

SI 506 The last assignment

1.0 Overview

Review the companion [last_assignment_overview.pdf](#) document available via Canvas *before* attempting this assignment. The document covers due dates, work rules (this is a solo effort), use of generative artificial intelligence (AI) tools, assignment format, code styling rules, Black Formatter line length, Slack etiquette, testing and debugging tips, and submission instructions.

Reminders	Description
Available	Tuesday, 5 December 2023, 4:00 PM Eastern
Due	On or before Friday, 15 December 2023, 11:59 PM Eastern
Points	Challenges 01-20: 1800 points
Authorship	Submitted solution must constitute your own work. Seeking and/or securing the assistance of others is prohibited; assisting other classmates who attempt the assignment is prohibited.
Web resource access	Permitted. Open network, open readings, open notes. You may refer to code in previous lecture exercises, lab exercises, and problem sets for inspiration.
Generative AI tool use	UMGPT and VS Code's GitHub Copilot extension permitted. No other generative AI tools can be used to assist in the completion of this assignment.
Questions/Help	Limited to scheduled office hours and asynchronous interactions with the teaching team over the Slack SI 506 workspace # last_assignment channel. Format messages per the specified rules. Do not send direct messages (DMs) to individual teaching team members unless a personal issue arises that blocks your progress. If an install, configuration, or hardware issues arises post a message to the # install channel. That said, if a personal issue arises during the assignment period please send a private DM to Anthony.
Code styling	Format code using the VS Code Black Formatter extension. Change line-length setting from 88 characters (default) to 100 characters. See VS Code install guides for instructions.
Debugging	Ensure you run your code locally and review any runtime exceptions. Use the VS Code debugger, the built-in print() function, and/or assert statements to check your code. For configuring the debugger see VS Code debugger: launch.json settings .
Submission attempts	Unlimited between start and end dates/times. Late submissions will not be accepted.
Test failures	If fail a test in Gradescope be sure to read the error message and any hints provided. If a traceback to an error is provided, review and resolve the runtime exception. Any tests involving student output files will automatically fail if there is a runtime exception in your code.

Reminders	Description
Previous score activation	Permitted. If your final submission results in a score that is lower than a previous submission score you will be permitted to activate the earlier submission and claim the higher score.
Submission review	Submissions that do not earn 1800 points will be reviewed by the teaching team. Partial credit may be awarded for submissions that fail one or more autograder tests if the teaching team (at their sole discretion) deems a score adjustment is warranted.
Final course grade	Per the Syllabus , section 5.4, you <i>must</i> meet the following two (2) requirements in order to earn a final course grade of A : earn a minimum 4650 course points <i>and</i> attempt all twenty (20) challenges comprising the last assignment.

2.0 Theme, files, imports, and caching

The Star Wars saga has spawned films, animated series, books, music, artwork, toys, games, fandom websites, emojis, cosplayers, scientific names for new organisms (e.g., [Trigonopterus yoda](#)), and even a Darth Vader *grotesque* attached to the [northwest tower](#) of the Washington National Cathedral. Leading US news sources such as the [New York Times](#) cover the Star Wars phenomenon on a regular basis.

The last assignment adds yet another Star Wars-inspired artifact to the list. The data used in this assignment is sourced from the [Star Wars API](#) (SWAPI), [Wookieepedia](#), [Wikipedia](#), and the [New York Times](#).

2.1 Files

In line with the weekly lab exercises and problem sets you will be provided with a number of files:

File	Purpose
last_assignment-README.md	Assignment instructions
last_assignment.py	Program/script including a <code>main()</code> function and other definitions and statements.
five_oh_six.py	Module containing utility functions and statements.
data-clone_wars_episodes.csv	Data file.
data-jedi.json	Data file.
data-key_mappings.json	Data file.
data-nyt_star_wars_articles.json	Data file.
data-wookieepedia_droids.json	Data file.
data-wookieepedia_people.json	Data file.

File	Purpose
data-wookieepedia_planets.csv	Data file.
data-wookieepedia_starships.csv	Data file.
fxt_*.json	Collection of test fixture files that you must match with the files you produce.

Please download the assignment files from Canvas Files as soon as they are released. This is a timed event and delays in acquiring the assignment files will shorten the time available to engage with the challenges. The clock is not your friend.

! *DO NOT* modify or remove the scaffolded code that we provide in the Python script or module files unless instructed to do so.

2.2 Module imports

The template file `last_assignment.py` includes the following `import` statements:

```
import copy
import five_oh_six as utl

from pathlib import Path
```

The utilities module `five_oh_six.py` includes the following `import` statements:

```
import csv
import json
import requests

from urllib.parse import quote, urlencode, urljoin
```

! **Do not** comment out or remove these `import` statements. Check your `import` statements periodically. If you discover that other `import` statements have been added to your Python files remove them. In such cases, VS Code is attempting to assist you by inserting additional `import` statements based on your keystrokes. Their presence can trigger `ModuleNotFoundError` runtime exceptions when you submit your code to Gradescope.

2.3 Caching

As discussed in class, this assignment utilizes a caching workflow that eliminates redundant HTTP GET requests made to SWAPI by storing the SWAPI responses locally. Caching is implemented *fully* and all you need do is call the function `get_swapi_resource()` whenever you need to retrieve a SWAPI representation of a person/droid, planet, species, or starship, either locally from the cache or remotely from

SWAPI. The cache dictionary is serialized as JSON and written to `CACHE.json` every time you run `last_assignment.py`.

! Do not call the function named `utl.get_resource` directly. Doing so sidesteps the cache and undercuts the caching optimization strategy.

3.0 Challenges

A long time ago in a galaxy far, far away, there occurred the Clone Wars (22-19 BBY), a major conflict that pitted the [Galactic Republic](#) against the breakaway [Separatist Alliance](#). The Republic fielded genetically modified human clone troopers commanded by members of the Jedi order against Separatist battle droids. The struggle was waged across the galaxy and, in time, inspired an animated television series entitled [Star Wars: The Clone Wars](#) which debuted in October 2008 and ran for seven seasons (2008-2014, 2020).

The last assignment features four groups of challenges:

Challenge 01-02. Implement a number of `utl.to_*` functions employing `try` and `except` blocks that will be employed in later challenges.

💡 Any challenges that implement `utl.*` function definitions will be completed in the provided `"five_oh_six.py"` module. Any challenges/task referencing `main()` or functions without the `utl` alias will be completed in the provided `"last_assignment.py"` file.

Challenges 03-06. Utilize a *Clone Wars* data set that provides summary data about the animated series. You will implement a number of functions that will simplify interacting with the data in order to surface basic information about the episodes and their directors, writers, and viewership.

Challenges 07-09. Work with New York Times article data that charts the creative, cultural, and economic impact of the *Star Wars* saga both within the US and elsewhere over the past forty-six years.

Challenges 10-20. Recreates the escape of the light freighter [Twilight](#) from the sabotaged and doomed Separatist heavy cruiser [Malevolence](#) which took place during the first year of the *Clone Wars* conflict (22 BBY).

Your task is to reassemble the crew of the *Twilight* and take on passengers before disengaging from the *Malevolence* and heading into deep space. The Jedi generals [Anakin Skywalker](#) and [Obi-Wan Kenobi](#) together with the astromech droid (robot) [R2-D2](#) had earlier boarded the *Malevolence* after maneuvering the much smaller *Twilight* up against the heavy cruiser and docking via an emergency air lock. Their mission was twofold:

1. Retrieve the Republican Senator [Padmé Amidala](#) and the protocol (communications) droid [C-3PO](#) whose ship had been seized after being caught in the *Malevolence*'s tractor beam.
2. Sabotage the warship.

In these challenges you will implement functions and follow a workflow that generates a JSON document that recreates the *Twilight*'s escape from the *Malevolence*.

May the Force be with You.

3.1 Challenge 01 (75 points)

Task: Implement the functions `utl.to_float()` and `utl.to_int()`. Each function attempts to convert a passed in `value` to a more appropriate type.

3.1.1 Implement `utl.to_float()`


Replace `pass` with a code block that attempts to convert the passed in `value` to a `float`. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. Employ `try` and `except` statements in order to handle runtime exceptions whenever an invalid conversion is attempted.

! Do not place code outside the `try` and `except` code blocks.

2. The function *must* convert numbers masquerading as strings, including those with commas that represent a thousand separator (e.g., '500,000,000') *and* those with a period that designates a fractional component (e.g., '500,000,000.9999'), to a whole number.
3. Make use of the built-in function `isinstance()` to confirm that the passed in `value` is a string. Some strings may need to be manipulated before attempting the float conversion.

 Recall that `isinstance()` accepts two arguments: an object and a type. The function returns `True` if the object is of the specified type; otherwise, it returns `False`.

4. If a runtime exception is encountered "catch" the exception in the `except` block and return the `value` to the caller **unchanged**.

 You do not need to specify specific exceptions in the `except` statement.

3.1.2 Test `utl.to_float()`

After implementing the function return to `main()`. Uncomment the relevant `assert` statements. Run your code. If an `AssertionError` is raised, debug your code, and then retest. Repeat as necessary.

3.1.3 Implement `utl.to_int()`

Replace `pass` with a code block that attempts to convert the passed in `value` to an `int`. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. Employ `try` and `except` statements in order to handle runtime exceptions whenever an invalid conversion is attempted.

! Do not place code outside the `try` and `except` code blocks.

2. The function *must* convert numbers masquerading as strings, including those with commas that represent a thousand separator (e.g., '500,000,000') *and* those with a period that designates a

fractional component (e.g., '500,000,000.9999'), to a whole number.

💡 Recall that `int()` truncates the fractional component of a number. Given this plus the requirement above, consider leveraging `to_float()` in the function block.

3. If a runtime exception is encountered "catch" the exception in the `except` block and return the `value` to the caller **unchanged**.

💡 You do not need to specify specific exceptions in the `except` statement.

3.1.4 Test `utl.to_int()`

After implementing the function return to `main()`. Uncomment the relevant `assert` statements. Run your code. If an `AssertionError` is raised, debug your code, and then retest. Repeat as necessary.

3.2 Challenge 02 (75 points)

Task: Implement the functions `utl.to_list()` and `utl.to_none()`. Each function attempts to convert a passed in `value` to a more appropriate type.

3.2.1 Implement `utl.to_list()`

Replace `pass` with a code block that attempts to convert the passed in `value` to a `list` using a `delimiter` if one is provided. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. Employ `try` and `except` statements in order to handle runtime exceptions whenever an invalid conversion is attempted.

❗ **Do not** place code outside the `try` and `except` code blocks.

2. If the caller provides a `delimiter` value the function *must* use it to split the `value`; otherwise, split the string without specifying a delimiter value.

💡 Let the truth value of `delimiter` determine how you choose to split the string.

❗ Don't assume that `value` is "clean"; program defensively and remove leading/trailing spaces before attempting to convert the string to a list.

3. If a runtime exception is encountered "catch" the exception in the `except` block and return the `value` to the caller **unchanged**.

💡 You do not need to specify specific exceptions in the `except` statement.

3.2.2 Test `utl.to_list()`

After implementing the function return to `main()`. Uncomment the relevant `assert` statements. Run your code. If an `AssertionError` is raised, debug your code, and then retest. Repeat as necessary.

3.2.3 Implement `utl.to_none()`

Replace `pass` with a code block that attempts to convert the passed in `value` to `None`. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. Employ `try` and `except` statements in order to handle runtime exceptions whenever an invalid conversion is attempted.

! **Do not** place code outside the `try` and `except` code blocks.

2. In the `try` block check if the passed in `value` can be found in the passed in `none_values` list (perform a **case insensitive** membership check). If a match is obtained return `None` to the caller; otherwise, return the `value` unchanged.

! Don't assume that `value` is "clean"; program defensively and remove leading/trailing spaces before checking if the "cleaned" version of the string matches a `none_values` item.

3. If a runtime exception is encountered "catch" the exception in the `except` block and return the `value` to the caller **unchanged**.

💡 You do not need to specify specific exceptions in the `except` statement.

3.2.4 Test `utl.to_none()`

After implementing the function return to `main()`. Uncomment the relevant `assert` statements. Run your code. If an `AssertionError` is raised, debug your code, and then retest. Repeat as necessary.

3.3 Challenge 03 (80 points)

Task: Refactor (e.g., modify) the function `utl.read_csv_to_dicts()` to use a **list comprehension** and then call the function to read a CSV file that contains information about the *Clone Wars* episodes. Then implement the function `has_viewer_data()` that checks whether or not an episode possesses viewership information.

💡 This challenge involves a list of nested dictionaries. Use the built-in function `print()` to explore one of nested dictionaries or call the function `utl.write_json()` in `main()`, encode the data as JSON, and write it to a "test" JSON file so that you can view the list of dictionaries more easily.

3.3.1 Refactor `utl.read_csv_to_dicts()`

Examine the commented out code in `utl.read_csv_to_dicts()` function (**do not** uncomment). Reimplement the function by writing code inside the `with` block that retrieves an instance of the `csv.DictReader` and then employs a list comprehension to traverse the lines in the reader object and return a new list of line elements to the caller.

! Review lecture notes and code solution files if you have forgotten how to write a list comprehension. If you are unsuccessful in your endeavors uncomment the code in `utl.read_csv_to_dicts()` and get the

function working so that you can continue with the assignment.

Requirements

1. You are limited to writing one (1) line of code by employing a list comprehension.
2. You *must* employ **existing variable names** that appear in the commented out code when writing your list comprehension.

! Utilize only those variable names that are relevant to the task at hand.

3.3.2 Test `utl.read_csv_to_dicts()`

After refactoring `utl.read_csv_to_dicts()` return to `main()`.

1. Call the function and retrieve the data contained in the file `data-clone_wars_episodes.csv`.
2. Assign the return value to a variable named `clone_wars_episodes`.

3.3.3 Implement `has_viewer_data()`

Replace `pass` with a code block that checks whether or not an individual *Clone Wars* episode possesses viewership information. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. The function *must* compute the truth value of the passed in episode's "episode_us_viewers_mm" key-value pair, returning either `True` or `False` to the caller.

💡 Recall that a function can include more than one `return` statement. That said, you can also employ Python's ternary operator to solve this challenge with a single line of code.

3.3.4 Call `has_viewer_data()`

After implementing the function return to `main()`.

1. Test your implementation of `has_viewer_data()` by counting the number of episodes in the `clone_wars_episodes` list that possess a "episode_us_viewers_mm" numeric value. Employ a loop, a conditional statement, and the accumulator pattern to accomplish the task. Whenever the return value of `has_viewer_data()` equals `True` increment your episode count by 1.

💡 Recall that a function call is considered an expression and `if` statements are composed of one or more expressions.

2. The number of episodes that possess an "episode_us_viewers_mm" viewership value equals eighty-eight (88). If your loop does not accumulate this total, recheck both your implementation of `has_viewer_data()` and your `for` loop and loop block `if` statement.


3.4 Challenge 04 (100 points)

Task: Implement a function that converts *Clone Wars* episode string values to more appropriate types.

3.4.1 Implement `convert_episode_values()`

Replace `pass` with a code block that converts specified string values to more appropriate types. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. The function accepts a list of nested "episode" dictionaries. You *must* implement a nested loop to perform the value type conversions.
 - Outer loop: passed in `episodes` list of nested dictionaries.
 - Inner loop: individual "episode" dictionary items.
 2. Employ `if-elif-else` conditional statements to convert the values encountered to more appropriate types. Utilize the conditional statements to perform the following operations on each key and value encountered:
 1. Check if the value is a member of `none_values`. If `True` assign `None` to the converted value's associated key.
 2. Convert certain episode string values to more appropriate types by passing the value to the appropriate `util.to_*` function and assigning the return value to the converted value's associated key. See the docstring's "Type conversions" section for a listing of required conversions.
-  Consider which conversions might be grouped together in your conditions. Remember that there can be more than one `elif` condition if needed.
3. After the outer loop terminates return the list of mutated dictionaries to the caller.

3.4.2 Call `convert_episode_values()`

After implementing the function, return to `main()`.

1. Call the function `convert_episode_values()` and pass it the following argument: `clone_wars_episodes` and the constant `NONE_VALUES`. Assign the return value to `clone_wars_episodes`.
2. Call the function `util.write_json()` and write `clone_wars_episodes` to the file `stu-clone_wars-episodes_converted.json`. Compare your file to the test fixture file `ftt-clone_wars-episodes_converted.json`. Both files *must* match, line-for-line, and character-for-character.

3.5 Challenge 05 (90 points)

Task: Implement a function that retrieves the most viewed *Clone Wars* episode(s).

3.5.1 Implement `get_most_viewed_episode()`

Replace `pass` with a code block that finds the most viewed *Clone Wars* episode(s) in the data set. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. The function *must* return a list of one or more episodes from the passed in `episodes` list that feature the highest recorded viewership. Include in the list only those episodes that tie for the highest recorded viewership. If no ties exist only one episode will be returned in the list.
2. The function *must* exclude from the list all episodes that lack a viewership value.
3. Delegate to `has_viewer_data()` the task of checking whether an episode contains a *truthy* "episode_us_viewers_mm" value. The function needs to check the truth value of "episode_us_viewers_mm" before you attempt to compare the current "episode_us_viewers_mm" value to the previous value.



Assign two local "accumulator" variables to the viewer count and the top episode(s).

3.5.2 Call `get_most_viewed_episode()`

After implementing the function return to `main()`.

1. Call the function and pass it the following argument: `clone_wars_episodes`.
2. Assign the return value to `most_viewed_episode`. Pass the variable to `print()` and review the terminal output. If the list contains the following elements proceed to the next challenge; if not, recheck your code.

```
[
  {
    'series_title': 'Star Wars: The Clone Wars',
    'series_season_num': 1,
    'series_episode_num': 2,
    'season_episode_num': 2,
    'episode_title': 'Rising Malevolence',
    'episode_director': 'Dave Filoni',
    'episode_writers': ['Steven Melching'],
    'episode_release_date': 'October 3, 2008',
    'episode_prod_code': 1.07,
    'episode_us_viewers_mm': 4.92
  },
  {
    'series_title': 'Star Wars: The Clone Wars',
    'series_season_num': 7,
    'series_episode_num': 134,
    'season_episode_num': 13,
    'episode_title': 'The Lecturers',
    'episode_director': 'Anthony Whyte',
    'episode_writers': ['Anthony Whyte', 'Chris Teplovs'],
    'episode_release_date': 'May 7, 2020',
```

```

        'episode_prod_code': 7.25,
        'episode_us_viewers_mm': 4.92
    }
]

```

3.6 Challenge 06 (100 points)

Task: Construct a dictionary of *Clone Wars* directors along with a count of the number of episodes each director directed. Sort by episode count (descending) and the director name (ascending).

3.6.1 Implement `count_episodes_by_director()`

Replace `pass` with a code block that returns a dictionary of key-value pairs that associate each director in the `episodes` list with a count of the episodes that they are credited with directing. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. The function *must* accumulate episode counts for each director listed in the `episodes` list. Create an empty accumulator dictionary to hold the director-count key-value pairs (variable name your choice).
2. The director's name comprises the key and the associated value represents a count of the number of episodes that they directed.

```

{
    < director_name_01 >: < episode_count >,
    < director_name_02 >: < episode_count >,
    ...
}

```

3. Employ a nested loop to solve this challenge. As you loop over each episode you will need to extract the director(s) from a string into a list and then loop over each in turn. In most cases you will encounter a single director but exceptions exist. For example Season 7, episode 128 was directed by Saul Ruiz and Bosco Ng.

```


series_title,series_season_num,series_episode_num,season_episode_num,e
pisode_title,episode_director, ....
...
Star Wars: The Clone Wars,7,128,7,Dangerous Debt,"Saul Ruiz, Bosco
Ng", ....
...

```

4. Implement conditional logic in the inner loop block to ensure each director's episode counts are properly tabulated per the following rules:

1. Check if the local accumulator dictionary possesses a key-value pair for the director. If **True**, increment the associated value; otherwise add a new key-value pair to the dictionary.
2. When accumulating values, increment the director's episode count by **1.0** (a **float**) **if, and only if**, the director is the only person credited with directing the episode.
3. Otherwise, if two or more directors are credited with directing the episode allocate a fraction of **1.0** to each director's episode count. This value is calculated by dividing **1.0** by the number of directors credited with directing the episode.

For example, if two directors are credited with directing the episode, each director's count is incremented by **0.5**; if three directors are credited with directing the episode, each director's count is incremented by **0.33**.

 Employ simple division when incrementing the count. Consider how you can employ the list of directors in the equation that you write.

3.6.2 Call `count_episodes_by_director()`

After implementing the function return to `main()`.


1. Call the function and pass `clone_wars_episodes` to it as the argument.
2. Assign the return value to `director_episode_counts`.
3. **Uncomment** the provided dictionary comprehension that employs the built-in function `sorted()` and a `lambda` function to sort the episode counts by the count (descending) and the director's last name.
4. Call the function `util.write_json()` and write the sorted `director_episode_counts` to the file `stu-clone_wars-director_episode_counts.json`. Compare your file to the test fixture file `fxt-clone_wars-director_episode_counts.json`. Both files *must* match, line-for-line, and character-for-character.

3.7 Challenge 07 (75 points)

Task: Implement the function `get_news_desks()`.

3.7.1 Implement `get_news_desks()`

Replace `pass` with a code block that returns a list of New York Times "news desks" sourced from the passed in `articles` list. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

 Each article dictionary contains a "news_desk" key-value pair.

Requirements

1. The list of news desk names returned by the function *must not* contain any duplicate elements. Accumulate the values carefully.

- The function must delegate to the function `utl.to_none()` the task of converting "news_desk" values that equal "None" (a string) to `None`. Only news_desk values that are "truthy" (i.e., not None) are to be returned in the list.



There are a number of articles with a "news_desk" value of "None". Exclude this value from the list by passing each "news_desk" value to `utl.to_none()` and assigning the return value to a local variable. You can filter out the `None` values with a truth value test.

- The function *must* return a new version of the accumulator list sorted alphanumerically.

3.7.2 Call `get_news_desks()`

After implementing the function return to `main()`.

- Call the function `utl.read_json()` and retrieve the New York Times article data in the file `./data-nyt_star_wars_articles.json`. Assign the return value to `articles`.
- Test your implementation of `get_news_desks()` by calling the function and passing to it the following arguments: `articles` and the constant `NONE_VALUES`. Assign the return value to the variable `news_desks`.
- Call the function `utl.write_json()` and write `news_desks` to the file `stu-nyt_news_desks.json`. Compare your file to the test fixture file `fxt-nyt_news_desks.json`. The files *must* match line for line, indent for indent, and character for character.

3.8 Challenge 08 (100 points)

Task: Implement the function `group_articles_by_news_desk()`.

3.8.1 Implement `group_articles_by_news_desk()`

Replace `pass` with a code block that returns a dictionary of "news desk" key-value pairs that group the passed in `articles` by their parent news desk drawn from the `news_desks` list. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

- Assign an empty dictionary to a local variable.
- Implement a nested loop. Review the `data-nyt_star_wars_articles.json` and `stu-nyt_news_desks.json` files and decide which list should be traversed by the outer loop and which list should be traversed by the inner loop.



The news desk name provides the link between the two lists.

- Assign an empty list to a "parent" news desk key within the local dictionary you created in step 1. You will accumulate article dictionaries in this list.



There are three locations in the function block where this initial variable assignment could be placed: outside the loops, inside the outer loop, or inside the inner loop. Choose wisely.

4. Each article dictionary added to its parent news desk list represents a "thinned" version of the original. The keys to employ and their order is illustrated by the example below:

```
{
  "web_url":
  "https://www.nytimes.com/2016/10/20/business/media/lucasfilm-sues-jedi-classes.html",
  "headline_main": "Classes for Jedis Run Afoul of the Lucasfilm Empire",
  "news_desk": "Business",
  "byline_original": "By Erin McCann",
  "document_type": "article",
  "material_type": "News",
  "abstract": "A man whose businesses offers private lessons and certifications for fine-tuning lightsaber skills is operating without the permission of the "Star Wars" owner.",
  "word_count": 865,
  "pub_date": "2016-10-19T13:26:21+0000"
}
```

! Certain keys such as "headline_main", "byline_original", and "material_type" are not found in the original New York Times dictionaries. Hopefully, the names provide a sufficient hint about which values to map (i.e., assign) to each key.

3.8.2 Call `group_articles_by_news_desk()`

After implementing the function return to `main()`.


1. Call the function and pass it `news_desks` and `articles` as arguments. Assign the return value to the variable `news_desk_articles`.
2. Call the function `utl.write_json()` and write `news_desk_articles` to the file `stu-nyt_news_desk_articles.json`. Compare your file to the test fixture file `fxt-nyt_news_desk_articles.json`. The files *must* match line for line, indent for indent, and character for character.

3.9 Challenge 09 (100 points)

Task Implement the function `calculate_articles_mean_word_count()`.

3.9.1 `calculate_articles_mean_word_count()` function

Replace `pass` with a code block that returns the mean (e.g., average) word count of the passed in list of `articles` less any articles with a word count of zero (0). Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

 **mean:** central value of a set of values that is determined by calculating *the sum of the values divided by the number of values*.

Requirements

1. The function *must* calculate the mean word count of the passed in articles **excluding** from the calculation all articles with a "word_count" value of zero (0) or **None**.
2. The function *must* maintain a count of the number of articles evaluated and a count of the total words accumulated from each article's "word_count" value. Assign the running counts to two local "accumulator" variables.
3. The function *must* check the truth value of each article's "word_count" before attempting to increment the article count and total words count. If the truth value of the "word_count" is **False** the article is excluded from the count.
4. The function *must* **round** the mean value to the second (2nd) decimal place before returning the value to the caller.

3.9.2 Call `calculate_articles_mean_word_count()`

After implementing the function return to `main()`.

1. Create an empty dictionary named `mean_word_counts`. You will use it to accumulate mean words counts.
2. Loop over the `news_desk_articles` key-value pairs. Write a conditional statement inside the loop block that checks if the current key is a member of the `ignore` news desks tuple. If the key is **not** a member call the function `calculate_articles_mean_word_count()` and pass it the list of articles mapped (i.e., assigned) to the key.
3. Inside the loop add a new key-value pair to `mean_word_counts` consisting of the current key and the return value of the call to `calculate_articles_mean_word_count()`. Below is one of the key-value pairs added to `mean_word_counts` that your code *must* produce:

```
{
    ...
    "Obits": 876.62,
    ...
}
```

4. Call the function `utl.write_json()` and write `mean_word_counts` to the file `stu-nyt_news_desk_mean_word_counts.json`. Compare your file to the test fixture file `fxt-nyt_news_desk_mean_word_counts.json`. The files *must* match line-for-line and character-for-character.

3.10 Challenge 10 (60 points)

Task: Implement the utility function `utl.get_nested_dict()`.

3.10.1 Implement `utl.get_nested_dict()`

Replace `pass` with a code block that utilizes a `filter` string to return a nested dictionary from the passed in `data` list. Review the function's docstring to better understand the task it is to perform, the parameters it

defines, and the return value it computes.

The function is employed to traverse lists of nested dictionaries sourced from the following files in search of a particular dictionary representation of a Star Wars droid, person, planet, or starship:

- `data-wookieepedia_droids.json`
- `data-wookieepedia_people.json`
- `data-wookieepedia_planets.csv`
- `data-wookieepedia_starships.csv`



Familiarize yourself with the Wookieepedia-sourced data files before commencing the remaining challenges.

Requirements

1. Loop over the nested dictionaries in the passed in `data` list.
2. Inside the loop block utilize the passed in `key` name to identify the key-value pair in the nested dictionary to evaluate. The value mapped to the `key` *must* be compared to the passed in `filter` value using a **case sensitive** comparison. If an **exact match** is obtained the nested dictionary is returned to the caller; otherwise `None` is returned.

3.10.2 Call `utl.get_nested_dict()`

After implementing the function return to `main()`.

1. Call the function `utl.read_csv_to_dicts()` and retrieve the supplementary Wookieepedia planet data in the file `data-wookieepedia_planets.csv`. Assign the return value to `wookiee_planets`.
2. Call the function `utl.get_nested_dict()` and pass it the following arguments: `wookiee_planets`, the key "name", and the string "Dagobah".
3. Assign the return value to the variable `wookiee_dagobah`.
4. Call the function `utl.write_json()` and write `wookiee_dagobah` to the file `stu-wookiee_dagobah.json`. Compare your file to the test fixture file `fxt-wookiee_dagobah.json`. The files *must* match line for line, indent for indent, and character for character.
5. Call `utl.get_nested_dict()` a second time and pass it the following arguments: `wookiee_planets`, the key "system", and the string "Al'Har system".
6. Assign the return value to the variable `wookiee_haruun_kal`.
7. Call the function `utl.write_json()` and write `wookiee_haruun_kal` to the file `stu-wookiee_haruun_kal.json`. Compare your file to the test fixture file `fxt-wookiee_haruun_kal.json`. The files *must* match line for line, indent for indent, and character for character.

3.11 Challenge 11 (85 points)

Task: Implement the functions `utl.to_gravity_value()` and `utl.to_year_era()`.

3.11.1 Implement `utl.to_gravity_value()`

Replace `pass` with a code block that attempts to convert a planet's "gravity" value to a float by first removing the "standard" unit of measure substring (if it exists) before converting the remaining number to a float. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

💡 Note that "gravity" values vary from planet to planet. The following examples illustrate the challenge:

```
{
    'name': Tatooine,
    ...
    'gravity': '1 standard',
    ...
}

{
    'name': Dagobah,
    ...,
    'gravity': 'N/A',
    ...
}

{
    'name': Haruun Kal,
    ...
    'gravity': '0.98',
    ...
}
```

Requirements

1. Employ `try` and `except` statements in order to handle runtime exceptions whenever an invalid conversion is attempted.

exclamation: **Do not** place code outside the `try` and `except` code blocks.

2. In the `try` block evaluate whether or not the substring "standard" is part of `value` (perform a case *insensitive* check). If found, remove the substring and pass the new string to the function `utl.to_float()` in order to convert the numeric part of the `value` to a float. If the substring "standard" is not found pass `value` directly to `utl.to_float()`.

❗ Don't assume that `value` is "clean"; program defensively and remove leading/trailing spaces and commas before attempting to convert the "cleaned" version of the string to a float.

3. If a runtime exception is encountered "catch" the exception in the `except` block and return the `value` to the caller **unchanged**.

💡 You do not need to specify specific exceptions in the `except` statement.

3.11.2 Test `utl.to_gravity_value()`

After implementing the function return to `main()`. Uncomment the relevant `assert` statements. Run your code. If an `AssertionError` is raised, debug your code, and then retest. Repeat as necessary.

3.11.3 Implement `utl.to_year_era()`

Replace `pass` with a code block that attempts to separate the Galactic standard calendar year and era (e.g., 896BBY, 24ABY) value into a dictionary comprising year and era key-value pairs.

Requirements

1. Employ `try` and `except` statements in order to handle runtime exceptions whenever an invalid conversion is attempted. **Do not** place code outside the `try` and `except` code blocks.
2. In the `try` block use slicing to access the year and era segments of the string.



Note that while the year segment's length varies (e.g., 896, 19, 0) the era segment of the Galactic calendar date string comprises three characters: "BBY" or "ABY". Keep this in mind as you design your slicing expressions.

3. Before mapping the sliced segments to a dictionary, you *must* first check if the "year" segment of the `value` is a number by employing the appropriate `str` method. If the substring **is numeric**, return a dictionary literal that maps the necessary slicing expressions to "year" and "era" keys as values. Structure the dictionary as follows:

```
{"year": < year > (int), "era": < era > (str)}
```

4. Otherwise, if the "year" segment is not considered numeric return the `value` to the caller **unchanged**.
5. If the year segment is numeric (check by calling the string's `isnumeric()` method), convert the "year" segment to an integer by passing it as the argument to the function `to_int()`. Call the function from within the dictionary literal.
6. If a runtime exception is encountered "catch" the exception in the `except` block and return the `value` to the caller **unchanged**.



You do not need to specify specific exceptions in the `except` statement.

3.11.4 Test `utl.to_year_era()`

After implementing the function return to `main()`. Uncomment the relevant `assert` statements. Run your code. If an `AssertionError` is raised, debug your code, and then retest. Repeat as necessary.

Transforming data dictionaries (Challenges 12-16)



The workflow outlined below illustrates the general creational pattern applied to each droid, person, planet, species, and starship encountered in the following challenges.

1. Retrieve a SWAPI representation of the entity if one exists. Deserialize the JSON into a dictionary and assign the dictionary to a local variable.
2. Retrieve a Wookieepedia representation of the entity if one exists. Read the data from a JSON or CSV file and assign the data to a local variable.
3. Perform an in-place operation that mutates the SWAPI dictionary with Wookieepedia data if provided. The SWAPI entity serves as the default representation of the entities that feature in the assignment. The Wookieepedia data is used to enrich the SWAPI data with new and updated key-value pairs.
4. Call the appropriate `transform_*` function to return a "thinned" version of the mutated SWAPI dictionary that retains a subset of the original SWAPI/Wookieepedia key-value pairs, substituting in new keys when required and converting certain values to more appropriate types, including replacing certain string values with `None`. Use the appropriate nested dictionary read from the "data-key_mappings.json" file to guide your transformations.
5. Serialize the new dictionary as JSON and write the object to a file in order to review the output.

3.12 Challenge 12 (70 points)

Task: Implement the function `transform_planet()`.

3.12.1 Implement `transform_planet()`

Replace `pass` with a code block that returns a dictionary representation of a planet based on the passed in `data` dictionary. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. Assign an empty dictionary to a local variable (name your choice). This "planet" dictionary will be employed to accumulate new key-value pairs sourced from the passed in `data` dictionary.
2. The function also requires that a dictionary of `keys` be provided by the caller. The `keys` dictionary (obtained from the file "data-key_mappings.json") includes nested droid, person, planet, species, and starship dictionaries. Each of these nested dictionaries specify the following attributes of the new dictionary that each `transform_*` function will construct:
 - the subset of `data` key-value pairs to be mapped to the new dictionary.
 - the order in which the `data` key-value pairs are mapped to the new dictionary.
 - the key names to be used in the new dictionary.

For example, each key in the `keys` "planet" dictionary corresponds to a key in the passed in `data` dictionary. Each value in the `keys` "planet" dictionary represents the (new) key name to be used in the new planet dictionary.

```

keys = {
    ...
    "planet": {
        "url": "url", # old key: new key
        ...,
        "orbital_period": "orbital_period_days", # old key: new key
        ...
    },
    ...
}

```

3. Loop over the `keys` dictionary's nested "planet" dictionary's keys or items (your choice). Inside the loop block employ `if-elif-else` conditional statements to populate the new planet dictionary with key-value pairs sourced from `data`.



Each key in the `keys` nested "planet" dictionary maps to a `data` key-value pair. The associated value provides the **new key** to utilize in the new dictionary.

4. Inside the loop convert `data` values to more appropriate types as outlined in the docstring's mappings section. Strings found in `none_values` must be converted to **None irrespective of case**. Delegate type conversions to the various `util.to_*` functions. Then map the `data` value to the new key when assigning the key-value pair to the new dictionary.

For example, if a `keys` key is named "diameter" perform the following actions:

1. access the corresponding `data` "diameter" value, converting it as required to a more appropriate type or **None** using the appropriate `util.to_*` functions.
2. assign the (converted) value to the new dictionary using the `keys` nested "planet" dictionary's "diameter_km" value as the new key.



Review the mappings carefully. Opportunities exist to reduce the number of `elif` statements by grouping keys whose values should be converted to the same type.

3.12.2 Test `transform_planet()`

After implementing `transform_planet()` return to `main()`.

1. Create a `pathlib.Path` object that provides an **absolute** path to the file "data-key_mappings.json". Assign the object to a variable named `keys_path`.
2. Call the function `util.read_json()` passing it the argument `keys_path`. Assign the return value to a variable named `keys`.



Review the nested JSON objects in the file `data-key_mappings.json`. Each object provides a mapping of *current* SWAPI/Wookieepedia key names to *new* key names (e.g., "length" -> "length_m") for each entity featuring in this assignment. After deserializing the JSON into a dictionary of dictionaries you will employ these mappings to create new dictionary representations of droids, people, planets, species, and starships that, in certain cases, feature new key names.

3. Call the function `get_swapi_resource()` and retrieve a SWAPI representation of the planet `Tatooine`. Make use of the appropriate constant to simplify construction of the URL. Access the "Tatooine" dictionary which is stored in the response object and assign the value to `swapi_tatooine`.
4. Access the Wookieepedia representation of the planet. Call the function `utl.get_nested_dict()` and pass it the following arguments: `wookiee_planets`, the key "name", and the `swapi_tatooine` `name` value. Assign the return value to `wookiee_tatooine`.
5. Combine the SWAPI and Wookieepedia planet dictionaries. Mutate `swapi_tatooine` by combining it with the Wookieepedia representation of the planet. Employ an in-place operation to accomplish the task.
6. Call the function `transform_planet()` and pass it the following arguments: `swapi_tatooine`, `keys`, and the constant `NONE_VALUES`. Assign the return value to a variable named `tatooine`.
7. Call the function `utl.write_json()` and write `tatooine` to the file `stu-tatooine.json`. Run your code. Compare your file to the test fixture file `fxt-tatooine.json`. Both files *must* match line for line, indent for indent, and character for character.

3.13 Challenge 13 (60 points)

Task: Implement the function `transform_droid()`.

3.13.1 Implement `transform_droid()`

Replace `pass` with a code block that returns a dictionary representation of a droid (e.g., a sentient robot) based on the passed in `data` dictionary. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. Assign an empty dictionary to a local variable (name your choice). This "droid" dictionary will be employed to accumulate new key-value pairs sourced from `data`.
2. Adopt the same key-value pair mapping pattern employed in the `transform_planet()` function. Loop over the `keys` dictionary's keys or items (your choice). Inside the loop block employ `if-elif-else` conditional statements to populate the new droid dictionary with key-value pairs sourced from `data`, converting `data` values to more appropriate types as outlined in the docstring's mappings section.

3.13.2 Test `transform_droid()`

After implementing `transform_droid()` return to `main()`.

1. Call the function `get_swapi_resource()` and retrieve a SWAPI representation of the astromech droid `R2-D2`. Make use of the appropriate constant to simplify construction of the URL. Access the "R2-D2" dictionary which is stored in the response object and assign the value to `swapi_r2_d2`.
2. Call the function `utl.read_json()` and retrieve the supplementary Wookieepedia droid data in the file `data-wookieepedia_droids.json`. Assign the return value to `wookiee_droids`.

3. Access the Wookieepedia representation of the droid. Call the function `utl.get_nested_dict()` and pass it the following arguments: `wookiee_droids`, the key "name", and the `swapi_r2_d2 name` value. Assign the return value to `wookiee_r2_d2`.
4. Combine the SWAPI and Wookieepedia droid dictionaries. Mutate `swapi_r2_d2` by combining it with the Wookieepedia representation of the droid. Employ an in-place operation to accomplish the task.
5. Call the function `transform_droid()` and pass it the following arguments: `swapi_r2_d2`, `keys`, and the constant `NONE_VALUES`. Assign the return value to a variable named `r2_d2`.
6. Call the function `utl.write_json()` and write `r2_d2` to the file `stu-r2_d2.json`. Run your code. Compare your file to the test fixture file `fxt-r2_d2.json`. Both files *must* match line for line, indent for indent, and character for character.

3.14 Challenge 14 (50 points)

Task: Implement the function `transform_species()`.

3.14.1 Implement `transform_species()`

Replace `pass` with a code block that returns a dictionary representation of a species based on the passed in `swapi_data` dictionary. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. Assign an empty dictionary to a local variable (name your choice). This "species" dictionary will be employed to accumulate new key-value pairs sourced from `data`.
2. Adopt the same key-value pair mapping pattern employed in the `transform_planet()` function. Loop over the `keys` dictionary's keys or items (your choice). Inside the loop block employ `if-elif-else` conditional statements to populate the new species dictionary with key-value pairs sourced from `data`, converting `data` values to more appropriate types as outlined in the docstring's mappings section.

3.14.2 Call `transform_species()`

After implementing `transform_species()` return to `main()`.

1. Call the function `get_swapi_resource()` and retrieve a SWAPI representation of the human species. Make use of the appropriate constant to simplify construction of the URL. Access the "human" species dictionary which is stored in the response object and assign the value to `swapi_human_species`.
2. Call the function `transform_species()` and pass it the arguments it requires to create a "thinned" representation of the human species. Assign the return value to a variable named `human_species`.
3. Call the function `utl.write_json()` and write `human_species` to the file `stu-human_species.json`. Run your code. Compare your file to the test fixture file `fxt-human_species.json`. Both files *must* match line for line, indent for indent, and character for character.

3.15 Challenge 15 (110 points)

Task: Implement the function `transform_person()`.

3.15.1 Implement `transform_person()`

Replace `pass` with a code block that returns a new person dictionary based on the passed in `swapi_data` dictionary. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. Assign an empty dictionary to a local variable (name your choice). This "person" dictionary will be employed to accumulate new key-value pairs sourced from `data`.
2. Adopt the same key-value mapping pattern employed in the `transform_planet()` function. Loop over the `keys` dictionary's keys or items (your choice). Inside the loop block employ `if-elif-else` conditional statements to populate the new person dictionary with key-value pairs sourced from `data`, converting `data` values to more appropriate types as outlined in the docstring's mappings section.
3. Both the "homeworld" and "species" values require special handling (performed inside the loop).
 1. Delegate to the function `get_swapi_resource()` the task of retrieving a dictionary representation of the person's home planet.
 2. If the caller passes in a Wookieepedia-sourced `planets` list, delegate to the function `utl.get_nested_dict()` the task of retrieving the Wookieepedia representation of the "homeworld" from `planets`.
 3. If the person's home planet is also found in `planets` mutate the SWAPI dictionary by enriching it with the Wookieepedia data. Employ an in-place operation to accomplish the task.
 4. Transforming the resulting homeworld dictionary is delegated to the function `transform_planet()`.
 5. Likewise, delegate to the function `get_swapi_resource()` the task of retrieving a representation of the person's species. Transforming the species dictionary is delegated to the function `transform_species()`.

3.15.2 Call `transform_person()`

After implementing the function return to `main()`.

1. Call the function `get_swapi_resource()` and retrieve a SWAPI representation of the Jedi knight `Anakin Skywalker`. Make use of the appropriate constant to simplify construction of the URL. Access the "Anakin" dictionary which is stored in the response object and assign the value to `swapi_anakin`.
2. Call the function `utl.read_json()` and retrieve the supplementary Wookieepedia person data in the file `data-wookieepedia_people.json`. Assign the return value to a variable named

`wookiee_people`.

3. Call the function `utl.get_nested_dict()` and pass it the arguments required to retrieve the "Anakin Skywalker" dictionary in `wookiee_people`. Assign the return value to a variable named `wookiee_anakin`.
4. Combine the SWAPI and Wookieepedia person dictionaries. Mutate `swapi_anakin` by combining it with the Wookieepedia representation of the Jedi knight. Employ an in-place operation to accomplish the task.
5. Call the function `transform_person()` and pass it the arguments it requires to create a "thinned" representation of the Jedi knight. Assign the return value to a variable named `anakin`.
6. Call the function `utl.write_json()` and write `anakin` to the file `stu-anakin_skywalker.json`. Run your code. Compare your file to the test fixture file `fxt-anakin_skywalker.json`. Both files *must* match line for line, indent for indent, and character for character.
7. Next, create an "enriched" dictionary representation of the Jedi master and general Obi-Wan Kenobi. Utilize the same "creational" workflow and variable name format employed earlier to create the combined and cleaned dictionary representation of Anakin Skywalker.
8. Call the function `utl.write_json()` and write Obi-Wan Kenobi (e.g., `obi_wan`) to the file `stu-obi_wan_kenobi.json`. Run your code. Compare your file to the test fixture file `fxt-obi_wan_kenobi.json`. Both files *must* match line for line, indent for indent, and character for character.

3.16 Challenge 16 (80 points)

Task: Implement the function `transform_starship()`.

3.16.1 Implement `transform_starship()`

Replace `pass` with a code block that returns a new starship dictionary based on the passed in `data` dictionary. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. Assign an empty dictionary to a local variable (name your choice). This "starship" dictionary will be employed to accumulate new key-value pairs sourced from `data`.
2. Adopt the same key-value mapping pattern employed in the `transform_planet()` function. Loop over the `keys` dictionary's keys or items (your choice). Inside the loop block employ `if-elif-else` conditional statements to populate the new starship dictionary with key-value pairs sourced from `data`, converting `data` values to more appropriate types as outlined in the docstring's mappings section.

3.16.2 Call `transform_starship()`

! The starship *Twilight* is sourced from Wookieepedia only. No SWAPI representation of the light freighter exists.

After implementing `transform_starship()` return to `main()`.

1. Call the `utl.read_csv_to_dicts()` function and retrieve the supplementary Wookieepedia starship data in the file `data-wookieepedia_starships.csv`. Assign the return value to `wookiee_starships`.
2. Call `utl.get_nested_dict()` and pass it the arguments required to retrieve the light freighter named *Twilight* in `wookiee_starships`. Assign the return value to a variable named `wookiee_twilight`.
3. Call the function `transform_starship()` and pass it the arguments it requires to create a "thinned" representation of the starship. Assign the return value to a variable named `twilight`.
4. Call the function `utl.write_json()` and write `twilight` to the file `stu-twilight.json`. Run your code. Compare your file to the test fixture file `fxt-twilight.json`. Both files *must* match line for line, indent for indent, and character for character.

3.17 Challenge 17 (75 points)

R2 are you quite certain that the ship is in this direction? This way looks potentially dangerous. C-3PO

Task: Implement the function `board_passengers()`. Get Senator Padmé Amidala, the protocol droid C-3PO, and the astromech droid R2-D2 aboard the *Twilight* as passengers.

3.17.1 Implement `board_passengers()`

Replace `pass` with a code block that assigns a limited number of passengers to a list. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. The passengers *must* be passed in a `list` to the `board_passengers()` function.
2. The number of passengers permitted to board a starship or other vehicle is limited by the passed in `max_passengers` value. If the number of passengers attempting to board exceeds `max_passengers` only the first `n` passengers (where `n = max_passengers`) are permitted to board the vessel.


For example, if a starship's `max_passengers` value equals `10` and `20` passengers attempt to board the starship, only the first `10` passengers are permitted aboard the vessel.


3.17.2 Call `board_passengers()`

After implementing `board_passengers()` return to `main()`.

1. Create a dictionary representation of the Galactic senator *Padmé Amidala*. Pass the senator's name as a `params` value. Utilize the same "creational" workflow employed to create the dictionary representations of *anakin* and *obi_wan*. Use the following variable names to represent Padmé Amidala.

- `swapi_padme` (assigned to the SWAPI dictionary)
 - `wookiee_padme` (assigned to the Wookieepedia dictionary)
 - `padme` (assigned to the `transform_person()` return value)
2. Call the function `utl.write_json()` and write `padme` to the file `stu-padme_amidala.json`. Compare your file to the test fixture file `fxt-padme_amidala.json`. Both files *must* match line for line, indent for indent, and character for character.
 3. Create a dictionary representation of the protocol droid named `C-3PO`. Pass the droid's name as a `params` value. Utilize the same "creational" workflow employed to create `r2_d2`. Consider using the following variable names to represent C-3PO.
 - `swapi_c_3po` (assigned to the SWAPI dictionary)
 - `wookiee_c_3po` (assigned to the Wookieepedia dictionary)
 - `c_3po` (assigned to the `transform_droid()` return value)
 4. Call the function `utl.write_json()` and write `c_3po` to the file `stu-c_3po.json`. Compare your file to the test fixture file `fxt-c_3po.json`. Both files *must* match line for line, indent for indent, and character for character.
 5. Create a `pathlib.Path` object that provides an **absolute** path to the file "data-jedi.json". Assign the object to a variable named `filepath`.

 The file "data-jedi.json" provides a JSON array of select members of the [Jedi Order](#). The array includes [Mace Windu](#), [Plo Koon](#), [Shaak Ti](#), and [Yoda](#).
 6. Call the function `utl.read_json()` passing it the argument `filepath`. Assign the return value to a variable named `jedi`.
 7. Unpack the `jedi` list into the following variables in the order specified:
 1. `mace_windu`
 2. `plo_koon`
 3. `shaak_ti`
 4. `yoda`
 8. Assign a variable named `passenger_manifest` to a list literal that contains the following elements ordered as follows: `padme`, `c_3po`, `r2_d2`, and the four Jedi (in the order unpacked).
 9. Uncomment the two `assert` statements and test your implementation of `board_passengers()`. Run your code. If an `AssertionError` is raised, debug your code, and then retest. Repeat as necessary.

 If the function `board_passengers()` is implemented correctly the passed in `max_passengers` value will impose a limit on the number of passengers that are permitted to board the starship.
 10. Next, call the function `board_passengers()` and pass the `twilight` starship's "max_passengers" value and a list of passengers comprising `padme`, `c_3po`, and `r2_d2` (in that order) as arguments. Assign the return value to the `twilight` dictionary's "passengers_on_board" key.

3.18 Challenge 18 (125 points)

Let's get back to the ship. Power up the engines R2. *Anakin Skywalker*

Task: Implement the function `assign_crew_members()`. Assign Anakin Skywalker and Obi-Wan Kenobi to the *Twilight* as crew members.

3.18.1 Implement `assign_crew_members()`

Replace `pass` with a code block that assigns personnel by position (e.g., pilot, copilot) to a starship using a dictionary comprehension. Review the function's docstring to better understand the task it is to perform, the parameters it defines, and the return value it computes.

Requirements

1. To earn full credit you *must* create the "crew_members" dictionary by writing a **dictionary comprehension** on a **single line**.

! If necessary write a `for` loop that adds the position/crew member key-value pairs to an accumulation dictionary named `crew_members`. Get it working first and then convert it to a dictionary comprehension.

💡 Avoid looping over the passed in lists. Instead **loop over a sequence of numbers** and think carefully about the appropriate stop value to employ in order to limit the number of loop iterations. Utilize the sequence of numbers to pair `crew_position` and `personnel` elements by their matching index position.

2. The crew positions (e.g., 'pilot', 'copilot') and personnel (e.g., Anakin Skywalker, Obi-Wan Kenobie) must be passed in separate `crew_positions` and `personnel` tuples to the function `assign_crew_members()`.
3. Assume that each ship requires a full compliment of personnel to crew the vessel. In other words, if a starship's "crew_size" equals three (3) you *must* pass to `assign_crew_members()` three crew positions and three personnel.

Assume too that the maximum number of crew members that can be assigned to a starship is limited by the starship's "crew_size" value. No additional crew members are permitted to be assigned to the starship even if included in the `crew_positions` and `personnel` tuples. This limitation *must* be imposed from **within** the dictionary comprehension.

For example, if a starship's "crew_size" value equals 3 but 4 crew positions/personnel are passed to the function only the first 3 crew positions/personnel are permitted to be added as key-value pairs to the crew members dictionary.

4. The passed in `crew_positions` and `personnel` tuples *must* contain the same number of items. The individual `crew_positions` and `personnel` items are then paired by index position and stored in a dictionary structured as follows:

```
{< crew_position[0] >: < personnel[0] >, < crew_position[1] >: <
personnel[1] >, ...}
```

3.18.2 Call `assign_crew_members()`

After implementing `assign_crew_members()` return to `main()`.

1. Uncomment the two `assert` statements and test your implementation of `assign_crew_members()`. Run your code. If an `AssertionError` is raised, debug your code, and then retest. Repeat as necessary.



If the function `assign_crew_members()` is implemented correctly the passed in `crew_size` value will impose a limit on the number of crew members that are permitted to crew the starship.

2. Call the function `assign_crew_members()` and pass the Twilight's "crew_size" value, a crew positions tuple comprising the following string elements: "pilot" and "copilot", and a personnel tuple comprising `anakin` and `obi_wan`. Assign the return value to the `twilight` dictionary's "crew_members" key.

3.18.3 Issue instructions to R2-D2

Create a list containing Anakin's "Power up the engines" order (a string) and map (i.e., assign) the list to the droid `r2_d2`'s "instructions" key.

3.19 Challenge 19 (150 points)

Task: Sort `wookiee_planets` and then issue commands to R2-D2 to chart a course to the planet Naboo. Also demonstrate that you can sort a list of dictionaries using a `lambda` function.

3.19.1 Sort `wookiee_planets`

1. Write a **single-line list comprehension** that transforms each Wookieepedia-sourced planet dictionary in the `wookiee_planets` list by passing each planet referenced in the comprehension along with other arguments to the function `transform_planet()`. Assign the new list to a variable named `planets`.



If your list comprehension triggers a `KeyError` exception, check your implementation `transform_planet()`. The function is likely attempting to access a key in the planet dictionary that does not exist. Recall that there is a friendly `dict` method for dealing with such issues; refactor (i.e., revise) your function block accordingly.

2. Perform an **in-place** sort of the `planets` list passing to it as the `key` a `lambda` function that sorts the planets **by name**. **Reverse** the sort so that the planets are sorted by name in **descending order**.
3. Call the function `utl.write_json()` and write `planets` to the file `stu-planets_sorted_name.json`. Compare your file to the test fixture file `fxt-planets_sorted_name.json`. Both files *must* match line for line, indent for indent, and character for character.

3.19.2 Issue instructions to R2-D2


1. Call the function `utl.get_nested_dict()` and pass it the following arguments: `planets`, `diameter_km`, and the integer `12120`. Assign the return value to a variable named `naboo`.

2. Access the `naboo` dictionary's "region" and "sector" values and include the names in a formatted string literal (f-string) structured as follows:

```
"Plot course for Naboo, < region >, < sector >"
```

3. Add the f-string to `r2_d2's` "instructions" list so that *Twilight* can be directed to the planet `Naboo`, Padmé Amidala's home world.

3.19.3 Sort planets by diameter and name

 If you get stuck on sorting `planets` by "diameter_km" and "name", pause your sorting work and proceed to the final task ("Escape from the Malevolence") and complete it. Then return and restart this standalone task.

1. Employ the built-in function `sorted()` and a `lambda` function to sort `planets` by the following attributes:

Key	Value	Order
diameter_km	<code>int</code> <code>None</code>	descending
name	ascending	<code>str</code>

2. You *must* write your `lambda` expression using the **ternary operator** when sorting on "diameter_km" because several planets lack a known diameter and in consequence `None` has been mapped (i.e., assigned) to their "diameter_km" key.
3. Assign the return value of `sorted()` to a variable named `planets_diameter_km`.

 Write the entire statement on a single line to facilitate auto grader testing:

```
planets_diameter_km = < expression >
```

4. Call the function `utl.write_json()` and write `planets_diameter_km` to the file `stu-planets_sorted_diameter.json`. Compare your file to the test fixture file `fxt-planets_sorted_diameter.json`. Both files *must* match line for line, indent for indent, and character for character.

3.20 Challenge 20 (140 points)

R2 release the docking clamp. *Anakin Skywalker*

Task: With our heroes on board the *Twilight* and the engines fired, Anakin Skywalker orders R2-D2 to release the docking clamp and detach the light freighter *Twilight* from the stricken heavy cruiser *Malevolence*. The *Twilight* then departs to rejoin the Republican fleet before heading to Naboo. Simulate the escape by updating `r2_d2's` "instructions" and writing the `twilight` dictionary to a file.

3.20.1 Release the docking clamp

Add Anakin's order "Release the docking clamp" to `r2_d2's` "instructions" key-value pair.

3.20.2 Escape from the Malevolence

Simulate the *Twilight's* escape from the *Malevolence* by writing the `twilight` dictionary to the file `stu-twilight_departs.json`. Run your code. Compare your file to the test fixture file `fxt-twilight_departs.json`. Both files *must* match line for line, indent for indent, and character for character.

If the files match your job submit your files to Gradescope. If you earn full points your job is done. Never mind that Separatist starfighters are in hot pursuit of the *Twilight*—declare victory!

Congratulations on completing SI 506.

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