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import math
import cmath

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#  SCIENTIFIC CALCULATOR - COLLEGE PROJECT
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def basic_operations(): 1 usage
    print("\n--- Basic Operations ---")
    print("1. Addition")
    print("2. Subtraction")
    print("3. Multiplication")
    print("4. Division")

    ch = int(input("Enter your choice: "))
    a = float(input("Enter first number: "))
    b = float(input("Enter second number: "))

    if ch == 1:
        print("Result =", a + b)
    elif ch == 2:
        print("Result =", a - b)
    elif ch == 3:
        print("Result =", a * b)
    elif ch == 4:
        if b != 0:

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        if b != 0:
            print("Result =", a / b)
        else:
            print("Error: Cannot divide by zero")
    else:
        print("Invalid choice")

def trigonometry(): 1 usage
    print("\n--- Trigonometric Operations ---")
    print("1. sin(x)")
    print("2. cos(x)")
    print("3. tan(x)")
    print("4. arcsin(x)")
    print("5. arccos(x)")
    print("6. arctan(x)")

    ch = int(input("Enter your choice: "))
    x = float(input("Enter value (in radians): "))

    if ch == 1:
        print("sin =", math.sin(x))
    elif ch == 2:
        print("cos =", math.cos(x))

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        print("cos =", math.cos(x))
    elif ch == 3:
        print("tan =", math.tan(x))
    elif ch == 4:
        print("arcsin =", math.asin(x))
    elif ch == 5:
        print("arccos =", math.acos(x))
    elif ch == 6:
        print("arctan =", math.atan(x))
    else:
        print("Invalid choice")

def logarithmic(): 1 usage
    print("\n--- Logarithmic Operations ---")
    print("1. Natural log (ln)")
    print("2. log base 10")
    print("3. log with custom base")

    ch = int(input("Enter your choice: "))
    x = float(input("Enter value: "))

    if x <= 0:
        print("Log undefined for non-positive numbers.")
        return

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    if ch == 1:
        print("ln =", math.log(x))
    elif ch == 2:
        print("log10 =", math.log10(x))
    elif ch == 3:
        base = float(input("Enter base: "))
        print("log base", base, "=", math.log(x, base))
    else:
        print("Invalid choice")

def power_operations(): 1 usage
    print("\n--- Power and Root Operations ---")
    print("1. Power (a^b)")
    print("2. Square root")
    print("3. Cube root")
    print("4. nth root")

    ch = int(input("Enter your choice: "))

    if ch == 1:
        a = float(input("Enter base: "))
        b = float(input("Enter exponent: "))
        print("Result =", math.pow(a, b))

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ch = int(input("Enter your choice: "))

if ch == 1:
    a = float(input("Enter base: "))
    b = float(input("Enter exponent: "))
    print("Result =", math.pow(a, b))

elif ch == 2:
    a = float(input("Enter number: "))
    print("Square root =", math.sqrt(a))

elif ch == 3:
    a = float(input("Enter number: "))
    print("Cube root =", a ** (1 / 3))

elif ch == 4:
    a = float(input("Enter number: "))
    n = float(input("Enter root value (n): "))
    print("nth root =", a ** (1 / n))

else:
    print("Invalid choice")

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def factorial_gcd_lcm(): 1 usage
print("\n--- Factorial, GCD, LCM ---")
print("1. Factorial")
print("2. GCD")
print("3. LCM")

ch = int(input("Enter your choice: "))

if ch == 1:
    n = int(input("Enter number: "))
    print("Factorial =", math.factorial(n))

elif ch == 2:
    a = int(input("Enter first number: "))
    b = int(input("Enter second number: "))
    print("GCD =", math.gcd(*integers: a, b))

elif ch == 3:
    a = int(input("Enter first number: "))
    b = int(input("Enter second number: "))
    print("LCM =", abs(a * b) // math.gcd(*integers: a, b))

else:
    print("Invalid choice")

def complex_operations(): 1 usage

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def complex_operations(): 1 usage
    print("\n--- Complex Number Operations ---")
    print("1. Addition")
    print("2. Subtraction")
    print("3. Multiplication")
    print("4. Division")
    print("5. Magnitude")

    ch = int(input("Enter choice: "))

    a = complex(input("Enter first complex number (e.g., 2+3j): "))
    b = complex(input("Enter second complex number: "))

    if ch == 1:
        print("Result =", a + b)
    elif ch == 2:
        print("Result =", a - b)
    elif ch == 3:
        print("Result =", a * b)
    elif ch == 4:
        print("Result =", a / b)
    elif ch == 5:
        print("Magnitude a =", abs(a))
        print("Magnitude b =", abs(b))
    else:
        print("Invalid choice")

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def matrix_operations(): 1 usage
    print("\n--- Matrix Operations (2x2 only) ---")
    print("1. Addition")
    print("2. Subtraction")
    print("3. Multiplication")
    print("4. Determinant")

    ch = int(input("Enter your choice: "))

    print("Enter values for Matrix A (2x2):")
    a = [[float(input()) for _ in range(2)] for _ in range(2)]

    print("Enter values for Matrix B (2x2):")
    b = [[float(input()) for _ in range(2)] for _ in range(2)]

    if ch == 1:
        res = [[a[i][j] + b[i][j] for j in range(2)] for i in range(2)]
        print("Result =", res)

    elif ch == 2:
        res = [[a[i][j] - b[i][j] for j in range(2)] for i in range(2)]
        print("Result =", res)

    elif ch == 3:
        res = [[sum(a[i][k] * b[k][j] for k in range(2)) for j in range(2)] for i in range(2)]
        print("Result =", res)

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def matrix_operations(): 1 usage
    print("\n--- Matrix Operations (2x2 only) ---")
    print("1. Addition")
    print("2. Subtraction")
    print("3. Multiplication")
    print("4. Determinant")

    ch = int(input("Enter your choice: "))

    print("Enter values for Matrix A (2x2):")
    a = [[float(input()) for _ in range(2)] for _ in range(2)]

    print("Enter values for Matrix B (2x2):")
    b = [[float(input()) for _ in range(2)] for _ in range(2)]

    if ch == 1:
        res = [[a[i][j] + b[i][j] for j in range(2)] for i in range(2)]
        print("Result =", res)

    elif ch == 2:
        res = [[a[i][j] - b[i][j] for j in range(2)] for i in range(2)]
        print("Result =", res)

    elif ch == 3:
        res = [[sum(a[i][k] * b[k][j] for k in range(2)) for j in range(2)] for i in range(2)]
        print("Result =", res)

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print("1. Linear equation ax + b = 0")
print("2. Quadratic equation ax2 + bx + c = 0")

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ch = int(input("Enter choice: "))

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if ch == 1:
    a = float(input("Enter a: "))
    b = float(input("Enter b: "))
    if a != 0:
        print("Solution x =", -b / a)
    else:
        print("Invalid equation")
elif ch == 2:
    a = float(input("Enter a: "))
    b = float(input("Enter b: "))
    c = float(input("Enter c: "))
    d = b ** 2 - 4 * a * c
    x1 = (-b + cmath.sqrt(d)) / (2 * a)
    x2 = (-b - cmath.sqrt(d)) / (2 * a)
    print("Roots are:", x1, "and", x2)
else:
    print("Invalid choice")

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def unit_conversion(): 1 usage
    print("\n--- Unit Conversion ---")

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def unit_conversion(): 1 usage
    print("\n--- Unit Conversion ---")
    print("1. Celsius → Fahrenheit")
    print("2. Fahrenheit → Celsius")
    print("3. Km → Miles")
    print("4. Miles → Km")

    ch = int(input("Enter choice: "))

    if ch == 1:
        c = float(input("Enter °C: "))
        print("°F =", (c * 9/5) + 32)

    elif ch == 2:
        f = float(input("Enter °F: "))
        print("°C =", (f - 32) * 5/9)

    elif ch == 3:
        km = float(input("Enter km: "))
        print("Miles =", km * 0.621371)

    elif ch == 4:
        m = float(input("Enter miles: "))
        print("Kilometers =", m / 0.621371)

    else:
        print("Invalid choice")

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        print("Kilometers =", m / 0.621371)

    else:
        print("Invalid choice")

# -----
# MAIN PROGRAM LOOP
# -----

def main(): 1 usage
    while True:
        print("\n===== SCIENTIFIC CALCULATOR =====")
        print("1. Basic Operations")
        print("2. Trigonometry")
        print("3. Logarithmic Functions")
        print("4. Power & Roots")
        print("5. Factorial | GCD | LCM")
        print("6. Complex Number Operations")
        print("7. Matrix Operations")
        print("8. Equation Solver")
        print("9. Unit Conversion")
        print("10. Exit")

        choice = int(input("Enter your choice:"))

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choice = int(input("Enter your choice:"))

if choice == 1:
    basic_operations()
elif choice == 2:
    trigonometry()
elif choice == 3:
    logarithmic()
elif choice == 4:
    power_operations()
elif choice == 5:
    factorial_gcd_lcm()
elif choice == 6:
    complex_operations()
elif choice == 7:
    matrix_operations()
elif choice == 8:
    equation_solver()
elif choice == 9:
    unit_conversion()
elif choice == 10:
    print("Exiting... Thank you!")
    break
else:
    print("Invalid choice. Try again!")

main()
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