ERTS Congress - 10th edition from 29 to 31 January 2020 - Toulouse

"There are still some theoretical obstacles to clear before producing safe neural networks"

Marta Kwiatkowska is a leading Researcher in Computing Systems at Trinity College, University of Oxford. She is known for fundamental contributions to the theory and practice of probabilistic model checking. She will deliver a keynote on the 29th about the safety verification for deep neural networks and has kindly accepted to answer our questions in preparation of this event.

The ERTS Congress will celebrate in January 2020 its 10th Edition: what is your motivation for attending this event and how do you assess its particularities in the domain of Embedded Real-Time Systems?

This is the first time that I will participate in ERTS. I think that my keynote is a great opportunity to share the outcomes of my work around formal verification towards safety of deep learning and obtain direct feedback from conference attendees. Deep learning is already being deployed in autonomous controllers, so the keynote offers a unique opportunity to exchange ideas with other researchers and practitioners of real-time systems about this work and real-time systems in general. It is a pleasure to come to Toulouse, and I anticipate that the exchange will also stimulate my future work by providing new concrete problems to work on.

What is your view on the maturity of your field of research? How far it is from potential repercussions that may affect the market of Artificial Intelligence and deep learning in particular?

Deep learning is already spreading very quickly into applications, especially in computer vision, but neural networks are very complex artefacts and I think that suitable testing and validation methods are far behind due to gaps in present theory. Before we can ensure safe deep learning systems, new models have to be developed in order to better understand how they work, improve prediction of their behavior and accurately measure uncertainty about their outcomes. Probabilistic assessment can be based on Bayesian variants of those models and is a good step towards robust and fail-safe methods, but we do have some obstacles to clear before providing guarantees of safe operation of neural networks and industrializing them in critical applications.

Some future deep learning products are announced to be on the shelves in the coming years (e.g. Thalès' PureFlyt) after a long period of simulation and pre-operation allowing them to acquire virtual experience before entry into service. What is your view on this type of verification and could it be appled in a more distant future to fully autonomous systems?

This simulation step is indeed essential to validate and assess the safety level of those products. It should be mandatory but we still need to measure its level of coverage before declaring the products

assessed that way as safe enough for operation. Developing theoretical models allows for better understanding of realistic scenarios and improvement in the coverage, especially of corner cases, such as pedestrians walking across the highway with a bike, whose natural frequency is too low to guarantee that they will be covered by a random simulation. Input test cases and scenarios must be biased to give those corner cases better coverage than in reality so that the system is challenged to respond correctly, because difficulties arise usually at the extremes of the operating domain.

It is also important that this phase of testing is performed by an independent entity as we cannot rely on the designers themselves to step back and see the big picture. Recent affairs around B737MAX's systems prove that this independence is mandatory to ensure safe operations.

We also want to address the ethical point of view of such breakthroughs. Would we be able at some point in future to trust deep learning systems the same (or even more) than we trust humans? Will we tolerate machines' errors or expect that they shall be perfect objects designed by imperfect biological entities?

The ethical point of view has to be considered from different angles. My expectation is that learning systems will also have to undergo regular proficiency checks like what we do with humans. When we consider them as black boxes, those systems learn between two proficiency checks and therefore are never the same at each assessment. However, they are far from being able to hide their own mistakes like humans can do, and therefore still far behind what is referred to as "Artificial Intelligence".

Presentation of Marta Kwiatkowska, Invited keynoter at ERTS 2020

Marta Kwiatkowska is Professor of Computing Systems and Fellow of Trinity College, University of Oxford. She is known for fundamental contributions to the theory and practice of model checking for probabilistic systems, focusing on automated techniques for verification and synthesis from quantitative specifications. She led the development of the PRISM model checker (www.prismmodelchecker.org), the leading software tool in the area and winner of the HVC Award 2016. Probabilistic model checking has been adopted in diverse fields, including distributed computing, wireless networks, security, robotics, healthcare, systems biology, DNA computing and nanotechnology, with genuine flaws found and corrected in real-world protocols. Kwiatkowska is the first female winner of the Royal Society Milner Award and was awarded an honorary doctorate from KTH Royal Institute of Technology in Stockholm. She won two ERC Advanced Grants, VERIWARE and FUN2MODEL, and is a coinvestigator of the EPSRC Programme Grant on Mobile Autonomy. Kwiatkowska is a Fellow of the Royal Society, Fellow of ACM and Member of Academia Europea.

About ERTS

ERTS is a high-level event, held every two years, for universities, research centres and industry. The 10th edition of this unique event in Europe for manufacturers and researchers in the sector of embedded systems and software, co-organized by 3AF (Association of Aeronautics and Astronautics of France) and the SEE (Society of Electricity, Electronics and Information and Communication Technologies) will take place from 29 to 31 January 2020 at the Pierre Baudis Convention Centre in Toulouse.
To probe further: https://www.erts2020.org

REGISTRATIONS ARE OPEN: www.erts2020.org

About the Aeronautics and Astronautical Association of France (3AF)

Created in 1972 is a French aerospace society. Its mission is to advance the aerospace profession, stimulate progress in the state of the art or aerospace science and technology and represent the profession in public policy discussions. Unite, share, enlighten and advance: 3AF is a forum for knowledge exchange. Unite a network of more than 1500 members, 60 companies from the scientific aerospace community. Share 10 international conferences and symposiums per year, experts publications. Enlighten a scientific society, an expert pool of knowledge consulted by decision makers and media. Advance 20 technical commissions which contribute to advancing the aerospace industry.

About the Society of Electricity, Electronics and Information and Communication Technologies (SEE)

The SEE is a non-profit-making scientific association, directed to the public benefit. The SEE groups its members into 22 Technical Committees and 12 Regional Groups, creating links between them through its Newsletter and website. SEE mission's is to promote French science and technology, as well as create within these two fields meeting opportunities for industrialists, research scientists, teachers, students and trainee engineers both from France and abroad. The SEE thereby organizes and co-organizes events in its particular fields of competence. These professional national colloquia deal with particular topics and prospects, as well as major international Conferences. Other events include technical visits, evening lectures and training courses.

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