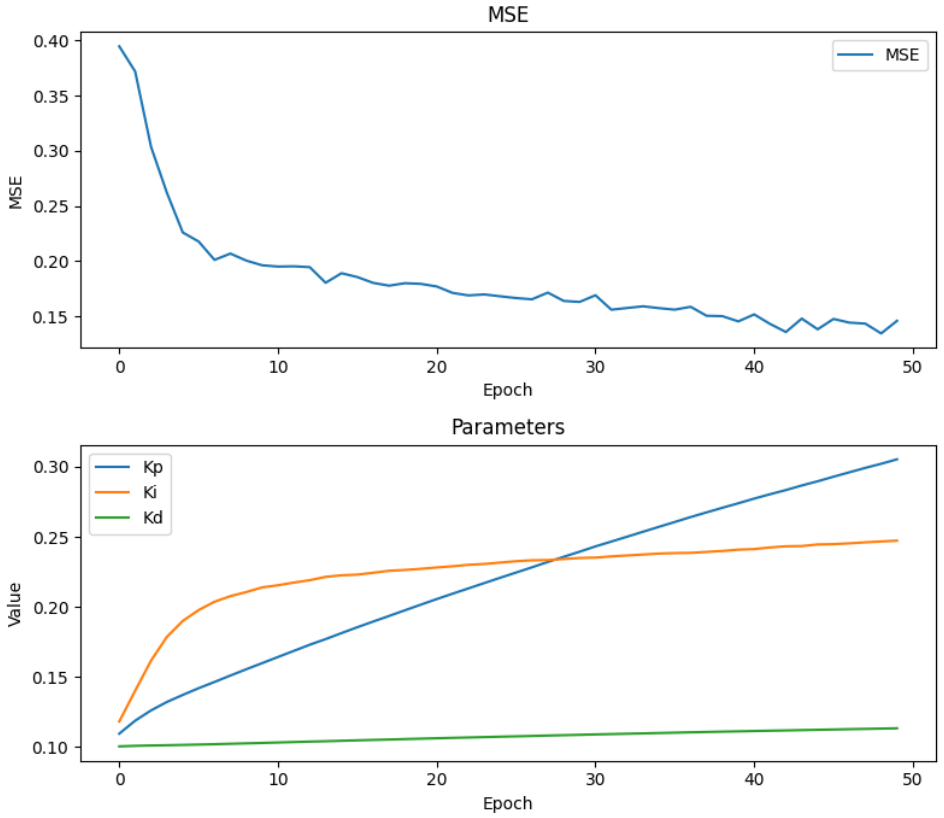
# Jax Controller Report

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 |

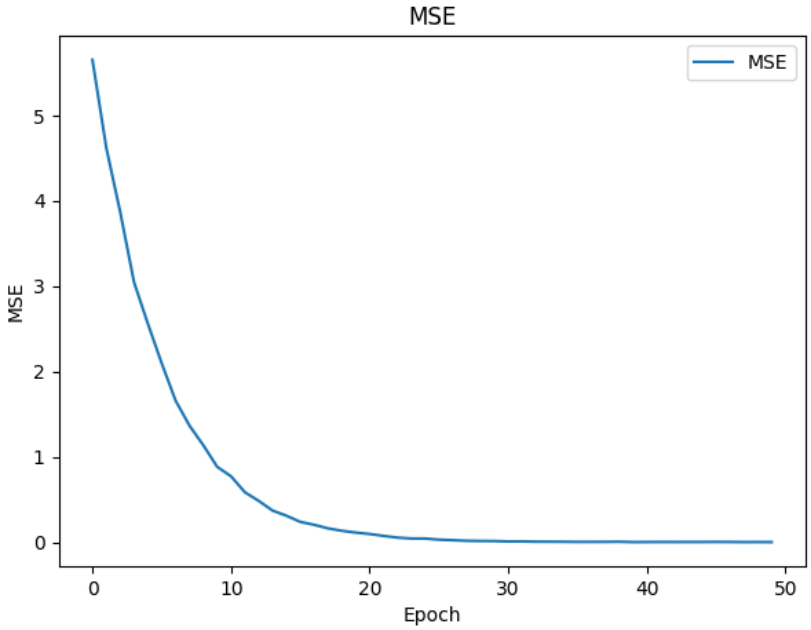



The initial error is not that high but it quickly goes down within the first 10 epochs. After

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

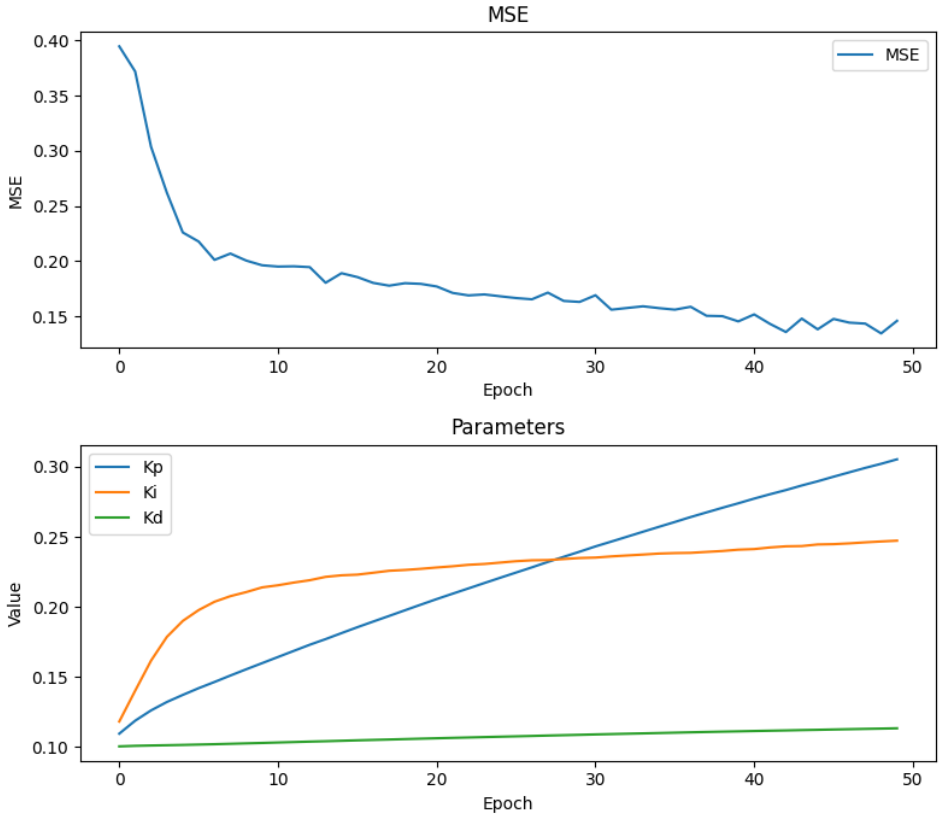
| **Parameter** | **Value** |
|---|---|
| Epochs | 50 |
| Timesteps | 50 |
| Learning Rate | 0.001 |
| Disturbance Range | (-0.05, 0.05) |
| Number of Hidden Layers | 2 |
| Neurons per Layer | [64, 32] |
| Initial Weight/Bias Range | (-0.001, 0.001) |
| Activation Function | sigmoid |
| A | 10 |
| C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

# Cournot Plant - AI Controller

# Population Plant - Classic Controller

# Population Plant - AI Controller

```
Training set MSE: 0.0392
Test set MSE: 0.0399
```

The result above was obtained with a learning rate of 0.001 and 1000 epochs.

```
Training set MSE: 0.0504
Test set MSE: 0.0517
```

The result above was obtained after setting the amount of epochs to 100 instead of 1000. Still using a learning rate of 0.001.

```
Training set MSE: 0.0389
Test set MSE: 0.0383
```

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 that say something about the oscilation of population in ecologic systems.