Programs, Functions, Strange Loops, and Consciousness
CIS 4930/CIS 6930 Co-Listing
Class Periods: M,W,F | Period 6 (12:50 – 1:40 PM)
Location: CSE E121
Academic Term: Fall 2023
Class Dates: 8/23/23 - 12/06/23

Instructor:
Steve Thebaut
smt@cise.ufl.edu (the best way to reach me!)
Office Hours via Zoom (link available via Canvas): Wed/Fri 4:30-5:30 PM or by appointment (request via e-mail)
Website (currently under construction): https://www.cise.ufl.edu/class/cen6070/special_topics_fa23.html

The course website will be used to post announcements, the course syllabus, self-study lecture notes, etc. ***To access the website, students will need to either be on campus or establish a Gatorlink VPN connection.***

In addition, a Canvas course shell will be available to registered students via E-Learning (https://elearning.ufl.edu/) to support posting of course assignments/uploading submissions, to view scores/grades, etc.

Teaching Assistant/Peer Mentor/Supervised Teaching Student: *TBD – see course website*

Course (Catalog) Description:
Variable content provides an opportunity for in-depth study of topics not offered elsewhere and of topics of current significance; 3 Credits, Max 9 Credits; Grading Scheme: Letter Grade; Prerequisites: CIS 4930 – COP 3503 ("Programming Fundamentals 2") or instructor permission; CIS 6930 – vary depending on topics

Expanded Course Pre-Requisites / Co-Requisites:
You should already be familiar with individual and (ideally) team-based software development/programming using a high-level language (C, C++, Java, SPARK, APL, Lisp, Python, etc.), and have a basic knowledge of algorithms, data structures, and discrete math, including symbolic logic.

Course Objectives
CIS 4930/6930, **Programs, Functions, Strange Loops, and Consciousness** is ***not a programming course*** or a practicum in software development. Rather, it explores some interesting connections among computer programs, mathematical functions, "strange loops", and human consciousness. It does so primarily via a survey of approachable ideas from the minds of the late mathematician and computer scientist Harlan Mills and cognitive scientist Douglas Hofstadter. Adopting a mostly computer and cognitive science (as opposed to an engineering) point of view, the course will present a relatively painless introduction of Mill's functional program correctness theory (including some unexpected implications concerning loop invariants) and most of Hofstadter's popular 2007 book, I Am a Strange Loop, which gently promotes the idea that key to understanding *consciousness* is the "strange loop" that inhabits our brains.

The specific computer science relevance of Hofstadter's idea is reflected in his stated goal: "…to relate the concept of a human self and consciousness to Gödel's stunning discovery of a majestic wraparound self-referenced structure (a 'strange loop')." In addition, he provides an interesting (if informal) introduction to "philosophy of mind" problems from a computer science perspective.

The other major topic of the course is no less ambitious but much more concrete. It concerns the "nuts and bolts" of Harlan Mill's "function-theoretic (program) verification" techniques. (What is functional verification? A mathematical methodology originally developed by Mills for formally/logically verifying program correctness with respect to an intended function specification. It represents an alternative to the well-known axiomatic verification method developed by Hoare and Floyd.)

Functional verification's connection with Hofstadter's "strange loops" is indirect at best, but this topic should be interesting to anyone who has ever been engrossed with the semantics of iterative programming structures (e.g., while loops) and recursion. Among other things, we will, subject to time constraints, work through the elucidating paper by Dunlap and Basili: "A Comparative Analysis of Functional Correctness," ACM Computing Surveys, Vol. 14, No. 2, June 1982.

Learning Modalities:
Students will explore course topics via assigned readings, the review of instructor provided self-study lecture notes, and various other learning activities that may or may not involve course content covered in the readings or lecture notes. In addition to physical face-to-face class meetings, recorded or online-only classes may be utilized in extreme circumstances when deemed necessary and appropriate by the University.

Covid-19, RSV, and Influenza:
Dr. Rochelle Walensky, former director of the Centers for Disease Control and Prevention (CDC), who left that post in June 2023, recently commented on how much of a better situation we seem to be in now w.r.t. Covid-19 than six months or a year ago: "We're down to perhaps 100 or 200 deaths a day." (The US experienced what was effectively a nine-month surge beginning in the summer of 2021 that ultimately cost more than 350,000 Americans their lives and had no parallel in peer countries.)

Fyi, the CDC currently (July 2023) advises that a Layered prevention strategy — like staying up to date on vaccines and wearing masks — can help prevent severe illness and reduce the potential for strain on the healthcare system. "**Wear a mask with the best fit, protection, and comfort for you.**"

PLEASE, If you become ill, do not come to class. If you have Covid, RSV, or Influenza symptoms, please seek treatment ASAP and get tested. If you test positive, please follow the CDC guidelines for isolation and let me know that you will be doing so.

Note that a mask is ***required*** when attending face-to-face office hours with the course instructor or when meeting face-to-face with CIS 4930/6930 teaching assistants/graders outside class.

Materials and Supply Fees: *N/A*

Relation to Degree Program Outcomes: *N/A*

Required Textbook:
I AM A STRANGE LOOP
Douglas Hofstadter
2007, *Basic Books*
ISBN 9780465030798

Course Schedule/Topics (tentative): Subject to time constraints, the following topics will be covered in the order given. Chapter numbers refer to the required textbook; "LNO" = Lecture Notes Only.

Part One: I AM A STRANGE LOOP

(Preface) An Author and His Book
(Prologue) An Affable Locking of Horns
(1) On Souls and Their Sizes
(2) This Teetering Bulb of Dread and Dream
(3) The Causal Potency of Patterns
(4) Loops, Goals, and Loopholes
(5) On Video Feedback
(6) Of Selves and Symbols
(7) The Epi Phenomenon
(8) Embarking on a Strange-Loop Safari
(9) Pattern and Provability
(10) Gödel's Quintessential Strange Loop
(11) How Analogy Makes Meaning
(12) On Downward Causality
(13) The Elusive Apple of My "I"
(14) Strangeness in the "I" of the Beholder
(15) Entwinement
(16) Grappling with the Deepest Mystery

(17) How We Live in Each Other
(18) The Blurry Glow of Human Identity
(19) Consciousness = Thinking
(20) A Courteous Crossing of Words
(21) A Brief Brush with Cartesian Egos
(22) A Tango with Zombies and Dualism
(23) Killing a Couple of Sacred Cows
(24) On Magnanimity and Friendship
(Epilogue) The Quandary

Part Two: A Painless Introduction to Functional Verification (LNO)

Formal Specification of Programs via Functions
Complete and Sufficient Correctness
Axiom of Replacement
Correctness Conditions
Iteration Recursion Lemma
Correctness conditions for while_do statement
Invariant Status Theorem (IST): *q(X)*

Part Three (bonus material, time permitting): New Perspectives on AI – Is it "deja vu all over again"?

Attendance Policy, Class Expectations, and Make-Up Policy
Face-to-face class attendance is required and may be verified as appropriate in connection with some scheduled class activities (e.g., exams, lectures for which textbook or other readings may not be available, in-class exercises, etc.) as posted on the course website.

Students are expected to complete all assignments in a timely manner. Failure to do so will be noted and may result in a grading penalty except in extenuating circumstances such as a period of excused absence. Excused absences must be consistent with university policies in the Undergraduate/Graduate Catalogs and require appropriate documentation. Additional information can be found here:

CIS 4930: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

CIS 6930: https://gradcatalog.ufl.edu/graduate/regulations/

IMPORTANT: please do NOT schedule elective activities (family gatherings, interview trips, weddings, divorces, vacations, visa application trips, etc.) that could interfere with completing course assignments on-time.

Fishbowl Group Discussion Format: Various forms of "fishbowl discussions/conversations" may be employed in this class. In a fishbowl activity, a small group of students is chosen to discuss and/or demonstrate their knowledge and understanding of a topic (based, for example, on completed readings or other assignments), provide logical arguments for a position concerning a topic, etc. Students "outside the fishbowl" observe, evaluate the arguments being presented, and reflect on new insights provided by the discussion. The presenter/observer roles change on a regular basis.

> *The fishbowl is a method to organize presentations and group discussions that offers the benefits of small group discussions – most notably, a spontaneous, conversational approach to discussing issues – within large group settings. This is done by arranging the room so that the speakers are seated in the center of the room with other participants sitting around them in a circle watching their conversation 'in the fishbowl.'*
>
> - *https://www.unicef.org/knowledge-exchange/files/Fishbowl_production.pdf*

Grading Policy/Evaluation of Grades:
Course grades will be based **solely** on (1) a number of individual and/or group assignments (readings, exercises, problem sets, etc.): 1/3 of course grade; and (2) two 50-minute in-class exams: (2/3 of course grade).

Exam schedule: in-class 50-minute "Exam 1" (Nov. 13, tntv) and 50-minute "Exam 2" (Dec. 6, tntv). Note: there is no "comprehensive final exam" for this course, and currently no plans to use the scheduled final exam period after classes end, but ALL students will be expected to make themselves available at this time should

this become necessary for some unanticipated reason (e.g., due to a significant weather-related campus closure).

There will be no online (e.g., "Honorlock") exams.

Grading Errors: General exam re-grade requests (AKA "fishing expeditions") are NOT accepted. Suspected grading errors (with appropriate supporting evidence) should be brought to the instructor's attention ASAP, but no later than one week after graded exams are made available for review. Your original, UNALTERED, exam must be returned together with a correction request form (to be made available) to the instructor. Note that partial credit policies are not subject to debate.

Course letter grades will be determined at the end of the semester. In the past, typical (BUT NOT PRE-DETERMINED) grade distributions for similar undergraduate courses have been A (4.00 grade points): 5-10% of students completing the course, A- (3.67 grade points): 10-15%, B+ (3.33 grade points): 15-20%, B (3.00 grade points): 15-20%, B-: 15-20%, C+ (2.50 grade points): 10-15%, C (2.00 grade points): 5-10%, lower than a C (0.00-1.50 grade points): 0-10%.

For similar graduate courses, typical grade distributions have been A (4.00 grade points): 10-20% of students completing the course, A- (3.67 grade points): 25-35%, B+ (3.33 grade points): 25-35%, B (3.00 grade points): 10-20%, lower than a B (0.00-2.67 grade points): 0-5%.

Grade requirements for graduation: Note that graduate students must have an overall GPA of 3.0 (B average) or better. (A B- average is equivalent to a GPA of 2.67, and therefore does NOT satisfy this requirement.) Under-graduate students must have an overall GPA and an upper-division GPA of 2.0 (C average) or better. (A C- average is equivalent to a GPA of 1.67, and therefore does NOT satisfy this requirement.)

More information on UF grading policy for graduate courses may be found at:

http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades

and at:

https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

for undergraduate courses.

Course Feedback:
Please provide the instructor with your feedback/recommendations about this course at any time during or after the semester in which you are enrolled. This may be done verbally (e.g., during online office hours), in writing, or via the end-of-semester course evaluation. Suggestions about how to improve the course *at any time* will be especially appreciated.

Instructor Biography:
Steve Thebaut received the BA in Mathematics from Duke University in 1977, and the MS and PhD in Computer Science from Purdue University in 1979 and 1983, respectively. His research interests have included software requirements engineering, software testing and formal verification, and software engineering technology transfer. He has received funding from the National Science Foundation, IBM, the Florida Department of Education, the Florida High Technology and Industry Council, the Sino-Software Research Center at Hong Kong University of Science and Technology (HKUST), the Software Engineering Research Center (SERC), an NSF Industry/University Cooperative Research Center, and the Software Engineering Institute (SEI) at Carnegie Mellon University, where he was an invited lecturer in the SEI production of "Software Project Management," a nationally distributed video-based continuing education course. From 1991-1993 he was a Visiting Scholar in the Department of Computer Science at the Hong Kong University of Science and Technology (HKUST), and was an Educational Consultant and Visiting Lecturer in Software Engineering at Infosys Technologies, Ltd., Mysore, India in 2009. He has been a course developer and consultant for IBM IS&PG Technical Education, and has served on the program committee of the IEEE International Conference on Software Engineering Education and Training. He was Associate Editor of the

International Journal of Computer and Software Engineering from 1990-1996, UF Site Director of the Software Engineering Research Center (SERC) from 1994-2004, and Associate Chair of the Computer and Information Science and Engineering Department at UF from 2000-2015.

Additional Important Information/Resources for Students:

Students Requiring Accommodations:
Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

End-of-Semester Course Evaluation via GatorEvals:
Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

In-Class Recording
Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy:
UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment:
The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you believe that your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use:
All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy:
There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html

Campus Resources:
Health and Wellness

U Matter, We Care:
Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: https://counseling.ufl.edu, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical suppor*t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; https://career.ufl.edu.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall*,* 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.

Student Complaints Campus*:* https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/ https://care.dso.ufl.edu.

On-Line Students Complaints*:* https://distance.ufl.edu/getting-help/ *https://distance.ufl.edu/state-authorization-status/#student-complaint*.