Investigating neural mechanisms of visual boundary detection using deep neural networks

Background and Motivation: Perhaps one of the most basic functions of the visual system is segmenting images into different regions by detecting the boundaries separating those regions. Although many boundaries in natural images can be readily detected using simple "first-order" cues like differences in luminance or color, many other boundaries are defined not by first-order cues but rather by differences in complex "second-order" cues like texture or contrast (Fig. 1). Although the neural mechanisms for detecting luminance boundaries are fairly well understood, the mechanisms employed for detecting texture boundaries remain unclear [1].

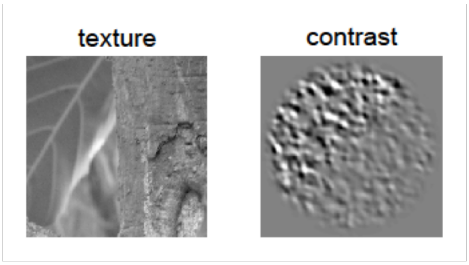

Figure 1: Boundaries defined by cues other than luminance (brightness) differences.

Primary Goal: We hope to gain insight into potential neural mechanisms for texture boundary detection by using machine learning to train biologically constrained neural models to detect natural texture boundaries. We are using biologically constrained neural models so that we can simulate the biological constraints that our human visual system experiences.

Neural Networks and Machine Learning: A *neural network* is a mathematical idealization of brain circuitry [2]. Fig. 2 illustrates a neural network whose task is to determine if a boundary is oriented left- or right-oblique. The input layer is a fixed set of first-stage filters (resembling neurons in primary visual cortex) that detect edges in the input image at multiple orientations and spatial scales. The outputs of this first layer are multiplied by a set of weights (blue lines), which describe how neurons in the hidden layer create a weighted sum of inputs from the first layer to detect feature combinations to diagnose the two categories. These weights are adjusted using a *machine learning* procedure to optimize model performance [2]. Finally, the outputs of these hidden units are multiplied by a second set of weights and summed to "vote" for each of the two stimulus categories (decision layer).

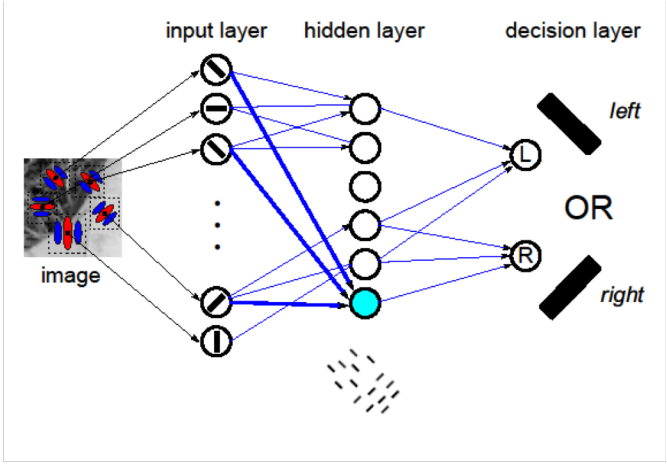

Figure 2: A three layer neural network which classifies a boundary as left- or right-oblique. When the modifiable weights (blue lines) are adjusted to optimize task performance, some hidden units (cyan unit) may learn to specialize for combinations of features (juxtaposed stripes of orthogonal orientation) which are diagnostic for some kinds of second-order boundaries.

Methodology: Specific Aims

(1) Develop a database of natural textures (done): We recently developed a massive database of natural textures for network training by selecting over 1000 texture regions, each containing ~1000 samples from a calibrated natural image database used in previous research [3, 4].

(2) Define neural network models and tasks (in progress): Currently we are working to define the neural models and tasks. The models will be similar to that in Fig. 2. The tasks will be to (1) Classify texture boundary orientation (left/right oblique), and (2) Classify which boundary category a particular exemplar belongs to (for instance, dog fur next to grass). These same tasks will also be performed on human subjects for direct comparison with model performance.

(3) Train models using GPU accelerated machines: Training the neural network models requires a large number of computationally expensive matrix operations, which can be greatly accelerated using specialized parallel computing hardware known as graphics processing units (GPUs). A number of machine learning studies have made use of GPUs and obtained tremendous speedups compared to standard CPU implementations, often by factors of 100x [5, 6].

(4) Interpret data: After the models are trained, we are interested in analyzing the structure of the hidden unit *receptive fields*, which describe how the hidden units integrate their inputs to detect features which may be diagnostic of a texture boundary. An example of a hypothetical hidden unit which detects texture boundaries defined by the juxtaposition of stripes having orthogonal orientations is shown in Fig. 2 (cyan unit in hidden layer). The model receptive fields will be compared with published neurophysiology literature on second-order boundary detection [7, 8], and used to make predictions of neural receptive field structure and psychophysical performance.

(5) Communicate results: Work will be presented at internal venues (FGCU Research Day, Whitaker STEMinars), external venues (Vision Sciences Society, CoSyNe, NIPS, etc…) and prepared for publication (see below).

Timeline: We expect this project to take 1-1.5 years. Chance will be graduating in Spring of 2019, so he will have a full 3 semesters plus 1 summer to work on this project. Charly will be graduating in Spring 2020 and will insure that we have ample time to complete all our goals. Specifically, goals (1) and (2) should be completed by Spring of 2018, (3) and (4) by Fall of 2018, and (5) by Spring 2019.

Student + Mentor Backgrounds: Chance Hamilton is regarded by the FGCU mathematics faculty as one of the best students in the Mathematics program, and he intends to apply to PhD programs in either Mathematics or Computer Science. He has taken many advanced math and computing courses directly relevant to machine learning.

Charly is currently working on his BS in Mathematics and Software Engineering here at FGCU. He actively attends every math seminar and colloquium that FGCU has hosted during his time here. He is very eager to gain experience in academic research and is regarded as a hard worker by many of his professors. This will be a first for him and so this is a perfect opportunity for him to learn from experienced researchers. Charly will be a valuable member of the team and will insure that we meet our deadlines.

Chance and Dr. Insko were awarded a Seidler Student/Faculty Collaborative Minigrant last summer to complete a project in computer vision and machine learning. Chance developed a machine learning algorithm that solved a difficult machine vision problem of recognizing a target (the cartoon character “Waldo”) in a cluttered background. His method identified Waldo in 100% of the 20 puzzles it was tested on, besting previous efforts by students at U. Iowa (78%). One of the original goals of Erik and Chance’s proposal submitted to the Seidler Fellowship was to apply their algorithm

and/or skill set to other FGCU faculty's research interests, and it is incredibly fortuitous that Dr. DiMattina reached out to them looking for student researchers.

Dr. Christopher DiMattina has a PhD in Neuroscience (Computational Neuroscience) and he has published several papers on neuroscience applications of neural networks and machine learning [9, 10]. Dr. Erik Insko has a PhD in Mathematics, and he has published several research articles in top mathematics journals (several with FGCU undergraduate coauthors) [11, 12, 13, 14]. Many of his research students are excited to study machine learning; Dr. DiMattina is happy to supervise them in the specific context of his research in Computational Neuroscience, and Dr. Insko is excited to learn from Dr. DiMattina's expertise in this area.

Research Outcomes: We are working on developing a computer program package that will provide insight on neural mechanisms for texture boundary detection. We aim to publish this work in a first-tier Neuroscience journal like PloS Computational Biology, Journal of Vision or Neural Computation, with Chance and Charly as a co-author. This publication will be used to help secure additional funding through NSF or NIH.

Student Growth: While working on this project Chance and Charly will gain invaluable experience in researching, writing, and presenting. Since Chance is planning to apply for PhD programs in either applied mathematics or computer science, this research project will help him further understand which field he wants to pursue if not both and make him highly marketable to any graduate program that he applies to. For Charly, this will be his first chance to conduct research on a topic. This without a doubt will give him valuable experience in the academic and professional world. Charly is still undecided if he would like attending graduate school and this opportunity will give him great insight as to if research is the right path for him. Regardless it will give him some much wanted experience before entering the workforce.

Benefit for FGCU: The proposed project will strengthen interactions between the department of Mathematics and various computational scientists at FGCU like Dr. DiMattina. Indeed, there is a currently a university-level proposal currently under consideration to create an interdisciplinary Center for Computational Modeling (CCM) at FGCU. Currently we have submitted a proposal for the Holmes Development Fund Award to secure the purchase of a GPU enabled computer for collaborative research, which will be a wonderful resource for students wanting to get experience with scientific computing, and we fully intend to share this resource with other FGCU faculty and students. Dr. DiMattina is also intending to apply for NSF funding (NSF-NCS: Integrative Strategies for Understanding Neural and Cognitive Systems) or NIH funding (R-15, National Eye Institute) during the 2018-2019 grant cycle to support future student research along these lines, possibly in conjunction with his collaborators at McGill University. Dr. Insko currently has a proposal pending to support up to 5 undergraduate students in the next academic year and plans to apply for NSF support to fund a summer REU in mathematics at FGCU next year.

REFERENCES

[1] Landy, M.S. (2014). In: The New Visual Neurosciences (Gazzaniga, Ed.). MIT Press.

[2] Goodfellow et al. (2016). Deep Learning. MIT Press.

[3] Olmos and Kingdom (2004). Perception 33(12): 1463-1473.

[4] DiMattina, Fox and Lewicki (2012). J. Vision. 12(13): 15, 1-20.

[5] Scherer et al. (2010). Artificial Neural Networks-ICANN 2010: 82-91.

[6] Ciresean et al. (2010). Neural Computation 22(12): 3207-3220.

[7] Mareschal and Baker (2001). Prog. Brain Res. 134: 171-191.

[8] Li et al. (2014). J. Neurosci. 34(36): 12081-12092.

[9] DiMattina and Zhang (2011). Neural Computation 23(9):2242-2288.

[10] DiMattina (2015). J. Vision. 15(9): 5, 1-20.

[11] Insko and Yong (2012). Transformation Groups 14(4). 1-26.

[12] Insko and Tymoczko (2016). Geometriae Dedicata 180(1): 95-116.

[13] David Blessing, Katie Johnson, Christie Mauretour, and Erik Insko. On (t,r) broadcast domination numbers of grids. Discrete Applied Mathematics 187: 19 – 40, 2015.

[14] Alexander Diaz-Lopez, Pamela E. Harris, Erik Insko, and Mohamed Omar. A proof of the peak polynomial positivity conjecture. Journal of Combinatorial Theory, Series A, 149:21 – 29, 2017

Christopher DiMattina, Ph.D.

CONTACT INFORMATION

Department of Psychology
Florida Gulf Coast University
10501 FGCU Blvd. South
Fort Myers, FL 33965-6565 USA

Office: (239)-590-1513
Cell: (239)-628-2415
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Web: itech.fgcu.edu/faculty/cdimattina/

RESEARCH INTERESTS

Computational Neuroscience, Vision Science, Machine Learning

FACULTY APPOINTMENTS

Florida Gulf Coast University, Ft. Myers, FL USA

Assistant Professor of Psychology, August 2013−present

- Appointment in Cognitive Neuroscience
- Supervisor: Roger Green, Ph.D. (rgreen@fgcu.edu)

Grinnell College, Grinnell, IA USA

Visiting Assistant Professor of Psychology, August 2012−August 2013

- Neuroscience Concentration faculty member
- Supervisor: Nancy Rempel-Clower, Ph.D. (rempelcl@grinnell.edu)

POSTDOCTORAL EXPERIENCE

Case Western Reserve University, Cleveland, OH USA

Research Associate in Computer Science, August 2009−July 2012

- Department of Electrical Engineering & Computer Science
- Advisor: Michael S. Lewicki, Ph.D.

EDUCATION

The Johns Hopkins University School of Medicine, Baltimore, MD USA

Ph.D., Neuroscience (Computational Neuroscience), September 2000−July 2009

- Thesis: *Neural network analysis of sensory processing and active data collection*
- Advisor: Kechen Zhang, Ph.D., Biomedical Engineering (2005-2009)
- Previous Advisor: Xiaoqin Wang, Ph.D., Biomedical Engineering (2001-2005)

Cornell University, Ithaca, NY USA

B.A., Mathematics, Psychology & College Scholar, August 1994−August 1998

- Phi Beta Kappa
- *Magna cum Laude* with distinction in all subjects
- Concentrations in Cognitive Studies & Biological Psychology

Binghamton University, Binghamton, NY USA

Non-degree student concurrent with high school, May 1993−August 1994

- 11 Courses in Math, Computer Science and Physics

Teaching Experience

Florida Gulf Coast University, Fort Myers, FL USA

Fall 2013 - present: Instructor of record for 3 courses per semester (FGCU has a 3-3 load; 2-2 with grant buyout). Courses taught to date at FGCU:

- EXP-3202: Sensation and Perception
- PSB-4002: Physiological Psychology
- PSY-2012: General Psychology
- PSY-3205: Survey of Analytical Techniques
- PSY-3017: Experimental Psychology

Grinnell College, Grinnell, IA USA

Instructor of record

- PSY 295: Sensation and Perception, Fall 2012
- NRS 495: Neuroscience Seminar in Vision Science, Fall 2012
- PSY 113: Introduction to Psychology (two sections with lab), Spring 2013

Publications

DiMattina, C., & Zhang, K. (2017). Adaptive stimulus optimization. In: *Encyclopedia of Computational Neuroscience, 2nd Ed.*. Springer: In press.

DiMattina, C. (2016). Comparing models of contrast gain using psychophysical experiments. *Journal of Vision* 16(9): 1-18.

DiMattina, C. (2015). Fast adaptive estimation of multi-dimensional psychometric functions. *Journal of Vision* 15(9):5, 1-20.

DiMattina, C., & Zhang, K. (2013). Adaptive stimulus optimization and model-based experiments for sensory systems neuroscience. *Frontiers in Neural Circuits* 7(101): 1-16.

DiMattina, C., Fox, S.A. & Lewicki, M.S. (2012). Detecting natural occlusions using local cues. *Journal of Vision* 12(13):15, 1-21

DiMattina, C., & Zhang, K. (2011). Active data collection for efficient estimation and comparison of nonlinear neural models. *Neural Computation* 23(9): 2242-2288.

DiMattina, C., & Zhang, K. (2010). How to modify a neural network gradually without changing its input-output functionality. *Neural Computation* 22(1):1-47.

DiMattina, C., & Zhang, K. (2008). How optimal stimuli for sensory neurons are constrained by network architecture. *Neural Computation* 20(3):668-708.

DiMattina, C., & Wang, X. (2006). Virtual vocalization stimuli for investigating neural representations of species-specific vocalizations. *Journal of Neurophysiology* 95(2):1244-1262.

Kotak, V.C., **DiMattina, C.**, & Sanes, D.H. (2001). GABA(B) and Trk receptor signalling mediates long-lasting inhibitory synaptic depression. *Journal of Neurophysiogy* 86(1):536-540.

In Preparation

Tam, W., Dekel, E. **DiMattina, C.**, Young, E.D. & Zhang, K. (2014). Using optimal experimental design for capturing parameters of neural networks in the inferior colliculus of the common marmoset. *In preparation*

Dissertation

DiMattina, C. (2009). Neural network analysis of sensory processing and active data collection. Unpublished PhD Thesis, The Johns Hopkins University School of Medicine.

Conference Publications

DiMattina, C. & Wang, X. (2002). Virtual Vocalization Stimuli for Systematic Investigation of Cortical Coding of Vocal Communication Sounds. *Association for Research in Otolaryngology*, Poster Abstract 455.

DiMattina, C. & Wang, X. (2004). Virtual vocalization stimuli for investigating neural representations of species-specific primate vocalizations. *Society for Neuroscience*, Poster Abstract 650.14.

DiMattina, C. & Zhang, K. (2008). Adaptive experimental design for online model comparison. *Society for Neuroscience*, Poster Abstract 798.15.

DiMattina, C. & Zhang, K. (2009). Active data collection for efficient estimation and comparison of sensory processing models. *Society for Neuroscience*, Poster Abstract 290.13.

DiMattina, C. & Zhang, K. (2010). Identifiability of nonlinear receptive field models from sensory neurophysiology data. *Frontiers in Neuroscience. Conference Abstract: Computational and Systems Neuroscience.*

DiMattina, C., Tam,W., Young, E.D., & Zhang, K. (2010). Adaptive design of stimuli for efficient characterization of nonlinear sensory responses. *Collaborative Research in Computational Neuroscience* (PI Meeting), Poster Abstract C15.

DiMattina, C., & Lewicki, M.S. (2010). Effects of database and fixations on receptive fields learned by a sparse coding model of natural images. *Gordon Research Conferences: Sensory Coding in the Natural Environment*, Bates College, ME.

Tam, W., Dekel, E. **DiMattina, C.**, Young, E.D. & Zhang, K. (2011). Using optimal experimental design for capturing paramters of neural networks in the inferior colliculus of the common marmosets. *Society for Neuroscience*, Poster Abstract 480.10.

DiMattina, C. & Lewicki, M.S. (2011). Representation of natural occlusion boundaries by human and ideal observers and relationship to natural image statistics. *Society for Neuroscience*, Poster Abstract 799.03.

DiMattina, C. & Zhang, K. (2015). Efficient implementations of the adaptive PSI procedure for estimating multi-dimensional psychometric functions . *J. Vision 1;15(12):477*

Invited Talks

Confereces and Workshops

- *Analyzing perception and neural coding using adaptive experiments.* COGSCI 2015: Workshop on Optimizing Experimental Designs: Theory, Practice, and Applications. July 22nd, Pasadena, CA.
- *Information theoretic stimulus design for neurophysiology and psychophysics.* Organization for Computational Neuroscience workshop on Information Theory in Neuroscience. July 30 2014, Quebec City, CA.

FLORIDA GULF COAST UNIVERSITY

College of Arts & Sciences
Department of Mathematics

February 2nd, 2018

Dear Seidler Fellowship Selection Committee Members,

My name is Chance Hamilton, and I am applying for the Seidler Fellowship Grant with Dr. DiMattina. I am excited to conduct a research project at the nexus of mathematics, deep learning algorithms, and biologically constrained neural networks!

Ever since I turned four and watched Star Wars Episode 1 I have been fascinated with two things: intergalactic space travel and robotics. I have long accepted the fact that I might never get to see the awe-inspiring sight of the Milky Way's spiral arms with my own eyes, but I firmly believe that I can help pioneer the development of artificial intelligence. It is this belief that is driving me to apply my education in mathematics to research the field of machine learning and computer vision.

In addition to helping the development of one of my childhood dreams, this project will give me the opportunity to gain insight into the world of research and help me decide whether to apply to PhD programs in Mathematics, Computer Science, or Machine Learning. This project will, with out a doubt, advance my current academic standing as well as give me an edge when I apply for PhD programs in the up coming years. I have always been a hard worker and dedicated student. To support my education, I have delivered pizzas, tutored, and served as a teaching assistant, but I would greatly appreciate an opportunity to dedicate my extracurricular hours to conduct research.

This project is an amazing opportunity to apply the skills that I developed while working with Dr. Insko under the Seidler Fellowship Grant. During this fellowship we successfully developed a machine-learning algorithm that was able to learn how to play the child's game Where's Waldo. Dr. Insko and I explored many topics in machine learning, but neural networks were by far the most interesting topic. So the fact that Dr. DiMattina approached us about working with him on this project that involves neural networks is incredibly exciting, as he is an expert on convoluted neural networks and their applications!

Yours Sincerely,

Chance Hamilton

Chance Hamilton.

Department of Mathematics cjhamilton4176@eagle.fgcu.edu (505) 320-0894
10501 FGCU Boulevard South Fort Myers, Florida 33965-6565

Chance Hamilton | Florida Gulf Coast University

206 Lincoln Ave. Lehigh, FL 33936| (505) 320 0894| cjhamilton4176@eagle.fgcu.edu

Education

Florida Gulf Coast University— [BS, in progress, GPA 3.88/4.0] 2016-present
Relevant coursework: Math Foundations, Linear Algebra, Into to Computer Science, Intro to computer Programming, Operation Research I

University of Florida— [BS(transfer), GPA 3.9/4.0] 2015-2016
Relevant coursework: Computational Technologies for chemical engineers,
Dean's List member two consecutive semesters

Florida SouthWestern State College— [AA, GPA 3.99/4.0] 2012-2014
Dean's List member for all semesters attended, graduated summa cum laude.

Programming Languages

Proficient: JAVA, MATLab, HTML
Moderately Proficient: Python, LATEX

Experience

TA for Math Foundations— Dr. F. Schnackenberg Spring 2017 — present
Graded homework all sets as well as aided students with course work

Peer Tutor — Edison State College 2012-2014
Conducted walk-in and appointment tutoring sessions for all subjects that I had previously taken.

Interests

Mathematical: Graph theory, combinatorics, and number theory
Future work: conduct further research in machine learning, and gain more experience in advance of graduate school

UNOFFICIAL TRANSCRIPT

Florida Gulf Coast University
Office of the Registrar
10501 FGCU Blvd. South
Fort Myers, FL 33965-6565

UOFF

Date Issued: 02-FEB-2018

Student Name: Chance Jordan Hamilton
UIN: 815024176
206 Lincoln Ave
Lehigh Acres, FL 33936

CLAST SCORES

Test	Score
Math	
Read	
Write	
Essay	

Prior Degree(s): Associate in Arts 2015-05-06

SSN: XXX-XX-7886
Date of Birth: 1995-05XXXX
Gender: M
Residency: Fla Resident Tuit Diff

Course Level: Undergraduate
Student Type: Other Transfer UL
High School: Immokalee High School 31-MAY-2013
Only Admit: Fall 2016

Current Program
Program : BS Mathematics
Major : Mathematics

Events: General Education Requirements
Decision: MET
Service Learning Hrs Earned
Decision: MET 62

SUBJ	NO.	COURSE TITLE	CRED	GRD	PTS	R
TRANSFER CREDIT ACCEPTED BY THE INSTITUTION:						
FAL12-SPR15		Florida Southwestern State Col				
AST	2004C	Stellar Astronomy	4.00	TA		
CHM	1045	General Chemistry I	3.00	TA		
CHM	1045L	General Chemistry I Lab	1.00	TA		
CHM	1046	General Chemistry II	3.00	TA		
CHM	1046L	General Chemistry II Lab	1.00	TB		
CHM	1XXX	Intro to Coll Chem	3.00	TA		
CHM	1XXXL	Intro Coll. Chem Lab	1.00	TA		
ECO	2013	Princ of Macro Economics	3.00	TB		
ECO	2023	Princ of Micro Economics	3.00	TA		
ENC	1101	Composition I	3.00	TA		
ENC	1102	Composition II	3.00	TA		
GEE	1XXX	Lower Level General Elective	1.00	TA		
HUM	1XXX	Renaissance-Age of Reason	3.00	TA		I
MAC	1105	College Algebra	3.00	TA		
MAC	1XXX	Trigonometry	3.00	TA		I
MAC	1XXX	Pre-Calculus Algebra	3.00	TA		I
MAC	2311	Calculus I	4.00	TA		
MAC	2312	Calculus II	4.00	TA		
MAC	2313	Calculus III	4.00	TA		
MAP	2302	Differential Equations	3.00	TA		
PHI	1XXX	Ethics - AA	3.00	TB		
PHY	1XXXL	General Physics I Lab	1.00	TA		A
PHY	1XXXL	General Physics II Lab	1.00	TA		I
PHY	2048C	General Physics w/Lab I	4.00	TA		

********** CONTINUED ON NEXT COLUMN **********

SUBJ	NO.	COURSE TITLE	CRED	GRD	PTS	R
Transfer Information continued:						
PHY	2049C	Gen'l Physics w/Lab II	4.00	TA		
SPC	1017	Fundamentals of Communication	3.00	TA		
SPN	1120C	Beginning Spanish 1	4.00	TA		
SPN	1121C	Beginning Spanish 2	4.00	TA		
WOH	1023	World Civilization 1500-1815	3.00	TA		
Ehrs: 82.00 GPA-Hrs: 83.00 QPts: 325.00 GPA: 3.91						
FAL15-SPR16		University of South Florida				
ART	2750	Ceramics I	3.00	TA-		
EGN	1XXX	Intro to Chem & Biomed Eng	3.00	TB		
EGN	3343C	Thermodynamics	3.00	TA+		
EGN	3XXX	Sustainable Energy	3.00	TW		
GEE	3XXX	Fnds of Engineering	0.00	T		
HUM	1XXX	Classical Mythology	3.00	TA		I
Ehrs: 12.00 GPA-Hrs: 12.00 QPts: 44.10 GPA: 3.67						
INSTITUTION CREDIT:						
Fall 2016						
Mathematics						
COP	1500	Intro to Computer Science	3.00	A	12.00	
MAP	3162	Probability & Statistics	4.00	A	16.00	
MAS	3105	Linear Algebra	3.00	A	12.00	
MHF	2191	Mathematical Foundations	3.00	A	12.00	
Ehrs: 13.00 GPA-Hrs: 13.00 QPts: 52.00 GPA: 4.00						
President's List						
Good Academic Standing						
Spring 2017						
Mathematics						
COP	2006	Introduction to Programming	3.00	A	12.00	
IDS	3920	University Colloquium	3.00	A-	11.10	
MAP	3163	Operations Research I	3.00	A	12.00	
Ehrs: 9.00 GPA-Hrs: 9.00 QPts: 35.10 GPA: 3.90						
Good Academic Standing						
Summer 2017						
Mathematics						
COP	2001	Programming Methodology	3.00	A	12.00	

********** CONTINUED ON PAGE 2 **********

Issued To: Student

UNOFFICIAL TRANSCRIPT

Florida Gulf Coast University
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Fort Myers, FL 33965-6565

Date Issued: 02-FEB-2018

Student Name: Chance Jordan Hamilton
UIN: 815024176

CLAST SCORES

Test	Score
Math	
Read	
Write	
Essay	

Prior Degree(s): Associate in Arts 2015-05-06

SSN: XXX-XX-7886
Date of Birth: 1995-05XXXX
Gender: M
Residency: Fla Resident Tuit Diff

SUBJ	NO.	COURSE TITLE	CRED	GRD	PTS
Institution Information continued:					
Ehrs: 3.00 GPA-Hrs: 3.00 QPts: 12.00 GPA: 4.00					
Good Academic Standing					
Fall 2017					
Mathematics					
COP	3003	Object-Oriented Programming	3.00	A	12.00
MAA	4226	Analysis I	3.00	A	12.00
MAS	4301	Abstract Algebra I	3.00	A	12.00
Ehrs: 9.00 GPA-Hrs: 9.00 QPts: 36.00 GPA: 4.00					
Good Academic Standing					
Spring 2018					
IN PROGRESS WORK					
MAA	4227	Analysis II	3.00	IN PROGRESS	
MAS	4302	Abstract Algebra II	3.00	IN PROGRESS	
MAS	4730	Computational Technology	2.00	IN PROGRESS	
In Progress Credits 8.00					

********** TRANSCRIPT TOTALS **********

	Earned Hrs	GPA Hrs	Points	GPA
TOTAL INSTITUTION	34.00	34.00	135.10	3.97
TOTAL TRANSFER	94.00	95.00	369.10	3.88

********** END OF TRANSCRIPT **********

FLORIDA GULF COAST UNIVERSITY

College of Arts & Sciences
Department of Mathematics

January 25, 2018

To Whom It May Concern:

RE: Chance Hamilton

I am able to recommend Chance Hamilton without reservation for participation in the Seidler Research Project. Chance did so well in my MHF 2191 Math Foundations class that I asked him to grade the homework submissions in the same class the following semester. He completed these tasks on time and very well. He is self-motivated and will anticipate any problems on the horizon.

Chance will make a great addition to any research project. I do recommend him without reservation.

Sincerely,

Richard Schnackenberg, Ph.D.
Assistant Professor, Mathematics
rschnack@fgcu.edu

FLORIDA GULF COAST UNIVERSITY

College of Arts & Sciences
Department of Mathematics

February 2nd, 2018

Dear Seidler Grants Selection Committee,

I would like to start off by thanking you for your consideration for such an amazing opportunity. My name is Charly Garcia and I am excited to be given the opportunity to work with my Advisor Dr. DiMattina and fellow peer Chance Hamilton involving deep learning algorithms and biologically constrained neural networks.

Even before I was introduced to coding and designing programs I was fascinated by the idea of integrating machines into our everyday life. Designing a program that can learn and do task as efficiently as any person could has all ways been a childhood dream. What I didn't know until I met Dr.DiMattina was that this is not just science fiction but rather just applications of the field of machine learning and AI development. Needless to say, I was instantly hooked.

As a dual Mathematics and Software Engineering major, conducting research on deep learning algorithms and biologically constrained neural networks is a great way to utilize both of my backgrounds. I would also gain invaluable experience in the process, and develop skills that can't be taught in any classroom. This experience would definitely put me a step ahead in my academic career and make me stand out when I apply for REU's and Graduate Programs in the future.

When I met Dr. DiMattina, I was truly excited to discover such a fascinating topic which at its core is the combination of my two favorite topics. To be able to work with someone who is an expert in the field of neuroscience and convoluted neural networks is fantastic, and I eagerly look forward to starting on the project. This will be my first ever research project as a sophomore, and I am more than eager to grab the bull by the horns. I will have, without a doubt, a great time honing my skills, learning, and discovering what the field of machine learning has to offer.

Sincerely,

Charly Garcia-Valero

Department of Mathematics cgraciavalero0739@eagle.fgcu.edu (239)258-7351
10501 FGCU Boulevard South Fort Myers, Florida 33965-6565

Charly Garcia-Valero

5534 Fourth Ave, Fort Myers FL
(239)258-7351
Charlygarcia0617@gmail.com
cgarciavalero0739@eagle.fgcu.edu

Education

Software Engineering B.S, Mathematics B.S (In progress)
Florida Gulf Coast University
Sophomore, 3.30GPA

Relevant Course Work:

- Intro to Computer Science(A)
- Computer Software and Technology(B)
- Introduction to Programming(B+)
- Programming Methodology (In progress)
- Calculus 1,2,3 (A-, A, In Progress)

Skills

- Programming languages: Java, Python, C, C++
- Software Design
- Code testing and Debugging
- Microsoft office suite proficient
- Superb Mathematical Analytics
- Problem Solving
- Critical Thinking

Honors and Awards

Manchester Scholarship Fund
FG-EverBank Fund
FL Student Assistant Grant
Federal Pell Grant
Ruth L. Faith Endowed Scholarship Fund
Elizabeth N. Barrick Scholarship Endowed Fund
FGCU Grant Undergrad

Goals and Interest

Throughout my academic career I have strived for more than just A's on a transcript. My plan for success is to gain extracurricular hands on experience that will put me ahead in my academics, such as REU's and other researcher opportunities. I hope that by doing so I become more marketable to any Master Program I apply to and eventually the work force.

UNOFFICIAL TRANSCRIPT

Florida Gulf Coast University
Office of the Registrar
10501 FGCU Blvd. South
Fort Myers, FL 33965-6565

Date Issued: 02-FEB-2018

Student Name: Charly Garcia-Valero
UIN: 815160739
5534 4th Ave
Fort Myers, FL 33907

CLAST SCORES

Test	Score
Math	
Read	
Write	
Essay	

Prior Degree(s):

SSN: XXX-XX-2770
Date of Birth: 1998-06XXXX
Gender: M
Residency: Fla Resident Tuit Diff

Course Level: Undergraduate
Student Type: Beginner FTIC
High School: South Fort Myers High School 10-JUN-2016
Only Admit: Summer 2016

Current Program
Program : BS Mathematics
Major : Mathematics

Secondary
Program : BS Software Engineering
Major : Software Engineering

SUBJ	NO.	COURSE TITLE	CRED	GRD	PTS	R

TRANSFER CREDIT ACCEPTED BY THE INSTITUTION:

2016 Advanced Placement

ECO	2013	Princ of Macro Economics	3.00	T		
PHY	2053C	College Physics w/Lab I	4.00	T		

Ehrs: 7.00 GPA-Hrs: 0.00 QPts: 0.00 GPA: 0.00

201705 Florida Southwestern State Col

COP	1500	Intro to Computer Science	3.00	TA		

Ehrs: 3.00 GPA-Hrs: 3.00 QPts: 12.00 GPA: 4.00

INSTITUTION CREDIT:

Summer 2016
Mathematics

ENC	1130	Improving College Writing	3.00	A-	11.10	
SLS	1501	Effective Learning	3.00	A-	11.10	

Ehrs: 6.00 GPA-Hrs: 6.00 QPts: 22.20 GPA: 3.70
Good Academic Standing

Fall 2016
Mathematics

CGS	1100	Computer Software & Technology	3.00	B	9.00	
ECO	2023	Princ of Micro Economics	3.00	F	0.00	E
ENC	1101	Composition I	3.00	B-	8.10	
MAC	2311	Calculus I	4.00	A-	14.80	

********** CONTINUED ON NEXT COLUMN **********

SUBJ	NO.	COURSE TITLE	CRED	GRD	PTS	R

Institution Information continued:

MUL	2010	Intro to Music Literature	3.00	C	6.00	

Ehrs: 13.00 GPA-Hrs: 13.00 QPts: 37.90 GPA: 2.91
Good Academic Standing

Spring 2017
Mathematics

ACG	2021	Intro to Financial Accounting	3.00	W	0.00	
ENC	1102	Composition II	3.00	A	12.00	
MAC	2312	Calculus II	4.00	A	16.00	
PHY	2048C	General Physics w/Lab I	4.00	B-	10.80	
STA	2023	Statistical Methods	3.00	B	9.00	

Ehrs: 14.00 GPA-Hrs: 14.00 QPts: 47.80 GPA: 3.41
Good Academic Standing

Summer 2017
Mathematics

ECO	2023	Princ of Micro Economics	3.00	A	12.00	I

Ehrs: 3.00 GPA-Hrs: 3.00 QPts: 12.00 GPA: 4.00
Good Academic Standing

Fall 2017
Software Engineering

COP	2006	Introduction to Programming	3.00	B+	9.90	
CRW	2732	Introduction to Nature Writing	3.00	B	9.00	
MAD	3107	Discrete Mathematics	3.00	A	12.00	
MAT	4930	ST: Mathematics& Science Ed	1.00	B	3.00	
MHF	2191	Mathematical Foundations	3.00	C	6.00	

Ehrs: 13.00 GPA-Hrs: 13.00 QPts: 39.90 GPA: 3.06
Good Academic Standing

Spring 2018
IN PROGRESS WORK

COP	2001	Programming Methodology	3.00	IN PROGRESS
MAC	2313	Calculus III	4.00	IN PROGRESS
MAP	2302	Differential Equations	3.00	IN PROGRESS
MAS	4730	Computational Technology	2.00	IN PROGRESS
PHY	2049C	Gen'l Physics w/Lab II	4.00	IN PROGRESS

********** CONTINUED ON PAGE 2 **********

Issued To: Student

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Prior Degree(s):

SSN: XXX-XX-2770
Date of Birth: 1998-06XXXX
Gender: M
Residency: Fla Resident Tuit Diff

SUBJ	NO.	COURSE TITLE	CRED	GRD	PTS	R
IN PROGRESS WORK continued:						
		In Progress Credits 16.00				
********** TRANSCRIPT TOTALS **********						
		Earned Hrs	GPA Hrs	Points	GPA	
TOTAL INSTITUTION		49.00	49.00	159.80	3.26	
TOTAL TRANSFER		10.00	3.00	12.00	4.00	
********** END OF TRANSCRIPT **********						

FLORIDA GULF COAST UNIVERSITY

College of Arts & Sciences
Department of Mathematics

January 30, 2018
Dear Seidler Grant Selection Committee,

I am writing in enthusiastic support of Charly Garcia-Valero's application for the Seidler Collaborative Fellowship with Dr. Christoper DiMattina. I had the pleasure of teaching Charly in Discrete Mathematics last semester, and he earned an A in that class. From that experience, I can say that Charly is a hardworking student who comes prepared for class and perseveres when faced with challenging problems.

Charly is the first in his family to go to college, and though he is only 19 years old, he already has 3 years of programming experience in several different computer languages. He has talked with me about his interest in Machine Learning, and I am confident that he will learn a great deal from Dr. DiMattina, who knows more about Machine Learning than anyone else I have met on this campus. I also believe that working with Dr. DiMattina this summer will make Charly an excellent candidate for NSF-funded REU programs next year.

If you have any further questions about her background or qualifications do not hesitate to call or email me.

Yours Sincerely,

Erik Insko, Ph.D
Associate Professor
Department of Mathematics
einsko@fgcu.edu