

**MASTER OF SCIENCE IN MANAGEMENT AND SYSTEMS**

**Applied Project Capstone**

**MASY GC- 4100**

**MEMORANDUM**

TO: Dr. Andres Fortino

FROM: Chongyuan Liu

DATE: September 22, 2023

RE: **Assignment 1B– Final Project Proposal**

**A Working Title: Research paper on LLM-Driven Robot Replaceability Assessment Tool**

**Name: RoboScale**

**The company name “the client”:**

NYU School of Professional Studies, and the Management and Systems program (MASY), is a New York-based learning institution.

**Company Location**

NYU School of Professional Studies is at 7 East 12Th Street, NY, NY.

**Name and role of your proposed project sponsor:**

The project sponsor will be Dr. Andres Fortino, Clinical Associate Professor, NYU (<https://www.linkedin.com/in/afortino>)

**Sponsor’s location:**

Dr. Andres Fortino ([agf249@nyu.edu](mailto:agf249@nyu.edu)) can be reached over virtual conference calls as per project requirements.

## Description of the client’s business:

New York University (NYU) is a private research university based in New York City. The MASY degree is based on a unique curriculum that provides students with experiential learning opportunities to develop strong management and leadership skills and gain a comprehensive knowledge of current information technologies.

## Goal of the project:

The primary goal of this project is to develop, validate, and document a comprehensive Robot Replaceability Scale Tool utilizing Large Language Models (LLM) to assist business reengineering analysts in evaluating the feasibility and ease of substituting human tasks with robotic alternatives. This tool will leverage the O\*NET dataset from the Bureau of Labor Statistics to derive replaceability scores for various occupations, thereby facilitating the strategic implementation of automation across diverse sectors. The project also aims to compare the tool’s output with predictions from subject matter experts to ensure its accuracy and reliability. Additionally, the process and findings will be meticulously documented and compiled into a research paper, conforming to IEEE conference paper submission standards, with the anticipation of presenting the findings at Princeton University in April 2024. Lastly, all relevant materials and documentation will be delivered and made accessible through a GitHub repository.

**Description of the Business Problem or Opportunity:**

In an era where technological advancement is rapidly reshaping industries, there is an escalating demand for robust tools that can accurately assess the potential for automating human tasks with robots. The existing scale by Goldman Sachs offers a foundational perspective, but there is an opportunity to extend this work and develop a more comprehensive and accessible tool, leveraging the capabilities of Large Language Models (LLM). The integration of LLM promises enhanced accuracy and adaptability across varied occupations listed in the Bureau of Labor Statistics O\*NET dataset. The opportunity lies in harnessing this technology to create a tool that not only provides a replaceability scale but also sheds light on the implementation feasibility of robotic automation. Addressing this will empower business reengineering analysts with insights that facilitate informed decision-making, optimize resource allocation, and drive organizational efficiency and innovation. By accomplishing this, the project stands to contribute significantly to the field of automation and workforce management, potentially guiding the future trajectory of human-robot collaboration in the professional landscape.

## Projected business benefit of the project:

The completion of this project stands to confer several significant benefits to NYU School of Professional Studies and the broader academic and business communities. First, by developing a sophisticated Robot Replaceability Scale Tool, the institution will be at the forefront of innovative solutions that assist business reengineering analysts in making informed decisions regarding the feasibility of automating human tasks. This tool will enable organizations to optimize their operations, reduce costs, and enhance efficiency, thereby potentially leading to groundbreaking advancements in the field of automation. Additionally, the documentation and publication of the research findings in the form of an IEEE conference paper will bolster the institution's reputation as a thought leader and innovator in the integration of management, systems, and technology. Furthermore, by making the tool and its accompanying documentation accessible via GitHub, the institution will foster knowledge sharing, collaboration, and further research, contributing to the ongoing dialogue and development in human-robot collaboration and workforce transformation.

## Brief description of your project:

## In this project, I will be developing a Robot Replaceability Scale Tool utilizing Large Language Models (LLM) to assess the feasibility and ease of replacing human tasks across various occupations with robots, based on the O\*NET dataset from the Bureau of Labor Statistics. The project involves not only building this innovative tool but also meticulously validating its accuracy by comparing its results with the predictions of subject matter experts. Throughout the project, every stage of development, validation, and application will be comprehensively documented. The culmination of this endeavor will be the submission of a detailed research paper, aligning with IEEE conference paper standards, slated for presentation at Princeton University in April 2024. Additionally, all relevant materials, documentation, and the developed tool will be made publicly accessible through a GitHub repository, facilitating further research and development in the field. This sophisticated, validated tool stands to significantly aid business reengineering analysts and contribute to advancements in automation and workforce management.

## Relationship to the client:

## I am not directly employed by NYU School of Professional Studies, but I am engaged with the Management and Systems program (MASY) under the sponsorship of Dr. Andres Fortino for this particular project. The MASY program focuses on equipping students with the necessary management, leadership, and technological skills through a blend of experiential learning opportunities and comprehensive knowledge of current information technologies.

## The business unit primarily benefitting from this project would be the Management and Systems program itself, as the development of the Robot Replaceability Scale Tool aligns with the program’s mission to foster innovation and leadership in technology and management. The successful completion of this project will not only enhance the program’s curriculum and learning outcomes by providing students and faculty with a practical tool and insights into human-robot collaboration but will also elevate the reputation of the program and the school by contributing groundbreaking research to the field. Additionally, other business units and research departments within NYU focusing on robotics, artificial intelligence, and workforce management may also derive significant benefits from the outcomes of this project

## Project objectives and Metrics for measuring project success:

## Objective 1: Build the Robot Replaceability Scale Tool and Document the Whole Process

## Deliverable: A fully functioning Robot Replaceability Scale Tool and comprehensive documentation detailing the development process, methodologies used, and insights gained.

## Metric for Success: Presentation of the developed tool and accompanying documentation to Dr. Andres Fortino and receiving acceptance and approval, ensuring alignment with project requirements.

## Timeframe: By October 15, 2023.

## Objective 2: Prove and Validate the Accuracy of the Tool

## Deliverable: Detailed results of the validation process, comparing the tool’s output with the predictions of subject matter experts, along with any adjustments made to enhance accuracy.

## Metric for Success: Acceptance and approval of the validation results and adjustments by Dr. Andres Fortino, confirming the tool’s accuracy and reliability.

## Timeframe: By October 31, 2023.

## Objective 3: Write the Research Paper

## Deliverable: A comprehensive research paper, conforming to IEEE conference paper submission standards, detailing the development, validation, and application of the Robot Replaceability Scale Tool.

## Metric for Success: Submission of the paper for review and acceptance by Dr. Andres Fortino, ensuring it meets the quality and standards for presentation at the IEEE conference in April 2024 at Princeton University.

## Timeframe: By November 30, 2023.

## Objective 4: Deliver All Necessary Materials in GitHub Repository

## Deliverable: A well-organized GitHub repository containing the developed tool, comprehensive documentation, validation results, and the final research paper.

## Metric for Success: Review and acceptance of the GitHub repository by Dr. Andres Fortino, ensuring all materials are correctly uploaded, organized, and accessible for further research and development.

## Timeframe: By December 14, 2023.

## These objectives, aligned with the SMART criteria, will serve as pivotal milestones in assessing the progress and success of the project, ensuring each phase is accomplished with diligence and precision, leading to the delivery of a valuable and innovative tool in the realm of automation and human-robot collaboration.

## Your role in the project:

## In this applied project, I wear two critical hats: that of the Project Conductor and the Project Manager, each with its distinctive set of responsibilities and tasks.

## As the Project Conductor:

## My role is primarily focused on the technical and subject-specific aspects of developing the Robot Replaceability Scale Tool. I will be responsible for conducting an extensive review of relevant literature and existing solutions, particularly the scale created by Goldman Sachs and the O\*NET dataset from the Bureau of Labor Statistics. I will then design, develop, and implement the tool utilizing Large Language Models (LLM) to assess the replaceability of human tasks with robots across various occupations.

## Part of this role also includes validating the accuracy of the tool by comparing its results with predictions made by subject matter experts and making necessary adjustments to enhance its reliability. Further, I will author a comprehensive research paper conforming to IEEE conference paper standards, detailing the development, validation, and application of the tool, and ensuring it is ready for presentation at Princeton University in April 2024.

## As the Project Manager:

## In this capacity, I oversee the overall planning, execution, and closing of the project. My responsibilities include defining the project scope, developing a detailed project plan, and ensuring that the project is on track to meet the defined objectives and deadlines. I will be actively communicating with the project sponsor, Dr. Andres Fortino, to update him on the project’s progress, address any issues or concerns, and seek approvals on deliverables.

## As the manager, I will also be responsible for managing risks and addressing any challenges or roadblocks that may arise during the project lifecycle. This includes ensuring that the project adheres to quality standards, managing any changes to the project scope, timeline, or costs, and ensuring that all project documentation is accurately maintained and organized. The final responsibility as a project manager will be to ensure the successful delivery of all necessary materials in a GitHub repository, making them accessible for further research and development.

## Balancing these dual roles, I aim to maintain a holistic view of the project, ensuring that while the technical details are being worked out meticulously, the overarching project goals, timelines, and stakeholder expectations are also being effectively managed and met.

## Proposed duration

Proposed Duration: 3 months

a) Expected Start and End Dates:

Expected Start Date: September 13, 2023

Expected End Date: December 14, 2023

b) Forecast for Total Number of Hours:

## Given the multifaceted nature of the project, the total 300 hours will be strategically allocated across various tasks and responsibilities to ensure effective progression and completion of the project. Below is a forecasted breakdown of the hours devoted to each major component of the project:

## 1. Research and Planning - 50 Hours

## Conducting literature review and studying existing solutions.

## Understanding the O\*NET dataset and the Goldman Sachs scale.

## Drafting the project plan, defining scope, objectives, and milestones.

## 2. Development of the Tool - 100 Hours

## Designing and implementing the Robot Replaceability Scale Tool using LLM.

## Iterating and refining the tool based on initial testing and feedback.

## Documenting the development process comprehensively.

## 3. Validation and Refinement - 60 Hours

## Comparing tool results with predictions of subject matter experts.

## Analyzing discrepancies and refining the tool for enhanced accuracy.

## Documenting the validation process and adjustments made.

## 4. Writing the Research Paper - 50 Hours

## Compiling findings, insights, and methodologies into a comprehensive paper.

## Ensuring the paper aligns with IEEE conference paper submission standards.

## Reviewing and revising the paper to ensure quality and coherence.

## 5. Repository Management and Finalization - 30 Hours

## Organizing and uploading all materials to the GitHub repository.

## Ensuring accessibility and proper documentation within the repository.

## Finalizing all deliverables and preparing for project closure.

## 6. Contingency Time - 10 Hours

## Addressing unforeseen challenges, issues, or refinements.

## Making any last-minute adjustments or enhancements to the tool or paper.

## This forecast provides a structured allocation of hours to each component, ensuring that each task is given adequate attention and effort, leading to the successful completion of the project. While this is an initial estimate, regular progress assessments and adjustments will be made as needed throughout the project lifecycle.

## Expected completion date and semester:

## Expected Completion Date and Semester:

## Forecasted Completion Date: December 14, 2023

## Semester: Fall 2023

## The project is slated to start on September 13, 2023, and conclude by December 14, 2023, aligning with the academic calendar for the Fall 2023 semester at NYU School of Professional Studies. This timeline takes into account all phases of the project, from initial research and development to all the final documents and the project presentation on December 14, 2023.

## Resources required:

For the successful completion of this project, several resources will be essential, encompassing human resources, data, technical infrastructure, and miscellaneous assets:

1. Human Resources:

Technical Advisors: Guidance from individuals with expertise in Large Language Models (LLM) and data analysis for tool development.

Reviewers for the Paper: Peers, colleagues, or faculty members to review and provide feedback on the research paper before submission.

2. Data:

O\*NET Dataset: Access to the Bureau of Labor Statistics O\*NET dataset of occupations is crucial for developing the replaceability scale.

Goldman Sachs Scale: Information and details on the scale developed by Goldman Sachs for reference and comparison.

3. Technical Infrastructure:

Development Environment: Access to suitable development tools, platforms, and libraries for implementing LLM and developing the tool.

Computing Resources: Sufficient computing power (CPU/GPU) and storage for developing, testing, and running the tool.

GitHub Repository: A GitHub account and repository for storing, managing, and sharing project materials and deliverables.

4. Software:

Document Writing Tools: Word processing software like Microsoft Word or LaTeX for writing and formatting the research paper.

5. Miscellaneous:

Communication Tools: Platforms like Zoom or Microsoft Teams for virtual meetings and communications with the project sponsor and other stakeholders.

Project Management Tools: Tools like Trello or Asana for planning, tracking, and managing project tasks and progress.

The detailed specification of these resources and any additional needs will be continually assessed and refined as the project progresses, ensuring all necessary assets are available for the successful development and completion of the Robot Replaceability Scale Tool.

## Areas of study in the MS program that the project would cover:

## The development of a Robot Replaceability Scale Tool using LLM encompasses a diverse range of disciplines within the MS Program. The areas of study that will be instrumental in planning and conducting the project include:

## 1. Data Science and Analytics:

## Leveraging data science techniques for analyzing the O\*NET dataset and deriving insights.

## Applying statistical methods and machine learning algorithms for tool development and validation.

## 2. Artificial Intelligence and Machine Learning:

## Understanding and implementing Large Language Models (LLM) for the development of the replaceability scale tool.

## Exploring techniques in natural language processing and understanding to enhance the tool's capabilities.

## 3. Management Information Systems:

## Learning about the practical application of information technology in solving business problems.

## Integrating the knowledge of IT systems and management to ensure the tool aligns with business reengineering analysts' needs.

## 4. Project Management:

## Employing project management principles and best practices for planning, executing, monitoring, and closing the project.

## Utilizing project management tools and techniques to ensure timely delivery of deliverables.

## 5. Human-Computer Interaction:

## Designing user interfaces and experiences that make the tool user-friendly and effective.

## Understanding the interaction between humans and computers to optimize the tool’s usability.

## 6. Ethics in Technology and Data:

## Ensuring ethical considerations are adhered to, particularly regarding data privacy and usage.

## Navigating the ethical implications of replacing human tasks with robots.

## 7. Business Strategy and Operations:

## Understanding how the tool can be integrated into broader business strategies and operations.

## Exploring how automation and robotics can impact and improve business processes and efficiency.

## 8. Research Methodology:

## Applying research methods for literature review, data collection, analysis, and validation.

## Writing and presenting the research paper according to IEEE conference paper standards.

## By leveraging the knowledge and skills acquired in these areas of study, the project will be well-positioned for success, ensuring a comprehensive approach to developing a robust and effective Robot Replaceability Scale Tool.

## Anticipated Learning outcomes:

Engaging in this innovative project to develop a Robot Replaceability Scale Tool using Large Language Models (LLMs) offers a multifaceted learning opportunity. Here are some anticipated learning outcomes:

1. Deepened Understanding of LLMs:

Gain hands-on experience and a deeper understanding of implementing and optimizing Large Language Models for specific applications.

Learn how to tailor LLMs to analyze and interpret diverse datasets effectively, particularly in the context of labor statistics and occupation classifications.

2. Data Analysis and Interpretation Skills:

Enhance skills in analyzing, interpreting, and drawing insights from complex datasets, such as the O\*NET dataset from the Bureau of Labor Statistics.

Develop proficiency in utilizing advanced data analysis tools and techniques to solve real-world problems.

3. Practical Application of Automation Concepts:

Acquire a practical understanding of the possibilities and limitations of automating human tasks using robots.

Explore the real-world implications of task automation on various occupations and industries.

4. Cross-disciplinary Integration:

Learn how to integrate knowledge from multiple disciplines, including data science, artificial intelligence, management, and human-computer interaction, to develop a comprehensive tool.

Explore how interdisciplinary approaches can yield more robust and versatile solutions.

5. User-Centric Design and Development:

Gain experience in designing user-friendly interfaces and experiences for a diverse user base.

Learn how to incorporate user feedback and needs into the development process to enhance tool usability and effectiveness.

6. Research and Academic Writing Skills:

Improve skills in conducting academic research, literature review, and organizing findings coherently.

Enhance proficiency in writing and formatting academic papers to meet the standards of reputable conferences like IEEE.

7. Project Management and Delivery:

Strengthen project management skills by planning, executing, and overseeing a complex project with multiple deliverables.

Learn how to manage time and resources efficiently to meet project milestones and deadlines.

8. Ethical Considerations and Implications:

Deepen understanding of the ethical considerations involved in replacing human tasks with robots and handling occupational data.

Explore how to address and navigate ethical dilemmas and challenges in technology development.

These learning outcomes will not only contribute to my academic and professional development but also provide valuable insights and skills applicable to future endeavors in technology, management, and research.

## 21. Anticipated Project Findings:

## The anticipated project findings are expected to be multifaceted, shedding light on the complexities and possibilities in the field of task automation using robots.

## Anticipated Findings:

## Robot Replaceability Scale:

## A nuanced Robot Replaceability Scale, indicating which human tasks across different occupations are most susceptible to automation.

## Insights into the varying degrees of complexity and human involvement required across different tasks and occupations.

## LLM Effectiveness:

## Evaluation of the effectiveness of Large Language Models (LLMs) in analyzing occupational data and contributing to the development of the replaceability scale.

## Identification of areas where LLMs excel and where they may have limitations in this context.

## Comparative Analysis:

## A comparative analysis between the developed tool's findings and the predictions of subject matter experts, showcasing the accuracy and reliability of the tool.

## Identification of any discrepancies and exploration of their causes.

## Usability and Application:

## Assessment of the tool's usability and its potential applications in assisting business reengineering analysts.

## Exploration of the tool's impact on various industries and its role in shaping future workforce dynamics.

## Limitations:

## Data Limitations:

## The O\*NET dataset's comprehensiveness and accuracy could limit the depth and breadth of the analysis.

## Evolving job roles and emerging occupations may not be fully represented in the available data.

## LLM Limitations:

## LLMs have inherent limitations in understanding context and making nuanced judgments, which might affect the tool's accuracy in certain scenarios.

## The need for large computational resources and potential biases in the model could pose challenges.

## Ethical and Societal Implications:

## The tool may raise ethical questions regarding job displacement and the societal implications of widespread automation.

## Addressing these concerns and ensuring ethical usage of the tool will be a continuous challenge.

## Generalization:

## The tool's findings might not be universally applicable across different industries, regions, and cultural contexts.

## Adaptation and customization may be necessary for broader applicability.

## Technological Advancements:

## Rapid advancements in technology might outpace the tool's current capabilities, necessitating regular updates and adaptations.

## Integration with emerging technologies and adapting to new forms of work will be essential for sustained relevance.

## By exploring these potential findings and limitations, the project aims to deliver a robust and insightful tool while acknowledging and addressing the inherent challenges in the automation of human tasks.

## *22. Your SPS Academic Advisor’s Name*

Paul Henkel (ph320@nyu.edu)

## *23. Your Expected Date of Graduation*

May 2024