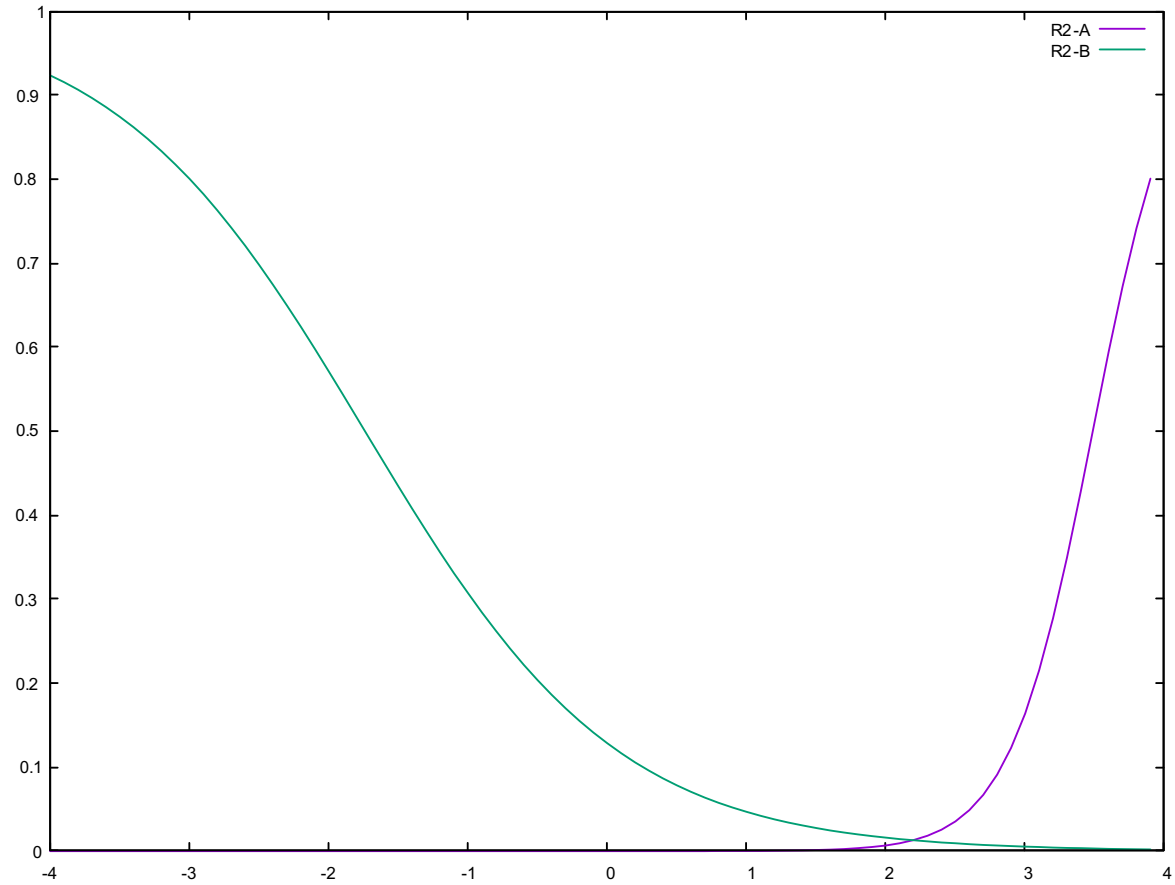

1 rule
2 rules
6 rules
80
70
60
50
40
30
20
10
0
-10
-20
-30
-4
-3
-2
-1
0
1
2
3

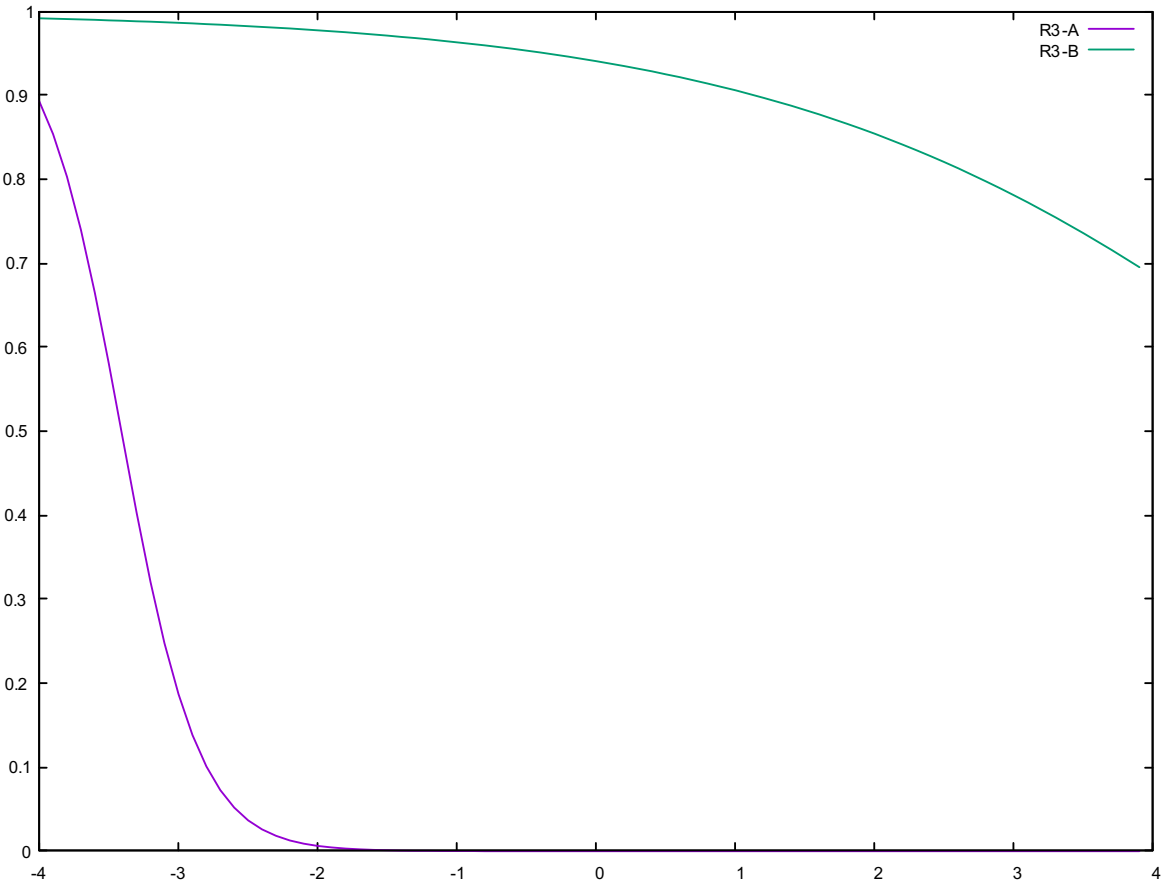

1 rule
2 rules
6 rules
50
40
30
20
10
0
-10
-20
-30
-40
4
3
2
1
0
-1
-2
-3
-4

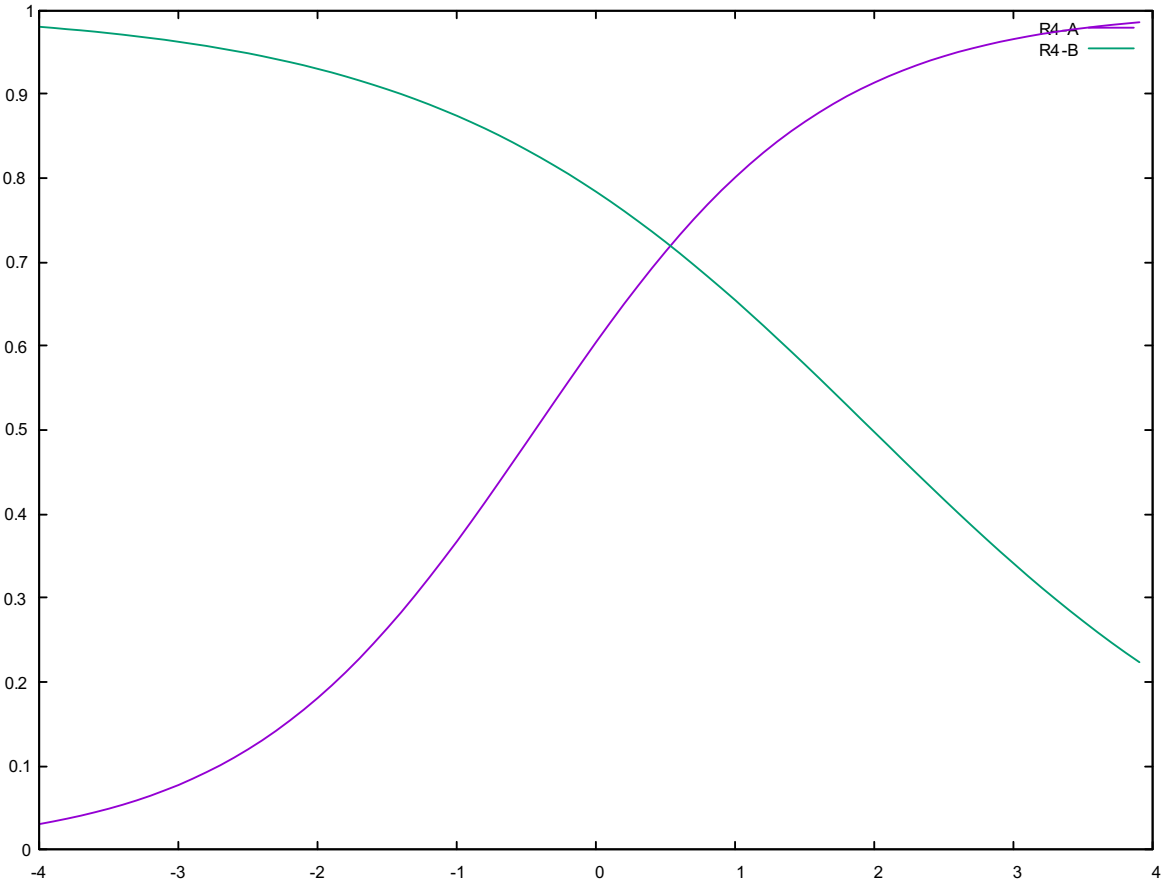

1 rule
2 rules
6 rules
50
40
30
20
10
0
-10
-20
-30
-40

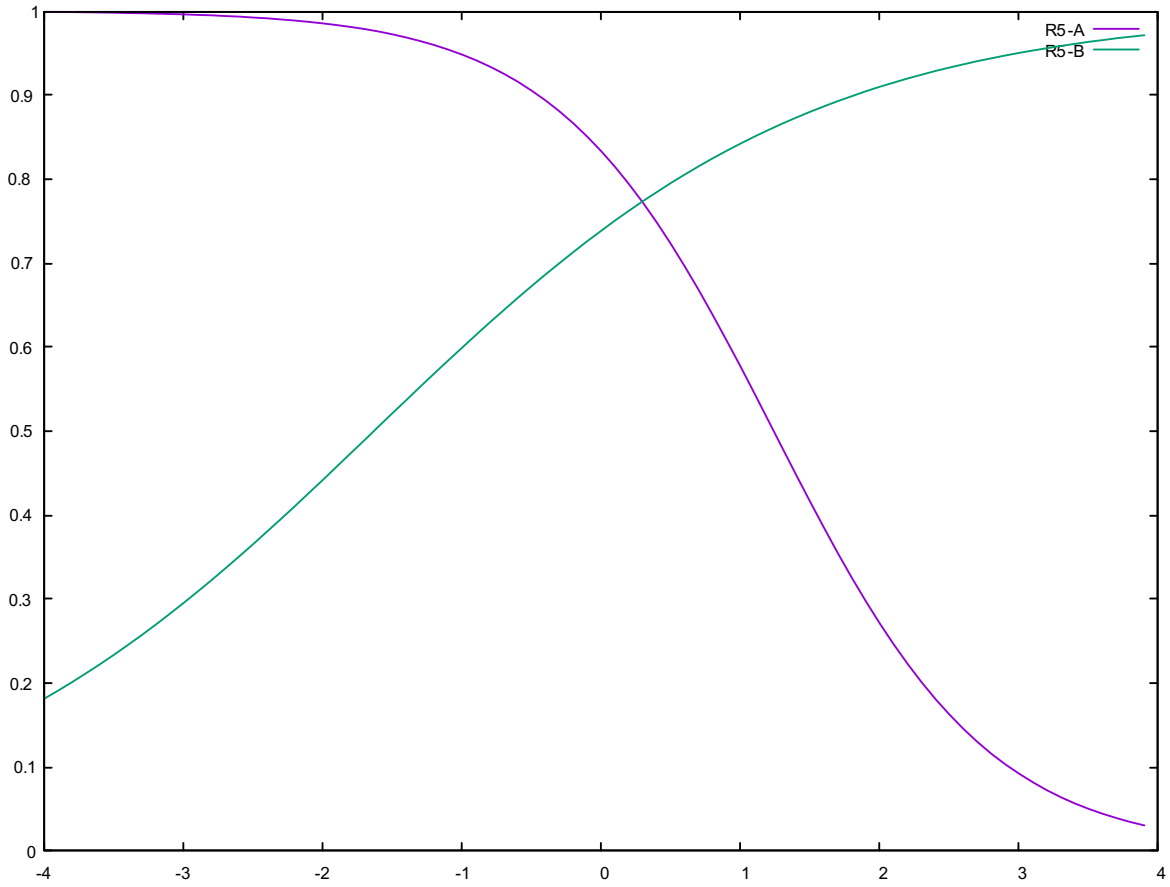
TASK 5

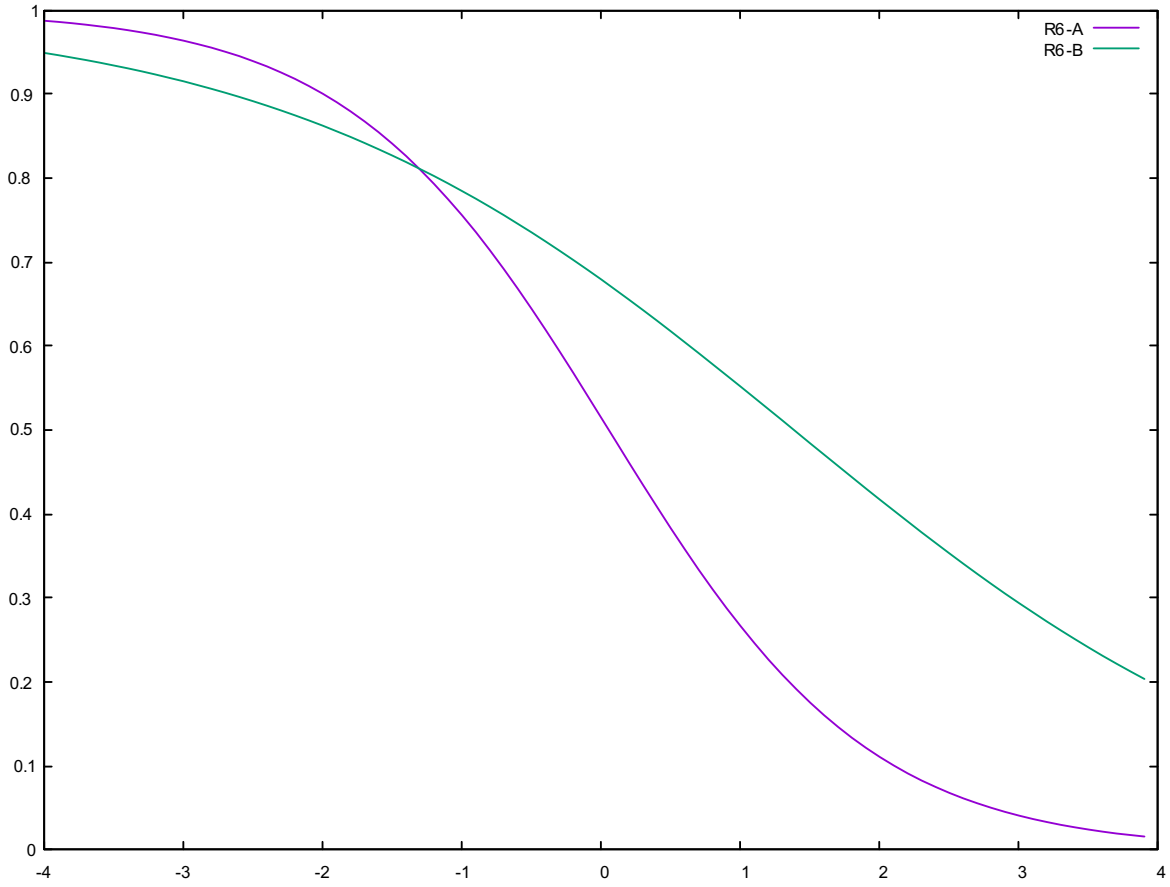

R1-A
R1-B
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-4
-3
-2
-1
0
1
2
3
4


R2-A
R2-B
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-4
-3
-2
-1
0
1
2
3
4

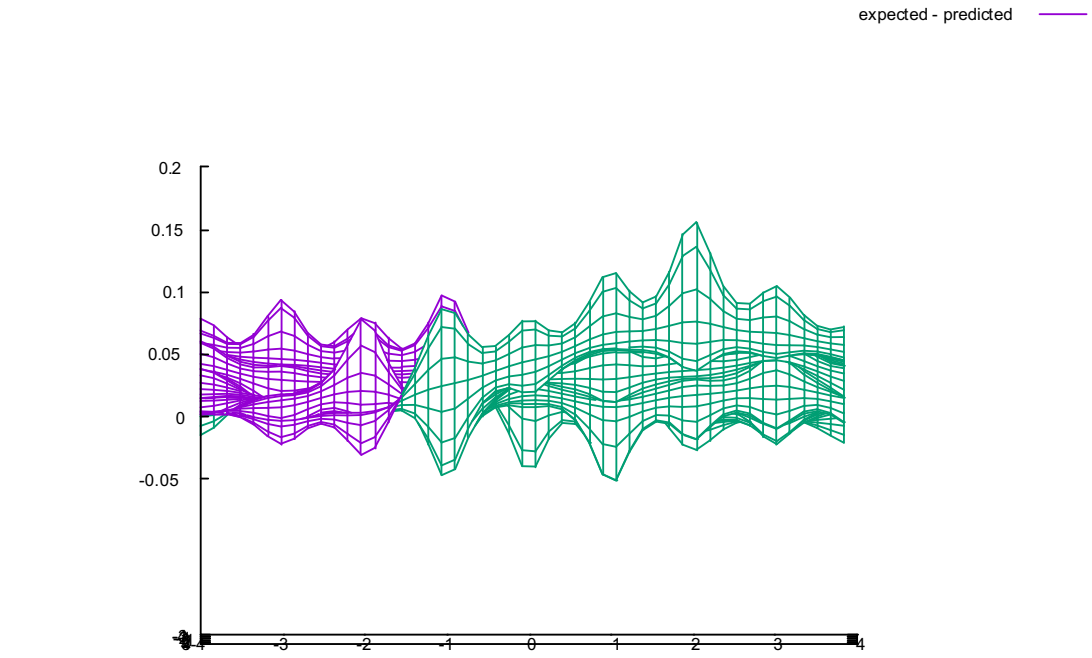

R3-A
R3-B
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-4
-3
-2
-1
0
1
2
3
4

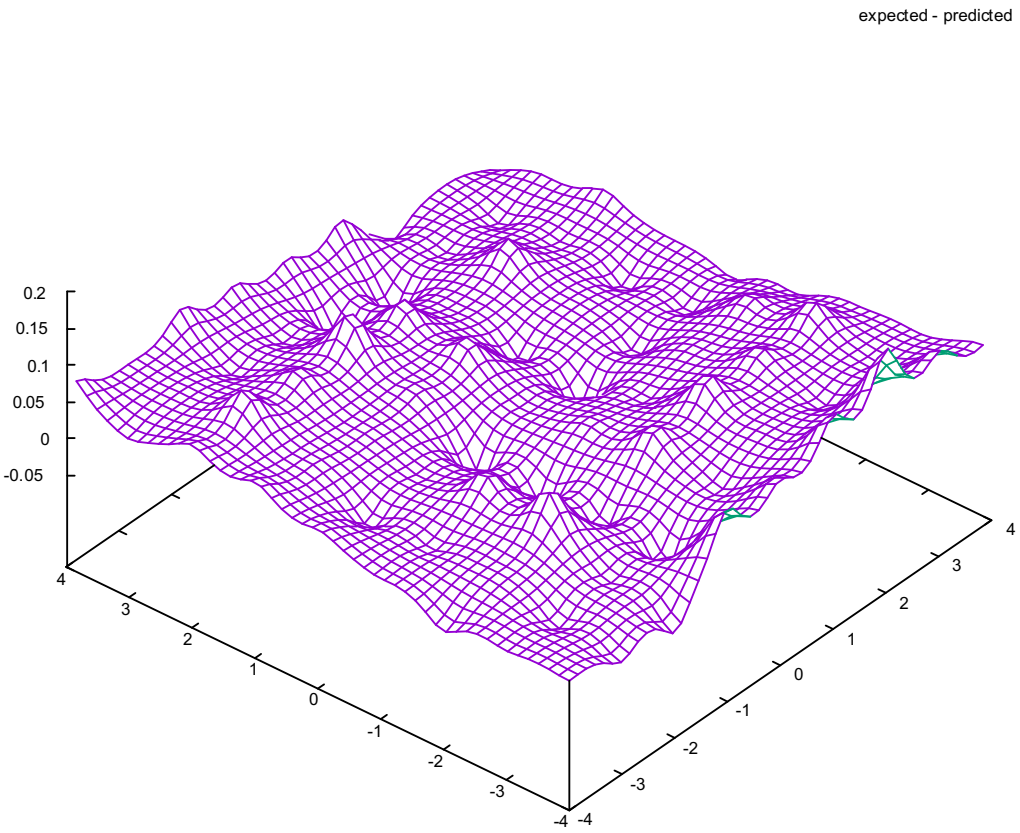

R4-A
R4-B
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-4
-3
-2
-1
0
1
2
3
4


R5-A
R5-B
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-4
-3
-2
-1
0
1
2
3
4

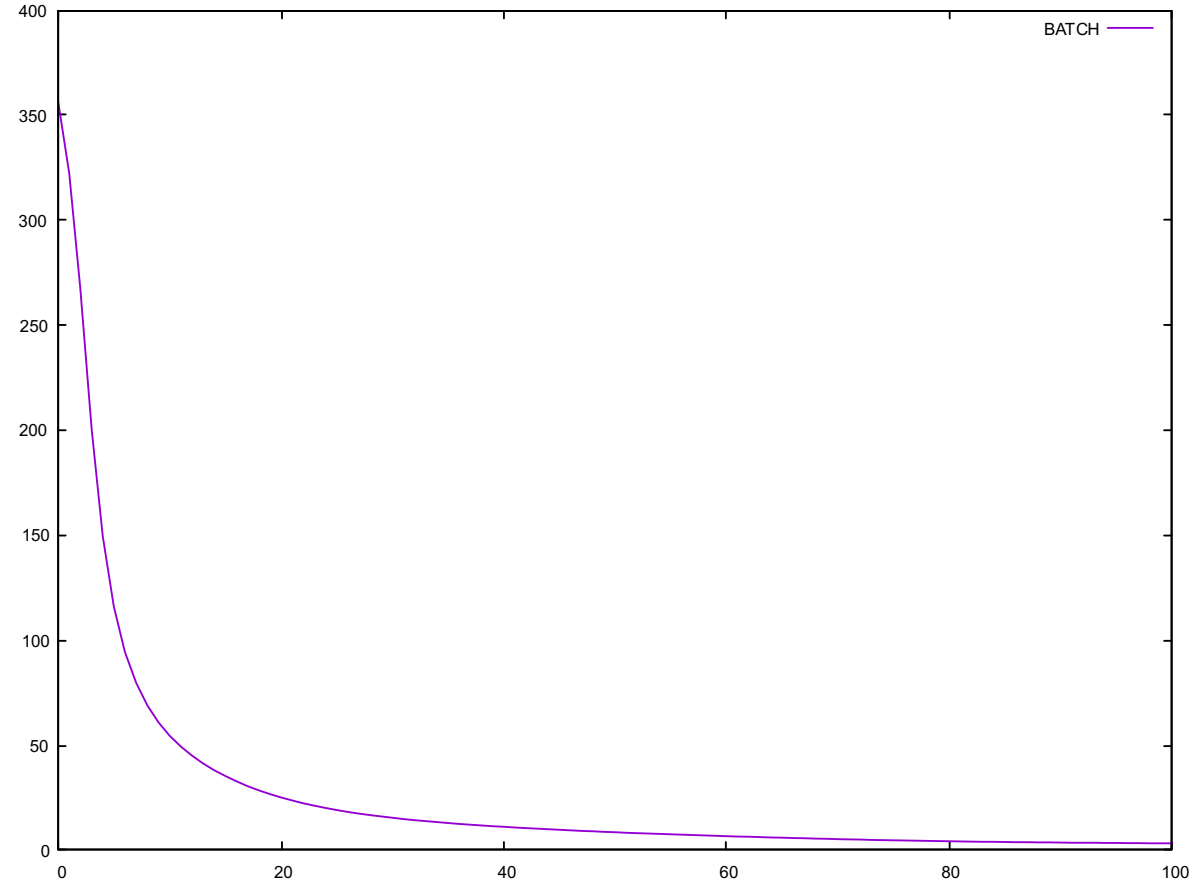

R6-A
R6-B
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-4
-3
-2
-1
0
1
2
3
4

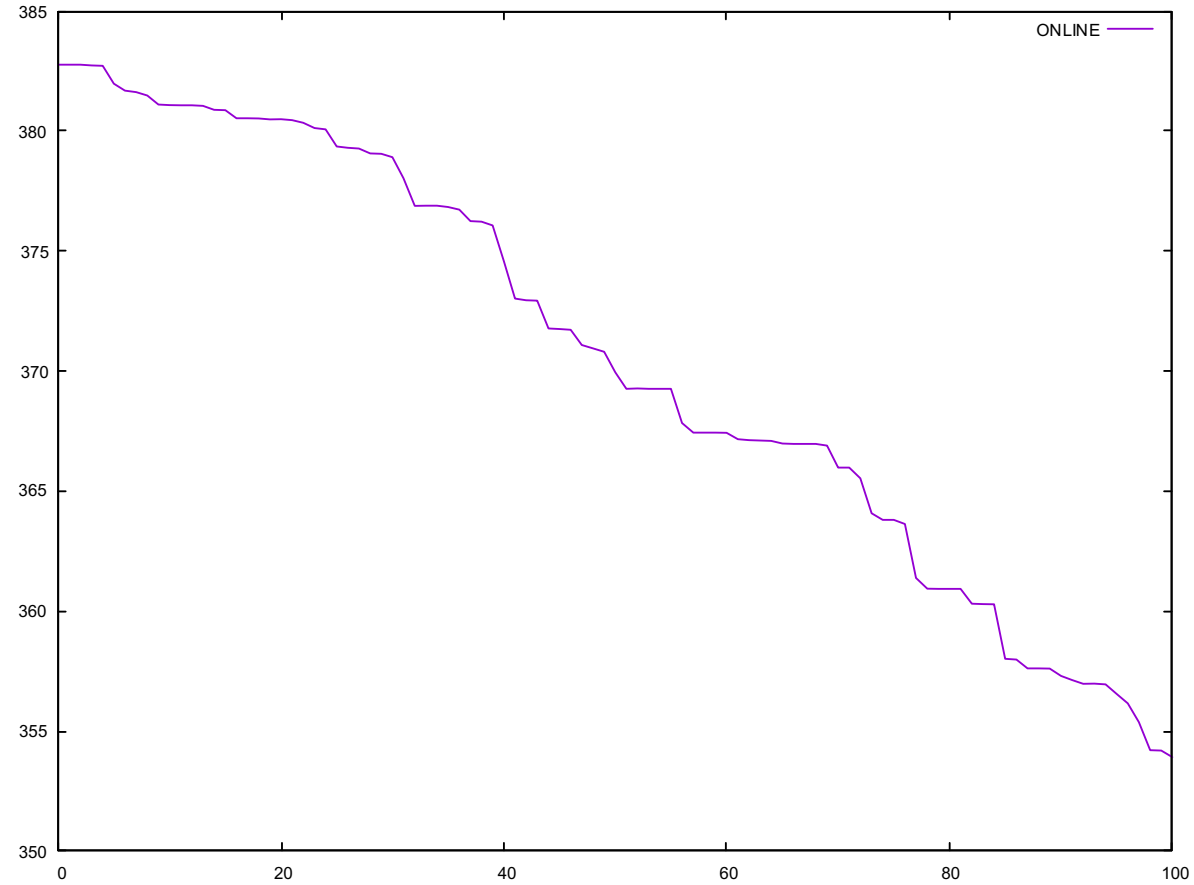
TASK 6

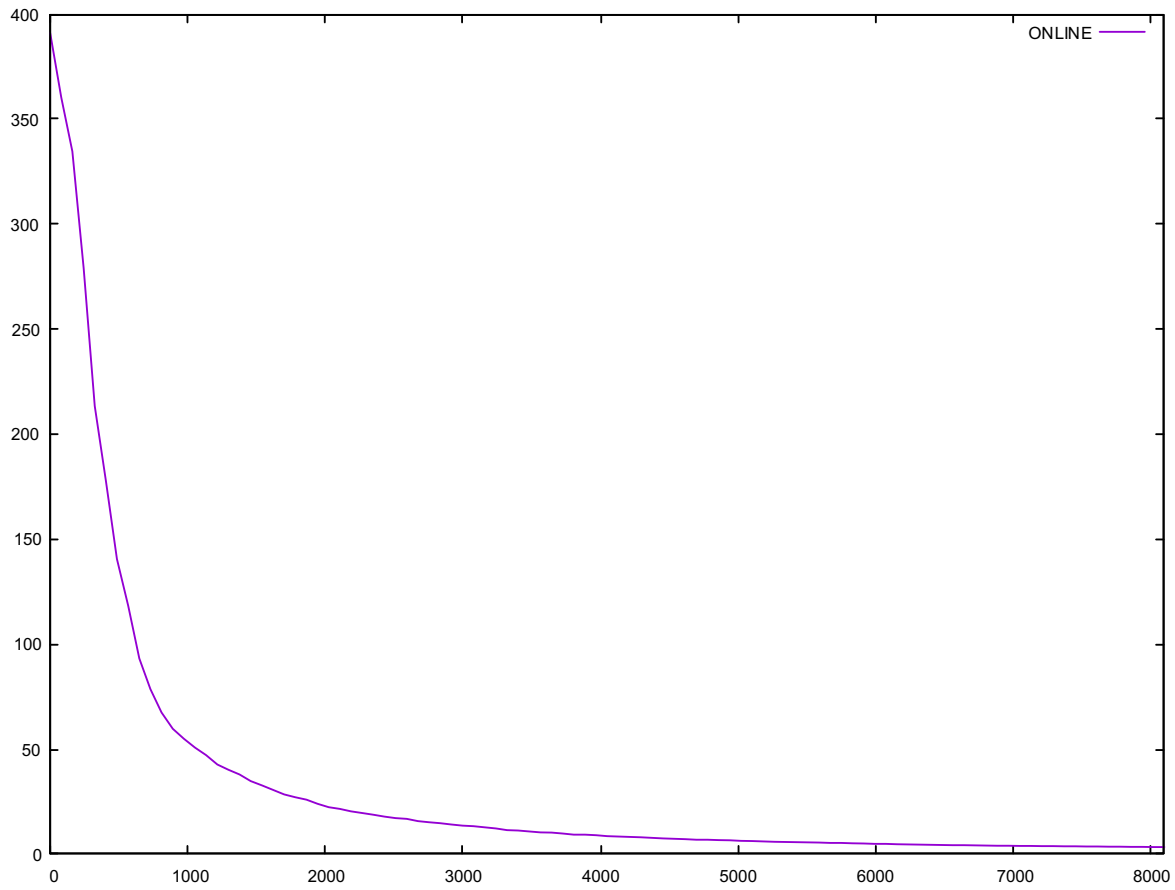

expected - predicted
0.2
0.15
0.1
0.05
0
-0.05
-3
-2
-1
0
1
2
3
4


expected - predicted
0.2
0.15
0.1
0.05
0
-0.05
4
3
2
1
0
-1
-2
-3
-4
-4
-3
-2
-1
0
1
2
3
4

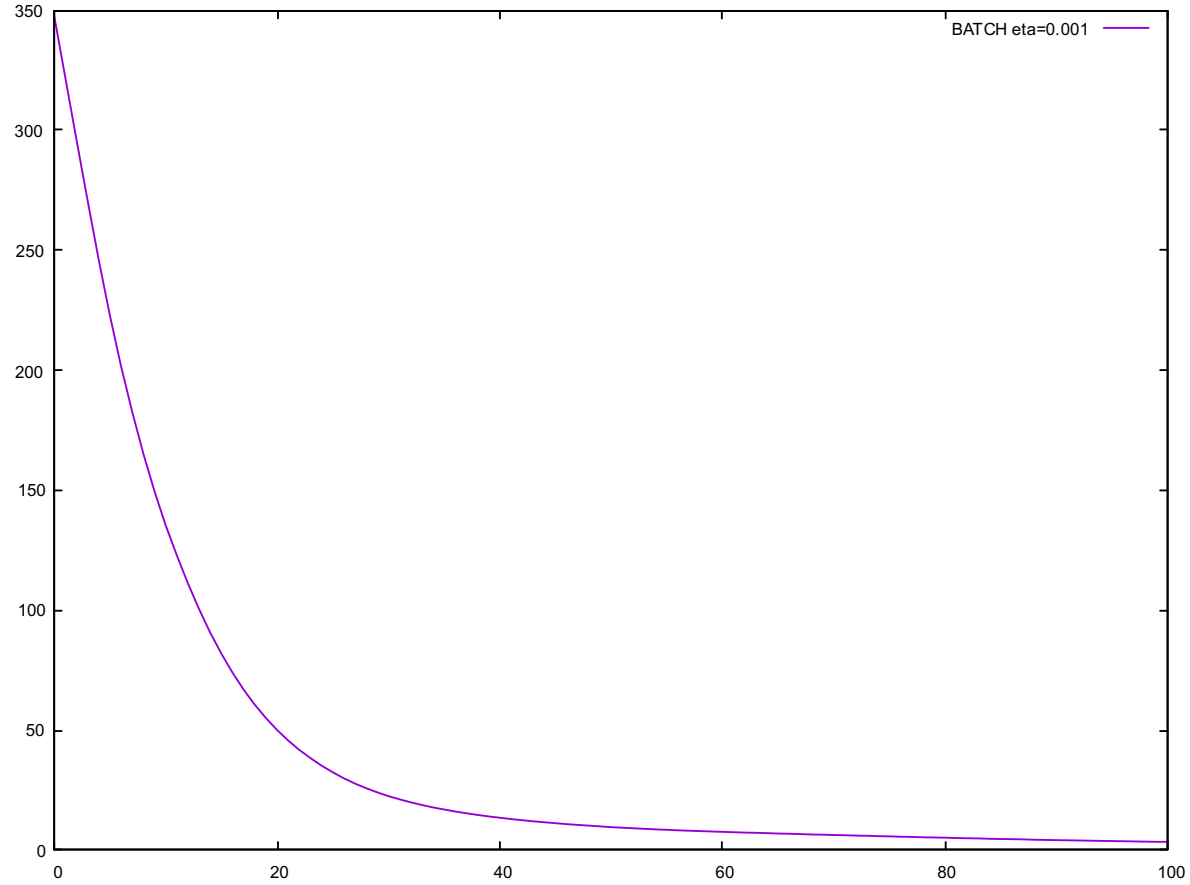
TASK 7

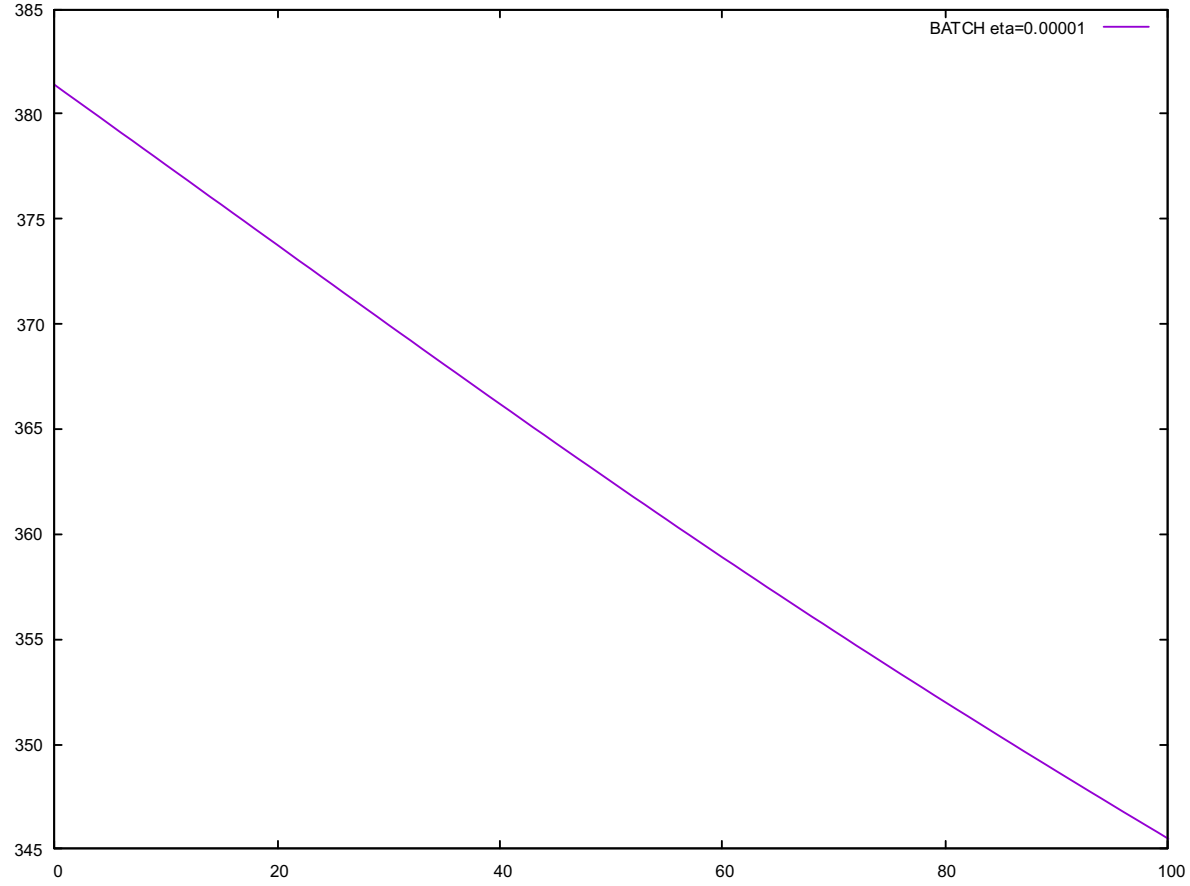

BATCH
400
350
300
250
200
150
100
50
0
0
20
40
60
80
100

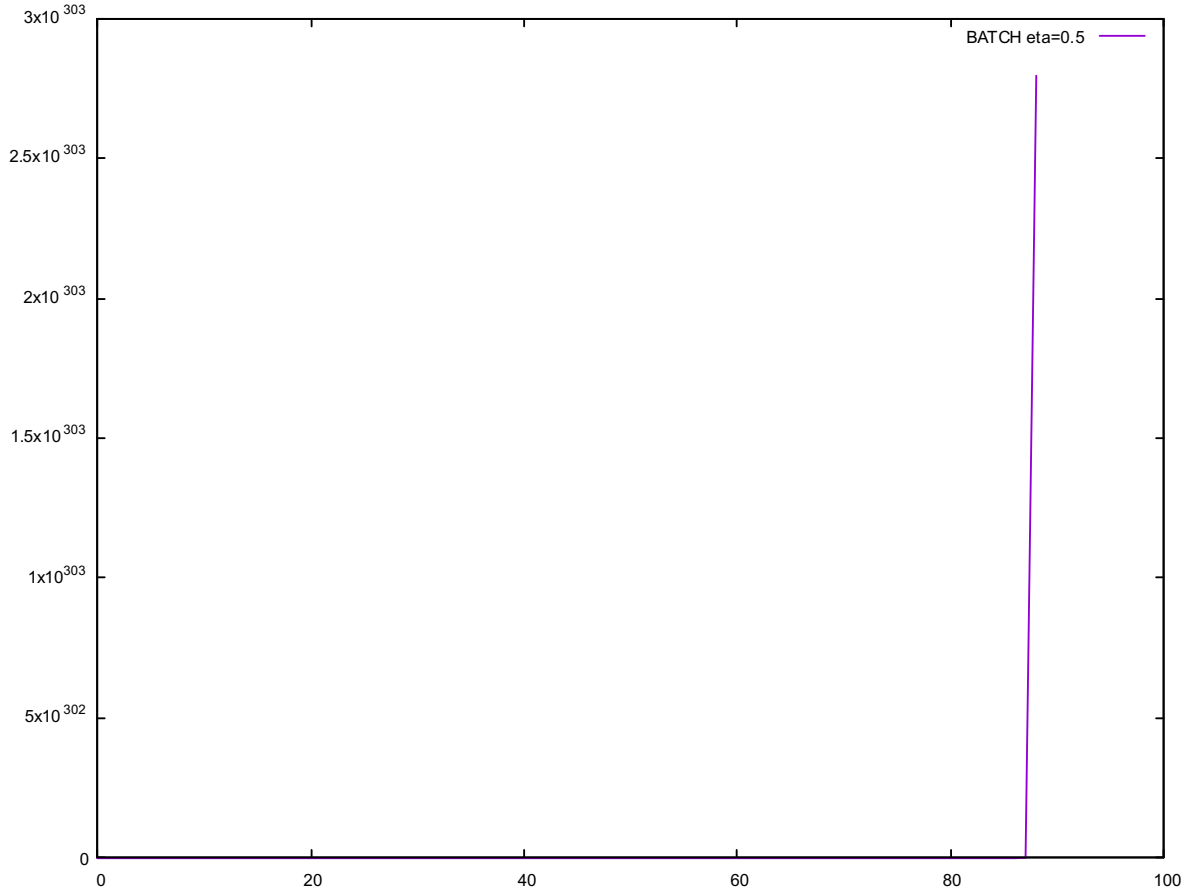

ONLINE
385
380
375
370
365
360
355
350
0
20
40
60
80
100

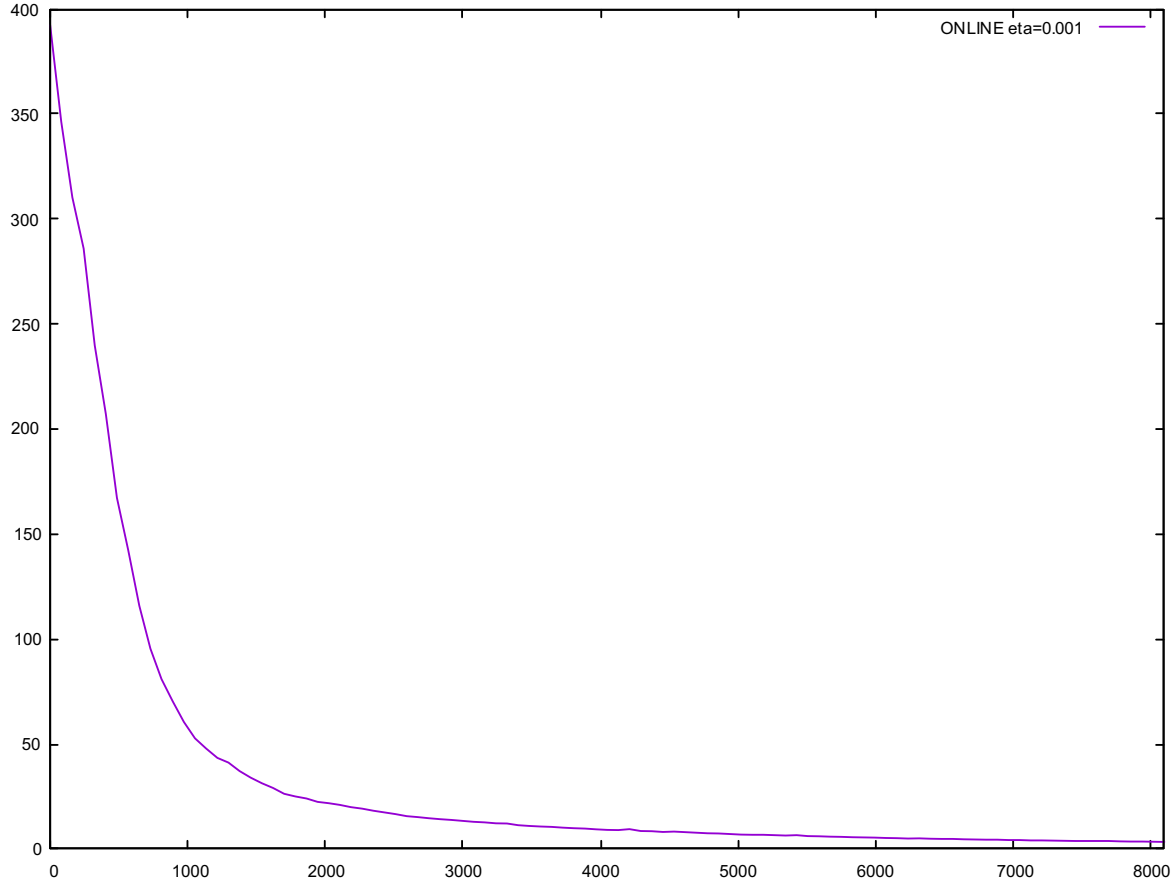

ONLINE
400
350
300
250
200
150
100
50
0
0
1000
2000
3000
4000
5000
6000
7000
8000

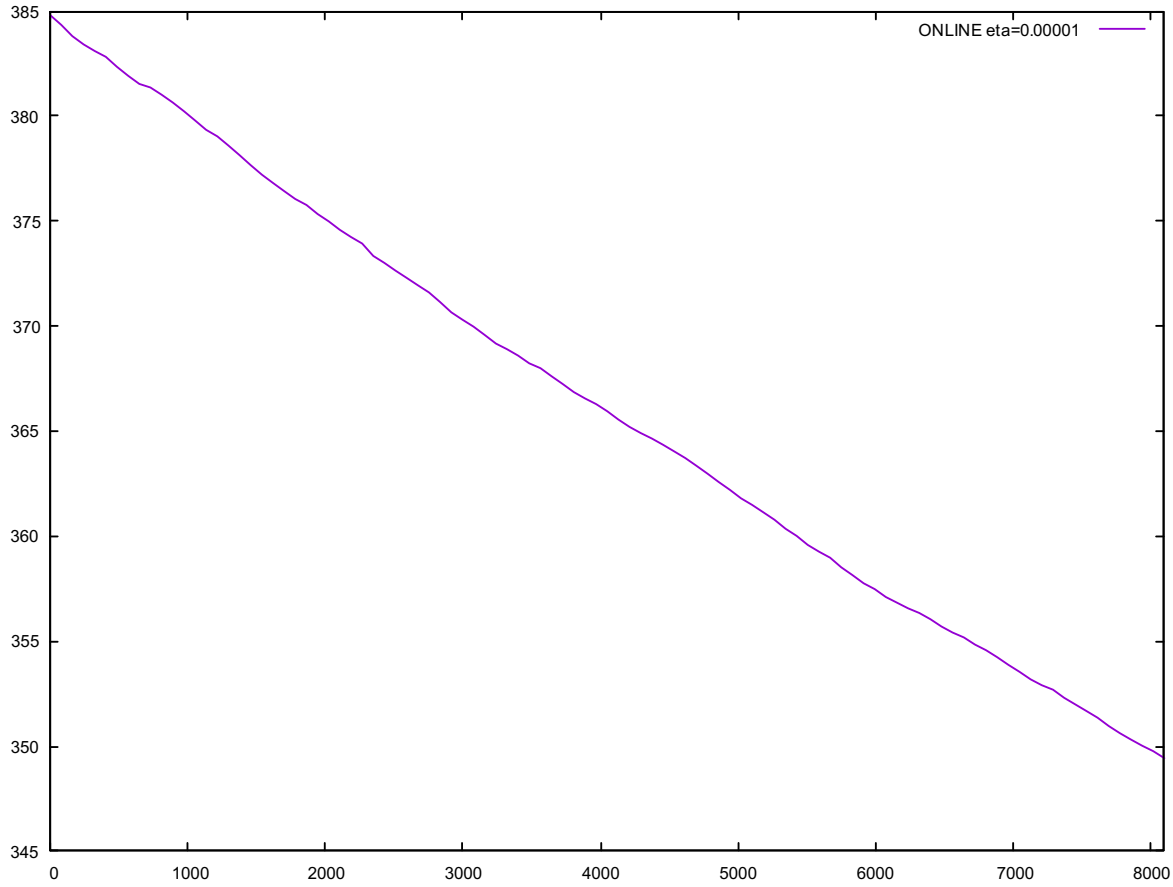
TASK 8

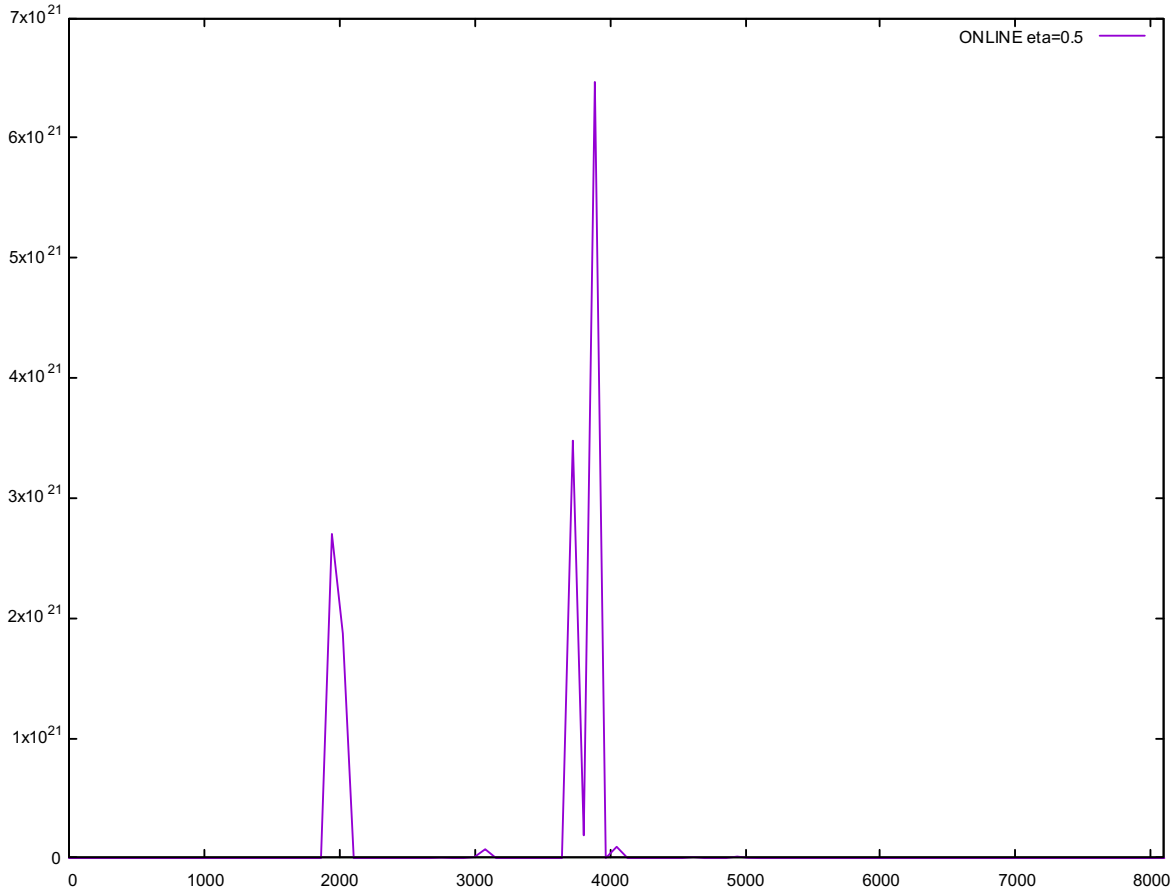

BATCH eta=0.001
350
300
250
200
150
100
50
0
0
20
40
60
80
100


BATCH eta=0.00001
385
380
375
370
365
360
355
350
345
0
20
40
60
80
100


BATCH eta=0.5
3x10^303
2.5x10^303
2x10^303
1.5x10^303
1x10^303
5x10^302
0
0
20
40
60
80
100


ONLINE eta=0.001
400
350
300
250
200
150
100
50
0
0
1000
2000
3000
4000
5000
6000
7000
8000


ONLINE eta=0.00001
385
380
375
370
365
360
355
350
345
0
1000
2000
3000
4000
5000
6000
7000
8000


ONLINE eta=0.5
7x10^21
6x10^21
5x10^21
4x10^21
3x10^21
2x10^21
1x10^21
0
0
1000
2000
3000
4000
5000
6000
7000
8000