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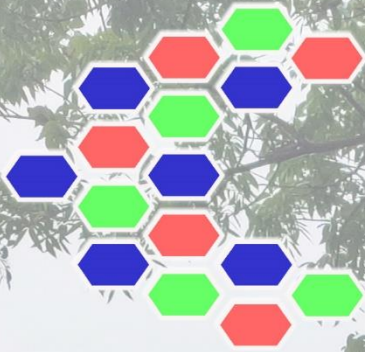
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Penelitian Ilmu Komputer
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*Unravelling How AI Is Applied In
All Aspects of Life*

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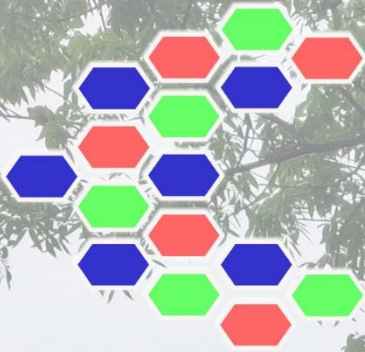


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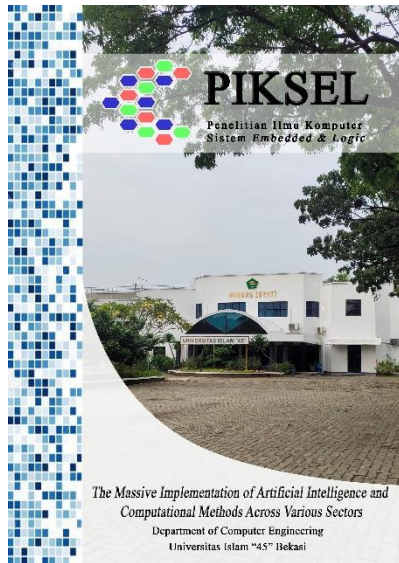
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From Editor-in-Chief

السَّلَامُ عَلَيْكُمْ وَرَحْمَةُ اللَّهِ وَبَرَكَاتُهُ

Best wishes to all the members of Editorial Board, Reviewers Panel, Authors and Readers of PIKSEL for a very happy, and stay healthy.



Rahmadya, Ph.D.
Editor-in-Chief

To meet the demands in the implementation of AI in various aspects of life, most research provides examples of how AI and other computer science methods are implemented in various fields, ranging from education, computer security, business, to information technology infrastructure.

Undoubtedly, Artificial Intelligence (AI) has permeated every facet of life. Every scientific field has acquired AI as part of its scientific aspect. The role of computer science becomes increasingly important in enhancing the performance of AI models implemented in these fields. Therefore, this edition of PIKSEL focuses on implementations in areas such as computer science, embedded systems, and logic, which are the focus of this journal.

To meet the demands in the implementation of AI in various aspects of life, most research provides examples of how AI and other computer science methods are implemented in various fields, ranging from education, computer security, business, to information technology infrastructure.

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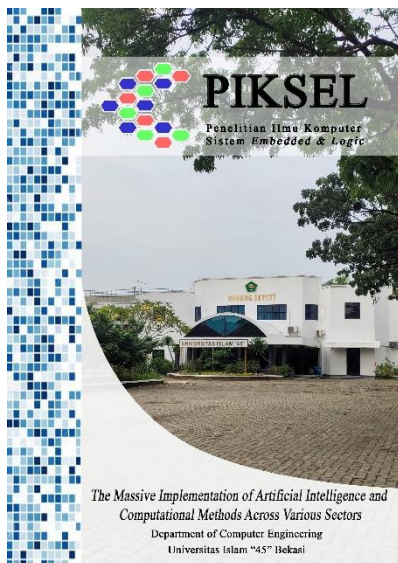
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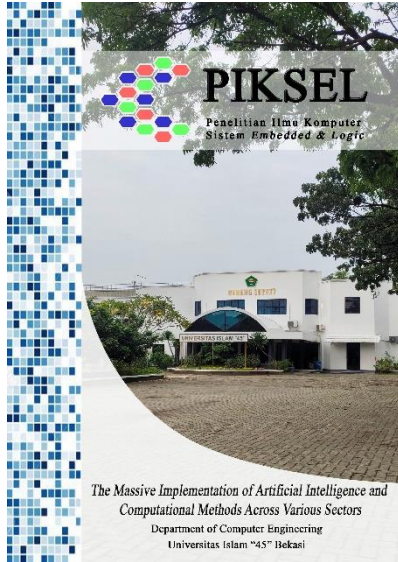
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Learning Tools for Artificial Intelligence Implementation

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Abstract

According to the rules of the Indonesian National Qualifications Framework (KKNI), undergraduate students fall into levels 5 and 6. Here, graduates are required to have the ability to apply existing knowledge according to the needs of the job. However, laboratory facilities that provide such competencies are very difficult to provide, especially for private campuses that rely on funding from students. This research tries to anticipate the gap between students' abilities and industry demands by providing laboratory facilities that do not require large costs. One of the courses demanded for students to master is Artificial Intelligence (AI), which has now spread to various fields. However, the curriculum currently applied usually focuses only on methods commonly used in the field of AI, while implementation in corporate fields requires direct application in the form of applications. Research results prove that several online applications can be used as substitutes for laboratories, including Google Colab, Play with Docker, Streamlit, and Teachable Machine. Compared to providing servers, computers containing development applications, using computers or laptops connected to the internet, students can easily implement the AI knowledge they have learned. For group work, applications for Continuous Integration/Continuous Delivery can be utilized, for example with Github, Gitlab, and similar ones.

Keywords: Learning Tool, AI, Containers, Google, Docker

1. Introduction

The development of information technology is currently advancing rapidly, both in terms of hardware and software (Gherman, Molociniuc, & Grosu, 2021). Meanwhile, educational institutions are required to produce students who are able to keep up with these technological advancements. One of the rapidly advancing technologies is Artificial Intelligence (AI), particularly its application in Deep Learning (Ferreira & Reis, 2023). Educational institutions in Indonesia are still constrained by funding issues, especially private institutions. Even if they can afford to procure such laboratories, due to the rapid development, campuses face difficulties in keeping up with these quick changes.

To overcome this, not only educational institutions but also offer cloud-based technologies. This technology is intended for users who do not have adequate infrastructure such as server rooms, security systems, backups, and so on. Simply by subscribing to Software as a Service (SaaS) and Infrastructure as a Service (IaaS) services, institutions can directly utilize these services (Wulf, Lindner, Westner, & Strahinger, 2021). In the field of education, cloud technology can be utilized (IRGASHEVICH, 2020; Korobeinikova et al., 2020; Kovalevskaia, Gilyazeva, Lobazova, & ..., n.d.; Nur Handayani, Muladi, Ari Elbaith Zaeni, Cahya Kurniawan, & Andrie Asmara,

2020; Qasem, Abdullah, Yaha, & Atana, 2020). Instead of providing servers for training, campuses can subscribe to cloud servers for students to practice server management.

AI has now implemented in all aspects of life, and some people even perceive its existence as a threat. Many are also aided by AI technology while under supervision. The industry's demand for graduate users in AI skills lies in its application within systems, such as Web-Based or Mobile-Based. Meanwhile, the current curriculum separates non-AI-based applications from AI-related courses, making it difficult for graduates to apply them in their future work. This research attempts to experiment on how to utilize existing cloud technology in lectures, especially in capstone courses that require integration between different courses, such as between web programming and AI.

The rest of the paper is organized as follows. After comparing several cloud-based applications that can be utilized for learning, the results and discussion section discusses the strengths and weaknesses of each analyzed tool. The conclusion section discusses which approach is currently more appropriate and closer to the working world where university graduates will be employed.

2. Research Method

The method used in this research is comparative analysis. As one case study, Iris classification is conducted using the dataset available on the official Kaggle dataset site (<https://www.kaggle.com/datasets/vikrishnan/iris-dataset>). Another case study involves object detection with Teachable Machine (<https://teachablemachine.withgoogle.com/>). Another site is Streamlit (<https://share.streamlit.io/>), which requires the assistance tool Github (<https://github.com/>). Google Collaboratory, also known as Google Colab (<https://colab.research.google.com/>), will also be analyzed for its application in AI education (Carneiro et al., 2018; Gunawan et al., 2020; Nur Handayani et al., 2020). Finally, the Docker site for exercises (<https://labs.play-with-docker.com/>) will also be analyzed to determine what services are offered, especially for education.

Each tool has its own characteristics, making it very difficult to compare based on a single case. However, each tool has its advantages and conveniences offered to users, in this case, educational institutions. Therefore, users can easily determine which tools are needed for teaching AI and machine learning so that students can quickly understand the methods being taught.

Aspects to be analyzed include the benefits of tools for some purposes, i.e. understanding AI method, implementing AI in information systems, and implementing AI in servers. The discussion is focused on free infrastructure that does not burden educational institutions. The programming language chosen is Python, including iPython-based (IPYNB) which is used in Google Collaboratory and Jupyter Notebook.

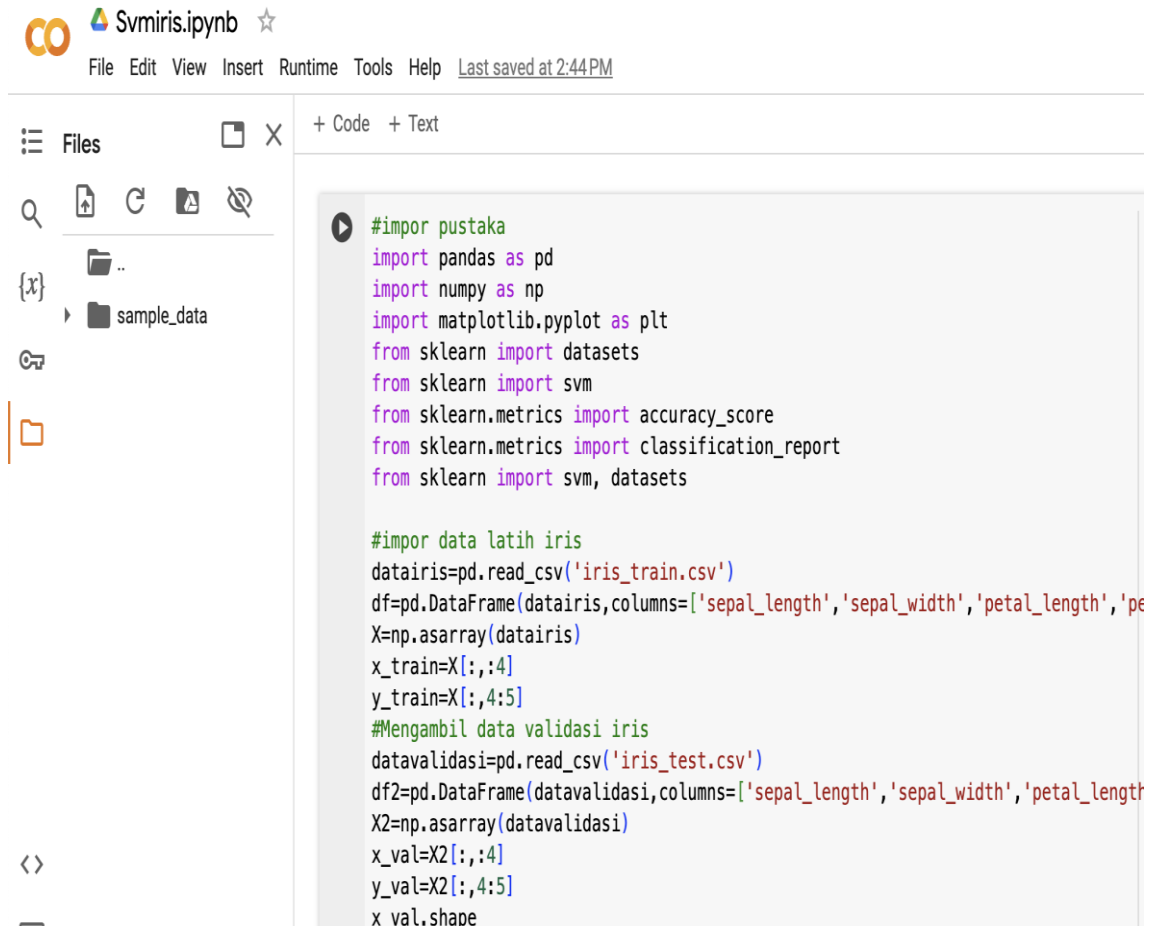
3. Results and Analysis

Several tools have been analyzed, including Google Colab, Teachable Machine, Streamlit, and Play with Docker. These tools can be accessed across all platforms, including operating systems and devices (Mac, PC, and mobile devices).

3.1. Google Colab

Google is a leader in cloud computing, from email and storage to office applications and multimedia-based applications, such as YouTube. Trusted by the global community, Google introduced Google Collaboratory (<https://colab.research.google.com/>) in April 2018, a cloud-based application providing an Integrated Development Environment (IDE) for Python-based programming. Besides offering an IDE, Google also allows users to utilize its powerful servers. Initially, Graphic Processing Units (GPUs) were provided for free, but as of October 2020, users need to pay a certain fee to use GPUs and Tensor Processing Unit (TPU) servers.

Google Colab provides a single window for typing source code and a toolbar for uploading files to be processed, such as images, Comma Separated Values (CSV), and supporting program files. The IDE contains cells where each can be run separately from one another. In the Google Colab IDE, comments can contain text and also embedded images for a more interactive display. For large files, Google Colab offers a connection to Google Drive so users don't need to upload files, saving time and connectivity.

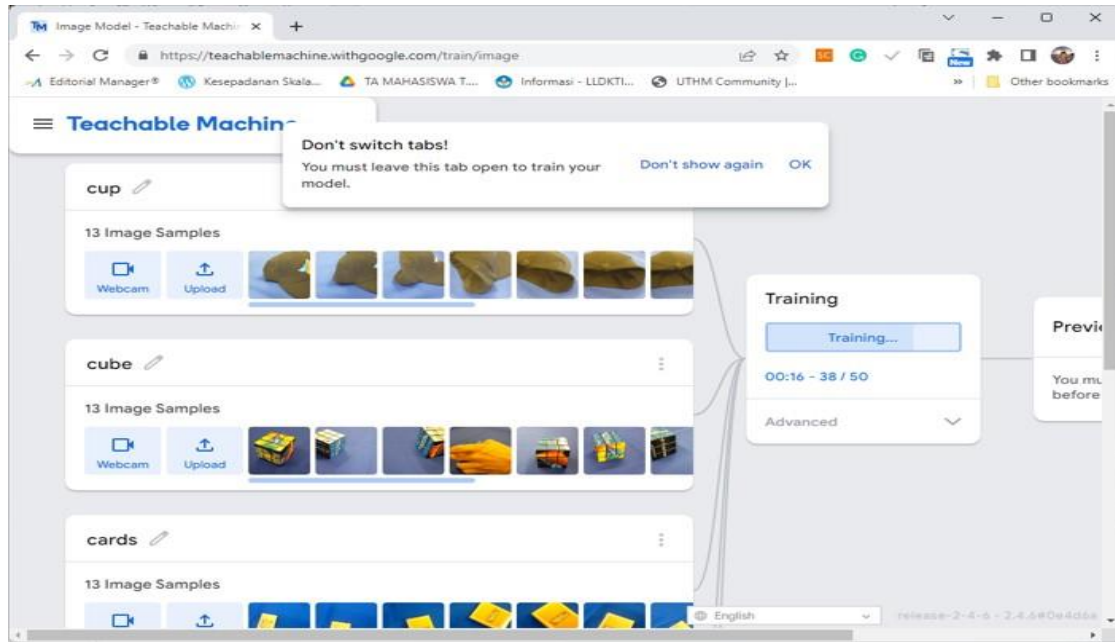


Source: Research's Result (2024)

Figure 1. Google Colab for IRIS Dataset Using SVM

3.2. Teachable Machine

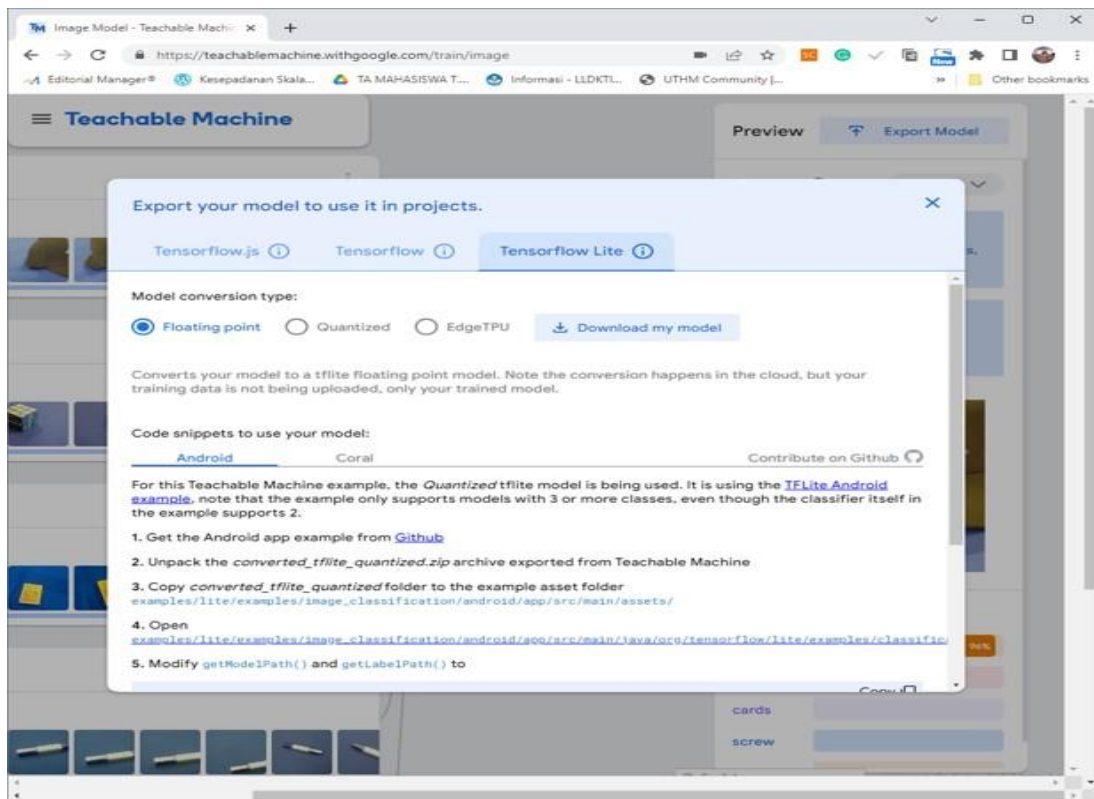
AI users are not always proficient in programming languages. Many operate outside the IT field, such as doctors, psychologists, economists, biologists, and others. Therefore, to understand the concept of Machine Learning, a tool that does not burden them with complex program codes is needed. To address this, Google provides the Teachable Machine service that available online (<https://teachablemachine.withgoogle.com/>), which explains the training process using data provided by users from specific fields.



Source: Research's Result (2024)

Figure 2. Training Using Teachable Machine

This application was introduced in 2017. The focus of this tool is pattern recognition, whether in the form of images, movies, or expressions. In addition to providing demos on how machine learning works, this application also provides facilities to convert into program code for further implementation, whether web-based, desktop, or mobile applications.

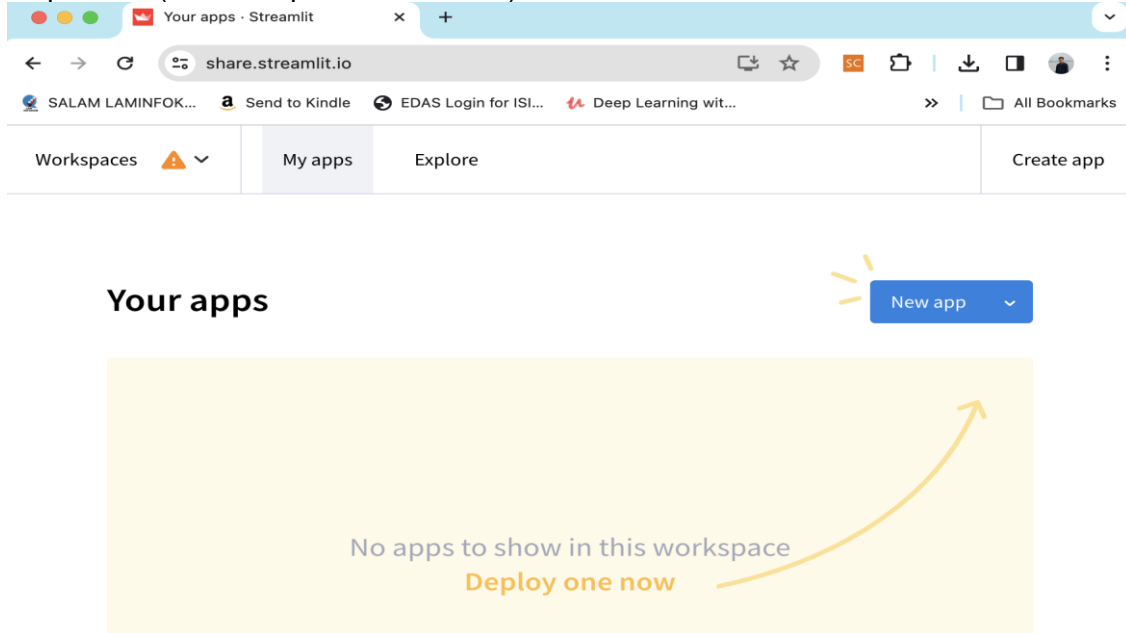


Source: Research's Result (2024)

Figure 3. Saving Training Result

3.3. Streamlit Share

Streamlit Share (<https://share.streamlit.io/>) is a prototype application that allows users to run designed AI applications, such as Teachable Machine. To run Streamlit Share, it must first be executed locally using the Streamlit library. Once running, the source code is uploaded (or via Git push mechanism) to GitHub.



Source: Research's Result (2024)

Figure 4. Streamlit Interface

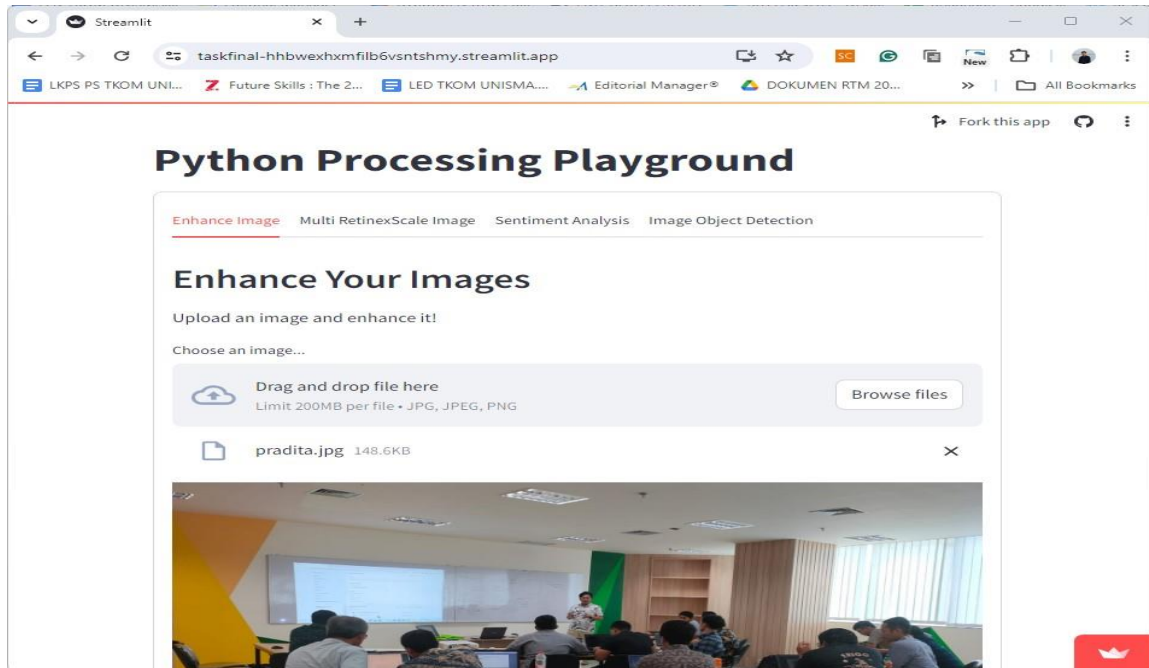
Before sharing on GitHub, it is first tested with Python on a local PC. Streamlit library needs to be installed first. If it runs on a local PC, then the code can be executed on Streamlit Share, which is publicly accessible.

```
import streamlit as st
from PIL import Image, ImageEnhance
def enhance_image(image, enhancement_factor):
    enhanced_image = ImageEnhance.Contrast(image).enhance(enhancement_factor)
    return enhanced_image
def main():
    st.title('Enhance Your Images')
    st.write('Upload an image and enhance it!')
    uploaded_image = st.file_uploader("Choose an image...", type=["jpg", "jpeg", "png"])
    if uploaded_image is not None:
        st.image(uploaded_image, caption='Original Image', use_column_width=True)
        enhancement_factor = st.slider('Enhancement Factor', 0.0, 2.0, 1.0)
        if st.button('Enhance'):
            # Load the image
            image = Image.open(uploaded_image)
            # Enhance the image
            enhanced_image = enhance_image(image, enhancement_factor)
            # Display the enhanced image
            st.image(enhanced_image, caption='Enhanced Image', use_column_width=True)
if __name__ == "__main__":
    main()
```

Source: Research's Result (2024)

Figure 5. Sample Code for Streamlit Implementation

Streamlit Share then requests a GitHub link containing the previously tested code. After some time, the application runs via the processed Streamlit link. The design results can be verified by examining lecturers to determine if they align with the initial design with precise accuracy.



Source: Research's Result (2024)

Figure 6. Streamlit Share Sample

3.4. Play with Docker

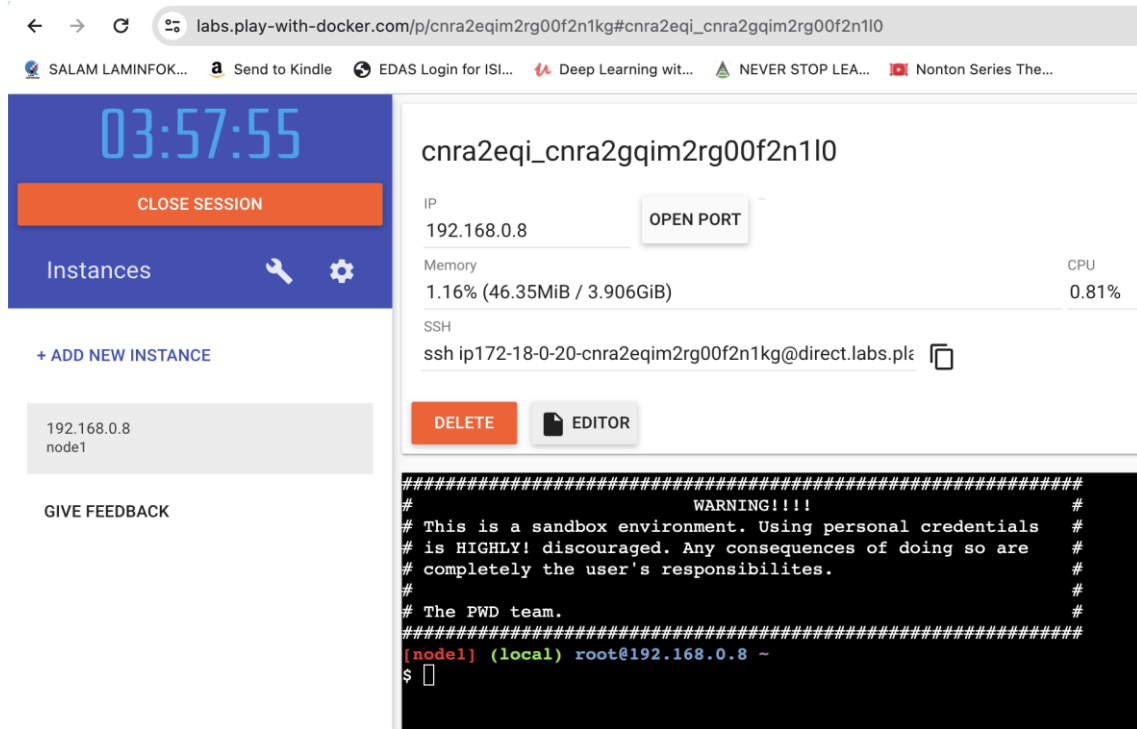
Undergraduate students, who are D3 and S1 level according to KKNI, enter levels 5 and 6, respectively. Graduates are expected to demonstrate the ability to implement a method in the form of an application applied in the workforce/industry. Although Google Colab can execute certain AI methods, real-world implementation forces graduate to integrate AI into systems that are typically web and mobile-based.

AI integration usually involves a container in the form of a server, whether a web server or a database server. For this, other courses are needed to support implementation. Several supporting applications can be used for this purpose, such as XAMPP, Django and Flask, Jenkins, and others for PHP, Python, and Java programming languages, respectively. Running these applications requires specific hardware and software infrastructure. When implemented in a laboratory, the installation of libraries, IDEs, and others is required, which sometimes makes laboratory PCs heavy, as they are usually used for other courses.

Figure 7 shows the facilities provided by Play with Docker. Multiple instances can be created to integrate between one Docker container and another Docker container. One node can contain separate applications from others, and even if they are written in different programming languages, they can interact with each other through connections in the form of Application Programming Interfaces (APIs). This type of infrastructure is typically in the form of microservices, one of the distributed programming techniques widely applied in the industry.

IT students usually have their own notebooks and are more comfortable using them than laboratory PCs. To see if an application runs on their own notebook usually poses no problem, but when run on another PC, it may not behave as desired. Unlike programming in the 90s, which produced installers for use elsewhere, applications today are difficult to package into installers due to programming languages relying on many libraries, such as

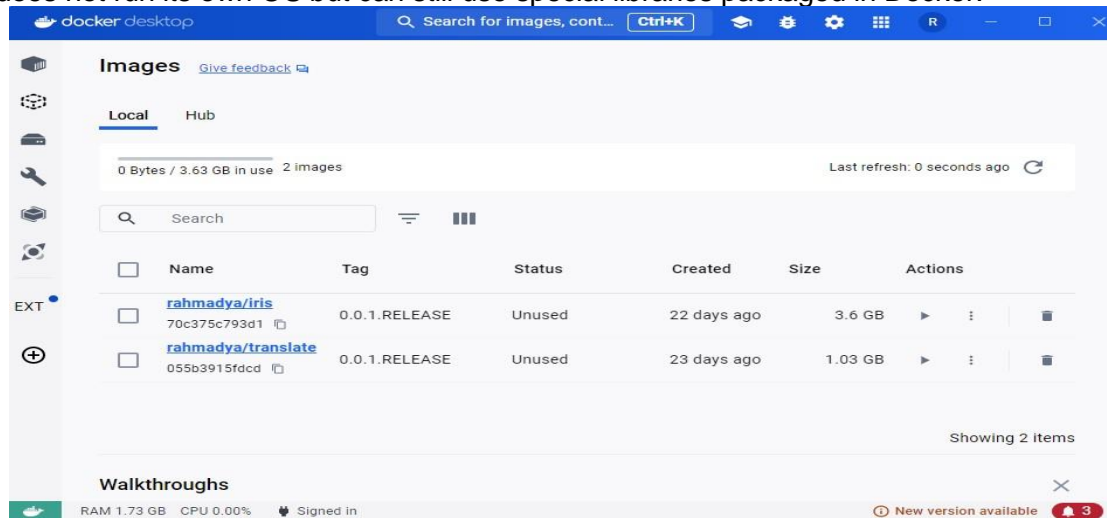
in Python, including TensorFlow, Pytorch, and others. Additionally, if involving databases, applications like MySQL and PostgreSQL need to be installed.



Source: Research's Result (2024)

Figure 7. Play with Docker IDE

In addition to programming, graduates are also required to be able to install AI applications on other computers, which usually come in the form of servers. To ensure the destination server does not encounter issues due to installing accompanying application libraries, there is currently Docker, which operates in virtualization form. Unlike virtual machines that virtualize operating systems, Docker does not virtualize the OS. The operating system still utilizes the server OS. Access is much faster than VMs because it does not run its own OS but can still use special libraries packaged in Docker.

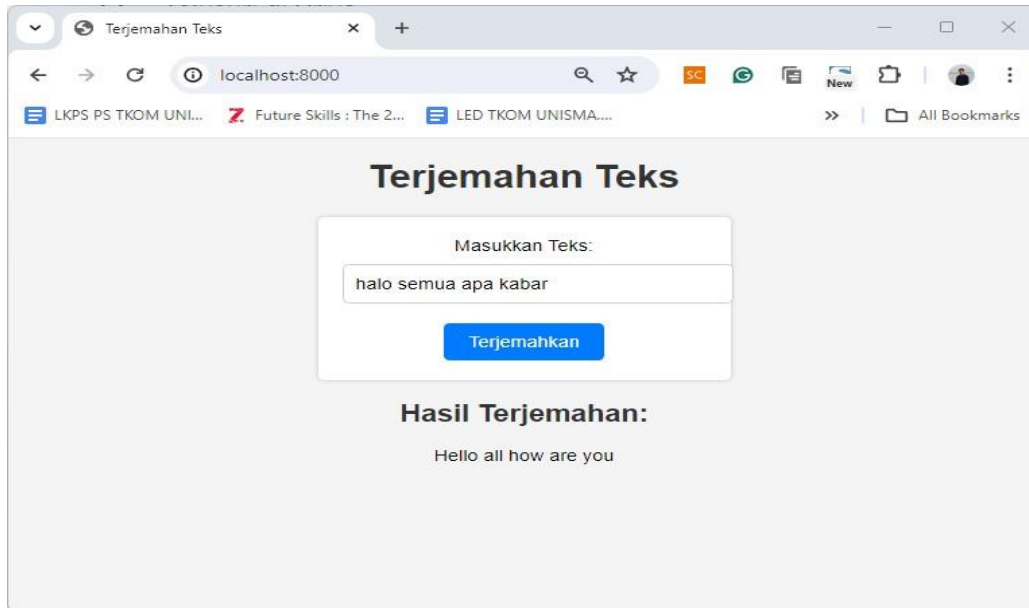


Source: Research's Result (2024)

Figure 8. Desktop Docker

For example, there are two images that will be executed by first creating a container with a specific port, for instance, port 8000. Without converting images into containers, applications cannot be executed. There are two ports involved: the internal application port and the port accessible to the public.

Since one application packaged with Docker requires libraries, it is necessary to download supporting libraries according to their version in the Docker package. As a result, the size of one Docker application increases. Experimental results show that an application below 1 MB, when packaged with Docker, swells to over 1 GB. However, one Docker package, when run on another device that already has Docker installed, does not require installing supporting libraries; even the database is included in the Docker package.



Source: Research's Result (2024)

Figure 9. The App Running Using Docker Instance

While Docker sufficiently meets the expectations of educational institutions, its large size (over 1 GB) can pose difficulties if students use laboratory PCs shared with other students. To address this, in addition to Docker Hub for sharing Docker applications (with limited storage for the free version), Docker provides Play with Docker (<https://labs.play-with-docker.com/>). This Docker facility has the advantage of providing servers with multiple instances that already include Docker applications within them. Although users are only given a four-hour server usage time, it can be utilized to train students to manage IT applications on servers.

4. Conclusion

To bridge the gap between university graduates and the workforce/industry, a suitable curriculum is needed. Considering that in the competency standards in Indonesia, undergraduate students (D3 and S1) are at levels 5 and 6, campuses need to provide facilities and infrastructure for students. Due to the rapid technological advancements, campuses sometimes struggle to keep up with these developments, especially in laboratories, both hardware and software. This research produces recommendations in the form of tools that can be utilized by laboratories. Considering their open-source and cloud-based nature, they do not require large resources; simply providing sufficient internet access is enough. The work results of students can be clearly seen, and it is hoped that students will not only understand the AI theory taught but also how to apply it in a complete system, which can serve as preparation for students after graduation. Thus, the gap between the workforce/industry is not too large, and it

produces graduates who are ready for use. However, it would be beneficial if campuses could provide laboratory facilities and keep up with the rapidly advancing IT technology, which usually undergoes several updates in one year.

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Author Contributions

Herlawati conducted research utilizing the latest technologies related to cloud-based programming methods.

Conflicts of Interest

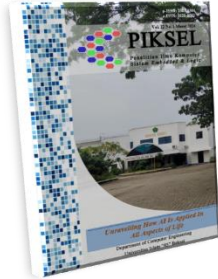
There is no conflict of interest for the author.

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