REPORT DOCUMENTATION PAGE

Form Approved OMB NO. 0704-0188

1. REPORT DATE (DD-MM-YYYY)	2. REPORT TYPE	3. DATES COVERED (From - To)
03-03-2015	Final Report	9-May-2011 - 8-May-2014

4. TITLE AND SUBTITLE
Final Report: "Enhancing Research in Networking & System Security, and Forensics, in Puerto Rico"

5a. CONTRACT NUMBER
W911NF-11-1-0174

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER
206022

6. AUTHORS
PI Dr. Alfredo Cruz; Co-PI Dr. Jeff Duffany; Administrative Assistant Alexander Lopez

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAMES AND ADDRESSES
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Hato Rey, PR 00918 -0000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS (ES)
U.S. Army Research Office
P.O. Box 12211
Research Triangle Park, NC 27709-2211

10. SPONSOR/MONITOR'S ACRONYM(S)
ARO

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
58924-CS-REP.61

12. DISTRIBUTION AVAILIBILITY STATEMENT
Approved for Public Release; Distribution Unlimited

13. SUPPLEMENTARY NOTES
The views, opinions and/or findings contained in this report are those of the author(s) and should not contrued as an official Department of the Army position, policy or decision, unless so designated by other documentation.

14. ABSTRACT
The activities developed during this award helped PUPR continue strengthening and enhancing research and education in IA and Computer Forensics in our Graduate and Undergraduate Computer Science and Computer Engineering programs. PUPR is committed to continue providing a consistent source of quality graduates for the public and private sectors in areas that are critical to the DoD such as Information Assurance and Computer Forensics.
We continued to improve the quality of student and faculty learning experiences through the lessons learned in

15. SUBJECT TERMS
Information Assurance, Cryptography, Cloud Forensics, Digital Forensics, Network Security

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	15. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Alfredo Cruz
UU	UU	UU	UU		19b. TELEPHONE NUMBER 787-717-3473

Report Title

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ABSTRACT

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We continued to improve the quality of student and faculty learning experiences through the lessons learned in prior activities, increasing research, and the participation of graduate and undergraduate students, and K-12 participants in outreach activities. This has attracted more students to the Computer Science and Engineering disciplines, significantly increasing the number of students in our Computer Science and Computer Engineering graduate programs. These experiences have also contributed to the development of more women in areas where the number of women and Hispanic students are limited. Enrollment in these programs has increased 8% in the academic year 2013/14. The amount of projects, papers, thesis, abstracts, and posters that we have published each year has been significant. After the DoD support, there continues to be a significant amount of work in progress in IA and Computer Forensics.

Enter List of papers submitted or published that acknowledge ARO support from the start of the project to the date of this printing. List the papers, including journal references, in the following categories:

(a) Papers published in peer-reviewed journals (N/A for none)

Received Paper

TOTAL:

Number of Papers published in peer-reviewed journals:

(b) Papers published in non-peer-reviewed journals (N/A for none)

Received Paper

TOTAL:

Number of Papers published in non peer-reviewed journals:

(c) Presentations

Number of Presentations: 0.00

Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received	Paper
08/26/2013	28.00 Dr. Aury M. Curbelo, Dr. Alfredo Cruz. Faculty Attitudes Toward Teaching Ethical Hacking to Computer and Information Systems Undergraduates Students, 11th Latin American and Caribbean Conference for Engineering and Technology. 14-AUG-13, . : ,
08/28/2012	20.00 Jan Flores, Dr. Alfredo Cruz. Information Prioritizing: Ranking Transactions to DetectAnomalies, Ninth LACCEI Latin American and Caribbean Conference (LACCEI'2011), Engineering for a Smart Planet, Innovation, InformationTechnology and Computational Tools for Sustainable Development. 05-AUG-11, . : ,
TOTAL:	**2**

Number of Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received	Paper
08/05/2014	52.00 Celedonio Arroyo. Interactive Learning Tool for Cryptography, Information Institute Conferences, Las Vegas, NV, May 21-23, 2014. , . : ,
08/05/2014	53.00 Jose F. Nieves, Dr. Alfredo Cruz. Genetic Algorithm for Cryptanalysis of the Vigenere Cipher, LACCEI 2014. 21-JUL-14, . : ,
08/26/2013	29.00 Dr. Alfredo Cruz, Dr. Jeff Duffany. Lessons Learned in the Development of a a Graduate Certificate in Information Assurance and Security (GCIAS), 11th Latin American and Caribbean Conference for Engineering and Technology. 14-AUG-13, . : ,
08/26/2013	30.00 Jose J. Flores, Dr. Alfredo Cruz. A Study in Wireless Attacks and its Tools, 11th Latin American and Caribbean Conference for Engineering and Technology. 14-AUG-13, . : ,
08/27/2013	45.00 Eduardo Melendez. FROM RANDOM EMBEDDING TECHNIQUES TO ENTROPY USING IMAGEPOINT ADJACENT SHADE VALUES, 12th Annual Security Conference, Las Vegas, Nevada. 10-APR-13, . : ,
08/27/2013	46.00 Dr. Jeff Duffany. INFORMATION ASSURANCE IN EMERGENCY AND VEHICULAR MANETS, 12th Annual Security Conference, Las Vegas, Nevada. 10-APR-13, . : ,
08/28/2012	19.00 Dr. Alfredo Cruz, Steven Nieves. Finding Patterns of Terrorist Groups in Iraq:A Knowledge Discovery Analysis, Ninth LACCEI Latin American and Caribbean Conference (LACCEI'2011), Engineering for a Smart Planet, Innovation, InformationTechnology and Computational Tools for Sustainable Development,. 04-AUG-11, . : ,
08/28/2012	21.00 Sandra Bonilla, Dr. Alfredo Cruz. Experience Learned in Obtaining the C$SS IA CourseCertification and the CAE/IAE designation at PolytechnicUniversity of Puerto Rico (PUPR), Tenth LACCEI Latin American and Caribbean Conference (LACCEI'2012), Megaprojects: Building Infrastructure by fosteringengineering collaboration, efficient and effective integration and innovative planning. 24-JUL-12, . : ,
08/28/2012	22.00 . Cloud Computing Security and Privacy, Tenth LACCEI Latin American and Caribbean Conference (LACCEI'2012), Megaprojects: Building Infrastructure by fostering engineering collaboration, efficient and effective integration and innovative planning. 24-JUL-12, . : ,
08/28/2012	23.00 Dr. Alfredo Cruz, Dr. Jeff Duffany. Development of a Graduate Certificate Programin Computer Forensics, Tenth LACCEI Latin American and Caribbean Conference for Engineering and Technology (LACCEI' 2012)"Megaprojects: Building Infrastructure by Fostering Engineering Collaboration, Efficient and Effective Integration and InnovativePlanning. 24-JUL-12, . : ,
08/28/2012	24.00 Sandra Bonilla, Dr. Alfredo Cruz. Creating a Common Body of Knowledge (CBK) for InformationAssurance and Security Academic Programs and Certificates, The 3rd International Conference on Society and Information Technologies (ICSIT 2012). 27-MAR-12, . : ,

TOTAL: 11

Number of Peer-Reviewed Conference Proceeding publications (other than abstracts):

(d) Manuscripts

Received Paper

TOTAL:

Number of Manuscripts:

Books

Received Book

TOTAL:

Received Book Chapter

TOTAL:

Patents Submitted

Patents Awarded

Awards

First Place in Code-a-Thon Competition at Tapia Conference 2014

Graduate Students

NAME	PERCENT_SUPPORTED	Discipline
Lyan Lugo	0.50	
Zuleika Lopez	0.50	
Jose Nieves	0.40	
Celedonio Arroyo	0.30	
Fabian Del Valle	0.30	
FTE Equivalent:	**2.00**	
Total Number:	**5**	

Names of Post Doctorates

NAME	PERCENT_SUPPORTED
FTE Equivalent:	
Total Number:	

Names of Faculty Supported

NAME	PERCENT_SUPPORTED	National Academy Member
Dr. Alfredo Cruz	0.25	No
Dr. Jeff Duffany	0.10	
FTE Equivalent:	**0.35**	
Total Number:	**2**	

Names of Under Graduate students supported

NAME	PERCENT_SUPPORTED	Discipline
Lyan Lugo	0.50	BS Computer Engineering
FTE Equivalent:	**0.50**	
Total Number:	**1**	

Student Metrics

This section only applies to graduating undergraduates supported by this agreement in this reporting period

The number of undergraduates funded by this agreement who graduated during this period: 1.00

The number of undergraduates funded by this agreement who graduated during this period with a degree in science, mathematics, engineering, or technology fields:..... 1.00

The number of undergraduates funded by your agreement who graduated during this period and will continue to pursue a graduate or Ph.D. degree in science, mathematics, engineering, or technology fields:..... 1.00

Number of graduating undergraduates who achieved a 3.5 GPA to 4.0 (4.0 max scale):..... 1.00

Number of graduating undergraduates funded by a DoD funded Center of Excellence grant for Education, Research and Engineering:..... 1.00

The number of undergraduates funded by your agreement who graduated during this period and intend to work for the Department of Defense 1.00

The number of undergraduates funded by your agreement who graduated during this period and will receive scholarships or fellowships for further studies in science, mathematics, engineering or technology fields: 0.00

Names of Personnel receiving masters degrees

NAME
Jose Nieves
Total Number: 1

Names of personnel receiving PHDs

NAME
Total Number:

Names of other research staff

NAME	PERCENT_SUPPORTED
FTE Equivalent:	
Total Number:	

Sub Contractors (DD882)

Inventions (DD882)

Scientific Progress

The goals and objectives of the proposed project during the third year of the award have been successfully accomplished through the development of the programmed activities. We have continued to enhance the graduate curriculum, and undergraduate and graduate research and development by offering excellent curricular alternatives that provide students the skills and knowledge to react to real world situations in the workplace (Government and Industry), strengthening the Information Assurance specialization in the Master in Computer Science program and other programs such as Computer Engineering.
In this third award period we are expecting local accreditation by the Council of Higher Education of Puerto Rico for the Graduate Certificate in Digital Forensics (GCDF). With this accreditation we will be integrating new developments in IA allowing us to continue generating fundamental scientific and
technical knowledge in areas that are critical to the DoD and national defense.
The activities experienced during the third year of this award have helped us to continue strengthening and enhancing research and education in Information Assurance and Computer Forensics in our Graduate and Undergraduate Computer Science and Computer Engineering programs. PUPR is committed to continue providing a consistent source of quality graduates for the public and private
sectors in critical areas Assurance and Computer Forensics. We continued to improve the quality of student and faculty learning experiences through the lessons learned in prior activities, increasing research, and the participation of graduate students in outreach activities. This has attracted more students to the Computer Science and Engineering disciplines, significantly increasing the number of students in our Computer Science and Computer Engineering
graduate programs. These experiences have also contributed to the development of more women in areas where the number of women and Hispanic students are limited. Enrollment in these programs has increased 8% in the academic year 2013/14. In this third year the outcomes have been as expected and the amount of projects, papers, thesis, abstracts, and posters that we have published has been significant.
There continues to be a significant amount of papers, projects, and thesis work supported by this award.

Technology Transfer

Polytechnic University of Puerto Rico

DoD HBCU # W911NF-11-1-0174:

"Enhancing Research in Networking & System Security, and Forensics, in Puerto Rico"

Final Report

Period 2013/14

(August 1, 2013 – Julio 31, 2014)

Scientific Progress and Accomplishments

Introduction

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DoD Research Assistant Zuleika G. Lopez

Polytechnic University Open House: February 20, 2014

Zuleika Lopez advised high school students about security and information science courses. On February 20, 2014 more than 300 high school students around the island came to see the Polytechnic University Open House on February 20, 2014. The DoD Research Assistant (RA) Zuleika Lopez participated as staff in a computer science booth. She did more than just give candidates a brochure, she took her computer and showed them some computer projects she had done in her Visual Basic class. She demonstrated them that some classes are very dynamic and interesting. She explained the difference between Computer Science and Computer Engineering, based on classes and future opportunities. In addition, she mentioned the security focus on the Computer Science curriculum, which is the main focus of the DoD research that has been done during this grant.

Figure 1: Zuleika advising the prospect student at the Polytechnic University Open House

Convention of Caribbean Women in Computing: February 26, 2014

For the first time the Regional Grace Hopper Conference was given in the Caribbean (Puerto Rico). The first celebration of Caribbean Women in Computing (CCWiC) was held at the Marriott Courtyard on the 27 and 28 of February 2014. The participation of 192 women included 38 high school girls, 29 mothers and teachers, 52 graduate students, and 73 members of the academia and industry. CCWiC 2014 promotes diversity with a particular effort in increasing the number of women who choose careers related to computer science and computer engineering. Opportunities were offered for mentoring, networking, and the technical/professional development of women in computing. Four major conferences were held by Mr. Nagin Cox, an engineer working on the "Mars Curiosity" NASA project, Dr. AJ Brush, director of "Lab of Things" for Microsoft Research, Mr. Brian Gonzalez, Director of “Global Education Intel”, and Dr. Karen Alkoby of “Gallaudet University”, the first deaf woman to earn a Ph.D. in Computer Science, who spoke about "overcoming the impossible".

She had the opportunity to present the poster “Mobile Device Threats and Countermeasures”. She presented and answered questions from the audience. They had a lot of questions and for many of them the Hacker tools that she presented were new concepts.

Her experience presenting in this conference was very special because she spent time with many women in the computer/technology fields.

The conferences held by Mrs. Cox, an engineer working on "Mars Curiosity" NASA project was her favorite. Mrs. Cox presented several videos about the moment in which the “Mars Curiosity” landed in moon. She demonstrated that women could reach any position in the society. She was extraordinary and very reachable (down to earth) giving Zuleika the opportunity to talk personally with her and discuss her research.

Figure 2: Zuleika Lopez Presenting the poster "Mobile Device Threat and Countermeasure" at CCWIC

Figure 3: Dr. Cox "Mars Curiosity" and Zuleika Lopez

Application Development for Exascale Computing, New Orleans, Louisiana: Feb. 27-March 1

The Application Development for Exascale Computing conference was celebrated in the Louisiana State University (LSU), Baton Rouge, Louisiana. Zuleika had the opportunity to participate in this conference thanks to an award of $1,300 from ICAM organization. The conference was organized by the LSU Center of Computation and Technology (CCT) organization. CCT is an innovative research environment, advancing computational sciences, technologies and the disciplines they touch. Researchers at CCT use the advanced cyber infrastructure –high-speed networks, high-performance computing, advanced data storage and analysis and hardware and software development – available on campus to enable research in many different fields. By uniting researchers from diverse disciplines, ideas and expertise are disseminated across LSU departments to foster knowledge and invention.

The diversity of attendance was very unique, people from Ukraine, China, Germany, among others.

The presentation that she liked most was the "The Futurization of Computing" presented by Thomas Heller. His demonstration was very interesting, because it showed how integrating different programs could develop a new "paradigm" of parallel computing. Zuleika had the opportunity to spend time with a great diversity of people and was very excited.

Mobile Security Presentation in the Info-Security Conference at Convention Center of Puerto Rico: March 18, 2014

The Info Security conference is an international event that is celebrated in countries such as Argentina, Chile, Puerto Rico, among other countries in South America and the Caribbean. Zuleika presented her work on "Mobile security threat and countermeasure" to approximately 200 people at the Convention Center of Puerto Rico.

Figure 4: Polytechnic University President Ernesto Vazquez, Zuleika Lopez, and Dr. Cruz, her mentor.

Security & Privacy Symposium at San Jose, California: May 15 – 21, 2014

Zuleika participated in the Security and Privacy Symposium celebrating at San Jose, California during May 17-21, 2014. Since 1980, the IEEE Symposium on Security and Privacy (SP) has been the premier forum for the presentation of developments in computer security and electronic privacy, and for bringing together researchers and practitioners in the field. Zuleika received an award of $1,500 from the IEEE organization to participate in the conference. The Security Symposium always expects an international participation of over 500 people. Some of the supporters are: Google, Goldman Sachs, Microsoft, Lincoln Laboratory (MIT), between others.

Figure 5: Zuleika Lopez explaining the statistics of her Poster to international participants.

Security Conference at Las Vegas, Nevada: May 21- 24, 2014

Zuleika also participated of the13th Annual Security Conference at Las Vegas, Nevada during May 21-24, 2014. The conference is jointly organized by the following institutions: Plymouth University (UK); Virginia Commonwealth University (USA); Oklahoma State University (USA); University of South Carolina USA). The conference theme for this year 2014 was "*Security in a socially connected world"*, in which actual threats were discussed and how the society could protected against and/or minimize the security breach. She presented her research paper titled "Mobile Security Threat and Countermeasures". The participation of this Security conference was possible thanks to a travel award of $1,250 received from the Department of Defense (DoD).

DoD Research Assistant Lyan M. Lugo

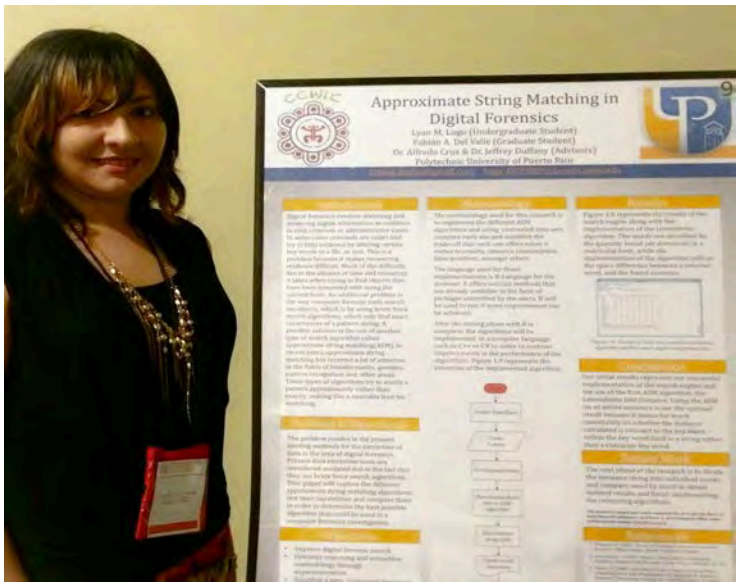

Figure 5. Lyan Lugo at the CCWiC Poster Presentation

During the time spent in the Department of Defense (DoD) HBCU program, the student Lyan M. Lugo of the Polytechnic University of Puerto Rico performed distinct activities to excel and apply the knowledge acquired through the program. She was undergoing research under the program investigating the area of "Digital Forensics with Approximate String Matching Algorithms".

The student also participated in the following activities:

- 2014 ACM Richard Tapia Celebration of Diversity in Computing Conference and Code-A-Thon
- Caribbean Celebration of Women in Computing Conference (CCWiC)
- WiCyS
- Mardis Gras Application Development for Exascale
- ISEC InfoSecurity 2014 Conference

Lyan was accepted as a scholarship recipient in all of the above activities but wasn't able to attend to WiCyS and Mardis Gras Application Development for Exascale due to conflicting dates between activities.

She participated in The Richard Tapia Conference and Code-A-Thon, CCWiC, and the ISEC InfoSecurity 2014 Conference. In the Richard Tapia Code-A-Thon, her team was assigned a Cyber Security task which they fulfilled and tied for first place in the competition. At the CCWiC she presented a poster of her current investigation of digital forensics titled "Approximate String Matching in Digital Forencics" under the support of the DoD HBCU program. This poster included her results until February this year. Lyan also participated in the ISEC InfoSecurity 2014 Conference as a speaker, informing the audience of information privacy in social media and legality of private information in social networks. The presentation was titled "The Repercussions of Social Networks". She was also granted a $2,000 scholarship under the CAHSI program for undergraduate studies and is expected to conduct a 6 month investigation in digital forensics for fall 2014.

DoD Research Assistant Jose Nieves

SACNAS National Conference at San Antonio, Texas

Jose Nieves participated at the SACNAS National Conference: "Strengthening the Nation Through Diversity, Innovation and Leadership in STEM", held on October 3-6 2013 in San Antonio, Texas and was supported by a full scholarship.

The conference was an enriching experience and a great opportunity for professional networking since it connected professionals and students within the disciplines of science, technology, engineering, and mathematics from across the country. It also facilitated the presentation of the RA's on-going research work: "Genetic Algorithm for Cryptanalysis on Substitution Ciphers".

In May 2014 Jose successfully defended his Theses "Genetic Algorithms for Cryptanalysis on Substitution Ciphers"

Figure 6. RA Jose Nieves

DoD Research Assistant Fabián A. Del Valle

Figure 7. Dr. Richard Tapia and RA Fabian Del Valle

Since becoming a DoD HBCU Research Assistant, Fabian del Valle has been able to participate in various activities that have helped him expand his knowledge and hone his skills:

2014 ACM Richard Tapia Celebration of Diversity in Computing Conference

In February Fabian was granted a scholarship to attend the 2014 Tapia Conference in Seattle, WA. The theme of this year's conference was "The Strength of Diversity". The conference brought together, students, professors, and professionals from broad and diverse communities to celebrate their contributions to computing. During the conference Fabian participated in many events; but one of the most interesting to him was the plenary speaker, Chieko Asakawa. Miss Asakawa is visually impaired, but this has not wavered her resolve to help and contribute to computing. She is an IBM Researcher and her research revolves around using Cognitive Systems, which are machines that can think, listen and see in order to help the disabled individuals. Miss Asakawa is a true inspiration that proves that with motivation and perseverance anything can be achieved. Fabian found in Tapia 2014 an amazing experience, being surrounded by a diverse group of individuals who were very much like himself. He made a lot of new academic and professional connections, and even got to meet and talk to Dr. Richard Tapia, considering him truly a great man. Most importantly he learned a lot from every one he talked to and this has given him a new insight on what's in store for the future of computing.

Tapia Code-a-Thon

During the conference Fabian was allowed to participate in the first Tapia Code-a-Thon. The focus was Cyber Security and each group of students were given a challenge. They were distributed into nine groups of six individuals with a mix of undergraduate, Masters and PhD students from universities across the country such as UC Berkeley, Carnegie Mellon University, West Point Military Academy

and MIT. The challenge consisted of developing two different programs to encrypt and decrypt information and using socket programming to develop programs to send encrypted messages between our teams. At the same time we had to be capturing the encrypted messages of the opposing teams and trying to decrypt them.

Figure 8. Code-a-Thon Team

Fabian had never participated in a Code-a-Thon or any challenge that consisted of intercepting messages via a wireless network. Everyone in the team he participated in brought a different skill to the table, Fabians contribution to the team was designing and implementing the encryption and decryption methods of one of the algorithms. Because of our individual skills and backgrounds in specific areas we were able to overcome the challenge. At the end the Code-a-Thon ended in a tie between Fabian's team and one of the other teams.

Polytechnic University of Puerto Rico Open House: February 20, 2014

Figure 9. Computer Science Booth at Open House: RA's Fabian Del Valle, Zuleika Lopez, and Celedonio Arroyo

On February 20 PUPR held its annual Open House even for high school students, university students and professionals. Fabian and another RA where asked to represent the Computer Science Department during the event. They showcased some of the tools and hardware available at the institution, as well some of the software developed by students. They also oriented high school students on computer security principles for social networks and guided some prospective and motivated students towards opportunities available for future college students in the field of computer science.

Poster Presentation at CCWIC: February 26 – 27, 2014

Fabian and RA research partner and co-author, Lyan M. Lugo, presented their first poster at the Caribbean Celebration of Women in Computing (CCWIC 2014). The conference was celebrated in Aguadilla, Puerto Rico. The objective of the conference was to promote diversity with efforts that address the decline of women who choose computing related professions. The conference offered opportunities for mentoring, networking, and technical/career development to women in computing. The research was well received by the community.

Internship Applications

Fabian applied to various internships oriented to the development of computer science and computer security, some of these are Global Security and Computation Internships at Lawrence Livermore National Labs, he has also applied to Oak Ridge National Lab Higher Education Research Experience (HERE). He has also applied to internships with the Department of Defense and Homeland Security.

Research Summary

Since starting in November 2013 Fabian's research has taken many leaps in its progress. His research is oriented towards the field of digital forensics; it involves comparing approximate string matching algorithms and combining them with the concepts of data mining and digital forensics in order to improve search capabilities on software tools. The algorithms that will be compared are the Levenshtein Distance, the Hamming Distance and the Longest Common Subsequence. The implementation is been conducted using R-Language because of its statistical and analysis abilities. Because it works using a command line and software packages developed by users it saves time in having to develop fresh code and allows to focus on testing and analysis. To date the Levenshtein Distance and the Hamming Distance have been successfully implemented and compared.

At this point Fabian has written a preliminary paper with the initial research results and comparisons. He submitted an abstract to the 13th Annual Security Conference in Las Vegas, NV, USA to present the paper and receive feedback from the community about his research. He also aspires to present a poster about his research the next Richard Tapia Conference.

Because his background is in chemical science, the future goal of his research is to implement approximate pattern matching algorithms to identify complex chemical compounds. His final goal is to be able to identify nuclear radiation signatures and its variants with his research.

DoD Research Assistant Celedonio Arroyo

As a DoD RA Celedonio Arroyo has been able to participate and work in various projects and research that has provided him important knowledge, skills and benefits to his Academic career. As an RA, Celedonio was looking for a research topic that was new and with possibilities of transcending in the future, following the academic path and continuing research into the PhD degree. He ended up with 3 possible security topics that are related to the areas of Information Assurance, Computer Forensic,

Cloud Computing and Security.

Figure 12. Celedonio as a speaker: "Cryptography Made Easy" @ INFOSECURITY 2014.

Information Assurance, Computer Forensic, Security, Cloud Computing Research

Celedonio started researching more into cloud computing due to the fact that most of the other areas were covered in the courses offered in the Master's degree. Cloud computing was not covered as profoundly as he wanted, so he developed an interest in knowing more about it. After searching and doing research on Cloud Computing he started to find a lot of information related to cloud security, and how important it was to be able to have the right to gather all the evidence from a cloud service provider in case that it was used to commit a crime or was the target. Then Celedonio found a new topic called Cloud Forensics. He is fascinated with it, because it combines areas that he had been working on, plus other areas that he had been studying in the past few years.

Cloud Forensics Research

During his research on cloud forensics he was able to find a lot of information related on the importance of being able to perform a forensic investigation on the cloud. But, there are many challenges involved, such as the jurisdiction of the cloud: if outside the US, this means that the forensic investigation team can't go there and seize all the data center as in a classic computer forensic gathering of data; also, the segmentation of the data available in the cloud makes it impossible to collect a digital copy of the hard drives. Another challenge is that even if the data was collected it would not be admissible in a court of law due to the fact that the data center won't stop providing services to their customers and the data changes during the time the data is collected. Many of the papers researched related to cloud forensic tried to provide different alternatives for many of the challenges mentioned, but they have not been implemented.

Celedonio was able to find that one of the major challenges of making the data valid in a court of law could be solved in an Infrastructure as a Service Cloud. Infrastructure as a Service is a provision model in which an organization outsources the equipment used to support operations, including storage, hardware, servers and networking components. The service provider owns the

equipment and is responsible for housing, running and maintaining it. The client typically pays on a per-use basis. In this type of cloud an agreement with the CSP could be made where the servers used by them would not be used to store data of any other company or person not authorized by them. A collection of evidence can be done using the network forensic approach and create a chain of custody-like document proving that the data collected would not be changed or affected.

Celedonio's proposed solution to this problem was to develop a tool where the investigator was able to connect to the CSP and gather all the evidence necessary, including all the files, records, log files, volatile and non-volatile data of the servers and store them as Secure Files Large Objects in a database table.

A set of PL/SQL procedures implement the file system access primitives such as create, open, read, write, and list directory. The implementation of the file system in the database is called the DBFS Content Store. The investigator will have a key to log in into the program, this key is composed of a word plus a file that works as a key. Once the tool is accessed all the activities in the tool will be recorded. This will act as the chain of custody once the investigator finish collecting the data that is needed. The tool will provide additional tools to collect volatile and non-volatile data; once collected all those files will be stored as LOBs in a database. Data collected will be processed using a strong hash algorithm to prove integrity of the data. Once the data is collected the investigator can disconnect from the CSP and print the chain of custody report. The data collected can then be copied for further investigation.

Cloud Computing Presentation to Graduate Students from Panama.

On November, 2013 Celedonio was selected as speaker to present a lecture to a group of Graduate students from Panama that were visiting the Polytechnic University of Puerto Rico, San Juan campus. In this activity he covered all the material and information related to his research about Cloud Computing and divided it in 3 different presentations. The presentations included: *"Introduction to Cloud Computing & History"*, *"Cloud Computing Security & Privacy Issues"*, and *"Cloud Forensics"*. After the presentations, he was awarded with a gift from the Graduate department and met the professor that was with the group. The professor asked him for the information of the presentation as a reference because he was planning in include the material into their curriculum.

TAPIA Conference 2014 – Seattle, WA – Travel Scholarship awarded by Google.

Celedonio was able to meet Mr. Tony Baylis, a recruiter from the Lawrence Livermore National Laboratory. Mr. Baylis visited the campus to promote the laboratory and to find suitable internship candidates for the laboratory. During his visit Celedonio was able to talk to him and show him his research and other things he had been doing. He also recommended us to apply to the TAPIA conference 2014, "Celebration of Diversity in Computing". A scholarship would be awarded to assist to this conference in Seattle, Washington.

After Applying for the conference Celedonio was awarded with a full scholarship by Google to assist to the conference. Google also sent him an invitation to meet their team in Seattle. This was an amazing opportunity because he was able to meet and network with different students and professionals with the same areas of interest. During the conference on February, 2014, he was able to meet many of the speakers of the conference and especially with the person that the conference honors, Dr. Richard Tapia, awarded with the National Medal of Science from President Barack Obama in October 2011.

Figure 10. Dr. Richard Tapia and Celedonio Arroyo

Figure 11. Tony Baylis and Celedonio Arroyo.

One of the plenary speakers that impacted Celedonio most was Latanya Sweeney, PhD Professor of Government and Technology in Residence at Harvard University. She was a Distinguished Career Professor of Computer Science, Technology and Policy in the school of Computer Science at Carnegie Mellon University. During her talk she told them about all the challenges she needed to surpass during her academic career and all the hard work and achievements. Part of her work is included in the HIPAA Health Insurance Portability and Accountability Act.

TAPIA Conference – Code-A-Thon

In the Tapia conference Celedonio participated in the code-a-thon. His team was composed of PhD students from different universities and he was the only Master Degree student. For Celedonio, it was an amazing experience, because he was able to meet all the members of the team, and get to work with them on encryption, decryption, and transmission/intersection of messages on a wireless network. Their team did not win because they ran out of time to prove that their application incorporated all the necessary things that were required for the code-a-thorn. They were able to develop a sniffing tool to monitor the wireless traffic TCP/IP, this tool was developed using Python, also the Caesar cipher was used to encrypt and decrypt the sent/intercepted message using a diversity of "jumping letters", an idea to make the encryption and decryption more challenging.

This activity gave Celedonio an insight of how powerful teamwork can be and how the diversity of knowledge is important to surpass any obstacle.

Cryptography Research

During his time at the TAPIA Conference and after acquiring extra knowledge about different areas of his research Celedonio was able to use his skills on the topic of Cryptography. After talking with his advisor Dr. Cruz, he developed a research project involving the creation of a tool that incorporated different classical cryptography algorithms.

Polytechnic University of Puerto Rico Open House.

Late February, 2014, Celedonio was asked to help with the open house of the PUPR. He was part of a booth promoting the Computer Science program. The RA's showed their respective research work related to security and information assurance to High School students and teachers interested in pursuing related careers. The RA's showed the High School students and teachers the career opportunities available in the area of information security in federal agencies such as the DoD, NSA, DHS,

among others. Many of the students and teachers were aware of the topic and already knew basic information about security and information assurance and how important it actually is. Celedonio was impressed to observe that some of these high school students had programming knowledge and even h a d skills programming in python and java. They wanted to create an application for android or apple devices and they decided to learn more and use the internet to find tutorials or relevant information about IDEs and programming languages related to the creation of applications.

Infosecurity Tour 2014: Security, It's a kind of magic?

While working on his cryptography research Celedonio was selected as a speaker in the Infosecurity Tour 2014. This year it was held in Puerto Rico, but since it's a tour they go around North & South America and the Caribbean. The topic of his conference was *"Cryptography made easy"*. In this conference he was able to talk and know many persons that are related to security and that work for various organization such as Microsoft, Encase, Avaya, McAfee, Cisco, Department of Homeland Security, Department of Defense, ISACA among others.

International Conferences in IA with the Participation of Faculty and Students

Infosec 2014: It's a Kind of Magic?

InfoSec 2014 Conference (San Juan International Congress of Information Security) –PUPR co-sponsors this activity. The attendance in the March 2014 activity was close to 400 participants from the industry, government, and academia. This is the principal forum for information security professionals in Puerto Rico and the Caribbean. This conference helps to increase the number of underrepresented student enrollment in the IA related academic programs.

Cybertech 2014: Looking into the Future

Cybersecurity 2014 Conference - On May 2, 2014 Polytechnic University of Puerto Rico held its second "CyberSecurity Conference "Looking into the Future" at the campus theater. The event gathered close to 400 students and professionals from the Financial, Insurance and Government sector. Ten conferences were offered to participants, making it a complete success. This conference was a total success thanks to the commitment and active participation of committee members, and the support of the DoD and the PUPR Administration Office. Based on feedback from participants, we conclude that for a future event or forum, a higher response and attendance can be expected.

Please see Agenda below for the Cybertech 2014: "Looking to the Future" Conference.

Conference Agenda

I. Friday, May 2, 2014 - Campus Amphitheater

7:00 am to 9:00 am	Registration, Coffee
9:00 am to 9:20am	Welcome Message – Eng.. Jose O. Rivera Rivera, Dean School of Business Administration, Conference Host Mr. Ernesto Vázquez, President Dr. Alfredo Cruz – Associate Director – MS CpE and MS CS
9:25 am to 9:45 am	Presentation: **Back to Basics - Mr. Moises Acevedo**
9:45 am to 10:25 am	Presentation: **Right under your nose: Cyber insider threat in trusted online communication** – Dr. Shuyuan Mary Ho, Florida State University
10:30 am to 10:50 am	Presentation**: Mobile Device Threats and Countermeassures** – Zuleika G. López, Graduate Student, Researcher, Polytechnic University
10:55 am to 11:25 am	Presentation: **DMAIC and Agile Project Management Strategies for Incident Response and Handling**. – Dra. Sandra Fonseca, Metropolitan University
11:30am to 12:00pm	Presentation: **TechnoStress** – Ms. Mabel Lasalle, Professional Coach
12:00 pm to 1:15 pm	Lunch
1:15 pm to 1:45 pm	Presentation: **An Overview of Digital Forensic Tools: Current and Future Trends** – Dr. Jeff Duffany, Turabo University
1:50pm to 2:20pm	Presentation: **Retos de la Seguridad de la Información en la Empresa** - Dra. Aury Curbelo, UPR Recinto Mayagüez
2:25 pm to 2:55pm	Presentation: **Legal Aspects of Social Computing and Networking** - Fernando Cervoni, Esq.
3:00 pm to 3:30 pm	Presentation: **Cyber Security: The Deep Dark Web, Tor, and Bitcoin**- Mr. John Robles, Independent Consultant
3:30pm to 3:45pm	Raffle******, Conference Closing

Conference Supported in part by the US Army Research Laboratory and the US Army Research Office

Participation of PI and Co-PI

The Principal Investigators continued to develop interdisciplinary research and increase Hispanic student and Hispanic faculty access to scientific and engineering equipment for research and research training in IA at PUPR:

PI, Dr. Cruz and Co-PI Dr. Duffany participated in following activities:

- Curriculum Development in Security and Information Assurance (CDSIA) Workshop in San Jose in May, 2014. CDSIA is an annual workshop and capacity building program held at San Jose State University.
- TAPIA 2014 Conference held in Seattle, Washington, February 5-8 2014. The goal of the Tapia Conference is to bring together undergraduate and graduate students, faculty, researchers, and professionals in computing from all backgrounds and ethnicities to: Celebrate the diversity that exists in computing; Connect with others with common backgrounds, ethnicities, disabilities, and gender so as to create communities that extend beyond the conference; Obtain advice from and make contacts with computing leaders in academia and industry; Be inspired by great presentations and conversations with leaders with common backgrounds.
- The 13th Annual Security Conference in Las Vegas, Nevada on May 21-23, 2014. The Security and Privacy conference is an event of choice in the security, assurance and privacy arena. It facilitates discussions and builds a community of interest. The Conference welcomes diverse views of managing security and privacy. These may range from being very technical to socio-organizational. The intention is to develop insights into the socio-technical nature of security problems. The following papers and extended abstracts were presented by PUPR participants in this conference:

  Students: Fabian A. Del Valle, Lyan Lugo
  Advisors: Dr. Jeffrey Duffany, Dr. Alfredo Cruz
  "Comparing Approximate String Matching Algorithms for Digital Forensics"

  Student: Zuleika G. Lopez
  Advisor: Dr. Jeffrey Duffany
  "Mobile Security Threat and Countermeasures"

  Students: Celedonio Arroyo
  Advisor: Dr. Alfredo Cruz, Dr. Jeffrey Duffany
  "Interactive Learning Tool for Cryptography"

- Dr. Cruz participated in the SC13 HPC Networking, Storage, and Analysis Conference in November 2013 in Seattle, Washington.
- Dr. Duffany worked in a Summer internship at LLNL in 2014. He taught security courses, and was one of the referees in the "Capture the Flag' competition.
- Dr. Cruz and Dr. Duffany participated in LACCEI 2014. Dr. Cruz presented the paper: "Genetic Algorithm for Cryptanalysis on Substitution Ciphers".

PI and Co-PI Proposal Writing

During this award period the PI and Co-PI have been very active submitting competitive proposals to different federal agencies that support research and education in Information Assurance. From October 2013 to June 2014 they have submitted five proposals:

DoD DURIP: October 2013, "State-of-the-Art Digital Forensics Equipment to Enhance the Infrastructure for Research and Education in Digital Forensics and Steganography" for $81,678.23.PI Dr. Alfredo Cruz, Co-PI Dr. Jeff Duffany.

NSF SFS: February 2014, "Development of a Federal Cyberforce in Puerto Rico" for $2,261,939.17. PI Dr. Alfredo Cruz, Co-PI Dr. Jeff Duffany.

NRC: March 2014, "NRC: Scholarship/Fellowship to Increase Undergraduate and Graduate Research and Education in NRC Related Areas in Puerto Rico" for $398,774.00. PI Dr. Alfredo Cruz, Co-PI Dr. Jeff Duffany.

DoD IC CAE: March 2014, "Polytechnic University of Puerto Rico Intelligence Community Center for Academic Excellence (PUPR IC-CAE)" for $399,948.80. PI Dr. Alfredo Cruz, Co-PI Dr. Jeff Duffany.

DoD CoE: June, 2014, "Polytechnic University of Puerto Rico Center of Excellence in Cyber Security" for $4,149,909.00. PI Dr. Alfredo Cruz, Co-PI's: Dr. Mary Ho; Dr. Li Yang; Dr. Victor Zahrov; Dr. Jeff Duffany.