CS 510
Semantics of Programming Languages
West Virginia University
Syllabus
Spring Semester 2020
version 1.1
17 January 2020

Course location: 251 ESB
Course times: Tuesdays and Thursdays, 2:00-3:15
Course Format and Credit Hours: 3 hours lecture
3 credit hours
Prerequisites: CS 110 Introduction to Computer Science
CS 220 Discrete Mathematics
CS 310 Principles of Programming Languages
CS 410 Compiler Construction
Instructor: Frances L. Van Scoy
304.293.0960 at 343 AER
submit assignments to frvanscoy@mix.wvu.edu
send all other email to frvanscoy@mail.wvu.edu
Office Hours: Tuesdays and Thursdays 9:30-10:45; 12:30-1:45
9:30 atrium, annex Engineering Science Building
3:30 ground floor hallway. Engineering Science Building
Course Objectives: Major topics to cover
Operational semantics
Denotational semantics
Axiomatic semantics
Functional programming
Expected Learning Outcomes: Construct definitions of semantics of programming languages using the
operational, denotation, and axiomatic semantics;
understand definitions of semantics of programming languages using the
operational, denotation, and axiomatic semantics;
apply definitions of semantics of programming languages using the
operational, denotation, and axiomatic semantics to determine properties of
programs such as running time and correctness;
construct Hoare proofs of partial correctness of programs using the
axiomatic semantics
Required Texts: Semantics with Applications: A Formal Introduction
Hanne Riis Nielson and Flemming Nielson.
Formal Syntax and Semantics of Programming Languages: A
Laboratory Based Approach
Kenneth Slonneger and Barry L. Kurtz

All 3 texts are available for free and legal downloading.
Other reading assignments:

Hanne Riis Nielson, Flemming Nielson
Semantics with Applications: Model-Based Program analysis
DAIMI FN-61 Aarhus University, Denmark, 1966
(available at same site as text)

Kenneth Iverson's "Notation as a Tool of Thought."
Available via the WVU Libraries web site in the ACM Digital Library collection.
https://lib.wvu.edu/
select Databases
enter ACM Digital Library
click on magnifying glass or press enter/return
click on ACM Digital Library
Go to http://www.libraries.wvu.edu
Under "Articles" click on "Databases"
Under "Databases by Subject" click on "Computer Science"
Click on "ACM Digital Library"
In search box type "Kenneth Iverson Notation as a Tool of Thought" [without quotes] and click on "Search"

Conception, Evolution, and Application of Functional Programming Languages
Paul Hudak
ACM Computing Surveys
vol. 21, no. 3, September 1989

others to be assigned (primarily from ACM and IEEE publications available online through WVU Libraries)

Office hours:

I'm holding official office hours Tuesdays and Thursdays (9:30-10:45; 12:30-1:45) and Thursdays (12:30-1:45; 3:30-4:45) in the Engineering Science Building.

I'm agreeable to appointments at other times as well by appointment. Also, I'm on campus most days but working in various university buildings. If you suddenly want to talk to me on a Monday/Wednesday/Friday, send me email or phone my office 304-293-0960. (Your voice mail will be turned into an attachment and sent to e via email. If I don't reply within an hour I'm probably not available. If I'm available I'll reply with my location so you can find me and we can talk.
### Schedule (readings are from indicated chapters of Nielson)

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Date</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 14</td>
<td>Introduction</td>
<td>Jan 16</td>
<td>Prolog programming language (Sloneger, A):</td>
</tr>
<tr>
<td>Jan 21</td>
<td>operational semantics 1 (2)</td>
<td>Jan 23</td>
<td>operational semantics 2 (2)</td>
</tr>
<tr>
<td>Jan 28</td>
<td>operational semantics 3 (2)</td>
<td>Jan 30</td>
<td>operational semantics 4 (3)</td>
</tr>
<tr>
<td>Feb 4</td>
<td>operational semantics 5 (3)</td>
<td>Feb 6</td>
<td>lambda calculus 1 (Hudak)</td>
</tr>
<tr>
<td>Feb 11</td>
<td>lambda calculus 2 (Hudak)</td>
<td>Feb 13</td>
<td>denotational semantics 1 21(4)</td>
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<tr>
<td>Feb 18</td>
<td>denotational semantics 2 (4)</td>
<td>Feb 20</td>
<td>Test 1 (operational semantics)</td>
</tr>
<tr>
<td>Feb 25</td>
<td>denotational semantics 3 (4)</td>
<td>Feb 27</td>
<td>Program 1 due</td>
</tr>
<tr>
<td>Mar 3</td>
<td>denotational semantics 4 (4)</td>
<td>Mar 5</td>
<td>(16) denotational semantics 5 (5)</td>
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<tr>
<td>Mar 10</td>
<td>axiomatic semantics 1 (11)</td>
<td>Mar 12</td>
<td>Test 2 (denotational semantics)</td>
</tr>
<tr>
<td>Mar 24</td>
<td>axiomatic semantics 2 (6)</td>
<td>Mar 26</td>
<td>axiomatic semantics 3 (6)</td>
</tr>
<tr>
<td>Mar 31</td>
<td>axiomatic semantics 4 (6)</td>
<td>Apr 2</td>
<td>axiomatic semantics 5 (6)</td>
</tr>
<tr>
<td>Apr 7</td>
<td>semantics using Scheme 1</td>
<td>Apr 9</td>
<td>Test 3 (axiomatic semantics)</td>
</tr>
<tr>
<td>Apr 14</td>
<td>semantics using ML 1</td>
<td>Apr 16</td>
<td>semantics using ML 2</td>
</tr>
<tr>
<td>Apr 21</td>
<td>semantics using Miranda 1</td>
<td>Apr 23</td>
<td>semantics using Miranda 2</td>
</tr>
<tr>
<td>Apr 28</td>
<td>semantics using Haskell 1</td>
<td>Apr 30</td>
<td>semantics using Haskell 2</td>
</tr>
</tbody>
</table>

### Grading
Eight grade components, each worth 12.5% of course grade
- Tests 1, 2, and 3
- Final exam
- Programs 1 and 2
- Programs 3 and 4
### about programs 1 and 2

<table>
<thead>
<tr>
<th>Book</th>
<th>Instructions</th>
<th>Reference</th>
<th>Detail</th>
<th>Due date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nielson and Nielson</td>
<td>Implement the structural operational semantics for the While language by modifying the authors' Miranda code.</td>
<td>Appendices B and C</td>
<td>B4 B5 B6 C4 C8</td>
<td>02/24/20</td>
</tr>
<tr>
<td>Nielson and Nielson</td>
<td>implement the structural operational semantics for the While language by modifying the authors' Miranda code.</td>
<td>Appendix D</td>
<td>D2 D4</td>
<td>March 25, 2020</td>
</tr>
</tbody>
</table>

### about programs 3 and 4

- a set of axiomatic proofs of partial correctness of Wren programs - due April 12
- definition of semantics of very small subset of Inform 7 - due April 22
Policies

Attendance is a not a factor in computing the grade, EXCEPT:
(1) you are responsible for all material presented, handouts distributed, announcements made, etc., in class;
(2) if you miss a test or exam without prior approval, your grade on that test or exam will be 0.

If you copy someone else's answers on a test, knowingly allow someone to copy from your test, turn in someone else's work as your own, or cheat in any other way, you can receive a failing grade in this course. There may also be further disciplinary measures. The penalty will always be more severe than a failing grade in the test or assignment involved.

The three tests and final exam will be open books, notes, references, computers and might be take-home. Lectures, the text book, course handouts, other reading assignments, and experience gained from doing assignments are all fair game for the tests and exam. There may be additional reading assignments (for example, from ACM and IEEE Computer Society publications available online through WVU Libraries) for which you will be responsible on the tests and exam.

I expect to send frequent messages to the class via email using the MIX system. You should either check your MIX email account daily or forward your MIX email to an account where you check mail daily.

I recommend that you read the assigned chapters in the text book at least three times:
(1) a quick reading, looking for points you don’t understand before the indicated lecture
(2) a careful reading, being careful to understand everything, soon after the indicated lecture
(3) a review reading before the first test on the chapter
University policies

WVU policies on academic integrity, social justice, and disabilities apply. Please consult these web pages for the current policies.

http://docs.facultysenate.wvu.edu/08Files/AcademicIntegrityStatement.pdf

West Virginia University
Recommended Academic Integrity
Syllabus Statement

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, I will enforce rigorous standards of academic integrity in all aspects and assignments of this course. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the Student Conduct Code at http://www.arc.wvu.edu/rightsc.html. Should you have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see me before the assignment is due to discuss the matter.
[adopted: 2-11-08]

http://diversity.wvu.edu/ddei/resources/syllabi

West Virginia University
Recommended Diversity, Equity, and Inclusion
Syllabus Statement

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Accessibility Services (304-293-6700). For more information on West Virginia University’s Diversity, Equity, and Inclusion initiatives, please see http://diversity.wvu.edu/.