Learn to Train Your Robot Butler

0.1 Overview

This seminar introduces participants to neural networks through the lens of simulation and play. Over the course of the semester, participants will build a simple feedforward neural network from scratch in the Julia programming language and train it to care for a virtual pet, inspired by the Tamagotchi toy. Along the way, they will explore key ideas in machine learning, agent-based modeling, and programming from first principles.

0.2 Participation and Structure

There are no graded assignments or exams. Participants are expected to:

- Engage in weekly seminar sessions and hands-on activities

- Contribute to discussions and collaborative exploration

- Work on a self-directed or group project that integrates neural networks and simulation

- Share progress and insights throughout the semester

0.3 Who Should Join

The seminar is designed to be accessible to those with little or no prior experience in programming or machine learning. It is particularly well-suited for:

- Undergraduate students interested in data science, mathematics, computer science, or artificial intelligence

- Graduate students and faculty looking to explore neural networks in a hands-on, low-stakes setting

- Anyone curious about how machines can learn to care for digital creatures

0.4 Learning Goals

By the end of the seminar, participants will:

1. Understand the basic structure and components of a feedforward neural network

2. Gain experience programming in Julia

3. Design and simulate a simple agent-based system

4. Train a neural network to model behavior from data

5. Build confidence in constructing computational models from scratch

0.5 The Virtual Pet

As a central project, participants will create and interact with a simplified virtual pet simulator. The pet will have internal states (such as hunger, boredom, or fatigue) and respond to external actions (like feeding, playing, or resting). After defining the rules of the simulation, participants will generate training data and develop a neural network to approximate the behavior of an ideal caretaker.

0.6 Weekly Topics and Milestones

Duration: 15 weeks
Meetings: Weekly 2–3 hour seminar sessions

Week	Topic	Milestone
1	Intro to Julia	Julia install + basic syntax
2	Control flow	Build a text-based mini-game
3	Functions & structs	Design a pet simulator prototype
4	Arrays & matrix operations	Implement feedforward logic
5	Neural network overview	Build a simple perceptron
6	Activation & loss functions	Implement sigmoid and loss
7	Forward propagation	Complete multi-layer forward pass
8	Backpropagation	Gradient calculation by hand
9	Training loop	Begin model training
10	Simulation design	Define pet rules and states
11	Data generation	Log caretaker behavior
12	Model training	Train NN on simulated data
13	Testing & refinement	Improve model performance
14	Project development	Finalize simulation and network
15	Project showcase	Demonstrations and reflections

0.7 Tools and Materials

- Programming Language: Julia

- Coding Environment: Pluto.jl notebooks

- Simulation Framework: Custom, participant-built

- Optional Tools: Git and version control platforms for collaboration

0.8 Challenges and Strategies

Challenge	Strategy
Limited programming background	Scaffold concepts with examples and hands-on walk-throughs
Matrix operations and math	Provide visualizations and intuitive analogies
Simulation complexity	Start with minimal designs, encourage iteration
Understanding neural network mechanics	Break down forward/backward passes with step-by-step visuals

0.9 Expected Outcomes

Participants will leave the seminar with:

- A functional understanding of neural networks and how they learn

- Practical experience with programming and debugging in Julia

- A working project that showcases AI behavior in a simulated environment

- New computational skills and creative confidence

Seminar Syllabus

Title

Learn to Train Your Robot Butler — A Playful Approach to Neural Networks, AI, and Julia Programming

Overview

This seminar explores neural networks and AI through the playful and hands-on challenge of building a virtual pet. Participants will learn to program in Julia, simulate a pet with changing needs, and train a neural network to respond to those needs like a helpful robot butler. No prior programming or machine learning experience is expected.

Structure

Weekly sessions over one semester (14–15 weeks) Participants will write code, reflect on AI behavior, and build a final project: a simulated pet cared for by a neural network. All programming will be done in Julia. There are no grades, but participants are expected to engage actively and build something by the end.

Course-Level Learning Objectives

- Use Julia to model and simulate dynamic systems
- Design and implement a virtual pet simulation
- Understand and describe the components of a basic neural network
- Generate and format training data from a simulation
- Train a neural network and evaluate its behavior
- Apply model predictions in real time to control simulation behavior
- Reflect critically on AI and automated caregiving
- Share code and ideas with others in the seminar

Weekly Schedule and Learning Objectives

Week 1: Welcome to Your Robot Butler

- Explore seminar goals and project theme
- Install Julia and run basic code
- Reflect on what it means to train a robot

Week 2: Julia for Curious Humans

- Use variables, functions, and conditionals in Julia
- Write simple behavior rules

Week 3: Simulating a Virtual Pet (Part 1)

- Define pet states (hunger, mood, energy, etc.)
- Update states over time using code

Week 4: Simulating a Virtual Pet (Part 2)

- Add inputs and outputs to interact with the pet
- Record and visualize how the pet changes

Week 5: Thinking in Arrays

- Work with vectors and matrices in Julia
- Represent and manipulate state using arrays

Week 6: A Peek Inside Neural Networks

- Understand neurons, weights, and activations
- Compute outputs from a simple network by hand

Week 7: Writing Your Own Neural Net

- Write code for a feedforward neural network
- Use activation functions like sigmoid and ReLU

Week 8: Midpoint Milestone

- Share a working version of your pet simulation
- Reflect on your design and coding so far
- Offer feedback on others' projects

Week 9: How Neural Networks Learn

- Explore the concept of loss and gradient descent
- Update weights using backpropagation

Week 10: Training the Network

- Write a training loop
- Feed real data into the model
- Observe and plot training progress

Week 11: Data from a Digital Pet

- Collect state-action pairs from the simulation
- Format and clean data for learning

Week 12: Watching the Robot Learn

- Evaluate model behavior
- Adjust training to improve results

Week 13: Let the Butler Take Over

- Connect the neural network to the pet simulation
- Automate care decisions in real time

Week 14: Project Studio

- Work on polishing your project
- Add creative or expressive features

Week 15: Final Showcase

- Present your working robot butler
- Reflect on what you built and learned
- Discuss the future of playful AI