

High Performance Computing Program at CSUSB

Presentation to Office of Academic Research

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Assistant Professor of Mathematics

2/23/2023

Agenda

- ❑ High-Performance Computing Program at CSUSB
- ❑ Why HPC? And how to use HPC?
- ❑ HPC support for research

Note: Part of this presentation was prepared by Dung Vu. Several faculty members shared invaluable feedback on their HPC experiences.

HPC Team at CSUSB

- ❑ **Dr. Sam Sudhakar** Vice President for ITS, Chief Information Officer
- ❑ **Gerard Au** Deputy Chief Information Officer & Chief Information Security Officer
- ❑ **Dr. Bradford Owen** AVP for Faculty Development, Chief Academic Technologies Officer
- ❑ **Dr. Dung Vu** HPC consultant, Analyst, Programmer
- ❑ **James MacDonell** HPC consultant, Operating Systems Analyst
- ❑ **Youngsu Kim** HPC Faculty Fellow, Assistant Professor of Mathematics

Mission of Information Technology Services

Our mission is to support student, faculty and staff success by providing world-class customer service, **fostering faculty-led innovation and research**, and enhancing operational efficiency through the effective use of information technologies

- ❑ In 2017, CSUSB joined the National Research Platform
- ❑ NRP resources are available via the internet.

Necessity of High Computing Power in Academic Research

Necessity of HPC

- ❑ Traditional needs from STEM related disciplines continue
- ❑ Big data and machine learning expand the necessity to all parts of our campus research community, including arts and letters, social sciences, etc

Disadvantage of owning HPC system

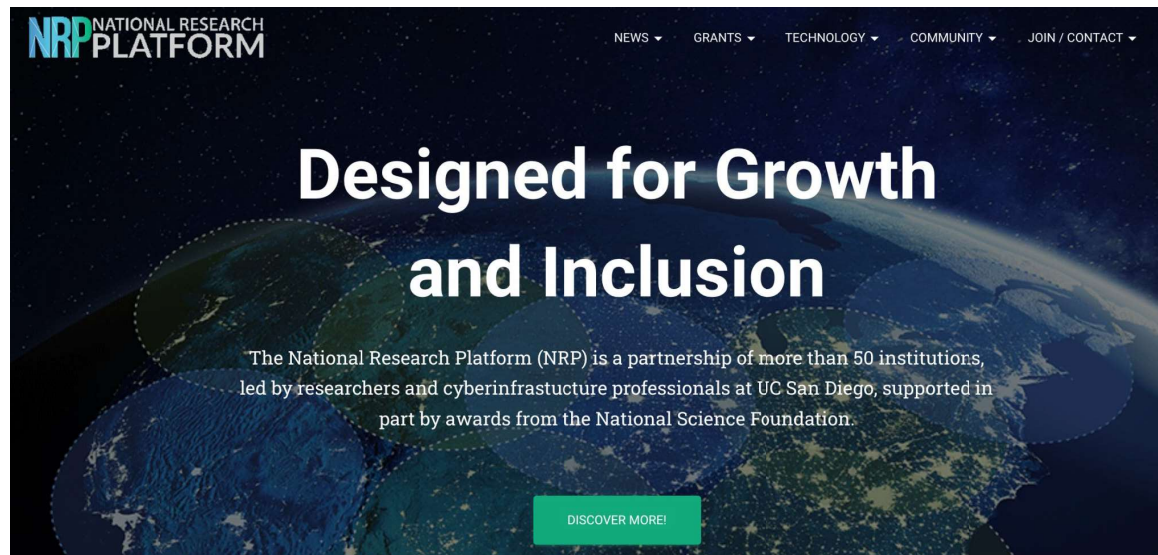
- ❑ High purchase cost
- ❑ Time and effort for maintenance
- ❑ Necessity of upgrading the system over time
- ❑ Fixed setting

Democratization of technology

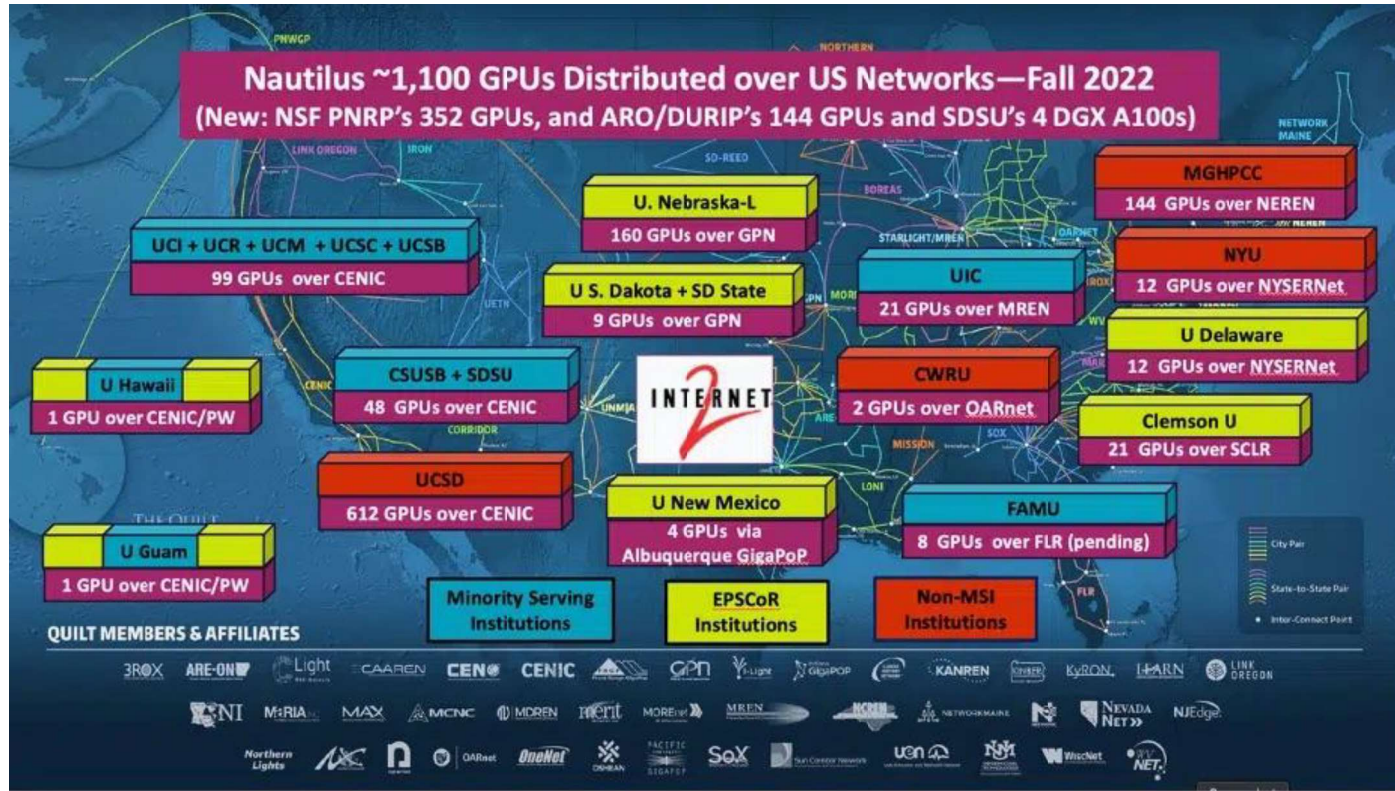
- ❑ National research platform, HPC
- ❑ Open Science Grid, HTC

National (Pacific) Research Platform

The National Research Platform (NRP) is a partnership of more than 50 institutions, led by researchers and cyberinfrastructure professionals at UC San Diego, supported in part by awards from the National Science Foundation



NRP works like a shared car or scooter



Source: NRP webpage

What is HPC?

HPC vs Supercomputer

- ❑ A **supercomputer** is one big computer customized to perform a **specific task**
- ❑ **High-performance computing** is many computers working toward the same goal and can be **adjusted** to meet other requirements

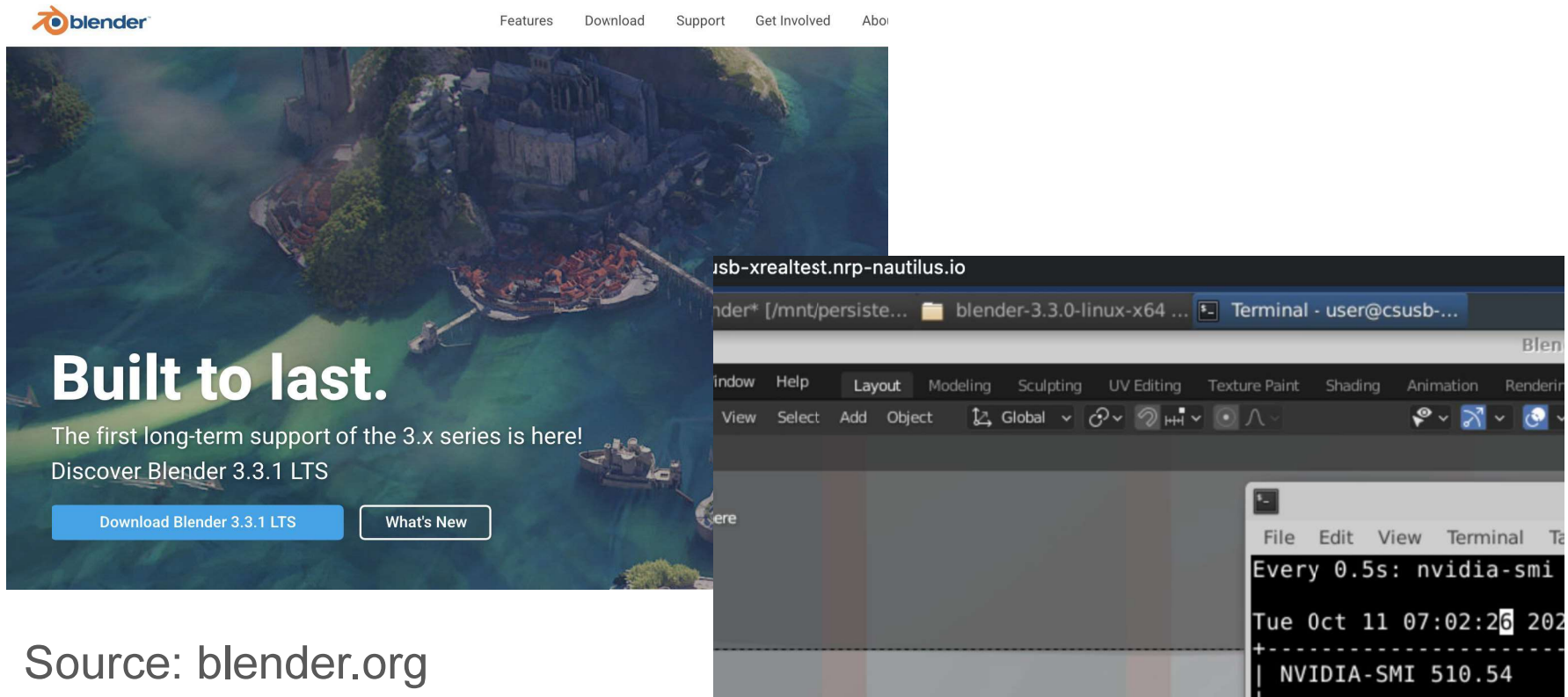
Source: [Fed Tech](#)

HPC Faculty Projects at CSUSB

- ❑ **Dr. B. J. Becerra** Information and Decision Sciences
- ❑ **Dr. K. Cousins** (tentative) Chemistry & Biochemistry
- ❑ **Dr. N. Mohabbati, Dr. S. Alavi** Information and Decision Sciences
- ❑ **Dr. Y. Kim** Mathematics
- ❑ **Dr. K. Liszka** History, Benson and Pamela Harer Fellow in Egyptology,
director of the Wadi el Hudi expedition,
Dr. B. Kraemer Robert and Frances Fullerton Museum of Art CSUSB,
co-director of the Wadi el Hudi expedition
- ❑ **Dr. J. Meyer** Mathematics
- ❑ **Dr. J. Pham** Chemistry & Biochemistry
- ❑ **Dr. S. Ratnasingam** Mathematics

Does HPC help?

Project A xREAL Lab, Dr. Popescu, faculty director, Blender



The image shows a composite of two elements. On the left is a promotional banner for Blender 3.3.1 LTS. The banner features a scenic 3D rendered landscape with a large stone structure on a cliffside overlooking a body of water. The text on the banner reads: "Built to last. The first long-term support of the 3.x series is here! Discover Blender 3.3.1 LTS". Below the text are two buttons: "Download Blender 3.3.1 LTS" and "What's New". On the right is a screenshot of a terminal window overlaid on the Blender interface. The terminal shows the command "nvidia-smi" being executed, with the output: "Every 0.5s: nvidia-smi Tue Oct 11 07:02:26 2022 +-----+ | NVIDIA-SMI 510.54". The Blender interface behind the terminal shows the top menu bar with options like "Layout", "Modeling", "Sculpting", "UV Editing", "Texture Paint", "Shading", "Animation", and "Rendering".

blender

Features Download Support Get Involved About

Built to last.
The first long-term support of the 3.x series is here!
Discover Blender 3.3.1 LTS

Download Blender 3.3.1 LTS What's New

Terminal - user@csusb-...
Every 0.5s: nvidia-smi
Tue Oct 11 07:02:26 2022
+-----+
| NVIDIA-SMI 510.54

Source: blender.org

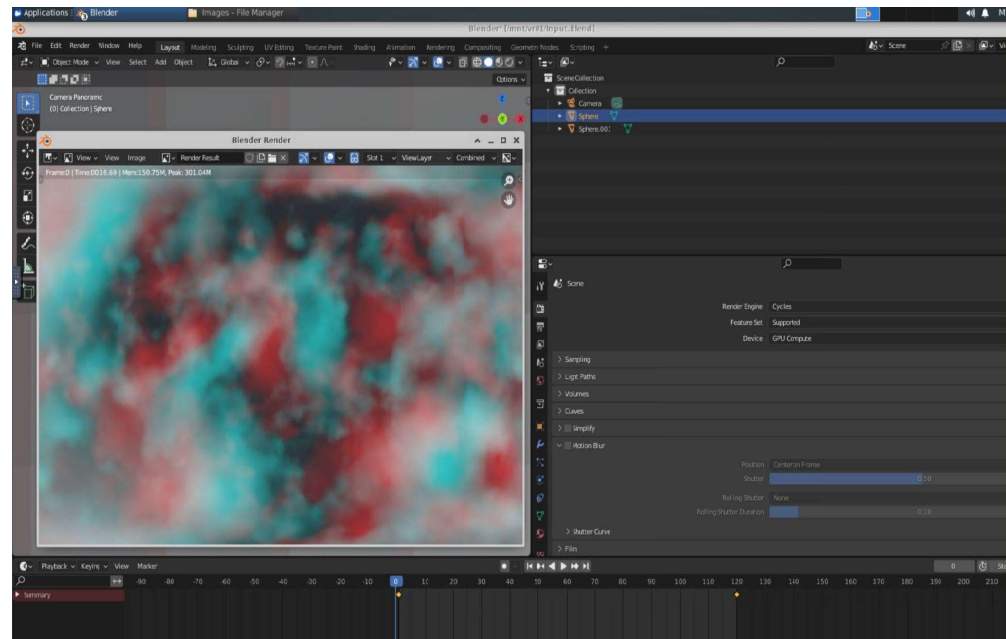
Project A (cont'd)

Improvements by the HPC

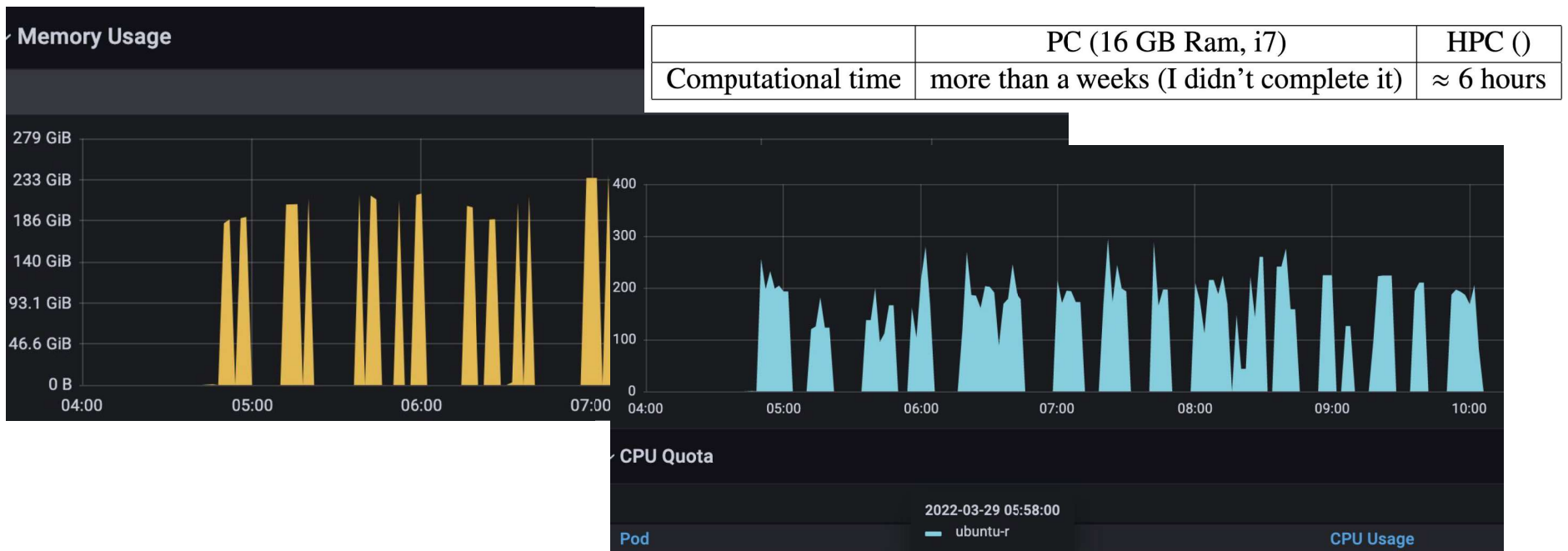
4 days => ~8 hrs

1200% improvement!

Providing the lab significantly more time to work on their projects



Project B Dr. Ratnasingam, R/RStudio



Project C (cont'd)

- ❑ S. Ratnasingam, S. Wallace, I. Amani, and J. Romero, *Non-Parametric Confidence Intervals for Generalized Lorenz Curve using Modified Empirical Likelihood* (Under review)

	PC (16 GB Ram, i7)	HPC ()
Computational time	> 2 days	≈ 2 hours

- ❑ C. Gu and S. Ratnasingam, *Real-Time Change Point Detection in Linear Models Using the Ranking Selection Procedure*

	PC (16 GB Ram, i7)	HPC ()
Computational time	more than a weeks (I didn't complete it)	≈ 6 hours

HPC team

Our HPC team can support faculty in

- ❑ preparing for grant writing where HPC resources are needed
- ❑ setting up their work environment on the server
- ❑ making a smooth transition from their local machines to the server

JupyterHub: research and classroom



A multi-user version of the notebook designed for companies, classrooms and research labs

A screenshot of a Jupyter Notebook interface. The left sidebar shows a file browser with a search bar and a list of files: /, R (5 days ago), shared (12 days ago), output.txt (5 days ago), output2.txt (8 days ago), Test.ipynb (8 hours ago), Test2.ipynb (11 days ago), and Untitled.ip... (seconds ago). The main area shows a code cell with the following Python code:

```
[1]: import time
import random

[2]: def my_function():
    time.sleep(1)

[ ]: startTime = time.perf_counter()

while 1:
    my_function()
    a = time.perf_counter() - startTime
    a = int(round(a,0))
    if a % 60 == 0:
        print(f"Running for {a} seconds." + f" That is {int(round(a/60)}
    if a % 3600 == 0:
        with open("output.txt", "a") as oFile:
            oFile.write(f"{round(a/3600,0)} hours \n")
```

The output of the code cell is:

```
Running for 60 seconds. That is 1 minutes or 0 hours
Running for 120 seconds. That is 2 minutes or 0 hours
Running for 180 seconds. That is 3 minutes or 0 hours
Running for 240 seconds. That is 4 minutes or 0 hours
Running for 300 seconds. That is 5 minutes or 0 hours
```

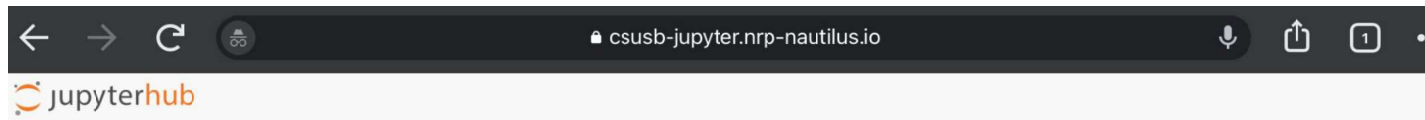
Source: <https://jupyter.org/hub>

1. Introduction

One of the most popular mobile systems today is the notebook computer. It combines features of a traditional workstation, a personal computer and a portable laptop computer. As a standalone machine with the processing power of a personal computer, it requires only a battery power supply and therefore can be used almost anywhere. Connected to a network, a notebook computer can act as a regular workstation, used in such tasks as electronic mail, appointment scheduling, design automation, scientific computing, software project development and many other tasks involving information sharing.

A notebook and even tablet is sufficient to take the full advantage of our HPC system.

CSUSB JupyterHub <https://csusb-jupyter.nrp-nautilus.io/>



Welcome to Cal State San Bernardino JupyterHub

The login process (the orange button) uses CSUSB's DUO system

Sign in with CILogon

Be sure to choose California State University San Bernardino on the next page instead of ORCID

► [Click here for more details](#)

This JupyterHub is provided by the [High Performance Computing Initiative](#) at [California State University San Bernardino](#) and [Pacific Research Platform](#)

If you obtain any results by utilizing our resources, please include [acknowledgements of our service](#) in your work e.g., presentations or papers.

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Services and programs for student research and student/faculty research collaboration



Research Compliance

Institutional Review Board (IRB), Institutional Animal Care and Use Committee (IACUC), and more



NIH CSUSB ASPIRE

Academic Research grant awarded by the National Institutes of Health - CSUSB ASPIRE

THANK YOU!

Feel free to contact us if you have any questions

- ❑ Youngsu Kim, youngsu.kim@csusb.edu
- ❑ <https://www.csusb.edu/high-performance-computing>