**Syllabus**

**CSE 6329-002 Special Topics in Advanced Software Engineering –**

Software Measurement and Quality Engineering

Spring, 2016

**Instructor:** Dr. Dennis J. Frailey

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**Faculty Profile:** PhD and MS, Computer Science, Purdue University; BS, Mathematics, U. of Notre Dame. Adjunct Professor, SMU and UTA; Principal Fellow, Raytheon (retired); Board of Governors, IEEE Computer Society; former Vice President, ACM; distinguished lecturer, ACM and IEEE Computer Society; former president, Association for Software Engineering Excellence; program evaluator in software engineering, computer engineering and computer science for ABET. Dr. Frailey recently retired after a 40+ year career in software engineering and computer design at Ford Motor Co, Texas Instruments and Raytheon. He proposed, planned and led software development activities for many projects; taught software development, software management and project management for internal training organizations; and also taught as an adjunct professor at SMU and several other universities for 40+ years. Over 150 publications -- specialties include compiler optimization, real-time operating systems, software development for large projects, software quality engineering, software safety, cycle time reduction, and six sigma techniques for software.

**Office Hours:** By appointment before or after class on Fridays

**Section Information:** CSE 6329-002

**Time and Place of Class Meetings:** 1:00pm – 3:50pm, Fridays, Classroom GACB 105

(This is the building North of ERB, on the other side of the street)

**Description of Course Content:** Software is replacing hardware devices and human decision making in many modern applications. More and more of those applications are safety critical or have other characteristics that demand very high quality. There is also intense pressure to produce software quickly and efficiently. This course covers how to manage and improve the quality, productivity and speed of software development by applying quality engineering, measurement and other techniques to software development projects. The course presents modern methods of achieving high quality software, with emphasis on pragmatic issues and use of examples from real applications. The course focuses on the importance of process definition, measurement and continuous improvement as part of a discipline of quality engineering. Topics include software measurement (principles and practice), conducting and evaluating experiments, data analysis, causal techniques such as Bayesian networks, value-added analysis, cost-of-quality analysis, software reliability, six sigma and zero defects, statistical process control and quantitative process management, productivity measures and productivity improvement, selection of appropriate measures for improving the software development process and assessing/assuring quality, as well as methods of analyzing failures such as root cause analysis. Specific measures and their uses are discussed along with pitfalls and risks in using measurement. The course is designed to delve into measurement and quality topics beyond those covered in CSE5325 -- the prerequisite for this course.

**Student Learning Outcomes:**

* Each student will learn the principles of quality engineering and how to apply them to realistic software projects.
* Each student will learn how to select and apply metrics and how to analyze the resulting data so as to understand and improve the quality and productivity of software projects.
* Each student will learn how to overcome the “zero sum game” perspective so as to improve software productivity, cycle time and quality at the same time.

**Required Textbooks and Other Course Materials:**

Fenton, Norman and James Bieman, ***Software Metrics: A Rigorous and Practical Approach, Third Edition***, Chapman and Hall, 2014. ISBN 978-1439838228. (A comprehensive book on software metrics that provides background and supplementary information for many topics covered in the course.) This book is available to UTA students and faculty electronically via the UTA library at:

[https://login.ezproxy.uta.edu/login?url=http://www.utarl.eblib.com/EBLWeb/patron/?target=patron&extendedid=P\_1575383\_0](https://owa.uta.edu/owa/redir.aspx?SURL=bTOu32IsFySSgNUXHKWB8VJheVGg5ydCyBGKFQsj5fofcgOBbIHSCGgAdAB0AHAAcwA6AC8ALwBsAG8AZwBpAG4ALgBlAHoAcAByAG8AeAB5AC4AdQB0AGEALgBlAGQAdQAvAGwAbwBnAGkAbgA_AHUAcgBsAD0AaAB0AHQAcAA6AC8ALwB3AHcAdwAuAHUAdABhAHIAbAAuAGUAYgBsAGkAYgAuAGMAbwBtAC8ARQBCAEwAVwBlAGIALwBwAGEAdAByAG8AbgAvAD8AdABhAHIAZwBlAHQAPQBwAGEAdAByAG8AbgAmAGUAeAB0AGUAbgBkAGUAZABpAGQAPQBQAF8AMQA1ADcANQAzADgAMwBfADAA&URL=https%3a%2f%2flogin.ezproxy.uta.edu%2flogin%3furl%3dhttp%3a%2f%2fwww.utarl.eblib.com%2fEBLWeb%2fpatron%2f%3ftarget%3dpatron%26extendedid%3dP_1575383_0)

The following may be helpful but are not required. Items with **(\*)** are strongly recommended. Other suggested reference materials will be provided in the course slides and many will be made available on the Blackboard.

***Books:***

(\*) Andersen, Bjorn and Tom Fagerhaug, ***Root Cause Analysis, 2nd Edition***, Quality Press, Milwaukee, WI, 2006. ISBN 13: 978-0-87389-692-4. (Addresses a key technique for quality improvement.)

Berger, Roger W, Benbow, D, Eishennawy, A and Walker, H., ***The Certified Quality Engineer***, Quality Press, Milwaukee, WI, 2006. ISBN 13: 978-0-87389-700-6. (Designed as a study aid for those seeking to become certified quality engineers; contains excellent coverage of many topics – more than this class has time to cover. Goes well beyond software topics alone.)

DeMarco, Tom, ***Controlling Software Projects: Management, Measurement, and Estimation***, New York, Yourdon Press, 1986. (Practical guidance for collecting and analyzing software data.)

Grady, Robert B. and Deborah L. Caswell, ***Software Metrics: Establishing a Company-Wide Program***. Englewood Cliffs, N.J., Prentice-Hall, Inc., 1987. ISBN 0-13-821844-7. (Although dated, this is a good description of the issues faced by a company developing a measurement program.)

Marciniak and Evans. ***Software Quality Assurance and Management*.** (Recommended by several SQA professionals)

Nanda, Vic and Jeffrey Robinson, ***Six Sigma Software Quality Improvement***, McGraw-Hill Professional Series, 2011. ISBN 978-0071700627. (Reports results from many years of the authors’ experience implementing six sigma techniques on realistic software projects.)

Schulmeyer, G. Gordon. ***Zero Defect Software*.** McGraw Hill, 1990. ISBN 0-07-055663-6. (Comprehensive coverage of the subject by one of the originators of the concept.)

Schulmeyer, G. Gordon and James McManus. ***Handbook of Software Quality Assurance*, *Third Edition*.** Van Nostrand Reinhold, New York, 1999. ISBN 0-442-00796-5. (One of the best references on conventional SQA.). The second edition, published in 1992, is similar but not all of the sections map to each other. Here is a map:

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2nd edition | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | - |
| 3rd edition | 1 | 2 | 3 | 5 | - | 4 | 6 | 8 | 9 | - | 11 | 14 | 10 | 15 | 16 | 17 | 19 | - | 20 | - | 7,12,13,18,21 |

Weinberg, Gerald M. ***Quality Software Management, Volume 1, Systems Thinking***, Dorset House, New York, 1992. ISBN: 0-932633-22-6. (Explores quality improvement with many insights from a psychological and cultural point of view.)

***Standards, Guidelines and other Reference Materials:***

IEEE Std 1045-1992.  ***IEEE Standard for Software Productivity Metrics***. New York, Institute of Electrical and Electronics Engineers, Inc. (Describes more than 30 software measures that can be used to manage software projects and measure productivity in a consistent manner.)

(\*)ISO/IEC/IEEE Std 15939:2007. ***Systems and software engineering - measurement process.*** Geneva, Switzerland: International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC), ISO/IEC/IEEE 15939:2007. (This standard defines a measurement process applicable to both systems and software engineering, and to their corresponding management disciplines. This standard is particularly valuable in that it defines both a well-conceived process and many terms and it illustrates those with examples in an appendix. The process is described via a highly tailorable model that defines the activities of the measurement process that are required to adequately specify what measurement information is required, how the measures and analysis results are to be applied, and how to determine if the analysis results are valid.)

(\*)P. Bourque and R.E. Fairley, eds., ***Guide to the Software Engineering Body of Knowledge, Version 3.0*, IEEE Computer Society, 2014;** [**www.swebok.org**](http://www.swebok.org)**.**

(This is ***SWEBOK – The Guide to the Software Engineering Body of Knowledge***, a compendium of what a professional software engineer should know. It includes fifteen key topics, covering software development, software project management, software process, software quality assurance, and several other topics of importance to software development professionals).

***SWX – The Software Extension to the Project Management Body of Knowledge***, available from the Project Management Institute ([www.pmi.com](http://www.pmi.com)). (This joint effort of the IEEE Computer Society and the Project Management Institute (PMI) extends includes topics that a project manager needs to know about managing projects with significant software content.)

**Descriptions of major assignments and examinations:**

1. There will be a midterm examination and a final examination based on the topics presented by the instructor. Each will count 15% of the final grade.
2. Each student (or team) will complete four other assignments that involve use of measurement in software engineering as well as quality engineering techniques. These assignments will require use of a spreadsheet and a word processor. One of them requires developing a small program in the C programming language.

**Attendance:** At The University of Texas at Arlington, taking attendance is not required. Rather, each faculty member is free to develop his or her own methods of evaluating students’ academic performance, which includes establishing course-specific policies on attendance. As the instructor of this section, I will not take attendance. However, due to the once-a-week nature of the course, missing a class will cause the student to miss a lot of material.

**Other Requirements:**

* CSE5325, and/or prior experience on a realistic software development project will be a prerequisite.
* Students must make extensive use of Excel® and MS Word® (or similar products whose output can be produced in these formats).

**Grading**:

30% of grade from midterm and final examination

70% of grade from four student assignments

5% penalty for assignments turned in late by a week or less

10% penalty for assignments turned in more than a week late

**Make-up Exams**: Students unable to take an exam at the scheduled time may discuss options for make-up exams with the instructor.

**Expectations for Out-of-Class Study**: Beyond the time required to attend each class meeting, students enrolled in this course should expect to spend, on average, at least an additional 9 hours per week of their own time in course-related activities, including reading required materials, completing assignments, preparing for exams, etc. Assignment 1 helps students plan how to allocate their time.

**Grade Grievances**: see <http://catalog.uta.edu/academicregulations/grades/#graduatetext>.

**Drop Policy:** Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance**. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://wweb.uta.edu/aao/fao/>).

**Americans with Disabilities Act:** The University of Texas at Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including the *Americans with Disabilities Act (ADA)*. All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability. Any student requiring an accommodation for this course must provide the instructor with official documentation in the form of a letter certified by the staff in the Office for Students with Disabilities, University Hall 102. Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at [www.uta.edu/disability](http://www.uta.edu/disability) or by calling the Office for Students with Disabilities at (817) 272-3364.

**Title IX:** The University of Texas at Arlington is committed to upholding U.S. Federal Law “Title IX” such that no member of the UT Arlington community shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity. For more information, visit [www.uta.edu/titleIX](http://www.uta.edu/titleIX).

**Academic Integrity:** Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

*I pledge, on my honor, to uphold UT Arlington’s tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.*

*I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.*

UT Arlington faculty members may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents’ Rule* 50101, §2.2, suspected violations of university’s standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student’s suspension or expulsion from the University.

**Lab Safety Training:**  **Not Applicable**

**Electronic Communication:** UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

**Student Feedback Survey:** At the end of each term, students enrolled in classes categorized as “lecture,” “seminar,” or “laboratory” shall be directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student’s feedback enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlington’s effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. For more information, visit <http://www.uta.edu/sfs>.

**Final Review Week:** A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

**Emergency Exit Procedures:** Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit. There are two nearby exits – to the West of the classroom (turn left upon exit) about 150 yards down and to the East of the classroom (turn right upon exit) about the same distance. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities. For further information see UT Arlington Procedure 7-6: Emergency/Fire Evacuation Procedures (<https://www.uta.edu/policy/procedure/7-6)>.

**Student Support Services**:UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to [resources@uta.edu](mailto:resources@uta.edu), or view the information at [www.uta.edu/resources](http://www.uta.edu/resources).

**Writing Center.** **:** The Writing Center, 411 Central Library, offers individual 40 minute sessions to review assignments, *Quick Hits* (5-10 minute quick answers to questions), and workshops on grammar and specific writing projects. Visit [https://uta.mywconline.com/](https://owa.uta.edu/owa/luket@exchange.uta.edu/redir.aspx?C=jqplelmmw0KcvkWv1pRv_rHS8ofUUtFIXl_CWZTLffEmCPyZf3x4ncUbBmD9p3gSPROCbhSJj7U.&URL=https%3a%2f%2futa.mywconline.com%2f) to register and make appointments. For hours, information about the writing workshops we offer, scheduling a classroom visit, and descriptions of the services we offer undergraduates, graduate students, and faculty members, please visit our website at [www.uta.edu/owl/](http://www.uta.edu/owl/).

**Librarian to Contact:** Since this course requires student research, the library will be a valuable resource. Here is some relevant contact information.

Library Home Page <http://www.uta.edu/library>

Subject Guides <http://libguides.uta.edu>

Subject Librarians <http://www.uta.edu/library/help/subject-librarians.php>

Database List <http://www.uta.edu/library/databases/index.php>

Course Reserves <http://pulse.uta.edu/vwebv/enterCourseReserve.do>

Library Tutorials <http://www.uta.edu/library/help/tutorials.php>

Connecting from Off- Campus <http://libguides.uta.edu/offcampus>

Ask A Librarian [http://ask.uta.edu](http://ask.uta.edu/)

The following URL houses a page where we have gathered many commonly used resources needed by students in online courses: <http://www.uta.edu/library/services/distance.php>.

The subject librarian for your area can work with you to build a customized course page to support your class if you wish. For examples, visit <http://libguides.uta.edu/os> and <http://libguides.uta.edu/pols2311fm> . If you have any questions, please feel free to contact Suzanne Beckett, at [sbeckett@uta.edu](mailto:sbeckett@uta.edu) or at 817.272.0923.

**Course Schedule:**

* See next page for initial draft of course schedule,
* Schedule may be updated from time to time to best serve the educational needs of the students in the class, although no major changes are expected.

**Emergency Phone Numbers**: In case of an on-campus emergency, call the UT Arlington Police Department at **817-272-3003** (non-campus phone), **2-3003** (campus phone). You may also dial 911.

**For non-emergencies, contact the UTA PD at 817-272-3381.]**

**COURSE SCHEDULE (tentative - subject to minor modification)**

| **Module** | **Day** | **Date of Lecture** | **Topics** | **Assignment Due** |
| --- | --- | --- | --- | --- |
| 0 | 1 | **1/22/16** | Administrative Details and Course Overview |  |
| 1 | Principles of Measurement, Part 1 |
| 2 | Principles of Measurement, Part 2; WBS info for A1 |
| 3 | 2 | **1/29/16** | Measurement Process, Terminology, and Issues | A1 – Personal Work Breakdown Structure (DRAFT) |
| 4 | Entities & Attributes 1 |
| 5 | Entities & Attributes 2; Quality Measures (for A2) |
| 6 | 3 | **2/5/16** | Selecting Goals |  |
| 7 | Selecting What to Measure – Goal/Question/Metric, QFD |
| 8 | Tying Metrics to the Process / Productivity & Quality Metrics |
| 9 | 4 | **2/12/16** | Conducting and Evaluating Experiments, Part 1 |  |
| 10 | Conducting and Evaluating Experiments, Part 2 |
| 11 | Data Collection |
| 12 | 5 | **2/19/16** | Collecting and Storing Data / Databases |  |
| 13 | Data Analysis, Part 1 – Basic Concepts |
| 14 | Data Analysis, Part 2 – Fundamental Techniques |
| 15 | 6 | **2/26/16** | Data Analysis, Part 3 – Advanced Techniques | A2 – Analysis of Quality Data |
| 16 | Data Analysis, Part 4 – Causal techniques / Bayesian Statistics |
| 17 | Bayesian Networks; Internal Measurements: Size, Part 1 |
| 18 | 7 | **3/4/16** | Internal Measurements: Size, Part 2 |  |
| 19 | Internal Measurements: Structure (Fundamentals) |
| 20 | Internal Measurements: Structure (Complexity) |
|  | 8 | **3/11/16** | ***Midterm Examination*** |  |
|  |  | **3/18/16** | ***Spring Break – No Class This Week*** |  |
| 21 | 9 | **3/25/16** | External Attributes: Overview of Software Quality Engineering | A3 – Complexity Analysis (phase 1) |
| 22 | The Context for Quality Improvement |
| 23 | Attributes of a Quality Product |
| 24 | 10 | **4/1/16** | Measuring the Attributes of a Quality Product |  |
| 25 | Analyzing Failures / Introduction to Root Cause Analysis |
| 26 | Root Cause Analysis Methods |
| 27 | 11 | **4/8/16** | Value-Added Analysis |  |
| 28 | Cost of Quality Analysis |
| 29 | Improving Customer Value |
| 30 | 12 | **4/15/16** | Software Reliability Overview | A3 –Complexity Analysis (phase 2) |
| 31 | Models and Methods of Software Reliability - Part 1 |
| 32 | Models and Methods of Software Reliability - Part 2 |
| 33 | 13 | **4/22/16** | Six Sigma and Zero Defects - Overview |  |
| 34 | Six Sigma Principles |
| 35 | Six Sigma Methods and Applications (DMAIC, DMADV, etc.) |
|  |  | **4/29/16** | Review Week – Questions on assignments and exams |  |
| 36 | 14 | **5/6/16** | Quantitative Process Management (QPM) | A4 – DMAIC / Root Cause Analysis  A1 (final) |
| 37 | Statistical Process Control for QPM |
| 38 | Using Defect Data to Predict Reliability and Warranty Cost |
|  | (15) | **5/13/16** | ***Final Examination*** |  |