

2020 Center for Undergraduate Research and Scholarship (CURS) Summer Scholar Program

CURS 4990 Syllabus

Clément Aubert & John Natale

May 13, 2020

Research Project Overview

The project aims at using mathematical tools (set theory, category theory) to get a better understanding of the mechanisms of distributed computation. The core idea is to use mathematical equivalences to equate programs that are unessentially different. This is an active area of study, with a large community of researchers, at the cross-roads of Computer Science and Mathematics.

Configuration structures are a frequently-used mathematical model relying on set and category theories that was introduced in the 80's, but that lacks an un-ambiguous and settled definition. The structure evolved over the time, and multiple definitions – apparently equivalent, but not proven to be equivalent – co-exist in the literature. We plan on settling an acceptable definition—using category theory—, compare it to variations of the definition, and to use it to compare and study the equivalences on concurrent programs, that exist in the litterature.

Goals

Educational

- Foster John's independence, to sharpen his capacities to solve problems by himself.
- Improve his self-efficacy, to believe in his capacities but also to identify when and how to ask for help.
- Encourage his curiosity, to drive his own intellectual journey.
- Leverage the CURS workshops to have a better understanding of the multiple facets of high-quality undergraduate research, and to benefit from a good professional development.
- Introduce to the administrative aspects of research¹ by e.g. searching for good-quality journals and venues to submit our work, or funds to sparkle other projects.
- Become confident with technologies (git, L^AT_EX, markdown, references managers, ...) common in research.

¹Something that already started, since John took an active part in the writing of the current proposal, and of this syllabus

Research

Our main goals, aside from the educational goals detailed below, are to produce a research document that will be shared with experts in the field through self-archiving on the [arXiv.org](https://arxiv.org) repository, and a poster for the Symposium that will get re-used in other venues and will be self-archived as well. All the material produced will be released under Creative Commons licenses, to ease distribution and re-use by the community.

Offering what we believe and justify to be the “right” definition will have several impacts:

- It will constitute a key-reference in the field, allowing to find in one handy document a clear and argued definition,
- It will allow to “iron out” the equivalences on programs, and lay the foundation of a clear, justified, rule to determine if two programs are “essentially the same”,
- It will be a useful entry door to researchers in close communities, containing numerous references to fundamental research articles.

A regularly updated document and journal will help in completing those milestones, and will constitute a way of assessing the progresses of the project as well as of the clarity of our understanding of the project’s developments.

Outcomes

Our goal is to have two tangible traces of our investigation by the end of the program:

- Slides or Poster, to be shared at the CURS final symposium, and hopefully re-used in other venues,
- A self-archived manuscript, that hopefully will be submitted to an open-access (undergraduate) journal.

Team & Participant Roles

Will be involved in this project (in alphabetical order):

- Dr. Clément Aubert, Augusta University, caubert@augusta.edu (mentor),
- Dr. Emmanuel Beffara, Aix-Marseille University, Marseille, emmanuel.beffara@univ-amu.fr.
- Dr. Ioana Cristescu, Tarides, Paris, ioana@irif.fr,
- John Natale, Augusta University, jnatale@augusta.edu (mentee).

John Natale’s Roles

For this project, his roles will include:

- Being the lead on the writing and editing of a document that summarizes our findings, as well as on the Symposium poster,
- Reading and understanding important (excerpts of) papers in the literature,
- Being able to re-formulate in his own term the research project we are following, to write a clear introduction to our document,
- Reporting regularly to Dr. Aubert (through daily entries in his journal, and discussion) and articulate clearly what has been achieved, what needs to be done, and where help is needed.

Dr. Aubert's Roles

For this project, his roles will include:

- Providing guidance and impromptu clarifications whenever needed, to develop John's skills and understanding, and to encourage interactions by letting him drive our discussions.
- Valuing John's skills and benefiting from his rigor and intuition to strengthen the project.
- Proposing short-term goals that support and realize long-term plan and achievements.
- Giving to John as much independence and liberty as wished, in conjunction with a constantly available support, while respecting his individuality.
- Easing John into formulating his own hypothesis, testing them, and guiding the future progresses of the project.
- Helping John formulating the research problem in his own term, and encouraging him to present his understanding of the project in public venues or through publication(s).

More generally, Dr. Aubert will always make sure that his expectations are clearly communicated and understood, and convey through regular meetings and email exchanges his intuitions, solutions, and suggestions to support the project's progress and our educational goals.

Drs. Beffara and Cristescu's Roles

Dr. Ioana Cristescu (Tarides, Paris) and Dr. Emmanuel Beffara (Aix-Marseille University, Marseille) already showed interest for this project, and should be able to review and comment on our findings on week 4, if not before. Their expertise in close fields will be an asset to open our project to new scientific directions and review the correctness of our findings.

Timeline

The program will start on May 18 (week 1) and ends on June 18 (week 5).

Research Timeline

Week	Main Activities
1	Review of existing literature, writing of first definitions (configuration structure, concurrent program)
2	Comparison between existing definitions, proof of (in)equivalence between them
3	Detail equivalences between programs induced by (variations on) configuration structures
4	Investigation of other sources of equivalences, reaching out to experts in the field
5	Wrap-up and document what is left to do, preparation of the poster
9	<i>Summer Scholars Symposium</i>

A regularly updated to-do list will support and clarify the steps needed to achieve those overall goals.

Training Timeline

Day	Time	Event
Mon 5/18	9-11:15am	SSP Kickoff and Orientation (<i>WebEx</i>)
Mon 5/18	5pm	Check in to Evaluate UR (students & faculty)
Thurs 5/21	12-1pm	Student Check in (<i>WebEx</i>)
Thurs 5/28	12-1:30pm	Lunch/Learn – Library Services & Research Swap (<i>WebEx</i>)
Fri 5/29	1-1:45pm	Mentor Meeting (faculty only) (<i>WebEx</i>)
Thurs 6/4	12-1:30pm	Lunch/Learn –Ethics Panel
Thurs 6/11	12-1:30pm	Lunch/Learn – Leadership/Decision Making (<i>WebEx</i>)
Fri 6/12	1-1:45pm	Mentor Meeting (faculty only) (<i>WebEx</i>)
Thurs 6/18	12-1:30pm	Lunch/Learn – Presenting Research (<i>WebEx</i>)
Mon 7/13	12pm	Poster due (BOX)
Thurs 7/16	4pm	Virtual Symposium
Fri 7/17	5pm	Final Check in –students and faculty (Evaluate UR)

Weekly Organization

- Every week, Dr. Aubert and John Natale will meet on Monday and Wednesday at 10:00pm, and on Friday at 11:00pm on Skype.
- Every day, John will complete his journal, by indicating what he accomplished, where he stands, and what he plans on doing for the next day. This will help
 - Him, to clarify his thoughts,
 - His mentor, to grasp where he is,
 - Him (again!), in case he needs to come back to them,
 - The CURS, to ease final check-in,
 - Our collaborators, so that we will be able to bring them up-to-speed easily.

Tools

Will be used during this program, among other resources:

- References will be shared on http://spots.augusta.edu/caubert/research/semantics_of_concurrency/papers/,
- Our document will be developed on https://github.com/aubertc/event_structures_for_us,
- Skype will be our main method of “live” communication,
- Email will be our main method of asynchronous communication.