Graduate Programs in Computer Science

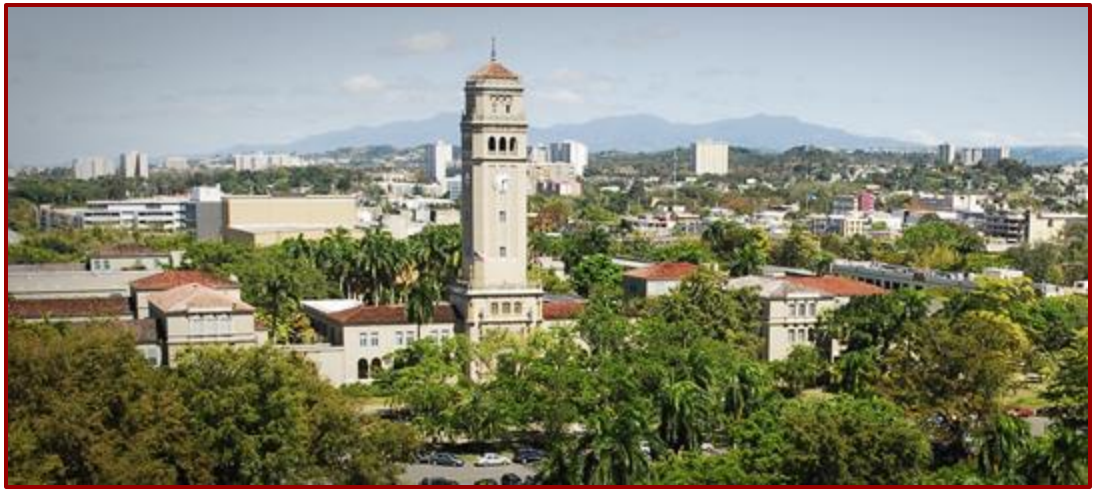
Computer Science Department

University of Puerto Rico at Río Piedras

Contact: Ivelisse Rubio Canabal, Ivelisse.rubio@upr.edu

Our Campus

CIENCIA DE CÓMPUTOS UPRRP



Natural Sciences

CIENCIA DE CÓMPUTOS UPRRP

- **8 Departments**
  - Biology
  - Chemistry
  - **Computer Sciences**
  - Environmental Sciences
  - Math
  - Nutrition
  - Physics
  - Interdisciplinary

Graduate Programs in Computer Science

CIENCIA DE CÓMPUTOS UPRRP

- Master's degree

  30 credits

- Ph.D. degree (applicants with a master in a CS related area*)

  30 credits

- Ph.D. degree (applicants without a master)

  54 credits

Goals

1. To provide **advanced knowledge** in computer science that develops graduates with **strong foundations** that allow them to **become leaders** that can adapt to the ever-changing nature of the area.
2. To provide **practical experiences** related to computer science that allow graduates to participate in as well as to create projects that **promote the economic development**.
3. To provide a **research-intensive environment** that will prepare graduates to be **internationally competitive** in their field of research.
4. To increase the **contributions** of the Department of Computer Science to the computer science **community as well as to society**.

Graduate Profile

Graduates of this program will be able to easily navigate the ever-changing area of Computer Science based on their **solid theoretical foundation** and their **lifelong-learning skills**. Similarly, they will contribute to the computer science community as well as to society by sharing their work with a vast audience while **promoting diversity in all aspects of their profession**. They will also be capable of **developing applications** that have direct impact on the commmunity and society following aspects of universal design.

Graduate Profile - Master

Master's graduates will present their work, of an expository nature related to the courses taken, at international conferences and develop projects that would solve a problem or a task for a specific target audience. They will **obtain and hold jobs in the technology industry or continue to a Ph.D. program.**

Graduate Profile – Ph.D.

The Ph.D. graduates will publish their work in renowed international peer-reviewed journals and conferences. This work will be a substantial, original and independent contribution to the knowledge in the field of Computer Science. They will **hold positions in academia or industry**. They will be recognized as **innovators as well as leaders** by their employers, and research and academic peers.

Master - Curriculum - 30 Credits

- Required Courses
  - CCOM 6029 High Level Languages
  - CCOM 6050 Algorithms
  - CCOM 6XXX One Systems course (some options are Operating Systems, Databases, Networking, Cyber Security, and Computer Architecture)
  - CCOM 6035 Development of Applications with Social Impact
  - **3 credits for thesis or project**
- Computer Science Electives
  - 6 credits in CCOM courses at the 6000 level or above.
- Free Electives
  - 9 credits of free electives at the 6000 level or above.

Master - Curricular Sequence (Full-time students)

First Year - First Semester		First Year - Second Semester	
CCOM 6029 High Level Languages	3 crd	CCOM 6050 Algorithms	3 crd
CCOM 6XXX Systems course	3 crd	CCOM elective course	3 crd
CCOM elective course	3 crd	Free elective	3 crd
Second Year - First Semester		**Second Year - Second Semester**	
CCOM 6035 Development of Applications with Social Impact	3 crd	CCOM 6XXX Thesis or project	3 crd
Free elective	3 crd		
Free elective	3 crd		

Master – path/requirements (Full-time students)

First Year - First Semester	First Year - Second Semester
	Select Topic, Director Thesis/Project
Second Year First Semester	**Second Year Second Semester**
Before October, Select Committee members	Before second week: Thesis/Project Proposal Defense
	Thesis/Project Defense

Master - Curricular Sequence (Part-time students)

First Year - First Semester		First Year - Second Semester	
CCOM 6029 High Level Languages	3 crd	CCOM 6050 Algorithms	3 crd
CCOM elective course	3 crd	CCOM elective course	3 crd
Second Year - First Semester		**Second Year - Second Semester**	
CCOM 6XXX Systems course	3 crd	Free elective	3 crd
CCOM 6035 Development of Applications with Social Impact	3 crd	Free elective	3 crd
Third Year - First Semester		**Third Year - Second Semester**	
CCOM 6XXX Thesis or project	1 crd	CCOM 6XXX Thesis or project	2 crd
Free elective	3 crd		

Master – path/requirements (Full-time students)

First Year - First Semester	First Year - Second Semester
Second Year - First Semester	**Second Year - Second Semester**
Select Topic, Director Thesis/Project	Before March, Select Committee members
Third Year - First Semester	**Third Year - Second Semester**
Before second week: Thesis/Project Proposal Defense	Thesis/Project Defense

Ph.D. - Curriculum - 54 Credits

- Required Courses
  - CCOM 6029 High Level Languages
  - CCOM 6050 Algorithms
  - CCOM 6XXX One Systems course (some options are Operating Systems, Databases, Networking, Cyber Security, and Computer Architecture)
  - CCOM 6035 Development of Applications with Social Impact
  - **6 credits for dissertation**
- Pass a Qualifying Exam before continuing to dissertation work
- Computer Science Electives
  - 27 credits in CCOM, 21 at the 8000 level, 6 at the 6000 level or above
- Free Electives
  - 9 credits of free electives at the 6000 level or above

Ph. D. - Curricular Sequence (54 credits)

First Year First Semester		**First Year Second Semester**	
CCOM 6029 High Level Languages	3 crd	CCOM 6050 Algorithms	3 crd
CCOM 6XXX Systems course	3 crd	CCOM elective course	3 crd
CCOM elective course	3 crd	Free elective	3 crd
Second Year First Semester		**Second Year Second Semester**	
CCOM 6035 Development of Applications with Social Impact	3 crd	CCOM 8XXX elective course	3 crd
CCOM 8XXX elective course	3 crd	CCOM 8XXX elective course	3 crd
Free elective	3 crd	Free elective	3 crd

Ph. D. - Curricular Sequence (54 credits)

Third Year First Semester		**Third Year Second Semester**	
CCOM 8XXX elective course	3 crd	CCOM 8XXX elective course	3 crd
CCOM 8XXX elective course	3 crd	CCOM 8XXX elective course	3 crd
CCOM 8996 Doctoral Dissertation	3 crd	CCOM 8997 Doctoral Dissertation	3 crd
Fourth Year First Semester		**Fourth Year Second Semester**	
CCOM 8997 Doctoral Dissertation Cont	0 crd	CCOM 8997 Doctoral Dissertation Cont	0 crd

Ph. D. - Curriculum (for students with a Master's Degree in CS) - 30 Credits

- Required Courses
  - 6 credits for dissertation
- Pass a Qualifying Exam
- Computer Science Electives
  - 18 credits in CCOM at the 8000 level
- Free Electives
  - 6 credits of free electives at the 6000 level or above

Ph. D. - Curricular Sequence (30 credits)

First Year First Semester		**First Year Second Semester**	
CCOM 8XXX elective course	3 crd	CCOM 8XXX elective course	3 crd
CCOM 8XXX elective course	3 crd	CCOM 8XXX elective course	3 crd
Free elective	3 crd	Free elective	3 crd
Second Year First Semester		**Second Year Second Semester**	
CCOM 8XXX elective course	3 crd	CCOM 8XXX elective course	3 crd
CCOM 8996 Doctoral Dissertation	3 crd	CCOM 8997 Doctoral Dissertation	3 crd
Third Year First Semester		**Third Year First Semester**	
CCOM 8997 Doctoral Dissertation Cont	0 crd	CCOM 8997 Doctoral Dissertation Cont	0 crd

Length of the Program and Maximum Time to Complete the Degree

		Full-time		Part-time	
Degree	**Crds**	**Length**	**Maximum**	**Length**	**Maximum**
Master	30	2 yrs	4 yrs	3 yrs	5 yrs
Ph.D after Master	30	3 yrs	5 yrs	4 yrs	7 yrs
Ph.D. without Master	54	4 yrs	7 yrs	6 yrs	8 yrs

Course Validation

- You can validate courses that you have taken up to a max of 30% of the required courses.
- Grade on these courses has to be B or above.
- Courses should have been approved in a period no longer than 5 years prior to admission.
- Courses cannot have been used for another degree.
- Student has to apply for the validation.

Financial Aid

- There are some teaching assistant positions that are shared among all graduate programs. It is important that when you apply you specify that you want to compete for an assistantship. When all applications are received, the available assistantships are divided among the programs.

- The Scholar COMPASS Program from the CCOM Department has fellowships for CS graduate students: https://ccom.uprrp.edu/~sstem/index.php#becas

- There are some research assistantships based on research projects but for that you have to contact the professors that lead the projects.

- You can apply to scholarships or fellowships to pay for your studies. More information on https://ccom.uprrp.edu/~labemmy/Wordpress/wp-content/uploads/2023/01/Listado-de-Becas.pdf

https://ccom.uprrp.edu/~sstem/index.php#becas

2025

Primera Clase
Maestría en Ciencia de Cómputos
Facultad de Ciencias Naturales

Héctor G. Sánchez Mercado

José E. Rodríguez Ríos

Benny S. Rodríguez Marrero


¡BIENVENIDOS AL CHOLI

Carlos Díaz, 27 de junio de 2025

Christian Matos, 30 de junio de 2025

Department of Computer Science

Our Faculty

Michael Álvarez

CIENCIA DE CÓMPUTOS UPRRP

- ✓ 2014 BS Electronic Engineering
- ✓ 2018 MSc Applied Mathematics
- ✓ 2024 PhD Electrical Engineering

keywords: AI & Deep Learning, Computer Vision, Computational Imaging, Applied Mathematics.

My research interests include computational imaging applications, mainly using ML and DL algorithms. Estimating properties and enhancing attributes in multidimensional signals. I am passionate studying numerical analysis and PDEs, to integrate physics simulations with real-world measurements to achieve more accurate modeling.

My lab: **Modeling Advanced Artificial Networks (MAAN) Laboratory**
https://ccom.uprrp.edu/~malvarez/index.html

Former:

- ✓ Center for the Advancement of Wearable Technologies (CAWT)
- ✓ Laboratory for Applied Remote Sensing Imaging and Photonics (LARSIP)
- ✓ Computational Optics and Imaging Laboratory (COIL)

Recent publications:

- **Alvarez, M.**, et al. Virtual stain and Phase estimation using Encoder-Decoder Networks. Conference ISICN 2025. Springer Nature. (In publication)
- **Alvarez, M.**, et al. FDTD-net+: Improving Execution Time in Light Propagation Modeling. IEEE Access, 2025. (Under revision)

Michael Álvarez

CIENCIA DE CÓMPUTOS UPRRP

Current Graduate Students

MSc: **Alejandro Vega-Nogales**

- ❖ BSc Computer Science
- ➢ Data Scientist
  Maxar Puerto Rico

Alejandro Vega

Current Research: ***Self-Supervised Learning for Enhancing Multimodal Earth Observation Data Analysis***

PhD: **Christian Perez Perez**

- ❖ BSc Electrical Engineer
- ❖ MECE in Computer Engineering
- ❖ MEEE in Electrical Engineering
- ➢ Process Development Sr. Scientist at Amgen

Christian Perez

Current Research: ***Enhancing Defect Detection in Pharmaceutical Products through Synthetic Data Generation and Deep Learning***

Michael Álvarez

CIENCIA DE CÓMPUTOS UPRRP

Current Graduate Students

MSc: **Alejandro Vega-Nogales**

Self-Supervised Learning for Enhancing Multimodal Earth Observation Data Analysis".

Michael Álvarez

CIENCIA DE CÓMPUTOS UPRRP

Current Under-Graduate Students

Gabriel Torres-Morales

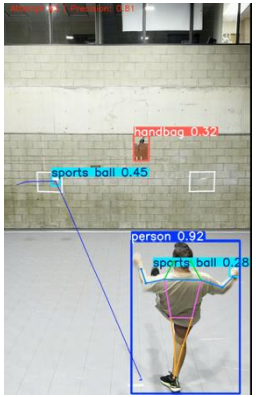
- ❖ BSc Computer Science | Jan 2023 – Present
- ❖ BB Administration | Aug 2021 – Present

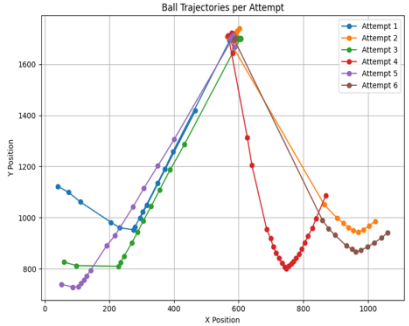
- ❑ Computer Vision
- ❑ Computer Architecture
- ❑ AI & Deep Learning

CV

GTM

Computer Vision and Artificial Intelligence in Sports Performance Analysis





Poster paper Accepted to present at CARLA 2025 (https://carlaconference.org/call-posters/). This is a high-performance computing event in the Caribbean, focused on advancing computational science, AI, and data-intensive applications.

CARLA 2025

Michael Álvarez

CIENCIA DE CÓMPUTOS UPRRP

Current Under-Graduate Students

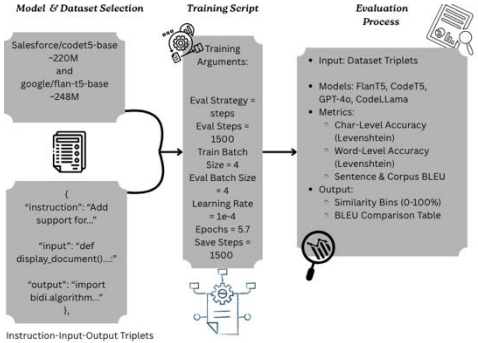
Yadiel Mercado-Rivera

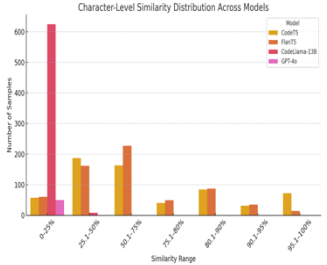
- ❖ BSc Computer Science | 2019 – Present
- ❖ Unreal Engine Developer | 2024 – Present

- ❑ Data Structures
- ❑ Cybersecurity
- ❑ Large Language Models

CV YMR

Instructional Code Editing Using Transformer Models





Poster paper Accepted to present at CARLA 2025 (https://carlaconference.org/call-posters/). This is a high-performance computing event in the Caribbean, focused on advancing computational science, AI, and data-intensive applications.

CARLA 2025

Rafael Arce Nazario

CIENCIA DE CÓMPUTOS UPRRP

keywords: CS education, FPGAs, reverse engineering

Office: A-157
Lab: A-156

I do high performance implementations of algorithms for finite field arithmetic, using FPGAs, distributed computing, and GPUs to explore mathematical structures and validate conjectures. Currently, I am leading a UPR-RP and Georgia Tech research collaboration for broadening participation in CS through culturally relevant interventions at middle and high schools. I have collaborated with several transdisciplinary teams to create computer and mobile applications for architectural design and behavioral science research.

Additional research interests:

- Software reverse engineering
- Hardware design automation
- Music information retrieval

Rafael Arce Nazario

CIENCIA DE CÓMPUTOS UPRRP

Campamento
Code Your Music
2024

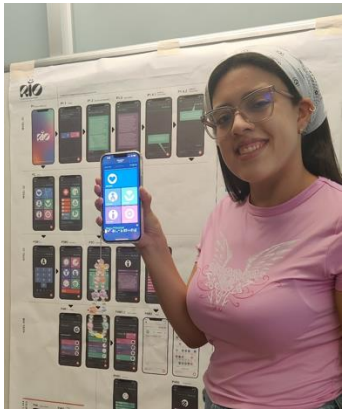
Rafael Arce Nazario

CIENCIA DE CÓMPUTOS UPRRP

Current MS students:

Gabriel Santiago

Visualization on Musical Harmony



Nicole Ramírez

Incorporation of dance programming into Earsketch

Tatiana Castro Vélez

CIENCIA DE CÓMPUTOS UPRRP

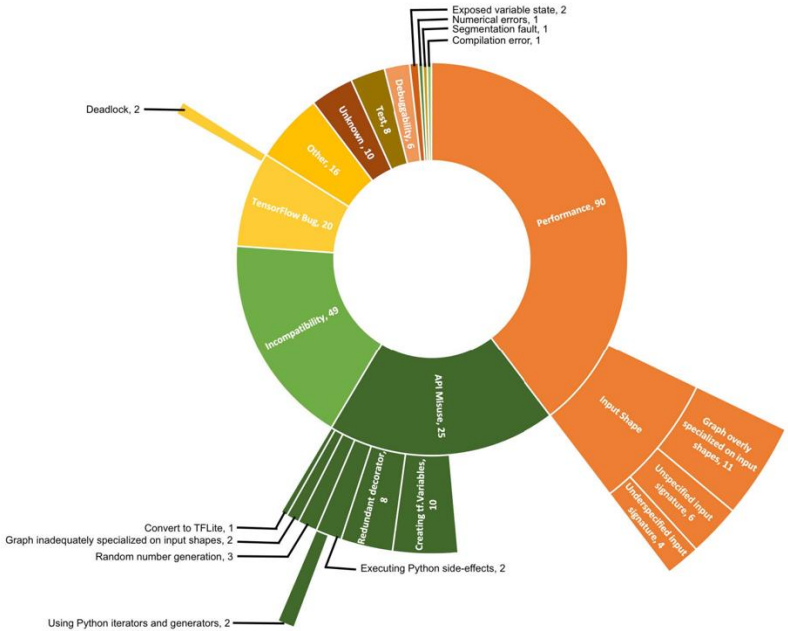
keywords: software engineering, programming languages, deep learning systems

Office: C-170

My research interests lie at the intersection of **software engineering** and **programming languages**. I am particularly interested in how automated refactoring and program analysis might lessen the load of correctly, quickly, and safely evolving large and complicated software. My ongoing research focuses on **enhancing and facilitating the long-term evolution of Deep Learning (DL) systems through SE methodologies**. I aim to continue exploring the applicability of SE techniques to DL systems, given their widespread use in the Computer Science community and today's society. DL systems, characterized by their vast scale and complexity, present unique challenges, distinct from traditional software systems. Thus, it is imperative to identify techniques conducive to their evolution and maintenance.

Tatiana Castro Vélez

CIENCIA DE CÓMPUTOS UPRRP



Vélez, T. C., Khatchadourian, R., Bagherzadeh, M., & Raja, A. (2022, May). Challenges in migrating imperative deep learning programs to graph execution: an empirical study. In *Proceedings of the 19th international conference on mining software repositories* (pp. 469-481).

TABLE I: CONVERT EAGER FUNCTION TO HYBRID preconditions.

	exe	tens	lit*	se	rec	trans
P1	eag	*T*	*F*	*F*	*F*	hyb

* An option exists in our implementation to not consider Boolean literals.

Fig. 2: High-level flowchart.

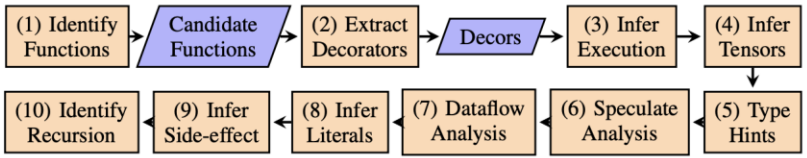


Fig. 3: Precondition checking flowchart.

Khatchadourian, R., Vélez, T. C. Vélez, Bagherzadeh, M., Jia, N., & Raja, A. (2025). Safe automated refactoring for efficient migration of imperative Deep Learning programs to graph execution. *arXiv preprint arXiv:2504.05424*.

Carlos J Corrada Bravo

CIENCIA DE CÓMPUTOS UPRRP

Keywords: Machine Learning, acoustic species identification, data science, software development, Scrum

Office: A-149
Lab: CNN-317

The development of **machine learning** algorithms for the identification of species of amphibians, birds, insects, and mammals through audio recordings, to contribute to our understanding of the natural world.

The development of sensors and software for applications with social impact using Scrum.

- Data Augmentation of a Bioacoustic Dataset for Deep Learning Classification
- Deep Learning For Animal Sound Classification with Scarce Data
- Clustering methods to classify broad range of species from their vocalization
- A Cloud Based Application Using Ecological Momentary Assessment to Evaluate the Impact of Undergraduate Research Experiences on Self-Efficiency Scientific Identity and Career Decidedness
- From zip to store: A comparison of JavaScript frameworks for the development of mobile applications
- Deep-Pollinator: Enabling Large-Scale Video Analysis Of Pollinator Behavior With Deep Learning
- Seasonal and Circadian Organismal Responses to Environmental Stress

Carlos Corrada Bravo

CIENCIA DE CÓMPUTOS UPRRP

The project's future work lies in the development of species-specific identification algorithms that use a combination of Convolutional Neural Networks (CNN) and transformers to improve the accuracy and efficiency of species identification. Transformers can be employed alongside CNNs to capture both local and global features of the input data, allowing the model to learn and recognize the unique patterns of each species' vocalizations accurately.

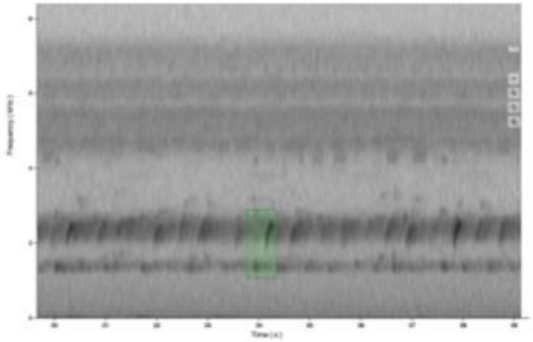
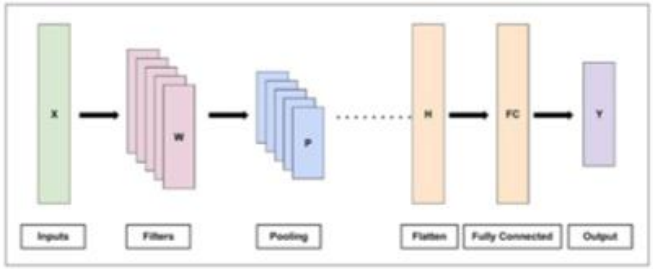


Table 1 Confusion matrix of the species-specific models. The confusion matrix results based on a comparison of the validation training set for each of the nine species with the model results.

Species	Site	Validation data (*n*)	True positives	False positives	True negatives	False negatives	Accuracy	Precision
Oophaga pumilio	LSBS	183	31	0	150	2	99	100
Ramphastos swainsonii	LSBS	395	24	5	348	18	94	83
Alouatta palliata	LSBS	342	35	11	288	8	94	76
Tinamus major	LSBS	407	67	1	298	41	90	99
Rana grylio	SS	127	37	6	76	8	89	86
Eleutherodactylus juanariveroi	SS	231	109	6	88	28	85	95
Insect 01	SS	130	50	7	61	12	85	88
Diaspora diastema	LSBS	190	54	4	101	31	82	93
Insect 02	LSBS	163	53	1	75	34	79	98

Notes.
LSBS – La Selva Biological Station, Costa Rica; SS – Sabana Seca, Puerto Rico.



General structure of a CNN

Carlos J Corrada Bravo

CIENCIA DE CÓMPUTOS UPRRP

Former master' students: Giovany Vega, Rafael Álvarez, Rafael Meléndez, Benny Rodríguez

Current master' student:

Carlos Pérez

Project title: A Metadata-Driven Framework for Managing High-Throughput Sensor Data in Ecological Edge Networks

David Flores

CIENCIA DE CÓMPUTOS UPRRP

Keywords: Bioinformatics, Data Sciences, Video games, Protein structure, Boids.

Office:
Lab: 155. Ext. 88360

Bioinformatics: Pattern recognition in three-dimensional protein structures.
Video game design and development: Simulations, educational video games, VR and AR applications.
Data Sciences: Extraction, transformation, analysis, modeling and visualization of data obtained from different fields of knowledge to make classifications or predictions.

Bioinformatics: Problems related to early cancer diagnosis from structural mutation detection.

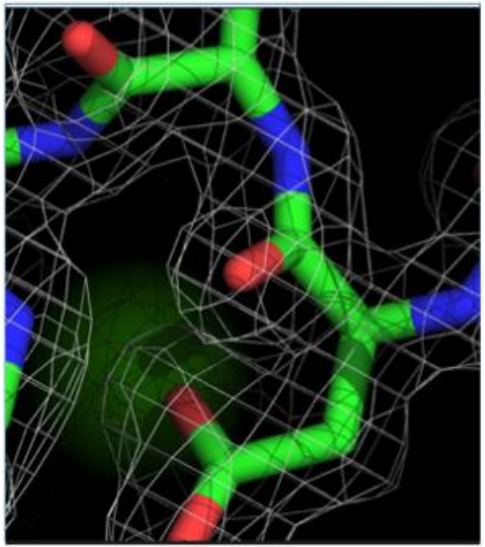
- Student work: Data cleansing and curation. Feature selection using machine learning.
- Future objectives: Propose effective hot spots to aid early diagnosis of cancer

Video game design and development: Simulation of organisms (boids) in self-organized groups, e.g., schools, swarms, flocks or herds, using 3D intelligent agents.

- Student work: Improving agent behavior using fuzzy logic as well as biological and mathematical models
- Future objectives: Integrate agent behavior on reef invasive species, such as lionfish.

David Flores

CIENCIA DE CÓMPUTOS UPRRP



Structural representation of a protein part

Examples of simulation and video game developments

Video game design and development: Development of a video game to raise awareness about the care of marine ecosystems.
Student work: Improve the design of the core mechanics and user interface of a video game aimed at children from 6 to 9 years old.
Future objectives: To make a new version of an online video game developed in Unity to measure the impact of the video game in raising awareness of the care of marine ecosystems.

David Flores

CIENCIA DE CÓMPUTOS UPRRP

Former master' student:

Carlos Díaz

Project title: Diseño de modelos de lógica difusa para simulación de comportamiento de agentes inteligentes usando el paradigma Data-Oriented Technology Stack

David Flores

CIENCIA DE CÓMPUTOS UPRRP

Current master' student:

Isabel Rivera

Project title: In silico method for extracting features of local protein structures BRCA, BRDA, and BRCT with hotspots of single missense mutations

Marie Lluberes

CIENCIA DE CÓMPUTOS UPRRP

Keywords: Bioinformatics, Data Science, Health equity, Machine Learning

Office: A-145
Lab: 019A
https://fury.hpcf.upr.edu/

Our lab works with:

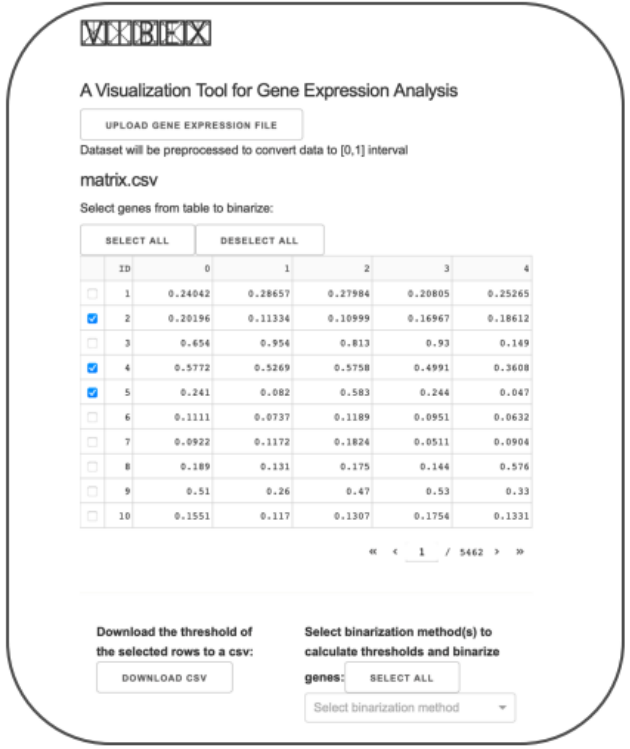
- Boolean Network (BN) representations of Gene Regulatory Networks (GRN), visualizing and analyzing binarization algorithms and, recently, Machine Learning algorithms for value imputation and network inference.
- Bee behavior analysis, using Data Science to assemble bee flights, analyze patterns and visualize trends.
- Data Science/Machine Learning for health disparities, applying DS and ML to study impact of social determinants of health — most recently, with post-COVID glycemic control.

Marie Lluberes

CIENCIA DE CÓMPUTOS UPRRP

1

ViBEx: A Visualization Tool for Gene Expression Analysis
Michael H. Terrefortes-Rosado , Andrea V. Nieves-Rivera, Humberto Ortiz-Zuazaga and Marie Lluberes-Contreras*

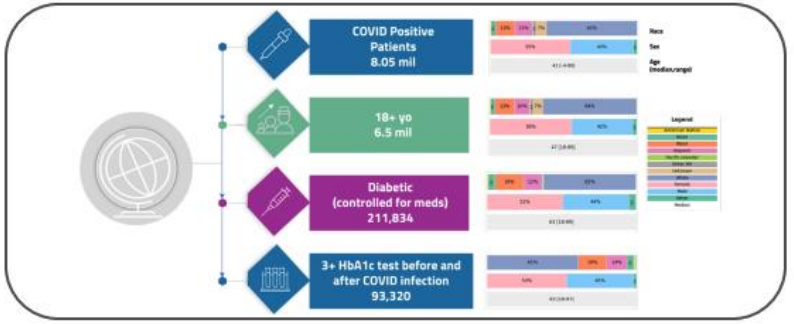


2

Using Bee Hive Video Monitoring Data for Individual Bee Flight Assembly and Analysis
Andrea Nieves-Rosado and Marie Lluberes-Contreras

Leveraging Machine Learning to Assess Post-COVID-19 Glycemic Control in Diabetic Patients: Understanding Preventable Health Differences.
Marie Lluberes-Contreras[1], Abiel Roche-Lima[2], Hamid Reza Kohan Ghadr[3]

3



Marie Lluberes

CIENCIA DE CÓMPUTOS UPRRP

Current master's student:

- Conferences:
  SIDIM 2024
- Publications:
  https://doi.org/10.3390/biomedinformatics5010013

Michael Terrefortes-Rosado

Project Title: Visualization and Analysis of Boolean Networks of Gene Expression

Marie Lluberes

CIENCIA DE CÓMPUTOS UPRRP

Current master's student:

- Conferences:
  SIDIM 2024, SIDIM 2025,
  IEEE International Conference on AgroGeoInformatics 2025

Andrea Nieves-Rosado

Project Title: Exploring Bee Behavior Throughout Travel Events

Rémi Mégret

CIENCIA DE CÓMPUTOS UPRRP

Keywords: Computer Vision, Machine Learning

Office: A150
Lab: CN-116

https://scholar.google.com/citations?user=zBcXSWoAAAAJ&hl=en

Deep Learning based tools for the analysis of challenging scientific data

Short bio:

- 2003-2014 Professor at Bordeaux Institute of Technology (France)
- 2014-2016 Professor at UPR Mayaguez
- 2016-now Professor at UPR Río Piedras

Current and recent projects

- **Automatic Analysis of Honeybee Behavior using Video**
  - NSF CyIndiBee (PI), USDA DeepPollinator (PI), NSF BigDBee (PI)
- **AI for multi-omics**
  - NSF E-RISE Cracking the developmental blueprint of life: Omics, Computational Science, and AI (Co-PI)
- **Microscopy Imaging**
  - Collaboration with Brookhaven National Lab, U. Penn
  - Collaboration with Brown University (Project PROBE)

Rémi Mégret – Active project

CIENCIA DE CÓMPUTOS UPRRP

NSF Project CyIndiBee -
CyberInfrastructure for video analysis of individual bee behavior

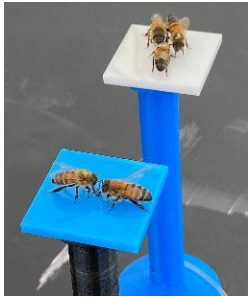
1. Design, train and use **ML models** (CNN, Transformer) to automate various tasks
2. Deployment for **large-scale analysis** (GPU server) and **real-time** (Edge GPU)
3. Design **applications** to accelerate annotation and analysis

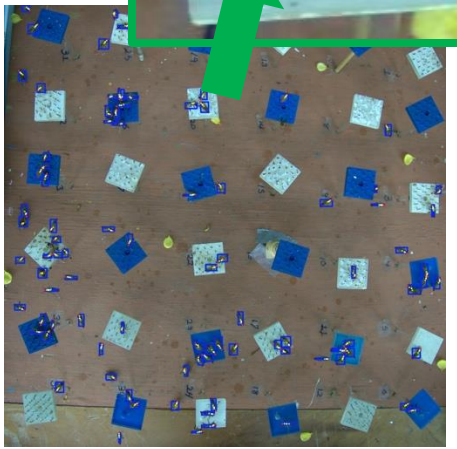
Examples of visual analysis tasks:

Trait recognition
(e.g. pollen, fanning…)

Automatic Re-Identification

Pose Detection, Tracking, Real-Time Monitorin





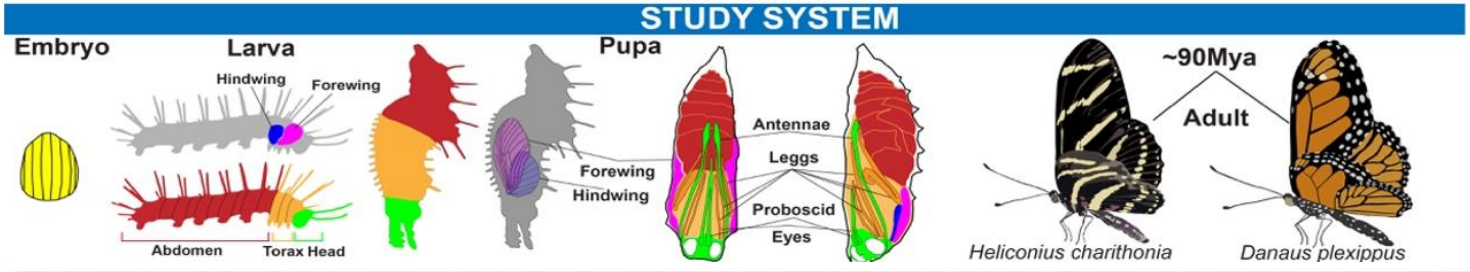
FlowerPatch experiment

ndiBee col10: 24 days analyzed (288h) – 28000 entrance/exit events
n 700 marked bees – tens of millions of images

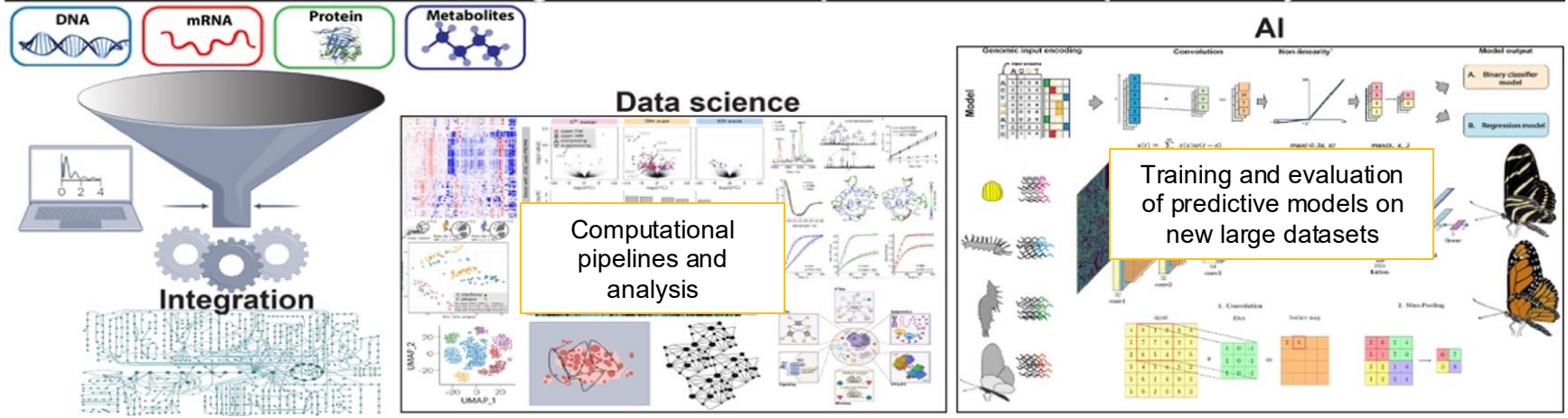
Rémi Mégret – Active project

CIENCIA DE CÓMPUTOS UPRRP

- **NSF E-RISE Cracking the developmental blueprint of life: Omics, Computational Science, and AI** (Co-PI)
  with Dr. Riccardo Papa (PI, Biology), Dr. Humberto Ortiz (CCOM)…



Unique new dataset combining single-cell sequencing of DNA and RNA with proteome, metabolome.



Rémi Mégret – MS Thesis Students

CIENCIA DE CÓMPUTOS UPRRP

Ivan Rodriguez: MSc Thesis 2019

Automatic Video Monitoring of Honeybee Foraging Behavior Using Convolutional Neural Networks

- I F. Rodriguez et al. Automated Video Monitoring of Unmarked and Marked Honey Bees at the Hive Entrance, Frontiers in Computer Science, Feb 2022. https://doi.org/10.3389/fcomp.2021.769338
- Continued to obtain a PhD in Cognitive Sciences at Brown university

Jeffrey Chan: undergrad research, MSc Thesis 2022

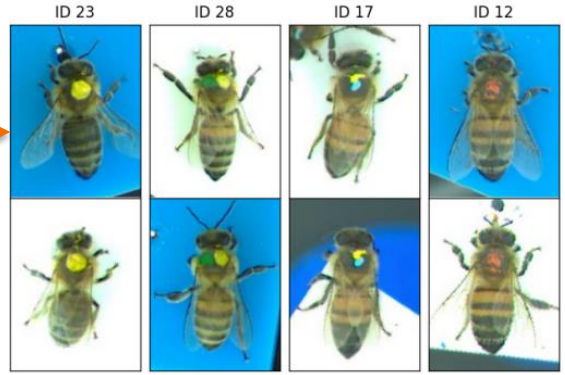
Deep Learning For Honeybees Re-identification

- J. Chan, et al. Honeybee Re-identification in Video: New Datasets and Impact of Self-supervision. VISIGRAPP (5: VISAPP) 2022: 517-525 https://doi.org/10.5220/0010843100003124
- Now pursuing a PhD in Computer Science at University of Central Florida

Luke Meyers: undergrad research, MSc started 2024

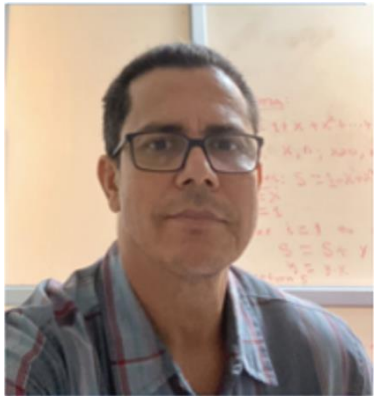
Foundational models for video analysis of individual pollinators

- L Meyers, et al. Towards Automatic Honey Bee Flower-Patch Assays with Paint Marking Re-Identification. arXiv preprint arXiv:2311.07407, 2023. https://arxiv.org/pdf/2311.07407 Poster at CVPR CV4Animals 2023.
- L. Meyers et al. Video Analysis and Machine Learning Tools Enable Fine-grained Tracking of Pollinators of Mango *Mangifera indica* in Puerto Rico . Poster at Entomological Society of America's 2025 Annual meeting.
- G. Santiago-Plaza, L. Meyers et al. Identification of honeybees with paint codes using convolutional neural networks. VISAPP 2024.
- A. Gómez-Jaime, L. Meyers et al. Paint Blob Detection and Decoding for Identification of Honey Bees, VISAPP 2025



Edusmildo Orozco

CIENCIA DE CÓMPUTOS UPRRP



Office: A-154
Lab: A-148

- Current research project is related to the design and development of a personalized intelligent assistant based on LLMs to foster scientific research skills in undergraduate students.
- Other research interests:
  - High performance computing/parallel algorithms
  - Computer Science Education
  - Applications of finite fields
  - Open to new topics of interest to students

Edusmildo Orozco

CIENCIA DE CÓMPUTOS UPRRP

Master' students:

Carlos Vázquez Echevarría

Project: *Hybrid system modeling for a personalized intelligent assistant*

Kenjiro García

Project: *Computational persuacion & applications to AI agents*

John Wilson

Project: *Platform for the visualization & analysis of medical facilities in Puerto Rico*

Freddy Bello

Project: *Forecasting and optimizing network operations for temporary IT infrastructure in high-demand scenarios*

Former master' students:

Efraín Vargas Ramos

Project: *Rutéate: Un app basada en la metodología "user experience" para promover la socio-economía puertorriqueña,* 2021

Heriberto Carbia

Project: *Classifying phenotypic traits from genomic data using convolutional deep learning methods,* 2019

Humberto Ortiz Zuazaga

Keywords: **bioinformatics, cybersecurity**

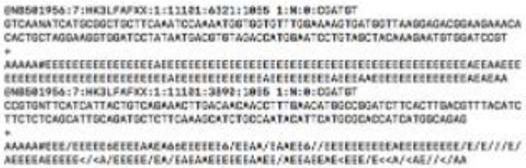
Office: **NCL A-159**
Lab: **NCL A-158**

Bioinformatics, especially gene expression analysis using sequence data.
Cybersecurity
Cyberinfrastructure

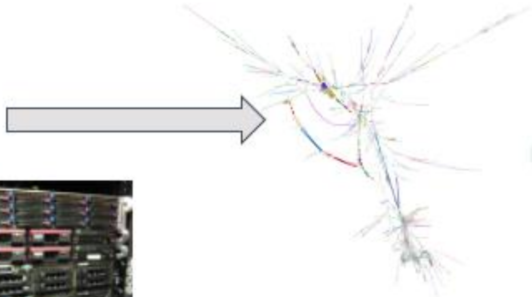
- Software for the analysis of sequence data and gene expression
- Visualization of public health data
- Analysis and visualization of network traffic

Humberto Ortiz Zuazaga

Like jigsaw puzzles? How about a puzzle with 448 million pieces? With missing pieces, bad pieces, no box?

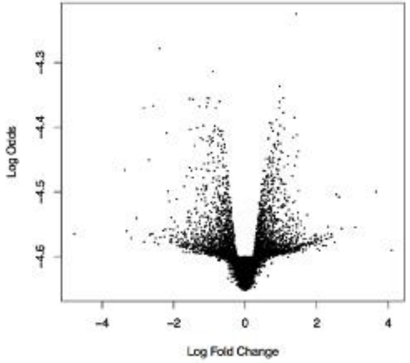


Take this
Turn it into that
With these



Then count the pieces, again

```
> volcanoplot(fit,coef=2)
```



Humberto Ortiz Zuazaga

Former master's student:

Héctor Sánchez

Thesis title: Benchmarking DYTAS Against HEFT and

Dynamic List DAG Scheduling Algorithms

Humberto Ortiz Zuazaga

Current master's student:

Isaac López

Thesis topic: High-level languages

Current undergraduate student:

Sebastian Hernandez

Internship: Texas Advanced Computing Center

José Ortiz Ubarri

CIENCIA DE CÓMPUTOS UPRRP

Keywords: Cybersecurity, HPC, Software, Codes

Office: A-146
Lab: 019B

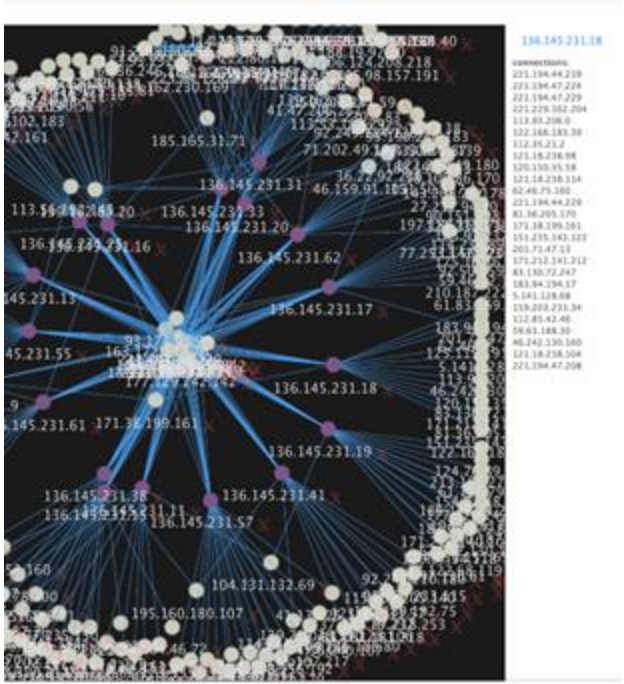
In the CSLab our goal is to develop research and development skills in our students which are important for graduate school or for Puerto Rico's workforce. We work in areas of Cybersecurity, particularly in finding methods to detect anomalies, cyber attacks, or intruders in systems and networks. We develop HPC solutions to different problems in security, math, and science in general. We are always looking for development opportunities of software for social impact.

Dissemination:

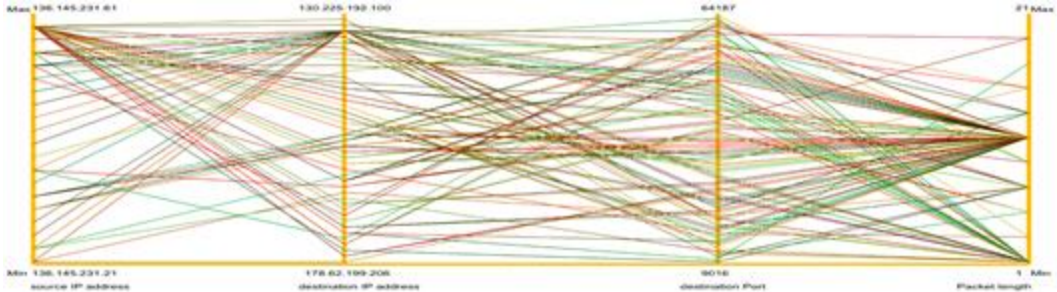
- J. Hernandez, **J. Ortiz Ubarri**. A Lightweight Remote NMS for Private Networks. Annual Computer Security Applications Conference (ACSAC). Austin Texas, USA, 2022.
- **J. Ortiz-Ubarri, H. Ortiz-Zuazaga**, A. Maldonado, E. Santos, J. Grullón. Toa: A Web-Based NetFlow Data Network Monitoring System at Scale. Proceedings of the IEEE Big Data Congress, New York, USA, 2015.
- J. de la Cruz, I. Dávila with **José Ortiz-Ubarri**. A Network Flows Visualization Framework and API for Network Forensics and Analytics in the Web. FloCon 2017. San Diego, CA. January 2017.
- **J. Ortiz-Ubarri**, **H. Ortiz-Zuazaga**, A. Maldonado, E. Santos, J. Grullón. Toa: A Web-Based NetFlow Data Network Monitoring System. In Proceedings FloCon 2015, Portland Oregon. January 2015.
- J. de la Cruz Natera, Ian Dávila, **J. Ortiz-Ubarri**. A network flows visualization framework and API for network forensics and analytics in the web. 37th IEEE Symposium on Security and Privacy. May 2016.
- J. Valles, I. Dávila, **J. Ortiz-Ubarri**. Automated Anomaly Detection Within The Toa Network Flow Data Monitoring System. 37th IEEE Symposium on Security and Privacy. May 2016
- A. Carrasquillo, A. Maldonado, E. Santos, **J. Ortiz-Ubarri**. Towards a framework for Network-based Malware detection system. IEEE Symposium in Security and Privacy. San Jose California, May 2014.

José Ortiz Ubarri

CIENCIA DE CÓMPUTOS UPRRP



Online tool for the detection of botnets and DoS



Web Visualization of network and port scans

- **Ortiz-Ubarri, J**. New asymptotically optimal three-dimensional wave-length/space/time optical orthogonal codes for OCDMA systems. J. Cryptography and Communications. (2020).
- **R. Arce-Nazario, J. Ortiz-Ubarri**. Multidimensional Costas arrays and their enumeration using GPUs and FPGAs. International Journal of Reconfigurable Computing (2012).
- **J. Ortiz-Ubarri,** O. Moreno, A . Tirkel, **R. Arce-Nazario**, S. Golomb. Algebraic symmetries of generic (m+1) dimensional periodic Costas arrays. IEEE Transactions on Information Theory 59(2):1076-1081 (2013).
- **J. Ortiz-Ubarri**, **R. Arce-Nazario**, and **E. Orozco**. “Modules to Teach Parallel and Distributed Computing Using MPI for Python and Disco.” In 2016 IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW), pp. 958-962. IEEE, 2016.

CSLAB

José Ortiz Ubarri

CIENCIA DE CÓMPUTOS UPRRP

Former master' student:

José Rodríguez

Project title: A lightweight remote NMS for private networks

José Ortiz Ubarri

CIENCIA DE CÓMPUTOS UPRRP

Current master' student:

Hallyma Gauthier

Project title: Automating content creation for cybersecurity hackathons

Ivelisse Rubio Canabal

CIENCIA DE CÓMPUTOS UPRRP

Keywords:
Finite fields
Permutations
Arrays

Office: A-151
Lab: A-152

My research in number theory is related to involutions and permutations of finite fields, divisibility of exponential sums and multidimensional linear complexity of arrays. The results have applications to digital watermarking, the constructions of codes and cryptosystems, to bounds on Hamming weights of deformations of Boolean functions and to the search of balanced functions for cryptosystems.

- Polynomials that produce permutations
- Properties of Multidimensional Arrays
- Solvability of equations over finite fields

- Undergraduate and Masters students have been involved in these projects
- Masters thesis on these topics have been written under my supervision
- Students have been co-authors of papers on these topics

Ivelisse Rubio Canabal

CIENCIA DE CÓMPUTOS UPRRP

Former master' students:

Carlos Seda – Master' student 2018-20

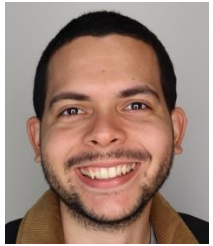
Found a bound for a power of a prime to divide the number of common zeros of multivariate polynomials with coefficients that also are polynomials.

Now: Lecturer @ Math Dept., UPR-Mayagüez

Lillian González– Master' student 2019-22

Found explicit formulas for certain permutation polynomials.

Now: Lecturer @ CCOM and researching on permutation polynomials.



Jaziel Torres – Master' student 2020-22

Implemented an algorithm to compute multidimensional linear complexity of arrays. Extended results on periodic properties of Costas arrays to multidimensional Costas arrays. Developed a unifying theoretical framework for multidimensional Costas arrays and proved several conjectures.

Now: Ph.D. student @ Notre dame University.

Ivelisse Rubio Canabal

CIENCIA DE CÓMPUTOS UPRRP

Students from the Emmy Noether Lab participate in local and national conferences.

Publications with students

D. Cruz, A. Ramos, I. Rubio, Differences of Functions with the Same Value Multiset. In: Hoffman, F., Holliday, S., Rosen, Z., Shahrokhi, F., Wierman, J. (eds) Combinatorics, Graph Theory and Computing. SEICCGTC 2021. Springer Proceedings in Mathematics & Statistics, vol 448. Springer, Cham, 2024 https://doi.org/10.1007/978-3-031-52969-6_3

J. Torres, I. Rubio, Circular Costas maps: a multidimensional analog of circular Costas sequences, Cryptography and Communications, 15(5), 941-958, DOI: 10.1007/s12095-023-00654-2, Sep 2023.

R. Arce, C. Hernández, J. Ortiz, I. Rubio, J. Torres, Analysis and Computation of Multidimensional Linear Complexity of Periodic Arrays, Designs, Codes and Cryptography, August 2023, https://doi.org/10.1007/s10623-023-01274-w

J. Torres, I. Rubio, "Multidimensional Costas Arrays and Their Periodicity", in *IEEE Transactions on Information Theory*, vol. 69, no. 8, pp 5032-5040, Aug. 2023, doi: 10.1109/TIT.2023.3264951.

A.Masuda, I. Rubio, J. Santiago, Permutation binomials of index $q^{e-1} + \ldots + q+1$ over F_q^e, Finite Fields and Their Applications, Vol. 79, March 2022, https://doi.org/10.1016/j.ffa.2022.102003.

Josué Ruiz Rodriguez

CIENCIA DE CÓMPUTOS UPRRP

My research focuses on the intersection of automated reasoning, Boolean satisfiability (SAT), and formal methods for policy analysis. I develop logic- and graph-based techniques to study structural properties of DNF formulas, such as convexity and co-convexity, with applications in access control verification. This work aims to enable scalable and sound analysis of security policies through efficient algorithms and formal logic.

Boolean Logic and Satisfiability: Using logical formulas and SAT solvers to model and solve complex computational problems.

Applications to Access Control: Formal analysis of rule-based access control (RBAC) policies using Boolean and relational logic.

Keywords: Automated Reasoning, SAT, Boolean Formulae

Office: TBA
Lab: TBA

Recent Research:

- J. A. Ruiz et al, “Graph-based algorithms for testing convexity of 2DNF,” Journal of Logical and Algebraic Methods in Programming, 2025, Submitted.
- J. A. Ruiz et al, “Converting Rule-Based Access Control Policies: From Complemented Conditions to Deny Rules,” in Proceedings of the 29th ACM Symposium on Access Control Models and Technologies, SACMAT 2024, San Antonio, TX, USA, May 15-17, 2024,

Josué Ruiz Rodriguez

CIENCIA DE CÓMPUTOS UPRRP

- RBAC policy with complemented and uncomplemented conditions

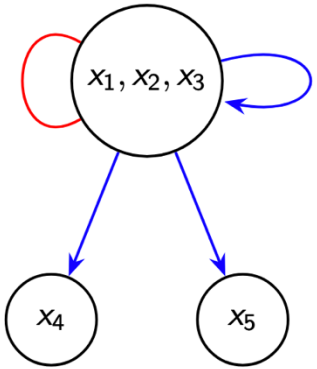
R_1: $(x_1 x_2 \overline{x_3}, PERMIT)$ R_2: $(x_1 \overline{x_2}\ \overline{x_3}, PERMIT)$ R_3: $(\overline{x_1} x_2 x_3, PERMIT)$ $\Phi = x_1 x_2 \overline{x_3} \vee x_1 \overline{x_2}\ \overline{x_3} \vee \overline{x_1} x_2 x_3$

- Testing convertibility (Convexity property in the DNF)

$$R_1\colon (x_1, PERMIT)\ R_2\colon (x_2 x_3, PERMIT)\ R_3\colon (x_1 x_3, DENY)$$

- Analyze formulae these properties in polynomial time using graphs (2DNF class)

- Particularly interested to explore:
  - properties in other classes of formulae
  - develop efficient algorithms for checking equivalence of policies



Chengyuan Zhuang

CIENCIA DE CÓMPUTOS UPRRP

Keywords: Computer Vision, Deep Learning, Remote Sensing

Office: C-169
Lab: A-316

My research includes, but is not limited to, computer vision, deep learning, and remote sensing. The initial aim is to advance classification models and enhance recognition through improved model architectures and backbones. Current considerations include novel design strategies and the challenge of handling large context.

- Improved Model with Boundary Supervision
  - Enhances classification performance by introducing boundary information through auxiliary supervision
- Improved Backbone with Predefined Filter and Attention
  - Integrating predefined filters and attention mechanisms to enhance feature extraction and classification

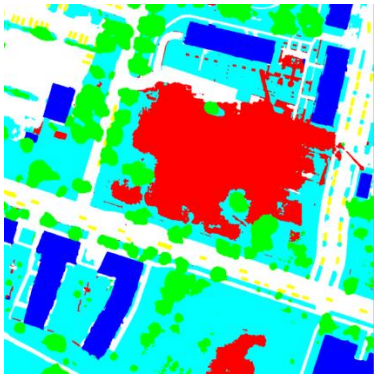
Current interests include:

- Remote Sensing and Climate Modeling
- Flight Scheduling
- Biologically Plausible Learning

Chengyuan Zhuang

CIENCIA DE CÓMPUTOS UPRRP

Boundary Supervision



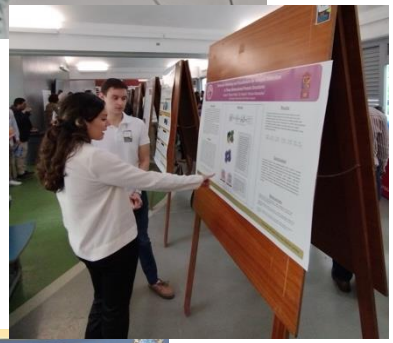
Improved Model with Boundary Supervision for Classification

Predefined Filter and Attention

Enhanced Features

Improved Backbone with Predefined Filter and Attention for Classification

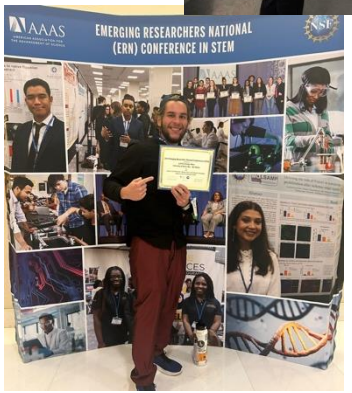

Usability Testing

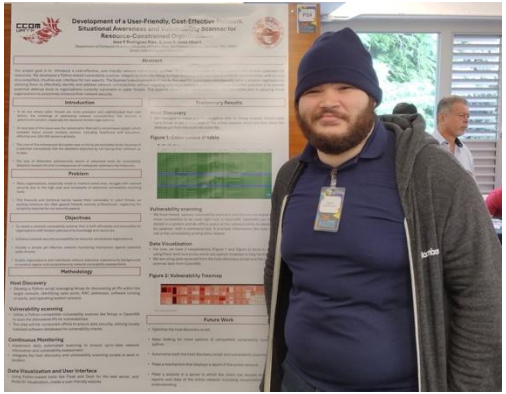


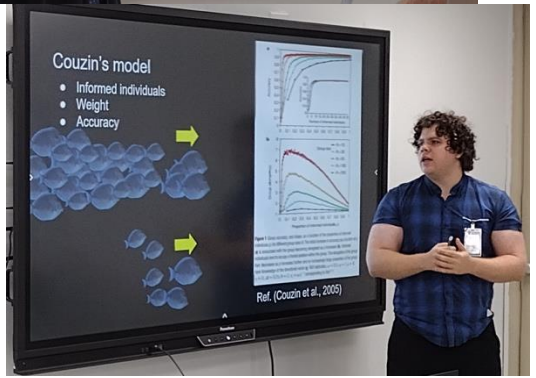

LA IUPI
UPRRP
CIENCIA DE CÓMPUTOS
UPR, RÍO PIEDRAS
CCOM
UPRRP

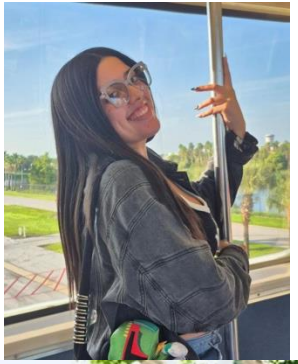

Apache
hudi
APACHE
spark
APACHE
hadoop
I WAS NEVER HERE


Interpolation for Displacement
Interpolation allows to see the displacement of the threshold with discretization
This displacement shows the "jumps" in the threshold values
This displacement is included in the computation of the binarization of the states
States within the displacement strip are labeled as "undefined".

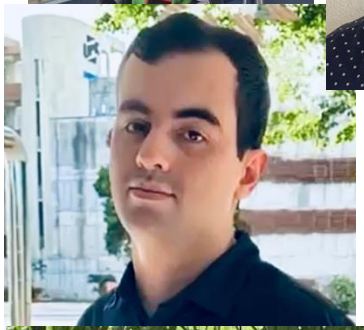

AAAS
EMERGING RESEARCHERS NATIONAL (ERN) CONFERENCE IN STEM
NSF


Development of a User-Friendly, Cost-Effective
Abstract
Introduction
Problem
Objectives
Methodology
Preliminary Results
Future Work


Couzin's model
Informed individuals
Weight
Accuracy
Ref. (Couzin et al., 2005)









Apache
hudi
park
WAS
NEVER
HERE


Questions?

- Email a ivelisse.rubio@upr.edu
- https://natsci.uprrp.edu/ccom/graduate-program/