Worth: 7.5% (*best four of the five assignments*) **Due:** *before* 6:00pm on Wed. 3 April

Required filename for MarkUs submission: `a5.pdf`
(Use a ***single*** *file to submit your answers for both Part I and Part II.)*

Remember to write the *full name* and *MarkUs username* of *every* group member (up to three) prominently on your submission.

Please read and understand the policy on Collaboration given on the Course Information Sheet. Then, to protect yourself, list on the front of your submission ***every*** *source of information you used to complete this homework (other than your own lecture and tutorial notes). For example, indicate clearly the* ***name*** *of every student from another group with whom you had discussions, the* ***title and sections*** *of every textbook you consulted (including the course textbook), the* ***source*** *of every web document you used (including documents from the course webpage), etc.*

For each question, please write up detailed answers carefully. Make sure that you use notation and terminology correctly, and that you explain and justify what you are doing. Marks ***will*** *be deducted for incorrect or ambiguous use of notation and terminology, and for making incorrect, unjustified, ambiguous, or vague claims in your solutions.*

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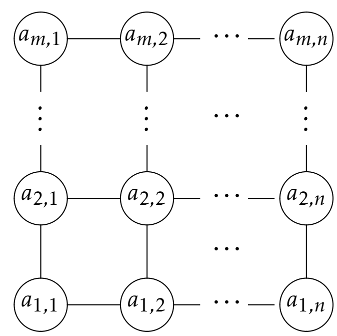
3. Suppose that the City of Toronto is considering a plan to install traffic light cameras at various intersections. They have a map of the intersections in a neighbourhood of Toronto (shown on the right), and estimates $a_{i,j}$ of the number of accidents that could be prevented at intersection (i, j) by installing a camera there. However, the camera technology makes it impossible to install cameras at intersections $(i-1, j)$, $(i+1, j)$, $(i, j-1)$, and $(i, j+1)$ (for those intersections that exist) if there is a camera at intersection (i, j). As you can guess, they would like to select intersections where to install cameras in order to maximize the total number of accidents prevented.



(a) Write a greedy algorithm to try and select intersections in order to maximize the total number of accidents prevented. (HINT: There is a natural greedy strategy to try here—use it!—the goal is *not* to come up with a fancy algorithm.)

Then, give a precise counter-example to show that your greedy algorithm does not always find an optimum solution. State clearly the solution found by your algorithm, and show that it is not optimum by giving another selection with a larger number of accidents prevented.

(b) Find and prove a bound on the approximation ratio of your algorithm. (HINT: Let S be the selection returned by your greedy algorithm and let T be any other valid selection of intersections. Show that for all $(i, j) \in T$, either $(i, j) \in S$ or there is an adjacent $(i', j') \in S$ with $a_{i',j'} \geqslant a_{i,j}$. What does this means for all $(i, j) \in S$ and their adjacent corners?)