09–27

CS 53, Fall 2017

Due September 29 at 2:59 pm

- 4.17.1 (auto-graded)

- the following procedures of `mat.py` (auto-graded):

    - `getitem`
    - `equal`
    - `add`
    - `scalar_mul`

Problem 1: The coordinates of a pixel in an image is (r, c) where r is the row index and c is the column index. Grayscale images with four rows of pixels and six columns can be represented as vectors over $\mathbb{R}$ with domain

$C =$\{(0, 0), (0, 1), (0, 2), (0, 3),(0, 4), (0, 5), (1, 0), (1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (2, 0), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (3, 0), (3, 1), (3, 2), (3, 3), (3, 4), (3, 5)\}

**Part 1: Write a Vec v of this form, using random integers between 1 and 255 as the entries**.

Similarly, grayscale images with two rows and three columns of pixels can be represented as vectors over $\mathbb{R}$ with domain
$$R = \{(0,0), (0,1), (0,2), (1,0), (1,1), (1,2)\}$$

Let f be the function such that

- the input is a C-vector x

- the output is an R-vector x

- if the input represents the original image with six columns and four rows of pixels, the output represents the downsampled image with three columns and two rows of pixels. Each pixel intensity in the output image is the average of the pixel intensities of four pixels in the input image.

Let A be the row-matrix such that downsampling from 6×4 images to 3×2 images is the function $x \mapsto Ax$.
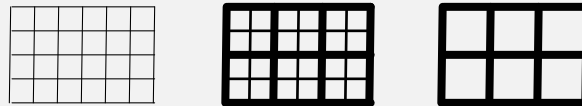
Part 2: Write A as a Mat in Python. Show the result of multiplying A by the vector v. **Hint:** Perhaps you have not not yet written the matrix-vector multiplication operation for Mat. To help with this calculation, thererfore, you might want to use procedures from the `matutil` module.