

CSC373 Fall'23  
Embedded Ethics Module: Pre-Assignment  
Due Date: 11:59pm ET on Dec 6

**Instructions**

1. Typed assignments are preferred (e.g., PDFs created using LaTeX or Word), especially if your handwriting is possibly illegible or if you do not have access to a good quality scanner. Either way, you need to submit a single PDF named "ethics-pre.pdf" on MarkUS at <https://markus.teach.cs.toronto.edu/csc373-2023-09>
2. Please submit a solution ONLY to Q1. This is the only graded question. Q2 and Q3 are food for thought. You are encouraged to think about them before coming to the module.
3. You will receive 20% of the points for Q1 if you leave it blank (or cross off any written solution) and write "I do not know how to approach this problem." If you leave it blank but do not write this or a similar statement, you will receive 10%.
4. You may receive partial credit for the work that is clearly on the right track. But if your answer is largely irrelevant, you will receive 0 points.

**Q1 [100 Points] Vaccine Distribution via Network Flow**

Imagine that you are an intern at an NGO, which has procured COVID-19 vaccines from multiple manufacturers and wants to allocate them, at a fixed discounted rate, to various countries requesting them. As a brilliant computer science undergraduate from UofT, you are tasked with coming up with a solution. You are provided the following information about the problem:

- There are  $n$  countries requesting the vaccines. Country  $i$  is willing to purchase up to  $c_i$  doses.
- There are  $m$  suppliers/warehouses. Warehouse  $r$  can supply up to  $s_r$  doses in total.
- Due to logistical constraints (such as the vaccines being needed to be kept at a very cold temperature and transferred swiftly), not every country can receive vaccines from every warehouse. You are given a list of pairs of the form  $(i, r)$ , which indicates that country  $i$  can feasibly receive vaccines from warehouse  $r$ .

Given your keen perception, this immediately reminds you of all those network flow exercises that you did during CSC373, and you recognize that you can maximize the number of vaccines allocated by maximizing flow in a suitably designed network. Design such a network and prove its correctness.

## **Q2 [0 Points] Ethical Issues with the Previous Approach**

After performing the above exercise, you diligently write code to maximize flow in your network. But you soon begin to wonder if your program may lead to certain undesirable outcomes, when deployed to the real world. Think about potential *ethical issues* with the approach taken in Q1 to solve the vaccine distribution problem. During the in-class module, we will conduct a group exercise in which you and your peers will discuss such ethical issues and dive deeper into understanding them.

Some ethical issues may lie in the way you approached the problem that was given to you. For example, you may want to consider whether maximizing the number of vaccines allocated can lead to an “unfair” outcome. Other issues may lie with the problem formulation itself. For example, are there perhaps parts of the input which are inaccurate simplifications of real-world constraints? Or perhaps the problem is “incompletely specified”: is there more information that you would like to know which can help you “better” formulate the problem?

These are just some example areas where you might find potential issues; please do not feel compelled to restrict your thoughts to these loosely-sketched prompts. Also, for this exercise, feel free to interpret the term “ethical issues” in its broadest sense as you understand it.

## **Q3 [0 Points] Identifying Stakeholders**

As we begin to try to design a more “ethical” solution to the vaccine distribution problem, we realize that “ethics” is often a subjective term. To understand what it may mean in a given context, one of the first steps is often to identify the various *stakeholders* in that context.

Stakeholders can be individuals, groups of individuals (such as members of a particular race or gender), or even non-human entities (such as nations and corporations). Stakeholders can be those affected by your solution (positively or negatively), those in a position to be able to influence the solution, or those who otherwise have an interest in it.

During the in-class module, we will engage in another group exercise in which you and your peers will discuss various stakeholders and their role in the vaccine distribution problem. Try to identify as many stakeholders as you can. For each stakeholder, think about (a) their needs and priorities, and (b) whether there are any factors that make them more or less important than other stakeholders.