


CS486C – Senior Capstone Design in Computer Science

Project Title: <u>Engineering Career Network (ECN)</u>	
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Project Overview:

High quality engineering education is vital to our society and nation’s economy, and pursuing a postsecondary education is one of the most important investments a student can make. College graduates with a bachelor’s degree typically earn 66 percent more than those with only a high school diploma; over the course of a lifetime, the average worker with a bachelor’s degree will earn approximately \$1 million more than a worker without a postsecondary education. Engineering programs are especially important in this picture given that, in our advanced technological world, the majority of today’s services and products have some element of engineering involved. But good engineering programs don’t just happen, they must be carefully planned and updated to match the needs of our rapidly changing high tech economy.

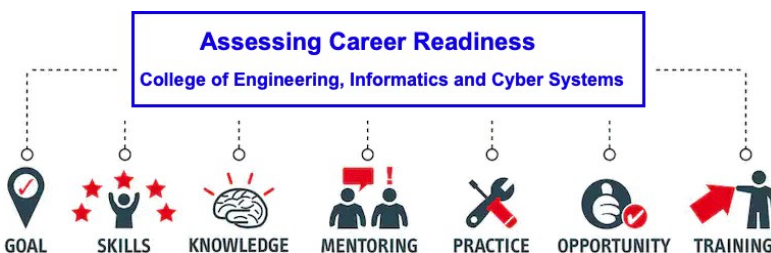


The College of Engineering, Informatics, and Applied Sciences (CEIAS) houses some of the major high-tech degree programs at NAU, including engineering programs (Mechanical, Electrical, Computer, Civil and Environmental), Informatics and Computer Science; and Applied Physics and Materials Science. As a cornerstone for ensuring the quality of all programs, the College has developed a set of strategic goals that quantify what “successful engineering training” means for us, e.g., numbers of graduates that have done internships, or how many graduates find jobs in their areas within six months of graduation. With over 2,500 students in CEIAS, however, monitoring the attainment status of these goals is a major challenge.

The Problem: An automated system to manage student career progress data

What is needed is a software tool to automate key data collection and updating aspects, and that provides a simple graphical interface for configuring and managing the student tracking process, and for doing some basic visualization (e.g., graphing, tables) and review of evolving progress on each goal. An effective tracking tool would tell us if we are on the roadmap described in the strategic plan, can help us periodically re-assess the attainability and appropriateness of goals, and will drive timely action to support student career success.

Providing such a tool is the focus of this project. Our current approach is almost completely “manual”, based on hardcopy student files, and periodic manual review of files to update various spreadsheets that can be used to write up a report. This system is not only difficult and arduous, it is continually out of date and cannot be easily searched to retrieve critical information in a timely fashion.



As an example of a specific shortcoming, we don’t have an effective way to quickly retrieve baseline data, such as: How many students in Mechanical Engineering had an internship or co-op experience in Spring 2021? What is the job placement rate for the College? With over 2,500 students in more than 20 academic disciplines, the College needs an automatic or semi-automatic tool

that can effectively monitor student progress in their career building activities, such as internship, externship, co-op, and other practical experience outside of classroom learning, and help students to land a job in their profession. This tool

will also support alumni for their professional development and continuing education. Considering the enrollment of STEM programs will increase in the future, this Engineering Career Network (ECN) tool should be able to scale up easily.

Envisioned Product: The Engineering Career Network

We envision a secure, modern web-based application, which we'll call the Engineering Career Network (ECN), that automates or streamlines specification of college strategic goals, collection of the needed data, and simple graphical analysis of where we stand on each goal. A dashboard should provide an overview of "active" college goals and a summary indication of progress on each; clicking to "drill in" on any goal to view details of progress towards that goal. Although the system should be designed so that it is extensible to allow addition of further goals to monitor, this initial prototype should prove this concept by focusing on just two of our strategic goals to start with:

1. By 2026, 100% of CEIAS students will have at least one practical experience (such as internship, externship, co-op, R&D, startup, etc.) before their graduation
2. By 2026, 100% of CEIAS students will receive at least one job offer within 6 months of their graduation

A central challenge in this project will be automating collection of the student career progress data that is at the heart of the progress tracking to be performed. We propose to address this task in two ways: first, students will have an account on the web app and can access their account to review their evolving digital portfolio and potentially add missing information. Second, we plan to require every CEIAS student to establish a LinkedIn professional account during their Freshman or Sophomore year. Students will update (possibly reminded/prompted by ECN) their LinkedIn accounts with their practical experience, such as projects in an internship job, or externship/co-op experience. Students may also find on-campus employment that provides valuable experience, and this should be captured in the existing Handshake student employment system. The ECN system would then "mine" these accounts periodically or on-demand, to update the core student career progress information within the ECN system.

In terms of ECN end-users, we ultimately envision some form of access (either authorized or "guest") to the student progress information in ECN by a wide variety of possible stakeholder groups, including system administrators, academic users (faculty, department leaders, upper administrators), industry partners, parents/students considering NAU for college, and, of course, our thousands of engineering students themselves. Each of these groups would, of course, be interested in somewhat different things and perspectives, and would therefore have different GUIs tailored to those.

Some initial project details

For this initial prototype, we will focus on implementing the core data collection, GUI display, and analysis modules for just the two key groups of users:

1. ECN administrators (college staff): An administrative interface for college staff (i.e., "the Dean's office") will require an administrative interface that serves two overall functions: first, it allows staff to set up and configure the system, i.e., manage users and permissions, control access permissions for various kinds of data/views, export datasets and similar "systems administration tasks". Second, it will provide the dashboard and other functions outlined above, i.e., will allow college staff to monitor goal achievement in various ways.
2. CEIAS students. Students will be given accounts and can set up their profiles in their accounts, including linking to their new LinkedIn accounts. They will be able to see and review data scraped from these accounts to catch errors, and potentially add missing information.

Detailed features and requirements will be developed in conversations by the clients (Dr. Andy Wang and Mr. José Díaz Aquino), as well as based on the team's evolving understanding of end user needs as the project progresses. As a starting point, some of the features we'd expect to see include:

Level 0: Minimum viable product (MVP)

- A secure web application, including user authentication and role-based user permissions to serve as a cornerstone for the ECN system. Permissions for at least system admins, staff, students, and "guests" (not authenticated) should be included.
- A powerful "data scraping module". This will be a key element and functional heart of the system. It should have "scraper blades" (basically "drivers") for both LinkedIn and Handshake. Given a list of students, and configuration of what info to look for and scrape, it visits the public profile on LinkedIn and tries to scrape out any relevant information; similarly for Handshake. The modular "scraper blade" concept means that "blades" for possible future data sources could be added easily. Places scraped data in the student database for access and display; reports on success or problems in a log.
- Basic authenticated interfaces for admins/staff: allows basic configuration of system, and basic listing and export of collected data (e.g. for further analysis in other applications)
- Basic authenticated interface for students: allows basic configuration of LinkedIn scraper, and simple review of collected data sufficient to identify errors.

Level 1: A complete and usable product

- Provides a professional landing/login page that introduces the system and provides some key “current stats” on the college based on current system contents. Also of course provides login for authorized users.
- Provides a dashboard page for admins: Gives overview of the goals in place and progress summary indications. Allows drilling into goals for closer analysis. Also allows sys. admins access to configure goals (the scrapers that collect data, what data is collected) and other system functions.
- Staff GUI also allows a mode for searching the database, e.g., “list all students in last two years who have done an internship”. This list could be exported, or one could click to view individual student data (what we’ll call a “career portfolio”); a means to manually edit/update would be useful to correct errors.
- Provides student interface: student can view their current career portfolio, and make edits/updates to correct problems. Students can also add other “profile” information, and can choose to make their profile “public”, meaning that it could be used, for instance, in a brochure. By default, all student information is secure and private.

Level 2: Stretch goals

- Ability to generate a templated sample resume for students based on the information and data that has been gathered from completed milestones and data mined from LinkedIn and Handshake platforms.
- A secure phone-based app including user authentication and role-based user permissions to serve as a vehicle for data collection and interaction with students and end users.

Potential Impact: CEAIS may be leading the charge, but engineering units (and other disciplines) at universities across the country will have a strong interest in better understanding the broader, non-classroom experiential growth of their students as they move towards graduation. If successful, this will be one more way in which colleges can differentiate themselves in the highly competitive higher education market, both to students and their parents, and to employers in industry. As highlighted above, a successful software product will be modular (e.g., allowing easy extension to scrape relevant information from other public sources) and highly configurable (e.g., to allow addition/modification of college goals and the data collected to measure progress towards each). In this way, a successful system could become a cornerstone for student career readiness profiling nationwide.

Knowledge, skills, and expertise required for this project:

- Familiarity with DB design, data visualization, and Microsoft SQL Server Management Studio.
- A solid knowledge about web design at both front end and back end.
- Capabilities in pattern matching and simple parsing, to scrape HTML content pages.
- A good understanding of information security and their implementations, including access control and data security.
- A fundamental knowledge of GUI design and usability testing.

Equipment Requirements:

- Free/open-source software tools should be preferred, for easy installation on any computer or mobile phones.
- There should be no major equipment or software required other than a development platform and software/tools freely available online

Software and other Deliverables:

- A fully-functioning web application, as outlined above, installed and tested on a platform of the client’s choice.
- A “system administrator’s manual,” which details step-by-step how the system can be installed, and how to perform basic configuration and maintenance.
- All the software engineering documents, including requirements specification, design, and implementation details. It should allow future team to easily pick up where left off.
- Complete professionally-documented codebase, delivered as a repository on GitHub. There should be special attention to the API usage documentation, which will be used by third-party.

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