Universidad Nacional de Ingeniería
Facultad de Ciencias

Fundamentos de Programación

Proyecto del Curso. Parte I. Ejercicios de Programación

Presentación del proyecto:
Tipo de letra: Times New Román, el código de los programas debe estar en Courier New
Tamaño de letra: 12 para el texto, 10 para el código de los programas.
Espaciado: simple

Estructura del proyecto: El proyecto debe contener como mínimo, el índice, la introducción, el enunciado de cada ejercicio, el análisis de cada ejercicio, la explicación de la técnica usada, el código de los programas, conclusión y apéndice.

Presentación: Se presentará una versión en PDF. Los códigos se enviarán en formato ZIP.
Forma de envío de los códigos: por correo electrónico al profesor de práctica.

Fecha límite de entrega: lunes 13 de Julio 2020.

Calificación: Se calificará la estructura del proyecto, la calidad de los programas, el estilo de programación y la documentación.

Lista de Ejercicios para el Proyecto

1. En una ciudad existen tres jefaturas de policía (comisarías). En cada una de ellas procesan los presos según el tipo de pista (indicio) en contra que tengan. Las pistas se clasifican en:

Tipo de pista	Puntuación
A	20
B	15
C	30

Un preso tiene M pistas en contra, las cuales pueden ser de cualquier tipo. Se desea un programa que procese los **n** presos de cada comisaría y produzca la siguiente información:

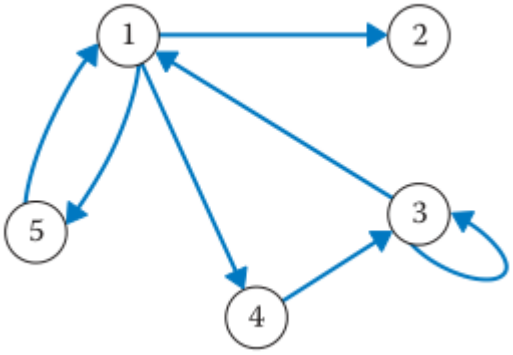
Para cada comisaría:

- Estatus de cada preso de acuerdo a la siguiente tabla:

Puntuación Total	Estatus
Más de 85	Culpable
Más de 65 menos de 85	Sospechoso de alto riesgo
Menos de 65	Sospechoso de bajo riesgo

- Cuántos presos hay.
- Cuál es el tipo de pista más frecuente.
- Porcentaje de cada tipo de pista.

2. A **directed graph,** or digraph, consists of a set of vertices and a set of directed arcs joining certain of these vertices. For example, the following diagram pictures a directed graph having five vertices numbered 1, 2, 3, 4, and 5, and seven directed arcs joining vertices 1 to 2, 1 to 4, 1 to 5, 3 to 1, 3 to itself, 4 to 3, and 5 to 1:



A directed graph having n vertices can be represented by its adjacency matrix, which is an n × n matrix, with the entry in the ith row and jth column 1 if vertex i is joined to vertex j, and 0 otherwise. The adjacency matrix for this graph is

$$\begin{bmatrix} 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix}$$

If a is the adjacency matrix for a directed graph, the entry in the ith row and jth column of Ak gives the number of ways that vertex j can be reached from the vertex i by following k edges. Write a program to read the number of vertices in a directed graph and a collection of ordered pairs of vertices representing directed arcs, construct the adjacency matrix, and then find the number of ways that each vertex can be reached from every other vertex by following k edges for some value of k.

3. A **Markov chain** is a system that moves through a discrete set of states in such a way that when the system is in state i there is probability Pij that it will next move to state j. These probabilities are given by a transition matrix P, whose (i, j) entry is Pij. It is easy to show that the (i, j) entry of Pn then gives the probability of starting in state I and ending in state j after n steps.

To illustrate, suppose there are two containers A and B containing a given number of objects. At each instant, an object is chosen at random and is transferred to the other container. This is a Markov chain if we take as a state the number of objects in container A and let Pij be the probability that a ball is transferred from A to B if there are i balls in container A. For example, for four objects, the transition matrix P is given by

$$\begin{bmatrix} 0 & 1 & 0 & 0 & 0 \\ 1/4 & 0 & 3/4 & 0 & 0 \\ 0 & 1/2 & 0 & 1/2 & 0 \\ 0 & 0 & 3/4 & 0 & 1/4 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix}$$

Write a program that reads a transition matrix P for such a Markov chain and calculates and displays the value of n and Pn for several values of n.

4. Research the method of least squares for finding the equation of a line that best fits a set of data points. This method can also be used to find best-fitting curves of higher degree. For example, to find the equation of the parabola

$$y = A + Bx + Cx^2$$

that best fits a set of n data points, the values of a, B, and C must be determined for which the sum of the squares of the deviations of the observed y-values from the predicted y-values (using the equation) is as small as possible. These values are found by solving the linear system

$$nA + \left(\sum x\right)B + \left(\sum x^2\right)C = \sum y$$

$$\left(\sum x\right)A + \left(\sum x^2\right)B + \left(\sum x^3\right)C = \sum xy$$

$$\left(\sum x^2\right)A + \left(\sum x^3\right)B + \left(\sum x^4\right)C = \sum x^2 y$$

Find the equation of the least-squares parabola for the following set of data points:

x	y
0.05	0.957
0.12	0.851
0.15	0.832
0.30	0.720
0.45	0.583
0.70	0.378
0.84	0.295
1.05	0.156
