

# CRISTIAN-PAUL BARA

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## SUMMARY

I am a 5<sup>th</sup> year Ph.D. Candidate. I study at the University of Michigan in the Department of Computer Science and Engineering's AI Lab. My research focus is studying Natural Language Processing in the context of Embodied Agents and Language grounding to Computer Vision. I am advised on this topic by Professor Joyce Chai. I also have 4 years of industry experience in the automotive industry mainly in driver assistance systems. My education is in control engineering up to my Master's which I believe gives me a strong grasp of applied mathematics which easily translates to my current focus in AI.

## EXPERIENCE

Projects described in the following section

### University of Michigan

Graduate Student Research Assistant, Graduate Student Instructor

📅 September 2019 – Present

📍 Ann Arbor, MI

Adviser: Joyce Chai ([chaijy@umich.edu](mailto:chaijy@umich.edu))

Projects: **Physical Causality in Grounded Word Acquisition - Theory of Mind Modeling for Situated Dialogue in Collaborative Tasks**

Teaching: **Natural Language Processing**

### Graduate Student Research Assistant

📅 September 2017 – August 2019

📍 Ann Arbor, MI

Adviser: Rada Mihalcea ([mihalcea@umich.edu](mailto:mihalcea@umich.edu))

Projects: **Multimodal Stress and Emotion**

### Amazon Alexa AI - Natural Language understanding

Applied Scientist Intern

📅 May 2021 – August 2021

📍 Manhattan Beach, CA

Managers: Gaurav Sukhatme ([sukhatme@amazon.com](mailto:sukhatme@amazon.com), [gaurav@usc.edu](mailto:gaurav@usc.edu)), Govind Thattai ([thattg@amazon.com](mailto:thattg@amazon.com))

Mentors: Qing Ping ([pingqing@amazon.com](mailto:pingqing@amazon.com)), Abhinav Mathur ([thattg@amazon.com](mailto:thattg@amazon.com))

### Robert Bosch SRL

Project Lead

📅 February 2015 - July 2017

📍 Cluj-Napoca, Romania

Projects: **Student Autonomous Driving Challenge**

### Image Processing Software-Developer

📅 January 2014 - January 2017

📍 Cluj-Napoca, Romania

Projects: **Automatic Emergency Braking - Construction Zone Assist**

### Universitatea Tehnica din Cluj-Napoca

Teaching Assistant

📅 March 2013 - June 2017

📍 Cluj-Napoca, Romania

Teaching: **Computer Architecture - Design with Microprocessors**

### Arobs Transilvania Software SRL

Embedded Software Developer

📅 October 2012 - November 2013

📍 Cluj-Napoca, Romania

Projects: **Vehicle Fleet Management System**

## TECHNICAL SKILLS

**Languages:** Python, C/C++, Bash, MATLAB, VHDL

**Libraries:** PyTorch, NumPy, Huggingface Transformers, Scikit-learn, SciPy, Pandas

**Operating Systems:** Windows, Linux

**Other Technologies:** FPGA, STM32 architecture, Git, Slurm, AWS,

**Misc.** Scrum, ISO26262, Computer Vision, Object Tracking, Natural Language Processing, Embodied Agents, Robotics

## EDUCATION

PhD - Computer Science and Engineering

University of Michigan

📅 2017 - 2022

📍 Ann Arbor, MI

Courses taken:

- Natural Language Processing
- Advanced Topics in Computer Vision
- Non-Linear Systems and Control
- Fundamentals of Artificial Intelligence
- Ethics for Robotics
- Advanced Programming Languages
- Advanced Cryptography
- Advanced Artificial Intelligence
- Algorithms
- Situated Language Processing for Embodied AI

MSc Control Engineering

Universitatea Tehnică din Cluj-Napoca

📅 2012 - 2014

📍 Cluj-Napoca, Romania

For my Master's thesis I implemented an L1 norm based adaptive state space estimator for use in objects tracking in stereo video applications.

BEng Control Engineering

Universitatea Politehnica București

📅 2008 - 2012

📍 Bucharest, Romania

For my Bachelor's Thesis I investigated control strategies for implementing an autopilot for a model helicopter. Linear Quadratic Gaussian Control was used as a reference and compared to H-infinity control and a fuzzy logic controller tuned through Machine Learning using a neural network.

## LANGUAGES

Romanian

English

French

German

Hungarian



## PROJECTS

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University of Michigan

### Physical Causality in Grounded Word Acquisition

Despite recent progress on language grounding, grounded word acquisition in artificial agents is still an under-explored area. To address this issue, this paper investigates word acquisition, focusing on verb acquisition, that gains insight from cognitive studies. In particular, we seek to address, from the computational point of view, first how causal modeling will impact verb acquisition and whether the understanding of action participants in causal relations influences verb acquisition; and second how the understanding of nouns in a causal relation may influence verb acquisition and how the acquired verbs can further facilitate the acquisition of new nouns that involved in causal relations. This work is summarised in a paper where we describe our investigation and our empirical results. The paper is planned to be submitted to ACL in November 2022. This work was done while being advised by Professor Joyce Chai ([chaijy@umich.edu](mailto:chaijy@umich.edu)).

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### Theory of Mind Modeling for Situated Dialogue in Collaborative Tasks

I am involved in an ongoing project where we seek to study human dialogue while in a collaborative setting. The medium is based on the Minecraft game where two human players aim to complete a task with controlled disparities in both knowledge and skill set. The purpose of the project is to gather insight towards developing embodied AI agents who can integrate into human activities, specifically through dialogue. Work on this project has been recognized as an outstanding paper at EMNLP 2021 [1].

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### Multimodal Stress and Emotion

I was advised by prof. Rada Mihalcea ([mihalcea@umich.edu](mailto:mihalcea@umich.edu)) in the Language and Information Technology group. My current project involves detection of stress in human subjects. I have recorded 28 subjects in stressful and non stressful situations with a thermal camera, video cameras (close-ups on their head and upper body), physiological sensors (breathing rate, heart rate, skin conductance and temperature) and microphones for their voice. I am currently running experiments on extracted features; i.e. temperatures of forehead, nose and upper lip; hand gestures; facial gestures; speech and text. Physiological gestures are used as a baseline measurement to simulate a polygraph. Features were inspired by relevant literature and further experiments involving Recurrent Auto-encoders on raw measurements are ongoing. The data-set [3] was used in [4, 2].

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Robert Bosch SRL

### Student Robotics Competition Platform

I have always been interested in robotics and have participated as a student in several robotics events. Starting with a more focused approach to sponsorship, we offered parts and expertise to students and not just money. I managed to get both an experienced team and a novice team on first and third place. The contest consisted of a robotics sumo competition and had about 50 participants that competed in an initial groups stage and continued with a knockout stage.

As a result my company agreed to fund another such project that I proposed. I envisioned a 10th scale incarnation of the DARPA Grand Challenge. I was approved a staff of 10 people ranging from technical to marketing and administration. I have handed over managerial responsibilities to Florin Cotofan ([Florin.Cotofan@ro.bosch.com](mailto:Florin.Cotofan@ro.bosch.com)) in July 2017. The contest was successfully started in October 2017 with the final event being held in May 2018 (see [video](#) [https://youtu.be/2TfQHO3\\_Kas](https://youtu.be/2TfQHO3_Kas) and the [competition website](#) <https://boschfuturemobility.com/>).

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## TEACHING

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University of Michigan

### Natural Language Processing

As part of my collaboration with Professor Joyce Chai ([chaijy@umich.edu](mailto:chaijy@umich.edu)) I have been a teaching assistant for the CSE department's Natural Language Processing. The course is a Master's level introductory course for which I was responsible with guiding students to successfully complete their assignments and projects as well as grading. I have also taught tutorials regarding writing software for NLP in python covering libraries like NLTK and PyTorch.

Universitatea Tehnică din Cluj-Napoca

### Computer Architecture

I was employed part time as Associate at the Technical University in my home town of Cluj-Napoca. I was a Teaching Assistant and I taught and oversaw student lab projects for the Computer Architecture and Design. I taught six hours a week in three two hour sessions of 16 students each. For Computer Architecture I guided students through an introduction to VHDL, implementation of a MIPS micro-processor in single cycle and pipeline configurations and implementing and interfacing with peripherals, e.g. a UART module. Within the limits of the course syllabus I was entirely responsible with running the lab. I took special care and pride in making sure the students got a good intuition of their work by in lab teaching and examination. I did my best to give the students an understanding of where the concepts being taught are useful and where they will be relevant in their career referring to literature and my own experience in industry. The course Professor for Computer Architecture and my reference is dr. Florin Oniga ([florin.oniga@cs.utcluj.ro](mailto:florin.oniga@cs.utcluj.ro)).

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Universitatea Tehnică din Cluj-Napoca

### Design With Microprocessors

Also as part of my employment as an Associate at the Technical University of Cluj-Napoca I also taught labs for the Design with Microprocessors course. I taught six hours a week in three two hour sessions of 16 students each. As part of this lab students were taught to develop solutions using an Arduino development board. They learned to program and use the internal peripherals of the Micro-controller, i.e. timers, Analog to Digital Converters and Pulse With Modulation systems, as well as external peripherals, i.e. inertial measurement devices, electric motors, various sensors or external non-volatile memory, using available communication protocols, i.e. I2C, SPI or RS232.

## PROJECTS

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### Automatic Emergency Braking (AEB)

I was responsible for developing software in the field of Image Processing in the Automotive Industry. Specifically algorithms for Bosch's Stereo Camera. My field expertise is signal processing and state estimation. I was part of a larger effort involving several departments focusing on Bosch's stereo video camera to provide perception for the Automatic Emergency Braking system. The software I helped develop is running on the Land Rover Discovery Sport. Topics I was responsible for include Object Tracking, Free-space estimation, Algorithm Validation and University Collaboration: e.g. mentoring interns, bachelor's thesis advising and organizing of student competitions. For more details please refer to the *Projects and Volunteer Work* section. Please contact Marco Schwarzmüller

([Marco.Schwarzmuller@ro.bosch.com](mailto:Marco.Schwarzmuller@ro.bosch.com) HoD Automotive Software Department).

Video Camera product page: <https://www.bosch-mobility-solutions.com/en/products-and-services/passenger-cars-and-light-commercial-vehicles/driver-assistance-systems/lane-departure-warning/stereo-video-camera/>  
AEB product page: <https://www.bosch-mobility-solutions.com/en/products-and-services/passenger-cars-and-light-commercial-vehicles/driver-assistance-systems/automatic-emergency-braking/>

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### Construction Zone Assist (CZA)

I was responsible for development testing and evaluation of several software modules running on Bosch's stereo video camera. My main focus was the module interpreting free-space in the camera's field of view and the car's trajectory within said free-space. I was component owner of the free-space module. I was also responsible for adapting the existing disparity image segmentation to evaluate road profile not only vertical obstacles. As a result of my modifications the camera system was able to restrict free-space also with negative space, e.g. ditches at the side of the road. The product that was presented in 2015 at IAA (International Auto Ausstellung) in Frankfurt.

CZA product page: <https://www.bosch-mobility-solutions.com/en/products-and-services/passenger-cars-and-light-commercial-vehicles/driver-assistance-systems/construction-zone-assist/>

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### Arobs Transylvania SRL

#### Vehicle Fleet Management System

I was responsible for developing a GPS/GPRS based Vehicle Tracking System starting from Hardware Abstraction up to Application Framework. The company tasked me to implement a custom RTOS, as such I implemented the boot-loader, the embedded side of the Firmware over the Air systems, task scheduler and pseudo-parallel message parser for the GPS and GPRS module. This was the company's own product and results were published here in [5]. My Colleagues developed the Application on top of my Framework.

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## STUDENT & VOLUNTEER WORK

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### Universitatea Politehnica București

#### Multi-processor architecture for a versatile autonomous robot

My colleagues and I responded to a call for participants from the Atmel Corporation for developing an autonomous robot able to navigate a map and collect objects and deliver them to a specified location. We chose to construct a four wheel robot using mecanum wheels in order to omnidirectional movement. I was responsible for the control algorithms. Our work was summarized here [6].

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### Universitatea Politehnica București

#### Ideas and Project Workshop

The organization holds a weekend long symposium and a two week long summer school meant to encourage high school and undergraduate students to pursue a career in IT. After my participation to their first summer school in 2007 I was impressed by the idea and chose to volunteer as help the following year. During the second iteration I showed initiative and organizational skills and was given the position of Chief of Operations. I was responsible with coordinating day to day tasks of the other NGO members and the seasonal help. The NGO would receive help from local Highschools students who acted as guides for the participants from other locations. For subsequent summer schools I also taught an introductory course to embedded software development.

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## PEER REVIEWED PUBLICATIONS

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### Conference Proceedings

- [1] **Cristian-Paul Bara**, Sky CH-Wang, and Joyce Chai. "MindCraft: Theory of Mind Modeling for Situated Dialogue in Collaborative Tasks". In: *Proceedings of the 2021 Conference on Empirical Methods in Natural Language Processing*. Online and Punta Cana, Dominican Republic: Association for Computational Linguistics, Nov. 2021, pp. 1112–1125. URL: <https://aclanthology.org/2021.emnlp-main.85>.
- [2] **Cristian-Paul Bara**, Michalis Papakostas, and Rada Mihalcea. "A Deep Learning Approach Towards Multimodal Stress Detection". In: *Proceedings of the AAAI-20 Workshop on Affective Content Analysis*. New York, USA: AAAI, 2020. URL: <http://ceur-ws.org/Vol-2614/>.
- [3] Mimansa Jaiswal, **Cristian-Paul Bara**, Yuanhang Luo, Mihai Burzo, Rada Mihalcea, and Emily Mower Provost. "MuSE: a Multimodal Dataset of Stressed Emotion". In: *Proceedings of The 12th Language Resources and Evaluation Conference*. Marseille, France: European Language Resources Association, May 2020, pp. 1492–1503. URL: <https://www.aclweb.org/anthology/2020.lrec-1.187>.
- [4] M. Jaiswal, Z. Aldeneh, **C. Bara**, Y. Luo, M. Burzo, R. Mihalcea, and E. M. Provost. "Muse-ing on the Impact of Utterance Ordering on Crowdsourced Emotion Annotations". In: *ICASSP 2019 - 2019 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*. May 2019, pp. 7415–7419. DOI: [10.1109/ICASSP.2019.8682793](https://doi.org/10.1109/ICASSP.2019.8682793).
- [5] **C. P. Bara**, I. Crețu, and I. Roșu. "Fleet management and driver supervision using GPS and inertial measurements over GPRS networks". In: *IEEE 9th International Conference on Intelligent Computer Communication and Processing (ICCP)*. Cluj-Napoca, Romania: International Institute of Informatics and Systemics, 2013, pp. 189–192. DOI: [10.1109/ICCP.2013.6646106](https://doi.org/10.1109/ICCP.2013.6646106).
- [6] A. Voinescu, D. Dragomir, A. Drăghici, and **P. Bara**. "Multi-processor architecture for a versatile autonomous robot". In: *2nd International Conference on Systems and Computer Science*. Villeneuve d'Ascq, France, 2013, pp. 109–114. DOI: [10.1109/IcConSCS.2013.6632032](https://doi.org/10.1109/IcConSCS.2013.6632032).

## REFEREES

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**Prof. Joyce Chai**,  
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@ [chaijy@umich.edu](mailto:chaijy@umich.edu)

**Prof. Gaurav Sukhatme**,  
Visiting Scholar, Amazon Alexa;  
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