ICT Exercise I

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1. Show the sequence of numbers that would be generated by each of the following range expressions.
   (a) `range(5)`
   (b) `range(3, 10)`
   (c) `range(4, 13, 3)`
   (d) `range(15, 5, -2)`
   (e) `range(5, 3)`
2. Show the output that would be generated by each of the following program fragments.
   (a)
   ```
   for i in range(1, 11):
       print (i*i)
   ```
   (b)
   ```
   for i in [1,3,5,7,9]:
       print(i, ":", i**3)
   print(i)
   ```
3. What does the following code print?

```
T = (0.1, 0.1)
x = 0.0
for i in range(len(T)):
     for j in T:
        x += i + j
        print(x)
print(i)
```

4. Given the initial statements s1 = [2,1,4,3], s2 = ['c', 'a', 'b'] show the result of evaluating each of the following sequence expressions:
   (a) s1 + s2
   (b) 3 * s1 + 2 * s2
   (c) s1[1]
   (d) s1[1:3]
   (e) s1 + s2[-1]

5. Given the same initial statements as in the previous problem, show the values of s1 and s2 after executing each of the following statements. Treat each part independently (i.e., assume that s1 and s2 start with their original values each time).
   (a) s1.remove(2)
   (b) s1.sort0
   (c) s1.append([s2.index('b')])
   (d) s2.pop(s1.pop(2))
   (e) s2.insert(s1[0], 'd')
6. Write a program that asks for user input and performs
   - Celsius to Fahrenheit conversion.
   - Fahrenheit to Celsius conversion.
   - Meter to foot conversion.
   - Foot to meter conversion.
   - Acre to square meter conversion.
   - Square meter to acre conversion.
   - Pound to kilogram conversion.
   - Kilogram to pound conversion.
7. Write a function that takes a list as the only argument and returns the following:
   - the number of odd items in the list;
   - the average of all the items in the list;
   - the sum of squared items in the list.
8. Write a function that computes and simplifies the following expression.

$$\prod_{i=1}^{5} \sum_{j=i}^{5} j(\sin(x) + \cos(x))$$

9. The Maclaurin series up to order N for e^x is defined as follows:

$$e^x \approx \sum_{n=0}^{N} \frac{x^n}{n!}$$

   Write a function that accepts an integer N. Define an expression for this equation, then substitute in $-y^2$ for x to get a truncated Maclaurin series of e^{-y^2}. **Lambdify** the resulting expression and plot the series on the domain $y \in [-2, 2]$. Plot e^{-y^2} over the same domain for comparison. Call your function with increasing values of N to check that the series converges correctly.

10. Write a Python script that computes tidal elevation h (in m) from the following three term series:

$$h(t) = 0.2\sin(0.5\omega t) + 3.0\sin(\omega t) + 1.0\sin(2\omega t)$$

where $\omega = 2\pi/24\, hr^{-1}$. Define a vector time with 1001 values [0., 0.1, 0.2, … , 100.0.] spaced every 0.1 hours from $t = 0$ to $t = 100$ hrs. **Plot** the tidal elevations **vs.** time. **Label** both axes and include a plot title.