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Profiling the National Center for Atmospheric Research's Weather Research and Forecasting Model

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Abstract

This project employs High Performance Computing (HPC) to analyze the National Center for atmospheric research's Weather, Research, and Forecasting Model (NCAR-WRF). Once an appropriate profiler is found, it will be used to determine if NCAR-WRF is compute bound, meaning its speed is determined by the power of its processors, or memory bound, meaning that the wall clock time is determined by the amount of available memory.

Project Summary

When dealing with weather, it is almost always better and safer to get predictions accurately and quickly. As it stands, NCAR-WRF is extremely accurate but can be a lengthy process if a large area is covered or a lot of variables are taken into account. Is it in the general interest then to further research just how much more quickly the program could be executed. Here, we discuss potential tools needed to examine the code of the program and its efficiency. Our past data suggested there is a lower bound to how quickly programs can complete.

Past

This project came about through a previous research project, in which the NCAR-WRF program was taken and run a scaling number of cores and nodes in order to inspect how the program scaled. It was found that the performance increased greatly when adding nodes, while adding cores was not nearly as effective, which sparked the question of whether WRF was memory or compute bound.

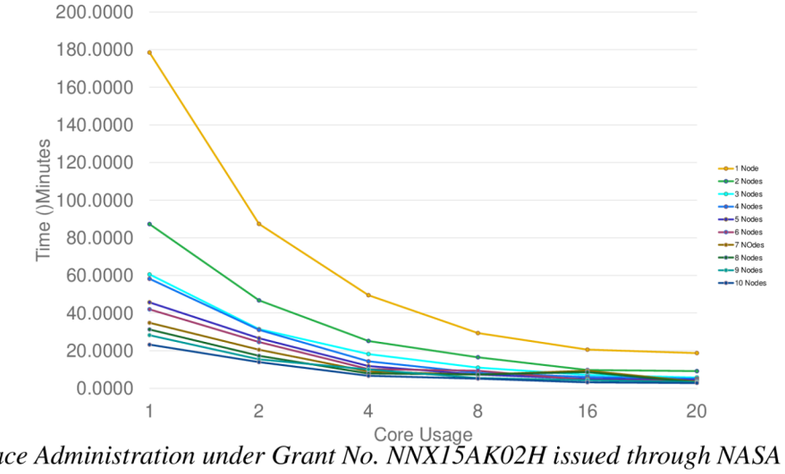
Project Effects

In Oklahoma, and especially the southwestern region, weather can be unpredictable at times. Usually, this is just an inconvenience on most people's everyday lives. However, it can quickly become a serious issue if the severity of the weather increases rapidly. The earlier accurate data can be produced, the further ahead of time families, schools, and workplaces can make the necessary calls to ensure safety.

Data

We continue to investigate the cause of this lower bound. Increasing cores per node does not seem to have a significant decrease in wall clock time, which may suggest the problem is memory bound. Memory bound problems can be sped up by increasing the node count as they have additional banks of memory to read and write from. The data suggests increasing the node count does not result in a significant reduction in wall clock time. Given these two observations, the problem may be limited by file read and write times.

Data



Past

The current phase of the project is analyzing several different code profiling tools in order to best determine what best suits our needs so that we can give it the needed time and energy to understand and run deeper examinations on the program. We have already examined Gprof, an are in the process of examining both Ganglia and Valgrind. We continue to examine the literature for other viable options.

Future

- After analysis on code profilers is finished, ideally we will be able to determine whether NCAR-WRF is compute or memory bound.
- Once this information is discovered, the next step is to develop a theoretical hardware solution to increase the program's efficiency, whether that be to increase the amount of processors working on it, or to increase the memory and speed in which it communicates. Regardless, there would be a lower limit to the wall clock time of the program meaning a hardware increase would eventually be ineffective. A software solution would then be required to be further efficient, but that is far beyond the scope of this project.

Works Cited

- http://www2.mmm.ucar.edu/wrf/users/
- Sadjadi, S. Masoud. Et all. "Finding an appropriate Profiler for the Weather Research and Forecasting Code." Aug 2007.

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