

CSC110 Assignment 3:

Carbon Footprint

Objectives

Upon completion of this assignment, you need to be able to:

- Pass *parameters* into a method.
- Return a value from a method.
- Use a Scanner object as a means to collect values to assign to variables.
- Experience the benefits (and limitations) of double precision in programming.
- Manage the flow of a program.
- Continue accumulating good programming skills.

Introduction

In his book, *How Bad Are Bananas*, Mike Berners-Lee describes the term *carbon footprint* as:

the best estimate that we can get of the full climate change impact of something. That something could be anything – an activity, an item, a lifestyle, a company, a country or even the whole world.

In this assignment, we take a much simpler estimate of a carbon footprint as the amount of CO₂ emissions generated by a single person in a year. We will implement a program that calculates a rough estimate of the amount of CO₂ generated, based on a person's vehicle use, electricity use, and food consumption.

The program will prompt a *user*, a person sitting at the keyboard, to respond to a series of questions about their transportation, electricity consumption, and diet. The program will then calculate three specific areas of carbon consumption and the resulting carbon dioxide emission. It will also calculate and report a total yearly CO₂ emission, measured in metric tons per year.

Quick Start

- (1) Download this pdf file and store it on your computer.
- (2) Create a directory / folder on your computer specific to this assignment. for example, CSC110/assn3 is a good name.
- (3) Save a file called CarbonFootprint.java in your directory. Fill the source code with the class name and the following methods:

```
public static double transportationFootprint(double kPD, double effic)
public static double electricityFootprint(double kWhours, int num)
public static double foodFootprint(double meat, double dairy, double fv, double carb)
public static double totalFootprint(double trans, double elec, double food)
public static void main(String[] args)
```

Hint: copy and paste the above methods, so you get them exactly. You may change the variable names, which were shortened here to fit on a single line.

- (4) Make each of the methods, except main, empty by adding a { return -1; } under the method header. Because the return type for each method is a double, you must return a double value, and -1 is an easy initial placeholder to get the program to compile.
- (5) Complete each method and test it thoroughly before moving onto the next one. Compile and run the program frequently; it is much easier to debug an error shortly after a successful and error-free run.

Background

To obtain the total yearly carbon footprint (kgCO₂), we break the calculations into three parts:

- (1) transportation footprint
- (2) electricity footprint
- (3) food footprint

1. transportation footprint

Given that regular gasoline in North America produces 2.3 kgCO₂ per litre, we have the following formula for the kilograms of CO₂ per year:

$$\text{kgCO}_2 = 2.3 \times \text{litresUsedPerYear}$$

The number of litres used per year is given by:

$$\text{litresUsedPerYear} = 365 \times (\text{kmPerDay} \div \text{fuelEfficiency})$$

where both `kmPerDay` varies per person and `fuelEfficiency` (measured in km/litre) varies with the make of car.

2. electricity footprint

The average Canadian household produces 0.257 kg of CO₂ per kilowatt in a month. To calculate the CO₂ emissions for a year, we use the following:

$$\text{kgCO}_2 = (\text{kWhPerMonth} \times 12 \times 0.257) \div \text{numPeopleInHome}$$

where the `kWhPerMonth` is obtained from the electric bill.

3. food footprint

A rough estimate is calculated based on the percentage of a person's consumption of meat & fish, dairy, fruit & vegetables, and carbohydrates. The following formulae provide the yearly footprint for these four categories. **Note** that percentages are usually expressed as numbers between 0 and 100, but when inserted into calculations, they are actually between 0 and 1.

meat kgCO ₂	=	(percent meat & fish) × 53.1
dairy kgCO ₂	=	(percent dairy) × 13.8
fruit & veg kgCO ₂	=	(percent fruits & veg) × 7.6
carbs kgCO ₂	=	(percent carbs) × 3.1

A person's total food kgCO₂ measurement is given by the sum of the above four values.

total carbon footprint

The total CO₂ emissions are measured in metric tons (tCO₂) per year:

$$\text{tCO}_2 = (\text{transportation footprint} + \text{electricity footprint} + \text{food footprint}) \div 1000$$

Detailed Instructions

See the [the specification document](#) for a detailed explanation of each of the required methods. Note that these details are examples of the type of commenting that must precede each method in your source code.

The main method will need to test each of the methods with some user values. Do this with a single Scanner object that prompts the user for the required data and then add the appropriate data to the argument list of the appropriate method. If you prefer, you may create a separate method that performs the interface between the user and the methods and then let this method be called from main.

Example

The following screenshot shows an example of a run, where the user provides the numbers for each prompt and the final report outlines all the details. Note that the results are rounded to the nearest 0.01; this can be done using the `System.out.printf` statement, which is very much like the `printf` statement in C. You do not have to do this, but if you have time, it is worthwhile to investigate this method.

```
bash
demo$ java CarbonFootprint
How many km do you drive in one day? 10
Choose the appropriate fuel efficiency for your car:
    very small car : 7.1 km/litre
    small car : 8.2 km/litre
    sports car : 14.9 km/litre
    SUV : 12.3 km/litre
Or, if you know the efficiency rating, choose another number: 8
Your Carbon footprint with respect to car use is 1049.37kg/year.

What is the average electricity consumption per month, in kilowatts? 900
How many people live in the house? 4
Your Carbon footprint with respect to electricity use is 693.90kg/year.

Of all the food you eat, what percent consists of meat or fish? 20
Of all the food you eat, what percent consists of dairy products? 5
Of all the food you eat, what percent consists of fruit and vegetables? 50
Of all the food you eat, what percent consists of carbohydrates? 75
Your Carbon footprint with respect to food consumption is 17.44kg/year.

You produce an annual total of 1.76 metric tons of CO2 per year.
demo$
```

The helpful hints for fuel efficiency estimates are not required, however, it may help you in your testing.

Submission

Submit the following completed file to the Assignment folder on `conneX`.

- `CarbonFootprint.java`

Please make sure you have submitted the required file(s) and `conneX` has sent you a confirmation email. Do not send `[.class]` (the byte code) files. Also, make sure you *submit* your assignment, not just save a draft. Draft copies are not made available to the instructors, so they are not collected with the other submissions. We *can* find your draft submission, but only if we know that it's there.

A note about academic integrity

It is OK to talk about your assignment with your classmates, and you are encouraged to design solutions together, but each student must implement their own solution.

Grading

Marks are allocated for . . .

- No errors during compilation of the source code.
- All method names, return types, and argument lists must be exactly as shown. Variable names in the argument lists do not need to be the same as shown, but the ordering and the data types must be. Be aware that Java is case-sensitive, so `'a'` is not the same letter as `'A'`.
- Appropriate prompts to the user. See the example output on the previous page.
- Style of the source code meets the requirements outlined in the [Coding conventions](#) document available in the Lab Resources folder of `conneX`.