Daniel **Saromo Mori**

Mechatronic Engineer · Inventor of the Auto-Rotating Neural Networks (ARNN) · AI Researcher and Lecturer

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About me

Hi! I'm Daniel, a mechatronics engineer passionate about AI-powered robot control. My main research interest is *robotics × machine learning: robot learning*. As a result of my research in AI, I have invented the ARP and the ARNN —algorithms that I have presented in five countries. Besides that, I have **5+ years of experience** in research and teaching AI, ML, and Data Science. Also, I have project experience in Robot Learning with physical robots, like my spider robot guided by AI, work recognized with the Innovation Award at IMECE 2019.

Education

M.Sc. in Automation and Control Engineering · Currently enrolled — *Milan, Italy*

Politecnico Di Milano — *Since Sep. 2022*

B.Sc. in Mechatronics Engineering & Mechatronics Engineering Professional Degree — *Lima, Peru*

Pontificia Universidad Católica del Perú (1ST in Peru: QS Ranking 2022) — *03/2014 - 07/2019, 08/2019 - 11/2020*

- **Bachelor's average course grade:** 15.70 (Scale: minimum: 0, required to pass: 11, maximum: 20).
- **Academic ranking:** Top fifth of class (6th of 32 mechatronics graduates) · Top 6.66% of the students of the Faculty of Science and Engineering.
- **Theses title:** Intelligent spider robot for detecting anti-personnel metallic landmines in uneven terrain.
- **Professional Degree Thesis Awards:** - Extraordinary Support Funding for Undergraduate Research Thesis.
  - **Ranking:** Degree thesis unanimously awarded by the tribunal with the qualification of *outstanding*.
- **B.Sc. Thesis Awards:** - Best bachelor's thesis and poster presentation at the PUCP Mechatronics Workshop of the semester 2019-1.
  - Innovation Recognition Award at the International Mechanical Engineering Congress & Exposition (**IMECE**) 2019.
- **Theses advisors:** Dr. Elizabeth Villota and Dr. Edwin Villanueva

Scientific Publications

[J1] **Saromo, D.** and Valdenegro-Toro, M. "Auto-Rotating Neural Networks: An Alternative Approach for Preventing Vanishing Gradients", *Transactions of Machine Learning Research (TMLR)*. 2023 · Paper under double-blind review.

[C4] Bravo, L., **Saromo, D.**, and Villota, E. "Smart Insole Sensor for vGRF Measurement", *9th International Symposium on Sensor Science*. Warsaw, Poland. 2022.

[C3] Valdenegro-Toro, M. and **Saromo, D.** "A Deeper Look into Aleatoric and Epistemic Uncertainty Disentanglement", *LXCV Workshop at CVPR 2022*. Louisiana, U.S.A. 2022 · Paper presented in the poster session and was one of the few selected for an oral presentation.

[C2] **Saromo, D.**, Bravo, L., and Villota, E. "Smart Sensor Calibration with Auto-Rotating Perceptrons", *LXAI Workshop at ICML 2020*. Vienna, Austria. 2020 · Paper presented in the poster session and was one of the few selected for an oral presentation.

[C1] **Saromo, D.**, Villota, E., and Villanueva, E. "Auto-Rotating Perceptrons", *LXAI Workshop at NeurIPS 2019*. Vancouver, Canada. 2019 · Paper presented in the poster session and was one of the few selected for an oral presentation.

[T1] **Saromo, D.** "Intelligent spider robot for detecting anti-personnel metallic landmines in uneven terrain", *Pontificia Universidad Católica del Perú*. Lima, Peru. 2020 · Thesis published in Spanish. English abstract available: link.

Teaching Experience

- PUCP's Center for Advanced Manufacturing Technologies (CETAM) — *Lima, Peru*

Lecturer — **Courses:** - ML for Industry (2020-2, 2021-1, 2021-2, 2022-1, 2022-2, 2023-1, 2023-2); - Python for Data Science (2021-1, 2021-2, 2022-1, 2022-2, 2023-1). — *Sep. 2020 - Sep. 2023*

- PUCP Grad. School · Continuing Education Department · Teacher at Specialization Diplomas — *Lima, Peru*

Lecturer — - Diploma in Development of AI Applications (**Course:** AI for Games): 2019-2, 2020-1, 2020-2, 2021-1, 2021-2, 2022-1, 2022-2, 2023-1, 2023-2. — *Since Sep. 2019*

- Diploma in Data Analytics (**Course:** Data Analysis Methods for Time Series): 2022-1. — *Jun. 2022 - Oct. 2022*

- National Meteorological and Hydrological Services (SENAMHI) · Peruvian Government Entity — *Lima, Peru*

Lecturer — **Course:** Introduc. to AI and ML for National Meteorological and Hydrological Services. — *May. 2022 - Jun. 2022*

- PUCP Undergraduate School · Faculty of Science and Engineering — *Lima, Peru*

Teaching Assistant — **Undergrad. courses:** AI (2019-1), ML (2019-2), Computer Science Applications (2019-2). — *Mar. 2019 - Dec. 2019*

Honors & Awards

Domestic

2020 **Extraordinary Support Funding for Undergraduate Research Thesis,** PUCP · 2500 PEN — *Lima, Peru*

2019 **Best bachelor thesis and poster presentation,** PUCP Mechatronics Engineering End of Career Workshop — *Lima, Peru*

2018 **Automatic system for pre-fried potatoes production:** **Best team project**, PUCP Mechatronics Project Fair — *Lima, Peru*

2017 **11th place (national level)**, FESTO's X Academic Mechatronics Olympics 2017 · Teamed with Leonardo Bravo — *Lima, Peru*

International

2023 **1st place**, at the Pitch Competition 2023 organized by Entrepreneurship Club POLIMI — *Milan, Italy*

2022 **CVPR Registration and Travel Grant**, for attending CVPR 2022 to be an oral and poster presenter · 900 USD — *New Orleans, U.S.A.*

2022 **LXCV Travel Grant**, for attending CVPR 2022 to be an oral and poster presenter · 2567 USD — *New Orleans, U.S.A.*

2019 **LXAI Travel Grant**, for attending NeurIPS 2019 to be an oral and poster presenter · 1860 USD — *Vancouver, Canada*

2019 **Innovation Recognition Award**, Old Guard 63rd Anual Oral Competition (World Finals at IMECE) · 250 USD — *Utah, U.S.A.*

2019 **ASME Travel Award**, to represent PUCP and South America at ASME IMECE Finals Competition · 1500 USD — *Utah, U.S.A.*

2019 **1st place + Technical Award**, Old Guard Oral Presentation Competition (ASME E-FEST South America) · 850 USD — *Lima, Peru*

Professional and Research Experience

German Research Center for Artificial Intelligence (DFKI) — *Bremen, Germany*

Guest researcher · Remote mode — *Aug. 2020 - Jul. 2022*

- **Auto-Rotating Neural Networks (ARNN):** I extended the ARP concept and created a new neural model family named Auto-Rotating Neural Networks. I've implemented dense, recurrent, LSTM, GRU, and convolutional layers with the Auto-Rotating operation; and obtained promising results. We finished the journal paper for this project, which is currently a submission under review at the TMLR journal. *Research advisor:* Dr. Matias Valdenegro-Toro
- We are testing the implementation of the ARNN, to validate and compare their performance against equivalent models without the Auto-Rotation. Experiments ran in the research center's GPU clusters. Results presented at the Online Asian Machine Learning School (OAMLS).

PUCP Applied Robotics and Biomechanics Research Group (GIRAB) — *Lima, Peru*

Research Assistant — *Mar. 2020 - Dec. 2020*

- **Smart Sensor Calibration with Auto-Rotating Perceptrons:** In this paper, we applied the ARP to calibrate a wearable force sensor. By changing classic neurons to ARP, we obtained 15x better neural network performance. *Research advisor:* Dr. Elizabeth Villota

PUCP Artificial Intelligence Research Group (IA-PUCP) — *Lima, Peru*

Research Assistant — *Since Mar. 2019*

- **Auto-Rotating Perceptrons:** I invented this neural unit to mitigate the vanishing gradient problem at deep neural networks. The results show that if we change classic perceptrons to ARP, we can improve the learning performance of neural networks. *Research advisors:* Dr. Elizabeth Villota and Dr. Edwin Villanueva

PUCP Polymers and Composites Research Group (POLYCOM) — *Lima, Peru*

Project Assistant · Pre-professional research internship — *Jul. 2018 - Oct. 2018*

- I supported the execution and documentation of these research projects: analysis of the mechanical properties of Peruvian spiders' silk, and extraction of starch nanoparticles from Peruvian potatoes. *Research advisor:* Dr. Omar Troncoso

Talks & Presentations

International

Nov. 2021 **Poster presentation: Auto-Rotating Neural Networks**, Online Asian Machine Learning School at ACML — *Singapore, Singapore*

Mar. 2021 **Tutorial: Auto-Rotating Perceptrons**, Invited speaker for the group Papers We Love Guatemala — *Guatemala, Guatemala*

Jul. 2020 **Paper exposition: Smart Sensor Calibration with Auto-Rotating Perceptrons**, Speaker at LXAI ICML — *Vienna, Austria*

Dec. 2019 **Paper exposition: Auto-Rotating Perceptrons**, Speaker at LXAI NeurIPS — *Vancouver, Canada*

Domestic

Jun. 2023 **Webinar: Auto-Rotating Perceptrons**, Conference speaker: Systems engineering & Research at UNAM — *Moquegua, Peru*

Oct. 2021 **Workshop: Introduction to AI and Robotics**, Conference speaker at IEEE Open Fest LATAM Week — *Lima, Peru*

Oct. 2021 **Conference: VII Research Meeting of the PUCP Engineering Department**, Conference speaker — *Lima, Peru*

Jul. 2020 **Fair: Getting to know your carrer: Mechatronics Engineering · Timestamp: 2:27:42**, Speaker — *Lima, Peru*

Feb. 2020 **Fair: CEFACI PUCP's Fair of Engineer Carreers 2020**, Speaker — *Lima, Peru*

Volunteer experience

International Women's Day Hackathon 2022 · Organized by the group Teens in AI — *Lima, Peru*

Tech Mentor — *Mar. 2022*

- The Teens in AI initiative, launched at the AI for Good Global Summit at the UN (2018), aims to give young people early exposure to AI.
- I was invited to be a mentor of one of the Peruvian teams, in the areas of AI and ML. My group was awarded first place in the hackathon.

PUCP's Women In Engineering (WIE) affinity group — *Lima, Peru*

Mentor — *Nov. 2021 - Dec 2021*

- I was assigned to a freshman mechatronics engineering student to guide her to transition to her university-level studies.
- I gave her academic advice, study tips, and orientation to help her reach her professional goals.

Continuing Education

Nov. 2023	**Disaster Risk Monitoring Using Satellite Imagery**, NVIDIA Deep Learning Institute	*NVIDIA DLI*
Aug. 2022	**Oxford Machine Learning Summer School**, Oxford University & AI for Global Goals	*Oxford University*
Jun. 2022	**AutoCAD - Level: Intermediate**, National University of Engineering (UNI)	*UNI*
Mar. 2022	**Solidworks - Level: Intermediate**, National University of Engineering (UNI)	*UNI*
Jan. 2022	**Solidworks - Level: Basic**, National University of Engineering (UNI)	*UNI*
Nov. 2021	**Online Asian Machine Learning School**, Asian Conference on Machine Learning (ACML)	*ACML 2021*
Aug. 2021	**RIIAA Summer School**, International Meeting on AI and its Applications (RIIAA)	*RIIAA 2021*
Jul. 2021	**Robot Operating System (ROS)**, Center for Advanced Manufacturing Technologies (CETAM)	*CETAM PUCP*
Nov. 2020	**Scrum Master Certification Training**, IEEE Ricardo Palma University Student Branch	*IEEE Peru Section*
Jul. 2019	**Getting started with AI on Jetson Nano**, NVIDIA Deep Learning Institute	*NVIDIA DLI*
Nov. 2018	**PyTorch Scholarship Challenge**, Udacity / Facebook	*Udacity / Facebook*
Apr. 2018	**Machine Learning for Data Science and Analytics**, Columbia University	*edX*
Feb. 2017	**PCB design with international standards oriented to manufacturing**, AlDelta Technologies	*AlDeltaTec.com*
May 2016	**Embedded Systems – Shape the World**, University of Texas at Austin	*edX*
May 2015	**Introduction to Robotics**, Queensland University of Technology	*QUT MOOC*

Robot Learning Projects

Robot learning using DDQN and Neuroevolution for my 2 DOF laser pointer robot — *Lima, Peru*

GOAL: TO HAVE A PHYSICAL ROBOT TO BE CONTROLLED USING MACHINE LEARNING — *Apr. 2020 - May 2020*

- I built an arm-type robot that learns to control a laser pointer using Deep Reinforcement Learning, Neuroevolution, and Computer Vision.
- The 2 DOF robot learned to point a laser beam to reach a target located at the center of two marks. The algorithms used were DDQN and NEAT.
- These algorithms were executed on Linux. Then, the commands were sent to an Arduino board using the PyDuino Bridge Library I authored.

My 8 DOF spider robot: making it learn to walk · Honored with IMECE's Innovation Award — *Lima, Peru*

GOAL: TO HAVE A PHYSICAL ROBOT TO TEST THE AI-BASED ALGORITHM I PROPOSED FOR MY THESES — *Aug. 2018 - Jul. 2019*

- A spider robot was designed an implemented following Kamrani's rapid prototyping methodology.
- Development of a novel algorithm that uses supervised ML, genetic algorithms and Arduino/Python interaction let the robot learn to walk.

Skills

Technical tools — **CAD/CAE:** *Mechanics:* Inventor, SolidWorks, AutoCAD. *Electronics:* EagleCAD, Altium Designer, Circuit Maker, Proteus, B2 Spice. | **Embedded Systems:** ATmega328P, ATmega2560 (Arduino IDE); Raspberry Pi (SBC and RP2040); Jetson Nano. | **Coding:** Python, MicroPython, C, C++, MATLAB, VBA (for Excel), UserRPL, LaTeX. | **Frameworks:** Git, Tensorflow, Keras, Scikit-learn, PyTorch, NumPy, Pandas, Seaborn, Matplotlib, Plotly, OpenCV, OpenAI Gym, PyDuino Bridge. | **Math Software:** Wolfram Mathematica, Simulink. | **Web:** HTML, CSS, Jekyll. | **Automation:** TIA Portal (PLC/HMI). LabView.

Technical skills — **Mechanics:** Parametric 3D modeling and assembly. Technical drawing. **Electronics:** Schematic drawing. PCB design, assembly, and testing. Excellent soldering skills (THT and SMT). | **Automatic Control:** Classical and state-space. | **Artificial Intelligence:** Deep Learning (MLP, CNN, ARNN, ARP). Search algorithms and heuristics. Bio-inspired optimization (ABC, ACO, and PSO). Decision Trees. Random Forests. SVM. Image Style Transfer. Clustering. PCA. Ensemble Learning. Transfer Learning. Neuro-Evolution of Augmenting Topologies (NEAT). Deep Reinforcement Learning (DQN, DDQN). Computer Vision.

Soft skills — Strong abilities in public speaking, teamwork, and leadership. Maker spirit. Curiosity and perseverance.

Languages — **Spanish** (native), **English** (TOEFL iBT [2020]: 97/120), and **Italian** (intermediate level)

Other Extracurricular Projects

For more information about my projects, please visit my web portfolio: https://www.danielsaromo.xyz/.

Auto-Rotating Perceptrons Library · Teamed with Dr. Matias Valdenegro-Toro — *Lima, Peru*

GOAL: TO MAKE AN OPEN-SOURCE LIBRARY FOR THE ARP NEURAL UNITS — *Oct. 2020 - Mar. 2021*

- We made a Keras implementation of the ARP units.
- The library is available on the Python Package Index (with the command: '`pip install arpkeras`').
- On March 2021, I presented this library in a tutorial for the research group Papers We Love Guatemala.

PyDuino Bridge Library — *Lima, Peru*

GOAL: TO DEVELOP AN OPEN-SOURCE LIBRARY TO EASILY LINK PYTHON AND ARDUINO — *Apr. 2020*

- I developed an open-source library for transparent bi-directional communication between Python and Arduino. It is available on the official Arduino Library Manager, and on the Python Package Index (it can be installed using the command `pip install pyduinobridge`).

NASA Human Exploration Rover Challenge 2017 — *Lima, Peru*

GOAL: TO DESIGN THE TELEMETRY SYSTEM OF A HUMAN-POWERED VEHICLE FOR A NASA CONTEST — *Jan. 2017 - Feb. 2017*

- I was selected to be part of the telemetry group on the PUCP's team that competed on the NASA Human Exploration Rover Challenge 2017.
- The system was devised to allow bi-directional communication from the vehicle to the base located 1 km away.
- We managed to elaborate a report paper titled: "Design of a real-time low-cost telemetry system in an all-terrain human-powered vehicle."