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CSCI 191.01: ST - Interdisciplinary Computing - Practical Computational Problem Solving

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CSCI 191ST (CSI 108): Interdisciplinary Computing: Practical Computational Problem Solving

Instructor: Rob Smith

Office: Social Science 413

Office Hours: MWF 10-11am

robert.smith@mso.umt.edu

Class times:

SS 362

MWF 11-11:50

Overview:

This is not a programming course.

Instead, our principle task in the course is to impart computational problem solving skills, the more substantial but infrequently described component of a computer science education. Students will experience the application of computational problem solving across a broad range of interdisciplinary endeavors to achieve improved critical thinking and problem solving skills. Students will also gain an understanding of the impact of the acquisition of computational skills on their vocational and general capabilities. This course is designed experientially: rather than be told how these skills are beneficial, students will learn a sampling of general CS-oriented skills and then employ them in a variety of interdisciplinary tasks, and analyze the difference these skills make.

Students will investigate the application of computational problem solving to a diverse set of fields and situations, including social issues, visual art, biology, medicine, chemistry, data science, mobile apps, data mining, robotics, drones, and bioinformatics.

Students will develop the following skills:

- Problem specification and meta-analysis.
- Writing formal instructions to describe the solution of a problem.
- Framing problems to fit pre-existing general solutions.
- Enumerating decision possibilities and outcomes.
- Process analysis for automation possibilities.
- Breaking large, informal problems into small, specific problems.
- Digital representation of non-digital data.

Objectives (* indicates intermediate writing course objectives):

- Develop abstract problem solving skills.
- Enhance critical thinking ability.

- Acquire an understanding of how computer science skills enable contributions in many diverse fields.
- Explore computer science and interdisciplinary career options.
- Obtain an awareness of computer science subdomains.
- Become familiar with computer science course offerings, certificates, and degree programs.
- Recognize the need for information.
- Recognize accurate and authoritative information.
- Recognize the differing roles of books, journal articles, government documents, etc. in the information-seeking process.
- Identify information on a given topic, using a variety of resources, both internal and external.
- Arrange and document research appropriately.
- Use writing to learn and synthesize new concepts.*
- Formulate and express written opinions and ideas that are developed, logical, and organized.*
- Compose written documents that are appropriate for a given audience, purpose and context.*
- Revise written work based on constructive comments from the instructor.*
- Find, evaluate, and use information effectively and ethically.*
- Begin to use discipline-specific writing conventions.*
- Demonstrate appropriate English language usage.*

Grades:

Intro essay (5%)*

Quizzes (25%)

Homework assignments (40%)*

Reading assignments (20%)* (20 chapters, 10 graded, 10 peer-reviewed)

Final essay (10%)*

(* indicates writing assignments)

Schedule:

With a few exceptions, each week of instruction consists of a homework writing assignment, two reading assignments, and a quiz.

Jan 23 – May 5

14 weeks, 41 classes

Week	Topic	Homework	In class
1	Introduction / Careers	Buy book HW 1 (Intro Essay)	
2	Interdisciplinary Applications	Start reading.	Interdisciplinary problem, R1, R2, Q1
3	Cynefin Framework	Continue reading.	HW 2, R3, R4, Q2
4	Analysis	HW 2 revision	R5, R6, Q3.

5	Analysis cont'd	HW 3	Analysis case studies – Create. R7, R8, Q4.
6	Analysis cont'd	HW 4	Analysis case studies – Present. R9, R10, Q5.
7	Design	HW 5	R-catch up. Q6.
8	Implementation	HW 6	R11, R12, Q7.
9	Design patterns and data structures	HW 7	R13, R14, Q8.
10	Subdivision and formal descriptions	HW 8	R15, R16, Q9.
11	Pseudocode	HW 9	R – catch up. Q10.
12	Algorithms and Testing	HW 10	R17, R18, Q11.
13	Examples of Interdisciplinary Computing	HW 11	R19, R20, Q12.
14	Curriculum Choices	HW 12 (Final Essay)	R – catch up. Q13.

Home Writing Assignments:

Format:

Assignments must be typed and printed, single spaced, with 1" margins. One half point will be taken off for each spelling or grammar mistake. Each assignment should have the following format:

YOUR NAME

HW #<1, 2, etc>

BEGIN FIRST PARAGRAPH...

Assignments:

1. INTRO ESSAY: "What is your plan"
 - a. Write a 4 page essay that answers the following questions:
 - i. What is important to you / what is your purpose in life/ what are your vocational plans? Why?
 - ii. How will you achieve your goals?
2. IN CLASS / HW ESSAY: Cynefin
 - a. Write a 2 page essay describing how computer science skills affect a worker in the modern economy. Address:
 - i. How computer science moves problems clockwise on the Cynefin matrix.
 - ii. Why CS skills increase the demand for workers in the modern economy.
 - b. Revise in class.
 - c. Take home for revision.
3. HW ESSAY: CS and effects on employability and capability.

- a. Write a 3 page essay explaining how and why computational skills affect a worker's capacity, compensation, and demand in the modern economy.
4. HW ESSAY: CS Problem solving framework, Analysis.
 - a. Select two problems from the field of your choice. For each problem, answer the analysis questions from the slides. Dedicate one paragraph per question/answer.
 - b. Responses should be approximately one page per problem, and one bolded question per paragraph.
5. HW ESSAY: CS Problem solving framework, Analysis, current event.
 - a. Find a recent news article on a meaningful problem where the author proposes a solution to the problem.
 - b. Answer each of the analysis questions using the information provided in the article.
 - c. Conduct your own research on the topic. Ensure that you investigate any other points of view on the same topic.
 - d. Write a position essay on the topic. Your essay should:
 - i. Give an introduction to the problem.
 - ii. Describe the author's position using the analysis question framework.
 - iii. Describe how the additional information you researched supported or refuted the author's position, within the context of the analysis question framework.
 - e. It should 3-4 pages.
6. HW ESSAY: CS Problem solving framework, Design.
 - a. For each of the two problems in the analysis assignment, write a half page essay answering the design question.
 - b. Put both paragraphs on one page.
7. HW: CS Problem solving framework, Design, Trees.
 - a. Pick a domain and make a tree. Use powerpoint or other software, generate a 1-page image representation of the tree. Must have at least 4 levels and 8 total nodes. Turn in a printed copy of your tree.
8. HW ESSAY: CS Problem solving framework, Design, Subdivision.
 - a. Write a half page essay describing a problem or scenario that you have partitioned into sub pieces. Describe how subdivision made the problem more tractable, how you thought to divide it, and how you divided it.
9. HW: CS Problem solving framework, Design, Pseudocode 1.
 - a. Provide pseudocode describing two common situations. Use only the keywords provided in these slides. Make sure your keywords are in bold.
10. HW: CS Problem solving framework, Design, Pseudocode 2.
 - a. Describe a complex situation with pseudocode using at least 3 functions.
11. HW ESSAY: CS Problem solving framework, Testing, Verification and troubleshooting.
 - a. Pick a publicly implemented solution to a problem.
 - b. Research the originally stated problem description as well as the outcomes of the solution.

- c. Submit a 3-5 page essay detailing the problem, the proposed solution, the expected outcomes for the solution, and the actual outcomes for the solution. Did it work as claimed? If not, what changes would you suggest, and why?
12. FINAL ESSAY: "What is your plan" (Revised). Revise your first essay to include what you have learned. Include your intended career is and why. Describe which CS courses you should take to achieve your goal, or why none of them apply if that is the case. Describe which aspects of the CS problem solving framework will assist you in your goals, and why. Length: 5 pages.

Writing Rubric:

Clarity of expression / Quality of writing (80 points)

The problem was sufficiently introduced (5).

The analysis questions were thoroughly addressed (30).

The author's solution was sufficiently analyzed (15).

A strong position was argued for or against the author's original solution (10).

The writing was clear and well-organized (20).

Accuracy of content (10 points)

An extensive number of opposing viewpoints are provided (5).

Opposing viewpoints were well-researched and well cited (5).

Formatting (10 points)

Document margins, font, spacing, page length, and citations follow course format standards.

Writing Feedback Key:

Awk – Sentence construction is awkward. Try thinking about what you intended to communicate, reading the sentence aloud, and rewriting.

Sp – Spelling mistake.

Ro – Run on sentence. Try chopping up and rewriting.

DP – Dangling participle. Rephrase sentence.

Home Reading Assignments:

The purpose of the reading assignments is to provide you with information that will expand your exposure to technology in the world. The objective is for you to experience secondary thoughts about how this material is useful in your life and change your perceptions and behavior.

Students will read two chapters from their book of choice each week. Note: introductions and conclusions count as chapters.

All students will read from *Algorithms to Live By: The Computer Science of Human Decisions* by Christian. In addition, students may choose an additional book from the following list:

- 1) *Rise of the Robots: Technology and the Thread of a Jobless Future* by Ford
- 2) *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies* by Brynjolfsson

3) *The Innovators: How a Group of Hackers, Geniuses, and Geeks Created the Digital Revolution* by Isaacson

On the due date of each reading assignment, students will respond to the following writing prompt in class:

Reading Prompt:

Closed book. Write ½ page, single spaced, by hand, choosing two of the following tasks:

Summarize. What is this chapter about?

Analyze. What creative ideas or questions were generated in your mind? Did you conduct additional research as a result of reading the chapter? If so, what?

Evaluate. Explain how the chapter was well- or poorly-written. Include topics it helped you understand and/or that could have been better explained.

Approximately half of the assignments will be evaluated (not for credit) by a classmate. The other assignments will be submitted to the instructor and graded according to the following rubric:

Reading Rubric (15 points possible):

Knowledgeable (1-3). Demonstrates familiarity with and understanding of the text by referring to it often.

Interesting (1-3). Offers new or unusual insights about the text.

Thoughtful (1-3). While it may contain some emotional response, it does so with balance and respect for the text.

Organized (1-3). It uses an organizational plan to present its ideas about the text, step by step.

Rational (1-3). It uses logic and reason in presenting its ideas.

Davidson Honors College Increment

In addition to the rest of this syllabus, students taking this course as honors credit will meet for an additional hour per week with the instructor. In this additional meeting, students will:

- Read one chapter per week from one additional book from the required reading list.
- Discuss and or write an additional review weekly from the additional reading.
- Deliver progress reports and receive guidance on the semester-long research task.

Research Task:

In groups of two, choose a course that you believe would be improved by infusing computation (rule: cannot be an already computational course). Find a faculty mentor that has taught the course and is willing to assist you. Meet with the faculty mentor as needed, conduct independent research, and create a presentation answering the questions: How could computation be infused in this course? What benefits would this bring? What specific tasks would be included? What challenges prevent the new curriculum? How could they be

overcome? Has anyone outside of University of Montana tried to do so? How have they overcome challenges? What have been the results?

The report should be a slideshow of around 10 slides and will be given in the last week of the semester.

Honor's Grades:

Intro essay (5%)*

Quizzes (20%)

Homework assignments (40%)*

Reading assignments (15%)* (20 chapters, 10 graded, 10 peer-reviewed)

Honors reading (5%)

Research Task (5%)

Final essay (10%)*

(* indicates writing assignments)

Miscellanea:

Attendance:

My intent is that every class will provide enough value to entice you to attend. You will also be completing assignments for a grade in class. Your absence will mean receiving a zero for any assignment performed during that class period. There is no make up policy. Students in extraordinary situations (e.g. death of an immediate family member or medical emergency) may approach me on a case-by-case basis.

Notice of Writing General Education Assessment:

This course requires an electronic submission of an assignment stripped of your personal information to be used for educational research and assessment of the writing program. Your paper will be stored in a database. A random selection of student papers will be assessed by a group of faculty using a rubric developed from the following writing learning outcomes.

- Compose written documents that are appropriate for a given audience or purpose
- Formulate and express opinions and ideas in writing
- Use writing to learn and synthesize new concepts
- Revise written work based on constructive feedback
- Find, evaluate, and use information effectively
- Begin to use discipline-specific writing conventions (largely style conventions like APA or MLA)
- Demonstrate appropriate English language usage

Cheating:

Any form of collusion or dishonesty will be prosecuted to the full extent allowable by University standards and may result in an automatic failing grade in the course.

Incompletes and Late Drops:

The university empowers instructors with discretion to approve incompletes or late drops (dropping the course after 45 days). I will not approve either as a means of avoiding a low grade or as a means of protesting course policies. Valid reasons include family emergencies, work complications, or registration issues, but I reserve the right of approval on a case-by-case basis.

Disabilities:

This course is accessible to and usable by otherwise qualified students with disabilities. To request reasonable program modifications, please consult with the instructor. Disability Services for Students will assist the instructor and student in the modification process. For more information, visit the Disability Services website at <http://life.umt.edu/dss/>.