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Application Summary

Competition Details

Competition Title:	2024Teaching Excellence Award for Online Teaching
Category:	Institutional Awards - CTL
Cycle:	2024
Submission Deadline:	02/9/2024 11:59 PM

Application Information

Application Title:	AJ Medford
Application ID:	11736
Submission Date:	02/9/2024 3:42 PM

Personal Details

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Primary School or Department
School of Chemical and Biomolecular Engineering

Primary Appointment Title:	Assistant Professor

Application Details

Proposal Title
AJ Medford

Nomination of Dr. Andrew (AJ) Medford: CTL 2024 Teaching Excellence Award for Online Teaching

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Georgia Institute of Technology

January 17, 2024

CTL Teaching Excellence Award for Online Teaching

Dear Award Selection Committee:

It is my pleasure to nominate Dr. **Andrew (A. J.) Medford** for the CTL Teaching Excellence Award for Online Teaching. AJ has achieved a level of educational innovation and teaching effectiveness that is astounding for a junior faculty member. He has created new courses, delivered them to great effect, and, together with Dr. Fani Boukouvala, led the launch of a new educational program within chemical and biomolecular engineering at Georgia Tech (ChBE@GT).

A.J. developed one of the first college-wide courses on data analytics for engineers, which he taught in Fall 2018 and 2019. Based on the success of this class, Prof. David Sholl (then Chair of ChBE@GT) asked A.J. to develop ChBE 4765/6765, Data Analytics for Chemical Engineers, which became a foundational course for our new Graduate Certificate for Data Science in the Chemical Industry (DSCI). This has been an exceptionally successful course, being reviewed highly positively by three distinct cohorts: GT undergraduate students, GT graduate students, and professional scientists and engineers in the workforce. Building and delivering an online asynchronous course from scratch and delivering a highly regarded learning experience to such disparate groups is an extraordinary achievement for a junior professor in the first few years of their teaching career. Extending beyond the significant impact made on the students as described by the attached student testimonials, the DSCI program has been an important thought leadership platform for ChBE@GT, as we were the first program in the nation offering a discipline specific program on data science in chemical engineering.

A.J.'s online, asynchronous course, has students ranging from their early 20s to 50 years old and beyond. They come in with mixed familiarity with programming and varied educational backgrounds, yet A.J. managed to create a learning environment where everybody leaves happy, feeling they have learned many new things from their experience. His CIOS teaching ratings for instructor effectiveness are uniformly outstanding – 4.9 was achieved in 4 sections, and 4.8 and 5.0 in one. On the question about stimulating student interest, A.J. has scored consistently in the 4.6 – 4.9 range.

I would argue that this new elective course has been the most impactful new course in ChBE in the last 10 years. It has allowed us to project thought leadership nationally, serve our GT undergraduate and graduate students in new ways on novel, timely course content, and established new relationships with professionals in the workforce through GTPE. A.J. has done a marvelous job in course construction and

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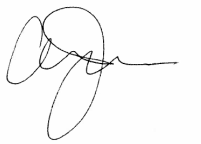
delivery, and our students appear uniformly happy with the course offering. I thus believe that Prof. AJ Medford is an ideal candidate for recognition with the CTL Teaching Excellence Award for Online Teaching, and he has my full endorsement.

Sincerely,



Christopher W. Jones, Ph.D.
John F. Brock III School Chair and Professor
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Reflective Teaching Statement & Innovative Practices

Andrew J. Medford, School of Chemical & Biomolecular Engineering

INTRODUCTION: I was both excited and nervous when my department chair asked me if I would be interested in leading the development of a new online course on data analytics for chemical engineers. Computers are the basis of all of the prior courses I taught and my research, so the idea of teaching an online course was a natural fit for my skills and interests. However, the prospect of reformatting all my teaching materials felt daunting, and I was afraid that losing regular face-to-face interactions with students would decrease engagement. Fortunately, I decided to take on the challenge. The COVID-19 pandemic began in the semester before my first online course, and changed the perspective of online teaching for both students and faculty across campus. Additionally, the "Data Analytics for Chemical Engineers" course I created was one of two core courses in the "Data Science for the Chemical Industry" online certificate program that integrated undergraduate, graduate, and professional education for data science in engineering. The program has been the subject of awards, talks, and publications both on campus and at a national level. I have found that, with the right strategies and tactics, it is possible to keep students engaged with online content. Moreover, leveraging online infrastructure enables new pedagogical tools that can improve the learning experience, especially for topics involving computation and programming.

TEACHING PHILOSOPHY AND APPROACH: One of the main challenges in teaching "Data Analytics for Chemical Engineers" is the wide variety of student experience and skill levels. The course includes three distinct student groups: undergraduate, graduate, and professional education students. In addition, the course requires a technical skillset — programming in the Python language — that is not a formal requirement for any of these student groups. Some students at each level have experience with Python programming, ranging from undergraduates with double-majors in computer science to professionals who lead data analytics groups within their companies. In contrast, some undergraduate students have never written a single line of Python, and some professionals have not taken a programming course in over a decade. Nonetheless, it is my philosophy that the course should provide **all** students with the skills needed to understand and apply analytics models in Python, while also ensuring that **all** students remain engaged and challenged by the course materials.

My approach to meeting the needs of all students is to view the diversity of skills and experience as an asset rather than a deficiency. Allowing and encouraging students to teach and learn from each other helps less experienced students gain the basic skills they need, while challenging more experienced students to gain skills in mentoring and leadership. The ability to create student groups that include working professionals is facilitated by the online nature of the course, and requiring students to regularly engage with their peers also causes the online class to feel more like an in-person course where students can create new social connections. These diverse student groups also work together on self-defined projects based on real-world problems chosen by the graduate and professional education students. These projects ensure that the course content is challenging and relevant for even the most experienced students, while also providing less experienced students with clear examples of how the skills they are learning can be impactful in academic or industrial research. Finally, the use of peer grading of both homeworks and project deliverables allows students to see the different creative ways that problems can be solved, and enforces critical thinking skills required to evaluate analytics models. This approach has led to positive student feedback and even publications that began as course projects, and more details on each strategy are provided below.

GENERAL STRATEGIES FOR ONLINE LEARNING: When designing the online version of my course, I worked closely with experts such as Dr. Fatimah Wirth from GTPE who was instrumental in ensuring that my course followed a number of established strategies for teaching online. For example, lectures were broken into short (10-15) minute segments, each with multiple choice questions to ensure students were watching and reflecting on the content. In addition, the course has numerous weekly office hours to provide students opportunities for direct interactions with instructors, meetings are held virtually to ensure a consistent experience for students regardless of their physical location, and all deadlines are clearly posted on the Canvas page. These established strategies were critical to the success of the course, but I also led the effort to incorporate novel elements not found in other GTPE courses. For example, I independently set up the course Github page to host notes, set up the Vocareum system to facilitate online assessment of coding problems, and incorporated several innovative teaching practices as described below.

Student Comments

- "Medford clearly cares about his students and has created a very effective and positive learning environment despite this course being fully remote (online). His enthusiastic and knowledgeable yet laid back approach to the topics provide an ideal example to encourage students to learn and take ownership."
- "Lectures were well recorded, short enough to not lose your attention span, and well organized on Canvas. Homework and exams really tested what was covered in the lecture slides and notes. Content and structure were great."
- "The course content is extremely well organized, and the course videos are high-quality, perfectly complimented by the detailed Jupyter Notebooks."

COURSE EVOLUTION AND RESPONSIVENESS TO FEEDBACK The course was originally an in-person course in 2018, and has evolved in several key ways to support online education, adapt to the pandemic, and respond to student feedback. The development of the online version of the course started in Fall 2019, so the launch of the online version in Fall 2020 was well-timed to provide students a virtual course offering during the pandemic. Since then, the course has continued to evolve based on student feedback. The most notable change is the style of exams, which were administered as strictly timed with HonorLock proctoring in 2020. This caused significant technical issues and student distress, prompting a transition to unproctored exams in 2021-2022. However, the strict time limit still caused a lot of stress, so the most recent iteration of the course allows students a full 36-hour period to complete the exams. The analysis of the exam results indicated a similar grade distribution, suggesting that the students were following the honor code, and student feedback was positive. Another significant change was combining auto-graded and peer-graded weekly homeworks to address student concerns that there were too many assignments to keep track of. Other minor adjustments to the course include the addition of on-demand office hours and the addition of introductory tutorial videos on Python and Jupyter notebooks.

Student Comments

- "[Medford] also actively worked on effective ways to conduct the exams despite the difficulties associated with distant learning. After accessing the midterm exam, he further improved the final exam platform." (2020)
- "I do not think Vocareum or Honorlock should be used for tests. I think a simple Jupyter notebook would be good for a test setup. Vocareum and Honorlock had the tendency to not work in some capacity for both the midterm and final." (2021)
- "Course Best Aspect: open exams window." (2023)
- "The structure of the course is quite fair, and the flexibility on exam logistics was appreciated (2023)"

INNOVATIVE TEACHING PRACTICES AND ARTIFACTS

Diverse Student Support Groups Students in the course are assigned to a group after the first week. These groups are crafted to maximize diversity in student experience, and typically consist of 2-3 undergraduates, 2-3 graduate students, and 1-2 professional education students. Students are given the option to request one team member based on research interest or professional connections, and other members are assigned semi-randomly to maximize schedule compatibility. Students are required to meet for at least one hour per week with their group, though more frequent meetings are encouraged. The groups work together on the semester-long project, but it is made clear that they are also meant as more general "support groups" where students can ask each other about homework assignments or programming questions. The students also complete bi-weekly "group assessments" that assess the participation, contributions, and professionalism of all group members. These regular assessments ensure that group members participate throughout the course, and the professionalism rubric explicitly sets an expectation that group members should use respectful language when communicating with each other to ensure that groups are inclusive to students regardless of skill level, ethnicity, and gender. The group assessments make up 5 - 10% of the grade for students, ensuring that the group meetings are taken seriously.

Student Comments

- "I liked the balance between graduate students/undergraduate students. Weekly meetings were very helpful with discussing homework and creating an open space for conversation."
- " I think the the group project during the course was a great way to discuss with other students some topics that may have been unclear to me, and that made me better overall in the course."
- "Weekly meeting was really helpful to make the proper plan ahead of time and distribute/discuss about the responsibility among us."

Real World Semester Long Projects The course project forms a core component of the course, and provides students with an opportunity to see how the skills they learn can be applied to a real-world problem. These projects are self-defined, which ensures that they are impactful and interesting for the students, and that they change each semester. The graduate and professional students in the group are ultimately responsible for defining the projects, although the undergraduate students are encouraged to contribute. Ideally, projects draw from the academic research or professional projects of students in the group, which ensures that at least some of the group members are intrinsically motivated to achieve good results. These projects also set the course apart from many other online courses in data analytics where students typically work on generic toy problems that are unrelated to chemistry or chemical engineering. The experience of working with real problems within the domain expertise of the students anchors the course in reality, providing students with the sense that although the course is online, the skills they learn can be applied in real life. The impact of these projects is evidenced by the fact that they have been the basis of one academic publication, with a second in preparation, and that at least one professional education student used their project as the basis for a successful internal company project.

Student Comments

- "I like having the group project. It helped connect the class concepts to the real world."
- "The project was a great experience, especially since I got the opportunity to interact with peers for this asynchronous virtual format."
- "The semester long project was a great opportunity to use concepts taught in lecture and apply them on real world datasets to solve problems. "

Combining Automatic And Peer Grading Weekly homeworks provide students with hands-on experience with the concepts and programming syntax that they see in the lecture videos. The homeworks are organized into "Jupyter Notebooks" which allow for a combination of regular text to define problems and code blocks where students can write their solutions. These assignments are delivered via the Vocareum environment, which minimizes technical challenges associated with different compute environments between students and graders. The Vocareum environment also facilitates novel grading approaches, including auto-grading and peer grading. The homeworks for the course begin with a section of auto-graded problems that are based heavily on examples from the lecture notes. Students can submit each problem to the auto-grader an unlimited number of times, allowing them to get real-time feedback and work out any wrinkles in their understanding of programming syntax. The second section of the homeworks includes a few open-ended problems, where students are asked to apply the techniques from the auto-graded portion to solve specific problems or analyze the characteristics of a data set. These problems do not have a single correct solution, so auto-grading is not an option. Instead, these problems are peer graded by three other students in the course. This experience facilitates scalability in the online environment, but more importantly it gives students an opportunity to see a variety of approaches for solving a problem, and provides them with experience in critically assessing a data analytics model.

Student Comments

- "The [autograded sections] were especially helpful because it gave people who were new to using Python instant feedback as to whether or not they were using it correctly."
- "The style of the assignment, which involves both auto-graded sections and those from my peers, is what I like most about the course. Getting to see others way of thinking and receiving feedback from peers about my work gives another dimension to how best to approach the problems."
- "It is good to have the opportunities to review different groups in each review. The homework peer reviews are a valuable way to learn more concise and elegant coding from others."

Openly Sharing Notes On Github In addition to the official lectures, videos, and assignments posted to Canvas, there is a course Github page (https://github.com/medford-group/data_analytics_ChE) where more detailed notes and coding examples are made available. This provides a reference that students can become familiar with during the class and refer to afterward as they use the techniques in other scenarios. It also provides a great way for prospective students to preview the material and decide whether the course is a good fit for them. The version control available in Github makes it easy to keep notes up to date while also keeping prior versions for reference, which is a powerful capability in a quickly changing field. Additionally, these notes have been used by colleagues at other institutions, expanding the impact of the course beyond Georgia Tech. For example, Prof. Chris Paolucci at the University of Virginia used the notes as the basis for his data analytics course, and noted that students of his course found them useful as well.

Student Comments

- "The project was the best part of the course along with the notebooks on Github which proved to be useful for referencing and studying."
- "Course Best Aspect: The github notebooks."
- "The github page is set up well in order for us to refer the course materials in the future."
- "GitHub code made for easy starting points when writing code for homework. GitHub explanations were very helpful for conceptual understanding."

Supporting Data & Documents

STUDENT FEEDBACK DATA Student feedback is regularly solicited through informal anonymous surveys (midterm and final) and the regular CIOS surveys. Additional feedback is received through direct emails and "Thank A Teacher" notes. Some data and quotes are highlighted here.

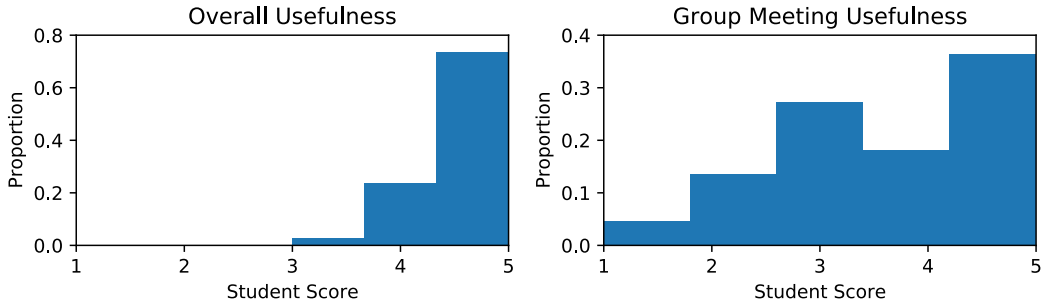

Figure 1.1: Feedback from student survey questions asking students to rate on a scale of 1-5 the "Overall usefulness of the course" (left) and the "Usefulness of regular group meetings" (right). Data compiled from F20 and F21.

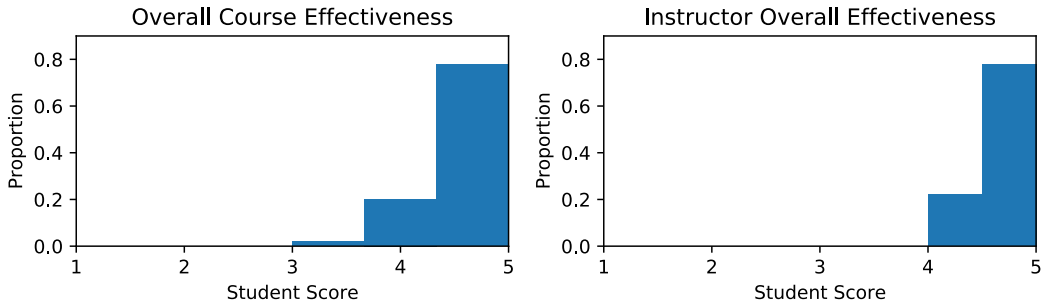

Figure 1.2: Data from CIOS survey for the "Overall course effectiveness" (left) the "Instructor: Overall effectiveness" (right) questions. Data compiled from F20, F21, and F22.

Student Quotes

- "Despite the online format, the course was consistently engaging with a variety of resources for learning and interaction. In some ways I got more out of it than some of the in-person courses I took in the past. Also huge thanks for being available for questions and for setting a great positive tone throughout the semester."
- " The structure and the lectures themselves are top notch, even compared to some of the famous courses out there (such as Machine Learning from Andrew Ng, Stanford). As an ML course tailored to the materials/chemical industry, a lot of the algorithms/tools and examples are introduced and designed for the area which was very helpful."
- "I was extremely impressed by the quality of the lecture notes and the accompanying lecture videos. I think overall the course did a wonderful job walking individuals through learning a new skill set and applying it to a real world application."
- "The asynchronous mode of learning gave me a great deal of freedom in attending classes (video lectures)!"

PROMOTING ONLINE EDUCATION The course has helped promote online education for data analytics in chemical engineering in several key ways:

- An invited presentation at the 2021 meeting of the "American Institute of Chemical Engineers" (AIChE) in a topical session on "Teaching Data Science to Students and Teachers." The presentation was titled "Insights from Teaching Data Analytics for Chemical Engineers." and was attended by approximately 40 people including graduate students, industry professionals, and other faculty members. The presentation is included in the teaching resources hosted by the "Computer Aids for Chemical Engineering" division of AIChE: https://cache.org/teaching-data-science-aiche-2021.
- An invited publication in the "Chemical Engineering Education" journal. The topic of the paper is the full "Data Science for the Chemical Industry" online certificate program, but the "Data Analytics for Chemical Engineers" course and innovative online teaching methods used throughout the program are discussed extensively. Medford is the co-first author of the publication, and an inclusive authorship list was used to attribute credit to the numerous other faculty members, teaching assistants, and professional education experts who made the course and certificate program possible.
- Free and open online notes for the course are available and hosted on Github: https://github.com/medford-group/data_analytics_ChE. These notes have been used by faculty members at other universities who are developing similar courses, including Prof. Chris Paolucci at the University of Virginia, Prof. Bryan Goldsmith at the University of Michigan, and Prof. Zachary Ulissi at Carnegie Mellon University. The notes also provide students with a resource that they can return to after the course is over to review the material at any point.
- Lessons learned from teaching the "Data Analytics" course online inspired Medford to teach his "Big Data & Quantum Mechanics" vertically-integrated project course (https://www.vip.gatech.edu/teams/vvi) online as well. The online format of this research-based course allows integrating professional OMSCS students in the course, online notes are hosted on Github to improve accessibility, and use of peer grading is also leveraged to allow students to critically assess the work of their peers.

SUPPORTING DOCUMENTS

The following additional documents are provided below:

- Excerpts from the course Github page and the second homework assignment. The course Github page shows how students and other educators can easily access the course materials, and the homework excerpts show how "Jupyter notebooks" are used to combine homework questions with code in an integrated format. The exerpts also show how both auto-graded and peer-graded sections are used, and provide a concrete example of how the online format is leveraged to provide an innovative homework experience.
- An abbreviated course syllabus. This document includes the verbatim information provided to students on several innovative online aspects of the course including online lecture notes, peer grading, the course project, group evaluations, office hours, and communication with instructors.

medford-group / data_analytics_ChE Public

Repository for notes and exercises for ChBE 4745/6745 - Data Analytics for Chemical Engineers.

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master

ssahoo41 Initial commit ... 2 weeks ago 1

View code

README.md

Data Analytics for Chemical Engineers (ChBE 4745/6745)

This repository is used for for lecture notes for ChBE 4745/6745 - Data Analytics for Chemical Engineers. The course is organized by modules. Under each module, you will find a Jupyter notebook for specific topics. The modules are:

Numerical Methods - basics of programming, linear algebra, and optimization.

Regression - introduction to non-parametric regression models, hyperparameter optimization, and regression methods for high-dimensional data.

Classification - formalism of classification problems, generalized linear models, and other classification techniques.

Data Management - overview of strategies for data organization and introduction to APIs and online data access.

Exploratory Data Analysis - unsupervised learning techniques including clustering, dimensional reduction, and generative models.

Auto-graded

In this assignment, you will be required to import three external packages (`scikit-learn` , `autograd` , and `scipy`) that were introduced in the lectures and write a few lines of codes with some useful objects in each package. This practice will provide you with an abstract idea of object-oriented programming (OOP). There is no need to know what exactly OOP means, but for the purpose of this course you can think of it as **using programmable "objects" made by others to save time**.

1. scikit-learn (15 pts)

`scikit-learn` is the most popular Python package that provides a plethora of useful functions and objects in machine learning. You will go through a workflow of building a simple regression model using `scikit-learn` . You will need to use this skill a lot to build more complicated models for the rest of the semester.

Let's import the `scikit-learn` package (no alias needed). (2.5 pts)

In [11]:
```
#####################################
# Start your code here
import sklearn
#####################################
```

In [12]:
```
assert sklearn.__version__, "scikit-learn not imported"
```

Simple linear regression can be implemented with `scikit-learn` . First, declare a `LinearRegression` model with a variable name `lr` . (2.5 pts)

In [13]:
```
#####################################
# Start your code here
from sklearn.linear_model import LinearRegression
lr = LinearRegression()
#####################################
```

In [15]:
```
assert type(lr) == sklearn.linear_model.LinearRegression
```

The `LinearRegression` object takes several parameters (or arguments) so that users can easily change the model settings. You can see the details of parameters as well as the model itself in the official documentation. In most cases, `scikit-learn` developers have already set the default value for each parameter. For `LinearRegression` , the `fit_intercept` parameter indicates whether the model will add an intercept column to the input matrix during the training process.

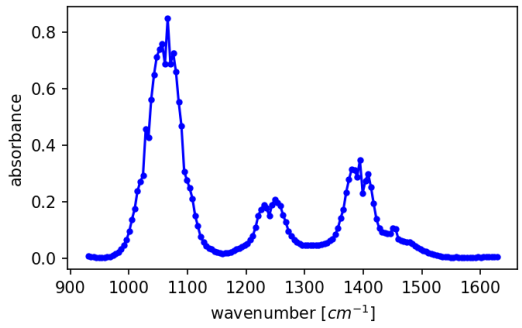
In [36]:
```
#####################################
# Start your code here
res = minimize(g, init_lamda, method = 'L-BFGS-B')
#####################################
```

In [37]:
```
assert np.isclose(np.linalg.norm(res.x), 5612.256072835871)
```

Peer-graded

In this part of the assignment, you will be asked to implement linear regression and nonlinear regression to fit the IR spectrum data with multiple Gaussians.

In [39]:
```
import pandas as pd
import matplotlib.pyplot as plt

df = pd.read_csv('ethanol_IR.csv')
x_all = df['wavenumber [cm^-1]'].values
y_all = df['absorbance'].values

x_peak = x_all[100:250]
y_peak = y_all[100:250]

fig, ax = plt.subplots(figsize = (5, 3), dpi = 150)
ax.plot(x_peak, y_peak, '-b', marker = '.')
ax.set_xlabel('wavenumber [$cm^{-1}$]')
ax.set_ylabel('absorbance');
```

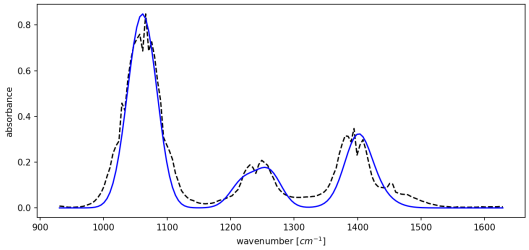


1. Gaussian Features

Repeat the gradient descent with 7 Gaussians. Print the weights.

In [60]:
```
def loss(lamda, X, y, N):
    y_i = np.zeros(len(y))
    for i in range(N):
        y_i += lamda[i] * np.exp(-(X-lamda[i+N])**2 / 2 / lamda[i+2*N]**2
    return ((y - y_i)**2).mean()

def g(lamda, X = x_peak, y = y_peak, N = 7):
    return loss(lamda, X, y, N)

diff_g = grad(g)

def grad_descent(lamda, diff_g, h, tol):
    err = np.inf
    current_lamda = lamda
    while err > tol:
        new_lamda = current_lamda - h * np.array(diff_g(current_lamda))
        err = np.linalg.norm(current_lamda - new_lamda)
        current_lamda = new_lamda

    return new_lamda
```

In [61]:
```
init_lamda = init_lamda = np.array([0.6, 0.7, 0.3, 0.3, 0.3, 0.3, 0.3, 10
opt_lamda = grad_descent(init_lamda, diff_g, 0.1, 0.0001)

y_hat = np.zeros(len(y_peak))
for i in range(7):
    y_hat += opt_lamda[i] * np.exp(-(x_peak-opt_lamda[i+7])**2 / 2 / opt_

fig, ax = plt.subplots(figsize = (10, 4.5), dpi = 150)
ax.plot(x_peak, y_peak, '--k')
ax.plot(x_peak, y_hat, '-b')

ax.set_xlabel('wavenumber [$cm^{-1}$]')
ax.set_ylabel('absorbance');
```



As the number of Gaussians taking place in nonlinear regression increases, it is more likely to have some negative weights as a result. However, we want our results to be

Abbreviated Syllabus for Data Analytics for Chemical Engineers

Aspects related to innovative online teaching practices are highlighted

Lecture Notes

The lecture notes for the course are presented in Jupyter Notebooks. The notes are available via Github: https://github.com/medford-group/data_analytics_ChE. Lecture notes will be continuously updated throughout the course so please check back regularly.

Peer Reviews

The goals of peer reviews are (1) to show you multiple different routes to solving open-ended problems, and (2) to give you multiple perspectives on how you choose to solve a problem. Please keep all feedback constructive and professional. Peer reviews for homeworks will use the built-in functionality of Vocareum (where assignments are hosted), and for the project milestones we will use the Peer Feedback tool for assigning peer reviews the course project. You will find the peer review assignments at http://peerfeedback.gatech.edu/ after logging in with your Georgia Tech account. For a guide to using this tool, check out https://www.youtube.com/watch?v=paLMTpUfC4o. The look of the interface will look different than it looked in this video, but the functionality is similar. After logging in, you will find a list of tasks to complete, including the feedback you should provide. Read through the assignment, then complete the rubric, write your feedback, and click to submit your feedback. The feedback will be available to the recipient, the instructor and all the reviewers of that assignment. Note that we will utilize an AI tool to evaluate the quality of peer feedback, and you will not receive credit for feedback that the AI is 95% confident is not substantiative, or if your feedback is overly negative, non-constructive, or unprofessional. If you receive feedback you feel is inappropriate, or disagree with the AI assessment, let an instructor know and we will review it.

Assessments

- Knowledge Checks - Multiple choice questions checking knowledge retention from lecture videos.
- Group Assessment - Evaluation of participation with your group, based on attendance of group meetings and participation at the end of each module.
- Homeworks – Homeworks will have two sections: “skill checks” and “open ended” questions. The skill check questions will be auto graded programming exercises focused on completing basic programming tasks, and they can be repeatedly submitted to the auto-grader to ensure that they are correct. The open-ended questions will be peer-graded math and programming exercises focused on extending lecture materials to new problems or data sets. 90% of the homework score will be based on the average of the auto+peer grades, and 10% will be awarded for completion of peer grading of other students.
- Midterm and Final Exams – Midterms and final exams will consist of a mix of problems similar to homeworks (auto-graded and open ended) and will be graded by instructors.

- Final Project – Semester-long project for developing a data analytics model for a self-defined dataset. The final project will be graded based on the following breakdown. More details/guidelines will be provided for each assignment and are subject to change.
    - 10% - Project proposal (6745 only): ~1-page description of dataset and project goals
    - 10% - Data preparation: Dataset ready for analysis (no missing values, etc.)
    - 15% - Baseline model: Simple model evaluated with an appropriate assessment metric.
    - 15% - Improved model: More accurate or efficient model with assessments.
    - 10% - Report draft: Draft of ~5 page project report detailing approach and results.
    - 25% - Final Report: Finalized version of project report.
    - 15% - Final Presentation: 10-minute presentation recorded and uploaded.

      Note: Some parts of the project will be due before a topic is covered in the course (e.g. data preparation). You may revise your strategies after we cover a topic in the course, but should be able to establish a simple strategy before a topic is covered.

Attendance Policy

- You will have a group that you are expected to interact with on a weekly basis. The core of the "Group Evaluation" portion of your grade will be related to your attendance of group meetings and participation.

Office Hours

- Office hours will be held by the TA and instructor on a weekly basis. Office hours will be scheduled after an availability poll for the class.
- An online sign-up sheet will be available to sign up for 10 minute slots during each office hour. This can be used to ensure that you will get at least 10 minutes of time dedicated to your question.
- Students may drop into office hours at any point regardless of whether they have signed up, but priority will be given to students who have signed up. Other questions will be answered on a first come, first serve basis.

Communication

- Please contact your instructor, teaching assistants, and fellow learners via the Piazza discussion forums for any content or conceptual questions. Often, discussions with fellow learners are the sources of key pieces of learning.
- All questions regarding homework problems or course concepts should be posted publicly to Piazza in the appropriate thread. Private messages should be reserved for individual matters. Private messages about general course questions will be redirected to the public thread.

Andrew J. Medford

Assistant Professor
Georgia Institute of Technology
School of Chemical & Biomolecular Engineering
ES&T L1222 ‖ (404)385-5531 ‖ ajm@gatech.edu

Education

Stanford University

- *Doctor of Philosophy* - Chemical Engineering (Sept. 2015)
- *Master of Science* - Chemical Engineering (Sept. 2014)

North Carolina State University

- *Bachelor of Science* - Textile Engineering (May 2009)

Professional Positions

Georgia Institute of Technology

- *Associate Professor* - School of Chemical & Biomolecular Engineering (Aug. 2023 - Present)
- *Assistant Professor* - School of Chemical & Biomolecular Engineering (Jan. 2017 - Aug. 2023)

Georgia Institute of Technology

- *Postdoctoral Researcher* - School of Mechanical Engineering (Oct. 2015 - Jan. 2017)

Selected Awards and Honors

- ACS CATL Division Early Career Award (2023)
- Georgia Tech Center for Teaching and Learning (CTL) Teaching Honor Roll (2023)
- Georgia Tech Curriculum Innovation Award (co-winner, 2022)
- AIChE "35 under 35" Award (2020)
- Georgia Tech CTL/BP Junior Faculty Teaching Excellence Award (2020)
- NSF CAREER Award - CBET Catalysis (2020)
- Sigma Xi Scientific Research Honor Society (2020)
- AFRL Materials Science and Engineering Data Challenge Grand Prize Project (May 2016)
- Outstanding Teaching Assistant Award (June 2012)
- National Defense Science and Engineering Graduate Research Fellow (September 2012 - September 2015)
- National Science Foundation Graduate Research Fellowship (August 2010 - September 2012)
- National Science Foundation Nordic Research Opportunity (July 2012 - September 2012)
- Department of Energy Computational Science Graduate Research Fellowship (2012 - Could not Accept)
- J. William Fulbright Fellowship - Risø National Labs, Denmark (August 2009 - June 2010)

Memberships and Activities

- Organized "Open-Source Software in Chemistry" ACS "Convergent Research Community" (Fall 2022 & 2023 meetings)
- Member of ChBE Diversity, Equity, and Inclusion committee (2021 - 2022)
- Co-organizer for "Complexity in Catalysis" session at ACS meeting (2021)
- Initiated "Data Science in Catalysis" and "Catalysis for Nitrogen Chemistry" sessions at AIChE meeting (2018, 2019)
- Chair of departmental IT committee (2019 - 2022) and institute HPC (PACE) advisory committee (2020 - 2021)
- Led development of "Materials Informatics 101" workshop (Sept. 2019, Oct. 2021)
- Organized "Data Carpentry" and "Software Carpentry" workshops (June 2018, May 2019)
- Serve-Learn-Sustain Energy Systems for Sustainable Communities Fellow (Fall 2017)
- Speaker at local AIChE chapter meeting (2017)
- ASEE Chemical Engineering Education Summer School Participant (2017)
- ChBE Graduate Recruiting Weekend Committee (2017-2019)
- American Institute of Chemical Engineers Member (2013 - Present)
- American Chemical Society Member (2017 - Present)
- Southeastern Catalysis Society Member (2017 - Present), Interim Secretary (2021), Webmaster (2018), local planning co-chair (2018, 2021, 2023)

Teaching Experience

ChBE 4745/6745 - Data Analytics for Chemical Engineers
Georgia Institute of Technology - Spring 2020, Fall 2020, Fall 2021, Fall 2022, Fall 2023

COE 3803 - Data Analytics for Engineers
Georgia Institute of Technology - Fall 2018, Fall 2019

ChBE 2120 - Numerical Methods
Georgia Institute of Technology - Fall 2017, Spring 2019, Spring 2022, Spring 2023

ChBE 4803/8803 - Advanced Data Analysis for Chemical Engineers
Georgia Institute of Technology - Spring 2018

VIP - Big Data & Quantum Mechanics (vertically-integrated research course)
Georgia Institute of Technology - Spring 2017 - Present

Selected Publications

- ☐ Total Publications: 82
- ☐ H-Index: 43 (Google Scholar)
- ☐ Total Citations: 8,554 (Google Scholar)

Corresponding or Leading Author with Georgia Tech Affiliation

24. "Model-based design of temporal analysis of products (TAP) reactors: A simulated case study in oxidative propane dehydrogenation"
A. C. Yonge, G. S. Gusmão, R. Fushimi, A. J. Medford
Industrial & Engineering Chemistry Research Accepted (2024)

23. "Maximum-likelihood Estimators in Physics-Informed Neural Networks for High-dimensional Inverse Problems"
G. S. Gusmão, A. J. Medford
Computers & Chemical Engineering 181 (2024)

22. "Formation of carbon-induced nitrogen-centered radicals on titanium dioxide under illumination"
P.-W. Huang, N. Tian, T. Rajh, Y.-H. Liu, G. Innocenti, C. Sievers, A.J. Medford, M. C. Hatzell
JACS Au (2023)

21. "Screening and discovery of metal compound active sites for strong and selective adsorption of N_2 in air"
N. Tian, B. M. Comer, A. J. Medford
ChemSusChem, e202300948 (2023)

20. "AmpTorch: A Python package for scalable fingerprint-based neural network training on multi-element systems with integrated uncertainty quantification"
M. Shuaibi, Y. Hu, ... A.J. Medford, Z. Ulissi
Journal of Open Source Software 8 (2023)

19. "Online Graduate Certificate in Data Science for the Chemical Industry"
A.J. Medford, F. Boukouvala, *et al.*
Chemical Engineering Education 56 (2022)

18. "Robust and scalable uncertainty estimation with conformal prediction for machine-learned interatomic potentials"
Y. Hu, J. Musielewicz, Z. Ulissi, A. J. Medford
Machine Learning: Science and Technology In Press (2022)

17. "Quantifying the impact of temporal analysis of products reactor initial state uncertainties on kinetic parameters"
A. Yonge, G. S. Gusmão, R. Batchu, M. R. Kunz, Z. Fang, R. Fushimi, A. J. Medford
AIChE Journal 68 pp. e17776 (cover article) (2022)

16. “Gaussian Approximation of Dispersion Potentials for Efficient Featurization and Machine Learning Predictions of Metal-Organic Frameworks”
S. Choi, D. S. Sholl, A. J. Medford
J. Chem. Phys. 156 pp. 214108 (2022)

15. “A Career in Catalysis: Jens Kehlet Nørskov”
A. J. Medford, P. G. Moses, K. W. Jacobsen, A. A. Peterson
ACS Catal. 12 pp. 9679-9689 (2022)

14. “A Universal Framework for for Featurization of Atomistic Systems”
X. Lei, A. J. Medford
J. Phys. Chem. Letters 13 pp. 7911-7919 (2021)

13. “Kinetics-Informed Neural Networks”
G. S. Gusmao, A. P. Retnanto, S. C. da Cunha, A. J. Medford *Catalysis Today* In Press. (2022)

12. “Ab-initio investigation of finite size effects in rutile titania nanoparticles with semilocal and nonlocal density functionals”
S. J. Sahoo, X. Jing, P. Suryanarayana, A. J. Medford *J. Phys. Chem. C* 126, 4, pp. 2121–2130 (2022)

11. “TAPsolver: A Python package for the simulation and analysis of TAP reactor experiments”
A. Yonge, M. R. Kunz, R. Batchu, Z. Fang, T. Issac, R. Fushimi, A. J. Medford *Chemical Engineering Journal* 420 pp. 129377 (2021)

10. “Application of Density Functional Tight Binding and Machine Learning to Evaluate the Stability of Biomass Intermediates on the Rh (111) Surface”
C. Chang, A. J. Medford *J. Phys. Chem. C* 125 pp. 18210–18216 (2021)

9. “Classification of biomass reactions and predictions of reaction energies through machine learning”
C. Chang, A. J. Medford *J. Chem. Phys.* 153 (4) pp. 044126 (2020)

8. “Computational Study of Transition-Metal Substitutions in TiO_2(110) for Photoelectrocatalytic Ammonia Synthesis”
B. M. Comer, M. H. Lenk, A. P. Rajanala, E. L. Flynn, A. J. Medford *Catalysis Letters* (2020)

7. “ElectroLens: Understanding Atomistic Simulations through Spatially-Resolved Visualization of High-Dimensional Features”
X. Lei, F. Hohman, D. H. Polo Chau, and A. J. Medford, *IEEE Visualization Conference (VIS)* 2019

6. “Prospects and Challenges for Solar Fertilizers”
B. M. Comer, C. O. Dimkpa, Y.-H. Liu, C. A. Fernandez, P. Arora, M. Realff, U. Singh, M. C. Hatzell, A. J. Medford *Joule* 3 pp. 1578-1605 (2019)

5. “Design and analysis of machine learning exchange-correlation functionals via rotationally invariant convolutional descriptors”
X. Lei, A. J. Medford, *Physical Review Materials* 3 (6) 2019

4. “The Role of Adventitious Carbon in Photo-catalytic Nitrogen Fixation by Titania”
B. M. Comer, Y.-H. Liu, M. B. Dixit, K. B. Hatzell, Y. Ye, E. J. Crumlin, M. C. Hatzell, A. J. Medford *Journal of the American Chemical Society* 45 pp. 15157-15160 (2018)

3. “Extracting Knowledge from Data through Catalysis Informatics”
A. J. Medford, M. R. Kunz, S. M. Ewing, T. Borders, R. Fushimi *ACS Catalysis* 8 pp. 7403-7429 (2018)

2. “Analysis of photocatalytic nitrogen fixation on rutile TiO_2 (110)”
B.M. Comer, A. J. Medford *ACS Sustainable Chemistry & Engineering* 6 pp. 4648-4660 (2018)

1. “Photon-driven Nitrogen Fixation: Current Progress, Thermodynamic Considerations, and Future Outlook”
A. J. Medford, M. C. Hatzell *ACS Catalysis* 7 pp. 2624-2643 (2017)

Georgia Institute of Technology

January 28, 2024

Dear CTL Awards Committee,

I strongly endorse ChBE's nomination of Andrew Medford for Georgia Tech's CTL Teaching Excellence Award for Online Teaching. I am a professor in the School of Chemical & Biomolecular Engineering and Associate Chair for Graduate Studies in ChBE. In this latter role I am also the administrator for ChBE's Online Graduate Certificate in Data Science for the Chemical Industry. My research area is in process control for materials processing, so I also have substantial overlap intellectually with Prof. Medford's research in computational materials science and machine learning. I am thrilled that he has been able to achieve this curriculum innovation in strong synergy with his research program.

Shortly after arriving at Georgia Tech, Prof. Medford took the initiative to develop a new undergraduate elective class in the area of data analytics for chemical engineers. It filled such a need and demand that he then began collaborating more broadly with the College of Engineering to develop a course in data analytics for engineers. Although at the time I did not have an administrative role regarding teaching assignments, I remember being impressed that he would take on this leadership as an junior assistant professor. He clearly had a vision and passion for how topics such as data science and machine learning should be integrated into the engineering curriculum.

In 2019 I took on the role of ChBE's Associate Chair for Graduate Studies. This was the period when ChBE was preparing to launch the Online Graduate Certificate in Data Science for the Chemical Industry (DSCI). The program is designed for working professionals in the chemical industry to learn data analytics, so that they can bring these skills back into their projects and companies. Prof. Medford teaches the first of two ChBE core courses: ChBE 4745/6745: Data Analytics for Chemical Engineers. Building on the successful curriculum development in his undergraduate elective course, Prof. Medford built this cross-listed undergraduate and graduate course, adapted to a fully online and asynchronous format for the graduate certificate program.

While the DSCI program was initially designed and conceived for working professionals in the chemical industry, we have also made it available to our "in-residence" students on the Atlanta campus, both undergraduate and graduate. Most students are in ChBE, but we also have students from other majors such as MSE, ME, and Chemistry, providing a helpful diversity for group projects. Moreover, the working professionals have started recruiting our in-residence students actively for internships and full-time positions. The course is limited in size, due to the "hands-on" focus of this asynchronous course (i.e. it is not a massive open online course), and every semester I have to manage the high demand amongst our students for limited spots (a good problem to have!).

School of Chemical & Biomolecular Engineering
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Georgia Institute of Technology

In November 2021, I co-organized a series of sessions at the American Institute for Chemical Engineers (AIChE) Annual Meeting in Boston, on "Teaching Data Science to Students and Teachers" [1] where Prof. Medford gave a talk entitled "Insights from Teaching Data Analytics for Chemical Engineers."[2] Working with him to support his preparation for the talk and then seeing it delivered, I was impressed by his thoughtful and reflective approach to his teaching. In his talk, he showed that, while limited, the early assessment shows many positives, to Prof. Medford's credit. Notably, the external students indicated that they were happy about their amount of interaction with the instructor. They expressed they would like more interaction with their classmates, and he shared ideas for how he was already promoting classmate interaction. I remember that an audience member from 3M raved about how valuable the course and certificate program was to her company. We were thrilled that she choose to share her positive experience from the corporate perspective. I do believe that this very unique venue to bring together working professionals with our in-residence students is valuable to all participants, and I give the credit to Prof. Medford to building this foundational course in the program. While biased, I also believe it was clear to the audience members that Prof. Medford gave by far the best presentation among the 16 presenters in the program. Not only was he ahead of the others in his vision for the field, but also he had assessment data to share and to reflect upon, giving unique insights to the community on how they can think about building their own curricula for data analytics in chemical engineering.

The program launched its first cohort in Fall 2020, which was an extremely challenging time for all. However, Prof. Medford had already laid the groundwork and begun recording videos and I am so grateful that he was able to develop the material, including the production of the recorded content, throughout the first half of 2020, to give us a strong launch of the program with his core course first in the fall semester of 2020.

Thank you for your consideration of Professor Andrew Medford for Georgia Tech's CTL Teaching Excellence Award for Online Teaching. I cannot think of a more deserving candidate.

Sincerely,

Martha Grover

Martha Grover

Professor and Associate Chair for Graduate Studies

School of Chemical & Biomolecular Engineering

[1] https://cache.org/teaching-data-science-aiche-2021
[2] https://cache.org/sites/default/files/506b_2021TeachingDataScience_Medford.pdf

School of Chemical & Biomolecular Engineering
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Phone: 404.894.2878

February 2, 2024

Dear CTL Awards Committee,

It is with great pleasure that I am writing this letter supporting the nomination of Dr. AJ Medford for the CTL Teaching Excellence Award for Online Teaching. I was enrolled in his Data Analytics for Chemical Engineers course (ChBE 6745) during Fall 2022, and in many respects could not have anticipated how beneficial it has been for my graduate research.

Dr. Medford's teaching style is perfect for students like me who do not have much of a data science background but are interested in learning and applying machine learning (ML) techniques. Firstly, I appreciate that the course notes were well organized on his website. Secondly, the course Python scripts were made publicly available, which decreased the learning curve for students with less coding experience. In addition, the peer-grading component of the class gave us additional exposure to other students' approaches to problem-solving, particularly on the programming side. While the course's sample problems were targeted for chemical engineers, I never felt out of my depth; Dr. Medford did well in making the content accessible to students from other engineering disciplines. Furthermore, I commend his approach in simplifying the mathematical rigor behind some of the ML methods. He instead made the priority to understand the strengths and limitations of the ML techniques used to solve various problems.

My favorite aspect of the class was the group project. Although it was an online course, Dr. Medford successfully promoted student engagement in various ways (e.g., Piazza forum), the most effective one being a semester-long group assignment. Every week 6 – 8 students met to define a data analytics problem and try to solve it. For this project, my group's objective was to develop a semi-supervised ML approach for characterizing material effects encoded in a multidimensional dataset. I enjoyed working with peers who had technical expertise that was much different from mine. The outcome of our efforts served as the basis for a research article, which is now an integral component of my graduate thesis. Dr. Medford also played an essential role in the success of the group project through his guidance during office hours, as well as the valuable feedback that he provided in our interim reports.

Overall, I had a great experience in ChBE 6745 and I would highly recommend it to any graduate student looking for an introduction to data science and ML. Despite the online format, Dr. Medford incorporated features that not only promoted student engagement, but also offered an opportunity for collaboration on solving real-world problems. In my case, it has tremendously pivoted the remaining studies of my graduate research and encouraged me to take additional ML courses for my minor field of study. Most importantly, I have expanded my skill set with analytical tools that complement my mechanical engineering background, thus making me more confident in my future career prospects in industry. For these reasons, I truly believe that he is worthy and deserving the CTL Teaching Excellence Award for Online Teaching.

Sincerely,

Kevin Ligonde
Ph.D. Candidate
GEM Fellow
G.W. Woodruff School of Mechanical Engineering
Georgia Institute of Technology

Dear members of the award committee,

I am writing to express my wholehearted support for Professor AJ Medford in their pursuit of the Teaching Excellence Award for Online Teaching. As a student in Dr. Medford's Data Analytics for Chemical Engineers course, I have had the privilege of learning from Dr. Medford in an online setting, and I can confidently say that they are an exceptional educator who truly cares about their students.

The Data Analytics for Chemical Engineering course is very dense, with 14 homework assignments, quizzes, and exams. What truly sets Dr. Medford apart is their caring and compassionate approach to teaching. He has always been supportive of the needs of their students during the course, going above and beyond to ensure that all students feel heard and valued. What makes the difference is that Dr. Medford is understanding and solution-oriented when teaching students with different backgrounds. During his weekly office hours, he was able to break down the material so well that a while an undergraduate student who is relatively new to coding and statistics understands the information, the graduate students with +5 years of experience were also learning and engaging.

In addition to creating an engaging learning environment, Dr. Medford has effectively achieved the desired learning outcomes for the course. Through his clear and concise explanations, real-world examples, and virtual office hours, I developed a deep understanding of the material. I apply the knowledge and skills learned in the class to my research.

I feel fortunate to have had the opportunity to learn from Dr. Medford in an online setting. Although I followed the entire course from a screen, I have experienced something that I haven't experienced much in my studies in GaTech. Dr. Medford is one of the rare faculty members who care about the teaching part of academia. We all love research, but after taking many courses from top researchers in GaTech I appreciate Dr. Medford's approach to teaching. Dr. Medford's ability to adapt and excel in an online environment while effectively achieving the desired learning outcomes and showing genuine care and compassion for their students is a testament to their commitment to student success and their expertise in teaching. I wholeheartedly believe Dr. Medford is a great candidate for the Teaching Excellence Award for Online Teaching. I know from experience that Dr. Medford will continue to positively impact the GaTech community.

Sincerely,

Kumru Kocaman

Graduate student in Civil and Environmental Engineering

Dear CTL Awards Committee,

I am writing this letter in enthusiastic support of Dr. AJ Medford's nomination for the Teaching Excellence Award for Online Teaching at Georgia Tech's Center for Teaching and Learning. Having had the privilege of being a student in Dr. Medford's Data Analytics for Chemical Engineers class, I can attest to his exceptional commitment to online teaching, dedication to student success, and continuous efforts to enhance the learning experience.

Dr Medford's, Data Analytics for Chemical Engineers, served as my inaugural exposure to Python, my first experience with online education, and an introduction to data analysis that surpassed the conventional statistics and regression fitting often found in undergraduate engineering classes. His unwavering encouragement and assistance in navigating the challenges posed by these novel experiences showcased his profound commitment to his students. The course itself, a masterful amalgamation of analytics, engineering fundamentals, and the intricate application of data-driven methods in an industry entrenched in scientific principles, fueled my desire to delve deeper into the subject. It played a pivotal role in my decision to pursue an Online Master of Science in Analytics, extending beyond the Graduate Certificate in Data Science for the Chemical Industry for which I initially attended Georgia Tech.

Even after completing his course, Dr. Medford has actively supported and maintained communication with me, demonstrating a genuine interest in my academic and professional progress. This outreach goes beyond the virtual classroom, creating a supportive and encouraging environment that extends beyond the confines of traditional student-teacher relationships.

Furthermore, Dr. Medford has demonstrated an exceptional receptiveness to feedback, proactively seeking input not only on the graduate certificate program but also on his course content and teaching methods. In personal meetings with Dr. Medford, I had the opportunity to provide feedback regarding the graduate certificate program, his course content, and teaching methods. His responsiveness during these discussions was particularly noteworthy, reflecting a genuine openness to constructive input. This commitment to actively seeking, listening, and adapting based on feedback underscores his dedication to continuous improvement and his unwavering aspiration to deliver the optimal learning experience for his online students.

In conclusion, Dr. AJ Medford is an exemplary candidate for the Teaching Excellence Award for Online Teaching. His dedication to fostering student success, commitment to quality online teaching, innovative practices, and openness to feedback make him a truly outstanding educator. I wholeheartedly support Dr. Medford's nomination and believe that his contributions to online education deserve recognition.

Sincerely,

Lisa Reisenauer

Sr Technology Manager
Technical Expertise & Support (TES)
The Dow Chemical Company
ldreisenauer@dow.com

Jason Yao
jasonyao@andrew.cmu.edu | (713) 918-9648
1927 Murray Ave. Apt 27 | Pittsburgh, PA 15217

January 27, 2024

Dear CTL Awards Committee:

I am a Georgia Tech alumnus recently graduated with a B.S. in Chemical and Biomolecular Engineering and minor in Computing and Intelligence, currently pursuing a PhD in Chemical Engineering at Carnegie Mellon University. Having had the opportunities to learn from him through class and for research, I think that Dr. Medford is without a doubt one of the best professors I have had at Georgia Tech, and a major positive influence to my undergraduate education.

My first class with Dr. Medford was during the peak of the COVID-19 pandemic, working from home. During this time, it is easy to say that I learned the most from ChBE 4745, Data Analytics for Chemical Engineers, out of all my distance learning classes. Video recordings and knowledge check quizzes gave me the flexibility of learning in my own time zone, and participation in peer-grading and a group project allowed me to actively interact with many other students online. It was also exciting for me to find the project involved working with graduate students and those from industry, who brought with them a wide range of expertise and interests. What I was most impressed by was the quality of online resources Dr. Medford provided us with through videos, reading suggestions, and lecture notes in his Github repository. On multiple occasions, I have recommended these resources to friends and underclassmen interested in learning Data Science.

Along with innovating in online education, Dr. Medford is a very caring instructor who has helped me grow as a chemical engineer while discovering new aspects to my interests in computing. He was extremely sympathetic about challenges in learning new software and programming languages, starting from the basics and holding extra sessions for complete beginners needing help, but also incorporated challenging problems into the coursework to allow more advanced programmers to thrive. Additionally, he was actively involved in facilitating students' learning through weekly office hours, detailed and insightful comments on our project's progress, and using student feedback to directly improve the class. Later on, my interactions with him doing research in his Big Data and Quantum Mechanics VIP inspired me to pursue graduate studies in computational chemical engineering.

In summary, the quality of education at Georgia Tech has benefited greatly from Dr. Medford's contributions. His work in creating Data Science classes for chemical engineers bridged a gap between my major and minor curriculum and made me excited to learn more in both fields, and his passion for teaching and learning have inspired and influenced my career trajectory. As such, I strongly recommend Dr. Medford for the 2024 GT CTL Teaching Excellence in Online Teaching Award.

Sincerely,

Jason Yao