W4. Linked lists

You are given the following definition of the *Island* datatype:

```
typedef struct island {

    char * name;

    int population;

} Island;
```

1. Write the program that defines 3 islands:

```
Island one = {"Happy",1000};

Island two = {"Empty",0};

Island three = {"Dense",1000000};
```

How would you represent a tour **one** → **two** → **three** using an array?

2. Now we have one more island:

```
Island four = {"Sad", 1, NULL};
```

And we want to change our tour to *one* → *two* → *four* → *three*.

How easy it is to dynamically insert a new island in the middle of an array? What data structure would you use instead? What should we add to the definition of Island?

Implement the original tour *one* → *two* → *three* using this new data structure, and insert island *four* after island *two*.

3.   Implement function **print_tour** which accepts the head of the linked list as a parameter, and prints all islands in the tour.

Submit the code in file islands1.c

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4.   We want to be able to build our tour <u>dynamically</u>, by reading island information from *stdin*. We will use function *fgets* to read each island name entered from the standard input.

Simplify *Island* definition. Now each island only stores the name and the pointer to the next, copy and update your *print_tour* function to a new file **islands2.c**.

```
typedef struct island {
      char * name;
      struct island * next;
} Island;
```

Write code for reading island names from *stdin* using *fgets* and print them to *stdout*. The program reads lines until user types "q".

When you run your code what do you notice about *fgets*? Does it include end-of-line characters?

Fix this problem by inserting '\0' instead of end-of-line characters:
```
buffer [strcspn (buffer, "\r\n")] = '\0';
```

5.   Read island names from *stdin*, and dynamically add new islands to the tour. After user enters "q", print islands using the *print_tour* function implemented in step 3.

6.   Compile your program into executable *islands* <u>with debugging flag -g</u>:
gcc -g -Wall -std=c99 islands.c -o islands
Now test your program for memory leaks with **valgrind**:
`valgrind --leak-check=full --show-leak-kinds=all --track-origins=yes ./islands`

Is the number of *mallocs* equal to number of *frees*?

7.   Implement function **free_islands** which will free all dynamically allocated list nodes. Call this function before the end of the program.

8.   Run *valgrind* again. Does it still complain?
Replace all calls to *malloc* with *calloc*, and run valgrind again. This should produce the following reassuring message:
==6627== All heap blocks were freed -- no leaks are possible
==6627== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)

Submit the final code in file islands2.c