

# Mach9 Project: National Bridge Inventory

Welcome to Mach9's project! Over the course of the next several hours, you'll be working on a project focused on the National Bridge Inventory, a dataset detailing the locations and attributes of bridges across the United States. You should expect to spend around **eight** hours on this project.

## Project Overview

You will be working with the National Bridge Inventory (NBI), a comprehensive database maintained by the Federal Highway Administration that contains detailed information about the nation's bridges, including their locations, structural conditions, and various other attributes. The primary goal of this project is to showcase your skills in backend and frontend design by creating a web application that leverages the NBI data to provide valuable insights and visualizations related to the country's bridge infrastructure.

This is an open-ended project, and we encourage you to bring your creativity and unique perspective to the table. We are interested in seeing how you approach the problem, make decisions, and ultimately deliver a solution that demonstrates your abilities in data processing, database design, API development, geospatial analysis, and visualization. We believe that this project will not only help us evaluate your technical skills but also provide you with an opportunity to make a lasting impression as a potential member of the Mach9 team.

After you've finished, we'll schedule an hour-long block of time for you to present your project to the team. We'll let you walk through your code and results for about 15-20 minutes, leaving the rest of the time for questions from the team. We'll ask you to explain what you've done so far and justify various design decisions that you make. These discussions will help us gain a deeper understanding of your thought process, engineering practices, and problem-solving abilities. We may also present new ideas or challenge your decisions to explore your reasoning and flexibility.

## Data sources

The primary data source for this project is the National Bridge Inventory (NBI), a comprehensive database maintained by the Federal Highway Administration (FHWA). The NBI contains detailed information about the nation's bridges, including their locations, structural conditions, design types, materials, dimensions, and various other attributes. This valuable dataset serves as a vital resource for understanding the current state of bridge infrastructure in the United States.

You can access the NBI dataset at <https://www.fhwa.dot.gov/bridge/nbi/ascii2022.cfm>. For concreteness and ease of import, we recommend that you use the [Delimited Pennsylvania file](#),

which is a text CSV. Additionally, you may choose to incorporate other relevant geospatial data sources or APIs to enrich your project, such as road networks, population data, or other infrastructure information. Please make sure to properly cite and attribute any external data sources you use in your project.

## Requirements

Although the project is open-ended, we'd like to see the following core components included as part of your application:

1. Database Design: You should design a database schema that effectively organizes the processed data.
2. API Development: Develop an API that exposes the processed data to frontend clients, enabling operations like searching, filtering, and retrieving bridge information based on various criteria.
3. Geospatial Visualization: Incorporate geospatial analysis or visualization into the application, such as identifying clusters of structurally deficient bridges or creating an interactive map that displays bridge locations and attributes. This will not only help convey the insights generated from the data, but also demonstrate your ability to work across the full stack and create a more engaging user experience.

## Tools and Technologies

You can use any APIs or tools that you find helpful for this project. In particular, Googling is highly encouraged. If you use a large language model such as ChatGPT to help, **please send a full transcript** of the conversation along with your project. This will help us evaluate which components of the results are your work.

You should feel free to build this application using any languages or frameworks that you want. I'm happy to learn new programming languages to evaluate the project.

Please track your code as a Git repository.

## Deliverables

We will be evaluating your performance on the following:

1. Code quality: Although this is a single-day project, your code should be readable, modular, and maintainable. The single day time constraint may mean that parts of the code are left incomplete, and we understand that.
2. Problem solving: Your ability to break down complex problems, identify potential solutions, and implement them effectively will be evaluated throughout the project.
3. Database Design: We will assess your ability to design a scalable and efficient database schema that effectively organizes and manages the processed data.
4. API Design: Your ability to create a well-designed and functional API that exposes the processed data to frontend clients and supports various operations will be evaluated.

5. Geospatial Analysis or Visualization: We will assess your ability to effectively analyze or visualize geospatial data in a meaningful way that enhances the user experience and provides valuable insights.