Skills Network

Data Visualization

Estimated time needed: **45** minutes

In this lab, you will focus on data visualization. The dataset will be provided through an RDBMS, and you will need to use SQL queries to extract the required data.

Objectives

After completing this lab, you will be able to:

- Visualize the distribution of data.
- Visualize the relationship between two features.
- Visualize composition and comparison of data.

Demo: How to work with database

Download the database file.

In [15]:

```
!wget https://cf-courses-data.s3.us.cloud-object-storage.appdomain.cloud/n01PQ9pSmiRX6520flujwQ/sur
```

```
--2025-06-18 14:18:30--  https://cf-courses-data.s3.us.cloud-object-storage.appdomain.cloud/n01PQ9pS
miRX6520flujwQ/survey-data.csv
Resolving cf-courses-data.s3.us.cloud-object-storage.appdomain.cloud (cf-courses-data.s3.us.cloud-ob
ject-storage.appdomain.cloud)... 169.63.118.104
Connecting to cf-courses-data.s3.us.cloud-object-storage.appdomain.cloud (cf-courses-data.s3.us.clou
d-object-storage.appdomain.cloud)|169.63.118.104|:443... connected.
200 OKequest sent, awaiting response...
Length: 159525875 (152M) [text/csv]
Saving to: ‘survey-data.csv.4’

survey-data.csv.4   100%[===================>] 152.13M  53.5MB/s    in 2.8s

2025-06-18 14:18:35 (53.5 MB/s) - ‘survey-data.csv.4’ saved [159525875/159525875]
```

Install and Import Necessary Python Libraries

Ensure that you have the required libraries installed to work with SQLite and Pandas:

In [16]:

```
!pip install pandas
!pip install matplotlib

import pandas as pd
import matplotlib.pyplot as plt
```

```
Requirement already satisfied: pandas in /opt/conda/lib/python3.12/site-packages (2.3.0)
Requirement already satisfied: numpy>=1.26.0 in /opt/conda/lib/python3.12/site-packages (from panda
s) (2.3.0)
Requirement already satisfied: python-dateutil>=2.8.2 in /opt/conda/lib/python3.12/site-packages (fr
om pandas) (2.9.0.post0)
Requirement already satisfied: pytz>=2020.1 in /opt/conda/lib/python3.12/site-packages (from pandas)
(2024.2)
Requirement already satisfied: tzdata>=2022.7 in /opt/conda/lib/python3.12/site-packages (from panda
s) (2025.2)
Requirement already satisfied: six>=1.5 in /opt/conda/lib/python3.12/site-packages (from python-date
util>=2.8.2->pandas) (1.17.0)
Requirement already satisfied: matplotlib in /opt/conda/lib/python3.12/site-packages (3.10.3)
Requirement already satisfied: contourpy>=1.0.1 in /opt/conda/lib/python3.12/site-packages (from mat
plotlib) (1.3.2)
Requirement already satisfied: cycler>=0.10 in /opt/conda/lib/python3.12/site-packages (from matplot
lib) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /opt/conda/lib/python3.12/site-packages (from ma
tplotlib) (4.58.4)
Requirement already satisfied: kiwisolver>=1.3.1 in /opt/conda/lib/python3.12/site-packages (from ma
tplotlib) (1.4.8)
Requirement already satisfied: numpy>=1.23 in /opt/conda/lib/python3.12/site-packages (from matplotl
ib) (2.3.0)
Requirement already satisfied: packaging>=20.0 in /opt/conda/lib/python3.12/site-packages (from matp
lotlib) (24.2)
Requirement already satisfied: pillow>=8 in /opt/conda/lib/python3.12/site-packages (from matplotli
b) (11.2.1)
Requirement already satisfied: pyparsing>=2.3.1 in /opt/conda/lib/python3.12/site-packages (from mat
plotlib) (3.2.3)
Requirement already satisfied: python-dateutil>=2.7 in /opt/conda/lib/python3.12/site-packages (from
matplotlib) (2.9.0.post0)
Requirement already satisfied: six>=1.5 in /opt/conda/lib/python3.12/site-packages (from python-date
util>=2.7->matplotlib) (1.17.0)
```

In [30]:

```
!pip install seaborn
!pip install numpy
import seaborn as sns
import numpy as np
```

```
Requirement already satisfied: seaborn in /opt/conda/lib/python3.12/site-packages (0.13.2)
Requirement already satisfied: numpy!=1.24.0,>=1.20 in /opt/conda/lib/python3.12/site-packages (from
seaborn) (2.3.0)
Requirement already satisfied: pandas>=1.2 in /opt/conda/lib/python3.12/site-packages (from seaborn)
(2.3.0)
Requirement already satisfied: matplotlib!=3.6.1,>=3.4 in /opt/conda/lib/python3.12/site-packages (f
rom seaborn) (3.10.3)
Requirement already satisfied: contourpy>=1.0.1 in /opt/conda/lib/python3.12/site-packages (from mat
plotlib!=3.6.1,>=3.4->seaborn) (1.3.2)
Requirement already satisfied: cycler>=0.10 in /opt/conda/lib/python3.12/site-packages (from matplot
lib!=3.6.1,>=3.4->seaborn) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /opt/conda/lib/python3.12/site-packages (from ma
tplotlib!=3.6.1,>=3.4->seaborn) (4.58.4)
Requirement already satisfied: kiwisolver>=1.3.1 in /opt/conda/lib/python3.12/site-packages (from ma
tplotlib!=3.6.1,>=3.4->seaborn) (1.4.8)
Requirement already satisfied: packaging>=20.0 in /opt/conda/lib/python3.12/site-packages (from matp
lotlib!=3.6.1,>=3.4->seaborn) (24.2)
Requirement already satisfied: pillow>=8 in /opt/conda/lib/python3.12/site-packages (from matplotli
b!=3.6.1,>=3.4->seaborn) (11.2.1)
Requirement already satisfied: pyparsing>=2.3.1 in /opt/conda/lib/python3.12/site-packages (from mat
plotlib!=3.6.1,>=3.4->seaborn) (3.2.3)
Requirement already satisfied: python-dateutil>=2.7 in /opt/conda/lib/python3.12/site-packages (from
matplotlib!=3.6.1,>=3.4->seaborn) (2.9.0.post0)
Requirement already satisfied: pytz>=2020.1 in /opt/conda/lib/python3.12/site-packages (from pandas>
=1.2->seaborn) (2024.2)
Requirement already satisfied: tzdata>=2022.7 in /opt/conda/lib/python3.12/site-packages (from panda
s>=1.2->seaborn) (2025.2)
Requirement already satisfied: six>=1.5 in /opt/conda/lib/python3.12/site-packages (from python-date
util>=2.7->matplotlib!=3.6.1,>=3.4->seaborn) (1.17.0)
Requirement already satisfied: numpy in /opt/conda/lib/python3.12/site-packages (2.3.0)
```

Read the CSV File into a Pandas DataFrame

Load the Stack Overflow survey data into a Pandas DataFrame:

In [31]:

```
# Read the CSV file
df = pd.read_csv('survey-data.csv')
```

```
# Display the first few rows of the data
df.head()
```

Out[31]:

	ResponseId	MainBranch	Age	Employment	RemoteWork	Check	CodingActivities	EdLevel	
0	1	I am a developer by profession	Under 18 years old	Employed, full-time	Remote	Apples	Hobby	Primary/elementary school	E
1	2	I am a developer by profession	35-44 years old	Employed, full-time	Remote	Apples	Hobby;Contribute to open-source projects;Other...	Bachelor’s degree (B.A., B.S., B.Eng., etc.)	E medi
2	3	I am a developer by profession	45-54 years old	Employed, full-time	Remote	Apples	Hobby;Contribute to open-source projects;Other...	Master’s degree (M.A., M.S., M.Eng., MBA, etc.)	E medi
3	4	I am learning to code	18-24 years old	Student, full-time	NaN	Apples	NaN	Some college/university study without earning ...	vi
4	5	I am a developer by profession	18-24 years old	Student, full-time	NaN	Apples	NaN	Secondary school (e.g. American high school, G...	vi

5 rows × 114 columns

Create a SQLite Database and Insert the Data

Now, let's create a new SQLite database (`survey-data.sqlite`) and insert the data from the DataFrame into a table using the sqlite3 library:

In [19]:

```
import sqlite3

# Create a connection to the SQLite database
conn = sqlite3.connect('survey-data.sqlite')

# Write the dataframe to the SQLite database
df.to_sql('main', conn, if_exists='replace', index=False)


# Close the connection
conn.close()
```

Verify the Data in the SQLite Database Verify that the data has been correctly inserted into the SQLite database by running a simple query:

In [20]:

```
# Reconnect to the SQLite database
conn = sqlite3.connect('survey-data.sqlite')

# Run a simple query to check the data
QUERY = "SELECT * FROM main LIMIT 5"
df_check = pd.read_sql_query(QUERY, conn)

# Display the results
print(df_check)
```

```
   ResponseId                      MainBranch                 Age  \
0           1  I am a developer by profession  Under 18 years old
1           2  I am a developer by profession     35-44 years old
2           3  I am a developer by profession     45-54 years old
3           4               I am learning to code     18-24 years old
4           5  I am a developer by profession     18-24 years old

            Employment RemoteWork   Check  \
0  Employed, full-time     Remote  Apples
1  Employed, full-time     Remote  Apples
2  Employed, full-time     Remote  Apples
3   Student, full-time       None  Apples
4   Student, full-time       None  Apples

                                    CodingActivities  \
0                                              Hobby
1  Hobby;Contribute to open-source projects;Other...
2  Hobby;Contribute to open-source projects;Other...
3                                               None
4                                               None

                                             EdLevel  \
0                          Primary/elementary school
1       Bachelor’s degree (B.A., B.S., B.Eng., etc.)
2    Master’s degree (M.A., M.S., M.Eng., MBA, etc.)
3  Some college/university study without earning ...
4  Secondary school (e.g. American high school, G...

                                           LearnCode  \
0                             Books / Physical media
1  Books / Physical media;Colleague;On the job tr...
2  Books / Physical media;Colleague;On the job tr...
3  Other online resources (e.g., videos, blogs, f...
4  Other online resources (e.g., videos, blogs, f...

                                      LearnCodeOnline  ... JobSatPoints_6  \
0                                                None  ...            NaN
1  Technical documentation;Blogs;Books;Written Tu...  ...            0.0
2  Technical documentation;Blogs;Books;Written Tu...  ...            NaN
3  Stack Overflow;How-to videos;Interactive tutorial  ...            NaN
4  Technical documentation;Blogs;Written Tutorial...  ...            NaN

  JobSatPoints_7 JobSatPoints_8 JobSatPoints_9 JobSatPoints_10  \
0            NaN            NaN            NaN             NaN
1            0.0            0.0            0.0             0.0
2            NaN            NaN            NaN             NaN
3            NaN            NaN            NaN             NaN
4            NaN            NaN            NaN             NaN

  JobSatPoints_11           SurveyLength SurveyEase ConvertedCompYearly JobSat
0             NaN                   None       None                None   None
1             0.0                   None       None                None   None
2             NaN  Appropriate in length       Easy                None   None
3             NaN               Too long       Easy                None   None
4             NaN              Too short       Easy                None   None

[5 rows x 114 columns]
```

Demo: Running an SQL Query

Count the number of rows in the table named 'main'

In [21]:

```
QUERY = """
SELECT COUNT(*)
FROM main
"""
df = pd.read_sql_query(QUERY, conn)
df.head()
```

Out[21]:

	COUNT(*)
0	65437

Demo: Listing All Tables

To view the names of all tables in the database:

In [22]:

```
QUERY = """
SELECT name as Table_Name FROM sqlite_master
WHERE type = 'table'
"""
pd.read_sql_query(QUERY, conn)
```

Out[22]:

	Table_Name
0	main

Demo: Running a Group By Query

For example, you can group data by a specific column, like Age, to get the count of respondents in each age group:

In [23]:

```
QUERY = """
SELECT Age, COUNT(*) as count
FROM main
GROUP BY Age
ORDER BY Age
"""
pd.read_sql_query(QUERY, conn)
```

Out[23]:

	Age	count
0	18-24 years old	14098
1	25-34 years old	23911
2	35-44 years old	14942
3	45-54 years old	6249
4	55-64 years old	2575
5	65 years or older	772
6	Prefer not to say	322
7	Under 18 years old	2568

Demo: Describing a table

Use this query to get the schema of a specific table, main in this case:

In [24]:

```
table_name = 'main'

QUERY = """
SELECT sql FROM sqlite_master
WHERE name= '{}'
""".format(table_name)

df = pd.read_sql_query(QUERY, conn)
print(df.iat[0,0])
```

```
CREATE TABLE "main" (
"ResponseId" INTEGER,
  "MainBranch" TEXT,
  "Age" TEXT,
  "Employment" TEXT,
  "RemoteWork" TEXT,
  "Check" TEXT,
  "CodingActivities" TEXT,
  "EdLevel" TEXT,
  "LearnCode" TEXT,
  "LearnCodeOnline" TEXT,
  "TechDoc" TEXT,
  "YearsCode" TEXT,
  "YearsCodePro" TEXT,
  "DevType" TEXT,
  "OrgSize" TEXT,
  "PurchaseInfluence" TEXT,
  "BuyNewTool" TEXT,
  "BuildvsBuy" TEXT,
  "TechEndorse" TEXT,
  "Country" TEXT,
  "Currency" TEXT,
  "CompTotal" REAL,
  "LanguageHaveWorkedWith" TEXT,
  "LanguageWantToWorkWith" TEXT,
  "LanguageAdmired" TEXT,
  "DatabaseHaveWorkedWith" TEXT,
  "DatabaseWantToWorkWith" TEXT,
  "DatabaseAdmired" TEXT,
  "PlatformHaveWorkedWith" TEXT,
  "PlatformWantToWorkWith" TEXT,
  "PlatformAdmired" TEXT,
  "WebframeHaveWorkedWith" TEXT,
  "WebframeWantToWorkWith" TEXT,
  "WebframeAdmired" TEXT,
  "EmbeddedHaveWorkedWith" TEXT,
  "EmbeddedWantToWorkWith" TEXT,
  "EmbeddedAdmired" TEXT,
  "MiscTechHaveWorkedWith" TEXT,
  "MiscTechWantToWorkWith" TEXT,
  "MiscTechAdmired" TEXT,
  "ToolsTechHaveWorkedWith" TEXT,
  "ToolsTechWantToWorkWith" TEXT,
  "ToolsTechAdmired" TEXT,
  "NEWCollabToolsHaveWorkedWith" TEXT,
  "NEWCollabToolsWantToWorkWith" TEXT,
  "NEWCollabToolsAdmired" TEXT,
  "OpSysPersonal use" TEXT,
  "OpSysProfessional use" TEXT,
  "OfficeStackAsyncHaveWorkedWith" TEXT,
  "OfficeStackAsyncWantToWorkWith" TEXT,
  "OfficeStackAsyncAdmired" TEXT,
  "OfficeStackSyncHaveWorkedWith" TEXT,
  "OfficeStackSyncWantToWorkWith" TEXT,
  "OfficeStackSyncAdmired" TEXT,
  "AISearchDevHaveWorkedWith" TEXT,
  "AISearchDevWantToWorkWith" TEXT,
  "AISearchDevAdmired" TEXT,
  "NEWSOSites" TEXT,
  "SOVisitFreq" TEXT,
  "SOAccount" TEXT,
  "SOPartFreq" TEXT,
  "SOHow" TEXT,
  "SOComm" TEXT,
  "AISelect" TEXT,
  "AISent" TEXT,
  "AIBen" TEXT,
  "AIAcc" TEXT,
  "AIComplex" TEXT,
  "AIToolCurrently Using" TEXT,
  "AIToolInterested in Using" TEXT,
  "AIToolNot interested in Using" TEXT,
  "AINextMuch more integrated" TEXT,
  "AINextNo change" TEXT,
  "AINextMore integrated" TEXT,
  "AINextLess integrated" TEXT,
  "AINextMuch less integrated" TEXT,
  "AIThreat" TEXT,
  "AIEthics" TEXT,
  "AIChallenges" TEXT,
  "TBranch" TEXT,
  "ICorPM" TEXT,
  "WorkExp" REAL,
  "Knowledge_1" TEXT,
  "Knowledge_2" TEXT,
  "Knowledge_3" TEXT,
  "Knowledge_4" TEXT,
  "Knowledge_5" TEXT,
  "Knowledge_6" TEXT,
  "Knowledge_7" TEXT,
  "Knowledge_8" TEXT,
  "Knowledge_9" TEXT,
  "Frequency_1" TEXT,
  "Frequency_2" TEXT,
  "Frequency_3" TEXT,
  "TimeSearching" TEXT,
  "TimeAnswering" TEXT,
  "Frustration" TEXT,
  "ProfessionalTech" TEXT,
  "ProfessionalCloud" TEXT,
  "ProfessionalQuestion" TEXT,
  "Industry" TEXT,
  "JobSatPoints_1" REAL,
  "JobSatPoints_4" REAL,
  "JobSatPoints_5" REAL,
  "JobSatPoints_6" REAL,
  "JobSatPoints_7" REAL,
  "JobSatPoints_8" REAL,
  "JobSatPoints_9" REAL,
  "JobSatPoints_10" REAL,
  "JobSatPoints_11" REAL,
  "SurveyLength" TEXT,
  "SurveyEase" TEXT,
  "ConvertedCompYearly" REAL,
  "JobSat" REAL
)
```

Hands-on Lab

Visualizing the Distribution of Data

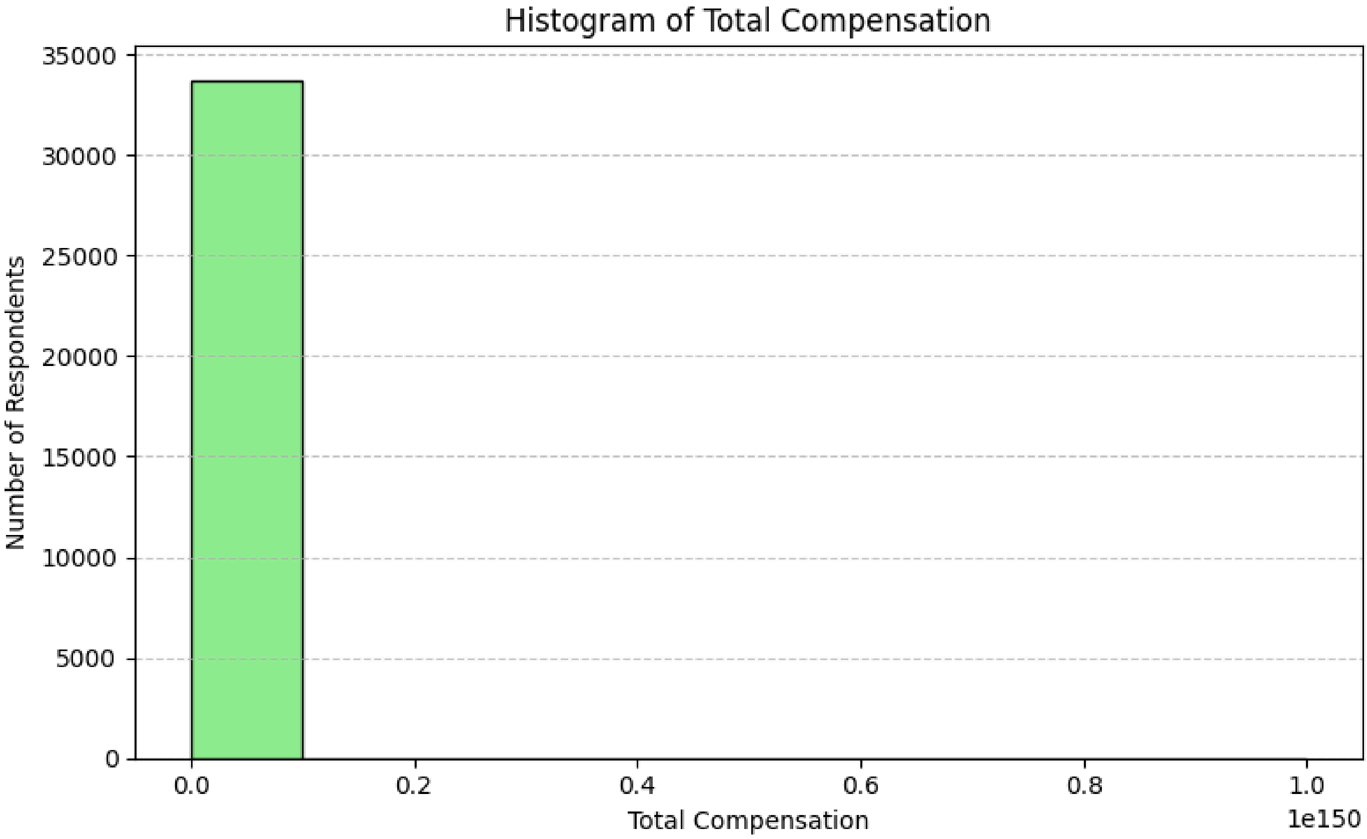
Histograms

Plot a histogram of CompTotal (Total Compensation).

In [27]:

```
## Write your code here
# --- Histograms: Plot a histogram of CompTotal ---
print("\n--- Histograms: CompTotal Distribution ---")

# **FIX:** Re-load the full DataFrame from SQLite to ensure 'CompTotal' is present.
# This is crucial because previous SQL snippets (like COUNT(*)) might overwrite df.
# Using a fresh query to get all data from 'main' table.
QUERY_FULL_DATA = "SELECT * FROM main"
df = pd.read_sql_query(QUERY_FULL_DATA, conn)
print("DataFrame 'df' reloaded from SQLite with all columns for plotting.")

if 'CompTotal' in df.columns and pd.api.types.is_numeric_dtype(df['CompTotal']):
    plt.figure(figsize=(8, 5))
    df["CompTotal"].plot(kind='hist', figsize=(8, 5), title='Histogram of Total Compensation', colo
    plt.xlabel('Total Compensation')
    plt.ylabel('Number of Respondents')
    plt.grid(axis='y', linestyle='--', alpha=0.7)
    plt.tight_layout()
    plt.show()

    print("\nInterpretation of CompTotal Histogram:")
    print("- This histogram shows the frequency distribution of total compensation amounts.")
    print("- You can observe the most common compensation ranges and the overall shape (e.g., skewn
else:
    print("'CompTotal' column not found or is not numeric in the DataFrame after reloading. Cannot
    print("Available columns: ", df.columns.tolist())
    print("CompTotal dtype:", df['CompTotal'].dtype if 'CompTotal' in df.columns else 'Not found')
```

```
--- Histograms: CompTotal Distribution ---
DataFrame 'df' reloaded from SQLite with all columns for plotting.
```



```
Interpretation of CompTotal Histogram:
- This histogram shows the frequency distribution of total compensation amounts.
- You can observe the most common compensation ranges and the overall shape (e.g., skewness).
```

Box Plots

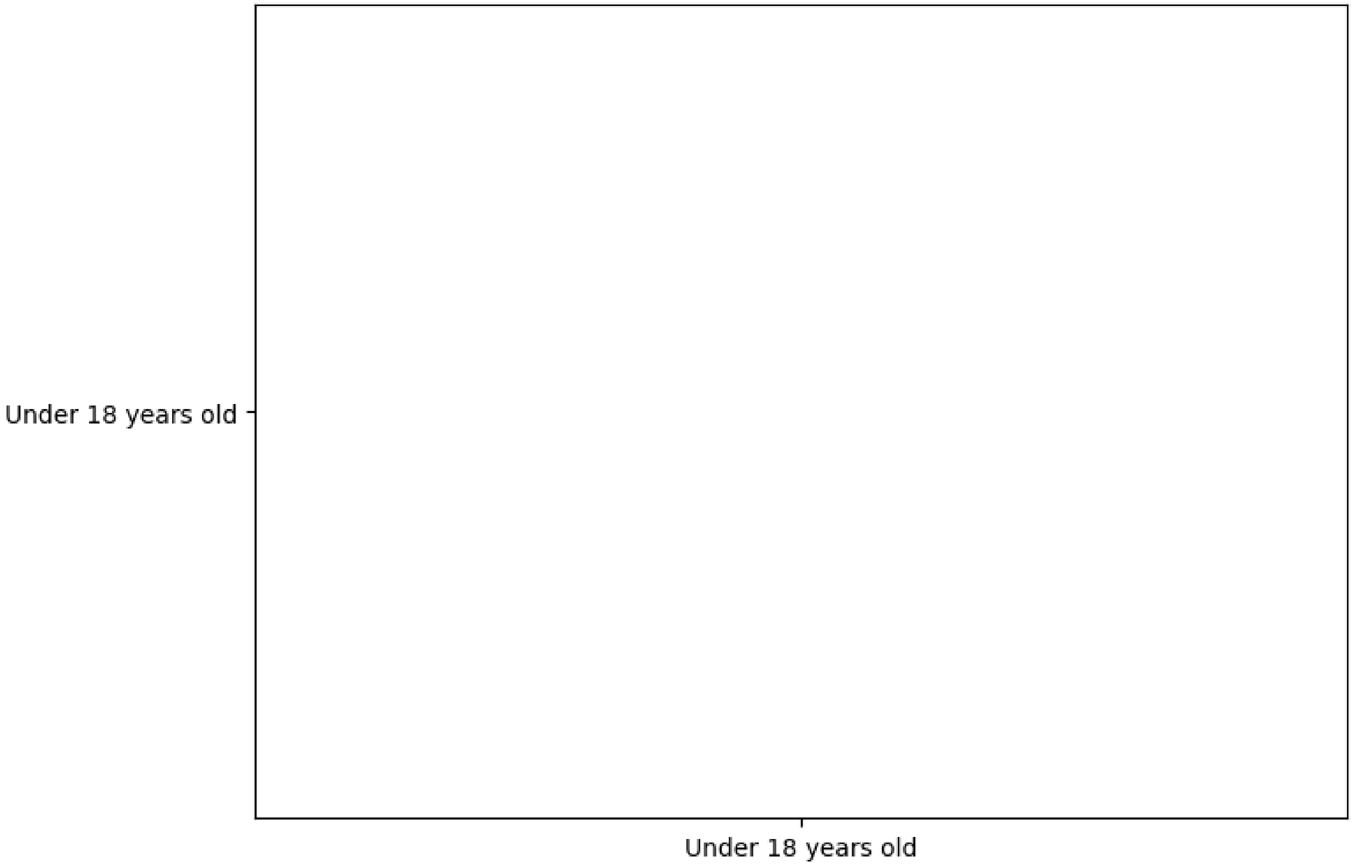
Plot a box plot of Age.

In [41]:

```
## Write your code here
# --- Box Plots: Plot a box plot of Age ---
print("\n--- Box Plots: Age Distribution ---")

# Ensure df is up-to-date and contains 'Age'
if 'Age' in df.columns:
    plt.figure(figsize=(8, 6))
    # Define a preferred order for Age categories for consistent plotting.
    # This order also implicitly handles the removal of 'Prefer not to say' if you don't want it pl
    # We will derive the 'actual_age_order' dynamically from the *present* data's value counts,
    # ensuring only existing and reasonably populated categories are included, then sort by the pre

    # Get the unique, non-NaN age categories from the DataFrame
    current_age_categories = df['Age'].dropna().unique().tolist()

    # Sort these categories based on a defined logical order
    age_order_preferred = ['Under 18 years old', '18-24 years old', '25-34 years old',
                           '35-44 years old', '45-54 years old', '55-64 years old',
                           '65 years or older', 'Prefer not to say']

    # Filter and sort `current_age_categories` based on `age_order_preferred`
    actual_age_order = [age for age in age_order_preferred if age in current_age_categories]

    # If after all filtering, actual_age_order is empty or too few for a boxplot,
    # then it indicates an issue with data in 'Age' column.
    if not actual_age_order:
        print("Warning: No valid age categories found in 'Age' column to plot box plot.")
    else:
        # MODIFIED: Explicitly set `fill=True` and a single `color`
        # Removed `palette` as it's typically used with `hue` for coloring different groups.
        sns.boxplot(y='Age', data=df, order=actual_age_order, color='skyblue', fill=True)
        plt.title('Box Plot of Age Distribution')
        plt.xlabel('Age Group')
        plt.ylabel('Age Group') # y-axis label is also Age Group here
        plt.grid(axis='x', linestyle='--', alpha=0.7)
        plt.tight_layout()
        plt.show()

        print("\nInterpretation of Age Box Plot:")
        print("- The box plot visualizes the median, quartiles, and potential outliers for Age dist
        print("- It helps to understand the spread and central tendency of ages.")
else:
    print("'Age' column not found. Cannot plot box plot.")
```

```
--- Box Plots: Age Distribution ---
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
Cell In[41], line 31
     27     print("Warning: No valid age categories found in 'Age' column to plot box plot.")
     28 else:
     29     # MODIFIED: Explicitly set `fill=True` and a single `color`
     30     # Removed `palette` as it's typically used with `hue` for coloring different groups.
---> 31     sns.boxplot(y='Age', data=df, order=actual_age_order, color='skyblue', fill=True)
     32     plt.title('Box Plot of Age Distribution')
     33     plt.xlabel('Age Group')

File /opt/conda/lib/python3.12/site-packages/seaborn/categorical.py:1634, in boxplot(data, x, y, hu
e, order, hue_order, orient, color, palette, saturation, fill, dodge, width, gap, whis, linecolor, l
inewidth, fliersize, hue_norm, native_scale, log_scale, formatter, legend, ax, **kwargs)
   1627 color = _default_color(
   1628     ax.fill_between, hue, color,
   1629     {k: v for k, v in kwargs.items() if k in ["c", "color", "fc", "facecolor"]},
   1630     saturation=saturation,
   1631 )
   1632 linecolor = p._complement_color(linecolor, color, p._hue_map)
-> 1634 p.plot_boxes(
   1635     width=width,
   1636     dodge=dodge,
   1637     gap=gap,
   1638     fill=fill,
   1639     whis=whis,
   1640     color=color,
   1641     linecolor=linecolor,
   1642     linewidth=linewidth,
   1643     fliersize=fliersize,
   1644     plot_kws=kwargs,
   1645 )
   1647 p._add_axis_labels(ax)
   1648 p._adjust_cat_axis(ax, axis=p.orient)

File /opt/conda/lib/python3.12/site-packages/seaborn/categorical.py:700, in _CategoricalPlotter.plot
_boxes(self, width, dodge, gap, fill, whis, color, linecolor, linewidth, fliersize, plot_kws)
    679 default_kws = dict(
    680     bxpstats=stats.to_dict("records"),
    681     positions=data[self.orient],
   (...)
    697     )
    698 )
    699 boxplot_kws = {**default_kws, **plot_kws}
--> 700 artists = ax.bxp(**boxplot_kws)
    702 # Reset artist widths after adding so everything stays positive
    703 ori_idx = ["x", "y"].index(self.orient)

File /opt/conda/lib/python3.12/site-packages/matplotlib/_api/deprecation.py:453, in make_keyword_onl
y.<locals>.wrapper(*args, **kwargs)
    447 if len(args) > name_idx:
    448     warn_deprecated(
    449         since, message="Passing the %(name)s %(obj_type)s "
    450         "positionally is deprecated since Matplotlib %(since)s; the "
    451         "parameter will become keyword-only in %(removal)s.",
    452         name=name, obj_type=f"parameter of {func.__name__}()")
--> 453 return func(*args, **kwargs)

File /opt/conda/lib/python3.12/site-packages/matplotlib/axes/_axes.py:4482, in Axes.bxp(self, bxpsta
ts, positions, widths, vert, orientation, patch_artist, shownotches, showmeans, showcaps, showbox, s
howfliers, boxprops, whiskerprops, flierprops, medianprops, capprops, meanprops, meanline, manage_ti
cks, zorder, capwidths, label)
   4480     positions = list(range(1, N + 1))
   4481 elif len(positions) != N:
-> 4482     raise ValueError(datashape_message.format("positions"))
   4484 positions = np.array(positions)
   4485 if len(positions) > 0 and not all(isinstance(p, Real) for p in positions):

ValueError: List of boxplot statistics and `positions` values must have same the length
```



Visualizing Relationships in Data

Scatter Plots

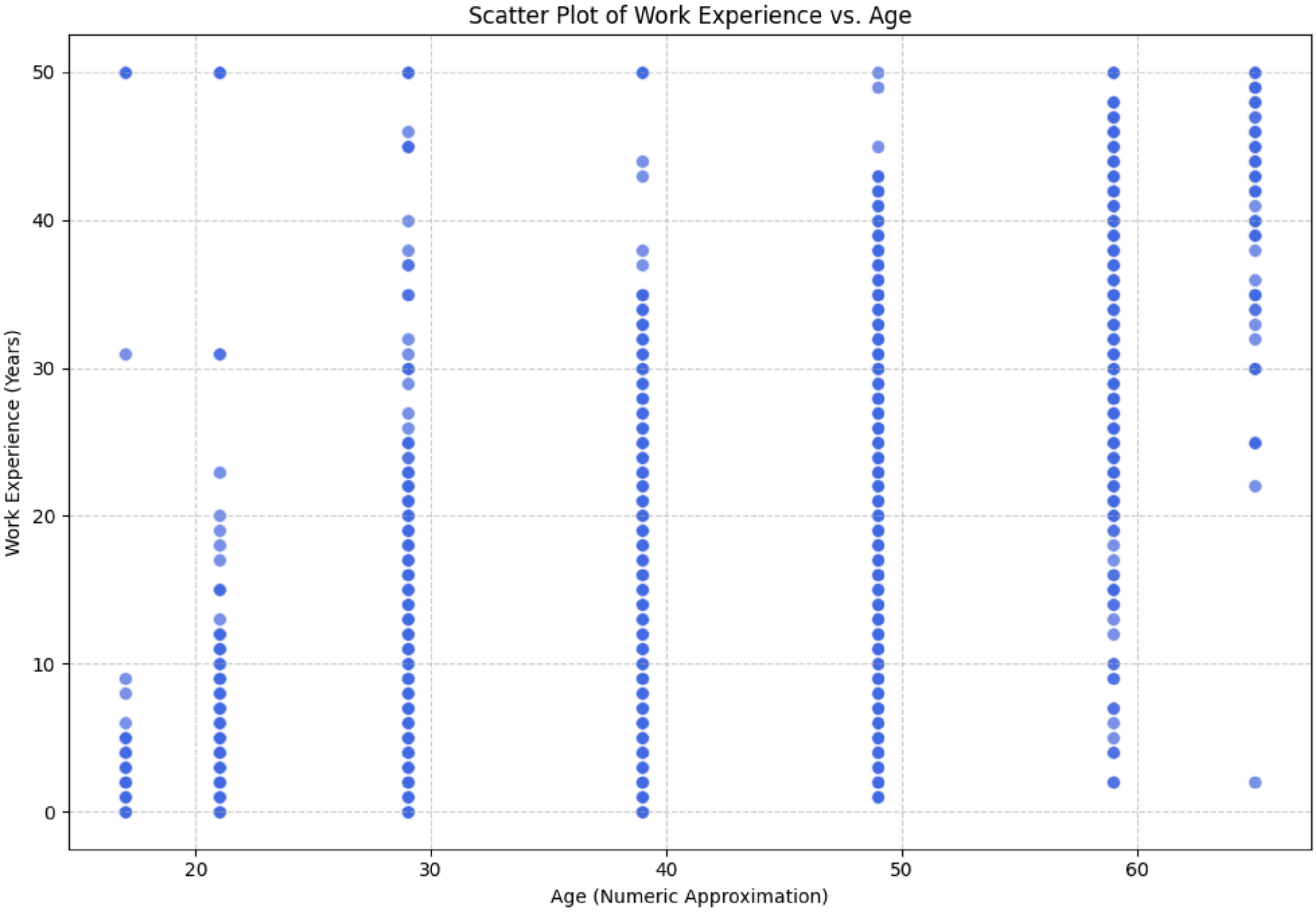
Create a scatter plot of Age and WorkExp.

In [33]:

```
## Write your code here
print("\n--- Scatter Plots: Age vs. WorkExp ---")

if 'Age' in df.columns and 'WorkExp' in df.columns:
    # Convert 'Age' to numeric for scatter plot if not already done.
    # Map age ranges to a single numeric value (e.g., midpoint or lower bound)
    age_numeric_mapping = {
        'Under 18 years old': 17, '18-24 years old': 21, '25-34 years old': 29,
        '35-44 years old': 39, '45-54 years old': 49, '55-64 years old': 59,
        '65 years or older': 65, 'Prefer not to say': np.nan # Handle 'Prefer not to say' as NaN
    }
    df['Age_Numeric'] = df['Age'].map(age_numeric_mapping)
    # Impute any new NaNs created by mapping
    if df['Age_Numeric'].isnull().any():
        df['Age_Numeric'].fillna(df['Age_Numeric'].median(), inplace=True)
        print("Imputed 'Age_Numeric' NaNs for scatter plot.")

    plt.figure(figsize=(10, 7))
    sns.scatterplot(x='Age_Numeric', y='WorkExp', data=df, alpha=0.7, s=50, color='royalblue')
    plt.title('Scatter Plot of Work Experience vs. Age')
    plt.xlabel('Age (Numeric Approximation)')
    plt.ylabel('Work Experience (Years)')
    plt.grid(True, linestyle='--', alpha=0.6)
    plt.tight_layout()
    plt.show()

    print("\nInterpretation of Age vs. WorkExp Scatter Plot:")
    print("- This plot visualizes the relationship between a person's age and their years of profes
    print("- You would typically expect a positive correlation (as age increases, work experience a
else:
    print("Required columns ('Age' or 'WorkExp') not found or not properly prepared. Cannot plot sc
```

```
--- Scatter Plots: Age vs. WorkExp ---
Imputed 'Age_Numeric' NaNs for scatter plot.
```

```
/tmp/ipykernel_785/2362874026.py:15: FutureWarning: A value is trying to be set on a copy of a DataF
rame or Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate
object on which we are setting values always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, in
place=True)' or df[col] = df[col].method(value) instead, to perform the operation inplace on the ori
ginal object.


  df['Age_Numeric'].fillna(df['Age_Numeric'].median(), inplace=True)
```



```
Interpretation of Age vs. WorkExp Scatter Plot:
- This plot visualizes the relationship between a person's age and their years of professional work
experience.
- You would typically expect a positive correlation (as age increases, work experience also tends to
increase).
```

Bubble Plots

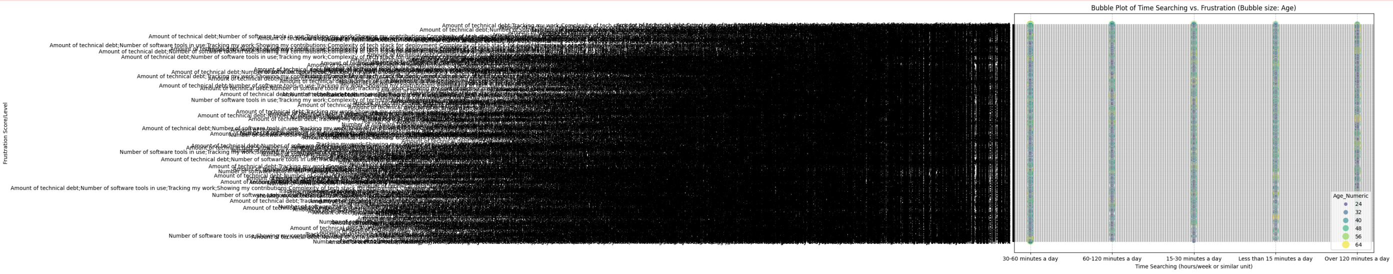
Create a bubble plot of `TimeSearching` and `Frustration` using the Age column as the bubble size.

In [34]:

```
## Write your code here
# --- Bubble Plots: Create a bubble plot of TimeSearching and Frustration using the Age column as t
print("\n--- Bubble Plots: TimeSearching & Frustration by Age ---")

if 'TimeSearching' in df.columns and 'Frustration' in df.columns and 'Age_Numeric' in df.columns:
    plt.figure(figsize=(12, 8))
    # 's' parameter controls bubble size. Normalize 'Age_Numeric' or scale it appropriately.
    # Multiply by a factor (e.g., 20 or 50) to make bubbles visible.
    sns.scatterplot(x='TimeSearching', y='Frustration', size='Age_Numeric', data=df,
                    sizes=(20, 200), alpha=0.6, hue='Age_Numeric', palette='viridis', legend='brief
    plt.title('Bubble Plot of Time Searching vs. Frustration (Bubble size: Age)')
    plt.xlabel('Time Searching (hours/week or similar unit)')
    plt.ylabel('Frustration Score/Level')
    plt.grid(True, linestyle='--', alpha=0.6)
    plt.tight_layout()
    plt.show()

    print("\nInterpretation of Bubble Plot:")
    print("- This plot shows the relationship between time spent searching and frustration, with th
    print("- Larger bubbles indicate older respondents. This helps to see if age plays a role in th
else:
    print("Required columns ('TimeSearching', 'Frustration', or 'Age_Numeric') not found or not pro
```

```
--- Bubble Plots: TimeSearching & Frustration by Age ---
```

```
/tmp/ipykernel_785/3964450170.py:15: UserWarning: Tight layout not applied. The left and right margi
ns cannot be made large enough to accommodate all Axes decorations.
  plt.tight_layout()
```



```
Interpretation of Bubble Plot:
- This plot shows the relationship between time spent searching and frustration, with the size of th
e bubbles representing age.
- Larger bubbles indicate older respondents. This helps to see if age plays a role in these relation
ships.
```

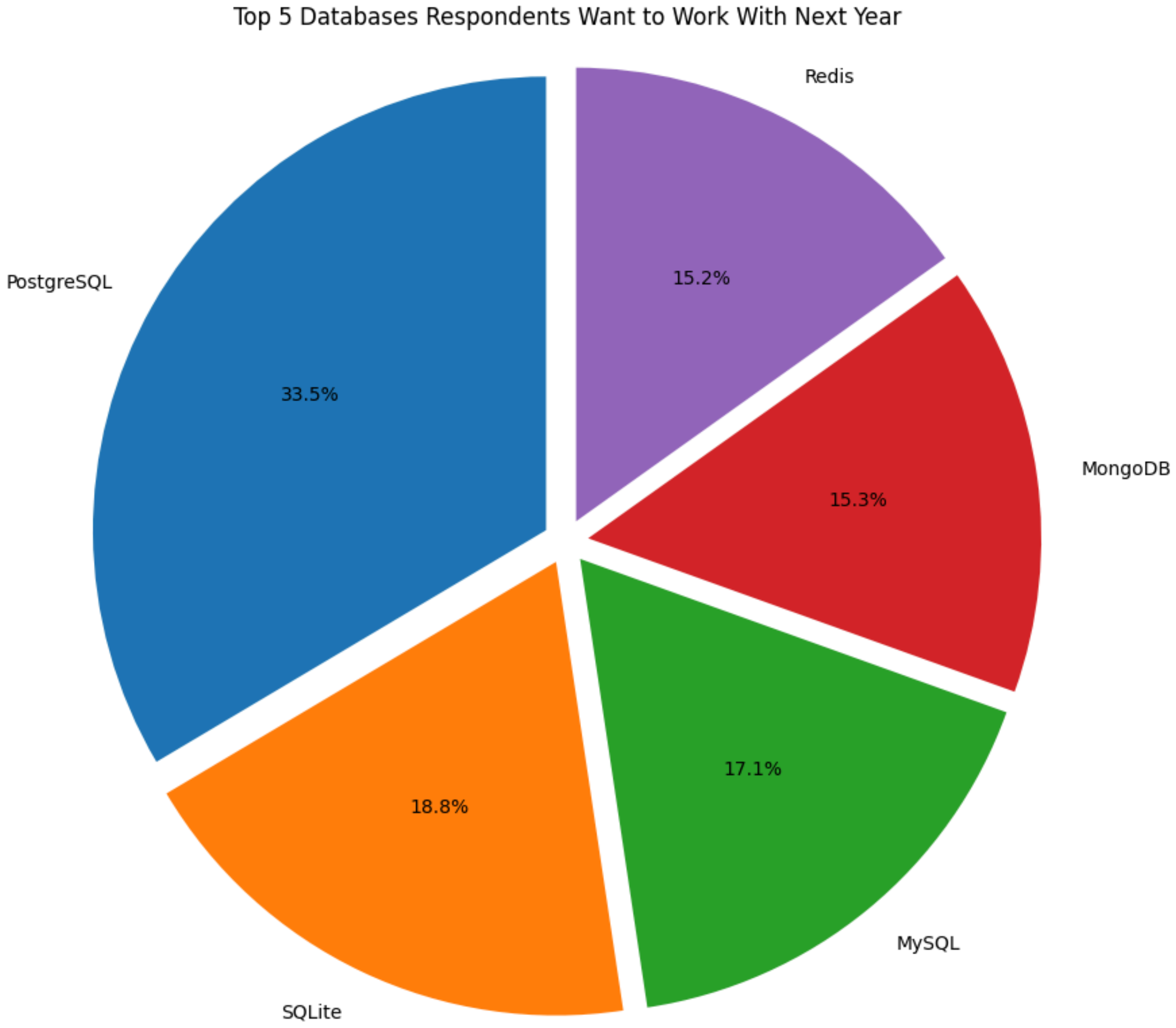
Visualizing Composition of Data

Pie Charts

Create a pie chart of the top 5 databases(`DatabaseWantToWorkWith`) that respondents wish to learn next year.

In [35]:
```
## Write your code here
print("\n--- Pie Charts: Top 5 Desired Databases ---")

if 'DatabaseWantToWorkWith' in df.columns:
    # Need to handle multiple selections in 'DatabaseWantToWorkWith'
    # First, handle NaN values, then split and explode.
    df_databases = df.dropna(subset=['DatabaseWantToWorkWith']).copy()
    df_databases['Database'] = df_databases['DatabaseWantToWorkWith'].str.split(';')
    df_exploded_databases = df_databases.explode('Database')
    df_exploded_databases['Database'] = df_exploded_databases['Database'].str.strip()

    # Get the top 5 databases
    top_5_databases = df_exploded_databases['Database'].value_counts().head(5)

    if not top_5_databases.empty:
        plt.figure(figsize=(10, 8))
        plt.pie(top_5_databases, labels=top_5_databases.index, autopct='%1.1f%%', startangle=90, ex
        plt.title('Top 5 Databases Respondents Want to Work With Next Year')
        plt.axis('equal') # Equal aspect ratio ensures that pie is drawn as a circle.
        plt.tight_layout()
        plt.show()

        print("\nTop 5 Desired Databases:")
        print(top_5_databases)
    else:
        print("No data or insufficient unique databases in 'DatabaseWantToWorkWith' to create a pie
else:
    print("'DatabaseWantToWorkWith' column not found or not properly prepared. Cannot plot pie char
```

```
--- Pie Charts: Top 5 Desired Databases ---
```



```
Top 5 Desired Databases:
Database
PostgreSQL    24005
SQLite        13489
MySQL         12269
MongoDB       10982
Redis         10847
Name: count, dtype: int64
```

Stacked Charts

Create a stacked bar chart of median `TimeSearching` and `TimeAnswering` for the age group 30 to 35.

In [36]:

```
## Write your code here
print("\n--- Stacked Charts: Median Time Searching & Answering for 30-35 Age Group ---")

# Assuming '30-35 years old' is a category in the 'Age' column or a range for 'Age_Numeric'
# Let's filter based on the 'Age_Numeric' that was created for scatter plot for consistency
if 'Age_Numeric' in df.columns and 'TimeSearching' in df.columns and 'TimeAnswering' in df.columns:
    # Filter for age group 30 to 35. Assuming 'Age_Numeric' captures these ranges.
    # Note: 'Age_Numeric' maps to ranges, so we need to find the approximate range.
    # If using string categories like '25-34 years old' and '35-44 years old', use string filtering
    # Based on PDF, it mentions "age group 30 to 35" which suggests a numeric range, so 'Age_Numeri
    age_filtered_df = df[(df['Age_Numeric'] >= 30) & (df['Age_Numeric'] <= 35)]

    if not age_filtered_df.empty:
        # Calculate median TimeSearching and TimeAnswering for the filtered group
        median_times = age_filtered_df[['TimeSearching', 'TimeAnswering']].median()

        # Create a DataFrame for plotting
        plot_data_stacked = pd.DataFrame(median_times).T # Transpose to have columns as metrics
        plot_data_stacked.index = ['Median Times (30-35 Age Group)'] # Label for the single bar

        plt.figure(figsize=(8, 6))
        plot_data_stacked.plot(kind='bar', stacked=True, cmap='coolwarm', ax=plt.gca())
        plt.title('Median Time Searching and Time Answering for Age Group 30-35')
        plt.xlabel('Metric')
        plt.ylabel('Time (Units)')
        plt.xticks(rotation=0) # No rotation for a single bar group
        plt.legend(title='Metric')
        plt.grid(axis='y', linestyle='--', alpha=0.7)
        plt.tight_layout()
        plt.show()

        print("\nMedian Time Searching and Time Answering for age group 30-35:")
        print(median_times)
    else:
        print("No respondents found in the age group 30 to 35 with relevant data. Cannot create sta
else:
    print("Required columns ('Age_Numeric', 'TimeSearching', or 'TimeAnswering') not found or not p
```

```
--- Stacked Charts: Median Time Searching & Answering for 30-35 Age Group ---
No respondents found in the age group 30 to 35 with relevant data. Cannot create stacked chart.
```

Visualizing Comparison of Data

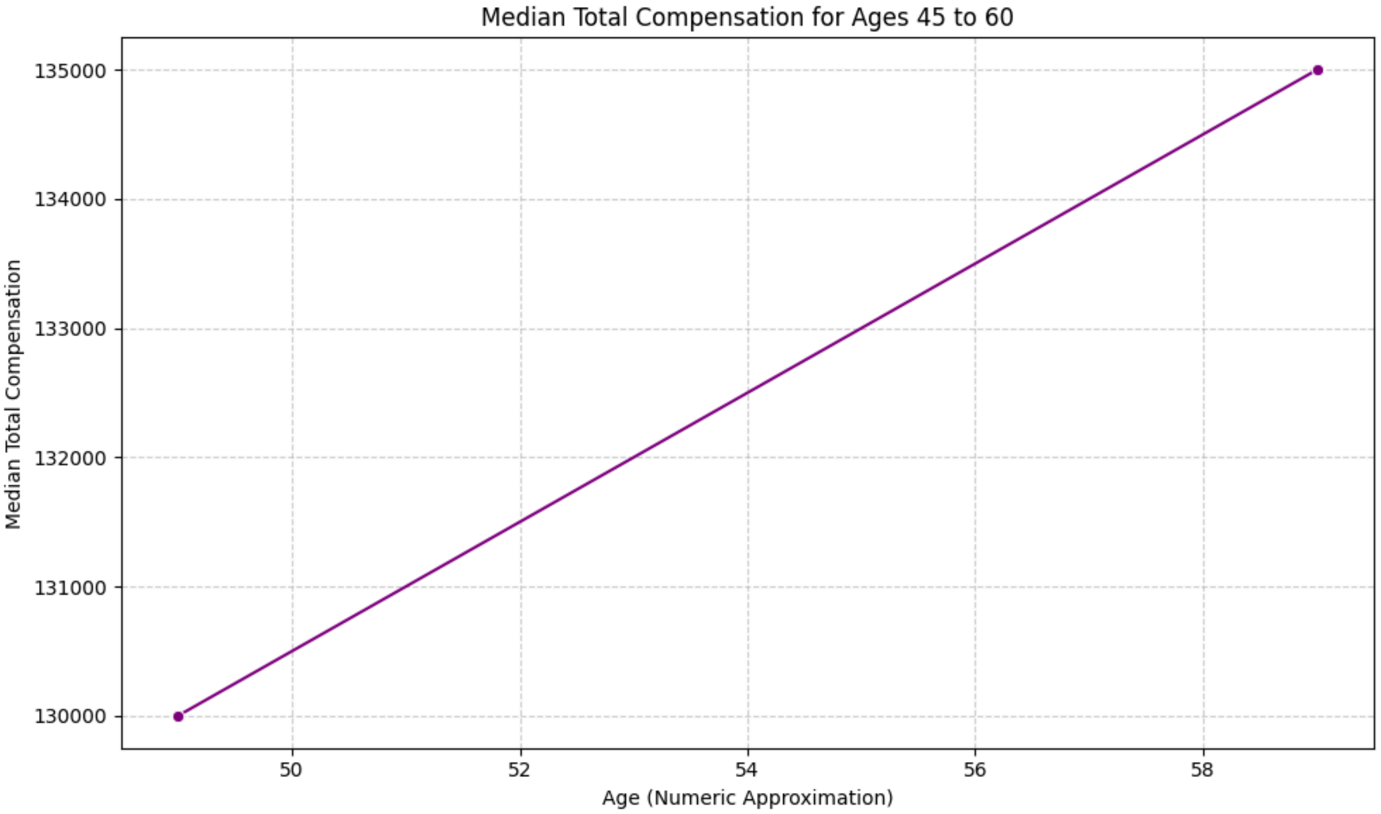
Line Chart

Plot the median `CompTotal` for all ages from 45 to 60.

In [37]:

```
## Write your code here
# --- Line Chart: Plot the median CompTotal for all ages from 45 to 60 ---
print("\n--- Line Chart: Median CompTotal for Ages 45 to 60 ---")

if 'Age_Numeric' in df.columns and 'CompTotal' in df.columns:
    # Filter for age group 45 to 60
    age_filtered_df = df[(df['Age_Numeric'] >= 45) & (df['Age_Numeric'] <= 60)]

    if not age_filtered_df.empty:
        # Group by Age_Numeric and calculate median CompTotal
        median_comptotal_by_age = age_filtered_df.groupby('Age_Numeric')['CompTotal'].median().sort

        plt.figure(figsize=(10, 6))
        sns.lineplot(x=median_comptotal_by_age.index, y=median_comptotal_by_age.values, marker='o',
        plt.title('Median Total Compensation for Ages 45 to 60')
        plt.xlabel('Age (Numeric Approximation)')
        plt.ylabel('Median Total Compensation')
        plt.grid(True, linestyle='--', alpha=0.6)
        plt.tight_layout()
        plt.show()

        print("\nMedian CompTotal by Age (45-60):")
        print(median_comptotal_by_age)
    else:
        print("No respondents found in the age group 45 to 60 with relevant data. Cannot create lin
else:
    print("Required columns ('Age_Numeric' or 'CompTotal') not found or not properly prepared. Cann
```

```
--- Line Chart: Median CompTotal for Ages 45 to 60 ---
```



```
Median CompTotal by Age (45-60):
Age_Numeric
49.0    130000.0
59.0    135000.0
Name: CompTotal, dtype: float64
```

Bar Chart

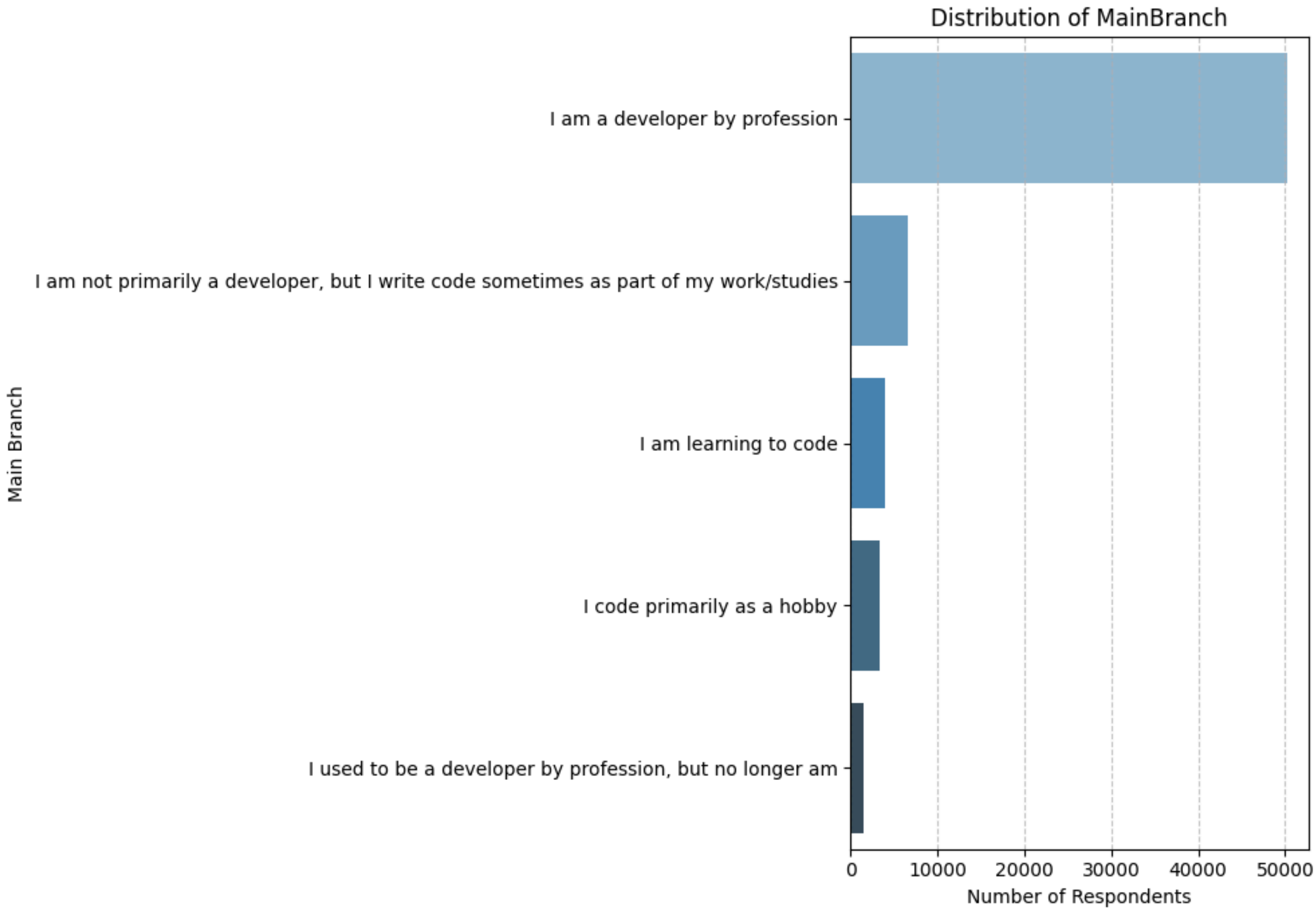
Create a horizontal bar chart using the `MainBranch` column.

In [38]:

```python
## Write your code here
# --- Bar Chart: Create a horizontal bar chart using the MainBranch column ---
print("\n--- Bar Chart: MainBranch Distribution ---")

if 'MainBranch' in df.columns:
    main_branch_counts = df['MainBranch'].value_counts()

    if not main_branch_counts.empty:
        plt.figure(figsize=(10, 7))
        sns.barplot(x=main_branch_counts.values, y=main_branch_counts.index, palette='Blues_d')
        plt.title('Distribution of MainBranch')
        plt.xlabel('Number of Respondents')
        plt.ylabel('Main Branch')
        plt.grid(axis='x', linestyle='--', alpha=0.7)
        plt.tight_layout()
        plt.show()

        print("\nMainBranch Value Counts:")
        print(main_branch_counts)
    else:
        print("No data in 'MainBranch' column. Cannot create bar chart.")
else:
    print("'MainBranch' column not found or not properly prepared. Cannot plot bar chart.")
```

```
--- Bar Chart: MainBranch Distribution ---
```

```
/tmp/ipykernel_785/1256390689.py:10: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `
y` variable to `hue` and set `legend=False` for the same effect.

  sns.barplot(x=main_branch_counts.values, y=main_branch_counts.index, palette='Blues_d')
```



```
MainBranch Value Counts:
MainBranch
I am a developer by profession                                                   50207
I am not primarily a developer, but I write code sometimes as part of my work/studies     6511
I am learning to code                                                             3875
I code primarily as a hobby                                                       3334
I used to be a developer by profession, but no longer am                          1510
Name: count, dtype: int64
```

Summary

In this lab, you focused on extracting and visualizing data from an RDBMS using SQL queries and SQLite. You applied various visualization techniques, including:

- Histograms to display the distribution of CompTotal.
- Box plots to show the spread of ages.
- Scatter plots and bubble plots to explore relationships between variables like Age, WorkExp, `TimeSearching` and `TimeAnswering`.
- Pie charts and stacked charts to visualize the composition of data.
- Line charts and bar charts to compare data across categories.

Close the Database Connection

Once the lab is complete, ensure to close the database connection:

In [39]:

```
conn.close()
# --- Close the Database Connection ---
print("\n--- Close the Database Connection ---")
try:
    conn.close()
    print("Database connection closed successfully.")
except Exception as e:
    print(f"Error closing database connection: {e}")

# --- Summary ---
print("\n--- Lab Summary ---")
print("In this lab, you focused on extracting and visualizing data from an RDBMS using SQL queries
print("• Histograms to display the distribution of CompTotal.")
print("• Box plots to show the spread of ages.")
print("• Scatter plots and bubble plots to explore relationships between variables like Age, WorkEx
print("• Pie charts and stacked charts to visualize the composition of data.")
print("• Line charts and bar charts to compare data across categories.")
```

```
--- Close the Database Connection ---
Database connection closed successfully.

--- Lab Summary ---
In this lab, you focused on extracting and visualizing data from an RDBMS using SQL queries and SQLi
te. You applied various visualization techniques, including:
• Histograms to display the distribution of CompTotal.
• Box plots to show the spread of ages.
• Scatter plots and bubble plots to explore relationships between variables like Age, WorkExp, TimeS
earching and TimeAnswering.
• Pie charts and stacked charts to visualize the composition of data.
• Line charts and bar charts to compare data across categories.
```

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