

Math/CprE/ComS 525, Spring 2016

Instructor: Professor Luecke

Time: T Th 11:00 – 12:15 lecture, 12:15-1:00 lab

Place: room 449 Carver

Office Hours: T Th 1:00 – 2:00 in 480 Carver

Grading: There will be two, in-class, closed book exams totaling 200 points. There will be a semester project worth 100 points. In addition, homework will be assigned and graded and will be worth about 140 points. Points will be deducted from home works received late. I will add all scores together and determine a grading scale using these sums. The grading scale will be **approximately** the following:

A 95 – 100%

A- 86 – 94%

B+ 78 – 85%

B 65 – 77%

Students are required to work independently and not with anyone else.

Syllabus

1. Introduction to HPC
2. Review of unix and the vi editor (you may use any editor you want)
3. How to use the student cluster
4. **Introduction to Fortran**
 - Declarations
 - arrays
 - dynamic allocation of arrays
 - loops
 - the PRINT statement
 - conditional IF statements
 - WHERE statements
 - functions and subroutines
 - array valued functions
 - recursive functions and subroutines
 - Intent
 - modules
 - Internal procedures
 - assumed shape arrays
 - automatic arrays
 - derived types
 - the SAVE statement and attribute
 - intrinsic functions
 - serial optimization
 - sorting
 - numerical integration
 - numerical linear equation solving with partial pivoting

5. **Parallel programming with OpenMP**

- background
- OpenMP run-time library routines
- OpenMP environment variables
- OpenMP directives and clauses
- parallel regions
- private and shared variables
- parallel loops
- race condition
- critical regions
- atomic regions
- single regions
- master regions
- barriers
- reduction clauses
- scheduling of OpenMP threads
- `omp_get_wtime()`
- workshare
- parallel sections
- the flush directive
- OpenMP tasks
- OpenMP locks
- false sharing
- domain decomposition: Jacobi iteration (Gauss-Seidel?)
- Gauss elimination

6. **Exam over all the items above (100 pts)**

7. **Parallel programming with MPI**

- overview of MPI: SPMD programming versus master/slave
- point-to-point blocking routines
- point-to-point non-blocking routines
- deadlocks
- collective routines
- MPI derived data types
- How to use the MAP and DDT tools
- parallel dot product
- parallel numerical integration
- parallel matrix-vector
- parallel domain decomposition and parallel Jacobi iteration
- parallel matrix-matrix multiply

8. **Exam over MPI (100 pts)**

9. **Semester projects: oral presentation (60 pts) written (40 pts)**

10. **No final exam**