**INTRODUCTION TO FUNCTIONS**

**Introduction to Functions**

In programming, as we start to write bigger and more complex programs, one thing we will start to notice is we will often have to repeat the same set of steps in many different places in our program.

Let’s imagine we were building an application to help people plan trips! When using a trip planning application we can say a simple procedure could look like this:

1. Establish your origin and destination

2. Calculate the distance/route

3. Return the best route to the user

We will perform these three steps every time users have to travel between two points using our trip application. In our programs, we could rewrite the same procedures over and over (and over) for each time we want to travel, but there’s a better way! Python gives us a useful concept called [*functions*](https://www.codecademy.com/resources/docs/python/functions?page_ref=catalog).

Functions are a convenient way to group our code into reusable blocks. A function contains a sequence of steps that can be performed repeatedly throughout a program without having to repeat the process of writing the same code again.

In this lesson, we are going to explore the idea of a function by slowly building out a Python program for our trip planning steps!

At the end of this lesson, you’ll know how to:

* Write a function and return values from it.
* Allow functions to take custom input.
* Experiment with how functions access our other python code.

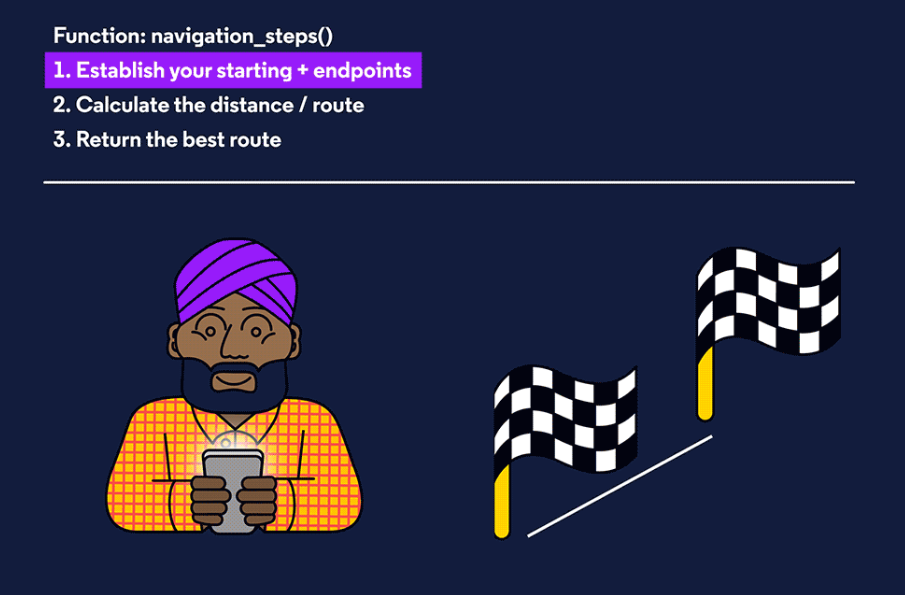
And much more!

**Instructions**

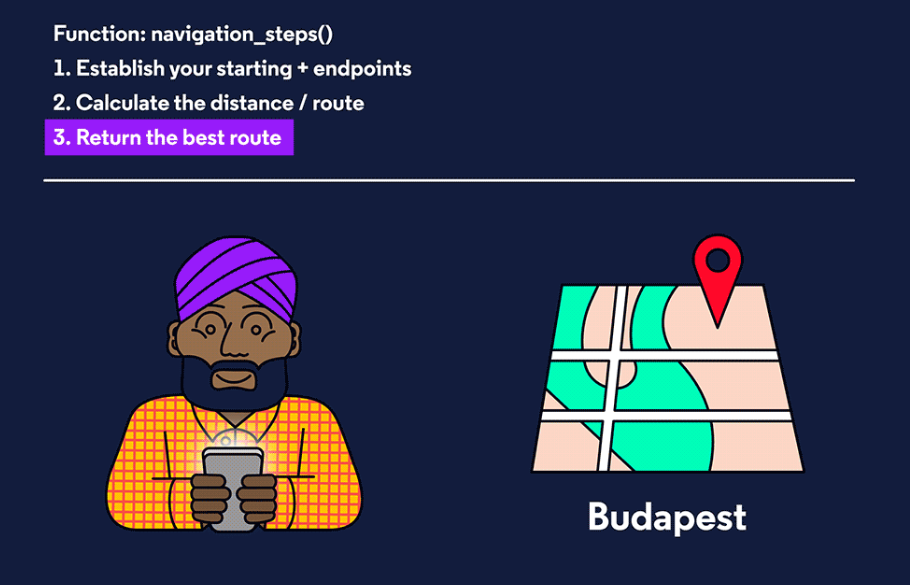
Review the visual for the function navigation\_steps().

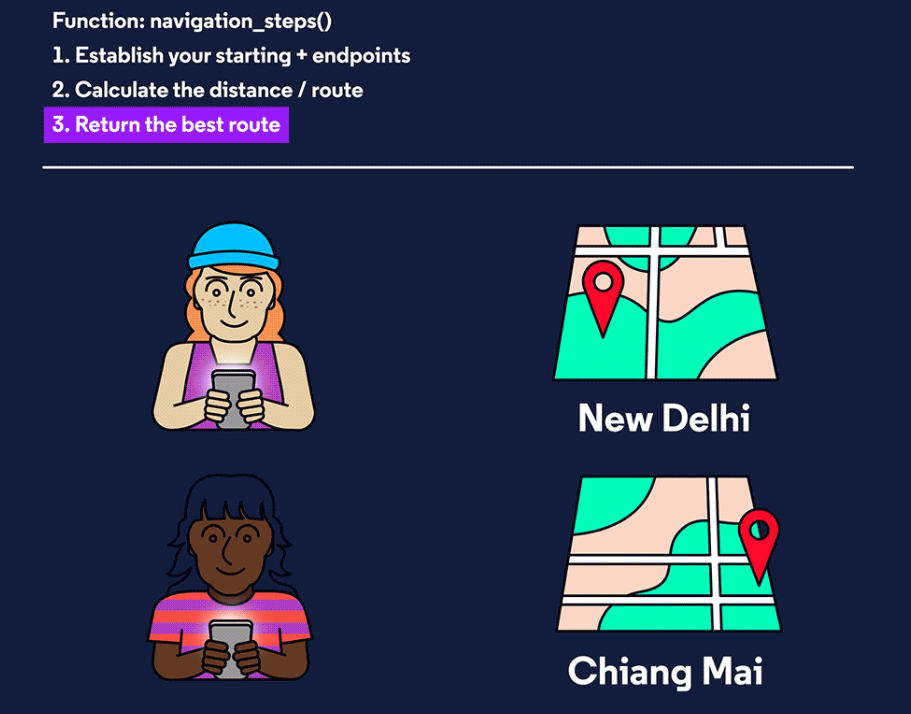
Notice how the function navigation\_steps() serves as a container for the three steps in the procedure and can be reused across multiple users as they plan their trips to different locations.

Click **Next** when you are ready to learn more about functions.









**Why Functions?**

Let’s come back to the trip planning application we just discussed in the previous exercise. The steps we talked about for our program were:

1. Establish an origin and destination

2. Calculate the distance/route

3. Return the best route

If we were to convert our steps into Python code, a very simple version that plans a trip between two popular New York tourist destinations might look like this:

print("Setting the Empire State Building as the starting point and Times Square as our destination.")  
   
print("Calculating the total distance between our points.")   
   
print("The best route is by train and will take approximately 10 minutes.")

Anytime we want to go between these two points we would need to run these three print statements (for now we can assume the best route and time will stay the same).

If our program now had 100 new people trying to find the best directions between the Empire State Building and Times Square, we would need to run each of our three print statements 100 times!

Now, if you’re thinking about using a loop here, your intuition would be totally right! Unfortunately, we won’t be always traveling between the same two locations which means a loop won’t be as effective when we want to customize a trip. We will address this in the upcoming sections!

For now, let’s gain an appreciation for functions.

**Instructions**

**1.**

***Run*** the pre-written print() statements to see what they output.

Checkpoint 2 Passed

**2.**

Write the same set of print statements three more times. Run the code again and see the output.

Checkpoint 3 Passed

Hint

Make sure that the three print statements are all duplicated three more times.

**3.**

Hopefully now you have some perspective about your life without functions!

In the next section, we will learn how we can [refactor](https://en.wikipedia.org/wiki/Code_refactoring) our code to utilize functions to reuse code.

Click ***Run*** your code again and then click ***Next*** to continue.

**travel.py**

# First user wants to travel between these two points!

print("Setting the Empire State Building as the starting point and Times Square as our destination.")

print("Calculating the total distance between our points.")

print("The best route is by train and will take approximately 10 minutes.")

# Second user wants to travel between these two points!

print("Setting the Empire State Building as the starting point and Times Square as our destination.")

print("Calculating the total distance between our points.")

print("The best route is by train and will take approximately 10 minutes.")

# Third user wants to travel between these two points!

print("Setting the Empire State Building as the starting point and Times Square as our destination.")

print("Calculating the total distance between our points.")

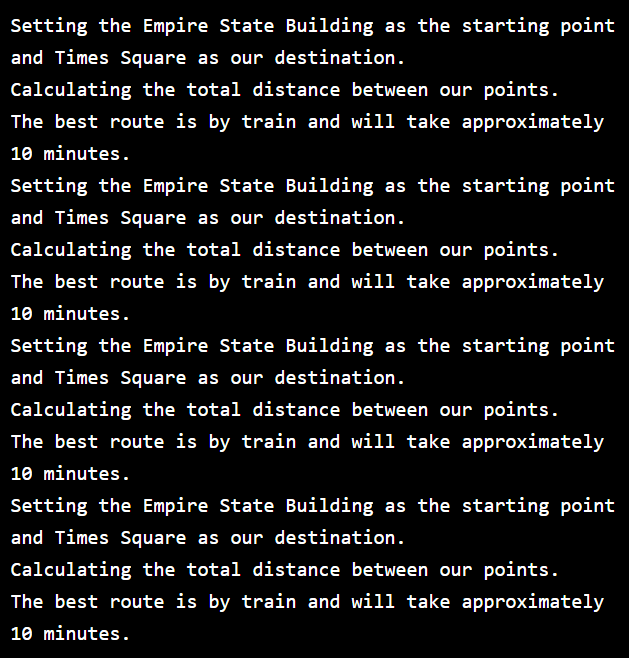
print("The best route is by train and will take approximately 10 minutes.")

# Fourth user wants to travel between these two points!

print("Setting the Empire State Building as the starting point and Times Square as our destination.")

print("Calculating the total distance between our points.")

print("The best route is by train and will take approximately 10 minutes.")



**Defining a Function**

A *function* consists of many parts, so let’s first get familiar with its core - a function definition.

Here’s an example of a function definition:

def function\_name():  
  # functions tasks go here

There are some key components we want to note here:

* The def keyword indicates the beginning of a function (also known as a function header). The function header is followed by a name in snake\_case format that describes the task the function performs. It’s best practice to give your functions a descriptive yet concise name.
* Following the function name is a pair of parenthesis ( ) that can hold input values known as parameters (more on parameters later in the lesson!). In this example function, we have no parameters.
* A colon : to mark the end of the function header.
* Lastly, we have one or more valid python statements that make up the function body (where we have our python comment).

Notice we’ve indented our # function tasks go here comment. Like loops and conditionals, code inside a function must be indented to show that they are part of the function.

Here is an example of a function that greets a user for our trip planning application:

def trip\_welcome():  
  print("Welcome to Tripcademy!")   
  print("Let's get you to your destination.")

***Note:*** Pasting this code into the editor and clicking ***Run*** will result in an empty output terminal. The print() statements within the function will not execute since our function hasn’t been used. We will explore this further in the next exercise; for now, let’s practice defining a function.

**Instructions**

**1.**

Two of the most common NYC attractions include the Empire State Building and Times Square.

In *travel.py*, we’ll write a function that prints the directions via subway from the Empire State Building to Times Square.

First, define a function, directions\_to\_timesSq(). Leave the body of the function empty for now.

***Note:*** When we run the code, we will see an error: SyntaxError: unexpected EOF while parsing. This will occur when we don’t populate a function with any statements. We will populate it with code in the next step.

EOF stands for “End of File” — Python is telling you that it was expecting some code in the body of the function, but it hit the end of the file first.

Checkpoint 2 Passed

Hint

Remember the core of a function - a definition. Check to make sure you have all the components for a function definition.

def my\_function\_name():

**2.**

Within the body of the function, use three print() statements to output the following directions:

Walk 4 mins to 34th St Herald Square train station  
Take the Northbound N, Q, R, or W train 1 stop  
Get off the Times Square 42nd Street stop

Remember, if you run your code, you shouldn’t see any output in the terminal at this point. Check out the hint if you want to see how to see the output (we will be doing it in the next section as well!)

Checkpoint 3 Passed

Hint

Check your statements for spaces, capitalization, and spelling. If you are still having problems getting the checkpoint to pass, try and copy and paste the text directly from the narrative into your print statement.

If you are interested in seeing the output, call your function like this:

directions\_to\_timesSq()

**travel.py**

# Your code below:

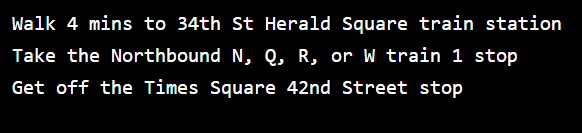
def directions\_to\_timesSq():

  print("Walk 4 mins to 34th St Herald Square train station")

  print("Take the Northbound N, Q, R, or W train 1 stop")

  print("Get off the Times Square 42nd Street stop")

directions\_to\_timesSq()

****

**Calling a Function**

Now that we’ve practiced defining a function, let’s learn about calling a function to execute the code within its body.

The process of executing the code inside the body of a function is known as calling it (This is also known as “executing a function”). To call a function in Python, type out its name followed by parentheses ( ).

Let’s revisit our directions\_to\_timesSq() function :

def directions\_to\_timesSq():  
  print("Walk 4 mins to 34th St Herald Square train station.")  
  print("Take the Northbound N, Q, R, or W train 1 stop.")  
  print("Get off the Times Square 42nd Street stop.")

To call our function, we must type out the function’s name followed by a pair of parentheses and no indentation:

directions\_to\_timesSq()

Calling the function will execute the print statements within the body (from the top statement to the bottom statement) and result in the following output:

Walk 4 mins to 34th St Herald Square train station.  
Take the Northbound N, Q, R, or W train 1 stop.  
Get off the Times Square 42nd Street stop.

Note that you can only call a function *after* it has been defined in your code.

Now it’s your turn to call a function!

**Instructions**

**1.**

Call the directions\_to\_timesSq() function.

Click ***Run*** to see it execute and print out.

Checkpoint 2 Passed

Hint

Make sure you call the function directions\_to\_timesSq() outside of the function definition. It should not be indented at all.

**2.**

Add an additional print statement to our directions\_to\_timesSq() function.

Have the statement print "Take lots of pictures!"

**Run** your code again and see how your output changes.

Checkpoint 3 Passed

Hint

Remember to add the print statement inside of the function definition for directions\_to\_timesSq(). It should be indented and contain the text "Take lots of pictures!". Make sure to place it after the other print statements in the function.

**travel.py**

def directions\_to\_timesSq():

  print("Walk 4 mins to 34th St Herald Square train station.")

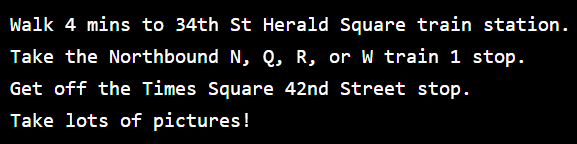
  print("Take the Northbound N, Q, R, or W train 1 stop.")

  print("Get off the Times Square 42nd Street stop.")

  print("Take lots of pictures!")

# Call your function here:

directions\_to\_timesSq()

****

**Whitespace & Execution Flow**

Consider our welcome function for our trip planning application:

def trip\_welcome():  
  print("Welcome to Tripcademy!")   
  print("Let's get you to your destination.")

The print statements all run together when trip\_welcome() is called. This is because they have the same base level of indentation (2 spaces).

In Python, the amount of [whitespace](https://www.codecademy.com/resources/docs/general/whitespace?page_ref=catalog) tells the computer what is part of a function and what is not part of that function.

If we wanted to write another statement outside of trip\_welcome(), we would have to unindent the new line:

def trip\_welcome():  
  # Indented code is part of the function body  
  print("Welcome to Tripcademy!")   
  print("Let's get you to your destination.")  
   
# Unindented code below is not part of the function body  
print("Woah, look at the weather outside! Don't walk, take the train!")  
   
trip\_welcome()

Our trip\_welcome() function steps will not print Woah, look at the weather outside! Don't walk, take the train! on our function call. The print() statement was unindented to show it was not a part of the function body but rather a separate statement.

We would see the following output from this program:

Woah, look at the weather outside! Don't walk, take the train!  
Welcome to Tripcademy!  
Let's get you to your destination.

Lastly, note that the execution of a program always begins on the first line. The code is then executed one line at a time from top to bottom. This is known as execution flow and is the order a program in python executes code.

Woah, look at the weather outside! Don't walk, take the train! was printed before the print() statements from the function trip\_welcome().

Even though our function was defined before our lone print() statement, we didn’t call our function until after.

Let’s play around with indentation and the flow of execution!

### Instructions

**1.**

We are going to help our trip planner users figure out if they should travel today based on the weather. Let’s let our users know we can check the weather for them.

Write a print() statement that will output Checking the weather for you!.

Checkpoint 2 Passed

Hint

To print() a string use the following syntax and replace <Your string in here> with the string you want to output:

print("<Your string in here>")

You can copy and paste the string from the checkpoint instructions to make sure there are no typos.

**2.**

We took a look outside and see a bright sunny day. Write a function called weather\_check() that will print a message to our users that it’s a great day to travel! The function should output:

Looks great outside! Enjoy your trip.

**Note:** Don’t call your function just yet! We will do that in the next step.

Checkpoint 3 Passed

Hint

Remember to use def before weather\_check(): to define the function and to indent the print statement to show that it is part of the function.

**3.**

Oh no! It looks like some clouds came in and it started raining. Our users shouldn’t go on a trip in the rain. In our weather\_check() function add a second print() statement under the first one which prints a warning message for our travelers! It should print:

False Alarm, the weather changed! There is a thunderstorm approaching. Cancel your plans and stay inside.

Checkpoint 4 Passed

Hint

Make sure to add another print() statement inside of your function under the first print() statement at the same level of indentation.

**4.**

Call the function weather\_check().

Checkpoint 5 Passed

Hint

Be sure to add weather\_check() at the bottom of your code without any indentation.

**5.**

Unindent your final print statement in your weather\_check() function. Run the program again.

What is different?

Checkpoint 6 Passed

Hint

Remember to unindent the front of the second print statement in your weather\_check() function. You should notice a different order in your output terminal due to the change in the indentation.

**travel.py**

# Your code below:

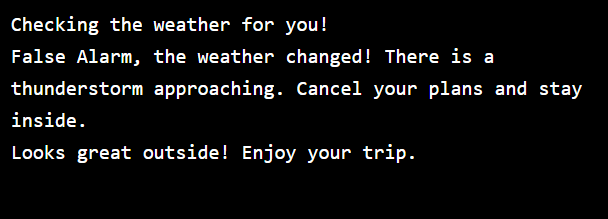
print("Checking the weather for you!")

def weather\_check():

  print("Looks great outside! Enjoy your trip.")

print("False Alarm, the weather changed! There is a thunderstorm approaching. Cancel your plans and stay inside.")

weather\_check()



**Parameters & Arguments**

Let’s return to our trip\_welcome() function one more time! Let’s modify our function to give a welcome that is a bit more detailed.

def trip\_welcome():  
  print("Welcome to Tripcademy!")   
  print("Looks like you're going to Times Square today.")  
   
trip\_welcome()

This will output:

Welcome to Tripcademy!  
Looks like you're going to Times Square today.

Our function does a really good job of welcoming anyone who is traveling to Times Square but a really poor job if they are going anywhere else. In order for us to make our function a bit more dynamic, we are going to use the concept of function [*parameters*](https://www.codecademy.com/resources/docs/python/functions/parameters-arguments?page_ref=catalog).

Function parameters allow our function to accept data as an input value. We list the parameters a function takes as input between the parentheses of a function ( ).

Here is a function that defines a single parameter:

def my\_function(single\_parameter)  
  # some code

In the context of our trip\_welcome() function, it would look like this:

def trip\_welcome(destination):  
  print("Welcome to Tripcademy!")   
  print("Looks like you're going to " + destination + " today.")

In the above example, we define a single parameter called destination and apply it in our function body in the second print statement. We are telling our function it should expect some data passed in for destination that it can apply to any statements in the function body.

But how do we actually use this parameter? Our parameter of destination is used by passing in an *argument* to the function when we call it.

trip\_welcome("Times Square")

This would output:

Welcome to Tripcademy!  
Looks like you're going to Times Square today.

To summarize, here is a quick breakdown of the distinction between a parameter and an argument:

* The parameter is the name defined in the parenthesis of the function and can be used in the function body.
* The argument is the data that is passed in when we call the function and assigned to the parameter name.

Let’s write a function with parameters and call the function with an argument to see it all in action!

**Instructions**

**1.**

We want to create a program that allows our users to generate the directions for their upcoming trip!

Create a function called generate\_trip\_instructions() that defines one parameter called location.

***Note***: Since we did not define any code in our function yet, we will receive an error in our output terminal. Don’t worry, we will be filling in the code in the next step.

Checkpoint 2 Passed

Hint

Function parameters must be defined in the parenthesis of our function definition:

def some\_function(single\_parameter):   
  #some code

**2.**

generate\_trip\_instructions() should print out the following:

Looks like you are planning a trip to visit <location>

Where <location> will represent the location parameter.

Checkpoint 3 Passed

Hint

Remember to concatenate the location to the end of the string in the print statement by using the + operator.

**3.**

generate\_trip\_instructions() should also let our users know they can reach their location using public transit.

Let’s have generate\_trip\_instructions()also print out the following on a new line:

You can use the public subway system to get to <location>

Where <location> will represent the location parameter.

Checkpoint 4 Passed

Hint

Remember to concatenate the location to the end of the string in the print statement by using the + operator.

**4.**

Time for some greenery! Let’s see what happens when we call the function and input the argument "Central Park", a backyard wonder in the heart of New York City.

Checkpoint 5 Passed

Hint

Make sure that you call generate\_trip\_instructions outside of the function definition and that you pass "Central Park" as the argument to the function.

**5.**

The day trip is over and we need to get back to the train station to head home. Change the argument to "Grand Central Station" and call the function again.

What changed in the output?

Checkpoint 6 Passed

Hint

Make sure that you call generate\_trip\_instructions outside of the function definition and that you pass "Grand Central Station" as the argument to the function.

**travel.py**

# Your code below:

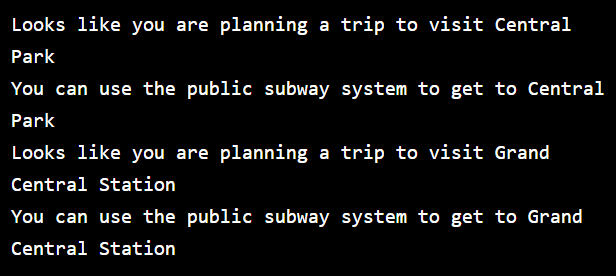
def generate\_trip\_instructions(location):

  print("Looks like you are planning a trip to visit " + location)

  print("You can use the public subway system to get to " + location)

generate\_trip\_instructions("Central Park")

generate\_trip\_instructions("Grand Central Station")

****

**Multiple Parameters**

Using a single parameter is useful but functions let us use as many parameters as we want! That way, we can pass in more than one input to our functions.

We can write a function that takes in more than one parameter by using commas:

def my\_function(parameter1, parameter2, parameter3):  
  # Some code

When we call our function, we will need to provide arguments for each of the parameters we assigned in our function definition.

# Calling my\_function  
my\_function(argument1, argument2)

For example take our trip application’s trip\_welcome() function that has two parameters:

def trip\_welcome(origin, destination):  
  print("Welcome to Tripcademy")  
  print("Looks like you are traveling from " + origin)  
  print("And you are heading to " + destination)

Our two parameters in this function are origin and destination. In order to properly call our function, we need to pass argument values for both of them.

The ordering of your parameters is important as their position will map to the position of the arguments and will determine their assigned value in the function body (more on this in the next exercise!).

Our function call could look like:

trip\_welcome("Prospect Park", "Atlantic Terminal")

In this call, the argument value of "Prospect Park" is assigned to be the origin parameter, and the argument value of"Atlantic Terminal" is assigned to the destination parameter.

The output would be:

Welcome to Tripcademy  
Looks like you are traveling from Prospect Park  
And you are heading to Atlantic Terminal

Let’s practice writing and calling a multiple parameter function!

**Instructions**

**1.**

Our travel application users want to calculate the total expenses they may have to incur on a trip.

Write a function called calculate\_expenses that will have four parameters (in exact order):

1. plane\_ticket\_price
2. car\_rental\_rate
3. hotel\_rate
4. trip\_time

Each of these parameters will account for a different expense that our users will incur.

**Note:** Like before, we will see an error: SyntaxError: unexpected EOF while parsing, since there is no code in the body of the function. In the next step we will add statements to the function.

However, you can also add a pass statement inside your empty function and it will prevent that error. Remove the pass statement in the next step when you add code to your function.

Checkpoint 2 Passed

Hint

Remember that the parameters go between the parentheses in the function definition and that they are separated by commas. The order of the parameters is also important!

**2.**

Within the body of the function, let’s start to make some calculations for our expenses. First, let’s calculate the total price for a car rental.

Create new variable called car\_rental\_total that is the product of car\_rental\_rate and trip\_time.

Checkpoint 3 Passed

Hint

Use \* to perform multiplication between the two variables.

**3.**

Next, we want to apply the same logic but for our hotel\_rate.

Create new variable called hotel\_total that is the product of hotel\_rate and trip\_time.

We also have a coupon to give our users some cashback for their hotel visit so subtract 10 from that total in the same statement. Woohoo, coupons! 💵

Checkpoint 4 Passed

Hint

Use \* to perform multiplication between the two variables. Don’t forget to subtract 10 after!

**4.**

Lastly, let’s print a nice message for our users to see the total. Use print to output the sum of car\_rental\_total, hotel\_total and plane\_ticket\_price.

Checkpoint 5 Passed

Hint

Use + to perform the addition operation on the three variables.

**5.**

Call your function with the following argument values for the parameters listed:

* plane\_ticket\_price : 200
* car\_rental\_rate : 100
* hotel\_rate : 100
* trip\_time: 5

Checkpoint 6 Passed

Hint

Your output should be:

1190

**travel.py**

# Write your code below:

#def calculate\_expenses(plane\_ticket\_price, car\_rental\_rate, hotel\_rate, trip\_time):

 #pass

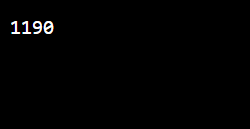
def calculate\_expenses(plane\_ticket\_price, car\_rental\_rate, hotel\_rate, trip\_time):

  car\_rental\_total = car\_rental\_rate \* trip\_time

  hotel\_total = hotel\_rate \* trip\_time - 10

  print(car\_rental\_total + hotel\_total + plane\_ticket\_price)

calculate\_expenses(200, 100, 100, 5)

****

**Types of Arguments**

In Python, there are 3 different types of arguments we can give a function.

* Positional arguments: arguments that can be called by their position in the function definition.
* Keyword arguments: arguments that can be called by their name.
* Default arguments: arguments that are given default values.

Positional Arguments are arguments we have already been using! Their assignments depend on their positions in the function call. Let’s look at a function called calculate\_taxi\_price() that allows our users to see how much a taxi would cost to their destination 🚕.

def calculate\_taxi\_price(miles\_to\_travel, rate, discount):  
  print(miles\_to\_travel \* rate - discount )

In this function, miles\_to\_travel is *positioned* as the first parameter, rate is positioned as the second parameter, and discount is the third. When we call our function, the position of the arguments will be mapped to the positions defined in the function declaration.

# 100 is miles\_to\_travel  
# 10 is rate  
# 5 is discount  
calculate\_taxi\_price(100, 10, 5)

Alternatively, we can use *Keyword Arguments* where we explicitly refer to what each argument is assigned to in the function call. Notice in the code example below that the arguments do not follow the same order as defined in the function declaration.

calculate\_taxi\_price(rate=0.5, discount=10, miles\_to\_travel=100)

Lastly, sometimes we want to give our function arguments default values. We can provide a default value to an argument by using the assignment operator (=). This will happen in the function declaration rather than the function call.

Here is an example where the discount argument in our calculate\_taxi\_price function will always have a default value of 10:

def calculate\_taxi\_price(miles\_to\_travel, rate, discount = 10):  
  print(miles\_to\_travel \* rate - discount )

When using a default argument, we can either choose to call the function without providing a value for a discount (and thus our function will use the default value assigned) or overwrite the default argument by providing our own:

# Using the default value of 10 for discount.  
calculate\_taxi\_price(10, 0.5)  
   
# Overwriting the default value of 10 with 20  
calculate\_taxi\_price(10, 0.5, 20)

Let’s practice using these different types of arguments!

**Instructions**

**1.**

Tripcademy (our trusty travel app) needs to allow passengers to plan a trip (duh).

Write a function called trip\_planner() that will have three parameters: first\_destination, second\_destination and final\_destination.

Give the final\_destination parameter a default value of "Codecademy HQ".

***Note***: Since we did not define any code in our function yet, we will receive an error in our output terminal. Don’t worry, we will be filling in the code in the next step.

Checkpoint 2 Passed

Hint

Remember the structure of a multi-parameter function:

def my\_function(param1, param2, param3):  
  # Some code..

**2.**

First, we want to introduce the trip to users. Use print() in our function to output Here is what your trip will look like!.

Checkpoint 3 Passed

Hint

Make sure to add the print() statement inside of your function by indenting it. Check spelling and capitalization for your string so it matches the one provided in the instructions.

**3.**

In our function definition let’s provide an itinerary that will describe the destinations our user will visit in order. Print a statement that follows this form:

First, we will stop in <first\_destination>, then <second\_destination>, and lastly <final\_destination>

An example call to our function using positional arguments:

trip\_planner("London", "India", "New Zealand")

Should output:

Here is what your trip will look like!  
First, we will stop in London, then India, and lastly New Zealand

To test out your function, call trip\_planner() with the following values for the parameters:

* first\_destination: "France"
* second\_destination: "Germany"
* final\_destination: "Denmark"

Checkpoint 4 Passed

Hint

Use + to concatenate strings together. Here is an example:

learning = "I am learning "   
py\_funcs = "Functions"  
   
print(learning + py\_funcs)

Would output:

I am learning Functions

***Note:*** We can add an extra space at the end of learning to make sure the string is properly formatted when it is combined.

Your output should be:

Here is what your trip will look like!  
First, we will stop in France, then Germany, and lastly Denmark

**4.**

Call the function trip\_planner() again with the following values for the parameters:

* first\_destination: "Denmark"
* second\_destination: "France"
* final\_destination: "Germany"

Note the difference in your output depending on the position of your arguments.

Checkpoint 5 Passed

Hint

Your output should be:

Here is what your trip will look like!  
First, we will stop in Denmark, then France, and lastly Germany

**5.**

Call the function trip\_planner() again using keyword arguments in this exact order:

1. first\_destination: "Iceland"
2. final\_destination: "Germany"
3. second\_destination: "India"

Checkpoint 6 Passed

Hint

Make sure to enter the arguments in the order specified.

Remember, that when using keyword arguments, we explicitly refer to the assignment of each argument in the function call. Here is an example:

trip\_planner(first\_destination = "Disney World", final\_destination = "Legoland", second\_destination = "Sea World")

**6.**

Lastly, go ahead and call the function trip\_planner() using only two positional arguments to see the default argument in action:

1. first\_destination: "Brooklyn"
2. second\_destination: "Queens"

Checkpoint 7 Passed

Hint

Your output should be:

Here is what your trip will look like!  
First, we will stop in Brooklyn, then Queens, and lastly Codecademy HQ

**travel.py**

# Write your code below:

def trip\_planner(first\_destination, second\_destination, final\_destination = "Codecademy HQ"):

  print("Here is what your trip will look like!")

  print("First, we will stop in " + first\_destination + ", then " + second\_destination + ", and lastly " + final\_destination)

#Positional Arguments

trip\_planner("France", "Germany", "Denmark")

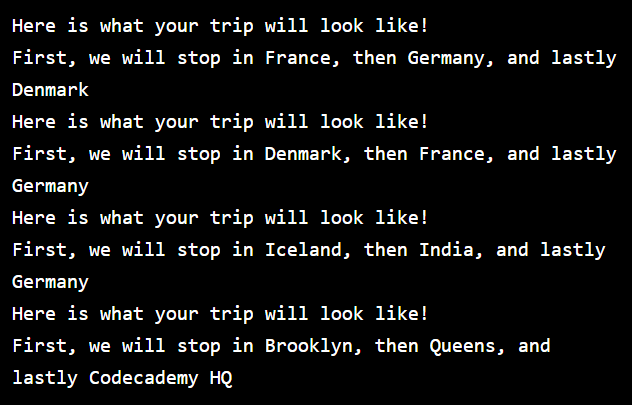
trip\_planner("Denmark", "France", "Germany")

#Keyword Arguments

trip\_planner(first\_destination="Iceland", final\_destination="Germany", second\_destination="India")

#Default Arguments

trip\_planner("Brooklyn", "Queens")

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