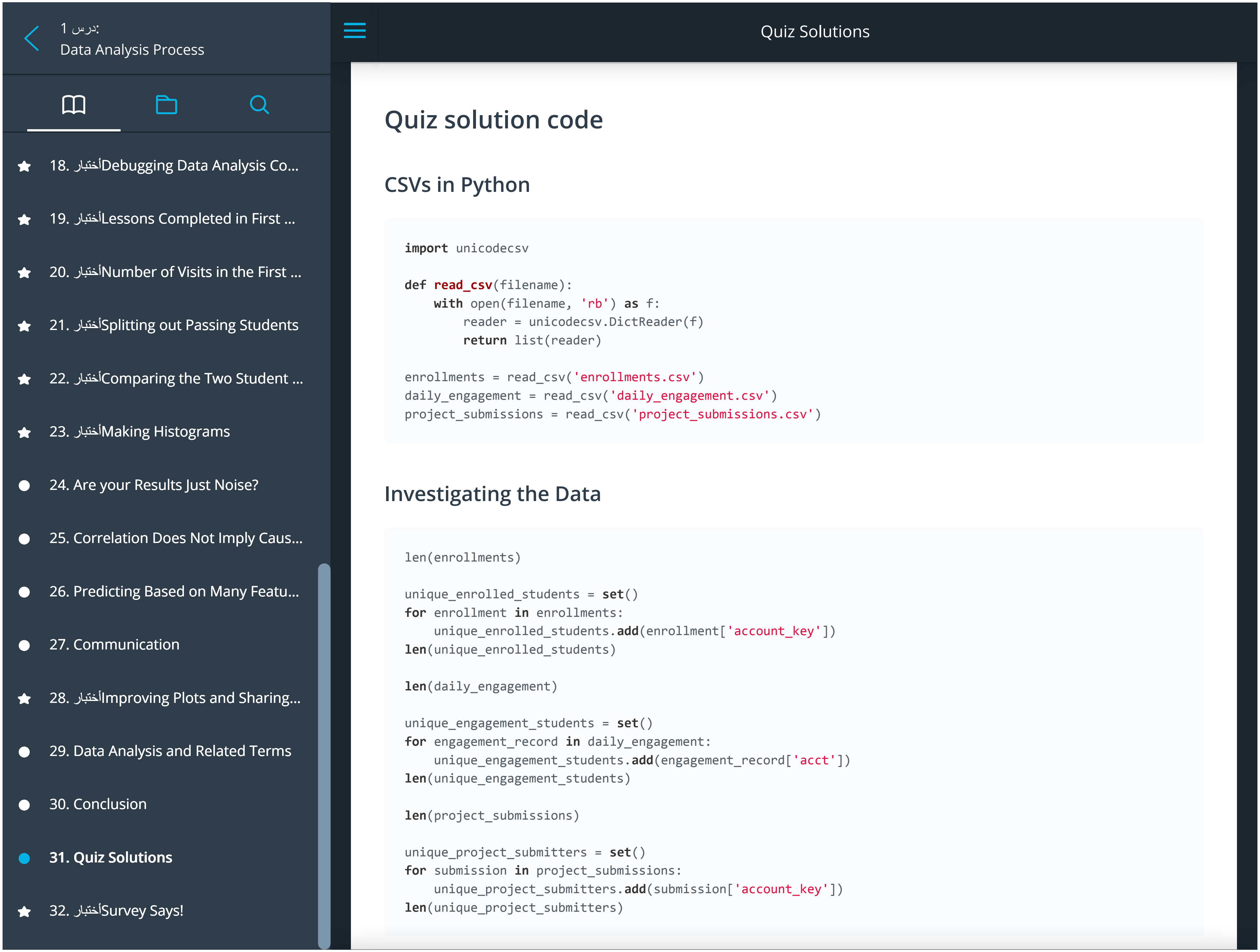

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Data Analysis Process

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Quiz solution code

CSVs in Python

```
import unicodecsv

def read_csv(filename):
    with open(filename, 'rb') as f:
        reader = unicodecsv.DictReader(f)
        return list(reader)

enrollments = read_csv('enrollments.csv')
daily_engagement = read_csv('daily_engagement.csv')
project_submissions = read_csv('project_submissions.csv')
```

Investigating the Data

```
len(enrollments)

unique_enrolled_students = set()
for enrollment in enrollments:
    unique_enrolled_students.add(enrollment['account_key'])
len(unique_enrolled_students)

len(daily_engagement)

unique_engagement_students = set()
for engagement_record in daily_engagement:
    unique_engagement_students.add(engagement_record['acct'])
len(unique_engagement_students)

len(project_submissions)

unique_project_submitters = set()
for submission in project_submissions:
    unique_project_submitters.add(submission['account_key'])
len(unique_project_submitters)
```

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```
for engagement_record in daily_engagement:
    engagement_record['account_key'] = engagement_record['acct']
    del[engagement_record['acct']]
```

Missing engagement records

```
for enrollment in enrollments:
    student = enrollment['account_key']
    if student not in unique_engagement_students:
        print enrollment
        break
```

Checking for more problem records

```
num_problem_students = 0
for enrollment in enrollments:
    student = enrollment['account_key']
    if (student not in unique_engagement_students and
            enrollment['join_date'] != enrollment['cancel_date']):
        print enrollment
        num_problem_students += 1

num_problem_students
```

Refining the Question

```
  if (not enrollment['is_canceled'] or
      enrollment['days_to_cancel'] > 7):
    account_key = enrollment['account_key']
    enrollment_date = enrollment['join_date']
    if (account_key not in paid_students or
        enrollment_date > paid_students[account_key]):
      paid_students[account_key] = enrollment_date
len(paid_students)
```

Note that if you switch the order of the second if statement like so

```
if (enrollment_date > paid_students[account_key] or
account_key not in paid_students)
```

you will most likely get an error. Why do you think that is? Check out this Stackoverflow discussion to find out more: http://stackoverflow.com/questions/13960657/does-python-evaluate-ifs-conditions-lazily

Getting Data from First Week

```
    return time_delta.days < 7

def remove_free_trial_cancels(data):
    new_data = []
    for data_point in data:
        if data_point['account_key'] in paid_students:
            new_data.append(data_point)
    return new_data

paid_enrollments = remove_free_trial_cancels(non_udacity_enrollments)
paid_engagement = remove_free_trial_cancels(non_udacity_engagement)
paid_submissions = remove_free_trial_cancels(non_udacity_submissions)

print len(paid_enrollments)
print len(paid_engagement)
print len(paid_submissions)

paid_engagement_in_first_week = []
for engagement_record in paid_engagement:
    account_key = engagement_record['account_key']
    join_date = paid_students[account_key]
    engagement_record_date = engagement_record['utc_date']

    if within_one_week(join_date, engagement_record_date):
         paid_engagement_in_first_week.append(engagement_record)

len(paid_engagement_in_first_week)
```

Debugging Data Analysis Code

Here is the code Caroline shows in the solution video:

```
for student, total_minutes in total_minutes_by_account.items():
    if total_minutes > max_minutes:
        max_minutes = total_minutes
        student_with_max_minutes = student

max_minutes

for engagement_record in paid_engagement_in_first_week:
    if engagement_record['account_key'] == student_with_max_minutes:
        print engagement_record
```

Alternatively, you can find the account key with the maximum minutes using this shorthand notation:

`max(total_minutes_by_account.items(), key=lambda pair: pair[1])`

Fixing Bug in within_one_week()

She also updated the code for the `within_one_week` function to the following:

```
def within_one_week(join_date, engagement_date):
    time_delta = engagement_date - join_date
    return time_delta.days >= 0 and time_delta.days < 7
```

Lessons Completed in First Week

First, Caroline refactors the given code to analyze total minutes spent in the first week into the following:

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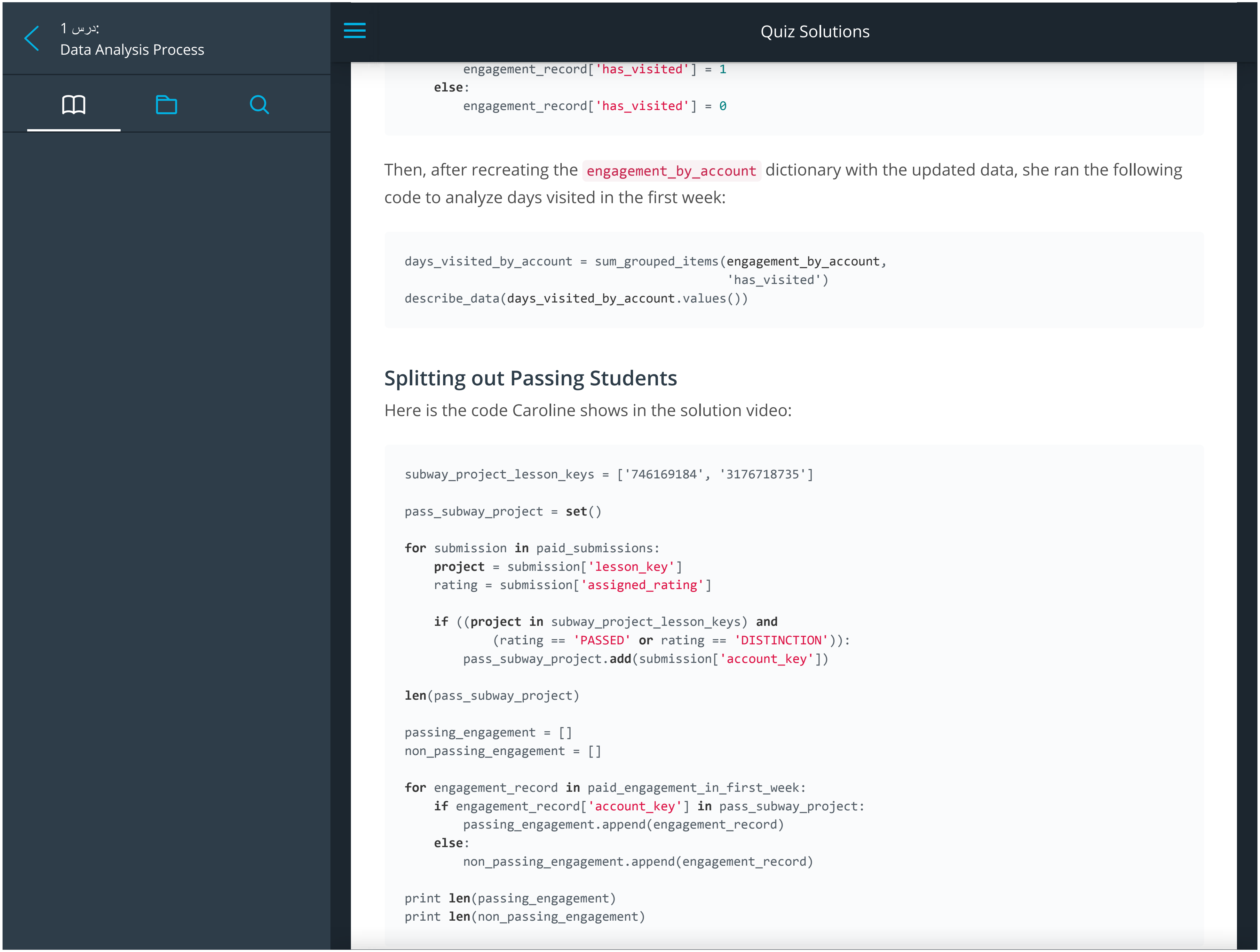
```
def group_data(data, key_name):
    grouped_data = defaultdict(list)
    for data_point in data:
        key = data_point[key_name]
        grouped_data[key].append(data_point)
    return grouped_data

engagement_by_account = group_data(paid_engagement_in_first_week,
                                   'account_key')

def sum_grouped_items(grouped_data, field_name):
    summed_data = {}
    for key, data_points in grouped_data.items():
        total = 0
        for data_point in data_points:
            total += data_point[field_name]
        summed_data[key] = total
    return summed_data

total_minutes_by_account = sum_grouped_items(engagement_by_account,
                                             'total_minutes_visited')

import numpy as np

def describe_data(data):
    print 'Mean:', np.mean(data)
    print 'Standard deviation:', np.std(data)
    print 'Minimum:', np.min(data)
    print 'Maximum:', np.max(data)

describe_data(total_minutes_by_account.values())
```

Then she called the functions she created to analyze the lessons completed in the first week as follows:

```
lessons_completed_by_account = sum_grouped_items(engagement_by_account,
                                                 'lessons_completed')
describe_data(lessons_completed_by_account.values())
```

Number of Visits in the First Week

Here is the code Caroline shows in the solution video. First she ran this code to create the `has_visited` field:



```
        engagement_record['has_visited'] = 1
    else:
        engagement_record['has_visited'] = 0
```

Then, after recreating the `engagement_by_account` dictionary with the updated data, she ran the following code to analyze days visited in the first week:

```
days_visited_by_account = sum_grouped_items(engagement_by_account,
                                            'has_visited')
describe_data(days_visited_by_account.values())
```

Splitting out Passing Students

Here is the code Caroline shows in the solution video:

```
subway_project_lesson_keys = ['746169184', '3176718735']

pass_subway_project = set()

for submission in paid_submissions:
    project = submission['lesson_key']
    rating = submission['assigned_rating']

    if ((project in subway_project_lesson_keys) and
            (rating == 'PASSED' or rating == 'DISTINCTION')):
        pass_subway_project.add(submission['account_key'])

len(pass_subway_project)

passing_engagement = []
non_passing_engagement = []

for engagement_record in paid_engagement_in_first_week:
    if engagement_record['account_key'] in pass_subway_project:
        passing_engagement.append(engagement_record)
    else:
        non_passing_engagement.append(engagement_record)

print len(passing_engagement)
print len(non_passing_engagement)
```

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```
non_passing_engagement_by_account = group_data(non_passing_engagement,
                                               'account_key')

print 'non-passing students:'
non_passing_minutes = sum_grouped_items(
    non_passing_engagement_by_account,
    'total_minutes_visited'
)
describe_data(non_passing_minutes.values())

print 'passing students:'
passing_minutes = sum_grouped_items(
    passing_engagement_by_account,
    'total_minutes_visited'
)
describe_data(passing_minutes.values())

print 'non-passing students:'
non_passing_lessons = sum_grouped_items(
    non_passing_engagement_by_account,
    'lessons_completed'
)
describe_data(non_passing_lessons.values())

print 'passing students:'
passing_lessons = sum_grouped_items(
    passing_engagement_by_account,
    'lessons_completed'
)
describe_data(passing_lessons.values())

print 'non-passing students:'
non_passing_visits = sum_grouped_items(
    non_passing_engagement_by_account,
    'has_visited'
)
describe_data(non_passing_visits.values())

print 'passing students:'
passing_visits = sum_grouped_items(
    passing_engagement_by_account,
    'has_visited'
)
describe_data(passing_visits.values())
```

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```
%pylab inline

import matplotlib.pyplot as plt
import numpy as np

# Summarize the given data
def describe_data(data):
    print 'Mean:', np.mean(data)
    print 'Standard deviation:', np.std(data)
    print 'Minimum:', np.min(data)
    print 'Maximum:', np.max(data)
    plt.hist(data)
```

Fixing the Number of Bins

To change how many bins are shown for each plot, try using the `bins` argument to the `hist` function. You can find documentation for the `hist` function and the arguments it takes here.

Improving Plots and Sharing Findings

Here is the code Caroline shows in the solution video:

```
import seaborn as sns

plt.hist(non_passing_visits.values(), bins=8)
plt.xlabel('Number of days')
plt.title('Distribution of classroom visits in the first week ' +
          'for students who do not pass the subway project')

plt.hist(passing_visits.values(), bins=8)
plt.xlabel('Number of days')
plt.title('Distribution of classroom visits in the first week ' +
          'for students who pass the subway project')
```

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