Software Design II

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Term Project (Job Vacancies in Canada)

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0.0 Milestone IV: Data Design

0.1 Milestone Scope

Build a software system that will allow the user to answer interesting questions within the domain of job vacancies within Canada. The key is **how to look at data to answer our questions**.

0.1.1 Details

- The software must run fast when answering the questions with varied parameters.
- The software should prompt the user with what its options or what needs to be entered.
- The software should close all files and clear all plots once it stops running
- The software must run all questions without needing to be restarted

0.1.2 To do list

- ☑ ~~Use testability checklist on each questions pre-process script~~
- ☑ ~~Use testability checklist on the final system script~~
- ☑ ~~Pre-process data for each question~~
- ☑ ~~Compare graphs for unity~~
- ☑ ~~Make a backup of the documentation~~
- ☑ ~~Do a mock run for this weekly standup meeting~~
- ☑ ~~Do a mock run of the final 10 min demo~~
- ☑ ~~Update report with feedback from Milestone II report~~
- ☑ ~~Do user testing to see what is understood or misunderstood~~
- ☑ ~~Create a slideshow to present~~

0.1.3 Testability Checklist

- ☐ **Comments and Documentation**
  - ☐ are there sufficient and consistent comments?
  - ☐ are important sections dated?
  - ☐ are comments out of date?
  - ☐ are the comments meaningful and useful?
    if not, why?
- ☐ **Functionality and Correctness**
  - ☐ Does the code correctly reflect the algorithm and comments and documentation?
  - ☐ Is there meaningful error checking?
  - ☐ Are there arithmetic errors?
    - division by zero
    - overflow
    - floating point issues
    - type conversion errors
  - ☐ Is the logic complete?
  - ☐ Are all pathways in the code able to be executed?
  - ☐ Loops:
    - `for`
    - `while`
    - other
  - ☐ Branches (check each one)
- ☐ **Program Structure**
  - ☐ Is the code modular?
  - ☐ Cut and paste programming?
  - ☐ Does the structure make sense? Does it model the algorithm or the problem or some other model? What is the model? Is it clear?
- ☐ **Coding Style**
  - ☐ variable names + initializations (list convention used)
  - ☐ function and type names
  - ☐ spelling and consistent word notation in names
  - ☐ bracketing and quoting
  - ☐ loops and control segments
  - ☐ size of subroutines or classes consistency

(Figure 7.1, page 66)

- ☐ **Maintainability**
  - ☐ Has maintainability been considered in the design?
  - ☐ Would the code be relatively straightforward to extend?
  - ☐ Would the code be relatively straightforward to port?
  - ☐ (Attach comments if necessary for all cases)
- ☐ **Completeness**
  - ☐ Are all referenced data defined, computed or obtained from external sources?
  - ☐ Are all defined data used?
  - ☐ Are all referenced subprograms/functions defined?
  - ☐ Are all referenced subprograms/functions used?
- ☐ **Efficiency**
  - ☐ Are all non-loop dependent computations kept out of the loop?
  - ☐ Are there values that are otherwise computed more than once?
  - ☐ Are data handled in a way that promotes efficient processing?
  - ☐ (Attach comments if necessary for all cases)
- ☐ **Understandability**
  - ☐ Is the code easy to read and understand?)
  - ☐ Is the code modular?
  - ☐ Does the modularity make sense?
  - ☐ (Attach comments if necessary for all cases)
- ☐ **Testing**
  - ☐ Is there testing included?)
  - ☐ Is the testing successful at showing flaws and weaknesses?
  - ☐ Are there other tests that should be in the testing suite?
  - ☐ (Attach comments if necessary for all cases)

(Figure 7.2, page 67)

(Hamilton-Wright, Andrew. et al. Collaborative Design Fundamentals For Software Engineers. Winter 2024 ed. University of Guelph, School of Computer Science, 2023.)

0.1.4 User Manual

The latest edition of the Statistics Canada databases will need to be downloaded, refer to 0.3 Data Sources Used for information about the database and refer to 0.3.4 Statistics Canada Table how to download on how to download it. Once the file .csv file is downloaded (1400328.csv) it will need to be run with each pre-processing question.

Python3 is the language used to run the program,

pre_process_question1.py is the script that is to be run, **“14100328.csv”** is the database that is being processed, **>** is sending the processed data to save in a new database with the name **“pre_process_question1.csv”** .

The exact commands to be run:

python3 pre_process_question4.py "14100328.csv" > "pre_process_question4.csv"

python3 pre_process_Q2_updated.py "14100328.csv" > "extract_Q2.csv"

python3 pre_process_question4.py "14100328.csv" > "pre_process_question4.csv"

python3 pre_process_question4.py "14100328.csv" > "pre_process_question4.csv"

After the pre-processing has been done, the main program can be run **MileStone-Final.py**, the program command is:

python3 MileStone_Final.py

The program will first start with a prompt that only shows once that states "**Data must be pre-processed before running the program.**"

Next the program will show a menu that will display each time a question has been completed

Tasks to display Job Vacancies in Canada

1. Total offered hourly wage for a particular season

2. Demand for non-university certificates or diplomas by sector and geographical location

3. Most vacant jobs by type of work and position

4. Job vacancies by education level

0. Exit

“0” will end the program and close all the open graphs.

0.2 Group Roles and Contributions

Daman Kumar (1306900)

Role: **Agile Lead, Quality Assurance/ Testability Lead**

Previous roles: **Quality Assurance/ Testability Lead**

Contributions:

- Question 1 Report
- Question 1 Slides
- Validate errors
- MileStone_final.py
- pre_process_question1.py

Hamza Irshad (1261380)

Role: **Project Manager**

Previous roles: **Process Coordinator/ Agile-Lead**

Contributions:

- Question 2 Report
- Question 2 Slides
- pre_process_Q2.py
- MileStone_final.py

Jacob Good (1300566)

Role: **Documentation Lead**

Contributions:

- Question 3 Report
- Question 3 Slides
- pre_process_quesiton3.py

- MileStone_final.py

Ryan Sass-Gregoire (1230473)

Role: **Architect/ Conceptual Interaction Lead**

Contributions:

- Question 4 Report
- Question 4 Slides
- Question 4 Code

0.3 Data Sources Used

Demographic information in Canada is provided through various Federal, Provincial and Territorial systems. Each province or territory has its own strategy for collecting data, and provides it in a different form. Data for the entire country is collected by Statistics Canada.

Statistics Canada. (Dec, 2023). Job vacancies, proportion of job vacancies and average offered hourly wage by selected characteristics, quarterly, unadjusted for seasonality. DOI: https://doi.org/10.25318/1410032801-eng Accessed (Mar, 2023).

0.3.1 How often is each data set updated?

Statistics Canada last updated the 14100328.csv file on December 18th 2023, which is one business day after the survey was uploaded to Statistics Canada on December 15th. The survey is completed every three months and we can assume the database will be updated shortly after the survey is completed. “Every three months, the JVWS survey frame is updated to reflect

new locations added to the BR and to eliminate those that no longer exist."(Statistics Canada, para 8).

(Government of Canada, Statistics Canada. "Job Vacancy and Wage Survey (JVWS)." Surveys and Statistical Programs, 15 Dec. 2023, https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5217)

0.3.2 How will this be incorporated into the system

The database does not come with the date it was last modified. However the python programs will show when they were last modified as well as the latest version of the database they were tested with. Statistics Canada will show if the data has been updated since the latest version of the software, if so the new database can be downloaded off of Statistics Canada and implemented into the system by rerunning the preprocessing scripts with the new database. Refer to 0.3.4 Statistics Canada Table how to download on how to download the new database.

0.3.3 Statistics Canada Table Layout

There are expected to be these fields:

- REF_DATE reference date
- GEO geographical region
- DGUID geographical region ID code
- National Occupational Classification one of 692 categories as listed in the meta-data file
- Job vacancy characteristics e.g. "Full-time", "Part-time"
- Statistics"Job vacancies", "Proportion of job vacancies" or "Average offered hourly wage"

- UOM “Unit of Measure”
- UOM_ID “Unit of Measure ID”
- SCALAR_FACTOR describes the measurement type – for this data always units
- SCALAR_ID ID for scalar factor
- VECTOR StatsCan vector code
- COORDINATE StatsCan cube coordinate
- VALUE the value that is being reported in fixed decimal notation (see “DECIMALS” below)
- STATUS encoded according to the metadata file
- SYMBOL always blank for this data
- TERMINATED always blank for this data
- DECIMALS number of decimals to use when interpreting the value (multiply the VALUE by 10e-{DECIMALS} to get a true floating point value)

0.3.4 Statistics Canada Table how to download

Access employment data from across the country at this link:

https://www150.statcan.gc.ca/n1/en/catalogue/14100328

To access the full database for one of the collection, choose the collection and then look for the button Download options. Clicking this button brings up a list of formats – the full database is the second last one, entitled “*Download the entire table*” (Hamilton-Wright, Andrew. et al. CIS2250_W24_Project. Winter 2024 ed. University of Guelph, School of Computer Science, 2023.)

1.0 Question One

What is the ***Total*** offered hourly wage for a particular season (quarterly) for Software Engineers and Designers over the years?

1.1 Why is this Interesting

Knowing the total offered hourly wage can provide an understanding for an organization to analyze their budget and economic condition of a particular season. It can help the businesses understand how much their wage offering is different from the previous year. Overall, monitoring the total offered hourly wage in a particular season provides valuable insights for businesses to stay competitive, attract talent, manage costs, and adapt to changing economic conditions.

1.2 Preliminary data processing required

As we have done the lab (project kick-off) and got a rough idea about how the data source is structured and what fields it contains. I just reviewed that lab and also a visualization lab prior to it. After getting the insights from these two labs. Filtering of data was processed by observing the file and selecting the required parameters. Used pre_proceess_question1.py to bring down the huge data file into a required data file and that data gets transferred into a pre_process_file.csv for further processing.

1.3 Parameters that can be Varied

- Province (Ontario, British columbia etc.)
- Quarters of a year (“01”, “02”, “03”, “04”)

1.4 Data Sources used for this Question

Statistics Canada. (Dec, 2023). Job vacancies, proportion of job vacancies and average offered hourly wage by selected characteristics, quarterly, unadjusted for seasonality. DOI: https://doi.org/10.25318/1410032801-eng Accessed (Apr, 2023).

1.4.1 Files used from Data Sources

Statistics Canada. (Dec, 2023). Table 14-10-0328-01 Job vacancies, proportion of job vacancies and average offered hourly wage by selected characteristics, quarterly, unadjusted for seasonality

DOI: https://doi.org/10.25318/1410032801-eng Accessed (Apr, 2023).

1.4.2 Fields used from Files

REF_DATE

- The year and quarter the data was collected.

GEO

- The region the data was collected from.
- Canada is being used as a fixed variable.

NATIONAL OCCUPATIONAL CLASSIFICATION

- Type of job.

JOB VACANCY CHARACTERISTICS

- Average hourly wage

SEASON

VALUE

- Amount of job vacancies recorded.

STATUS

- How reliable the data is
- This will not be displayed in graphs just recorded with a table.

1.5 Final data processing (using parameters)

Final data is processed using a python file, MileStone_Final.py helps to analyze and visualize the data by prompting the required parameters i.e. province and season. Entered Parameters are compared with Data using if statements. When we run the python script or the above mentioned file, it asks one for province and then season, data gets analyzed according to the parameters. Now, visualization comes into play, with three different kinds of visual options (bar, pie and line). It shows the total offered hourly wage of Software Engineers and Designers [2173] occupation for each type of work for a particular season. The quarter's parameters are compared using slicing by examining the months from the data source. If the quarter is "02" then data from mon Apr to Jun of each year will be selected

1.6 How to run the program

The Data must be pre-processed before using the MileStone_Final.py (it must be pre-processed using the pre_process_question1.py and the processed data should be directed to a csv file called pre_process_file.csv as it is hard-coded into the file). pre_process_file.csv should be present in the same folder as MileStone_Final.py.

Command line argument: **python3 MileStone_Final.py**

```
Data must be pre-processed before running the program.
Tasks to display Job Vacancies in Canada
1. Total offered hourly wage for a particular season
2. Demand for non-university certificates or diplomas by sector and geographical location
3. Most vacant jobs by type of work and position
4. Job vacancies by education level
0. Exit
1
```

Option (1) for question 1

```
1
Provinces:
1. Newfoundland and Labrador
2. Prince Edward Island
3. Nova Scotia
4. New Brunswick
5. Quebec
6. Ontario
7. Manitoba
8. Saskatchewan
9. Alberta
10. British Columbia
11. Yukon
12. Northwest Territories
13. Nunavut
```

Then the program shows the list of provinces to the user.

Then , it asks the user for the season.

```
3
Season:
1. Spring
2. Summer
3. Fall
4. Winter
2
```

If the user inputs '2' then the program will find out the *total hourly wage spent* on *Software Engineers and Designers* in *Nova Scotia* who worked in the *Summer* season.

The extracted data looks like this :

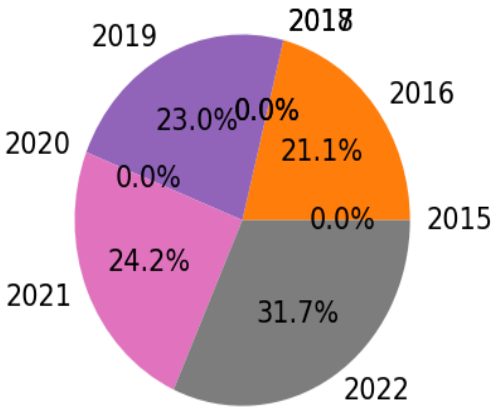
```
REF_DATE,GEO,Statistics,VALUE
2015,Nova Scotia,Total Wage,0
2016,Nova Scotia,Total Wage,844
2017,Nova Scotia,Total Wage,0
2018,Nova Scotia,Total Wage,0
2019,Nova Scotia,Total Wage,921
2020,Nova Scotia,Total Wage,0
2021,Nova Scotia,Total Wage,971
2022,Nova Scotia,Total Wage,1271
would you like to graph the data? (y/n)
```

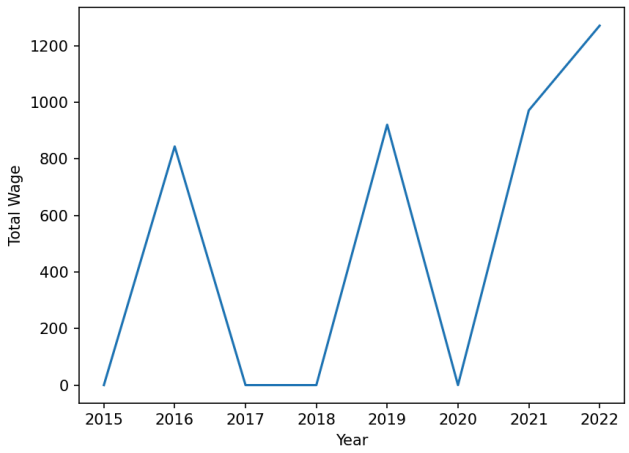
Now, According to the user's preference, system shows three different visual choices

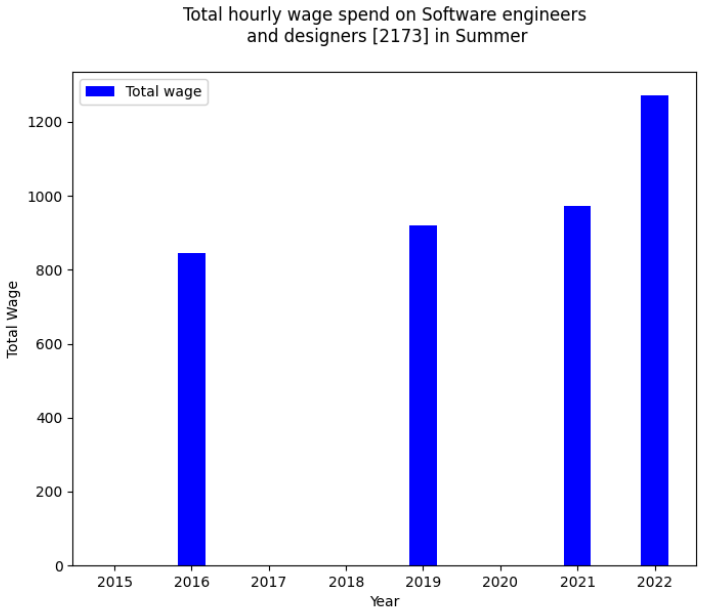
If the user wants to visualize the data in the form of a bar graph or pie or a line chart then according to the choice, it displays it. Back to the main menu.

1.7 Visualization using finished script

"Nova Scotia" "Summer"







2.0 Question Two

Which sectors show the highest demand for non-university certificates or diplomas?

2.1 Why is this Interesting

The non-university certificate or diploma segment is a crucial segment in the labor market that bridges the gap between high school education and university degrees and therefore

exploring the demand in this segment could offer valuable insights. This can acknowledge the role that college diplomas and vocational training play in preparing people for the workforce, supporting industry growth, and addressing skills shortages. Such qualifications often lead to careers in technical, skilled trades, and health services, among others, which are essential for the economy's sustainability and resilience. Understanding where the demand is highest for these qualifications can help guide education policy, curriculum development, and career decision-making. This ensures that the workforce's skills align with market expectations.

2.2 Preliminary data processing required

- **Filtering**: Start with the raw dataset (14100328.csv) and filter them out to only include job vacancies that meet the requirement for non-university certificates or diplomas.
- **Grouping:** Group entries by industry sector.

2.3 Parameters that can be Varied

- Industry Sector: Identifying which sectors have the highest demand for such qualifications.
- Geographical Location: Examining demand across different provinces or territories.

2.4 Data Sources used for this Question

Statistics Canada (Dec, 2023). Table 14-10-0328-05 *Job vacancies, proportion of job vacancies and average offered hourly wage by occupation and minimum level of education sought, quarterly, unadjusted for seasonality*

DOI: https://doi.org/10.25318/1410032801-eng Accessed (Apr, 2023).

2.4.1 Files used from Data Sources

Statistics Canada (2023). Table 14-10-0328-05 *Job vacancies, proportion of job vacancies and average offered hourly wage by occupation and minimum level of education sought, quarterly, unadjusted for seasonality*

DOI: https://doi.org/10.25318/1410032801-eng

2.4.2 Fields used from Files

- ➢ National Occupational Classification
    - Helps categorize the types of jobs available in each sector.
- ➢ Geography
    - To understand how demand varies by province.
- ➢ Minimum Level of Education Required (Job Vacancy Characteristics)
    - "Non-university certificate or diploma" category to focus on the qualifications of interest.
- ➢ Number of Vacancies
    - Indicates the level of demand within each sector.

2.5 Final data processing (using parameters)

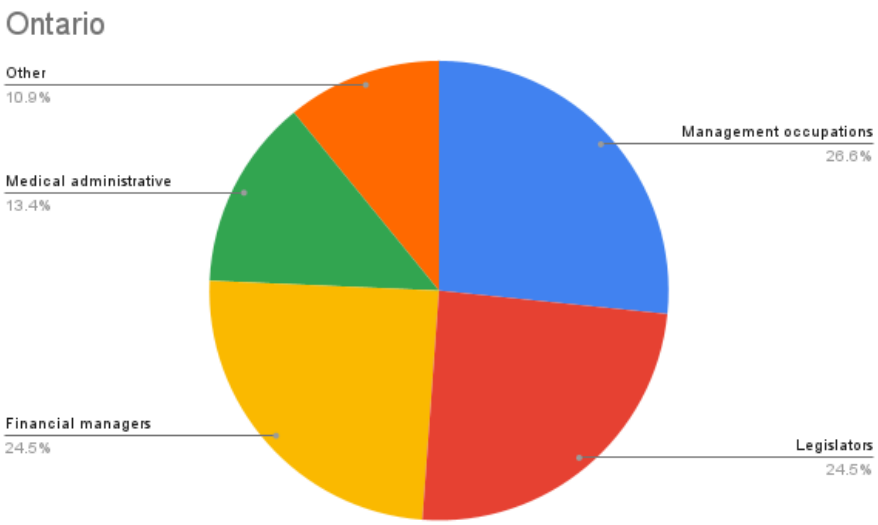
This step takes our parameters into account.

- Geographical location
    - Rows where the ‘geo’ column matches the parameter sent to the program are recorded for analysis.

- National Occupation Classification that matches the Industry Sector
    - Data is filtered based on part of the national occupation classification that matches the industry sector parameter. This helps provide insight into the correct sector such as technology, accounting, etc.

This step refines the dataset so that we may use it specifically to answer our research question by focusing on relevant activities.

2.6 Visualization example



Which sectors show the highest demand for non-university certificates or diplomas in Ontario?

2.6 Running the program

The Data must be pre-processed before using the MileStone_Final.py (it must be pre-processed using the pre_process_Q2_updated.py and the processed data should be directed to a csv file called extract_Q2.csv as it is hard-coded into the file). extract_Q2.csv should be present in the same folder as MileStone_Final.py.

Command line argument for pre-processing:

python3 pre_process_Q2_updated.py "14100328.csv" > "extract_Q2.csv"

Command line argument after preprocessing: **python3 MileStone_Final.py**

```
Data must be pre-processed before running the program.
Tasks to display Job Vacancies in Canada
1. Total offered hourly wage for a particular season
2. Demand for non-university certificates or diplomas by sector and geographical location
3. Most vacant jobs by type of work and position
4. Job vacancies by education level
0. Exit
2
```

The user must choose 2 in order to examine data related to question 2.

```
2
Please choose a province:
Provinces:
1. Newfoundland and Labrador
2. Prince Edward Island
3. Nova Scotia
4. New Brunswick
5. Quebec
6. Ontario
7. Manitoba
8. Saskatchewan
9. Alberta
10. British Columbia
11. Yukon
12. Northwest Territories
13. Nunavut
6
```

The user is then prompted to choose the first parameter, the geographical location (province/territory). The user can type in the corresponding number for each location.

```
6
Enter keyword from NOC, such as Software: software
```

After selecting a location, the user can type in a keyword from the industry they want to research. For example, if you'd like to know about software engineers/designers, you could input software. For marketing, you could type in marketing, etc. Case does not matter.

```
Enter keyword from NOC, such as Software: software
REF_DATE,GEO,National Occupational Classification,Statistics,VALUE
2015-01,Ontario,Software engineers and designers [2173],Job vacancies,0
2015-04,Ontario,Software engineers and designers [2173],Job vacancies,0
2015-07,Ontario,Software engineers and designers [2173],Job vacancies,40
2015-10,Ontario,Software engineers and designers [2173],Job vacancies,90
2016-01,Ontario,Software engineers and designers [2173],Job vacancies,60
2016-04,Ontario,Software engineers and designers [2173],Job vacancies,110
2016-07,Ontario,Software engineers and designers [2173],Job vacancies,205
2016-10,Ontario,Software engineers and designers [2173],Job vacancies,40
2017-01,Ontario,Software engineers and designers [2173],Job vacancies,180
2017-04,Ontario,Software engineers and designers [2173],Job vacancies,130
2017-07,Ontario,Software engineers and designers [2173],Job vacancies,130
2017-10,Ontario,Software engineers and designers [2173],Job vacancies,80
2018-01,Ontario,Software engineers and designers [2173],Job vacancies,0
2018-04,Ontario,Software engineers and designers [2173],Job vacancies,0
2018-07,Ontario,Software engineers and designers [2173],Job vacancies,0
2018-10,Ontario,Software engineers and designers [2173],Job vacancies,150
2019-01,Ontario,Software engineers and designers [2173],Job vacancies,125
2019-04,Ontario,Software engineers and designers [2173],Job vacancies,110
2019-07,Ontario,Software engineers and designers [2173],Job vacancies,95
2019-10,Ontario,Software engineers and designers [2173],Job vacancies,95
2020-01,Ontario,Software engineers and designers [2173],Job vacancies,115
2020-10,Ontario,Software engineers and designers [2173],Job vacancies,95
2021-01,Ontario,Software engineers and designers [2173],Job vacancies,85
2021-04,Ontario,Software engineers and designers [2173],Job vacancies,150
2021-07,Ontario,Software engineers and designers [2173],Job vacancies,350
2021-10,Ontario,Software engineers and designers [2173],Job vacancies,600
2022-01,Ontario,Software engineers and designers [2173],Job vacancies,695
2022-04,Ontario,Software engineers and designers [2173],Job vacancies,340
2022-07,Ontario,Software engineers and designers [2173],Job vacancies,230
2022-10,Ontario,Software engineers and designers [2173],Job vacancies,230
2023-01,Ontario,Software engineers and designers [2173],Job vacancies,145
2023-04,Ontario,Software engineers and designers [2173],Job vacancies,0
2023-07,Ontario,Software engineers and designers [2173],Job vacancies,0
Do you want to plot the data? (yes/no):
```

After that, the program will output the data for the parameters chosen. The program will ask if the user wishes to plot the data. The user can answer yes/no. Case does not matter.

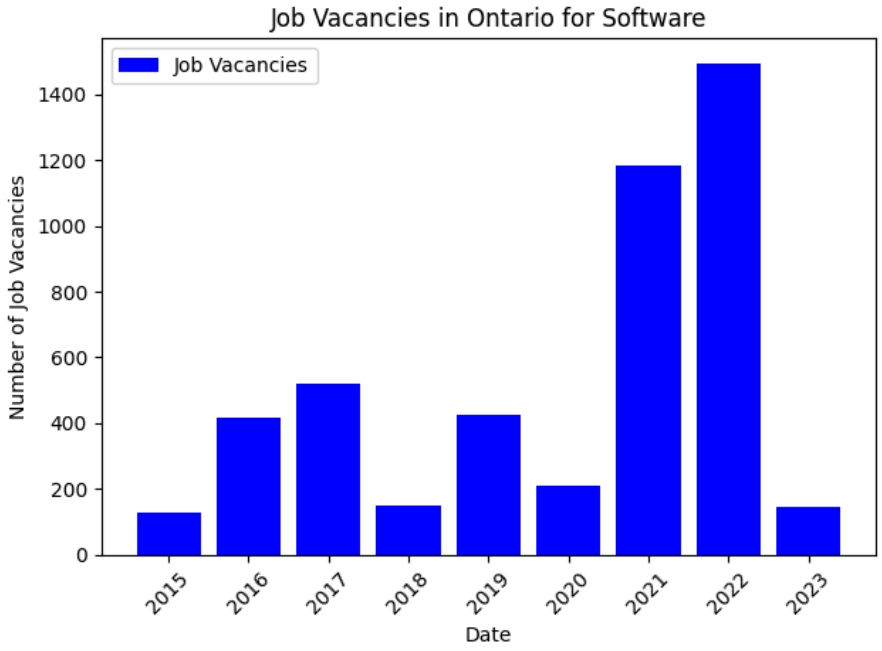
```
2023-01,Ontario,Software engineers and designers [2173],Job vacancies,145
2023-04,Ontario,Software engineers and designers [2173],Job vacancies,0
2023-07,Ontario,Software engineers and designers [2173],Job vacancies,0
Do you want to plot the data? (yes/no): YES
Choose the type of graph (1 for Bar chart, 2 for Line chart): 1
```

Now, the user has a choice to choose the type of graph they would like to plot data on (should they decide to plot data). 1 can be inputted for a bar chart and 2 for a line chart. The program will now display the graph based on the type of chart chosen. Back to the main menu.

2.7 Visualization using finished script

From the charts below, we see that:

- **More Jobs in Marketing**: Our charts show that marketing jobs in Ontario are more common than software jobs (for non-university certificates or diplomas). In 2022, there were around 7000 marketing jobs but only about 1400 in software.
- **Learning and Jobs**: These numbers tell us that if schools offer more courses in marketing, they might help people get ready for the jobs that are out there.
- **Trends**: It's good to look at how the job numbers change each year. This can show us if the growth in marketing jobs just happened or if it has been going on for a while. We see that both Marketing and Software saw a decrease in 2023 for their job vacancies.


Job Vacancies in Ontario for Software
Job Vacancies
Number of Job Vacancies
0
200
400
600
800
1000
1200
1400
2015
2016
2017
2018
2019
2020
2021
2022
2023
Date


Job Vacancies in Ontario for Marketing
Job Vacancies
Number of Job Vacancies
0
1000
2000
3000
4000
5000
6000
7000
2015
2016
2017
2018
2019
2020
2021
2022
2023
Date

Furthermore, we see from this chart for Marketing in Quebec that Ontario would be a better choice for someone who holds a non-university certificate or diploma within the Marketing industry. This is because Ontario has held a higher number of job vacancies than Quebec in Marketing. It's also worth noting that Quebec has been at a steady decline in vacancies, however, Ontario took a notable drop in the year 2023 after previously reaching the 5-year-high.

3.0 Question Three

What type of work positions are the most vacant in Canada for Software Engineers and Designers over the years?

3.1 Why is this Interesting

As the Software Engineering field grows it would be interesting to know if the type of work and type of position vacancies grow at a ratio or if different positions grow at a faster rate. Since the standard for industry jobs used to be nine to five full-time permanent positions but recently contract type work like seasonal full-time work has been gaining interest in the market.

We can expect the data to show a linear or exponential graph as the number of jobs increase over time so do vaccines. Another variable to take into account is Covid-19 this caused many layoffs in tech which could cause more vacant job positions to be filled as the labor force would be over saturated.

3.2 Preliminary data processing required

Since file 14100328.csv is too large (7.86GB) straight from Statistics Canada, extracting the data down into a file with data related to question 3. Filtering data by "job vacancies" for "Software engineers and designers [2173]" creates a new csv table that is only 2.2MB allowing for quick real time processing for the question.

3.3 Parameters that can be Varied

Job vacancy characteristics can be varied by type of work and type of position.

Type of work:

- Full-time (A full-time job is a job requiring 30 or more hours of work per week)
- Part-time (A part-time job is a job requiring less than 30 hours of work per week.)
- All types of work(Job requiring any number of hours worked)

Type of position:

- Permanent (A permanent position is one that is expected to last as long as the employee wants it, given that business conditions permit. That is, there is no predetermined termination date.)
- Temporary (A temporary position has a predetermined end date, or will end as soon as a specified project is completed.)

- Seasonal (Some temporary jobs are seasonal when they are linked to a recurring event (for example, public holidays) or time of the year (for example, summertime))
- All types of positions(Just has to a be a position at a job)
-

3.4 Data Sources used for this Question

Statistics Canada. (Dec, 2023). Job vacancies, proportion of job vacancies and average offered hourly wage by selected characteristics, quarterly, unadjusted for seasonality. DOI: https://doi.org/10.25318/1410032801-eng Accessed (Apr, 2023).

****Statistics Canada notes**: Data for the second and third quarters of 2020 are unavailable due to some Statistics Canada operations being temporarily suspended during the COVID-19 pandemic.**

3.4.1 Files used from Data Sources

Statistics Canada. (2023). *Table 14-10-0328-04 Job vacancies, proportion of job vacancies and average offered hourly wage by occupation and type of position, quarterly, unadjusted for seasonality.* DOI: https://doi.org/10.25318/1410032801-eng Accessed (Apr, 2023).

Statistics Canada. (2023). *Table 14-10-0328-02 Job vacancies, proportion of job vacancies and average offered hourly wage by occupation and type of work, quarterly,*

unadjusted for seasonality. DOI: https://doi.org/10.25318/1410032801-eng

Accessed (Apr, 2023).

3.4.2 Fields used from Files

REF_DATE

- The year and quarter the data was collected.
- Combining the quarters of each year to just display the year overall.
- Will be used as the x value of bar graphs.

GEO

- The region the data was collected from.
- Canada is being used as a fixed variable.

National Occupational Classification

- Type of job.
- Software Engineer and Designer [2173] is being used as a fixed variable.

Job vacancy characteristics

- The characteristics of the job, using two argument variables.
- Type of work and type of position.

VALUE

- Amount of job vacancies recorded.
- Will be used as the y value in bar graphs

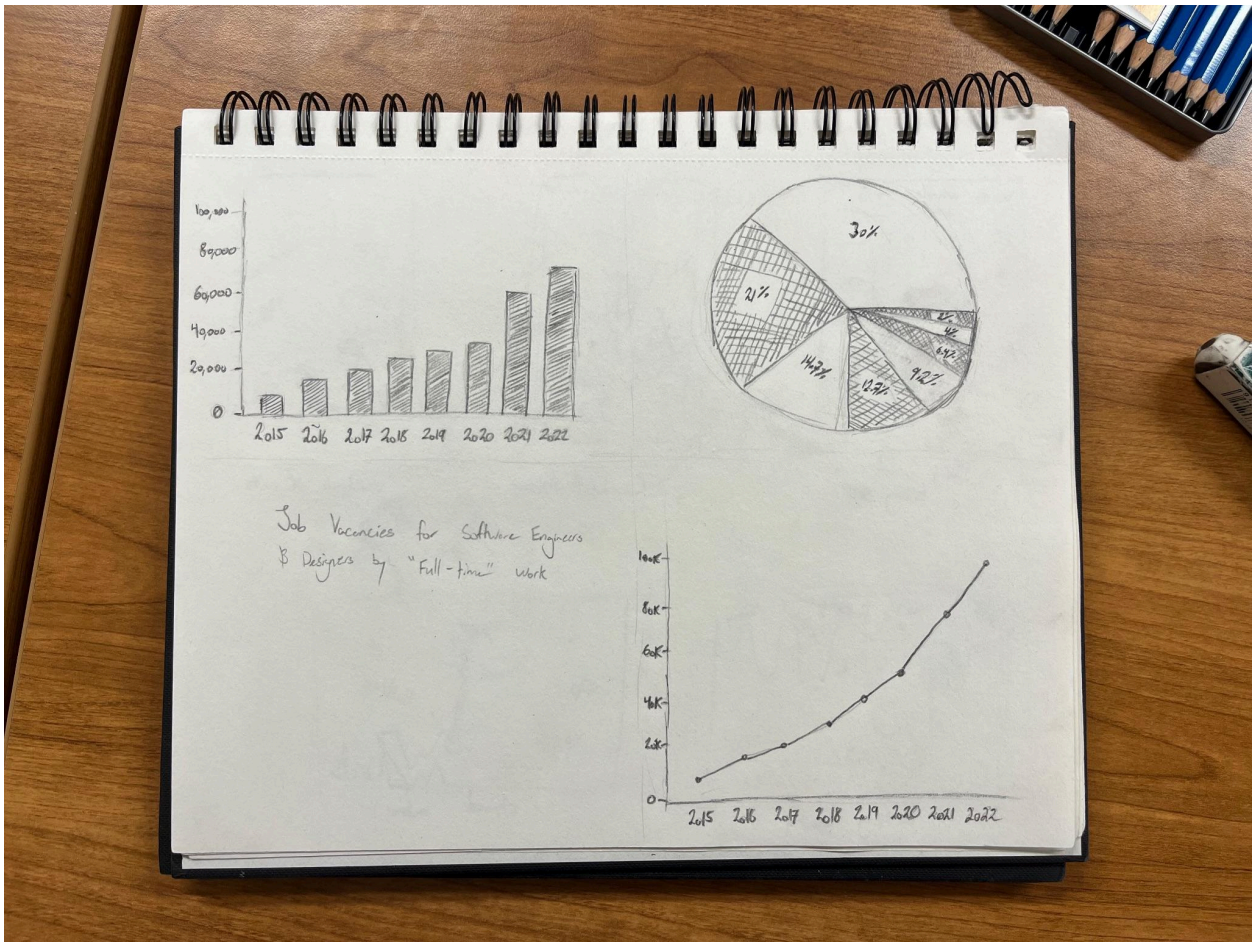
STATUS

- How reliable the data is
- This will not be displayed in graphs just recorded with a table.

3.5 Final data processing (using parameters)

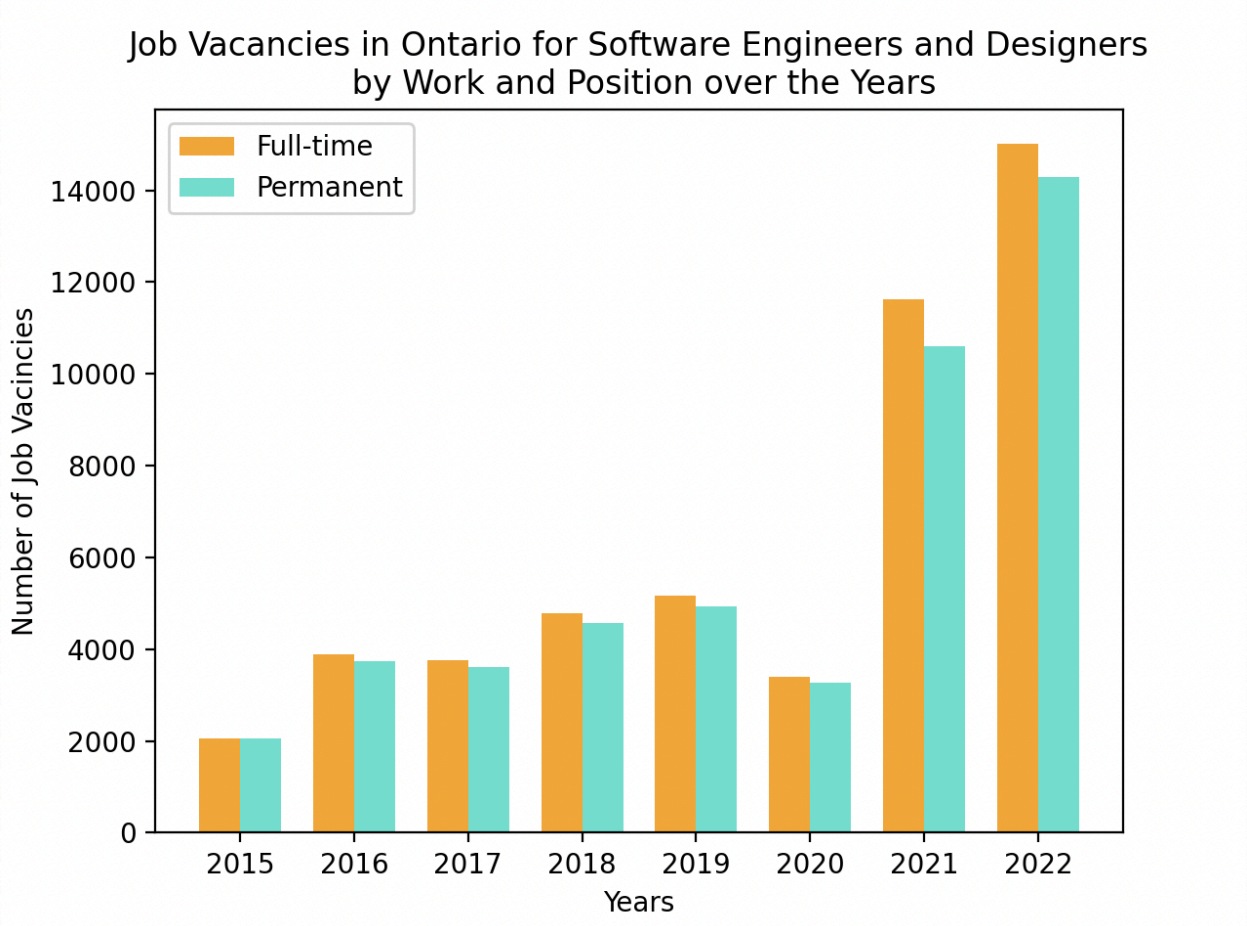
To filter data into by year form, a loop will run checking if (i[0][:4] == year). With year being the starting year (2015), the if statement will check REF_Date's (2015-01) first four digits are the same as year, this will disregard the quarter term displayed after the year. The loop will calculate the total value i[5] if the Job vacancy characteristics match either one of parameters of type of work or type of position.

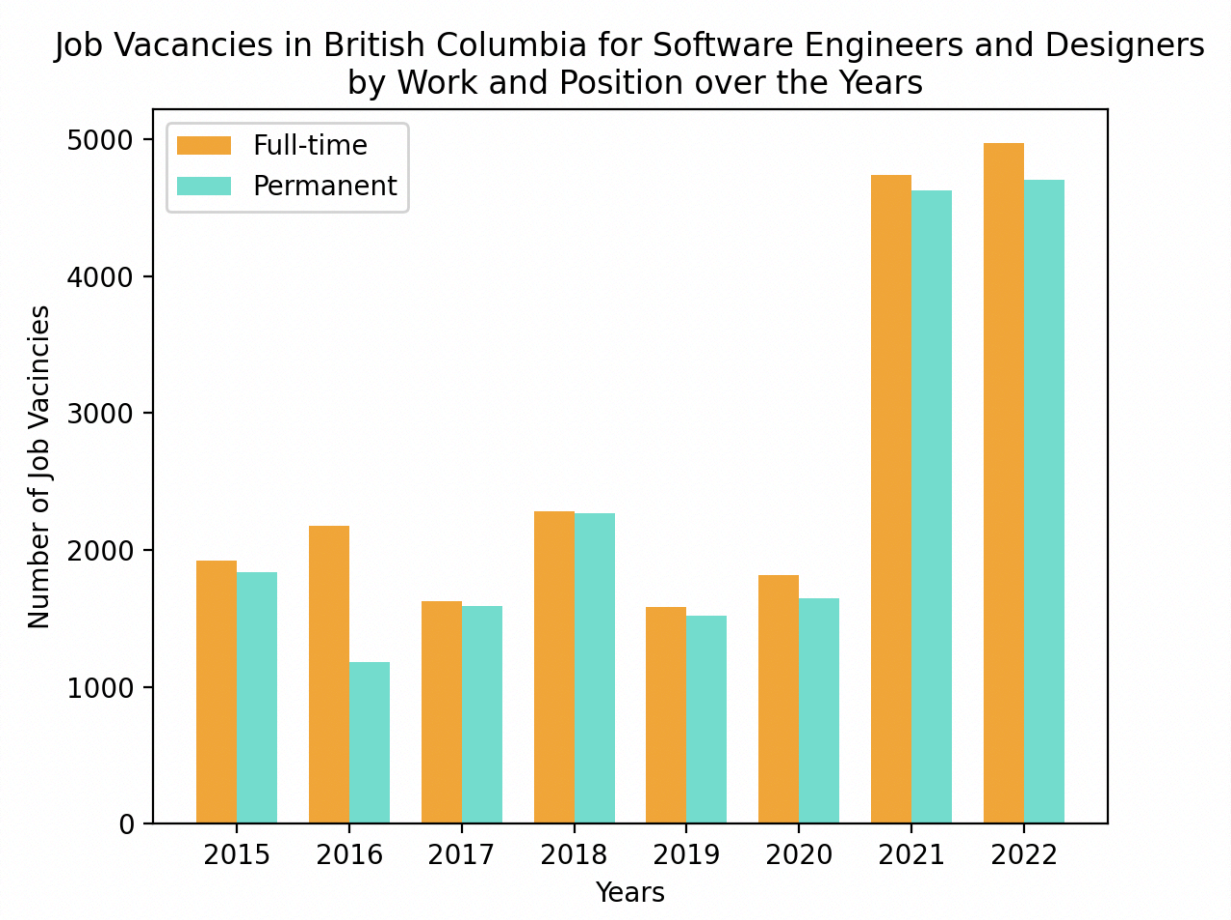
3.6 Visualization example



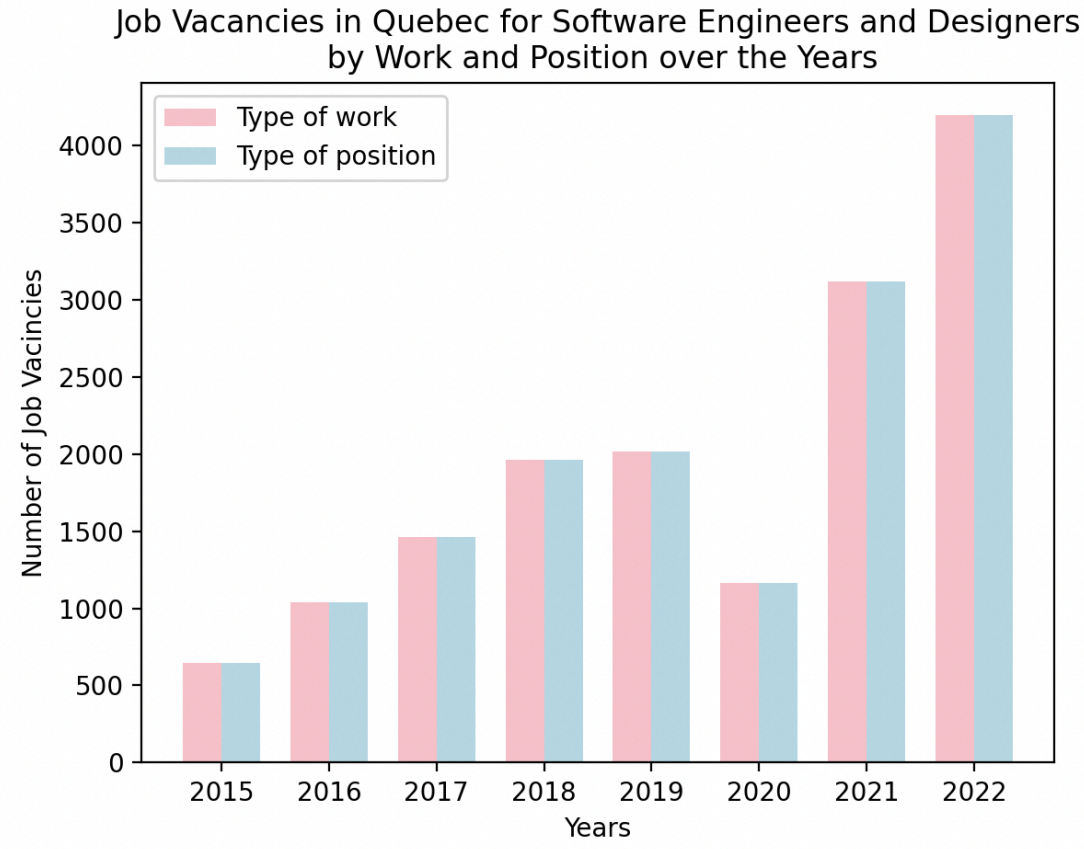
3.7 Visualization using finished script

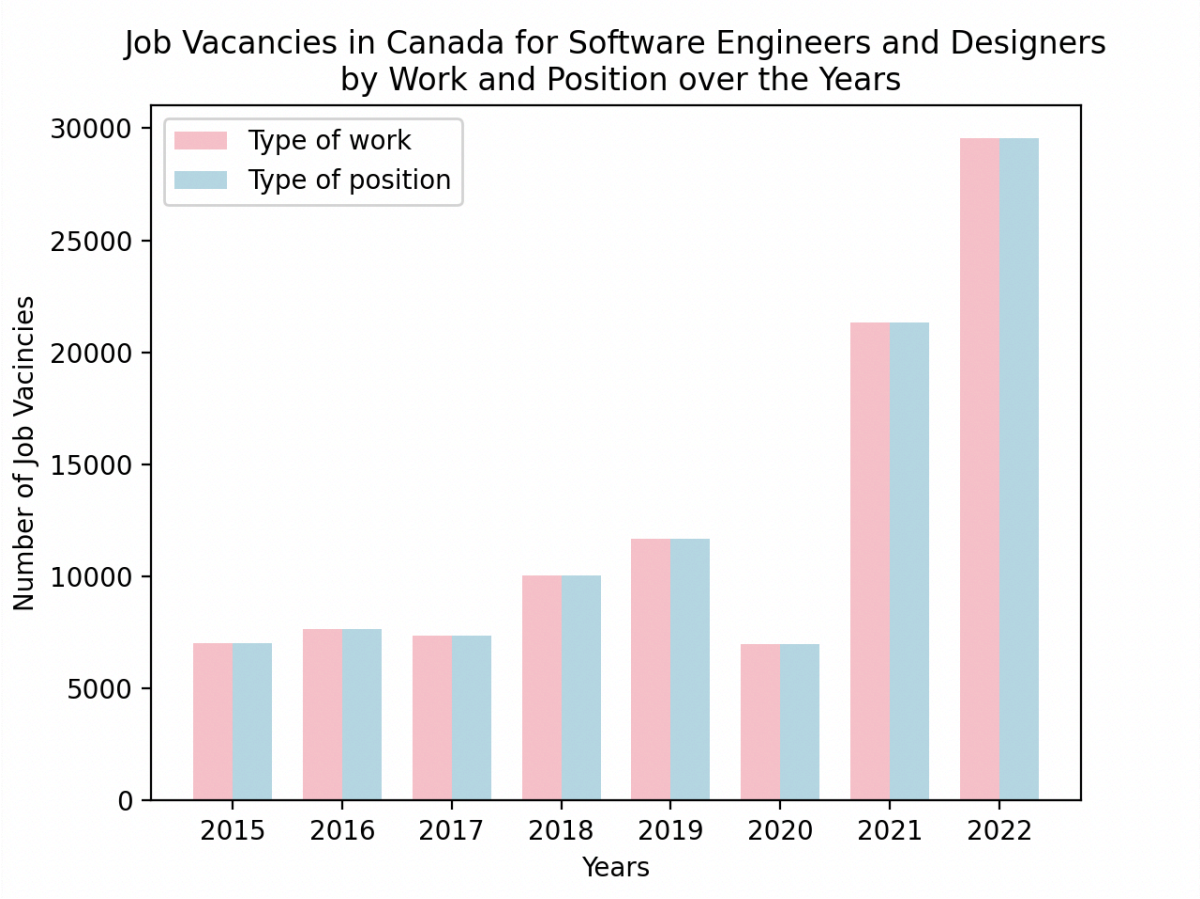
Job vacancies of full-time permanent positions for software engineers between 2015 to 2022. The graph on the left is for Ontario and the graph on the right is for British Columbia, from this data we can tell there was the same amount of job vacancies between the two in 2015. However, Ontario's job vacancies have increased exceptionally over the years. We can also tell the number of job vacancies took a jump after covid.




Job Vacancies in British Columbia for Software Engineers and Designers
by Work and Position over the Years
Full-time
Permanent
Number of Job Vacincies
0
1000
2000
3000
4000
5000
2015
2016
2017
2018
2019
2020
2021
2022
Years

Job vacancies of all types of positions for software engineers between 2015 to 2022, The graph on the left is for Quebec and the graph on the right is for all of Canada. Quebecs job vacancies have been growing at a steady rate while all of Canada has only started having job vacancies grow from 2018.





3.8 running script example

The user is prompted to enter the first parameter which is the type of work, (full-time is 30+ hrs a week and part-time is less than 30 hrs a week)

Type of work:

1. Full-time

2. Part-time

3. All-types

3

Next the system shows the second parameter of the position which is the how long the position is for at the company.

Type of position:
1. Permanent
2. Temporary
3. Seasonal
4. All-types

1

After the system prompts for which province of canada or all of them.

Provinces:
1. Newfoundland and Labrador
2. Prince Edward Island
3. Nova Scotia
4. New Brunswick
5. Quebec
6. Ontario
7. Manitoba
8. Saskatchewan
9. Alberta
10. British Columbia
11. Yukon
12. Northwest Territories
13. Nunavut
14. All provinces

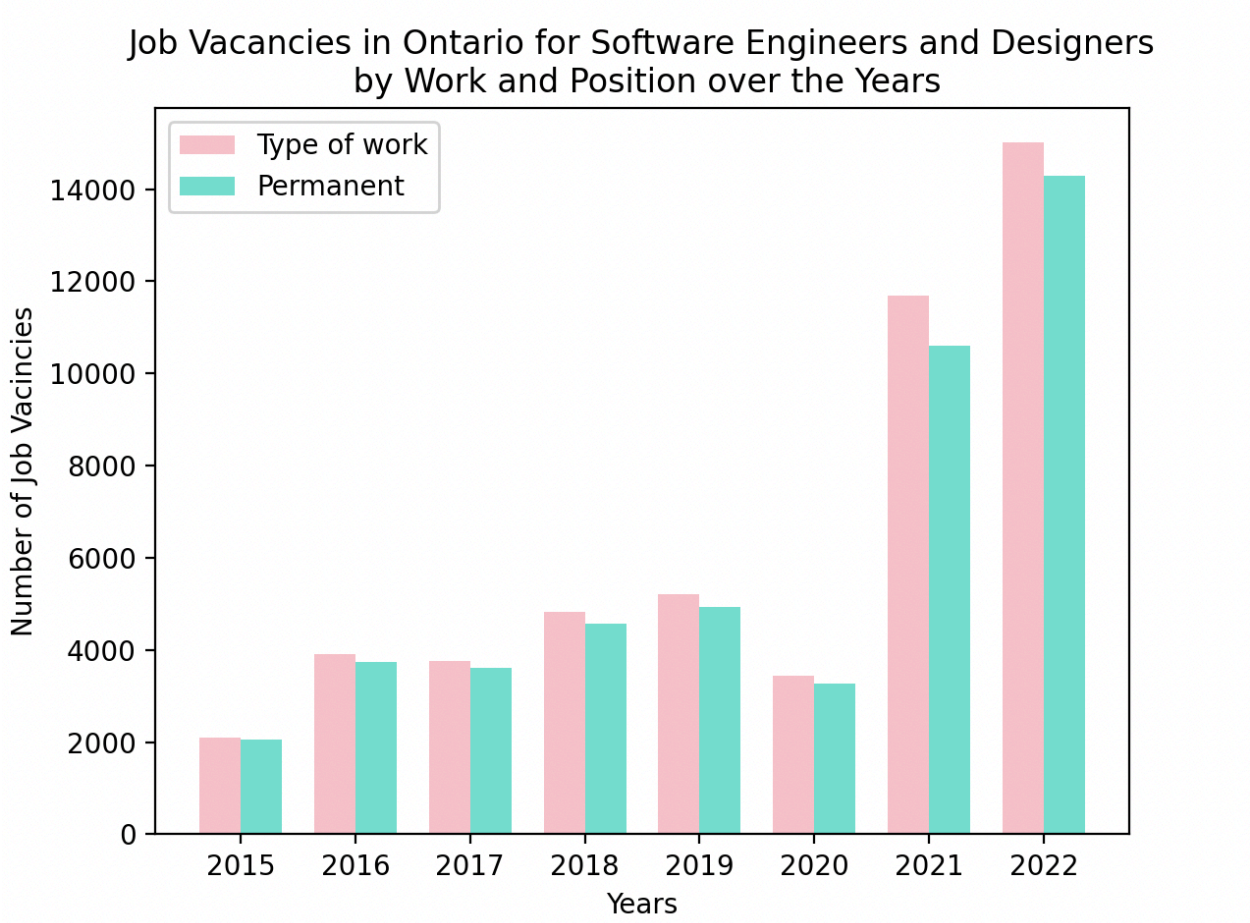
6

Next the system will create a figure number for this database in incremental order of processing the questions which can later be displayed with the graph, the figure number will correspond to the ith table created.

REF_DATE,GEO,Job vacancy characteristics,VALUE
2015,Ontario,Type of work,2105
2015,Ontario,Permanent,2045
2016,Ontario,Type of work,3900
2016,Ontario,Permanent,3740
2017,Ontario,Type of work,3770
2017,Ontario,Permanent,3610
2018,Ontario,Type of work,4825
2018,Ontario,Permanent,4580
2019,Ontario,Type of work,5215
2019,Ontario,Permanent,4925
2020,Ontario,Type of work,3440

2020,Ontario,Permanent,3275
2021,Ontario,Type of work,11685
2021,Ontario,Permanent,10595
2022,Ontario,Type of work,15005
2022,Ontario,Permanent,14280
Would you like to graph the data? (y/n)

y



Finally the system will take the user back to the [main menu] while also leaving the graph up and table in the terminal.

4.0 Question Four

How do the different levels of education play a role in job vacancies for total occupational classifications?

4.1 Why is this Interesting

As many people our age are figuring out what the next step is after high school, whether going to university, college, or straight to work it is interesting what level of education correlates with job vacancies. From having just a high school diploma to having a bachelor's degree can play a big difference in job vacancies. What we can expect from this, is that there will be a decrease in job vacancies as the higher level of education you have. This is shown by how many people depict that people with a university or college degree would be better suited for a job than someone with a degree. As well the occupation you choose to pursue will play a difference in what education you have and the amount of job vacancies.

4.2 Preliminary data processing required

- Start with the job vacancy characteristic and then sort based on level of education (will start with 'no level of education' and work up to 'degree above bachelor's')
- Filter the job vacancy characteristics data into their own group

4.3 Parameters that can be Varied

- The occupation which is the type of job title
- The region which is the province

4.4 Data Sources used for this Question

Job Vacancies, Proportion of Job Vacancies and Average Offered Hourly Wage by Occupation and Minimum Level of Education Sought, Quarterly, Unadjusted for Seasonality, Government of Canada, Statistics Canada, 18 Dec. 2023, DOI: www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410032805. Accessed (Apr. 2023)

4.4.1 Files used from Data Sources

Job Vacancies, Proportion of Job Vacancies and Average Offered Hourly Wage by Occupation and Minimum Level of Education Sought, Quarterly, Unadjusted for Seasonality, Government of Canada, Statistics Canada, 18 Dec. 2023, DOI: www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410032805. Accessed (Apr, 2023).

4.4.2 Fields used from Files

National Occupational Classification

- Will show different types of occupations/jobs

Job Vacancy Characteristics

- Shows different levels of education

Geography

- The region the data was collected from

Number of Vacancies

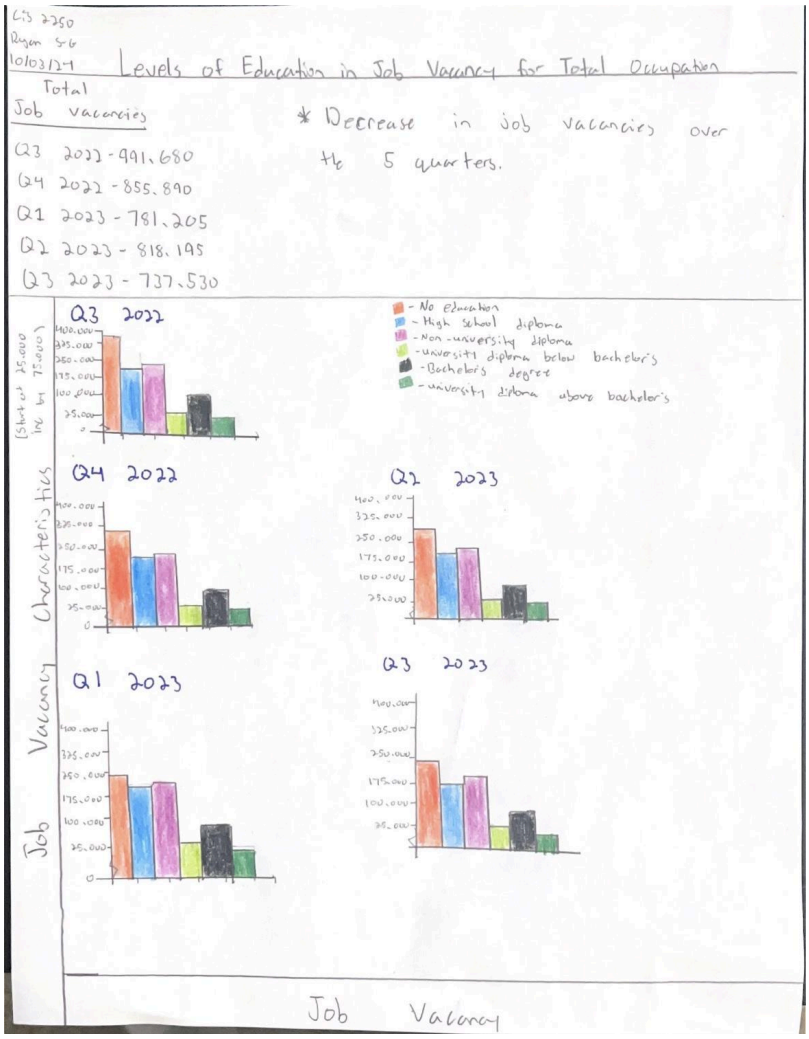
- Shows number of each job vacancy for each sector

4.5 Final data processing (using parameters)

Filter data in from the job vacancies and process it through the type of education level. Run through each quarter starting with q3 from 2022 to q3 in 2023 and data will be from total occupational classification. When a user enters a certain quarter it will show the job vacancies in that quarter based on level of education.

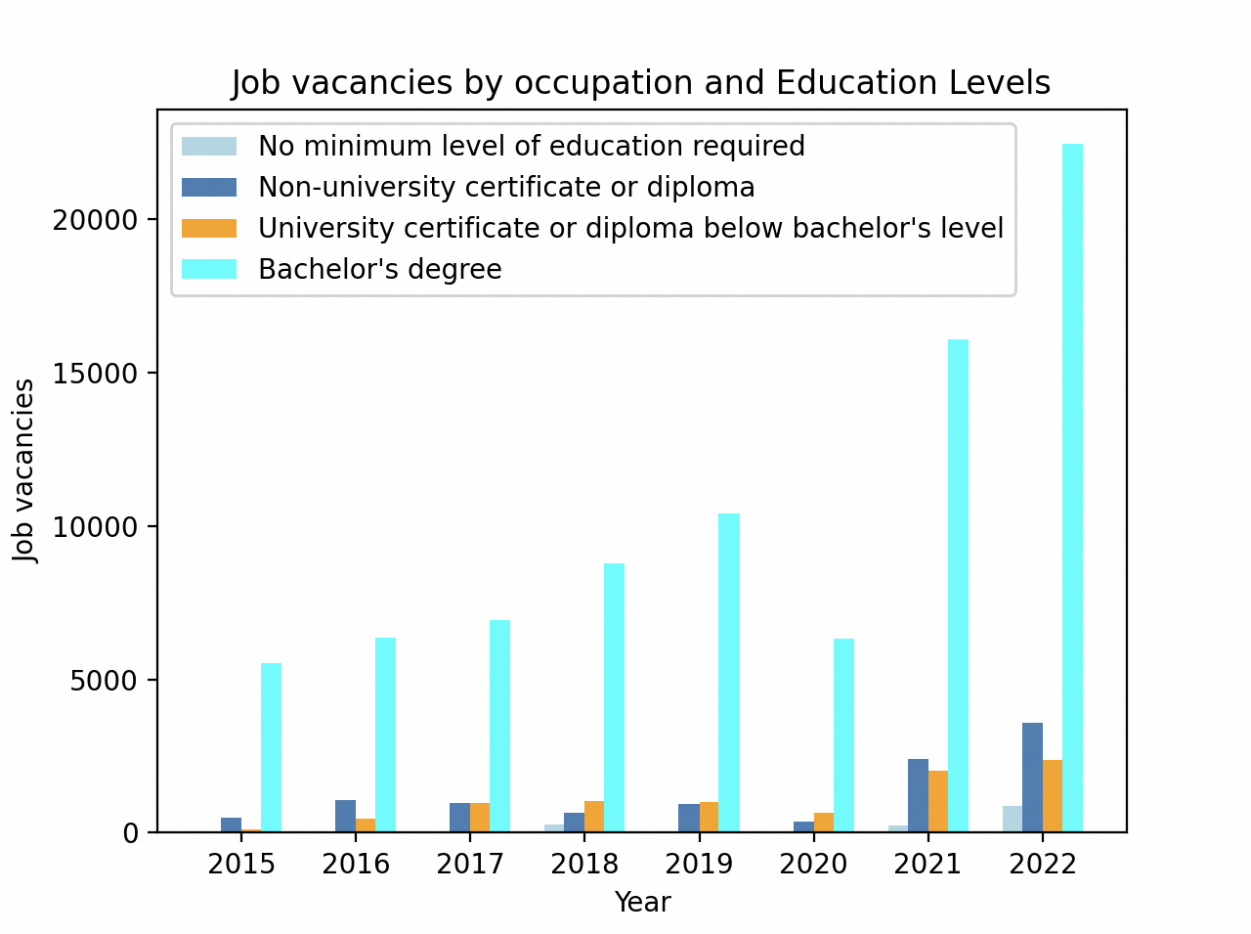
4.6 Visualization example

Shown in the visualization example are 5 graphs for each of the quarterly stats for each type of job vacancy for each education level

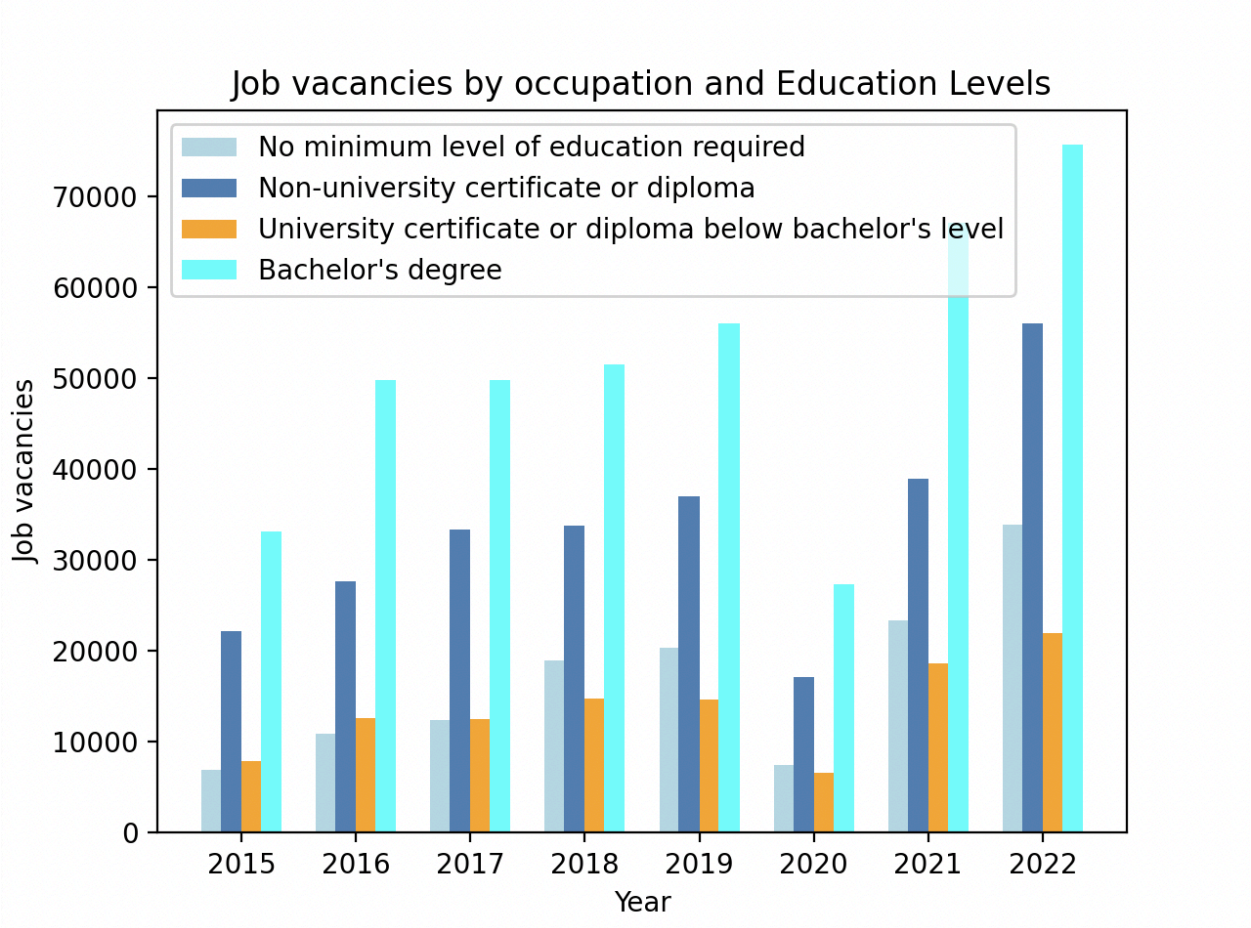


4.7 Visualization using finished script

Job vacancies for computer engineers over Canada sorted by education over the years.



Job vacancies for Senior government managers and officials over Canada sorted by education over the years.



4.8 Final code example

The first parameter is what occupation you would like to sort by

Please choose an occupation: (ex. software, financial)

computer

Next the system displays the provinces as the second parameter

Provinces:
1. Newfoundland and Labrador
2. Prince Edward Island
3. Nova Scotia
4. New Brunswick
5. Quebec
6. Ontario
7. Manitoba

8. Saskatchewan
9. Alberta
10. British Columbia
11. Yukon
12. Northwest Territories
13. Nunavut
14. All provinces

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Next the program will display a table of the data, below is just the first few as the list is long.

The system will ask if you want to display the table as a graph.

REF_DATE,GEO,National Occupational Classification,Job vacancy characteristics,VALUE

2015,Canada,Computer engineers [2147],Minimum level of education required,0

2015,Canada,Computer engineers [2147],No minimum level of education required,10

2015,Canada,Computer engineers [2147],High school diploma or equivalent,10

2015,Canada,Computer engineers [2147],Non-university certificate or diploma,505

2015,Canada,Computer engineers [2147],Trade certificate or diploma,0

2015,Canada,Computer engineers [2147],College,0

2015,Canada,Computer engineers [2147],University certificate or diploma below bachelor's level,100

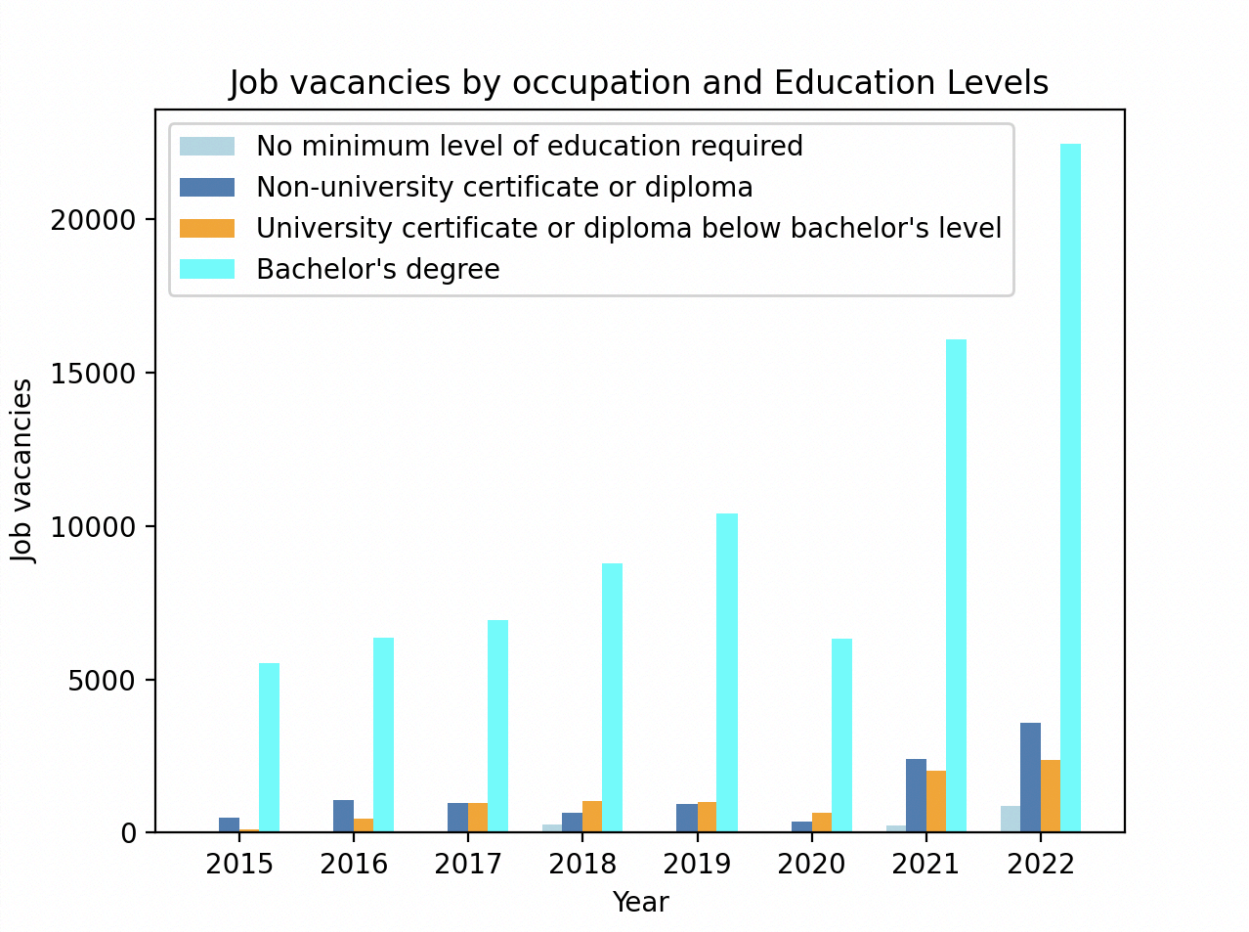
2015,Canada,Computer engineers [2147],Bachelor's degree,5530

2015,Canada,Computer engineers [2147],University certificate,0

2015,Canada,Computer engineers [2147],Certification requirement,0

Would you like to graph the data? (y/n)

y



The graph shows the four education categories. Back to the main menu.