

SYS750: System Architecture and Design

Overview

This course presents the fundamentals of complex systems architecting using the Object Modeling Group's (OMG) SysML. It addresses the differences between functional decomposition and object oriented decomposition while architecting complex systems. Emphasis is placed on modeling mission objectives to the definition of the system level architecture. Topics include identification of system level architecture alternatives and considerations, including definition of objectives for physical (hardware) and logical (software) structure, information and system assurance, behavior, cost, performance and human integration based on the system concept at every level of system decomposition. System of System (SoS) architecture is examined, addressing composition of multiple systems and engineering new, emergent behavior in the SoS. Examples used will come from a variety of operational environments (e.g. communications systems, space systems, weapon systems, etc) Special consideration is given to the importance of effective construction and transitioning of the SysML models to software engineering for software intensive systems projects.

Prerequisites

SYS650: System Architecture and Design

Learning Goals

After taking this course, the student will be able to:

- Document requirements, generate use cases, capture activity diagrams, and document logical and physical architecture using SysML
- Understand the value of modeling to architects when reasoning about the system and it's constituent parts
- Apply a process for modeling system and system of systems using SysML
- Apply the experience gained through the use of a systems engineering based tool that supports systems engineering requirements, architecture and modeling processes.
- Develop an architecture applying the methods learned in the course.

Pedagogy

The course will employ lectures, supplemental reading and additional resources, online discussion, individual and team assignments and an individual project.

Required Text(s)

In support of the Course Objectives, the textbook we will be using two books:

- Friedenthal, Sanford, Alan Moore and Rick Steiner, *A Practical Guide to SysML: The Systems Modeling Language*, The MK/OMG Press, Amsterdam, ISBN 978-0-12-378607-4
- Firesmith, Donald, *The Method Framework for Engineering System Architectures*, CRC Press, Boca Raton, ISBN 978-1-4200-8575-4

Another fine, but not required book is:

- Holt, John and S. Perry, SysML for Systems Engineering, IET, ISBN 978-0863418259

Textbook examples used in the lecture notes are further explained in the text. The textbook should provide reference material for both your individual and team assignments.

Required Readings

Required Readings will be assigned for each week from the text books, and will be augmented with a number of relevant articles. The assignment can be found on the course website.

Course Outline

The course is divided into thirteen modules that are completed over the same number of weeks. Students are required to complete the reading assignments, review the PowerPoint slides, and view any associated video made available each week. Individuals must also participate in an online discussion each week in which discussion topics are presented. The online discussion requires an individual response by Wednesday of each week followed by a follow-up response later in the week (by Sunday). To promote full team member participation, students are required to assess their own contributions and other members of their team about midway in the semester and then again towards the end of the semester, prior to the grading of the final team project. In Week 10, each student is required to submit an individual project to demonstrate personal mastery of the course material. In week 13, a written paper, based on a selected article from the pre-reading is due.

Assignments

Specific details on the assignments are found on the course website. The assignments and their weights are as shown below:

| | |
|--|-------------|
| 1. Class Participation (includes team assessments and profile) | 26% |
| 2. Individual Practicum | 64% |
| 3. Written paper | 10% |
| TOTAL | 100% |

Please note that assignments in this class may be submitted to www.turnitin.com, a web-based anti-plagiarism system, for an evaluation of their originality.

Course Schedule

| Week # | Topic |
|---------------|---|
| 1 | Introduction to SysML and the Sparx EA tool Model Based System Architecting (MBSA) Model Organization. Practicum Introduction |
| 2 | Object Oriented concepts for Systems Engineering Modeling stakeholders and requirements |
| 3 | Operational Concept as an Input to Architecture |
| 4 | Using Use Cases and Activity Diagrams to Reason about the Problem |
| 5 | The System Domain – modeling with blocks |
| 6 | Design Structure Matrices (DSM) and Systems Architecting Decomposing the System in SysML |
| 7 | Patterns and Reference Architectures |
| 8 | Modeling Non-functional and Parametric Data |
| 9 | System of Systems Architecting |
| 10 | Architect Like Da Vinci – Whole Brain Architecting |
| 11 | Architecture Frameworks Agile Systems Engineering with Models |
| 12 | Architecture Management, Assessing Architecture in a Model Based Environment |
| 13 | Other Modeling topics Wrap-Up and Final Discussions |