

ANN Simulation

This is done only for the cross evaluation, as it is the most useful

Importing Data

```
In[412]:= SetDirectory[NotebookDirectory[]]
```

```
Out[412]= /home/ff278/Desktop/Previous_Lutein/Current/Lutein_Experiment
```

```
In[413]:= (*Type 1 Network*)
```

```
(*Against set 1,2 4*)
```

```
(*For Test cases the Rows are in order, from left to right
```

```
Index (1)
```

```
Illumination DCW nitrate lutein for the experimental data (2,3,4,5)
```

```
Illumination DCW nitrate lutein for the 12 step (6,7,8,9)
```

```
Illumination DCW nitrate lutein for the 24 step (10,11,12,13)
```

```
Illumination DCW nitrate lutein for the 36 step (14,15,16,17)
```

```
Illumination DCW nitrate lutein for the 72 step (18,19,20,21)*
```

```
From left to Right they are set 1, 2 and 4*)
```

```
In[414]:= (*Lutein thus is index 5,9,13,17,21*)
```

```

In[415]:=
IntervalsLength = {{0, 12, 24, 36, 48, 60, 72, 84, 96, 108, 120, 132},
  {0, 24, 48, 72, 96, 120, 144}, {0, 36, 72, 108, 144}, {0, 72, 144}}
{{0, 12, 24, 36, 48, 60, 72, 84, 96, 108, 120, 132, 144},
  {0, 24, 48, 72, 96, 120, 144}, {0, 36, 72, 108, 144}, {0, 72, 144}}
(*Type 2 Network*)
(*Against set 1,2 4*)
(*For Test cases the rows are in order, from up to down
  Illumination DCW nitrate lutein for the experimental data (2,3,4,5)
  Illumination DCW nitrate lutein for the simulated data (6,7,8,9)*
  From up to down they are set 1, 2 and 4.
  Lutein is 5 and 9*)

lutInd2 = {5, 10}
nitInd2 = {4, 9}
DCWInd2 = {3, 8}

Out[415]= {{0, 12, 24, 36, 48, 60, 72, 84, 96, 108, 120, 132},
  {0, 24, 48, 72, 96, 120, 144}, {0, 36, 72, 108, 144}, {0, 72, 144}}

Out[416]= {{0, 12, 24, 36, 48, 60, 72, 84, 96, 108, 120, 132, 144},
  {0, 24, 48, 72, 96, 120, 144}, {0, 36, 72, 108, 144}, {0, 72, 144}}

Out[417]= {5, 10}

Out[418]= {4, 9}

Out[419]= {3, 8}

In[420]:= ValT2H1Cross = DeleteCases[
  Import["data/Lutein_NN_Type2H1_CrossValNew_LessNoise2_ExpTrajSTD_Rescale.csv",
    "CSV"][[3 ;;]] // Transpose, "", -1];
LUTEIN1A = Part[ValT2H1Cross, lutInd2];
NIT1A = Part[ValT2H1Cross, nitInd2];
DCW1A = Part[ValT2H1Cross, DCWInd2];

In[424]:= (*The two cross validation sets*)

In[425]:= RealLut1 = LUTEIN1A[[1]][[ ;; 12]];
RealNit1 = NIT1A[[1]][[ ;; 12]];
RealDCW1 = DCW1A[[1]][[ ;; 12]];
RealLut2 = LUTEIN1A[[1]][[13 ;;]];
RealNit2 = NIT1A[[1]][[13 ;;]];
RealDCW2 = DCW1A[[1]][[13 ;;]];

In[431]:= LUTEINA1 = LUTEIN1A[[2]][[ ;; 12]];
NITA1 = NIT1A[[2]][[ ;; 12]];
DCWA1 = DCW1A[[2]][[ ;; 12]];
LUTEINB1 = LUTEIN1A[[2]][[13 ;;]];
NITB1 = NIT1A[[2]][[13 ;;]];
DCWB1 = DCW1A[[2]][[13 ;;]];

```

```

In[437]:= RealLutA1 = Table[{IntervalsLength[[1, i]], RealLut1[[i]]},
  {i, Length[IntervalsLength[[1]]]};
RealNitA1 = Table[{IntervalsLength[[1, i]], RealNit1[[i]]},
  {i, Length[IntervalsLength[[1]]]};
RealDCWA1 = Table[{IntervalsLength[[1, i]], RealDCW1[[i]]},
  {i, Length[IntervalsLength[[1]]]};
RealLutB1 = Table[{IntervalsLength[[1, i]], RealLut2[[i]]},
  {i, Length[IntervalsLength[[1]]]};
RealNitB1 = Table[{IntervalsLength[[1, i]], RealNit2[[i]]},
  {i, Length[IntervalsLength[[1]]]};
RealDCWB1 = Table[{IntervalsLength[[1, i]], RealDCW2[[i]]},
  {i, Length[IntervalsLength[[1]]]};

In[443]:= CROSSLUT1A = Table[{IntervalsLength[[1, i]], LUTEINA1[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSNIT1A = Table[{IntervalsLength[[1, i]], NITA1[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSDCW1A = Table[{IntervalsLength[[1, i]], DCWA1[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSLUT1B = Table[{IntervalsLength[[1, i]], LUTEINB1[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSNIT1B = Table[{IntervalsLength[[1, i]], NITB1[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSDCW1B = Table[{IntervalsLength[[1, i]], DCWB1[[i]]},
  {i, Length[IntervalsLength[[1]]]};

In[449]:= (*Against set 3*)
ValT2H1CrossVal = DeleteCases[
  Import["data/Lutein_NN_Type2H1_CrossValNew_LessNoise2_SimTrajSTD_Rescale.csv",
    "CSV"][[3 ;;]] // Transpose, "", -1];
LUTEIN5A = Part[ValT2H1CrossVal, lutInd2][[2]];
NIT5A = Part[ValT2H1CrossVal, nitInd2][[2]];
DCW5A = Part[ValT2H1CrossVal, DCWInd2][[2]];

In[453]:= LUTEINA5 = LUTEIN5A[[ ;; 12]];
NITA5 = NIT5A[[ ;; 12]];
DCWA5 = DCW5A[[ ;; 12]];
LUTEINB5 = LUTEIN5A[[13 ;;]];
NITB5 = NIT5A[[13 ;;]];
DCWB5 = DCW5A[[13 ;;]];

```

```

In[459]:= CROSSLUT5A = Table[{IntervalsLength[[1, i]], LUTEINA5[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSNIT5A = Table[{IntervalsLength[[1, i]], NITA5[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSDCW5A = Table[{IntervalsLength[[1, i]], DCWA5[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSLUT5B = Table[{IntervalsLength[[1, i]], LUTEINB5[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSNIT5B = Table[{IntervalsLength[[1, i]], NITB5[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSDCW5B = Table[{IntervalsLength[[1, i]], DCWB5[[i]]},
  {i, Length[IntervalsLength[[1]]]};

In[465]:= ValT2H2CrossVal = DeleteCases[
  Import["data/Lutein_NN_Type2H2_CrossValNew_LessNoise2_ExpTrajSTD_Rescale.csv",
    "CSV"][[3 ;;]] // Transpose, "", -1];
LUTEIN7A = Part[ValT2H2CrossVal, lutInd2][[2]];
NIT7A = Part[ValT2H2CrossVal, nitInd2][[2]];
DCW7A = Part[ValT2H2CrossVal, DCWInd2][[2]];

In[469]:= LUTEINA7 = LUTEIN7A[[ ;; 12]];
NITA7 = NIT7A[[ ;; 12]];
DCWA7 = DCW7A[[ ;; 12]];
LUTEINB7 = LUTEIN7A[[13 ;;]];
NITB7 = NIT7A[[13 ;;]];
DCWB7 = DCW7A[[13 ;;]];

In[475]:= CROSSLUT7A = Table[{IntervalsLength[[1, i]], LUTEINA7[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSNIT7A = Table[{IntervalsLength[[1, i]], NITA7[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSDCW7A = Table[{IntervalsLength[[1, i]], DCWA7[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSLUT7B = Table[{IntervalsLength[[1, i]], LUTEINB7[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSNIT7B = Table[{IntervalsLength[[1, i]], NITB7[[i]]},
  {i, Length[IntervalsLength[[1]]]};
CROSSDCW7B = Table[{IntervalsLength[[1, i]], DCWB7[[i]]},
  {i, Length[IntervalsLength[[1]]]};

In[481]:=

In[482]:= ValT2H2CrossVal = DeleteCases[
  Import["data/Lutein_NN_Type2H2_CrossValNew_LessNoise2_SimTrajSTD_Rescale.csv",
    "CSV"][[3 ;;]] // Transpose, "", -1];
LUTEIN8A = Part[ValT2H2CrossVal, lutInd2][[2]];
NIT8A = Part[ValT2H2CrossVal, nitInd2][[2]];
DCW8A = Part[ValT2H2CrossVal, DCWInd2][[2]];

```

```

In[486]:= LUTEINA8 = LUTEIN8A[[ ; ; 12]];
          NITA8 = NIT8A[[ ; ; 12]];
          DCWA8 = DCW8A[[ ; ; 12]];
          LUTEINB8 = LUTEIN8A[[13 ; ;]];
          NITB8 = NIT8A[[13 ; ;]];
          DCWB8 = DCW8A[[13 ; ;]];

In[492]:= CROSSLUT8A = Table[{IntervalsLength[[1, i]], LUTEINA8[[i]]},
                             {i, Length[IntervalsLength[[1]]]}];
          CROSSNIT8A = Table[{IntervalsLength[[1, i]], NITA8[[i]]},
                             {i, Length[IntervalsLength[[1]]]}];
          CROSSDCW8A = Table[{IntervalsLength[[1, i]], DCWA8[[i]]},
                             {i, Length[IntervalsLength[[1]]]}];
          CROSSLUT8B = Table[{IntervalsLength[[1, i]], LUTEINB8[[i]]},
                             {i, Length[IntervalsLength[[1]]]}];
          CROSSNIT8B = Table[{IntervalsLength[[1, i]], NITB8[[i]]},
                             {i, Length[IntervalsLength[[1]]]}];
          CROSSDCW8B = Table[{IntervalsLength[[1, i]], DCWB8[[i]]},
                             {i, Length[IntervalsLength[[1]]]}];

```

Plotting Data

Lutein

```

In[498]:= (*This is plotted in regard to the cross validation data*)

In[499]:= (*Type 1, 1 Layer*)

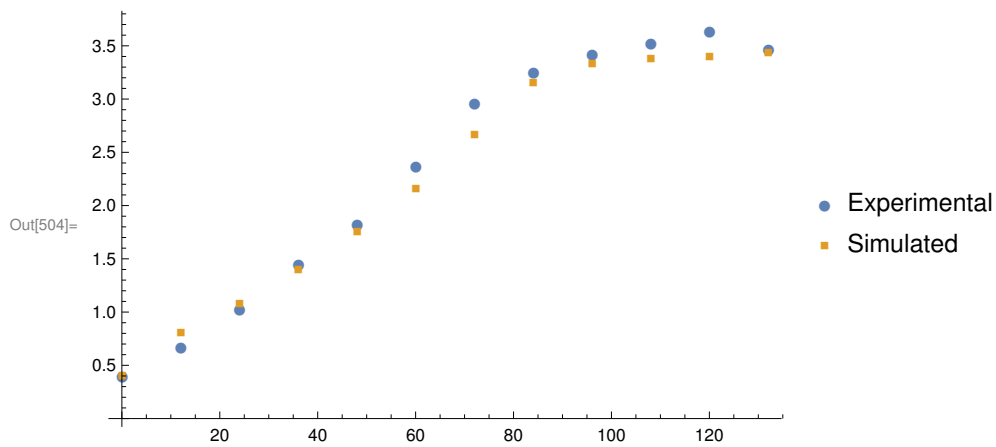
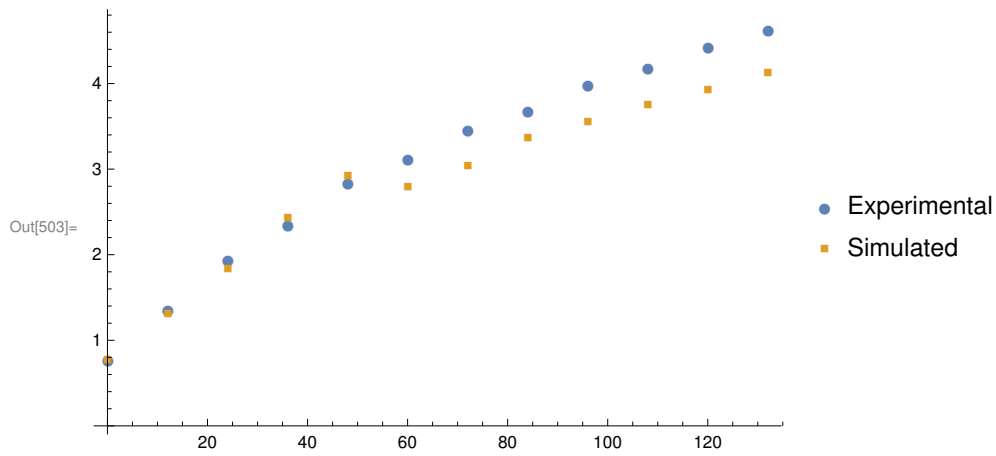
In[500]:= legendLab2 = {"Experimental", "Simulated"}
Out[500]= {Experimental, Simulated}

In[501]:= (*1 Hidden layer*)

In[502]:= (*Expected value from experimental point*)

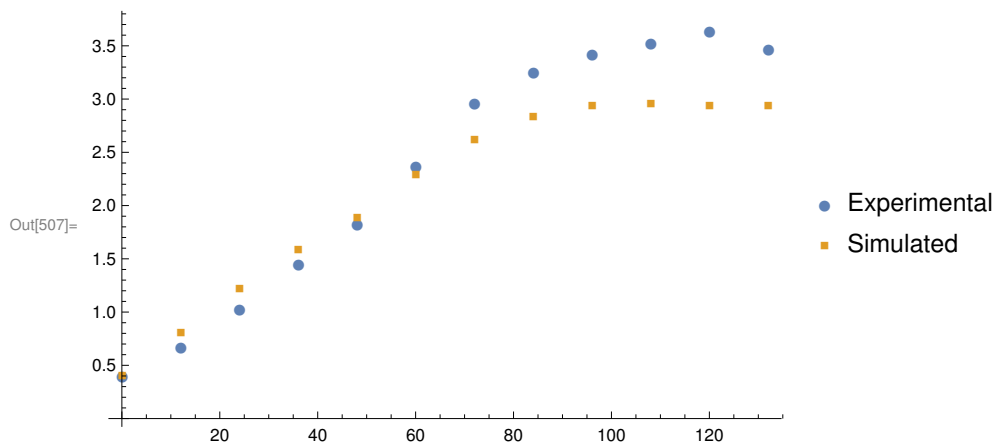
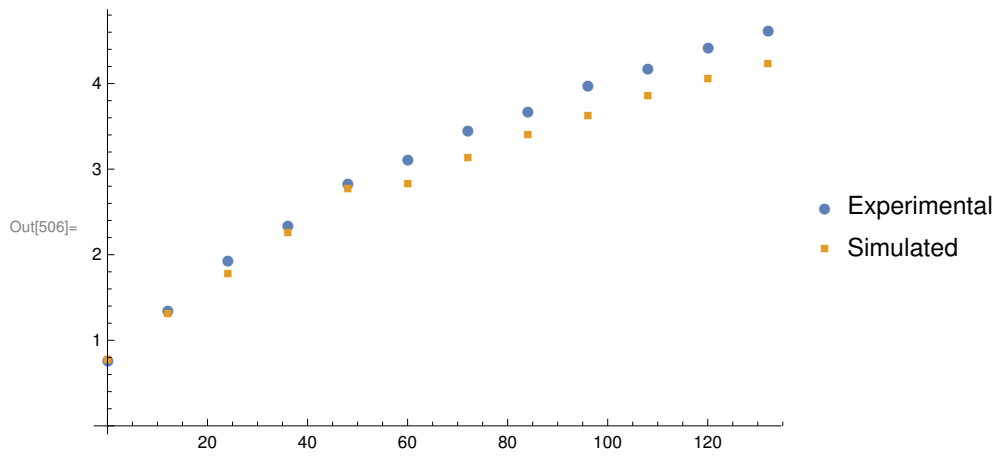
```

```
In[503]:= ListPlot[{RealLutA1, CROSSLUT1A}, PlotMarkers → Automatic, PlotLegends → legendLab2]  
ListPlot[{RealLutB1, CROSSLUT1B}, PlotMarkers → Automatic, PlotLegends → legendLab2]
```



```
In[505]:= (*Fully Simulated Trajectory*)
```

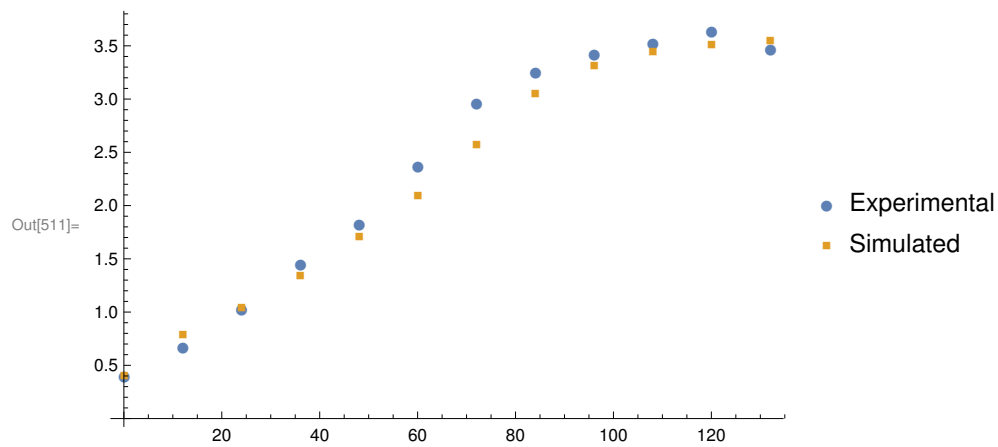
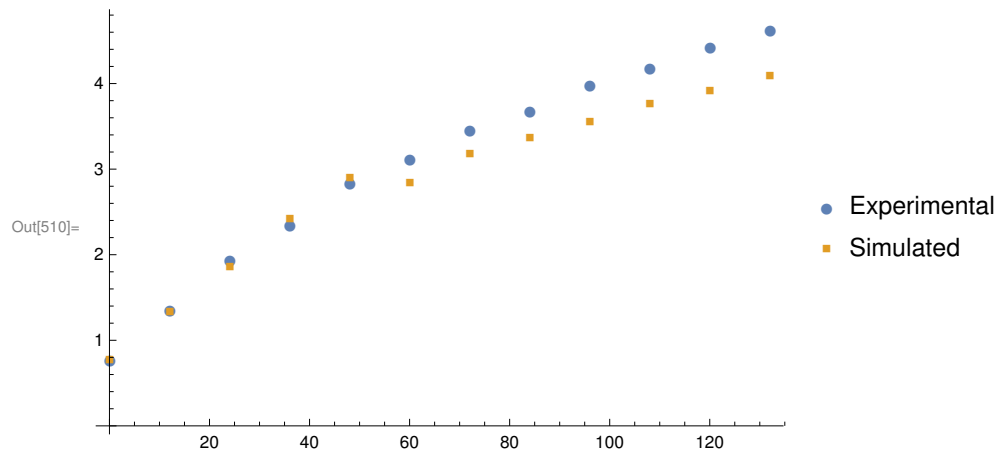
```
In[506]:= ListPlot[{RealLutA1, CROSSLUT5A}, PlotMarkers → Automatic, PlotLegends → legendLab2]
ListPlot[{RealLutB1, CROSSLUT5B}, PlotMarkers → Automatic, PlotLegends → legendLab2]
```



```
In[508]:= (*2 Hidden Layers*)
```

```
In[509]:= (*From Experimental points*)
```

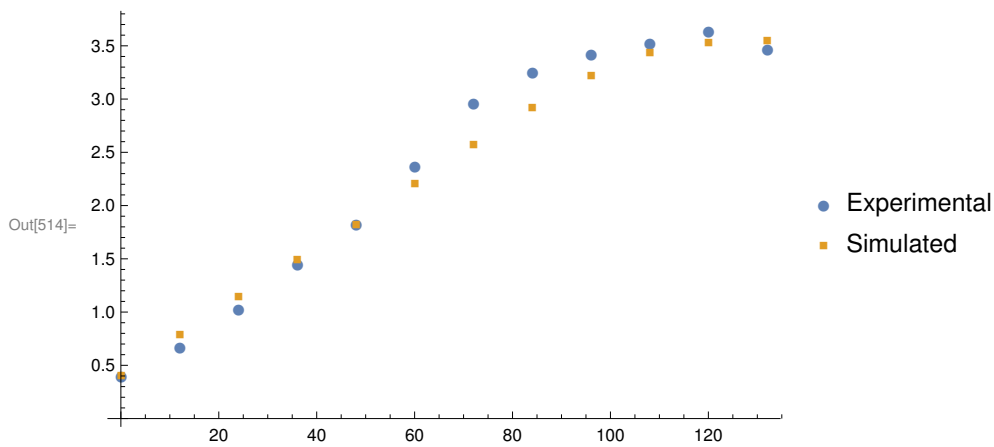
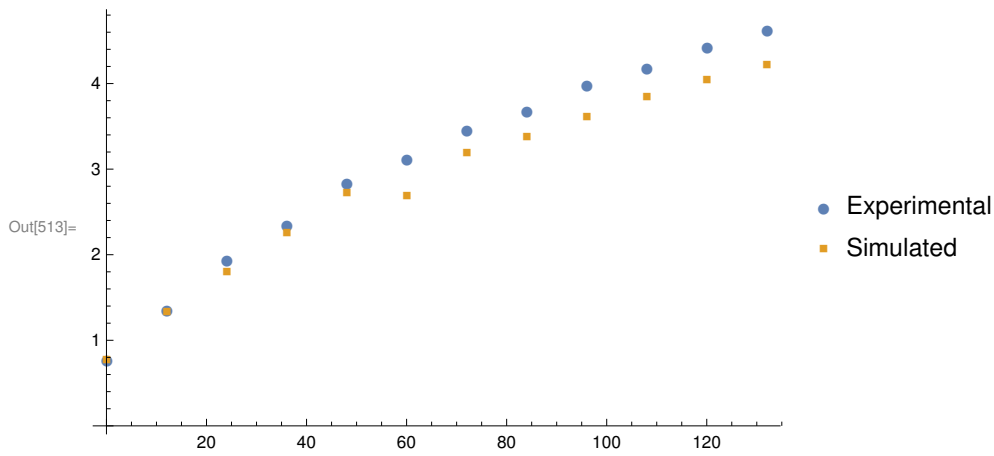
```
In[510]:= ListPlot[{RealLutA1, CROSSLUT7A}, PlotMarkers → Automatic, PlotLegends → legendLab2]  
ListPlot[{RealLutB1, CROSSLUT7B}, PlotMarkers → Automatic, PlotLegends → legendLab2]
```



```
In[512]:= (*Fully Simulated Trajectory*)
```



```
In[513]:= ListPlot[{RealLutA1, CROSSLUT8A}, PlotMarkers → Automatic, PlotLegends → legendLab2]
ListPlot[{RealLutB1, CROSSLUT8B}, PlotMarkers → Automatic, PlotLegends → legendLab2]
```



Nitrogen

```
In[515]:= (*This is plotted in regard to the cross validation data*)
```

```
In[516]:= (*Type 1, 1 Layer*)
```

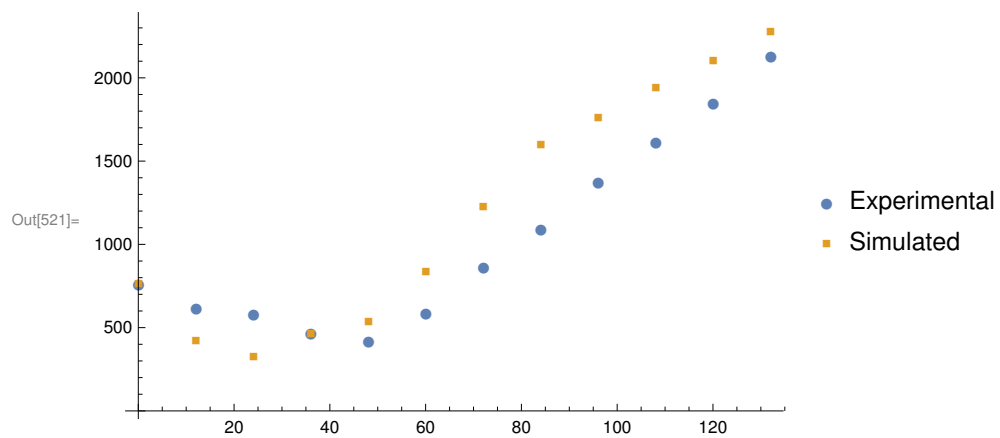
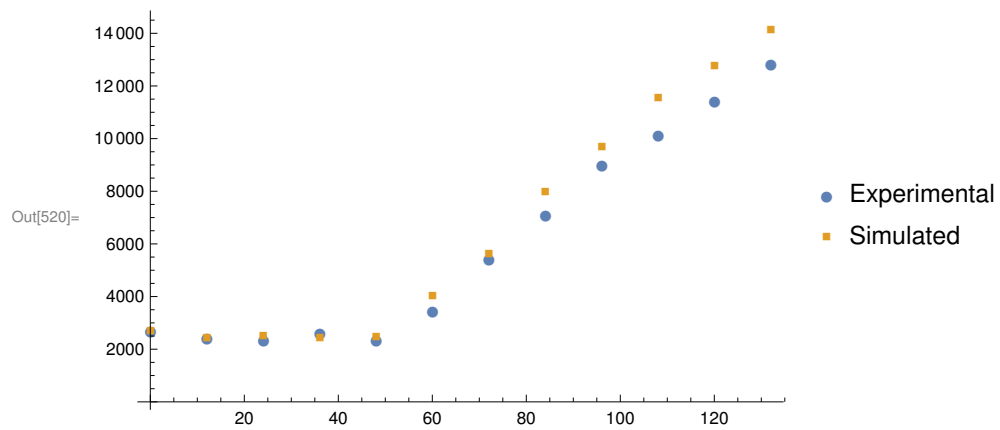
```
In[517]:= legendLab2 = {"Experimental", "Simulated"}
```

```
Out[517]= {Experimental, Simulated}
```

```
In[518]:= (*1 Hidden layer*)
```

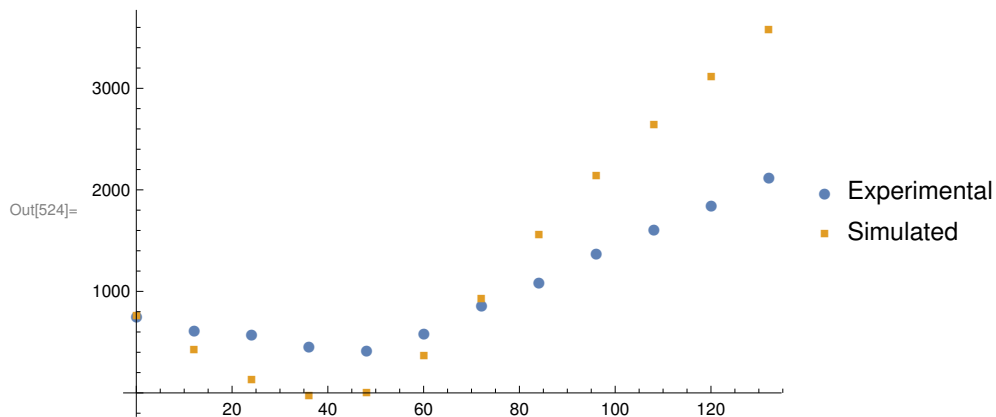
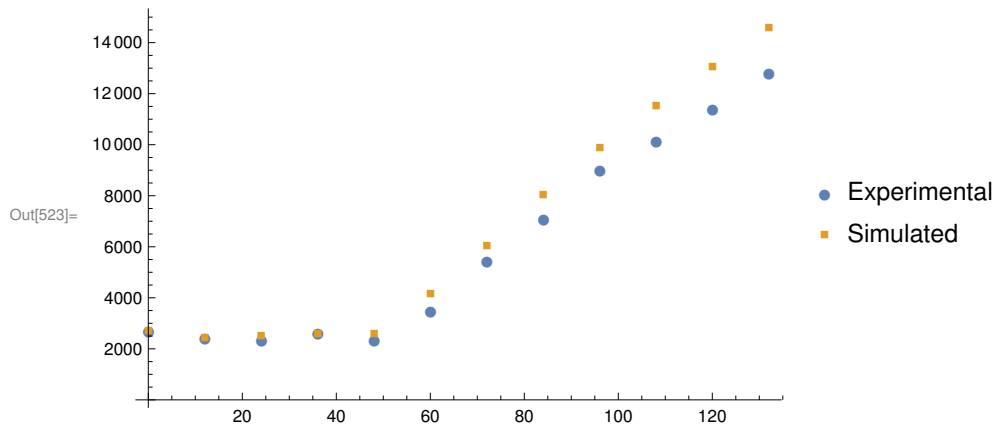
```
In[519]:= (*Expected value from experimental point*)
```

```
In[520]:= ListPlot[{RealNitA1, CROSSNIT1A}, PlotMarkers → Automatic, PlotLegends → legendLab2]  
ListPlot[{RealNitB1, CROSSNIT1B}, PlotMarkers → Automatic, PlotLegends → legendLab2]
```



```
In[522]:= (*Fully Simulated Trajectory*)
```

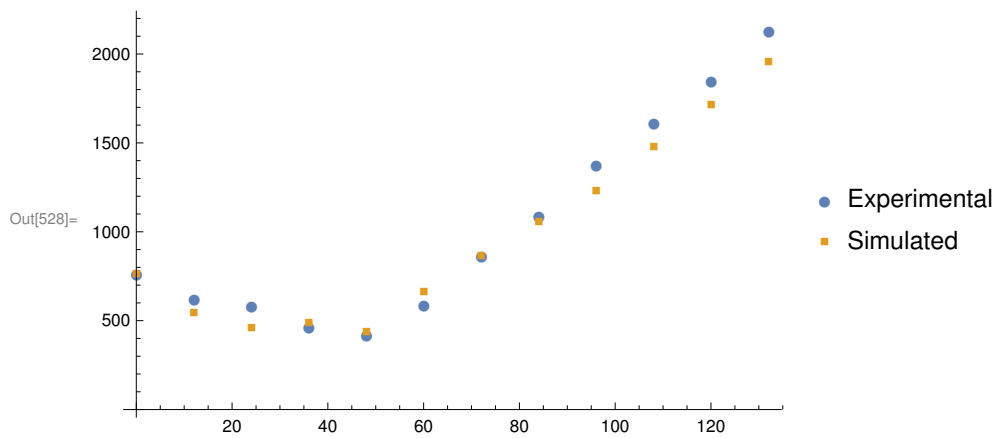
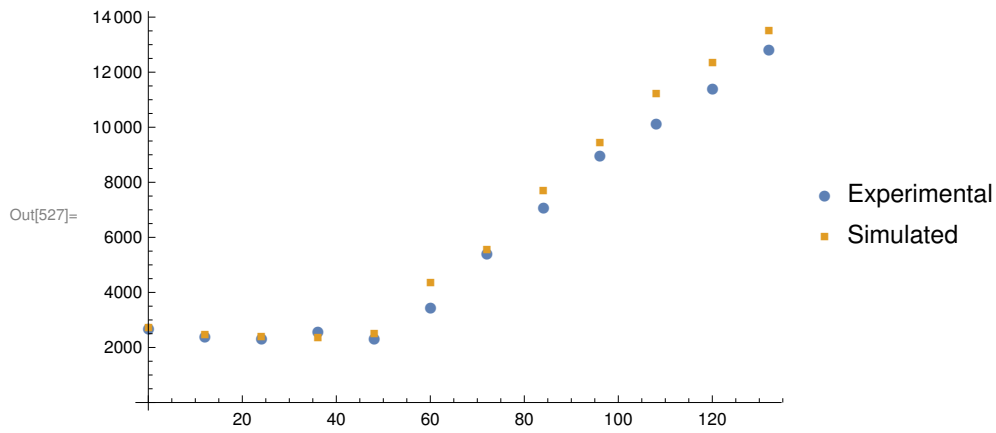
```
In[523]:= ListPlot[{RealNitA1, CROSSNIT5A}, PlotMarkers → Automatic, PlotLegends → legendLab2]
ListPlot[{RealNitB1, CROSSNIT5B}, PlotMarkers → Automatic, PlotLegends → legendLab2]
```



```
In[525]:= (*2 Hidden Layers*)
```

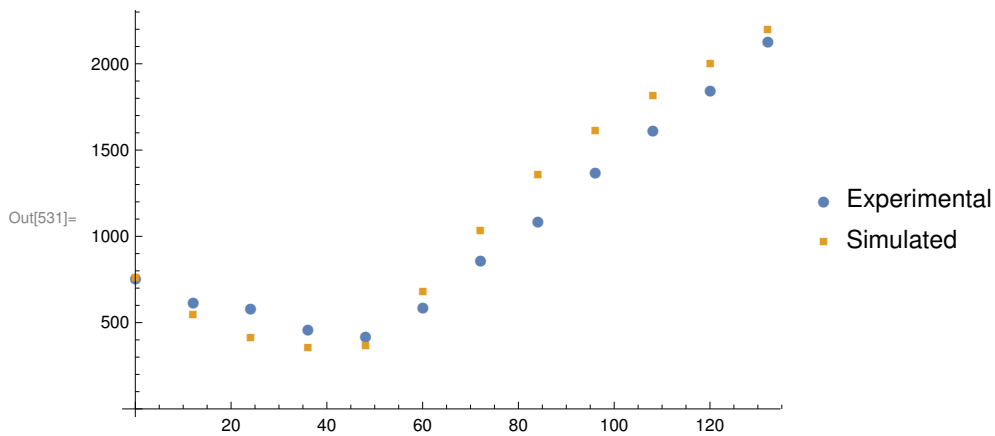
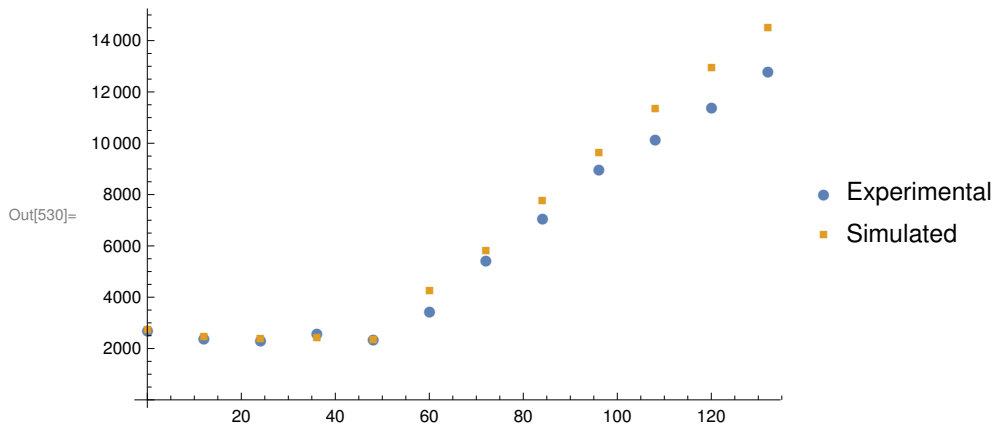
```
In[526]:= (*From Experimental points*)
```

```
In[527]:= ListPlot[{RealNitA1, CROSSNIT7A}, PlotMarkers → Automatic, PlotLegends → legendLab2]  
ListPlot[{RealNitB1, CROSSNIT7B}, PlotMarkers → Automatic, PlotLegends → legendLab2]
```



```
In[529]:= (*Fully Simulated Trajectory*)
```

```
In[530]:= ListPlot[{RealNitA1, CROSSNIT8A}, PlotMarkers → Automatic, PlotLegends → legendLab2]
ListPlot[{RealNitB1, CROSSNIT8B}, PlotMarkers → Automatic, PlotLegends → legendLab2]
```



DCW

```
In[532]:= (*This is plotted in regard to the cross validation data*)
```

```
In[533]:= (*Type 1, 1 Layer*)
```

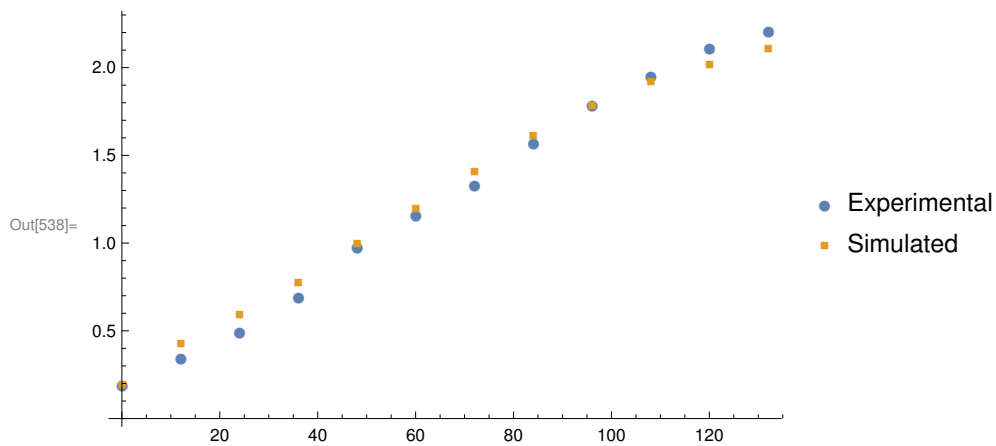
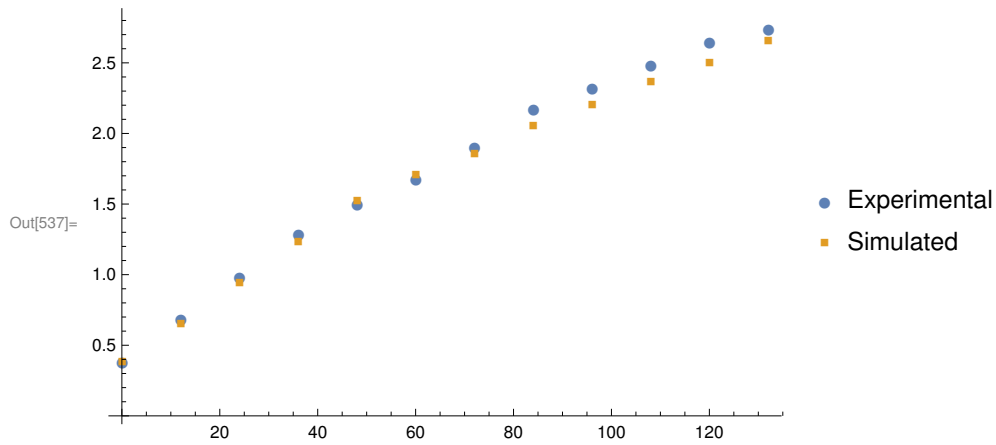
```
In[534]:= legendLab2 = {"Experimental", "Simulated"}
```

```
Out[534]= {Experimental, Simulated}
```

```
In[535]:= (*1 Hidden layer*)
```

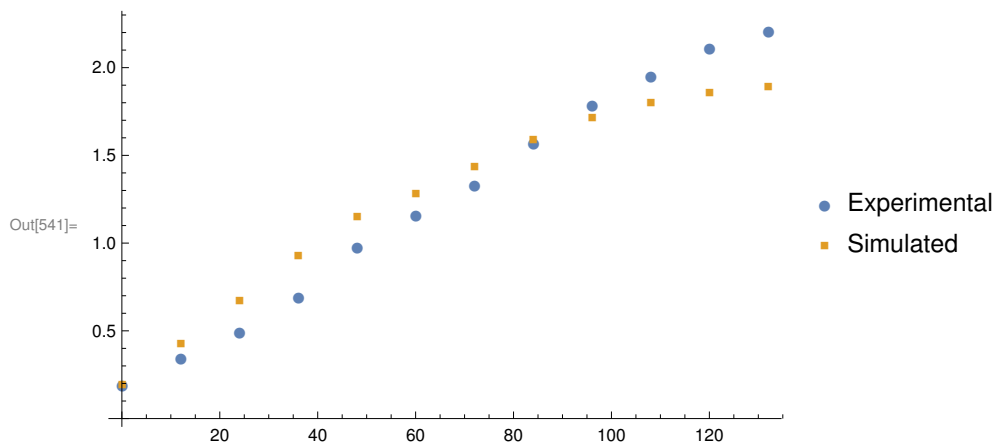
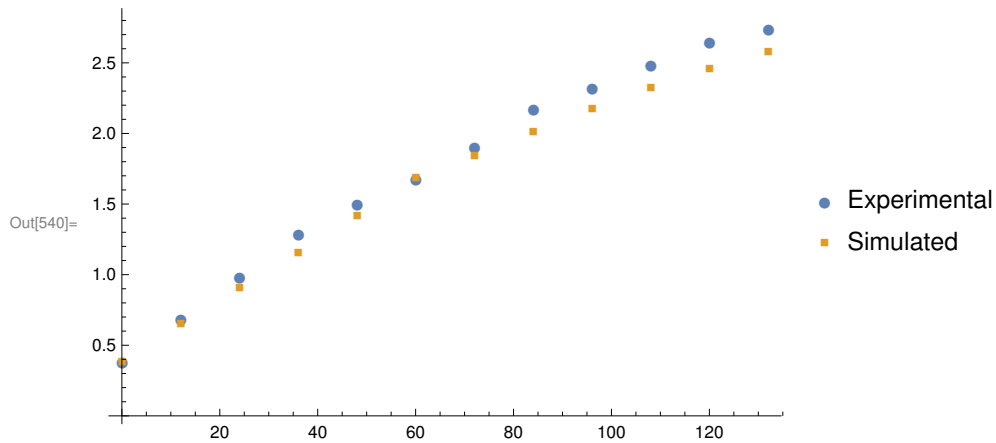
```
In[536]:= (*Expected value from experimental point*)
```

```
In[537]:= ListPlot[{RealDCWA1, CROSSDCW1A}, PlotMarkers → Automatic, PlotLegends → legendLab2]  
ListPlot[{RealDCWB1, CROSSDCW1B}, PlotMarkers → Automatic, PlotLegends → legendLab2]
```



```
In[539]:= (*Fully Simulated Trajectory*)
```

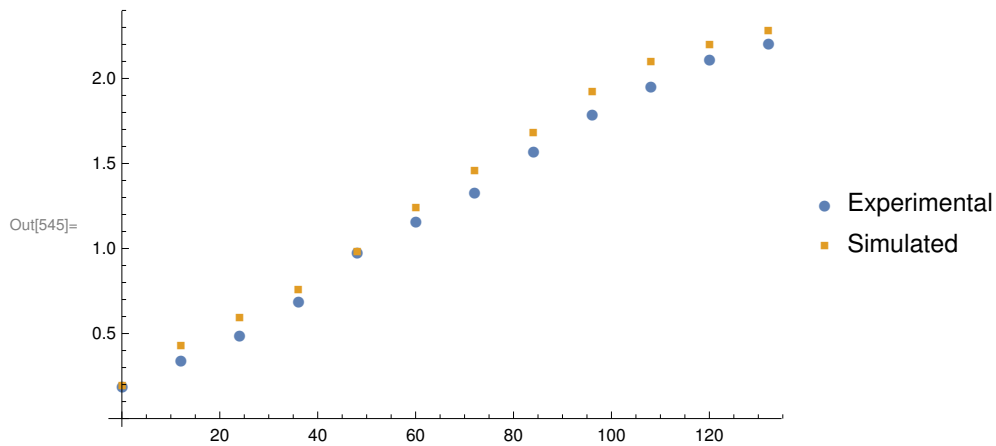
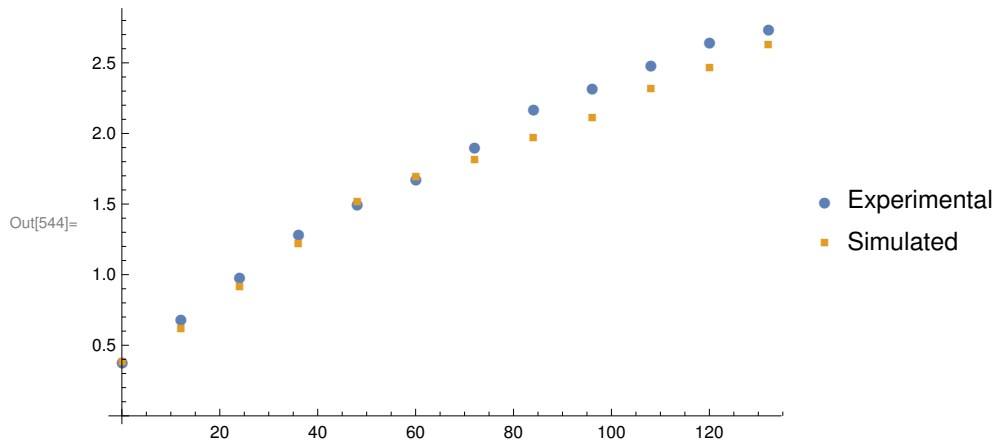
```
In[540]:= ListPlot[{RealDCWA1, CROSSDCW5A}, PlotMarkers → Automatic, PlotLegends → legendLab2]
ListPlot[{RealDCWB1, CROSSDCW5B}, PlotMarkers → Automatic, PlotLegends → legendLab2]
```



```
In[542]:= (*2 Hidden Layers*)
```

```
In[543]:= (*From Experimental points*)
```

```
In[544]:= ListPlot[{RealDCWA1, CROSSDCW7A}, PlotMarkers → Automatic, PlotLegends → legendLab2]  
ListPlot[{RealDCWB1, CROSSDCW7B}, PlotMarkers → Automatic, PlotLegends → legendLab2]
```



```
In[546]:= (*Fully Simulated Trajectory*)
```



```
In[547]:= ListPlot[{RealDCWA1, CROSSDCW8A}, PlotMarkers → Automatic, PlotLegends → legendLab2]  
ListPlot[{RealDCWB1, CROSSDCW8B}, PlotMarkers → Automatic, PlotLegends → legendLab2]
```

