Jupyter Notebook Execution Report

Name: Your Name

Date: November 20, 2025

Cell 1: ■ Code

```
using SciMLSensitivity
using DifferentialEquations
using SciMLSensitivity # or DiffEqSensitivity if you prefer
using Zygote
using Optimisers # for optimizer & update
using LinearAlgebra
using DifferentialEquations
using Flux
using Plots
using Optimization
using OptimizationOptimisers
using Zygote
using DataFrames
```

```
using Random
Random.seed!(1234)
println("All the nessecessary packages have been imported")
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 1
    using SciMLSensitivity
          ^^^^^^^^^^^^^^^^
SyntaxError: invalid syntax
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 1
```

```
    using SciMLSensitivity
          ^^^^^^^^^^^^^^^^
SyntaxError: invalid syntax
```

Cell 2: ■ Code

```
# Hodgkin-Huxley Model Parameters (Global Constants)
```

```
# Physical Constants
const Cm = 1.0 # µF/cm^2
const g_Na = 120.0 # mS/cm^2
const g_K = 36.0 # mS/cm^2
const g_L = 0.3 # mS/cm^2
const E_Na = 50.0 # mV
const E_K = -77.0 # mV
const E_L = -54.387 # mV
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 5
    const Cm = 1.0        # µF/cm^2
          ^^
SyntaxError: invalid syntax
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 6
    const Cm = 1.0        # µF/cm^2
          ^^
SyntaxError: invalid syntax
```

Cell 3: ■ Code

```
# --- Cell 2: Known Physics & Stimulus ---
```

```
# Voltage-gated ion channel kinetics
α_n(V) = 0.01 * (V + 55) / (1 - exp(-(V + 55) / 10))
β_n(V) = 0.125 * exp(-(V + 65) / 80)
α_m(V) = 0.1 * (V + 40) / (1 - exp(-(V + 40) / 10))
```

```
β_m(V) = 4.0 * exp(-(V + 65) / 18)
α_h(V) = 0.07 * exp(-(V + 65) / 20)
β_h(V) = 1 / (1 + exp(-(V + 35) / 10))
```

```
# Steady-state & time-constant functions for the 2D model
m_inf(V) = α_m(V) / (α_m(V) + β_m(V))
h_inf(V) = α_h(V) / (α_h(V) + β_h(V))
n_inf(V) = α_n(V) / (α_n(V) + β_n(V))
tau_n(V) = 1 / (α_n(V) + β_n(V))
```

```
println("Physics of neural dynamics has been defined")
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 4
    α_n(V) = 0.01 * (V + 55) / (1 - exp(-(V + 55) / 10))
    ^^^^^^
SyntaxError: cannot assign to function call here. Maybe you meant '==' instead of '='?
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 4
    α_n(V) = 0.01 * (V + 55) / (1 - exp(-(V + 55) / 10))
    ^^^^^^
SyntaxError: cannot assign to function call here. Maybe you meant '==' instead of '='?
```

Cell 4: ■ Code

```
function Stimulus(t)
# A 1ms pulse starting at 10ms
return(t&gt;-10.0 && t&lt;11.0) ? 20 : 0.0
end
```

```
println(" An extra current form neighbour to generate a pulse")
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 1
    function Stimulus(t)
```

```
            ^^^^^^^^
SyntaxError: invalid syntax
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 1
    function Stimulus(t)
             ^^^^^^^^
SyntaxError: invalid syntax
```

Cell 5: ■ Code

```
# --- Cell 3: Data Generation ---
```

```
# 2D Hodgkin-Huxley reduced model engine
function hodgkin_huxley_reduced!(du, u, p, t)
V, n = u
I_ext = Stimulus(t)
```

```
# Known 2D current
I_Na = g_Na * m_inf(V)^3 * h_inf(V) * (V - E_Na)
I_K = g_K * n^4 * (V - E_K)
I_L = g_L * (V - E_L)
du[1] = (I_ext - I_Na - I_K - I_L) / Cm
du[2] = (n_inf(V) - n) / tau_n(V)
end
```

```
# Generate Data
u0_true = [-65.0, n_inf(-65.0)]
tspan = (0.0, 50.0)
prob_true = ODEProblem(hodgkin_huxley_reduced!, u0_true, tspan)
sol_true = solve(prob_true, Rodas5P(), saveat=0.5)
```

```
# Extract and structure the training data
data_V = sol_true[1, :]
t_train = sol_true.t
```

```
# (Optional) Verify data shape and content
df = DataFrame(t=t_train, V=data_V )
println("Generated Training Data:")
```

```
display(first(df, 5))
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 4
    function hodgkin_huxley_reduced!(du, u, p, t)
             ^^^^^^^^^^^^^^^^^^^^^^
SyntaxError: invalid syntax
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 4
    function hodgkin_huxley_reduced!(du, u, p, t)
             ^^^^^^^^^^^^^^^^^^^^^^
SyntaxError: invalid syntax
```

Cell 6: ■ Code

```
U = Chain(

Dense(1,15, tanh,init = Flux.glorot_uniform),

# Dense(15,30,tanh,init = Flux.glorot_uniform),

Dense(15,1,init=Flux.glorot_uniform)

)
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 1
    U = Chain(
             ^
SyntaxError: '(' was never closed
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 1, in &lt;module&gt;
NameError: name 'Chain' is not defined
```

Cell 7: ■ Code

```
# Extract the trainable parameters (p_nn) and the re-structuring function (re)
```

```
p_nn, re = Flux.destructure(U)
println("Recruit Constructed. Parameters: ", length(p_nn))
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 2, in &lt;module&gt;
NameError: name 'Flux' is not defined
```

Cell 8: ■ Markdown

The hybrid UDE

Cell 9: ■ Code

```
# Define the UDE function with the embedded neural network
function ude_dynamics!(du, u, p, t)
V, n = u
# p --&gt; p_nn neural network parameters
# Neural network component to learn the unknown current
# we will normalize V roughly ( divide by 100) to keep inputs clean for the NN
```

```
nn_input = V / 100.0
# We divide V by 100.0 to keep inputs small for the Neural Network
# Example: -65mV becomes -0.65
```

```
nn_I_Na = re(p)([nn_input])[1]
# Known physics components
I_ext = Stimulus(t)
I_K = g_K * n^4 * (V - E_K)
I_L = g_L * (V - E_L)
```

```
# The hybrid dynamics equation
du[1] = (I_ext + nn_I_Na - I_K - I_L) / Cm
du[2] = (n_inf(V) - n) / tau_n(V)
end
println("Hybrid Engine Assembled.")
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 2
    function ude_dynamics!(du, u, p, t)
             ^^^^^^^^^^^^
SyntaxError: invalid syntax
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 4
    function ude_dynamics!(du, u, p, t)
             ^^^^^^^^^^^^
SyntaxError: invalid syntax
```

Cell 10: ■ Code

```
# ---- Stable predict function using BacksolveAdjoint and Float64 inputs ----
```

```
prob_nn = ODEProblem(ude_dynamics!,u0_true,tspan , p_nn)
function predict_ude(p)
# build problem with the current flattened NN params
```

```
_prob=remake(prob_nn,p=p)
```

```
solve(_prob, Rodas5P(), saveat=t_train,
sensealg=InterpolatingAdjoint(autojacvec=ZygoteVJP()))
end
```

```
# ---- Loss function (keep as Float64) ----
function loss(p)
pred = predict_ude(p)
if pred.retcode != :Success
return 1e6
end
pred_V = pred[1, :]
loss_val = sum(abs2, pred_V .- data_V)
return loss_val
end
```

```
println("Objective Functions Defined.")
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 5
    prob_nn = ODEProblem(ude_dynamics!,u0_true,tspan , p_nn)
                                       ^
SyntaxError: invalid syntax
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 5
    prob_nn = ODEProblem(ude_dynamics!,u0_true,tspan , p_nn)
                                       ^
SyntaxError: invalid syntax
```

Cell 11: ■ Code

```
losses=[]

callback = function (p, l)

push!(losses, l)

if length(losses) % 50 == 0

println("Iteration: $(length(losses)) | Loss: $l")

end

return false

end
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 3
    push!(losses, l)
IndentationError: unexpected indent
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 4
    push!(losses, l)
IndentationError: unexpected indent
```

Cell 12: ■ Code

```
# Define the optimization problem
optf = Optimization.OptimizationFunction((x, p) -&gt; loss(x),
Optimization.AutoZygote())
optprob = Optimization.OptimizationProblem(optf, p_nn)
```

```
# Execute the training mission
println("Commencing Training...")
# We use a lower learning rate for stability and more iterations.
# This is a full-scale training run. It may take a few minutes.
res = Optimization.solve(optprob, OptimizationOptimisers.Adam(0.02),
callback=callback, maxiters=5000)
```

```
println("--- TRAINING COMPLETE ---")
println("Training Complete. Final Loss: ", res.objective)
```

Error:

```
  Traceback (most recent call last):
    File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
      exec('\n'.join(lines[:-1]), glb)
    File "&lt;string&gt;", line 2
      optf = Optimization.OptimizationFunction((x, p) -&gt; loss(x), Optimization.AutoZygote())
                                                 ^^
  SyntaxError: invalid syntax
  During handling of the above exception, another exception occurred:
  Traceback (most recent call last):
    File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
      exec(source, glb)
    File "&lt;string&gt;", line 3
      optf = Optimization.OptimizationFunction((x, p) -&gt; loss(x), Optimization.AutoZygote())
                                                 ^^
  SyntaxError: invalid syntax
```

Cell 13: ■ Code

```
using OptimizationOptimJL # Essential for L-BFGS/BFGS
```

Error:

```
  Traceback (most recent call last):
    File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 403
      result = eval(lines[-1], glb)
               ^^^^^^^^^^^^^^^^^^^^
```

```
  File "&lt;string&gt;", line 1
    using OptimizationOptimJL # Essential for L-BFGS/BFGS
          ^^^^^^^^^^^^^^^^^^^
SyntaxError: invalid syntax
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 1
    using OptimizationOptimJL # Essential for L-BFGS/BFGS
          ^^^^^^^^^^^^^^^^^^^
SyntaxError: invalid syntax
```

Cell 14: ■ Code

Cell 15: ■ Code

```
# 2. Set up the problem again using Adam's final result (res.u)
# Note: We stick with the same 'optf' we defined earlier.
optprob2 = Optimization.OptimizationProblem(optf, res.u)
```

```
losses_phase2 = []
```

```
callback_phase2 = function (p, l)
push!(losses_phase2, l)
if length(losses_phase2) % 10 == 0 # Log more frequently
println("Phase II Iter: $(length(losses_phase2)) | Loss: $l")
end
return false
end
```

```
println("--- ATTEMPTING PHASE II: BFGS (Heavy Tank) ---")
```

```
# STRATEGY CHANGE:
# 1. Use BFGS() instead of LBFGS() - it is more robust.
# 2. Use linesearch=BackTracking() - helps it step carefully over rough terrain.
try
res_final = Optimization.solve(optprob2, OptimizationOptimJL.BFGS(),
callback=callback_phase2,
maxiters=500)
```

```
println("--- MISSION SUCCESS ---")
println("Final Refined Loss: ", res_final.objective)
```

```
# Update the plotting with the new data
final_solution_params = res_final.u
```

```
catch e
println("BFGS Stalled/Failed. Fallback to parameters from Adam.")
println("Error: ", e)
final_solution_params = res.u
end
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 8
    push!(losses_phase2, l)
IndentationError: unexpected indent
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 9
    push!(losses_phase2, l)
IndentationError: unexpected indent
```

Cell 16: ■ Code

```
# Use the final parameters from the sniper mission (res_final.u)
final_sol = predict_ude(res_final.u)
```

```
p2 = plot(t_train, data_V,
label="Ground Truth (Biology)", lw=4, color=:green, alpha=0.4)
```

```
plot!(p2, final_sol.t, final_sol[1, :],
label="Hybrid Agent (UDE)", lw=2, color=:red, linestyle=:dash)
```

```
title!(p2, "Mission Outcome: UDE Prediction vs Reality")
xlabel!("Time (ms)")
ylabel!("Voltage (mV)")
```

```
display(p2)
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 5
    label="Ground Truth (Biology)", lw=4, color=:green, alpha=0.4)
                                                        ^
SyntaxError: invalid syntax
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 5
    label="Ground Truth (Biology)", lw=4, color=:green, alpha=0.4)
                                                        ^
SyntaxError: invalid syntax
```

Cell 17: ■ Code

```
# 1. Calculate the TRUE Sodium Current from the biology (Analytic)
# We use the data we generated way back in step 3
I_Na_true = [g_Na * m_inf(v)^3 * h_inf(v) * (v - E_Na) for v in data_V]
```

```
# 2. Calculate what our Neural Network THINKS the current is
# We pass the voltage data through the trained network 're(res_final.u)'
nn_currents = [re(res_final.u)([v/100])[1] for v in data_V]
```

```
# 3. Compare them
p3 = plot(t_train, I_Na_true,
label="True Physics (Hidden)", lw=4, color=:blue, alpha=0.4)
```

```
plot!(p3, t_train, nn_currents,
label="Neural Network Inferred Physics", lw=2, color=:orange, linestyle=:dash)
```

```
title!(p3, "SciML Victory: Recovering Missing Physics")
xlabel!("Time (ms)")
ylabel!("Sodium Current (μA/cm²)")
```

```
display(p3)
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
```

```
  File "&lt;string&gt;", line 11
    label="True Physics (Hidden)", lw=4, color=:blue, alpha=0.4)
                                                 ^
SyntaxError: invalid syntax
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 11
    label="True Physics (Hidden)", lw=4, color=:blue, alpha=0.4)
                                                 ^
SyntaxError: invalid syntax
```

Cell 18: ■ Code

```
plot(losses,
xlabel="Iteration",
ylabel="Loss",
title="Training Loss (Linear Scale)",
label="Loss",
lw=2)
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 1
    plot(losses,
        ^
SyntaxError: '(' was never closed
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 1, in &lt;module&gt;
NameError: name 'plot' is not defined
```

Cell 19: ■ Code

```
# 2. Visualizing the Recruit vs The Master
# Run a prediction with the TRAINED parameters (res.u)
final_sol = predict_ude(res.u)
```

```
p2 = plot(t_train, data_V, label="Ground Truth", lw=3, alpha=0.5, color=:green)
```

```
plot!(p2, final_sol.t, final_sol[1,:], label="UDE Prediction", lw=2, color=:red,
linestyle=:dash)
title!(p2, "Neural Network Performance")
xlabel!("Time (ms)")
ylabel!("Voltage (mV)")
display(p2)
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 5
    p2 = plot(t_train, data_V, label="Ground Truth", lw=3, alpha=0.5, color=:green)
                                                                           ^
SyntaxError: invalid syntax
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 5
    p2 = plot(t_train, data_V, label="Ground Truth", lw=3, alpha=0.5, color=:green)
                                                                           ^
SyntaxError: invalid syntax
```

Cell 20: ■ Code

```
# Combined Plotting
total_iterations = 1:(length(losses_adam) + length(losses_lbfgs))
```

```
# Setup the canvas
p_combined = plot(title="Dual-Phase Training (Adam -&gt; L-BFGS)",
xlabel="Iteration", ylabel="Loss (Log Scale)", yaxis=:log)
```

```
# Plot Phase 1: Adam (Blue)
plot!(p_combined, 1:length(losses_adam), losses_adam,
label="Phase I: Adam (Coarse)", color=:blue, lw=2)
```

```
# Plot Phase 2: L-BFGS (Red)
# We shift the x-axis so it starts exactly where Adam ended
range_phase2 = (length(losses_adam)+1):length(total_iterations)
plot!(p_combined, range_phase2, losses_lbfgs,
label="Phase II: L-BFGS (Fine)", color=:red, lw=2)
```

```
# Add a vertical line to mark the hand-off
vline!(p_combined, [length(losses_adam)], label="Optimizer Switch", color=:black,
linestyle=:dash)
```

```
display(p_combined)
```

Error:

```
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 401
    exec('\n'.join(lines[:-1]), glb)
  File "&lt;string&gt;", line 2
    total_iterations = 1:(length(losses_adam) + length(losses_lbfgs))
                         ^
SyntaxError: invalid syntax
During handling of the above exception, another exception occurred:
Traceback (most recent call last):
  File "c:\Users\Admin\.vscode\extensions\ganeshkumbhar.nb2pdf-1.1.9\scripts\nb2pdf.py", line 408
    exec(source, glb)
  File "&lt;string&gt;", line 2
    total_iterations = 1:(length(losses_adam) + length(losses_lbfgs))
                         ^
SyntaxError: invalid syntax
```

Cell 21: ■ Code

Cell 22: ■ Code

Cell 23: ■ Code