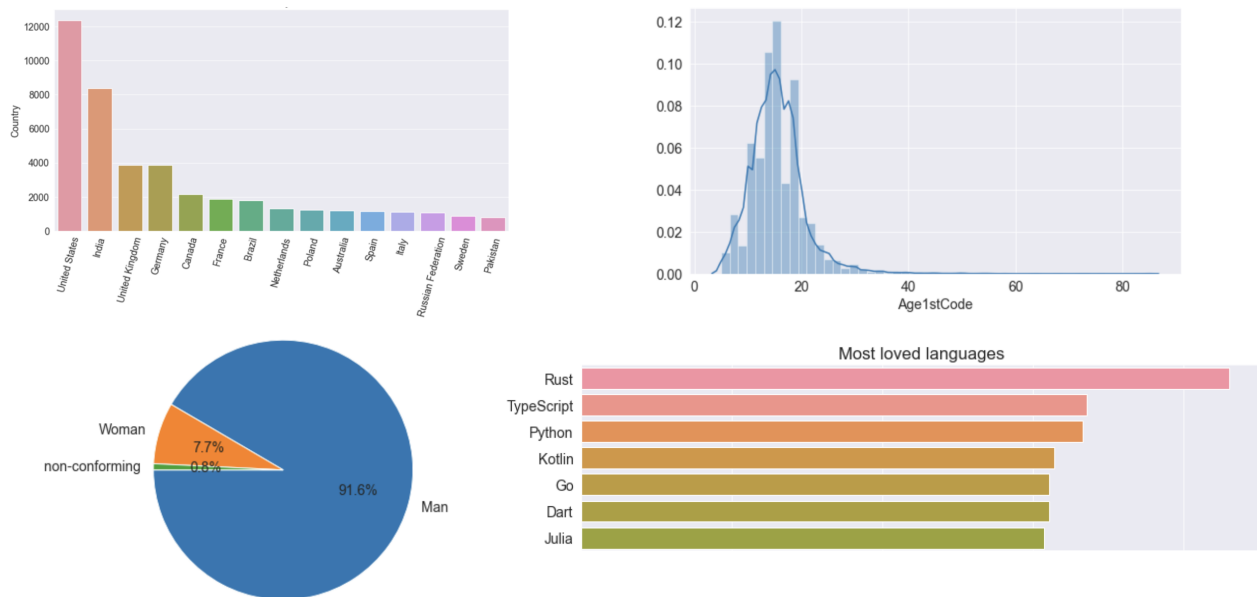


eda-stackoverflow-survey-project

Exploratory Data Analysis Of StackOverFlow Survey Data 2020

By - MD KAIF

Analyzing responses from the Stack Overflow Annual Developer Survey 2020



Introduction

Stack Overflow's annual Developer Survey is the largest and most comprehensive survey of people who code around the world. Each year, we field a survey covering everything from developers' favorite technologies to their job preferences. Year 2020 marks the ninth year that StackOverflow published their annual Developer Survey results, and nearly 90,000 developers took the 20-minute survey.

Under this project, we'll analyze the StackOverflow developer survey dataset. The dataset contains responses to an annual survey conducted by StackOverflow. We can find the raw data & official analysis easily here:

<https://insights.stackoverflow.com/survey>.

There are several options for getting the dataset into Jupyter:

- Download the CSV manually and upload it via Jupyter's GUI
- Use the `urlretrieve` function from the `urllib.request` to download CSV files from a raw URL
- Use a helper library, e.g., [opendatasets](#), which contains a collection of curated datasets and provides a helper function for direct download.

We'll use the `opendatasets` helper library to download the files.

Let's first install the OpenDataSets Library to use the Dataset.

```
!pip install opendatasets --upgrade
```

Collecting opendatasets

Downloading opendatasets-0.1.22-py3-none-any.whl (15 kB)

Requirement already satisfied: click in /opt/conda/lib/python3.9/site-packages (from opendatasets) (8.0.3)

Collecting kaggle

Downloading kaggle-1.5.13.tar.gz (63 kB)

|████████████████████| 63 kB 2.3 MB/s

Preparing metadata (setup.py) ... done

Requirement already satisfied: tqdm in /opt/conda/lib/python3.9/site-packages (from opendatasets) (4.62.3)

Requirement already satisfied: six>=1.10 in /opt/conda/lib/python3.9/site-packages (from kaggle->opendatasets) (1.16.0)

Requirement already satisfied: certifi in /opt/conda/lib/python3.9/site-packages (from kaggle->opendatasets) (2021.10.8)

Requirement already satisfied: python-dateutil in /opt/conda/lib/python3.9/site-packages (from kaggle->opendatasets) (2.8.2)

Requirement already satisfied: requests in /opt/conda/lib/python3.9/site-packages (from kaggle->opendatasets) (2.26.0)

Collecting python-slugify

Downloading python_slugify-8.0.1-py2.py3-none-any.whl (9.7 kB)

Requirement already satisfied: urllib3 in /opt/conda/lib/python3.9/site-packages (from kaggle->opendatasets) (1.26.7)

Collecting text-unidecode>=1.3

Downloading text_unidecode-1.3-py2.py3-none-any.whl (78 kB)

|████████████████████| 78 kB 2.8 MB/s

Requirement already satisfied: idna<4,>=2.5 in /opt/conda/lib/python3.9/site-packages (from requests->kaggle->opendatasets) (3.1)

Requirement already satisfied: charset-normalizer~=2.0.0 in /opt/conda/lib/python3.9/site-packages (from requests->kaggle->opendatasets) (2.0.0)

Building wheels for collected packages: kaggle

Building wheel for kaggle (setup.py) ... done

Created wheel for kaggle: filename=kaggle-1.5.13-py3-none-any.whl size=77734 sha256=5b1906dd8acda11ffe694f80a90aacaba312946aea74fb40baba6f5ed388c390

Stored in directory:

/home/jovyan/.cache/pip/wheels/9c/45/15/6d6d116cd2539fb8f450d64b0aee4a480e5366bb11b42ac7
Successfully built kaggle

Installing collected packages: text-unidecode, python-slugify, kaggle, opendatasets
Successfully installed kaggle-1.5.13 opendatasets-0.1.22 python-slugify-8.0.1 text-unidecode-1.3

In the next step, we will import the library as 'od' for using in the code.

```
import opendatasets as od
```

Now we will download the file name 'stackoverflow-developer-survey-2020'

```
od.download('stackoverflow-developer-survey-2020')
```

Downloading

https://raw.githubusercontent.com/JovianML/opendatasets/master/data/stackoverflow-developer-survey-2020/survey_results_public.csv to ./stackoverflow-developer-survey-2020/survey_results_public.csv

94609408it [00:04, 22449920.46it/s]

Downloading

https://raw.githubusercontent.com/JovianML/opendatasets/master/data/stackoverflow-developer-survey-2020/survey_results_schema.csv to ./stackoverflow-developer-survey-2020/survey_results_schema.csv

16384it [00:00, 77413.21it/s]

Downloading

<https://raw.githubusercontent.com/JovianML/opendatasets/master/data/stackoverflow-developer-survey-2020/README.txt> to ./stackoverflow-developer-survey-2020/README.txt

8192it [00:00, 45521.04it/s]

Let's verify that the dataset was downloaded into the directory `stackoverflow-developer-survey-2020` and retrieve the list of files in the dataset.

For doing so, we need to use the `os` library

```
import os
```

using the `.listdir` function to check the files inside the specified directory.

```
os.listdir('stackoverflow-developer-survey-2020')
```

```
['README.txt', 'survey_results_public.csv', 'survey_results_schema.csv']
```

We can also go through the downloaded files using the "File" > "Open" menu option in Jupyter. The dataset contains three files:

- `README.txt` - Information about the dataset
- `survey_results_schema.csv` - The list of questions, and shortcodes for each question
- `survey_results_public.csv` - The full list of responses to the questions

Let's load the CSV files using the Pandas library. We'll use the name `survey_raw_df` for the data frame to indicate this is unprocessed data that we might clean, filter, and modify to prepare a data frame ready for analysis.

```
import pandas as pd
```

```
survey_raw_df = pd.read_csv('stackoverflow-developer-survey-2020/survey_results_public.
```

Calling the survey_raw_df

```
survey_raw_df
```

	Respondent	MainBranch	Hobbyist	Age	Age1stCode	CompFreq	CompTotal	ConvertedComp	Country	C
0	1	I am a developer by profession	Yes	NaN	13	Monthly	NaN	NaN	Germany	
1	2	I am a developer by profession	No	NaN	19	NaN	NaN	NaN	United Kingdom	
2	3	I code primarily as a hobby	Yes	NaN	15	NaN	NaN	NaN	Russian Federation	
3	4	I am a developer by profession	Yes	25.0	18	NaN	NaN	NaN	Albania	
4	5	I used to be a developer by profession, but no...	Yes	31.0	16	NaN	NaN	NaN	United States	
...	
64456	64858	NaN	Yes	NaN	16	NaN	NaN	NaN	United States	
64457	64867	NaN	Yes	NaN	NaN	NaN	NaN	NaN	Morocco	
64458	64898	NaN	Yes	NaN	NaN	NaN	NaN	NaN	Viet Nam	
64459	64925	NaN	Yes	NaN	NaN	NaN	NaN	NaN	Poland	
64460	65112	NaN	Yes	NaN	NaN	NaN	NaN	NaN	Spain	

64461 rows × 61 columns

The dataset contains over 64,000 responses to 60 questions. The responses have been anonymized to remove personally identifiable information, and each respondent has been assigned a randomized respondent ID.

Let's view the list of columns contained in the data frame using the .columns function

```
survey_raw_df.columns
```

```
Index(['Respondent', 'MainBranch', 'Hobbyist', 'Age', 'Age1stCode', 'CompFreq',
```

```
'CompTotal', 'ConvertedComp', 'Country', 'CurrencyDesc',
'CurrencySymbol', 'DatabaseDesireNextYear', 'DatabaseWorkedWith',
'DevType', 'EdLevel', 'Employment', 'Ethnicity', 'Gender', 'JobFactors',
'JobSat', 'JobSeek', 'LanguageDesireNextYear', 'LanguageWorkedWith',
'MiscTechDesireNextYear', 'MiscTechWorkedWith',
'NEWCollabToolsDesireNextYear', 'NEWCollabToolsWorkedWith', 'NEWDevOps',
'NEWDevOpsImpt', 'NEWEdImpt', 'NEWJobHunt', 'NEWJobHuntResearch',
'NEWLearn', 'NEWOftTopic', 'NEWOnboardGood', 'NEWOtherComms',
'NEWOvertime', 'NEWPurchaseResearch', 'NEWPurpleLink', 'NEWSOSites',
'NEWStuck', 'OpSys', 'OrgSize', 'PlatformDesireNextYear',
'PlatformWorkedWith', 'PurchaseWhat', 'Sexuality', 'SOAccount',
'SOComm', 'SOPartFreq', 'SOVisitFreq', 'SurveyEase', 'SurveyLength',
'Trans', 'UndergradMajor', 'WebframeDesireNextYear',
'WebframeWorkedWith', 'WelcomeChange', 'WorkWeekHrs', 'YearsCode',
'YearsCodePro'],
dtype='object')
```

It appears that shortcodes for questions have been used as column names.

We can refer to the schema file to see the full text of each question. The schema file contains only two columns: `Column` and `QuestionText`. We can load it as Pandas Series with `Column` as the index and the `QuestionText` as the value.

```
schema_fname = 'stackoverflow-developer-survey-2020/survey_results_schema.csv'
schema_raw = pd.read_csv(schema_fname, index_col='Column').QuestionText
```

Let's check out the `schema_raw` Dataframe

```
schema_raw
```

```
Column
Respondent      Randomized respondent ID number (not in order ...
MainBranch      Which of the following options best describes ...
Hobbyist        Do you code as a hobby?
Age             What is your age (in years)? If you prefer not...
Age1stCode      At what age did you write your first line of c...
...
WebframeWorkedWith  Which web frameworks have you done extensive d...
WelcomeChange     Compared to last year, how welcome do you feel...
WorkWeekHrs       On average, how many hours per week do you wor...
YearsCode        Including any education, how many years have y...
YearsCodePro     NOT including education, how many years have y...
Name: QuestionText, Length: 61, dtype: object
```

Now retrieving any question becomes very easy. We can now use `schema_raw` to retrieve the full question text for any column in `survey_raw_df`.

Let's check if it is working for column name `'YearsCodePro'`

```
schema_raw['YearsCodePro']
```

'NOT including education, how many years have you coded professionally (as a part of your work)?'

Let's again check using the 'WorkWeekHrs' column

```
schema_raw['WorkWeekHrs']
```

'On average, how many hours per week do you work? Please enter a whole number in the box.'

Another method of doing the same thin is using the . operator after writing the dataframe name.

```
schema_raw.YearsCodePro
```

'NOT including education, how many years have you coded professionally (as a part of your work)?'

We've now loaded the dataset. We're ready to move on to the next step of preprocessing & cleaning the data for our analysis.

Saving and uploading the notebook.

We will be using [Jovian.ml](https://jovian.ml) for saving our notebook time to time. For that we need to install and import jovian.

```
# Select a project name
project="eda-stackoverflow-survey-project"
```

```
# Install the Jovian library
!pip install jovian --upgrade --quiet
```

```
import jovian
```

```
jovian.commit(project=project)
```

[jovian] Updating notebook "abhishekbittu279/eda-stackoverflow-survey-project" on <https://jovian.com>

[jovian] Committed successfully! <https://jovian.com/abhishekbittu279/eda-stackoverflow-survey-project>

'<https://jovian.com/abhishekbittu279/eda-stackoverflow-survey-project>'

Data Preparation & Cleaning

Our next step will be prepration of data and its cleaning. While the survey responses contain a wealth of information, we'll limit our analysis to the following areas:

- Demographics of the survey respondents and the global programming community
- Distribution of programming skills, experience, and preferences

- Employment-related information, preferences, and opinions

Let's select a subset of columns with the relevant data for our analysis.

```
selected_columns = [  
    # Demographics  
    'Country',  
    'Age',  
    'Gender',  
    'EdLevel',  
    'UndergradMajor',  
  
    # Programming experience  
    'Hobbyist',  
    'Age1stCode',  
    'YearsCode',  
    'YearsCodePro',  
    'LanguageWorkedWith',  
    'LanguageDesireNextYear',  
    'NEWLearn',  
    'NEWStuck',  
  
    # Employment  
    'Employment',  
    'DevType',  
    'WorkWeekHrs',  
    'JobSat',  
    'JobFactors',  
    'NEWOvertime',  
    'NEWEdImpt'  
]
```

Let's check the length of selected_columns

```
len(selected_columns)
```

20

We don't want to alter our original data, for that we need to extract a copy of this original dataframe with the selected columns. Let's extract a copy of the data from these columns into a new data frame survey_df. We can continue to modify further without affecting the original data frame.

```
survey_df = survey_raw_df[selected_columns].copy()
```

```
schema = schema_raw[selected_columns]
```

Checking the survey_raw_df dataframe

```
survey_df
```

	Country	Age	Gender	EdLevel	UndergradMajor	Hobbyist	Age1stCode	YearsCode	YearsCode
0	Germany	NaN	Man	Master's degree (M.A., M.S., M.Eng., MBA, etc.)	Computer science, computer engineering, or sof...	Yes	13	36	
1	United Kingdom	NaN	NaN	Bachelor's degree (B.A., B.S., B.Eng., etc.)	Computer science, computer engineering, or sof...	No	19	7	
2	Russian Federation	NaN	NaN	NaN	NaN	Yes	15	4	1
3	Albania	25.0	Man	Master's degree (M.A., M.S., M.Eng., MBA, etc.)	Computer science, computer engineering, or sof...	Yes	18	7	
4	United States	31.0	Man	Bachelor's degree (B.A., B.S., B.Eng., etc.)	Computer science, computer engineering, or sof...	Yes	16	15	
...	
64456	United States	NaN	NaN	Master's degree (M.A., M.S., M.Eng., MBA, etc.)	Computer science, computer engineering, or sof...	Yes	16	10	Less than 1 year
64457	Morocco	NaN	NaN	NaN	NaN	Yes	NaN	NaN	1
64458	Viet Nam	NaN	NaN	Primary/elementary school	NaN	Yes	NaN	NaN	1
64459	Poland	NaN	NaN	NaN	NaN	Yes	NaN	NaN	1
64460	Spain	NaN	NaN	Other doctoral degree (Ph.D., Ed.D., etc.)	Computer science, computer engineering, or sof...	Yes	NaN	NaN	1

64461 rows × 20 columns

Similarly, let's see the schema DF

schema

Column	
Country	Where do you live?
Age	What is your age (in years)? If you prefer not...
Gender	Which of the following describe you, if any? P...
EdLevel	Which of the following best describes the high...
UndergradMajor	What was your primary field of study?
Hobbyist	Do you code as a hobby?

Age1stCode	At what age did you write your first line of c...
YearsCode	Including any education, how many years have y...
YearsCodePro	NOT including education, how many years have y...
LanguageWorkedWith	Which programming, scripting, and markup langu...
LanguageDesireNextYear	Which programming, scripting, and markup langu...
NEWLearn	How frequently do you learn a new language or ...
NEWStuck	What do you do when you get stuck on a problem...
Employment	Which of the following best describes your cur...
DevType	Which of the following describe you? Please se...
WorkWeekHrs	On average, how many hours per week do you wor...
JobSat	How satisfied are you with your current job? (...
JobFactors	Imagine that you are deciding between two job ...
NEWOvertime	How often do you work overtime or beyond the f...
NEWEdImp	How important is a formal education, such as a...

Name: QuestionText, dtype: object

Let's view some basic information about the data frame like shape,info,describe etc.

```
schema.shape
```

```
(20,)
```

That means schema contains 20 rows.

```
survey_df.shape
```

```
(64461, 20)
```

Survey_df contains 64461 rows and 20 columns.

```
survey_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 64461 entries, 0 to 64460
```

```
Data columns (total 20 columns):
```

#	Column	Non-Null Count	Dtype
0	Country	64072 non-null	object
1	Age	45446 non-null	float64
2	Gender	50557 non-null	object
3	EdLevel	57431 non-null	object
4	UndergradMajor	50995 non-null	object
5	Hobbyist	64416 non-null	object
6	Age1stCode	57900 non-null	object
7	YearsCode	57684 non-null	object
8	YearsCodePro	46349 non-null	object
9	LanguageWorkedWith	57378 non-null	object
10	LanguageDesireNextYear	54113 non-null	object

11	NEWLearn	56156	non-null	object
12	NEWStuck	54983	non-null	object
13	Employment	63854	non-null	object
14	DevType	49370	non-null	object
15	WorkWeekHrs	41151	non-null	float64
16	JobSat	45194	non-null	object
17	JobFactors	49349	non-null	object
18	NEWOvertime	43231	non-null	object
19	NEWEdImpt	48465	non-null	object

dtypes: float64(2), object(18)

memory usage: 9.8+ MB

Most columns have the data type `object` , either because they may contain values of different types or contain empty values (`NaN`). It appears that every column contains some empty values since the Non-Null count for every column is lower than the total number of rows (64461). We'll need to deal with empty values and manually adjust the data type for each column on a case-by-case basis.

Only two of the columns were detected as numeric columns (`Age` and `WorkWeekHrs`), even though a few other columns have mostly numeric values. To make our analysis easier, let's convert some other columns into numeric data types while ignoring any non-numeric value by using `.to_numeric` function. The non-numeric are converted to `NaN` .

```
survey_df['Age1stCode'] = pd.to_numeric(survey_df.Age1stCode, errors='coerce')
survey_df['YearsCode'] = pd.to_numeric(survey_df.YearsCode, errors='coerce')
survey_df['YearsCodePro'] = pd.to_numeric(survey_df.YearsCodePro, errors='coerce')
```

Setting `Errors= 'coerce'` return `NaN` whenever error is encountered.

Let's now view some basic statistics about numeric columns using the `describe()` function.

```
survey_df.describe()
```

	Age	Age1stCode	YearsCode	YearsCodePro	WorkWeekHrs
count	45446.000000	57473.000000	56784.000000	44133.000000	41151.000000
mean	30.834111	15.476572	12.782051	8.869667	40.782174
std	9.585392	5.114081	9.490657	7.759961	17.816383
min	1.000000	5.000000	1.000000	1.000000	1.000000
25%	24.000000	12.000000	6.000000	3.000000	40.000000
50%	29.000000	15.000000	10.000000	6.000000	40.000000
75%	35.000000	18.000000	17.000000	12.000000	44.000000
max	279.000000	85.000000	50.000000	50.000000	475.000000

There seems to be a problem with the age column, as the minimum value is 1 and the maximum is 279 which is a vague fact. This is a common issue with surveys, responses may contain invalid values due to accidental or intentional errors while responding. A simple fix would be to ignore the rows where the age is higher than 100 years or lower than 10 years as invalid survey responses. We can do this using the `.drop` method.

```
survey_df.drop(survey_df[survey_df.Age < 10].index, inplace=True)
survey_df.drop(survey_df[survey_df.Age > 100].index, inplace=True)
```

The same holds for `WorkWeekHrs` . Let's ignore entries where the value for the column is higher than 140 hours i.e 20 hours per day,which may sound absurd.

```
survey_df.drop(survey_df[survey_df.WorkWeekHrs > 140].index, inplace=True)
```

The gender column also allows for picking multiple options which means a single person could have chose multiple option under Gender. We'll remove values containing more than one option to simplify our analysis.

Before doing that,let's analyze the question.

```
schema.Gender
```

'Which of the following describe you, if any? Please check all that apply. If you prefer not to answer, you may leave this question blank.'

```
survey_df['Gender'].value_counts()
```

```
Man                                     45895
Woman                                  3835
Non-binary, genderqueer, or gender non-conforming    385
Man;Non-binary, genderqueer, or gender non-conforming  121
Woman;Non-binary, genderqueer, or gender non-conforming  92
Woman;Man                                           73
Woman;Man;Non-binary, genderqueer, or gender non-conforming  25
Name: Gender, dtype: int64
```

Removing the records which contains multiple values using ;

```
import numpy as np
```

```
survey_df.where(~(survey_df.Gender.str.contains('; ', na=False)), np.nan, inplace=True)
```

We've now cleaned up and prepared the dataset for analysis. Let's take a look at a sample of rows from the data frame.

```
survey_df.sample(10)
```

	Country	Age	Gender	EdLevel	UndergradMajor	Hobbyist	Age1stCode	YearsCode	YearsCode1
47648	United States	41.0	Man	Associate degree (A.A., A.S., etc.)	I never declared a major	Yes	13.0	4.0	N
72	Sweden	NaN	Man	Bachelor's degree (B.A., B.S., B.Eng., etc.)	Web development or web design	Yes	12.0	23.0	1

	Country	Age	Gender	EdLevel	UndergradMajor	Hobbyist	Age1stCode	YearsCode	YearsCodeL
47273	Brazil	NaN	NaN	NaN	NaN	Yes	NaN	NaN	N
10850	Bosnia and Herzegovina	33.0	Man	Bachelor's degree (B.A., B.S., B.Eng., etc.)	Computer science, computer engineering, or sof...	Yes	14.0	20.0	1
9988	India	29.0	Man	Bachelor's degree (B.A., B.S., B.Eng., etc.)	Information systems, information technology, o...	Yes	21.0	9.0	
62202	Viet Nam	NaN	NaN	NaN	NaN	Yes	NaN	NaN	N
62070	United States	NaN	NaN	NaN	NaN	No	NaN	NaN	N
56088	Algeria	NaN	Man	Master's degree (M.A., M.S., M.Eng., MBA, etc.)	Computer science, computer engineering, or sof...	No	20.0	7.0	
38187	Poland	32.0	Man	Bachelor's degree (B.A., B.S., B.Eng., etc.)	Computer science, computer engineering, or sof...	Yes	12.0	11.0	
52623	United States	46.0	Man	Some college/university study without earning ...	A humanities discipline (such as literature, h...	Yes	46.0	NaN	N

Let's save and commit our work before continuing.

```
import jovian
```

```
jovian.commit()
```

[jovian] Updating notebook "abhishekbittu279/eda-stackoverflow-survey-project" on <https://jovian.com>

[jovian] Committed successfully! <https://jovian.com/abhishekbittu279/eda-stackoverflow-survey-project>

'<https://jovian.com/abhishekbittu279/eda-stackoverflow-survey-project>'

Exploratory Analysis and Visualization

Before we ask questions about the survey responses, it would help to understand the respondents' demographics, i.e., country, age, gender, education level, employment level, etc. It's essential to explore these variables to understand how representative the survey is of the worldwide programming community. A survey of this scale generally tends to have some selection bias i.e it doesn't represent the universal situation but is true only for

smaller portion of population. for example,since english is spoken majorly in US and India, most of the users of stackoverflow are also from the same countries.

For the data visualuzation we will be using Matplotlib and Seaborn Libraries. Let's begin by importing matplotlib.pyplot and seaborn .

```
import seaborn as sns
import matplotlib
import matplotlib.pyplot as plt
%matplotlib inline

sns.set_style('darkgrid')
matplotlib.rcParams['font.size'] = 14
matplotlib.rcParams['figure.figsize'] = (9, 5)
matplotlib.rcParams['figure.facecolor'] = '#00000000'
```

%matplotlib inline command is used to embed the plots/graph in the same notebook rather than showing it in any other pop up window.

Country

Let's look at the number of countries from which there are responses in the survey and plot the ten countries with the highest number of responses.

```
schema.Country
```

```
'Where do you live?'
```

Let's count the number of unique countries in the dataframe using the .nunique command

```
survey_df.Country.nunique()
```

```
183
```

We can identify the countries with the highest number of respondents using the value_counts method.

```
survey_df.Country.value_counts()
```

United States	12371
India	8364
United Kingdom	3881
Germany	3864
Canada	2175
...	
Nauru	1
Lesotho	1
Saint Lucia	1
Antigua and Barbuda	1
Marshall Islands	1

Name: Country, Length: 183, dtype: int64

Now let's select the top 15 countries having highest number of counts using `.head()` function.

```
top_countries = survey_df.Country.value_counts().head(15)
top_countries
```

United States	12371
India	8364
United Kingdom	3881
Germany	3864
Canada	2175
France	1884
Brazil	1804
Netherlands	1332
Poland	1259
Australia	1199
Spain	1157
Italy	1115
Russian Federation	1085
Sweden	879
Pakistan	802

Name: Country, dtype: int64

We can visualize this information using a bar chart.

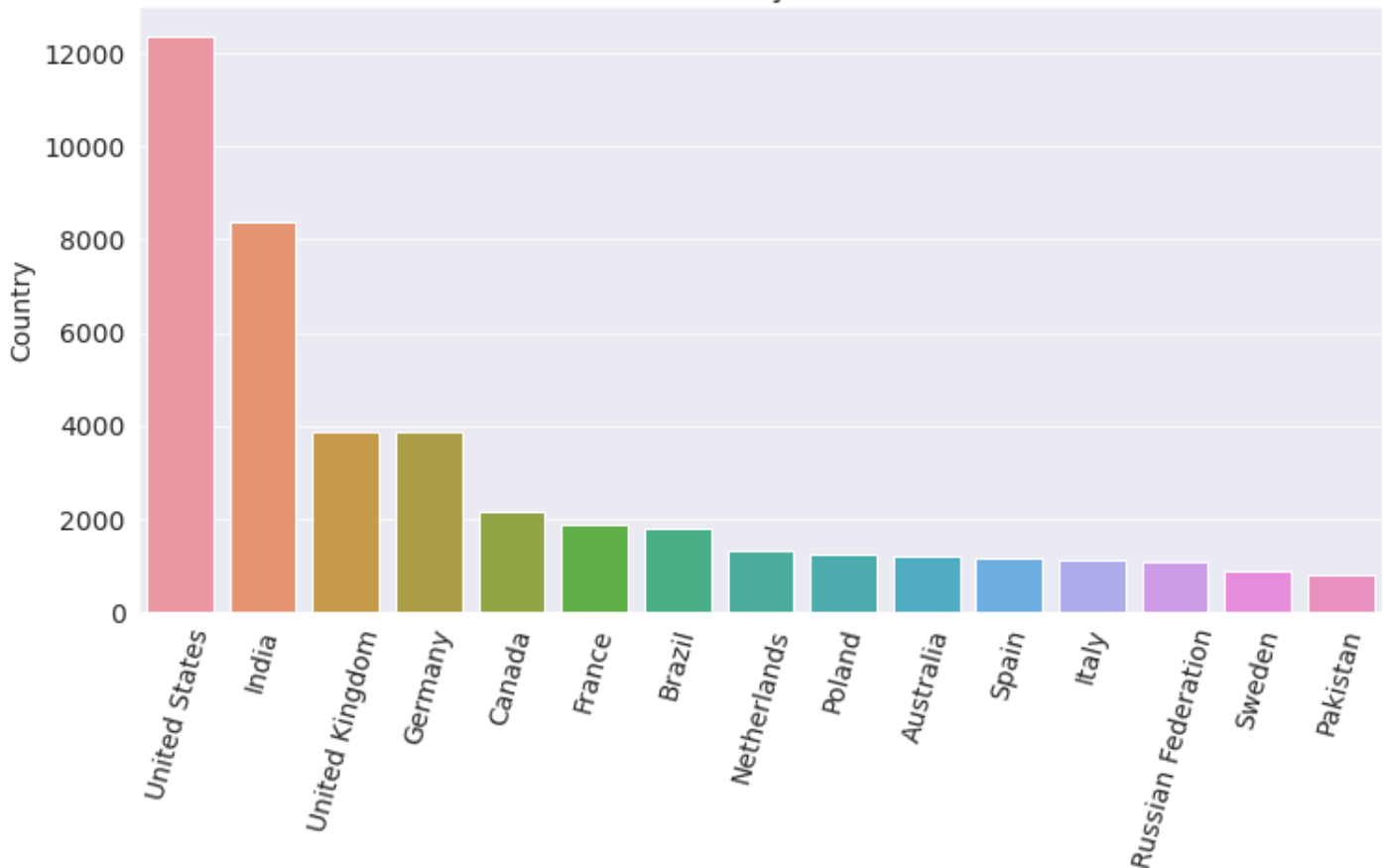
`plt.figure(figsize)` function is used to alter the figure size.

`plt.xticks(rotation)` function is used to rotate the x-axis mark.

`plt.title()` function is used for giving a title to the plot.

```
plt.figure(figsize=(12,6))
plt.xticks(rotation=75)
plt.title(schema.Country)
sns.barplot(x=top_countries.index, y=top_countries);
```

Where do you live?



It appears that a disproportionately high number of respondents are from the US and India, probably because the survey is in English, and these countries have the highest English-speaking populations. We can already see that the survey may not be representative of the global programming community - especially from non-English speaking countries. Programmers from non-English speaking countries are almost certainly underrepresented.

Age

The distribution of respondent's age is another crucial factor to look at. We can use a histogram to visualize it.

```
schema.Age
```

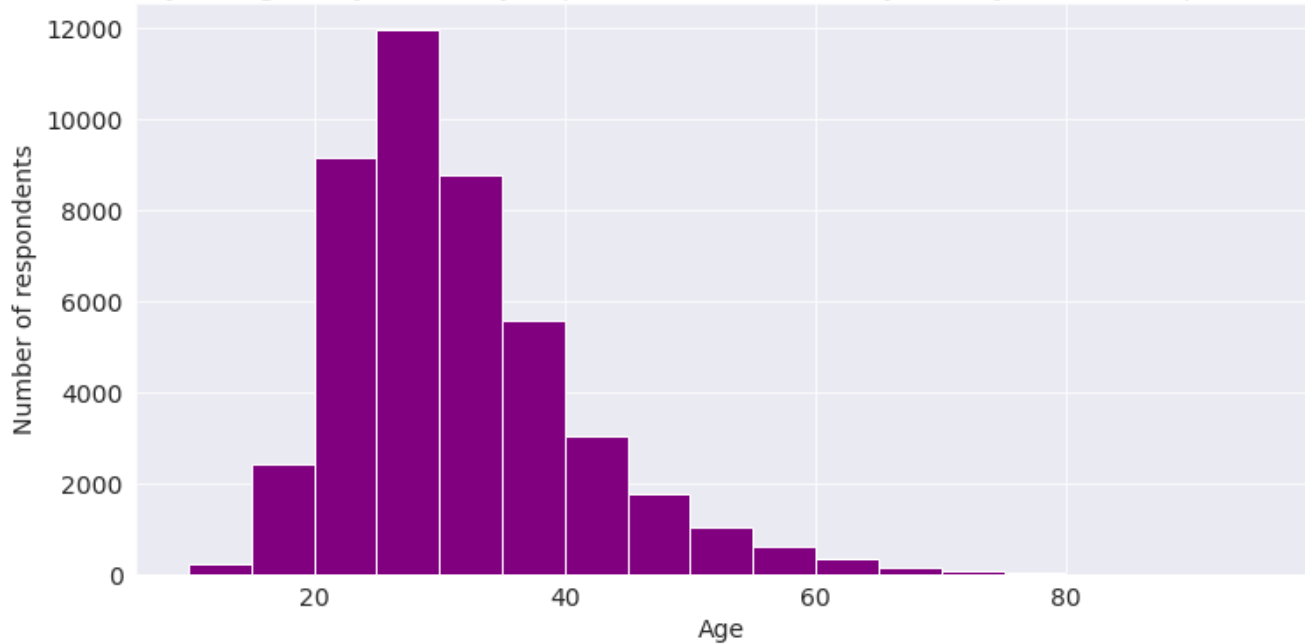
'What is your age (in years)? If you prefer not to answer, you may leave this question blank.'

`plt.x/ylabel()` - This function is used to allot label to the respective axis

```
plt.figure(figsize=(12, 6))
plt.title(schema.Age)
plt.xlabel('Age')
plt.ylabel('Number of respondents')

plt.hist(survey_df.Age, bins=np.arange(10,100,5),color="purple");
```

What is your age (in years)? If you prefer not to answer, you may leave this question blank.



It appears that a large percentage of respondents are 20-45 years old. It's somewhat representative of the programming community in general. Many young people have taken up computer science as their field of study or profession in the last few decades.

Gender

Let's look at the distribution of responses for the Gender. It's a well-known fact that women and non-binary genders are underrepresented in the programming community, so we might expect to see a skewed distribution here.

```
schema.Gender
```

'Which of the following describe you, if any? Please check all that apply. If you prefer not to answer, you may leave this question blank.'

```
gender_counts = survey_df.Gender.value_counts(dropna=False)
gender_counts
```

Man	45895
NaN	14191
Woman	3835
Non-binary, genderqueer, or gender non-conforming	385

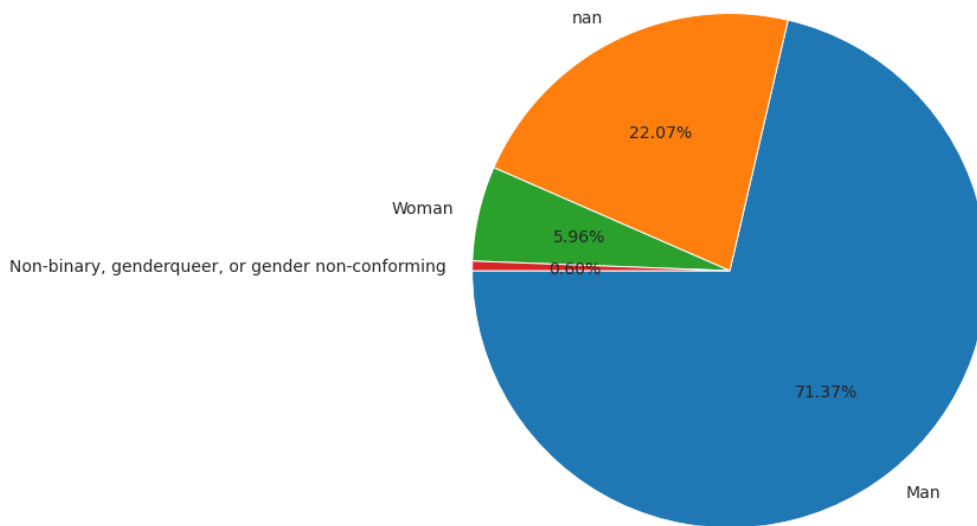
Name: Gender, dtype: int64

A pie chart would be a great way to visualize the distribution.

A pie chart can be called up using `plt.pie` function

```
plt.figure(figsize=(12,10))
plt.title(schema.Gender)
plt.pie(gender_counts, labels=gender_counts.index, autopct='%.2f%%', startangle=180);
```


Which of the following describe you, if any? Please check all that apply. If you prefer not to answer, you may leave this question blank.



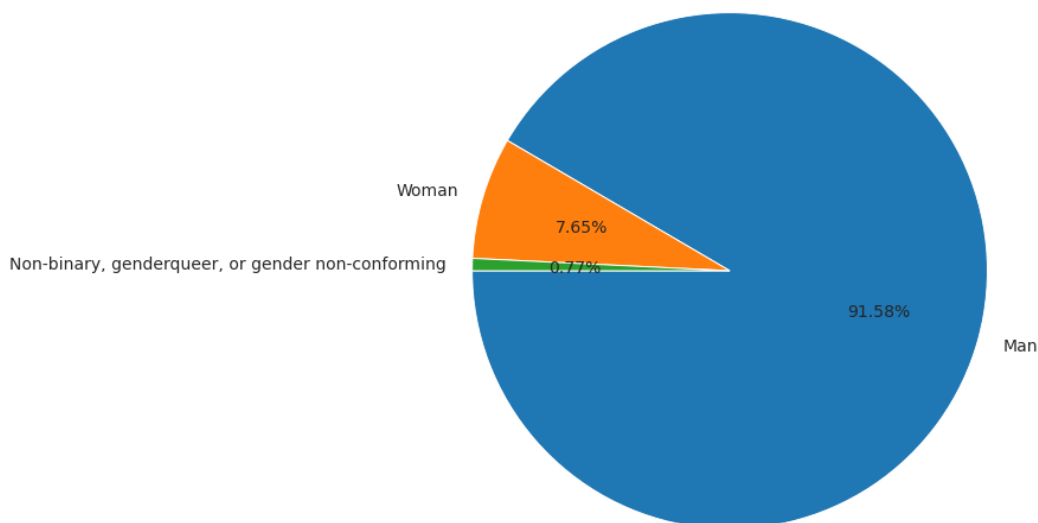
Let's see the case when NaN values aren't included.

```
gender_counts = survey_df.Gender.value_counts()
gender_counts
```

```
Man                45895
Woman              3835
Non-binary, genderqueer, or gender non-conforming    385
Name: Gender, dtype: int64
```

```
plt.figure(figsize=(12,10))
plt.title(schema.Gender)
plt.pie(gender_counts, labels=gender_counts.index, autopct='%.2f%%', startangle=180);
```

Which of the following describe you, if any? Please check all that apply. If you prefer not to answer, you may leave this question blank.



When NaN values are also included, Only about 8% of survey respondents who have answered the question identify as women or non-binary. This number is lower than the overall percentage of women & non-binary genders

in the programming community - which is estimated to be around 12%.

Education Level

Formal education in computer science is often considered an essential requirement for becoming a programmer. However, there are many free resources & tutorials available online to learn programming. Let's compare the education levels of respondents to gain some insight into this. We'll use a horizontal bar plot here.

```
schema.EdLevel
```

'Which of the following best describes the highest level of formal education that you've completed?'

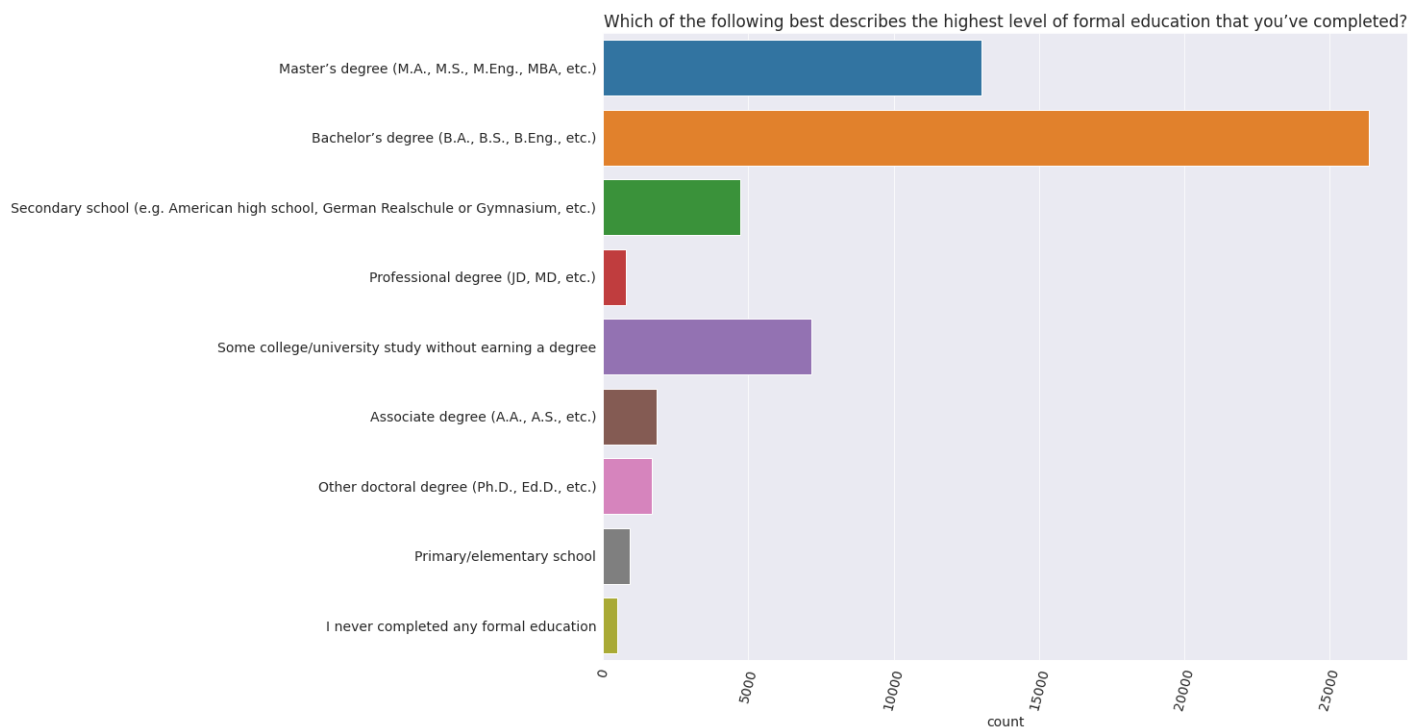
Let's have our eye on the unique entries in the EdLevel column.

```
survey_df.EdLevel.unique()
```

```
array(['Master's degree (M.A., M.S., M.Eng., MBA, etc.)',  
      'Bachelor's degree (B.A., B.S., B.Eng., etc.)', nan,  
      'Secondary school (e.g. American high school, German Realschule or Gymnasium,  
etc.)',  
      'Professional degree (JD, MD, etc.)',  
      'Some college/university study without earning a degree',  
      'Associate degree (A.A., A.S., etc.)',  
      'Other doctoral degree (Ph.D., Ed.D., etc.)',  
      'Primary/elementary school',  
      'I never completed any formal education'], dtype=object)
```

To insert a horizontal barplot we will be using `sns.countplot()` under the seaborn library.

```
plt.figure(figsize=(15, 12));  
sns.countplot(y=survey_df.EdLevel)  
plt.xticks(rotation=75);  
plt.title(schema['EdLevel'])  
plt.ylabel(None);
```



It appears that well over half of the respondents hold a bachelor's or master's degree, so most programmers seem to have some college education. However, it's not clear from this graph alone if they hold a degree in computer science.

Let's also plot undergraduate majors, but this time we'll convert the numbers into percentages and sort the values to make it easier to visualize the order.

```
schema.UndergradMajor
```

```
'What was your primary field of study?'
```

```
plt.figure(figsize=(15,15));
undergrad_pct = survey_df.UndergradMajor.value_counts() * 100 / survey_df.UndergradMajor
```

<Figure size 1080x1080 with 0 Axes>

```
undergrad_pct
```

```
Computer science, computer engineering, or software engineering
61.939193
Another engineering discipline (such as civil, electrical, mechanical, etc.)
9.354195
Information systems, information technology, or system administration
7.983168
A natural science (such as biology, chemistry, physics, etc.)
4.316561
Mathematics or statistics
3.627097
Web development or web design
3.502637
A business discipline (such as accounting, finance, marketing, etc.)
```

2.700567

A humanities discipline (such as literature, history, philosophy, etc.)

1.969616

A social science (such as anthropology, psychology, political science, etc.)

1.821450

Fine arts or performing arts (such as graphic design, music, studio art, etc.)

1.412513

I never declared a major

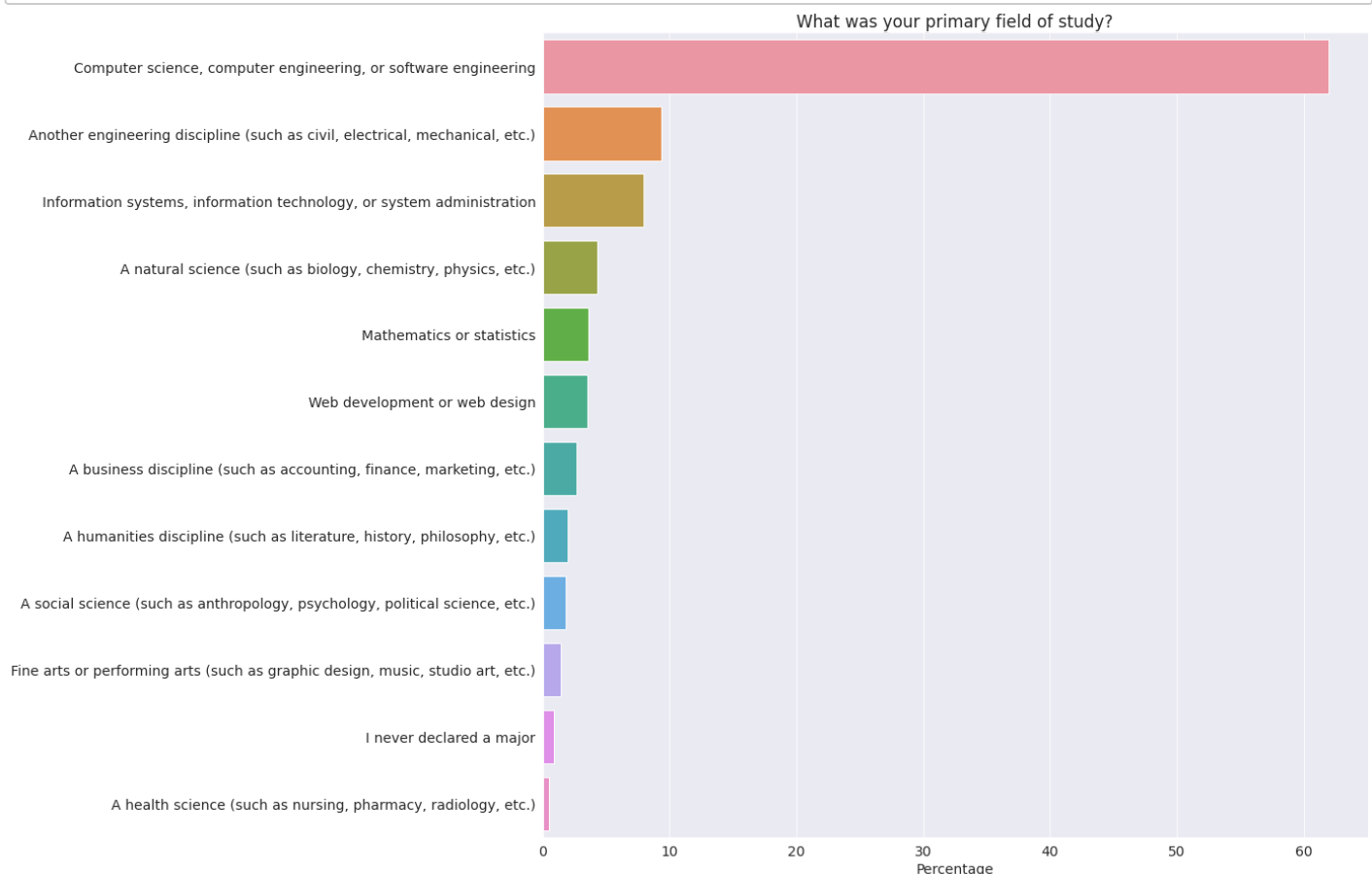
0.885043

A health science (such as nursing, pharmacy, radiology, etc.)

0.487959

Name: UndergradMajor, dtype: float64

```
plt.figure(figsize=(15,15));
sns.barplot(x=undergrad_pct, y=undergrad_pct.index)
plt.title(schema.UndergradMajor)
plt.ylabel(None);
plt.xlabel('Percentage');
```



It turns out that 40% of programmers holding a college degree have a field of study other than computer science - which is very encouraging. It seems to suggest that while a college education is helpful in general, you do not need to pursue a major in computer science to become a successful programmer.

Employment

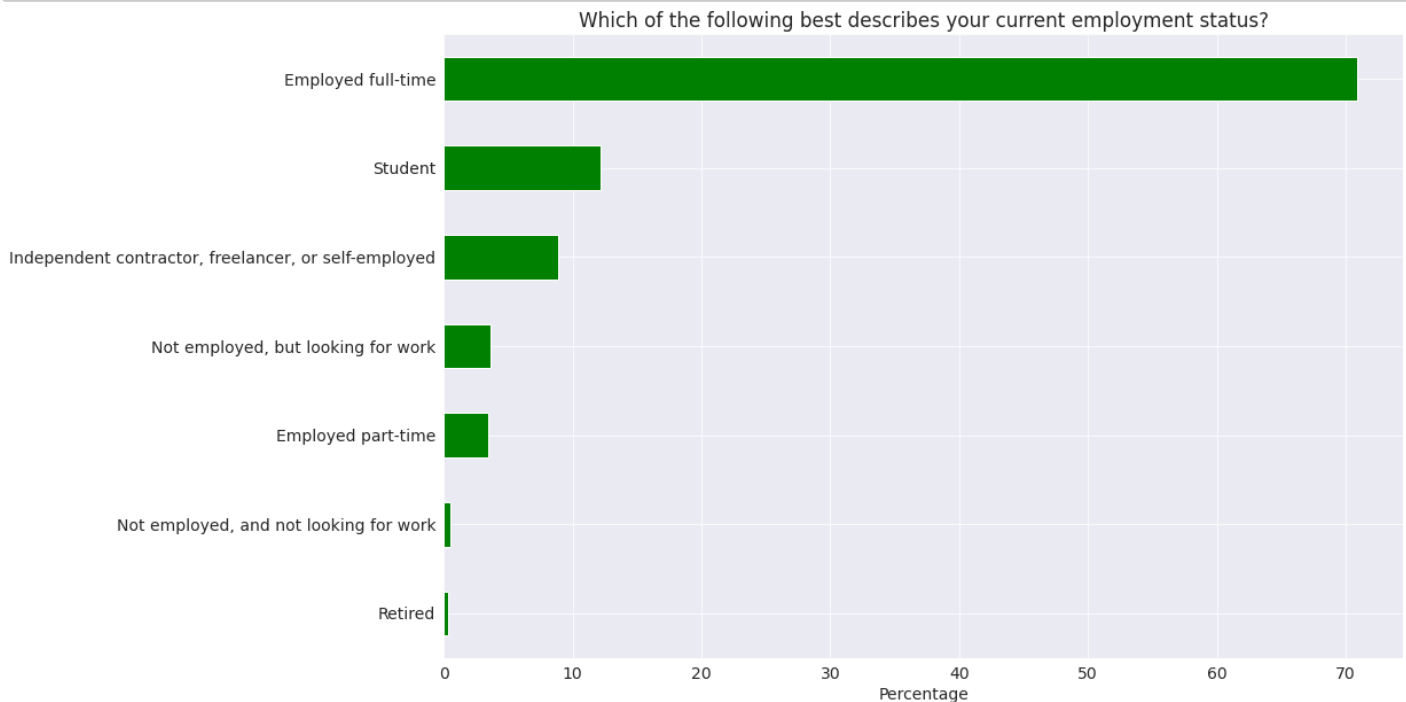
Freelancing or contract work is a common choice among programmers, so it would be interesting to compare the breakdown between full-time, part-time, and freelance work. Let's visualize the data from the `Employment` column.

```
schema.Employment
```

'Which of the following best describes your current employment status?'

Another way to plot the horizontal graph in percentage using a single line code is as follows.

```
plt.figure(figsize=(15,10));  
(survey_df.Employment.value_counts(normalize=True, ascending=True)*100).plot(kind='barh')  
plt.title(schema.Employment)  
plt.xlabel('Percentage');
```



It appears that close to 10% of respondents are employed part time or as freelancers.

The `DevType` field contains information about the roles held by respondents. Since the question allows multiple answers, the column contains lists of values separated by a semi-colon ; , making it a bit harder to analyze directly.

```
schema.DevType
```

'Which of the following describe you? Please select all that apply.'

```
survey_df.DevType.value_counts()
```

Developer, full-stack
4396

Developer, back-end
3056

Developer, back-end;Developer, front-end;Developer, full-stack
2214

Developer, back-end;Developer, full-stack
1465

Developer, front-end

```

...
Database administrator;Developer, back-end;Developer, front-end;Developer, full-
stack;Developer, QA or test;Senior executive/VP
1
Database administrator;Developer, back-end;Developer, front-end;Developer, full-
stack;Product manager;Senior executive/VP
1
Developer, back-end;Developer, full-stack;Developer, mobile;DevOps
specialist;Educator;System administrator
1
Data or business analyst;Database administrator;Developer, back-end;Developer, desktop
or enterprise applications;Developer, front-end;Developer, mobile;Engineering manager
1
Data or business analyst;Developer, mobile;Senior executive/VP;System administrator
1
Name: DevType, Length: 8213, dtype: int64

```

```
survey_df.DevType.nunique()
```

```
8213
```

```
survey_df.DevType
```

```

0      Developer, desktop or enterprise applications;...
1      Developer, full-stack;Developer, mobile
2                                          NaN
3                                          NaN
4                                          NaN
...
64456      Senior executive/VP
64457      NaN
64458      NaN
64459      NaN
64460      NaN
Name: DevType, Length: 64306, dtype: object

```

Let's define a helper function that turns a column containing lists of values (like `survey_df.DevType`) into a data frame with one column for each possible option.

```

def split_multicolumn(col_series):
    result_df = col_series.to_frame()
    options = []
    # Iterate over the column
    for idx, value in col_series[col_series.notnull()].iteritems():
        # Break each value into list of options
        for option in value.split(';'):
            # Add the option as a column to result
            if not option in result_df.columns:

```

```

options.append(option)
result_df[option] = False
# Mark the value in the option column as True
result_df.at[idx, option] = True
return result_df[options]

```

```
dev_type_df = split_multicolumn(survey_df.DevType)
```

```
dev_type_df
```

	Developer, desktop or enterprise applications	Developer, full-stack	Developer, mobile	Designer	Developer, front-end	Developer, back-end	Developer, QA or test	DevOps specialist	Developer, game or graphics	Dat adminis
0	True	True	False	False	False	False	False	False	False	
1	False	True	True	False	False	False	False	False	False	
2	False	False	False	False	False	False	False	False	False	
3	False	False	False	False	False	False	False	False	False	
4	False	False	False	False	False	False	False	False	False	
...	
64456	False	False	False	False	False	False	False	False	False	
64457	False	False	False	False	False	False	False	False	False	
64458	False	False	False	False	False	False	False	False	False	
64459	False	False	False	False	False	False	False	False	False	
64460	False	False	False	False	False	False	False	False	False	

64306 rows × 23 columns

The `dev_type_df` has one column for each option that can be selected as a response. If a respondent has chosen an option, the corresponding column's value is `True`. Otherwise, it is `False`.

We can now use the column-wise totals to identify the most common roles.

```

dev_type_totals = dev_type_df.sum().sort_values(ascending=False)
dev_type_totals

```

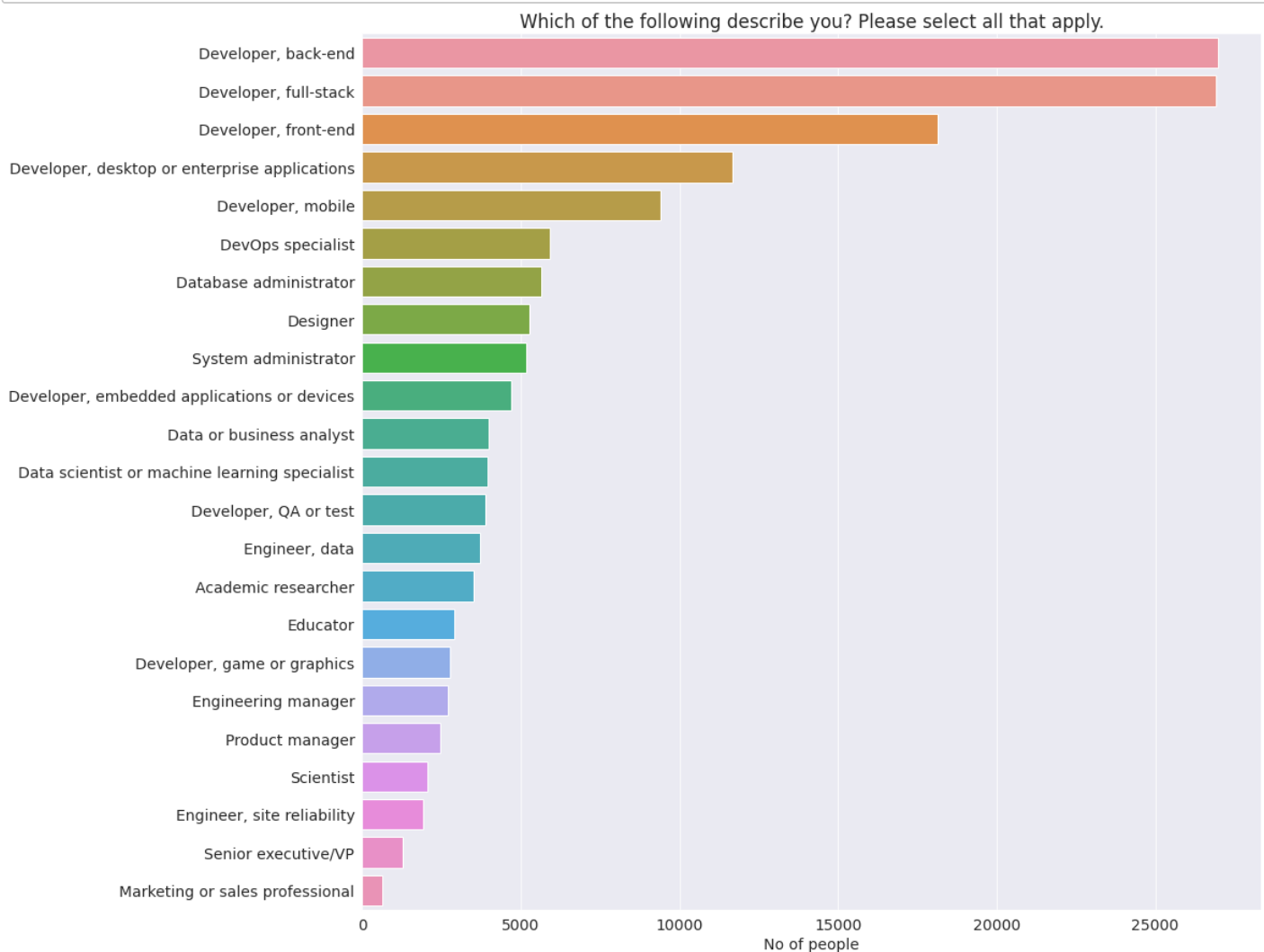
Developer, back-end	26996
Developer, full-stack	26915
Developer, front-end	18128
Developer, desktop or enterprise applications	11687
Developer, mobile	9406
DevOps specialist	5915
Database administrator	5658
Designer	5262
System administrator	5185
Developer, embedded applications or devices	4701
Data or business analyst	3970

Data scientist or machine learning specialist	3939
Developer, QA or test	3893
Engineer, data	3700
Academic researcher	3502
Educator	2895
Developer, game or graphics	2751
Engineering manager	2699
Product manager	2471
Scientist	2060
Engineer, site reliability	1921
Senior executive/VP	1292
Marketing or sales professional	625

dtype: int64

As one might expect, the most common roles include "Developer" in the name.

```
plt.figure(figsize=(15,15));
sns.barplot(x=dev_type_totals, y=dev_type_totals.index)
plt.title(schema.DevType)
plt.ylabel(None);
plt.xlabel('No of people');
```



Let's get a clear insight on how many people code as a hobby with a help of a pie chart.


```
schema.Hobbyist
```

```
'Do you code as a hobby?'
```

```
survey_df.Hobbyist
```

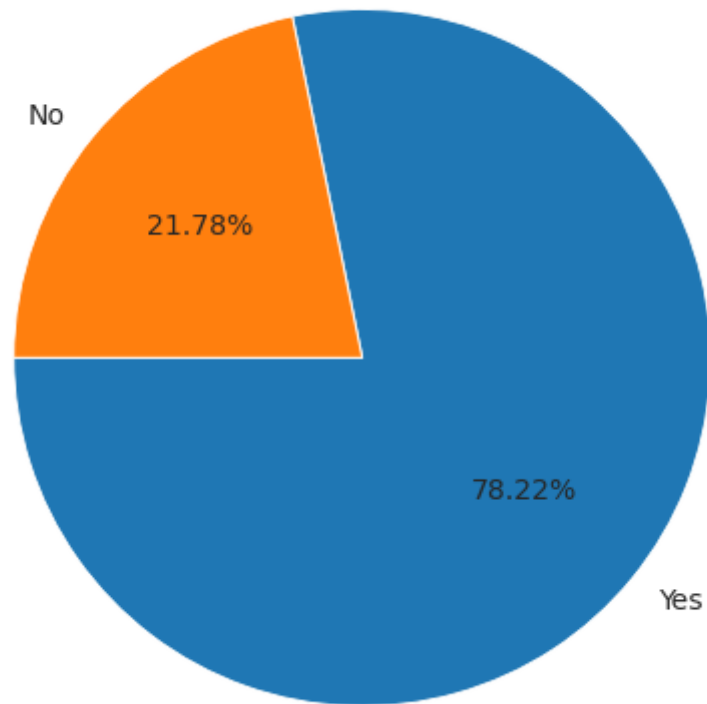
```
0      Yes
1      No
2      Yes
3      Yes
4      Yes
...
64456   Yes
64457   Yes
64458   Yes
64459   Yes
64460   Yes
Name: Hobbyist, Length: 64306, dtype: object
```

```
hobbyist_sum=survey_df.Hobbyist.value_counts()
hobbyist_sum
```

```
Yes      50019
No       13931
Name: Hobbyist, dtype: int64
```

```
plt.figure(figsize=(12,8))
plt.title(schema.Hobbyist)
plt.pie(hobbyist_sum, labels=hobbyist_sum.index, autopct='%.2f%%', startangle=180);
```

Do you code as a hobby?



It is clearly evident that majority of people i.e 78% of the people code as a hobby.

```
schema.JobSat
```

'How satisfied are you with your current job? (If you work multiple jobs, answer for the one you spend the most hours on.)'

```
survey_df.JobSat
```

```
0      Slightly satisfied
1      Very dissatisfied
2      NaN
3      Slightly dissatisfied
4      NaN
```

...

```
64456      NaN
64457      NaN
64458      NaN
64459      NaN
64460      NaN
```

Name: JobSat, Length: 64306, dtype: object

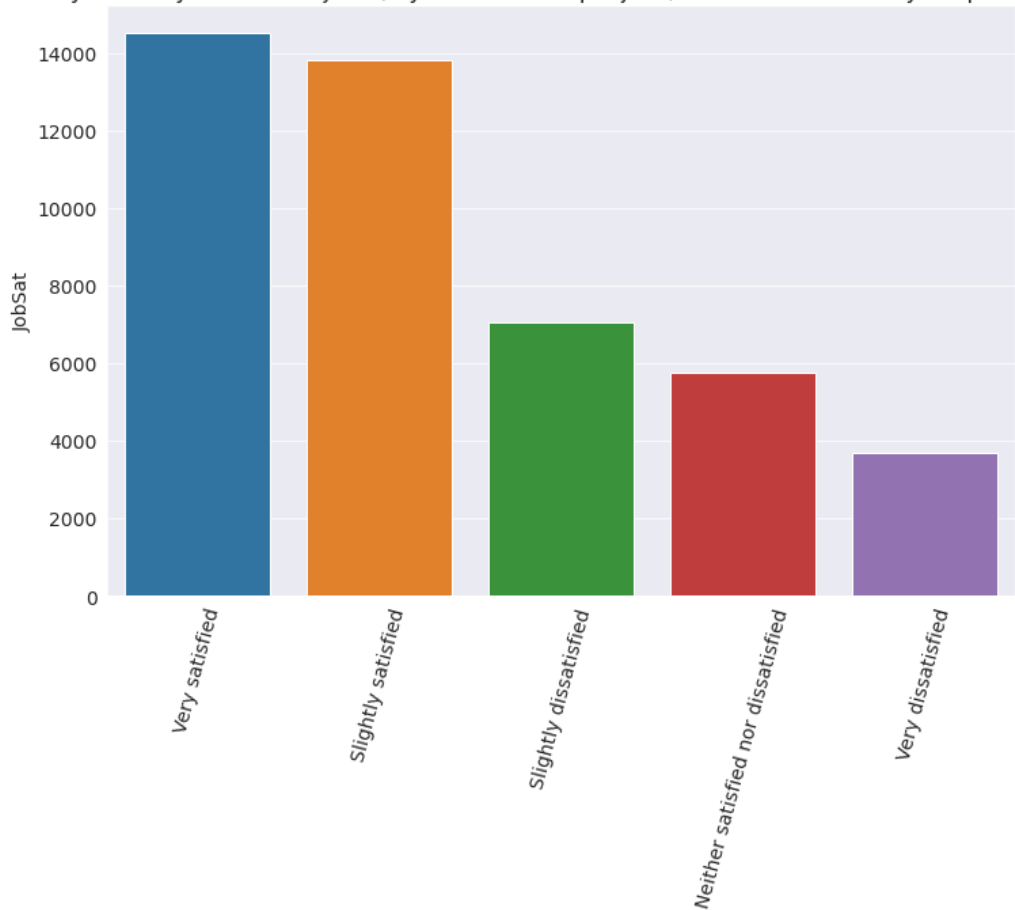
```
survey_jobsat_result= survey_df.JobSat.value_counts()
survey_jobsat_result
```

```
Very satisfied      14502
Slightly satisfied  13811
```

Slightly dissatisfied 7070
Neither satisfied nor dissatisfied 5747
Very dissatisfied 3705
Name: JobSat, dtype: int64

```
plt.figure(figsize=(12,8))
plt.xticks(rotation=75)
plt.title(schema.JobSat)
sns.barplot(x=survey_jobsat_result.index, y=survey_jobsat_result);
```

How satisfied are you with your current job? (If you work multiple jobs, answer for the one you spend the most hours on.)



With the help of above drawn barplot it can be easily concluded that high number of people are either satisfied than the number of people dissatisfied due to their job roles,

```
schema.JobFactors
```

'Imagine that you are deciding between two job offers with the same compensation, benefits, and location. Of the following factors, which 3 are MOST important to you?'

```
survey_df.JobFactors
```

```
0      Languages, frameworks, and other technologies ...
1                                           NaN
2                                           NaN
3      Flex time or a flexible schedule;Office enviro...
4                                           NaN
...
64456                                           NaN
```

```
64457
64458
64459
64460
Name: JobFactors, Length: 64306, dtype: object
```

Since every entry contains more than one option, analysis becomes difficult, thus we will use the `split_multicolumn` function to create a new dataframe containing column for each of the entries. Thus calling the `~split_multicolumn~` over `JobFactors` column.

```
JobFactors_df=split_multicolumn(survey_df.JobFactors)
JobFactors_df
```

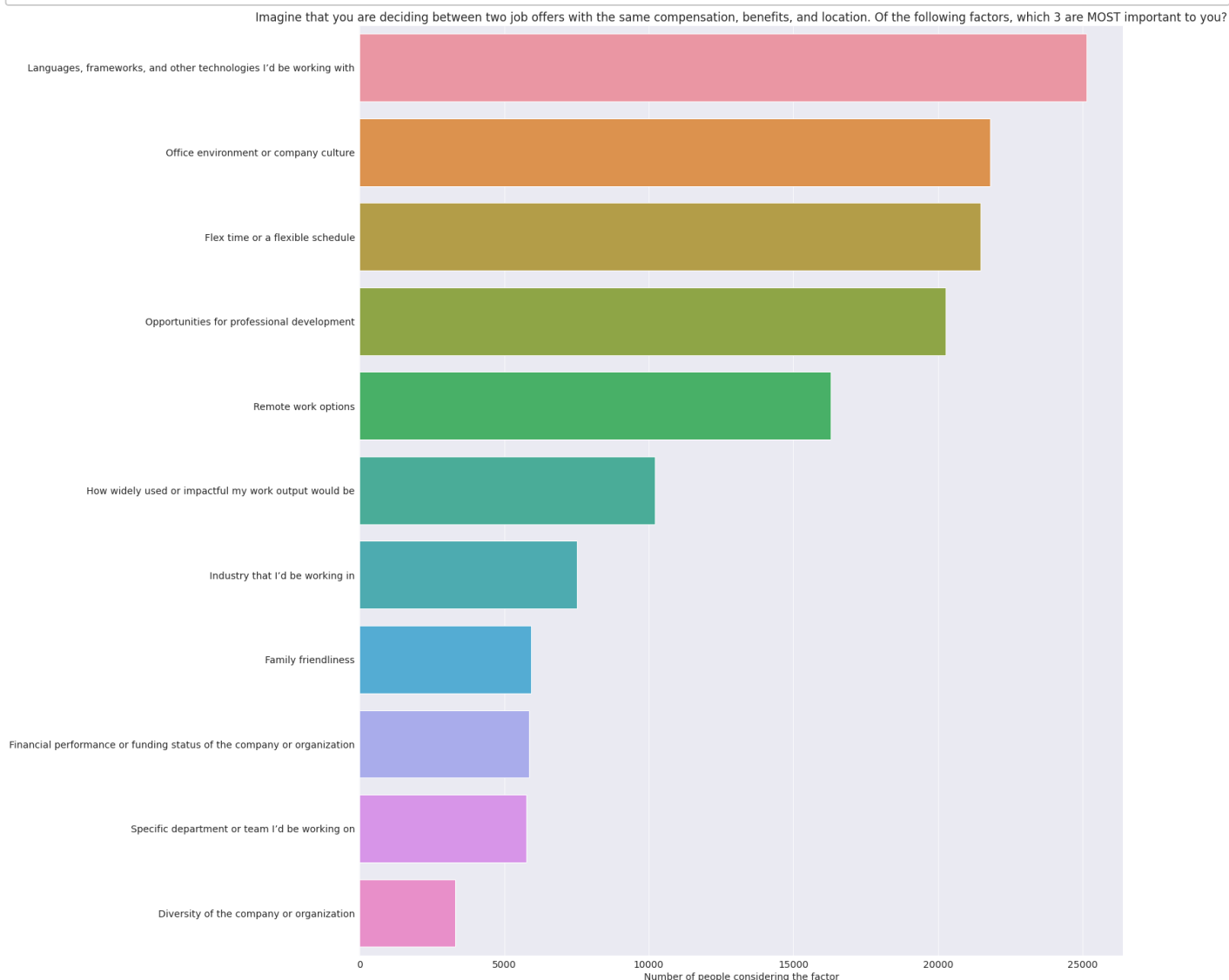
	Languages, frameworks, and other technologies I'd be working with	Remote work options	Opportunities for professional development	Flex time or a flexible schedule	Office environment or company culture	Diversity of the company or organization	Family friendliness	How widely used or impactful my work output would be	Industry that I'd be working in	Performance or
0	True	True	True	False	False	False	False	False	False	
1	False	False	False	False	False	False	False	False	False	
2	False	False	False	False	False	False	False	False	False	
3	False	False	True	True	True	False	False	False	False	
4	False	False	False	False	False	False	False	False	False	
...	
64456	False	False	False	False	False	False	False	False	False	
64457	False	False	False	False	False	False	False	False	False	
64458	False	False	False	False	False	False	False	False	False	
64459	False	False	False	False	False	False	False	False	False	
64460	False	False	False	False	False	False	False	False	False	

64306 rows × 11 columns

```
JobFactors_total=JobFactors_df.sum().sort_values(ascending=False)
JobFactors_total
```

Languages, frameworks, and other technologies I'd be working with	25146
Office environment or company culture	21801
Flex time or a flexible schedule	21483
Opportunities for professional development	20266
Remote work options	16290
How widely used or impactful my work output would be	10205
Industry that I'd be working in	7513
Family friendliness	5938
Financial performance or funding status of the company or organization	5855
Specific department or team I'd be working on	5764
Diversity of the company or organization	3300
dtype: int64	

```
plt.figure(figsize=(20,25));
sns.barplot(x=JobFactors_total, y=JobFactors_total.index)
plt.title(schema.JobFactors)
plt.ylabel(None);
plt.xlabel('Number of people considering the factor');
```



With the help of above plotted graph we can easily conclude that technologies to be used, company environment & culture and flexibility in schedule are the main factors which are top priorities for majority of the programmers.

```
schema. NEWLearn
```

'How frequently do you learn a new language or framework?'

```
survey_df.NEWLearn
```

```
0      Once a year
1      Once a year
2      Once a decade
3      Once a year
4      Once a year
...
64456  Once a decade
```

```
64457      NaN
64458      NaN
64459      Once a year
64460      Once a year
Name: NEWLearn, Length: 64306, dtype: object
```

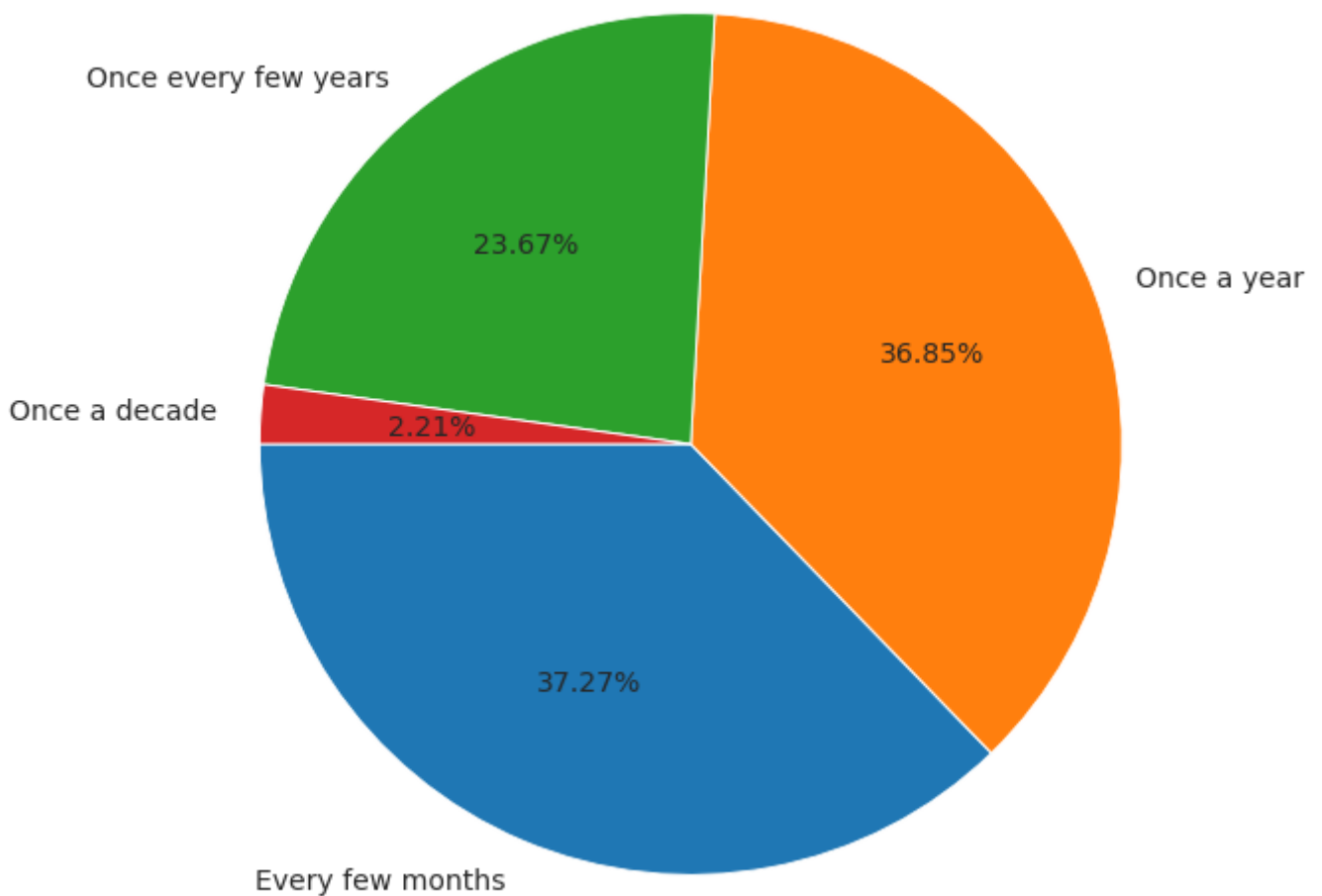
```
NewLearnCount=survey_df. NEWLearn.value_counts()
NewLearnCount
```

```
Every few months      20771
Once a year           20534
Once every few years   13194
Once a decade         1231
Name: NEWLearn, dtype: int64
```

Let's plot a pie chart to visualize this same data.

```
plt.figure(figsize=(15,10))
plt.title(schema.NEWLearn)
plt.pie(NewLearnCount,labels=NewLearnCount.index, autopct='%.2f%%', startangle=180);
```

How frequently do you learn a new language or framework?



From the above pie chart it can be easily deduced that most of the people either learn new language or framework at every few months or once a year.

```
schema.NEWStuck
```

```
'What do you do when you get stuck on a problem? Select all that apply.'
```

```
survey_df.NEWStuck
```

```
0      Visit Stack Overflow;Go for a walk or other ph...
1      Visit Stack Overflow;Go for a walk or other ph...
2                                           NaN
3                                           NaN
4      Call a coworker or friend;Visit Stack Overflow...
...
64456      Call a coworker or friend
64457                                           NaN
64458                                           NaN
64459      Call a coworker or friend;Visit Stack Overflow
64460      Meditate;Visit Stack Overflow;Go for a walk or...
Name: NEWStuck, Length: 64306, dtype: object
```

```
NewStuck_count=survey_df.NEWStuck.value_counts()
NewStuck_count
```

```
Visit Stack Overflow
2886
Visit Stack Overflow;Watch help / tutorial videos
2848
Call a coworker or friend;Visit Stack Overflow;Watch help / tutorial videos
2818
Call a coworker or friend;Visit Stack Overflow;Do other work and come back later
2326
Call a coworker or friend;Visit Stack Overflow
2186
...
Meditate;Play games;Call a coworker or friend;Visit Stack Overflow;Visit another
developer community (please name):
1
Meditate;Play games;Call a coworker or friend;Visit Stack Overflow;Panic
1
Meditate;Play games;Go for a walk or other physical activity;Panic;Do other work and
come back later;Visit another developer community (please name):
1
Play games;Go for a walk or other physical activity;Panic;Watch help / tutorial
videos;Do other work and come back later;Visit another developer community (please
name):      1
Play games;Call a coworker or friend;Go for a walk or other physical activity;Watch
```

help / tutorial videos;Visit another developer community (please name):

1

Name: NEWStuck, Length: 444, dtype: int64

```
NewStuck_count_df=split_multicolumn(survey_df.NEWStuck)
NewStuck_count_df
```

	Visit Stack Overflow	Go for a walk or other physical activity	Do other work and come back later	Call a coworker or friend	Watch help / tutorial videos	Visit another developer community (please name):	Play games	Meditate	Panic
0	True	True	True	False	False	False	False	False	False
1	True	True	False	False	False	False	False	False	False
2	False	False	False	False	False	False	False	False	False
3	False	False	False	False	False	False	False	False	False
4	True	False	True	True	True	True	False	False	False
...
64456	False	False	False	True	False	False	False	False	False
64457	False	False	False	False	False	False	False	False	False
64458	False	False	False	False	False	False	False	False	False
64459	True	False	False	True	False	False	False	False	False
64460	True	True	True	False	True	False	False	True	False

64306 rows × 9 columns

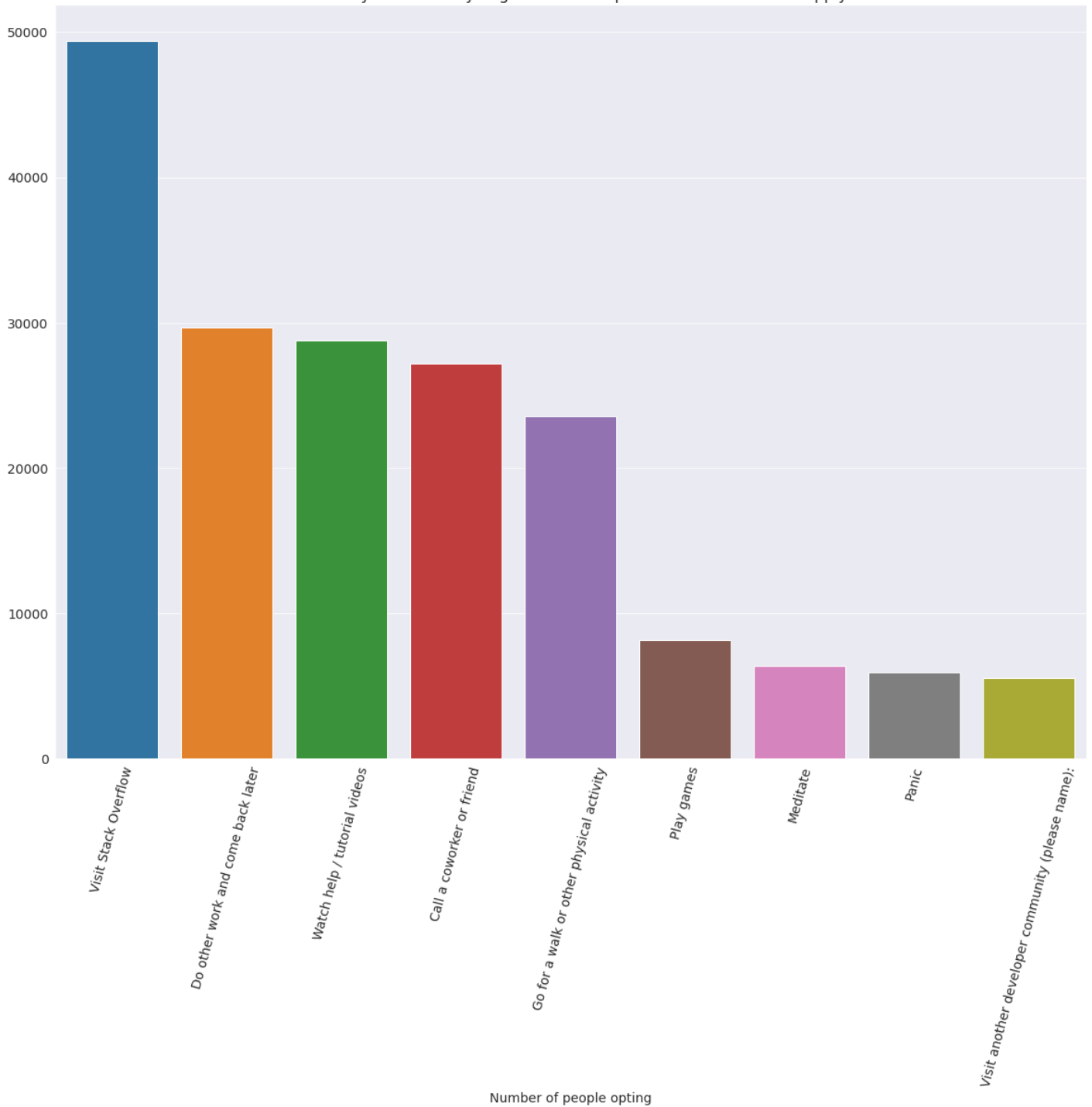
```
NewStuck_total=NewStuck_count_df.sum().sort_values(ascending= False)
NewStuck_total
```

Visit Stack Overflow	49414
Do other work and come back later	29666
Watch help / tutorial videos	28800
Call a coworker or friend	27186
Go for a walk or other physical activity	23586
Play games	8162
Meditate	6352
Panic	5906
Visit another developer community (please name):	5581

dtype: int64

```
plt.figure(figsize=(20,15));
plt.xticks(rotation=75)
sns.barplot(y=NewStuck_total, x=NewStuck_total.index)
plt.title(schema.NEWStuck)
plt.ylabel(None);
plt.xlabel('Number of people opting');
```


What do you do when you get stuck on a problem? Select all that apply.



It seems like people prefer to visit stack overflow website whenever they stuck in a problem.

```
schema.NEWOvertime
```

'How often do you work overtime or beyond the formal time expectation of your job?'

```
survey_df.NEWOvertime
```

```
0          Often: 1-2 days per week or more
1                                           NaN
2                                           NaN
3  Occasionally: 1-2 days per quarter but less th...
4                                           NaN
...
```

64456	NaN
64457	NaN
64458	NaN
64459	NaN
64460	NaN

Name: NEWOvertime, Length: 64306, dtype: object

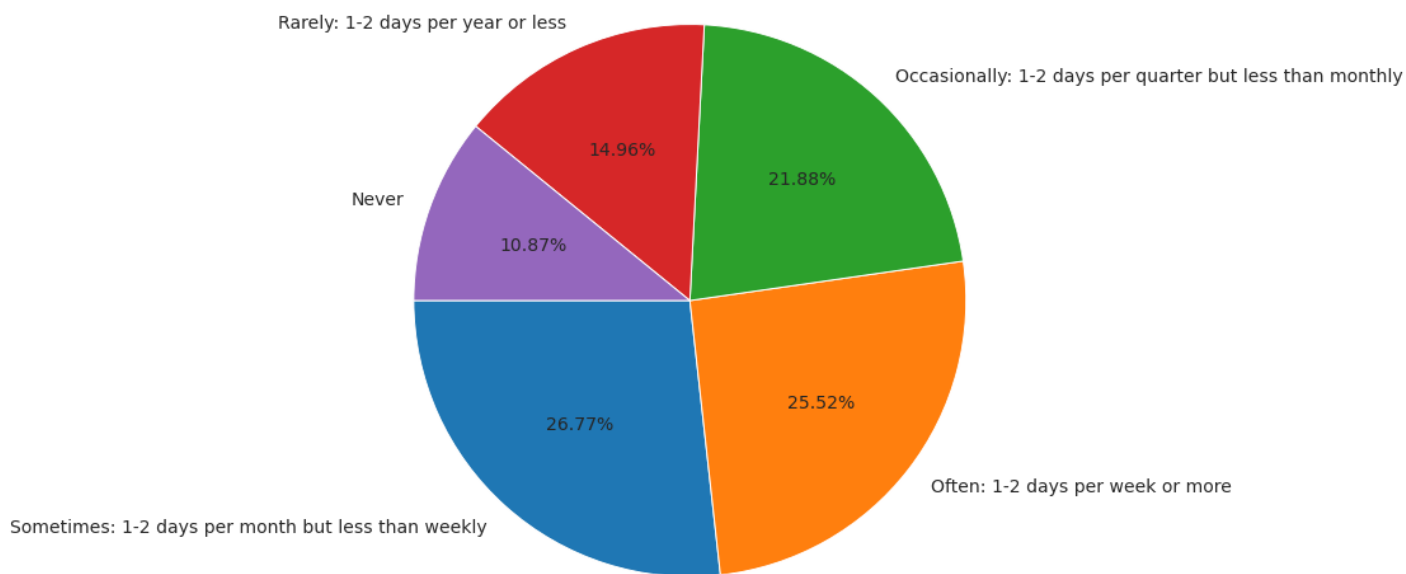
```
overtime_results=survey_df.NEWOvertime.value_counts()
overtime_results
```

Sometimes: 1-2 days per month but less than weekly	11476
Often: 1-2 days per week or more	10941
Occasionally: 1-2 days per quarter but less than monthly	9383
Rarely: 1-2 days per year or less	6414
Never	4662

Name: NEWOvertime, dtype: int64

```
plt.figure(figsize=(15,10))
plt.title(schema.NEWOvertime)
plt.pie(overtime_results,labels=overtime_results.index, autopct='%0.2f%%', startangle=180)
```

How often do you work overtime or beyond the formal time expectation of your job?



The data suggests that only few percent of people are opting for overtimes.

```
schema.NEWEdImpt
```

'How important is a formal education, such as a university degree in computer science, to your career?'

```
survey_df.NEWEdImpt
```

0	Fairly important
1	Fairly important

```

2                                NaN
3    Not at all important/not necessary
4                                Very important
...
64456                            Very important
64457                                NaN
64458                                NaN
64459                                NaN
64460                            Critically important
Name: NEWEdImpt, Length: 64306, dtype: object

```

```

NEWEdImpt_count=survey_df.NEWEdImpt.value_counts()
NEWEdImpt_count

```

```

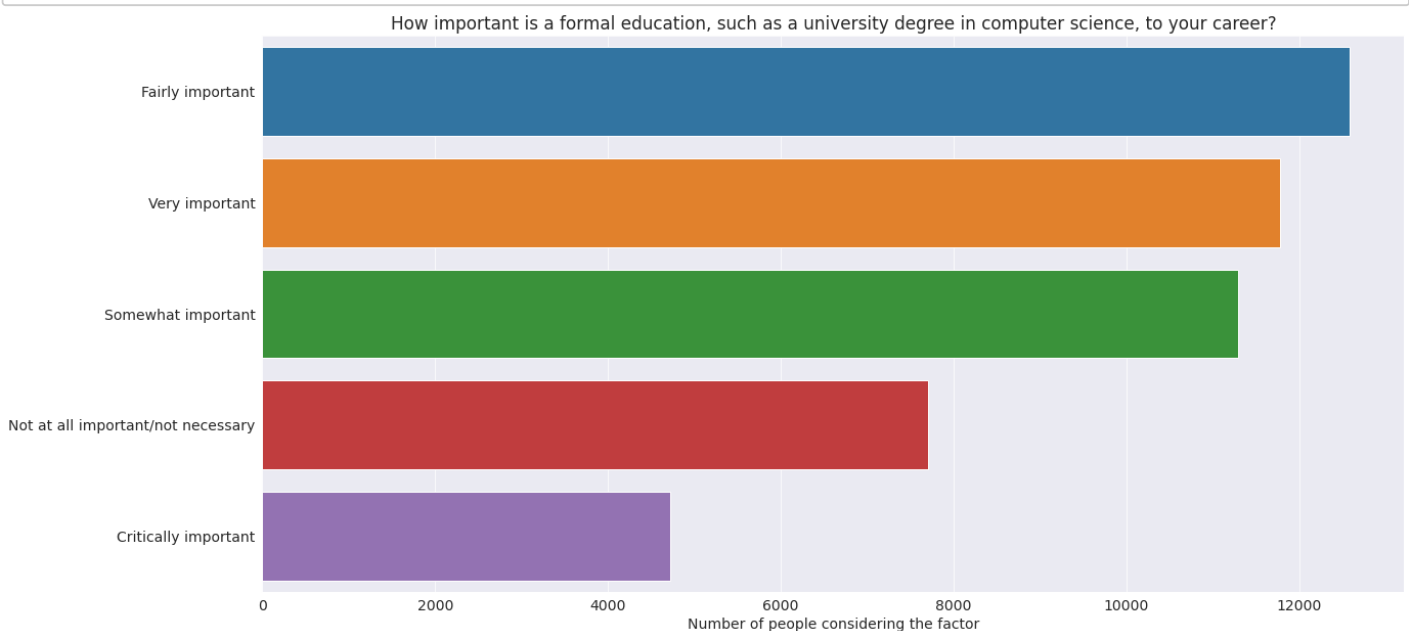
Fairly important                12588
Very important                  11783
Somewhat important              11298
Not at all important/not necessary  7707
Critically important             4716
Name: NEWEdImpt, dtype: int64

```

```

plt.figure(figsize=(20,10));
sns.barplot(x=NEWEdImpt_count, y=NEWEdImpt_count.index)
plt.title(schema.NEWEdImpt)
plt.ylabel(None);
plt.xlabel('Number of people considering the factor');

```



Using the above plot the trend could be easily analyzed.

Let's save and upload our work before continuing.

```
import jovian
```

```
jovian.commit()
```

```
[jovian] Updating notebook "abhishekbittu279/eda-stackoverflow-survey-project" on
https://jovian.com
[jovian] Committed successfully! https://jovian.com/abhishekbittu279/eda-stackoverflow-
survey-project
'https://jovian.com/abhishekbittu279/eda-stackoverflow-survey-project'
```

Asking and Answering Questions

Q: In which countries do developers work the highest number of hours per week?
Consider countries with more than 250 responses only.

To answer this question, we'll need to use the `groupby` data frame method to aggregate the rows for each country. We'll also need to filter the results to only include the countries with more than 250 respondents.

```
countries_df = survey_df.groupby('Country')[['WorkWeekHrs']].mean().sort_values('WorkWeekHrs', ascending=False)
```

```
countries_df
```

WorkWeekHrs	
Country	
Kuwait	58.222222
Iraq	52.153846
Grenada	50.000000
Maldives	47.300000
Afghanistan	46.500000
...	...
North Korea	NaN
Saint Lucia	NaN
Sierra Leone	NaN
Solomon Islands	NaN
Timor-Leste	NaN

183 rows × 1 columns

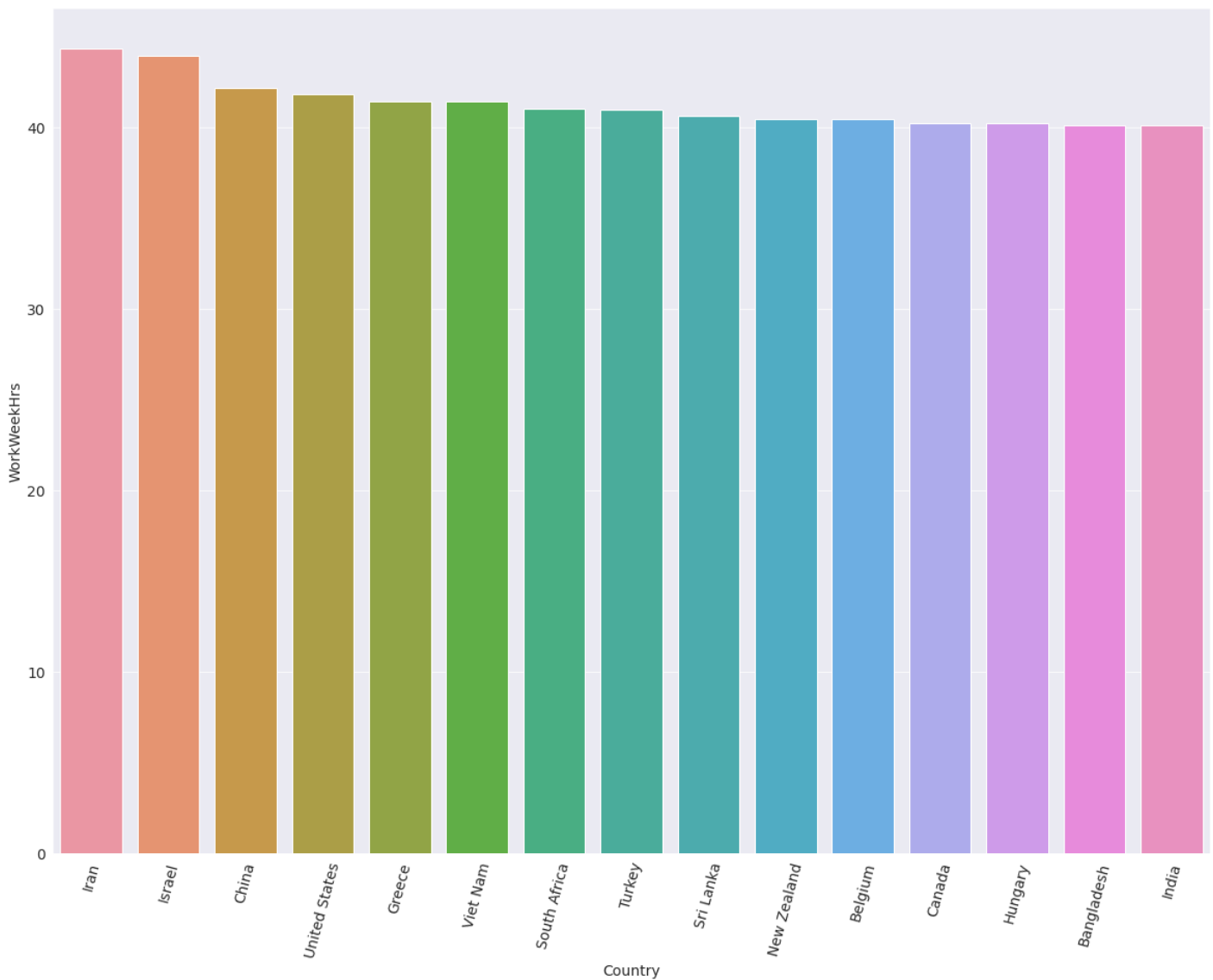
```
high_response_countries_df = countries_df.loc[survey_df.Country.value_counts() > 250].h
```

```
high_response_countries_df
```

WorkWeekHrs	
Country	
Iran	44.337748
Israel	43.915094
China	42.150000

	WorkWeekHrs
Country	
United States	41.802982
Greece	41.402724
Viet Nam	41.391667
South Africa	41.023460
Turkey	40.982143
Sri Lanka	40.612245
New Zealand	40.457551
Belgium	40.444444
Canada	40.208837
Hungary	40.194340
Bangladesh	40.097458
India	40.090603

```
plt.figure(figsize=(20,15));
plt.xticks(rotation=75)
sns.barplot(x=high_response_countries_df.index, y=high_response_countries_df.    WorkWee
<AxesSubplot:xlabel='Country', ylabel='WorkWeekHrs'>
```



The Asian countries like Iran, China, and Israel have the highest working hours, followed by the United States. However, there isn't too much variation overall, and the average working hours seem to be around 40 hours per week.

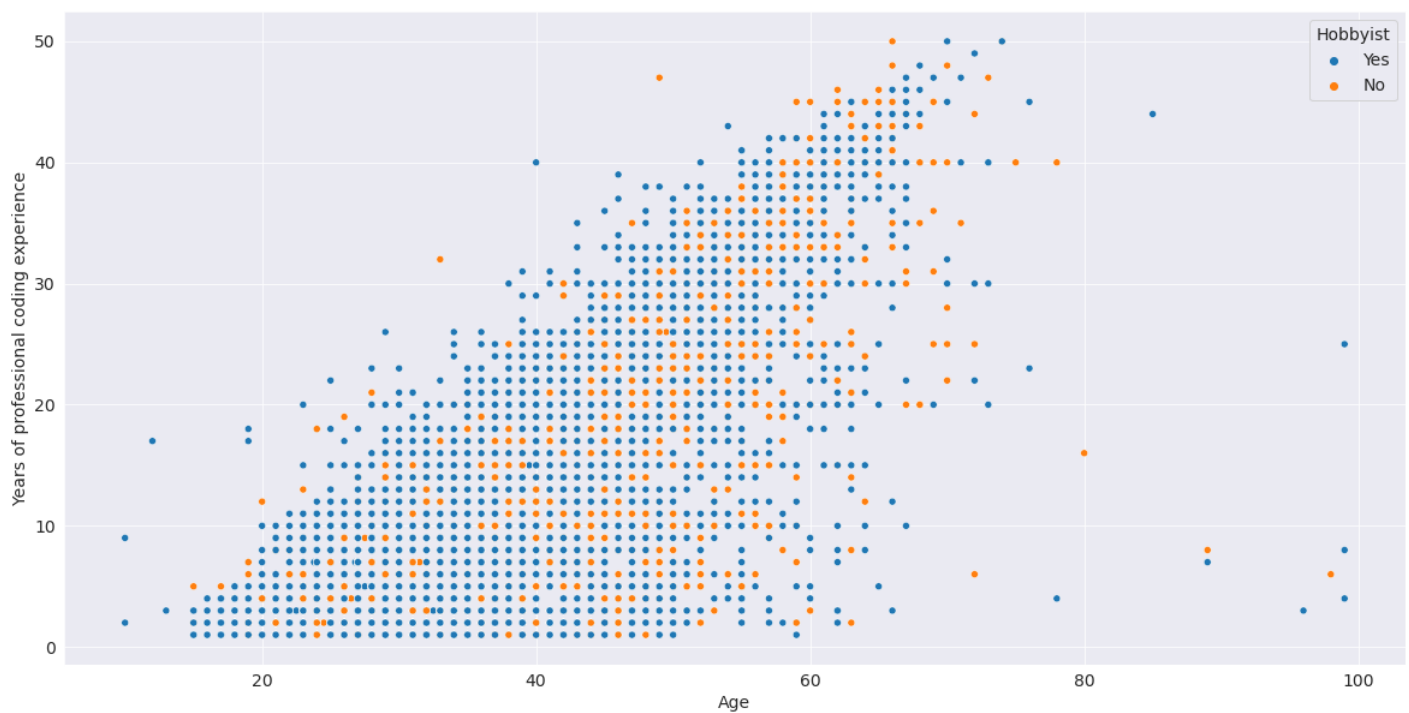
Q: How important is it to start young to build a career in programming?

Let's create a scatter plot of Age vs. YearsCodePro (i.e., years of coding experience) to answer this question.

```
schema.YearsCodePro
```

'NOT including education, how many years have you coded professionally (as a part of your work)?'

```
plt.figure(figsize=(20,10));  
sns.scatterplot(x='Age', y='YearsCodePro', hue='Hobbyist', data=survey_df)  
plt.xlabel("Age")  
plt.ylabel("Years of professional coding experience");
```



We can see points all over the graph, which indicates that one can **start programming professionally at any age**. Many people who have been coding for several decades professionally also seem to enjoy it as a hobby.

We can also view the distribution of the `Age1stCode` column to see when the respondents tried programming for the first time.

```
plt.figure(figsize=(20,10));
plt.title(schema.Age1stCode)
sns.histplot(x=survey_df.Age1stCode, bins=30, kde=True);
```



As we might expect, most people seem to have had some exposure to programming before the age of 40. However, but there are people of all ages and walks of life learning to code.

We've already gained several insights about the respondents and the programming community by exploring individual columns of the dataset. Let's discuss the most important question of this EDA i.e about the

languages most used and languages people are most interested in.

Q: What are the most popular programming languages in 2020?

To answer, this we can use the `LanguageWorkedWith` column. Similar to `DevType`, respondents were allowed to choose multiple options here.

```
schema.LanguageWorkedWith
```

'Which programming, scripting, and markup languages have you done extensive development work in over the past year, and which do you want to work in over the next year? (If you both worked with the language and want to continue to do so, please check both boxes in that row.)'

```
schema.LanguageDesireNextYear
```

'Which programming, scripting, and markup languages have you done extensive development work in over the past year, and which do you want to work in over the next year? (If you both worked with the language and want to continue to do so, please check both boxes in that row.)'

```
survey_df.LanguageWorkedWith
```

```
0          C#;HTML/CSS;JavaScript
1          JavaScript;Swift
2      Objective-C;Python;Swift
3                          NaN
4          HTML/CSS;Ruby;SQL
...
64456                          NaN
64457  Assembly;Bash/Shell/PowerShell;C;C#;C++;Dart;G...
64458                          NaN
64459          HTML/CSS
64460      C#;HTML/CSS;Java;JavaScript;SQL
Name: LanguageWorkedWith, Length: 64306, dtype: object
```

First, we'll split this column into a data frame containing a column of each language listed in the options.

```
languages_worked_df = split_multicolumn(survey_df.LanguageWorkedWith)
```

```
languages_worked_df
```

	C#	HTML/CSS	JavaScript	Swift	Objective-C	Python	Ruby	SQL	Java	PHP	...	VBA	Perl	Scala
0	True	True	True	False	False	False	False	False	False	False	...	False	False	False
1	False	False	True	True	False	False	False	False	False	False	...	False	False	False
2	False	False	False	True	True	True	False	False	False	False	...	False	False	False
3	False	False	False	False	False	False	False	False	False	False	...	False	False	False
4	False	True	False	False	False	False	True	True	False	False	...	False	False	False

	C#	HTML/CSS	JavaScript	Swift	Objective-C	Python	Ruby	SQL	Java	PHP	...	VBA	Perl	Scala
...
64456	False	False	False	False	False	False	False	False	False	False	...	False	False	False
64457	True	True	True	True	True	True	True	True	True	True	...	True	True	True
64458	False	False	False	False	False	False	False	False	False	False	...	False	False	False
64459	False	True	False	False	False	False	False	False	False	False	...	False	False	False
64460	True	True	True	False	False	False	False	True	True	False	...	False	False	False

64306 rows × 25 columns

It appears that a total of 25 languages were included among the options. Let's aggregate these to identify the percentage of respondents who selected each language.

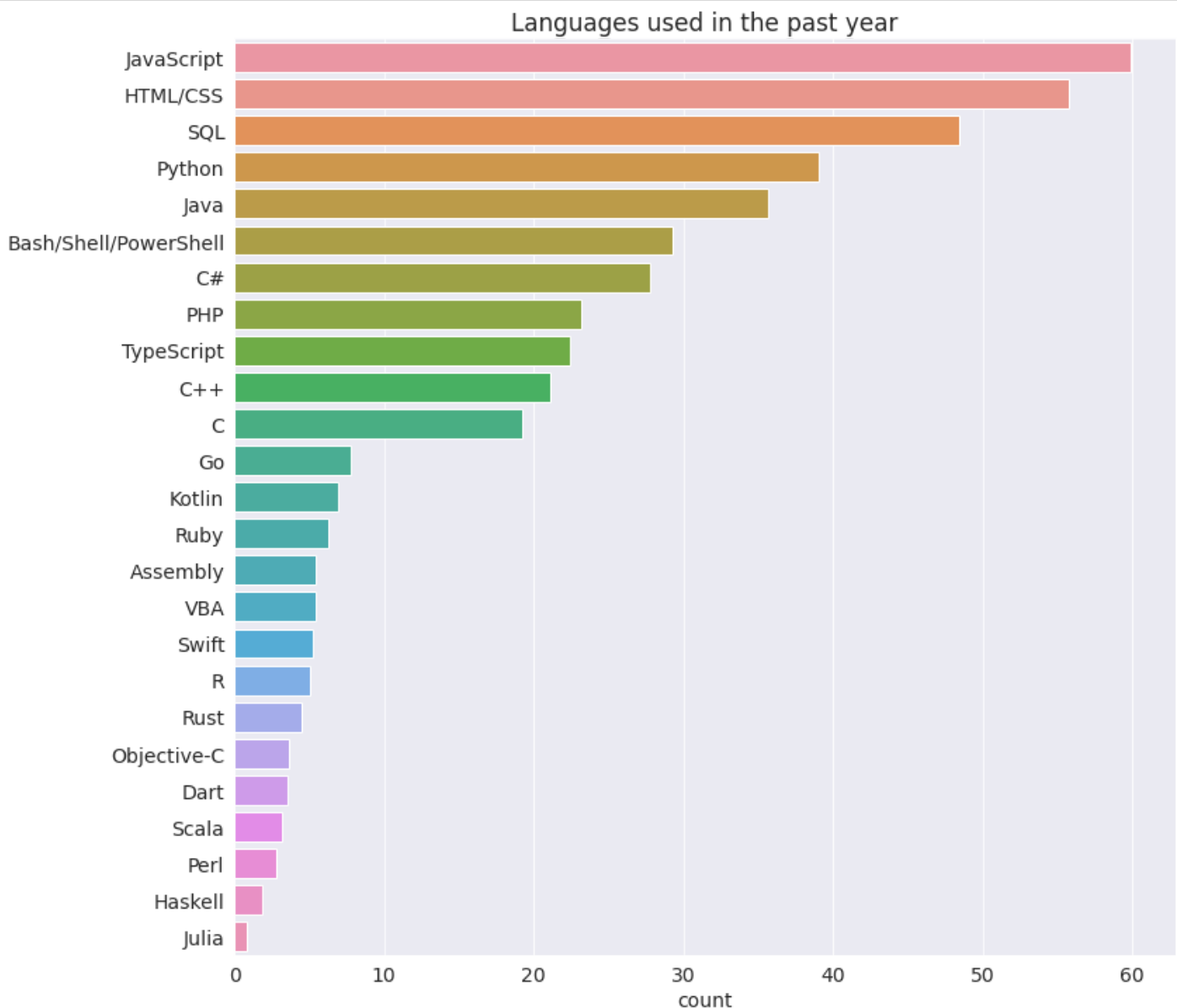
```
languages_worked_percentages = languages_worked_df.mean().sort_values(ascending=False)
languages_worked_percentages
```

```
JavaScript          59.893323
HTML/CSS           55.801947
SQL                 48.444935
Python              39.001026
Java                35.618760
Bash/Shell/PowerShell 29.239884
C#                  27.803004
PHP                 23.130035
TypeScript          22.461357
C++                 21.114670
C                   19.236152
Go                  7.758219
Kotlin              6.887382
Ruby                6.229590
Assembly            5.447392
VBA                  5.394520
Swift               5.226573
R                   5.064846
Rust                4.498803
Objective-C         3.603085
Dart                3.517557
Scala               3.150561
Perl                2.757130
Haskell             1.861413
Julia               0.782198
dtype: float64
```

We can plot this information using a horizontal bar chart.

```
plt.figure(figsize=(12, 12))
sns.barplot(x=languages_worked_percentages, y=languages_worked_percentages.index)
```

```
plt.title("Languages used in the past year");
plt.xlabel('count');
```



Perhaps unsurprisingly, Javascript & HTML/CSS comes out at the top as web development is one of today's most sought skills. It also happens to be one of the easiest to get started. SQL is necessary for working with relational databases, so it's no surprise that most programmers work with SQL regularly. Python seems to be the popular choice for other forms of development, beating out Java, which was the industry standard for server & application development for over two decades.

Q: Which languages are the most people interested to learn over the next year?

For this, we can use the `LanguageDesireNextYear` column, with similar processing as the previous one.

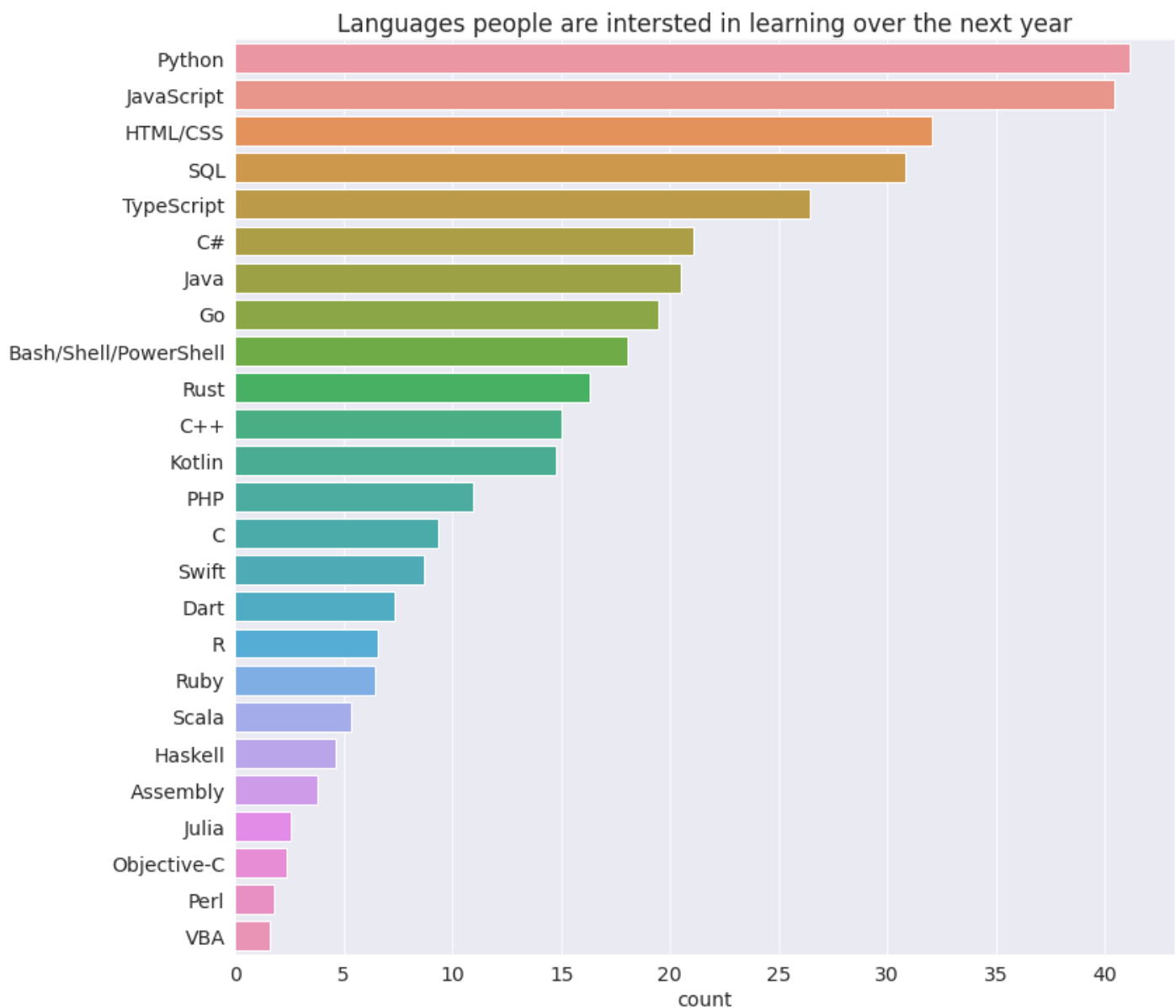
```
languages_interested_df = split_multicolumn(survey_df.LanguageDesireNextYear)
languages_interested_percentages = languages_interested_df.mean().sort_values(ascending
languages_interested_percentages
```

Python	41.143906
JavaScript	40.425466
HTML/CSS	32.028116
SQL	30.799614

TypeScript	26.451653
C#	21.058688
Java	20.464653
Go	19.432090
Bash/Shell/PowerShell	18.057413
Rust	16.270643
C++	15.014151
Kotlin	14.760676
PHP	10.947657
C	9.359935
Swift	8.692812
Dart	7.308805
R	6.571704
Ruby	6.425528
Scala	5.326097
Haskell	4.593662
Assembly	3.766367
Julia	2.540976
Objective-C	2.338818
Perl	1.761888
VBA	1.611047

dtype: float64

```
plt.figure(figsize=(12, 12))
sns.barplot(x=languages_interested_percentages, y=languages_interested_percentages.index)
plt.title("Languages people are intersted in learning over the next year");
plt.xlabel('count');
```



Once again, it's not surprising that Python is the language most people are interested in learning - since it is an easy-to-learn general-purpose programming language well suited for a variety of domains: application development, numerical computing, data analysis, machine learning, big data, cloud automation, web scraping, scripting, etc.

Q: Which are the most loved languages, i.e., a high percentage of people who have used the language want to continue learning & using it over the next year?

We will solve using Pandas array operations. The steps to be followed are:

- Create a new data frame `languages_loved_df` that contains a True value for a language only if the corresponding values in `languages_worked_df` and `languages_interested_df` are both True
- Take the column-wise sum of `languages_loved_df` and divide it by the column-wise sum of `languages_worked_df` to get the percentage of respondents who "love" the language
- Sort the results in decreasing order and plot a horizontal bar graph

&- And bitwise Operator.

```
languages_loved_df = languages_worked_df & languages_interested_df
```

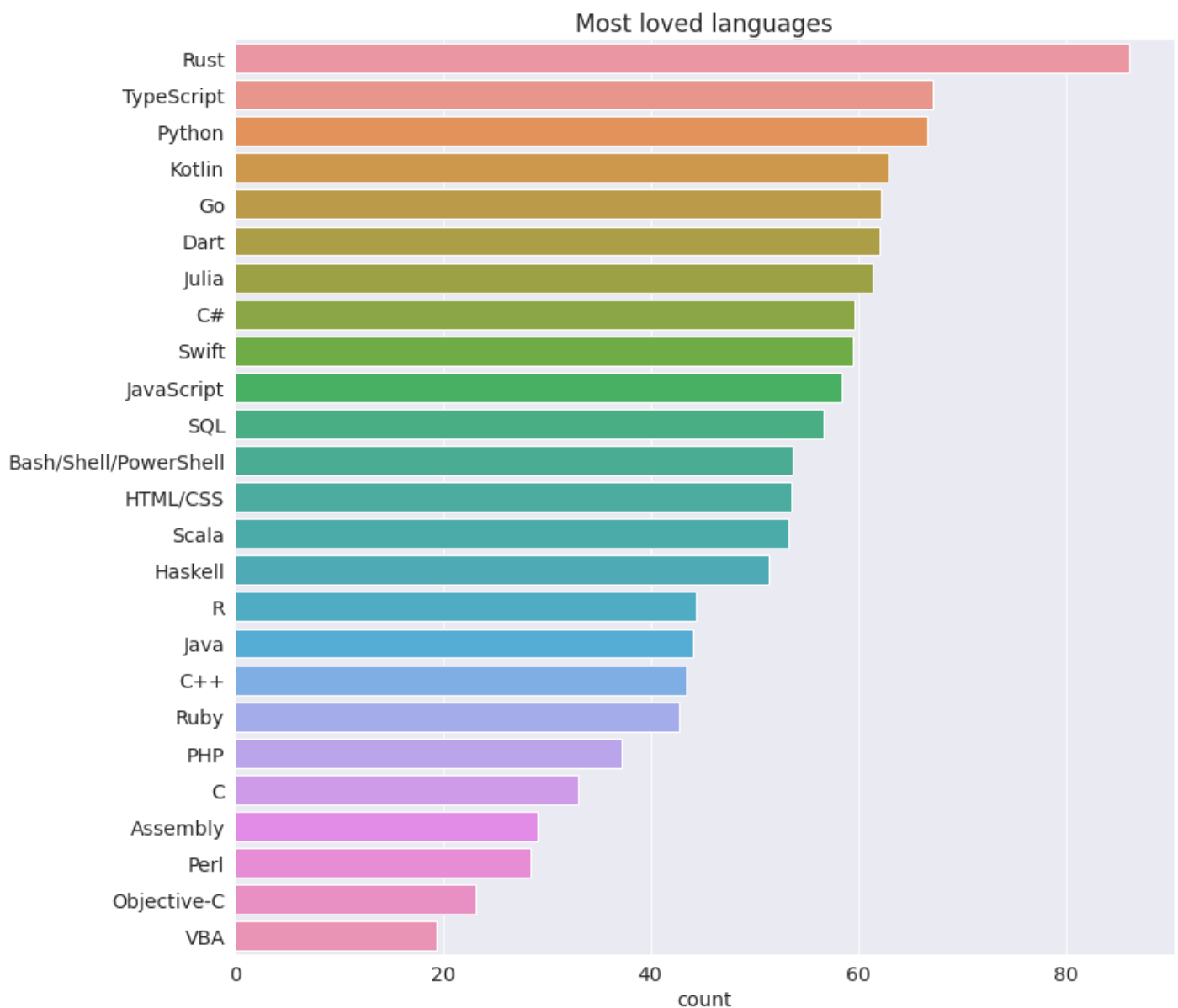
```
languages_loved_df
```

	Assembly	Bash/Shell/PowerShell	C	C#	C++	Dart	Go	HTML/CSS	Haskell	Java	...	Perl	Py
0	False	False	False	True	False	False	False	True	False	False	...	False	
1	False	False	False	False	False	False	False	False	False	False	...	False	
2	False	False	False	False	False	False	False	False	False	False	...	False	
3	False	False	False	False	False	False	False	False	False	False	...	False	
4	False	False	False	False	False	False	False	False	False	False	...	False	
...
64456	False	False	False	False	False	False	False	False	False	False	...	False	
64457	True	True	True	True	True	True	True	True	True	True	...	True	
64458	False	False	False	False	False	False	False	False	False	False	...	False	
64459	False	False	False	False	False	False	False	True	False	False	...	False	
64460	False	False	False	True	False	False	False	True	False	True	...	False	

64306 rows × 25 columns

```
languages_loved_percentages = (languages_loved_df.sum() * 100 / languages_worked_df.sum()
```

```
plt.figure(figsize=(12, 12))
sns.barplot(x=languages_loved_percentages, y=languages_loved_percentages.index)
plt.title("Most loved languages");
plt.xlabel('count');
```



Rust seems to be StackOverflow's most-loved language for the year 2020. The second most-loved language is TypeScript, a popular alternative to JavaScript for web development.

Python features at number 3, despite already being one of the most widely-used languages in the world. Python has a solid foundation, is easy to learn & use, has a large ecosystem of domain-specific libraries, and a massive worldwide community.

Inferences and Conclusions

We've drawn many inferences from the survey. Here's a summary of a few of them:

- Based on the survey respondents' demographics, we can infer that the survey is somewhat representative of the overall programming community. However, it has fewer responses from programmers in non-English-speaking countries and women & non-binary genders.
- The programming community is not as diverse as it can be. Although things are improving, we should make more efforts to support & encourage underrepresented communities, whether in terms of age, country, race, gender, or otherwise.
- Although most programmers hold a college degree, a reasonably large percentage did not have computer science as their college major. Hence, a computer science degree isn't compulsory for learning to code or building a career in programming.

- A significant percentage of programmers either work part-time or as freelancers, which can be a great way to break into the field, especially when you're just getting started.
- Javascript & HTML/CSS are the most used programming languages in 2020, closely followed by SQL & Python.
- Python is the language most people are interested in learning - since it is an easy-to-learn general-purpose programming language well suited for various domains.
- Rust and TypeScript are the most "loved" languages in 2020, both of which have small but fast-growing communities. Python is a close third, despite already being a widely used language.
- Programmers worldwide seem to be working for around 40 hours a week on average, with slight variations by country.
- We can learn and start programming professionally at any age. We're likely to have a long and fulfilling career if we enjoy programming as a hobby.

References

- Stack Overflow Developer Survey: <https://insights.stackoverflow.com/survey>.
- Pandas user guide: https://pandas.pydata.org/docs/user_guide/index.html
- Matplotlib user guide: <https://matplotlib.org/3.3.1/users/index.html>
- Seaborn user guide & tutorial: <https://seaborn.pydata.org/tutorial.html>
- opendatasets Python library: <https://github.com/JovianML/opendatasets>

```
import jovian
```

```
jovian.commit()
```

```
[jovian] Updating notebook "abhishekbittu279/eda-stackoverflow-survey-project" on  
https://jovian.com
```

```
[jovian] Committed successfully! https://jovian.com/abhishekbittu279/eda-stackoverflow-survey-project
```

```
'https://jovian.com/abhishekbittu279/eda-stackoverflow-survey-project'
```