CS486C – Senior Capstone Design in Computer Science
## Project Description
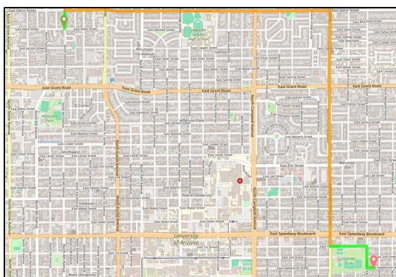
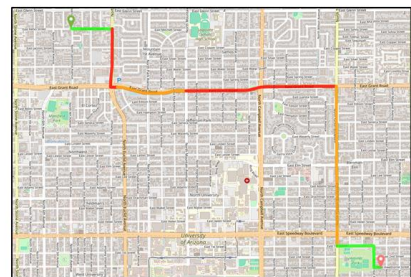| Project Title:	Cyclist Routing Algorithm for Network Connectivity
Sponsor Information: CRAℕC	Dr. Steven R. Gehrke Associate Professor, Department of Geography, Planning, and Recreation Steven.Gehrke@nau.edu David Wessel Transportation Planning Manager, MetroPlan David.Wessel@metroplanflg.org

Project Overview

Promoting bicycling in urban areas is seen as an important transportation strategy for combating increasing societal concerns related to physical inactivity, worsening air quality, and escalating motor vehicle costs. Yet, the increased adoption of bicycling for utilitarian (e.g., commuting) travel in the United States is only likely to be achieved through the identification and mitigation of traffic safety barriers in existing bike networks. The Cyclist Routing Algorithm for Network Connectivity (CRANC) is an innovative planning tool designed to offer bicyclists with recommended routes based on their varying physical abilities and sensitivities to bike infrastructure availability and perceived safety risks.
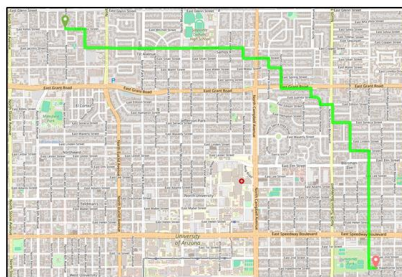
Interested but Concerned   Enthused and Confident   Strong and Fearless

The CRANC planning tool was initially developed for a study with the City of Cambridge, Massachusetts to quantify the potential accessibility-related benefits of a proposed off-street multi-use path to commuters and employers in the Boston metro region[1]. Recently, the CRANC planning tool was updated and implemented in a project funded by the US Department of Transportation to evaluate bicycling access to jobs, schools, and grocery stores in Arizona's metropolitan regions[2]. To help advance the ability of the CRANC planning tool to promote wider bicycling activity in urban areas, this capstone project proposes to improve the web interface of the routing platform and design an app with a GPS logger capable of linking person-level attributes to observed bike routing decisions in US metro regions. By deploying a combination of web- and app-based platforms, an intended project outcome is to offer transportation planning agencies new evidence on bike routes and infrastructure conditions needed to inform facility investments.

---

[1] Gehrke, S.R., Akhavan, A., Furth, P.G., Wang, Q., & Reardon, T.G. (2020). A cycling-focused accessibility tool to support regional bike network connectivity. *Transportation Research Part D: Transport and Environment*. doi.org/10.1016/j.trd.2020.102388.

[2] Gehrke, S.R., Allam, M.K., Martinez, A.E., Holliday, T.M., Russo, B.J., & Smaglik, E.J. (2025). Cycling accessibility to employment, schools, and grocery stores in Arizona metropolitan regions. *International Journal of Sustainable Transportation*. doi.org/10.1080/15568318.2025.2460637.

Project Scope/Features

Several key features are sought to improve the CRANC tool's web interface and design its associated mobile app.

CRANC web Interface

- **Transportation network upgrade**: CRANC tool currently uses OpenStreetMap for network routing, which will be updated to General Modeling Network Specification to promote standardization and scaling efforts.
- **Study area expansion**: CRANC tool currently provides bike route directions across Arizona, which will be expanded to include other southwestern states with planning agencies interested in bicycling promotion.
- **Isochrone tool improvement**: CRANC tool currently has isochrone feature to visualize bicycling access, which will be enhanced by providing user instructions and locational details on accessible points of interest.

CRANC mobile app

- **App design**: Development of CRANC mobile app compatible with iOS and Android operating systems.
- **User profiles**: Feature will include a user interface in which bicyclists can report personal and trip context details that is integrated with a GPS logger designed to collect spatiotemporal details on recorded routes. Using profiles that are available in the web interface and mobile app, users can suggest alternative routes.
- **Navigation system**: Feature will provide bicyclists with both audio and text-based turn-by-turn directions.

Knowledge, skills, and expertise required for this project

- Interest in the sustainable transportation field and toward developing open-source routing engine tools.
- Competencies in user experience, user design, and producing accessible web application interfaces.
- Skills in crafting responsive layouts, optimizing cross-platform performance, and integrating efficient APIs.
- Knowledge of programming languages for data visualization and innovative data visualization techniques.

Equipment requirements for this project

- Project should not require any equipment other than a development platform and any relevant software or tools that are freely available online.

Project Deliverables

- Updated CRANC web interface with described features to be deployed on the NAU Monsoon platform.
- CRANC mobile app delivered in a deployable and tested state for iOS and Android operating systems.
- Well-documented codebase delivered as a GitHub repository and supplemented with a physical archive.