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)

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

Circle your section number/instructor’s name:

<table>
<thead>
<tr>
<th>Tuesday</th>
<th>Wednesday</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:10</td>
<td>Sucheta Soundarajan</td>
</tr>
<tr>
<td>11:15</td>
<td>Josef Broder</td>
</tr>
<tr>
<td>12:20</td>
<td>Sucheta Soundarajan</td>
</tr>
<tr>
<td>1:25</td>
<td>Sucheta Soundarajan</td>
</tr>
<tr>
<td>2:30</td>
<td>Stefan Ragnarsson</td>
</tr>
<tr>
<td>3:35</td>
<td>Josef Broder</td>
</tr>
</tbody>
</table>

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 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 use switch, try, catch, or break statements.
- You may find the following MATLAB predefined functions useful:
  sqrt, rem, floor, ceil, rand, zeros, length, fprintf, disp, plot

Examples: rem(5, 2) → 1, the remainder of 5 divided by 2
          rand(1) → a random real value in interval (0,1)
          ceil(8.1), ceil(9) → 9, rounds up to the nearest integer
          length([2 4 8]) → 3, length of a vector
**Question 1:** (10 points)

**Part (a):** (4 points)

What will be displayed at the end of each fragment below? If there is an error write the word “error” in the box.

```
> w = [2 3];
> x = w(w(1))
```

```
z = [2 3 1];
for k = 1:length(z)
    z(k+1) = z(k);
end
> disp(z)
```

**Part (b):** (6 points)

What will be printed when the following script is executed?

<table>
<thead>
<tr>
<th>Script</th>
<th>Function</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>a=2; b=6; c=3; d= zoo(c,b); fprintf('a is %d\n', a); fprintf('b is %d\n', b); fprintf('c is %d\n', c); fprintf('d is %d\n', d);</td>
<td>function a = zoo(b,c) b= b/c; a= b; fprintf('c is %d\n', c); fprintf('d is %d\n', d);</td>
<td></td>
</tr>
</tbody>
</table>
Question 2: (20 points)

Complete each of the functions below according to the specifications. Do not use function find.

Part (a): (10 points)

```
function h = histData(yr, maj)
% h is the data for drawing a bar graph showing the number of UNDERGRADUATE
% students in each of the 90 majors at Cornell.
% yr and maj are vectors of the same length. For a valid index k:
% yr(k) is the year code of student k. Possible values are integers
% in [1..13]; values 1,2,3,4 indicate undergraduate.
% maj(k) is the major code of student k; possible values are integers
% in [1..90].
% Assume that the length of yr (and maj) is greater than 1.

h= zeros(1,90); % h(i) will be the number of undergrads in major i

bar(1:90, h)
title('Number of UNDERGRADUATE students in each major')
```

Part (b): (10 points)

```
function s = smoothVec(v)
% Smooth vector v by averaging each "interior" value with its left and right
% neighbors. s is the smoothed vector and is two components shorter than v.
% Example: If v=[-2 5 3 4 8] then s=[2 4 5]
% Assume that the length of v is greater than 2.
```
Question 3: (20 points)

Complete each of the functions below according to the specifications. Do not use function `find`.

Part (a): (6 points)

```matlab
function r = randInt(lo, hi)
    % r is a uniformly random INTEGER in [lo..hi].
    % lo and hi are integers.
```

Part (b): (14 points)

```matlab
function ind = myFind(x, v)
    % ind is the index of the first occurrence of value x in vector v.
    % If x is not found in v then ind is 0.
    % x is a scalar. v is a vector with length greater than 1.
    % For full credit your code should be efficient--stop as soon as x is found.
```
Question 4: (25 points)

Write the function header for the function below. The function name is `checkLengths`. It has two input parameters, `a` and `b`, and returns two vectors, `shortV` and `longV`.

% a and b are vectors with length>1; assume their lengths are different.
% shortV is the shorter vector between a and b
% longV is the longer vector between a and b

if length(a)<length(b)
    shortV= a;  longV= b;
else
    shortV= b;  longV= a;
end

Complete the function below to interleave two vectors. You must use function `checkLengths` from Part (a) above as part of your solution. Do not use vectorized code!

```matlab
function v = interleave(a,b)
% Interleave the values from vectors a and b to form vector v.
% a and b are vectors with length > 1; assume their lengths are different.
% The first value in v comes from the longer vector of a and b.
% The "leftover" values from the longer vector are copied to the end of v.
% For example, if a=[10 90 30] and b=[8 4 5 2 4]
% then v=[8 10 4 90 5 30 2 4]
% NO VECTORIZED CODE!
```
Question 5: (25 points)

Complete the function below to draw a set of grayscale disks arranged in a triangle. Read the specifications in the function comment. An example figure is shown on the right with \( n=6, s=0.5 \). Assume the availability of function \texttt{DrawDisk} and recall that you can specify a color in Matlab using a vector of length 3:

\[
\texttt{colr} = [1 \ 1 \ 1]; \quad \% \text{white}
\]
\[
\texttt{DrawDisk(5,0,1, colr)}
\]

draws a white disk with radius 1 centered at (5,0). The grid lines and “color values” are shown on the diagram on the right for your convenience; you do not have to draw them.

\[
\texttt{function grayness(n,s)}
\]
\[
\%	ext{ Draw a triangle of disks; there are } n \text{ disks on each side of the triangle.}
\%	ext{ The disk in row 1 is black } [0 \ 0 \ 0]; \text{ the disks in row } n \text{ are white } [1 \ 1 \ 1];
\%	ext{ the rows in between vary uniformly in grayness.}
\%	ext{ The disks have unit radius and are spaced } s \text{ units apart.}
\%	ext{ The center of the lower left disk is at } (0,0).
\]
\[
\texttt{close all; figure; axis equal; hold on}
\]

\[
\texttt{hold off}
\]