CyberGIS-Compute for enabling computationally intensive geospatial research

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ABSTRACT

Geospatial research and education have become increasingly dependent on cyberGIS to tackle computation and data challenges. However, the use of advanced cyberinfrastructure resources for geospatial research and education is extremely challenging due to both high learning curve for users and high software development and integration costs for developers, due to limited availability of middleware tools available to make such resources easily accessible. This tutorial describes CyberGIS-Compute as a middleware framework that addresses these challenges and provides access to high-performance resources through simple easy to use interfaces. The CyberGIS-Compute framework provides an easy to use application interface and a Python SDK to provide access to CyberGIS capabilities, allowing geospatial applications to easily scale and employ advanced cyberinfrastructure resources. In this tutorial, we will first start with the basics of CyberGIS-Jupyter and CyberGIS-Compute, then introduce the Python SDK for CyberGIS-Compute with a simple Hello World example. Then, we will take multiple real-world geospatial applications use-cases like spatial accessibility and wildfire evacuation simulation using agent based modeling. We will also provide pointers on how to contribute applications to the CyberGIS-Compute framework.

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CCS CONCEPTS

• Applied computing~Physical sciences and engineering~Earth and atmospheric sciences • Computing methodologies~Distributed computing methodologies

KEYWORDS

CyberGIS, GIScience, CyberGIS-Jupyter, High Performance Computing

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Short description.

CyberGISX provides an integrated development and sharing platform with particular support for cyberGIS and geospatial software and applications. CyberGIS-Compute enables students and researchers from diverse backgrounds to take advantage of

High Performance Computing (HPC) resources without having to delve into the details of system HPC setup, maintenance and management. With CyberGIS-Compute, powerful HPC resources are made easily accessible on CyberGISX so its users can leverage these powerful computational resources for geospatial problem solving with minimal effort and a low learning curve. Using geospatial examples, in this tutorial, we will cover how to take advantage of CyberGIS-Compute for computationally intensive geospatial research.

Detailed description of which functionality or parts of the APIs the tutorial will cover.

CyberGIS, defined as geographic information science and systems based on advanced cyberinfrastructure (CI), [1] has emerged as a new generation of GIS. However, the use of advanced cyberGIS capabilities has typically been constrained to a small set of research groups who have the technical expertise of using CI resources. Over the past few years CyberGIS-Jupyter [2,3] has been developed to provide access to cyberGIS capabilities through an easy-to-use Jupyter Notebook interface which has made cyberGIS more accessible. For many cyberGIS and geospatial applications accessing CI resources needed for solving complex problems at scale. However, leveraging CI resources for geospatial application is challenging both due to the steep learning curve and lack of appropriate tools. CyberGIS-Compute fills this gap by providing an easy-to-use middleware tool for using and contributing geospatial application codes that leverage CI resources. This substantially lowers the learning curve for both geospatial users and developers to access cyberGIS capabilities at scale. CyberGIS-Compute is backed by Virtual ROGER (Resourcing Open Geospatial Education and Research); a geospatial supercomputer with access to a number of readily available popular geospatial libraries.

In this tutorial we will cover the basics of CyberGIS-Compute, with a number of hands-on examples. These examples will go through the basics of CyberGIS-Compute and teach participants how to employ CyberGIS-Compute for solving geospatial problems. On finishing this tutorial, a learner should be able to use CyberGIS-Compute services via the Python SDK to submit geospatial computational tasks to HPC systems such as Virtual ROGER and XSEDE (Extreme Science and Engineering Discovery Environment). They will also be pointed to the procedures to contribute their models via CyberGIS-Compute for making their work accessible to the community.

Tutorial plan.

30min session

- Introduction to CyberGIS, CyberGIS-Jupyter and CyberGIS-Compute (5 mins)
- Hands on Example 1: A simple hello world use-case of CyberGIS-Compute using a CyberGIS-Jupyter notebook (10 mins). This session covers
    - The basics of the CyberGIS-Compute Python SDK
    - The life cycle of a typical computation job in CyberGIS-Compute
    - Using the CyberGIS-Compute Python SDK to run a simple example on HPC
- Example 2: Using CyberGIS-Compute to run a spatial accessibility analysis (10 mins)
    - Using the CyberGIS-Compute Python SDK to review available resources and models
    - Executing the spatial accessibility computation, downloading and displaying results
- Discussion and Q/A (5 mins)

Attendees should sign up for the free account on CyberGISX before the session following instructions provided by the authors. The authors will also provide them with executable notebooks that they can follow along using CyberGISX.

List of any additional material or prerequisites that you expect the tutorial attendees to have.

It would be helpful if they had some familiarity with the Python programming language, Jupyter Notebooks, and Git repositories. All resources and materials needed for the tutorial will be provided to the participants on CyberGISX. Participants will be expected to sign for a free CyberGISX account to conduct the hands-on part.

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