Informatics for Astronomers - WS2020

Roland Ottensamer, Marina Dütsch, Miguel Verdugo, Gerald Mösenlechner

Exercise sheet 5 - Python loops and C

The following will be also part of the assessment:

(1) Try to present exercises in a way that everyone can understand (even those who didn't do the exercises), so please explain the vital parts of your solution in a clear way.

(2) Try to also include some background information where applicable, and/or explain the possible context/motivation for the given exercise.

---

1. In Exercise 4, question 5, you were asked to calculate the distance between these two points (vectors)

   ```
   point_1 = [2.8, -4.7, 0.4]
   point_2 = [-8.1, 3.0, -10.6]
   ```

   - Transform that script into a function
   - Create functions that also calculate the dot (•) and cross (×) products of vectors.

   (Do not use `numpy` here)

2. `Python` provides a standard module (`timeit`) for timing the execution of scripts and pieces of code. Please time the execution of these two equivalents blocks

   ```
   N = 10**8
   # Time from here
   daten=[]
   for i in range(0,N) :
       daten.append(i**0.5)
   # to here

   # and from here
   daten = np.sqrt(np.arange(0,N))
   # to here
   ```

   - Which one is faster?
   - For what values of `N` the effect is really noticeable. Please try a few wildly different values to have an idea.

3. `numpy` is likely the most important library in `python`.

- How do `numpy` arrays differ from `python` lists?
- Show the creation of `numpy` arrays with different properties (e.g. converting from a `list`, different step size and dimensions)
- Apply some mathematical functions to arrays and comment the differences with using `lists`
- What is `array` broadcasting?

4. Write a `Python` script that asks for a integer and then prints every prime number up to that value. Check the execution time with the module `timeit`. What can be said about the complexity of the algorithm you use (how many iterations does it need to process a dataset of n entires)? Look at different approaches to this problem and their complexity.

5. Now write the same script in `C`. Please also check the execution time using the `clock()` function.