COM Hackathon - Pitch

- **Problem Statement**: Start by explaining how flooding impacted our experience on Highway 410, emphasizing the need for better urban stormwater management.
- **Solution**: Present the blue roof system as an innovative, distributed solution to alleviate stormwater pressure during peak events.
    - Optimization model for blue roof systems which takes in data sets and checks if the blue roof should release or sustain water based on factors.
    - To show this work, we will provide a simulation model using a front-end application which can display this data and run simulations.
    - Machine learning models could predict peak flow times and automatically control the release of water from blue roofs, ensuring a staggered release to avoid overwhelming the drainage systems.
- **Data and Results**: Share insights from simulations and testing, highlighting how this approach can help mitigate flooding in flood-prone areas. How data analytics and AI add value through prediction and optimization.
- **Scalability and Community Impact**: Explain how scaling this to multiple rooftops in flood-prone areas could significantly reduce flooding impacts.

Project Breakdown with the Enhanced Approach

1. Data Collection and Real-Time Monitoring

- **IoT Sensors**:
    - Install sensors on blue roofs to collect **real-time water level data**.
    - Place rainfall gauges on rooftops to capture **precipitation intensity** and feed this data into your AI model.
- **Data Sources**:
    - Combine real-time data from sensors with the **daily weather data** and **storm sewer network** datasets to make effective decisions.

2. Machine Learning Model

- **Model Objective**: Predict the **best action** (retain or release water) to prevent flooding, while also preventing overloading of the stormwater network.
- **Training Dataset**: Use the **historical weather data** (rainfall, temperature, humidity) along with **flood-prone areas** data to train a machine learning model.
- **Approach**:
    - Implement a **Reinforcement Learning (RL) agent** trained to release water in a manner that minimizes the risk of flooding.
    - Use **geospatial data** (from TRCA Floodline and Flood Vulnerable Areas) to understand where water should be released and to identify potential risk zones.

3. System Simulation and Optimization

- **Hydrological Modeling**:
    - Use the **Hydrologic Network** dataset to simulate the flow of stormwater, assessing how blue roof installations impact the broader system.
- **InfoDrainage-Inspired Simulation**:
    - Develop a simulation that shows how rainwater interacts with the **storm sewer network** and **storm pipes**, using Python libraries such as **SimPy**.
    - Adjust water release schedules to optimize for the real-time status of stormwater nodes and pipes.

4. Decision-Making and Blue Roof Optimization

- **Real-Time Release Optimization**:
    - Based on inputs from rainfall, water levels, and **storm pipe capacity**, the AI model makes **release decisions** to manage flooding risks.
    - Implement **machine learning models** to predict peak flow times and adjust release volumes accordingly.

5. Front-End Visualization and Dashboard

- **User Simulation Dashboard**:
    - Build a front-end using **Dash** (Python library) or **Flask** to visualize blue roof system status, water levels, and predicted flooding risks.

    - Include maps showing **flood-prone areas**, **hydrologic networks**, and the **impact** of current blue roof water release decisions.
    - Allow users to interact with the model by changing conditions (e.g., increased rainfall) and observe system responses in real-time.

6. Proposed Implementation Plan

- **Pilot Deployment**:
    - Identify and implement blue roofs on selected buildings based on **flood-vulnerable areas** and **stormwater network** analysis.
- **Feedback Loop**:
    - Use real-time data to continuously train the reinforcement learning agent, making the blue roof system smarter over time.
- **Evaluation Metrics**:
    - Use metrics such as **runoff volume reduction**, **flood risk reduction**, and **network load** to evaluate the performance of the system.

Summary of Hackathon Deliverables

- **Machine Learning Model**: A trained model capable of making real-time decisions about water retention or release, with predictions based on input from the dataset and sensor data.
- **Simulation and Visualization Dashboard**: A front-end application showing real-time data flows, including water levels, rainfall, predicted risks, and flood-prone areas.
- **Hydrological Impact Analysis**: Insights derived from integrating **stormwater network data**, showing how blue roof releases affect the broader stormwater system.
- **Pitch Presentation**: A 3-minute pitch that presents the problem, the AI-powered blue roof solution, the datasets used, simulation results, and the expected impact on reducing urban flooding.

By integrating these datasets effectively, your project can now provide a **comprehensive flood mitigation solution**, combining **real-time data analysis**, **machine learning predictions**, and **hydrological modeling** to tackle urban flooding in a systematic and scalable way.

Hackathon Resources

- Webinar Slides
  https://mississauga.app.box.com/s/gbaybvnx0pj5p11aoen2i62e6pe4mbt6

- Hackathon Booklet
  https://mississauga.app.box.com/s/rfmsrn4p8hpbxwtp6ccwys3j5gx2falv
- Hackathon Sample
  https://mississauga.box.com/s/tq2w7g0a0oc2q4g887ngi5tic7mggz20

- Presentation Template
  https://mississauga.app.box.com/s/9want4c4jwr65kbreu5kdhrylh1n6fc3

Research Material

- Blue Roofs
  https://sustainabletechnologies.ca/home/urban-runoff-green-infrastructure/low-impact-development/blue-roofs/

  https://www.bdc.ca/en/articles-tools/sustainability/environment/what-blue-roof-and-how-can-help-business#:%7E:text=A%20blue%20roof%20with%20a,per%20square%20foot%2C%20Taylor%20says

  - Blue Roofs are specifically designed to store rainwater temporarily, reducing runoff and mitigating flood risks. You can leverage rooftops as collection points for your rainwater harvesting system. The water captured can be stored temporarily on blue roofs before being directed into storage tanks or used for other applications.
  - AI and data analytics can be used to determine the optimal storage time before releasing water into the harvesting system, ensuring that roofs aren't overloaded and helping manage stormwater flow efficiently.
  - Blue Roofs – Blue Roofs are roofs adapted to store rainwater. Blue roofs can help storm pipes from backing up, which can cause flooding damage to buildings and prevent localized flooding.
  - Typical Cost of a Blue Roof – CAD $1 – CAD $2 per square foot. A basic Blue Roof will have a containment area, pipes, sensors, and valve costs.

- Blue Roof Planning and Design Guide
  https://wiki.sustainabletechnologies.ca/wiki/Blue_roofs
- Mississauga Flooding Update
  https://www.mississauga.ca/city-of-mississauga-news/news/flooding-update-city-approves-financial-relief-for-property-owners-and-fast-tracks-infrastructure/
- 2024 Budget
  https://www.mississauga.ca/wp-content/uploads/2024/01/budget-2024.pdf
- Corporate Report of Flood events
  https://pub-mississauga.escribemeetings.com/filestream.ashx?DocumentId=61527
- Examining How a Smart Rainwater Harvesting System Connected to a Green Roof Can Improve Urban Stormwater Management
  https://www.mdpi.com/2073-4441/14/14/2216
- Autodesk InfoDrainage integrates Artificial Intelligence with Machine Learning Deluge tool
  https://www.autodesk.com/blogs/water/2023/11/13/autodesk-infodrainage-machine-learning-deluge-tool/
- Revolutionising Stormwater Management with Visual AI
  https://www.aquawatchsolutions.com/post/seeing-beyond-assumptions-revolutionising-stormwater-management-with-visual-ai

Datasets

- StormNode
  https://data.mississauga.ca/datasets/03d590fc7586457fb5f2818d62f3b5c5_0/explore?location=43.635250%2C-79.798088%2C15.83
- StormPipes
  https://data.mississauga.ca/datasets/8aff41843ec44a74a309148d28e1b989_0/explore?location=43.609411%2C-79.673070%2C9.92
- Watercourses
  https://data.peelregion.ca/datasets/d8afd94d3f684e248993d29e7473c38e_0/explore

- Mississauga Weather
  https://mississauga.weatherstats.ca/download.html
- Floodline TRCA Polygon
  https://trca-camaps.opendata.arcgis.com/datasets/16356f40517d4e32aca9c86b257198e0_1/explore?location=43.785161%2C-79.466616%2C11.57
- Floodline TRCA Line
  https://trca-camaps.opendata.arcgis.com/datasets/231d09f8cecf48f796bf6eeacfb8032c_0/explore?location=43.800884%2C-79.501537%2C9.96