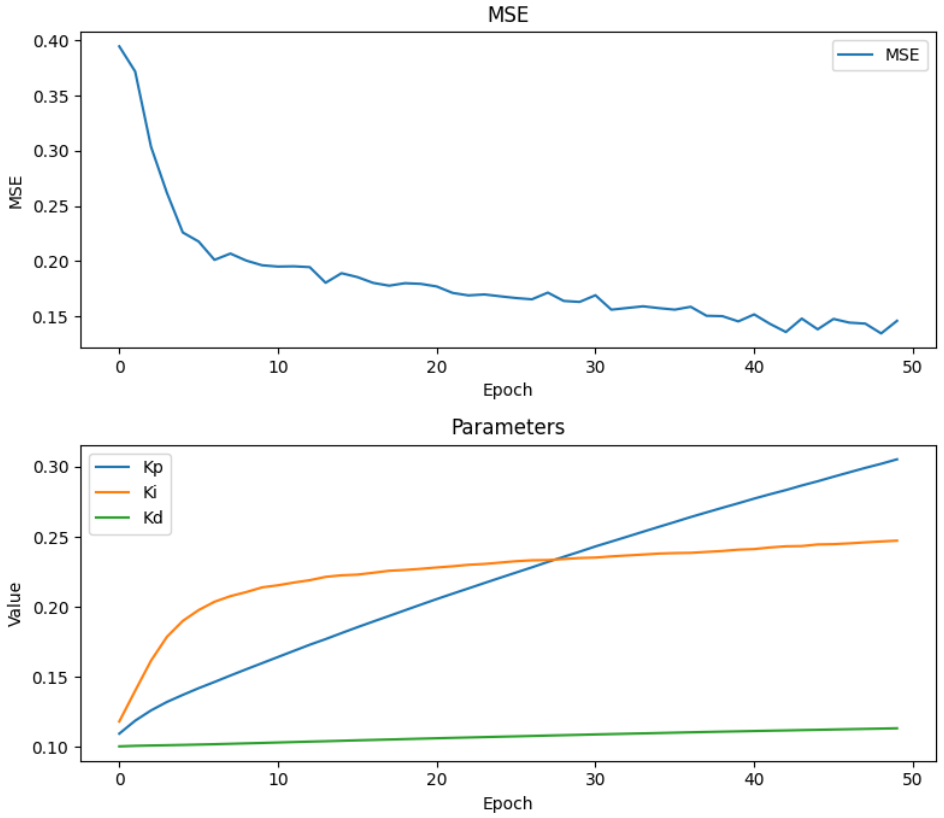
Jax Controller Report

Group 128

Bathtub Plant - Classic Controller

Parameter	Value
Epochs	50
Timesteps	50
Learning Rate	0.01
Disturbance Range	(-0.05, 0.05)
Initial K_p	0.1
Initial K_i	0.1
Initial K_d	0.1
A	10
C	0.1
Initial Height Water	5

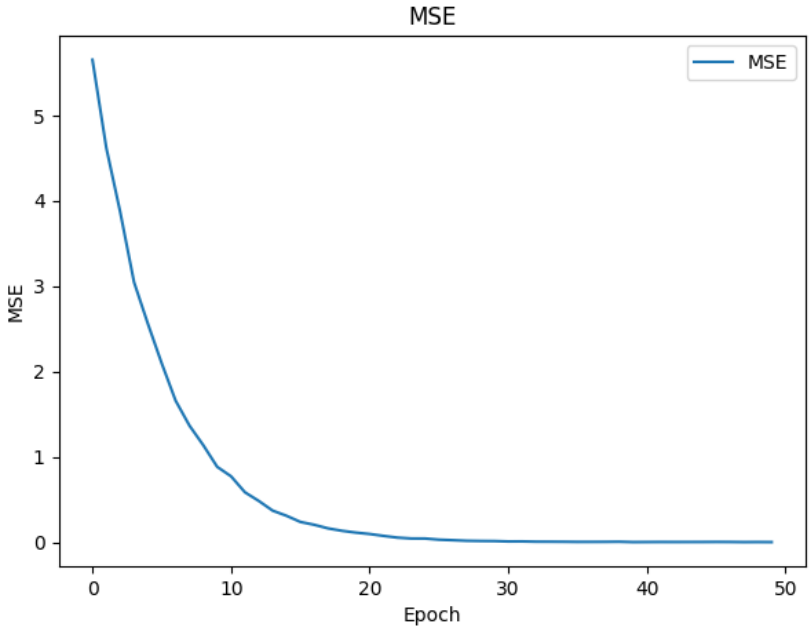


The initial error is not that high but it quickly goes down within the first 10 epochs. After

that it continues to go down, but at a lower rate. Given more epochs it might go down further. The MSE varies but this might be a response to the relatively high disturbance range. The parameters change more in the earlier epochs, especially the K_i. After about 10 epochs the K_i parameter changes at a lower rate. This is probably reflected in the MSE plot after 10 epochs, as we can see that the rate of change is lower after that point.

Bathtub Plant - AI Controller

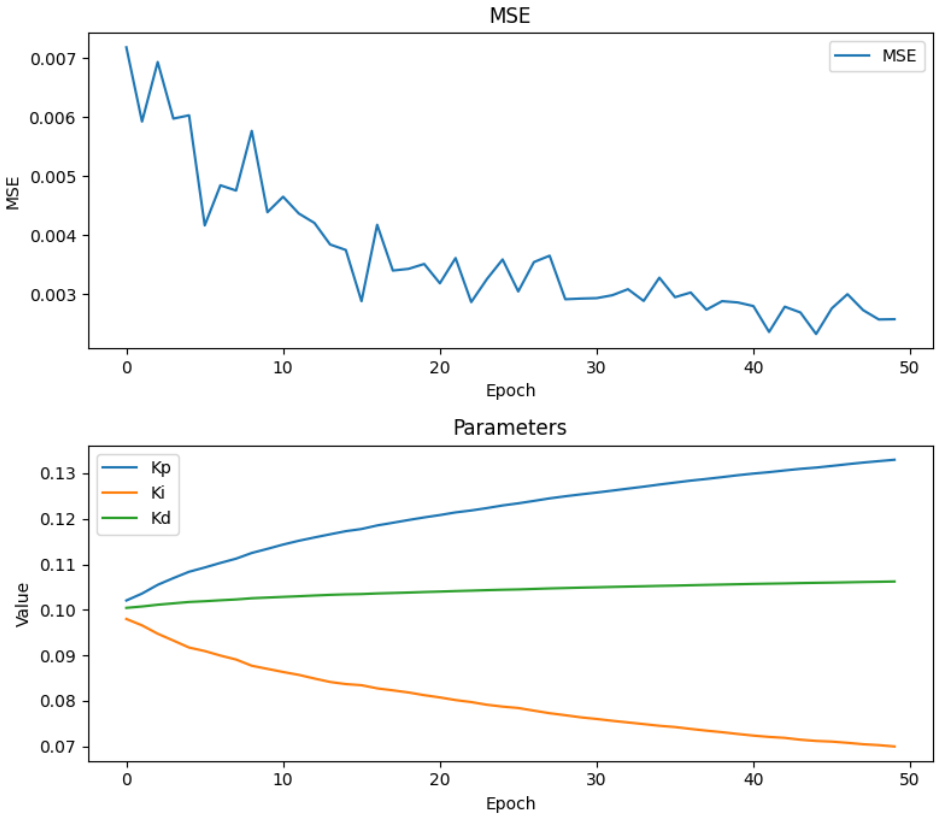
Parameter	**Value**
Epochs	50
Timesteps	50
Learning Rate	0.001
Disturbance Range	(-0.05, 0.05)
Number of Hidden Layers	2
Neurons per Layer	[64, 32]
Initial Weight/Bias Range	(-0.001, 0.001)
Activation Function	sigmoid
A	10
C	0.1
Initial Height Water	5



In this run the initial error is higher. This might be because of the random initializing of weights and biases. We can see that it goes steadily down, but the curve is not that steep. This is because the learning rate in this run is set to 0.001 instead of 0.01 as in the run with the classic controller above. In particular we observed that the gradients for the output layer could be high, indicating that these values were far off after initializing them. The controller still manages to learn, and displays a considerate change in MSE.

Cournot Plant - Classic Controller

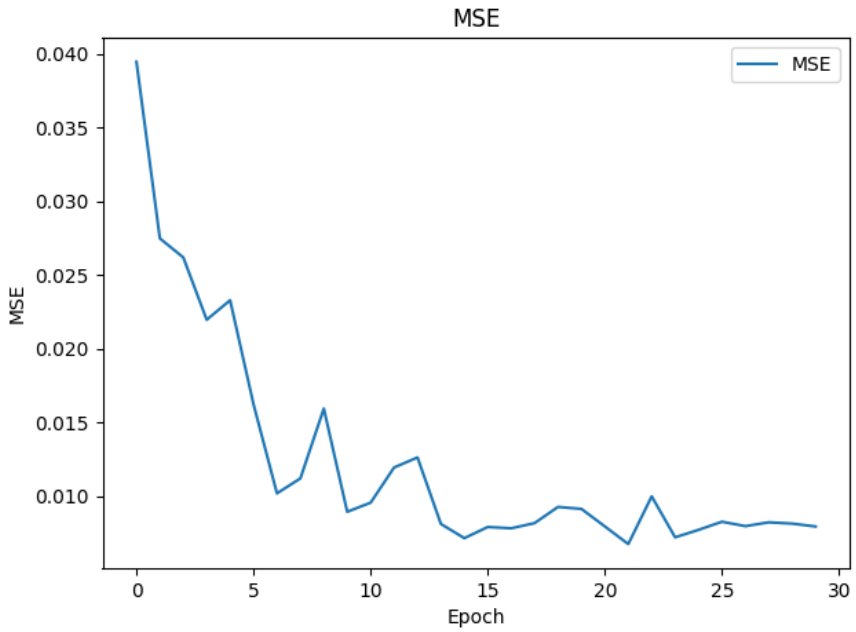
Parameter	Value
Epochs	50
Timesteps	50
Learning Rate	0.01
Disturbance Range	(-0.02, 0.02)
Initial K_p	0.1
Initial K_i	0.1
Initial K_d	0.1
Maximum Price	3
Marginal Cost	0.1
Target Profit	0.55
Initial q_1	0.4
Initial q_2	0.7



For this run we are using a slightly lower disturbance range. This is because the plant was more sensitive, caused by the lower numbers as input and used as state variables in the plant. The MSE plot indicates a lot of disturbance since it is not monotonous. The parameter tuning indicates that the K_i is initially too high, and it seems like in this plant it is more important to consider current error and the differentiation of error instead of the past error history.

Cournot Plant - AI Controller

Parameter	Value
Epochs	30
Timesteps	30
Learning Rate	0.0001
Disturbance Range	(-0.02, 0.02)
Number of Hidden Layers	3
Neurons per Layer	[64, 64, 32]
Initial Weight/Bias Range	(-0.001, 0.001)
Activation Function	relu
Maximum Price	3
Marginal Cost	0.1
Target Profit	0.55
Initial q_1	0.4
Initial q_2	0.7



The error for this run starts at 0.04. This is a lot higher than 0.007 which is the starting error for the classic controller when controlling this plant.

Population Plant - Classic Controller

Population Plant - AI Controller

```
Training set MSE: 0.0392
Test set MSE: 0.0399
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The result above was obtained with a learning rate of 0.001 and 1000 epochs.

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Training set MSE: 0.0504
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Test set MSE: 0.0517
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The result above was obtained after setting the amount of epochs to 100 instead of 1000. Still using a learning rate of 0.001.

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Training set MSE: 0.0389
Test set MSE: 0.0383
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The best results was obtained with a learning rate of 0.05 and 1000 epochs. Slightly better than a learning rate of 0.001

Population Plant Description

This plant is based on Lotka-Volterra equations, which are used to model population oscillations in ecological systems.