

I T P 4 4 9

INTRODUCTION

L e c t u r e 1



About *me*

Reza Jafarkhani

Lecturer

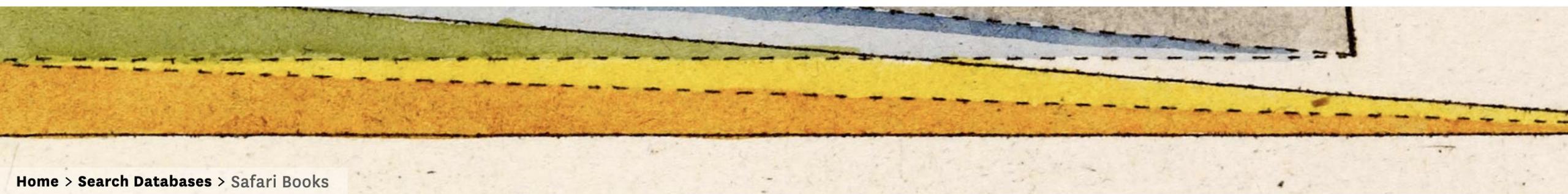
Information Technology Program and
Viterbi School of Engineering
University of Southern California
Los Angeles

- PhD in Civil Eng. (USC)
- MSc in Electrical Eng. – Control Systems (USC)
- Worked in Oil & Gas Industry as Sr. Data Analyst
 - Applications of Machine Learning methods in structural health monitoring of offshore oil platforms*
- Taught Programming and Numerical Methods at California State University

About *class*

The Syllabus ...

References



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Python Machine Learning

<https://learning.oreilly.com/library/view/python-machine-learning/9781119545637/>



Python Machine Learning

★★★★★ 1 REVIEW

by Wei-Meng Lee

Publisher: Wiley

Release Date: April 2019

ISBN: 9781119545637

Topic: Machine Learning

61

Book Description

Python makes machine learning easy for beginners and experienced developers

With computing power increasing exponentially and costs decreasing at the same time, there is no better time to learn machine learning using Python. Machine learning tasks that once required enormous processing power are now possible on desktop machines. However, machine learning is not for the faint of heart—it requires a good foundation in statistics, as well as programming knowledge. *Python Machine Learning* will help coders of all levels master one of the most in-demand programming skillsets in use today.

Readers will get started by following fundamental topics such as an introduction to Machine Learning and Data Science. For each learning algorithm, readers will use a real-life scenario to show how Python is used to solve the problem at hand.

- Python data science—manipulating data and data visualization
- Data cleansing
- Understanding Machine learning algorithms
- Supervised learning algorithms
- Unsupervised learning algorithms
- Deploying machine learning models

Python Machine Learning is essential reading for students, developers, or anyone with a keen interest in taking their coding skills to the next level.

About the Publisher

John Wiley & Sons, Inc. is a leading global publisher providing print and online content and services for worldwide academic, professional, scientific, technical, medical, scholarly and consumer markets.

[More about Wiley](#)

Table of Contents

Cover

What is Python?

- Object-oriented programming language
 - Interpreted
 - First released in 1991
- Emphasis on readability, simplicity
 - Easy to learn/use
 - Runs on MAC/WIN/UNIX
 - Free

Where is Python used?

- Web Applications
 - Desktop apps
- Mobile apps (using frameworks)
 - Scientific computation
 - Engineering
 - Machine learning/AI
 - Data Visualization

Why Python for Machine Learning?

Both Python and R are suitable

R is better suited for statistical analysis

Python for machine learning (predictive)

R is better suited for research

Python is easier to learn, practical, professional world

We have switched ITP 449 from R to Python in 2019

Python Setup

Installing Python

- Install Python 3 <https://www.python.org/downloads/>
- Install an IDE (integrated development environment)
 - PyCharm IDE(Free community edition)
<https://www.jetbrains.com/pycharm/download/>
 - Install packages

- <https://www.python.org/downloads/>

The screenshot shows the Python.org homepage with a dark blue header. The top navigation bar includes links for Python, PSF, Docs, PyPI, Jobs, and Community. Below the header is the Python logo and a search bar with a magnifying glass icon and a 'GO' button. A 'Socialize' button is also present. The main content area features a navigation bar with tabs: About, Downloads, Documentation, Community, Success Stories, News, and Events. The 'Downloads' tab is active. To its right is a section titled 'Intuitive Interpretation' with text about Python's arithmetic operators and a link to 'More about simple math functions in Python 3'. Below this is a numbered navigation bar with buttons for 1, 2, 3 (which is highlighted in yellow), 4, and 5. On the left side of the main content area, there is a code editor window displaying Python code for simple arithmetic operations like division and floor division.

Python is a programming language that lets you work quickly
and integrate systems more effectively. [»» Learn More](#)

Get Started

Whether you're new to programming or an experienced developer, it's easy to learn and use Python.

[Start with our Beginner's Guide](#)

Download

Python source code and installers are available for download for all versions!

Latest: [Python 3.7.2](#)

Docs

Documentation for Python's standard library, along with tutorials and guides, are available online.

[docs.python.org](#)

Jobs

Looking for work or have a Python related position that you're trying to hire for? Our [relaunched community-run job board](#) is the place to go.

[jobs.python.org](#)

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 python™

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Download the latest version for Windows

[Download Python 3.8.3](#)

Looking for Python with a different OS? Python for [Windows](#), [Linux/UNIX](#), [Mac OS X](#), [Other](#)

Want to help test development versions of Python? [Prereleases](#), [Docker images](#)

Looking for Python 2.7? See below for specific releases



Active Python Releases

For more information visit the [Python Developer's Guide](#).

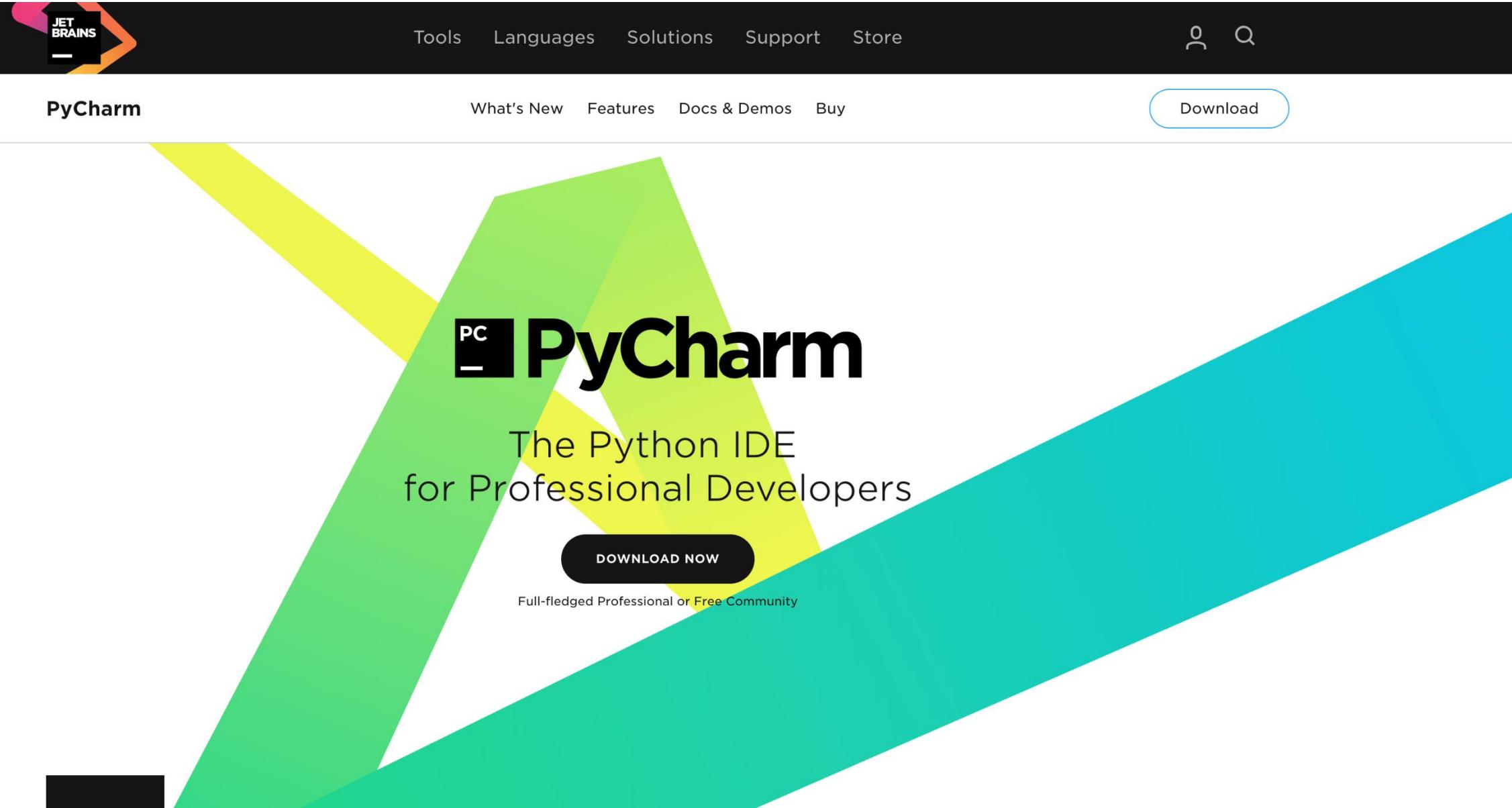
Python version	Maintenance status	First released	End of support	Release schedule
3.8	bugfix	2019-10-14	2024-10	PEP 569
3.7	bugfix	2018-06-27	2023-06-27	PEP 537
3.6	security	2016-12-23	2021-12-23	PEP 494
3.5	security	2015-09-13	2020-09-13	PEP 478
2.7	end-of-life	2010-07-03	2020-01-01	PEP 373

Looking for a specific release?

Python releases by version number:

Release version	Release date	Click for more
Python 3.8.3	May 13, 2020	 Download Release Notes
Python 3.8.3rc1	April 29, 2020	 Download Release Notes
Python 2.7.18	April 20, 2020	 Download Release Notes
Python 3.7.7	March 10, 2020	 Download Release Notes
Python 3.8.2	Feb. 24, 2020	 Download Release Notes

<https://www.jetbrains.com/pycharm/>



The image shows the official website for PyCharm, a Python IDE developed by JetBrains. The header features the JetBrain logo and navigation links for Tools, Languages, Solutions, Support, and Store. Below the header, there's a secondary navigation bar with links for PyCharm, What's New, Features, Docs & Demos, and Buy, along with a prominent 'Download' button. The main visual is a large graphic composed of overlapping triangles in yellow, green, and cyan. Overlaid on this graphic is the PyCharm logo, which includes a stylized 'PC' icon followed by the word 'PyCharm' in a bold, sans-serif font. Below the logo, the text reads 'The Python IDE for Professional Developers'. A black call-to-action button with the text 'DOWNLOAD NOW' is centered. At the bottom of the graphic, the text 'Full-fledged Professional or Free Community' is visible.

JET BRAINS

Tools Languages Solutions Support Store

PyCharm What's New Features Docs & Demos Buy Download

PC PyCharm

The Python IDE
for Professional Developers

DOWNLOAD NOW

Full-fledged Professional or Free Community

<https://www.jetbrains.com/pycharm/>

The screenshot shows the official PyCharm website at <https://www.jetbrains.com/pycharm/>. At the top, there's a navigation bar with links for Tools, Languages, Solutions, Support, and Store, along with user and search icons. Below the navigation is a secondary navigation bar with links for What's New, Features, Docs & Demos, and Buy, followed by a prominent blue "Download" button.

On the left side, there's a large image of the PyCharm logo, which consists of a black square containing the letters "PC" with a horizontal line through it, set against a background of overlapping green, yellow, and blue geometric shapes.

Below the logo, the text "Version: 2018.3.2", "Build: 183.4886.43", and "Released: December 18, 2018" is displayed. There are also links for "System requirements", "Installation Instructions", and "Previous versions".

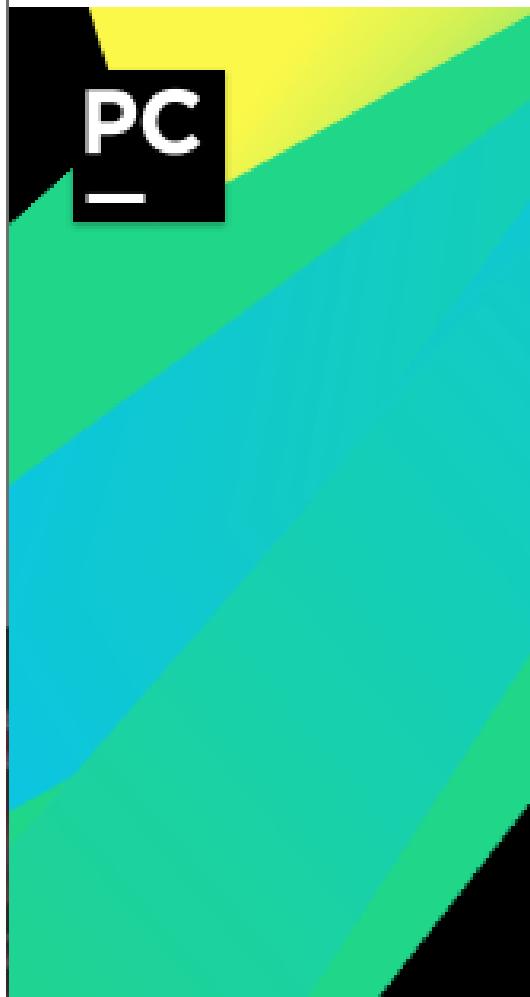
The main content area features two download sections:

- Professional**: Described as a "Full-featured IDE for Python & Web development". It includes a "DOWNLOAD" button, a "Free trial" link, and a "macOS" download option.
- Community**: Described as a "Lightweight IDE for Python & Scientific development". It includes a "DOWNLOAD" button, a "Free, open-source" link, and a "Linux" download option.

At the bottom, there's a callout for the "Toolbox App" with the text: "Get the Toolbox App to download PyCharm and its future updates with ease".



PyCharm Community Edition Setup



Completing PyCharm Community Edition Setup

PyCharm Community Edition has been installed on your computer.

Click Finish to close Setup.



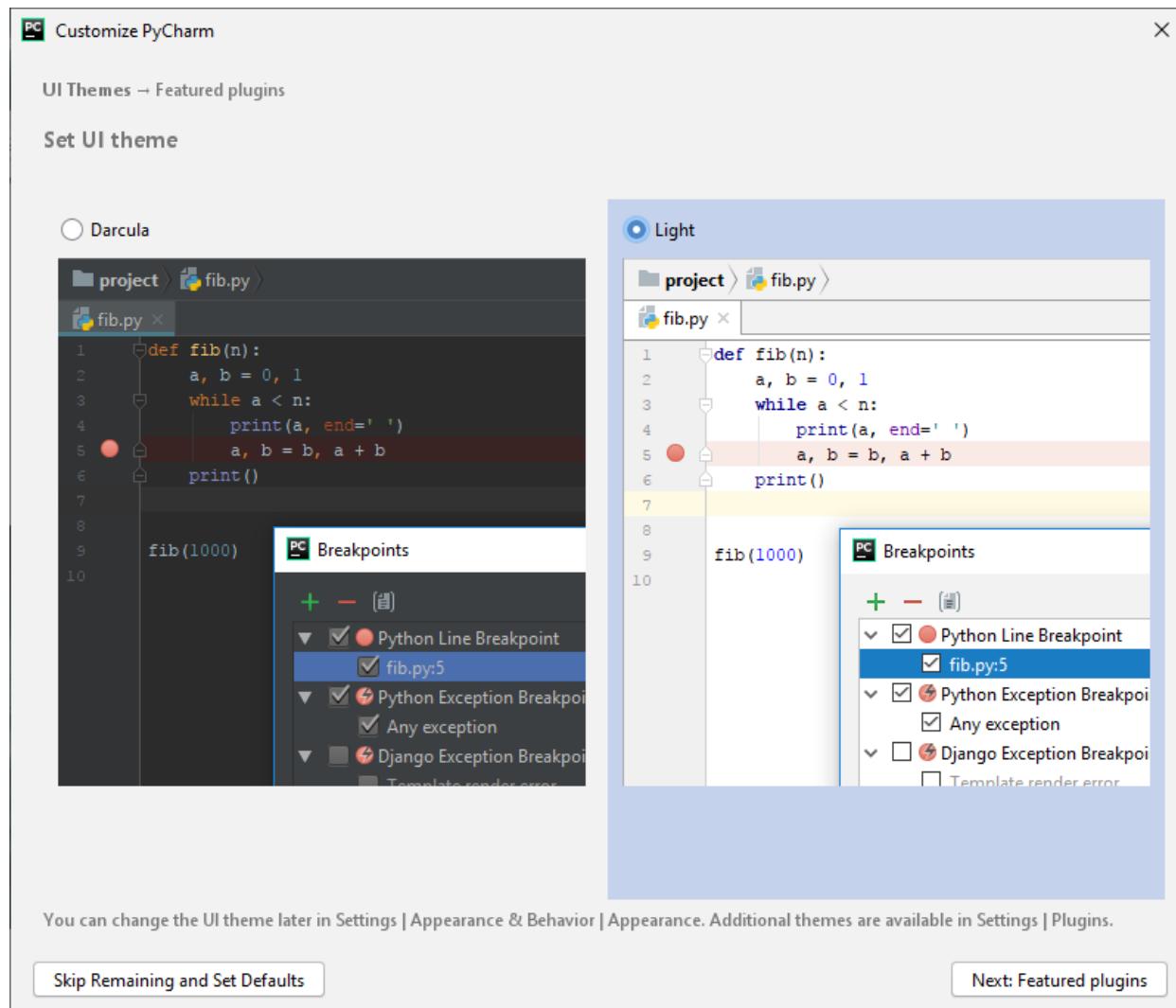
[Run PyCharm Community Edition](#)

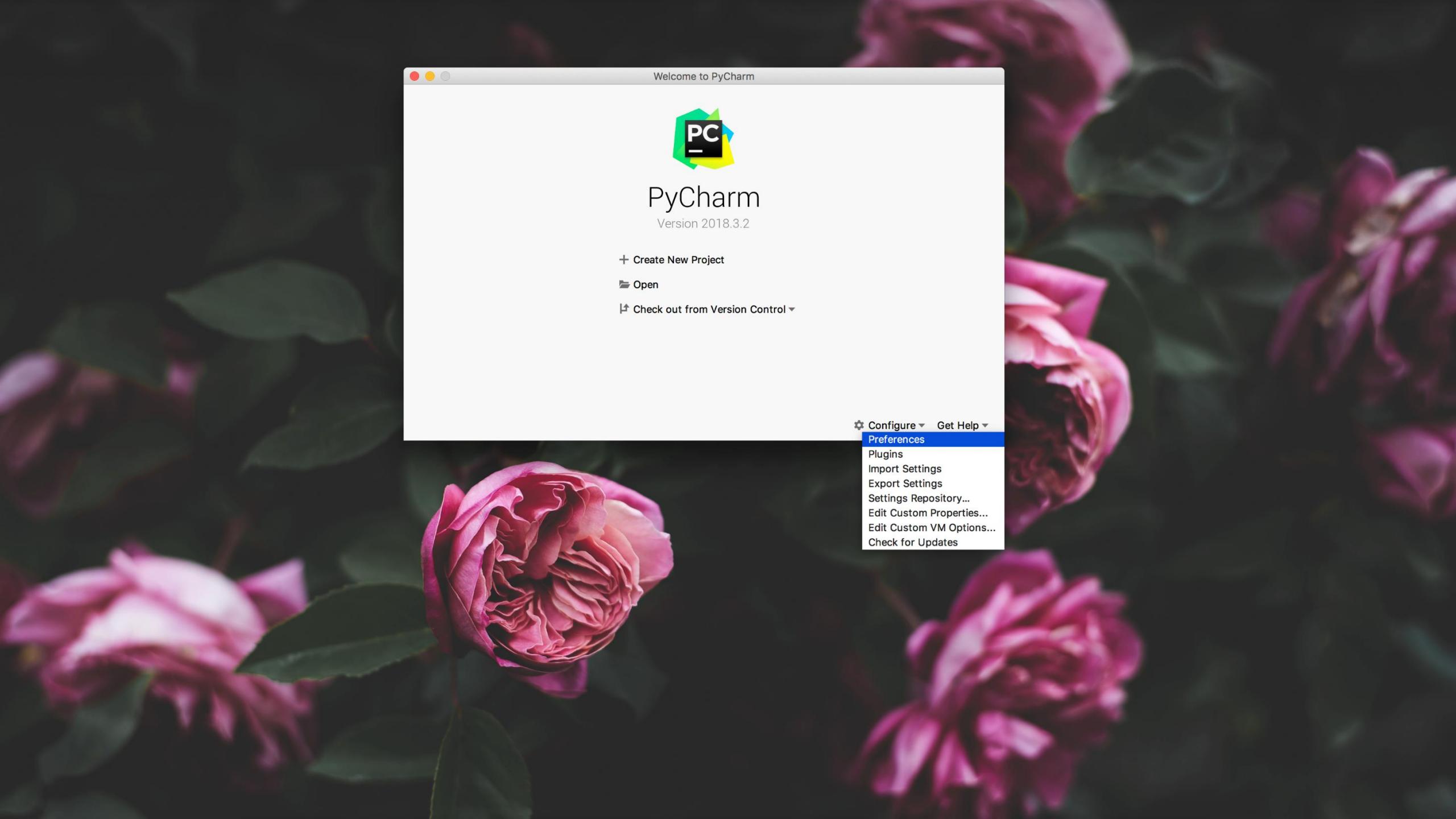
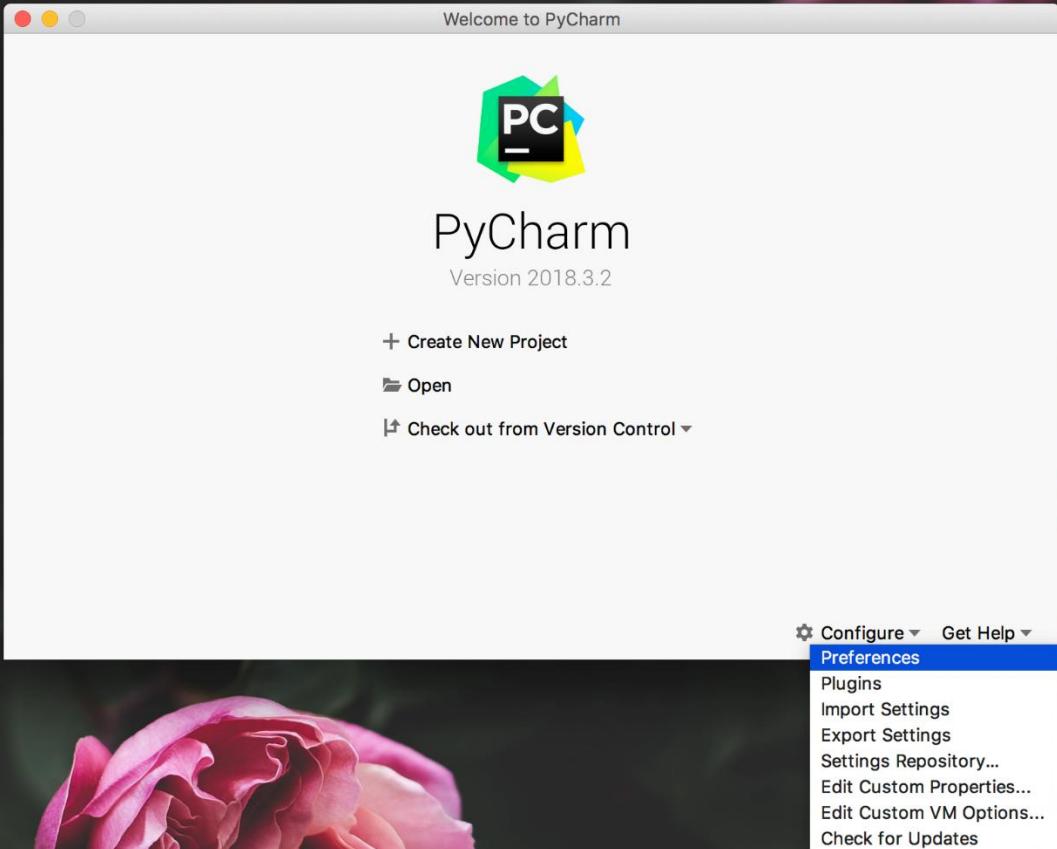
< Back

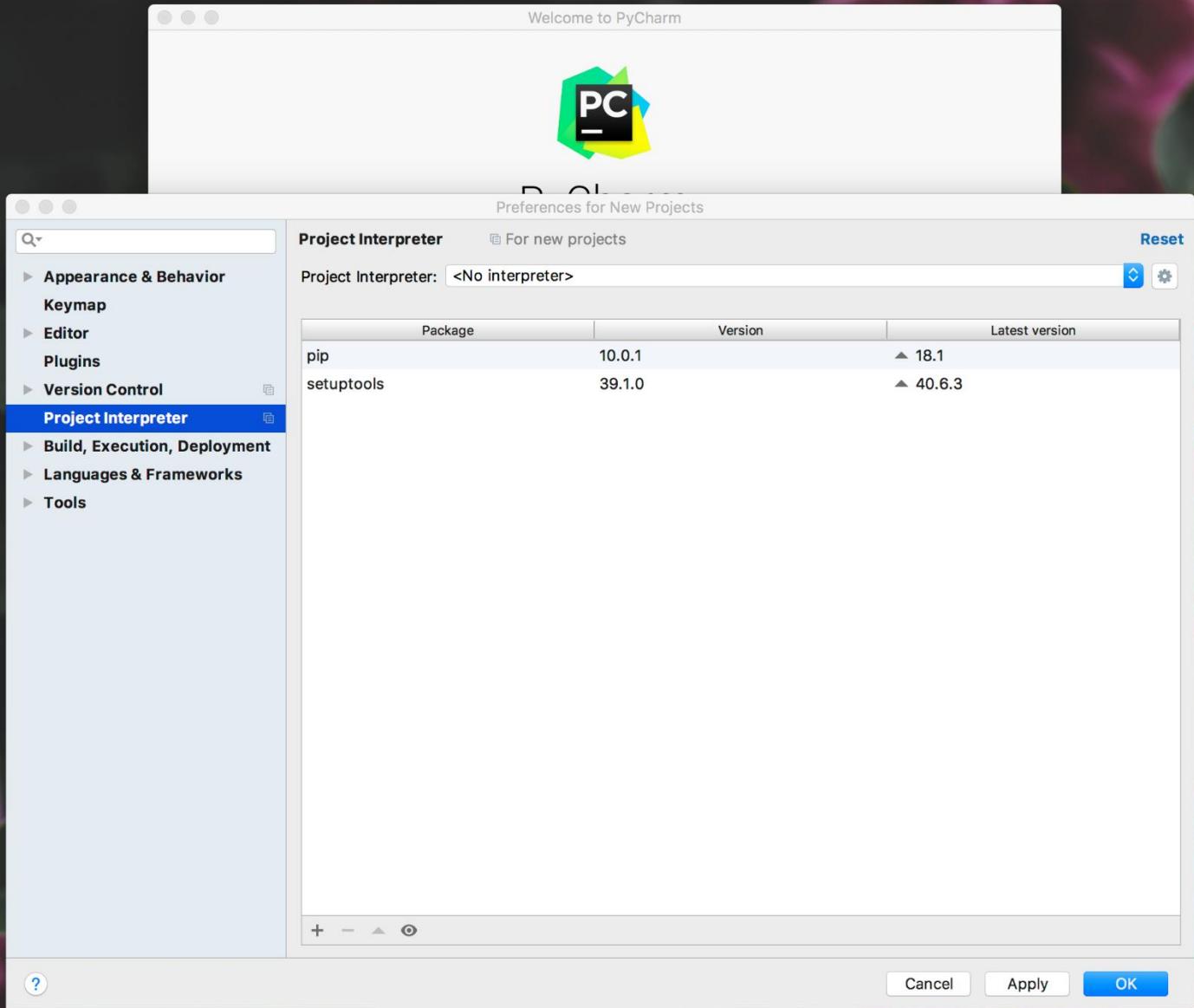
Finish

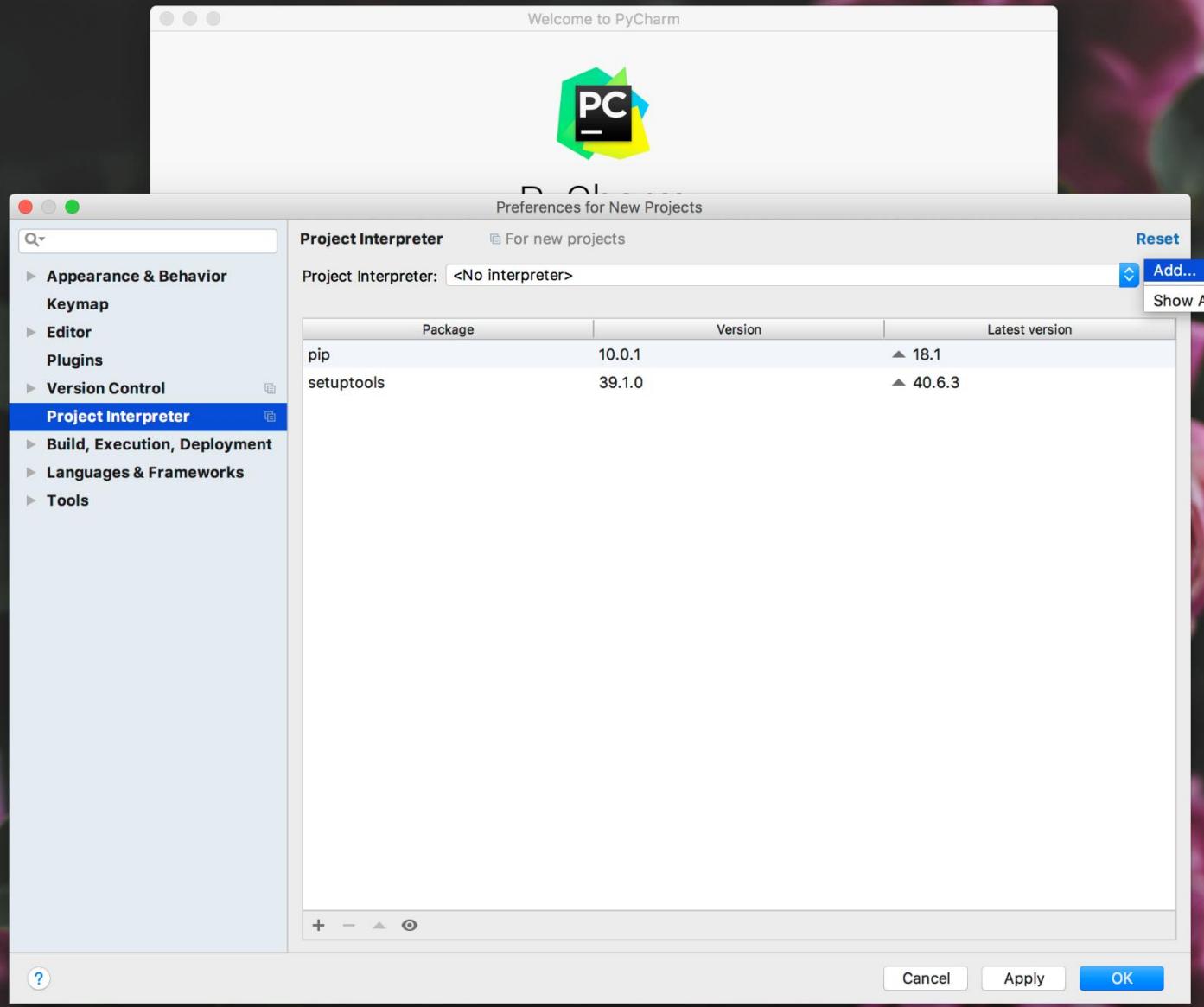
Cancel

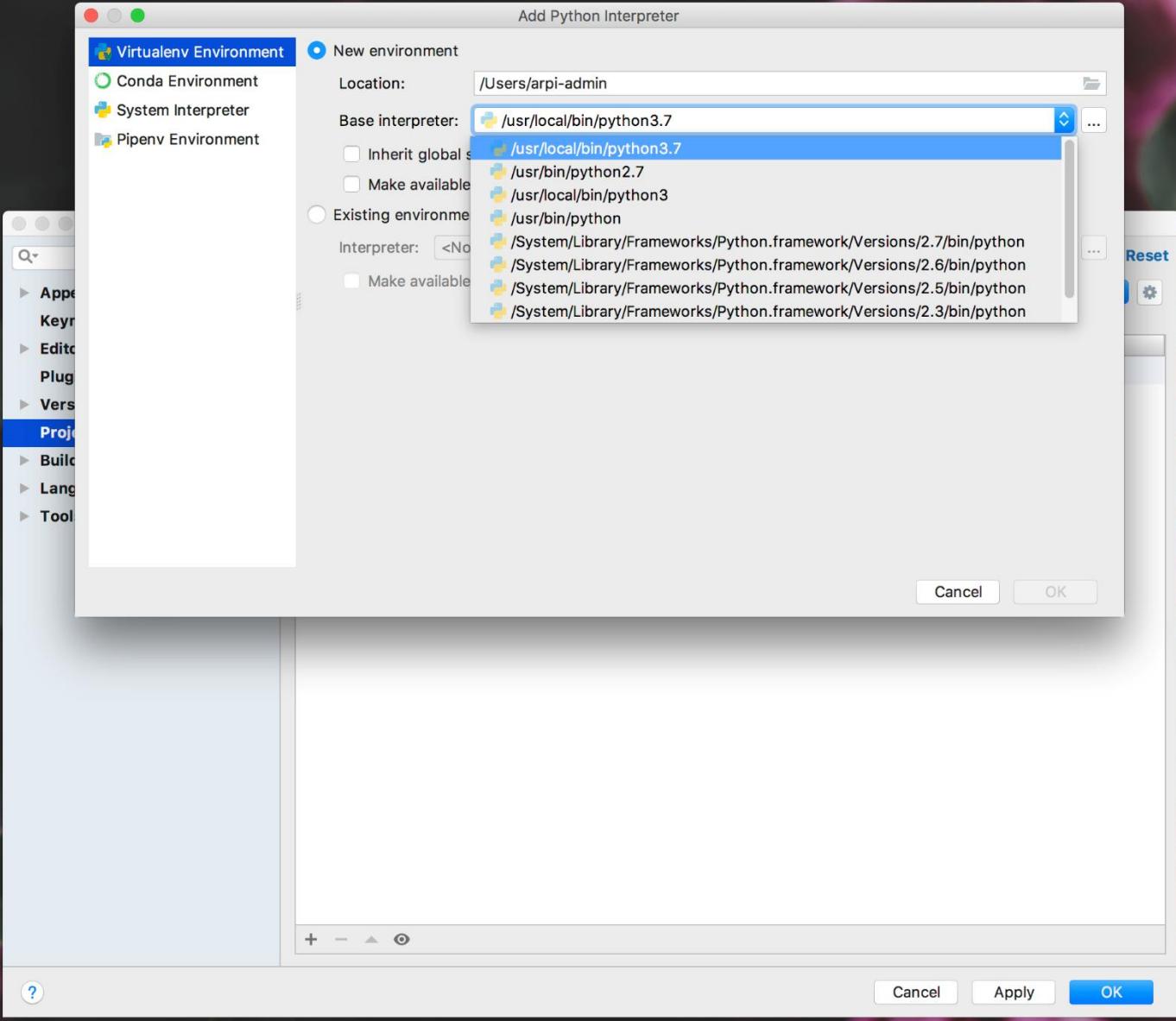
Choose your UI Theme

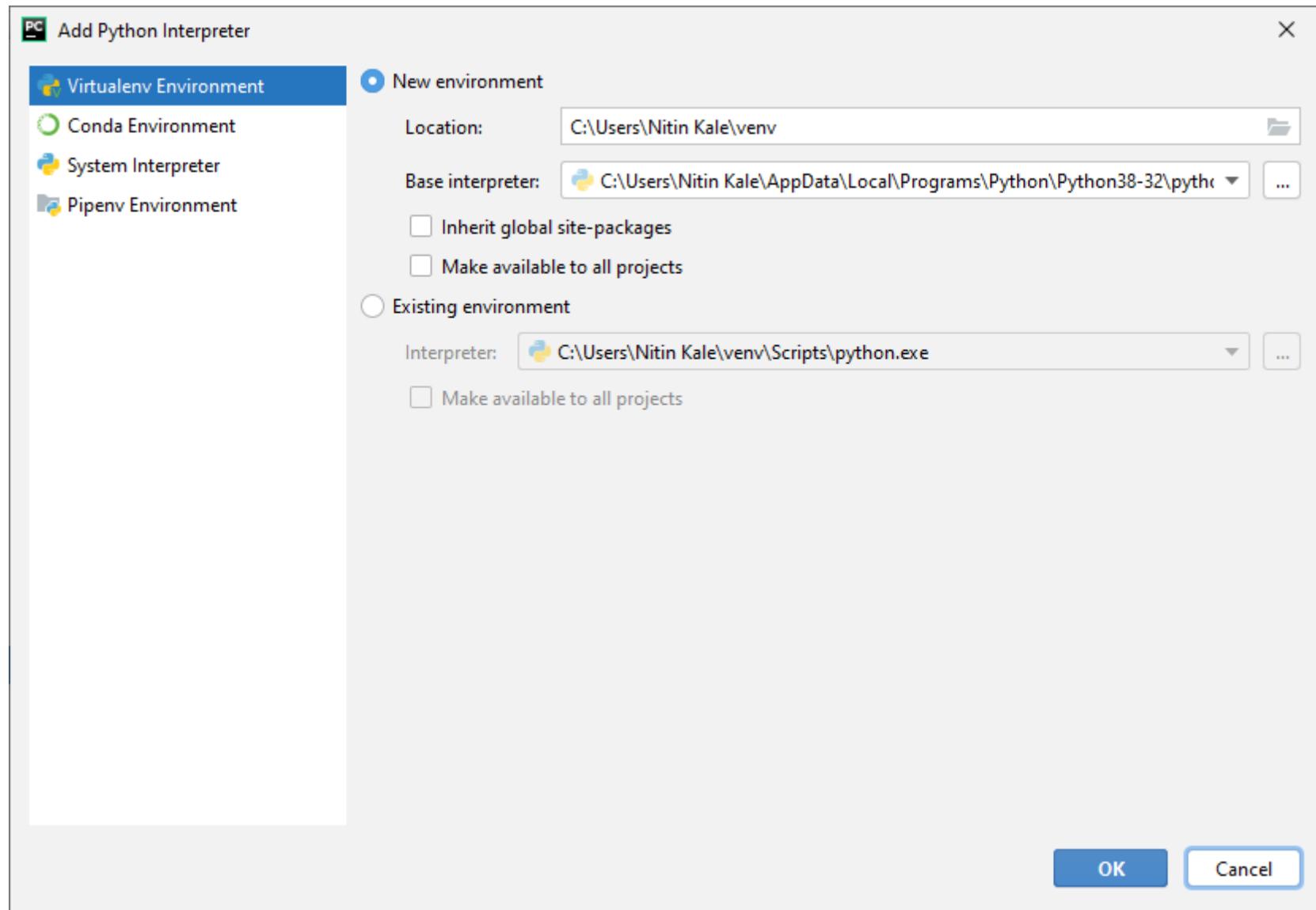




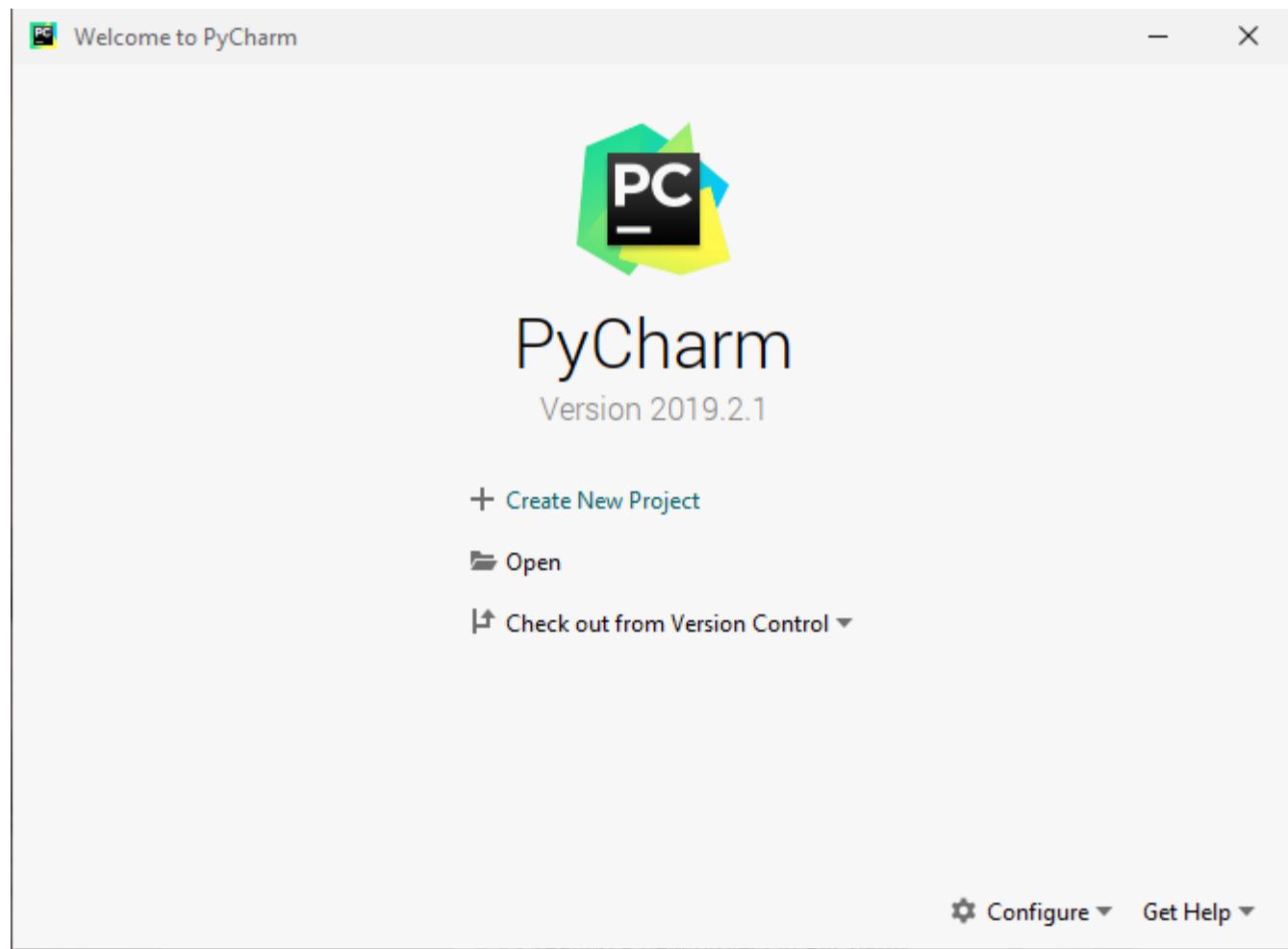








Create New Project



 Create Project X

Location: 

▼ Project Interpreter: Python 3.8 (venv)

New environment using



Location:

Base interpreter:

 C:\Users\Nitin Kale\AppData\Local\Programs\Python\Python38-32\python.exe ▼ ...

Inherit global site-packages

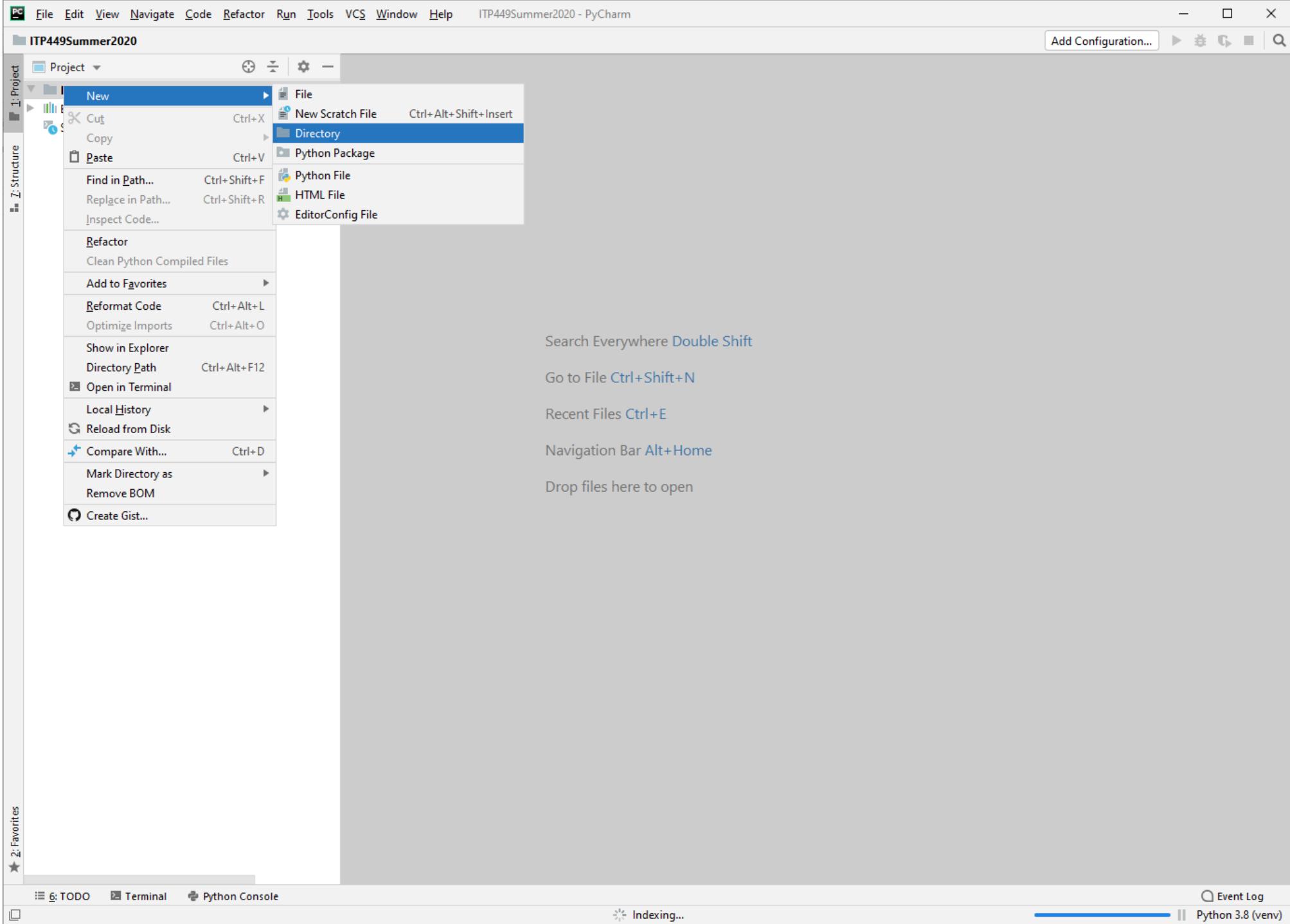
Make available to all projects

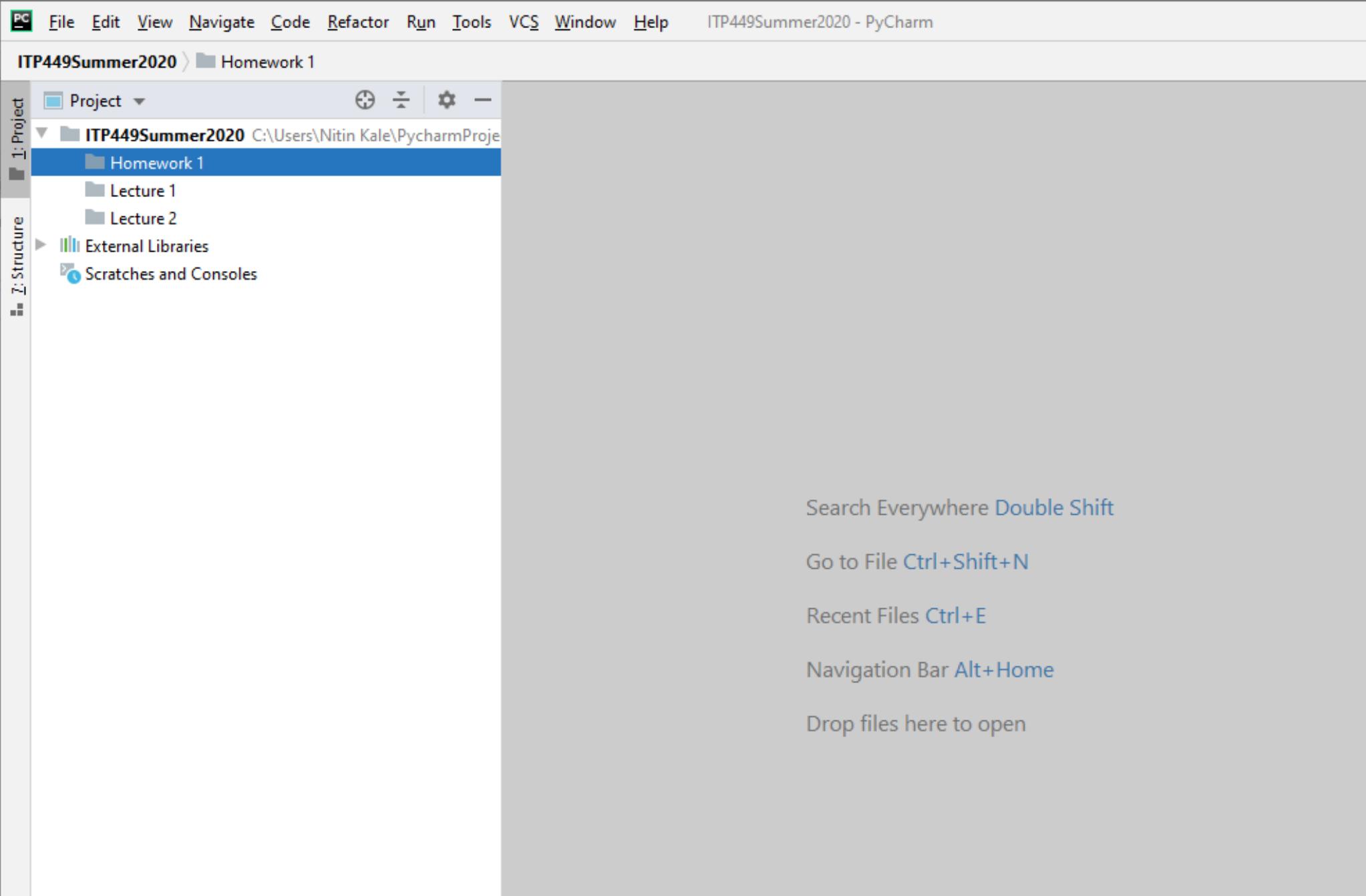
Existing interpreter

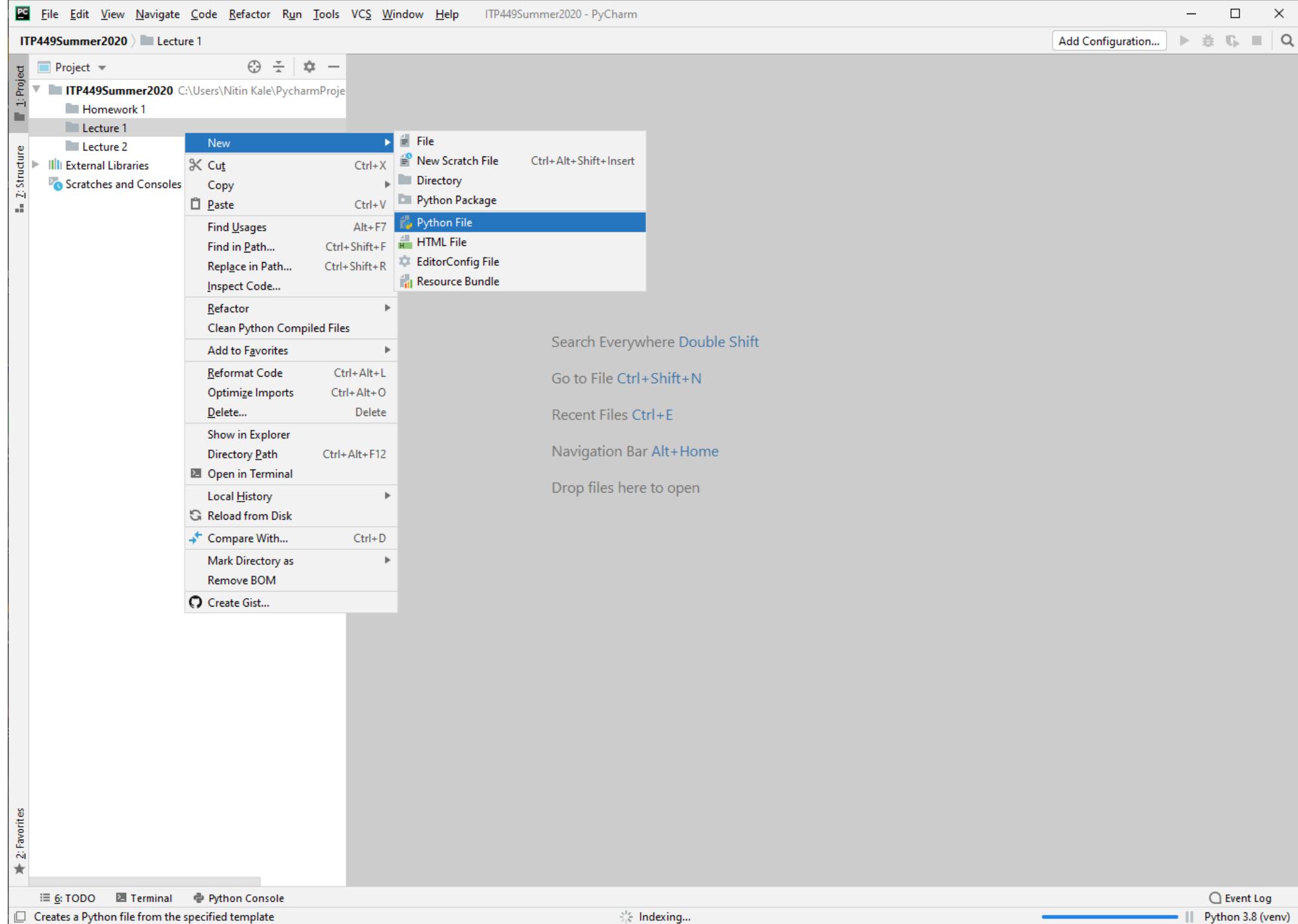
Interpreter:

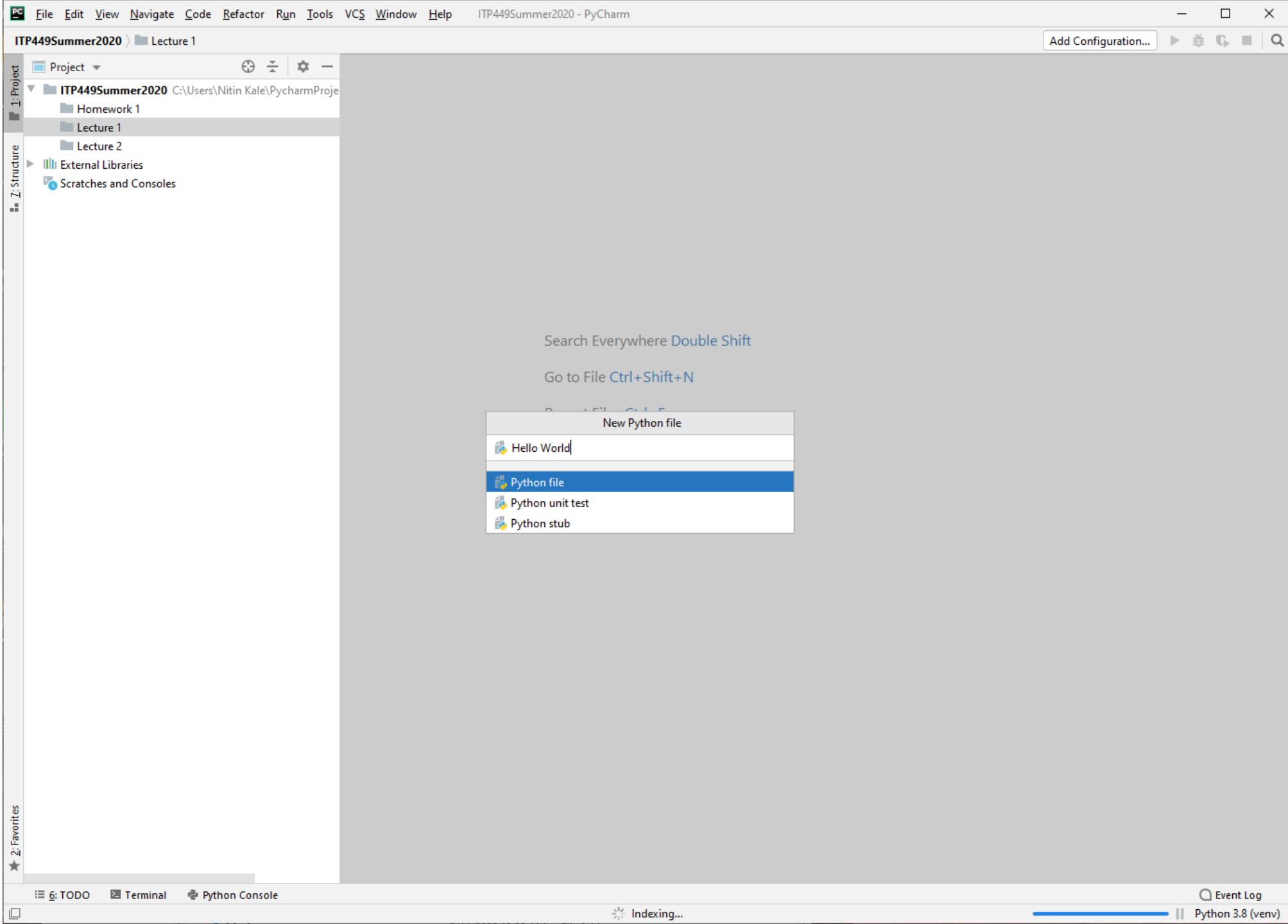
 Python 3.8 (venv) C:\Users\Nitin Kale\venv\Scripts\python.exe ▼ ...

Create









A screenshot of the PyCharm IDE interface. The top menu bar includes File, Edit, View, Navigate, Code, Refactor, Run, Tools, VCS, Window, and Help. The title bar shows "ITP449Summer2020 - Hello World.py - PyCharm". The left sidebar has sections for Project, Structure, and Favorites. The main code editor window titled "Hello World.py" contains the single line of Python code: `print("Hello World")`. Below the code editor is a "Run" tool window titled "Hello World" which displays the command "C:\Users\Nitin Kale\venv\Scripts\python.exe" "C:/Users/Nitin Kale/PycharmProjects/ITP449Summer2020/Lecture 1>Hello World.py" followed by the output "Hello World" and "Process finished with exit code 0". The bottom navigation bar includes tabs for TODO, Run, Terminal, and Python Console, along with an indexing progress bar and an Event Log tab.

right click and Run

```
print("Hello World")
```

Run: Hello World

"C:\Users\Nitin Kale\venv\Scripts\python.exe" "C:/Users/Nitin Kale/PycharmProjects/ITP449Summer2020/Lecture 1>Hello World.py"

Hello World

Process finished with exit code 0

Indexing...

<https://www.datacamp.com>

The screenshot shows the DataCamp homepage with a prominent sign-in modal overlay. The modal is titled "Create Your Free Account" and includes social media sign-in buttons for LinkedIn, Facebook, and Google+. It also features fields for "Email address" and "Password", and a large yellow "Create Free Account" button at the bottom. Below the modal, a small legal note states: "By continuing you accept the Terms of Use and Privacy Policy, that your data will be stored outside of the EU, and that you are 16 years or older." The main page background is dark blue, featuring the DataCamp logo, a search bar, and navigation links for Learn, Pricing, For Business, and Sign in. The central message on the page is "THE SMARTEST WAY TO Learn Data Science Online", followed by a description of the skills learned and a "Start Learning For Free" button. Various programming language and tool logos are displayed at the bottom.

THE SMARTEST WAY TO

Learn Data Science Online

The skills people and businesses need to succeed are changing. No matter where you are in your career or what field you work in, you will need to understand the language of data. With DataCamp, you learn data science today and apply it tomorrow.

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or



mardiros@usc.edu



••••••|

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DataCamp offers interactive R, Python, Sheets, SQL and shell courses. All on topics in data science, statistics and machine learning. Learn from a team of expert teachers in the comfort of your browser with video lessons and fun coding challenges and projects.

Before we get started...

First Name * ?

Last Name * ?

Company/school * ?

Role * ?

Telephone * ?

Example: +1 555 555 5555

 +1

Start Learning

Welcome to DataCamp

Do you want to...



Start learning R for Data Science ➤



Start learning Python for Data
Science ➤



Develop your Data Science skill set ➤

ⓘ Learn more about the difference between R and Python

Start learning Python

→ Start our recommended beginner track



Python Programmer



Enroll

Want to learn something specific?

Programming

Machine Learning

Probability & Statistics

Data Manipulation

Importing & Cleaning Data

Or see our [Career tracks](#)

Exercise

The Python Interface

In the Python script on the right, you can type Python code to solve the exercises. If you hit *Run Code* or *Submit Answer*, your python script (`script.py`) is executed and the output is shown in the IPython Shell. *Submit Answer* checks whether your submission is correct and gives you feedback.

You can hit *Run Code* and *Submit Answer* as often as you want. If you're stuck, you can click *Get Hint*, and ultimately *Get Solution*.

You can also use the IPython Shell interactively by simply typing commands and hitting Enter. When you work in the shell directly, your code will not be checked for correctness so it is a great way to experiment.

Instructions

70 XP

- Experiment in the IPython Shell; type `5 / 8`, for example.
- Add another line of code to the Python script: `print(7 + 10)`.
- Hit *Submit Answer* to execute the Python script and receive feedback.

[Show Answer \(-70 XP\)](#)

Hint

Simply add `print(7 + 10)` in the script on the right and hit 'Submit Answer'.

Did you find this hint helpful?

Yes No

script.py

```
1 # Example, do not modify!
2 print(5 / 8)
3
4 # Put code below here
5
```

IPython Shell

Slides

In [1]:



Run Code

Submit Answer



Exercise

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Simply add `print(7 + 10)` in the script on the right and hit 'Submit Answer'.

Awesome, thanks for your feedback!

script.py

```
1 # Example, do not modify!
2 print(5 / 8)
3
4 # Put code below here
5 print(7 + 10)
```



Run Code

Submit Answer

IPython Shell

Slides

In [1]: `5/8`Out[1]: `0.625`In [2]: `# Example, do not modify!``print(5 / 8)``# Put code below here``print(7 + 10)``0.625``17`

In [3]: |

Exercise

The Python Interface

In the Python script on the right, you can type Python code to solve the exercises. If you hit *Run Code* or *Submit Answer*, your python script (`script.py`) is executed and the output is shown in the IPython Shell. *Submit Answer* checks whether your submission is correct and gives you feedback.

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You can also use the IPython Shell interactively by typing commands and hitting Enter. When you work in the shell directly, your code will not be checked for correctness so it is a great way to experiment.

Great! On to the next one!

PRESS ENTER TO

70 XP

Continue

- Experiment in the IPython Shell; type `print(5 / 8)` for example.
- Add another line of code to the Python script: `print(7 + 10)`.
- Hit *Submit Answer* to execute the Python script and receive feedback.

Show Answer (-70 XP)

Hint

Simply add `print(7 + 10)` in the script on the right and hit 'Submit Answer'.

Awesome, thanks for your feedback!

Become a power user!

SUBMIT ANSWER: **CTRL** + **SHIFT** + **ENTER**

See all keyboard shortcuts

script.py

```
1 # Example, do not modify!
2 print(5 / 8)
3
4 # Put code below here
5 print(7 + 10)
```



Run Code

Submit Answer

IPython Shell

Slides

Out[1]: 0.625

```
In [2]: # Example, do not modify!
         print(5 / 8)
```

```
# Put code below here
print(7 + 10)
```

0.625
17

```
<script.py> output:
    0.625
    17
```

In [3]:



Introduction to Python

1 Python Basics

16%

An introduction to the basic concepts of Python. Learn how to use Python both interactively and through a script. Create your first variables and acquaint yourself with Python's basic data types.

- | | | |
|--|-----------------------------|--------|
| | Hello Python! | 50 XP |
| | The Python Interface | 70 XP |
| | When to use Python? | 50 XP |
| | Any comments? | 100 XP |
| | Python as a calculator | 100 XP |
| | Variables & Types | 50 XP |
| | Variable Assignment | 100 XP |
| | Calculations with variables | 100 XP |
| | Other variable types | 100 XP |
| | Guess the type | 50 XP |
| | Operations with other types | 100 XP |
| | Type conversion | 100 XP |

 Back to Dashboard

Reset Course Progress

SUBMIT ANSWER: CTRL + SHIFT + ENTER

ISSN 1990-0902

What is machine learning?

machine learning

The process of a machine learning from experience. It deals only with algorithms that automatically extract patterns from data by taking a data set, feeding it into an algorithm that learns from it, and outputs predictions.

machine learning lifecycle

ask the right question/set the problem →
collect and prepare data →
choose the appropriate algorithm →
train the algorithm →
test it →
collect feedback →
use feedback to improve the algorithm

machine learning lifecycle

ask the right question/set the problem →

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use feedback to improve the algorithm

supervised learning

Defines a function that best approximates the relationship between input and output observable in the data.

unsupervised learning

Defines a function that infers the natural structure present within a set of data points

What is data?



7

data



noun, plural in form but singular or plural in construction, often attributive | da-tə | \dā-tə, 'da- also 'dā-\

Popularity: Top 1% of lookups | Updated on: 9 Aug 2018

⚡ TRENDING NOW: [hogwash](#) [probity](#) [sequacious](#) [inadmissible](#) [oligarch, pejorative](#) [SEE ALL >](#)

Usage guide: Is DATA singular or plural? ▾

Examples: DATA in a Sentence ▾

Definition of DATA

- 1 : factual information (such as measurements or statistics) used as a basis for reasoning, discussion, or calculation
 - the *data* is plentiful and easily available —H. A. Gleason, Jr.
 - comprehensive *data* on economic growth have been published —N. H. Jacoby
- 2 : information in digital form that can be transmitted or processed
- 3 : information output by a sensing device or organ that includes both useful and irrelevant or *redundant* information and must be processed to be meaningful

Is DATA singular or plural?

Data leads a life of its own quite independent of *datum*, of which it was originally the plural. It occurs in two constructions: as a plural noun (like *earnings*), taking a plural verb and plural modifiers (such as *these*, *many*, *a few*) but not cardinal numbers, and serving as a referent for plural pronouns (such as *they*, *them*); and as an abstract mass noun (like *information*), taking a singular verb and singular modifiers (such as *this*, *much*, *little*), and being referred to by a singular pronoun (*it*). Both constructions are standard. The plural construction is more common

WORD OF THE DAY

satiety



fullness to the point of excess

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- 1 [hogwash](#)
'nonsense, balderdash'
- 2 [probity](#)
'adherence to the highest pri...'
- 3 [sequacious](#)
'intellectually servile'
- 4 [inadmissible](#)
'not capable of being allowed'
- 5 [oligarch, pejorative](#)
'a member a government in ...'

[SEE ALL >](#)

BROWSE DICTIONARY

dat

DAT

structured data

Data that is sorted into a row/column structure, where rows represent observations and columns represent the characteristics of observations

unstructured data

Data that is in a free form that must be parsed further to become organized

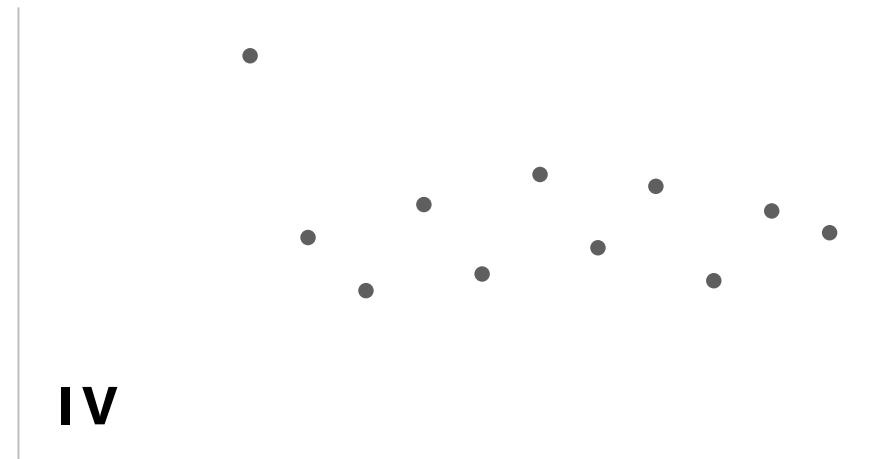
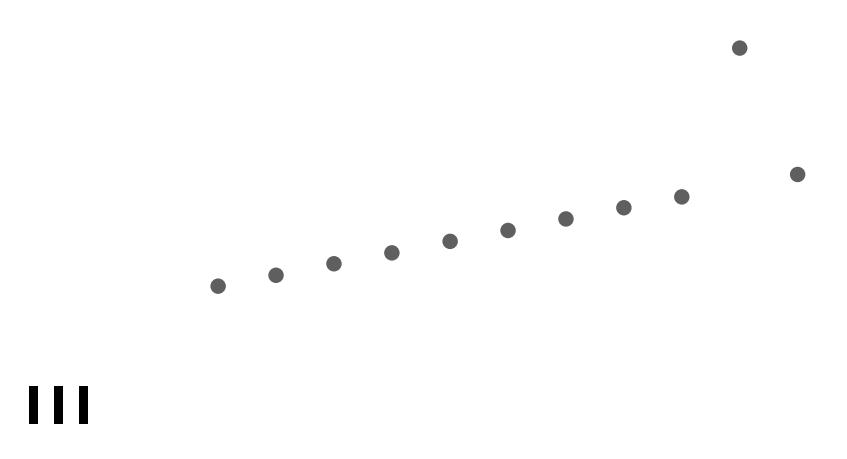
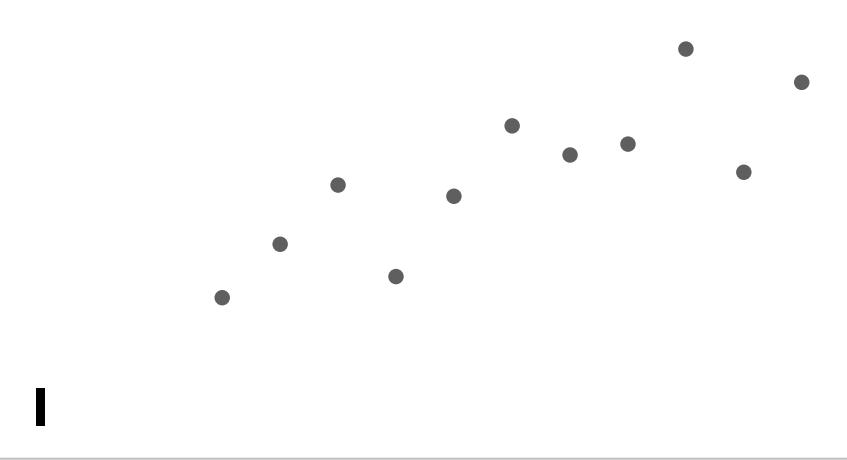
Visualization

I		II		III		IV	
x	y	x	y	x	y	x	y
10.0	8.04	10.0	9.14	10.0	7.46	10.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	13.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	9.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	11.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	14.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	6.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	4.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	12.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	7.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	5.0	6.89

METRICS

- ☞ n 11
- ☞ mean of x's 9.0
- ☞ mean of y's = 7.5
- ☞ equation of regression line $Y = 3 + 0.5X$
- ☞ standard error of estimate of slope 0.118
- ☞ correlation coefficient 0.82
- ☞ r^2 0.67

VISUALS



machine learning lifecycle

ask the right question/set the problem →

collect and prepare data →

choose the appropriate algorithm →

train the algorithm →

test it →

collect feedback →

use feedback to improve the algorithm

Summary

- Course overview
- Python intro
- Setting up our programming environment
- Datacamp
- Intro to Machine Learning