

# Scientific Computing

## Project Details

### Premise

- Experience writing a scientific code from start to finish
- Explore your own PDE of interest\*
  - for undergrads
- Graduates will be doing both the projects

## Ideas

- One of the projects will be assigned
- Project A - 2D Poisson equation in a rectangle
  - Choose and compare 2 linear solvers among Gauss elimination, Gauss-Seidel, and Successive Over Relaxation (SOR).
- Project B - 2D Diffusion equation in a rectangle
  - Choose and compare 2 time integration methods among explicit, implicit, Crank-Nicolson, ADI and Runge-Kutta (RK).
- Contact one of the instructors to receive a detailed description of your project

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## Requirements

- The whole project must be done individually!
- Report \*
- Written in either MATLAB, C, C++ or Fortran \*
- Employs checkpoint/restart capability \*
- Uses source control \*
- Uses visualization \*
- *Performance/efficiency measurement*
- *Code verification/validation*

\*=mandatory

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## Report

- Abstract: Half page description of an application that you plan on implementing. (This is an "elevator" pitch with purpose and features of the project.)
- Mathematical statement of the problem
- Discretized version of the equations
- Description of the numerical method (pseudo code included)
- Technical specifications of the computer used
- Results (include graphs and comments)
  - Specifications of parameters used in simulations
  - Evaluate the effect of number of points used for discretization
  - Perform grid convergence study
  - Evaluate the effect of diffusive CFL\*
  - Comparison of results with expected theoretical behavior
  - Verify the order of spatial accuracy of discretization
- Commit your report to your git repository

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## Grading of projects

- Report
  - Discretization of mathematical problem (10%)
  - Description of algorithm (10%)
  - Verification (15%)
  - Presentation of results
    - Grid independence (5%)
    - Graphs and tables (10%)
- Code
  - Working (30%)
  - Optimization (10%)
  - Readability (comments) and modularity (5%)
  - Check pointing and version control (5%)

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## Project submission (Due - 5/4/2019)

- Submit the git repository via blackboard
  - project
  - project/doc/ {for Final Report} – 50%
  - project/src/ {for all working code} – 50%
  - project/bin/ {for executable(s)}
  - project/tests/ {for test cases (if any)}