



## Undergraduate Summer Research Academy

### Project Details

#### Project 1

**Research Project Title:** Privacy-Preserving Machine Learning for Healthcare  
**Research Professor:** **Dr. Abdur Rahman Bin Sahid**, Computer and Information Systems, SIHSS

#### Project 2

**Research Project Title:** Beijing's Olympics and President Biden: Did the White House influence U.S. reporting of this sports spectacle?  
**Research Professor:** **Dr. Anthony Moretti**, COMM/ORGL, SIHSS

#### Project 3

**Research Project Title:** Quantum Computing for Inequality Aversion Pricing  
**Research Professor:** **Dr. Sangho Shim**, Engineering Department, SEMS

#### Project 4

**Research Project Title:** A New Model of Plasticity  
**Research Professor:** **Dr. Gavin Buxton**, Science Department, SEMS

#### Project 5

**Research Project Title:** National Divorce: Impact of Media and Politics on Divergent National Identities  
**Research Professor:** **Dr. Soren Fanning and Dr. Anthony Moretti**, Social Sciences/Communications and Organizational Leadership, SIHSS

#### Project 6

**Research Project Title:** Establishing a Framework of Athletic Coaching Success across Generations.  
**Research Professor:** **Dr. Mary Hansen**, Education, SNEHS

Application Deadline  
**March 18, 2022**



# Project 1 of 6

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**Research Project Title:** Privacy-Preserving Machine Learning for Healthcare

**Research Project Summary:** Machine Learning (ML) has been engaged in intensive research to build an efficient and effective intelligent system for the early identification of chronic diseases. Cardiovascular diseases (CVDs) prediction is a single instance from a large pool of healthcare problems that have benefited from ML. According to World Health Organization (WHO), CVDs are the leading cause of death globally, taking an estimated 17.9 million people died from CVDs in 2019, representing 32% of all global deaths. Already, statistical Machine Learning methods are central in assessing cardiovascular disease risk and U.S. prevention guidelines. Nonetheless, the vulnerabilities associated with the design of ML-based systems have not yet been fully understood. In prediction-based healthcare applications, the ML model is considered a precious intellectual property. An attack on the model could seriously undermine the privacy of the patients' data used to train and test the model. The goal of this project is to develop a privacy-preserving ML model. This project resonates with the PIs' long-term research and educational goals of contributing to developing secure and privacy-preserving Artificial Intelligence (AI) Systems. This project continues PI's published work on "A Study of Differentially Private Machine Learning in Healthcare," where the group proposed privacy-preserving ML models for Breast Cancer and Diabetes prediction. In this project, the student will study differential privacy-based Logistic Regression and Naive Bayes models for CVD prediction and the privacy requirement and model accuracy trade-off.

**Student Research Objectives:**

1. Discuss the concept of privacy in machine learning systems
2. Demonstrate an application of privacy in machine learning
3. Solve a healthcare problem using machine learning tools
4. Work collaboratively with other researchers
5. Identify and practice research ethics and responsible conduct in research
6. Contributing to economic development and society through the prevention and detection of cyber threats in the computer-based information systems for business, government, and other organizations.
7. Communicate effectively in a variety of professional contexts.

**Skills Required:**

- Basic experience in any programming language is desired.

**Note:** The student will work on a python code done for a previous project on developing privacy-preserving ML models for Breast Cancer and Diabetes prediction. Here, the student will adapt the existing code for a Cardiovascular disease dataset.

**Expected Student Research Outcomes:**

1. The result will be published in a peer-reviewed conference as an undergraduate poster
2. The result will be published as a part of journal publication

**Research Professor: Dr. Abdur Rahmann Bin Sahid**, Computer and Information Systems, SIHSS



## Project 2 of 6

**Research Project Title:** Beijing's Olympics and President Biden: Did the White House influence U.S. reporting of this sports spectacle?

**Research Project Summary:** The already strained diplomatic relationship between the United States and China has grown worse in recent years. While it is convenient to point to the presidency of Donald Trump as the linchpin for the deterioration of this relationship, the reality is the two nations also witnessed stress points during the Barack Obama presidency (Canrong, 2016).

Of course, Trump's rhetorical blasts, including consistently referring to coronavirus as the "Wuhan virus," ensured the bilateral relationship cratered. But Trump's successor has maintained an equally strident approach toward China; as just one example, consider how Joe Biden's secretary of state "publicly clashed" with his Chinese counterparts when they met in 2021 in Alaska (McCurry, 2021). That meeting affirmed that a new president wouldn't mean a new attitude toward China. The decisions by America's political leaders influence how China is reported in U.S. mainstream media agencies. But this is influence is not new; there is substantial scholarship examining the ability the White House has in shaping media coverage of major news and sports events, especially when those events involve nations considered hostile to the United States (Moeller, 2018; Billings, Brown & Brown, 2013; Moretti, 2013; Edwards & Wood, 1999).

This research paper will explore how the Biden administration attempted to influence media reporting of the 2022 Winter Olympics, hosted by Beijing. The spectacle that is the Olympics provided China with the opportunity to showcase what it sees as the strengths of its economic and political systems, both of which are in sharp contrast to the United States. This research explores how the White House sought to counter that narrative and whether selected mainstream media adopted or challenged the president's interpretation of what was taking place in China before and during the Games. Because of their national reach and prestige, the New York Times and the Los Angeles Times will be the media examined in this study.

### **Student Research Objectives:**

1. Become familiar with U.S. media practices
2. Examine how audiences influence and are influenced by media reporting
3. Explore how powerful political forces influence media reporting
4. Learn about the oftentimes hostile U.S.-China diplomatic relationship.

### **Skills Required:**

- Fundamental understanding of U.S. political structure
- Familiarity with mainstream media practices and programs
- Experience with database research (can be from library assistance)

### **Expected Student Research Outcomes:**

1. Complete a research poster highlighted his/her key findings
2. Draft a literature review
3. Determine whether he/she wishes to continue on this project in the fall

**Research Professor:** Dr. Anthony Moretti, COMM/ORGL, SIHSS



## **Project 3 of 6**

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**Research Project Title:** Quantum Computing for Inequality Aversion Pricing

**Research Project Summary:** The inequity aversion pricing aims to maximize revenue while providing discount prices to people connected in a social network such that connected people receive prices that are not too different. The inequity aversion pricing problem is one of the most important problems in business analytics. The problem can be modeled into a quadratic unconstrained binary optimization (QUBO) formulation which can be solved by a Quantum Annealing (QA) machine. This project solves the problem on Facebook network data using the QA hardware provided by D-Wave Systems. To solve the problem on large scale social networks, we discuss a scheme to embed the decision variables of the QUBO model into the hardware graph of the D-Wave machine.

**Student Research Objectives:**

1. To be familiar with new technology, "Quantum Computing"
2. To know the strength of Quantum Computing in business
3. To understand the limitation of the current Quantum Computing machines
4. To know how to develop mathematical models of the e-commerce business
5. To learn communication skills for collaborative computational projects.

**Skills Required:**

- Not required but recommended: Python coding, ENGR3900 Optimization Techniques or MATH3030 Operations Research.

**Expected Student Research Outcomes:**

1. 6 pages of project report and a poster for RMU undergraduate research poster presentation in the following Spring

**Research Professor:** Dr. Sangho Shim, Engineering Department, SEMS



## **Project 4 of 6**

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**Research Project Title:** A New Model of Plasticity

**Research Project Summary:** The project will involve using a new model of elasticity and adding plasticity. The model consists of a network of springs, where the stiffnesses of the springs can be varied to capture linear elasticity theory. The idea will be to move the nodes of the network in response to flow plasticity theory and capture plastic deformation in an emergent way. Potential applications will be considered.

**Student Research Objectives:**

1. The student will learn how to run an existing program of elasticity.
2. The student will work with me in extending this model to include plasticity
3. The student will keep an electronic lab book
4. Student will get their name on an academic paper

**Skills Required:**

- An engineering student with some knowledge of C.

**Expected Student Research Outcomes:**

1. Learn how research is conducted and improve computer skills
2. Help in developing a new computer model of plasticity
3. Help think of potential applications for new model
4. Get name on a paper.

**Research Professor:** Dr. Gavin Buxton, Science Department, SEMS



## Project 5 of 6

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**Research Project Title:** National Divorce: Impact of Media and Politics on Divergent National Identities

**Research Project Summary:**

In an effort to reach a more comprehensive understanding of the contemporary sociopolitical strife in the USA, we will be researching the impact of media, media conglomerates, and media markets in shaping competing political narratives which have driven political engagement. This project seeks to not only explain how the American national identity became so bifurcated, but also to describe the challenges presented by the prospect of a right-left political separation.

**Student Research Objectives:**

1. Become familiar with U.S. media practices
2. Examine how audiences influence and are influenced by media reporting
3. Explore the current fractured U.S. political landscape
4. Make meaningful contributions to a multi-part research project examining media and politics

**Skills Required:**

- Become familiar with U.S. media practices
- Examine how audiences influence and are influenced by media reporting
- Explore the current fractured U.S. political landscape
- Make meaningful contributions to a multi-part research project examining media and politics

**Expected Student Research Outcomes:**

1. Complete a research poster documenting media bias
2. Submit a written footnoted overview of research findings

**Research Professor: Dr. Soren Fanning and Dr. Anthony Moretti, Social Sciences/Communications and Organizational Leadership (SIHSS)**



## Project 6 of 6

**Research Project Title:** Establishing a Framework of Athletic Coaching Success across Generations

**Research Project Summary:** This research project involves aims to determine and describe the attributes that result high quality, successful athletic coaches pass on to their players, who in turn become successful athletic coaches (i. e., success across generations). Research suggests that athletic coaches have a powerful impact on youth athletes, second to their parents. Additionally, the short term and long term benefits of sports participation by athletes are well-known, and include physical, mental, and emotional benefits. Successful athletic coaches share common philosophies that focus on teaching life skills, promoting teamwork and goal-setting, and developing well-rounded individuals, rather than focusing solely on athletic skill development. This study will explore the relationships formed, lessons learned, impact of coaching philosophies, and changes made across several "generations" of coaches--meaning the coach and their former players who became successful coaches, and so forth. The study will attempt to identify key components that work for coaches across generations in developing athletes who are successful in sports and beyond, as well as components that individual coaches change from what they learned from their mentors, as they continue to develop. The research will involve data collection through questionnaires and interviews. The ultimate goal for the project after data collection and analysis is to suggest a model highlighting best-practice for athletic coaches. The summer work involves instrument development of a questionnaire and interview protocol, piloting each instrument, and submitting the instruments for IRB approval. As time permits, data collection will commence.

### **Student Research Objectives**

1. Understand the research process
2. Conduct a literature review
3. Draft an interview protocol
4. Draft a questionnaire
5. Submit research for IRB approval
6. Conduct pilot data collection

### **Skills Required:**

- Students should have an interest in athletic coaching
- Students should have an interest in learning about qualitative and quantitative data collection and analysis.
- Students will need to work within an online survey development software package.
- Prior experience within the package is not necessary.

### **Expected Student Research Outcomes:**

1. Reviewed literature
2. Engaged in the development of a questionnaire
3. Engaged in the development of an interview protocol

**Research Professor:** Dr. Mary Hansen, Education /SNEHS

***Undergraduate Summer Research Academy***