

上海交通大学试卷

(2014–2015 Academic Year / Summer Semester)

Class No. _____ Student No. _____ Name (Chinese & Pin Yin) _____

Course Title _____ Grade _____

Mid-term Exam 1 – VG101 Introduction to Computer and Programming

June 9th, 2015, 14:00 – 15:40

You are to abide by the University of Michigan-Shanghai Jiao Tong University Joint Institute (UM-SJTU JI) honor code. Please sign below to signify that you have kept the honor code pledge.

THE UM-SJTU JI HONOR CODE

I accept the letter and spirit of the honor code.

I have neither given nor received aid on this examination, nor have I concealed a violation of the Honor Code.

Signature: _____

Important notes

- ❑ Write the source code for each problem in a different file (e.g. ex1.m)
- ❑ For each source file, write a corresponding README file (e.g. README.ex1), containing clear explanations on your work. This file **must** be in text format (in particular: no Word or PDF).
- ❑ Create an archive `yourID_exam1.{zip|rar|tar}` containing all the previous files
- ❑ Post the archive on [Sakai](#), under the assignment corresponding to your room number
- ❑ Allowed documents: course slides, personal notes and MATLAB documentation
- ❑ The use of a dictionary is allowed
- ❑ Any kind of communication is strictly prohibited, **no internet connection**
- ❑ Duration: 100 min

Ex. 1 — Graph — [50 marks]

The goal of this exercise is to generate n random points and link them following four rules:

- The first point is not random but defined to be $(0,0)$.
- Link the i -th point to its closest neighbor if i is even.
- Link the i -th point to its furthestest neighbor if i is odd.
- The n -th point is connected to the first point.

1. In the README file, write a clear algorithm describing how to construct the graph.
2. Write a MATLAB function taking as input n . The function should plot all the points and then construct all the edges, displaying them as they are added.

Hint 1: a matrix can be used to represent the distance between each point of the graph. For instance the distance between nodes i and j can be represented by the matrix entry (i,j) .

Hint 2: by default MATLAB only shows a plot at the end of the computation. However it is possible to update the figure window at each iteration in a loop using an appropriate command.

Ex. 2 — Economics — [20 marks]

For 20 years a company has sustained a 2.4% increase over the previous year. Knowing that on the 10th year the benefits amounted to \$10,000, write a MATLAB script to calculate the benefits at the end of each years. Assuming the 20th year is 2015, dump the results in a file where each line is composed of a 32-bit integer representing the year and a float corresponding to the benefits on that year.

Hint: an exponential growth of 2.4% means that the company improves on the results of the previous year by 2.4%. In other words the benefits b_i of year i are given by $b_i = b_{i-1} \cdot 102.4\%$.

Ex. 3 — Image manipulation — [30 marks]

In this exercise we will use the colour image from figure 1 displayed below. Extract the picture from the file and work on it using MATLAB.

MATLAB reads an image into a 3-dimensional array. Each pixel of the picture is represented in this matrix by a 3-dimensional vector with values in the range $[0,255]$. These 3 numbers express the amount of Red Green Blue (RGB). For instance a picture of size 640x480 will be represented as an array of size 480x640x3 (480 rows, 640 columns, 3 components (RGB) for each pixel).

Write a MATLAB script which reads an image and displays three pictures in a figure. The sub-figures consist of the original image, the inverse of the Red channel and the blue channel. Each sub-figure should have a label specifying the name of the variation. Those actions should be performed through the script. Then the resulting figure should be saved into a .jpg file and added it to the archive.

Hint 1: `imread, image`

Hint 2: in an inverse image the value of each pixel is subtracted from the maximum pixel value.



Figure 1: Image to save and manipulate in MATLAB