Cloud-based Ocular Disease Diagnosis

Description of Project
Eye diseases can be very difficult to diagnose, especially those that are detectable only by a combination of specialized tests. The goal of this project is to develop and scale a web-based software tool to help diagnose retinal disease “in the cloud.”

Past work on this project has developed an automated genetic diagnostic prediction method. The algorithm is based on machine learning, which automatically creates a model from past patient data. This is implemented in a web interface that is useful for a small number of users.

In 2017 the project team will develop a scalable and secure cloud application for clinicians around the world. This first deliverable entails developing a scalable, robust and secure server back end and a polished user interface.

A second deliverable is an expanded database incorporating new, larger quantities of data from partner institutions; interpreting and cleaning new data from partner institutions; and joining it with existing data. In addition, the existing machine learning algorithm will need to be adapted to incorporate the information present from new data. Rigorous evaluation and validation of the updated algorithm with the new data will then be required.

The third deliverable is the development of an algorithm that classifies inheritance patterns. Inheritance patterns are one of the inputs to our “main” machine learning algorithm, and
determining an inheritance pattern is currently done by human experts. We have experimented with several options. Rigorous evaluation of multiple candidate algorithms will be required, comparing the speed, accuracy, and scalability of the algorithm, along with its effects on the main “downstream” machine learning algorithm’s results.

Location

- North Campus and Kellogg Eye Center, University of Michigan Campus

Project Sponsor Mentor

Dana Schlegel

Genetic Counselor at University of Michigan Kellogg Eye Center

Dana is a genetic counselor at the Retinal Dystrophy Clinic and also sees genetics patients in the Ocular Oncology Clinic. She supervises students during clinical rotations and is involved in classroom genetics teaching. She is involved in research projects relating to retinal dystrophies and autofluorescence imaging.

Executive Sponsor Mentors

K. Thiran Jayasundera, M.D., FACS, FRCSC, FRANZCO

Retina and Uveitis
Assistant Professor, Ophthalmology and Visual Sciences
Fellow of the American College of Surgeons
Fellow of the Royal College of Surgeons of Canada
Fellow of the Royal Australia and New Zealand College of Ophthalmologists

Specialty Interests

Diseases of the retina and vitreous including retinal detachment, diabetic retinopathy, retinal vascular diseases, macular diseases, age-related macular degeneration, surgical management of complex retinal detachments, anti-angiogenic therapy and photodynamic therapy.

Diagnosis and treatment of inherited retinal degenerative diseases, including Stargardt disease, retinitis pigmentosa variants, cone dystrophies and unusual retinal dystrophies requiring electrophysiological testing.

Naheed Wali Khan, Ph.D.

Clinical Assistant Professor, Ophthalmology and Visual Sciences
Electrophysiologist - Diagnostic Visual Electrophysiology Service
Research Focus

Visual electrophysiology of retinal degenerative diseases and clinical electrodiagnostics

Project Faculty Mentor

Drew DeOrio
Electrical Engineering and Computer Science

Andrew DeOrio is a lecturer at the University of Michigan. His research interests are in ensuring the correctness of digital hardware designs. In addition to teaching software and hardware courses, he teaches Creative Process and works with students on technology-driven creative projects. Andrew also plays music and makes fire organs.

Key Skills & Project Roles

MDP Sponsored Projects are both a professional and academic learning experience for students. By participating in this program, students are actively preparing for graduate school and a professional career. As part of the experience, MDP expects professional behavior. To best prepare you for future professional opportunities, your experiences on this MDP team will be very broad. In addition to key technical skills that you will bring to the team, you will engage deeply in the self-directed learning of new and important concepts, demonstrate flexibility, collaboration, and cooperation, and develop strong professional communication skills. This also means that you will need to be able to work outside of your traditional area of study in the true multidisciplinary nature of our projects. You won’t always be able to anticipate how your skills and expertise will be used, so the MDP Sponsored Project will challenge you to grow and develop as a professional.

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<tr>
<th>Project Roles</th>
<th>Key Skills and/or Knowledge</th>
<th>Likely Majors</th>
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<tr>
<td>Web Development and general programming (2 or 3</td>
<td>Web development experience</td>
<td>Computer Science,</td>
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<tr>
<td>students)</td>
<td>Amazon Web Services (AWS) or similar</td>
<td>or significant web programming experience</td>
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<tr>
<td>Database Design (1 or 2 students)</td>
<td>SQL, NoSQL AND Data security</td>
<td>Computer Science, Data Science</td>
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<tr>
<td>Machine Learning (1 or 2 positions)</td>
<td>Familiarity with general machine learning concepts</td>
<td>Computer Science, Electrical Engineering, Mathematics, Statistics, Data Science</td>
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<td></td>
<td>Python</td>
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| Biomed / Health Care (1 position)                  | Clinical usability                                 |                                                                                |
|                                                    | Genetics                                           |                                                                                |
|                                                    | Model Development                                  |                                                                                |
|                                                    | (should have some basic CS knowledge)              |                                                                                |

**Desired Additional Knowledge, Skills and Experience:**

- Python machine learning tools (Scikit/Pandas/Matplotlib/Numpy)
- Python frameworks such as flask, django, etc.
- Career interest in medicine or research

**Organization Overview**

Understanding, Curing, Preventing, and Treating Eye Disease

The Kellogg Eye Center has always upheld the values of exemplary patient care and dedication to our patients and their families. Kellogg faculty and staff together have developed a statement of purpose, a longterm vision, and a set of guiding principles that reaffirm these values.

**Purpose:** Improve lives through curing, preventing, and treating eye disease.

**Vision:** We seek to improve lives around the world by enhancing vision.

**Guiding Principles**

- **Teamwork:** We are a collegial, productive, and collaborative community.
- **Caring:** We are respectful and compassionate.
- **Innovation:** Our curiosity drives innovation and the quest for knowledge.
- **Integrity:** Our ethics are built on openness, honesty, and trust.
Legal Requirements

Citizenship and Right to Work Options

☐ This project is open to all students

Intellectual Property Agreements / Non-Disclosure Agreements

All students will sign the standard MDP IP & NDA.

Internship Information

Summer Funding may be available for students