FAIRnets Search - A Prototype Search Service to Find Neural Networks

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Abstract. Research on neural networks has gained significant momentum over the past few years. A vast number of neural networks is currently being developed and trained on available data in research as well as in industry. As the number of neural network architectures increases, we want to support people in the field of machine learning by making existing architectures easier to find and reuse.

In this Demo, we support the findability and reusability of Neural Networks by using the *FAIRnets Search*. Attendees will learn how to use the *FAIRnets Search* web service to search the *FAIRnets dataset*. The *FAIRnets dataset* is an RDF dataset containing information about already modeled neural networks. By applying RDF and OWL, our system can be queried using SPARQL queries indicating the desired characteristics of the neural network. As a result, all neural networks fulfilling the search query are returned to the user. The returned search results support users to gain insights into existing neural networks. Furthermore, we give the possibility to get more detailed information about the architecture of the networks, as well as further links. The demo is available at http://km.aifb.kit.edu/services/fairnets/.

Keywords: Neural Network · Ontology · Reusability · FAIR.

1 Introduction

Neural networks (NNs) have become an important tool in research to make predictions on measured data. Apart from preparing the data, it is use case and data specific which neural network to use regarding architecture and parameters. Despite the huge amount of available neural network architectures online, finding one that fits your problem is quite challenging because of information overload. There are approaches in machine learning such as neural architecture search [1] for neural network architecture design based on human knowledge and trial-and-error. However, these methods are time and memory consuming following a brute-force approach. Therefore, we want to focus on finding existing archi- tectures given a use case to amplify the reuse of pre-trained neural networks. Until now, there are neural network architecture repositories from

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the Berkeley Artificial Intelligence Research Lab Caffe Model Zoo[1], Keras[2] and Wolfram Alpha[3] containing a variety of architectures. However, these repositories represent only a fraction of the already developed neural networks. An overview of the neural networks implemented in practice is not given. With this demo, we want to give the user the possibility to access and query implemented neural networks. For this purpose, we make *FAIRnets Search* available to search for neural networks in the *FAIRnets dataset* which is available at https://zenodo.org/record/3228378. This dataset contains over 500 publicly available neural networks under a license uploaded to GitHub. It is modeled in RDF and uses the *Neural Network Ontology* for modeling the information which is available at https://w3id.org/nno/ontology. These two resources are described in a previous work [2] on representing neural networks according to the FAIR guiding principles [4].

Based on these two existing resources, we present in this work *FAIRnets Search*, a search service to query, search and find neural networks. The following three use cases are covered by our demo:

- Search for neural networks
- Search for used datasets
- Fine-grained Search by exploiting the *SPARQL Endpoint*.

2   FAIRnets Search

FAIRnets Search is a service provided by us to make neural networks searchable and findable. The service is available at the following URI http://km.aifb.kit.edu/services/fairnets/. It represents an attempt to search for all neural network architectures or neural network instances that fulfill specific requirements (e.g., used for specific tasks, having a specific architecture, etc.). For this purpose, the Web service uses the *FAIRnets dataset*. This dataset currently contains more than 500 neural networks. The *FAIRnets dataset* is modeled in RDF and uses the *Neural Network Ontology* to structure the information. Figure 2 shows an overview of the framework. We collected neural networks from GitHub and retrieved the information. The data is annotated using the *Neural Network Ontology* and represented in RDF. For each of the neural networks in the *FAIRnets dataset*, the relevant properties according to the Neural Network Ontology such as the description and the architecture are stored. That way, the *FAIRnets dataset* can be queried with a set of desired properties and responds with a set of neural networks that have these properties with the *SPARQL Endpoint*. The *FAIRnets Search* combines these implementations by a browser-based frontend to the SPARQL endpoint.

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[1] https://github.com/BVLC/caffe/wiki/Model-Zoo, last accessed 2019-06-18

[2] https://keras.io/applications/, last accessed 2019-06-18

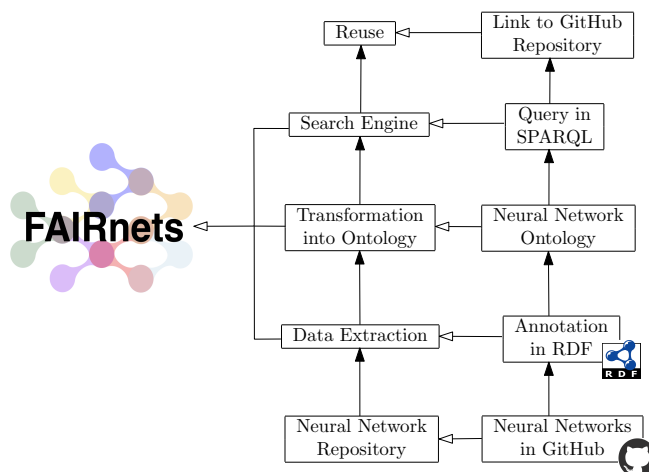[3] https://resources.wolframcloud.com/NeuralNetRepository, last accessed 2019-06-18

Fig. 1: The FAIRnets Search Framework

3 Demonstration of Use Cases

The attendees of the demo will learn how FAIRnets Search can be used to gain insights into the usage of existing neural networks and datasets in machine learning. In the online demo, the users are encouraged to use the search engine to find and access neural network architectures. With the FAIRnets Search Demo we will tackle the following three scenarios:

Search for Neural Networks. The FAIRnets Search engine allows users to search keyword-based for neural networks. The FAIRnets dataset is searched using SPARQL. Multiple keywords are supported in the search. The results are sorted based on the number of hits counted, i.e. how often the keywords appear in title and description. The attendee of the demo can, for example, search for the terms *image* and *classification* and will get a list of neural networks that are related to these terms (see Figure 2). Existing neural networks in this area can thus easily be retrieved. Detailed information on the individual neural networks can be accessed on the model sites of the neural network. Information such as the publisher, links, architecture information and the latest update of the network are provided and shown by our demo. The attendees of the demo can choose based on the information and links provided by us if an already modeled neural network fits their use case. We support the reusability of neural networks with the FAIRnets Search Demo.

Search for used datasets. Another use case is the usage of datasets. Attendees of the demo can search for specific datasets (e.g. search for *mnist*). FAIRnets Search lists neural networks that are related to the searched dataset. This gives the attendees the possibility to find out which neural network architectures have been applied to a given dataset. Additional information such as the link to the GitHub repository is available on the respective pages. This allows for getting
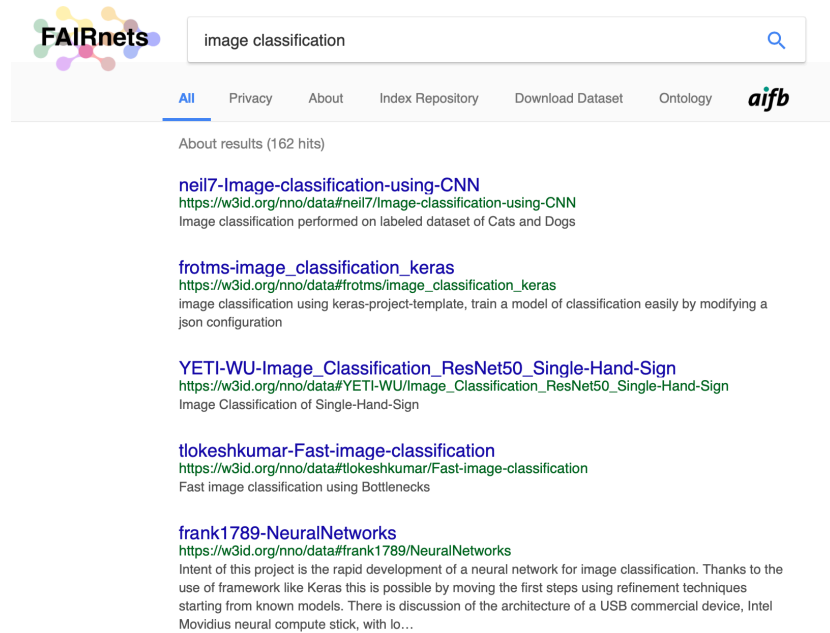
Fig. 2: Returned hits of the FAIRnets Search Demo, based on the entered keywords. In the search presented here, the user was interested in image classification.

more information about the performance of the architectures on the datasets. Besides identifying already applied neural network architectures on a given dataset, the search can also be used to identify new datasets. This information is implicit in the descriptions of neural networks. Searching for *image classification* lists all available neural networks in this domain. In the description of the neural network or on the corresponding GitHub repository page further information about the used datasets for training can be found. This supports the attendees of the demo to find new datasets suitable for their use case.

Fine-grained Search by exploiting the SPARQL Endpoint. Besides the search functionality, we offer the attendees of the demo the possibility to post individual SPARQL queries to the FAIRnets endpoint. We use YASGUI [3] to display the results of the queries. The interface to the provided endpoint can be accessed via the following link: https://km.aifb.kit.edu/services/fairnets/sparql. The endpoint allows for answering individual requests upon the dataset. We already offer some pre-selected SPARQL queries, such as a list of all neural networks with a maximum number of layers (see figure 3) and an overview of the frequencies of the activation functions used. Further ad-hoc requests during the demo are welcome.

Fig. 3: List of all GitHub links, which provide neural networks that have at most 10 layers.

4 Conclusions

This demo presents *FAIRnets Search*, a web service that allows users to query for publicly available neural networks. *FAIRnets Search* allows for making neural networks better findable, searchable and accessible. Also, it allows for gaining a better understanding of the used architectures of neural networks. In three use cases, we allow the attendees for querying neural networks, finding the use cases for datasets and analyzing the structure of neural networks.

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