FALL 2025– COS 397 COMPUTER SCIENCE CAPSTONE PROJECT PROPOSALS

Project Title: Climate Reanalyzer made available to planetariums through OpenSpace and other software platforms.

Submitted By: Dr. Sean Birkel and Shawn Laatsch in partnership with Dr. Carter Emmart and Micah Acinapura (OpenSpace Team)

Brief Description:

The purpose of this project is to setup a map tile server and APIs to deliver climate and weather data from the website Climate Reanalyzer (CR) (https://ClimateReanalyzer.org) to planetaria and other venues that use the software *OpenSpace* (https://www.openspaceproject.com). Climate Reanalyzer is a data visualization website that sees about 2,500–6,000 users daily, and includes more than a dozen pages that provide access to climate and weather datasets in the form of high-quality 2D map visualizations and CSV and JSON time series displayed through interactive charts. All climate and weather data are sourced public repositories, most of which are operated through NOAA. This project will enable the detailed viewing of weather events (e.g., storms, heatwaves, frontal systems) and climate trends such as changes in temperature and precipitation over time on planetarium domes for teaching.

The problem: Visualizations of gridded climate and weather datasets on CR are currently only available through interfaces on the website itself, and not available to a wider range of software that loads map data, including planetariums and other digital display packages.

Goals for the project:

The project goals for the capstone team are twofold:

1) The team will setup an image tile server to make CR climate and weather maps available to planetarium open source software such as *OpenSpace* and GIS. The codes will be open-source and using open-source tools/technologies such as Apache HTTPD Tile Server Ecosystem, GDAL and WMS. The weather maps themselves will be prepared by Dr. Birkel, and the capstone team will need to tile the supplied images and make them available through a tile server that they setup. Dr. Birkel will setup a virtual Linux machine from ARCSIM for the capstone team to use. Once the map tile server is setup, the capstone team will develop a means in *OpenSpace* to load the CR map image tiles for rendering onto a globe projection (*OpenSpace* already has this rendering capability, but the code will need to be modified to load files specifically from the new map tile server). Dr. Carter Emmart and Micah Acinapura will assist the capstone team in *OpenSpace*.

2) In addition to maps, CR provides access to climate and weather data time series in CSV and JSON files. The capstone team will develop a means to query these time series from CR (perhaps by REST API) and display the results on an x/y plot (e.g., annual temperature values each year since 1950) in *OpenSpace*.

The capstone team does not have to achieve to achieve both parts; if at least the first goal is completed, then the project will be considered a success.

Total Duration / Elapsed Time [in weeks]:

The expected duration is 24 weeks unless the project is completed early.

External Schedules / Deadlines:

None.

Learning Objectives for student teams:

Some members of the capstone team may not have prior experience working with gridded datasets, tiling map data, or setting up APIs. If this is the case, then there is opportunity for the students to learn standard practices, and to consult relevant literature.

Expected Project Experiences (select from the list):

- Problem definition
- Project scope definition
- Data analysis
- Workflow analysis
- Examination of an unfamiliar technical area
- Identification and evaluation of alternatives

Recommended experience (What operating system is required? What programming language? Other skills?):

Proficiency with Linux/UNIX is recommended. Experience with HTML, PHP, and Javascript is also recommended. Some prior exposure to API development would be helpful.

Expected Outputs/Products and likely requirements (specific programming language, operating system, integration with existing software, web-based requirements, etc.):

Students will need to become familiar with the HTML, PHP, and Javascript codes for CR in the process of porting content to **OpenSpace** (https://www.openspaceproject.com/)**.** They will need to become familiar with **OpenSpace**, which is a PC operating system based visualization software that works on flat screens and planetariums.

Proposed Testing Plan (How will the team test their product? Do you have recommended/required testing strategies? What resources are available (test platform, stand-alone network, etc.)? Is test data available?):

The testing plan is to ensure that datastreams from CR can easily be ported into **OpenSpace**. Testing can be done on laptops and also at the Versant Power Astronomy Center.

Benefits to U Maine:

The development of Climate Reanalyzer has been supported by both the Climate Change Institute and the University of Maine. Images from Climate Reanalyzer are commonly shared on social media and cited in news media. The Versant Power Astronomy Center's Jordan Planetarium is looking to share more climate and weather data with university and other constituents. Increasing Climate Reanalyzer's usability on for planetarium platforms can help increase visibility for UMaine, particularly in the context of climate research and visualization.

Project Sponsor(s):

Climate Change Institute & Versant Power Astronomy Center - University of Maine.

Other Resource People:

Capstone students will interact with Dr. Birkel and Shawn Laatsch from the planetarium. Additionally, they will interact with Dr. Carter Emmart and Micah Acinapura from the *OpenSpace* team.

Software/server access required:

Dr. Birkel will arrange for access to a Linux virtual machine hosted by the UMaine ARCSIM. This system will have most needed software already installed, and Dr. Birkel can help acquire additional software as needed.

The *OpenSpace* software is free and open source. Micah Acinapura can assist students in getting it set up and configured on laptops used by students.