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THIRD EDITION

A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code

ZED SHAW

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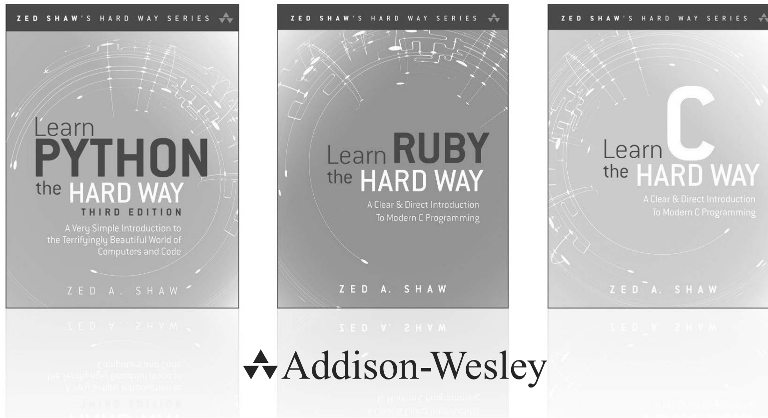

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LEARN PYTHON THE HARD WAY

A Very Simple Introduction
to the Terrifyingly Beautiful World
of Computers and Code

Third Edition

Zed A. Shaw

Addison-Wesley

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Preface

This simple book is meant to get you started in programming. The title says it's the hard way to learn to write code, but it's actually not. It's only the "hard" way because it uses a technique called *instruction*. Instruction is where I tell you to do a sequence of controlled exercises designed to build a skill through repetition. This technique works very well with beginners who know nothing and need to acquire basic skills before they can understand more complex topics. It's used in everything from martial arts to music to even basic math and reading skills.

This book instructs you in Python by slowly building and establishing skills through techniques like practice and memorization, then applying them to increasingly difficult problems. By the end of the book, you will have the tools needed to begin learning more complex programming topics. I like to tell people that my book gives you your "programming black belt." What this means is that you know the basics well enough to now start learning programming.

If you work hard, take your time, and build these skills, you will learn to code.

Acknowledgments

I would like to thank Angela for helping me with the first two versions of this book. Without her, I probably wouldn't have bothered to finish it at all. She did the copy editing of the first draft and supported me immensely while I wrote it.

I'd also like to thank Greg Newman for doing the cover art for the first two editions, Brian Shumate for early website designs, and all the people who read previous editions of this book and took the time to send me feedback and corrections.

Thank you.

The Hard Way Is Easier

With the help of this book, you will do the incredibly simple things that all programmers do to learn a programming language:

1. Go through each exercise.
2. Type in each sample *exactly*.
3. Make it run.

That's it. This will be *very* difficult at first, but stick with it. If you go through this book and do each exercise for one or two hours a night, you will have a good foundation for moving on to another

book. You might not really learn "programming" from this book, but you will learn the foundation skills you need to start learning the language.

This book's job is to teach you the three most essential skills that a beginning programmer needs to know: reading and writing, attention to detail, and spotting differences.

Reading and Writing

It seems stupidly obvious, but if you have a problem typing, you will have a problem learning to code. Especially if you have a problem typing the fairly odd characters in source code. Without this simple skill, you will be unable to learn even the most basic things about how software works.

Typing the code samples and getting them to run will help you learn the names of the symbols, get you familiar with typing them, and get you reading the language.

Attention to Detail

The one skill that separates bad programmers from good programmers is attention to detail. In fact, it's what separates the good from the bad in any profession. Without paying attention to the tiniest details of your work, you will miss key elements of what you create. In programming, this is how you end up with bugs and difficult-to-use systems.

By going through this book and copying each example *exactly*, you will be training your brain to focus on the details of what you are doing, as you are doing it.

Spotting Differences

A very important skill—which most programmers develop over time—is the ability to visually notice differences between things. An experienced programmer can take two pieces of code that are slightly different and immediately start pointing out the differences. Programmers have invented tools to make this even easier, but we won't be using any of these. You first have to train your brain the hard way—then you can use the tools.

While you do these exercises, typing each one in, you will make mistakes. It's inevitable; even seasoned programmers make a few. Your job is to compare what you have written to what's required and fix all the differences. By doing so, you will train yourself to notice mistakes, bugs, and other problems.

Do Not Copy-Paste

You must *type* each of these exercises in, manually. If you copy and paste, you might as well just not even do them. The point of these exercises is to train your hands, your brain, and your mind

in how to read, write, and see code. If you copy-paste, you are cheating yourself out of the effectiveness of the lessons.

Using the Included Videos

Included in the third edition of *Learn Python The Hard Way* is more than five hours of instructional videos. There is one video for each exercise where I either demonstrate the exercise or give you tips for completing the exercise. The best way to use the videos is to attempt or complete the exercises without them first, then use the videos to review what you learned or if you are stuck. This will slowly wean you off of using videos to learn programming and will build your skills at understanding code directly. Stick with it, and over time you won't need these videos, or any videos, to learn programming. You'll be able to just read for the information you need.

A Word of Advice for "Visual Learners"

Your belief that you are "only" a visual learner is potentially holding you back in your educational goals. The idea that a person could only possibly learn from one of their senses is preposterous. It is possible to learn to use all of your senses when tackling a complex subject such as programming. If you've locked yourself in the visual- or kinetic-learner prison your whole life, then this book is a great way to break out of it and build up your analytic skills.

By first attempting each exercise from the book, you will build your skills at analytic thinking, skills which most likely you already have but have simply forgotten how to use effectively. However, when you get stuck, grab the video for that exercise and use your ability to process visual information to help. In fact, finding ways to apply all of your sense to a given difficult problem will give you new insights into that problem no matter how strange it may seem at first.

A Note on Practice and Persistence

While you are studying programming, I'm studying how to play guitar. I practice it every day for at least two hours a day. I play scales, chords, and arpeggios for an hour at least and then learn music theory, ear training, songs, and anything else I can. Some days I study guitar and music for eight hours because I feel like it and it's fun. To me, repetitive practice is natural and is just how to learn something. I know that to get good at anything you have to practice every day, even if I suck that day (which is often) or it's difficult. Keep trying and eventually it'll be easier and fun.

As you study this book and continue with programming, remember that anything worth doing is difficult at first. Maybe you are the kind of person who is afraid of failure, so you give up at the first sign of difficulty. Maybe you never learned self-discipline, so you can't do anything that's "boring." Maybe you were told that you are "gifted," so you never attempt anything that might

make you seem stupid or not a prodigy. Maybe you are competitive and unfairly compare yourself to someone like me who's been programming for 20+ years.

Whatever your reason for wanting to quit, *keep at it*. Force yourself. If you run into a Study Drill you can't do or a lesson you just do not understand, then skip it and come back to it later. Just keep going because with programming there's this very odd thing that happens. At first, you will not understand anything. It'll be weird, just like with learning any human language. You will struggle with words and not know what symbols are what, and it'll all be very confusing. Then one day—*BANG*—your brain will snap and you will suddenly "get it." If you keep doing the exercises and keep trying to understand them, you will get it. You might not be a master coder, but you will at least understand how programming works.

If you give up, you won't ever reach this point. You will hit the first confusing thing (which is everything at first) and then stop. If you keep trying, keep typing it in, trying to understand it and reading about it, you will eventually get it.

But if you go through this whole book and you still do not understand how to code, at least you gave it a shot. You can say you tried your best and a little more and it didn't work out, but at least you tried. You can be proud of that.

A Warning for the Smarties

Sometimes people who already know a programming language will read this book and feel I'm insulting them. There is nothing in this book that is intended to be interpreted as condescending, insulting, or belittling. I simply know more about programming than my *intended* readers. If you think you are smarter than me, then you will feel talked down to and there's nothing I can do about that because you are not my *intended* reader.

If you are reading this book and flipping out at every third sentence because you feel I'm insulting your intelligence, then I have three points of advice for you:

1. Stop reading my book. I didn't write it for you. I wrote it for people who don't already know everything.
2. Empty before you fill. You will have a hard time learning from someone with more knowledge if you already know everything.
3. Go learn Lisp. I hear people who know everything really like Lisp.

For everyone else who's here to learn, just read everything as if I'm smiling and I have a mischievous little twinkle in my eye.

EXERCISE 1

A Good First Program

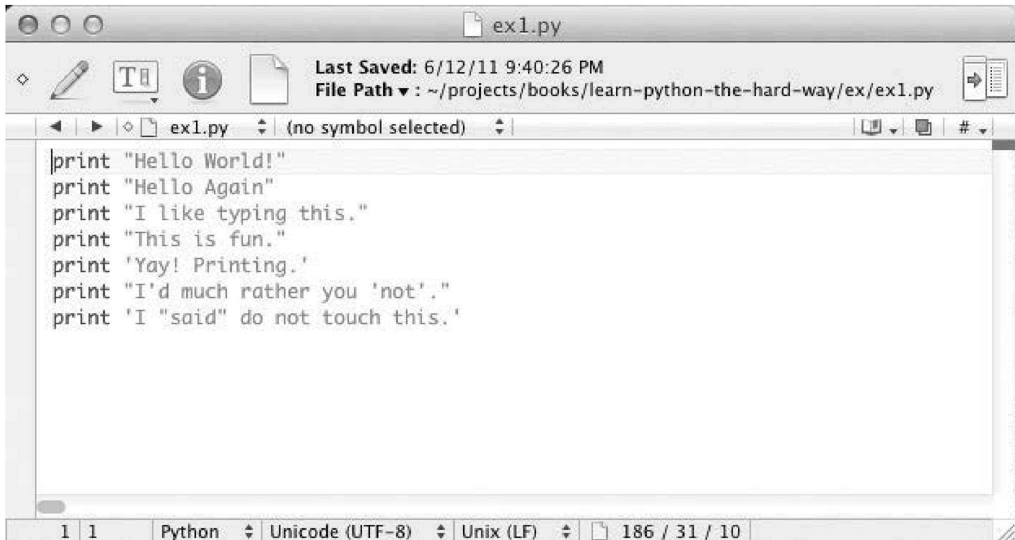
Remember, you should have spent a good amount of time in Exercise 0, learning how to install a text editor, run the text editor, run the Terminal, and work with both of them. If you haven't done that, then do not go on. You will not have a good time. This is the only time I'll start an exercise with a warning that you should not skip or get ahead of yourself.

Type the following text into a single file named `ex1.py`. This is important, as Python works best with files ending in `.py`.

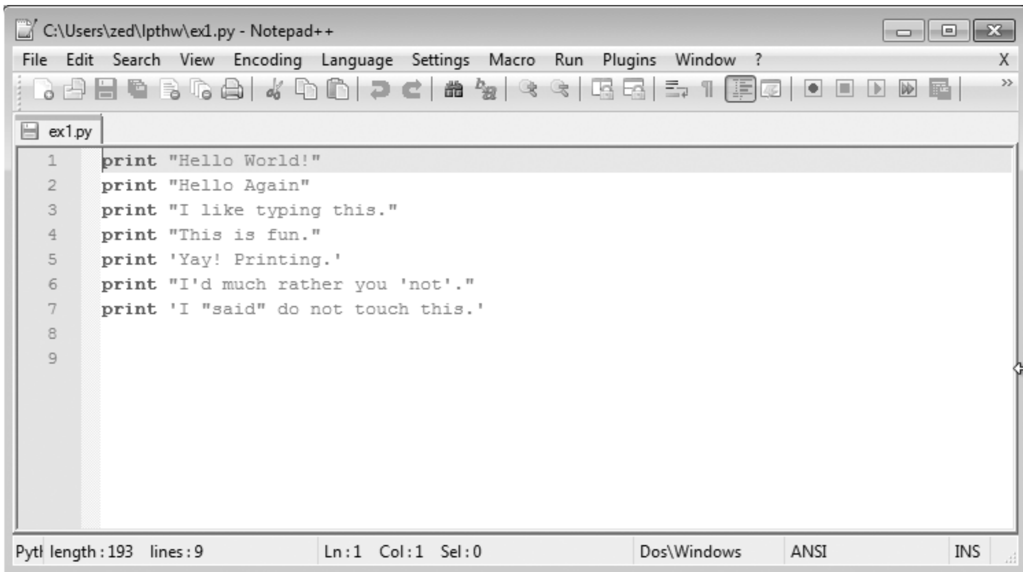
ex1.py

```
1    print "Hello World!"
2    print "Hello Again"
3    print "I like typing this."
4    print "This is fun."
5    print 'Yay! Printing.'
6    print "I'd much rather you 'not'."
7    print 'I "said" do not touch this.'
```

If you are on Mac OSX, then this is what your text editor might look like if you use TextWrangler:



If you are on Windows using Notepad++, then this is what it would look like:



Don't worry if your editor doesn't look exactly the same; the key points are as follows:

1. Notice I did not type the line numbers on the left. Those are printed in the book so I can talk about specific lines by saying, "See line 5 . . ." You do not type those into Python scripts.

2. Notice I have the `print` at the beginning of the line and how it looks exactly the same as what I have above. Exactly means exactly, not kind of sort of the same. Every single character has to match for it to work. But the colors are all different. Color doesn't matter; only the characters you type.

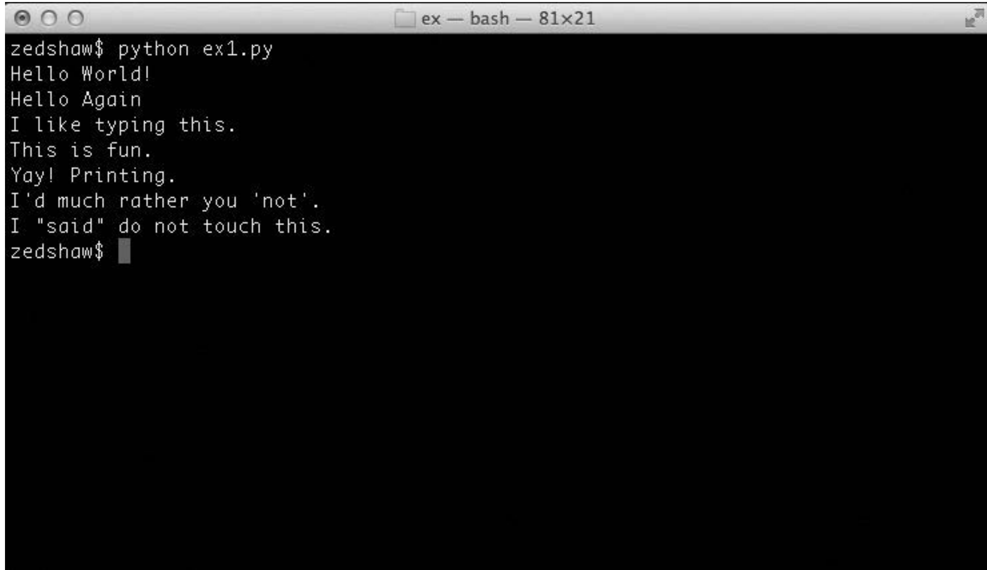
Then in Terminal, *run* the file by typing:

```
python ex1.py
```

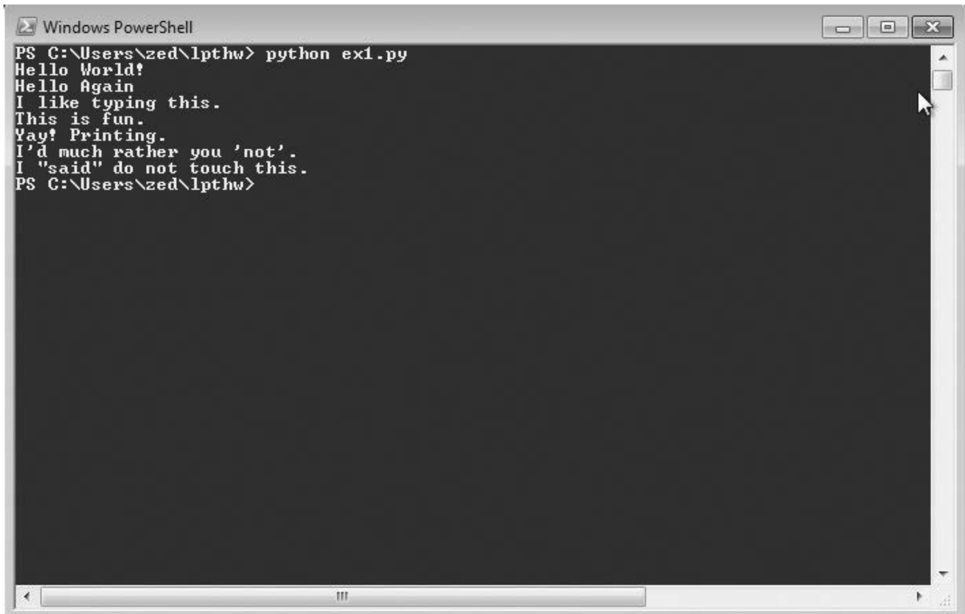
If you did it right, then you should see the same output I have below. If not, you have done something wrong. No, the computer is not wrong.

What You Should See

On Max OSX in the Terminal, you should see this:



On Windows in PowerShell, you should see this:



You may see different names, the name of your computer or other things, before the `python ex1.py`, but the important part is that you type the command and see the output is the same as mine.

If you have an error, it will look like this:

```
$ python ex/ex1.py
  File "ex/ex1.py", line 3
    print "I like typing this.
                              ^
SyntaxError: EOL while scanning string literal
```

It's important that you can read these, since you will be making many of these mistakes. Even I make many of these mistakes. Let's look at this line by line.

1. Here we ran our command in the Terminal to run the `ex1.py` script.
2. Python then tells us that the file `ex1.py` has an error on line 3.
3. It then prints this line for us.
4. Then it puts a ^ (caret) character to point at where the problem is. Notice the missing " (double-quote) character?
5. Finally, it prints out a `SyntaxError` and tells us something about what might be the error. Usually these are very cryptic, but if you copy that text into a search engine, you will find someone else who's had that error and you can probably figure out how to fix it.

WARNING! If you are from another country and you get errors about ASCII encodings, then put this at the top of your Python scripts:

```
# -*- coding: utf-8 -*-
```

It will fix them so that you can use Unicode UTF-8 in your scripts without a problem.

Study Drills

Each exercise also contains Study Drills. The Study Drills contain things you should *try* to do. If you can't, skip it and come back later.

For this exercise, try these things:

1. Make your script print another line.
2. Make your script print only one of the lines.
3. Put a "#" (octothorpe) character at the beginning of a line. What did it do? Try to find out what this character does.

From now on, I won't explain how each exercise works unless an exercise is different.

NOTE: An "octothorpe" is also called a "pound," "hash," "mesh," or any number of names. Pick the one that makes you chill out.

Common Student Questions

These are *actual* questions by real students in the comments section of the book when it was online. You may run into some of these, so I've collected and answered them for you.

Can I use IDLE?
No, you should use Terminal on OSX and PowerShell on Windows, just like I have here. If you don't know how to use those, then you can go read the Command Line Crash Course in the appendix.

How do you get colors in your editor?
Save your file first as a `.py` file, such as `ex1.py`. Then you'll have color when you type.

I get `SyntaxError: invalid syntax` when I run ex1.py.
You are probably trying to run Python, then trying to type Python again. Close your Terminal, start it again, and right away type only `python ex1.py`.

I get `can't open file 'ex1.py': [Errno 2] No such file or directory`.
You need to be in the same directory as the file you created. Make sure you use the `cd` command to go there first. For example, if you saved your file in `lpthw/ex1.py`, then you would do `cd lpthw/` before trying to run `python ex1.py`. If you don't know what any of that means, then go through the Command Line Crash Course (CLI-CC) mentioned in the first question.

How do I get my country's language characters into my file?
Make sure you type this at the top of your file: `# -*- coding: utf-8 -*-`.

My file doesn't run; I just get the prompt back with no output.
You most likely took the previous code literally and thought that `print "Hello World!"` meant to literally print just `"Hello World!"` into the file, without the `print`. Your file has to be *exactly* like mine in the previous code and all the screenshots; I have `print "Hello World!"` and `print` before every line. Make sure your code is like mine and it should work.

Comments and Pound Characters

Comments are very important in your programs. They are used to tell you what something does in English, and they also are used to disable parts of your program if you need to remove them temporarily. Here's how you use comments in Python:

ex2.py

```
1    # A comment, this is so you can read your program later.
2    # Anything after the # is ignored by python.
3
4    print "I could have code like this." # and the comment after is ignored
5
6    # You can also use a comment to "disable" or comment out a piece of code:
7    # print "This won't run."
8
9    print "This will run."
```

From now on, I'm going to write code like this. It is important for you to understand that everything does not have to be literal. Your screen and program may visually look different, but what's important is the text you type into the file you're writing in your text editor. In fact, I could work with any text editor and the results would be the same.

What You Should See

Exercise 2 Session

```
$ python ex2.py
I could have code like this.
This will run.
```

Again, I'm not going to show you screenshots of all the Terminals possible. You should understand that the above is not a literal translation of what your output should look like visually, but the text between the first `$ Python ...` and last $ lines will be what you focus on.

Study Drills

1. Find out if you were right about what the # character does and make sure you know what it's called (octothorpe or pound character).

2. Take your `ex2.py` file and review each line going backward. Start at the last line, and check each word in reverse against what you should have typed.

3. Did you find more mistakes? Fix them.
4. Read what you typed previously out loud, including saying each character by its name. Did you find more mistakes? Fix them.

Common Student Questions

Are you sure # is called the pound character?
I call it the octothorpe and that is the only name that no country uses and that works in every country. Every country thinks its way to call this one character is both the most important way to do it and also the only way it's done. To me this is simply arrogance and, really, y'all should just chill out and focus on more important things like learning to code.

If # is for comments, then how come `# -*- coding: utf-8 -*-` works?
Python still ignores that as code, but it's used as a kind of "hack" or workaround for problems with setting and detecting the format of a file. You also find a similar kind of comment for editor settings.

Why does the # in `print "Hi # there."` not get ignored?
The # in that code is inside a string, so it will be put into the string until the ending " character is hit. These pound characters are just considered characters and aren't considered comments.

How do I comment out multiple lines?
Put a # in front of each one.

I can't figure out how to type a # character on my country's keyboard?
Some countries use the Alt key and combinations of those to print characters foreign to their language. You'll have to look online in a search engine to see how to type it.

Why do I have to read code backward?
It's a trick to make your brain not attach meaning to each part of the code, and doing that makes you process each piece exactly. This catches errors and is a handy error-checking technique.

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