DOWNLOAD PDF NEURAL NETWORKS AND ANIMAL BEHAVIOR

Chapter 1 : Index : Neural Networks and Animal Behavior

"Neural Networks and Animal Behavior will interest students of animal behavior, cognitive scientists, engineers, and anyone working with neural networks. In a real way, this book is a bridge across the disciplines, constructing connections between animal behavior theories to other modes of understanding.".

Received Jun 16; Accepted Aug To view a copy of this license, visit http: Abstract High-throughput analysis of animal behavior requires software to analyze videos. We used multiple nets and image transformations to optimize accuracy for our classification task, achieving a surprisingly low error rate of just 0. Classifying one of our 8 h videos took less than 3 h using a fast GPU. The approach enabled uncovering a novel egg-laying-induced behavior modification in Drosophila. Furthermore, it should be readily applicable to other behavior analysis tasks. Understanding the neural mechanisms that control animal behavior often requires recording animals during behavioral tasks and then analyzing the videos. Human analysis of the videos is both highly labor-intensive and possibly error-prone, making automation very desirable and often critical to achieve acceptable throughput. To address this problem, multiple software systems for analyzing animal behavior have been developed, either for a particular model organism such as Drosophila 1 , 2 , 3 , 4 , 5 or mice 6 , 7 , or less commonly, for multiple species 8 , 9 , For a comprehensive and up-to-date review, see Anderson and Perona Such software systems firstâ€”during the tracking phaseâ€”analyze each frame of the video individually, detecting the main parts of the bodies and possibly the appendages, and then use the detected parts as basis for further behavior analysis. Convolutional neural networks CNNs 12 , a machine learning approach, are a promising technique for recognizing behavioral states directly from images. While CNNs could hence likely improve body part detection in traditional tracking systems, our goal was to recognize behavioral states directly from images. Lastly and most relevant, CNNs recently became the leading technique for human action recognition on the PASCAL VOC action classification challenge 21 , where the task is to recognize ten actions such as jumping, walking, and reading 22 , For action recognition it is often critical to recognize differences in pose and in the relationship between the actor and the environment context ; in contrast, in object recognition it is important to learn that different poses and contexts do not change the class of the object. We achieved classification error rates on this 2-class problem of just 0. The low error rate was surprising to us given, e. Classifying one of our 8h videos, which has , frames and 2 flies per frame, typically took less than 2. Moreover, applying CNNs to our videos uncovered a novel egg-laying-induced behavior modification in Drosophila females that was difficult to ascertain with a conventional tracking approach. None of our techniques is specific to Drosophila egg-laying, and the same approach should be readily applicable to other species and behavior analysis tasks. We previously discovered that Drosophila females prefer to lay their eggs on a sucrose-free plain substrate over a sucrose-containing one in two-choice chambers we designed Fig. To study the decision process in more depth, we wanted to examine how females explore the two substrates before they execute each egg-laying decision.

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Chapter 2 : Neural Networks and Animal Behavior : Stefano Ghirlanda :

The first chapter introduces various approaches to animal behavior and provides an informal introduction to neural networks, their history, and their potential advantages. The second chapter reviews artificial neural networks, including biological foundations, techniques, and applications.

Additional Information In lieu of an abstract, here is a brief excerpt of the content: Chapter Six Conclusions In this book we have explored the potential of neural networks to model behavior. The results suggest that neural networks can model behavior systems in all their parts, reproducing a wide range of behavioral phenomena. The model includes reception and further processing of sensory input, central mechanisms of decision making and the control of muscles and other effectors. The figure shows only a few recurrent connections, but in principle connections between any nodes in the system can be included, e. Additional flexibility can be gained by including nodes with different dynamics, although we have only touched upon this possibility. By putting together these components in suitable ways, virtually any behavior map can be implemented. In this last chapter we make an assessment of neural networks as models of behavior and compare them with other modeling approaches, in particular, cognitive models. We recall that our aim is to understand behavior, and we use neural networks because we think that they can provide better models of behavior. Of course, behavior can be used to study what occurs inside animals, but this is not our principal aim. See Staddon for a penetrating discussion of the different aims of behavior studies, with a focus on behaviorism. In Chapter 1 we listed some requirements that a general model of behavior should satisfy page 7. Below we reproduce these requirements in italics , and we evaluate to what extent neural network models fulfill them. We recall that we consider animals in general, ranging from the simplest to the most complex. Our interest is in how behavior systems in general operate and how they can be elaborated during evolution. Humans have very special abilities, sometimes shared with our closest relatives Tomasello , that are outside our scope. Currently we do not have good neural network models of, say, human symbolic reasoning. Such critiques, however, are less relevant when we consider animals in general. Starting from humans would mean starting from a very special and complex case of behavior rather than from typical or simple behavior. The model includes reception of stimuli, processing of sensory input, a central decision making mechanism and a part that controls muscles and other effectors. An example with more sophisticated decision making is in Figure 3. The basic structure of a general model of behavior should allow for a diversity of behavior maps to be formed. We have shown throughout this book that neural network models seem able to implement practically any behavior system we consider. Additionally, neural networks can integrate diverse features and subsystems within a single basic architecture , allowing unified models of fields that earlier have been treated separately e. Formally, it has been proved that a three-layer feedforward network with sufficiently many hidden nodes can approximate to any degree of accuracy any continuous map from the input to the output space Cybenko ; Funahashi ; Hornik et al. These theorems guarantee that networks are general enough to encompass the diversity we observe in animal behavior, although they do not show how to build a network that implements any particular map. For this, the techniques described in Chapter 2 can be used. Thus small disturbances should not cause any major changes in performance. You are not currently authenticated. View freely available titles:

Chapter 3 : Neural Networks and Animal Behavior

The results suggest that neural networks can model behavior systems in all their parts, reproducing a wide range of behavioral phenomena. Figure provides a summarizing sketch of a simple but complete model of an animal's behavior mechanism.

Chapter 4 : Neural Networks and Animal Behavior: Magnus Enquist and Stefano Ghirlanda | NHBS Book S

How can we make better sense of animal behavior by using what we know about the brain? This is the first book that

attempts to answer this important question by applying neural network theory.

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Neural Networks and Animal Behavior will interest students of animal behavior, cognitive scientists, engineers, and anyone working with neural networks. In a real way, this book is a bridge across the disciplines, constructing connections between animal behavior theories to other modes of understanding.

Chapter 6 : Project MUSE - Neural Networks and Animal Behavior

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Chapter 7 : Analyzing animal behavior via classifying each video frame using convolutional neural networks

Neural networks and animal behavior. [Magnus Enquist; Stefano Ghirlanda] -- How can we make better sense of animal behavior by using what we know about the brain? This is the first book that attempts to answer this important question by applying neural network theory.