

Finding job Prediction During Pathrise Program

K Nearest Neighbor

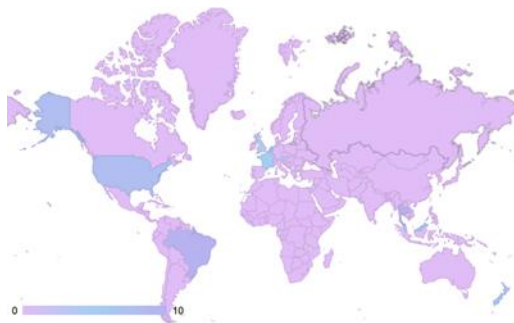
Delaram Doroudgarian



2024/2025

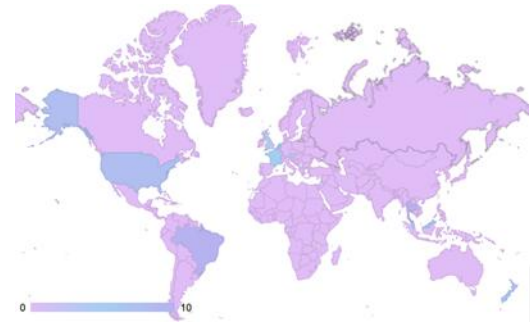
INTRODUCTI ON

In this analysis, we explore data from Pathrise, an online program aiding job seekers in the tech industry. The primary focus is to predict if a fellow will be placed at a company.



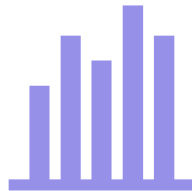
The main question that needs to be answered in this project is:

- Can we predict if candidate will be placed at Pathrise?



Dataset

Participant information of the Pathrise program

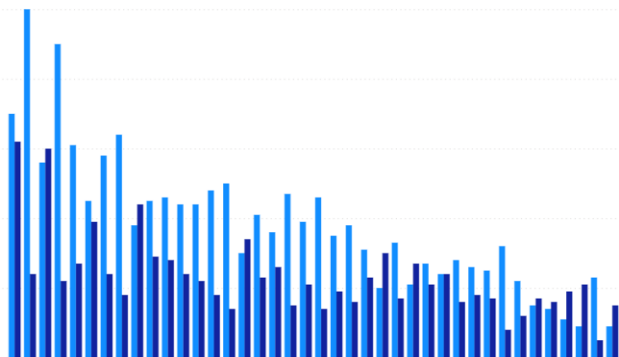


The dataset contains information including high level of education, length of job search, professional experience, and more for 2544 individuals, and the "placed" column represents the main outcome, indicating whether a person was hired (1) or not (0) during the program

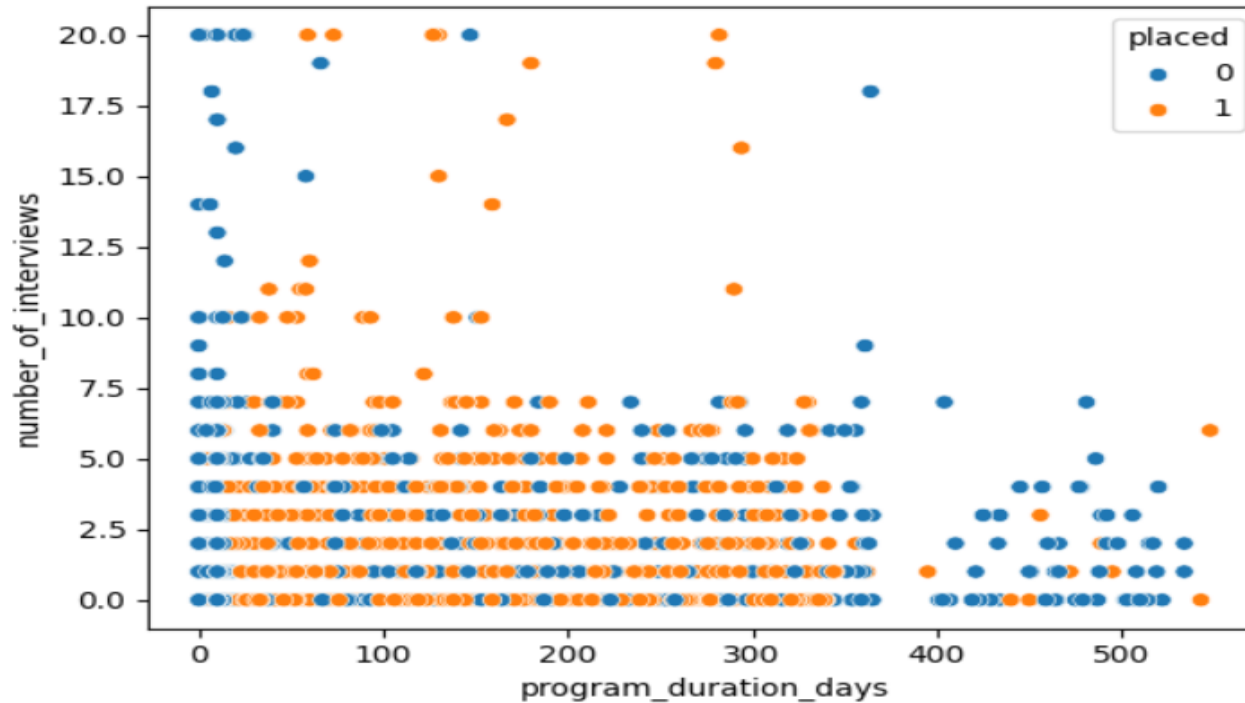


Type	Column	Row
All	17	2544
Object	11	2544
Int	4	2544
Float	2	2544

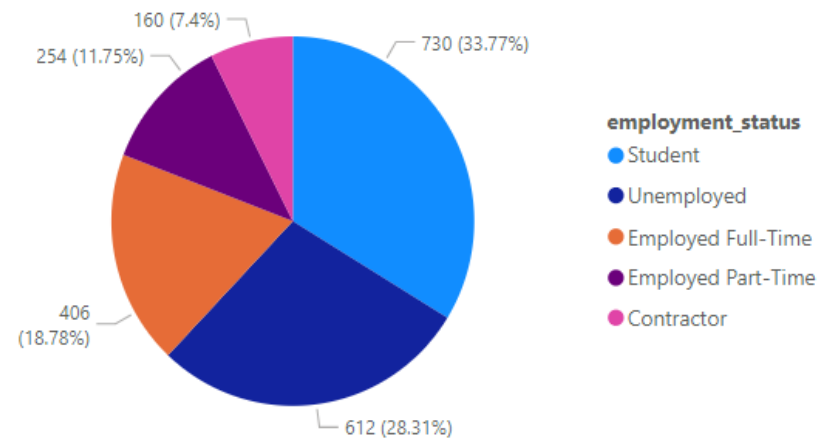
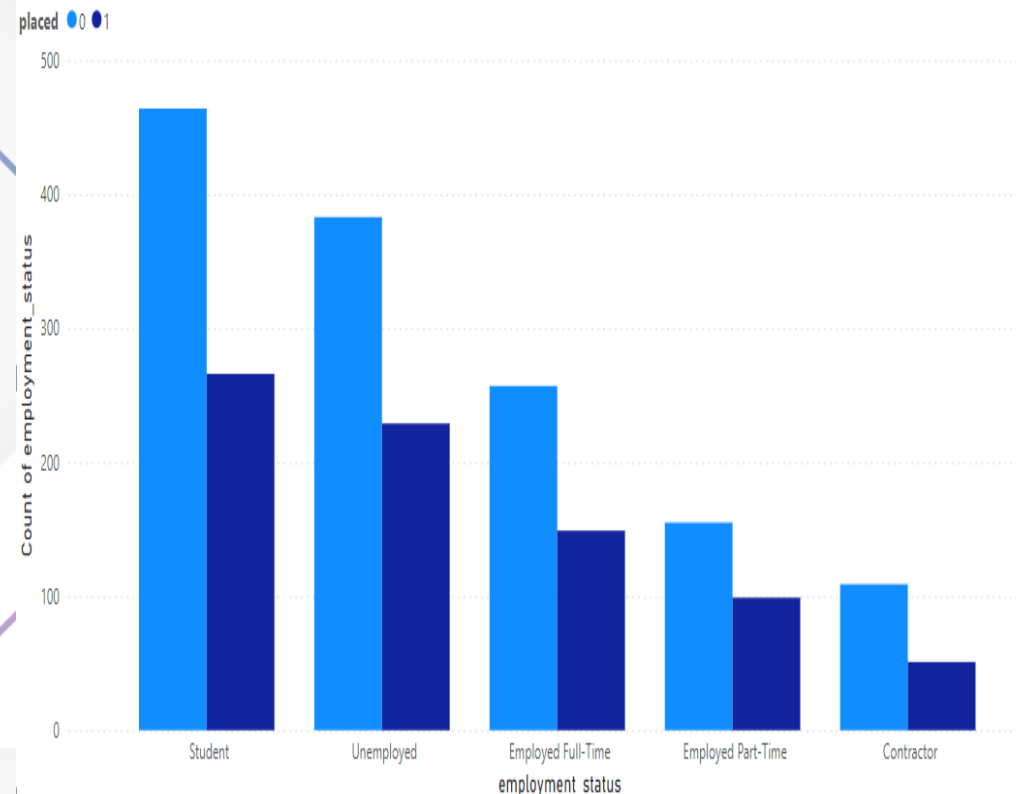
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	id	pathrise_status	primary_track	cohort_tag	program_duration_days	placed	employment_status	highest_level_of_education	length_of_job_search	biggest_challenge_in_search	professional_experience	work_authorization_status	number_of_interviews	number_of_applications	gender	race	
2	0	1 Active	SWE	OCT19A			0 Unemployed	Bachelor's Degree	3-5 months	Hearing back on my applications	3-4 years	Canada Citizen	2		900 Male	Non-Hisp	
3	1	2 Active	PSO	JAN20A			0 Unemployed	Some College, No Degree	3-5 months	Getting past final round interviews	1-2 years	Citizen	6		0 Male	Non-Hisp	
4	2	3 Closed Lost	Design	AUG19B		0	0 Employed Part-Time	Master's Degree	Less than one month	Figuring out which jobs to apply for	Less than one year	Citizen	0		0 Male	East Asia	
5	3	4 Closed Lost	PSO	AUG19B		0	0 Contractor	Bachelor's Degree	Less than one month	Getting past final round interviews	Less than one year	Citizen	5		25 Male	Decline to	
6	4	5 Placed	SWE	AUG19A		89	1 Unemployed	Bachelor's Degree	1-2 months	Hearing back on my applications	1-2 years	F1 Visa/OPT	10		100 Male	East Asia	
7	5	6 Closed Lost	SWE	AUG19A		0	0 Employed Full-Time	Master's Degree	1-2 months	Technical interviewing	3-4 years	Green Card	5		100 Male	East Asia	
8	6	7 Closed Lost	SWE	AUG19B		0	0 Employed Full-Time	Master's Degree	Less than one month	Getting past phone screens	3-4 years	Green Card	0		9 Male	Black, Afr	
9	7	8 Withdrawn (Failed)	SWE	AUG19A		19	0 Employed Part-Time	Bachelor's Degree	Less than one month	Getting past final round interviews	1-2 years	Citizen	4		15 Female	Latino or	
10	8	9 Active	SWE	AUG19B			0 Student	Master's Degree	Less than one month	Technical interviewing	1-2 years	F1 Visa/CPT	1		5 Male	East Asia	
11	9	10 Withdrawn (Trial)	SWE	SEP19A		13	0 Employed Full-Time	Master's Degree	Less than one month	Getting past final round interviews	3-4 years	Citizen	0		10 Male	Black, Afr	
12	10	11 Closed Lost	PSO	AUG19B		0	0 Unemployed	Master's Degree	1-2 months	Hearing back on my applications	1-2 years	Other	0		3 Male	Latino or	
13	11	12 Withdrawn	Data	AUG19C		158	0 Unemployed	Master's Degree	3-5 months	Lack of relevant experience	5+ years	Citizen	5		50 Male	Decline to	
14	12	13 Withdrawn (Trial)	Design	OCT19A		12	0 Contractor	Bachelor's Degree	6 months to a year	Getting past phone screens	1-2 years	Green Card	3		10 Male	Middle Ea	
15	13	14 Withdrawn	PSO	OCT19A		52	0 Employed Part-Time	Bachelor's Degree	1-2 months	Lack of relevant experience	Less than one year	Citizen	4		40 Male	Non-Hisp	
16	14	15 Active	PSO	DEC19A			0 Employed Full-Time	Bachelor's Degree	1-2 months	Technical skills	1-2 years	Citizen	2		35 Male	Non-Hisp	
17	15	16 Active	PSO	JAN20A			0 Employed Full-Time	Bachelor's Degree	3-5 months	Getting past mid-stage interviews	Less than one year	Citizen	1		25 Male	South Asi	
18	16	17 Active	PSO	FEB20A			0 Student	Bachelor's Degree	Less than one month	Getting past phone screens	3-4 years	Green Card	1		35 Male	East Asia	
19	17	18 Active	SWE	JAN20A			0 Student	Bachelor's Degree	1-2 months	Lack of relevant experience	1-2 years	Green Card	5		45 Female	Middle Ea	
20	18	19 Active	SWE	JAN20A			0 Unemployed	Bachelor's Degree	3-5 months	Hearing back on my applications	Less than one year	Citizen			15 Male	East Asia	
21	19	20 Withdrawn (Trial)	Data	AUG19A		13	0 Employed Full-Time	Bachelor's Degree	1-2 months	Getting past final round interviews	1-2 years	Citizen	0		70 Male	Latino or	
22	20	21 Active	Data	FEB20A			0 Employed Part-Time	Master's Degree	3-5 months	Technical interviewing	3-4 years	Citizen	3		30 Male	East Asia	
23	21	22 Withdrawn (Trial)	SWE	NOV19A		11	0 Student	Master's Degree	3-5 months	Hearing back on my applications	3-4 years	F1 Visa/OPT	1		9 Male	Black, Afr	
24	22	23 Withdrawn	SWE	AUG19A		93	0 Contractor	Bachelor's Degree	6 months to a year	Hearing back on my applications	1-2 years	Citizen	1		10 Female	East Asia	
25	23	24 Placed	PSO	NOV19B		193	1 Unemployed	Master's Degree	6 months to a year	Hearing back on my applications	1-2 years	Citizen	5		4 Male	Non-Hisp	
26	24	25 Closed Lost	Design	NOV19B		0	0 Contractor		1-2 months	Hearing back on my applications	3-4 years	Green Card	0		20	East Asia	
27	25	26 Active	SWE	JAN20B			0 Student	Bachelor's Degree	1-2 months	Lack of relevant experience	Less than one year	F1 Visa/OPT	0		130 Male	East Asia	
28	26	27 Active	SWE	FEB20B			0 Student	Bachelor's Degree	1-2 months	Figuring out which jobs to apply for	1-2 years	Citizen	2		15 Male	Latino or	
29	27	28 Withdrawn (Trial)	SWE	NOV19A		12	0 Unemployed	Bachelor's Degree	3-5 months	Technical interviewing	5+ years	Citizen	0		20 Female	East Asia	
30	28	29 Closed Lost	PSO	JAN20A		0	0 Employed Full-Time	Bachelor's Degree	6 months to a year	Hearing back on my applications	Less than one year	Citizen			45 Male	Non-Hisp	
31	29	30 Withdrawn (Trial)	Design	JAN20B		13	0 Unemployed	Master's Degree	1-2 months	Getting past phone screens	1-2 years	F1 Visa/OPT	0		110 Female	Latino or	
32	30	31 Placed	SWE	NOV19A		73	1 Student	Master's Degree	Less than one month	Figuring out which jobs to apply for	1-2 years	F1 Visa/CPT	0		1 Male	East Asia	
33	31	32 Active	SWE	JAN20B			0 Student	Bachelor's Degree	3-5 months	Getting past phone screens	Less than one year	Other	5		10 Male	East Asia	
34	32	33 Withdrawn	SWE	NOV19A		286	0 Student	Bachelor's Degree	1-2 months	Hearing back on my applications	1-2 years	F1 Visa/OPT	0		15 Female	East Asia	
35	33	34 Active	SWE	NOV19A			0 Employed Part-Time	Master's Degree	Less than one month	Technical interviewing	Less than one year	F1 Visa/CPT	1		3 Male	Black, Afr	
36	34	35 Withdrawn (Trial)	SWE	JAN20B		5	0 Student	Some College, No Degree	6 months to a year	Figuring out which jobs to apply for	5+ years	Citizen	5		30 Female	Two or M	
37	35	36 Active	Design	FEB20A			0 Student	Bachelor's Degree	1-2 months	Hearing back on my applications	1-2 years	F1 Visa/OPT	2		15 Female	East Asia	
38	36	37 Withdrawn (Trial)	Data	NOV19A		19	0 Student	Master's Degree	Less than one month	Behavioral interviewing	3-4 years	F1 Visa/OPT	3		9 Female	East Asia	
39	37	38 Withdrawn (Trial)	Design	DEC19A		7	0 Contractor	Master's Degree	1-2 months	Hearing back on my applications	1-2 years	Citizen	6		80 Female	East Asia	
40	38	39 Active	PSO	NOV19B			0 Contractor	Bachelor's Degree	1-2 months	Getting past final round interviews	5+ years		4		25 Male	East Asia	
41	39	40 Placed	SWE	NOV19A		83	1 Employed Full-Time	Master's Degree	3-5 months	Getting past final round interviews	5+ years	F1 Visa/OPT			15 Male	Native Am	
42	40	41 Active	PSO	DEC19A			0 Unemployed	Master's Degree	1-2 months	Getting past mid-stage interviews	Less than one year	Citizen	20		8 Female	Black, Afr	



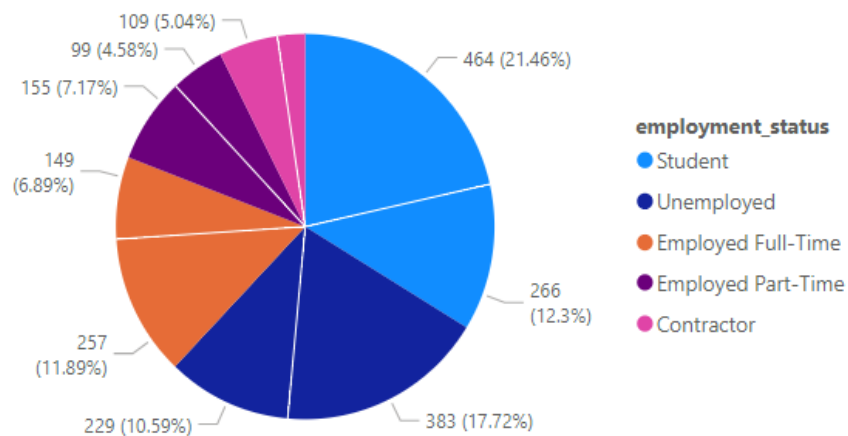
Scatter plot of program duration days vs number of interviews (colored by placement status)



employment status

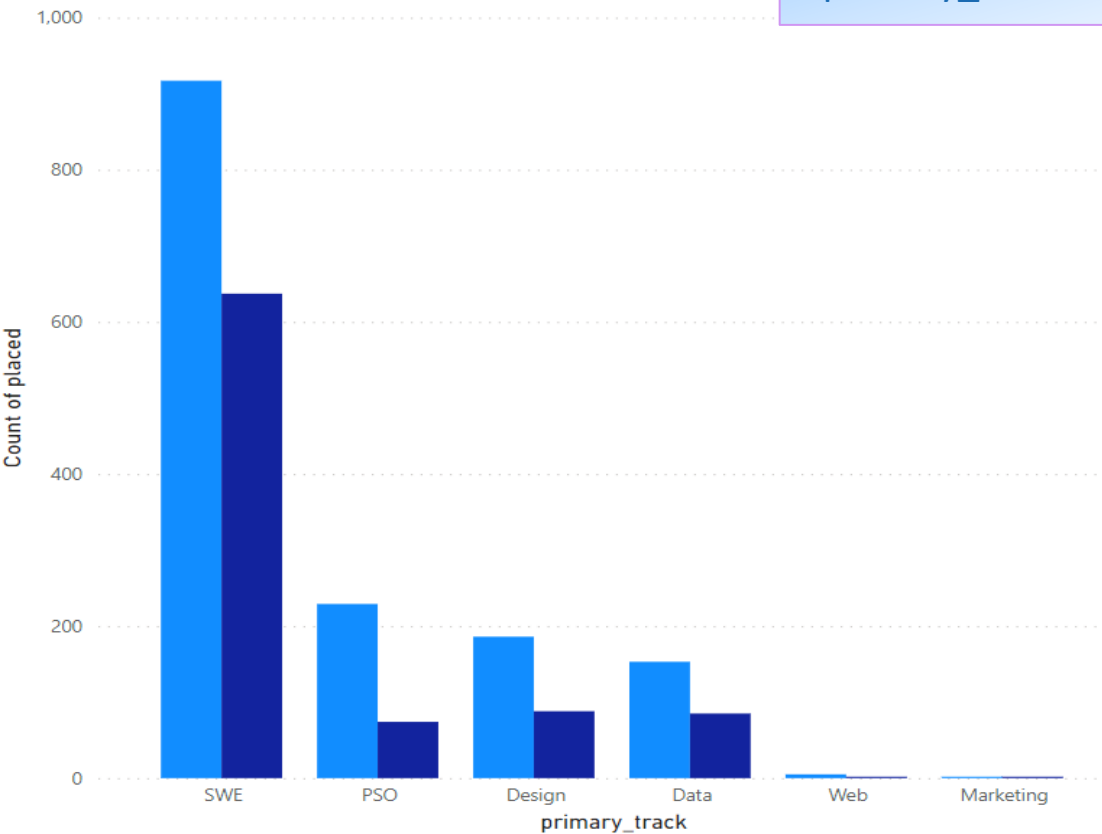


Count of employment_status by employment_status and placed



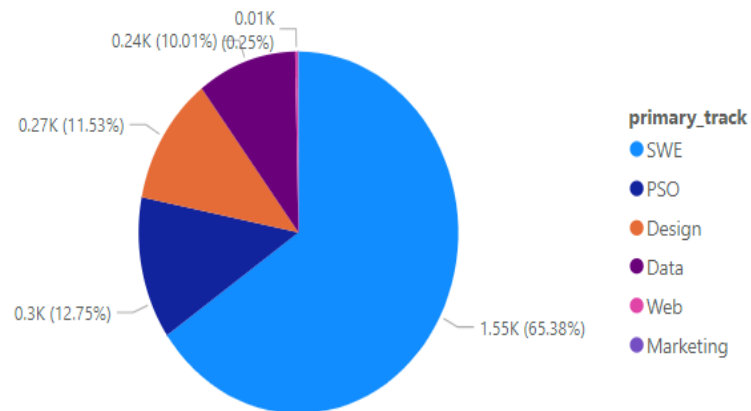
Count of placed by primary_track and placed

placed ● 0 ● 1

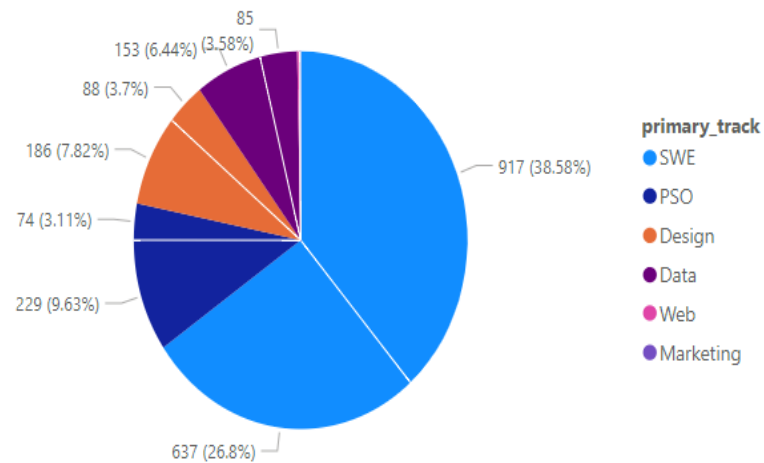


primary_track

Count of primary_track by primary_track



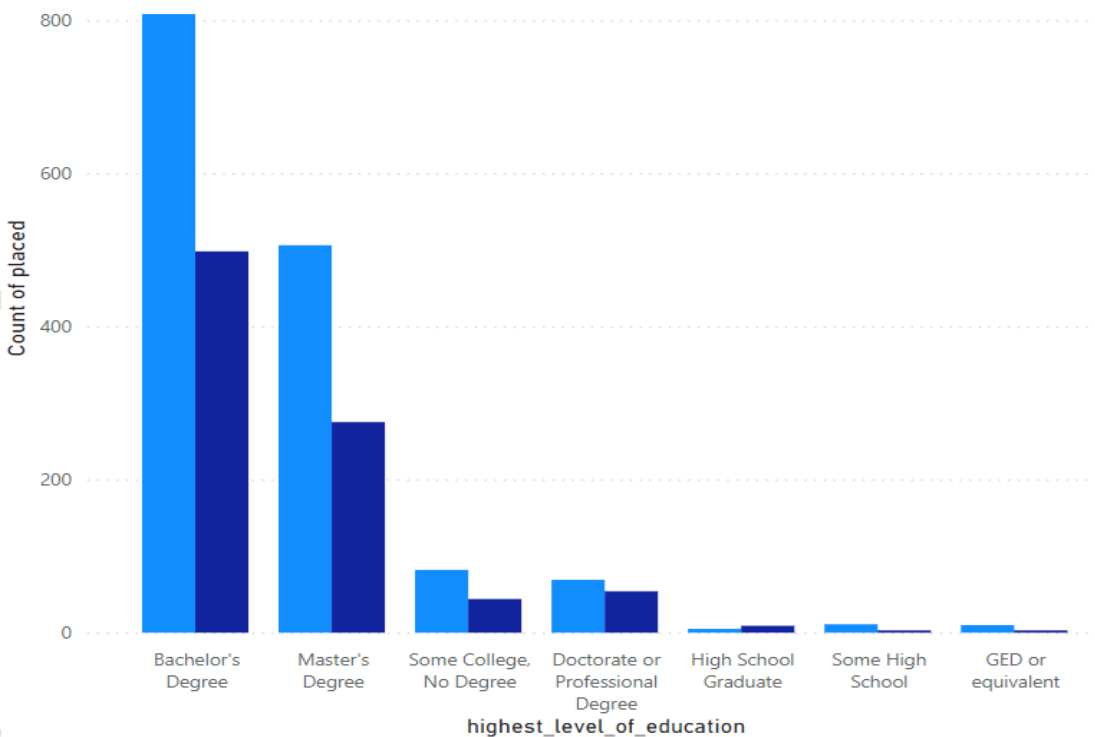
Count of primary_track by primary_track and placed



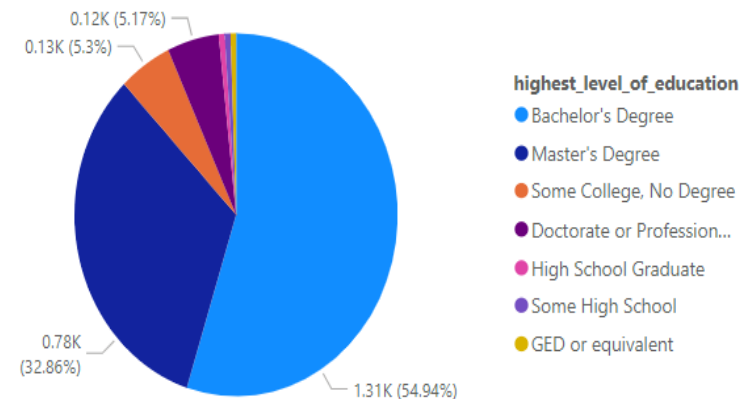
Count of placed by highest_level_of_education and placed

placed ● 0 ● 1

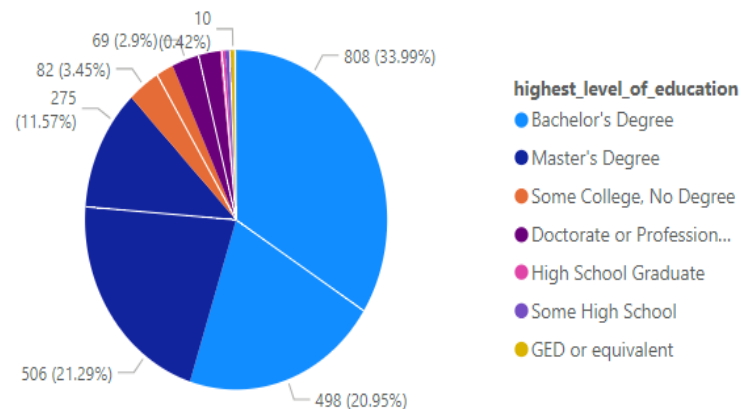
Highest_Level_of_Education



Count of highest_level_of_education by highest_level_of_education

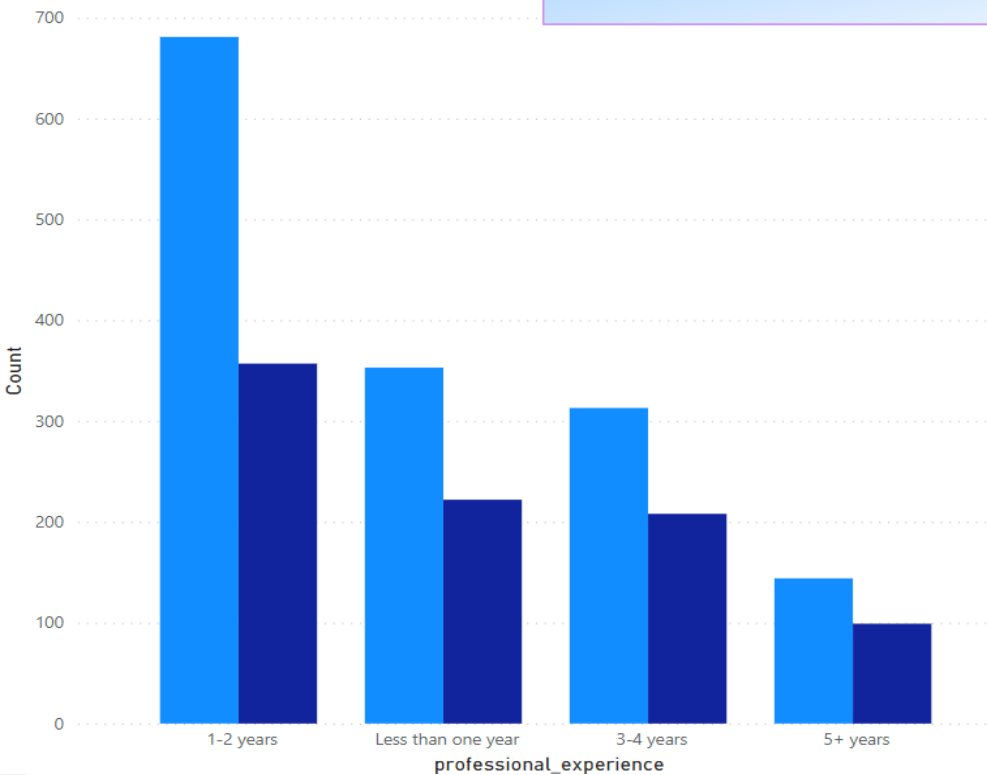


Count of highest_level_of_education by highest_level_of_education and placed



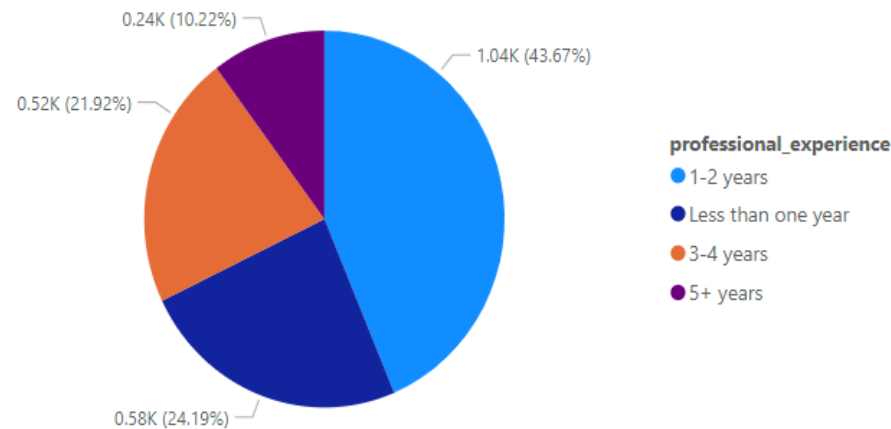
Count by professional_experience and placed

placed ● 0 ● 1

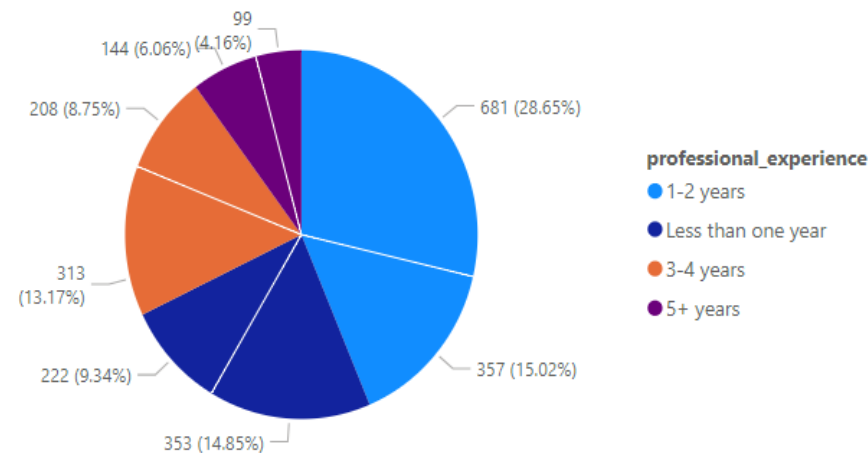


professional experience

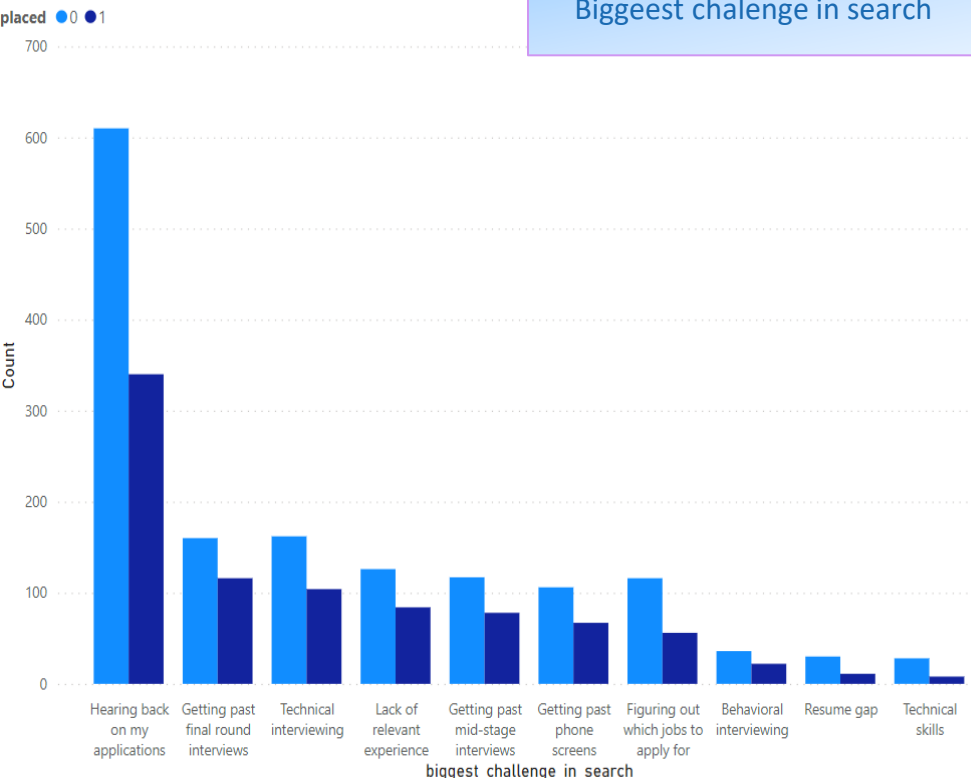
Count of professional_experience by professional_experience



Count of professional_experience by professional_experience and placed

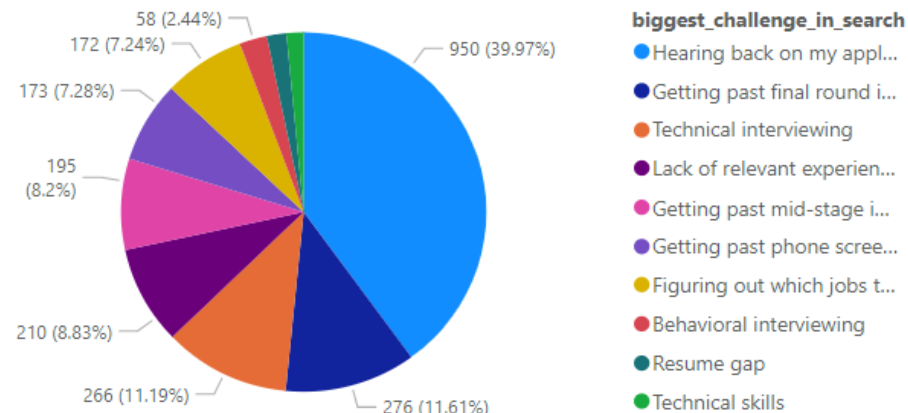


Count by biggest_challenge_in_search and placed

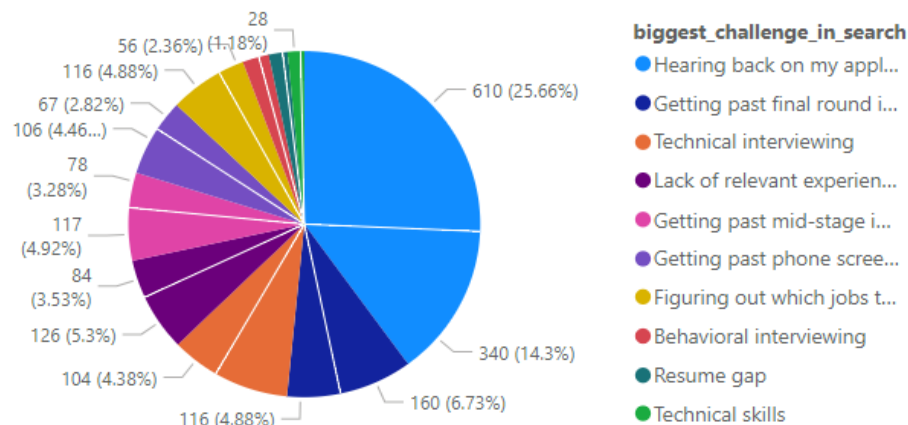


Biggeest challenge in search

Count of biggest_challenge_in_search by biggest_challenge_in_search

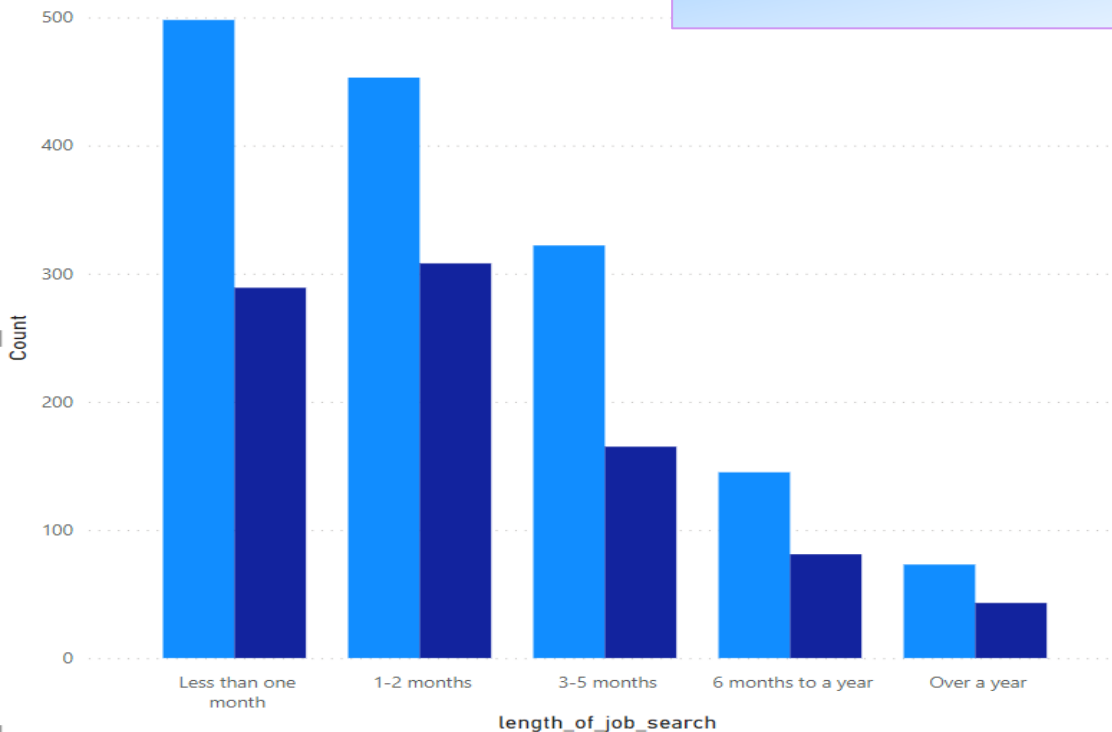


Count of biggest_challenge_in_search by biggest_challenge_in_search and placed



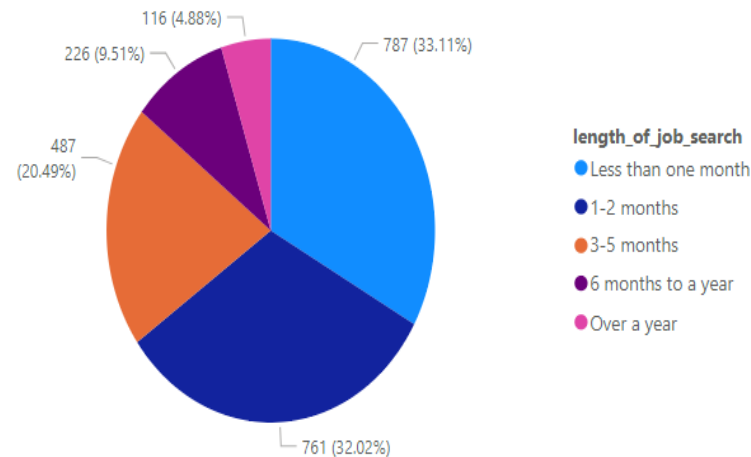
Count by length_of_job_search and placed

placed ● 0 ● 1

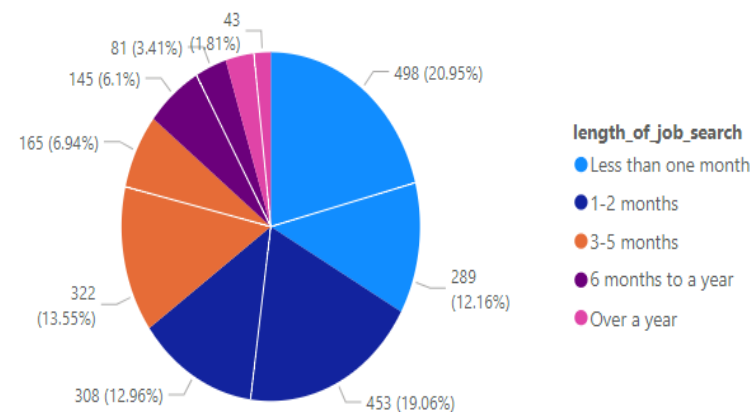


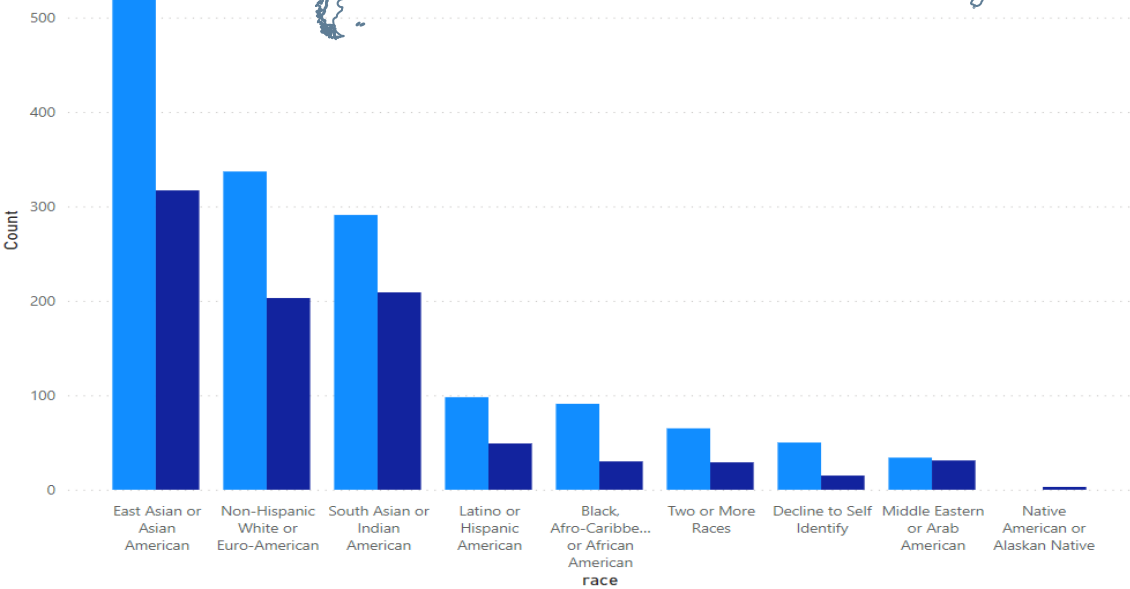
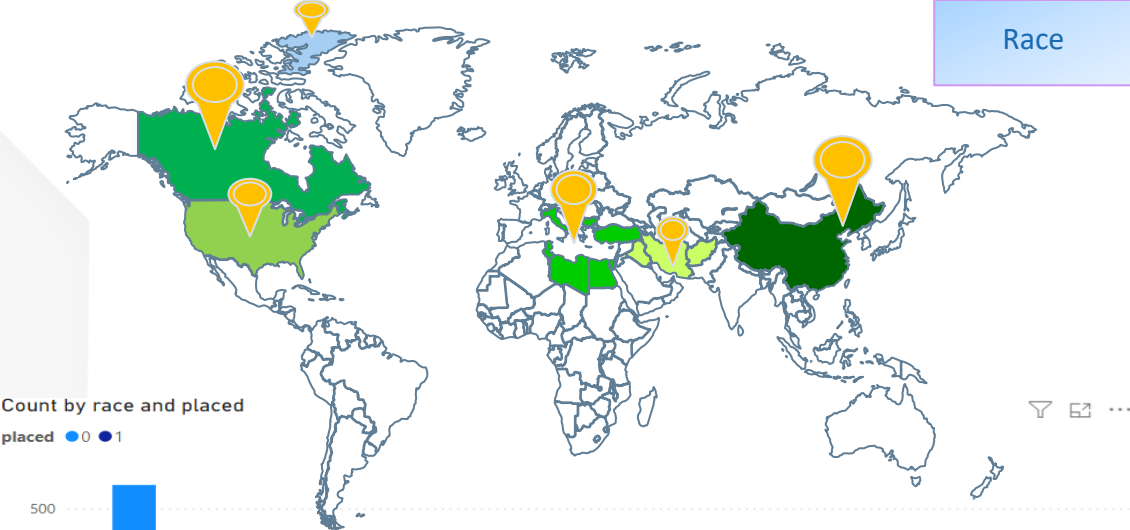
Length of job search

Count of length_of_job_search by length_of_job_search

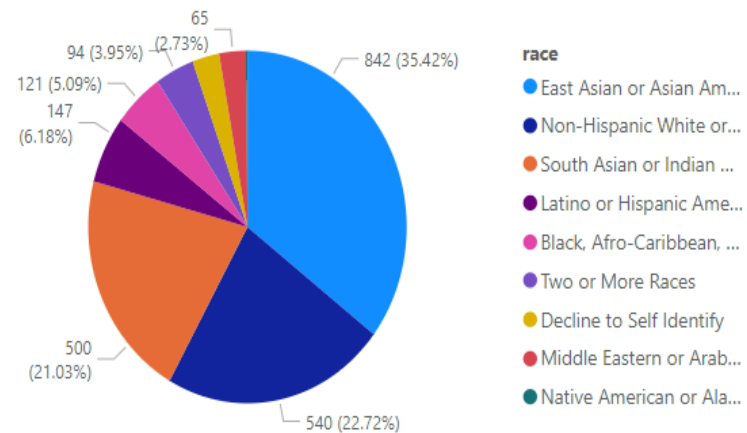


Count of length_of_job_search by length_of_job_search and placed

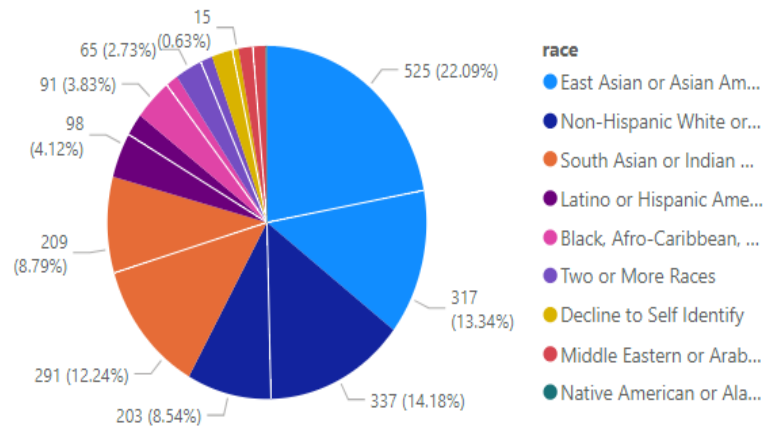




Count of race by race

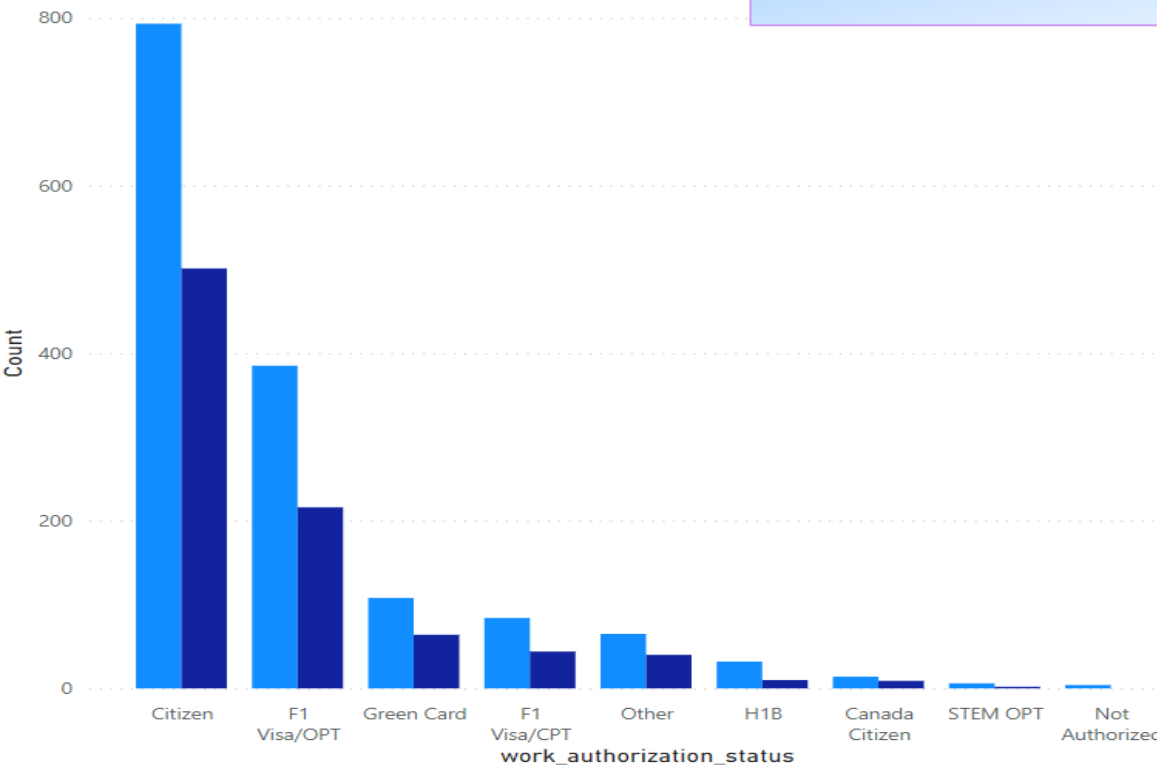


Count of race by race and placed



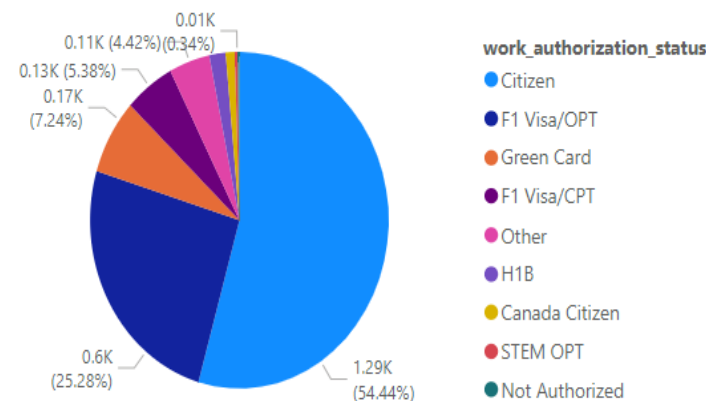
Count by work_authorization_status and placed

placed ● 0 ● 1

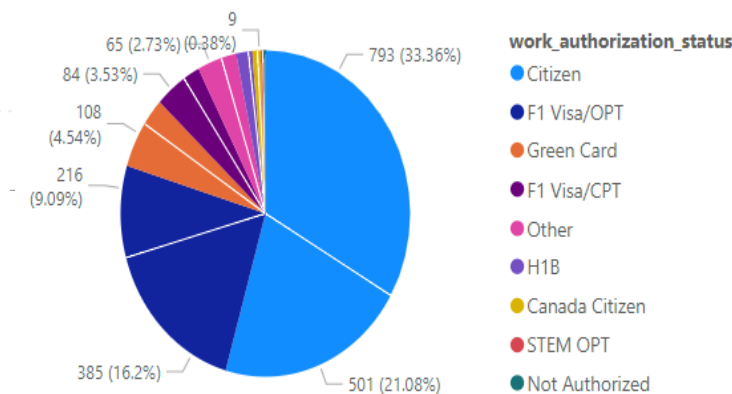


Work authorizathion

Count of work_authorization_status by work_authorization_status



Count of work_authorization_status by work_authorization_status and placed





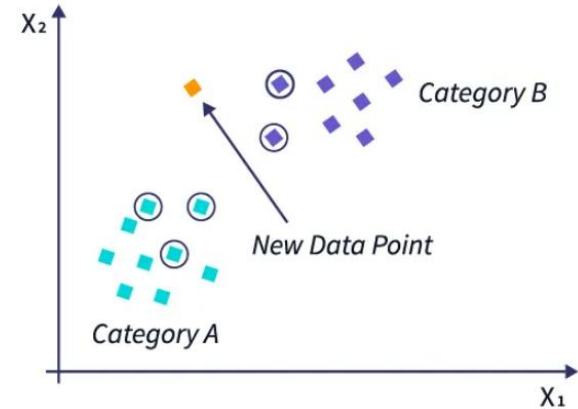
Provide Solution

For the question posed in the introduction section :

- Can we predict if candidate will be placed at Pathrise?

Leveraging Machine Learning

- Machine learning helps extract important information from data, leading to better decision-making.
- Machine learning models can learn from data and make decisions automatically and improve overtime.
- The KNN is a supervised learning classifier, which works well for simple classification tasks, making it ideal for small datasets.

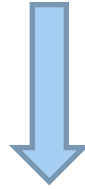




To make the dataset ready, it's needed to do
preprocessing

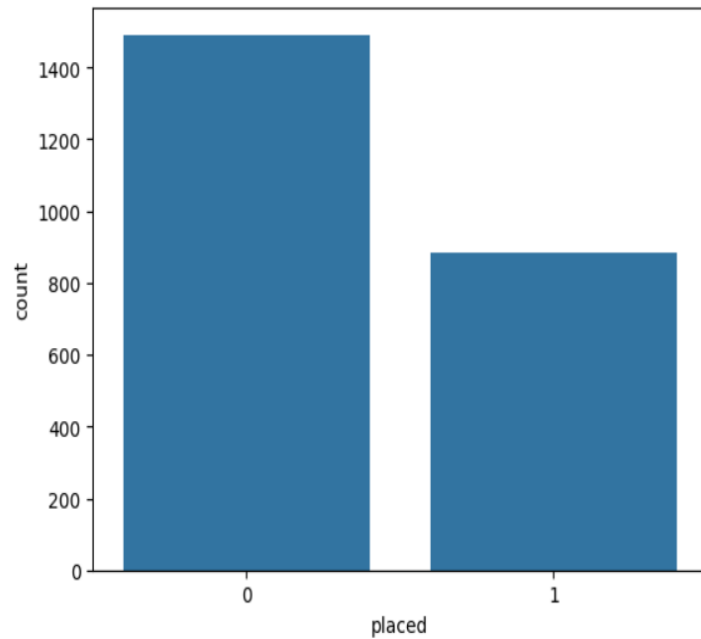
Program durations <15 days are excluded

2544

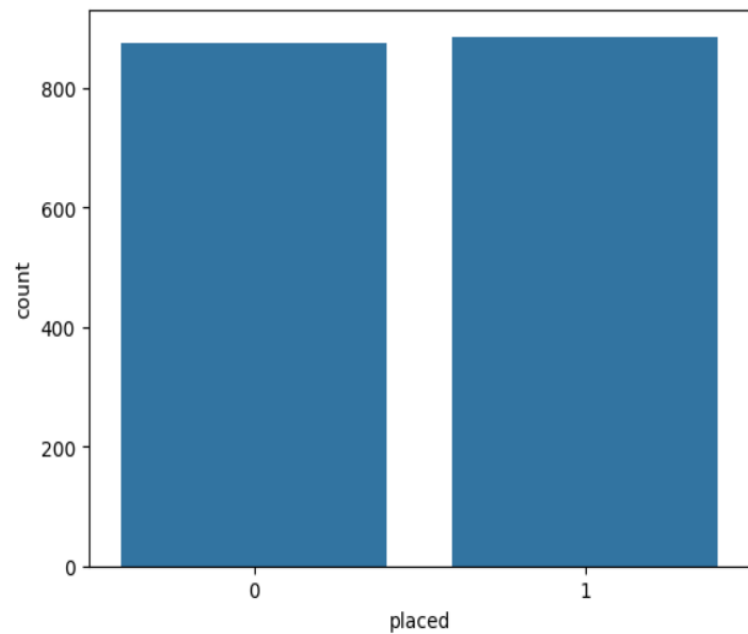


1894

Unballenced placed



Ballenced placed



✓ 0s [421] df.isnull().sum()



	0
pathrise_status	0
primary_track	0
program_duration_days	0
placed	0
employment_status	0
highest_level_of_education	0
length_of_job_search	0
biggest_challenge_in_search	0
professional_experience	0
work_authorization_status	0
number_of_interviews	0
number_of_applications	0
gender	0
race	0

dtype: int64

There is no Null value in the used dataset.

```
df.drop(columns=['Unnamed: 0'], inplace=True)
df.drop(columns=['id'], inplace=True)
df.drop(columns=['cohort_tag'], inplace=True)
df.drop(columns=['pathrise_status'], inplace=True)
df.drop(columns=['number_of_interviews'], inplace=True)
```

Columns cohort_tag, pathrise_status, number_of_interviews and id have no effect on our prediction so they were excluded.

As we need to have **non-object** values in our dataset, we converted the columns with object type to int.

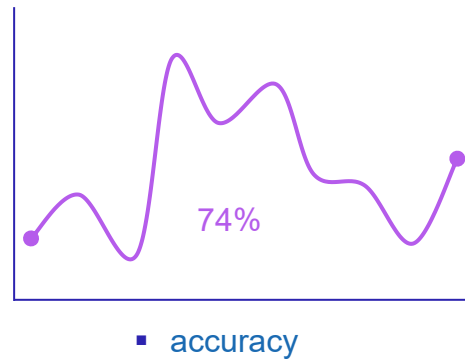
```
df=pd.get_dummies(df,columns=['employment_status ','primary_track','highest_level_of_education','length_of_job_search','gender','race','professional_experience'],dtype=int)
```



To automate tasks and gain insights from data,
we need to make a machine learning

model

- KNN is easy to understand and implement, as it relies on **calculating distances between data points** to make predictions without requiring complex training phases.
- KNN is a **non-parametric** algorithm which means it doesn't make any assume on structure of the underlying data.
- KNN **memorizes** training instances and uses them directly for predictions, which allows it to **adapt quickly to new data** but can make it slower and more memory-intensive for large datasets.





It was necessary to optimize

Hyperparameters

But what are they?

Hyperparameters necessity

In the KNN model, **hyperparameters** are essential settings that significantly affect the model's performance and accuracy. For example, the number of neighbors determines how many nearby points the model considers in making decisions. Choosing the right distance metric and weighting method helps the model achieve the best prediction results, especially with complex data.

- **Set Prior to Training:** Hyperparameters must be configured before the training process begins. They are not directly learned from the data but require manual selection and optimization.
- **Control Over Model Performance:** Hyperparameters play an essential role in managing the model's behavior and accuracy, helping to prevent issues like overfitting or underfitting.
- **Optimization Through Trial and Error:** Tuning hyperparameters is usually done through optimization techniques such as Grid Search or Random Search to achieve the best performance on a specific dataset.



which
Hyperparameters

do we used?

Used Hyperparameter

- ✓ `n_neighbors`: The number of neighbors in the K-Nearest Neighbors model, with values set between 1 and 10 to find the best value.



To optimize the hyperparameters, we have used

Grid Search

Grid Search

```
✓ [242] # Allows us to test parameters of classification algorithms and find the best one  
0s      from sklearn.model_selection import GridSearchCV
```

```
✓ [243] parameters = {'n_neighbors': [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]}
```

```
✓ [244] knn_cv = GridSearchCV(knn_1, parameters)  
1s      knn_cv.fit(X_train, y_train)
```



What are the

Results

that we have obtained?

KNN Mean Absolute Error

- **MAE** calculates the average absolute difference between the predicted probabilities (usually between 0 and 1) and the actual labels (0 for benign, 1 for malware)
- Hyperparameter tuning reduced the model's average error by 0.5% (MAE).

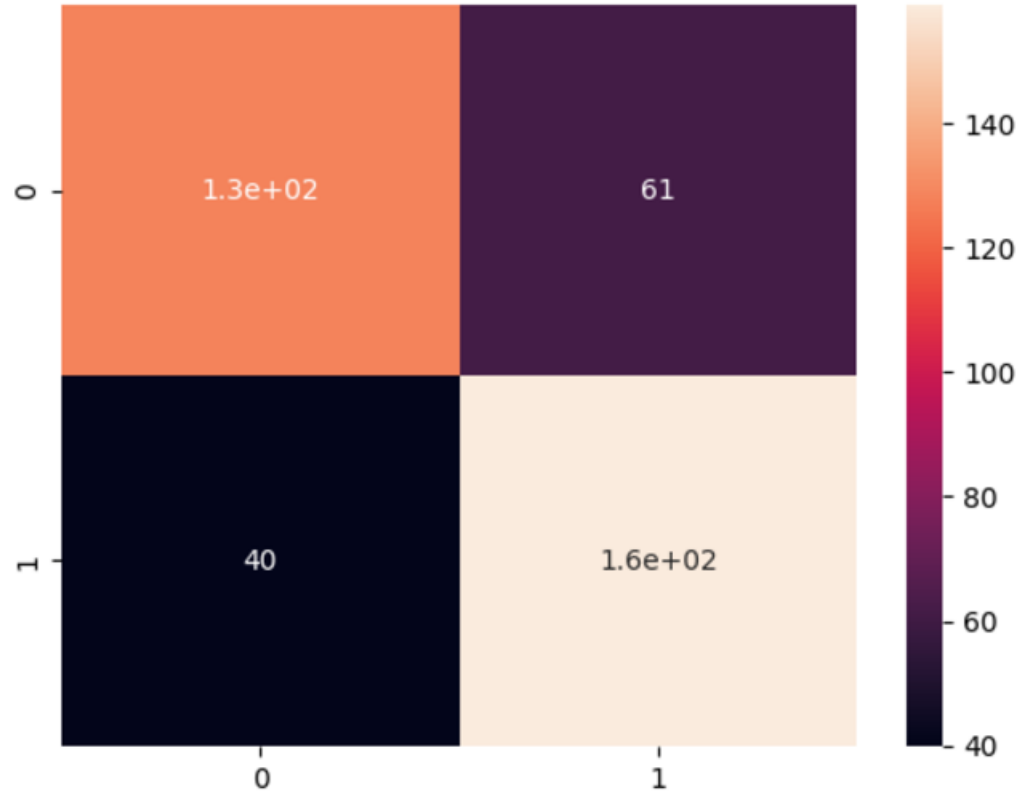
Before Grid Search : 26%

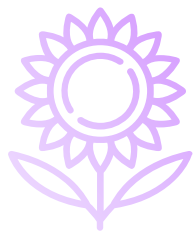
After Grid Search : 25.5%

- Mean Absolute Error

Confusion matrix

- We have used confusion matrix to visualize the performance of our classification model.
- It helps us to understand how many predictions the model got right and wrong for each class in the data.





THANKS

