SAE 549: Systems Architecting

Class Session: Tuesdays, 3:30 pm – 6:40 pm, Location Ronald Tutor Hall (RTH) Room 109 Online

Class Section: 32322D (DEN/Off-campus) and 32349R (On Campus)

Contact Information:

Instructor: Kenneth Cureton
Office hours: by appointment
E-mail: cureton@usc.edu

Teaching Assistant: TBD
Office hours: by appointment
E-mail: TBD@usc.edu

Course Learning Objectives:

■ To improve students’ ability to think critically, ask the right questions, and apply the right methods when architecting various types of systems.

■ To improve students’ understanding of the role of system architects and their relationship to systems engineers and transdisciplinary systems engineering.

■ To introduce the students to new, advanced multidisciplinary topics (e.g., systems thinking, systems modeling, psychological principles in systems architecting, biologically-inspired architectures, agent-based modeling, human capabilities and limitations) relevant to complex systems architecting.

■ To introduce the students to key concepts in performing trade-off analysis which is important to both systems architecting and engineering.

Readings and Notes:

■ Weekly lecture notes will be posted on the Desire to Learn (http://courses.uscden.net)

■ Required Reader:

■ Required Texts: Note: you can download these books through USC Libraries for free.
Required Readings: Note: you can download these papers via the DEN/D2L or Google Scholar or USC Libraries for free.

SAE 549: Systems Architecting

Grade
Your grade will be based on:

- Homework assignments (total of 4 assignments) = 20%
- Midterm exam = 30%
- Research paper = 50%

Exam
- The exam will consist of multiple questions that will test students’ knowledge about the fundamentals of systems architecting, complex systems, and systems thinking. The exam will be on all the subjects covered in previous lectures and assigned readings. This will be timed exam (2 hours and 40 minutes). The exam will be available on D2L at any time between Thursday July 9, 2020 at 6:00 AM Pacific Time and Sunday July 12, 2020 at 6:00 PM Pacific Time. Answers to the exam will be reviewed in Lecture #12.
- **Collaboration on the exam is forbidden.** Violators will receive an automatic F for the course.

Research Paper:
The research paper should address the following problem:
*Describe and analyze the architecture of a selected system (see below). Your analysis must discuss how the architecting process led to the architecture. The architecting process must address the heuristics used, key tradeoffs, questions posed, people involved, options generated, and decisions made.*

*Submit a maximum 1 page abstract for approval by June 23, 2020 6:00 PM Pacific Time.*

You must write on a **specific** system from one of the following categories.
- Automated (Self-Driving) Cars
- Smart Phones or Smart Tablet Computers
- Space Telescopes
- Robotic Systems (including Unmanned Space Exploration)
- Manned Space Transport
- Passenger Aircraft
- Airborne Platforms (Fighter / Bomber Aircraft / Helicopter / Unmanned Aerial Vehicles)

You should **not** propose an individual component or subsystem or process, but an entire vehicle (or phone/tablet) from one of the above categories in the above list.

**LENGTH:** The research paper should be approximately 8 pages (excluding references, appendices, and cover page), single-spaced, single column, standard (1” top and bottom, 1.25” left and right) margins, 12-point Times New Roman type.

**DELIVERY:** The research paper must be submitted through the Desire to Learn (D2L) system. Links for submitting the research paper will be available on D2L (http://courses.uscden.net).

**DEADLINE:** Research papers are due on **August 11, 2020 at 11:59 PM Pacific Time. No late papers will be accepted after the due date and time, and the student will receive an automatic F grade for the research paper.**

*Collaboration or plagiarism in the research paper is forbidden.* Violators will receive an automatic F grade for the research paper.
**Homework**

- Each homework assignment will consist of a few questions to briefly analyze the system you chose for your research paper. The homework will be assigned at the end of Lectures #2, #3, #5, and #6 and will be **due before start of class** the following week. Late submissions will receive a score of zero after the due date/time.
- The analyses used for homework assignments can be used in your research paper.
- **Collaboration on the homework assignments is forbidden.** Violators will receive an automatic score of zero for that assignment.

**Final Grade**

GRADING: Your class grade is computed as follows:

First, your project/research paper letter grade is converted into a numerical score according to USC Grading Standards: 4.0 for A, 3.7 for A-, 3.3 for B+, 3.0 for B, 2.7 for B-, 2.3 for C+, 2.0 for C, 1.7 for C-, 1.5 for D+, 1.0 for D, 0.7 for D-, 0.0 for F. This score is then multiplied by 12.5 to achieve a point range of 50-to-0.

Your midterm score is added to the above (0 to 30 points total). The total of all homework scores is added to the above. Note that the score for any one of the four homework assignments may range from 0 to 5 points.

The grand total of points is divided by 25 (to scale your total to a range of four-to-zero):

CLASS SCORE = (PROJECT/PAPER + MIDTERM + HOMEWORK) / 25

This class score is converted into a letter grade for the class:

A  4.0 to above 3.7
A- 3.7 to above 3.3
B+ 3.3 to above 3.0
B  3.0 to above 2.7
B- 2.7 to above 2.3
C+ 2.3 to above 2.0
C  2.0 to above 1.7
C- 1.7 to above 1.5
D+ 1.5 to above 1.0
D  1.0 to above 0.7
D- 0.7 to above 0.5
F  0.5 or below.

This letter grade is reported to USC as your class grade.
Schedule of Class Sessions: Any changes will be announced.

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<tr>
<th>2020</th>
<th>Lecture Topics</th>
<th>Readings</th>
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| May 26 | 1. Intro to SAE Program, the course, the instructor, and systems architecting | 1. “Preface” from Rechtin, 1991  
2. Chapter 1,2, and 3 from Rechtin, 1991  
3. Chapter 1 from Madni 2018                                                                 |
| June 2 | 2. System Architecture and Architectural Frameworks                           | 1. Chapter 6 from Madni 2018  
2. Chapter 15 from Rechtin 1991  
Submit student bio by 6:00 PM Tuesday June 2, 2020 Pacific Time  
Identify selected SYSTEM for Research Paper along with student bio  
Homework #1 Due by 6:00 PM Tuesday June 2, 2020 Pacific Time  
Homework #2 Assigned                                                                 |
3. Section 2.3 from Bahill & Madni 2017  
4. Chapter 5.1 from Bahill & Madni 2017  
5. Chapter 6 from Madni 2018  
Homework #1 Due by 6:00 PM Tuesday June 9, 2020 Pacific Time  
Homework #2 Due by 6:00 PM Tuesday June 16, 2020 Pacific Time  
Homework #3 Assigned                                                                 |
2. Chapter 2 from Madni 2018  
Homework #2 Due by 6:00 PM Tuesday June 16, 2020 Pacific Time  
Homework #3 Assigned                                                                 |
2. Section 2.4 from Bahill & Madni 2017  
Submit abstract by 6:00 PM Tuesday June 23, 2020 Pacific Time  
Homework #3 Due by 6:00 PM Tuesday June 23, 2020 Pacific Time  
Homework #4 Assigned                                                                 |
3. Chapter 11 from Rechtin 1991  
4. Chapter 7, Human Performance Enhancement, from Madni 2018  
Homework #3 Due by 6:00 PM Tuesday June 30, 2020 Pacific Time  
Homework #4 Due by 6:00 PM Tuesday July 7, 2020 Pacific Time  
Note: Midterm Exam this weekend!  
Homework #3 Due by 6:00 PM Tuesday July 7, 2020 Pacific Time  
Homework #4 Assigned                                                                 |
2. Chapter 5 from Madni 2018  
Homework #4 Due by 6:00 PM Tuesday July 7, 2020 Pacific Time  
Note: Midterm Exam this weekend!  
Homework #3 Due by 6:00 PM Tuesday July 7, 2020 Pacific Time  
Homework #4 Assigned                                                                 |
| Jul 9-12| Midterm Exam                                                                   | 2 hour 40 minute timed exam at any time of your choice between July 9 at 6 AM and July 12 Midnight (Pacific Times)  
Note: Midterm Exam this weekend!  
Homework #3 Due by 6:00 PM Tuesday July 7, 2020 Pacific Time  
Homework #4 Due by 6:00 PM Tuesday July 7, 2020 Pacific Time  
Note: Midterm Exam this weekend!  
Homework #3 Due by 6:00 PM Tuesday July 7, 2020 Pacific Time  
Homework #4 Assigned                                                                 |
## Lecture Topics and Readings

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<tr>
<th>Date</th>
<th>Topic</th>
<th>Readings</th>
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<tr>
<td>Jul 28</td>
<td>10. Systems Architecting of Complex Systems</td>
<td>1. Section 2.2.7 from Madni 2018</td>
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<tr>
<td>Aug 4</td>
<td>11. Special Topics - Guest Lecture</td>
<td>(none)</td>
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   3. Chapter 16 from Rechtin 1991  
   4. Chapter 11 from Madni 2018  

*Research Paper Due by 11:59 PM August 11, 2020 Pacific Time*
Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call studenthealth.usc.edu/counseling
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call suicidepreventionlifeline.org
Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call studenthealth.usc.edu/sexual-assault
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298 equity.usc.edu, titleix.usc.edu
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298 usc-advocate.symplicity.com/care_report
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity |Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776 dsp.usc.edu
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.
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USC Campus Support and Intervention - (213) 821-4710
campussupport.usc.edu
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101
diversity.usc.edu
Information on events, programs and training, the Provost’s Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
dps.usc.edu, emergency.usc.edu
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call
dps.usc.edu
Non-emergency assistance or information.