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01 May 2025

基礎 Python 程式設計練習

— Session 09 —

https://meet.google.com/wpx-yabb-tka

進來的人請跟我說一聲

有人進來我們就開始

Please talk to me, when you come in.

When you come in, we start the session.

- Date/Time: 01 May 2025
- Google Meet: `https://meet.google.com/wpx-yabb-tka`
- Language: English, or Chinese, or Japanese
- Anyone can join this activity.
- This activity is organised in conjunction with the course “Doing Astrophysics using Python”. If you take the course “Doing Astrophysics using Python” and you would like to study basic Python programming, you are highly encouraged to join this activity.
- Activity web page: `https://s3b.astro.ncu.edu.tw/ipype/`

https://s3b.astro.ncu.edu.tw/ipype/

Some notes for you

- Ask a question to me at any time, if you have any difficulty.
- When you finish writing your code, tell me about it.
- Show me your source code, if you have an error for your code and cannot find a way to fix it.
- Tell me if you want me to provide a sample code for you.
- Be active, then you gain more.

Some notes for you

- 如果想要問問題, 請跟我說. 什麼時候都可以.
- 你的程式寫完的時候, 請跟我說一聲.
- 如果你不確定你自己寫的程式寫得好不好, 請給我看你寫的原始碼. 我跟你說我的意見.
- 如果你想要看我的寫法, 請跟我說. 我寫給你看.
- 比較主動一點, 你的收穫比較多.

Downloading the data file

- Visit the following web page, and download machine-readable version of Table 3 “Cloud Catalog”.
  - “A UNIFORM CATALOG OF MOLECULAR CLOUDS IN THE MILKY WAY”
    - ApJ, Rice et al., 2016, 822, 52.
    - `https://iopscience.iop.org/article/10.3847/0004-637X/822/1/52`

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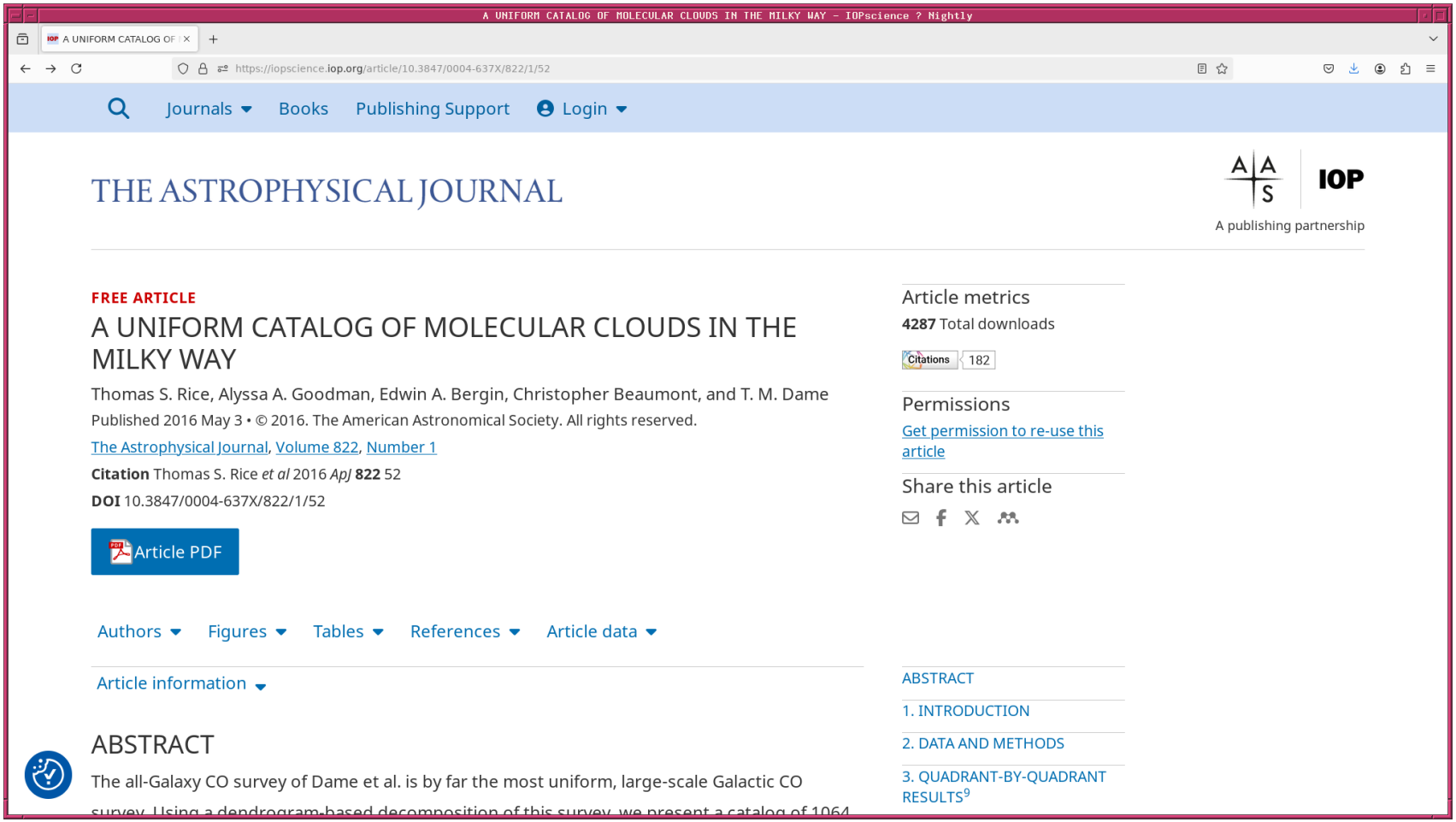

https://iopscience.iop.org/article/10.3847/0004-637X/822/1/52

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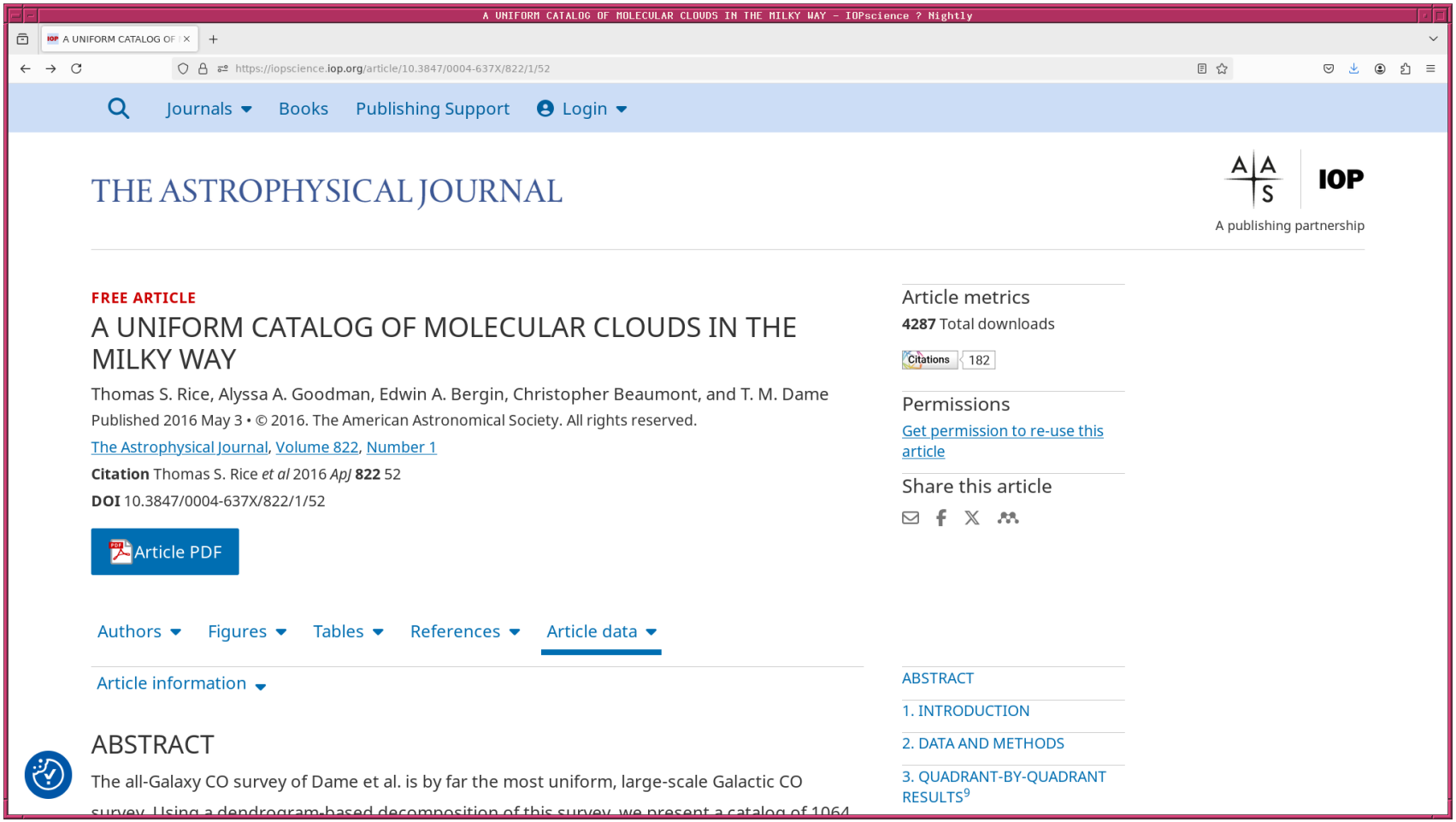

Move your mouse cursor to “Article data”.

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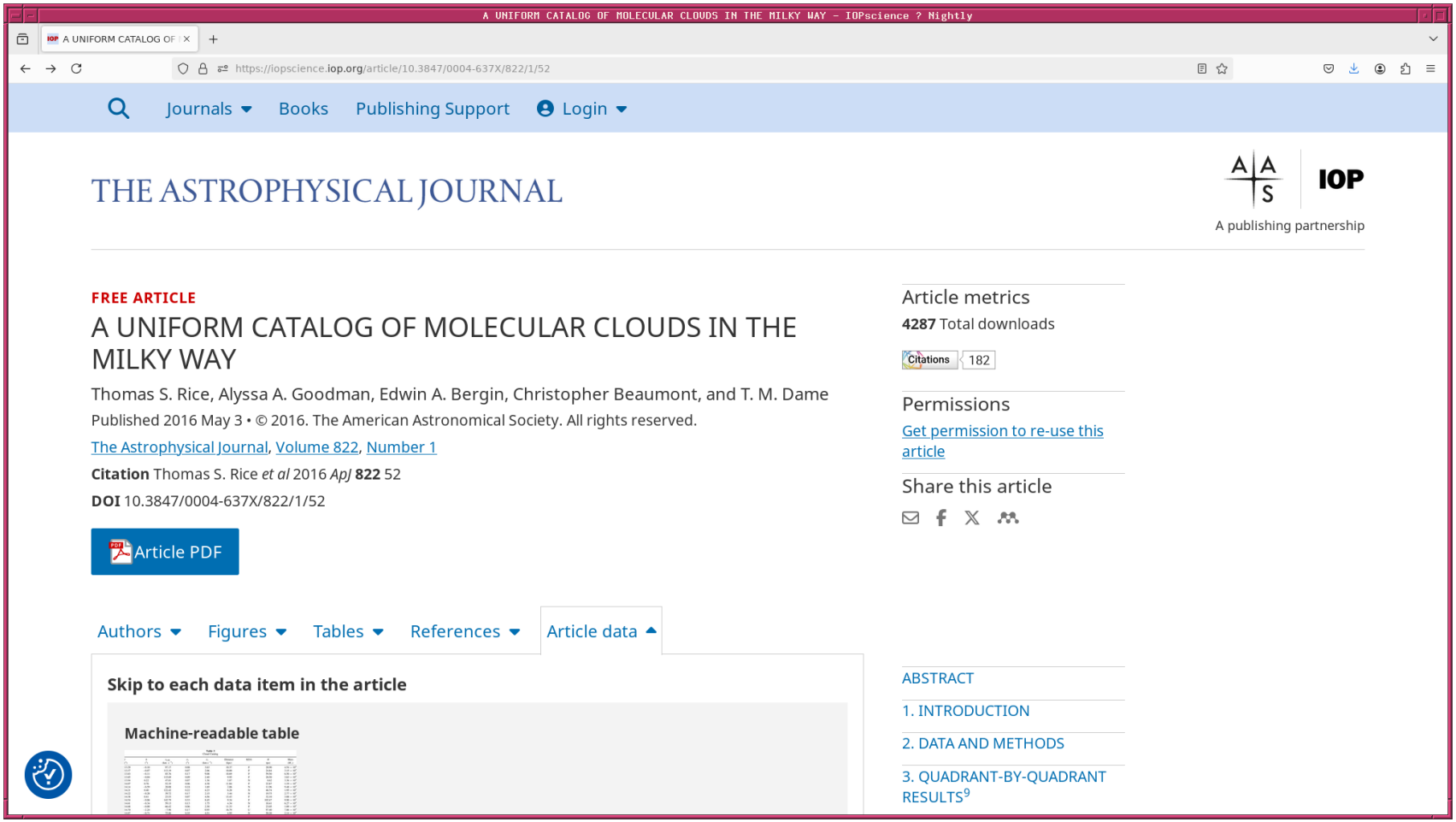

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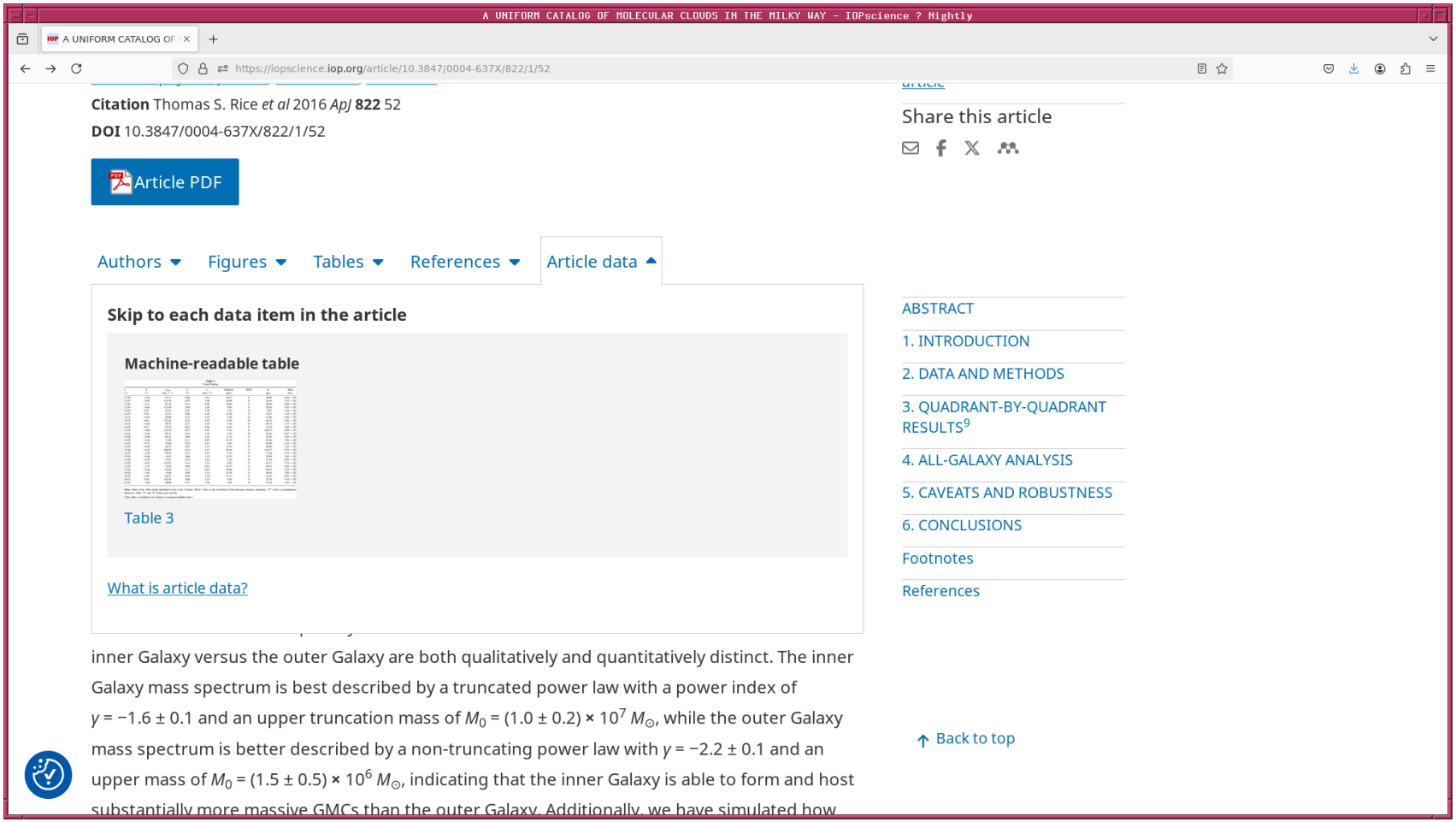

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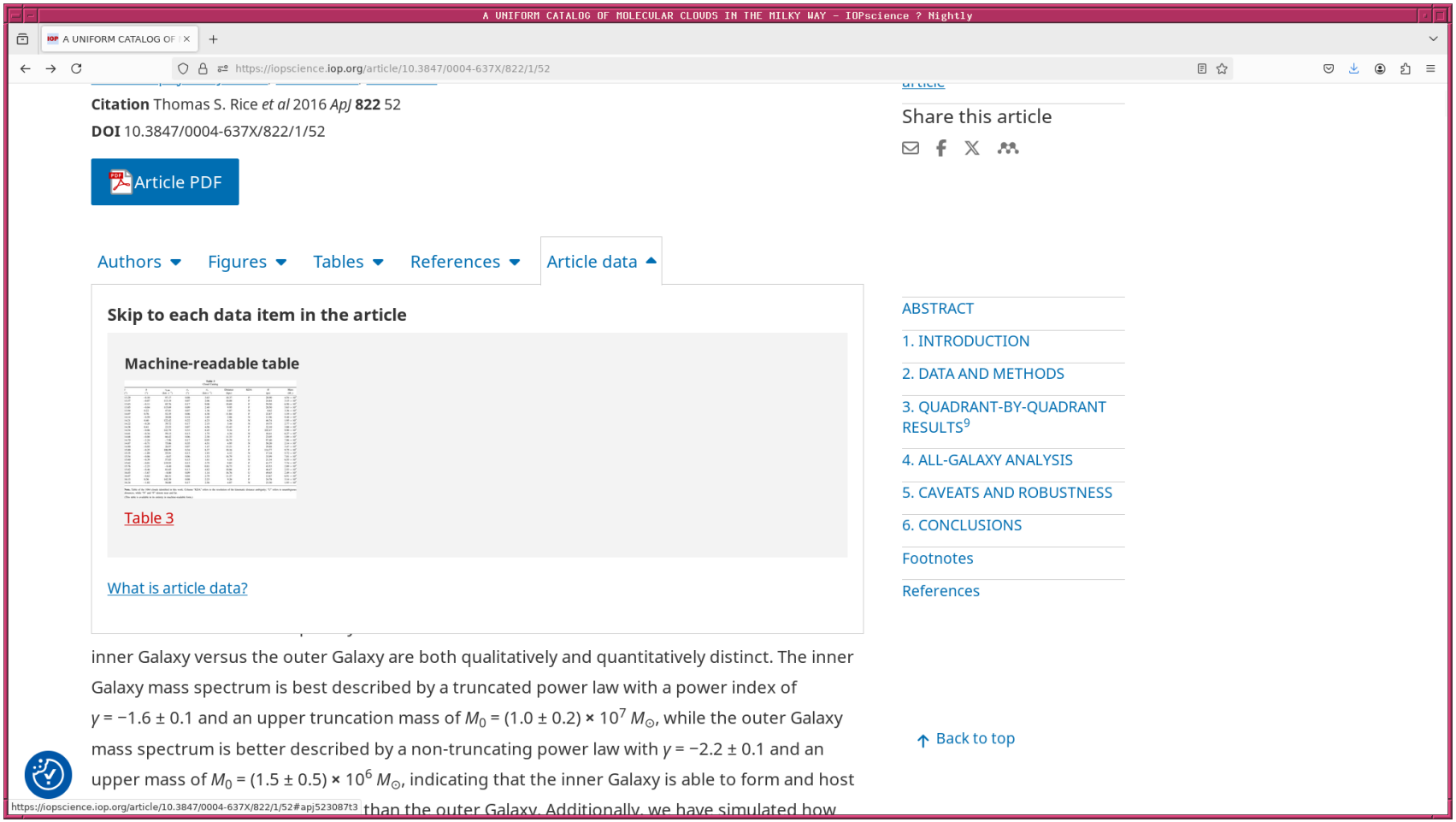


Click the link “Table 3”.

Downloading the data file

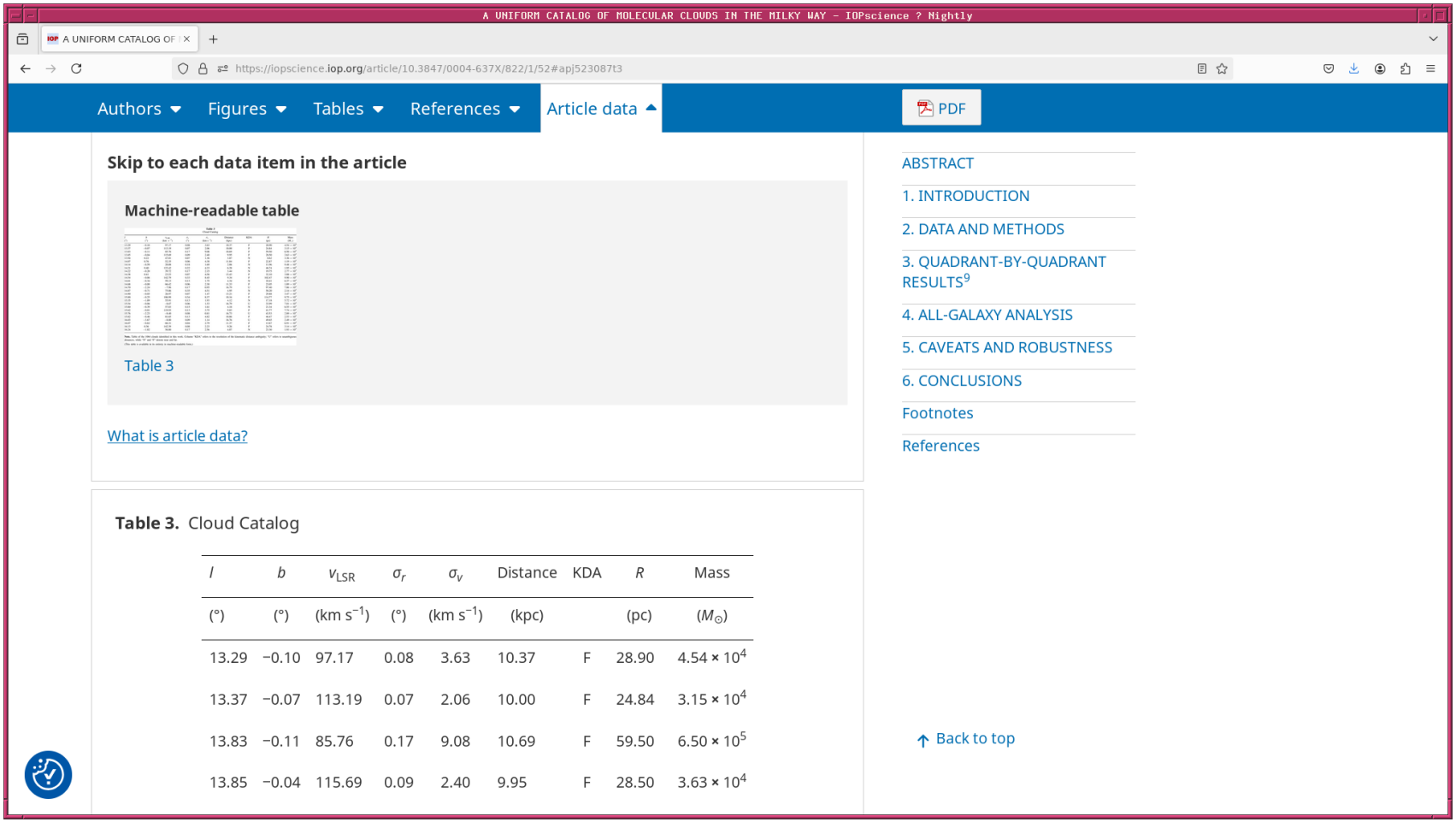
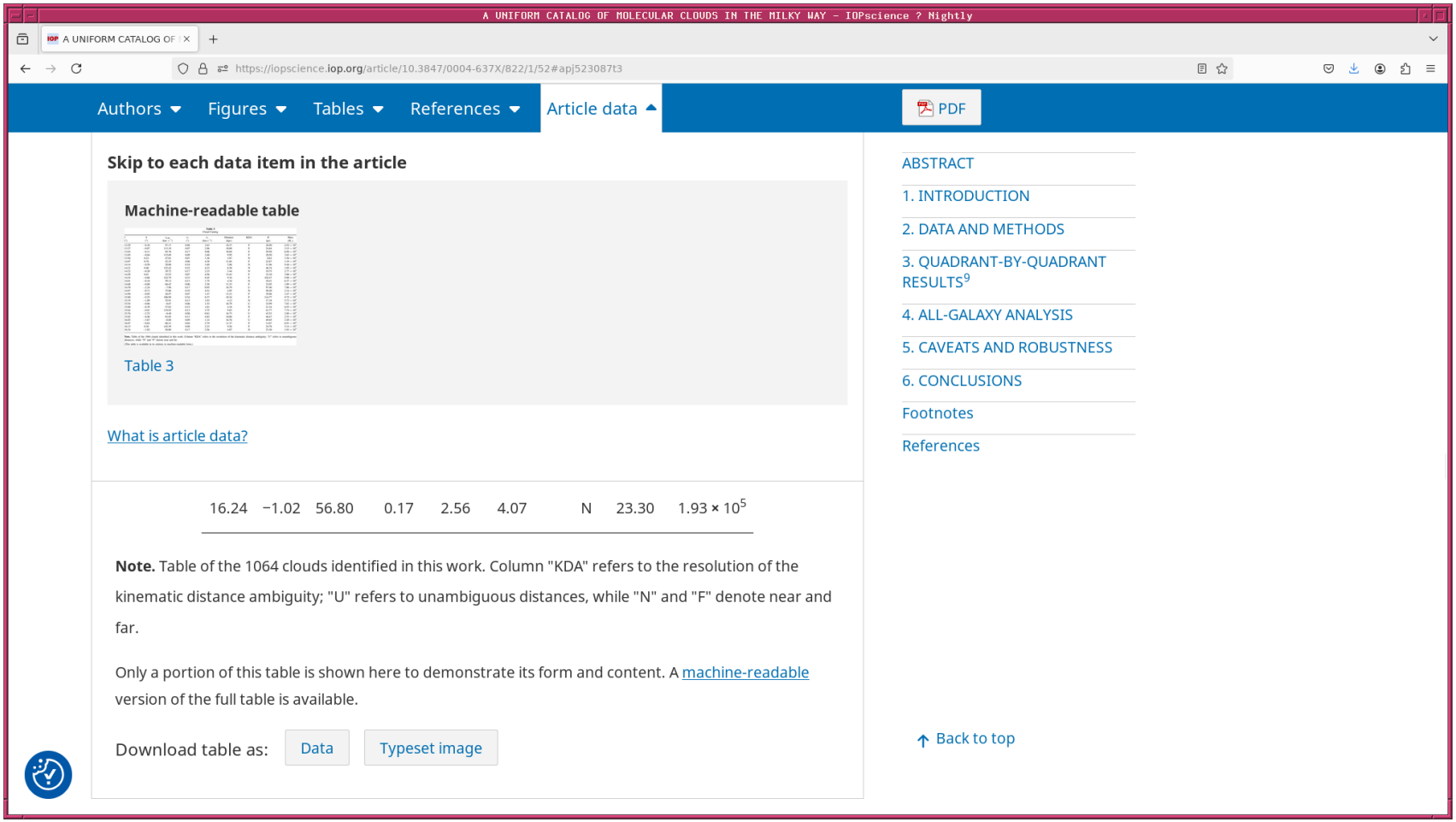


Table 3. Cloud Catalog

l	b	v_{LSR}	σ_r	σ_v	Distance	KDA	R	Mass
(°)	(°)	(km s^{-1})	(°)	(km s^{-1})	(kpc)		(pc)	($M_\odot$)
13.29	−0.10	97.17	0.08	3.63	10.37	F	28.90	4.54×10^4
13.37	−0.07	113.19	0.07	2.06	10.00	F	24.84	3.15×10^4
13.83	−0.11	85.76	0.17	9.08	10.69	F	59.50	6.50×10^5
13.85	−0.04	115.69	0.09	2.40	9.95	F	28.50	3.63×10^4

Table 3 is shown.

Downloading the data file



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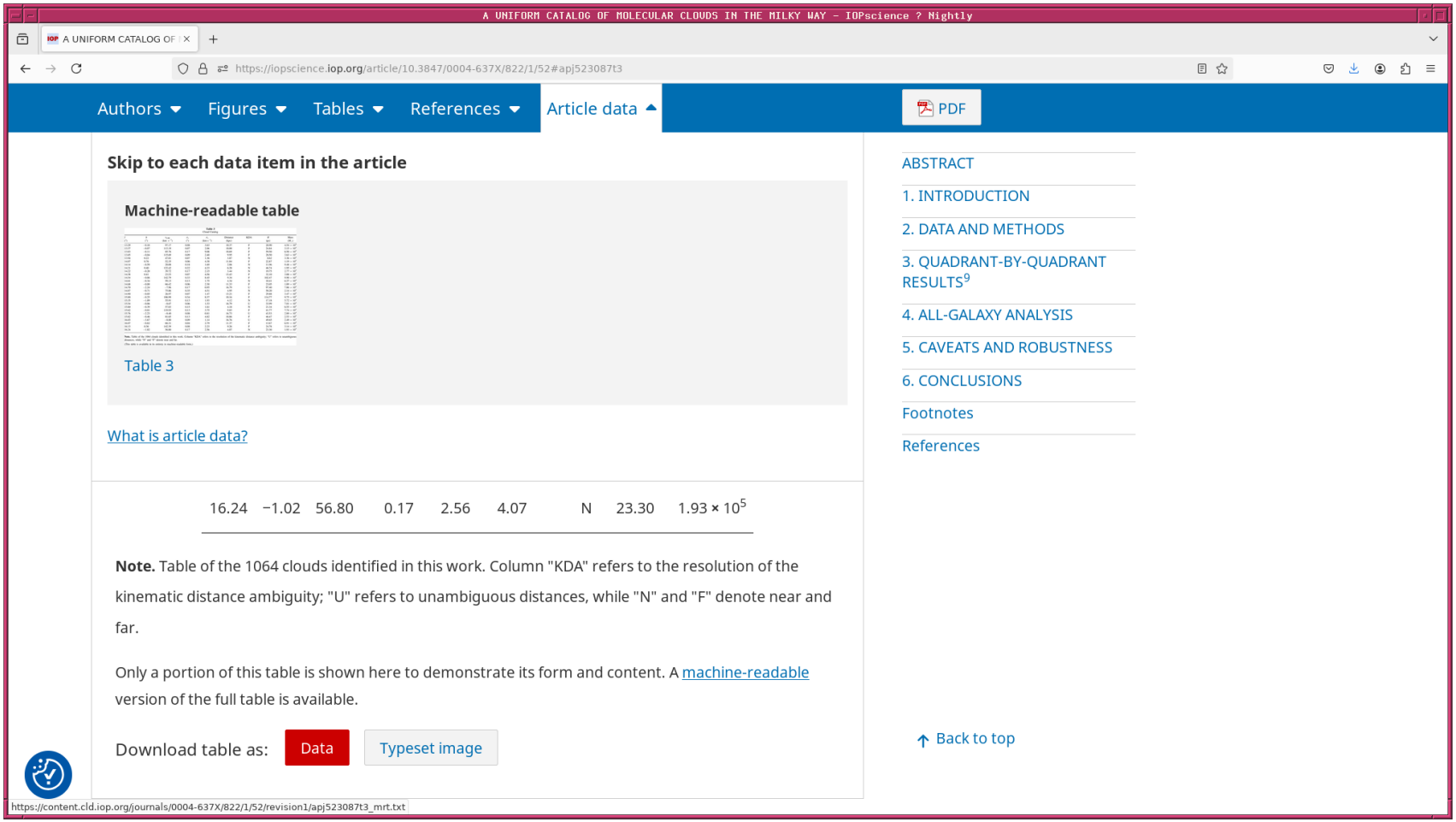
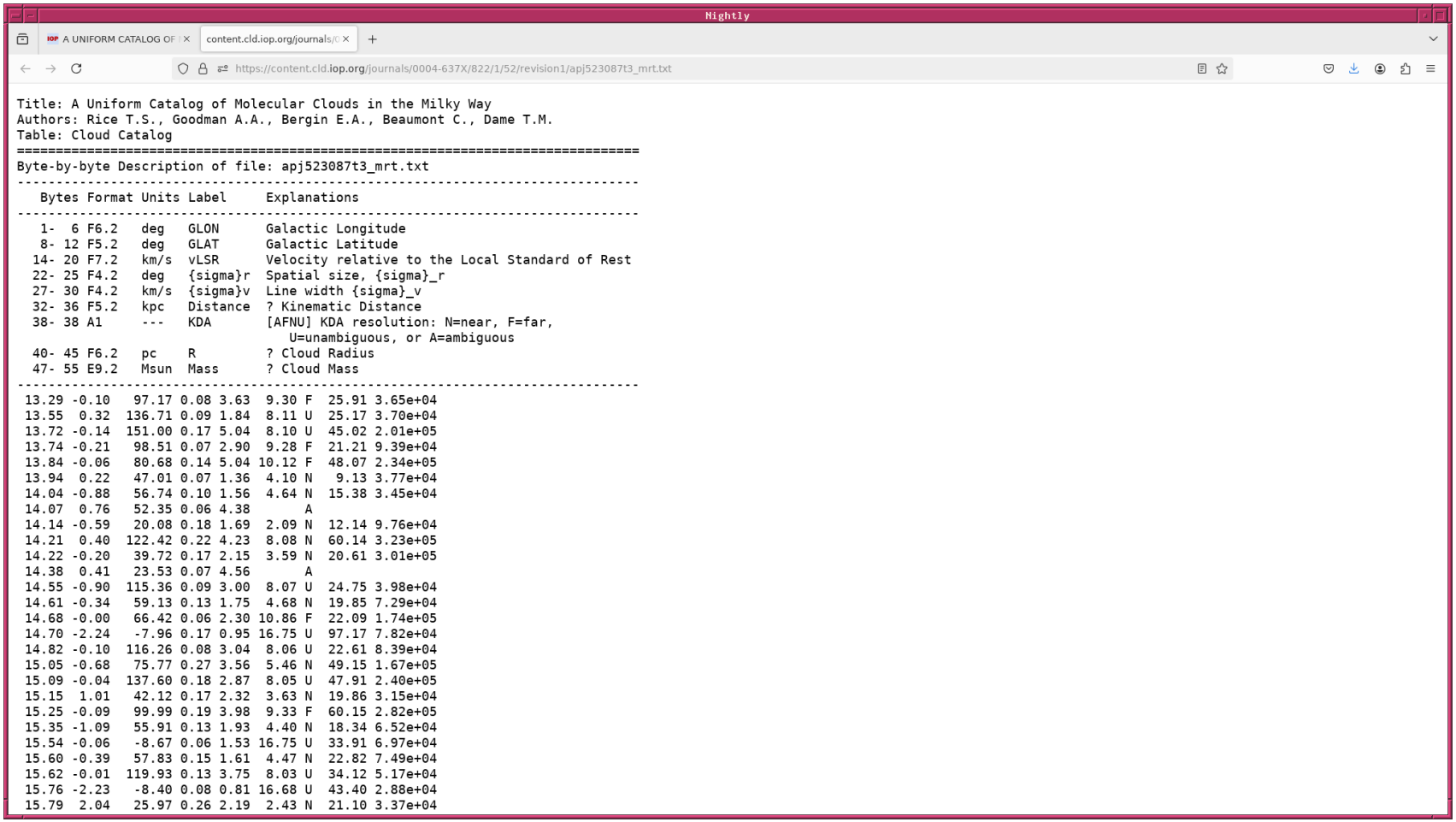


Find the link to machine-readable version of the table, and click the link “Data”.

Downloading the data file




```
Title: A Uniform Catalog of Molecular Clouds in the Milky Way
Authors: Rice T.S., Goodman A.A., Bergin E.A., Beaumont C., Dame T.M.
Table: Cloud Catalog
================================================================================
Byte-by-byte Description of file: apj523087t3_mrt.txt
--------------------------------------------------------------------------------
   Bytes Format Units Label     Explanations
--------------------------------------------------------------------------------
   1-  6 F6.2   deg   GLON      Galactic Longitude
   8- 12 F5.2   deg   GLAT      Galactic Latitude
  14- 20 F7.2   km/s  vLSR      Velocity relative to the Local Standard of Rest
  22- 25 F4.2   deg   {sigma}r  Spatial size, {sigma}_r
  27- 30 F4.2   km/s  {sigma}v  Line width {sigma}_v
  32- 36 F5.2   kpc   Distance  ? Kinematic Distance
  38- 38 A1     ---   KDA       [AFNU] KDA resolution: N=near, F=far,
                                  U=unambiguous, or A=ambiguous
  40- 45 F6.2   pc    R         ? Cloud Radius
  47- 55 E9.2   Msun  Mass      ? Cloud Mass
--------------------------------------------------------------------------------
 13.29 -0.10   97.17 0.08 3.63  9.30 F  25.91 3.65e+04
 13.55  0.32  136.71 0.09 1.84  8.11 U  25.17 3.70e+04
 13.72 -0.14  151.00 0.17 5.04  8.10 U  45.02 2.01e+05
 13.74 -0.21   98.51 0.07 2.90  9.28 F  21.21 9.39e+04
 13.84 -0.06   80.68 0.14 5.04 10.12 F  48.07 2.34e+05
 13.94  0.22   47.01 0.07 1.36  4.10 N   9.13 3.77e+04
 14.04 -0.88   56.74 0.10 1.56  4.64 N  15.38 3.45e+04
 14.07  0.76   52.35 0.06 4.38       A
 14.14 -0.59   20.08 0.18 1.69  2.09 N  12.14 9.76e+04
 14.21  0.40  122.42 0.22 4.23  8.08 N  60.14 3.23e+05
 14.22 -0.20   39.72 0.17 2.15  3.59 N  20.61 3.01e+05
 14.38  0.41   23.53 0.07 4.56       A
 14.55 -0.90  115.36 0.09 3.00  8.07 U  24.75 3.98e+04
 14.61 -0.34   59.13 0.13 1.75  4.68 N  19.85 7.29e+04
 14.68 -0.00   66.42 0.06 2.30 10.86 F  22.09 1.74e+05
 14.70 -2.24   -7.96 0.17 0.95 16.75 U  97.17 7.82e+04
 14.82 -0.10  116.26 0.08 3.04  8.06 U  22.61 8.39e+04
 15.05 -0.68   75.77 0.27 3.56  5.46 N  49.15 1.67e+05
 15.09 -0.04  137.60 0.18 2.87  8.05 U  47.91 2.40e+05
 15.15  1.01   42.12 0.17 2.32  3.63 N  19.86 3.15e+04
 15.25 -0.09   99.99 0.19 3.98  9.33 F  60.15 2.82e+05
 15.35 -1.09   55.91 0.13 1.93  4.40 N  18.34 6.52e+04
 15.54 -0.06   -8.67 0.06 1.53 16.75 U  33.91 6.97e+04
 15.60 -0.39   57.83 0.15 1.61  4.47 N  22.82 7.49e+04
 15.62 -0.01  119.93 0.13 3.75  8.03 U  34.12 5.17e+04
 15.76 -2.23   -8.40 0.08 0.81 16.68 U  43.40 2.88e+04
 15.79  2.04   25.97 0.26 2.19  2.43 N  21.10 3.37e+04
```

Download the data file “apj523087t3_mrt.txt”.

Exercise s09-01

- Make your own Python script to open the data file "`apj523087t3_mrt.txt`", extract galactic longitude, galactic latitude, kinematic distance, and KDA resolution for each molecular cloud. Check the value of KDA, and discard the data if the value of KDA is not "`U`" (unambiguous).

Exercise s09-02

- Make your own Python script to calculate the galactocentric coordinate (x_{gal}, y_{gal}, z_{gal}) for each molecular cloud using galactic longitude, galactic latitude, and distance.
  - Assume 8.34 kpc for the distance of the Sun from the Galactic centre.
  - Assume 25 pc for the distance of the Sun from the Galactic mid-plane.
  - For the calculation of galactocentric coordinates, read the Section 2.4.1 “Physical Properties” of the paper.

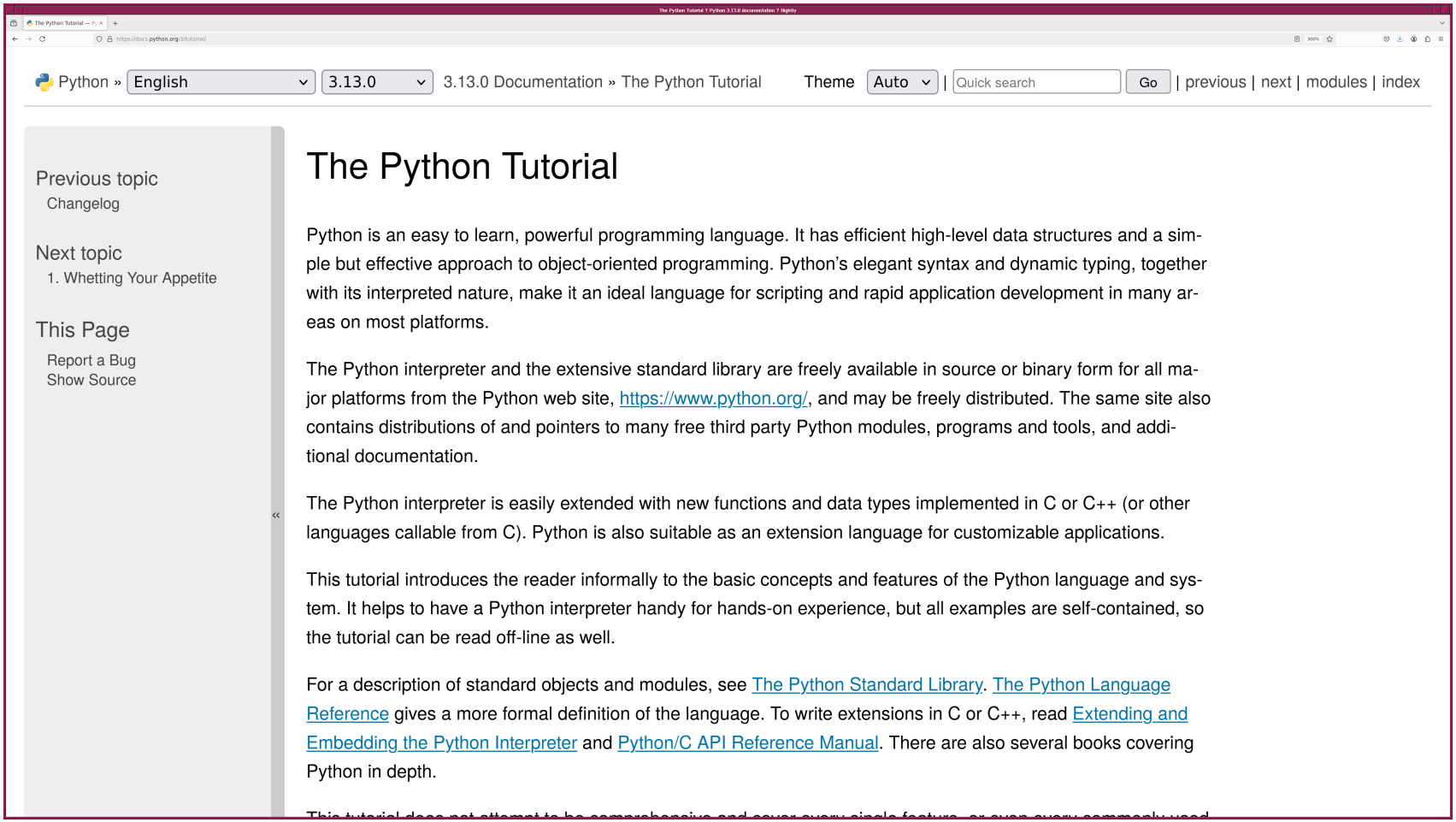
Exercise s09-03

- Make your own Python script to visualise positions of each molecular cloud in the Milky Way Galaxy using Matplotlib.
  - Make a top-down view of the Milky Way Galaxy. (Use the coordinates (x_{gal}, y_{gal}).)

Next meeting

- We will have next meeting on 08 May 2025.
  - Google Meet: `https://meet.google.com/wpx-yabb-tka`
- We start the activity at 20:00.

"The Python Tutorial"



https://docs.python.org/3/tutorial/

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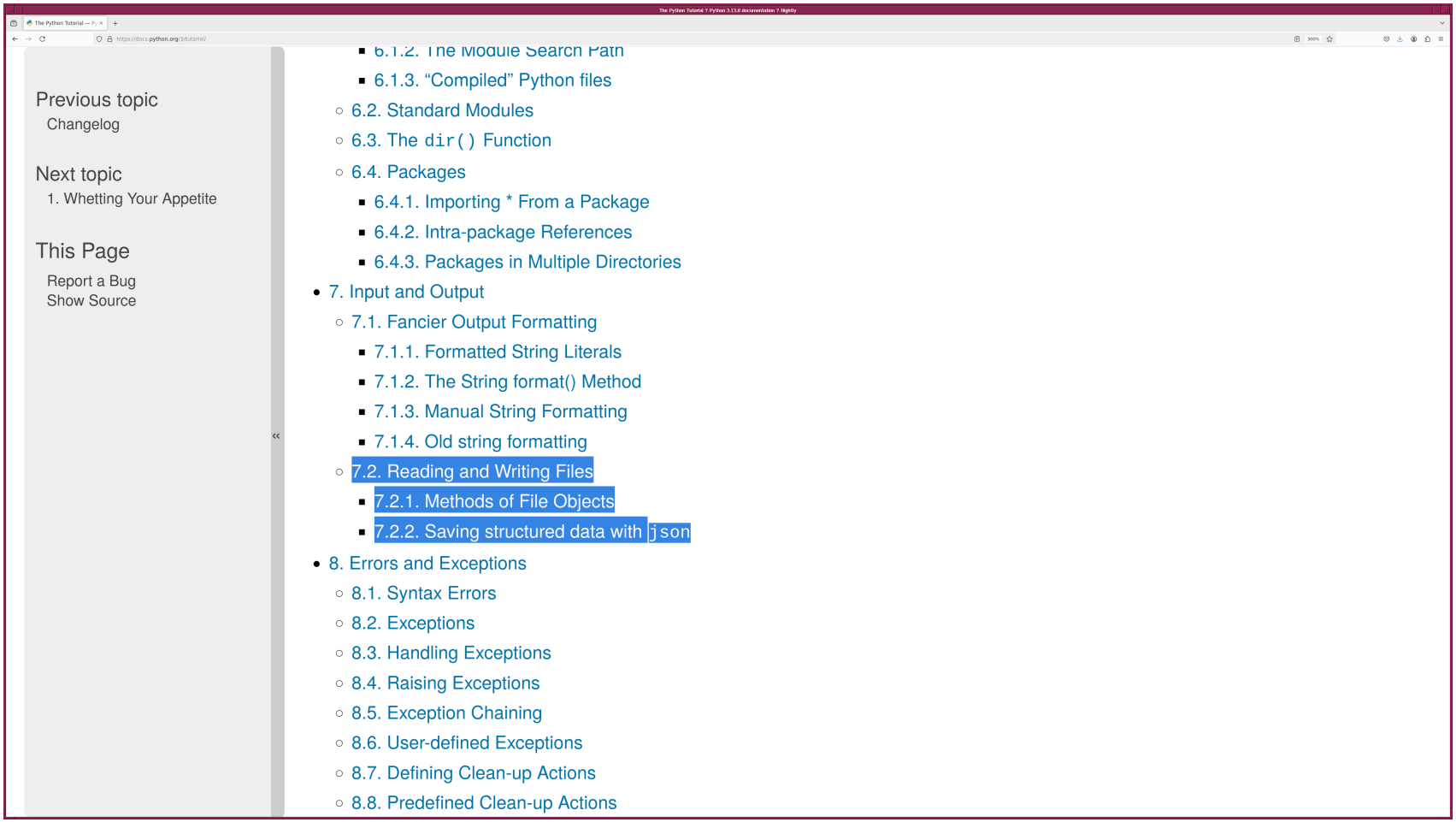

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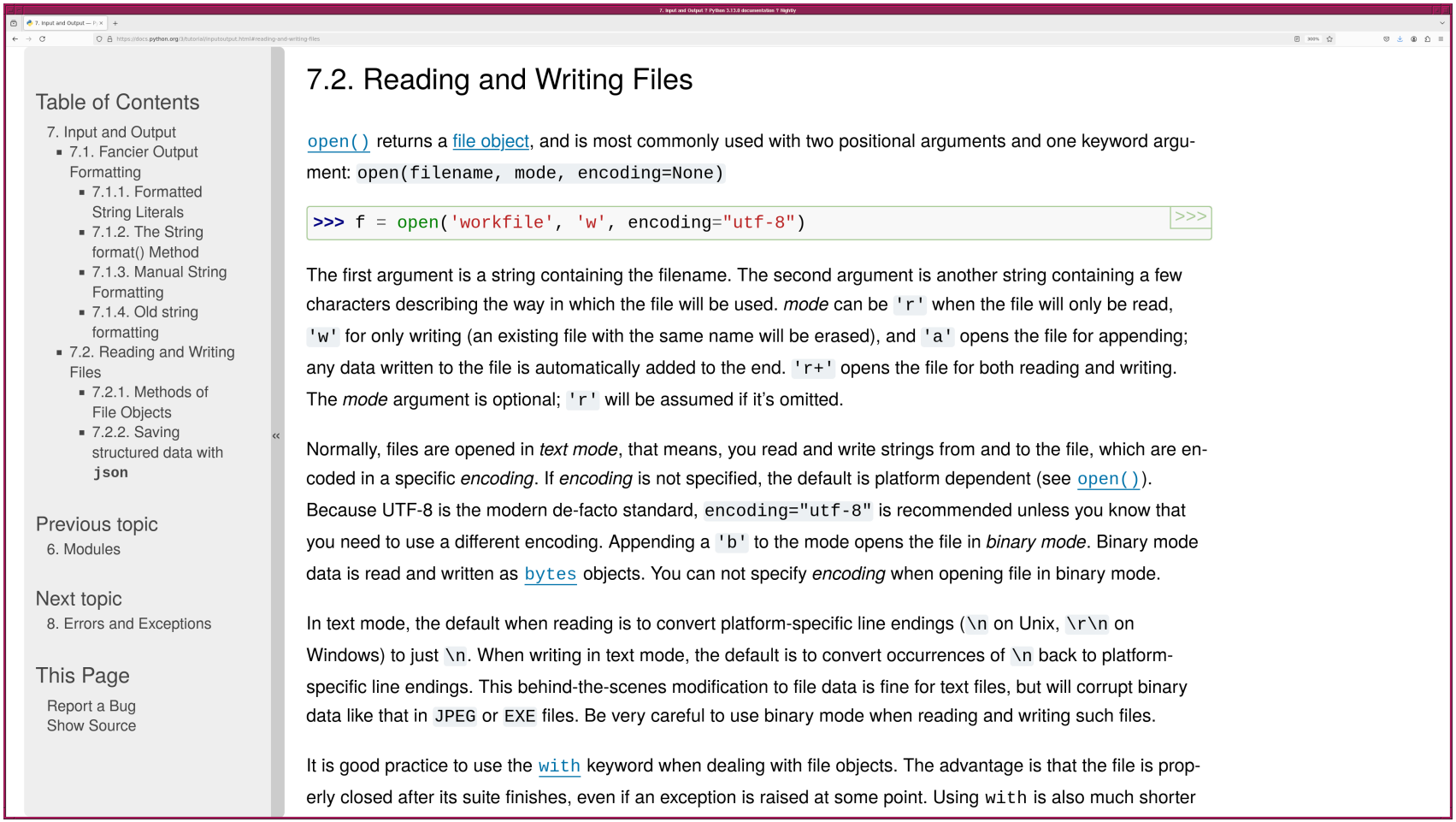

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7.2. Reading and Writing Files

`open()` returns a file object, and is most commonly used with two positional arguments and one keyword argument: `open(filename, mode, encoding=None)`

```
>>> f = open('workfile', 'w', encoding="utf-8")
```

The first argument is a string containing the filename. The second argument is another string containing a few characters describing the way in which the file will be used. *mode* can be `'r'` when the file will only be read, `'w'` for only writing (an existing file with the same name will be erased), and `'a'` opens the file for appending; any data written to the file is automatically added to the end. `'r+'` opens the file for both reading and writing. The *mode* argument is optional; `'r'` will be assumed if it's omitted.

Normally, files are opened in *text mode*, that means, you read and write strings from and to the file, which are encoded in a specific *encoding*. If *encoding* is not specified, the default is platform dependent (see `open()`). Because UTF-8 is the modern de-facto standard, `encoding="utf-8"` is recommended unless you know that you need to use a different encoding. Appending a `'b'` to the mode opens the file in *binary mode*. Binary mode data is read and written as `bytes` objects. You can not specify *encoding* when opening file in binary mode.

In text mode, the default when reading is to convert platform-specific line endings (`\n` on Unix, `\r\n` on Windows) to just `\n`. When writing in text mode, the default is to convert occurrences of `\n` back to platform-specific line endings. This behind-the-scenes modification to file data is fine for text files, but will corrupt binary data like that in `JPEG` or `EXE` files. Be very careful to use binary mode when reading and writing such files.

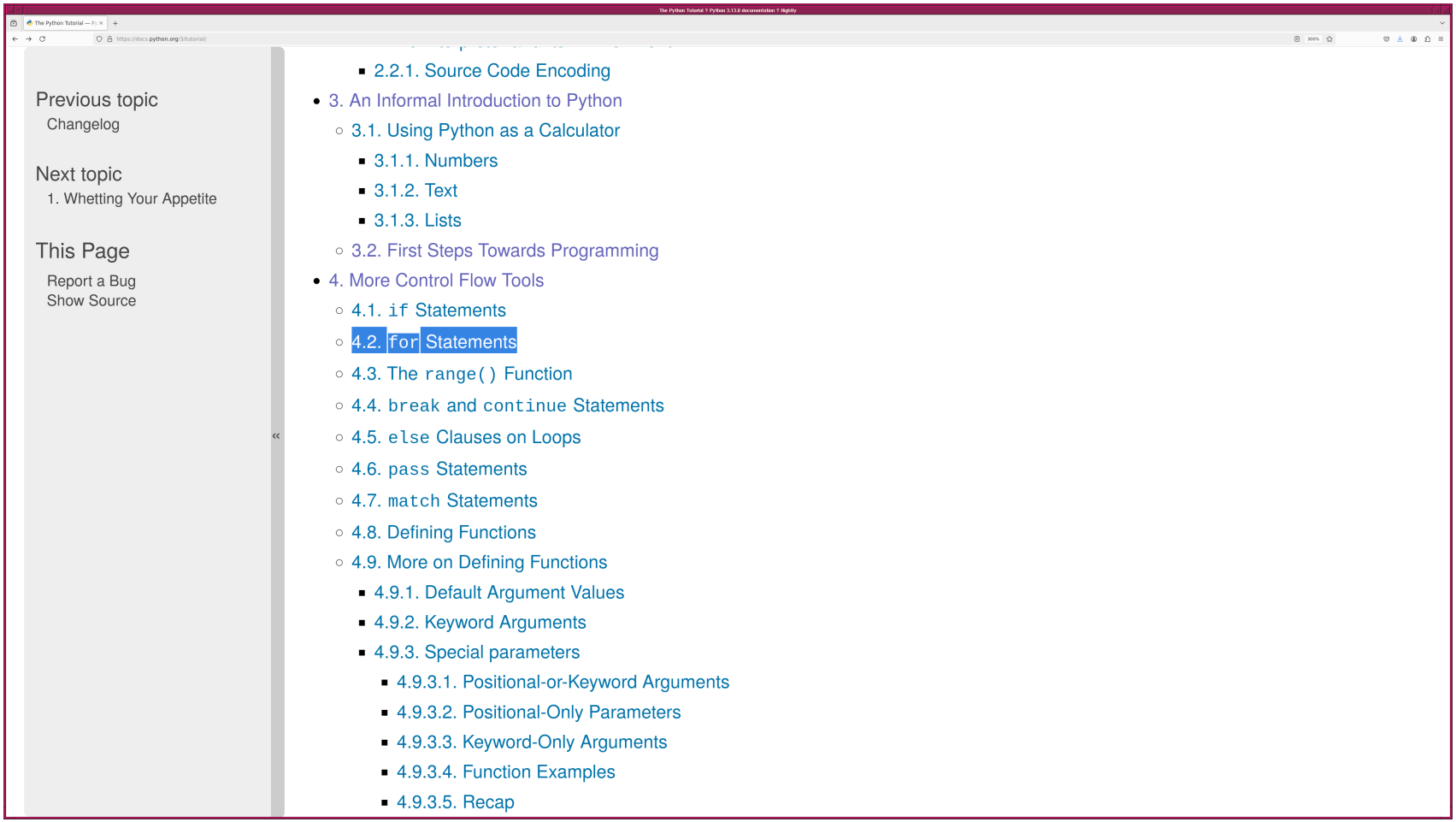
It is good practice to use the `with` keyword when dealing with file objects. The advantage is that the file is properly closed after its suite finishes, even if an exception is raised at some point. Using `with` is also much shorter

https://docs.python.org/3/tutorial/inputoutput.html#reading-and-writing-files

"The Python Tutorial"

- To learn about the "`for`" statement, read the section 4.2 "for Statements".
  - `https://docs.python.org/3/tutorial/controlflow.html#for-statements`

"The Python Tutorial"



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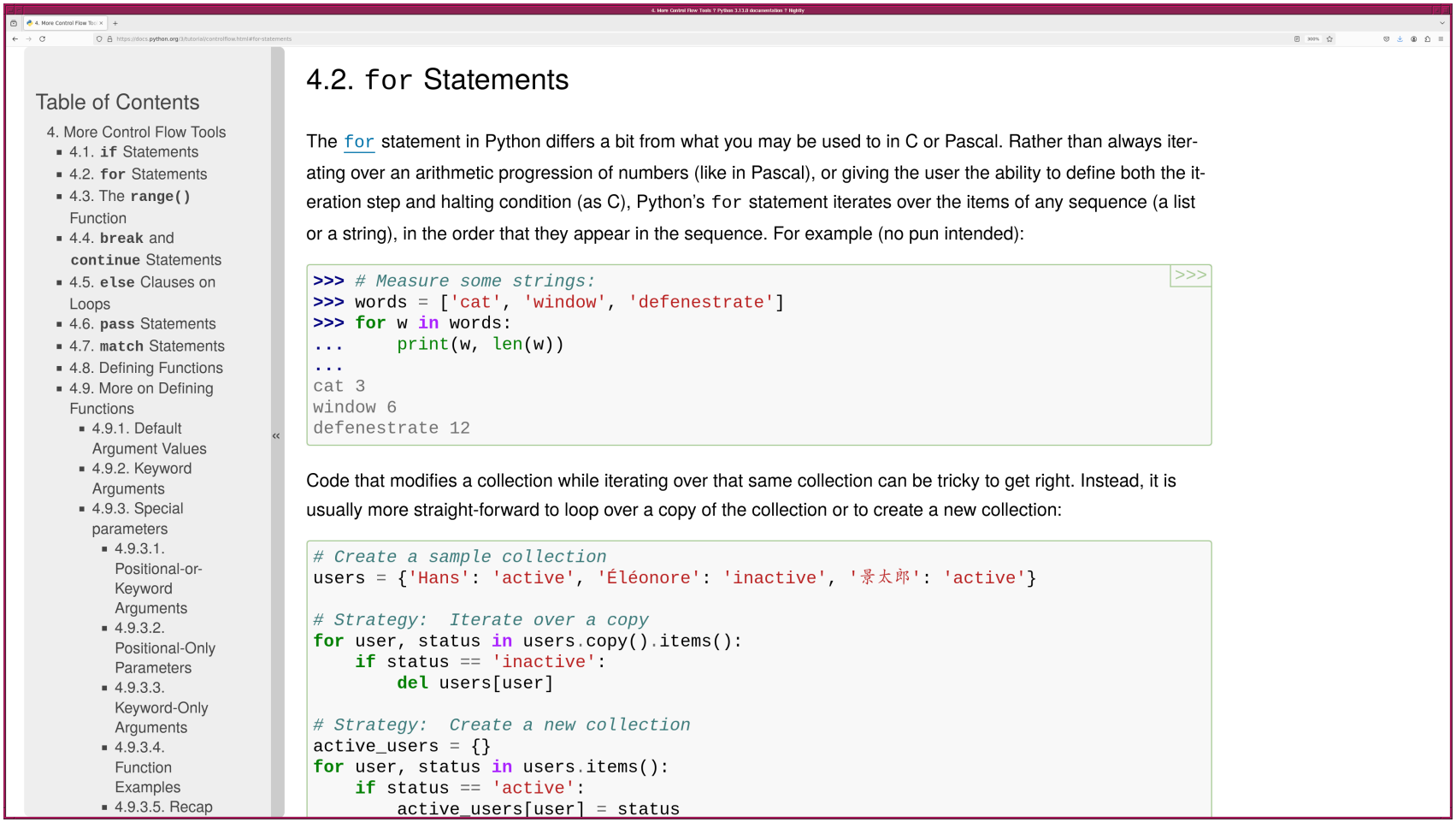

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- 4.8. Defining Functions
- 4.9. More on Defining Functions
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4.2. for Statements

The for statement in Python differs a bit from what you may be used to in C or Pascal. Rather than always iterating over an arithmetic progression of numbers (like in Pascal), or giving the user the ability to define both the iteration step and halting condition (as C), Python's for statement iterates over the items of any sequence (a list or a string), in the order that they appear in the sequence. For example (no pun intended):

```
>>> # Measure some strings:
>>> words = ['cat', 'window', 'defenestrate']
>>> for w in words:
...     print(w, len(w))
...
cat 3
window 6
defenestrate 12
```

Code that modifies a collection while iterating over that same collection can be tricky to get right. Instead, it is usually more straight-forward to loop over a copy of the collection or to create a new collection:

```
# Create a sample collection
users = {'Hans': 'active', 'Éléonore': 'inactive', '景太郎': 'active'}

# Strategy:  Iterate over a copy
for user, status in users.copy().items():
    if status == 'inactive':
        del users[user]

# Strategy:  Create a new collection
active_users = {}
for user, status in users.items():
    if status == 'active':
        active_users[user] = status
```

https://docs.python.org/3/tutorial/controlflow.html#for-statements

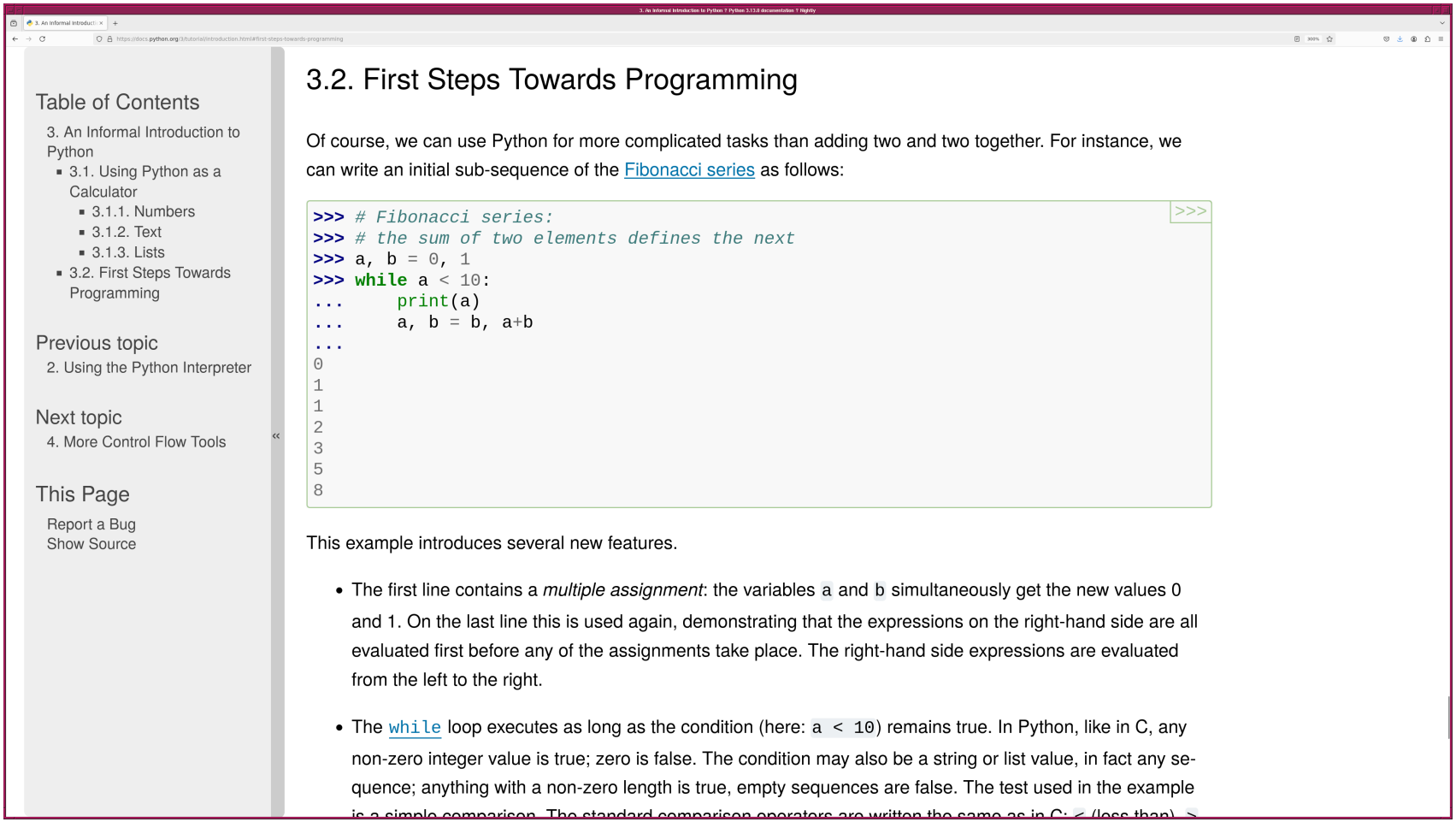
"The Python Tutorial"

- To learn about the "`while`" statement, read the section 3.2 "First Steps Towards Programming".
  - `https://docs.python.org/3/tutorial/introduction.html#first-steps-towards-programming`

"The Python Tutorial"

https://docs.python.org/3/tutorial/

"The Python Tutorial"



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     - 3.1.3. Lists
   - 3.2. First Steps Towards Programming

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3.2. First Steps Towards Programming

Of course, we can use Python for more complicated tasks than adding two and two together. For instance, we can write an initial sub-sequence of the Fibonacci series as follows:

```
>>> # Fibonacci series:
>>> # the sum of two elements defines the next
>>> a, b = 0, 1
>>> while a < 10:
...     print(a)
...     a, b = b, a+b
...
0
1
1
2
3
5
8
```

This example introduces several new features.

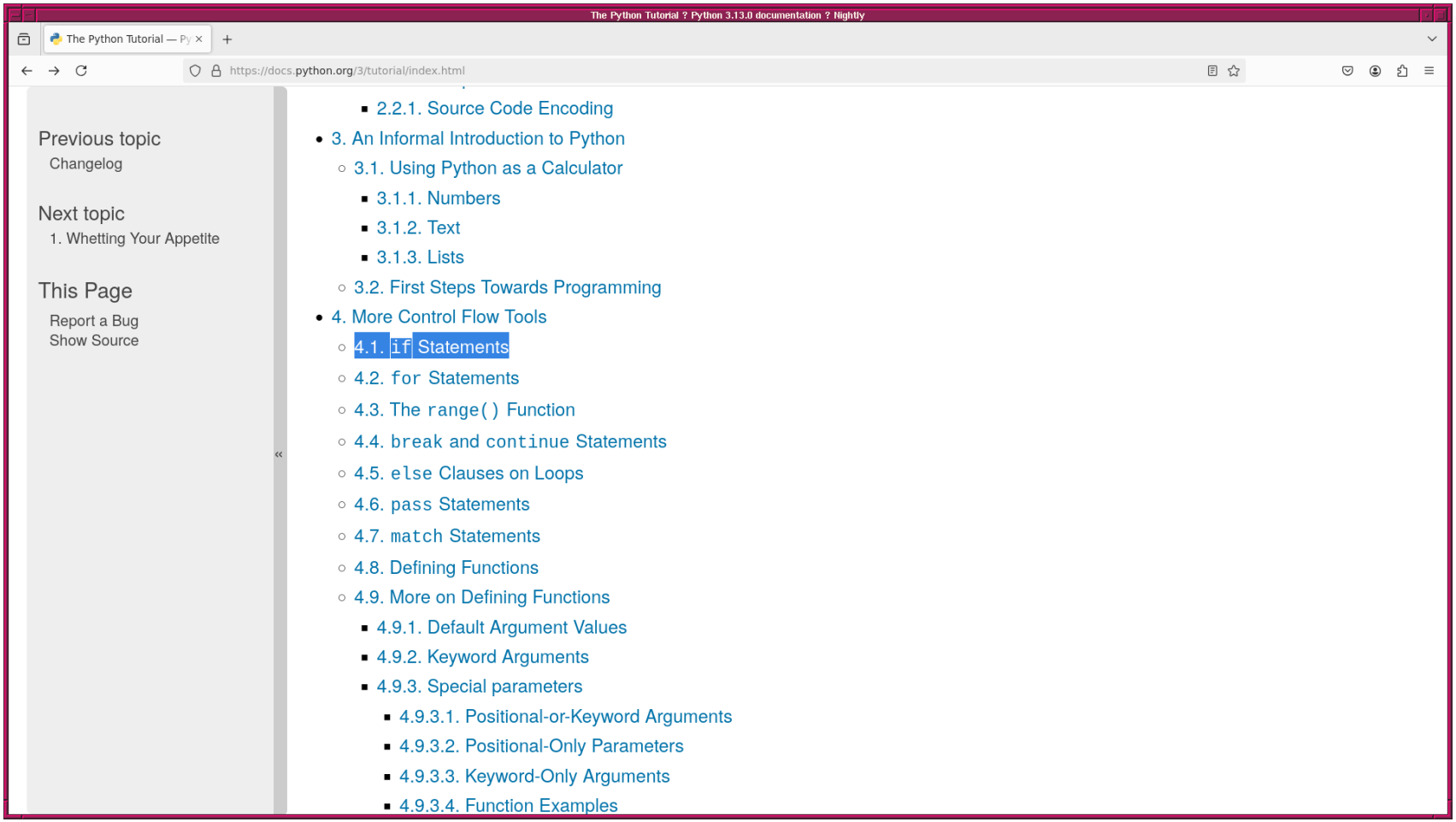
- The first line contains a *multiple assignment*: the variables `a` and `b` simultaneously get the new values 0 and 1. On the last line this is used again, demonstrating that the expressions on the right-hand side are all evaluated first before any of the assignments take place. The right-hand side expressions are evaluated from the left to the right.
- The `while` loop executes as long as the condition (here: `a < 10`) remains true. In Python, like in C, any non-zero integer value is true; zero is false. The condition may also be a string or list value, in fact any sequence; anything with a non-zero length is true, empty sequences are false. The test used in the example is a simple comparison. The standard comparison operators are written the same as in C: `<` (less than), `>`

https://docs.python.org/3/tutorial/introduction.html#first-steps-towards-programming

"The Python Tutorial"

- To learn about the "`if`" statement, read the section 4.1 "`if` Statements".
  - `https://docs.python.org/3/tutorial/controlflow.html#if-statements`

"The Python Tutorial"



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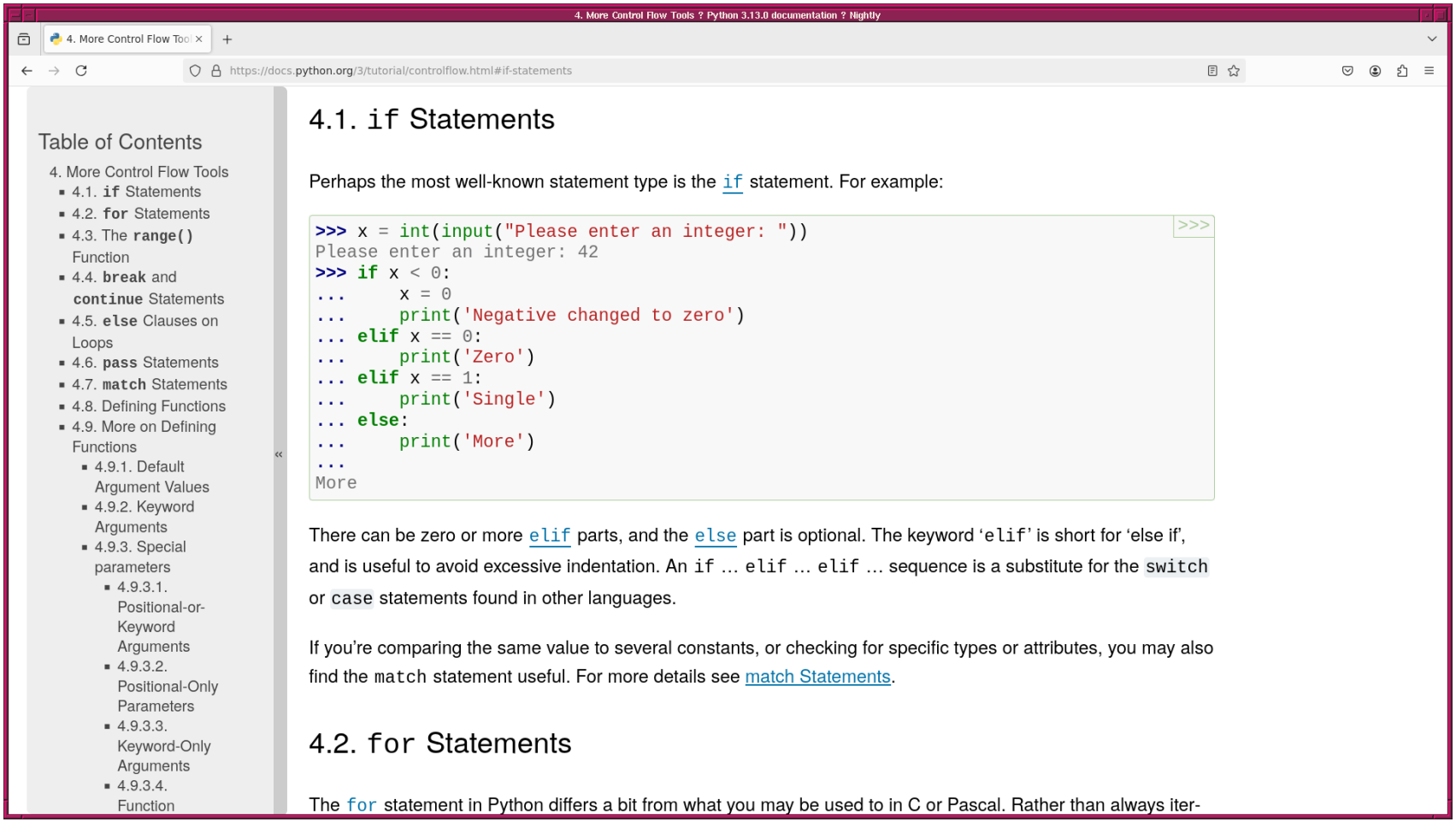

https://docs.python.org/3/tutorial/

"The Python Tutorial"

- To learn about the way to define a function, read the sections 4.8 "Defining Functions" and 4.9 "More on Defining Functions".
  - https://docs.python.org/3/tutorial/controlflow.html#defining-functions
  - https://docs.python.org/3/tutorial/controlflow.html#more-on-defining-functions

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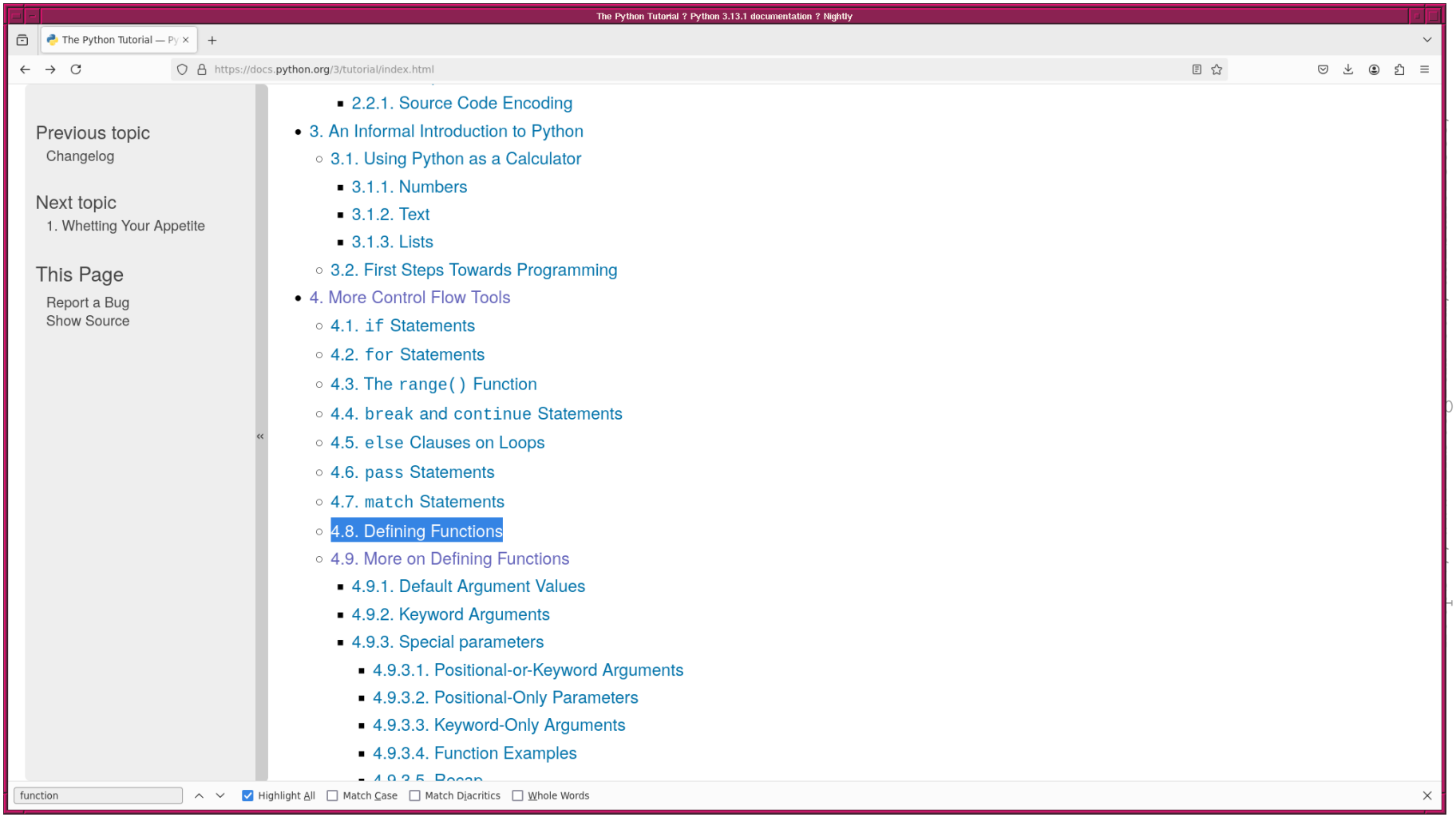

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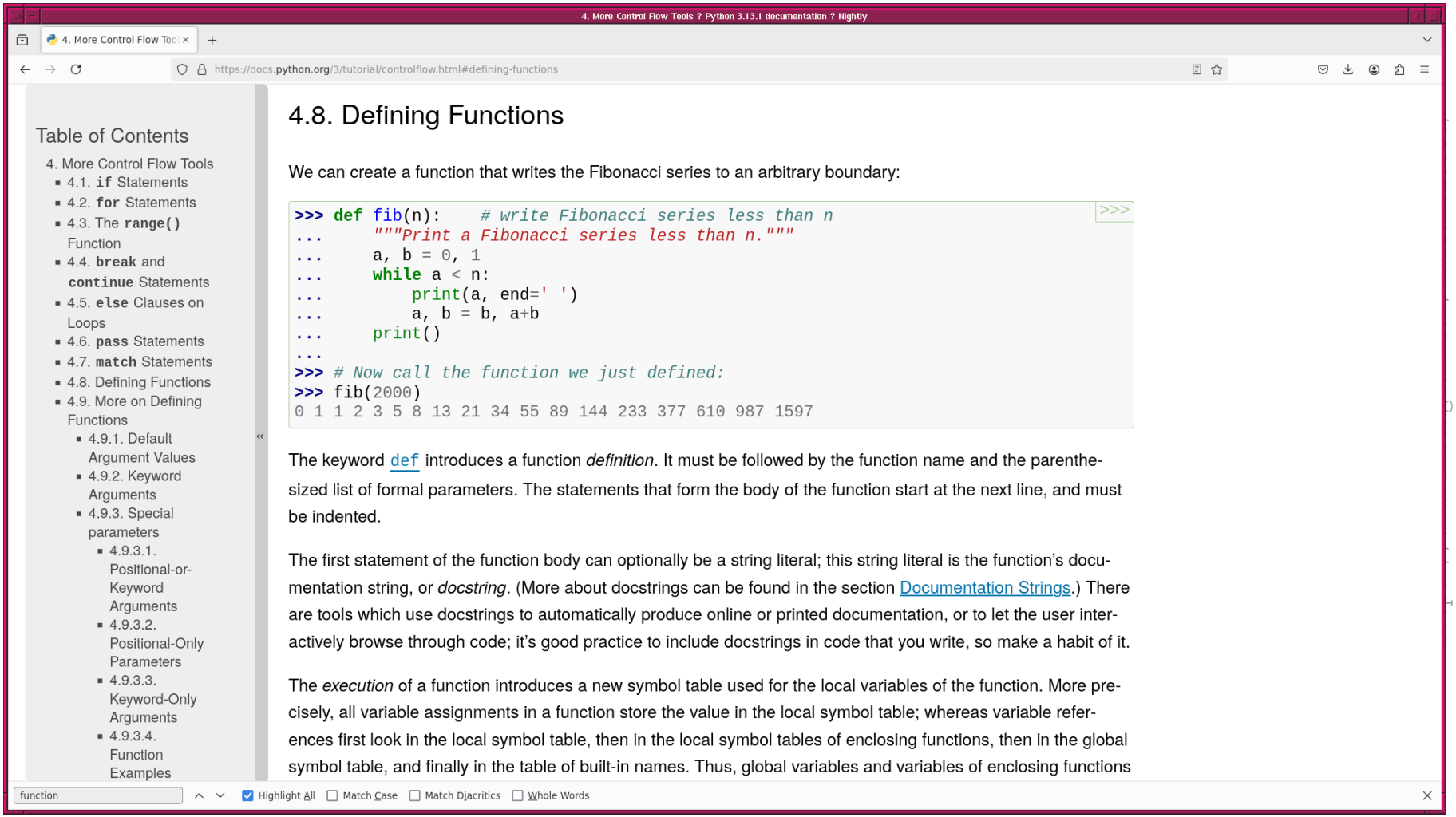

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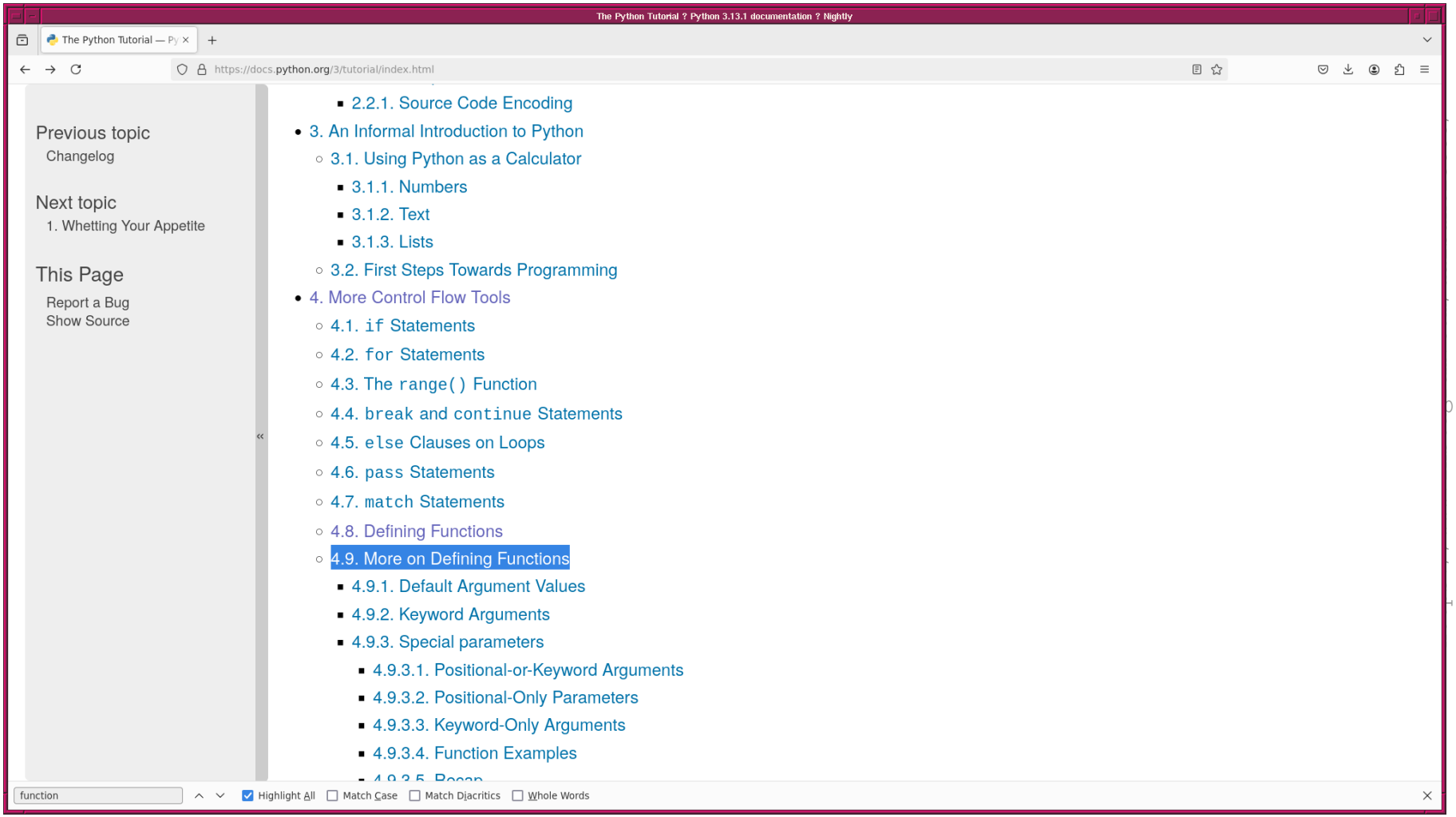

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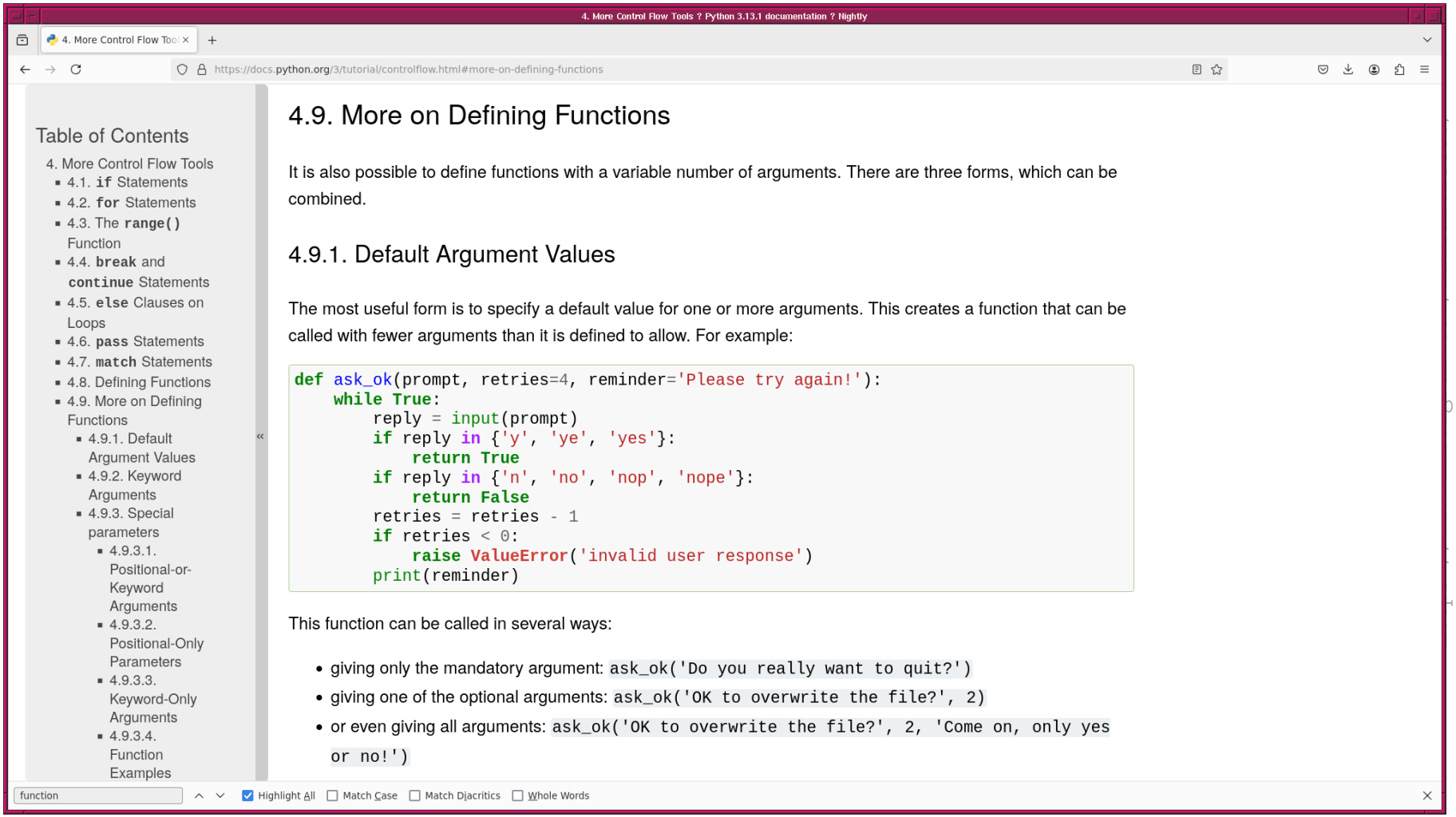

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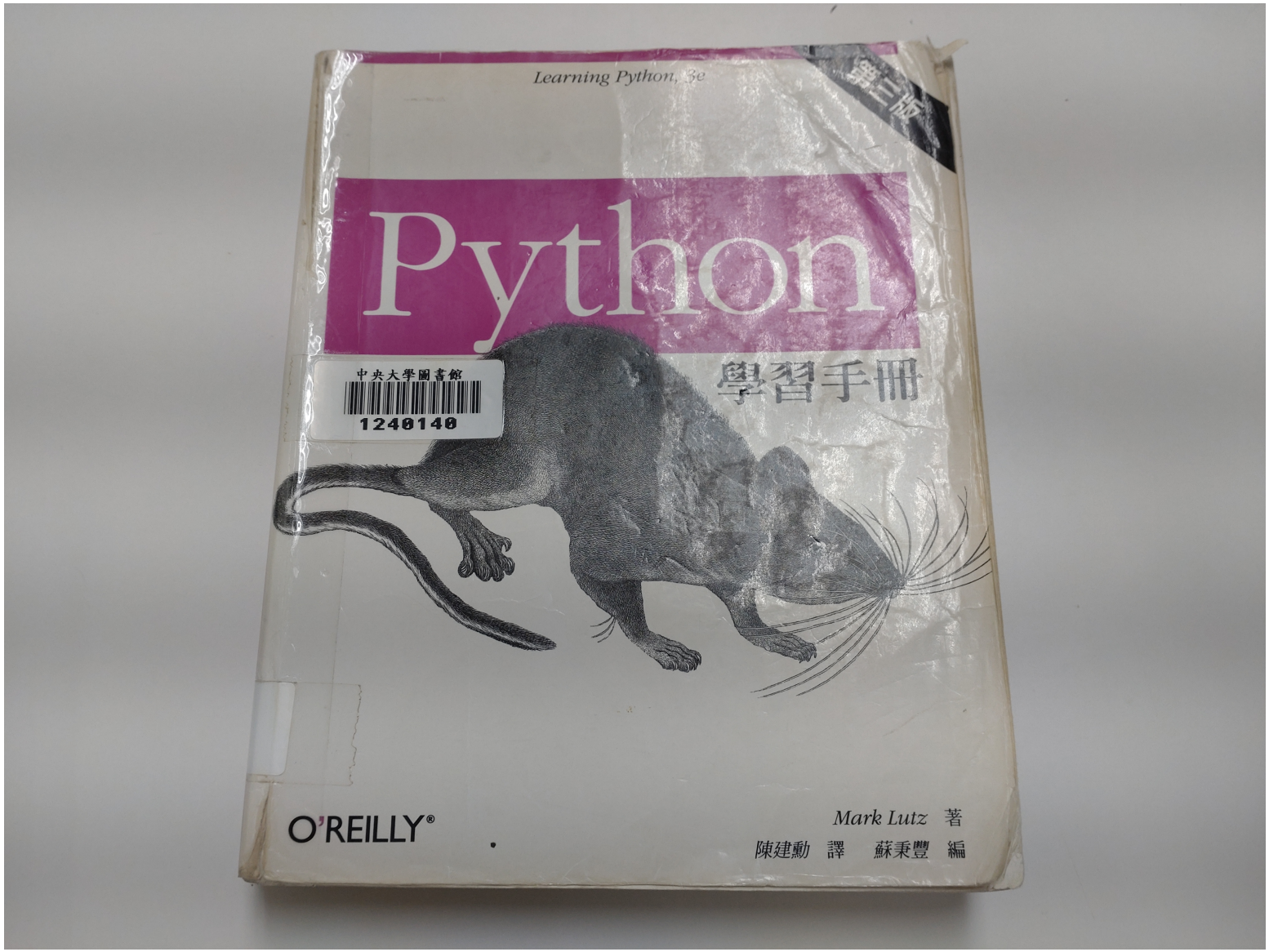
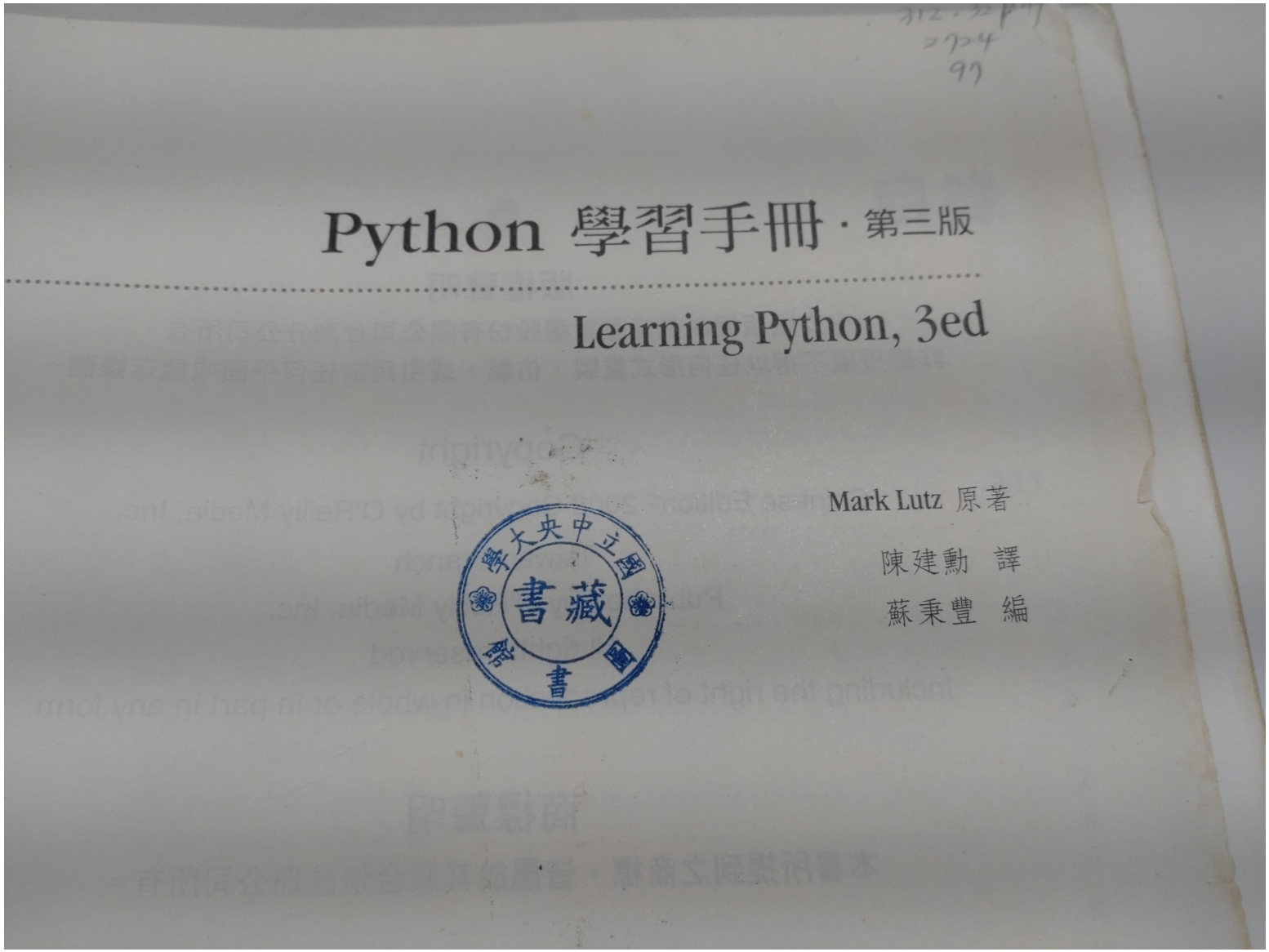
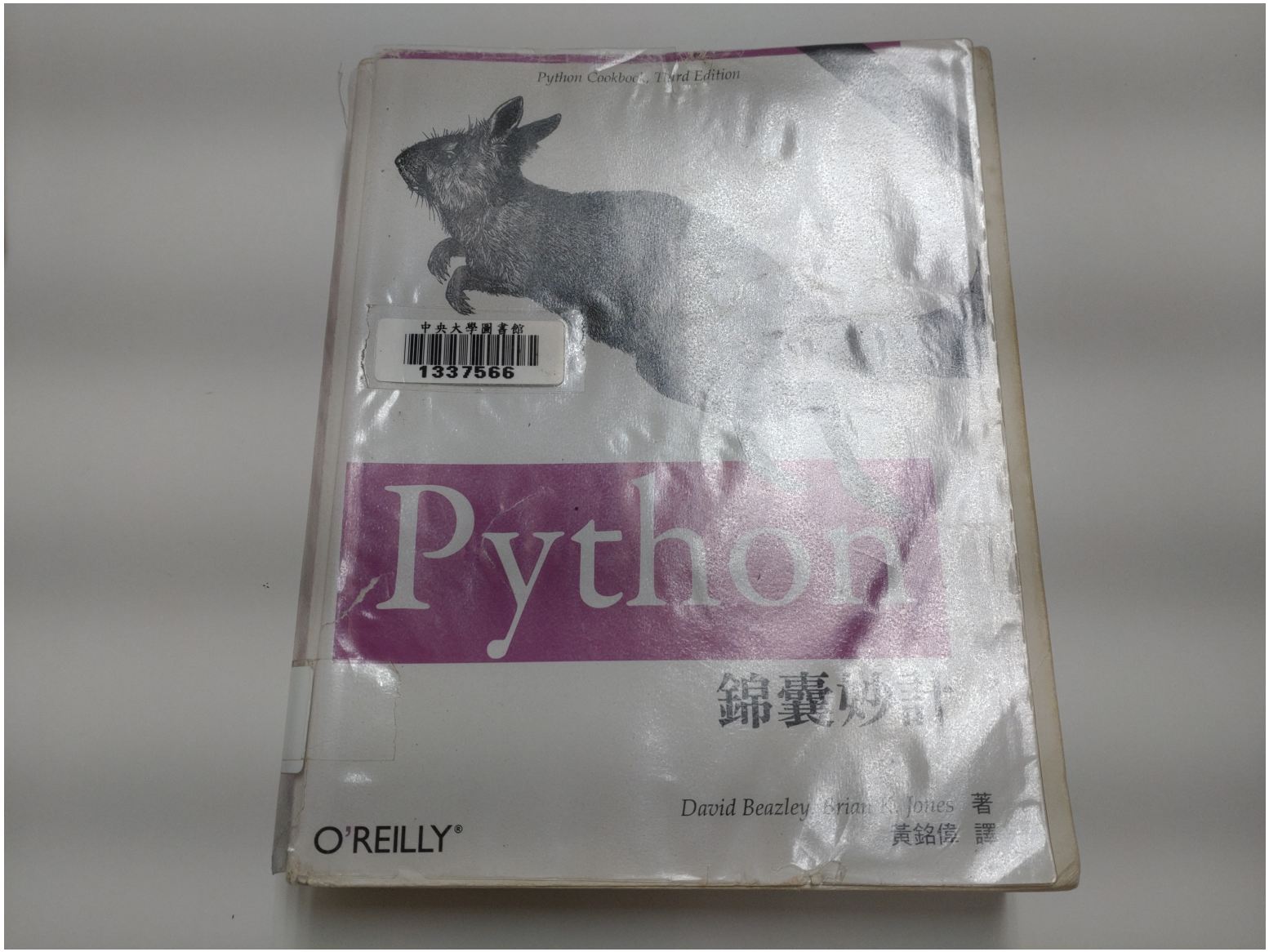


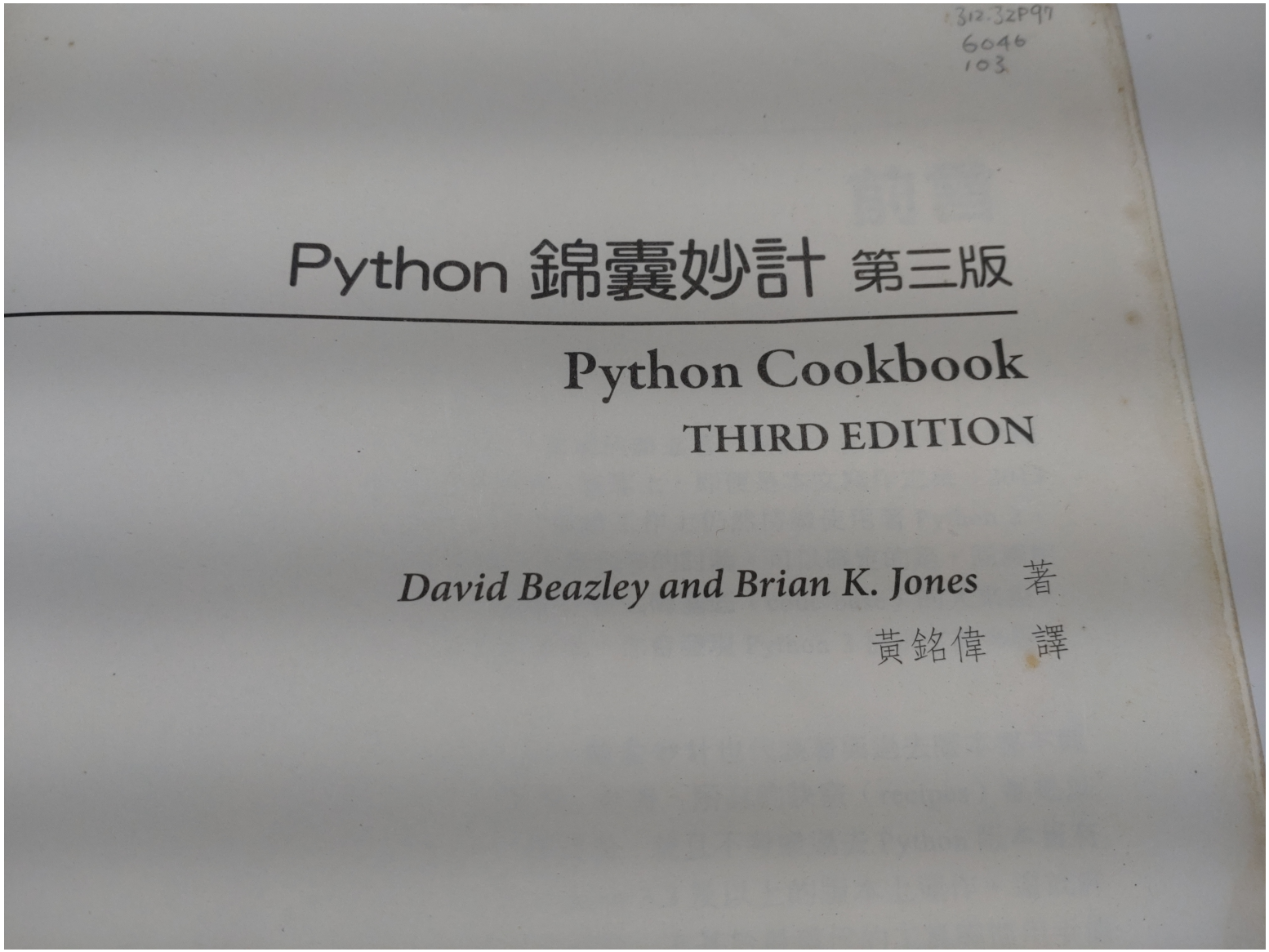
Recommended books



Recommended books



Recommended books



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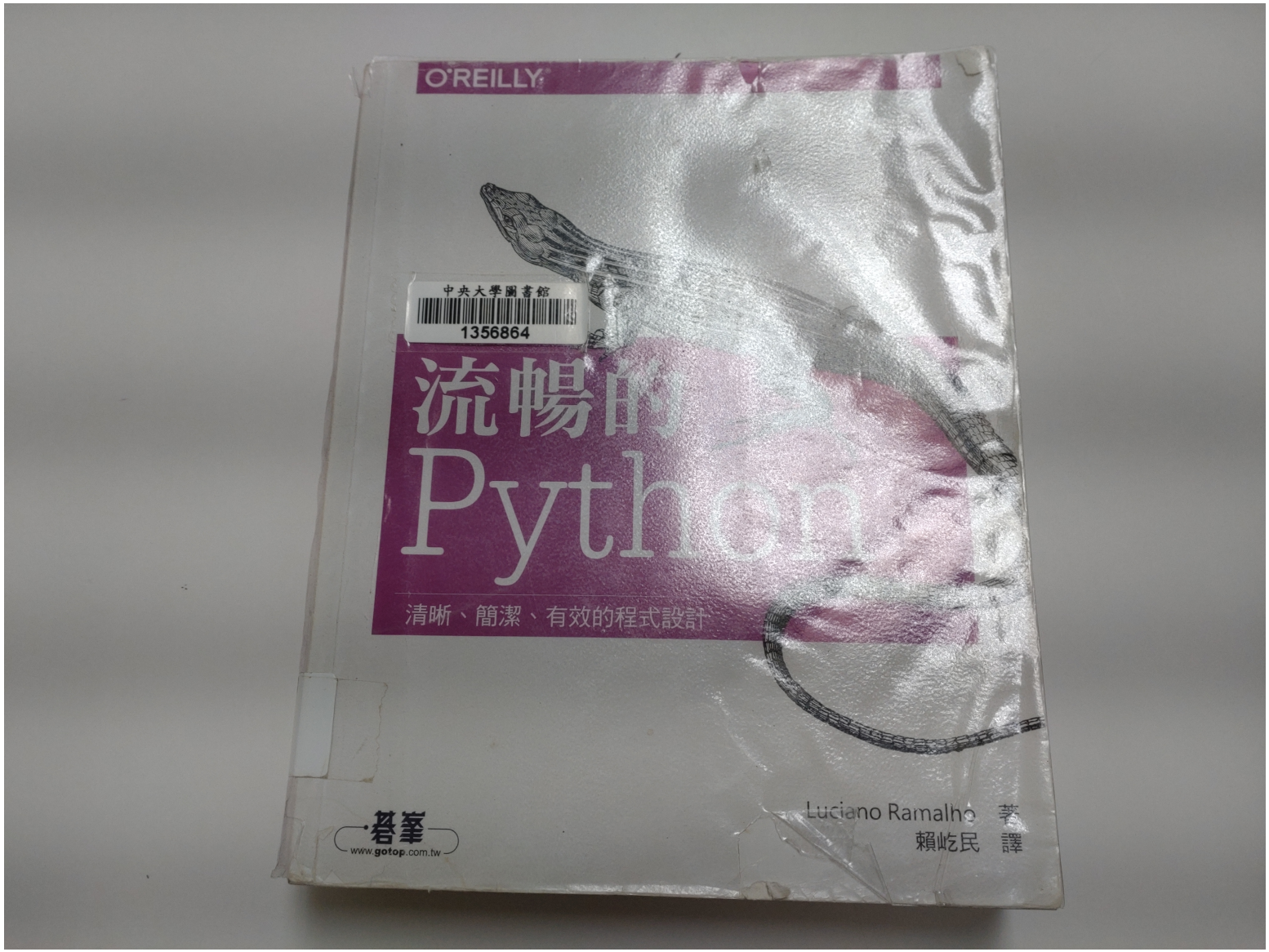

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