Name: _____

Date: _____

Collaborators: _____

(Collaborators submit their individually written assignments together)

Question:	1	2	Total
Points:	55	10	65
Score:			

Instructor/grader comments:

BVPs for ODEs

1. The Blasius' equation is the following nonlinear third-order ordinary differential equation for a function of a single variable, $f(x)$, that describes the two-dimensional laminar viscous fluid flow along a flat plate in the absence of stream-wise pressure gradient.

$$2f''' + f''f = 0,$$

where the prime denotes derivation with respect to x.

The boundary conditions for the Blasius' equation are as following:

$$f(0) = 0, \qquad f'(0) = 0, \qquad f'(\infty) = 1.$$

The task is to solve the BVP for Blasius' equation by the shooting method.

(a) (10 points) (pen and paper problem) Rewrite the Blasius' equation as a system of three first order differential equations.

(b) (5 points) Replace the boundary condition at infinity by the condition at the sufficiently large value of x of your choice. (When you have the running code, try several values to verify that your choice is acceptable.)

(c) (30 points) Write the function `hw06shoot` that implements the shooting method to solve the two-point BVP for Blasius' equation:

```
function [x, f, dfdx, d2fdx2] = hw06shoot(xspan, fppinit)
% HW06SHOOT   Shooting method for the two-point BVP
%             for Blasius' equation
%
% Input:
%   xspan    endpoints of the domain (vector)
%   fppinit  initial guess for f''(0) (scalar)
%
% Output:
%   x        nodes in x
%   f        values of f(x)
%   dfdx     values of f'(x)
%   d2fdx2   values of f''(x)
```

Use the code of the function `shoot` that we discussed in class as a template for your code.

(d) (10 points) Write a matlab script that solves the BVP for the Blasius' equation.

On the same graph plot $f'(x)$ and $f''(x)$.

Provide axes labels, a grid, a legend, and a title for your graph.

Print the value of $f''(0)$. (The value (that should be close to 1/3) is called the Blasius constant; it determines the value of the drag force on the plate.)

Place the commands `clear`, `clf` at the top of your script.

Place the code you wrote for this part of the homework into a matlab file **hw06p1.m**

Gitlab

2. (10 points) Create a gitlab project called **hw06** (name it exactly as shown). Upload **all** Matlab files that are needed to run your code.

   Scan your answers/solutions of Problems 1(a), combine all scans into a single pdf file (call it **hw06.pdf**) and upload it to Gitlab. **Do not** upload other types of files (e.g. no graphics files or multiple pdf files).

   Share the project with the instructor and the grader and grant them **Reporter** privileges.