Summer Research Promises Opportunity for Students

By: Desiré Bennett

Underrepresented students encounter endless opportunities via summer undergraduate research programs offered through CEAS.

In summer 2013, CEAS launched Protégé, an undergraduate research pilot project, providing summer opportunities for underrepresented minorities and female students who had just completed their freshman year.

Students worked with faculty mentors on a variety of research projects – from solving the Traveling Salesman Problem to developing support material in desktop 3D printing.

The program was launched by a team of three accomplished senior faculty, Professors F. James Boerio and Professors Emeriti Ronald Huston and Thomas Mantei, and Senior Associate Dean for Graduate Studies Frank M. Gerner, who all worked together with their colleagues to provide challenging research experiences for promising undergraduate students.

During his summer research experience working with Department of Aerospace Engineering and Engineering Mechanics professor Kelly Cohen, computer engineering sophomore Taylor Okel worked on developing a method to quickly approximate a solution to the Traveling Salesman Problem (TSP), which Okel defines as "given a set of cities/coordinates/tasks, find the route between each that (1) is the shortest cost/distance, (2) visits each city exactly once, and (3) returns to the point of origin.”

Noting that his research pertained to the strictly mathematical approach to the TSP, that is, it is assumed only two dimensions are considered, and a straight connection was used for each pair, Okel says the algorithm he developed approximates an optimal route that satisfies the above conditions, and returns a solution with the lowest time and cost combination, with an acceptable amount of cost error.

“Solutions for TSP are highly sought after from businesses for project streamlining. Uses of it range from fairly simple, such as logistics in package delivery (UPS), or UAV flight mapping (Air Force),” he said. “More interesting adaptations can be seen in factories with machinery, or even within the design of circuit boards (wiring of one component to
Okel, who was named recipient of the Office of Undergraduate Research Scholarly Endeavors and Creative Practice (URSC) Student of the Month Award for September 2013, says that in addition to gaining various skills such as professional communication and experience with MATLAB that will greatly help him in future ventures, this experience was a great chance to learn about business settings. “It gave me an opportunity to gain experience with goals and deadlines, similar to what I expect an actual business setting to hold, but did so in a more friendly and instructive manner.”

During her summer research experience working in the lab of the Department of Electrical Engineering and Computing Systems professor Fred Beyette, electrical engineering sophomore Chelsea Duran studied the use of PVA as a water-soluble support material in desktop 3D printing.

Duran’s research focused on the challenges of ABS-PVA dual-extrusion printing, and optimal settings and techniques for such hybrid printing. “Using a water-soluble material as one of the printing filaments in a dual-extrusion 3D printer provides the flexibility of printing support structures in complex prints,” she explains.

Duran says this research is needed due to the expanding field of 3D printing. “Desktop 3D printers can be found in many offices and even houses. The recent increase in [3D printing] popularity, due to its relatively low cost, has prompted more experimentation with complex pieces that may have multiple overhangs.”

According to Duran, the main drawback of creating objects using a desktop 3D printer is the inability to print overhangs (a part of the model that has empty space directly underneath it) since each layer is printed on top of a previous layer. “In order to overcome this issue in a dual-extrusion printer, PVA (Poly-vinyl alcohol), a water-soluble material, can be printed in the space below the overhang in an object, which could be made of ABS (a petroleum based plastic). After the print, the PVA support material can dissolve without damaging the object.” Duran’s research studied this type of printing process.

In addition, Duran designed an experimental study to examine the solubility of the PVA support in water by varying four different parameters: length of time in water, water temperature, stirring rate, and PVA surface area. She then used the rate of PVA solubility in water to examine its relationship with each parameter.

Duran says that participation in this summer research experience gave her the opportunity to see how research is conducted in an academia setting. “I was able to apply what I have learned in the
classroom to current, practical problems in my field, which I would have little knowledge about if it was not for this experience,” she said. “In addition, this experience helped me prepare for graduate school, which I now plan on attending after doing this research.”

CEAS plans to continue the Protégé program in the summer of 2014.

In addition to Protégé, CEAS offers the UC WISE/REWU (Women in Science and Engineering/Research Experience for Women Undergraduates) program. The effort is led by Urmila Ghia, PhD and Chair of the WISE Program, and has been offered annually since 1999 providing workshops on:

- The research process
- Leadership skills
- Learning styles
- Business etiquette
- Preparation for graduate school

For 12 weeks during the summer, undergraduate women students work with faculty mentors on research projects in Biology, Chemistry, Mathematics, Physics, Engineering, Nursing, Pediatrics, and Science and Health (Clermont).

During their 12 weeks, each student is paired with a UC faculty mentor. Each week, all women in the program meet as a group to hear from guest speakers and discuss their individual projects. Weekly workshop topics range from how to read scientific papers, to developing leadership skills and to making decisions on graduate work. Visit WISE/REWU to learn more about this endeavor.

Summer research opportunities like Protégé and WISE/REWU have far reaching benefits. In markets where demand far outstrips supply, Boerio says, “Anything we can do to improve the quality of the research experience and attract more interest among undergraduates is a plus.”

Photography note.