



Pioneer Research Program Evaluation Form

Pioneer Academics certifies the authenticity and rigor of the research study as well as the enclosed grade and evaluation content. *

Student name: Feng (Fred) Cheng

Evaluator name and full title: Carl Yerger, Associate Professor of Mathematics and Chair, Assistant Dean for Educational Policy

College/university and department: Davidson College

Full educational background of evaluator: BS, Harvey Mudd College, Master of Advanced Study, University of Cambridge, PhD, Georgia Institute of Technology

Pioneer Program title and title of student's research project topic: Program title: Introduction to Combinatorics and Graph Theory; Student project topic: The Fundamentals of Extremal Graph Theory

Please briefly explain the nature and requirements of the research project and your interaction with the student: Fred was asked to write a research project extending a topic discussed in our initial course sessions. We examined an area of structural graph theory that we were unable to cover in our group sessions called extremal graph theory. This sub-field is concerned with finding upper and lower bounds related to particular graph properties subject to some sort of restriction. I met with Fred through online videoconferencing five times as part of 90-minute group classes and five times for 60-minute individual sessions.

Program grade A

Please rate the student in the following areas as compared to undergraduate students at your institution:

	Excellent	Good	Average	Below Average	Poor
Ability to form original ideas and concepts	x				
Ability to communicate thoughts in an effective and articulate manner	x				
Ability to synthesize and organize information from disparate sources	x				
Level of student's curiosity, aptitude and industriousness	x				

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How would you rate this student's potential for undergraduate level academic work at a top college/university?

One of the best I have encountered, top 5% <u>x</u>	Excellent, top 10% <u> </u>
Very Good, top 25% <u> </u>	Good, top 50% <u> </u>
Below Average <u> </u>	

Describe some of the student's strengths: Fred is a self-starter and a very organized student. I had to provide little direction other than describing what extremal graph theory was and naming important theorems. Fred was able to research and find some proofs of results that I (whose PhD is in graph theory) have never heard of. This was really impressive. Fred's project is a very detailed exposition of fundamental results in extremal graph theory. Specifically, Fred gave four different proofs of Mantel's theorem, one of the basic results in this area. He also gave two proofs of Turan's theorem, proved Goodman's theorem and proved a number of other fundamental results.

All of this work was very well-written. In fact, I could see myself using Fred's work as the basis for an expository talk at Davidson or a "team time" group activity with the Charlotte Math Club (a community organization I organize). Fred's proofs were explained clearly and the figures provided help the reader better understand his ideas. Everything was very professionally done.

Describe some areas in which the student can improve: Perhaps the results of the project could have been connected in a clearer way for the uninitiated reader. Overall, Fred's project was excellent!

While the second half of the research work was one-to-one with the professor, the first half involved a small research cohort of 2-5 students. Describe the contribution that the student made to research group discussion and learning:

Fred was a good contributor to class discussions. He answered some of the "in-class activities" very well when he volunteered his solution to the class. In addition, Fred's homework assignments were all well done. There was a nice efficiency to his solution techniques.

Would you recommend this student to a college admissions officer at a top college or university? Why or why not?

Definitely! Fred is a very strong student who is excited about mathematics. He is well-organized, persistent and a self-starter. Fred's English and mathematical writing skills are already at the level of many math majors at Davidson. He deserves the opportunity to learn mathematics at a top college or university. Fred would be an important contributor to departmental "math club" activities as well. I give Fred my highest possible recommendation.

Evaluator name (signed): Carl Yerger

Evaluator name (printed): Carl Yerger

Date: 10-8-2019

Evaluator contact details (email and phone): cayerger@davidson.edu 704-894-2904

	Distinguished (A-range)	Proficient (B-range)	Apprentice (C-range)	Novice (D-range)
Demonstrates the ability to use mathematical reasoning with appropriate technology to solve problems	x			
Demonstrates the ability to test conjectures and judge the validity of arguments	x			
Demonstrates the ability to formulate valid arguments, check answers to determine reasonableness, and communicate reasoning and results	x			
Demonstrates the ability to recognize and use connections within mathematics and between mathematics and other disciplines		x		
Demonstrates the ability to utilize current scientific literature to formulate new research questions	x			
Demonstrates the ability to appropriately cite sources in discussion of results	x			

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Demonstrates the ability to apply basic results in graph theory and combinatorics to solve proof-based problems	x			
Demonstrates the ability to write clear and concise mathematical proofs	x			
Demonstrates the ability to synthesize multiple sources to write a research paper extending results from the program	x			