Incorporating Ethics into Computer Science Education

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Crystal Lee, Mozilla / MIT
Helena Mentis, Information Systems, U. Maryland Baltimore County
Atri Rudra, Computer Science, Computer Science and Engineering, U. Buffalo
(Kathy Pham, Mozilla / Harvard)
Bobby Schnabel, Computer Science, U. Colorado Boulder
Apple delays the rollout of child-safety features over privacy concerns. Apple had not expected the kind of backlash the new features faced.

Young People, Especially Young Women, Are Reporting Concerning Medical And Behavioral Changes Due To Social Media, And I Hope We’re Paying Attention

Privacy fears as Moscow metro rolls out facial recognition pay system

In India, Facebook Grapples With an Amplified Version of Its Problems

Internal documents show a struggle with misinformation, hate speech and celebrations of violence in the country, the company’s biggest market.

Report: Robots, other advances will cost humans 5.1 million jobs by 2020
Plan for Session:

• First half: presentations covering experience with:
  • Incorporating ethics into tech classes, including intro programming
  • Teaching standalone ethics and computing classes
  • Comparison of the above two approaches
  • Industry needs and trends for ethics and computing education
  • ACM repository of materials for ethics and computing education

• Second half: audience discussion
My journey until today......

I have the least impressive/important back story in the panel....

No point ”regaling” y’all with another dude’s journey towards doing that he should have been doing earlier...
I’m representing work done by others @UB...

Varun Chandola  Jesse Hartloff  Matt Hertz  Kenny Joseph  Oliver Kennedy  Jenn Winikus

Matt Bolton  Kim Boulden  Jonathan Mannes  Dalia Muller

Maria Rodriguez  Melanie Sage  Mark Shepard  Sama Waham
How do you teach responsible computing?
Let’s dive right in the dimensions....

Traditional CSE instruments
- Proof based assignments
- Programming assignments/projects

Non-traditional CSE instruments

UG Algorithms course (CSE 331 @UB)

Ethics/Responsible Computing
- Right vs. Wrong
- Doing the right thing
- Typically abstract in nature

Social Justice
- Right vs. Wrong for whom?
- Who gets to decide what is Right vs. Wrong?
- Putting thought into practice
Actual quote from an algorithms instructor

“\[\text{I would not want to incorporate such topics into my algorithms course.}\]

\[\text{I prefer to keep it a technical, politics-free zone,}\]

\[\text{and I think any discussion of ethics and society would take away from that.}\]”
The “hook” is broadband access
Erie county is reasonably good
One county over

Fast forward to last couple of weeks of class

Homework 7

Due by 8:00am, Wednesday, December 1, 2021.

Make sure you follow all the homework policies.

All submissions should be done via Autolab.
Question 2 on HW 7

Question 2 (Accessing Internet at the Library) [25 points]

The Problem

Unfortunately it turns out that after all the work you put into Q1 of HW 5 to designing optimal placement of cell towers to give Internet access to everyone in SomePlaceInUSA, the funding for putting up the cell towers fell through. Fortunately, there is a small glimmer of hope in that the town was able to secure a small grant to install a high speed Internet connection to one computer in the town's library. In this problem you will explore how effectively the town can share the resource of this one computer among the needy citizens of SomePlaceInUSA in order to maximize the social good that this computer with high speed Internet connection can provide to the town as a whole.

Residents of SomePlaceInUSA have applied to use the library's high speed Internet computer. Each of the $n$ citizens provides the following information. The $i$'th citizen submits a tuple $(s_i, f_i, w_i)$, where $s_i$ and the $f_i > s_i$ are the start and finish times of when the applicant plans to use the computer every weekday; $w_i$ is their estimation of the worth of getting to use the terminal from $s_i$ to $f_i$. (Note: the larger the value of $w_i$ the better for citizen $i$ and you can assume that $w_i \geq 0$ are integers.)

Your initial goal is to determine the maximum worth among all valid subset of citizens $S \subseteq [n]$. A subset $S$ is valid if the start and finish times of any citizen $i \neq j \in S$ do not conflict (i.e. either $s_i > f_j$ or $s_j > f_i$). Further, the worth of a subset is

$$w(S) = \sum_{i \in S} w_i$$

Sample Input/Output

Here is a sample input/output pair (the input array is stated as $[(s_1, f_1, w_1), \ldots, (s_n, f_n, w_n)]$ for $n = 3$:

- Input: $[(1, 4, 10), (5, 10, 20), (1, 10, 100)]$. 

Dynamic Program question
Going back to our 2D space....

Traditional CSE instruments
- Proof based assignments
- Programming assignments/projects

Non-traditional CSE instruments

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Q2 HW 7 (Dynamic program HW Q)
Now, let’s push the ethical angle more....

Coding Problems for Project

Problem 1 (Coding) due at 11:59pm, Friday, October 29, 2021.

Problem 2 (Coding) due at 11:59pm, Friday, November 5, 2021.

Problem 3 (Coding) due at 11:59pm, Friday, December 3, 2021.

Problems 4 and 5 (Coding) due at 11:59pm, Friday, December 10, 2021.

All submissions should be done via Autolab.

Acknowledgment

The development of the project was supported by a Mozilla Responsible Computer Science award. The support is gratefully acknowledged.
SUPREME COURT OF THE STATE OF NEW YORK
COUNTY OF NEW YORK

THE PEOPLE OF THE STATE OF NEW YORK,
by ERIC T. SCHNEIDERMAN, Attorney General of the
State of New York,

 Plaintiff,

-against-

CHARTER COMMUNICATIONS, INC. and SPECTRUM
MANAGEMENT HOLDING COMPANY, LLC
(f/k/a TIME WARNER CABLE, INC.),

SUMMONS

Index No.: 450318/2017

Plaintiff designates New York County as the Place of Trial
The Basic Problem

The Problem

Essentially, Spectrum used unethical and fraudulent ways to make profits. Now imagine that you just graduated from UB with a bachelor’s degree in Computer Engineering/Computer Science and got hired by ForProfitOnly Internet provider. You’re recruited into ForProfitOnly as a junior software engineer. It’s your first day at work and your first assignment/task is to come up with routing algorithms to generate paths that will be used to route packets in ForProfitOnly’s network topology. Since it’s your first day at work, you’re very eager to please your superiors by delivering as much revenue as possible to ForProfitOnly. Below is a detailed description of your task and the various problems that you need to solve.

Student solve 5 problems
Allegation #10 against Spectrum

10. To conceal this failure, Spectrum-TWC assured the FCC in or about July 2013, that it would replace its older-generation modems for all of its subscribers, but in fact it did not. The FCC relied on that commitment to exclude the poor results of the speed tests on those modems in the FCC’s subsequent public reports. Had these modems’ results been included in the FCC’s testing program, they would have revealed Spectrum-TWC’s deceptive practices.
For each problem, students submit code

Problem 3

You are provided a subset of the test suite!
For the third problem, there are four testcases on Autolab. The first one, input1.txt in conjunction with input1.txt-info is provided to you. The other testcases will use the same graph from input1.txt but with different info files.

Do not modify the output!
Please do not change the return statement. All the problems return the same tuple, but priorities should be set to the empty dictionary for this problem. You need to assign a value to the paths and bandwidths variables as your solution.

What's the difference in the zips?
The templates for the different problem are essentially the same except that Driver.py sets the appropriate problem value. So while you can modify the zip from another problem to work for Problem 3, to be on the safe side, we still encourage you all to download the zip for this problem and work on it separately from your work on other problems.
Problem 5: Do the ethical thing

The Problem

Like Spectrum, ForProfitOnly gets hit with multiple lawsuits and you decide it is a good time to work for another company where profit is not the only motive. Luckily for you, a new startup EthicalInternet promises to keep customers first and then worry about profit. More precisely, EthicalInternet will guarantee that no customer would complain/drop-out. You apply for a position at EthicalInternet and you get the job: congratulations! You have a similar problem to solve as you did when you were at ForProfitOnly but now your objectives are different.

For this problem, there is no notion of a complaining client (but see the definition of penalty for how we will ensure that no customer would dropout). You are still allowed to set/change the priority for every client, and increase the bandwidth for any router at a cost of $Z$ per increase in bandwidth like before.
Coding project was built by CSE 331 UTAs

Sanchit Batra  Elijah Einstein  Sean Mackay  Supratik Neupane  Tom Sherwood  Veronica Vitale

Alex Fernandez  Snigdha Motadaka  Aman Timalsina
Going back to our 2D space....

Typically abstract in nature
Putting thought into practice

Traditional CSE instruments
Proof based assignments
Programming assignments/projects

Non-traditional CSE instruments

Coding project
(Routeing under constraints)

Q2 HW 7
(Dynamic program HW Q)

Ethics/Responsible Computing
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Why not here?
Student submissions were autograded...

Grading Guidelines

The grading works a little differently for this project.

Each testcase is worth 5 points. The number of testcases for each problem depends on the maximum points ($\text{max\_points}$) achievable, and is equal to $\frac{\text{max\_points}}{5}$. For eg. Problem 1 has one testcase, since it is worth 5 points, Problem 2 has two testcases, since it is worth 10 points and so on.

For Problem 1, you get the full 5 points if your revenue matches ours and 0 otherwise.

Except for Problem 1, there is partial grading for each testcase. The number of points awarded to you depend on how well your solution’s revenue compares with our revenue.

For other problems, the thresholds are outlined below, the numbers on the left indicate the ratio of (your solution’s revenue - revenue of optimal Solution for Problem 1) and (our revenue - revenue from optimal Solution for Problem 1) in percentage, and the right half indicates the points achieving that ratio will award you.

- [100, 80] -> 5 points
- [80, 60] -> 4 points
- [60, 40] -> 3 points
- [40, 20] -> 2 points
- [20, 5] -> 1 points
- [0, 5] -> 0 points
Business/assessment as usual will not work....

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- Coding project (Reflection questions)
- Coding project (Routing under constraints)
- Q2 HW 7 (Dynamic program HW Q)

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Students reflect on their design choices

Problem 3 (25 points)

Your Task
Listed below are seven questions. The first question is to present the algorithm idea of the code that you submitted for the third coding problem. For the rest of the questions, you group has to answer each question and justify your answers.

Coding problem three raises the question: When an algorithm doesn’t work as advertised, who is responsible? Accountability for proprietary informational technologies can be difficult to assign. As you’ve seen in the problem description, both the Office of the Attorney General and the Federal Communications Commission have assigned responsibility to your ForProfitOnly employer based on customer complaints and their own bandwidth tests.

Obviously, as a software engineer, you have little control over how your ForProfitOnly company advertises its products. However, as O’Neil and Gunn argue, both designers and deployers of algorithms bear an ethical responsibility for the consequences of their designs. Developers, in particular are “in a unique position of responsibility over the design of the algorithm as they are typically the only ones in a position to understand how the algorithm functions and are responsible for rendering the design goals into the algorithm” (242). As you no doubt saw in the problem description, most of the customers who complained didn’t know (or even really need to know) why their internet did not meet advertised speeds, only that it did not meet them. And while it might be tempting to assign responsibility to customers for leasing older modems, they are not responsible for ensuring a paid service works. In this case, you are responsible.

For reflection three, please answer the following questions about designers’ responsibility for how their algorithm works:

Algorithm Idea (2 points)
State the algorithm idea behind the code that you submitted for for the third coding problem. This would be similar to an usual algorithm idea submission in a homework (though it does not really have to longer than one paragraph).

Lawsuit threat (2 points)
How did the threat of a lawsuit change your group’s algorithm idea from the second coding problem to this problem? Specifically, which changes were motivated by the lawsuit threat, and why did you choose those adjustments as opposed to others?

FCC fine threat (2 points)
How did the threat of an FCC fine change your group’s algorithm idea from the second coding problem to this problem? Specifically, which changes were motivated by the FCC fine, and why did you choose those adjustments as opposed to others?

Which customers are favored? (3 points)
Which clients did the changes to the bandwidth values favor? Show how your answer follows from the algorithm idea above.
The next Question

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Non-traditional CSE instruments
- Reflection questions

Traditional CSE instruments
- Proof based assignments
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Coding project (Reflection questions)
Coding project (Routing under constraints)
Q2 HW 7 (Dynamic program HW Q)
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#### Traditional CSE instruments

- Proof based assignments
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#### Non-traditional CSE instruments

- Reflection questions

**Need help from non-CSE folx!**

**Q2 HW 7**

- Coding project (Routing under constraints)

**Coding project**

- Reflection questions
Reflection Qs were co-created w/ Macy McDonald
Our initial attempt at incorporating SJ

Non-traditional CSE instruments
- Reflection questions

Traditional CSE instruments
- Proof based assignments
- Programming assignments/projects

Coding project
- (Reflection questions)
- (Routing under constraints)
- Q2 HW 7 (Dynamic program HW Q)

First year seminar (CSE 199)
- (Making Computing Anti-Racist)

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“doing computer science”: ethics as specialization & ethics as technical practice

Casey Fiesler
Implementing A Tenth Strand in the CS Curriculum

"Computer Science Education should not drive a wedge between the social and the technical, but rather link both through the formal and informal curriculum" [5].

"Societal and technical aspects of computing are interdependent. Technical issues are best understood (and most effectively taught) in their social context, and the societal aspects of computing are best understood in the context of the underlying technical detail. Far from detracting from the students' learning of technical information, including societal aspects in the computer science curriculum can enhance students' learning, increase their motivation, and deepen their understanding" [10].

... the most glaring problem is that **proposed subject matter is not computer science**...the content of the ‘strand’ has no algorithms, no data structures, no mathematical analysis, neither software development nor software design, no computer science theory. In short the content is devoid of every standard element present in computer science research and education. ... **It’s hard to imagine a computer scientist teaching these things.** ... Ethical and social concerns may be important, but as debating the morality of nuclear weapons is not doing physics, **discussing the social and ethical impact of computing is not doing computer science.**
/benefits of standalone classes

- Taught by experts with deep subject matter expertise
- Room to discuss ethical foundations rather than focusing on applications
- Provides a foundation for a way of thinking to be applied to other classes
/benefits of ethics integration

> Ensures that anyone who takes a computing class hears about ethics

> Avoids isolating ethics learning from its context

> Emphasizes that ethics is part of the practice of computing, not an add-on

... that thinking about ethics is doing computer science.
/barriers to ethics integration

➤ Too much other material to cover

➤ Not part of the course materials provided / lack of control over curriculum

➤ Lack of understanding for how it relates to the course

➤ Not enough expertise
/structures to support ethics integration

- Community
- Collaboration
- Confidence building
- Open resources
I was scouting around for ideas... there was a literal template right there for how to do it... it was so helpful to have instructions and examples...

internetruleslab.com/black-mirror-writers-room
Teaching Responsible Computing Playbook

Teaching Materials

Below is a list of schools that have incorporated responsible computing in their curriculum. This list is meant to record a landing page (and a few specific pages) in these schools and is not meant as a comprehensive listing of resources pages. If your school's effort is not listed below, please send us up to three links that best represent teaching responsible computing resources that have been developed at your school.

tinyurl.com/rcs-materials

bit.ly/ethics-syllabi

internetruleslab.com/responsible-computing
Institutional Support

Helena Mentis
Professor, Information Systems
Affiliate Professor, CSEE
Former Associate Dean, Academic Programs and Learning
Institutional Support for Responsible Computing

1. Identify a champion + team.
2. Make visible leadership buy-in.
3. Give resources to RC champion/team.
4. Make visible existing faculty efforts and create a community.
5. Identify faculty barriers/concerns and then provide resources.
Funding interdisciplinary computing curricula

- Funders are listening!
  - **Current funders:** Omidyar Network, Craig Newmark Philanthropies, Schmidt Futures
  - **Mozilla’s new partnerships:** Mellon Foundation and USAID
  - Broadening participation in computing – MSIs and HBCUs; integrating existing curricula
  - **Interdisciplinary work with a global perspective** – expanding beyond the Global North

- It’s not just Mozilla...
  - Social Science Research Council (SSRC), Just Tech Fellowship
  - Public Interest Technology - University Network (PIT-UN), New America Foundation
  - Ethical and Responsible Research, National Science Foundation
Building sustainable systems

**Investing top down / bottom up:** in some cases, students are the ones pushing faculty members for change!

Reboot HQ, Cyber Collective, Encode Justice, Log off Movement/Technically Politics

**Creating the talent pipeline:** experiential learning + transferable skills

Building it into internship models (Schmidt Futures APM Program)

*Interdisciplinary work:* imagining a new kind of technologist with the humanities

*Kenya:* collaborations between coding schools, CS departments, tech companies
Mozilla’s Responsible Computer Science Challenge

New challenge will launch sometime before the end of this year!
Design grants (<$25k), pilot grants (<$100k), and scale grants (<$150k)

http://responsiblecs.org/

Sign up for the Global Community of Practice!
https://tinyurl.com/rcs-sign-up

Email me!
crystal@mozillafoundation.org
@crystaljjlee
Experience Teaching Ethics and Computing at University of Colorado Boulder

- Undergraduate computer science majors course: Computing, Ethics and Society
- (1 credit course in MS in data science – Ethical Issues in Data Science – both residential and Coursera)
- ACM / EngageCSEdu Ethics and Computing Repository
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Computing, Ethics and Society – Student Experiences

• Students enjoy subject matter and having a different (more humanities style) type of course
• Course work – reading, writing, discussing, presenting – is good experience for students, and a challenge for some
• Students especially enjoy small group discussions/debates on course topics – incorporate some of this into every class
Computing, Ethics and Society – Reflections on Course Materials

• Looked online at many similar courses at other universities
• Not many courses like this are based around a textbook
• Almost all, including mine, are based on reading articles (and occasionally viewing videos) – mainly from mainstream media, some scholarly articles (more in graduate level courses) – example next slide
• Need to refresh readings at least every 1-2 years
• Motivated providing a community resource of these types of references on ethics and computing, that is continually updated
Example of a daily reading assignment

- **Topic:** Misinformation

- **Reading:**
  - Google maps showing disputed territory different to different audiences: video *(very interesting, please watch)*  
    [twistedsifter.com](http://twistedsifter.com)
  - The surprising nuance behind the Russian troll strategy  
    [medium.com](http://medium.com)
  - Internet companies prepare to fight the “deepfake” future  
    [nytimes.com](http://nytimes.com)
  - Misinformation about COVID vaccines  
    [cnbc.com](http://cnbc.com)
  - Summary of Pew Research Center study on future and truth of misinformation online  
    (long, please skim through “major themes” summary table early in article)  
    [pewinternet.org](http://pewinternet.org)

- **Additional optional reading:**
  - If you’d like to understand the Russian troll article in more detail: research paper  
    [U. Wash.](http://U.Wash.)
  - More information about COVID misinformation and conspiracy theories  
    [nature.com](http://nature.com)
https://engage-csedu.org/ethics-and-computing/

Ethics & Computing Repository

Browse by Topic

Technical Topics
- Algorithmic Bias
- Collection and Storage of Data