Programming projects for
Intro Scientific Programming

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https://tinyurl.com/vle322course

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1. In a nutshell

- I teach C++ (and Fortran2008) to engineering-type students at The University of Texas at Austin
- End-of-semester programming project instead of exam
- Do a semi-realistic scientific simulation
  Write up your findings as if research article
2. Why this presentation?

- Share and enjoy! https://tinyurl.com/vle322course
- Invite contributors and collaborators.
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3. Project: infectious disease simulation

• How does an infectious disease spread through the population? Does anyone escape being infected? How long does the disease run?

• Investigate influence of parameters: chance of transmission, incubation period, how many people are vaccinated, . . .

• Programming: basic OO, great for C++ 101

• Sample graph:
4. Project: Amazon delivery trucks

- How do you plan an optimal route for a delivery truck? How about if you have more than one truck?
- Investigate heuristics for route planning. Discuss management and ethics issues.
- Programming: Multiple Traveling Salesman Problem

- Sample graph:
5. Project: redistricting

- Redistricting / Gerrymandering
- Group census districts into congressional districts.
- Is it possible for a minority to gain the upper hand? Is it possible to prevent this?
- Programming: dynamic programming
6. Project: Google Pagerank

- Simulate the internet
  Which web pages are important?
Search-Engine Optimization
- Different techniques for modeling the problem.
- Dig into the mathematics of it: relation between graphs and sparse matrices.
- Programming: DAG vs Sparse Matrix

- Sample graph:

  ![Sample Graph](image)

  **Figure 6:** Web with one page artificially made ‘important’
7. Project: High performance linear algebra

- Linear algebra algorithms that are optimized for architecture
- Cache-oblivious strategy: `std::span`