Multidimensional Data Analysis
CSC 790
Course Syllabus

Fall 2021

Instructor: Dr. Grey Ballard
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Office: Manchester 234
Office Hours: T 2-4 and W 11-1, or by drop-in or appointment
Class: 9:30–10:45 TR, Manchester 17
Course Schedule: `http://users.wfu.edu/ballard/teaching/CSC790/`

1 Course Description

This course focuses on tensor decompositions as a tool to analyze multidimensional data sets. After taking the course, students will be able to describe tensor notation and various tensor decompositions, apply the decompositions to different types of data using existing software, evaluate results and interpret them when appropriate, analyze and evaluate existing algorithms for computing tensor decompositions, and design new algorithms for related problems. Students will program in MATLAB and/or Python. Background in numerical linear algebra, numerical optimization, or basic statistical analysis (e.g., principle component analysis) will be helpful but not required.

2 Learning Outcomes

By the end of this course, students will be able to

1. *understand* tensor notation and how tensor decompositions express full tensors
2. use existing libraries to *apply* tensor decompositions to multidimensional data and understand the structure of solutions
3. *analyze* various tensor decompositions and differentiate among their utility across data analytic problems

4. *analyze* the computational costs of algorithms for computing tensor decompositions
5. *evaluate* tensor decomposition approximations to select among approximation variants and ranks, and appraise how confidently results can be interpreted
6. *evaluate* the tradeoffs among accuracy, efficiency, and robustness of different algorithms for computing tensor decompositions
7. *create* algorithms for tensor decomposition variants with nonstandard constraints, regularization, or tensor structure

3 Projects

The project can be done individually or in groups of 2 and should either be connecting your research to topics in this class or digesting a topic of interest related to this class. The main output of the project is a report (in ACM format: `https://www.acm.org/publications/proceedings-template`) and a presentation to the class at the end of the semester. Projects must include the use of a real multidimensional data set. They may focus on tensor decomposition pedagogy, along with some artifact (such as a lesson plan, assignment scaffolding, and/or demonstration), with the intent of being useful in future versions of the class.

4 Assessment and Grading

Course grades are determined using the following weightings:

- 66% homework/programming assignments
- 34% project

Letter grades are assigned based on the following categorization:

A	93 or above	**C**	73–76.99
A$^-$	90–92.99	**C**$^-$	70–72.99
B$^+$	87–89.99	**D**$^+$	67–69.99
B	83–86.99	**D**	63–66.99
B$^-$	80–82.99	**D**$^-$	60–62.99
C$^+$	77–79.99	**F**	below 60

5 Contacting Me

In general, email is the best way to reach me, and I'm happy to take questions over email. The easiest way to find me in person is to stop by my office during office hours, though please feel free to drop by any time. If you want to be sure

to find me then you can also email ahead to schedule a time; it helps to propose a few times that work for you so that I can choose one that works for me too.

6 Learning Assistance Center

If you have a disability that may require an accommodation for taking this course, then please contact the Learning Assistance Center (758-5929) within the first two weeks of the semester and bring it to my attention as appropriate.

7 Emergency Preparedness Policy

In the event of a major disruption of normal university activities, a course continuation contingency plan will be enacted in order to allow completion of the course. During this time, students should continue with the reading and other assignments listed on the syllabus and monitor email, Canvas, and the WFU website for information. If students have questions or are in doubt about how to proceed, they should contact the instructor by email if available, otherwise they should contact by phone.