HAEC HELLENIC AMERICAN COLLEGE in cooperation with HellenicAmericanUniversity

Summer 2023 UG Fellowship program

Hellenic American University / College Project Descriptions

Project #1

Supervisor's name	Didoe Prevedourou, https://www.linkedin.com/in/didoe-prevedourou-1b0804/
Project title	Guiding Ethical Research and Design of XR Technologies and Applications
Estimated group size	3 students
Estimated duration	6 weeks
Project description	Extended reality (XR) technologies, including AR, VR, and mixed reality, will see pervasive and widespread adoption and revolutionize many aspects of everyday life in the coming decades. The autonomous and intelligent systems (A/IS) backbone enabling real-time personalization of any end-users' Extended Reality (XR) world raises a host of ethical and philosophical questions about the collection, control, and exploitation of user data within these ecosystems [1]. Ethical design is user-centered or human-centered, meaning that the design work is governed by the needs and problems experienced by users, instead of by a primary focus on what is technically possible and economically viable. The present project aims to study ethical concerns in the context of XR, where a./ the breadth of sensing in XR enables XR applications and platforms to process captured data toward unanticipated and unintended ends; b./ on-line harassment behavior can occur in social and multi-user VR and be quite impactful; and c./ virtual clones with full fidelity (indistinguishable from the human individual) can be created resulting in the replication of identity which can become unethical or problematic. Students will be asked to review a number of XR applications with the view to identify unintended negative consequences that could diminish human well-being, express their feelings and thoughts about the negative consequences and propose design guidelines and mechanisms to prevent or counter-act them and drive the implementation of trustworthy systems. [1] The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems - Extended Reality in A/IS [2] Independent High-Level Expert Group on Artificial Intelligence, https://digital-σtrategy.ec.europa.eu/en/library/ethics-guidelines-trustworthy-ai

Project #2

Supervisor's name	Sokratis Sofianopoulos
Project Title	Building a chatbot using Python and Machine Learning
Estimated group size	3-5 students
Estimated duration	6 weeks
Project description	**Summary of the proposal** The project's goal is to create a functional chatbot using the Python programming language. With the emergence on chatGPT and the impact that huge language models have on our daily routines, conversational agents are on the spotlight. Participants will learn the fundamentals of natural language processing (NLP) and how it can be used to create a conversational chatbot. They will also be introduced to the various Python libraries and tools for building NLP applications, such as NLTK, spaCy, and Rasa. The program will include lectures and hands-on exercises, that will allow participants to create their own chatbot in a specific domain of their choice. Throughout the program, participants will be expected to work on a project and will receive feedback and guidance. In the end, they will have a solid understanding of the principles of chatbot development. They will have also implemented a fully functional chatbot that can respond to user inputs and carry out basic conversations in a specific domain. Finally, they will also have the opportunity to present their application to the group and receive feedback from their peers. Both analytical and computational tools will be employed. Familiarity with Python or any coding language will be an asset. **Plan** • Introduction to Chatbots and Natural Language Processing ➢ Introduction to chatbots and their applications ➢ Introduction to Python and its libraries for NLP • NLP Fundamentals ➢ Natural language processing (NLP) and its applications to chatbot development ➢ Tokenization, stemming, lemmatization and Part-of-speech (POS) tagging o Named entity recognition (NER) • Understanding User Inputs ➢ Supervised and unsupervised learning for intent recognition ➢ Designing conversation flows and dialogues o Introduction to Rasa framework. • Creating Chatbot Responses ➢ Introduction to dialogue generation 2 ➢ Retrieval-based vs. generative-based approaches

	➢ Building a chatbot using a simple rule-based system ➢ Implementing chatbot responses with Natural Language Generation (NLG) • Advanced Chatbot Techniques ➢ Implementing a chatbot using deep learning ➢ Handling more complex user queries **References** • "Building Chatbots with Python: Using Natural Language Processing and Machine Learning" by Sumit Raj (2019) • "Practical Natural Language Processing" by Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, and Harshit Surana (2019) • "Python for Data Analysis" by Wes McKinney (2017

Project #3

Supervisor's name	Sokratis Sofianopoulos
Project Title	Collecting and analyzing data from Twitter using Python
Estimated group size	3-5 students
Estimated duration.	6 weeks
Project description	The primary focus of this project is on collecting twitter data and then using this data for natural language processing applications. Students will begin by learning the basic syntax and usage of the Python programming language. Afterwards, we will talk about web APIs and see first-hand how we can use an API such as the one provided by Twitter to collect data. Finally, we will study NLP techniques such as data cleaning, text similarity and sentiment analysis and apply them to the collected twitter data. Both analytical and computational tools will be employed. Familiarity with Python or any coding language will be an asset.

Project #4

Supervisor's name	Didoe Prevedourou, https://www.linkedin.com/in/didoe-prevedourou-1b0804/
Project title	Digital Twins (DTs) of Smart Cities
Estimated group size	3 students

Estimated duration	6 weeks
Project description	Digital Twins (DTs) of smart cities offer tangible digital replicas of several aspects of a city (from social, business, cultural dynamics to actual infrastructure) and allow various parties, policymakers, urban planners, engineers, developers, entrepreneurs, citizens etc., to assess the effects of any changes before investments and implementations of strategic plans occur. Cities are faced with complex major challenges for reducing issues such as air pollution, noise nuisance and traffic overload in the city center. They need to keep urban areas attractive, liveable, and healthy. Action to improve the situation in a particular area may have an impact on multiple factors and/or locations elsewhere in a city. Digital Twins build a bridge between the digital and physical urban world. By first modifying livability factors digitally, their effects on the city can be simulated and tested properly. The project aims to familiarize students with Digital Twins (DTs) of smart cities as a concept and as a tool. During the project students will be asked to: 1./ survey digital twins of smart cities around the world, such as Singapore, Amaravati in India, and a number of cities in Europe, in terms of use cases addressed and technologies used such as AI, high performance computing, data and cloud infrastructures, 5G connectivity; 2./ identify reference architectures, open frameworks (e.g., Open Digital Twin Framework, ODTF), tools that have been commonly used in the development of digital twins of smart cities; and 3./ take a glimpse into Metaverse cities: collect younger generations' views and visions.

Project #5

Supervisor's name	Panayotis Kalozoumis (LinkedIn)
Project Title	Quantum Computing and Quantum Technologies
Estimated group size	2-4 students
Estimated duration	6 weeks
Project description	**Project description and plan** Quantum computers and quantum technologies are the main pillars of the second quantum revolution, which has already shown tremendous potential towards emerging technologies with unprecedented impact on sciences, industry, health, and everyday life. With quantum computers, specific problems that would take thousands of years to be solved in classical computers, will be tackled within minutes. Throughout the project students will become familiar with the

	principles of quantum mechanics and how to use them in quantum computers. They will write our own codes and understand how real quantum computers work. A high school level of mathematical knowledge is adequate. The programming language will be Python and no prior knowledge is required. Throughout the course we will discuss topics such as: • Principles of Quantum and Classical Computers • Superposition • Entanglement • Qubits • Quantum Teleportation • Shor Algorithm • Deutsch Algorithm • Grover Algorithm By the end of the project students will have a basic theoretical and practical knowledge of Quantum Computing, they will be able to write their own circuits and execute codes on real quantum computers. **References:** P. Kaye, R. Laflamme, and M. Mosca, *"An Introduction to Quantum Computing An Introduction to Quantum Computing,"* Oxford University Press (2007).

Project #6

Supervisor's name	Panayotis Kalozoumis (LinkedIn)
Project Title	Manipulation of light in nanophotonic waveguides
Estimated group size	2-4 students
Estimated duration	6 weeks
Project description	**Project description and plan** Discrete optics [1] is one of the most active and promising fields in Engineering, Physics, and technology. Devices based on this concept offer unique opportunities to control and manipulate the flow of light [2]. Discretizing light behavior requires optical elements that can confine optical energy at distinct sites. In this project, students will be introduced ot the concepts of nanophotonic devices, discrete optics, the cutting-edge technology that emerges, existing applications, and future perspectives.

	Students will: • become familiar with the basic elements of coupled mode theory. • explore the propagation properties of light in waveguide arrays via analytical and numerical techniques. • consider the case of active materials • build appropriate codes to model the corresponding systems and investigate the behavior under different parameter choices. Both analytical and computational tools will be employed. Familiarity with MATLAB, Mathematica or any coding language is desirable. 1. A. Szameit and S. Nolte, J. *Phys. B: At. Mol. Opt. Phys.* **43,** 163001 (2010). 2. P. A. Kalozoumis, C. V. Morfonios, F. K. Diakonos, and P. Schmelcher, Phys. Rev. A **93**, 063831 (2016)

Project #7

Supervisor's name	Themis Kaniklidou
Project Title	Technocratic communication in political discourse
Estimated group size	2 - 3
Estimated duration.	6 weeks
Project description	This project looks to identify traces of technocratic communication in political discourse. It seeks to collect data on the use of lexical item *strategic* in collocational clusters and argues that these are often discursively deployed to assign overtones of centrist, neoliberal populism to a more traditional or "old" left-wing populist ideology. The project will investigate website, manifestoes and campaign material to retrieve the semantic associations established between the business domain, by using the lexical items *strategy* and *strategic,* and that of politics may be key for legitimizing policies underway and for fostering trust-building.

Project #8

Supervisor's name	Eugenia Arsenis
Project Title	DISCOVERING TOGETHER!

Estimated group size	2 to 4 students
Estimated duration.	6 weeks
Project description	Throughout this project, the students will discover more about Greek culture by exploring works of art from all fields. The course will combine visits in spaces that are related with art and culture, as long as, work in the classroom with texts written by the students after their visits. The aim is an intercultural exchange between Greek culture and the culture of the participants, by employing theatrical tools. The project will be completed with a performance – theatrical presentation by the students, as an outcome of their writing, inspired by the cultural spaces, that will be developed in the class with additional acting work. Yet, prior acting experience is not necessary.

Project #9

Supervisor's name	G. Kontaxis
Project Title	Managing IT projects
Estimated group size	3-5 students
Estimated duration.	6 weeks
Project description	**Summary of the proposal** In this course, students will become familiar with the Project Management methodology. They will develop the required plans for an IT project of their choice, based on the Project Management Body of Knowledge [1]. **Related Work** Participants will use MS Project to develop a Schedule and a Cost plan in a Gantt Chart [2] and MS Visio for creating a Work Breakdown Structure diagram. **Plan** – Prepare a project charter document. – Create detailed plans for scope, schedule, cost, resources, quality, and risks. – Monitor the project through its progress. – Present reports for project's execution **References:**

	1. Project Management Institute, “Project Management Body of Knowledge”, 6th edition, 2016 2. C.Lewis, C. Chatfield, T. Johnson, “MS Project step by step”, 2019