2018 Undergraduate Summer Research Program Projects:

APPLIED PHYSICS

Professor Lorcan Folan
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Research Project:

- Fabry Perot Interferometry using CCD cameras

Note: Preference will be given to students who have completed PH-UY 2033 & 2131.

CENTER FOR URBAN SCIENCE AND PROGRESS

Professor Debra Laefer
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Other Mentor:
Vu Vo – anh.vu.vo@nyu.edu
Research Projects:

- Graphical User Interface Design for Viewing Massive Remote Sensing Data
  Distributed data storage is essential for large aerial remote sensing datasets as typical data sets new exceed 1 TB/km2 and commonly contain billions of points. Yet available storage strategies have been generic in nature and not designed for the many data types and functionalities needed for manipulating aerial remote sensing (ARS) data. This project will help design a graphical user interface to support a new spatio-temporal database design that uses Hbase as its back bone and strives to offer unprecedented flexibility for the storage, querying, and ultimately visualization of these dense urban data sets. The students will learn about the remote sensing data and the distributed computing database structure but will primarily contribute to the creation of an easy to use but high functionality graphical user interface.
- Aerial Laser Scanning Analysis
  This project will look at characterizing large-scale, dense urban LiDAR data sets through several approaches. These will include basic statistics, derived geometries, and machine learning. These will be employed for a number of key tasks including the following: (1) describing the data, its coverage level, heterogeneity, and level of occlusions; (2) deriving basic information about the scene such as average street width, building height, and available floor space in the built structures; and (3) determining to what extent typical urban items (e.g. light poles, fire hydrants, man hole covers, etc.) can be automatically extracted from an urban environment and the level of training data needed to do this

robustly. Each student recruited to this project will take adopt one of the three strategies identified above for one of the three application areas.

- Soundless Chemical Demolition Agents
  Soundless chemical demolitions agents (SCDA) provide a non-percussive alternative to jack hammers and explosives. While commercially available since the 1970s, this class of products has only enjoyed modest industrial uptake, in part due to an absence of rigorous usage guidelines. To help fill this gap, this project will reanalyze two dozen large-scale demolitions (mostly done 2001-2004) in light of newly published research related to expansive pressure as a function of hydration heat and ambient temperature. The summer research student would have an ideal opportunity to learn about a set of highly useful specialty products. This project would be well suited for a Civil or Mechanical Engineering student, although others (including non-engineers) would be welcome. Only a working knowledge of excel is needed. Younger students are especially encouraged to apply.

Note: Preference will be given to students with enthusiasm and a good work ethic; coding experience is a plus for projects 1 and 2.

CHEMICAL AND BIOLOGICAL ENGINEERING

Professor Alexandra Seidenstein
ahs342@nyu.edu
Other Mentor:
Tommy Lee – tsl2@nyu.edu
Research Projects:

- FarmBytes: Autonomous Vertical Farm Design & Impact
- FarmBytes: Autonomous Vertical Farm Tech & Coding
- 3D Printing of Neurons and Bone

Professor Ayaskanta Sahu
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Research Projects:

- Designing novel two-dimensional graphene-like nanomaterials for energy applications
- Designing sustainable nanomaterials for lighting applications like photovoltaics and light emitting diodes
- Studying fundamental thermal and electrical transport in hybrid organic inorganic nanomaterials

Note: Preference will be given to students a GPA of at least 3.0 and a strong background in chemical engineering, electrical engineering, physics, chemistry and materials science with interest in working with chemicals and electronics.

Professor's Bruce Garetz
bgaretz@nyu.edu
Research Projects:

- Characterization of block copolymer grain structure using depolarized light scattering
  We use light scattering to study the micrometer-scale grain structure of block copolymer materials, in an effort to understand how this structure affects the conductivity of polymer/lithium salt mixtures that can be used as lithium battery electrolytes.
- Effect of gold nanoparticles on laser-induced nucleation
  Gold nanorods exhibit plasmon resonances that can enhance the strength of electric fields. We propose to test whether the threshold for laser-induced crystallization of supersaturated aqueous glycine solutions is reduced in the presence of gold nanorods.

Note: Preference would be given to students with some lab experience.

Professor Eugene Callahan
ejc369@nyu.edu
Research Projects:

- Animated Algorithms
  Place animated algorithms on web pages using Javascript
- Assembly Language Emulator
  Allow students to learn assembler on the web.

Note: Preference will be given to students with some programming experience in Python and/or Javascript.

Professor Jin Kim Montclare
montlcare@nyu.edu
Other Mentors:
Priya Katyal – priya.katyal@uconn.edu
Joseph Thomas – jst390@nyu.edu
Research Projects:

- Protein Engineered Biomaterials for Treating Osteoarthritis
  Individuals will biosynthesize and characterize protein engineered biomaterials.
- Engineered Lipoproteoplexes for Gene Delivery

Individuals will produce engineered proteins and lipid mixtures to generate new lipoproteoplexes for gene delivery.

Note: Preference will be given to rising sophomores or juniors with a GPA of 3.2 and above.

Professor Jin Ryoun Kim
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Research Project:

- Amyloid aggregation implicated in neurodegenerative diseases

Notes: Preference will be given to students with a minimum cumulative GPA of 3.4.

Professor Mary Cowman
mary.cowman@nyu.edu
Research Projects:

- Glycosaminoglycan Biomarker Isolation
  We are developing new kit-based isolation protocols for glycosaminoglycans, and investigating their potential application to biomarker assay development.
- AlphaScreen Assays for Glycosaminoglycan Biomarkers
  We are testing the bead-based AlphaScreen platform for use in specific and quantitative assays of glycosaminoglycan biomarkers.
- Liposome Models for Extracellular Vesicles
  Exosomes and microvesicles play important roles in cell-cell communication. This project involves creation, characterization, and modulation of hyaluronan-coated liposome models for microvesicles.

Note: Students must have completed one year of biochemistry.

Professor Miguel Modestino
modestino@gmail.com
Other Mentors:
Daniela Blanco – deb420@nyu.edu
Adlai Katzenberg – abk403@nyu.edu
Research Projects:

- Solar-Hydrogen Production Devices
- Nanostructured Electrocatalysts for Renewable Energy Conversion

Professor Rastislav Levicky
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Research Projects:

- Hybridization Thermodynamics

Analysis and modeling of associations between nucleic acids and their analogues

- Pulsed Field Hybridization
  Use of electric fields to purify hybridization products

Notes: Preference will be given to students who have completed of CM-GY 5040 Chemical Laboratory Safety.

Professor Ryan L. Hartman
ryan.hartman@nyu.edu
Research Projects:

- Continuous-flow methane C-H activation catalysis
- Design of a robust microfluidic wire-guided jet

Note: Preference will be given to junior level students with a GPA of 3.5.

Professor Tommy Lee
tsl2@nyu.edu
Other Mentor:
Alexandra Seidenstein - ahs242@nyu.edu
Research Projects:

- Chemtris
  Topics in organic chemistry and biochemistry will be used to build the next level of Chemtris. In Chemtris I, chiral forms were used to understand rotation of molecules. In Chemtris II, concepts of chemical bonding were introduced, along with more complex chiral forms. In Chemtris III, the concepts of hydrophobicity and hydrophilicity will be developed, and additional chiral forms will be included. Players will gain better knowledge of chemistry through visual representation of molecules and gaming.
- The Panic Button
  Project aimed to develop methods through which large groups of people can be notified of emergency situations quickly. These methods will be evaluated to find the safest and most efficient method the accomplish the task of rapid information dissemination. An application will be made in order to accomplish these goals.
- Dead Man Walking
  Strives to create a continuous health monitoring system that notifies elderly users, and their physicians, on their health status from their homes. By keeping an active record of vital signs, through facial recognition and infrared signals, the system will record the normal ranges, as well as alert emergency services in the case of adverse events.

Notes: Preference will be given to students with a minimum GPA of 3.0 with coding experience.

Professor Wendy Hom
wendy.hom@nyu.edu
Research Projects:

- Dash Cam
  The goal of this project is to create an application for devices that is able to display content from both cameras simultaneously. This will allow phones with both front and back cameras to be used as dash cams where a portion of the screen displays what is seen in the front camera, and another portion displays what is seen in the back camera.
- Staff of Gandalf
  The electronic transport aid for the visually impaired will be further developed to create a working prototype. This prototype will include an array of sensors that is able to signal to the user if there are any obstacles ahead. Improvements will be made to the design of the prototype to enable the visually impaired to navigate their surrounding environment more easily.
- Simulation of Origins of life
  Students will work to understand the intricacies of amino acid linkage and protein folding to create a computer simulation of how amino acids combine to create fully functioning enzymes. The simulation will model the formation of proteins from amino acids and the way in which separate amino acids can come together to form much longer chains that eventually make up enzymes that are able to perform specific functions. Beginning with simple amino acids, the formation of much more complex proteins will be tracked by observing the interactions between side-chains of amino acids formed at set intervals.

Notes: Preference will be given to students with a minimum GPA of 3.0 who have coding and possibly electronics experience.

CIVIL AND URBAN ENGINEERING

Professor Joseph Chow
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Research Projects:

- Electric Vehicle Carsharing Rebalancing
  The student will work with graduate students to test dynamic optimization models based on queueing networks to maximize availability of vehicles for passenger

demand. This includes working on a multiagent transportation simulation model of NYC.

- Large Scale Multiagent Simulation of NYC Mobility
  The student will help develop and calibrate a multiagent transportation simulation model of NYC which will serve as a virtual test bed for evaluating the social impacts of future transportation technologies.
- Hacking Mobility Company Data
  Private mobility providers are hesitant to share certain data with the public. We will explore different inverse optimization algorithms to reverse engineer their operational policies to help design preventive data diffusion mechanisms protect privacy.

Note: Preference will be given to students with a GPA of 3.0 or higher.

Professor Cassandra L Thiel
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Research Projects:

- Environmental Life Cycle Assessment and Modeling of Medical Wastes
  Healthcare is 18% of the US Gross Domestic Product and 10% of the US carbon footprint. Medical waste must be treated via very specific pathways, and each hospital generates over 5 lbs of garbage per patient per day. In partnership with medical professionals at NYU Langone Health and Yale University, this project will map out disposal pathways of medical waste to the few treatment sites across the US. Students will learn and use material flow mapping and life cycle assessment (LCA) to track waste and estimate environmental emissions.
- Accuracy of Waste Monitoring Systems for Medical Facilities
  Medical facilities generate large amounts of solid waste, and this is especially true in operating rooms (OR). Policies require that, even if an item wasn't used in a surgery, it must be thrown out at the end of each case. (https://www.propublica.org/article/what-hospitals-waste) Electronic health records can keep track of surgical supplies that were thrown out without being used, but they require someone in the OR to log this in the system. This project will observe the waste from multiple surgeries to determine the accuracy of this component of the electronic health record.
- Environmental Footprint of Cataract Surgery in the US
  Studies have shown that cataract eye surgery in the United Kingdom emits the same greenhouse gases as driving a car 500km. With the same outcomes, a facility in India's cataract surgery emits the same as driving a car 25km. We have been gathering data to assess the footprint of surgery at multiple facilities in the US, using environmental life cycle assessment (LCA). Students will learn to use

LCA software and help manage the data. They may also assist in writing academic publications.

Note: Students should be comfortable with data management and basic statistics. Those with experience with programming languages (R, Python, or SQL) and matrix math (linear algebra) will be given preference. Though not necessary, students should also have an interest in healthcare, waste, or medical systems.

Professor Andrea Silverman
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Research Projects:

- Decay of Antibiotic Resistance Genes In the Environment
  Students will work with a graduate student, and use microbiological laboratory methods and environmental engineering concepts to study the fate of antibiotic resistance genes in surface waters.

Note: Wet lab experience OR enthusiasm to learn laboratory skills is preferred.

COMPUTER SCIENCE AND ENGINEERING

Enrico Bertini
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Research Projects:

- Visualizing Machine Learning
  The main goal of the project is to develop data visualization methods to visualize and better understand decisions machine learning models make.
- Visualizing Reddit
  The main goal of the project is to develop data visualizations that help people explore how people interact in a forum. Who are the main players? How does their activity change over time? What do they talk about? Etc.
- Distraction Free Mobile Apps
  The main goal of the project is to build one or more mobile applications that permit only to send messages and receive only at predetermined times. The goal is to see if this will lead to an healthier use of mobile devices.

Note: Experience with Python and Jupyter and experience with Javascript and D3 (or React) is a plus.

Fred Strauss
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Other Mentor:
Project 2: Ross Kopelman – rlk314@nyu.edu

Research Projects:

- U•START

  We plan for U•START to become a website where college students can highlight their talents and portfolio in a very accessible manner. Students can also post and share ideas for projects with other students. It will allow students without ideas to browse through projects and contact fellow users about joining project teams, while providing a way to gain experience for résumés. We also plan to expand the website to high school students, exposing them to STEM by allowing the opportunity to shadow college students' projects.

  U•Start is a creation platform where college students can highlight all their skills, portfolio, and past projects in a modern, sleek way that does not require going to multiple different sources. Users can also share ideas for new projects with others on the U•Start network in hopes of finding people with the necessary skillsets to develop the project. It will also allow students without ideas to browse through projects and contact other users about joining the projects that interest them. Through working on these projects, students can gain valuable experience in their respective fields. Most internships have become highly competitive, even though positions often result in more paperwork than actual work related to the intern's field of study. U•Start will allow students across all disciplines to gain experience by working with ideas and projects that pique their interest, with the potential to grow beyond a simple project. The beauty in U•Start is it is not niche-based; collaboration between individuals from different schools and schools of thought becomes possible, and is encouraged. U•Start has been created with all skillsets and categories of projects in mind. For example, a solo musician can find other musicians to form a band, find a sound engineer, and create a demo much faster than before. Another example would be someone with an affinity for coding helping develop a website using languages they want to learn; the finished product may be added to one's resume alongside the newly learned languages. This provides legitimate experience alongside an opportunity to learn and further one's skillset. We hope to give every student the chance to make their ideas come to life by helping them find the resources they need.

- Edu.Chat

  The Edu.Chat project based course will involve 5 different technical teams focused on improving the development of an academic messaging platform built with A.I. to improve communication and enhance collaboration on university campuses. This is a very exciting project, with the vision of making NYU's Global campus come alive so that students and faculty from each campus can more effectively communicate with one another. The Edu.Chat project will coordinate with professors and students at NYU who will pilot the technology within their

courses in order for the VIP team to enhance the technology further to improve its practical usage in the classroom. The team will work to improve Edu.Chat's A.I. teaching bot and have the opportunity to work within any realm of the technology that support the A.I. bot. The sub-teams will develop software and work closely with peers to merge different technologies together that include web, backend, and mobile development. Each student will be responsible for having a clear research focus then have the opportunity to implement and test their hypothesis.

Professor Haldun Hadimioglu
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Research Project:

- Exploring New Types of Computing
  Traditional computing utilizes multiple processors (cores) on a microprocessor chip. This computing is not satisfactory for a number of applications (apps), as it is slow : It implements apps via software. New chips, reconfigurable chips (field programmable gate array, FPGA, chips) implement apps via hardware, offering an attractive alternative : They run at much higher speeds. One can also program a FPGA chip to have cores on it, making a run more flexible : An app is part hardware and part software. FPGA chips can also be used to emulate non-traditional hardware, including reversible computing. In summary, the project explores new types of computing.

Note: Preference will be given to students with knowledge of Digital Logic, Computer Architecture and VHDL

Professor Gustavo Sandoval
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Research Projects:

- Security and Machine Learning
  Based on the paper written by Prof. Siddharth Garg and Prof. Dolan-Gavitt (https://arxiv.org/abs/1708.06733), we want to extend this research into Natural Language Processing. We will investigate the possibility of hiding back doors in pre-trained Neural Networks for NLP. These backdoors could be used to launch attacks without the user's knowledge.
- Using the Go Programming Language to teach Distributed Systems
  Currently I am teaching a Distributed Systems Course that is based on the courses at NYU Courant (http://www.news.cs.nyu.edu/~jinyang/fa17-ds/schedule.html) and MIT (https://pdos.csail.mit.edu/6.824/schedule.html). For both of these courses the

professors have created a great codebase for the students to complete the assignments. The codebase is of medium size at about 15K lines of code including the solutions. It's also pretty complex as it's composed of distributed programs written in Go with a full test suite. The problem is that a lot of the solutions can now be found on the internet with a little bit of persistence. Given that we will be teaching the class again at least a few more times, I want to invest in creating a different set of exercises in Go. This also will include test cases and solutions.

Note: Preference will be given to junior or senior with a GPA of at least 3.3 and have received a grade of A- or higher on the following: Object Oriented Programming, Data Structures and/or Operating Systems.

Professor Torsten Suel
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Research Projects:

- Index Tiering Techniques for Search Engines
  Index tiering is a technique for more efficient query processing in web search engines, which is currently in use in all major engines. Basically, the idea is to divide the indexed web pages into tiers of good, mediocre, and bad pages, and to try to evaluate most queries only on the first, relatively small, tier with the best pages, and only selectively access further tiers. The goal of this project is to explore new data partitioning and query routing algorithms for tiered search engines, resulting in higher query throughput und thus lower operational costs of such engines.
- Load Balancing and Query Routing Problems in Parallel Search Engines
  Large search engines execute queries by parallelizing them across hundreds or thousands of machines. This is done by splitting the document and index data into shards, and then assigning shard replicas to machines. Finally, queries are routed to shard replicas under various policies to satisfy service level agreements (SLAs) that place limits on the delays that queries may incur. The goal of this project would be to propose, analyze, and experimentally evaluate new policies for assigning documents to shards, for assigning shard replicas to machines, and for routing queries to shard replicas. The goal is to obtain policies that achieve high throughput while satisfying a given SLA; in addition, such policies should also be robust against machine slowdowns and failures and against changes in workload.
- SIMD-Algorithms for Top-k Search Query Processing with Large K
  A lot of research has focused on top-k query processing, where the goal is to return the k highest-scoring results as quickly as possible. There are many

algorithms that can do much better than a brute-force scan. However, the performance of these algorithms breaks down when k is larger than about 50, and for k of 1000 or more the brute-force approach can often win out. The goal here is to come up with algorithms that are much faster even for large k, and that achieve high speed by using the SIMD commands available in the current generation of Intel processors.

Note: Preference will be given to students with strong programming skills in C/C++ or Java, good understanding of algorithms and data structures, high GPA (3.5 minimum). Some knowledge of, or at least interest in, machine learning would be useful for project #3, while the first one would benefit from experience doing performance tuning in C/C++.

ELECTRICAL AND COMPUTER ENGINEERING

Professor Farshad Khorrami
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Research Projects:

- Robotics
- Autonomous Unmanned Systems

Note: Preference given to junior or senior students with a 3.5 GPA and knowledge of C programming.

Michael Knox
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Research Project:

Mixed Reality Engineering Laboratory

Note: Experience with Unity and/or Microsoft HoloLens

Professor Quanyan Zhu
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Research Projects:

- Adversarial Machine Learning
  This project aims to understand the robustness and security of deep learning algorithms. This project aims at designing mechanisms to improve the robustness of the recognition system. An example is the traffic sign recognition system on the self-driving car and the pattern recognition systems unmanned aerial systems.
- Deception in Cyber Security and Robotics

This project studies deception techniques such as honeypots, camouflaging, and moving targets to protect critical infrastructure systems and robotic systems. Students will develop tools to understand the design specifications of deception technologies and implement them on robotic systems and the Internet of Things devices.

- Cognitive Resource Allocation for the Internet of Things
  With recent advances in communication technologies, the Internet of Things enables ubiquitous connectivity among a very large number of persons and physical objects. This project aims to develop cross-layer cognitive and adaptive mechanisms for resource management problems in future large-scale IoT systems. The project will investigate smart city and smart home applications as examples and evaluate the system-level performance in a densely populated area.

Note: Preference will be given to students with a GPA above 3.7 and those who have a strong mathematical background.

Yao Wang
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Research Projects:

- 360 Degree Video Streaming Testbed Development and Evaluation
- Computer Vision or Medical Image Analysis

Note: Preference will be given to students with a GPA of 3.5 or higher, who have a good math background, and good programming experience (C or Python or MATLAB).

Zhong-Ping Jiang
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Other Mentor:
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Research Project:

- Self-driving Cars
  Experimental validations of data-driven control theory

MATHEMATICS

Professor Lindsey Van Wagenen
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Other Mentor:
Michel Lobenberg – ml2796@nyu.edu
Research Projects:

- Mathematics of Climate Change
  Mathematical models are at the heart of climate change research. We will study some of the fundamental models and their domains of applicability and gain familiarity with running and interpreting climate simulations with an emphasis on the New York City region. Applications of the Mahalanobis-Taguchi System and other statistical methods to climate change research will be investigated.
- Hudson River Oyster Research Restoration Study
  Oysters were once a very abundant and essential part of the Hudson river estuary, filtering the water and protecting the shoreline but by the early 20th century, sediment, water pollution and overharvesting had all but eliminated them. A diverse partnership of not-for-profit organizations, federal, state and city agencies, citizens, and scientists has formed to reintroduce oysters into the NY/NJ Harbor Estuary with the goal of restoring one billion live oysters in the harbor by 2035. In this project students will analyze the available data and apply the Mahalanobis-Taguchi System (MTS) and other statistical methods to identify the factors most promising in achieving the goals of the restoration project.

Note: Preference will be given to students with experience in data analysis, differential equations, general physics and programming.

MECHANICAL ENGINEERING

Dzung Luong
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Other Mentor:
Nikhil Gupta – ngupta@nyu.edu
Research Projects:

- Simulation of the 3D printing process by Finite Element Method
- Characterization of Composite Materials

Joo H. Kim
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Other Mentors:
William Peng – william.peng@nyu.edu
Carlos Gonzalez – cig243@nyu.edu
Inigo Sanz Pena – isp240@nyu.edu
Yunjiageng Chen – yc2540@nyu.edu
Research Projects:

- Robotic Gait and Manipulation: Modeling, Control, and Experiment

Activities will include programming, hands-on building and experiments, and/or data processing as related to the energetics and stability of a robotic arm and a biped robot.

- Biomechanical Modeling and Testing of Human Kinematics and Dynamics
  Activities will include programming, human subject experiments, and/or data processing as related to the energetics and stability of human walking.

Note: Preference will be given to students with a GPA of 3.4 or higher. Juniors and seniors only.

Maurizio Porfiri
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Other Mentors:
Peng Zhang – pzhang@nyu.edu
Shinnosuke Nakayama – sn2286@nyu.edu
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Research Projects:

- Velocity and pressure quantification of a subsonic flow past an airfoil
  Flow velocity visualization techniques have improved our understanding of aerodynamics and facilitated the design of aircrafts. However, methods of pressure quantification of high-speed airflows are still lacking. In this project, we seek to combine the novel pressure sensitive tracer particles with flow visualization techniques to quantify the aerodynamic velocity and pressure around an airfoil in a subsonic airflow. Working under the supervision of senior laboratory members, the student will construct a miniature high-speed wind tunnel that sustains steady laminar subsonic airflow, and perform experiments on an airfoil. The student will fabricate pressure-sensitive particles, conduct airflow visualization experiments in the wind tunnel, and process experimental data. Through this project, the student will be trained in experimental design, material science, fluid mechanics, and image analysis.
- Robotic platform for fish behavioral experiments using a manipulator arm
  Fish–robot interactions are one of the staple research subjects of the Dynamical Systems Laboratory. The use of robots can help us better understand fish behavior by providing a customizable, standardized and consistent stimulus. The goal of this project is to build a compact platform for fish experiments and educational outreach activities. Working under the supervision of senior laboratory members, the student will design and build a robotic manipulator to control a 3D-printed fish replica. Through this work, the student will get hands-on experience with robot actuation. In addition, the student will adapt control methods to produce biologically-inspired movements of a fish, similar to an

already existing platform. By the end of this project, the student will gain experience in machine design, prototyping, electronics, coding and robot dynamics and kinematics.

- Information flow between musicians in jam sessions
  Collaboration in a group requires complex behavioral adaptation that arises from feedback between members. In this regard, it is astonishing to see musicians in jam sessions collaborate toward achieving a common goal—to make good music. Improvised collaboration through an acoustic form is observed in free jazz jam sessions and drum circles, as well as in clapping and cheering crowds. How do people collaborate acoustically without predefined arrangements? The overarching goal of this project is to elucidate an underlying process of spontaneous collaboration through musical improvisation. To that end, we will conduct a series of simple behavioral experiments where human subjects play music together in a small group by clapping or playing musical instruments. Through the audio data, we will quantify the musical causality between a pair of players by computing transfer entropy, an information-theoretic measure of causality between two stochastic processes. Transfer entropy will then be used to construct a social network to shed light on the dynamics between players. Simultaneously, we will build a theoretical model of human collaboration through an acoustic form, which will be validated by the observed data.

Professor Weiqiang Chen
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Research Projects:

- Bioengineering of Bone marrow-on-a-Chip model for immunotherapy of acute myeloid leukemia
- Plasmofluidic Biosensing Microarray for Single-Cell Analysis
- Tunable and Multifunctional Vascularized Brain Tumor Microenvironment for Cancer Angiogenesis Study

Note: Preference will be given to students with a GPA of 3.5 or greater.

Professor Nikhil Gupta
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Other Mentors:
Fei Chen – fc954@nyu.edu
Ashish Singh – aksingh@nyu.edu
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Research Projects:

- Product security in additive manufacturing (3D printing)

Additive manufacturing, also known as 3D printing, has been adopted in many fields including automotive, aerospace, and medical. As a completely digital process chain from developing a CAD model to the final printing step, it is vulnerable to cyber-attacks. Due to the incidents of cybersecurity breaches around the world, protecting the hardware CAD models with embedded security features has become a priority. In this project, we will develop and implement a surface pattern on the product during the CAD stage, which will make a counterfeit product identifiable if it is not printed under the prescribed conditions. Basic knowledge of SolidWorks is required for this project. Familiarity with 3D printers is will be useful.

- Development of lightweight polymer matrix composite materials
  This research project focuses on manufacturing of lightweight polymer based composites and their use in 3D printing. Hollow microparticles are used as fillers in the polymer to create composite material that is converted to a filament used in 3D printers. The project includes studying the extrusion process, quality of the filament, and printing process using this new composite filament. Mechanical and thermal properties of this filament will also be studied to understand the optimum process conditions to print lightweight composite structures.
- Development of fiber-optic loop sensor for structural health monitoring
  Fiber optic loop sensor (FOLS), invented at Composite Materials and Mechanics Lab, provides advantages of simple construction and versatility in detecting transient changes in surrounding environment. FOLS has been demonstrated for use in detection of force, displacement, and vibration. The current research is being conducted to theoretically and experimentally demonstrate that FOLS can also be applied to structural health monitoring application in wind turbine blades.

TECHNOLOGY, CULTURE AND SOCIETY

Professor Amber Benezra
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Research Project:

- To Co-Evolve
  Microbiota, Breastmilk, Mothers, and Babies. This summer I will be starting research and preliminary ethnographic fieldwork on a new project that looks at the possibilities of human-microbial socialities emerging from the scientific studies of the gut microbiome, specifically the complicated relationship between breastfeeding mothers, babies, and microbes. Human breast milk has biochemically evolved nutrients and bioactive components that best support microbial partners, and human mothers develop genes to support the production

of these glycans. This relationship is biological, but social lives play a crucial part, based on specific practices of birthing, breastfeeding, touch, care, and hygiene. Environment and exposures also matter in this relationship. A research assistant will help in doing archival research, as well as participate in the beginning stages of doing ethnographic fieldwork; collecting data and interviews with interlocutors in New York City.

Note: Preference will be given to students with high academic standing, exceptional writing and communication skills, research and fieldwork experience, interests in public health and social science/biomedical collaborations.

Professor Beth Simone Noveck
noveck@thegovlab.org

Research Projects:

- Legislature 2.0: CrowdLaw
  The GovLab is seeking to understand how cities can use technology to engage the public and to test whether such engagement results in laws and policies that are more legitimate or more effective. We start from the hypothesis that by introducing more and more diverse opinions, ideas and information into the legislative process using new technology has the potential to produce higher quality lawmaking, that is to say, laws that achieve their intended purpose. The GovLab is working with the City Councils of several major cities to design, implement and evaluate new tech-enabled practices of public engagement in local lawmaking. We call such participatory urban lawmaking: crowdlaw. We are seeking student(s) to participate in mixed-methods research to document current law and policymaking practices in order to understand how information flows and where the gaps are in how councils and implementing agencies obtain expertise in order to identify opportunities for engagement. Students will assist with drafting in-depth case studies on how cities are using new technology for greater public engagement. This is an excellent job for students interested in next generation governing and the intersection between technology, policy and law.
- Public Entrepreneurship
  Just as composers and dancers must learn both music theory and the science of labanotation, passionate changemakers wishing to “build a lever long enough” to move the world need to develop a new kind of skillset and mindset that we call Public Entrepreneurship. In this research assistant will work with me to research different approaches to problem solving across university programs. Public Entrepreneurs are distinct from entrepreneurs because they are uniquely focused on the public interest and doing good in the world.But, unlike social entrepreneurs, they are not limited to market-based solutions and, instead, know

how to leverage public and private sector institutions to achieve their aims. They learn how to leverage new tools and alternative models of innovation, including crowdsourcing and open innovation, big data and predictive analytics, to solve problems need to master a new set of tools. They want to take advantage of new technology to do good in the world and measure success, not by how many apps they create or nonprofits they stand up, but by the impact of their work on the individuals and communities the wish to help.If, as Bertrand Russell said, the ability to be powerful is to produce intended results then, in fact, the power to solve vexing societal problems depends heavily on combining the learning from multiple disciplines that have not heretofore been in dialog: legal education cultivates an ethical mindset with deep substantive knowledge of institutions, how they work and the rules that govern them; social entrepreneurship fosters training in innovation skills and leadership verve; computer science and engineering cultivate a collaborative ethos and networking mindset as exemplified by hackathons. Although each discipline is facing its own debate about skills-based reform, there is far too little overlap or conversation between their practitioners. Each discipline, in its own way, sets out to cultivate the next generation of leader and problem solver. But the complexity of today's challenges demands an amalgam of approaches that combine substance with skills, ethics with innovation. This is an excellent internship for students interested in entrepreneurship, innovation and education.

- Solving Public Problems with Data
  Solving public problems with data is an online lecture series developed by the GovLab to help those working for the public sector, or simply in the public interest, learn to use data to improve decision-making. Through real-world examples and case studies -- captured in 10 video lectures from leading experts in the field -- the course outlines the fundamental principles of data science and explores ways practitioners can develop a data analytical mindset.The GovLab is working towards expanding the course to cover more topics to equip public officials with the legal and technical skills needed to take advantage of the availability of new sources of data responsibly and ethically. Students will work on researching and developing new training exercises and assist with the production of additional videos with leading experts in the field of data science as part of this series.This is an excellent internship for those interested in the intersection of data science and policy.

Note: Preference will be given to students who are passionate about the intersection between technology and policy and have excellent research and writing skills.

Professor Dana Karwas

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Research Projects:

- Climate Change Communication through Neural Networks and Machine Learning
- Other Fields: Aesthetic Inquiry into Image Making with Scientific Data

Note: Preference will be given to students with a minimum GPA of 3.2 or higher. Student must have experience working with python and databases and also completed a statistics class or similar. The projects will both include programming in python, working with datasets in python, running statistical analysis and tests in python, generating visuals based on analysis in python, and working with image based content in python. Basic understanding of Neural Networks, Machine Learning, and Data Visualization are also required.

Professor Jonathan Bain

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Research Project:

- Holographic Spacetime and Quantum Error Correction Codes

  This project in the foundations of physics seeks to understand, at a conceptual level, recent proposals that link aspects of the AdS/CFT correspondence with quantum error correction codes. The AdS/CFT correspondence is a formal correspondence between a (d+1)-dimensional theory of gravity formulated in Anti de-Sitter (AdS) spacetime on the one hand, and a d-dimensional conformal quantum field theory (CFT), on the other. One way of describing this correspondence is in terms of a "bulk" theory of gravity encoded in a "boundary" quantum field theory (this is an example of a "holographic" correspondence). Physicists are interested in such correspondences since they suggest one way of formulating a quantum theory of gravity. One feature of the AdS/CFT correspondence involves encoding a local bulk field in a boundary operator. This faces the "bulk locality paradox": Under a standard encoding procedure, any local bulk field must correspond to a multiple of the identity operator on the boundary, and this seems to make the AdS/CFT correspondence uninteresting. One attempt to resolve this paradox involves interpreting the boundary as the codespace of a quantum error correction code (QECC). A QECC is a protocol for encoding information using qubits in such a way that errors, represented by local operators, can be detected and corrected. In this project, we will consider what it might mean to interpret the AdS/CFT correspondence in this way: What does this information-theoretic interpretation of this approach to quantum gravity entail about the nature of spacetime and the nature of gravity?

Note: Preference will be given to students with some exposure to college-level physics and math, and an interest in conceptual and foundational issues in quantum computation, and/or quantum gravity.

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Other Mentors:
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Katherine Bennett - katherine.bennett@nyu.edu
Research Projects:

- p5.js
  p5.js is an open source client-side JavaScript library used widely in creative fields. It is a core technology used at NYU in our programs in applied media, including IDM. p5.js allows for expansion with third-party libraries. We are looking for coders / software engineers / CS majors to develop libraries to provide ease of access to (a) Google front-end APIs, (b) web-based deep learning APIs, (c) networking APIs, (d) computer vision and image recognition / classification APIs, and (e) other technologies of interest, including of interest to the students.
- OpenProcessing
  OpenProcessing is an online sharing community for software developers engaged in creative professions (digital art, design, games, music, etc.). We are interested in students with experience in full-stack (esp. database) development to work with us and the community developer to augment it's usability for students, faculty, and researchers working worldwide in art/technology programs like IDM.
- OpenFrame
  IDM is interested in develop low-cost solutions for the physical exhibition of interactive / generative media, using low-cost single-board computers such as the Raspberry PI and inexpensive screens, in collaboration with OpenFrame, an open source exhibition platform. This involves developing software to allow for remote loading and management of content as well as the systems engineering of working with displays, networks, etc.

Note: Preference will be given to students with a GPA of 3.3 or higher. Experience in coding is required; experience in client-side JavaScript, node.js, REST APIs strongly recommended. Interest in media and creativity a must.

TECHNOLOGY MANAGEMENT AND INNOVATION

Professor Oded Nov

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Research Projects:

- Human-computer interaction: design novel user interfaces for consumer finance
- Human-computer interaction: design novel user interfaces for personal genomics

Note: The projects involve web development for research projects, including: interface and back-end development for users to interact with their personal genomics data; and interface and back-end development for experimental consumer finance (saving) systems.