Name: _____
(Legibly print last name, first name, middle name)

NetID: _____

Statement of integrity:
I did not, and will not, violate the rules of academic integrity on this exam.

_____ (Signature)

Q1:	(10)	_____ ____
Q2:	(20)	_____ ____
Q3:	(25)	_____ ____
Q4:	(20)	_____ ____
Q5:	(25)	_____ ____
Total:	(100)	_____ ____

Circle your lecture time: 9:05 or 11:15

Circle your section instructor's name:

	Tuesday	Wednesday
10:10		Hyundo Reiner
11:15		Jiexun Xu
12:20	Tim English	Michael Flashman
1:25	Nipun Jasuja	Chau Nguyen
2:30	Nipun Jasuja	Chau Nguyen
3:35	Jeff Ames	Ankit Arora

Instructions:

- This is a 90-minute, closed-book exam; no calculators are allowed.
- The exam is worth a total of 100 points, so it's about one point per minute!
- Read each problem completely, including any provided code, before starting it.
- Raise your hand if you have any questions.
- Use the backs of the pages or ask for additional sheets of paper as necessary.
- Clarity, conciseness, and good programming style count for credit.
- If you supply multiple answers, we will grade only one.
- Use only MATLAB code. No credit for code written in other programming languages.
- Assume there will be no input errors.
- Write user-defined functions only if asked to do so. Do not write subfunctions.
- Do not use `switch`, `try`, `catch`, `break`, or `continue` statements.
- You may find the following MATLAB predefined functions useful:
  `abs`, `sqrt`, `rem`, `floor`, `ceil`, `rand`, `zeros`, `ones`, `length`, `size`, `fprintf`, `disp`, `uint8`, `double`, `strcmp`, `cell`, `struct`, `fopen`, `fclose`, `feof`, `fgetl`

  Examples:
  `rem(5,2)` → 1, the remainder of 5 divided by 2
  `floor(6.9)`, `floor(6)` → 6, rounds down to the nearest integer
  `ceil(8.1)`, `ceil(9)` → 9, rounds up to the nearest integer
  `length([2 4 8])` → 3, the length of a vector
  `zeros(2,4)` → a 2-by-4 matrix of zeros, type `double`
  `strcmp('cat','Cat')` → 0, the two strings are not identical
  `struct('a',1,'b',0)` → a structure with 2 fields: a has value 1, b has value 0

Question 1: (10 points)

(a) What is the output from executing the following fragment? Write the word "error" instead of the output if executing the fragment would cause a run-time error.

```
M = [4 3 2; ...
     3 2 1; ...
     1 2 3];
for k = 1:3
    M(k,k) = M(M(k,k)-1, k);
end
disp(M)
```

Output:

(b) Consider the script below which reads a plain text file:

```
% Read a text file

fid = fopen('myfile.txt','r');



while ~feof(fid)



    s = fgetl(fid);



end



fclose(fid);
```

Add code to the script to determine and print the number of lines in the file that begins with the string `'POS'`. Do not modify or cross out the given statements and do not use built-in functions `find` or `strfind`.

Question 2: (20 points)

(a) Implement function `findMaxInMatrix` as specified. *Do not* use any built-in functions other than `size`.

```
function [row,col] = findMaxInMatrix(M)
% M(row,col) is the largest value in matrix M.  row and col are scalars.
% Assume M is not empty.  If the max value appears in multiple
% locations in M, (row,col) may be any one of those locations.
```

(b) Implement function `stringLengths` as specified.

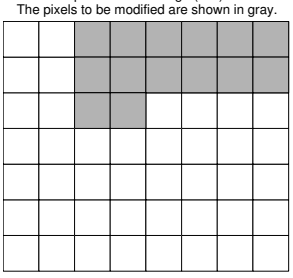
```
function len = stringLengths(S)
% Find the lengths of the strings in S, a 1-d cell array of strings.
% len is a vector that has the same length as cell array S.  len(k) is the
% length of the kth string in S.  S is not empty.
```

Question 3: (25 points)

Implement function `hide` as specified. *Do not* use vectorized code. Similar to the digital steganography problem in Project 4, you will modify the 3-d array of a color image by adding to (or subtracting from) the RGB values of a set of pixels.

```
function P = hide(P,vec,cs)
% Hide the values of vector vec in the image data array P, starting at pixel (1,cs).
% P is a 3-d uint8 array from a color image. (type uint8)
% vec is 1-d array of positive integer values; each value is less than 5. (type double)
%   Each value of vec is to be added to (or subtracted from) an RGB value of one pixel,
%   so the length of vec is the number of pixels to modify.  For the kth pixel to be
%   modified, select randomly one layer (red, green, or blue) with equal likelihood and
%   add (or subtract) vec(k).  Choose to add or subtract so that the range of type
%   uint8 is handled correctly.
% cs is a valid column index of array P.  Start the modification at pixel (1,cs),
%   continue to the right, and if necessary continue on the rows below starting at
%   column cs.  (See example diagram at bottom of page.)
% Assume array P is big enough to hide all the values in vec.
```

Example: cs=3 and length(vec)=14.
The pixels to be modified are shown in gray.



Question 4: (20 points)

Consider a Student structure (struct) that has three fields: `name`, `netID`, and `major`. All three fields store strings. Assume that each student has only one major and can be in only one college. Implement function `committee` as specified. Your code should be efficient—avoid unnecessary iterations.

```
function committee(E,A)
% Display all possible 3-member committees with one Engineering and two A&S students.
% The three members must have DIFFERENT majors--e.g., an Engineering CS major and an
% A&S CS major cannot both be on a committee.
% E and A are 1-d arrays of Student structs; each array has a length greater than 2.
% Array E holds the data of the Engineering candidates; array A holds the data of the
% A&S candidates.
% For each possible committee, display the NetIDs of the three members on one line.
% Display only unique committees.  For example, the committees "ac14 raf9 jer88" and
% "ac14 jer88 raf9" are duplicates and should not both be displayed.
```

Question 5: (25 points)

Consider the string `'matt uses matlab'`. We say that the word `'uses'` is located at index 6; i.e., the location of a word in a string is the index of the first letter of the word. Implement function `findPrefix` as specified. Note the example on the bottom of the page. *The only built-in functions allowed are* `size`, `length`, `strcmp`, and `cell`.

```
function C = findPrefix(M,p)
% Locate in matrix M all the words that begin with the string in p.
% M is a 2-d array of characters.
% p is a 1-d array of characters and is the prefix to locate.
% Assume all letters in M and p are in lower case.
% C is a 1-d cell array.  The rth cell in C is a vector, possibly empty, storing
% the locations (column indices) of the prefix p in row r of matrix M.
```

Example: The function call `C = findPrefix(M, 'mat')` where

```
M= ['there is a mat in the lab'; ...
    'there is a bat in the lab'; ...
    'matt uses matlab on a mat'; ...
    'format a plot in matlab  ']
```

results in a cell array `C` of length 4. The first cell stores the value 12, the second cell stores the empty vector, the third cell stores the vector [1 11 23], and the fourth cell stores the value 18.