

PAULO BRUNO DE SOUSA SERAFIM

*Brazilian
L'Aquila, Italy*

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EDUCATION

Ph.D. student in Computer Science <i>Gran Sasso Science Institute (GSSI), L'Aquila, Italy</i>	November 2022 - Present
Master's degree in Computer Science <i>Federal University of Ceará (UFC), Fortaleza, Brazil</i>	March 2016 - April 2018
Bachelor's degree in Computer Science <i>Federal University of Ceará (UFC), Fortaleza, Brazil</i>	January 2013 - February 2016
Bachelor's degree in Chemical Engineering (incomplete) <i>Federal University of Ceará (UFC), Fortaleza, Brazil</i>	January 2010 - December 2012

MASTER'S THESIS

Title: Evaluating competition in training of Deep Reinforcement Learning agents in First-Person Shooter games (*in Portuguese*)

Comparison of autonomous agents' performance in relation to different training opponents. Multiple agents were trained from image data in a competitive scenario of a First-Person Shooter environment using Deep Q-Networks (DQN). Agents that trained against DQN opponents performed better.

Advisor: Prof. Joaquim Bento Cavalcante-Neto (UFC)

Co-advisors: Prof. Creto Vidal (UFC) and Prof. Yuri Nogueira (UFC)

Outside reader: Prof. Soraia Musse - Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS)

RESEARCH EXPERIENCE

Gran Sasso Science Institute (GSSI)

PhD student

November 2022 - Present

Working on a multi-agent system to explain any tabular classifier in natural language. Using a conversational interface to generate simplified explanations for non-expert users.

CRAb Research Group - Department of Computer Science (UFC)

External Collaborator

March 2018 - Present

Working on analysis of agent's performance under different views of the same scenario by using XAI methods. Started research on character-oriented player modelling behaviour.

Master's student

March 2016 - February 2018

Master's work in Deep Reinforcement Learning.

Volunteer Researcher

August 2014 - February 2016

Undergraduate research in Neuroevolution, constructing autonomous agents immersed in a resource gathering environment and in a simplified version of a MOBA game.

Undergraduate scholarship

August 2013 - July 2014

Undergraduate research on hair animation using mass-spring systems and Neuroevolution for autonomous game agents.

WORK EXPERIENCE

Inria - Sophia Antipolis Méditerranée

April 2022 - October 2022

Research Engineer

Optimisation of Neural Networks with implementation using Julia programming language. Benchmarks of Neural Network pruning following a newly developed method. Lead programmer of WorldDynamics.jl, an open-source framework for world dynamics modelling and simulation.

Instituto Atlântico

May 2021 - March 2022

Data Scientist

Technical Leader in a team of three Data Scientists on an R&D project for Dell EMC. Worked on anomaly detection using unsupervised learning methods, classification using supervised learning, and development of dashboards to assist tactical and operational decision making.

Instituto Atlântico

September 2020 - April 2021

Computer Vision Engineer

Developer on an R&D Computer Vision project for HP Inc using Deep Learning for human segmentation in photos. Worked on OCR methods applied to printed text documents and developed a synthetic document generator.

Instituto Atlântico

February 2019 - August 2020

Computer Graphics Engineer

Developer on an R&D project for HP Labs in the field of 3D printing. Applied Computer Graphics techniques to build voxelised tree-like support structures.

GREAT - ASTEF

May 2018 - February 2019

Software Developer

Developed solutions for fingerprint minutiae extraction and matching focused on high performance. Started a side research project using Convolutional Neural Networks for fingerprint ROI segmentation.

TEACHING EXPERIENCE

Teaching Internship

February 2017 - July 2017

Graduate Teaching Assistant of the Introduction to Computer Science course under the supervision of Prof. Yuri Nogueira, Assistant Professor at the Department of Computer Science (UFC).

Teaching Initiation Program

September 2014 - December 2014

Scholarship (R\$ 1,600.00) funded by the Vice Provost for Undergraduate Studies (Prograd-UFC).

Undergraduate Teaching Assistant of the Elementary Calculus course under the supervision of Prof. Frederico Girão, Associate Professor at the Department of Mathematics (UFC).

Short-duration courses taught

An Introduction to Reinforcement Learning (18 hours)

February 2020 - April 2020

Internal course at Instituto Atlântico organised by the Group of Cognitive Computing

Introduction to 2D Game Development (4 hours)	August 2015
<i>Organised by the Program of Tutoring Education of the Computer Science Department (UFC)</i>	
Elementary Excel (3 hours)	June 2015
<i>Organised by the Program of Tutoring Education of the Economics Department (UFC)</i>	
Introduction to C Programming Language (20 hours)	June 2012
<i>Organised by the Junior Enterprise of Chemical Engineering (UFC)</i>	

SUPERVISORY EXPERIENCE

Graduate students	2021 - Present
Co-supervisor of a Ph.D. candidate, providing support in the field of Deep Reinforcement Learning.	
Direct supervisor of two Master's students in their works and thesis.	
Undergraduate students	2015 - 2022
Direct supervisor of three undergraduate students in their Bachelor's thesis.	
Tutor of four undergraduate students during their one-year internships in the CRAb research group.	
Company employees	2018 - 2022
Co-leader of a study group, leading proof-of-concept research in Reinforcement Learning.	
Direct supervisor of three interns during their first months in the company.	
Started and led a research subgroup with five people in Deep Learning applied to fingerprint image problems.	

RESEARCH VISITS

Scuola Normale Superiore di Pisa	June 2025
Under the supervision of Prof. Fosca Giannotti.	
Federal University of Ceará	June 2024 - November 2024
Under the supervision of Prof. Joaquim Bento Cavalcante-Neto.	
Scuola Normale Superiore di Pisa	January 2024 - February 2024
Under the supervision of Prof. Fosca Giannotti.	

BOARDS

Federal University of Ceará (UFC)	November 2024
Advisor of a Master's student in the field of Deep Reinforcement Learning.	
Federal University of Ceará (UFC)	August 2024
Advisor of a Master's student in the field of Explainable Reinforcement Learning.	
Federal University of Ceará (UFC)	April 2021
Co-advisor of an undergraduate student in the field of Deep Reinforcement Learning.	
Federal University of Ceará (UFC)	June 2019
Outside reader of an undergraduate thesis in the field of Computer Vision.	

AWARDS AND HONOURS

Magna Cum Laude

Federal University of Ceará

2015

Academic distinction awarded by the Federal University of Ceará for students that conclude the Bachelor's degree with elevated academic performance.

Best Paper Nominations

XXIII Brazilian Symposium on Computer Games and Digital Entertainment (SBGames)

2024

XIX Brazilian Symposium on Computer Games and Digital Entertainment (SBGames)

2020

XVI Brazilian Symposium on Computer Games and Digital Entertainment (SBGames)

2017

FELLOWSHIPS AND GRANTS

Ph.D. Scholarship

€ 64,639.64

Novembre 2022 - October 2026

Funded by the Gran Sasso Science Institute (GSSI).

Visiting Student Period @ SNS Pisa

€ 990.65

January 2024 - February 2024

Funded by the Gran Sasso Science Institute (GSSI).

Master's Fellowship

R\$ 36,000.00

March 2016 - February 2018

Funded by the Brazilian National Council for Scientific and Technological Development (CNPq).

Program Young Talents for Science

R\$ 4,800.00

August 2013 - July 2014

Funded by the Brazilian Coordination for the Improvement of Higher Education Personnel (CAPES).

PATENT

Generating supports

WO2021107916A1

2019

Generation of tree-like supporting structures for 3D printing. Developed when I was working at Instituto Atlântico in partnership with HP Inc., under the supervision of HP Labs Senior Researcher Jun Zeng.

OPEN-SOURCE SOFTWARES

MAINLE

First Author, Main Developer

2025

<https://github.com/paulobruno/ecml-pkdd-2025>

Code for paper “Exploring Large Language Models Capabilities to Explain Decision Trees”

First Author, Main Developer

2024

<https://github.com/paulobruno/hhai-2024>

WorldDynamics.jl

Collaborator, Lead Developer

2022-2023

<https://github.com/worlddynamics/WorldDynamics.jl>

STUDENT SOCIETIES

Politeq Jr. (currently called Ciclo Jr.)

Junior Enterprise affiliated to the Departments of Chemical and Environmental Engineering at UFC

President

June 2012 - January 2013

Director of Finance and Administration

February 2012 - June 2012

Trainee

August 2011 - February 2012

FEJECE

Federation of Junior Enterprises of Ceará

Board member representing Politeq Jr.

February 2012 - January 2013

ACADEMIC SERVICE

Reviewer

2021

SVR 2021

Invited reviewer for the 23rd Symposium on Virtual and Augmented Reality.

Reviewer

2020

IWSSIP 2020

Requested reviewer for the 27th International Conference on Systems, Signals and Image Processing.

Organisation Committee

June 2012

O CT quer você!

An event idealised by the Centre of Technology at UFC comprising all engineering courses to help secondary school students. I was a member of the Chemical Engineering organisation committee.

LECTURES

Exploring Large Language Models Capabilities to Explain Decision Trees

February 2024

Invited seminar presented at Officine Garibaldi in Pisa.

Integrated assessment modeling using WorldDynamics.jl

July 2023

Workshop presented at JuliaCon 2023.

Deep Reinforcement Learning in Foraging Simulation

July 2023

Guest lecturer at the Future of Foraging seminar series.

Technological Advances in 3D Printing

August 2020

In Portuguese

Guest lecturer invited by the University for the International Integration of Afro-Brazilian Lusophony.

Deep Reinforcement Learning: Today's AIs that beat humans

August 2020

Lecturer at CorongaMeet 2.0 Ceará.

Autonomous Bots in StarCraft II

November 2019

In Portuguese

Lecturer at the Brazilian Developer's Conference 2019 (TDC).

How do Robots See?

October 2019

An introduction to semantic segmentation in images

Lecturer at HP Spark Day 2019, organised by HP Inc.

Introduction to Artificial Intelligence Applied to Digital Games
In Portuguese

October 2018

Guest lecturer invited by the University Centre UniFanor.

Artificial Intelligence Applied to Digital Games
In Portuguese

November 2017

Guest lecturer invited by the University Centre Unichristus.

Introduction to Digital Games Development
In Portuguese

June 2017

Guest lecturer invited by the State School of Professional Education Julia Giffoni.

SELECTED PUBLICATIONS

European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases
September 2025

MAINLE: a Multi-Agent, Interactive, Natural Language Local Explainer of Classification Tasks

Paulo B. S. Serafim, Rômulo F. Férrer Filho, Stenio Wagner Freitas, Gizem Gezici, Fosca Giannotti, Franco Raimondi, Alexandre M. M. Santos.

Journal of Open Source Software

March 2024

WorldDynamics.jl: A Julia Package for Developing and Simulating Integrated Assessment Models

Pierluigi Crescenzi, Emanuele Natale, Aurora Rossi, Paulo B. S. Serafim.

XX Brazilian Symposium on Computer Games and Digital Entertainment

October 2021

Assessing the Robustness of Deep Q-Network Agents to Changes on Game Object Textures

Paulo B. S. Serafim, Yuri L. B. Nogueira, Creto A. Vidal, Joaquim B. Cavalcante-Neto.

ADDITIONAL PUBLICATIONS

Hybrid Human AI Systems for the Social Good

June 2024

Exploring Large Language Models Capabilities to Explain Decision Trees

Paulo B. S. Serafim, Pierluigi Crescenzi, Gizem Gezici, Eleonora Cappuccio, Salvatore Rinzivillo, Fosca Giannotti.

XXIII Brazilian Symposium on Computer Games and Digital Entertainment

October 2024

Using Curriculum to Train Multisensory Foraging DRL Agents

Rômulo F. Férrer Filho, Alexandre M. M. Santos, Halisson R. Rodrigues, Yuri L. B. Nogueira, Creto A. Vidal, Joaquim B. Cavalcante-Neto, Paulo B. S. Serafim.

XXII Brazilian Symposium on Computer Games and Digital Entertainment

November 2023

Unveiling the Key Features Influencing Game Agents with Different Levels of Robustness

Alexandre M. M. Santos, Halisson R. Rodrigues, Rômulo F. Férrer Filho, Yuri L. B. Nogueira, Creto A. Vidal, Joaquim B. Cavalcante-Neto, Artur O. R. Franco, Paulo B. S. Serafim.

24ème Congrès annuel de la Société Française de ROADEF (in French)

February 2023

Un framework open-source écrit en Julia pour la modélisation d'évaluation globale intégrée

Pierluigi Crescenzi, Hicham Lesfari, Emanuele Natale, Aurora Rossi, Paulo B. Serafim.

XXI Brazilian Symposium on Computer Games and Digital Entertainment	October 2022
<i>DRLeague: a Novel 3D Environment for Training Reinforcement Learning Agents</i>	
Hyuan P. Farrapo, Rômulo F. Férrer Filho, José G. R. Maia, Paulo B. S. Serafim.	
XX Brazilian Symposium on Computer Games and Digital Entertainment	October 2021
<i>Gym Hero: A Research Environment for Reinforcement Learning Agents in Rhythm Games</i>	
Rômulo F. Férrer Filho, Yuri L. B. Nogueira, Creto A. Vidal, Joaquim B. Cavalcante-Neto, Paulo B. S. Serafim.	
28th International Conference on Systems, Signals and Image Processing	June 2021
<i>Robust Fingerprint Singular Point Detection using a Single-Stage CNN for Object Detection</i>	
Lucas S. Fernandes, João P. B. Andrade, Leonardo F. Costa, Paulo B. S. Serafim, Paulo A. L. Rego, José G. R. Maia.	
Book Chapter - Introduction to Virtual and Augmented Reality (in Portuguese)	November 2020
<i>Deep Reinforcement Learning em Ambientes Virtuais (Deep Reinforcement Learning in Virtual Environments)</i>	
Paulo B. S. Serafim, Yuri L. B. Nogueira, Joaquim B. Cavalcante-Neto, Creto A. Vidal.	
XIX Brazilian Symposium on Computer Games and Digital Entertainment	November 2020
<i>Investigating Deep Q-Network Agent Sensibility to Texture Changes on FPS Games</i>	
Paulo B. S. Serafim, Yuri L. B. Nogueira, Creto A. Vidal, Joaquim B. Cavalcante-Neto, Rômulo F. Férrer Filho.	
XXII Symposium on Virtual and Augmented Reality	November 2020
<i>Autonomous Foraging with SARSA-based Deep Reinforcement Learning</i>	
Anderson O. Mesquita, Yuri L. B. Nogueira, Creto A. Vidal, Joaquim B. Cavalcante-Neto, Paulo B. S. Serafim.	
XIX Brazilian Symposium on Computer Games and Digital Entertainment	November 2020
<i>Simplifying Attribute Balancing in Electronic Role-Playing Games (in Portuguese)</i>	
Alexandre M. M. Santos, Paulo B. S. Serafim, Artur O. R. Franco, Rafael A. F. Carmo, José G. R. Maia.	
2020 International Joint Conference on Neural Networks	July 2020
<i>A Novel Approach for Automatic Enhancement of Fingerprint Images via Deep Transfer Learning</i>	
Aldísio G. Medeiros, João P. B. Andrade, Paulo B. S. Serafim, Alexandre M. M. Santos, José G. R. Maia, Fernando A. M. Trinta, José A. F. Macêdo, Pedro P. R. Filho, Paulo A. L. Rego.	
XVIII Brazilian Symposium on Computer Games and Digital Entertainment	October 2019
<i>A Minimal Training Strategy to Play Flappy Bird Indefinitely with NEAT</i>	
Matheus G. Cordeiro, Paulo B. S. Serafim, Yuri L. B. Nogueira, Creto A. Vidal, Joaquim B. Cavalcante-Neto.	
2019 International Joint Conference on Neural Networks	July 2019
<i>A Method based on Convolutional Neural Networks for Fingerprint Segmentation</i>	
Paulo B. S. Serafim, Aldísio G. Medeiros, Paulo A. L. Rego, José G. R. Maia, Fernando A. M. Trinta, Marcio E. F. Maia, José A. F. Macêdo, Aloísio V. Lira Neto.	
XVII Brazilian Symposium on Computer Games and Digital Entertainment	October 2018
<i>Evaluating Competition in Training of Deep Reinforcement Learning Agents in First-Person Shooter Games</i>	
Paulo B. S. Serafim, Yuri L. B. Nogueira, Creto A. Vidal, Joaquim B. Cavalcante-Neto.	
XVI Brazilian Symposium on Computer Games and Digital Entertainment	November 2017
<i>On the Development of an Autonomous Agent for a 3D First-Person Shooter Game Using Deep Reinforcement Learning</i>	

Paulo B. S. Serafim, Yuri L. B. Nogueira, Creto A. Vidal, Joaquim B. Cavalcante-Neto.

19th Symposium on Virtual and Augmented Reality

November 2017

Towards Playing a 3D First-Person Shooter Game Using a Classification Deep Neural Network Architecture

Paulo B. S. Serafim, Yuri L. B. Nogueira, Creto A. Vidal, Joaquim B. Cavalcante-Neto.

LANGUAGES

Portuguese	Native speaker
English	Full professional working proficiency
Italian	Professional working proficiency
French	Elementary proficiency

REFERENCES

Dr. Franco Raimondi, Professor at GSSI

PhD Advisor

Affiliation: Department of Computer Science, Gran Sasso Science Institute (GSSI)

E-mail: franco.raimondi@gssi.it

Dr. Pierluigi Crescenzi, Former Professor at GSSI

PhD Advisor

Affiliation: Department of Computer Science, Gran Sasso Science Institute (GSSI)

E-mail: pierluigi.crescenzi@gssi.it

Dr. Emanuele Natale, CNRS Researcher

Research Supervisor

Affiliation: CNRS, Université Côte d'Azur, Inria, I3S

E-mail: emanuele.natale@inria.fr

Dr. Joaquim Bento Cavalcante-Neto, Full Professor at UFC

Master's and Bachelor's Advisor

Affiliation: Department of Computer Science, Federal University of Ceará (UFC)

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