SOFTWARE MAINTENANCE AND EVOLUTION

CS563
TUE/THU @2PM,

Danny Dig
Today’s goals

- Discovery: learning about each other (Family Occupation Recreation Motivation)
- Examples of Research in Software Maintenance and Evolution
- How can I be successful in CS563?
Family
Change is the heart of software development

Programming is program transformation

Q1: Analyze what software changes occur in practice?
Q2: How can we automate them?
Q3: Can we represent programs as transformations? Archive, retrieve, and visualize them?
Q4: Can we infer higher-level transformations?

Automated changes in (i) upgrading library APIs, (ii) convert sequential to parallel code, (iii) improve responsiveness in mobile
On Aug 5, 2015 …

A life of significance: intentionally add value to others
Quiz #1: About YOU

- Write down your name
- FORM (family, occupation, recreation, motivation)
- Grad Program (e.g., EECS PhD, EECS MS, MEng), year of study, who is your grad advisor
- Your background (e.g., undergrad SE classes that you took, industry SE experience, other CS background – such as strong ML, PL, etc.)
- What is the ONE Thing that you expect to take out of CS563?
- What are your plans post graduation?
What are your expectations from CS563?

A. ...Get ideas for PhD/MS dissertation
B. ...Learn about the Practical aspects of SE
C. ...Learn about the Theoretical aspects of SE
D. ...Learn about the state of the art in SE
E. Get equipped for being a researcher
F. Improve programming skills
Topics in Software Maintenance and Evolution

- Reverse engineering and re-engineering
- Software refactoring and restructuring
- Software migration and renovation
- Software and system comprehension
- Software repository analysis and mining
- Code cloning and provenance
- Concept and feature location
- Change and defect management
- Evolution of non-code artefacts
- Software testing
- Maintenance and evolution processes
- Software quality assessment
- Run-time evolution and dynamic configuration
- Human aspects of software evolution
Theme: Mobile &

IoT revolution: digitization & connection of everything

In 15 years, smart Infrastructure estimated to become $59T market

Q: What do you envision as some Killer Feature for IoT?
Q: What are the Killer Features for IoT?

K1:
K2:
K3:
K4:
K5:
K6:
K7:
Q: What are the Killer Features for IoT?

Smart home:
- managing the home (monitoring energy and resources), scheduling family activities, housekeeping (auto-replenish consumables, cleaning, pet feeding), health monitoring (assistive care)

Smart City:
- transportation (find parking), environmental monitoring of pollution, manage resources (control street lighting), enhances perception of city activities

Smart Manufacturing:
- virtual chief foreman assisting managers
From IoT 1.0 to 2.0

V 1.0: sensors and actuators to collect data

V 2.0: augmenting our intelligence with knowledge to expedite decision-making, everyday activities, and processes

Pushing intelligence to the edge of network, where latency, mobility, privacy, context awareness

Intelligent computing becomes anticipatory, proactive, adaptive
Pervasive Personalized Intelligence

- Remember names
- Activity-based reminders
- Scheduling for busy people
- Information sharing
- Interfacing with Smart City & Home
Enabling Research Thrusts

- Security & Privacy: Software Security
- Cloud: Systems
- Intelligence: ML, AI, NLP
- Energy Efficiency: PL, SE
- Evolution & Testing: SE
- Usability: HCI, PL, SE
Reflections and Lessons
L1: Work in Your Strength Zone, but Reinvent Yourself

- Mobile
  - add async
  - fix async
  - privacy

- Parallelism & Concurrency
  - make thread-safe
  - improve throughput
  - improve scalability

- Library migration
  - upgrade APIs

Principles for changing between different programming models
Automating
- ship with official
- hundreds of accepted patches
- first open-source refactoring

Inferring
- used at
- dozen labs

Understanding
- shaped APIs in Java and .NET official concurrency libraries

Refactoring

Testing

L2: Find Your Dream and then Live It
## L3: Be Proactive, but Be Flexible

<table>
<thead>
<tr>
<th>Expected Company</th>
<th>Actual Company</th>
<th>Expected Target</th>
<th>Actual Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM</td>
<td>ORACLE®</td>
<td>Lambda Expressions</td>
<td>Lambda Expressions</td>
</tr>
<tr>
<td>Google</td>
<td>Google</td>
<td>Async Programming</td>
<td>Security &amp; Privacy</td>
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</tbody>
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Course Administration

Check webpage:
http://web.engr.oregonstate.edu/~digd/courses/cs563_S18/

Work items due today:
- Familiarize with class webpage
- sign up on Piazza (all communications through Piazza, no email)
- Read one paper about how to read Soft Eng papers

Prereqs are enforced: 361 & 362 --> 561 --> 562 \(\rightarrow\) 563
- took at least two classes of undergrad coursework in Software Engineering (e.g., equivalent CS361 & 362 @ OSU)
CS563 is Different!!!

Research-based course:
- at times it would feel it is not "organized"
- there are lots of choices, you need to select
- structure is fixed, but content is dynamic

Complete a research or industrial-novel project of your choice (teams of 2-3 students)
- follow the steps of open-ended/risky research (proposal, fit in SE literature, evaluate empirically)
- at the end of the term you would have produced a research paper that you can submit to conference
- WHY: equips you to conduct novel research
CS563 is Different!!!

Participate in class discussion and activities.

Read 1-2 research papers for every class meeting (11 pages each, double column => total of 500 research pages)

- later on, you choose papers that match your project
- 1 book chapter /week (Put Your Dream to the Test)

Paper Critiques: for each class meeting, for each research paper, submit before class (by 5pm previous day)

- WHY: equips you with critical thinking

Research presentation: you prepare and deliver for the selected research papers

- WHY: equips you to communicate your ideas
Projects Focus on SE + Mobile & IoT

Technological shifts/opportunities for IoT:
- constraints on memory/CPU/bandwidth/battery usage
- connectivity with the cloud
- rapid evolution of the platform

Encouraging good (old) software engineering practices

Industrial-innovation: availability of rich data from sensors (e.g., dataset from City of Portland)

Research projects (not implementing an app)
- teams of 2-3 people
Example Transformations for Mobile & IoT

What are the new transformations we need to automate?
- inspiration from explorative studies
- empirical studies to find performance or energy anti-patterns

Examples of transformations:
- candidate programs with trade-offs between performance & power consumption
  - adaptation to different display technologies
- split functionality between the device and cloud
1-hour Group Discussion

Soft Skills: leadership, creating a vision and plan for accomplishing

WHY: Soft Skills make a greater Difference in life than “Hard Skills”

WHAT: Take your dream through 10-step process to see, own, reach it

HOW: learning environment in a roundtable format
Testimonials

“This course was exceptionally difficult and carried a massive time requirement. I only took two courses this quarter and even then I'm not sure I was able to give either of the classes the amount they deserved because of the time requirement for this class.” [student from Fall 2015]

“… But that doesn't mean that I'm not satisfied, have students who previously took the course convey this”

Announcements for next class:
- Read the posted 2 papers and write critiques

Office hours: right after the class