

**12<sup>th</sup> Symposium on Conformal and  
Probabilistic Prediction with Applications**

13 – 15 September 2023

Atlantica Miramare Beach Hotel

**Limassol – Cyprus**

**P R O G R A M M E**

Organized by:



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## Welcome to COPA 2023

Welcome to the 12<sup>th</sup> Symposium on Conformal and Probabilistic Prediction with Applications (COPA 2023), which is being held in Lemesos, Cyprus, from the 13<sup>th</sup> to the 15<sup>th</sup> of September 2023. The 1<sup>st</sup> COPA symposium was held in Halkidiki, Greece in 2012 and since then it has been held annually, offering researchers and practitioners the chance to present their work and exchange ideas on any aspect of conformal and probabilistic prediction.

The 2<sup>nd</sup> COPA (2013) was organized in Paphos, Cyprus along with the 9th IFIP International Conference on Artificial Intelligence Applications and Innovations (AIAI 2013) and the “Measures of Complexity”, symposium which celebrated the 75th birthday of Professor Alexey Chervonenkis. Now, 10 years later, it returns to Cyprus as the biggest COPA event since its beginning, featuring almost double the number of papers of the previous years. COPA 2023 is being organized by Frederick University and sponsored by Albourne and Mitie as Gold Sponsors and by Cyta and Kroo as Bronze Sponsors. It is being held in the seaside city of Lemesos, Cyprus, a city rich in history and culture.

Overall, 33 full papers and 7 extended abstracts have been accepted for presentation at the symposium after being reviewed by at least two independent academic referees. The authors of these papers come from 15 different countries, namely: Australia, China, Cyprus, France, Germany, Greece, Hong Kong, Italy, the Netherlands, Norway, Russia, Spain, Sweden, the United Kingdom and the United States. The papers and extended abstracts are divided into the following 7 groups:

- Applications – 10 papers and 3 extended abstracts,
- New adaptations – 8 papers and 1 extended abstract,
- Hypothesis Testing – 2 papers and 1 extended abstract,
- Regression and Conformal Predictive Systems – 5 papers,
- Explainability – 2 papers and 1 extended abstract,
- Classification – 3 papers and 1 extended abstract, and
- Implementations / Libraries – 3 papers.

In addition to the accepted papers, the technical programme of the symposium features two keynote lectures by:

- Yannis Manolopoulos (Open University of Cyprus, Cyprus) on *Recommendation Systems in Scholarly Publishing*, and
- Yaniv Romano (Israel Institute of Technology, Israel) on *Conformal prediction is robust to label noise*.

Furthermore, a tutorial will be given by Anastasios Angelopoulos (University of California, Berkeley, USA) on *Conformal Prediction Under Distribution-Shift*.

We would like to express our gratitude to everyone who has contributed to the success of COPA 2023. We are grateful to the Organizing Committee members for their great effort in the organization of the symposium and to the Programme Committee members who did an excellent job in a timely manner during the review process. Special thanks to the keynote and tutorial speakers for their inspiring talks. We are indebted to our sponsors:

- Gold Sponsors:
  - Albourne: [www.albourne.com](http://www.albourne.com)
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  - Kroo: [www.kroo.com](http://www.kroo.com)

We are also grateful to the conference secretariat, Keystone Conferences & Events, for its important support in the Organization of the symposium. Finally, we would like to thank all authors for contributing their work to COPA.

Harris Papadopoulos  
Khuong An Nguyen

# Organization

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Andreas Paisios                      Frederick University, Cyprus

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Vladimir Vovk                      Royal Holloway University of London, UK

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David Stutz (UK)  
Jesus Vega (Spain)  
George Vostrov (Ukraine)  
Vladimir Vovk (UK)  
Vladimir V'yugin (Russia)  
Fan Yang (China)

## Keynote Lectures

### **Prof. Yannis Manolopoulos**

Open University of Cyprus, Cyprus

#### **Title: Recommendation Systems in Scholarly Publishing**

Thursday, September 14<sup>th</sup>, 09:00 – 10:00

#### **Brief Biography:**

Yiannis Manolopoulos is a Professor of the Open University of Cyprus, as well as Professor Emeritus of the Aristotle University of Thessaloniki. Also, he is a Member of the Board of the University of Macedonia, Thessaloniki. Moreover, he is a Member of Academia Europaea, London. He has been with the University of Toronto, the University of Maryland at College Park, the University of Cyprus and the Hellenic Open University. He has served as Vice-Rector of the Open University of Cyprus, President of the Board of the University of Western Macedonia in Greece, Vice-President of the Greek Computer Society, President of the Excellence Committee of Aristotle University of Thessaloniki, Member of the Board of Alexander Innovation Zone and Member of the Board of the Research and Innovation Foundation of Cyprus. Currently, he serves as Dean of the Faculty of Pure and Applied Sciences of the Open University of Cyprus. Finally, he is a student of the Graduate Program on Creative Writing of the Hellenic Open University.

His research interest focuses in Data Management. He has co-authored 6 monographs and 10 textbooks (in Greek), as well as >350 journal and conference papers. He has received ~18000 citations from >2700 distinct academic institutions from >100 countries (h-index=60 according to Google Scholar, d-index=61 according to Research.com). He has also received 5 best paper awards from SIGMOD, ECML/PKDD, MEDES (2) and ISSPIT conferences. Currently, he serves in the Editorial Boards of the following journals (among others): Digital (Editor-in-Chief), The Computer Journal (Deputy Editor), SN Computer Science (Track Editor), Information Systems, World Wide Web, Expert Systems, Data Science & Analytics.

**Abstract:**

The area of Recommendation Systems has matured after intensive theoretical studies by researchers and practical applications by large e-commerce companies. On the other hand, Scientometrics has become an independent field, focusing in the study of laws and statistics related to scholarly publications. Nowadays, the publishing industry has accumulated big bibliographic data. Thus, the need to provide recommendations when searching in the abundance of bibliographic data has arisen.

- Journal recommenders are important tools for researchers as many journals belonging to different publishers have emerged.
- Conference recommenders are useful towards avoiding predatory ones.
- Citation recommenders play an important role to alleviate the dilemma that researchers spend a lot of time and experiences for literature survey.
- Reviewer recommenders for scientific research proposals are helpful tools for funding agencies.
- Article recommendation to best fit reviewers is crucial to achieve constructive reviews towards a strong conference program.
- Collaborator Recommenders learn from researchers' publications and advice about persons which can give research directions.

These are some fundamental research questions in the intersection area between Recommendation Systems and Scientometrics. In this talk, key approaches for each question will be presented, discussed and compared.



## **Dr. Yaniv Romano**

Israel Institute of Technology, Israel

### **Title: Conformal Prediction is Robust to Dispersive Label Noise**

Friday, September 15<sup>th</sup>, 09:00 – 10:00

#### **Brief Biography:**

Yaniv Romano is an assistant professor in the Departments of Electrical Engineering and of Computer Science at the Technion—Israel Institute of Technology. Before that, he was a postdoctoral scholar in the Department of Statistics at Stanford University.

He is a recipient of the 2015 Zeff Fellowship, the 2017 Andrew and Erna Finci Viterbi Fellowship, the 2017 Irwin and Joan Jacobs Fellowship, the 2018–2020 Zuckerman Postdoctoral Fellowship, the 2018–2020 ISEF Postdoctoral Fellowship, the 2018–2020 Viterbi Fellowship for nurturing future faculty members, Technion, the 2019–2020 Koret Postdoctoral Scholarship, Stanford University, and the 2021-2022 Leaders in Science and Technology Career Advancement Chair (CAC), Technion.

#### **Abstract:**

In most supervised classification and regression tasks, one would assume the provided labels reflect the ground truth. In reality, however, this assumption is often violated; for example, doctors labeling the same medical image may have different subjective opinions about the diagnosis, leading to variability in the ground truth label itself.

In this talk, we will study the robustness of conformal prediction, a powerful tool for uncertainty quantification, to label noise. Our analysis tackles regression and classification, as well as challenging risk-controlling problems, characterizing when and how it is possible to construct uncertainty sets that correctly cover the unobserved noiseless ground truth labels.

# Tutorial

## Anastasios Angelopoulos

University of California, Berkeley, USA

### Title: Conformal Prediction under distribution-shift

Wednesday, September 13<sup>th</sup>, 09:30 – 10:30

#### **Brief Biography:**

Anastasios Angelopoulos is a rising fourth-year Ph.D. student at the University of California, Berkeley, advised by Michael I. Jordan and Jitendra Malik. He works on theoretical machine learning with applications in vision and healthcare. His goal is to apply modern statistical ideas to increase robustness of black-box models like deep neural networks. He is motivated by medical diagnostics: statistical reliability will become paramount as computer vision and machine learning become ubiquitous in such high-risk settings. His other applied interests include computational imaging and ophthalmology.

#### **Abstract:**

Conformal prediction is seen as a technique for working with exchangeable data. But in the real world, the exchangeability assumption is violated all the time. I'll be presenting recent work that takes conformal prediction far beyond the exchangeable setting into the realm of distribution shift, wherein data distribution morph and change over time, subject to all the complexities and intricacies of real-world dynamics.

## Programme at a Glance

Wednesday 13 <sup>th</sup> September 2023	
08:00-09:00	<i>Registration</i>
09:00-09:30	<b>Welcome Address</b>
09:30-10:30	<b>Tutorial:</b> Conformal Prediction Under Distribution-Shift
10:30-11:00	<i>Coffee Break</i>
11:00-13:00	<b>Session 1:</b> Applications (1)
13:00-14:30	<i>Lunch</i>
14:30-16:20	<b>Session 2:</b> Applications (2)
16:20-16:50	<i>Coffee Break</i>
16:50-18:00	<b>Session 3:</b> Classification
19:30	<b>Symposium Dinner</b>

Thursday 14 <sup>th</sup> September 2023	
08:30-09:00	<i>Registration</i>
09:00-10:00	<b>Keynote 1:</b> Prof. Yannis Manolopoulos
10:00-10:50	<b>Session 4:</b> Hypothesis Testing
10:50-11:20	<i>Coffee Break</i>
11:20-13:00	<b>Session 5:</b> Regression and Conformal Predictive Systems
13:00-14:30	<i>Lunch</i>
14:30-16:00	<b>Session 6:</b> New adaptations (1)
16:00-16:30	<i>Coffee Break</i>
16:30-17:50	<b>Session 7:</b> New adaptations (2)

<b>Friday 15<sup>th</sup> September 2023</b>	
08:30-09:00	<i>Registration</i>
09:00-10:00	<b>Keynote 2: Dr. Yaniv Romano</b>
10:00-10:50	<b>Session 8: Explanability</b>
10:50-11:20	<i>Coffee Break</i>
11:20-12:20	<b>Session 9: Implementations / Libraries</b>
12:20-12:50	<b>Closing Address</b>
12:50-14:20	<i>Lunch</i>
14:30-20:00	<b>Half-Day Excursion to Ancient Kourion and Omodos Village</b>

# Detailed Programme

**Wednesday 13<sup>th</sup> September 2023**

08:00 – 09:00

Registration

09:00 – 09:30

Welcome Address

09:30 – 10:30

**Tutorial: Conformal Prediction Under Distribution-Shift**

*Anastasios Angelopoulos*

Chair: Harris Papadopoulos

10:30 – 11:00

Coffee Break

11:00 – 13:00

**Session 1: Applications (1)**

Chair: Giovanni Cherubin

**Conformal Regression in Calorie Prediction for Team Jumbo-Visma**

*Kristian van Kuijk, Mark Dirksen, Christof Seiler*

**Evaluating potential sensitive information leaks on a smartphone  
using the magnetometer and Conformal Prediction**

*Robert Choudhury, Zhiyuan Luo, Khuong An Nguyen*

**Confident Object Detection via Conformal Prediction and Conformal Risk Control:  
an Application to Railway Signaling**

*Leo Andeol, Thomas Fel, Florence de Grancey, Luca Mossina*

**Enterprise Disk Drive Scrubbing Based on Mondrian Conformal Predictors**

*Rahul Vishwakarma, Jinha Hwang, Soundouss Messoudi, Ava Hedayatipour*

**An Uncertainty-Aware Sequential Approach for Predicting Response to  
Neoadjuvant Therapy in Breast Cancer**

*Alberto Garcia-Galindo, Marcos Lopez-De-Castro, Ruben Armananzas*

**Online NoVaS Conformal Volatility Prediction**

*Alejandro Canete*

**Capturing prediction uncertainty in upstream cell culture models  
using conformal prediction and Gaussian processes**

*Tien Dung Pham, Uwe Aickelin, Robert Bassett*

<b>13:00 – 14:30</b>	<b>Lunch</b>
<b>14:30 – 16:20</b>	<p><b>Session 2: Applications (2)</b> Chair: Ulf Johansson</p> <p><b>Market Implied Conformal Volatility Intervals</b> <i>Alejandro Canete</i></p> <p><b>Evaluation of conformal-based probabilistic forecasting methods for short-term wind speed forecasting</b> <i>Simon Althoff, Johan Hallberg Szabadvary, Jonathan Anderson, Lars Carlsson</i></p> <p><b>Applying the conformal prediction paradigm for the uncertainty quantification of an end-to-end automatic speech recognition model (wav2vec 2.0)</b> <i>Fares Ernez, Alexandre Arnold, Audrey Galametz, Catherine Kobus, Nawal Ould-Amer</i></p> <p><b>Neural Networks based Conformal Prediction for Pipeline Structural Response</b> <i>Sara El Mekkaoui, Carla J Ferreira, Juan Camilo Guevara Gomez, Christian Agrell, Nicholas James Vaughan, Hans Olav Heggen</i></p> <p><b>Applications of Conformal Regression on Real-world Industrial Use Cases using Crepes and MAPIE</b> <i>Nasir Uddin, Tuwe Lofstrom</i></p> <p><b>Variable Sparring of Disk Drives Based on Failure Analysis</b> <i>Rahul Vishwakarma, Mahshid Fardadi, Bing Liu</i></p>
<b>16:20 – 16:50</b>	<b>Coffee Break</b>
<b>16:50 – 18:00</b>	<p><b>Session 3: Classification</b> Chair: Alex Gammerman</p> <p><b>Multi-label Classification under Uncertainty: A Tree-based Conformal Prediction Approach</b> <i>Chhavi Tyagi, Wenge Guo</i></p> <p><b>Confidence Classifiers with Guaranteed Accuracy or Precision</b> <i>Ulf Johansson, Cecilia Sonstrod, Tuwe Lofstrom, Henrik Bostrom</i></p> <p><b>Coverage vs Acceptance-Error Curves for Conformal Classification Models</b> <i>Evgueni Smirnov</i></p> <p><b>How do the performance of a Conformal Predictor and its underlying algorithm relate?</b> <i>Giovanni Cherubin</i></p>
<b>19:30</b>	<b>Symposium Dinner</b>

## Thursday 14<sup>th</sup> September 2023

08:30 – 09:00

Registration

09:00 – 10:00

**Keynote 1 by Prof. Yannis Manolopoulos**

*Recommendation Systems in Scholarly Publishing*

Chair: Harris Papadopoulos

10:00 – 10:50

**Session 4: Hypothesis Testing**

Chair: Yaniv Romano

**A Conformal Martingales Ensemble Approach for addressing Concept Drift**

*Charalambos Eliades, Harris Papadopoulos*

**The power of forgetting in statistical hypothesis testing**

*Vladimir Vovk*

**The Venn-ABERS Testing for Change-Point Detection**

*Iliia Nouretdinov, Alex Gammerman*

10:50 – 11:20

Coffee Break

11:20 – 13:00

**Session 5: Regression and Conformal Predictive Systems**

Chair: Tuwe Lofstrom

**A Review of Nonconformity Measures for Conformal Prediction in Regression**

*Yuko Kato, David M.J. Tax, Marco Loog*

**On training locally adaptive CP**

*Nicolo Colombo*

**Mondrian Predictive Systems for Censored Data**

*Henrik Bostrom, Henrik Linusson, Anders Vesterberg*

**Evaluating Machine Translation Quality with Conformal Predictive Distributions**

*Patrizio Giovannotti*

**Online aggregation of conformal predictive systems**

*Vladimir G. Trunov, Vladimir V. V'yugin*

13:00 – 14:30

Lunch

14:30 – 16:00

**Session 6: New adaptations (1)**

Chair: Vladimir Vovk

**Recommendation Systems with Distribution-Free Reliability Guarantees**

*Anastasios N Angelopoulos, Karl Krauth, Stephen Bates, Yixin Wang, Michael I Jordan*

**Conformal Prediction with Partially Labeled Data**

*Alireza Javanmardi, Yusuf Sale, Paul Hofman, Eyke Hullermeier*

**Conformal Credal Self-Supervised Learning**

*Julian Lienen, Caglar Demir, Eyke Hullermeier*

**Self Learning using Venn-Abers predictors**

*Come Rodriguez, Vitor Martin Bordini, Sebastien Destercke, Benjamin Quost*

**Efficient Approximate Predictive Inference Under Feedback Covariate Shift  
with Influence Functions**

*Drew Prinster, Suchi Saria, Anqi Liu*

16:00 – 16:30

**Coffee Break**

16:30 – 17:50

**Session 7: New adaptations (2)**

Chair: Henrik Bostrom

**Data-driven Reachability using Christoffel Functions and Conformal Prediction**

*Abdelmouaiz Tebjou, Goran Frehse, Faicel Chamroukhi*

**Conformal Association Rule Mining (CARM):**

**A novel technique for data error detection and probabilistic correction**

*Iliia Nouretdinov, James Gammerman*

**Anomalous Edge Detection in Edge Exchangeable Social Network Models**

*Rui Luo, Buddhika Nettasinghe, Vikram Krishnamurthy*

**Conformalized Adversarial Attack Detection for Graph Neural Networks**

*Sofiane Ennadir, Amr Alkhatib, Henrik Bostrom, Michalis Vazirgiannis*



## Friday 15<sup>th</sup> September 2023

8:30 – 9:00

Registration

9:00 – 10:00

**Keynote 2 by Dr. Yaniv Romano**

*Conformal Prediction is Robust to Dispersive Label Noise*

Chair: Harris Papadopoulos

10:00 – 10:50

**Session 8: Explanability**

Chair: Lars Carlsson

**Approximating Score-based Explanation Techniques Using Conformal Regression**

*Amr Alkhatib, Henrik Bostrom, Sofiane Ennadir, Ulf Johansson*

**Investigating the Contribution of Privileged Information in Knowledge Transfer LUPI  
by Explainable Machine Learning**

*Niharika Gauraha, Henrik Bostrom*

**CONFIDERAL: CONFormal Interpretable-by-Design score function  
for Explainable and Reliable Artificial Intelligence**

*Sara Narteni, Alberto Carlevaro, Fabrizio Dabbene, Marco Muselli, Maurizio Mongelli*

10:50 – 11:20

Coffee Break

11:20 – 12:20

**Session 9: Implementations / Libraries**

Chair: Evgueni Smirnov

**Flexible and Systematic Uncertainty Estimation with Conformal Prediction via the MAPIE library**  
*Thibault Cordier, Vincent Blot, Louis Lacombe, Thomas Morzadec, Arnaud Capitaine, Nicolas Brunel*

**PUNCC: a Python Library for Predictive Uncertainty Calibration and Conformalization**

*Mouhcine Mendil, Luca Mossina, David Vigouroux*

**Tutorial on using Conformal Predictive Systems in KNIME**

*Tuwe Lofstrom, Alexander Bondaletov, Artem Ryasik, Henrik Bostrom, Ulf Johansson*

12:20 – 12:50

Closing Address with Best Paper Awards

12:50 – 14:20

Lunch

14:30 – 20:00

Half-Day Excursion (Ancient Kourion & Omodos Village)

## Social Programme

### **Symposium Dinner – Wednesday September 13<sup>th</sup>**

The dinner will take place at a local Tavern, at 20:00.

Return Transfer by bus will be provided between the Conference Venue (Atlantica Miramare Beach Hotel) and the Tavern.

*Departure from Atlantica Miramare Beach Hotel: 19:30.*

### **Half-Day Excursion to Ancient Kourion and Omodos Village – Friday September 15<sup>th</sup>**

The bus will depart from the hotel and drive along the Limassol coastline. We will continue through the citrus plantations passing by Kolossi Castle, and then proceed to visit the ancient city of Kourion. Here, we will see the Mosaic floors and the magnificent Greco-Roman Amphitheatre (2nd century BC), from the top of which you will enjoy impressive views of the sea. Our journey will then take us north on the Troodos mountain range until we reach the charming village of Omodos. Our first stop will be at a local winery for wine tasting experience, followed by a visit to the village centre. After a brief tour, you will have free time to stroll through the beautifully paved village square, surrounded by traditional houses with balconies and narrow picturesque alleys. Finally, we'll depart Omodos village and return to the hotel.

*Departure from Atlantica Miramare Beach Hotel: 14:15.*

*Expected return time (approximately): 19:45 - 20:15.*

## General Information

**Registration:** Registration takes place on the 1<sup>st</sup> day of the Symposium (13<sup>th</sup> September) from 8:00am to 9:00am and on the next two days (14<sup>th</sup> - 15<sup>th</sup> September) from 8:30am to 9:00am.

**Important phone numbers:** The emergency number in Cyprus that will put you in contact with emergency services is 112. The country code of Cyprus is +357.

**Public transportation:** The city of Limassol is served by buses. You may find routes and maps at:

- <https://www.cyprusbybus.com/routes.aspx?sid=1>
- <https://2gis.com.cy/cyprus/search/Limassol%20busses>

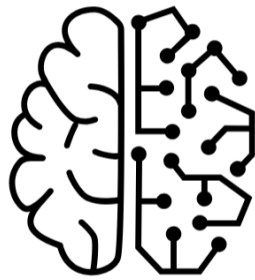
All information about bus routes in Cyprus can be found at: <https://www.cyprusbybus.com/>

**Electricity:** The plug type in Cyprus is G (of British origin), which is the plug that has 3 rectangular pins in triangular pattern. Cyprus operates on a 230V supply voltage, at 50Hz. Europlug adapters are widely available in local stores.

**Time zone:** Cyprus is located in the Eastern European Time (EST). During the conference the summer Daylight Saving Time is in effect: UTC +3 hours or GMT +2 hours.

**Information for Presenters:** The allocated presentation time (including time for questions) is 20 minutes for full papers and 10 minutes for extended abstracts. Presenters need to be considerate to other speakers and keep to the allowed time.

Presenters will use the laptop placed in the presentation room. It is kindly requested that all presenters go to the symposium room at least 10 minutes before the session of their presentation starts and place their presentation files onto the laptop. If any help is required, please ask the technical staff. Presenters are also asked to test their presentations to make sure they run as expected.



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