Automatic Composition of Behaviors
Composición Automática de Comportamientos
Course under ERASMUS+ KA107 Program

Dates and time schedule: Thursday March 28 - Wednesday April 3 (11am to 1pm)
Location: IIIA-CSIC, http://iiia.csic.es/en/location   **Language:** English
Instructor: A/Prof. Sebastian Sardiña (RMIT University, Australia)
Course web-page & material: http://sites.google.com/site/compositionka107

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 exercises, and a final small project.

TENTATIVE SCHEDULE	Who should be interested?
Session 1 [Motivation & Preliminaries] ● Introduction, motivations, course overview. ● Preliminaries: Behaviors as Transition systems, nondeterminism, reachability, simulation, bisimulation. **Session 2 [Service Orchestration via Simulation]** ● The Roman Model for Service Orchestration. ● Composition with nondeterministic behaviors. ● Orchestration and Composition via Simulation and ND-simulation; failures. **Session 3 [Composition via 2-player Games]** ● Behavior synthesis against opponent, two player game structure and game goals, LTL for goals, safety (goal) games. **Session 4 [Behavior Composition via TLV]** ● Realizing a 2GS for composition in TLV (tool for Linux and Windows). **Session 5 [Composition Optimization & Agent Planning Programs]** ● Unsolvable composition problems. ● Programming behaviors via declarative goals.	Students interested in the ambitious *"automatic programming" or "program synthesis"* problem (the "Church Problem"): *automatically building an executable piece of code given (high-level) user intent*. Behavior Composition is a "nice" special case. It is easy to understand for the non-expert in synthesis, and is complex enough (hard to do it manually), intuitive (can be grounded in many domains); complete (includes all the main synthesis components/features); has full output (synthesis is a finite program); and is feasible (can be done computationally!) **What would be good to know before?** ● **Mandatory:** knowledge of discrete mathematics for Computer Science (e.g., graphs, propositional logic, set theory). ● **Desirable:** automata theory (e.g., finite state machines).