Escuela de Ciencias Informáticas 2017
Propuesta de Curso

Título del curso: *Automatic Behavior Composition of Behaviors -- From Devices to Smart Houses*
Idioma: Español/Inglés (material en Inglés)
Profesor: A/Prof. Sebastian Sardina (RMIT University, Australia)

Resumen del curso (máximo 1000 caracteres).

This course will survey some of the main developments in *agent behavior synthesis and composition*, the problem of automatically synthesizing a *coordinator controller* that *implements* a given desired but non-existing *target* complex behavior (e.g., a home system) by using a set of available existing behavior modules (e.g., cameras, TVs, lights, blinds, music system, phone). The composition problem is relevant and important in that with computers now present in everyday devices like mobile phones, credit cards, cars and planes or places like homes, offices and factories, the trend is to build embedded complex systems from a collection of simple components. Also, the problem can be recast in a variety of forms within several sub-areas of Artificial Intelligence and Computer Science, including verification, automated planning, intelligent spaces, agent programming, web-services, and business processes. The course will mix technical presentation with small class exercises.

Índice breve del programa del curso.

Day 1 [Introduction & Motivation]
- Motivation, domains of applicability, relevant areas of CS and AI.
- Background: Transition systems, Bisimulation and Simulation, LTL temporal logic.
- Service Composition: deterministic stateful service as transition systems, service composition.

Day 2 [Agent Behavior Composition]
- Nondeterministic agent behaviors as transition systems.
- Behavior composition: The Decision and Synthesis Problem.
- Composition by ND-simulation.
- Just in time, failures, parsimonious refinements.

Day 3 [Composition as 2-player Games]
- Game Structures: Behavior synthesis against opponent, two player game structure and game goals, mu-calculus for goals, model checking game structures.
- Composition via 2GS Model Checking: safety (goal) games, composition via 2GS model. checking, controller Synthesis, relationship with LTL and ATL synthesis, Tools and exercises: TLV, MCSMAS, NuGAT.

Day 4 [Composition Optimization, Program Composition]
- Unsolvable problems: decision-theoretic composition, supremal realizable target.
- High-level program composition.
- Planning-based composition.

Day 5 [Agent Planning Programs]
- Agent Planning Programs: Programming with planning.
- Further work/Extensions: Data box/planning domain, composition under partial observability, multi-target composition.

Bibliografía.

1. Giuseppe De Giacomo, Alfonso Gerevini, Fabio Patrizi, Alessandro Saetti, and Sebastian Sardina (2016). Agent planning programs. *Artificial Intelligence*, 231:64--106.
2. Giuseppe De Giacomo, Massimo Mecella, Fabio Patrizi (2014). Automated Service Composition Based on Behaviors: The Roman Model. *Web Services Foundations,* pages 189-214.
3. Giuseppe De Giacomo, Fabio Patrizi, Sebastian Sardiña: Automatic behavior composition synthesis (2013). *Artificial Intelligence* 196: 106-142.
4. Yoad Lustig, Moshe Y. Vardi (2013). Synthesis from component libraries. *International Journal on Software Tools for Technology Transfer* 15(5-6): 603-618.
5. Nitin Yadav, Paolo Felli, Giuseppe De Giacomo, Sebastian Sardiña (2013). Supremal Realizability of Behaviors with Uncontrollable Exogenous Events. In *Proceedings of the International Joint Conference on Artificial Intelligence (IJCAI)*, pages 1176-1182.
6. Alfonso Gerevini, Fabio Patrizi, Alessandro Saetti (2011). An Effective Approach to Realizing Planning Programs. In *Proceedings of the International Conference on Automated Planning and Scheduling (ICAPS),* 2011
7. Mario Caruso, Claudio Di Ciccio, Ettore Iacomussi, Eirini Kaldeli, Alexander Lazovik, Massimo Mecella (2012). Service Ecologies for Home/Building Automation. In *Proceedings of the 10th IFAC* Symposium on Robot Control, pages 467-472.
8. Giuseppe De Giacomo, Claudio Di Ciccio, Paolo Felli, Yuxiao Hu, Massimo Mecella (2012). Goal-Based Composition of Stateful Services for Smart Homes. In Proceedings of OTM Conferences (1):194-211
9. Thomas Ströder, Maurice Pagnucco (2009). Realising Deterministic Behavior from Multiple Non-Deterministic Behaviors. In *Proceedings of the International Joint Conference on Artificial Intelligence (IJCAI)*, pages 936-941
10. Daniela Berardi, Diego Calvanese, Giuseppe De Giacomo, Richard Hull, Massimo Mecella (2005). Automatic Composition of Transition-based Semantic Web Services with Messaging.In *Proceedings of Very Large Data Bases (VLDB)*, pages 613-624.
11. Daniela Berardi, Diego Calvanese, Giuseppe De Giacomo, Maurizio Lenzerini, Massimo Mecella: Automatic Composition of E-services That Export Their Behavior. In Proceedings of the International Conference on Service Oriented Computing (ICSOC), pages 43-58.
12. Roderick Bloem, Barbara Jobstmann, Nir Piterman, Amir Pnueli, Yaniv Sa'ar: Synthesis of Reactive(1) designs. Journal of Computing and System Sciences 78(3): 911-938.