

The following exercises are related to the Racket programming language [3].

1. Re-write the following expressions in Racket and evaluate them using a Racket interpreter/compiler.

- (a) $(3 \times (5 + (10 \div 5)))$
- (b) $(2 + 3 + 4 + 5)$
- (c) $(1 + (5 + (2 + (10 \div 3))))$
- (d) $(1 + (5 + (2 + (10 \div 3.0))))$
- (e) $(3 + 5) \times (10 \div 2)$
- (f) $(3 + 5) \times (10 \div 2) + (1 + (5 + (2 + (10 \div 3))))$

2. Define a procedure `discount` that takes two arguments: an item's initial price and a percentage discount [2]. It should return the new price:

```
> (discount 10 5)
9.50
> (discount 29.90 50)
14.95
```

3. Define a function `grcomdiv` that takes two integers and returns their greatest common divisor.

```
> (grcomdiv 10 15)
5
> (grcomdiv 64 30)
2
```

4. Write a function called `appearances` that returns the number of times its first argument appears as a member of its second argument [2].
5. Write a procedure `inter` that takes two lists as arguments. It should return a list containing every element that appears in both lists, exactly once.
6. Write a procedure `noatoms` that takes a list and returns the number of atoms it contains.
7. Here is a Racket procedure that never finishes its job:

```
(define (forever n)
  (if (= n 0)
      1
      (+ 1 (forever n))))
```

Explain why it doesn't give any result[2].

8. Write a function called `range` that takes an integer n and returns a list containing the atoms $1, 2, 3, \dots, n$.
9. Write a function called `reversel` that takes a list and returns it reversed.
10. If we list all the natural numbers below 10 that are multiples of 3 or 5, we get 3, 5, 6 and 9. The sum of these multiples is 23. Write a procedure to find the sum of all the multiples of 3 or 5 below 1000 [1].
11. Write a procedure called `flatten` that takes as its argument a list, possibly including sublists, but whose ultimate building blocks are atoms. It should return a sentence containing all the atoms of the list, in the order in which they appear in the original:

```
> (flatten '(((a b) c (d e)) (f g) (((h))) (i j) k)))
(a b c d e f g h i j k)
```

12. Each new term in the Fibonacci sequence is generated by adding the previous two terms. By starting with 1 and 2, the first 10 terms will be:

$1, 2, 3, 5, 8, 13, 21, 34, 55, 89, \dots$

By considering the terms in the Fibonacci sequence whose values do not exceed four million, find the sum of the even-valued terms [1].

13. Write a procedure `to-binary`:

```
> (to-binary 9)
1001
> (to-binary 23)
10111
```

14. Write Heap's algorithm for generating permutations in Racket.

References

- [1] Project Euler. Project euler.
- [2] Brian Harvey and Matt Wright. Simply scheme: Introducing computer science.
- [3] PLT Inc. Racket – a programmable programming language.