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ную автоматизированную обучающую систему. Использование данного виртуального лабораторного стенда позволит значительно улучшить качество подготовки студентов специальностей электротехнического направления. А повсеместное внедрение современных информационных ресурсов в образовательном процессе, становится важным элементом менеджмента образовательных услуг.

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A REVIEW OF COMMERCIALLY AVAILABLE ARTIFICIAL NEURAL NETWORK FRAMEWORKS

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Artificial Neural Networks are a relatively new and very complex field of computer science that has a lot of potential not to just improve current information technology systems but to create whole new fields of study. Artificial Neural Networks (ANNs), as the name suggests, is an attempt to mimic the way neurons operate within a human brain. Simple cells that, in numbers, are capable of processing untold volumes of data. ANNs operate by passing data through multiple layers of decision making. Starting from the input layer, (receiving input data), through different hidden layers to the output. However, the algorithm it's self is useless without training. Ironically, just like a human brain, an ANN setup needs to be trained before completing a task it was assigned to. For example, if one wants to detect cats on pictures, they would first need to run the algorithm through a database of pictures of cats and make sure it detects them correctly. This process is required in order to cali-

brate the variables in the layers of the ANN for the task at hand, in this case – cat recognition. Depending on the amount of training data required for the final system to function appropriately, the training process can take a very long time, from a few minutes or hours to days or even months. Once calibrated and trained, ANN is fully operational. It can be copied and distributed as a ready-to-go package. In the end, the point of this whole process is categorization. Visual, voice, text or raw data, with proper training and fine tuning, ANNs excel at tasks that require categorization of large amounts of data. As you can imagine, in the modern world with its ever-increasing dataflow there is great need in such algorithms.

While neural networks can be applied to any sort of data they are perhaps most famous for their use in visual recognition software. Due to their nature, ANNs are perfect for processing live video. They can be trained to detect and categorize practically unlimited amount of different objects while producing a great deal of information about said objects, like their general size, screen coordinates, shape and more. Despite such a large dataflow, ANNs require relatively little computational power to process it. For example, a simple object detecting neural network algorithm can produce probabilities of that object pictures in fractions of a second while running on the commonly used raspberry pi platform. Because of all these factors, many ANN frameworks were created to simplify the process of working with these algorithms. Nowadays it got to a point that practically anyone with a basic knowledge of programming can get a so called “black box” neural network algorithm (pre-coded package containing everything needed for training and running an ANN without any further development required) working on their home computer.

In these paper we will be taking a look at these frameworks based on how well they deal with visual processing. A large factor in comparing these frameworks is not only their performance, but the community and the amount of materials available for it. Most of the frameworks in this review are open-source free packages specifically for that reason. Due to their availability, a lot of helpful material and resources, as well as examples have been created, allowing novice programmers to quickly familiarize themselves with the framework.

TensorFlow: Perhaps the most well-known machine –learning framework. It has been adopted by a long list of hi-profile companies, even tech giants as IBM and Twitter. TensorFlow is being developed by google and is perhaps the most flexible and easy to get into framework. It is completely open-source and has a large community following. There is plenty of exam-

ples and material to learn on as well as simple tutorials to get a user started. [1] The only downside that can be distinguished from other frameworks, is that TensorFlow, while very flexible, is not configured to excel at one exact task. Because of this it lags slightly behind other frameworks in speed when it comes to particular cases.

Caffe: A framework created by Berkeley Vision and Learning Center. Caffe is known for its simplicity and a large number of available pre-trained models called “Model zoo”. One of its main perks is that it is supported by Nvidia and can be integrated with Nvidia’s Cuda Deep Neural Network Library (CuDNN). [2] This means that it can be very well optimized to run on GPUs and is capable of very rapid and efficient image processing while using Nvidia technology.

Microsoft Cognitive Toolkit (CNTK): Unsurprisingly, this framework is wildly used in Microsoft. While similar in many ways to Caffe, Keras and other competitors. Originally CNTK was built for speech-recognition, but nowadays can be adopted to almost any application. Overall this s a very well performing framework, but has failed to attract a large (relative to other frameworks) following outside of direct connection with Microsoft products.

Keras: this framework has been developed by a google engineer with one simple idea in mind – fast prototyping. Modular, and supporting practically every type of a neural algorithm, it is easily adjustable and modifiable. It is also compatible with Tensorflow CNTK and Torch. Keras is compatible with both CPUs and GPUs and in general is very flexible. While it may lack base functionality, it can easily be expanded on and modified.

Torch: A scientific computational framework that is in some ways similar to Keras. It is capable of supporting most types of neural network algorithms. Has modular extensions that can boost its performance in different areas. And is quite flexible in what it is capable of. While it is commonly used for data categorization, it can also be adopted for visual recognition. PyTorch is also worth noting, as it is a Python adaptation of Torch and is becoming very popular due to its ease of operation through basic python commands.

There are dozens of other frameworks available, but these five are the most prominent across both, neural network enthusiasts and large IT companies. While the frameworks do differ in their contents and performance, the difference is rather negligible to a novice programmer. Any framework, when properly applied can produce satisfiable results that are on par with other frameworks. It is when it comes to optimization that the differences show. Some frameworks are better suited for specifically visual recognition, like Caffe. They rely heavily on the GPU and have auxiliary libraries to help interface it with visual recognition tools. While some are better optimized to

be changed on the go like Keras. In the end, for a person who is just starting to learn ANNs, it comes down to personal preference to make the choice. However, if the framework is being chosen with a specific project in mind, then it is worth paying attention to what framework would best fit the task at hand.

Overall, two frameworks do tend to stand out in their performance, and that is TensorFlow and Caffe. Most outlets tend to agree that these frameworks have the most developer and community support as well as high performance when applied properly. They tend to be relatively user friendly, with plenty of learning material for beginners and enormous library variety for more advanced use. Their functionality is still being expanded by the developers and the frameworks have a bright future.

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GESTURE BASED TERRAIN MAPPING SYSTEM-OVERVIEW

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Up until a few years ago, the only way to get an aerial overview of a designated area was to fly over it with a manned aircraft and physically inspecting the areas or taking pictures of it. Unmanned Aerial Vehicles, have been a blessing to all the industries which relied on aerial images or drawings for their work. Unmanned aerial vehicles also knows as drones, in more colloquial terms, is a blessing to all industries in the world. The cost of manufac-