Seetha Kumaran

From: Langara | Applied Research Center <appliedresearch@langara.ca>
Sent: Tuesday, December 17, 2024 10:23 AM
To: Quynh Nguyen
Cc: Applied Research
Subject: Thank you for submitting your ARC Final Report

EXTERNAL: Do not interact, click on links, or download any attachments if the sender is unknown.

snəweyəɬ leləm̓.

Thank you for submitting

ARC Final Report

Our team may reach out to you with follow-up requests for clarification regarding your submission.

Review your submission responses below:

Researcher First Name: Monica

Researcher Last Name: Nguyen

Department: Mathematics and Statistics

Other Department: Statistics and Data Analytics

Project Title: Real time object detection deployment

Start semester: 1/5/2024

End Semester: 12/18/2024

Introduction - Please introduce yourself and include pertinent background information as it relates to your project's research area. Computer vision technology has shown great promise in detecting and classifying objects from images and videos. The YOLO algorithm is a popular object detection model that excels at detecting small objects in complex scenes. In the context of household waste, a deployed YOLO model can enable households to easily identify and categorize their waste streams. This can facilitate more effective waste reduction strategies, such as optimizing recycling and composting practices. Moreover, a computer vision-based solution can help reduce the environmental impacts associated with manual sorting and processing of household waste. In this research, I explored the feasibility of deploying YOLO on Aamazon Web Services (AWS) to identify potential issues that companies might face when integrating their object detection models with cloud-based infrastructure, including latency concerns (for example potential delay or sluggishness that can occur when transmitting visual data), or data transfer costs, associated with storing and processing visual data in the cloud. As a capstone instructor teaching data-related missions that cater to various industry needs, including computer vision product deployments, it is essential for both my students and me to have hands-on experience in integrating complex models like YOLO with cloud-based infrastructure. This expertise will enable us to provide innovative solutions that meet the diverse requirements of companies, thereby fostering a strong connection between academic learning and real-world applications.

Please discuss your educational background and your work experience as it relates to this project. If possible, include a quote that helps define your interest in the project. As an instructor for data science capstones, I've had the privilege of guiding students through complex projects that require strategic problem-solving and technical expertise. My own educational background in Computer Science has instilled in me a passion for harnessing data to drive insights and innovation. With over 4 years of experience managing data-related projects, I've developed a keen eye for optimizing workflows, streamlining processes, and driving results. When I stumbled upon the challenge of deploying YOLO on AWS, I knew it was an opportunity to bring my expertise to the table and explore innovative solutions. Similarly, I believe that leveraging data-driven approaches can unlock new possibilities for problem-solving and innovation - and this project embodies that spirit. By bringing together my teaching experience, technical expertise, and passion for data science, I'm excited to have run the experiment using YOLO on AWS and run the demos with the students who are about to be data scientists.

Please summarize your project in plain language that others not in your field could understand. Since the project aimed at setting up an environment where a

deep-learning algorithm can detect household waste items in real time. I deployed YOLO on multiple EC2 instances for different purposes: database, scheduling, and web hosting. I run 2 different testing sessions with 30 different users who interacted with the web application and simultaneously sent images to the cloud. While the users uploaded images onto the web application, I checked how quickly YOLO could process these images and returned predictive results. I found out that the speed was acceptable, and the inference (processing) was quick. The key takeways that I offered are: • Deploying YOLO on multiple EC2 instances can work well for different tasks like storing data, scheduling, and hosting a web application. • With proper setup and testing, users will have good experiences with data science applications since cloud-based systems can give good performance and low latency. • Moreover, the setting-up time is not lengthy and that helps start-up companies to quickly launch data-products live.

Identify the project goals and objectives. Explain how the results may be used to solve a problem or inform further research in the field. As mentioned above, the main goal of this project is to set up an environment where a deep-learning algorithm can detect household waste items in real time. This started with a hypothesis that many start-ups have ideas to develop data-products but do not possess expertise on deploying such a product live with a low-cost budget. Therefore, 2 main objects were to execute, including: • Potential problems when deploying a computer vision product live. • Optimal solutions to launch a computer vision data product. To do so, I have set up web applications using AWS and Pii devices (local environment assuming that start-ups wish to have a full control of their systems and products). Through these set-ups, I have some findings for further research: • Scalability and Performance Optimization: As a computer vision system grows, there is a real need to ensure that it can handle increased traffic and data volumes. Research on scaling strategies, load balancing, and performance optimization techniques (e.g., caching, queuing) can help you achieve this. • Multimodal Fusion and Transfer Learning: Investigate ways to integrate multiple modalities (e.g., images, videos, audio) into a single inference pipeline. Additionally, explore transfer learning techniques to leverage pre-trained models for specific domain adaptation or zero-shot learning scenarios. • Human-Machine Collaboration: Investigate ways to integrate human judgement and feedback into YOLO-based decision-making processes to create more effective and collaborative AI systems.

Briefly explain the steps taken (methods used) to conduct the research, and describe the key findings. I wish to share this project with Langara. Therefore, students and I will participated in the research day in 2025.

Who was involved in this project (eg. faculty, students, community partners)? How did their involvement contribute to the project's success? Were there any challenges to overcome? The main challenges that I foresee is that a data science project requires different expertise, such as web designer, system architecture expert, machine learning operator, and data engineer. For this particular project, all of those roles were

combined into a small team of 2 people (myself and WOC student). Therefore, the front-end design was not perfect and therefore, users take time to understand how to use the web application.

Please share any personal stories that made this research experience memorable/valuable.
What stood out for me during the test session was the palpable excitement and newfound confidence exhibited by our Data Analytics students. Prior to this experience, they had only heard about data products in theory, but had never had the opportunity to engage with one firsthand. As they interacted with the product, their faces lit up with understanding and enthusiasm, and I could sense a significant shift in their perception of what is possible when it comes to developing a data product. The test session was a powerful catalyst for their learning, inspiring them to take on new challenges and pursue their own data-driven projects.

What are the next steps for this project and for you as a researcher?
The follow to conduct this project is below: • Step 1: prepared a set of 720 household waste images to train Yolo_v7 model. • Step 2: a S3 bucket was created to store your trained YOLO model, dataset, and any other files required for the computer vision system. • Step 3: a SageMaker notebook instance was created to run the trained YOLO model and perform inference on new images. • Step 4: developed a Streamlit app that loaded the trained YOLO model from SageMaker and used it to perform inference on uploaded images. This app was runed on a medium EC2 instance. • Step 5: designed a structured databased and set up PostgreSQL database instance on AWS RDS. • Step 6: Integrated Streamlit with SQL database. • Step 7: Set up a scheduler using Airflow on another EC medium instance. This scheduler aimed to load new data into the existing database. Also, this scheduler allowed users to monitor the system and ensured that tasks were being executed successfully and efficiently.

Please upload any images that will help to showcase your project.

By submitting, I consent to uploading my ARC Fund final report to the Langara Institutional Repository (The LaIR). True

By submitting this form, you're consenting to receive communications from Langara College and agreeing to Langara's privacy policy statement. You may unsubscribe at any time. (1) Consent

Connect with us!

Langara.ca/AppliedResearch | LinkedIn

Copyright © 2024. All rights reserved.
Langara College | 100 49th Ave W, Vancouver BC V5Y2Z6

Privacy Policy