CSE650
Advanced Concepts in Programming Languages

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Software Applications:
Services vs. Requirements
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- Security
- Privacy
- Efficiency
- Usability
- Accuracy
- Resources
Challenge:
The Problem

Building reliable software is hard!
Techniques to improve software reliability

- recommendations about managing software projects and programming teams (e.g. agile programming, extreme programming, etc.)

- design philosophies for libraries (e.g. model-view-control, publish-subscribe, etc.)

- programming languages (e.g., object-oriented programming, aspect-oriented programming, functional programming, ...)

- mathematical techniques for specifying and reasoning about properties of software
Techniques to improve software reliability

• recommendations about managing software projects and programming teams (e.g. agile programming, extreme programming, etc.)

• design philosophies for libraries (e.g. model-view-control, publish-subscribe, etc.)

• programming languages (e.g., object-oriented programming, aspect-oriented programming, functional programming, ...)

• mathematical techniques for specifying and reasoning about properties of software
Content

(1) basic tools from logic for making and justifying precise claims about programs;

(2) the use of proof assistants to construct rigorous logical arguments;

(3) the idea of functional programming, both as a method of programming that simplifies reasoning about programs and as a bridge between programming and logic;

(4) formal techniques for reasoning about the properties of specific programs (e.g., the fact that a sorting function or a compiler obeys some formal specification); and
Syllabus for the course

Location: Davis Hall 338A
Time: Friday 4:00 - 6:40
Credits: 3
Office Hours: Friday 11:00 - 12:00 338B or by appointment
Discussion forums: Piazza

Course load:
- active participation in class,
- work on assignments,
- participation on Piazza,
- prepare the midterm and final
Grading

50% - Assignments
20% - engagement and participation in class and on NB and Piazza
15% - midterm
15% - final
- Projects are optional,
- they can fulfill the 6xx requirement,
- if you opt for the project you can skip midterm and final,
- project ideas must be discussed with the instructor.
<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Software Foundations</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/29</td>
<td>Introduction to the course</td>
<td></td>
<td></td>
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<tr>
<td>9/09</td>
<td>Functional programming in Coq</td>
<td>Basics.v</td>
<td></td>
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<tr>
<td>9/16</td>
<td>Proof by Induction</td>
<td>Induction.v</td>
<td></td>
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<tr>
<td>9/23</td>
<td>Working with Structured Data</td>
<td>Lists.v</td>
<td></td>
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<tr>
<td>9/30</td>
<td>Midterm</td>
<td></td>
<td></td>
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<tr>
<td>10/07</td>
<td>Polymorphism and Higher-order Functions</td>
<td>Poly.v</td>
<td></td>
</tr>
<tr>
<td>10/14</td>
<td>More basic tactics</td>
<td>Tactics.v</td>
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<tr>
<td>10/21</td>
<td>Inductively Defined Propositions</td>
<td>IndProp.v</td>
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<tr>
<td>10/28</td>
<td>Total and Partial Maps</td>
<td>Maps</td>
<td></td>
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<tr>
<td>11/04</td>
<td>Simple Imperative Programs</td>
<td>Imp.v</td>
<td></td>
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<tr>
<td>11/11</td>
<td>Program Equivalence</td>
<td>Equiv.v</td>
<td></td>
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<tr>
<td>11/18</td>
<td>Hoare Logic (Part I)</td>
<td>Hoare1.v</td>
<td></td>
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<tr>
<td>11/25</td>
<td>Fall Break - no class</td>
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<tr>
<td>12/02</td>
<td>Hoare Logic (Part II)</td>
<td>Hoare2.v</td>
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<td>12/09</td>
<td>Probabilistic Hoare Logic</td>
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<tr>
<td>12/16</td>
<td>Final</td>
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The proof assistant Coq

http://coq.inria.fr
Assignments

• After each class I will point to the exercises that are part of the assignment for the week after,

• Each assignment will consist of 3-4 exercise (you are expected to work 2-3 hours every week)

• Assignments have to be handled in by the next class (strict deadline).

• The first 30-45 minutes of class we will discuss the assignments.

• Assignments will be graded during the week after from 0 to 4.
Solutions to assignments

Please, do not distribute!