CS 116 Homework 1

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Q3:

We assume that each sub-question has knowledge of the explanation of all sub-questions before it.

(a) Result: $a = [5 : 15], b = [5, 8, 11, 14]$.

Explanation: $[J : K]$ is the same as $[J, J + 1, ..., J + m]$, where $m = fix(K - J)$; and $[J : I : K]$ is the same as $[J, J + I, ..., J + m \times I]$, where $m = fix((K - J)/I)$. $fix(X)$ rounds the elements of X to the nearest integers towards zero. *end* here serves as the last index in an indexing expression. When X is positive, it means taking floor of the result. Therefore b will have $I = 3$, and $m = fix((15 - 5)/3) = 3$. Hence the result is $b = [5, 5 + 3, 5 + 2 \times 3, 5 + 3 \times 3] = [5, 8, 11, 14]$.

(b) Result: $f = [1501 : 2000], g = [351 : 500], h = [1851 : 2000]$.

Explanation: $find(X)$ returns the linear indices corresponding to the nonzero entries of the array X. X may be a logical expression. Therefore $find(f > 1850)$ returns the indices in f with value greater than 1850, which is from $1851 - 1501 + 1 = 351$ to $2000 - 1501 + 1 = 500$. Hence $g = [351 : 500]$. The parenthesis after an array returns the value in the array specified by the indices in the parenthesis. Therefore $f(g)$ returns the 351st element to the 500th element in the f array, which is $1501 + 351 - 1 = 1851$ to $1501 + 500 - 1 = 2000$. Hence $h = [1851 : 2000]$.

(c) Result: $x = [22, 22, 22, 22, 22, 22, 22, 22, 22, 22], y = 220$.

Explanation: $ones(M, N)$ is an M-by-N matrix of ones. $X. * Y$ denotes element-by-element multiplication. Therefore $22. * ones(1, 10)$ means 22 element-wise-multiply a 1-by-10 matrix of 1, which is a 1-by-10 matrix of 22. Hence $x = [22, 22, 22, 22, 22, 22, 22, 22, 22, 22]$. $sum(X)$ is the sum of the elements of the vector X. Therefore $y = sum(x) = 22 \times 10 = 220$.

(d) Result: $a = [1 : 100], b = [100, 99, 98, ..., 1]$.

Explanation: By (a) we know that $[J : I : K]$ is the same as $[J, J + I, ..., J + m \times I]$, where $m = fix((K - J)/I)$. Here $J = 100, I = -1$, $m = fix((1 - 100)/ - 1) = 99$, and therefore $b = [100, 100 - 1, 100 - 2, ..., 100 + 99 \times (-1)] = [100, 99, 98, ..., 1]$.

Q4:

(a) The core part is x = sort(reshape(A, 1, [])), which first sorts A and resizes it into 1×10000.

(b) Just use hist(A, 32). 32 here means 32 bins.

(c) Since x is sorted, we can simply let t = x(5000);, which means the median of A. Then the image A_c after thresholding is A_c = A $\geq$ t, which is a 0-1 matrix.

(d) First compute the mean m = mean(x), then the image A_d after mean-shifting is A_d = (A $\geq$ m).*(A-m). Here we multiply the result by (A $\geq$ m), which means if A is greater than m, then do mean shift (multiply by 1), otherwise multiply by 0.

(e) Just use reshape: z = reshape(y, 3, 2).

(f) First x = min(A(:)) finds the min value, then [r, c] = find(A==x) returns the row and column of x.

(g) We use size(unique(v), 2) to compute total numbers. Here unique() returns a unique vector of v, and then we count number of columns in this 1D vector.

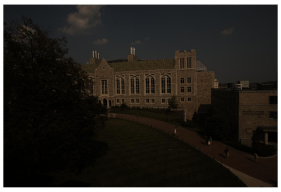
Q5:
For each set of pictures, we first create a zero matrix, and add each picture matrix to it. After the loop we just divide this matrix by the number of pictures and then we can get the result.


The result pictures, as shown above, are similar to the pictures provided in this question: they looks blurred heavily but one can still tell what they are. There are two main reasons: First, the images are cropped as same size and the objects are in the middle of the image with similar scale. Second, the objects in each image set share major features, and we can observe them from the result pictures: The averaged ship image - background with sky and ocean, ship with multiple sails, ship body darker than sails. The averaged aircraft image - background with sky and grassland, head higher than tail, with vertical tail and (blurred Landing gears).

Q6:
We implement the bilinear interpolation by using a ones(3, 3) filter on each RGB layer, with each missing value in each layer be the sum of all surrounding values. After dividing each new value by the number of non-zero neighbors they use, we complete the interpolation. Finally we combine the three RGB layers to a 3D matrix to return.


Ground Truth


Unprocessed Image


Demosaiced Image