CMSC 355 - Fundamentals of Software Engineering

Dr. Rodrigo Spínola

Agenda

- About me
- Who are you?
- Why do we study software engineering?
- Fundamentals of Software Engineering
  - Content
  - Class and Office hours
  - Grading
  - Calendar

> Lecture 1 - Course Logistics

TDresearchteam
Technical Debt Research Team

VCU Computer Science
College of Engineering

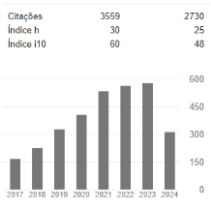
Dr. Rodrigo Spínola

Education

2012: Postdoc (UMBC + Fraunhofer)
2010: Ph.D. (UFRJ)
2004: M.S. (UFRJ)
2001: B.S. (Unifacs)

Research Productivity

- **Some numbers**
  - 27 jounal papers (JSS, IST, EMSE, TOSEM, IEEE Software)
  - 80 conference papers (ICSE, EASE, CHASE, SANER, ACM SAC, EASE, TechDebt, ESEM…)
  - 3559 Google Scholar Citations
  - H index 30



Awards

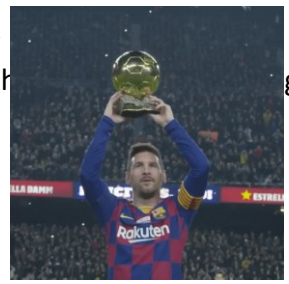
- Top 10 Most Impactful Software Engineering Researchers at the "Consolidators" Level (2013-2020). ***Reported in the Journal of Systems & Software.***
- CNPQ Researcher Level 2. ***Research productivity distinction grant from the Brazilian National Research Council (CNPq), which is given only to the Brazilian most productive researchers.***
- ….


The Journal of Systems & Software

A bibliometric assessment of software engineering themes, scholars and institutions (2013–2020)

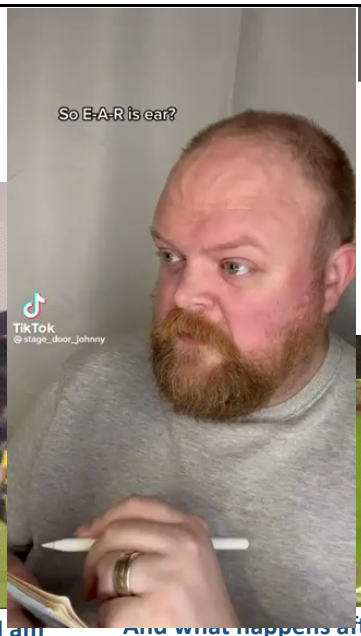
and... as a Brazilian

- A good dancer?
  Definitely not!
- A good soccer player?
  It depends…
- Well, English



Before exams

Actually as I am



And what happens after exams…

Contact information

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David Ferrufino (TA)

- Ph.D. Student in Computer Science
- You can always find him at the Software Engineering Lab (ERB Room 2337)
- Also available by e-mail at ferrufinoda2@vcu.edu

Victoria Gomes (TA)

- Ph.D. Student in Computer Science
- You can always find her at the Software Engineering Lab (ERB Room 2337)
- Also available by e-mail at oliveiragov@vcu.edu

Who are you?

- How much software development have you done?
  - I have completed small class assignments
  - I have completed large class assignments
  - I have coded professionally
  - I have contributed to open source
  - I have taught others to code
- Do you have any experience with other software development activities than code?
  - Testing, requirements, software design, process modeling...

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Technical Debt Research Team

VCU Computer Science
College of Engineering

Enhancing Multidisciplinary STEM Undergraduate Education through Living Labs

- We will recruit **CS undergraduate students**
  - 6 months **paid** internship at the Software Engineering Lab (AIHealt-LL)
  - Interplay between SE + AI + Health + Cutting edge devices
- New knowledge units on Engineering AI Systems for Health.

Total Awarded $750K

Leveraging Scholarships and Vertically Integrated Projects to Increase Transfer Undergraduates Engagement, Capacity, and Continuity in Computer Science

- We will recruit **(low income) transfer CS undergraduate students**
  - Scholarships up to 3 years (up to $11K per year)
  - + 6 months paid internship at the new AIHeatlh-LL
  - Interplay between SE + AI + Health + Cutting edge devices

A comprehensive support system that includes financial aid, academic guidance, personal and professional development opportunities, and a supportive peer community for transfer students from community colleges.

Total Awarded ~$2M

Stay Tuned!

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Software Engineering is about…?

Why do we need software engineering?

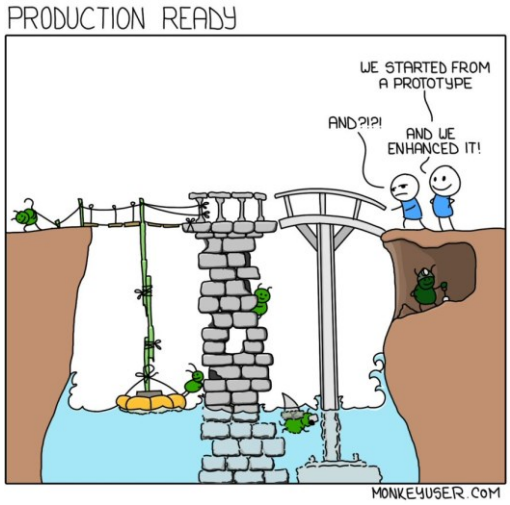
13

Why do we study software engineering?

- A computer is a programmable device
  - So programming it is a fundamental activity
- We ask a lot from our software
  - Complexity
  - Heterogeneous tasks
    - Inside a car vs inside a server
- Managing that complexity requires more than just programming skill
  - Software engineering is a collaborative task

14

Why do we study software engineering?



15

Software Engineering

- A systematic, disciplined, quantifiable approach designed to develop, administer, and maintain software products (IEEE Standard 610.12).

16

Software Development Effort

Size	Example	
10^2 LOC	Class Exercise	Programming Effort
10^3 LOC	Small Project	
10^4 LOC	Term Project	
10^5 LOC	Business Application	Software Engineering Effort
10^6 LOC	Word Processor	
10^7 LOC	Operating System	

17

Software Engineering Goals

- Software quality
- Productivity when developing and maintaining a software product
- Development of software projects under planned costs, deadlines, and quality levels

18

What should you expect to learn in this course?

Methodologies

Techniques

Tools

…to build high-quality software that fits budget and customer expectations.

Fundamentals of Software Engineering

Content

- Software development lifecycle
- Framework of the software process
- Requirement engineering
- Software architecture and design
- Software modeling via UML
- Software verification and validation
- Agile software development
- Design patterns
- Software maintenance
- AI applied to SE

Book

21

- https://softengbook.org/

Chapter 1: Introduction
Historical Context, Topics of Study

Chapter 2: Processes
Agile Manifesto, XP, Scrum, Kanban

Chapter 3: Requirements
User Stories, Use Cases, MVP, A/B Testing

Chapter 4: Models
Class, Package, Sequence, Activity Diagrams

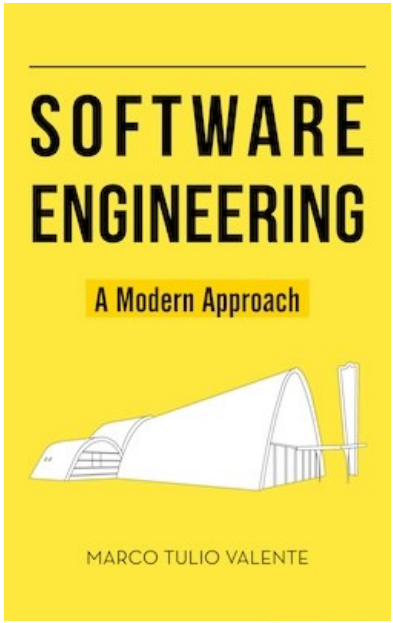
Chapter 5: Design Principles
Conceptual Integrity, Information Hiding, Cohesion, Coupling, SOLID

Chapter 6: Design Patterns
Factory, Singleton, Proxy, Adapter, Facade, Decorator, Strategy, Observer, Template Method, Visitor

Chapter 7: Architecture
MVC, Microservices, Message-Oriented, Pub/Sub

Chapter 8: Testing
Unit Tests, Principles and Smells, Coverage, Testability, Mocks, TDD, Integration Tests, E2E Tests

Chapter 9: Refactoring
Examples, Refactoring Practice, Automated Refactorings, Code Smells



Class and Office hours

22

- **Lecture:** M, W, F 2:00pm – 2:50pm
- **Office Hours:** W 10am – 12pm
- **Contact e-mail:** spinolaro@vcu.edu

Grading

- 30% Exams
- 30% Project
- 20% In class activities
- 20% Research corner

Exams

- Content from lectures
  - Use the slides, as they are posted on the web
  - Take notes
  - Ask questions

Project (group task)

- Home + class work
  - Software project:
    - Process modeling
    - Requirements specification
    - Software Design
    - Test case planning
    - Coding

Research Corner (group task)

- Opportunity to engage with AI applied to Software Engineering
- Research and presentation of topics such as:
  - Software fairness
  - AI applied to software refactoring
  - AI applied to coding
  - AI applied to requirements definition
  - AI applied to testing planning
  - AI applied to software design

Technical SE Skills

Process modeling
Requirements
Software Design
Test case planning
…

Remember: managing software complexity requires more than just programming skill. Software engineering is a collaborative task!

Soft Skills

Communication
Teamwork ability
Collaboration
Empathy
Creativity
Decision making
Problem solving
Adaptability
…

Calendar

August	Week 1	20-Aug	Course Logistics
		22-Aug	Hands on Day - All in one Project Scenario
	Week 2	25-Aug	Software Development Process
		27-Aug	Group assignments and logistics
		29-Aug	Hands on Day - Software process modeling
September	Week 3	1-Sep	University closed
		3-Sep	Intro to Agile Development
		5-Sep	Group Project - Process
	Week 4	8-Sep	Github
		10-Sep	Github
		12-Sep	Group Project - Github
	Week 5	15-Sep	Requirements Engineering - Introduction
		17-Sep	Requirements Engineering - Req Elicitation
		19-Sep	Group Project - Requirements
	Week 6	22-Sep	Hands on Day - Interviews
		24-Sep	Hands on Day - Requirements Specification
		26-Sep	Group Project - Requirements
October	Week 7	29-Sep	Intro to Testing - Part 1
		1-Oct	Intro to Testing - Part 2
		3-Oct	Test case planning
	Week 8	6-Oct	Group Project - Testing Planning
		8-Oct	Midterm Exam #1
		10-Oct	Principles of Good Unit Tests
	Week 9	13-Oct	Software Design; Software Architecture
		15-Oct	Group Project - Testing Planning / New Assignments
		17-Oct	Reading day, no classes held
	Week 10	20-Oct	Software Modeling: UML
		22-Oct	Use Case Diagram - Theory and Practice
		24-Oct	Group Project - Software design
	Week 11	27-Oct	Class Diagram - Theory and Practice
		29-Oct	Class Diagram - Theory and Practice
		31-Oct	Group Project - Software Design - Sprint 1

November	Week 12	3-Nov	SOLID Design Principles
		5-Nov	Good OO Design Practices and the Observer Design Pattern
		7-Nov	Group Project - Coding
	Week 13	10-Nov	Software Maintenance and Technical Debt
		12-Nov	TBD
		14-Nov	Group Project - Sprint 2
	Week 14	17-Nov	AI applied to code review
		19-Nov	AI applied to software refactoring
		21-Nov	AI applied to coding
	Week 15	24-Nov	Fall break
		26-Nov	Fall break
		28-Nov	Fall break
December	Week 16	1-Dec	AI applied to requirements definition
		3-Dec	AI applied to testing planning
		5-Dec	AI applied to software design
	Week 17	8-Dec	Last day of classes - Monroe Park Campus

Hands on day
Group project day
No class
Midterm exam
Research corner

Summary

- We need software engineering to manage the complexity of designing software
  - A set of scientific principles and best practices
  - We will discuss these in the lectures
  - We will experience some of them in our team project
  - We will know some state-of-the-art SE methodologies in research corner

Welcome Onboard!

See you Friday :)

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