

Testimonial on Integrating Cloud and Container Technologies into University Numerical Weather Prediction (NWP) Curriculum

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MSU Denver Background

- Metropolitan State University of Denver (MSU Denver) is an urban higher-education institution located in downtown Denver, Colorado.
- Approximately 45% of the 19,258 undergraduates define themselves as “students of color.”
- In 2019, the program had 64 students, with 56% of the total number being female and 17% identify themselves as students of color.
- We are a “Commuter” University.



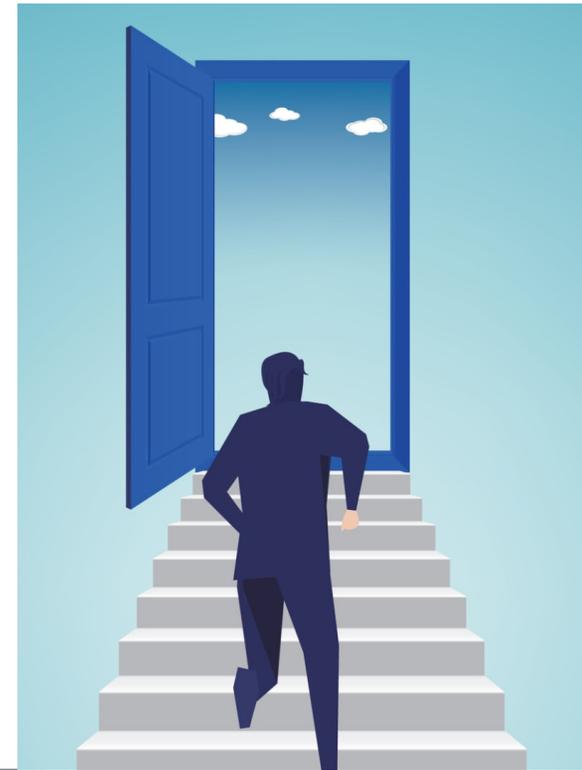
Challenges

- Due to a heavy teaching load (12 credits per semester) and small faculty size, professors do not have the academic and research freedom.
- A lack of computing support to configure, compile, and optimize the code and libraries necessary to run numerical weather prediction in a lab environment where the students can access it at will.
- Until recently, the Computer Science department programming course offering was minimal for emerging STEM scientists.
- Advanced computing can be daunting and discouraging for most undergraduates due to the hearsay horror stories.



Partnership and Motivation

- Simplifying and speeding up the learning curve for advanced computing can enrich student's overall learning experience.
- Using Container technology would be a way to bridge the hesitancy gap for students who do not have the aptitude in advanced computing quite yet.
- The overall goal is to provide undergraduate students with the opportunity to learn more about end-to-end NWP systems using software containers running in the cloud.



How the partnership got started...

- During the Spring of 2019, Jamie Wolff contacted me about a unique opportunity for bachelor's degree-granting Meteorology programs to learn about NWP utilizing cloud computing with a series of workshops/seminars.
- Jamie and I decided that the best way to offer the students information was to disseminate the material through an active learning approach.
- We decided we needed longer than 75 minutes to make the experience more impactful since MSU Denver students are primarily commuters.

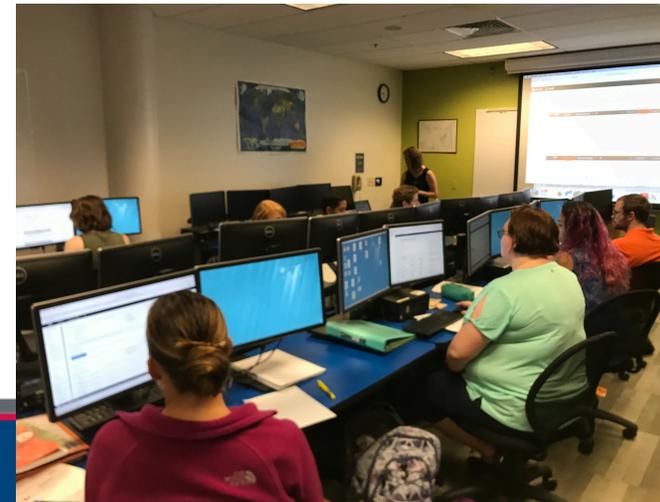


How the partnership got started...

- I converted my Forecasting Lab course to an NWP learning class for the Fall of 2019.
- This course met once a week for 2 hours.
- The extended class time allowed Jamie and her team (UCAR WRF Team) to demonstrate and instruct students on how to compile and run the Weather Research and Forecasting (WRF) Model within the Amazon Web Service (AWS) Cloud Server.
- Jamie agreed to meet with my students for a total of 8 hours (six face-to-face hours and two bonus hours via Google Meet).

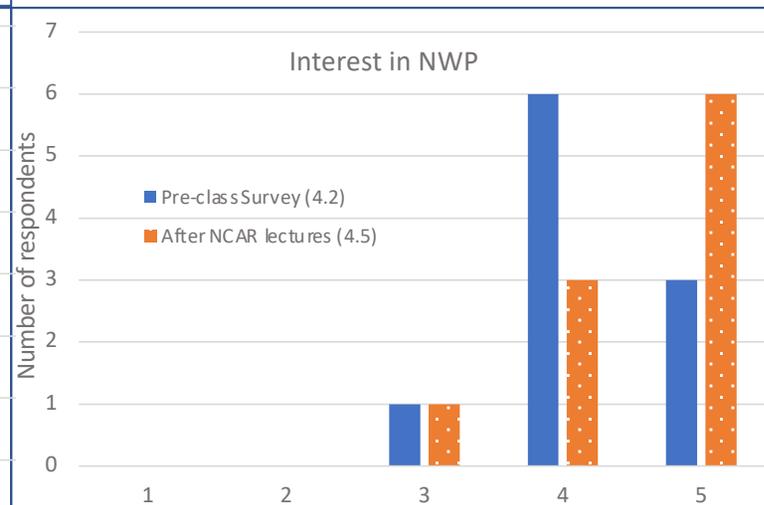
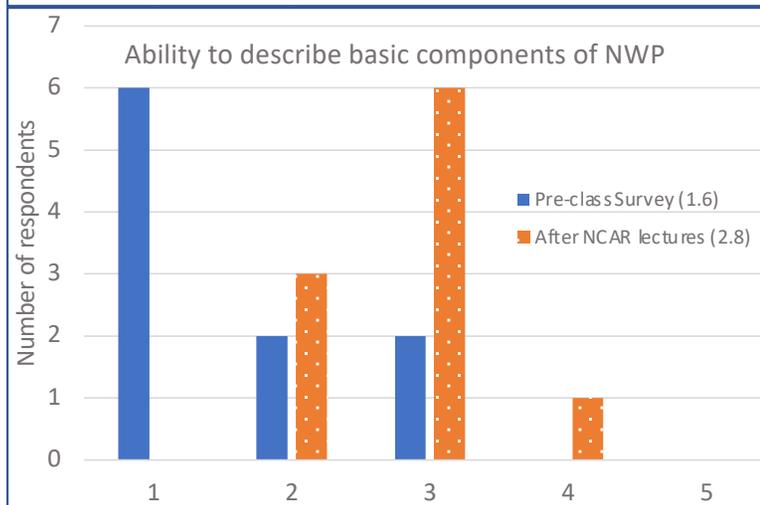
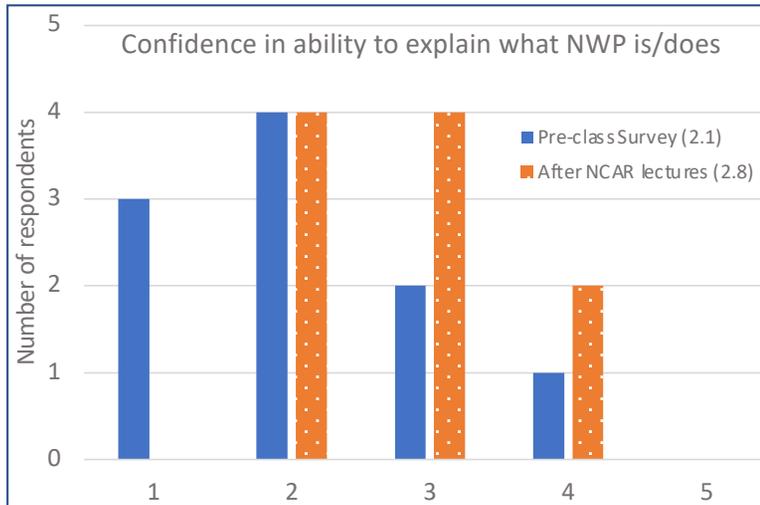
How the class was managed...

- A total of 10 students were registered for the class.
- The students' computing knowledge varies greatly.
- For my portion of the course, I was responsible for teaching:
 - NWP basic concepts
 - Essential UNIX commands
 - Plotting utility (GEMPAK)
- Pre- and post-class surveys were conducted by the NCAR team to determine if the course was a success.



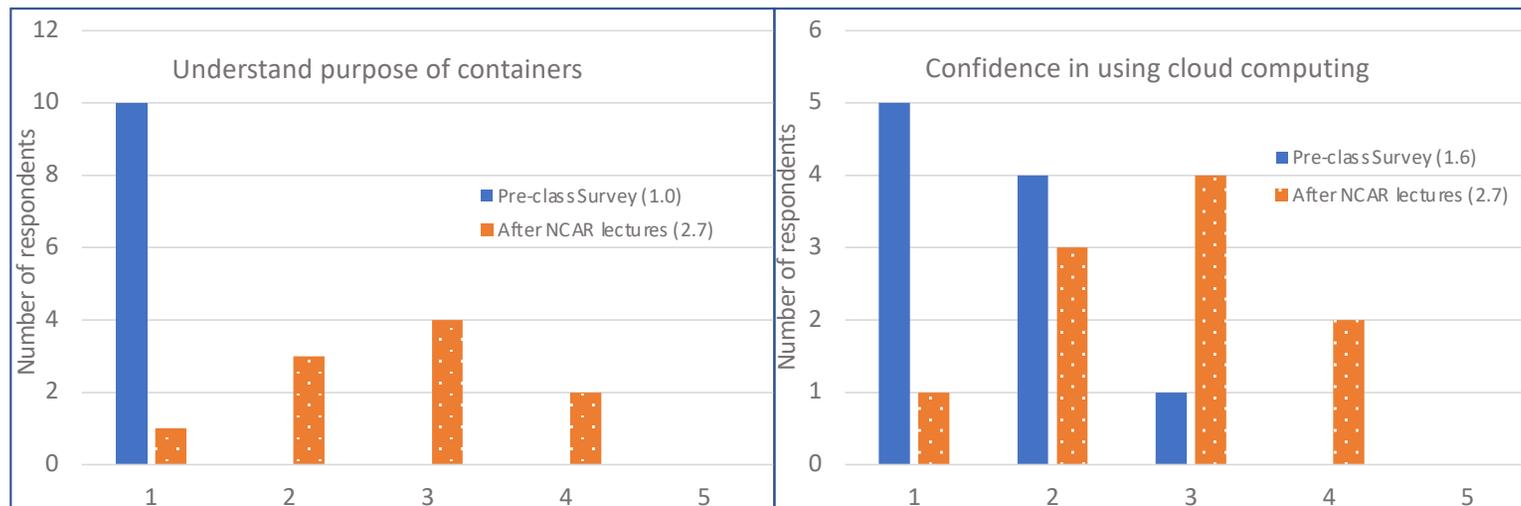
Survey Results

- We made a positive impact and increased students' interest in NWP and their confidence and ability to explain what NWP is and consists of!



Survey Results

- Clear evidence of increased knowledge and confidence in using containers and cloud computing.



My Personal Experience



**Undergrads
Before
the
Course on NWP**



**Undergrads
After the
Course on NWP**

My Personal Experience

- Students wanted more exercises and case studies after going through the examples from DTC.
- They tinkered with the parameterization schemes and other configurations.
- Students were using the WX lab during free time more.
- The AWS cost was around \$800 for the semester, which is manageable (no educational discount).
- The NWP stigma was eased away and allowed more in-depth lectures in my other courses.