

## COMPUTER PROGRAMMING I

## KEYS TO MIDTERM EXAM

This is a 90-Minute Exam

Q.1)	Q.2)	Q.3)	Q.4)
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Q.1) (20) Write a function to calculate the area of a triangle with side lengths  $a$ ,  $b$ , and  $c$ . The area can be computed using the Heron's formula:  $Area = \sqrt{s \times (s - a) \times (s - b) \times (s - c)}$  where  $s = \frac{1}{2}(a + b + c)$ . For  $a$ ,  $b$ , and  $c$  to form a triangle, two conditions must be satisfied. First, all side lengths must be positive:  $a > 0, b > 0, c > 0$ . Second, the sum of any two side lengths must be greater than the third side length:  $a + b > c, b + c > a$ , or  $a + c > b$ .

```
from math import sqrt

def get_triangle_area(a,b,c):
    if a <= 0 or b <= 0 or c <= 0:
        raise ValueError("All side lengths must be positive!")
    if (a + b) > c or (a + c) > b or (b + c) > a:
        s = 0.5 * (a + b + c)
        return sqrt(s * (s-a) * (s-b) * (s-c))
    raise ValueError("This is not a valid triangle!")

print(f"get_triangle_area(4,13,15): {get_triangle_area(8,4,5)}")
```

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Q.2) (45) A quadratic equation of the form

$$Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$$

with the product  $ABC \neq 0$  corresponds to a conic section (parabola, ellipse, circle, or hyperbola). The type of conic section is determined by the values of the *characteristic* and the *discriminant*. The **discriminant** is the value  $B^2 - 4AC$ , and the **characteristic** is

$$\begin{vmatrix} A & B/2 & D/2 \\ B/2 & C & E/2 \\ D/2 & E/2 & F \end{vmatrix} = A \begin{vmatrix} C & E/2 \\ E/2 & F \end{vmatrix} - \frac{B}{2} \begin{vmatrix} B/2 & E/2 \\ D/2 & F \end{vmatrix} + \frac{D}{2} \begin{vmatrix} B/2 & C \\ D/2 & E/2 \end{vmatrix} \quad \text{where} \quad \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc.$$

The resulting conic sections are classified as follows:

Discriminant	Characteristic	Type of Conic Section
0	$\neq 0$	Nondegenerate Parabola
0	0	Degenerate Parabola
<0	$\neq 0$	Nondegenerate ellipse or circle
<0	0	Degenerate Ellipse
>0	$\neq 0$	Nondegenerate Hyperbola
>0	0	Degenerate Hyperbola

```
def get_discriminant(a,b,c):
    return b*b-4*a*c

def get_determinant(a,b,c,d):
    return a*d-b*c

def get_characteristic(A,B,C,D,E,F):
    return A * get_determinant(C, E / 2, E / 2, F)
        - (B/2) * get_determinant(B / 2, E / 2, D / 2, F)
        + (D/2) * get_determinant(B / 2, C, D / 2, E / 2)

def get_type_of_conic(A,B,C,D,E,F):
    discriminant = get_discriminant(A,B,C)
    characteritic = get_characteristic(A,B,C,D,E,F)
    if discriminant == 0 and characteristic != 0:
        return "Nondegenerate Parabola"
    elif discriminant == 0 and characteristic == 0:
        return "Degenerate Parabola"
    elif discriminant < 0 and characteristic != 0:
        return "Nondegenerate ellipse or circle"
    elif discriminant < 0 and characteristic == 0:
        return "Degenerate Ellipse"
    elif discriminant > 0 and characteristic != 0:
        return "Nondegenerate Hyperbola"
    elif discriminant > 0 and characteristic == 0:
        return "Degenerate Hyperbola"
```

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Q.3) (15) What is the output of the following script? Write your answer inside the boxes.

```
def fun(t):
    a, b, c = t
    if a <= b <= c:
        return b
    elif b <= a <= c:
        return a
    else:
        return c

for u in [(7,2,4), (22,15,33), (14,15,16)]:
    print(f"fun({u}): {fun(u)}")
```

fun((7, 2, 4)): 4
fun((22, 15, 33)): 22
fun((14, 15, 16)): 15

Q.4) (20) What is the output of the following script? Write your answer inside the boxes.

```
for i in range(0,5):
    for j in range(0,10):
        if 5-i <= j <= 5+i:
            print("*",end="")
        else:
            print(" ",end="")
    print()
```

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				*	*	*				
			*	*	*	*	*			
		*	*	*	*	*	*	*		
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