Free CS For All: PY4E Python for Everyone

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Introduction

After being a software engineer and engineering manager for 27 years, I would like to leverage my experience to introduce computer science to eighth to 12 graders. I am inspired by Dr. Beatty's use of free textbooks in our ITEC classes. Even though there are widely adopted commercial LMS and learning tools available to learn to code, there are also very capable free, open content, LMS, and engagement platforms to learn computer science.

Even though I have been a software engineer for 27 years, for the last seven years, my role has been in people management, hence my coding skills have atrophied. In this paper, I will demonstrate how I personally brush up my coding skills in Python using PY4E.com (Python for Everyone), and how PY4E can teach children programming via a 100% free content, engagement, and assessment learning management system.

What is PY4E

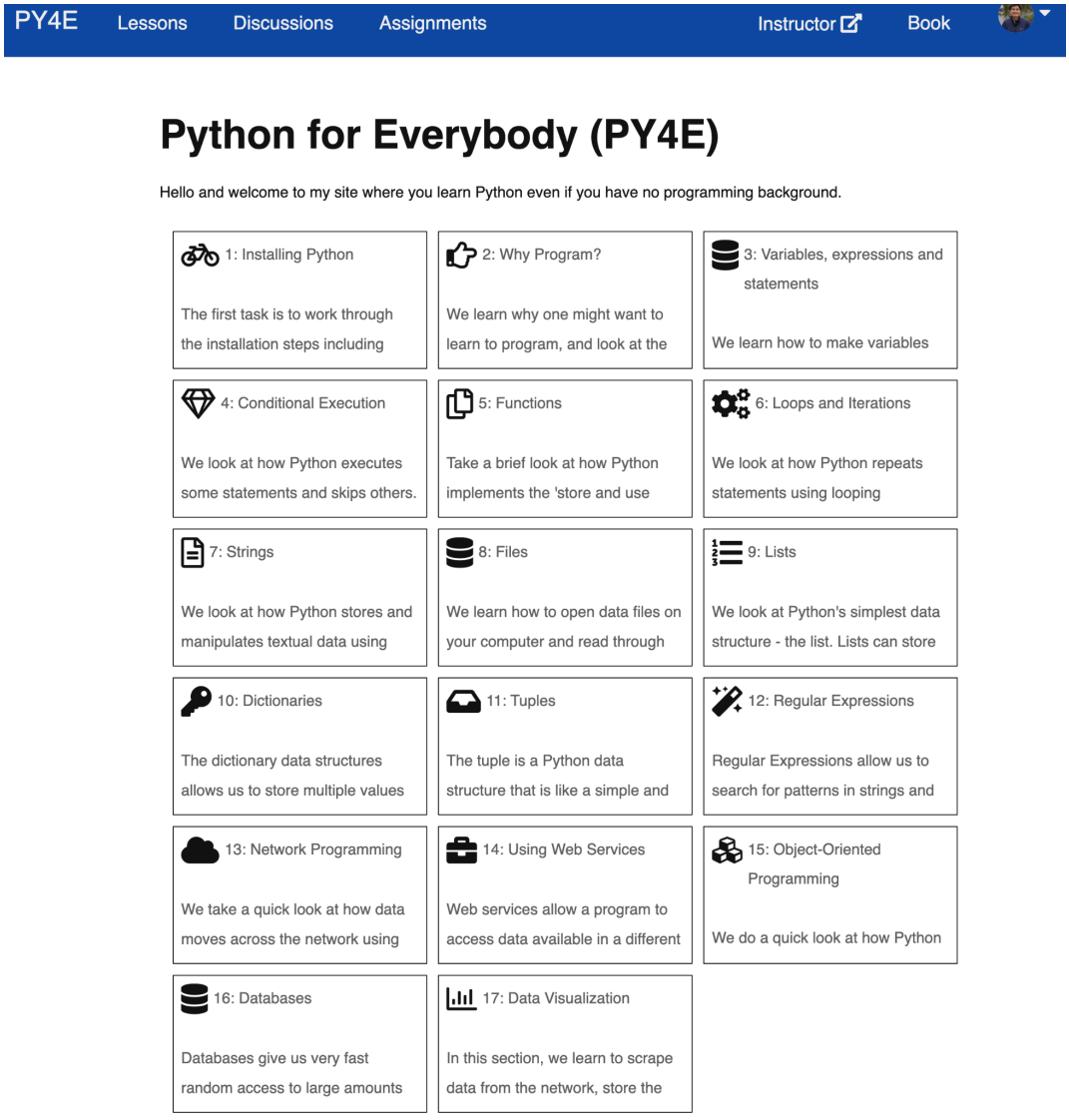
PY4E (Python For Everyone) (*PY4E - Python for Everybody*, n.d.) is a free, online, and open course to learn the programming language Python. PY4E is built on top of a free and open-source MOOC platform called Tsugi. (Severance, n.d.). The website, content, and MOOC platform is created by Charles Severance who is a Clinic Professor at the University of Michigan. He is a "long-time advocate of open source educational technology and open educational resources to empower teachers." (*Charles R. Severance Short Biography*, n.d.). The same course offered on Coursera has 220,000+ ratings and 2,845,864 enrolled. (*Programming for Everybody (Getting Started With Python)*, n.d.)

For free content, there are 17 lessons with topics such as 1: Installing Python, 6: Lists, 12: Regular Expressions, 13: Network programming, and 17: Data Visualization. (See Figure 1)

For engagement, there is a discussion forum linked to each lesson for students to help each other.

For assessment, there is a 10-question quiz at the end of each session and an auto-grader that will evaluate the code as well as the correctness of the output of the code.

Figure 1: List of 17 lessons available on PY4E



Free Content: Videos, Slides, References

Each lesson has a series of videos hosted on Youtube where the instructor would explain concepts, or work through a programming example. Most of these videos are no more than 12 minutes long. This is helpful for students who learn by watching and Youtube is a very familiar video player for children.

As a lesson plan, I would design my course to ask my students to watch these videos and write a reflection using Google Docs about 3 things they learn from each of the videos and also 1 question or topic they would discuss in our synchronous class.

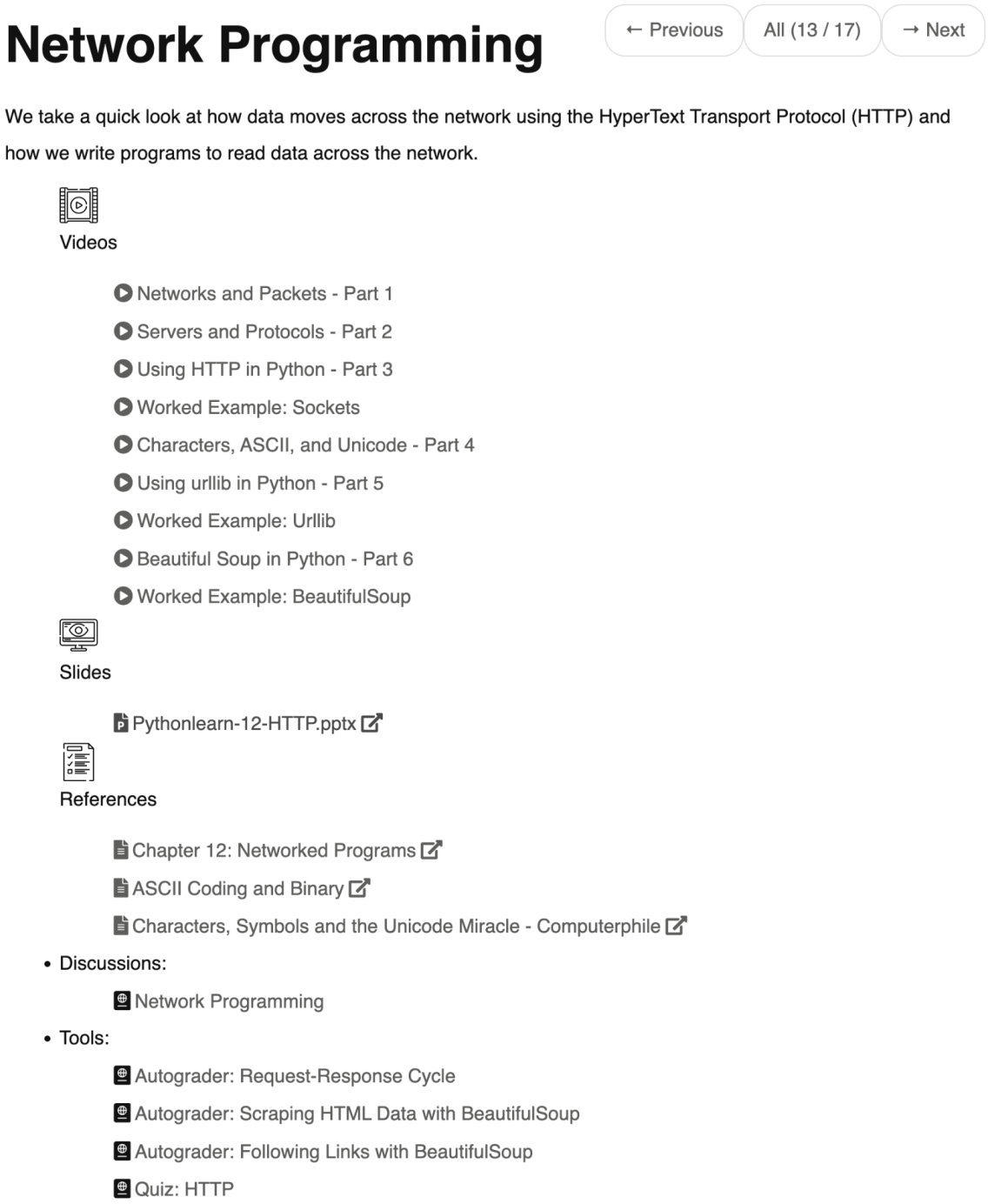
PY4E also makes PowerPoint slides used in the Youtube video freely available if a teacher or students want to take their time to go through the material in a visual format.

As a lesson plan in my course, I would ask each student to screen capture their favorite slide in a Google doc and annotate the screenshot with something new they learn from that slide.

The reference guides are dense material consisting of explanations of concepts Dr. Chuck goes over in the video and slides. The material is helpful to answer the quizzes or to complete the hands-on coding exercise. I will remind my students to make heavy use of the reference guides to help them through the coding portion.

As an experienced programmer, I leveraged the references to refresh my memory. I skipped the slides and videos and jumped into the Autograder hands-on exercises and the quizzes to check my knowledge. Students of varied backgrounds in programming, they could also choose to skip over certain portions of the video or slide content.

Figure 2: A single lesson showing the videos, slides, references, and tools



Free Engagement: Discussion Boards and Peer Feedback

PY4E offers a discussion board for students to help each other and ask for feedback. Unfortunately, this is not really well done because there are a lot of students posting their full solutions and it's not helpful. In the first lesson, there is a peer review system where you have to upload 2 screenshots of your installation of Python. You have to review at least 2 other submissions and give out a 6-point grade. (See Figure 3) There is a lot of value if some of the other lessons also incorporate peer review.

As a lesson plan, I would ask students to submit their code to Github for each lesson and ask for students to review at least 2 other submissions. Since no 2 students write the exact the same code, as part of learning, when a student is asked to review and comment on other people's code, they also learn by giving meaningful feedback

Figure 3: Peer reviews using uploaded screenshots

Welcome Tony Tam from Python for Everybody

Peer Review: Installing and Running Python Screen Shots

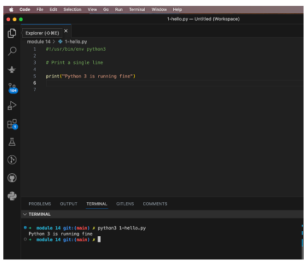
Install Python and a programming text editor and write a program that prints one line other than 'hello world', then take two screen shots and upload them below. You should use the command line to execute the Python program you wrote in the text editor. Please do *not* use the IDLE Python Shell, the Python Interpreter (>>>), or a shortcut in your text editor to run the code. Later in the class when we start reading files, we will need to be able to run Python programs from particular directories. See the videos for details.

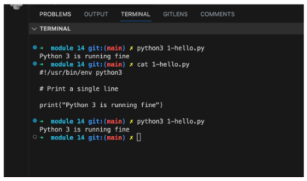
This is a relatively simple assignment. The goal is to simply show that each student has Python installed on their desktop or laptop and can take screen shots. Please make your comments to help the student that you are reviewing.

Review other students

You have reviewed 4 other student submissions. You must review at least 2 submissions for full credit on this assignment. You *can* review up to 8 submissions if you like.

Your Submission:





Click on each image/pdf to see a larger view of the image.

You have the following grades from other students:

Points	Comments	Action
6	Good job!	Flag
6		Flag

Your overall score from your peers: 6

Delete Your Submission

Your current grade is 100%

Free Assessment: Autograder and quizzes

For each lesson in PY4E, there are 10 multiple-choice questions that attempt to assess the student's understanding of the concepts of that lesson. The student can retake the quiz as many times as they would like, but they do have to wait at least 10 minutes to retake the entire quiz. As a professional, I went through every quiz and when I missed 1 or 2 questions, the quiz tells me which ones I answer incorrectly. I find the delay helpful for me to take a breath and come back later.

For my lesson plan, I would encourage the students to try to get to 100% on the quizzes because they could find most of the answers in the reference guide and I would rather they master all the concepts.

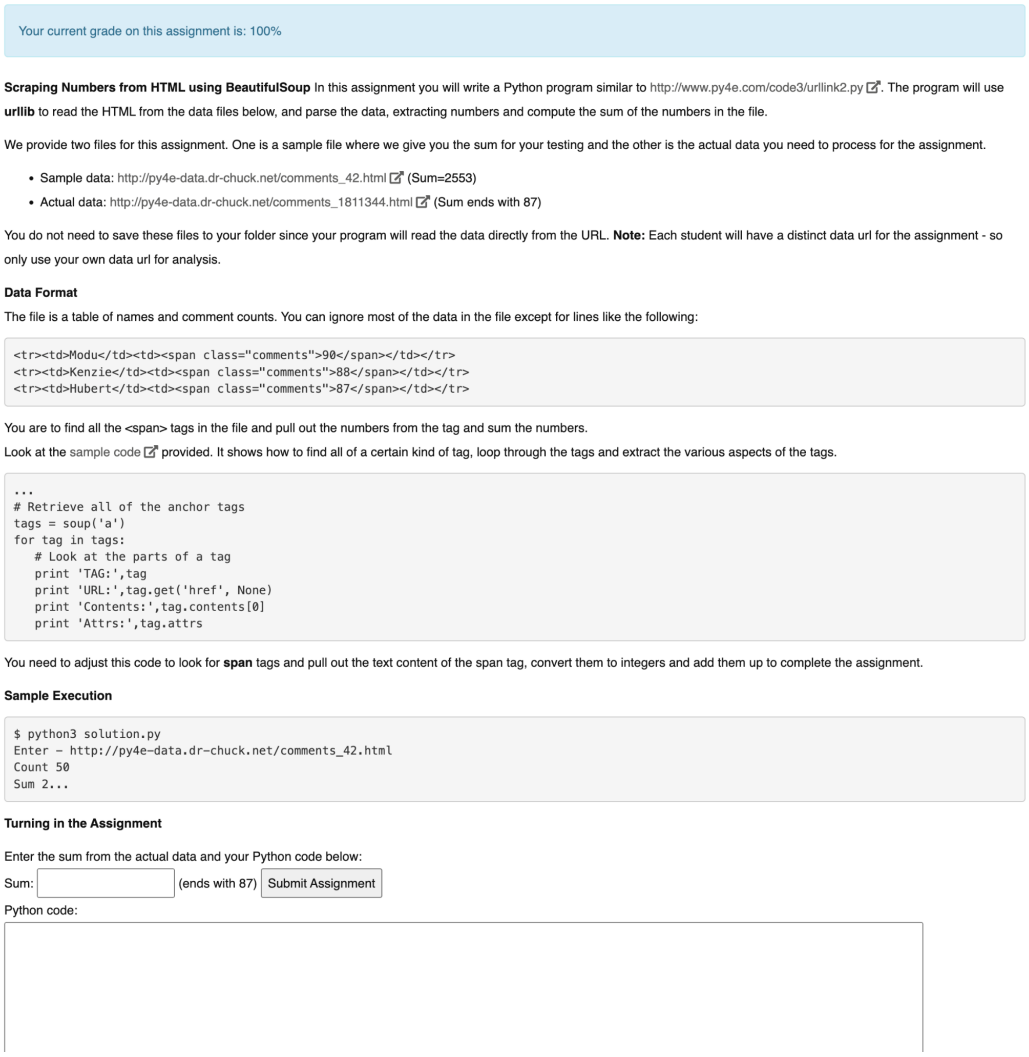
Finally, each lesson has one to three hands-on projects where the students are expected to modify or write code from scratch to accomplish a goal. For example, in lesson 13 with Network Programming, one of the hands-on project is "*Scraping Numbers from HTML using BeautifulSoup In this assignment you will write a Python program similar to http://www.py4e.com/code3/urllink2.py. The program will use urllib to read the HTML from the data files below, and parse the data, extracting numbers and compute the sum of the numbers in the file.*"

The student has to enter in a text box the sum of the numbers, and the code, and the Autograder will give the student 100% or 0%. The student can try as many times as they want. What is really unique is the dataset the student uses is unique to them, so no two students will have the same answer for the sum of the numbers. (See Figure 4)

As the student progresses, they see their grade in the Assignment tab. Even though there isn't an LMS for the teacher to review progress, this is a personalized self-paced LMS. As a student, I find myself very motivated to get a perfect score on the coding and quizzes. (Figure 5)

For my lesson plan, I would ask students to share their assignment tab with me weekly via email so I can track their progress.

Figure 4: Coding exercise and submission page



Your current grade on this assignment is: 100%

Scraping Numbers from HTML using BeautifulSoup In this assignment you will write a Python program similar to http://www.py4e.com/code3/urllink2.py. The program will use **urllib** to read the HTML from the data files below, and parse the data, extracting numbers and compute the sum of the numbers in the file.

We provide two files for this assignment. One is a sample file where we give you the sum for your testing and the other is the actual data you need to process for the assignment.

- Sample data: http://py4e-data.dr-chuck.net/comments_42.html (Sum=2553)
- Actual data: http://py4e-data.dr-chuck.net/comments_1811344.html (Sum ends with 87)

You do not need to save these files to your folder since your program will read the data directly from the URL. **Note:** Each student will have a distinct data url for the assignment - so only use your own data url for analysis.

Data Format

The file is a table of names and comment counts. You can ignore most of the data in the file except for lines like the following:

```
<tr><td>Modu</td><td><span class="comments">90</span></td></tr>
<tr><td>Kenzie</td><td><span class="comments">88</span></td></tr>
<tr><td>Hubert</td><td><span class="comments">87</span></td></tr>
```

You are to find all the tags in the file and pull out the numbers from the tag and sum the numbers.

Look at the sample code provided. It shows how to find all of a certain kind of tag, loop through the tags and extract the various aspects of the tags.

```
...
# Retrieve all of the anchor tags
tags = soup('a')
for tag in tags:
   # Look at the parts of a tag
   print 'TAG:',tag
   print 'URL:',tag.get('href', None)
   print 'Contents:',tag.contents[0]
   print 'Attrs:',tag.attrs
```

You need to adjust this code to look for **span** tags and pull out the text content of the span tag, convert them to integers and add them up to complete the assignment.

Sample Execution

```
$ python3 solution.py
Enter - http://py4e-data.dr-chuck.net/comments_42.html
Count 50
Sum 2...
```

Turning in the Assignment

Enter the sum from the actual data and your Python code below:

Sum: (ends with 87) Submit Assignment

Python code:

Figure 5: Grades for quizzes and coding exercises

PY4E Lessons Discussions Assignments Instructor Book

☑	Autograder: Exercise 3.1	Score: 100
☑	Autograder: Exercise 3.3	Score: 100
☑	Quiz: Conditional Execution	Score: 100
Functions		
☑	Autograder: Exercise 4.6	Score: 100
☑	Quiz: Functions	Score: 100
Loops and Iterations		
☑	Autograder: Exercise 5.2	Score: 100
☑	Quiz: Loops and Iterations	Score: 90
Strings		
☑	Autograder: Exercise 6.5	Score: 100
☑	Quiz: Strings	Score: 100
Files		
☑	Autograder: Exercise 7.2	Score: 100
☑	Quiz: Files	Score: 100
Lists		
☑	Autograder: Exercise 8.4	Score: 100
☑	Autograder: Exercise 8.5	Score: 100
☑	Quiz: Lists	Score: 100
Dictionaries		
☑	Autograder: Exercise 9.4	Score: 100
☑	Quiz: Dictionaries	Score: 90.9091
Tuples		
☑	Autograder: Exercise 10.2	Score: 100
☑	Quiz: Tuples	Score: 100
Regular Expressions		
☑	Autograder: Regular Expressions	Score: 100
☑	Quiz: Regular Expressions	Score: 100
Network Programming		
☑	Autograder: Request-Response Cycle	Score: 100
☑	Autograder: Scraping HTML Data with BeautifulSoup	Score: 100
☑	Autograder: Following Links with BeautifulSoup	Score: 100
☑	Quiz: HTTP	Score: 90.9091

Conclusion

PY4E offers a truly 100% free course in computer programming. The free and open content (videos, presentations, reference), interactive quizzes, coding platform, and assessment all make this a fantastic resource for students to learn to program in a self-pace and no-pressure environment. Even an experienced programmer like myself found the platform enjoyable to use to brush up on my coding skills. Charles Severance's commitment towards a free and open education platform is very inspiring and has already educated thousands of children and adults.

References

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