NATIONAL UNIVERSITY
School of Engineering, Technology and Media (SETM)

SEN 601
Software Engineering Fundamentals

COURSE DESCRIPTION

A survey of principles of modern software engineering; requirements analysis, development and maintenance of a software product and its supporting documents, software lifecycle and various models of development. Course also introduces students to tools and processes needed to development a software product, system or application, in a systematic manner.

Course Details
This course provides foundations of modern software engineering. It focuses on the survey of principles of modern software engineering including the development and maintenance of a software product and its supporting documents, software life cycle, and various models of development. As such, this course includes an overview of Computer-based System engineering, Software Processes, Software Requirements, Architectural Design, User Interface Design, Software Verification and Validation, Software Project Management, and the basic UML-based software modeling concepts. Students will be challenged with learning and applying their knowledge within the basic framework of the necessary hardware and software resources allocated to the MSSE Program. Students are encouraged to learn and use these resources, as they will be required to apply their knowledge and skills of these tools to future projects throughout the software engineering program.

The software engineering problems are so complex or large, that a single developer cannot solve them anymore. A team of developers work together in a collaborative manner to engineer a product in a complex process. Robert Baber (1997) explained engineering aspects of software engineering as ". . . the systematic and regular application of scientific and mathematical knowledge to the design, construction, and operation of machines, systems, and so on of practical use and, hence, of economic value. Particular characteristic of engineers is that they take seriously their responsibility for correctness, suitability, and safety of the results of their efforts. In this regard they consider themselves to be responsible to their customer (including their employers where relevant), to the users of their machines and systems, and to the public at large." Most engineering fields are founded on scientific disciplines. Software engineering is based partly on computer science and partly on psychology, management, economics, and intuitive judgments although there are attempts to establish "software science" (Wang 2008) as the primary basis for software engineering. "Software engineering is the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software" (IEEE, 1990). There are many alternative definitions of software engineering along this line. According to Laplante (2007), software engineering is the "systematic approach to the analysis, design, assessment, implementation, test, maintenance and reengineering of software, that is, the application of engineering to software". This definition, like the IEEE definition, emphasizes systematic

approach. However, current best practices play an important role in software engineering (Pressman 2010; Bass, Clements, & Kazman, 2012). Controversies about software development have been profoundly ostentatious and often explicated with effective metaphors. Donald Knuth (1969) initially suggested that software writing is an art. David Gries (1981) argued it to be a science. Watts Humphrey (1989) viewed it as a process. In recent years, practitioners have come to realize that software is engineered (Pressman 2010; Wang 2008; Braude & Bernstein, 2011; Sommerville 2010; Pfleeger & Atlee 2010; Agarwal, Tayal & Gupta 2010; Tsui & Karam, 2011).

Most software projects start with some fuzzy requirements. After some systematic analysis of the requirements, a software requirement specification (SRS) document is produced. Based on this, software design and implementation are performed along with software testing. Finally, the software is delivered or installed at customer sites and the maintenance phase starts. Modern software requirements analysis and management are use-case driven (Leffingwell & Widrig 2003; Babar et al. 2007). In the next phase, the software architectural design is developed based on the requirements analysis according to some design approach. "In the use-case driven architecture design approach, use cases are applied as the primary artifacts for deriving the architectural abstractions" (Tekeinerdogan, & Aksit, 2002: page 13). Engineers need to pay attention to details during the architectural design process, because "Architectures allow or preclude nearly all of the system's quality attributes" (Clements, Kazman, & Klein 2005). An elegant generic architectural framework, the Model-View-Controller (MVC) architecture, often helps software engineers in developing an architectural design for a given problem. Use case driven derivation of an instance of the MVC architecture for a specific problem allows efficient and cost effective development.

According to Pressman (2010: page 223] "One goal of software design is to derive an architectural rendering of a system". Architectural design, detailed design and design reviews provide the most important steps in a cost effective software development process. Software engineering activities are goal directed in order to produce working software in a timely manner within some cost constraints. For any complex computer based system, software architecture plays a very important role in its success or failure. Software architecture is "the overall structure of the software and the ways in which that structure provides conceptual integrity for a system" (Shaw & Garlan 1995). According to Braude and Bernstein (2011: page 438], "A software architecture describes the overall components of an application and how they relate to each other." In practice, software architectural design is immensely challenging, strikingly multifaceted, extravagantly domain based, perpetually changing, and rarely cost-effective. The best architectural practices are rarely published and often inferred from excellent products (Hong 2010).

REFERENCES

- Agarwal, B., Tayal, S. & Gupta, M. (2010). Software Engineering and Testing, Jones and Bartlet.
- Babar, M, Dingsoyr, T., Lago, P. & van Vliet, H. (Editors) (2009). Software Architecture Knowledge Management, Springer.
- Baber, R. (1997). Comparison of Electrical "Engineering" of Heaviside's Times and Software "Engineering" of our Times. IEEE Annals of the History of Computing, 19(4): 5-17.
- Bass, L., Clements, P. & Kazman, R. (2012). Software Architecture in Practice, 3rd Edition Addison-Wesley.
- Boehm B, (1988). A Spiral Model of Software Development and Enhancement, IEEE Computer, IEEE, 21(5):61-72, May 1988.
- Braude, E. & Bernstein, M. (2011). Software Engineering: Modern Approaches, (2nd Edition), John Wiley & Sons.
- Clements, P., Kazman, R. & Klein, M. (2005). Evaluating Software Architectures. Addison-Wesley.
- Gries, D. (1981). The Science of Programming. Springer.

- Hong, J. (2010) "Why is Great Design so Hard?", Communications of the ACM, July 2010.
- Humphrey,W. (1989). Managing the Software Process, Reading, MA. Addison-Wesley.
- IEEE (1990). IEEE Standard 610.12-1990, IEEE Standard Glossary of Software Engineering Terminology.
- Knuth, D. (1969). Seminumerical Algorithms: The Art of Computer Programming 2. Addison-Wesley.
- Laplante, Phillip (2007). What Every Engineer Should Know about Software Engineering, Boca Raton: CRC.
- Leffingwell, D. & Widrig, D. (2003). Managing Software Requirements: A Use Case Approach (2nd Edition), Addison Wesley.
- McConnel, S. (2004). Code Complete, Microsoft Press.
- Miller, J. & Mujerki, J. (Editors) (2003) MDA Guide, Version 1, OMG Technical Report. Document OMG/200-05-01, http://www.omg.com/mda.
- Pfleeger, S. & Atlee, J. (2010). Software Engineering, Prentice-Hall.
- Pressman, R. (2010). Software Engineering: A Practitioner's Approach. (7th ed.), McGraw-Hill.
- Rumbaugh, R., Jacobson, I. & Booch, G. (2005). The Unified Modeling Language Reference Manual. (2nd Edition), Addison Wesley
- Shaw, M. & Garlan, D. (1995). Formulations and Formalisms in Software Architectures, Computer Science Today: Recent Trends and Developments, Springer-Verlag LNCS, 1000, 307-323.
- Sommerville, I. (2010). Software Engineering, 9th Edition, Addison Wesley.
- Tekeinerdogan,B. & Aksit, M. (2002). Classifying and Evaluating Architecture Design Methods, in M. Aksit (editor), Software Architectures and Component Technology, Kluwer Academic Publishers.
- Tsui, T. & Karam, O. (2011). Essentials of Software Engineering, 2nd Ed., Jones and Bartlet.
- Wang, Y. (2008). Software Engineering Foundations: A Software Science Perspective, Auerbach Publications.

INSTRUCTOR

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REQUIRED TEXTBOOK

"Software Engineering: A Practitioner's Approach," Pressman, Roger S., McGraw Hill, 7th Edition (ISBN# 978-0-07-337597-7) or the most recent edition; check the Pressman website: www.mhhe.com/engcs/compsci/pressman

REFERENCE BOOK

"Object-Oriented Software Engineering", Timothy C. Lethbridge and Robert Laganiere, ISBN – 0-07-283495-1 or most recent edition.

LEARNING OUTCOMES

Upon successful completion of this course, students will be able to:

- Evaluate software engineering principles
- Form and manage product teams.
- Produce appropriate documentation for a software product development.
- Create software requirements specifications for a given problem.
- Analyze various software development processes, theories and methodologies.

COURSE REQUIREMENTS

All students are required to meet the following minimum requirements:

- Homework assignments
- Exercises/Quizzes
- Project
- Class participation/Discussion
- Midterm examination
- Final examination

Lectures will be provided to introduce the subject material and concepts. Participation is a major factor and is encouraged in the classroom discussions. Sharing of real world experiences and current events will also be encouraged in the classroom.

ASSIGNMENTS DUE DATES

(Start date: 03/03/2013 End date: 03/29/2013)

	Mon	Wed	Mon	Wed	Mon	Wed	Mon	Wed	Sat
Lecture	03/03	03/05	03/10	03/12	03/17	03/19	03/24	03/26	03/29
Chapters	1-3	4-6	7-10	11-12	13-16	16-18	19-23	24-30	
Discussion/Participation		x	x	x	x	x	x	x	
Homework/Assignment				x (03/15)			x (03/25)		
Project (Ind.)									x
Midterm					x (Monday, 03/17)				x
Final									
							(Saturday, 03/29)		

Lecture notes/Reading materials:
Students are expected to read all the class notes and check all the PowerPoint slides provided in the class (and also in eCompanion). They are also expected to read the chapters as specified for each week from the text book. In addition, they are also expected to gather additional reading materials through research.

Final Project:

Students are encouraged to select a suitable topic in consultation with me (instructor). Instructor's approval for the selected topic is required to ensure the quality and scope as outlined in the course syllabus. A detailed analysis of Software Requirement Analysis on any real-world software development

effort may be selected as a topic. The instructor may also suggest a list of topics to choose. Further details will be provided by the instructor at the beginning of the class.

Suggested topics for the final Project Assignment – will be decided after discussion in the class. For this assignment, you will write a minimum of 10 -12 pages document (not including cover page and references) on Software Requirements Specification (SRS). Also, elaborate your plan for testing strategies and methods (details will be provided in the class).

The content section of the paper will be 10-12 pages in length (not including cover page and references), 11-point Times New Roman font, one-inch boarders, and 1.5-spaced. You will need at least five professional journal or book references. Grading shall be based on the quality of the contents, writing & presentation style, and the references, the depth of your requirement analysis, diagrams, the format and structure of your work, and your ability to write at the graduate level. You may use APA format for the document.

All students are required to demonstrate a sufficient writing skill in composing and clearly express the main ideas for the assignment, constructing supporting evidence, as well as following structured format in business communication. If you have any concerns about writing style on this subject, please contact the writing center at:
http://www.nu.edu/OurPrograms/StudentServices/WritingCenter.html

All class works are expected to confirm with APA/MLA Style. The American Psychological Association (APA) has established a style that it uses in all of the books and journals that it publishes. Editorial style consists of rules or guidelines that a publisher observes to ensure clear and consistent presentation of written material.

Editorial style concerns uniform use of such elements as:

- Punctuation and abbreviations
- Construction of tables
- Selection of headings
- Citation of references
- Presentation of statistics
- As well as many other elements that are a part of every manuscript.

Please consult http://www.apastyle.org/ for detailed information

Evaluation Presentation:
This is a five-minute presentation on your analysis. Each student will be responsible for making a presentation for their contribution to the project. The project presentation should evaluate the strengths and weaknesses of the methodology to the class. The criteria for presentations are as follows:

Content: Level of detail of information
On time: Five minute presentation, agreed upon day
Format: Organization of presentation
Overheads: Quality and creativity of PowerPoint (multimedia preferable).
Graphics: Charts, graphs, etc.
Handouts: For students to take home
Creativity: Presentation style, individual inventiveness
Insight: Understanding of core concepts
Interesting: Overall presentation quality, do NOT read it

Writing Assignments Rubric:

A:
The paper is well organized both overall and at the paragraph level. Sentences are smooth and carefully crafted. There are virtually no errors in punctuation or spelling, grammar or usage. Words are chosen with precision. Informal language or dialect is used only when appropriate. The paper avoids triteness and unwarranted generalization: the language is fresh and vivid. The paper is tight, not wordy. The ideas show a thorough understanding of the work and are often insightful; the ideas are developed and supported. The ideas illuminate the work as a whole and do not contradict other parts of the work or overlook parts, which are relevant to the topic. The writer keeps his/her audience in mind and, as a consequence, the paper engages and interests the reader.

B:
The paper is well-organized, but the paragraph structure may sometimes be disjointed. The paper may have a few awkward passages and a few errors in punctuation, spelling, grammar, or usage. The language may at times be too general; it may lack the freshness or precision of the "A" paper. But none of these errors is glaring or highly distracting. The ideas are worthwhile and show good understanding of the work; they are sometimes insightful, generally well developed, and well supported. The ideas help illuminate the work as a whole and contradict or overlook no major aspects. While the paper is always clear and thus suggests that the writer had his/her audience in mind in a general way, the style or presentation of the ideas does not always engage or interest the reader.

C:
The paper is basically well-organized, though individual paragraphs may be disunited or misplaced. Generally, however, the paper shows that the writer has followed a logical plan. The writing is competent, but often wordy, overly general, imprecise, or trite. Sentences may at times be awkwardly constructed, but their meaning is clear. Grammar, punctuation, spelling, and usage are not highly distracting, but there may be some errors. The ideas are generally worthwhile, but not very insightful; development and support are present but sometimes less than adequate. The ideas illuminate parts of the work, but not the whole; no major aspects of the work are contradicted or entirely disregarded. While the writing is usually competent, the writer does little to interest or engage the reader in what he/she has to say.

D:
The paper is poorly organized, though there is a recognizable thesis. Some sentences may be so confused that their meaning does not clearly emerge. Words may be imprecise, incorrect, trite or vague. In general, however, the paper is understandable. Ideas are generally superficial and weakly developed or supported, although some development and support are present. Obvious aspects of the work have been overlooked or disregarded; some significant facts may be incorrect. Audience "engagement" cannot occur, although the writer may have attempted to elicit it, because of the serious deficiencies already noted.

F:
The paper lacks a clear thesis; the language or sentence structure is so muddled as to be unclear in several spots; or the errors in punctuation, spelling, grammar, and usage are highly distracting. The ideas are superficial and show no real understanding of the work beyond, perhaps, plots; important facts are incorrect. The paper relies on generalizations with little or no development or support. The paper blatantly overlooks, disregards, or contradicts important aspects of the work. Under any of these conditions audience "engagement" is impossible.

Evaluation Presentation (TBD):
This is a five-minute presentation on your analysis. Each student will be responsible for making a presentation for their contribution to the project. The project presentation should evaluate the strengths and weaknesses of the methodology to the class. The criteria for presentations are as follows:

Content: Level of detail of information
On time: Five minute presentation, agreed upon day
Format: Organization of presentation
Overheads: Quality and creativity of PowerPoint (multimedia preferable).
Graphics: Charts, graphs, etc.
Handouts: For students to take home
Creativity: Presentation style, individual inventiveness
Insight: Understanding of core concepts
Interesting: Overall presentation quality, do NOT read it

Quizzes:
Practice quizzes are available in the eCompanion site. Students are expected to practice these in each week and be prepared for tests (Midterm and Final).

Assignments (Home work):
The assignments will be provided in the class. The content section of the paper will be 5-6 pages in length (not including cover page and references), 11-point Times New Roman font, one-inch boarders, and 1.5-spaced. You will need at least five professional journal or book references. Grading shall be based on the quality of the contents, writing & presentation style, and the references, the depth of your requirement analysis, diagrams, the format and structure of your work, and your ability to write at the graduate level. You may use APA format for the document.

When you are ready to submit a week's assignment to me, please submit that in the *dropbox*.

Dropbox Assignment Submission Procedures

To submit to the Dropbox, click on the Dropbox tab at the top of this course content frame. Click on the Submit an Assignment link. Choose the Dropbox Basket titled Assignment for a week (e.g., Wk1_Assignment). Click the Add Attachments button to browse for the assignment document on your computer that you would like to submit. After attaching this document, you may add comments to your instructor in the Comments field if you wish, then click the Submit button.

DISCUSSION QUESTIONS (to be conducted in the classroom or through threaded discussions; TBD)
It is important that you participate in the mandatory discussions to obtain full credit.

• **Midterm (03/17) -** Please note that there would be no makeup exam. Students must be present on this date to take the exam.

• **Final (03/29) -** Please note that there would be no makeup exam. Students must be present on this date to take the exam.

NOTE: MID_TERM AND FINAL EXAM
Students are expected to pass a midterm and final exam. Any of the materials covered in the class through the presentations, text, research, discussions, etc., may be on this exam. Exams may be either essay style or True/False-Multiple Choice format.

COURSE GRADING

Grades will be weighted as follows:

Midterm	20%
Final	25%
Quizzes/Exercises	10%
Homework Assignments	20%
Participation/Discussion	5%
Project	20%

The final course grades are based on the grading system in the catalog:

A	95-100	B	84-86.9	C	74-76.9	D	64-66.9
A-	90-94.9	B-	80-83.9	C-	70-73.9	D-	60-63.9
B+	87-89.9	C+	77-79.9	D+	67-69.9	F	00-59.9

Definition of Grades: You may check the University's General Catalog for definition of the grades:

A Outstanding Achievement Significantly exceeds standards
B Commendable Achievement * Exceeds standards
C Acceptable Achievement Meets standards
D Marginal Achievement Below standards
F Failing **

I Incomplete: A grade given when a student who has completed at least two-thirds of the course class sessions and is unable to complete the requirements of the course because of uncontrollable and unforeseen circumstances. Students must communicate these circumstances (preferably in writing) to the instructor prior to the final day of the course. If an instructor decides that an "Incomplete" is warranted, they provide the student with the conditions for removal of the "Incomplete" in writing and place a copy on file with the Office of the Registrar. The file copy remains in place until the "Incomplete" is removed or the time limit for removal has passed. An "Incomplete" is not assigned when the only way the student could make up the work would be to attend a major portion of the class when it is offered again. Students must resolve "Incompletes" no later than the second complete quarter following the course completion date. Students can be required to remove an "Incomplete" in a shorter period at the discretion of the instructor.

An "I" that is not removed within the stipulated time becomes an "F." No grade points are assigned. The "F" will be calculated in the grade point average.

W Withdrawal: Signifies that a student has withdrawn from a course after beginning the third class session. Students who wish to withdraw must notify their admissions advisor before the beginning of the sixth class session in the case of graduate courses, or before the seventh class session in the case of undergraduate courses. Instructors are not authorized to issue a "W" grade.

*Graduate students are reminded that a cumulative grade point average (GPA) of 3.0 is required to achieve a degree.

Grade or point reduction may be taken for failure to meet presentation schedule, late papers, late homework, inadequate class discussion and participation, poor attendance including late arrivals and early departures. This is a graduate level course and as such it demands the following:

1 Correct writing and use of the English language
1.1 Presentations (Oral & Overhead Graphics)
1.2 Written assignments (Grammar & Composition, spelling, punctuation)
2 Concentration
3 Dedicated hard work covering a large volume of material
4 Class participation

The instructor reserves the right to vary the work within the overall class schedule. Should class size increase or decrease, work or group assignments may be changed, or current topics may require more time for study or discussion. All classes start at 5:30 PM each morning. The Saturday class is scheduled as per the catalog (change of this schedule may be possible with everybody's approval).

GENERAL POLICIES - You may check the University's General Catalog for policies regarding ethics, plagiarism, civility, etc.

Technology:
Students are expected to be competent in using current technology appropriate for this discipline. Such technology will include word processing, spreadsheet, and presentation software. Students will gain rudimentary competence in the use of diagramming software (MS Visio). Use of the internet and e-mail may also be required.

Students with Disabilities:
Students seeking special accommodations due to a disability must submit an application with supporting documentation, as explained under this subject heading in the General Catalog. Instructors will provide such accommodations if they receive written notification from the University.

Writing Across the Curriculum:
Students are expected to demonstrate writing skills in describing, analyzing and evaluating ideas and experiences. Written reports and research papers must conform to the APA (American Psychological Association) standards regarding construction, citations of an author's work within the text, and references at the end of the paper. Students are encouraged to use the services of the University's Writing Center when preparing materials.

The following websites provide information on APA style:
http://apastyle.org/
http://owl.english.purdue.edu/owl/resource/560/01/

Library Electronic Resources
National University Library supports academic rigor and student academic success by providing access to scholarly books and journals both electronically and in hard copy. Print materials may be accessed at the Library in San Diego or through document delivery for online and regional students. Librarians are available to provide training, reference assistance, and mentoring at the San Diego Library and virtually for online or regional students. Please take advantage of Library resources:

• URL: http://www.nu.edu/library.

Contact the Library:
RefDesk@nu.edu
(858) 541-7900 (direct line)
1-866-NU ACCESS x7900 (toll free)

Additional Resources

Websites:

The Object Management Group	http://www.omg.org
OMG Unified Modeling Language	http://www.uml.org
cetuslinks.org	http://www.cetuslinks.org
San Diego Java User Group	http://www.sdjug.com
More resources	To be provided in the class