Unit 2: Using Variables and Expressions

In Unit 2 you learned to write programs to evaluate some mathematical formulas.

Objectives:

- Try these additional tasks to practice what you learned in Unit 2.

---

1. Write a program to determine the value of a formula of your choosing. Your programs should display the purpose of the program and clearly label the values of the arguments or inputs and the result of the calculation (Output) using string labels, such as

   Side of Square = 5
   Area of Square = 25

   Consider using an input statement such as: **Input "Enter a number: ",x**
   Some suggestions:

   Areas of plane geometric shapes:
   Square: side²
   Triangle: ½*b*h
   Circle: pi*r²
   Trapezoid: ½*(b1+b2)*h

   Volumes of solids:
   Cube: side³
   Square Pyramid: 1/3*side²*height
   Sphere: 4/3*pi*r³

   Finance:
   Simple interest: A=P+P*R*T
   Compound interest (annual) : $A=P*(1+r)^t$
   Compound Interest (monthly): $A= P*(1+r/12)^{12*t}$

   Physics:
   Force = m*a (mass * acceleration)
   Velocity = d/t (distance / time)
   Acceleration = v/t (velocity / time)
   Momentum: P = m*v (mass * velocity)
   Potential Energy = m*g*h (mass * gravity * height)
   Kinetic Energy=1/2*m*v^2 (mass * velocity squared)

2. Write a program that inputs two values (a,b) and displays their geometric mean, sqrt(a*b). How does it compare to the arithmetic mean (average) of a and b?

3. 'Rotate' the values of three variables. Example:
   2→A
   7→B
   5→C
   <rotate a,b, and c>
   A is now 7
   B 5
   C 2
   (or input the three numbers)
4. Determine the third angle in a triangle given two of the angles.
5. Find the measure of each angle in a regular polygon.
6. Find the number of seconds in a given number of days: 10 days produces 864000.
7. Convert a number of seconds into days. How long is a million seconds? A billion seconds? A trillion seconds?
8. **Pythagorean Theorem**: Enter the lengths of the legs of a right triangle and calculate and display the length of the hypotenuse.
9. **Heron's Formula**: Enter the lengths of the three sides of a triangle and determine the area:
   s = ½ * (a + b + c) (the semi-perimeter)
   A = sqrt(s*(s-a)*(s-b)*(s-c))
10. **Quadratic Formula**: Enter the three coefficients of a quadratic equation and determine the roots. Bonus: display complex roots as well.
11. **Temperature Scales**: convert between Celsius and Fahrenheit.
12. Ask for the radius of a circle and display the circumference and area. Use the number π on your keyboard (it represents 3.1415926535…).
13. Ask for the three dimensions of your room (in feet) and display the volume (in cubic feet).
14. Ask for the dimensions of your room in centimeters and display the liters (1 liter = 1000 cubic centimeters).
15. Ask for the price of a taxable item in the store and calculate the sales tax and total cost of the item including the tax. Use the tax rate for your area.
16. Determine savings account interest:
    a. Simple interest A = P + P*R*T where A = final amount, P = principal, R= interest rate (in decimal form) and T= time (years)
    b. Annual Compound Interest A = P*(1+R)^T
    c. Monthly Compound Interest: A = P*(1+R/12)^(12*T)
17. Perimeter and Area of a Regular Polygon:
    a. Input the number of sides N and the length of each side S and give the perimeter.
    b. Give the area (A = ½*n*a*s where a = apothem, the distance from the center of the polygon to the sides). **Trigonometry** is required to find a.

18. Speaking of **Trigonometry**…
    a. Enter the lengths of three sides of a triangle and determine the three angles (in degrees). (SSS)
    b. Enter two sides of a triangle and the angle between them and determine the length of the third side. (SAS)
    c. Can you think of the third situation?

19. **Vertex of a Parabola**: Input the three coefficients, a, b and c of a quadratic function $y=a*x^2 + b*x + c$ and display the function and the x- and y-coordinates of the vertex of the parabola.

20. **Windchill (°F and m/h):** Have you ever wondered how to calculate the "feels like" temperature? Wind makes the temperature outside feel cooler than the temperature of the air. The formula is:
    $feelsLike = 35.74 + 0.6215*temp - 35.75*windspeed^{0.16} + 0.4275*temp*windspeed^{0.16}$

21. **Wind Chill (°C and km/h)**: The formula is

    $feelsLike = 13.12 + 0.6215*temp - 11.37*windspeed^{0.16} + 0.3965*temp*windspeed^{0.16}$