

**SUNIVERSITY OF DAYTON**  
**Department of Computer Science**  
**CPS 530 - Algorithm Design**  
**Spring 2020 Assignment 1 (100 pts)**  
**Due: February 26, 2020 by 11:55pm**

**(50 pts)**

1. Implement Gale-Shapley Algorithm for computing Stable Marriage Assignment in any language, such as ***Python, Java, C++ or MATLAB***, using the approach and data structures described in the first two Chapters of the Kleinberg and Tardos text. The input file should include number of subjects,  $n$ , preference list for men and women one line for each.

$$\begin{array}{c} n \\ m_1: w_{11}, w_{12}, \dots, w_{1n} \\ \dots \\ m_n: w_{n1}, w_{n2}, \dots, w_{nn} \\ w_1: m_{11}, m_{12}, \dots, m_{1n} \\ \dots \\ w_n: m_{n1}, m_{n2}, \dots, m_{nn} \end{array}$$

- a) Write a function to create preference lists for men and women. Function should take number of men (women), say  $n$ , create preferences and output them.
- b) Write the output, explicitly checking to see that it is a stable match (It requires a separate function to check). Turn in sample inputs and corresponding outputs in separate files.
- c) Run the algorithm on several instances of the problem for  $n = 10$  with different input files and plot the variation in the running time.
- d) Run the algorithm on several instances of the problem for  $n = 10$  with the same input file and plot the variation in the running time.
- e) Run the algorithm on problem instances with  $n = 10, 15, 20, 50, 100$ , and plot the average running time as a function of the problem input size ( $n$ ).
- f) Run the algorithm on several instances of the problem for  $n = 10$  with the same input file, let a different man start proposing and output the matches.

2. (20 pts)

- Run Gale-Shapley Algorithm and show your steps using the preference lists tables below. Are there any unstable pairs in the final match?
- Modify Gale-Shapley Algorithm such that women will propose instead of men. Show the final match.
- Compare and discuss the matches produced above in terms of men-optimality/women-pessimality and women-optimality/men-pessimality.

	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
Xavier	Amy	Clare	Bertha
Yancey	Bertha	Clare	Amy
Zeus	Clare	Amy	Bertha

	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
Amy	Xavier	Yancey	Zeus
Bertha	Xavier	Yancey	Zeus
Clare	Xavier	Yancey	Zeus

(15 pts)

- Do Problem 3 in Chapter 2 on page 67 of the Kleinberg and Tardos text. Provide a “clear” explanation in each case.

(15 pts)

- Do Problem 1 in Chapter 3 on page 107 of the Kleinberg and Tardos text. Look at solved exercise 1 on page 104 as an example.

You can write your answers for the questions 2 through 4 on paper, scan and create a pdf file.

**TURNIN:** Bundle your source code, sample inputs/results, timing plots and answers of each question as a single zip archive, name it using “lastname-firstname” format, and submit to Isidore by the deadline.