CPSC 320 2016W2: Quiz 5 Pre-Release Information

March 14, 2017

For Friday only: This week's quizzes will follow up on the problem domains described below. It's worth spending a few minutes reading and understanding each domain before your tutorial!

Note that if you collaborate on understanding this information, you should follow the academic conduct guidelines. Among other rules, take down the GradeScope student #s or account names of collaborators for acknowledgment, but take **no other notes** away from those collaborations!

NOTE: The names of problems and (on the quiz and assignment) subproblems are often intended to be fun and are completely irrelevant. Feel free to ignore them here, on the quiz, and on the assignment!

1 Ruler of My Non-Domain

There's no domain information for this problem. Amazing but true! :)

2 Parking in Wonderland

RECALL the parking optimization problem from quiz 3:

> A company called Wonderland offers several types of parking permits to its employees, with different durations and prices. The co-op student Alice will work in Wonderland for n consecutive days. She wants to figure out the cheapest collection of parking permits that would cover all days she needs to be present at work. Alice can buy as many permits of a given type as she likes. Let's assume there are k type of permits $1, \ldots, k$: the price of permit type t is p_t dollars and duration d_t. Alice needs to stay at work on n consecutive days. Our goal is to help Alice figure out how to park for all n days as cheaply as possible.

3 Pwner of All I Survey

You're managing an online survey. You have a training set of responses to the survey. From this you have extracted the average time spent on each of the survey's n questions (numbered 1 through n).

You're using this to optimize later offerings of the same survey. In particular, you are "paginating" the survey. You are leaving the questions in the same order but breaking them up into pages. (So, for example, questions 1–4 may be on page 1, in which case question 5 will start page 2. Each page will have at least one question.)

You're particularly interested in the average time a page takes (i.e., the total of the average times of the questions on that page) compared to the maximum time that any one question takes on average, which we call m. You have decided that no page should take more than $2m$ time (on average).

4 Seam Carving

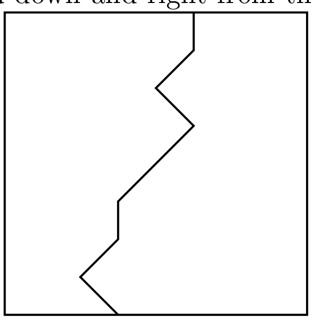
You can resize an image by scaling or cropping it, but what if the pieces of the image that you want are not all in one rectangular area, and you don't want to make those parts of the image smaller by scaling?[1]

In that case, you might instead choose to eliminate one pixel from each row (to make the image one pixel narrower) or one pixel from each column (to make the image shorter) while somehow optimizing for the "best" pixels to remove. In this problem, we focus on removing one pixel from each row.

We'll assume an image is an n column by m row array of pixels $A[1 \ldots n][1 \ldots m]$, where each pixel is an "energy" rather than a color. Energies are non-negative numbers representing the importance of the pixel.

A legal seam must include one pixel from every row. Each pair of seam pixels in neighbouring rows must be either in the same column or one column apart (i.e., on a diagonal). The cost of a seam is the total energy of all the pixels in the seam. The best seam is the one with lowest cost.

So, a seam of pixels to remove often looks a little like a "lightning bolt" moving down, down-and-left, and down-and-right from the top to the bottom of the image, such as this:



[1]This method was developed by Avidan and Shamir.