Prerequisite Self-Test

Check the background that CSCI 201 assumes, before the course starts

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This self-test checks the background that CSCI 201 assumes from its first week: programming from CSCI 141 and 145, and the algebra from your math prerequisite. It is not graded, and nobody sees your answers.

Work each exercise on paper, without notes or a calculator. The solutions are on the web page https://morrison-lab.github.io/csci201/chapters/prerequisite-self-test.html.

The whole test takes about 45 minutes. Only your final answers need checking, but work that you can follow helps you find a mistake. Each solution explains the answer and names a page to review if you missed the exercise. The code is in Python. The course itself programs in Racket, which it teaches from the start.

Your results tell you what to do next:

- If you got almost everything right, you are ready.
- If you missed a few exercises, read the review pages that their solutions name before the first week.
- If you missed several exercises in one part, send me a message through the Canvas inbox in the first week, and we will plan how you can catch up.

Programming

Exercise 1 (A Boolean expression)**.** Let `x` hold the value 2.
Is this Python expression `True` or `False`?

```
not (x % 3 == 0) and (x > 4 or x == 2)
```

Exercise 2 (Integer division)**.** In Python, `//` is integer division.
What is the value of `2027 // 10`?

Exercise 3 (A remainder)**.** In Python, `%` gives the remainder after integer division.
What is the value of `2027 % 10`?

Exercise 4 (Nested loops)**.** Consider this Python code:

```
count = 0
for i in range(5):
    for j in range(i, 5):
        count = count + 1
```

What is the value of `count` after the code runs?

Exercise 5 (Tracing a recursive function)**.** Consider this Python function:

```
def p(b, n):
    if n == 0:
        return 1
    return b * p(b, n - 1)
```

What does `p(3, 4)` return?

Exercise 6 (What a recursive function computes)**.** The Python function `p` computes a familiar quantity:

```
def p(b, n):
    if n == 0:
        return 1
    return b * p(b, n - 1)
```

In one sentence, what does `p(b, n)` compute for a nonnegative integer `n`?

Exercise 7 (Writing a recursive function)**.** You may use `xs == []` to test for the empty list, `xs[0]` for the first element of a list `xs` and `xs[1:]` for the list without its first element.
Write a recursive Python function `total(xs)` that returns the sum of the numbers in the list `xs`, without a loop or the built-in `sum`.

Exercise 8 (A stack)**.** Start with an empty stack and perform these operations in order: push 5, push 8, push 2, pop, push 7, pop, pop.
Which values do the three pops return, in order?

Exercise 9 (A queue)**.** Start with an empty queue and perform these operations in order, where "add" puts a value at the back and "remove" takes the value at the front:
add 5, add 8, add 2, remove, add 7, remove, remove.
Which values do the three removes return, in order?

Math

Exercise 10 (Multiplying powers)**.** Write $8^3 \cdot 2^4$ as a single power of 2, such as 2^7.

Exercise 11 (Doubling a power)**.** Let n be an integer.
Write $2^n + 2^n$ as a single power of 2.

Exercise 12 (A logarithm)**.** Evaluate $\log_2(8^5)$ without a calculator.

Exercise 13 (Rounding a logarithm down)**.** For a real number x, the floor $\lfloor x \rfloor$ is the largest integer that is at most x.
Find $\lfloor \log_2 100 \rfloor$ without a calculator.

Exercise 14 (Composing two functions)**.** Let $f(x) = 3x - 1$ and $g(x) = x^2$.
Find $f(g(2))$.

Exercise 15 (Composing in the other order)**.** Let $f(x) = 3x - 1$ and $g(x) = x^2$.
Find $g(f(2))$.

Exercise 16 (Evaluating a sum)**.** Evaluate $\sum_{i=0}^{4} 2^i$.

Exercise 17 (Writing a sum)**.** Write $3 + 6 + 9 + \cdots + 30$ in summation notation.

Exercise 18 (Expanding a square)**.** Let n be an integer.
Simplify $(n+1)^2 - n^2$.

Exercise 19 (Adding to a fraction)**.** Let n be an integer.
Write $\dfrac{n(n+1)}{2} + (n+1)$ as one fraction whose numerator is factored.

Exercise 20 (Solving an inequality)**.** For which integers n is $3n - 7 > n + 5$?

Exercise 21 (Negating an inequality)**.** True or false: for all real numbers a and b, if $a < b$ then $-a < -b$.