Shiv Nadar University

CSD101: Introduction to Computing and Programming

Lab #7

Max marks: 85
Due on/before:22.00, 18-Oct-2021. 4-Oct-2021

1. A *rational number* is an number of the form $\frac{m}{n}$ where both m and n are integers - we often call them fractions. A rational number is said to be in *normal form* when the when the largest divisor of m and n is 1. For example, $\frac{2}{4}$, $\frac{7}{14}$ have the normal form $\frac{1}{2}$. We will represent rational numbers with arrays of size 2 with index 0 as the numerator and 1 as the denominator. Later, after we study pointers, we will use pointers integers to do this more naturally.
   (a) Write a function `normalize` that takes a rational number and normalizes it.
   (b) Write functions to do arithmetic with rational numbers. That is implement the operations: add, subtract, multiply and divide. Each operation takes two rational numbers and returns a normalized result whichi is the result of doing the said operation on those numbers.

[10,40=50]

2. In this question you will represent and manipulate 2D vectors. We know that we can represent a 2D vector using an X-Y coordinate system and a pair of real numbers (x, y) - called the Cartesian representation. A vector can also be expressed in polar coordinates using the magnitude (r) and angle (θ) measured counterclockwise from the positive X-axis (r, θ) - polar representation.

   Represent a vector with an array of size two and implement the following operations (for the definitions of the operations see the Wikipedia or any elementary book on vectors) as functions. You can use functions from the library `math.h` where needed.
   (a) Addition, subtraction and multiplication with a constant.
   (b) Convert from the Cartesian representation and from the polar representation to the Cartesian one.
   (c) Scalar or dot product of two vectors. Vector product of two vectors. Create a unit vector corresponding to a given vector.
   (d) Tests for whether two vectors are orthogonal to each other or parallel to each other.
   (e) Given two vectors find the angle between the two vectors.

[6,8,12,6,3=35]