JOWO 2020
The Joint Ontology Workshops

Proceedings of the Joint Ontology Workshops 2020
Episode VI: The Bolzano Summer of Knowledge

Virtual & Bozen-Bolzano, Italy, August 31st to October 7th, 2020

Edited by

Karl Hammar | Oliver Kutz | Anastasia Dimou | Torsten Hahmann
Robert Hoehndorf | Claudio Masolo | Randi Vita

and for

DeepOntoNLP | FOUST IV
ROBONTICS | SKALE | WOMoCoE

S. B. Abbès, P. Calvez, R. Hantach	**(DeepOntoNLP)**
T. P. Sales, D. Porello	**(FOUST IV)**
D. Beßler, S. Borgo, M. Diab, A. Gangemi, A. Olivares-Alarcos, M. Pomarlan, R. Porzel	**(RobOntics)**
M. G. Skjæveland, D. P. Lupp, I. Horrocks, J. W. Klüwer, C. Kindermann	**(SKALE)**
S. Borgo, L. Bozzato, T. Mossakowski, L. Serafini	**(WOMoCoE)**

http://www.iaoa.org/jowo/2020/

PREFACE

JOWO – The Joint Ontology Workshops

These proceedings include the papers presented at JOWO 2020, the sixth edition of the Joint Ontology WOrkshops (JOWO). JOWO is a venue of workshops that, together, address a wide spectrum of topics related to ontology research, ranging from cognitive science to knowledge representation, natural language processing, artificial intelligence, logic, philosophy, and linguistics.

JOWO's mission is to provide a platform for the diverse communities interested in building, reasoning with, and applying formalised ontologies both in theory and applications.

The previous editions of the JOWO series were the following:

- The first JOWO edition was 'Episode I: The Argentine Winter of Ontology', held in Buenos Aires, Argentina, in co-location with the 24th International Joint Conference on Artificial Intelligence (IJCAI 2015). The proceedings of JOWO 2015 appeared as volume 1517 of CEUR.[1]
- The second JOWO edition was 'Episode II: The French Summer of Ontology', held in Annecy, France, in co-location with the 9th International Conference on Formal Ontology in Information Systems (FOIS 2016). The proceedings of JOWO 2016 appeared as volume 1660 of CEUR.[2]
- The third JOWO edition was 'Episode III: The Tyrolean Autumn', hosted by the Free University of Bozen-Bolzano in Bolzano, Italy, in September 21–23, 2017. The proceedings of JOWO 2017 appeared as volume 2050 of CEUR.[3]
- The fourth JOWO edition was 'Episode IV: The South African Spring (JOWO 2018 @ FOIS 2018)', held in Cape Town, South Africa, in co-location with the 10th International Conference on Formal Ontology in Information Systems (FOIS 2018). The proceedings of JOWO 2018 appeared as volume 2205 of CEUR.[4]
- The fifth JOWO edition was 'Episode V: The Styrian Autumn of Ontology (JOWO 2019)', held in Graz, Austria, on September 23–25, 2019. The proceedings of JOWO 2019 appeared as volume 2518 of CEUR.[5]

JOWO 2020 comprised a confederation of nine ontology workshops, covering a broad spectrum of contemporary applied ontology research, including its foundational aspects (FOUST IV), its methodology, evaluation and collaboration (WOMoCoE, COB) and scalable ontology tooling supporting industrial uptake (SKALE). The JOWO workshops also discussed and contributed to the appli-

[1] See http://ceur-ws.org/Vol-1517/.
[2] See http://ceur-ws.org/Vol-1660/.
[3] See http://ceur-ws.org/Vol-2050/.
[4] See http://ceur-ws.org/Vol-2205/.
[5] See http://ceur-ws.org/Vol-2518/.

cation of and intersection between ontology and other technologies, including deep learning (DeepOntoNLP), robotics (RobOntics), agriculture and nutrition (IFOW), the life sciences (CELLS, VDOS).

The proceedings of five of those workshops are presented in this volume, while the remaining four will publish proceedings through, e.g., journal special issues. A total of 43 papers were submitted for this volume, of which 32 were accepted.

JOWO workshops published in this volume:

- **DeepOntoNLP**: Deep Learning meets Ontologies and Natural Language Processing – 1st International Workshop[6]
- **FOUST IV**: 4th Workshop on Foundational Ontologies[7]
- **RobOntics**: International Workshop on Ontologies for Autonomous Robotics[8]
- **SKALE**: Workshop on Scalable Knowledge Graph Engineering[9]
- **WOMoCoE**: 5th International Workshop on Ontology Modularity, Contextuality, and Evolution[10]

JOWO workshops published separately:

- **CELLS**: 4th International Cells in Experimental Life Science Workshop[11]
- **COB**: A Core set of Open Biological and Biomedical Ontology (OBO) Foundry Terms
- **IFOW**: Integrated Food Ontology Workshop[12]
- **VDOS**: 9th International Workshop on Vaccine and Drug Ontology Studies [13]

[6]See https://www.dl-onto-nlp-fois2020.ml.
[7]See https://foust.inf.unibz.it/foust4.
[8]See https://robontics2020.github.io.
[9]See https://skale-workshop.gitlab.io.
[10]See https://womocoe20.fbk.eu.
[11]See https://sites.google.com/view/cells-2020-workshop/home.
[12]See https://foodon.org/icbo-2020-food-workshop/.
[13]See https://sites.google.com/site/vdosworkshop/VDOS-2020.

Acknowledgements

We would like to thank all authors and speakers for their contributions, and the programme committee members and additional reviewers for their timely reviewing. Moreover, we would like to thank the International Association for Ontology and its Applications (IAOA)[14] for providing support and facilities.

JOWO Chairs

Anastasia Dimou	Ghent University, Belgium
Karl Hammar	Jönköping University, Sweden
Torsten Hahmann	University of Maine, USA
Claudio Masolo	Laboratory for Applied Ontology, ISTC-CNR, Italy
Randi Vita	La Jolla Institute for Immunology, USA / OBO Foundry
Robert Hoehndorf	King Abdullah University of Science and Technology (KAUST), Saudi Arabia

Local Chair

Oliver Kutz	Free University of Bozen-Bolzano, Italy

Proceedings Chair

Karl Hammar	Jönköping University, Sweden

Web Chair

Selja Seppälä	University College Cork, Ireland

JOWO Steering Committee

Stefano Borgo	Laboratory for Applied Ontology, ISTC-CNR, Italy
Oliver Kutz	Free University of Bozen-Bolzano, Italy
Frank Loebe	University of Leipzig, Germany
Fabian Neuhaus	Otto-von-Guericke-University of Magdeburg, Germany

[14] See http://iaoa.org.

JOWO 2020 Workshops

DeepOntoNLP

Deep Learning meets Ontologies and Natural Language Processing – 1st International Workshop

Programme Chairs

Sarra Ben Abbès	Engie, France
Rim Hantach	Engie, France
Philippe Calvez	Engie, France

Programme Committee

Lynda Temal	ENGIE, France
Nada Mimouni	CNAM, France
Rafika Boutalbi	Trinov, France

Deep Learning (DL) meets Natural Language Processing (NLP) to solve human language problems for further applications, such as information extraction, machine translation, search and summarization. Previous works has attested the positive impact of domain knowledge on data analysis and vice versa, for example pre-processing data, searching data, redundancy and inconsistency data, knowledge engineering, domain concepts and relationships extraction, etc. Ontology is a structured knowledge representation that facilitates data access (data sharing and reuse) and assists the DL process as well. DL meets recently ontologies and tries to model data representations with many layers of non-linear transformations.
The combination of DL, ontologies and NLP might be beneficial for different tasks:

- Deep Learning for Ontologies: ontology population, ontology extension, ontology learning, ontology alignment and integration,
- Ontologies for Deep Learning: semantic graph embeddings, latent semantic representation, hybrid embeddings (symbolic and semantic representations),
- Deep Learning for NLP: summarization, translation, named entity recognition, question answering, document classification, etc.
- NLP for Deep Learning: parsing (part-of-speech tagging), tokenization, sentence detection, dependency parsing, semantic role labeling, semantic dependency parsing, etc.

FOUST IV

4th Workshop on Foundational Ontologies

Programme Chairs

Tiago Prince Sales	Free University of Bozen-Bolzano, Italy
Daniele Porello	Laboratory for Applied Ontology, ISTC-CNR, Trento, Italy

Programme Committee

Adrien Barton	Institut de Recherche en Informatique de Toulouse, CNRS, France
Antony Galton	University of Exeter, UK
Barry Smith	University of Buffalo, USA
C. Maria Keet	University of Cape Town, South Africa
Emilio Sanfilippo	Le Studium, Institute for Advanced Studies, France
Fabian Neuhaus	University of Magdeburg, Germany
Frank Loebe	University of Leipzig, Germany
Giancarlo Guizzardi	Free University of Bozen-Bolzano, Italy
João Paulo Almeida	Federal University of Espírito Santo, Brazil
Laure Vieu	Institut de Recherche en Informatique de Toulouse, CNRS, France
Mattia Fumagalli	Free University of Bozen-Bolzano, Italy
Michael Grüninger	University of Toronto, Canada
Nicola Guarino	Laboratory for Applied Ontology, ISTC-CNR, Italy
Oliver Kutz	Free University of Bozen-Bolzano, Italy
Pierre Grenon	University College London, UK
Riichiro Mizoguchi	Japan Advanced Institute of Science and Technology, Japan
Roberta Ferrario	Laboratory for Applied Ontology, ISTC-CNR, Italy
Stefano Borgo	Laboratory for Applied Ontology, ISTC-CNR, Italy

Foundational ontology is about categories of reality or thought which are common to all or almost all subject-matters. Commonly considered examples of such categories include 'object', 'quality', 'function', 'role', 'process', 'event', 'time', and 'place'. There are several foundational ontologies that provide a systematic formal representation of these categories, their relationships, and interdependencies. Amongst existing foundational ontologies, there is both a substantial measure of agreement and some dramatic disagreements. There is currently no uniform consensus concerning how a foundational ontology should be organised, how far its 'reach' should be (e.g., is the distinction between physical and non-physical entities sufficiently fundamental to be included here?), and even what role it should play in relation to more specialised domain ontologies.

The main use of foundational ontologies is as a starting point for the development of domain ontologies and application ontologies. A foundational ontology provides an ontology engineer with a conceptual framework that enables her to analyse a given domain, identify the entities in the domain as specialisations of the generic categories in the foundational ontology, and often reuse relationships (e.g., parthood) from the foundational ontology. The utilisation of foundational ontologies for the development of domain and application ontologies has two main benefits.

Firstly, the ontology engineer can reuse an existing set of well-studied ontological distinctions and design principles instead of having to develop an ad-hoc solution. Secondly, if two domain ontologies are based on the same foundational ontology, it is easier to integrate them.

FOUST is an ontology workshop series that offers researchers in foundational ontology an opportunity to present their results. This includes work on specific areas of foundational ontology as well as work on a particular foundational ontology. Topics covered in this edition of FOUST include, amongst others, processes, events, functions, roles, and identity criteria.

RobOntics

International Workshop on Ontologies for Autonomous Robotics

Programme Chairs

Daniel Beßler	University of Bremen, Germany
Stefano Borgo	Laboratory for Applied Ontology, ISTC-CNR, Italy
Mohammed Diab	Universitat Politècnica de Catalunya, Spain
Aldo Gangemi	University of Bologna and ISTC-CNR, Italy
Alberto Olivares-Alarcos	Institut de Robòtica i Informàtica Industrial (CSIC-UPC), Spain
Mihai Pomarlan	University of Bremen, Germany
Robert Porzel	University of Bremen, Germany

Programme Committee

John Bateman	University of Bremen, Germany
Michael Beetz	University of Bremen, Germany
Julita Bermejo	Universidad Isabel I, Spain
Katrien Beuls	Free University of Brussels, Belgium
Carlos Hernández Corbato	Delft University of Technology, Netherlands
Paul Van Eecke	Free University of Brussels, Belgium
Kerstin Fischer	University of Southern Denmark, Denmark
Sebastian Höffner	University of Bremen, Germany
Oliver Kutz	Free University of Bolzano, Italy
Antonio Lieto	University of Turin, Italy
Chris Nowak	Defence Science and Technology Group, Australia
Alessandro Oltramari	Bosch Research, USA
Daniele Porello	Laboratory for Applied Ontology, ISTC-CNR, Italy
Jan Rosell	Universitat Politècnica de Catalunya, Spain
Ricardo Sanz Bravo	Universidad Politécnica de Madrid, Spain
Paulo Jorge Sequeira Gonçalves	Polytechnic Institute of Castelo Branco, Portugal
Luc Steels	Free University of Brussels, Belgium
Elisa Tosello	University of Padova, Italy
Remi Van Trjp	Sony Computer Science Laboratory Paris, France

ROBONTICS focuses on the area of robot autonomy enabled by knowledge-driven approaches, and in particular formal ontologies. It aims to foster interaction across robotics, ontology, and knowledge representation and reasoning, to match open problems to promising approaches, and to review progress in knowledge-driven robotics.
A partial list of topics of interest includes:

- Foundational issues: which ontological approaches are better suited for autonomous robotics? how should notions such as capability or context be modelled?
- Robustness: how can ontologies help robots cope with the variety and relatively fluid structure of human environments?

- Ontologies in the perception-action loop: how might ontologies be used to recognize action possibilities?
- Interactivity: how should conversations be formalized, in particular the giving of instructions?
- Normed behavior: how can we represent, and then have a robot act according to, norms on behavior?
- Explainability: what is an explanation, and how can one be generated from a collection of knowledge items?

SKALE

Workshop on Scalable Knowledge Graph Engineering

Programme Chairs

Martin G. Skjæveland	University of Oslo, Norway
Daniel P. Lupp	University of Oslo, Norway
Ian Horrocks	University of Oxford, UK
Johan W. Klüwer	DNV GL, Norway
Christian Kindermann	University of Manchester, UK

Programme Committee

Aidan Hogan	DCC, Universidad de Chile
Alan Ruttenberg	
Alba Fernandez	Universidad Politécnica de Madrid
Alessandro Adamou	The Open University
Anastasia Dimou	Ghent University
Bijan Parsia	The University of Manchester
Boris Motik	University of Oxford
Ernesto Jimenez-Ruiz	City, University of London
Eva Blomqvist	Linköping University
Evgeny Kharlamov	Bosch; University of Oslo
Francisco Martin-Recuerda	DNV GL
Frank Van Harmelen	Vrije Universiteit Amsterdam
Gezim Sejdiu	University of Bonn
Giancarlo Guizzardi	Federal University of Espirito Santo & UFES
Ioan Toma	STI Innsbruck
Jeff Z. Pan	University of Aberdeen
Jens Wissmann	Festo AG & Co. KG
Juan Sequeda	data.world
Laurent Pierre	Electricité De France
Mariano Rodríguez Muro	Google
Markus Krötzsch	TU Dresden
Martin Giese	University of Oslo
Maxime Lefrançois	MINES Saint-Etienne
Ognjen Savkovic	Free University of Bolzano
Oscar Corcho	Universidad Politécnica de Madrid
Paul Groth	University of Amsterdam
Peter Haase	metaphacts
Petr Kremen	Czech Technical University in Prague
Rafael S. Gonçalves	Stanford University
Roman Kontchakov	Birkbeck, University of London
Steffen Staab	IPVS, Universität Stuttgart, DE and WAIS, University of Southampton, UK
Uli Sattler	University of Manchester
York Sure-Vetter	Karlsruhe Institute of Technology

While the use of knowledge bases is rapidly gaining industrial interest, ontologies are by and large still a fringe technology in most industries. A major impedi-

ment for industrial uptake is often attributed to the lack of scalable knowledge engineering tools and methodologies. Moreover, the development, maintenance, and use of knowledge bases and the tools and methods that are built to support these tasks usually require considerable specialist training. Enterprises that wish to explore the benefits of using semantic technologies will likely lack the necessary competence and will find that there are a few off-the-shelf ontologies, tools, and methodologies that fit their existing system architecture and information flow.
The SKALE workshop wants to attract and stimulate novel research and innovative advances of semantic technologies with the aim of making these technologies more easily accessible to and useful for modern data-driven industries. The workshop also wants to investigate where the real world problems are, and where and what are the current show-stoppers for efficient large-scale deployments of ontology-based information systems?

WOMoCoE

5th International Workshop on Ontology Modularity, Contextuality, and Evolution

Programme Chairs

Stefano Borgo	Laboratory for Applied Ontology, ISTC-CNR, Italy
Loris Bozzato	Fondazione Bruno Kessler, Italy
Till Mossakowski	Otto-von-Guericke University Magdeburg, Germany
Luciano Serafini	Fondazione Bruno Kessler, Italy

Programme Committee

Valeria De Paiva	Samsung Research America and University of Birmingham, UK
José M. Giménez-García	Université Jean Monnet Saint-Étienne, France
Adila A. Krisnadhi	University of Indonesia, Indonesia
Raphael Peñaloza	University of Milano-Bicocca, Italy
Patrick Rodler	Alpen-Adria Universität Klagenfurt, Austria
Vojtěch Svátek	Univ. Economics Prague, Czech Republic
George Vouros	University of Piraeus, Greece

In the area of ontologies for Knowledge representation and reasoning, knowledge is rarely considered as a monolithic and static structure: partitioning knowledge into distinct modular structures is central to organize knowledge bases, from their design to their management, from their maintenance to their use in knowledge sharing. Moreover, keeping knowledge in separate modules is essential for representing and for reliable and effective reasoning in changing situations. Finally, evolution of knowledge resources, in terms of updates by newly acquired knowledge, is an important factor influencing the meaningfulness of stored knowledge over time.

Considering these emerging needs, the International Workshop on Ontology Modularity, Contextuality, and Evolution (WOMoCoE) offers the ground to practitioners and researchers to discuss current work on practical and theoretical aspects of modularity, contextuality and evolution of ontology based knowledge resources.

WOMoCoE 2020, the 5th edition of the Workshop on Ontology Modularity, Contextuality, and Evolution, takes place (as a virtual workshop) in Bolzano on Sept. 16, 2020 within the framework of the 6th Joint Ontology WOrkshops (JOWO 2020) and the 22nd International Conference on Knowledge Engineering and Knowledge Management (EKAW 2020).

The workshop schedule included the oral presentation of the accepted contributions included in this volume. As in the past, in order to foster active, broad and cross-disciplinary interactions, much time is dedicated to the discussion of the papers. Each submitted paper was reviewed by at least three members of the program committee.

CELLS

The 4th International Cells in Experimental Life Science Workshop

Programme Chairs

Alexander D. Diehl	University at Buffalo, USA
Sirarat Sarntivijai	ELIXIR, UK
Yongqun "Oliver" He	University of Michigan, USA

The rapid advancement of experimental technologies for understanding cellular biology has led to challenges in keeping up with the volume and format of the data being produced and its distillation into new biological knowledge. Current high throughput methods such as single cell RNA sequencing and flow and mass cytometry are producing a large amount of data related to existing and novel cell types in health and disease. At the same time, experimental approaches such as microscopy, genomics, and metabolomics are expanding understanding of cellular functioning in relation to neighboring cells and the whole organism. Ontologies are being increasingly used as a tool for integrating and analyzing these diverse data types. The Cell Ontology (CL) and Cell Line Ontology (CLO) have long been established as reference ontologies in the OBO framework for representing cell type information, but additional ontologies such as the Gene Ontology, Protein Ontology, and the Ontology for Biomedical Investigation are also important for representing not only experimental data about cell types but also the methods used to produce that data. There is a continuing need for improve automated analysis techniques to link data about cells with appropriate ontologies. The CELLS 2020 workshop will focus on two themes: (i) challenges in the knowledge representation of newly-discovered and known cell types, and (ii) challenges in the knowledge representation of cells in disease states. This workshop will provide a venue for panel discussions of innovative solutions as well as the challenges in the development and application of biomedical ontologies to represent and analyze in vivo and in vitro cell- and cell line-related knowledge and data, including stem cell technologies. The workshop will cover the extension of CL and CLO for ontological representation of cell types and cell lines in new methodologies and experiments. It will also cover the applications and challenges in real-world use cases which may require other ontological adaptations beyond CL and CLO. Selected submissions will be featured in a BMC Bioinformatics thematic CELLS issue, as those from previous CELLS workshops have been.

COB

A Core set of Open Biological and Biomedical Ontology (OBO) Foundry Terms

Programme Chair

Randi Vita La Jolla Institute for Immunology, USA

The Open Biological and Biomedical Ontology (OBO) project is a collective of ontology developers that are committed to collaboration and adherence to shared principles. The OBO Foundry mission is to develop a family of interoperable ontologies that are both logically well-formed and scientifically accurate. Participants voluntarily adhere to and contribute to the development of an evolving set of principles including open use, collaborative development, non-overlapping and strictly-scoped content, and common syntax and relations. The OBO Foundry provides services to the community such as hosting persistent URLs and ontology files, recording metadata for all ontologies in the OBO registry, as well as supporting discussion forums and regular calls between participants. We have developed a set of key top-level ontology terms that unify the many OBO Foundry ontologies, termed COB. COB simplifies the identification of terms, organizes terms, and helps users navigate across OBO projects. It includes logic that links OBO ontologies together, allowing interoperability problems to be detected and corrected. It also allows users to see related ontology terms from multiple ontologies at the same time. This helps users understand how OBO ontologies and their terms are related, as well as aiding developers to ensure interoperability. The purpose of this workshop is to continue active development of COB, taking advantage of the ICBO meeting to gather together, in person, representatives from the diverse OBO Foundry ontologies. As COB is still in development, we are eager to obtain feedback from the ontology community. We want to collect actionable suggestions on how OBO ontologies work or do not work for users, and what users most want to see included in COB.

IFOW

Integrated Food Ontology Workshop

Programme Chairs

Damion Dooley	University of British Columbia, Canada
Emma Griffiths	Simon Fraser University, Canada
Hande Kucuk McGinty	Collaborative Drug Discovery, USA
Robert Warren	Myra Analytics, Canada

Programme Committee

Leigh Carmody	Robinson Lab / Jackson Laboratory, USA
Melissa Haendel	Oregon State University, USA
Lauren Chan	Oregon State University, USA
Lynn Schriml	University of Maryland, USA
Duccio Cavalieri	University of Florence, Italy
Tarini Naravane	University of California, Davis, USA
Damion Dooley	University of British Columbia, Canada
Robert Warren	Myra Analytics, Canada
Jessica Singer	Myra Analytics, Canada

Controlled vocabulary standardization efforts covering agricultural and food domains are evolving since their inception decades ago thanks to the mandates and continued support of institutional caretakers. Popular examples are FoodEx2, the European Food Safety Authority (EFSA) food classification and description system, the Global Language of Business GS1 product categorization scheme, the EUROFIR promoted LanguaL food composition thesaurus, the UN Food and Agriculture Organization's AGROVOC SKOS-based vocabulary, and its support of the International Network of Food Data Systems (INFOODS) vocabulary for food nutrition testing. These vocabularies are used in a growing interconnected food database landscape but suffer from format issues like textual or spreadsheet formats, unresolvable identifiers, and inconsistent category semantics. Ontologies are new entrants into the food domain, bringing a wave of Semantic Web technology and philosophy to bear on the issue of data sharing and modeling of food-related activity and research which are becoming critical in the face of rapid change to our environment and anthroposphere. Examples range from BBC's Food Ontology, driving its culinary media universe, to recently published research laboratory initiated ontologies like OBOFoundry members FoodOn, the Food Biomarker Ontology (FOBI), and the Ontology for Nutritional Studies (ONS), and related ontologies like the Medical Action Ontology (MAxO) and the Environmental Conditions, Treatments and Exposures ontology (ECTO) that are under development. Underpinning these mid-level, model-focused ontologies are environmental, chemical, biological, anatomical, disease and phenotype ontologies. Academic, agricultural and public health agencies are considering the benefits and complexities of adopting ontology in their research and data manage-

ment and reporting infrastructure. How can ontologies interface to legacy datasets and online databases described by existing vocabularies? What vocabulary, tool ecosystem and data models are needed to correlate agricultural treatments, nutritional data, eating patterns, biomarkers, pathogens, and phytochemical levels with disease and health phenotypes? This workshop seeks to define the coverage of the different ecological, agricultural, nutritional, dietary, public health, one health surveillance, food security, and trade domains that food-related ontologies are modeling, and the use of data translation tools for bringing legacy data into the ontology fold.

VDOS

9th International Workshop on Vaccine and Drug Ontology Studies

Programme Chairs

Cui Tao	University of Texas, USA
Yongqun "Oliver" He	University of Michigan, USA
Junguk Hur	University of North Dakota, USA

Programme Committee

Guoqian Jiang	Mayo Clinic, USA
Jie Zheng	University of Pennsylvania, USA
Richard Boyce	University of Pittsburgh, USA
Asiyah Yu Lin	Food and Drug Administration (FDA), USA
Yuji Zhang	University of Maryland, USA

Drugs and vaccines have contributed to dramatic improvements in public health worldwide. Over the last decades, there have been efforts in the biomedical ontology community that represent various areas associated with drugs including vaccines that extend existing health and clinical terminology systems (e.g., SNOMED, RxNorm, NDF- RT, and MedDRA), vernacular medical terminologies, and their applications to research and clinical data. This workshop will provide a platform for discussing innovative solutions as well as the challenges in the development and application of biomedical ontologies to representing and analyzing drugs and vaccines, their administration, immune responses induced, adverse events, and similar topics. The workshop will cover two main areas: (i) ontology representation of vaccines, drugs, and vaccine/drug-related domains (e.g., adverse events), and (ii) applications of the ontologies in real world situations – administration, adverse events, etc. Examples of biomedical subject matter in the scope of this workshop: drug components (e.g., drug active ingredients, vaccine antigens, and adjuvants), administration details (e.g., dosage, administration route, and frequency), gene immune responses and pathways, drug-drug or drug-food interactions, and adverse events. Both research and clinical subjects will be covered. We will also focus on computational methods used to study these, for example, literature mining of vaccine/drug-gene interaction networks, pathway analysis, meta-analysis of host immune responses, and time event analysis of the pharmacological effects. We encourage submissions related to the COVID-19 pandemic. Drugs and vaccines are critical to fight against the COVID-19. We welcome papers in the domain of drugs and vaccines against COVID-19.


I A O A