Another Python Module

CONCURRENT.FUTURES

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CODE COFFEE: 27 JULY 2021

Outline

- Immediately give resources
- Talk through how I have used it
  - WARNING: I don’t do anything super crazy.
- Go through a “baby” example
- Give a few real-world Astrophysics examples

Resources

Tutorial video:

- https://www.youtube.com/watch?v=fKl2JW_qrso
- Easy-to-understand examples—a bit basic
- Concurrent.futures() shows up around 17 min mark
- Provides building blocks to work from (as I did when I first learned)

Documentation:

- https://docs.python.org/3/library/concurrent.futures.html
- Official documentation
- Level of clarity and help? Meh…

How I use it

Basic idea:

- Make a function out of the process(es) you want parallel
- Specify a certain type of Executor depending on what you want to do:
  - ProcessPoolExecutor() – CPU-intensive tasks
  - ThreadPoolExecutor() – I/O intensive tasks
  - Here is where you tell it how many workers (CPUs or threads) you want to use
- Create a parameter list
  - Essentially all the parameters you would run through in a for-loop
- Map the parameter list onto the function
- Collect the results into a more analysis-friendly format

Example 2: RADMC3D Image Rendering

- RADMC3D (radiative transfer code) can (currently) only perform image renderings serially
- One image takes ~7.5 hours to render
- Thus, doing more than 1 image rendering per workday is basically impossible (serially)

- Using concurrent.futures, I can do 5+ images in a day
  - WARNING: This is a memory HOG

- See Jupyter Notebook

Example 3: Cosmology Parameter Spaces

Loop over:

- Paradigms ∈ {CDM, SIDM, SIDM DMO}
- M ∈ {Mean200, TopHat200, Crit200, Crit500}
- Halos ∈ {51, 70, 120, 140, 113}
- Particle Type ∈ {DM, gas, stars}
- Coordinates ∈ $\{x, y, z\}$
- Radius ∈ $\{0.1, 0.2, 0.3, \dots, 1.0\} \times R_{group}$

SERIAL: 1 trial

On average:

$$t_{elapsed} = n_{process} \times \frac{time}{process}$$

= 54 000 sec
= 15 hours

$$n_{process} = 3 \times 4 \times 5 \times 3 \times 3 \times 10 = 5400$$

$$\frac{time}{process} = 10 \text{ sec}$$

PARALLEL

900 trials!