Professional Evaluation and Growth Plan, 2017

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October, 2017

Contents

1 Introduction **1**

2 Teaching **1**
- 2.1 Teaching Philosophy 1
  - 2.1.1 What is Applied Mathematics 1
  - 2.1.2 Teaching Mathematics: Active Learning and the Moore Method 1
- 2.2 Teaching Evaluations 3
  - 2.2.1 Math 079 Fall 2015 and Spring 2016 3
  - 2.2.2 Math 350 Fall 2016 7
  - 2.2.3 Math 354 Fall 2015 8
  - 2.2.4 Math 345A Spring 2017 9
  - 2.2.5 Math 141A, Spring 2016 11
  - 2.2.6 COSC 120, Fall 2016 (sections 1 and 2) 13
  - 2.2.7 COSC 220, Spring 2017 15
  - 2.2.8 INTD 100, Fall 2015 17
  - 2.2.9 COSC 190 (CON1 Pairs Course), Spring 2017 20
  - 2.2.10 Courses Not Recently Taught 23
- 2.3 Trends in Evaluations 23
- 2.4 Current and Future Courses 24
  - 2.4.1 Current Courses 24
  - 2.4.2 Future Courses: Paired Course and Machine Learning Course 25
- 2.5 Teaching Growth 25

3 Scholarship **25**
- 3.1 Point Cloud Surface Reconstruction 26
- 3.2 Face Tracking via Convexified Segmentation 26
- 3.3 Shape Prior Image Segmentation and Disocclusion 27
- 3.4 Non-Convex Optimization with Applications to Segmentation and Tracking 27
- 3.5 Journal Referee 29
- 3.6 Presentations 29
- 3.7 Undergraduate Research 30

4 Advising **30**
- 4.1 First Year Pairs Advising 30
- 4.2 Trends in Advising 30
- 4.3 Letters of Recommendation 31

5 Service **31**
- 5.1 Committee Work 31
- 5.2 Other College Service 31
- 5.3 Department Service 32

6 Closing Remarks **32**

A Appendices **33**
A.1 Additional Figures 33
A.2 Math 345A Spring 2015 35
A.3 Math 242 Spring 2014, Spring 2015 37

1 Introduction

I am a sixth-year, tenure-track Assistant Professor in the Department of Mathematics at Whittier College. I completed my Ph.D. in applied mathematics in 2006 at UCLA specializing in mathematical image processing and computer vision. I held a one-year postdoctoral assistant professor position at the University of Michigan at Ann Arbor from 2006-2007, a two-year adjunct assistant professor position at UCLA from 2007-2009, and a three-year postdoctoral scholar position at UC Irvine (UCI) from 2009-2012. In my final year at UCI, my position became an associate research scientist level V. I also hold both a Masters degree and a Bachelor's of Science degree in mathematics from UCLA.

2 Teaching

2.1 Teaching Philosophy

My teaching philosophy lies in vertical integration of mathematical subject matter and active learning. My goal is to get students to understand mathematics at a multitude of levels stemming from the theoretical level to the computational level and finally the connection of these two to the level of applications. If a student is able to understand these connections and internalize the mathematics at each level, then they have achieved mastery.

2.1.1 What is Applied Mathematics

Applied mathematics is a branch of mathematics that is in essence the mathematics of application. Applied mathematicians work in a wide range of areas like technology, business, and science. They engage in diverse fields like optimization, game theory, and numerical analysis to name a few. Applications are numerous and can include many real world problems like those related to weather prediction, image processing, medical applications, and even artificial intelligence. There is a broad range in applied mathematics. On one side, there is more theoretical or pure mathematics (the theoretical nature of differential equations and functional analysis are two that come to mind), while on the other lies entirely computational and application driven subjects that lean more towards the engineering spectrum. One of the things that I enjoy the most about my field is the vast opportunity in this range for interesting work and also the impact that it has on far reaching real world applications.

2.1.2 Teaching Mathematics: Active Learning and the Moore Method

Active learning can be defined as a more 'hands on approach' to learning. It places more emphasis of learning on the learner themselves through active participation. This differs greatly from a passive learning style which usually involves a more lecture oriented format in the classroom. Since dabbling with active learning throughout my career, I took the plunge and attended an MAA PREP workshop on Inquiry Based Learning (IBL) at UCSB in the spring of 2012. Practitioners of IBL are essentially disciples of the Moore Method which was originally developed by the Topologist R.L. Moore who pioneered the use of this guided discovery approach to learning mathematics. In general, math is not a spectator activity, it must have active participation for the methodologies and concepts to be internalized. A couple of quotes that summarize this philosophy are as follows:

> "I hear, I forget. I see, I remember. I do, I understand." (Chinese proverb)
>
> "That student is taught the best who is told the least." R.L. Moore, quote

For the most part, Moore method is nearly 100% discovery based only, with minimal direction given. Modern practitioners of the Moore method (what is called IBL) follow the same methodology but use questions or inquiries to guide a student to the answer of a particular problem. I have found this method to keep students much more actively engaged in my classrooms and also to have the advantage over passive learning in that students gain the micro calibration skills necessary to solve mathematical problems.

My course style involves minimal lecturing as needed and modified Moore method. A typical class day would include me initially spending 10-15 minutes answering questions on HW and I would then give them a general overview of the new concept for the day. After that, I would administer active learning worksheets to the class and would then break the students up into small groups of 2-3 students. The students would work on the exercises from the worksheet while I would walk around and check on each of the groups progress, asking them questions on their approach and methodology to solving a problem. Often, students would present their results on the board. This inquiry based learning method is extremely effective in engaging the students in the material and actively working through problems. The students learn the micro-calibration required to solving difficult math problems which translates to being able to solve an entire range of problems regardless of variability. One of the most difficult parts of this approach is the "holding back" where I allow the student to make the mathematical discovery on their own. Only my tactful inquiries about the problem at hand are used to guide them through this approach.

In general, I have found that this style of teaching is quite a bit more difficult than lecturing since I have to calibrate and adjust my inquiries to the given stage that a student is at while they are working on a problem or discovering a concept. Learning is not so much a linear process, especially in mathematics, but a dynamic back and forth process of analysis, synthesis, and evaluation. Nonetheless, the retention of knowledge from utilizing this approach has been scientifically shown to be increased greatly versus a passive style[1]. Recent reports by the United States President's Council of Advisors on Science and Technology (PCAST) have deduced that active learning approaches increase student retention and improve performance in STEM courses. From first-hand knowledge, I concur with their findings.

From this past years teaching, I have found that active learning has been effective in a broad range of courses including:

1. for math majors like Math 345A (differential equations), Math 350 (numerical analysis), Math 354 (mathematical modeling)
2. STEM major courses like calculus (Math 141A, 141B, 241, and 242)
3. non-major, non-STEM courses like Math 79 (quantitative reasoning)
4. Lib-Ed CON1 pairs course like COSC 190
5. computer science courses like COSC 120 and 220.

In this way, active learning is an excellent match to Whittier's emphasis on the liberal arts in that it makes it possible for Math 79 or COSC 190 students to have not only a positive experience in mathematics or computer science, but a genuine mathematical or computer science experience. The methodology of learning through active participation and micro-calibration that works on STEM students also has the same beneficial impact on non-majors. Thus, Math 79 or COSC 190 students obtain similar quantitative skill sets as the STEM students through broad and interdisciplinary applications.

[1] President's Council of Advisors on Science and Technology. (2012). *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.*

2.2 Teaching Evaluations

In the last 2 years, I have taught the following types of courses:

1. Math 79 (2 times), Non-Majors Course
2. INTD 100 (once), Non-Majors College Writing Seminar Linked Course
3. Math 141A (once), Freshman Level Calculus I
4. Math 345A (once), 350 (once), and 354 (once), Upper Level Applied Math Courses
5. COSC 120 (twice) and 220 (once), Intro Computer Science I and II Courses
6. COSC 190 (once), CON1 Paired Course on AI, Computer Vision, and Cognition

Math 79 is a service course that I have taught a total of 9 times since I have been at Whittier. It is an important course due to the broad impact it has to the general student population on campus. INTD 100 is an important Lib. Ed. linked course where I served as both the instructor and advisor to the 16 students enrolled. Math 141A is the first course in the calculus sequence at Whittier, and it serves both STEM majors as well as business and social science majors. Math 345A, 350, and 354 all have been taught twice since my start here. These are important upper level applied mathematics courses serving math, 3/2 engineering, and math–business majors as well as scientific computing minors. COSC 120 and 220 form a year long sequence of introductory computer science courses that serve the new ICS major, scientific computing minor, math–business major, as well as the math with teaching emphasis major. COSC 190 is a new CON1 paired course that links with PSYC 336, cognitive psychology. It serves as an important Lib. Ed. requirement.

In this section, I will discuss the teaching evaluations of all courses taught from F15-S17. These include both major courses in Math and COSC as well as Lib. Ed. courses in COM1, College Writing, and CON1. In my previous PEGP submission, I did not include my reflections and evaluations for Math 345A (S15) and 242 (S14 and S15) (they were included in the backing documents for that submission). For completions sake, I have included them in the Appendix of this PEGP submission. Also, FPC has asked me how I could engage my students to utilize my availability during office hours (OH's) even more. To answer this, I found that using an early and often approach worked quite well. This is seen in my COSC 190 and COSC 220 courses, each of which had scores in the student categories for question 5 "I attended scheduled office hours if I had questions about the course material" of 4.32/5 and 4.86/5 respectively. I encouraged students to attend office hours (OH's) in the first week of class and allowed them to come often on a daily basis. This sets up a positive pattern for their attendance. It also sets up a back and forth process between them working on problems and often getting stuck and resolving the sticking point in OH's for further progress. Also, having an interactive office hour seemed to keep them engaged and looking forward towards attending.

2.2.1 Math 079 Fall 2015 and Spring 2016

MATH 079 Quantitative Reasoning is a course that is generally taken by students not majoring in science or mathematics in order to fulfill the COM1 Liberal Education requirement. The course catalog description follows:

> **Math 079 Quantitative Reasoning** This course is designed to help students develop their ability to create, analyze, and communicate quantitative and scientific arguments. It will emphasize critical thinking and problem-solving skills while also giving students practice in computation and symbolic manipulation. Topics to be covered include elementary linear equations, polynomial modeling, working with and understanding graphs and graphical presentations, and elementary probability and statistics. These topics will be presented in

Table 1: Math 79 Comparison of S13, F13, S14, S15, F15, and S16

	Evaluation Questions	S13	F13	S14	S15	F15	S16	AVG
	I. Student Self-Evaluation							
1.	I attended class regularly.	4.61	4.96	4.75	4.92	4.74	4.58	4.74
2.	I was academically prepared to handle the material.	4.10	4.29	4.28	4.58	3.89	3.93	4.15
3.	I came prepared for each class session (i.e. have read all course readings and completed assignments).	4.35	4.46	4.32	4.67	4.42	4.73	4.47
4.	I actively participated in class discussions.	4.00	3.83	3.81	4.67	4.06	4.20	4.03
5.	I attended scheduled office hours if I had questions about the course materials.	3.41	3.42	3.46	4.33	3.94	3.73	3.62
6.	I tried to relate course material to other things I know and/or study.	4.38	4.00	4.02	4.42	4.16	4.39	4.21
7.	I worked to my full potential in this course.	4.19	4.29	4.19	4.58	4.37	4.35	4.29
8.	I was satisfied with my performance in this course.	4.00	4.25	4.19	4.67	3.95	4.05	4.15
9.	I had a strong desire to take this course.	3.10	3.52	3.29	4.00	3.05	3.24	3.29
	Section Mean (Student)	4.04	4.08	4.03	4.54	4.06	4.13	4.11
	II. Course							
10.	This course had clear goals and objectives.	4.68	4.38	4.63	4.92	4.37	4.31	4.55
11.	This course was academically challenging.	4.58	4.65	4.66	4.83	4.95	4.81	4.73
12.	This course offered useful learning tools.	4.48	4.42	4.66	4.92	4.58	4.39	4.51
13.	This course had grading criteria that were clearly identified.	4.52	4.46	4.66	4.92	4.84	4.34	4.62
14.	This course improved my understanding of the material.	4.65	4.61	4.54	4.91	4.53	3.92	4.47
15.	This course increased my interest in the subject matter.	4.26	4.00	3.84	4.67	3.72	3.65	3.98
16.	Overall, I would recommend this course to others.	4.47	4.08	4.22	4.83	3.89	3.77	4.18
	Section Mean (Course)	4.52	4.38	4.46	4.86	4.41	4.17	4.43
	III. Professor							
17.	The professor used class time effectively and demonstrated preparation for class.	4.74	4.50	4.66	4.92	4.89	4.38	4.68
18.	The professor's teaching style and/or enthusiasm for the material strengthened my interest in the subject matter.	4.65	4.43	4.28	4.92	4.53	4.24	4.46
19.	The professor was able to explain complicated ideas.	4.65	4.48	4.19	4.75	4.37	4.11	4.39
20.	The professor challenged students to think critically and/or imaginatively about the course material.	4.65	4.78	4.75	4.92	4.89	4.73	4.76
21.	The professor provided clear and timely feedback.	4.48	4.17	4.63	4.83	4.37	4.43	4.47
22.	The professor encouraged meaningful class discussions.	4.65	4.26	4.51	4.83	4.59	4.44	4.54
23.	The professor was receptive to differing views.	4.77	4.43	4.66	4.67	4.76	4.36	4.60
24.	The professor was available for help outside of class.	4.90	4.79	4.91	4.83	4.89	4.77	4.85
25.	Overall, I would recommend this professor to others.	4.71	4.65	4.51	4.83	4.68	4.23	4.57
	Section Mean (Professor)	4.69	4.52	4.56	4.83	4.66	4.41	4.59

Math 79 Comparisons. AVG = weighted average across courses in differing years. Weights are the number of students reporting: S13 (31), F13 (24), S14 (32), S15 (12), F15 (19), and S16 (26).

the context of applications and models from various disciplines. (Not open to those who have had 81, 85, 139A, or 141A. Does not satisfy the prerequisite for MATH 81 or 85 or

PSYC 314.) Prerequisite: 74 or 76, or sufficient score on Math Placement Exam. One semester, 3 credits.

Since my last PEGP submission, I have taught Math 79 on two more occasions: one section in F15 and 2 sections in S16. F15 had 21 students while S16 had two sections with 27 total students combined. F15 was taught in a manner similar to previous iterations of this course. In S16, the course incorporated more active learning and computational work. Both used Matlab software through the virtual computer laboratory (VCL). Course breakdown for both sections include: HW (15%), a presentation (5%), two midterms (20% each), and a final exam. On the first midterm, students were allowed 50% credit back on improperly done problems.

I chose 4 topics, much like I did in S14 and S15, that included: probability, growth and decay, consumer mathematics, and a topic in coding. With coding, we solved models from the first 3 topics. For example, we computed a solution to the predator-prey system of coyotes and rabbits inspired by those seen around the college. We also coded probability experiments using millions of trials like the Monty Hall or Birthday Problems. Also, prior to S14, we did not do any coding and had an extra topic on shapes and tilings.

In Table 1, the average responses are observed for F15 and S16, along with the scores for all math 79 courses I have taught at Whittier, including: S13, F13, S14, and S15. As in my previous PEGP, since there were two back sections taught in S16, I calculated a weighted average (based on total # students reporting) of these scores to obtain the average seen in the table. The weighted average avoids bias in the data. From the section averages, scores for F15 seem to be on par with the 4 previous iterations of this course. There is a small decline in the course and professor categories in S16 which can be attributed to the increase in IBL and computing. For example, in Q14 "This course improved my understanding of the material" had a 3.92/5, indicative of a discovery based method versus a more lecture based one. The section average was 4.45/5 for F15 and 4.17/5 for S16 in the course category. The averages were 4.66/5 for F15 and a 4.41/5 for S16 for the professor, all of which are close to the section averages for the F13 and S14 iterations. Some comments include:

- "I loved this class", "Hard class, Professor Park is a great professor, very much challenges you", "He is a great professor!" (What useful feedback can you provide the professor of this course?)
- "Dr. Park is very enthusiastic and dedicated to his students in the classroom and beyond.", "Challenging active learning!", "funny professor" (What were the best aspects of this course?)
- "Group Activities", "Enthusiastic teacher" (What were the best aspects of this course?)
- "The professor was funny and inspiring. I can relate it to real life.", "The active participation and interactive learning..." (What were the best aspects of this course?)
- "being able to understand concepts I wouldn't think I would ever do (coding)" (What were the best aspects of this course?)

From the response scores and comments it seemed that most students enjoyed both of the F15 and S16 courses despite them being challenging. Some liked the coding as seen from comments like "[r]eally amazing real-world activities on Matlab" while others wanted less coding. I plan to reduce the amount of coding and offer more scaffolding, like I did in my COSC 190 this past spring, for both IBL and code for clearer understanding during their participation in these activities. Overall, many students seemed to gain a deeper understanding through the connection between concept and computation; the very essence of quantitative reasoning.

I have taught 9 total sections of math 79 seem in Table 1. From S13-F15, the average responses look consistent with a small decrease in S16 as discussed earlier. I introduced coding in S14 and found that it did not affect the consistency in evaluations across the years. In the AVG column, an average of 3.29/5 is seen over 9 iterations for the question "I had a strong desire to take this course." The section mean over 9 courses was 4.11/5 pertaining to the student, 4.43/5 for the course, and 4.59/5 for the professor. Despite the students somewhat lack of desire to take this course, it appears that the course and teaching style were both quite favorable despite the variations in course material and teaching methods over the years.

Table 2: Math 350, Fall 2014 and Fall 2016

Evaluation Questions				
	I. Student Self-Evaluation	F14	F16	AVG
1.	I attended class regularly.	4.80	4.91	4.88
2.	I was academically prepared to handle the material.	4.60	4.36	4.44
3.	I came prepared for each class session (i.e. have read all course readings and completed assignments).	4.20	4.27	4.25
4.	I actively participated in class discussions.	4.80	4.45	4.56
5.	I attended scheduled office hours if I had questions about the course materials.	4.40	4.09	4.19
6.	I tried to relate course material to other things I know and/or study.	4.80	4.64	4.69
7.	I worked to my full potential in this course.	4.80	4.55	4.63
8.	I was satisfied with my performance in this course.	4.80	4.64	4.69
9.	I had a strong desire to take this course.	4.60	4.45	4.50
	Section Mean (Student)	4.64	4.48	4.53
	II. Course			
10.	This course had clear goals and objectives.	5.00	4.36	4.56
11.	This course was academically challenging.	5.00	4.91	4.94
12.	This course offered useful learning tools.	5.00	4.82	4.88
13.	This course had grading criteria that were clearly identified.	5.00	4.82	4.88
14.	This course improved my understanding of the material.	5.00	4.36	4.56
15.	This course increased my interest in the subject matter.	4.80	4.27	4.44
16.	Overall, I would recommend this course to others.	4.80	4.36	4.50
	Section Mean (Course)	4.94	4.56	4.68
	III. Professor			
17.	The professor used class time effectively and demonstrated preparation for class.	5.00	4.82	4.88
18.	The professor's teaching style and/or enthusiasm for the material strengthened my interest in the subject matter.	4.80	5.00	4.94
19.	The professor was able to explain complicated ideas.	4.80	5.00	4.94
20.	The professor challenged students to think critically and/or imaginatively about the course material.	5.00	5.00	5.00
21.	The professor provided clear and timely feedback.	4.60	3.45	3.81
22.	The professor encouraged meaningful class discussions.	5.00	4.90	4.93
23.	The professor was receptive to differing views.	4.80	4.89	4.86
24.	The professor was available for help outside of class.	5.00	4.82	4.88
25.	Overall, I would recommend this professor to others.	5.00	5.00	5.00
	Section Mean (Professor)	4.89	4.76	4.80

Math 350 Comparisons. AVG = weighted average across courses in differing years. Weights are the number of students reporting: Fall 2014 (5) and Fall 2016 (11).

2.2.2 Math 350 Fall 2016

MATH 350 - Numerical Analysis
Description: The numerical solutions of non-linear equations, curve fitting, error estimation and analysis. Selected topics chosen from the following are also covered: numerical differentiation, numerical integration, solution of linear systems, solution of initial value problems i.e. numerical solution to ODE's, discrete least squares approximation, the discrete Fourier Transform.
Prerequisite: A C- grade or better in MATH 242 and MATH 345A or permission from the instructor. 3 credits.

This course consists of lecture 2 days a week of 75 minutes each. Lab is integrated into the course and we utilized the powerful scientific computational tool Matlab (Matrix Laboratory). Grading was based on homework (30%), midterm (30%), and a final exam (40%). HW included graded IBL worksheets from class and code. I had 12 students in this course. This class is similar to the one I taught in F14. Class consisted of minimal lectures and group active learning work with the occasional lecture or coding demonstration as needed. Active learning was used in 90% of the course. Homework was assigned weekly and includes programming work and pen and pencil type of problems. Exams consist of 1 midterm exam (take-home) and a final exam (take-home).

Students were required to work on project type of activities during class involving both theoretical and computational work. More IBL and coding was done in this course than the previous one from F14. Also, the number of students more than doubled. In Table 2, the response scores can be seen along with those from F14 for comparison. For questions 18, 19, 20, and 25 the scores were all 5/5. From this I can see that my teaching style and enthusiasm strengthened their interest in the material and despite being a discovery based teaching course, I was able to explain complicated ideas. The students thought critically about the course material and would recommend me to others. Some comments include:

- "Active learning & coding exercises & Fred Park :)" (What were the best aspects of this course?)
- "Coding!!!", "The Professor by far." (What were the best aspects of this course?)
- "It was fun doing real world applications..." (What were the best aspects of this course?)
- "[1.] Dr. Fred Park [2.] Matlab [3.] My seat partner" (What were the best aspects of this course?)

The students seemed to enjoy the course and the way it was taught. Many commented on how much they liked the coding. This course was more coding intensive than the previous iteration, and seemed to be a strong positive. Comparing F14 and F16 courses, responses are fairly constant across both the student and professor categories. There is a bit of a decrease in the overall section mean for the course which I think is related to a larger class size and wider range of preparedness. Here, question 2 "I was academically prepared to handle the material" registered a 4.36/5, down from a 4.60/5 in the previous iteration. There is variation in computational ability of students year to year. In future iterations I will spend the first week focusing on coding to ensure uniform ability here. I noticed that for question 21, "The professor provided clear and timely feedback" had gone from a 4.60/5 in F14 to 3.45/5 in F16. Increasing the amount of coding in the HW and active learning exercises from class both increased my grading, which in turn increased the turnaround time. In future iterations, I will not have IBL exercises due, just HW problems. Otherwise, I am content about having some consistency across two iterations of this course. Moreover, this is an intensive upper division applied mathematics course that is rigorous and demanding. Despite this, I averaged a 4.68/5 in the course and 4.80/5 in the professor categories across two iterations. I can deduce that an IBL methodology for teaching this course has been effective across all years. In both courses, we utilized a dedicated physical computer classroom.

Table 3: Math 354, Fall 2013 and Fall 2015

Evaluation Questions				
	I. Student Self-Evaluation	F13	F15	AVG
1.	I attended class regularly.	4.92	5.00	4.96
2.	I was academically prepared to handle the material.	3.85	4.13	3.99
3.	I came prepared for each class session (i.e. have read all course readings and completed assignments).	4.23	4.13	4.18
4.	I actively participated in class discussions.	4.08	4.27	4.17
5.	I attended scheduled office hours if I had questions about the course materials.	3.58	4.13	3.85
6.	I tried to relate course material to other things I know and/or study.	4.46	4.67	4.56
7.	I worked to my full potential in this course.	4.62	4.40	4.51
8.	I was satisfied with my performance in this course.	4.46	3.80	4.13
9.	I had a strong desire to take this course.	4.54	4.27	4.40
	Section Mean (Student)	4.30	4.31	4.30
	II. Course			
10.	This course had clear goals and objectives.	4.85	4.07	4.46
11.	This course was academically challenging.	5.00	4.93	4.96
12.	This course offered useful learning tools.	4.77	4.20	4.48
13.	This course had grading criteria that were clearly identified.	4.85	4.33	4.59
14.	This course improved my understanding of the material.	4.69	4.20	4.45
15.	This course increased my interest in the subject matter.	4.77	4.20	4.48
16.	Overall, I would recommend this course to others.	4.77	4.00	4.38
	Section Mean (Course)	4.81	4.28	4.54
	III. Professor			
17.	The professor used class time effectively and demonstrated preparation for class.	5.00	4.50	4.75
18.	The professor's teaching style and/or enthusiasm for the material strengthened my interest in the subject matter.	4.85	4.57	4.71
19.	The professor was able to explain complicated ideas.	4.62	3.79	4.21
20.	The professor challenged students to think critically and/or imaginatively about the course material.	4.77	4.87	4.82
21.	The professor provided clear and timely feedback.	4.31	3.27	3.79
22.	The professor encouraged meaningful class discussions.	4.75	4.47	4.61
23.	The professor was receptive to differing views.	4.90	4.67	4.79
24.	The professor was available for help outside of class.	4.54	4.80	4.67
25.	Overall, I would recommend this professor to others.	4.85	4.40	4.62
	Section Mean (Professor)	4.73	4.35	4.54

Math 354 Comparisons. AVG = weighted average across courses in differing years. Weights are the number of students reporting: Math Fall 2013 (12) and Fall 2015 (15).

2.2.3 Math 354 Fall 2015

MATH 354 Mathematical Modeling is a course that is generally taken by students majoring in mathematics, physics, minoring in scientific computing, or taking part in the 3/2 engineering program. The course catalog description follows:

MATH 354 Mathematical Modeling Formulation and evaluation of models; continuous and stochastic models; sources of error; accuracy, precision and robustness; mathematical techniques used in modeling; analytical and numeric solutions; optimization.

Pre-req: A C- or better in MATH 242 and MATH 345A. 3 credits.

This is a semester long applied math course in math modeling. The version of this course from F13 had little to no computing (5%) while this version had a significant amount of computation (60%). In this iteration, I also swapped out the traffic modeling topic and added the topics of the calculus of variations with applications to computer vision. This is an advanced and rigorous upper division applied math course.

Grading was based on HW (20%), a graded class presentation (10%), a take home midterm exam (30%), and a take home final exam (40%). The IBL component consisted of in-class exercises and class presentations. Worksheets, projects, and code were due with the HW. We heavily utilized Matlab to implement the models from class. HW deadlines were calibrated with the pace of the course and varied between 1-2 weeks. I allowed up to 50% credit back on incorrectly solved problems on the midterm.

In Table 3 are the response scores for the F15 course along with the iteration taught in F13. There is a moderate decrease in the scores for the course and professor while the student category remained constant. A supplemental question was added to the evaluations at the time they were administered: "Virtual Computer Lab (VCL) reliability" which scored a 2.60/5. From the scores, I found that the students were challenged to think critically and imaginatively about the course material (4.87/5), liked the professor's teaching style and/or enthusiasm which strengthened their interest in the subject matter (4.57/5). They also felt the professor used class time effectively and demonstrated preparation (4.5/5) and was available for help outside the class (4.8/5). Many students were not satisfied by their performance (3.8/5) and found it academically challenging (4.93/5). The question: "[t]he professor was able to explain complicated ideas" had a score of 3.79/5 which I feel is from the guided discovery method which was used more heavily here than the previous iteration. This semester F17, I am adding more scaffolding to the IBL materials to allow for a wider range of abilities like I did in COSC 190. I also noticed that the feedback for: "the professor provided clear and timely feedback" was a 3.27/5 attributed to the increased amount of computational work in the assignments which increased grading work. Thus, increased turnaround. In the current iteration F17, IBL exercises will not be due to allow for faster turnarounds. We have also switched the 2nd topic to a machine learning one that is more accessible to a wider audience.

This course utilized the virtual computer laboratory (VCL), where students remotely accessed servers from their own personal devices to do intensive computations, a program I piloted with IT in S15. For F15/S16 year, the VCL was less reliable. In the comments, I noticed the students did not like using the VCL and really favored a dedicated computer lab. Nonetheless, we did the best that we could with the facilities we had at the time. Contrasting to my math Math 350 course, which had a dedicated computer lab all semesters, no such remarks were present.

Lastly, I wanted to note that the average for both the course and professor over 2 iterations of teaching this course, despite the variations to the course material, methodology, and logistics, was a 4.54/5. This shows effectiveness of the instructor and course over the years, despite the aforementioned variations.

2.2.4 Math 345A Spring 2017

Math 345* A,B Differential Equations I, II The theory of first-and second-order ordinary differential equations including their series solutions, introduction to Laplace Trans-

Table 4: Math 345A, Fall 2012, Spring 2015, and Spring 2017

Evaluation Questions					
	I. Student Self-Evaluation	F12	S15	S17	AVG
1.	I attended class regularly.	4.90	4.91	4.89	4.90
2.	I was academically prepared to handle the material.	4.70	4.68	4.53	4.63
3.	I came prepared for each class session (i.e. have read all course readings and completed assignments).	4.60	4.73	4.63	4.67
4.	I actively participated in class discussions.	4.50	4.59	4.56	4.56
5.	I attended scheduled office hours if I had questions about the course materials.	4.22	4.32	4.12	4.23
6.	I tried to relate course material to other things I know and/or study.	4.80	4.73	4.74	4.75
7.	I worked to my full potential in this course.	4.60	4.73	4.74	4.71
8.	I was satisfied with my performance in this course.	4.50	4.64	4.58	4.59
9.	I had a strong desire to take this course.	4.50	4.68	4.42	4.55
	Section Mean (Student)	4.59	4.67	4.57	4.62
	II. Course				
10.	This course had clear goals and objectives.	5.00	4.86	4.84	4.88
11.	This course was academically challenging.	5.00	4.95	5.00	4.98
12.	This course offered useful learning tools.	4.90	4.91	4.79	4.86
13.	This course had grading criteria that were clearly identified.	4.80	4.91	4.84	4.86
14.	This course improved my understanding of the material.	4.90	4.91	4.79	4.86
15.	This course increased my interest in the subject matter.	4.80	4.82	4.63	4.75
16.	Overall, I would recommend this course to others.	4.80	4.73	4.58	4.69
	Section Mean (Course)	4.89	4.87	4.78	4.84
	III. Professor				
17.	The professor used class time effectively and demonstrated preparation for class.	5.00	4.95	4.79	4.90
18.	The professor's teaching style and/or enthusiasm for the material strengthened my interest in the subject matter.	5.00	4.91	4.74	4.86
19.	The professor was able to explain complicated ideas.	5.00	4.95	4.74	4.88
20.	The professor challenged students to think critically and/or imaginatively about the course material.	5.00	5.00	5.00	5.00
21.	The professor provided clear and timely feedback.	4.30	4.59	4.11	4.35
22.	The professor encouraged meaningful class discussions.	4.90	4.91	4.83	4.88
23.	The professor was receptive to differing views.	4.89	4.85	4.94	4.89
24.	The professor was available for help outside of class.	4.70	4.86	4.63	4.74
25.	Overall, I would recommend this professor to others.	5.00	4.86	4.68	4.82
	Section Mean (Professor)	4.87	4.88	4.66	4.80

Math 345A Comparisons. AVG = weighted average across courses in differing years. Weights are the number of students reporting: Math Fall 2012 (10), Spring 2015 (22), and Spring 2017 (19).

forms with applications, including the solutions of differential equations, systems of ordinary linear differential equations, introduction to Fourier Series and integrals with applications, difference equations, partial differential equations with applications, introduction to the boundary and initial value problems and their applications. Also other selected topics in ordinary and partial differential equations depending on the particular emphases of the students in the class. Prerequisite: 141B. Two semesters, 3 credits each.

This is the third time teaching this course having previously taught it in F12 and S15. The course has evolved from one in the major to one that is also part of the 3/2 engineering transfer curriculum for USC as of S15. The S17 course is similar to the one taught in S15 and had 19 students. In the most recent iteration, due to the amount of material, it was taught in a lecture style with sparse active learning. Course breakdown was HW (20%) (due every 1-2 weeks), a take home midterm (30%), and a take-home final (50%). We did some work with Matlab as well. Like the S15 course, this one relaxes the Math 242 prerequisite which was enforced in the past (F12). For this reason, there is now a wider range of preparedness in this course. I adjusted the pace of the course to allow for a slower pace early and then accelerated from the midpoint until the end. This was to allow less prepared students to gain confidence.

In Table 4 are the average responses for 345A for years F12, S15, and S17. The responses and section means seem positive where those pertaining to the course and professor were 4.78 and 4.66 respectively. From the comments, many students answered “nothing” to the question “What would you change about this course?” which I take as a positive. Many students seemed to like the course material, the examples, and class discussions with some using the word “great” and “fantastic” to describe the course. Some students commented on how they enjoyed the HW and midterm. For example, one student stated that “[i]t was a fun course. The[ ] homework and midterm was fun and challenging. Great course!” The word “challenging” came up quite often in the comments and this correlates with question 11 in the response “This course was academically challenging” which was 5/5. Average section means viewed in Table 4 for the student, course, and professor are somewhat level across all years. S17 has a slight downward trend from the mean across the previous years in the professor category and negligible difference in the course category. The notable change in S17 from previous years was the departure from active learning. Adding more IBL would be beneficial as the two previous years utilized significantly more. Looking at trends, I noticed that for question 20 “[t]he professor challenged students to think critically and/or imaginatively abut the course material” registered a 5/5 across all years the course was taught. While for question 11 “[t]his course was academically challenging” had a score of 4.98/5 across all 3 courses, and thus showing consistency in thought provocation and rigor. The average section means over all 3 years was a 4.84/5 in the course category and a 4.80/5 in the professor category. The course has been enjoyable to teach and seems to be well received despite the changes in content, prerequisites, and student demographics. Lastly, I want to remark that the “no typo” problem discussed in the F15 reflections (see Appendix A.2) was finally solved during the midterm in S17. A first in 3 iterations of teaching this course.

2.2.5 Math 141A, Spring 2016

Math 141A is the first part of a 2 course sequence of calculus. From the course catalog, the description follows:

> **Math141 A,B Calculus and Analytic Geometry I-II** First two semesters of a three-semester unified course in analytic geometry and calculus: progresses from functions of one real variable, their derivatives and integrals, through multivariate calculus; topics from infinite series and differential equations. Prerequisite: 85 or sufficient score on math Placement Exam. Two semesters, 4 credits each.

This course consists of lecture 4 days a week and a lab portion that meets once a week. The lab utilizes Matlab and the VCL interface. Each class meeting was for a period of 50 minutes. Grading was based on homework (20%), lab (5%), class presentation (5%), two midterms (total

Table 5: Math 141A, Fall 2012 and Spring of 2016

Evaluation Questions				
	I. Student Self-Evaluation	F12	S16	AVG
1.	I attended class regularly.	4.93	4.85	4.89
2.	I was academically prepared to handle the material.	4.53	4.15	4.35
3.	I came prepared for each class session (i.e. have read all course readings and completed assignments).	4.80	4.54	4.68
4.	I actively participated in class discussions.	4.40	4.33	4.37
5.	I attended scheduled office hours if I had questions about the course materials.	4.40	3.64	4.05
6.	I tried to relate course material to other things I know and/or study.	4.80	4.08	4.47
7.	I worked to my full potential in this course.	4.87	4.23	4.57
8.	I was satisfied with my performance in this course.	4.67	3.23	4.00
9.	I had a strong desire to take this course.	4.73	3.85	4.32
	Section Mean (Student)	4.68	4.09	4.41
	II. Course			
10.	This course had clear goals and objectives.	5.00	4.15	4.61
11.	This course was academically challenging.	4.87	4.92	4.89
12.	This course offered useful learning tools.	4.93	4.38	4.67
13.	This course had grading criteria that were clearly identified.	4.93	4.31	4.64
14.	This course improved my understanding of the material.	4.93	3.85	4.43
15.	This course increased my interest in the subject matter.	4.80	3.77	4.32
16.	Overall, I would recommend this course to others.	5.00	3.62	4.36
	Section Mean (Course)	4.92	4.14	4.56
	III. Professor			
17.	The professor used class time effectively and demonstrated preparation for class.	5.00	4.15	4.61
18.	The professor's teaching style and/or enthusiasm for the material strengthened my interest in the subject matter.	5.00	3.46	4.28
19.	The professor was able to explain complicated ideas.	4.87	3.46	4.22
20.	The professor challenged students to think critically and/or imaginatively about the course material.	5.00	4.42	4.73
21.	The professor provided clear and timely feedback.	4.93	4.46	4.71
22.	The professor encouraged meaningful class discussions.	4.93	4.18	4.58
23.	The professor was receptive to differing views.	5.00	4.20	4.63
24.	The professor was available for help outside of class.	5.00	4.77	4.89
25.	Overall, I would recommend this professor to others.	5.00	3.54	4.32
	Section Mean (Professor)	4.97	4.07	4.55

Math 141A Comparisons. AVG = weighted average across courses in differing years. Weights are the number of students reporting: Fall 2012 (15) and Spring 2016 (13).

40%), and a final exam (30%). The homework also included graded active learning worksheets from class. I had 14 students in this course. Classes consisted of group active learning work and occasional lectures as outlined in my teaching statement. The main difference between this course and the one taught in F12 was that significantly more IBL was used as well as more computation to showcase the concepts. In addition, this course required a graded presentation of a HW problem. Grading was on a straight curve and students were allowed to redo both midterms for 50% back. There were also practice problems and review sessions before all exams.

In Table 5 are the evaluation scores for S16 and also for a previous iteration taught in F12. In general, the spring semester 141A course is less positive than the fall one and students tend to have an even wider range of preparedness. The fall students tend to have high placement or AP scores that allow them into calculus and have often taken more math at a higher level than the the spring group. This seems to be reflected in the response scores. For example, question 2 "I was academically prepared to handle the material" had a 4.15/5 for S16 versus a 4.53 for F12. Question 8 "I was satisfied with my performance" had a score of 3.23/5 in S16; a change from 4.67/5 found in F12. For question 23 "[the] professor was available for help outside of class" had a score of 4.77/5 while question 5 "I attended scheduled office hours if I had questions about the course material" yielded a 3.64/5. In the future, I will use both the early and often approach used in COSC 190 and 120 to get more students to attend office hours. Most of the written comments for this course were about the active learning approach used. Some liked the active learning: "[t]he active learning is very helpful and beneficial[,]" while others found this style of teaching challenging and difficult. This is reflected in the response scores to questions 18 and 19 (both a 3.46/5) which ask about teaching style and ability for the instructor to explain complicated ideas. These also tie into question 14 about increasing their understanding of the material as well. Adjusting this by adding more scaffolding to the IBL exercises and adding more lectures will be helpful. The scaffolding approach was used recently in COSC 190 with very positive results (see Section 2.2.9). In the F12 iteration of 141A , the scores for questions 14, 18, and 19 seem to be higher from having more lectures. Overall, from the feedback, the students seemed to indicate that they wanted more lectures and that will be the case for the next iteration of this course.

2.2.6 COSC 120, Fall 2016 (sections 1 and 2)

COSC 120 Computer Science I is an introductory computer science course that is part one in a two part introduction series that also includes COSC 220. It is the first course in the COSC core required by the Integrated Computer Science major. The course catalog description follows:

> **COSC 120 - Computer Science I** Introduction to computer programming in a high-level language such as C, C++, or Java, emphasizing structured programming techniques, procedural methods and simple user-defined data structures.
> Pre-req: 2 on the placement test, or a C- or better in COSC 100, or a C- or better in Math 076, or a C- or better in Math 079. 3 credits.

Course breakdown: HW (30%), in-class midterm (30%), and final project (40%). For software, we used Python 2.7, the Anaconda package (from Continuum analytics), and the Pycharm integrated development environment (IDE). The Anaconda package includes many of the popular packages like scientific python (SciPy). This was the first time teaching a computer science (COSC) course at Whittier. It was a brand new preparation with 2 sections taught.

The in-class active learning consisted of worksheets with starter code (on the projector) for the students to begin mini projects. There were also live demos of the code during every class meeting. Each class was a mix of lecture, demos, and active learning in a cyclic manner throughout the class period. If students were stuck on one concept, I would explain it and then share some example code on the projector to help them reinforce the concept. I would also demonstrate applications like replicating probability experiments with millions of runs in class. There was a graphics portion to the course where we visualized and altered images.

Table 6: COSC 120, Fall 2016

Evaluation Questions		Average Response
	I. Student Self-Evaluation	S2017
1.	I attended class regularly.	4.74
2.	I was academically prepared to handle the material.	4.13
3.	I came prepared for each class session (i.e. have read all course readings and completed assignments).	4.70
4.	I actively participated in class discussions.	4.17
5.	I attended scheduled office hours if I had questions about the course materials.	4.21
6.	I tried to relate course material to other things I know and/or study.	4.56
7.	I worked to my full potential in this course.	4.39
8.	I was satisfied with my performance in this course.	4.36
9.	I had a strong desire to take this course.	4.48
	Section Mean (Student)	4.42
	II. Course	
10.	This course had clear goals and objectives.	4.90
11.	This course was academically challenging.	4.84
12.	This course offered useful learning tools.	4.74
13.	This course had grading criteria that were clearly identified.	4.81
14.	This course improved my understanding of the material.	4.74
15.	This course increased my interest in the subject matter.	4.39
16.	Overall, I would recommend this course to others.	4.29
	Section Mean (Course)	4.67
	III. Professor	
17.	The professor used class time effectively and demonstrated preparation for class.	4.84
18.	The professor's teaching style and/or enthusiasm for the material strengthened my interest in the subject matter.	4.74
19.	The professor was able to explain complicated ideas.	4.80
20.	The professor challenged students to think critically and/or imaginatively about the course material.	4.97
21.	The professor provided clear and timely feedback.	4.42
22.	The professor encouraged meaningful class discussions.	4.72
23.	The professor was receptive to differing views.	4.80
24.	The professor was available for help outside of class.	4.97
25.	Overall, I would recommend this professor to others.	4.75
	Section Mean (Professor)	4.77

COSC 120, Intro to Computer Science. 31 students reporting.

One HW assignment was to create a text based game with graphics that the students really enjoyed (from the feedback in the comments). I played what I felt were the most engaging of these games in front of the class. There were IBL projects targeted at all levels. The first set of questions were aimed at a lower level and then would build up to more advanced questions. The goal was to allow access to all abilities while still challenging the more advanced students. Office hours for this course were heavily utilized as I encouraged early and often attendance. The final project was the students' choice with instructor permission and must include elements from the course beyond the midterm exam.

Since I taught 2 sections of this course in the same semester, I took the weighted average between them, with the weight being the student. The evaluation scores are quite positive as seen in Table 6. The section mean was a 4.67/5 for the course and 4.77/5 for the professor. For the question "This course had clear goals and objectives[,]" the response was 4.90/5 while "The professor was available for help outside of class" earned a score of 4.97/5. The question, "The professor used class time effectively and demonstrated preparation for class[,]" yielded a score of 4.84/5. Office hours utilized dual screen coding where students were able to see coding on two 27" screens; greatly aiding their understanding. From the response scores, the "course was academically challenging" (4.84/5), and I was able to "challenge students to think critically and imaginatively about the course material" (4.97/5). Despite using lots of IBL, the question "[t]he professor was able to explain complicated ideas" scored a 4.80/5. I made sure to clearly explain any points of confusion. Some comments include:

- "You! You're the best professor I've ever had at Whittier and every class of yours that I take is extremely enjoyable. You are very engaged and make learning fun. Thank you! I also really liked making the game." (What were the best aspects of this course?)
- "All of your availability outside of class was very helpful and appreciated." (What useful feedback could you provide the professor of this course?)
- "Always a great professor! Liked active learning style mixed with lecture." (What useful feedback could you provide the professor of this course?)
- "The professor made coding fun, interactive and engaging despite the academic workload." (What were the best aspects of this course?)
- "I feel like I challenged myself past limits I thought I couldn't achieve." (Please evaluate your own performance in this course?)

From the comments, I feel that the course was quite successful. Students seemed to find it enjoyable despite the challenges and liked the mix of lecture, class demos, and active learning. They seemed engaged and many commented that the class was "fun".

2.2.7 COSC 220, Spring 2017

COSC 220 Computer Science II is the second part in a two part introduction series to COSC that also includes COSC 120. It is the second course in the COSC core required by the Integrated Computer Science major. The course catalog description follows:

> **COSC 220 – Computer Science II** Computer programming emphasizing data structures, algorithms, pointers, and low-level interface.
> Pre-req: COSC 120. 3 credits.

Course breakdown: HW (30%), midterm (30%), and take-home final exam (40%). For software, we used the CLion IDE. This was a brand new preparation and first time teaching this course. Despite having COSC 120 as prerequisite, there was a broad range of student preparedness. This course was taught in a similar manner as COSC 120 and consisted of a a mix of lecture, demos, and IBL. Active learning consisted of worksheets and starter code placed on the projector for the students to begin working. There were live demos of the code every class. Topics covered included data structures like stacks, queues, linked lists, maps, grids, etc. as well as applications of these. We also covered sorting algorithms, complexity analysis, pointers, arrays, and user defined data types (object oriented programming). Due to the wide range of preparedness, I taught the course at a moderate pace early and then accelerated through to the end.

Table 7: COSC 220, Spring 2017

Evaluation Questions		Average Response
	I. Student Self-Evaluation	S2017
1.	I attended class regularly.	4.71
2.	I was academically prepared to handle the material.	4.71
3.	I came prepared for each class session (i.e. have read all course readings and completed assignments).	4.43
4.	I actively participated in class discussions.	4.71
5.	I attended scheduled office hours if I had questions about the course materials.	4.86
6.	I tried to relate course material to other things I know and/or study.	5.00
7.	I worked to my full potential in this course.	5.00
8.	I was satisfied with my performance in this course.	4.86
9.	I had a strong desire to take this course.	5.00
	Section Mean (Student)	4.81
	II. Course	
10.	This course had clear goals and objectives.	5.00
11.	This course was academically challenging.	5.00
12.	This course offered useful learning tools.	4.71
13.	This course had grading criteria that were clearly identified.	4.57
14.	This course improved my understanding of the material.	5.00
15.	This course increased my interest in the subject matter.	5.00
16.	Overall, I would recommend this course to others.	4.86
	Section Mean (Course)	4.88
	III. Professor	
17.	The professor used class time effectively and demonstrated preparation for class.	4.57
18.	The professor's teaching style and/or enthusiasm for the material strengthened my interest in the subject matter.	4.57
19.	The professor was able to explain complicated ideas.	4.43
20.	The professor challenged students to think critically and/or imaginatively about the course material.	4.71
21.	The professor provided clear and timely feedback.	5.00
22.	The professor encouraged meaningful class discussions.	4.71
23.	The professor was receptive to differing views.	5.00
24.	The professor was available for help outside of class.	4.57
25.	Overall, I would recommend this professor to others.	4.33
	Section Mean (Professor)	4.65

COSC 220, Computer Science II, 7 students responding.

Table 7 displays the response scores. Section averages for the student registered a 4.81/5, the course 4.88/5, and the instructor a 4.65/5. I note that the section average on the standardized summary sheet provided to me has a 4.58/5 for the professor category, which is in fact incorrect. It should be 4.65/5. Overall, the responses look very positive. I did notice that one student evaluation had large deviation responses. The student did not leave any comments so I cannot completely explain the reasoning. For response questions pertaining to the course in 10, 11, 14, and 15, the scores were a 5/5. From this I can deduce that the course had clear goals, was challenging, and the students understood the material and increased their interest in the subject matter. This correlates with some of the feedback comments where the students stated that they wanted a second semester of this course. This is a good sign since it shows interest in more advanced COSC at Whittier. In the professor section, the responses to question 21 and 23 had a score of 5/5, while question 22 had a score of 4.71/5. From this I can see that the students enjoyed the class discussions, fast grading turnaround, and openness to different ways of thinking about the material. Comments include:

- "nothing it was awesome!" (What useful feedback could you provide the professor of this course?)
- "Great class.", "The challenges were amazing once you can overcome them.", "Fantastic Job!" (What useful feedback could you provide the professor of this course?)
- "clear explanation of things" (What were the best aspects of this course?)
- "The professor and interesting course material." (What were the best aspects of this course?)
- "nothing", "wish this was a 2 semester course" (What would you change about this course?)

The comments indicate that the students enjoyed the course and the way it was taught. Some found it challenging but rewarding. In the future, I will have an even wider range of difficulty on the projects and use a slightly faster pace in the beginning of the course.

2.2.8 INTD 100, Fall 2015

This course is known as the College or Freshman Writing Seminar (FWS) which is an intensive course designed to increase the level of writing in incoming Freshman. The link provides a method of connection to the college and camaraderie in the link cohort, thus also building community. My class was linked with Math 141A taught by Prof. Bill Kronholm and my peer mentors were Jenna Cohen and Samantha Blum. Prior to the start of the semester, I attended Charlie Eastman's workshop for new FWS instructors. The course catalog description follows:

> **INTD 100 College Writing Seminar** Students read complex texts chosen to sharpen students critical reading and thinking skills. Texts frame a central course theme. Writing assignments based on these texts are designed to teach and practice persuasion, description, narration, exposition, and research-based writing, as well as writing under pressure of time. Extensive revision is emphasized. Letter grade only. 3 credits

Stated in my previous 2nd and 4th year PEGP submissions was a plan to teach a freshman writing seminar. INTD 100: *Ethics in Finance in a Post Recession Era* is this seminar. I had 15 freshmen advisees and 1 transfer advisee enrolled. The theme I chose for my course was Ethics in Finance in a Post Recession Era. The course description follows:

In this post global financial crisis era, we look both backward and forward in discussing moral issues within the financial industry worldwide. We will use the events from the 2008 financial crisis to motivate topics like wealth inequality, predatory lending, stock market manipulation, and the so called 1%'ers. We will look at what blurs the lines between what is legal and what is ethical. We will discuss questions like how can a part time working American making $25,000 a year obtain a loan for $1,000,000 to buy his dream house with no money down and interest only payments? Or is it reasonable to bailout big banks in 2008? In the latter, taxpayer money was loaned to banks at a low interest rate and the banks then re-loaned the money back to the taxpayers at a higher rate banking the profits. We will examine questions like these and more.

Required course readings:

1. *The Big Short*, Michael Lewis
2. *The End of Wall Street*, Roger Lowenstein
3. *Flash Boys*, Michael Lewis
4. Online articles, blog entries, movies, etc.

Table 8: INTD 100, Fall 2015

Evaluation Questions		Average Response
	I. Student Self-Evaluation	F2015
1.	I attended class regularly.	4.71
2.	I was academically prepared to handle the material.	3.93
3.	I came prepared for each class session (i.e. have read all course readings and completed assignments).	3.71
4.	I actively participated in class discussions.	3.71
5.	I attended scheduled office hours if I had questions about the course materials.	3.79
6.	I tried to relate course material to other things I know and/or study.	3.79
7.	I worked to my full potential in this course.	4.00
8.	I was satisfied with my performance in this course.	4.00
9.	I had a strong desire to take this course.	3.07
	Section Mean (Student)	3.86
	II. Course	
10.	This course had clear goals and objectives.	4.64
11.	This course was academically challenging.	4.86
12.	This course offered useful learning tools.	4.71
13.	This course had grading criteria that were clearly identified.	4.21
14.	This course improved my understanding of the material.	4.57
15.	This course increased my interest in the subject matter.	4.14
16.	Overall, I would recommend this course to others.	3.93
	Section Mean (Course)	4.44
	III. Professor	
17.	The professor used class time effectively and demonstrated preparation for class.	4.57
18.	The professor's teaching style and/or enthusiasm for the material strengthened my interest in the subject matter.	4.29
19.	The professor was able to explain complicated ideas.	4.14
20.	The professor challenged students to think critically and/or imaginatively about the course material.	4.71
21.	The professor provided clear and timely feedback.	4.14
22.	The professor encouraged meaningful class discussions.	4.57
23.	The professor was receptive to differing views.	4.43
24.	The professor was available for help outside of class.	4.57
25.	Overall, I would recommend this professor to others.	4.14
	Section Mean (Professor)	4.40

INTD 100, 14 reporting.

Class time was used for student refection writing from the reading. They also did mini rhetorical writing exercises. Both of these could then spiral off into more refined paragraphs used in their essays. They were expected to write every class. Course breakdown follows: final grade is based on four essays at (20% each), while Journals, Discussions, Summaries of Reading, and

Quizzes accounted for the remaining 20%. Essays increase in length and rigor as they progress.

This course had strict deadlines for the reading, drafts, and final papers. Essays were allowed multiple drafts before final submission. Feedback from myself was given on each draft which included the current grade on that particular essay. This preliminary grade allowed room for improvement on subsequent drafts. It was, in many ways, a difficult course to teach since feedback on essays must be given at multiple levels addressing errors from the most egregious all the way to the least. The grading and feedback took an immense amount of time, hence the tiered approach. There was a 1-1.5 weeks turnaround on the grading of essays.

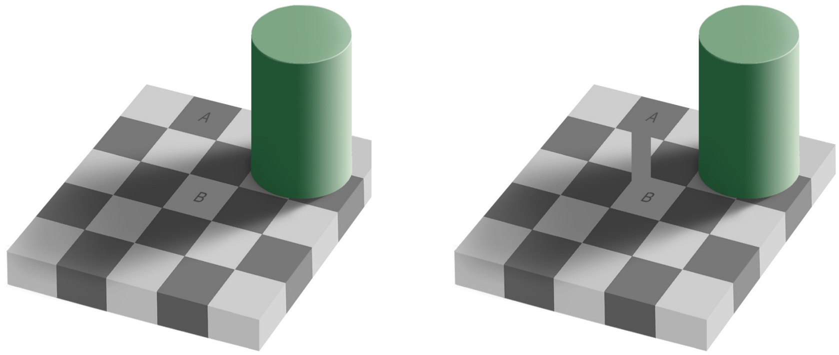
The response scores and comments overall are positive as seen in Table 8. Some written comments include the following:

- "Great course, academically challenging, but learned a lot", "Professor[ ] Park giving feedback on essays!" (What useful feedback could you provide the professor of this course?)
- "There are no useful feedback I can provide because this course was perfect" (What useful feedback could you provide the professor of this course?)
- "The rewrites that made me a better writer. Great feedback.", "The best aspect of this course was learning writing skills" (What were the best aspects of this course?)
- "The class discussions & challenging aspects" (What were the best aspects of this course?)
- "everything", "It was thought provoking" (What were the best aspects of this course?)
- "I was ... satisfied ... because I was able to increase my writing skills" (Please evaluate your own performance in this course?)

From the comments it seems the students found the course "academically challenging, "thought provoking" and intensely paced. Many felt they got better at writing. Comments stated that they liked my feedback on essays and felt it helped them. Numerous comments stated that they had bettered their writing skills. A couple comments stated to have more time for the final essay and I will make sure to allow for that in the future. One student said to encourage more discussion while another student said the best aspects were "the class discussions." In future iterations, I will have as many discussions as possible. Only 1 comment on grading time "[m]aybe give the feedback of essays quickly." I'm not sure how to read into this comment as it can mean quicker feedback or try quick feedback. I spoke with colleagues and they felt that my turnaround of 1-1.5 weeks was perfectly acceptable and that 2 weeks was average. I can possibly experiment with more revisions and shorter turnarounds in future iterations of the course.

The response question "[t]his course was academically challenging" received a 4.86/5 and "[t]his course offered useful learning tools" a 4.71/5. Here, they seem to point in the direction that the course was rigorous but the learning tools were useful. Moreover, from the response "[t]he professor challenged students to think critically and/or imaginatively about the course material" received a 4.71/5 while "meaningful class discussions" received a 4.57/5. I feel that these are very positive and that the topic was engaging. On the flip side, I noticed that in the category "[o]verall, I would recommend this course to others" registered the lowest in the course section at 3.93/5. This correlates with the lowest of 3.07/5 in the student self evaluation of "I had a strong desire to take this course." An intensive writing course is intense and this echoes the comments about the course being rigorous. It was meant to be.

Overall, I enjoyed teaching freshman writing and felt many of the students made a strong connection to the college through the link. The topic was thought provoking and led to many interesting papers. I look forward to teaching this topic or a variant thereof in this course again.



(a) Original Image (b) Bridge Between Squares

Figure 1: ***Retinex Color Illusion in Action***

2.2.9 COSC 190 (CON1 Pairs Course), Spring 2017

COSC 190 was a course designed from the ground up for the Spring 2017 semester as a CON1 pairs course. The course was paired with PSYC 336, Cognitive Psychology. The course catalog description follows:

> **COSC 190, Artificial Intelligence, Computer Vision, and Cognition** Have you ever wondered how a computer can tell the difference between the letter B and the number 8? This simple process can be extended to recognizing faces in an FBI database or even tracking moving airplanes in live video. In this course we will look at how computers recognize objects, patterns, and more. Moreover, we will detail the links between human cognition and how computers attempt to mimic such cognitive processes. Prerequisites: C- or higher in MATH 76 or MATH 79 or COSC 100 or 2 or higher on the MATH placement test. 3 credits. Note: Students must also enroll in PSYC 336 to receive CON1 credit.

In my two previous PEGP submissions, I discussed the possibility of creating a paired course with computer vision and cognition in my fifth year. This past spring of 2017, this course finally came into fruition as COSC 190. I paired with Joanne Hash's PSYC 336 course in cognitive psychology. The pair was popular and over enrolled by 5 students with many more turned away. This course investigates the connections between artificial intelligence (AI), computer vision (CV), and human cognition. It is broad but rigorous in the sense that current real world applications are investigated from a conceptual, mathematical, and computational perspective. Connections to human cognition were made throughout the course at multiple levels.

Course breakdown follows: four HW projects (30%), a take home midterm (30%), and a final project (40%). The course was both lecture and project based using significant amounts of IBL. HW projects were due about every two weeks and each project consisted of mathematical write-ups, code, and output. The final project involved a machine learning application in optical character recognition. IBL projects consisted of quantitative work, coding, and visualization and were often starters/catalysts for the HW projects. Two extra credit assignments were also given: a writing assignment on an AI topic and a computer vision project.

This course was a new preparation. I found this course to be the most difficult one to teach in my 5 years at Whittier due to, as my paired course partner stated, a "giant chasm" between student preparedness. Some students were advanced math and computer science majors while others have never taken a math course beyond Math 79. For most, this was the first COSC course they had ever taken. This wide range of preparation was addressed by adding many extra office hours to help bridge this "chasm" and having the IBL activities targeted at all levels. This spectrum approach was meant to build up the skills of the lesser prepared, while also engaging the

Table 9: COSC 190, Spring 2017

	Evaluation Questions	Average Response
	I. Student Self-Evaluation	S2017
1.	I attended class regularly.	4.79
2.	I was academically prepared to handle the material.	4.25
3.	I came prepared for each class session (i.e. have read all course readings and completed assignments).	4.85
4.	I actively participated in class discussions.	4.56
5.	I attended scheduled office hours if I had questions about the course materials.	4.32
6.	I tried to relate course material to other things I know and/or study.	4.68
7.	I worked to my full potential in this course.	4.75
8.	I was satisfied with my performance in this course.	4.79
9.	I had a strong desire to take this course.	4.11
	Section Mean (Student)	4.56
	II. Course	
10.	This course had clear goals and objectives.	4.79
11.	This course was academically challenging.	4.89
12.	This course offered useful learning tools.	4.93
13.	This course had grading criteria that were clearly identified.	4.86
14.	This course improved my understanding of the material.	4.96
15.	This course increased my interest in the subject matter.	4.57
16.	Overall, I would recommend this course to others.	4.44
	Section Mean (Course)	4.78
	III. Professor	
17.	The professor used class time effectively and demonstrated preparation for class.	4.82
18.	The professor's teaching style and/or enthusiasm for the material strengthened my interest in the subject matter.	4.75
19.	The professor was able to explain complicated ideas.	4.79
20.	The professor challenged students to think critically and/or imaginatively about the course material.	4.82
21.	The professor provided clear and timely feedback.	4.68
22.	The professor encouraged meaningful class discussions.	4.81
23.	The professor was receptive to differing views.	4.73
24.	The professor was available for help outside of class.	5.00
25.	Overall, I would recommend this professor to others.	4.89
	Section Mean (Professor)	4.80

COSC 190 AI, Computer Vision, and Cognition Evaluations. 28 students reporting.

more advanced students. IBL included much 'scaffolding' to allow direction and reinforcement for all levels. For example, IBL projects had some hints and suggestions for direction and starter code was given for the computational parts of both the IBL and HW projects. If a student had a question or was stuck on a problem, I gave code for a simpler example where they gained ability and skills that could then be extrapolated to the next level. I found that teaching the course in this IBL setting catered to a wider audience. It was done in a way that was tangible, accessible, and inclusive to all levels by the methods and varying stratum of challenge in the materials.

A computer vision example from class involving retinex (color based on perception and context) can be seen in Fig. 1 (a) where the squares labeled A and B look to different due to shadowing. In (b), the students built a color bridge from A to B showing that they are the same! Another example is in Fig. 4 (a) in Appendix A.1, where a low contrast image is seen. In (b), a student equalized image is observed with vibrant colors. Students also used this technology on their low light 'selfie' photos, essentially creating a 'selfie' rescuing algorithm. These students now feel more secure taking photos in social gatherings regardless of the lighting conditions.

In the last topic we looked into one of the top trends today in technology, namely machine learning. The key idea is to automatically learn from data to make decisions. In the final project, we used machine learning to successfully tell within 96%+ accuracy, the differences between 1,900 handwritten digits obtained from the US Postal Service, after training on 11,500 such examples. Some of these actual digits can be seen in Fig. 5 in Appendix A.1.

The responses to the course look quite positive as seen in Table 9. By providing many office hours to help bridge the "chasm" of preparedness, the help outside of class category registered a 5.0/5.0 while the category pertaining to recommending this professor to others yielded a 4.89/5. The students seemed to find the course offering useful learning tools: 4.93/5 while also being academically challenging 4.89/5. They also found that the course improved their understanding of the material: 4.96/5. One of the main purposes of a CON1 course was understanding a field outside of their major discipline and this course achieved this. I think the IBL materials struck a balance between accessibility and challenge, and thus allowed for better understanding. I also noticed in the comments that some students were asking for a second semester to this course. In many ways, this is the ultimate compliment. Students seemed to really like the subject matter as one student wrote that the "subject matter was incredibly interesting" while others wrote that the course "made [them] wish [they] took more COSC" after taking this course. Some other comments include:

- "Professor worked with all students even though we were all at different levels.", "Dr. Park's helpfulness" (What were the best aspects of this course?)
- "The best aspects of this course was the eureka moment that I felt when I got the code to run. The professor made an extremely difficult concept easy to understand." (What were the best aspects of this course?)
- "Dr. Park is one of Whittier College's hidden treasure[s]. His passion, compassion, and humor are invaluable additions to the college" (What were the best aspects of this course?)
- "The professor's jokes." "hands on learning" (What were the best aspects of this course?)
- "This was such a fun course, it was really cool to see some more realistic/real world uses for programming" (What useful feedback could you provide the professor of this course?)
- "I only wish I could have taken the second semester of this class" (Please evaluate your own performance in this course)
- "It would be neat to have an upper division version of this course to learn the mathematical background for the algorithms." (What would you change about this course)
- "The best part of this course was learning something completely new, applying it to the everyday advancements in the news and technology that is changing the game, and tying it back into the paired course." (What were the best aspects of this course?)
- "This has been one of my favorite courses, thank you for all of your help and for a great experience. :)" (Please evaluate your own performance in this course)
- "I am overall very satisfied. Dr. Park is one of the best professors at Whittier College. He really wants everyone to succeed." (Please evaluate your own performance in this course)

From the comments, I can deduce that the students enjoyed the course, learned something useful, and found the material interesting. COSC 190 was the most rewarding teaching experience for me during my time at Whittier. There were significant challenges in the course that were overcome to offer a genuine COSC and math experience while relating to and incorporating cognitive psychological concepts. I am greatly looking forward to teaching this regularly as well as spinning it into an upper division course. For example, we can look into the hot topic of deep learning utilizing neural networks. This is the same technology used by Google in their language translation program and Apple in their face recognition technology (see iPhone X for example). I am very excited about the reception of this course and all the future possibilities.

2.2.10 Courses Not Recently Taught

In the following Table 10 are the weighted average response section means for courses that have not been taught recently. These scores along with those shown earlier in this section comprise all of the courses I taught in the past 5 years at Whittier College.

Table 10: Non Recently Taught Courses

Math Course (Year)	141B (F13)	241 (F13)	241 (F14)	242 (S14)	242 (S15)
I. Student Self-Evaluation	4.21	4.43	4.44	4.54	4.27
II. Course	4.61	4.65	4.85	4.80	4.70
III. Professor	4.60	4.41	4.98	4.71	4.82

Response scores for 141B seem quite good. There is a strong upward trend in Math 241 from F13 to F14 due to the changes described in my previous PEGP submission where the course was revamped for improvement. For Math 242, the response scores look constant and strong across two sequential years in the course and professor categories. I feel that for these courses, a good balance between IBL and lectures was obtained. I will continue to experiment with more IBL the next time I teach these again.

2.3 Trends in Evaluations

In Table 11 are the weighted section averages for each year from the student evaluations. This also includes the total weighted average over all years. In Table 12 are the weighted section averages for specific courses in the major, non-major, and COSC. The weighted average across all years as well as the average when omitting academic year F15/S16 are both included for comparison. In both tables, AVG: the weighted average across years, and Weights: number of students reporting per academic year. The number of students per year are: F12/S13 (69), F13/S14 (109), F14/S15 (80), F15/S16 (87), F16/S17 (96). Total number of students reporting from F12 to S17 is 441 (a 5 year span).

Table 11: Average Evaluation Response Scores from F2012-S2017

All Courses	**Weighted Average**					
	F12/S13	F13/S14	F14/S15	F15/S16	F16/S17	AVG
I. Student Self-Evaluation	4.29	4.25	4.49	4.10	4.53	4.33
II. Course	4.68	4.58	4.83	4.28	4.73	4.61
III. Professor	4.76	4.57	4.88	4.41	4.77	4.67

In Table 11 are the weighted average across all courses taught at Whittier registered a 4.33/5 for the student, 4.61/5 for the course, and 4.67/5 for the professor. This includes non-major Lib.

Table 12: Average Evaluation Response Scores for Specific Courses

Specific Courses	Weighted Average				
	All Yrs.	Omit F15/S16	Non-Majors	Majors	COSC
I. Student Self-Evaluation	4.33	4.39	4.16	4.45	4.52
II. Course	4.61	4.70	4.49	4.71	4.74
III. Professor	4.67	4.73	4.61	4.71	4.78

Ed. requirement courses as well as courses for either the math or ICS major. In the course and professor categories, the numbers are quite strong. This shows an ability for myself to teach a wide range of courses across the curriculum. There is a dip in the scores across all student, course, and professor categories for F15/S16 which coincides with the year of the SLC renovation. Besides F15/S16, the average evals per year are quite positive. F15/S16 is lower in relation to the other years, but still well above a 4.00/5 in both the course and professor categories. If I omit this year in the total average over all years, as seen in Table 12, we obtain a 4.39/5 for the students, 4.7/5 for the course, and a 4.73/5 for the professor.

In Table 12, we see the weighted averages when breaking the courses into non-majors, majors, and COSC categories. Scores for the non-majors include a 4.49/5 for the course and a 4.61/5 for the professor. The non-major courses are courses that satisfy the Lib. Ed. curriculum: COM1 (9 instances), CON1 (1 instance), and the College Writing Seminar (1 instance). For the majors, the average is 4.71/5 for both the course and professor. For COSC courses, the weighted average is 4.74/5 for the course and 4.78/5 for the professor. This exhibits my ability to not only teach math and COSC courses favorably, but also courses for the non-major as well.

From the overall trends, I feel that I am getting closer to finding the optimal balance of IBL, lectures, and technology utilization in the classroom. In the past two years I have experimented with adding more IBL and computation to my courses. From the most recent upward trend viewed in F16/S17, I feel that successful integration of these is being achieved.

Even with a strong showing in my evaluation averages over the years, there will always be room for improvement as student demographics, preparation, and course materials continually evolve. I feel that my approach has been robust during my time here at Whittier despite an ever changing student population. I look forward to seeing more long term trends in the future.

2.4 Current and Future Courses

2.4.1 Current Courses

I am currently teaching the following courses:

1. Math 354: Mathematical Modeling
2. Math 79: Quantitative Reasoning
3. COSC 120: Computer Science I
4. Math 491A/B: Senior Seminar.

Math 354 is an applied math course on modeling similar to the one I taught in the S13 and F15 with some changes in material to include machine learning. This course is very interdisciplinary and I have students from business, STEM, social sciences, and 3/2 engineering. Math 79 this semester is being taught similarly to the course in F15. We are experimenting with new software natively installed on student devices. COSC 120 is similar to the course I taught in F16 but with more in-class projects. Math 491A/B is our senior seminar course.

2.4.2 Future Courses: Paired Course and Machine Learning Course

In my previous PEGP I spoke about either teaching a paired course with Psychology and/or teaching a collaborative course with Business Administration (BSAD). I taught the pair with Psychology this past S17 in COSC 190. I decided not to pursue the collaboration with BSAD since I had already committed to the paired course. In the future, I am planning another pair with Josh Haworth from KNS. We will pair a variant of my COSC 190 course with one of his (possibly biomechanics). The goal would be to tie together biomechanics and machine learning. We will look into how a computer can learn human movements and give suggestions on the observed movements. For example, it will be able to discern between a bicep curl versus a tricep press and even tell if the form is correct or not. This has numerous applications to physical therapy. I am also considering creating a spin off of COSC 190 into an upper division computer science course for the new integrated computer science major (ICS). I am planning a sabbatical at both the UCI Math and Computer Science Departments to learn ML at a deeper level. I can then bring back those tools to be used in the development of the aforementioned courses and also for undergraduate research.

2.5 Teaching Growth

In my previous PEGP I spoke about the possibility of attending another IBL workshop to deepen my knowledge. My goal is to have new techniques to utilize in my courses often. Attending workshops on IBL will facilitate this and I plan on attending one during my sabbatical year.

3 Scholarship

Whittier College utilizes Boyer's model to evaluate scholarship. This particular model of scholarship includes four different categories as follows: the scholarship of discovery, the scholarship of integration, the scholarship of application, and the scholarship of teaching. I address my contributions to each category below.

My primary area of research is in variational mathematical image processing and computer vision. Here, my goal is to find novel mathematical models for particular image processing and computer vision tasks. Moreover, I also work in finding fast numerical algorithms associated to these models. Image processing can be thought of as the use of mathematical techniques to manipulate images in order to solve a myriad of imaging problems. Computer vision can be viewed as a form of pattern recognition. Some image processing and computer vision tasks can include:

1. Image Restoration: to restore or repair degraded images. Some specific problems are
   - de-noising: removing noise or spurious oscillations from a given image
   - de-blurring: reconstructing a sharply focused image from a blurry image
2. Image Segmentation: identifying and extracting salient features in a given image
3. Image Decomposition: breaking an image into additive sums of components where each component has a specific geometric property. e.g. texture and structure.

Current research topics include non-convex optimization with applications to segmentation and tracking, and machine learning using neural networks.

In addition to the above mentioned image processing/computer vision problems, I have also worked on a computer graphics related problem of point cloud surface reconstruction. This basically amounts to having a set of data points in space with no specific ordering or connection and fitting a smooth surface to these points while capturing all geometric properties and fine details. The approach was a mix of computer vision, graphics, and mathematics.

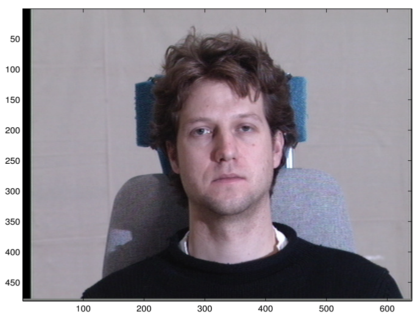
3.1 Point Cloud Surface Reconstruction

As mentioned in my previous PEGP, this paper was published in February of 2013 in the Journal of Scientific Computing:

> *"Robust and Efficient Implicit Surface Reconstruction for Point Clouds Based on Convexified Image Segmentation,"* Journal of Scientific Computing, 54:2-3, Feb. 2013.

The method is shown to outperform the current state of the art in point cloud surface reconstruction. An example can be seen in Figure 6 in Appendix A.1. This work falls under the scholarship of discovery and application. A copy of the paper can be found in my backing documents.

3.2 Face Tracking via Convexified Segmentation



(a) Color Facial Image

(b) Final Ellipse Fit Face Detection

Figure 2: Face Detection with Ellipse Fitting.

In the summer of 2013, I was hired as a paid visiting researcher in the department of mathematics at UCI under the mentorship of Jack Xin on a real time face tracking project. This was a joint project with Math and Computer Science (CS) where we collaborated with visiting professor Xiaohua Shi from the CS department at Beihang University. Xiaohua is a prominent researcher and brings his expertise in parallel computing to this project. Our goal was to develop a real time face tracking algorithm. The development was two part:

1. Develop a mathematical method to robustly segment and track faces in video frames
2. Fast implementation on a Graphics Processing Unit (GPU): implement and optimize code from part 1 onto a GPU to obtain speed increases to real time 1/25th of a second.

We are at the end of stage 2 in this development and the manuscript from part 1 has been submitted to a journal and is currently under review. Part 2 was published in August 2015:

> *"Parallelization of a color-entropy preprocessed ChanVese model for face contour detection on multi-core CPU and GPU,"*
> Xiaohua Shi, Fredrick Park, Lina Wang, Jack Xin, and Yingyong Qi.
> Parallel Computing, August 2015, pp. 28-49.

Real time video demos of the method can be found on my webpage: `www.fredpark.com/research` This work is the fastest documented implementation of a convex relaxed formulation of the two-phase Chan-Vese model in the literature. It is a significant contribution to the mathematical image processing and computer vision field. A face detection result result from this method can be found in Figure 2. Under departmental guidelines for research, this work falls under the scholarship of discovery and integration. The paper can be found in my backing documents. Part 1 (modeling) of this project is currently under review from an international journal and the manuscript can be found in my backing documents. Thus, both stages are essentially complete at the time of this PEGP submission and this project, as outlined above, is complete.

3.3 Shape Prior Image Segmentation and Disocclusion

In addition to the above point cloud research work, I have made contributions in the field of mathematical image processing and computer vision by way of the following work that was published in September of 2015:

> *"Image Segmentation Using Clique Based Shape Prior and the Mumford Shah Functional,"* Fredrick Park.
> Published in Proceedings of the 2015 IEEE International Conference on Image Processing (ICIP), September 27-30th, 2015, Quebec City, Canada.

IEEE stands for the Institute of Electrical and Electronics Engineers and is the "world's largest professional association for the advancement of technology." IEEE ICIP is described as:
The International Conference on Image Processing (ICIP), sponsored by the IEEE Signal Processing Society, is the premier forum for the presentation of technological advances and research results in the fields of theoretical, experimental, and applied image and video processing.

This was a solo work and the paper was recognized as part of the Top 10% papers in ICIP 2015. Publication in this conference requires a 3 referee review panel, the same rigorous standards as required for journal acceptance. The top 10% designation was decided based on comments and feedback from these reviewers. In the field of mathematical image processing and computer vision, conference attendance and publications are an integral part of a research program given the technological and innovative emphasis. An example of shape prior segmentation from the proposed method can be found in Figure 7 in Appendix A.1. Video demos of the method can be found on my webpage: `www.fredpark.com/research`

3.4 Non-Convex Optimization with Applications to Segmentation and Tracking

(a) Convex   (b) Non-Convex

Figure 3: Results from Non-Convex Optimization.

In my second PEGP submission, I spoke about a new project in non-convex optimization with applications to image processing. The first part of this work has been realized as I have made a recent contribution in the field of mathematical image processing and computer vision by way of the following paper published in September of 2016:

> *"A Weighted Difference of Anisotropic and Isotropic Total Variation for Relaxed Mumford-Shah Image Segmentation,"* Fredrick Park.
>
> Published in Proceedings of the 2016 IEEE International Conference on Image Processing (ICIP), September 25-28th, 2016, Phoenix, Arizona, USA.

Coauthors for this work include Yifei Lou (Assist. Prof. at Univ. Texas Dallas) and Jack Xin (Professor of Math at UC Irvine), both prominent experts in signal processing; Jack is world renowned in this field. In the field of mathematical image processing and computer vision, conference publications and attendance are an integral part of a research program. ICIP is one of the largest image processing conferences in the world and this was the 23rd year it has taken place. This particular conference was sponsored by Google, YouTube, Intel, Qualcomm, and Disney Research to name a few. I presented a poster of my work at this conference. An example of segmentation from the proposed method can be found in Fig. 3 where in (a) is the standard result from convex optimization where the chair leg cannot be segmented properly, regardless the choice of parameters. In (b) is the proposed result from a non-convex energy yielding a properly segmented chair leg. Video demos of the method can be found on my webpage: `www.fredpark.com/research`

One of FPCs comments was regarding the completion of projects. Despite the completion of the earlier mentioned face tracking project comprised of 2 stages, in many ways, it will in a sense never be fully complete. I, as most others in my field, will always have a relentless pursuit of improvement in speed, robustness, and accuracy in methodology that drives us in the direction of research. No research is ever complete and many projects spin off into new ones. Successfully completing stages is important. For example, in my new work involving non-convex optimization, the first stage has been completed and published. We are currently looking into a second stage involving a convergence proof of the method. Either stage can serve as an individual project, and thus stage one is a completed project. Completing multiple stages shows progress in research, however, there is no real end to research as long as intellectual curiosity persists. In this theme, I am currently looking into incorporating a machine learning approach into my existing facial boundary detection and tracking methodology, earlier discussed, for further improvements.

Current and future research work includes a non-parametric Radon based shape prior segmentation method, convergence analysis for non-convex functional minimization with applications to segmentation, and a machine learning project on image classification. The Radon shape prior project is in the preliminary testing phase of the model and I include preliminary results in the backing documents (confidentiality requested as this is unpublished). The ML project on diabetic retinopathy mentioned in my previous PEGP has moved into a different direction and has now morphed into an image classification project, giving wider impact. I plan to delve deeper into ML during my sabbatical as I am planning on a dual visit in both the UCI math and CS departments. I look forward to seeing the products from my sabbatical.

FPC has also asked that I reflect on how my research work has informed my work as a teacher–scholar. I feel that my research ties into the main premise of my teaching statement on vertical integration. I have been able to integrate aspects of my research naturally and directly into my courses (COSC 190, Math 354, Math 350) as well as into undergraduate research by way of senior seminar in the following related projects:

1. Anastasia Bergara: *Variational Image Segmentation Utilizing the Chan Vese Model with Applications to Medical Imaging*

2. Crystabel Camacho: *Image Deblurring Using the Backward Heat Equation*
3. Callie Mitchell: *Image Denoising by Non-local Means*
4. Patrick Hagman: *Nonlinear Conjugate Gradient Method with Applications to Pokemon*
5. Lauren Gandi: *Variational Image Super-Resolution*
6. Ann Bailleul: *Machine Learning with Linear Regression, Logistic Regression, and Applications.*

Samples of the above works can be found in my backing documents. I look forward to further integrating my research work into multiple levels of teaching. Acquiring more machine learning knowledge during my sabbatical will allow for more course development and undergraduate research in that field. Thus, further reinforcing the teacher–scholar paradigm.

3.5 Journal Referee

According to departmental guidelines, scholarship of discovery also includes referee work for journals. I have been a referee for several mathematical image processing and computer vision journals since I have been at Whittier including:

- IEEE Transactions on Image Processing (TIP) (2012, 2014, 2016), 3 papers refereed
- Inverse Problems in Imaging (2013), 1 paper refereed
- Mathematical Problems in Engineering (2013), 1 paper refereed
- International Journal of Applied and Computational Mathematics (2017), 1 paper refereed
- Nonlinear Analysis Series B: Real World Applications (2016), 1 paper refereed.

It is my professional duty to peer review work that is in my field of expertise. I also wanted to note that IEEE TIP is one of the top journals (by impact factor) in the field of image processing and the journal I have done the most referee work for.

3.6 Presentations

I have also given two talks here at Whittier to stimulate interest from both faculty and students in my work that I discussed in my previous PEGP submissions. These include:

- Math club talk: "Some Undergraduate Research Topics in Image Processing and Computer Vision" September 12th, 2012.
- Hartley House Talk: "Image Processing and Computer Vision: Research and Applications" November 13th, 2012.

In addition to these talks at Whittier, I have also given the following talk at UCI in 2013 on research in applied mathematics.

- UCI Interdisciplinary and Computational Applied Mathematics Program (iCAMP): "Research in Image Processing and Computer Vision" July 30th, 2013.

In regard to research presentations, I have given the following 3 recently:

- Show & Tell Demo: *"Shape Prior Segmentation and Disocclusion,"* 2015 IEEE International Conference on Image Processing (ICIP), September 27-30th, 2015, Quebec City, Canada. 2 hour real time demo of my proposed method. Only 34/1048 accepted papers at the conference were given this opportunity.
- Poster Presentation: *"Image Segmentation Using Clique Based Shape Prior and the Mumford Shah Functional,"* 2015 IEEE International Conference on Image Processing (ICIP), September 27-30th, 2015, Quebec City, Canada.
- Poster Presentation: *"A Weighted Difference of Anisotropic and Isotropic Total Variation for Relaxed Mumford-Shah Image Segmentation,"* 2016 IEEE International Conference on Image Processing (ICIP), September 25-28th, 2016, Phoenix, Arizona, USA.

3.7 Undergraduate Research

I have been successful in the past with undergraduate research from my mentor work in two UCI REUs that led to a publication in the SIAM Undergraduate Research Journal in 2013 (SIURO vol. 6). I have utilized this mentoring experience to involve Whittier students in research in the past and am currently working with the following student: Julian Droetti (Math Major, Whittier 18'), *Image Classification via Neural Networks.* Integrating undergraduates into research is important since these students have a higher probability of entering graduate school or gaining employment after college. Such research also deepens and broadens knowledge base in mathematics.

In addition to the above, I also advised an HHMI SMART Fellow for 1 year in 2014. We worked on a traffic modeling problem using machine learning. In the future, it is entirely possible that we will have more scholarship students wanting to do research projects in applied mathematics.

4 Advising

4.1 First Year Pairs Advising

In the F13, I took on 15 freshmen advisees by linking my Math 79 course with freshmen writing. For F15, while teaching INTD 100, I took on 15 new freshmen advisees and 1 transfer advisee. My goal with these students is to get them acquainted with college life and integrated into the Whittier community.

4.2 Trends in Advising

During my time at Whittier, advising has followed the trends shown below:

Fall 2013 Advising (19 students):
- 4 students in their primary or secondary major
- 15 freshman

Spring 2014 Advising (17 students):
- 5 students in their primary or secondary major
- 12 freshman

Fall 2014 Advising (14 students):
- 6 students in their primary or secondary major
- 8 students transitioning to their majors

Spring 2015 Advising (11 students):
- 9 students in their primary or secondary major
- 2 students transitioning to their majors

Fall 2015 Advising (27 students):
- 9 students in their primary or secondary major
- 15 freshman and 1 transfer student
- 2 students transitioning to their majors.

Spring 2016 Advising (27 students):
- 9 students in their primary or secondary major
- 15 freshman and 1 transfer student
- 2 students transitioning to their majors.

Fall 2016 Advising (27 students):
- 13 students in their primary or secondary major
- 1 WSP student
- 13 students transitioning to their majors

Spring 2017 Advising (20 students):
- 14 students in their primary or secondary major
- 1 WSP student
- 5 students transitioning to their majors

Fall 2017 Advising (16 students):
- 10 students in their primary or secondary major
- 1 WSP student
- 5 students transitioning to their majors.

In academic year F15/S16 I advised 27 students. Of these, 15 were freshman and 1 a transfer student by way of my INTD 100 linked course. During that year, I had 9 in either their primary or secondary majors. I advised 27 students in years F15, S16, and F16. In the last two years, the number of students being advised in their primary or secondary majors has increased. In F16 I had 13, in S17 14, and in F17 I currently have 10. These include a wider variety of majors including Math, Math & Physics double, Math-Business, Engineering 3/2 Math, and Math &

Economics. In F16 I also started advising a Whittier Scholars Program (WSP) major on the topic: *Social Space: Theory and Design.* In the S17, I began advising an Integrated Computer Science-Math major as well as an Engineering 3/2 Computer Science Major. Some of my advisees and senior seminar students have gone on to work at places like The Irvine Company, Goldman Sachs, and Raytheon to name a few.

4.3 Letters of Recommendation

From F15-S17, I wrote letters for 8 students. Many included multiple letters since some were for research experience for undergraduates (REU) programs, while others were for graduate school. In particular, for two of the letters written for REUs in 2017, both students were successfully admitted to an REU at Texas A&M and UCLA Research in Industrial Projects for Students (RIPS) Program. Both are highly selective and acceptance is difficult. In both instances, it was the first time a student was admitted to the program from Whittier College. For graduate schools, 2 of the 2 applying recently were successfully admitted into at least one program of interest to them. As evident from my recent letters for REUs and graduate programs above, I am currently having a higher success rate with students being accepted into highly competitive programs.

5 Service

5.1 Committee Work

Committees or sub-committees I served on in academic years 2015-2017 includes:

1. ESAC (2014-2017)
2. First Year Reading Subcommittee of ESAC (2015-2016)
3. INTD 101 Subcommittee (Spring 2017)
4. HSI/MSI Subcommittee (2016-2017)
5. Fellowships Committee (2016-present)
6. Academic Appeals/Review Committee (Jan 2016, Summer 2016)
7. Academic Dishonesty Review Committee (Jan 2016).

I also served on the following task forces, planning meetings, or as a fellowship advisor:

1. Retention Task force and retreat (Jan 2016)
2. Faculty Master House Planning Meeting (Spring 2016)
3. Goldwater Fellowship Advisor (Jan 2016-Present).

I served on ERC my first two years and ESAC the past 3 years. ESAC has broadened and deepened my understanding about how the college works. Serving on multiple subcommittees allowed for more specialized understanding. ESAC outcomes the past 2 years include: test optional recommendation, revision of academic dishonesty policy, ESAC service in student life, revision of roles of peer mentors and orientation week leaders, early registration policy information, and INTD 101. The INTD101 pilot for F17 is one of the largest fruits of labors of ESAC in recent memory and I look forward to contributing more to the college in this manner.

5.2 Other College Service

I represented the math department at the President's Reception for Admitted Students during the spring semester in 2015, 2016, and 2017. I was also a representative in fall 2016 for the exploring majors event. In fall of 2017, I served on an orientation panel for new faculty. I also was invited and attended the Whittier Board of Trustees hosted conference: *What Matters Most in the Undergraduate Experience at Whittier* this past October 6-7th, 2017. Here, my role was to work with staff, board members, and faculty on short and midterm solutions to increase student engagement and learning. I am very honored to have been invited to such an important event.

5.3 Department Service

Some department service for F15-S17 includes:

1. Math Club and Pi Mu Epsilon (PME) advisor 2013–Present
2. PME induction ceremony in 2016, invited speaker: David Weisbart (UCR), 10 students inducted
3. PME induction of 3 students in 2017
4. Took part in 4 VAP searches from 2014–2017
5. Took part in a tenure track search for ICS faculty in academic year 2016–2017
6. Organized a "3/2 Engineering and Beyond" talk with 4 alumni serving on a panel (S17)
7. 3 senior seminar student projects advised (F15–S17)
8. 7 total senior seminar student projects advised from (F12–S17)
9. Took part in the Western Association of Schools and Colleges (WASC) accredidation department self study (F16–Present).

6 Closing Remarks

Since arriving at Whittier in the fall of 2012, my teaching ability and methodology has grown immensely. I have gained new techniques as well as used compelling technology in the classroom. I have expanded my courses to include a broad range in both math and computer science as well as outside the major. I have taught 17 classes that count towards some form of either the math or ICS major or associated minors. Many of these courses count towards majors and minors outside of math and ICS, and serve the college entirely. I have contributed to the liberal education curriculum by teaching 9 COM1 courses, 1 CON1 course, and 1 FWS course, for a total of 11, all outside the major. I have advised 7 senior seminar projects and am currently advising a WSP student. I have written numerous letters of recommendation for students applying to graduate programs, research programs, fellowships, and more.

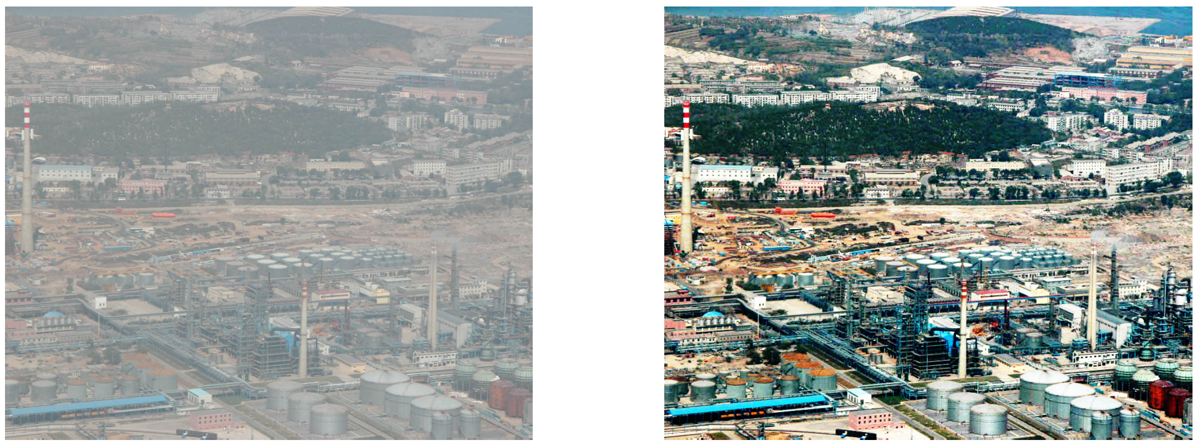
I have served on ERC, ESAC, and Fellowships as well as served on a number of sub-committees and a task force. I have represented my department at college events and also during the SLC renovation planning meetings. I even recently attended and participated in a Board of Trustees sponsored conference.

My scholarship has grown significantly during my time at Whittier. I have published 4 papers in the past 5 years, currently have another manuscript under review, and presented at a premier image processing and computer vision conference on three occasions. One of my papers was designated a top 10% out of all papers at one of these very conferences; and thus showing that I am able to conduct top level research on an international level at a liberal arts institution. I have worked with collaborators outside of the college and in diverse fields. I have conducted undergraduate research with many students and I am greatly looking forward to continuing with my research in various directions in the future.

In short, my academic career has flourished since arriving at Whittier College. I feel a strong connection to the institution, my students, the faculty, and my department. I want to thank FPC for your time and energy in reviewing this submission regarding my tenure application.

A Appendices

A.1 Additional Figures



(a) Original Image (b) Histogram Equalized Image

Figure 4: *Computer Vision:* Automatic histogram equalization in COSC 190.

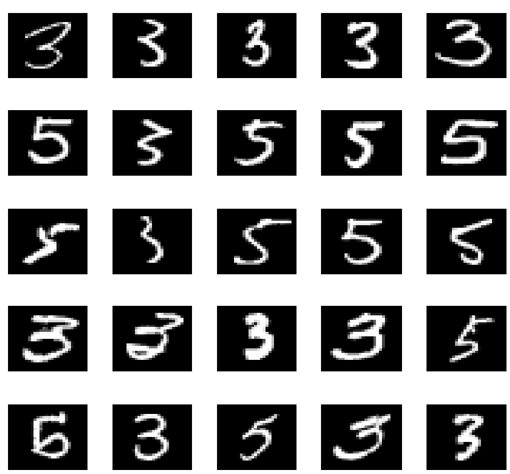
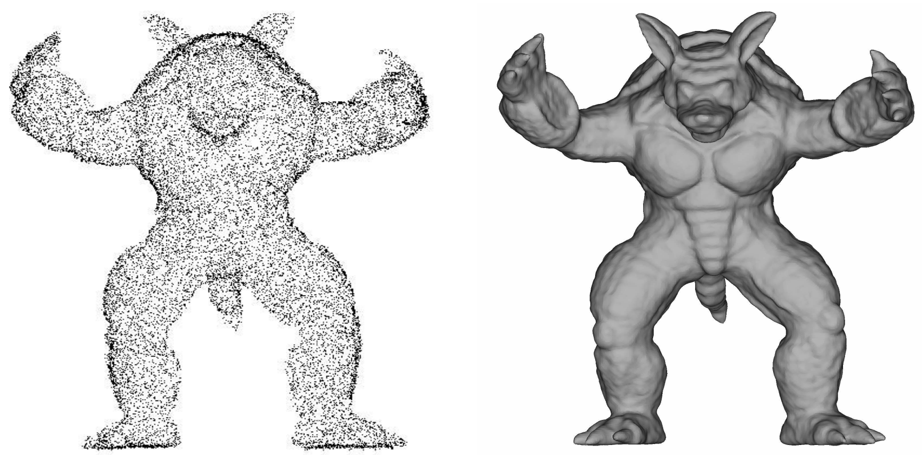


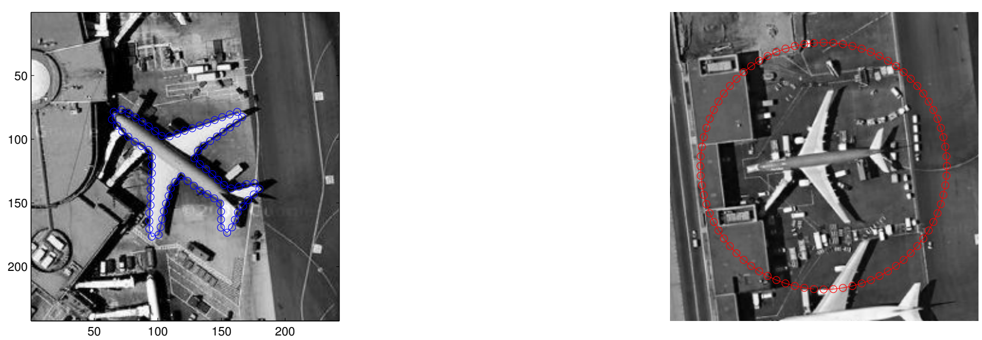
Figure 5: *Machine Learning:* Some handwritten digits from the MNIST database that the computer learned to identify.



(a)
Cloud of Sparse Points in 3D

(b)
Surface Reconstruction of Points

Figure 6: ***Point Cloud Reconstruction of an Armadillo from the Stanford Database***



(a) Reference Shape

(b) Initial Contour

(c) Shape Param. = 0.0

(d) Shape Param. = 1.0

Figure 7: ***Shape Prior Segmentation.*** **A learned reference shape in (a) while in (b) an initial contour is seen. Segmentation result without shape in (c) while a succesful result from the proposed model is observed in (d).**

A.2 Math 345A Spring 2015

> **Math 345* A,B Differential Equations I, II** The theory of first-and second-order ordinary differential equations including their series solutions, introduction to Laplace Transforms with applications, including the solutions of differential equations, systems of ordinary linear differential equations, introduction to Fourier Series and integrals with applications, difference equations, partial differential equations with applications, introduction to the boundary and initial value problems and their applications. Also other selected topics in ordinary and partial differential equations depending on the particular emphases of the students in the class. Prerequisite: 242. Two semesters, 3 credits each.

I have taken differential equations courses at both the undergraduate and graduate level and have taught several different courses on differential equations at UCLA and UCI. The main goal for this course is two fold: 1. understand the qualitative theory of differential equations and 2. the intimate connections between the theory with both the associated computations and resulting applications. In short, without the theoretical understanding, one could not begin to look into applications. With this in mind, I tailored the course around this principle. I also utilized a Modified Moore Method for this course. Active learning was a good component of the class time, but given the amount of material to be covered in a short span, I would mix lecture with student in class work that consisted of active learning exercises. One class presentation (10%), HW (20%) (due every 1-2 weeks floating deadline), a take home midterm exam (30%), and an in class final exam (40%). For the in class student presentation, both the student giving the presentation was graded on knowledge, ability to explain the material to the class coherently, and ability to answer questions from the class. This was based on a 10 point rubric for each category and the final score was an average. During the presentations, the class was also graded on their ability to ask insightful questions and to find any mistakes from the presenter. We also utilized the BYOD and VCL to access Matlab for in-class computational exercises.

I taught this course in the Fall of 2012 (F12) to much success as noted in my previous PEGP. For S15 course, it has now become one of the core transfer courses for the USC 3/2 engineering program. In fact, my course topic breakdown (along with Damien Martin's 345A syllabus) was submitted by Bill Kronholm to USC and led to 345A being accepted in the transfer agreement with them. This more than doubled the enrollment and allowed for a more diverse class. Unfortunately, math 242 is no longer a pre-requisite and I am now incorporating some of the needed linear algebra into the course on top of the previous differential equations material. At this point, there is no straightforward solution given the tight constraints with the courses in the 3/2 engineering program.

From the student comments, they seemed to really enjoy the class. In fact, they wanted more active learning. If I teach this course again, I think I would have more group and board work to satisfy this request. Perhaps up the amount of student presentations to 3 total and adjust the class format to consist of 25% lecture and 75% in class exercise work. Overall, the class was an overwhelming success. I do like having the take home midterm with 50% back. I had some comments from my colleagues that the 345A students were working diligently for many many hours on both the take home midterm and the subsequent re-do. The whole point was to get them working hard and thinking about mathematics. Simple things like this particular style of exam for upper division students seemed to work well. In fact, the average time needed to complete the midterm exam was in excess of 20 hours. The students learned the true meaning of grit and determination in finishing such an exam.

In Table 12, the course evaluation scores are displayed. Nine of the questions pertaining to the course and professor had an average response of 4.9/5 or higher. In particular, from question

Table 13: Math 345A, Fall 2012 and Spring 2015, 22 Students

Evaluation Questions		Average Response	
	I. Student Self-Evaluation	F12	S15
1.	I attended class regularly.	4.90	4.91
2.	I was academically prepared to handle the material.	4.70	4.68
3.	I came prepared for each class session (i.e. have read all course readings and completed assignments).	4.60	4.73
4.	I actively participated in class discussions.	4.50	4.59
5.	I attended scheduled office hours if I had questions about the course materials.	4.22	4.32
6.	I tried to relate course material to other things I know and/or study.	4.80	4.73
7.	I worked to my full potential in this course.	4.60	4.73
8.	I was satisfied with my performance in this course.	4.50	4.64
9.	I had a strong desire to take this course.	4.50	4.68
	II. Course		
10.	This course had clear goals and objectives.	5.00	4.86
11.	This course was academically challenging.	5.00	4.95
12.	This course offered useful learning tools.	4.90	4.91
13.	This course had grading criteria that were clearly identified.	4.80	4.91
14.	This course improved my understanding of the material.	4.90	4.91
15.	This course increased my interest in the subject matter.	4.80	4.82
16.	Overall, I would recommend this course to others.	4.80	4.73
	III. Professor		
17.	The professor used class time effectively and demonstrated preparation for class.	5.00	4.95
18.	The professor's teaching style and/or enthusiasm for the material strengthened my interest in the subject matter.	5.00	4.91
19.	The professor was able to explain complicated ideas.	5.00	4.95
20.	The professor challenged students to think critically and/or imaginatively about the course material.	5.00	5.00
21.	The professor provided clear and timely feedback.	4.30	4.59
22.	The professor encouraged meaningful class discussions.	4.90	4.91
23.	The professor was receptive to differing views.	4.89	4.85
24.	The professor was available for help outside of class.	4.70	4.86
25.	Overall, I would recommend this professor to others.	5.00	4.86

20: "The professor challenged students to think critically and/or imaginatively about the course material," I obtained a 5/5 average response score. My key goal was to get them to think on this level and to not only internalize the methodology of differential equations, but to think of real world applications. One of the lowest response scores from my previous F12 course was for question 21: "The professor provided clear and timely feedback" where the score for this was 4.3/5. For this S15 course, I utilized a floating deadline for the HW that was calibrated to where we were exactly in the lectures. HW was due every 1-2 weeks depending on our schedule. Doing so led to a score of 4.59/5 for the S15 course which was a measurable difference. Nonetheless, I am still getting a few comments asking for smaller and more frequently due assignments, while others stated that feedback was timely. I am at a loss at this point of what to do. Weekly assignments can be one solution, but then some assignments would have very few problems, while others even more and I would be back to square one. Either way, I will experiment more in future iterations of this course. Another comment that I found amusing was one stating “No Typo” and also those directed to question 1a on the midterm. They are both one and the same. The comment stated “No Typo” pertaining to problem 1a on the midterm was from myself to the class after no one in the class was able to solve it, and this was exactly correct. The students were wishing it was a typo since if one changes a sign on one of the terms in problem 1a, the DE becomes exact and it is straightforward to solve. There was no typo since, in general, my exams are not straightforward. For this problem, one checks exactness criteria and sees that it is not to be and then tries a combination of other methods to solve it. Many students assumed it was exact even though they checked the criteria and it clearly was not. Only 1 student successfully solved this problem during the subsequent re-do by correctly using a change of variables and realizing it is homogenous of degree 1. Point being that the “No Typo” comment was clearly stated “tongue in cheek” on the evaluations. Lastly, I wanted to state that despite having more than double the students as the last time I taught this course in F2012, 16 out of the 25 questions have the property that the scores from F12 and S15 are within 1/10 of a point of each other. Thus, showing consistency in my approach to this course.

A.3 Math 242 Spring 2014, Spring 2015

Math 242 is a semester long course on linear algebra and differential equations. From the course catalog, the description follows:

> **MATH 242 - Introduction to Elementary Applied Linear Algebra & Differential Equations** Introduction to linear algebra, including vector and matrix algebra, Gaussian elimination, determinants, real vector spaces, subspaces, dimension, the fundamental theorem of linear algebra, orthogonality, eigenvalues, and eigenvectors. Pre-req: A C- or better in MATH 141B 3 credits

This course consists of lecture 3 days a week and some lab work done sporadically during the semester. The lab utilizes the powerful scientific computational tool Matlab. Each class meeting was for a period of 50 minutes.

For spring 2014 (S14), the course consisted of linear algebra and differential equations (DE’s). For spring 2015 (S2015), the course consisted of solely linear algebra and went much deeper into that topic at a much higher abstract level. Both semesters were new preps for me and for S14, it was the first time teaching the course at Whittier.

Grading was based on the following:

- for S14, homework (20%), two midterms (total 50%), and a final exam (30%)
- for S15, homework (15%), class presentation (5%), two midterms (total 50%), and a final exam (30%).

The homework also included graded active learning worksheets from class. I had 24 students in S14 and 21 in S15. Classes in general consist of lectures and group active learning work as outlined in my teaching statement above. I utilized IBL as much as possible. We also did lab work utilizing Matlab programming.

Homework is assigned every week. I assign a significant amount that allows students to see the patterns in solving a class of problems. Quizzes are also administered on a weekly basis, but I have the students, upon completion, swap their finished quizzes over to a fellow student for peer evaluation. The fellow student grades the quiz based on some of my input and returns it to the fellow student for instant feedback. I think that being able to solve problems in a time pressure situation and obtaining fast feedback is key to performance gains. Exams for this class consist of two midterm exams (50 minutes) and a two hour final exam. For the midterms, I grade them on a straight curve. I allowed the students to redo the graded exams for 50% credit back on the first exam only.

In Table 13, the questions pertaining to each element of the evaluation are presented from 1-25 along with the average response score. Questions 1-9 pertain to the student, 10-16 are questions about the course, and 17-25 are specifically about the professor. Overall, I was quite satisfied with the response scores. For question 11 "This course was academically challenging" the scores for spring 2014 (S14) and spring 2015 (S15) were 4.95/5 and 4.80/5 respectively. In relation, question 20 "The professor challenged students to think critically and/or imaginatively about the course material," the scores were 4.95/5 and 5/5 for S14 and S15 respectively. Clearly both courses were rigorous and challenging to the students. For question 21 "The professor provided clear and timely feedback" received scores of 4.35/5 and 4.65/5 for S14 and S15 respectively. This was a noticeable increase. Overall, I am satisfied with how both courses turned out. I did notice however that on question 8 "I was satisfied with my performance in this course" the scores were 4.55/5 and 4.15/5 for S14 and S15 respectively. I suspect the reason is that the F2015 iteration of 242 is much more abstract in nature and we spent quite a bit of time learning how to do basic proofs. These can be daunting for students new to abstract mathematics. I also noticed a score of 3.95/5 for S15 regarding the question 4 "I actively participated in class discussions." I am somewhat baffled by this response since the course was nearly a 50/50 split between IBL and lecture based format. This is something I will look into in further versions of this course.

Table 14: Math 242, Spring 2014, 24 Students, Spring 2015, 21 Students

Evaluation Questions		Average Response	
	I. Student Self-Evaluation	S2014	S2015
1.	I attended class regularly.	5.00	4.85
2.	I was academically prepared to handle the material.	4.75	4.55
3.	I came prepared for each class session (i.e. have read all course readings and completed assignments).	4.55	4.15
4.	I actively participated in class discussions.	4.30	3.95
5.	I attended scheduled office hours if I had questions about the course materials.	3.85	3.78
6.	I tried to relate course material to other things I know and/or study.	4.60	4.30
7.	I worked to my full potential in this course.	4.65	4.40
8.	I was satisfied with my performance in this course.	4.55	4.15
9.	I had a strong desire to take this course.	4.60	4.30
	II. Course		
10.	This course had clear goals and objectives.	4.85	4.85
11.	This course was academically challenging.	4.95	4.80
12.	This course offered useful learning tools.	4.80	4.75
13.	This course had grading criteria that were clearly identified.	4.90	4.60
14.	This course improved my understanding of the material.	4.75	4.85
15.	This course increased my interest in the subject matter.	4.65	4.55
16.	Overall, I would recommend this course to others.	4.70	4.50
	III. Professor		
17.	The professor used class time effectively and demonstrated preparation for class.	5.00	4.85
18.	The professor's teaching style and/or enthusiasm for the material strengthened my interest in the subject matter.	4.70	4.85
19.	The professor was able to explain complicated ideas.	4.75	4.85
20.	The professor challenged students to think critically and/or imaginatively about the course material.	4.95	5.00
21.	The professor provided clear and timely feedback.	4.35	4.65
22.	The professor encouraged meaningful class discussions.	4.58	4.80
23.	The professor was receptive to differing views.	4.59	4.60
24.	The professor was available for help outside of class.	4.70	5.00
25.	Overall, I would recommend this professor to others.	4.80	4.79