

Name: _____

Date: _____

Collaborators: _____

(Collaborators submit their individually written assignments together)

Question:	1	2	3	4	5	Total
Points:	15	20	15	20	10	80
Score:						

Instructor/grader comments:

Solving linear systems

1. Alice buys three apples, a dozen bananas, and one cantaloupe for \$2.36. Bob buys a dozen apples and two cantaloupes for \$5.26. Carol buys two bananas and three cantaloupes for \$2.77. How much do single pieces of each fruit cost?

(a) (5 points) In the space below write down the system of three linear equations with three unknowns that describe the problem:

(b) (5 points) In matrix notation, $Ax = b$, what are A and b for your system of equations:

(c) (5 points) Use matlab's backslash operator to solve the system of equations above. Store your code (generation of A and b , calling your function, printing the solution, etc.) in the file **hw02p1.m**. Place the command `clear` at the top of your script.

Hint: Use the command `format bank` to show numbers with only two digits after the decimal point.

2. (20 points) Write a script (place it into a file **hw02p2.m**) that uses the function `hw02p2data` (available for download from the class website) to plot a figure consisting of four subplots that represent the data provided by the function using linear, loglog and semilogx/semilogy axes. Each subfigure should have grid, a title, and axes labels. Use a linestyle that marks the data points and connects them with a line. The very first two command in your script must be `clear` and `clf`.

Hint: to plot a figure consisting e.g. of 3x3 grid of nine subplots, use the following script (here $n = 1, 2, \dots, 9$):

```
figure(1)

...
...
subplot(3, 3, n)
plot(x, y, '.-')
title('Linear plot')
xlabel('x')
ylabel('y')
grid on
...
...
```

3. Floating point numbers typically represented in computers in the following binary form:

$$\pm \left(1 + \frac{b_1}{2} + \frac{b_2}{2^2} + \dots + \frac{b_d}{2^d} \right) \times 2^E$$

- (a) (5 points) What is the (approximate) value of machine epsilon for a microprocessor that uses $d = 10$? Briefly explain.
- (b) (5 points) For the same microprocessor, how many floating point numbers x , such that $4 \leq x \leq 8$ are there? Briefly explain.
- (c) (5 points) For the same microprocessor, assuming that the largest value of E is 16, what is (approximately) the largest positive floating point number? Briefly

explain.

4. In statistics one defines the mean and the variance of sample values x_1, \dots, x_n by

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i,$$

$$\sigma^2 = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2.$$

- (a) (10 points) Write a matlab function **hw02p4stat(x)** that takes as input a vector x of any length, and returns \bar{x} and σ^2 calculated using the formulas above. Use *for* loops in your code. Place the code of the function into a dedicated file.
- (b) (10 points) Write a matlab script **hw02p4.m** that uses your function to calculate the mean and the variance for a random vector of length $n = 1000$. Place the command `clear` at the top of your script. Properly seed your random number generator. Compare your results to matlab's built in functions *mean* and *var*.

Gitlab

5. (10 points) Create a gitlab project called **hw02** (name it exactly as shown). Upload **all** matlab files that are required to run your code. Share the project with the instructor and the TAs and grant them **Reporter** privileges.