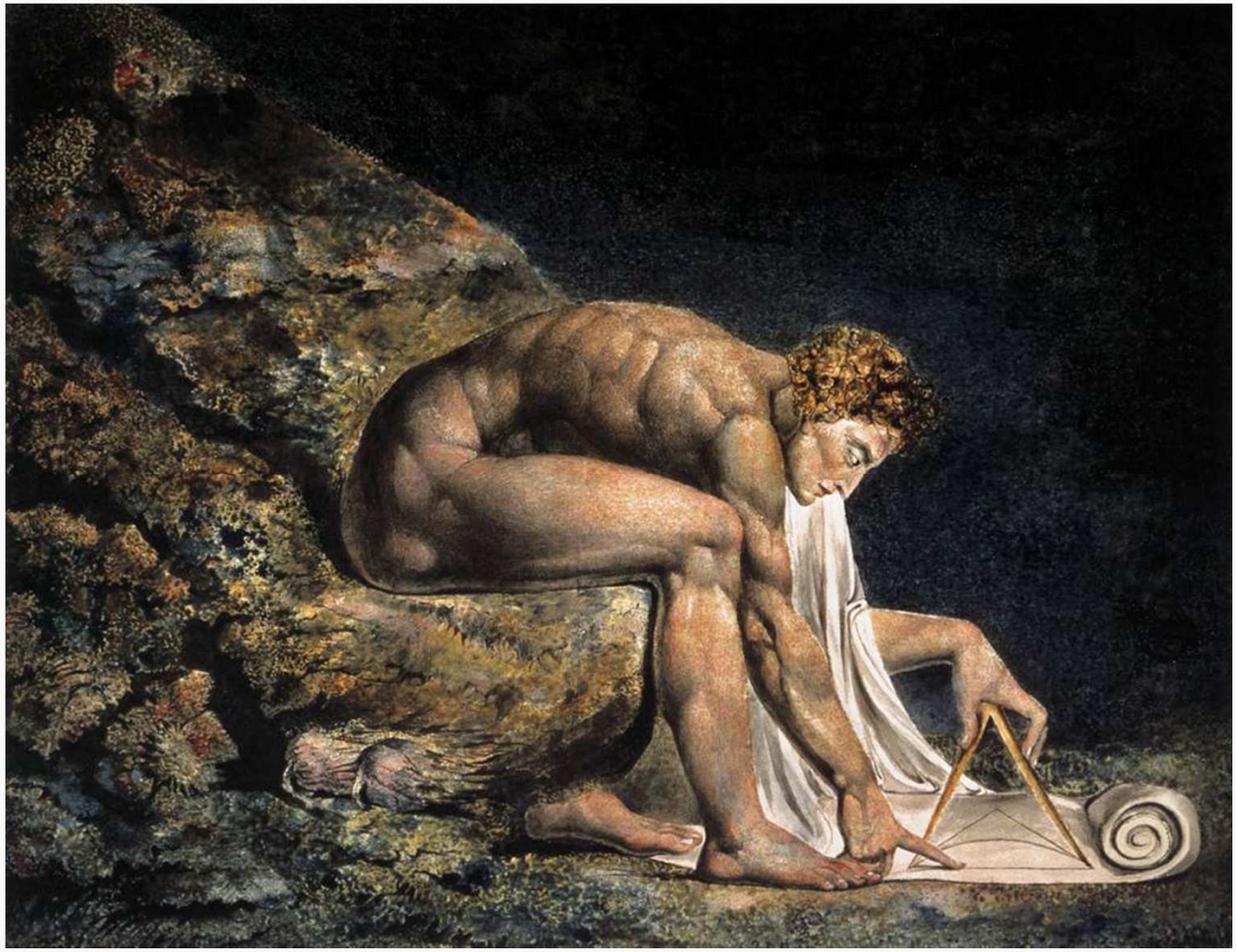
Problem Solving in Computer Science



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Course Information

CS 2104 Problem Solving in Computer Science

This course introduces the student to a broad range of heuristics for solving problems in a range of settings that are relevant to computation. Emphasis on problem-solving techniques that aid programmers and computer scientists. Heuristics for solving problems "in the small" (classical math and word problems), generating potential solutions to "real-life" problems encountered in the profession, problem-solving through computation, and problem-solving in teams.

Topical Course Outline

The formal course definition says:

Heuristics for problem solving: • Externalize • Deduction • Symmetry • Simplify • Go to extremes • Penultimate step	25%
Communicating problem solutions: argument & proof, presentation (written and oral)	20%
Problem-solving in the large: generating potential solutions, evaluating solutions, working in teams	15%
Human aspects: self assessment, succeeding as a student, inter-personal problem solving	15%
Problem-solving for computer scientists: programming and problem solving, computation in problem solving	15%
Skills for problem types: verbal reasoning, analogy, comprehension, trends, deduction	10%

We will follow this to some extent.

Course Objectives

Having successfully completed this course, the student will be able to:

- Identify skills and personality traits of successful problem solvers.
- Apply standard problem-solving heuristics to aid in problem solving related
- to computer science.
- Apply problem-solving techniques to programming activities.
- Apply problem-solving techniques to school and personal interactions.
- Apply pair and team problem-solving techniques.
- Generate potential solutions to problems with standard heuristics.
- Formulate and successfully communicate problem solutions.

Prerequisites

Math 1205 Calculus
or
Math 1526 Elem Calculus with Matrices

EngE 1024 Engineering Exploration
or
Programming Experience

There will be absolutely NO exceptions to these requirements.

In-class Exercises

Some class meetings will be devoted to pair or group problem-solving exercises.

This will involve:

- partitioning the students who attend that day into suitable groups
- assigning each group a problem (or small set of problems)
- allowing an appropriate amount of time for the groups to work on their problems
- In some cases, allowing a spokesperson from each group to present a solution (produced by the group) to the entire class; during the presentation, students from other groups are expected to follow the presentation, watch for difficulties, and query the presenter about those difficulties, or simply when things are not clear; the presenter may be allowed a very brief consultation with his/her group members before responding to questions; the course instructor may "pull the plug" on a presentation if excessive difficulties occur.
- In some cases, each group will submit a formal, written presentation of their solution, which will be evaluated by the course staff
- In some cases, each group will submit a written presentation of their solution during the class session, and the problem solution may be presented by the instructor.

Classroom Etiquette

When we focus on the in-class exercises, students may present solutions that they might not be entirely sure of, and other students will attempt to find problems with those solutions.

Therefore, it is important that we all be respectful of each other in class:

- There is to be no ridiculing of other students, under any circumstances.
- Any critiques during a presentation are to be directed to the presenter.
- Any critiques during a presentation are to be phrased as inquiries, not as accusations.
- The presenter is to respond politely to all questions.

See the Resources page on the course website for an expanded version of these rules.

Do not violate these rules, no matter how much they may challenge your current level of social skills.

As the course instructor, it will be my obligation to enforce these rules, and I enthusiastically embrace that obligation. Violators will be warned once. Repeat violators will earn demerits (think of this as negative extra credit) that will be applied at the end of the term.

Out-of-Class Assignments

Out-of-class assignments will make up a substantial portion of your grade in the course.

Some may involve pair or group work and some may be strictly individual.

Each of these assignments will require solving one or more problems, of varying difficulty and submitting a formal, written presentation of the solution(s).

As a general rule, solutions to these assignments will be presented in class during the class meeting that follows the due date; therefore there may be NO opportunity to make late submissions of your solutions to these assignments.

Evaluation of Written Solutions

When we evaluate your written solutions to problems, we will consider:

- the extent to which your solution is correct
- the completeness of your presentation of your solution
- the clarity of your presentation of your solution

Of necessity, the evaluation of a written solution must take into account the quality of your writing. Since that is a legitimate emphasis of this course, I have no problem with that.

However, we will not penalize you for errors in spelling or grammar unless those errors directly impact the clarity of your presentation. So you should pay attention to spelling and grammar when you write your solution.

When students turn in a written portion of a pairs or group assignment, all students involved will normally receive the same grade. You are free to use different partners for different assignments. You may not switch partners in the middle of an assignment.

Evaluation of Written Solutions

When students work in pairs or groups, it is important that all students involved completely understand the answers that they submit. The instructor reserves the right to require any student to present the answers to their homework assignment verbally to insure that each student does in fact meet the minimum requirement of understanding the solutions they submitted, and may reduce credit given for the assignment (to all students in the pair/group!) if the verbal answer is not compatible with understanding of the written answer.

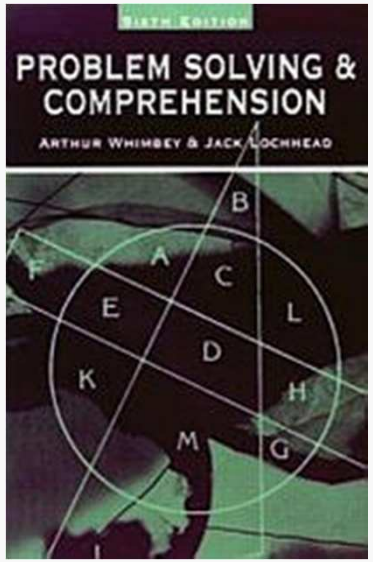
All submissions of pair/group assignments must contain a statement that clearly indicates, for each problem, the contribution of each student to the problem. Some possible contributions for a problem might include one or more of the following: cracked the problem, wrote up the solution, found flaws, improved earlier versions of the solution.

All homework submissions that involve working problems must contain the following Pledge Statement:

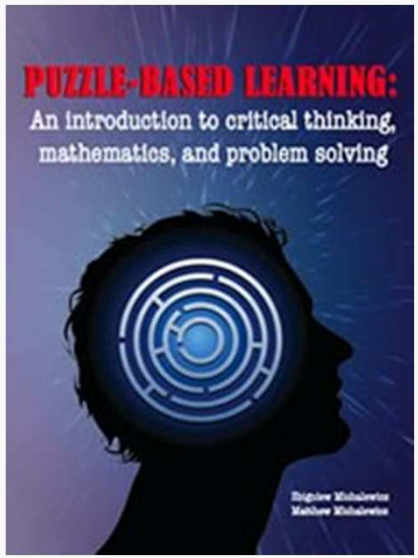
> I have not received unauthorized aid on this assignment. I understand the answers that I have submitted. The answers submitted have not been directly copied from another source, but instead are written in my own words.

Required Texts

Problem Solving and Comprehension, 6th Edition
Arthur Whimbey & Jack Lochhead
Lawrence Erlbaum Associates, Publishers ©1999
ISBN 0-8058-3274-2



Puzzle-Based Learning: an introduction to critical thinking, mathematics, and problem solving
Zbigniew Michalewicz and Matthew Michalewicz
Hybrid Publishers ©2008
ISBN 978-1-876462-63-5



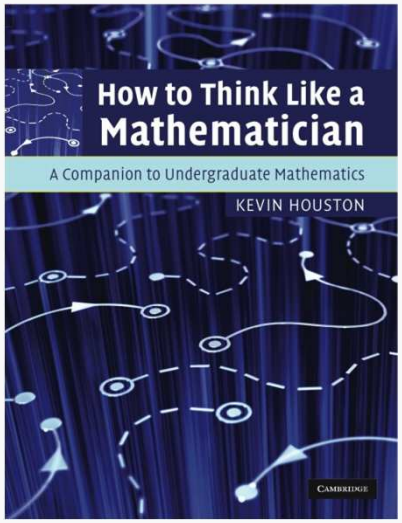
Required Texts

How to Think Like a Mathematician

Kevin Houston

Cambridge University Press ©2009

ISBN 978-0-521-71978-0



Recommended References

The following books are good references on relevant material. Some were used as sources for some of the course notes. You are not expected to obtain or read any of them, but if you are interested in supplemental reading, these are good.

Effective Problem Solving, 2nd Edition

M Levine, Prentice-Hall, ©1994, 0-13-245481-5

The Art and Craft of Problem Solving, 2nd Edition

Paul Zeitz, John Wiley and Sons, ©2007, 978-0-471-78901-7

Conceptual Blockbusting: a Guide to Better Ideas, 4th Edition

James L Adams, Basic Books, ©2001, 978-0-7382-0537-3

Logic: Techniques of Formal Reasoning, 2nd Edition

Donald Kalish, Richard Montague, Gary Mar, Houghton Mifflin, ©1980, 978-0-15-551181-5

Course TAs

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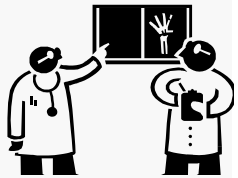
Graded Work



Final grades will be based on the average achieved over the following :

Item	Weight	Dates
Out-of-class assignments	36%	See website
In-class exercises	24%	See website
Tests	8% each	TBA
Final Exam*	24%	TBA

Grade Scale

The usual 10-point scale will apply (subject to any curve). A final average of 90% will guarantee an A-, 80% will guarantee a B-, and so forth.

Curve

A grade curve may or may not be employed in this course. The application of a curve is dependent upon class performance on tests, projects and homework. The decision to utilize a curve rests entirely with the course instructor.

* Exam score will replace the midterm score, if it is higher.

Grade Policies

Statute of Limitations

Any questions about the grading of an assignment must be raised with your instructor within two weeks after the graded assignment has been made available to you.

Accommodations

If any student needs special accommodations because of a disability, please contact the instructor during the first week of class.

Attendance

Educational studies consistently show a strong correlation between class attendance and class grade. Much of the grading for this class will be based on in-class assignments and activities, some of which are difficult or impossible to make up at another time.

Attendance to every class is mandatory, and will be monitored at every class meeting. Students will lose 1% of the semester grade for every class missed. There are no excused absences for any reason.

However, any student who needs to miss class for a legitimate reason can recover those points by scheduling a meeting with the instructor (normally this must be done before the next class) at which the student presents the gist of the material covered during the missed class. The instructor may choose instead of a meeting to have the student write a 1–2 page summary of the material from the missed lecture.

Notice that the student is presenting the material, not the instructor! So the student will need to prepare for the meeting or the summary write-up by carefully reading the lecture notes and any associated reading assignments. Lecture notes will be available from the course website shortly before or after each lecture.

Using External Sources

The following statement is adapted from one given by Walker White to his problem-solving class at Cornell University:

I am of mixed mind about the use of external sources. On one hand, some of the problems that we will discuss are classic problems. Hence it is conceivable that the solution is available on-line. Getting a solution on-line and presenting it as your own is essentially plagiarism and is in violation of the Virginia Tech Honor Code; it is no different than trying to pass off someone else's essay as your own. Needless to say, I discourage this use of external sources.

However, my expectations for this class imply that this is not really an issue. In your presentations, both I and the other students will challenge you to explain *how* you came up with the solution to the problem. If you cannot adequately explain this, then the whole purpose of the exercise is lost. This class is about how to come up with solutions, not the solutions themselves. Everyone typically gets this, so there is no reason to look-up the solutions online.

With that said, it is still cheating, so please do not do it.

Using External Sources

Where external sources are okay are in looking up well-known algorithms. Not everyone in this class has the same background. Some of you will be familiar with mathematical and computational concepts that others have not yet seen. In this regard, external sources are good because they are the great equalizer among different students.

While you are still doing the work solving the problem, they allow you to access that extra little tool that can help you. The use of external sources to find generic algorithms (as opposed to the specific solution to the problem) or theorems is fine. However, you should adequately document the algorithm/theorem and where you got it from.

If in doubt about your use of external sources, a good rule to follow is to "Google your work, not the problem".

If you have any doubts or concerns, come ask me.

As long as you are honest about your use of external sources, there are no repercussions.

Working in Groups

The in-class exercises will most often involve working in a group, and each group is expected to work in isolation from the other groups (usually on a different problem, so this will not usually be a potential issue).

The out-of-class exercises may be strictly individual or may allow (or require) that you work in pairs or in larger groups.

You are required to conform to those restrictions, so on an assignment that is specified as strictly individual effort, you may not consult with other students but you may consult with the instructor and the course TAs.