

Floating Point Precision

1. This problem aims to explore the accuracy of floating point representations in your system. You should investigate the float and double data types in C as well as the default floating point representation in R. Write a program that calculates the following three quantities:
 - a. The smallest positive number ε such that $1.0 + \varepsilon > 1.0$.
 - b. The smallest positive number ε^* such that $1.0 - \varepsilon^* < 1.0$.
 - c. The smallest positive number that can be stored in a variable and is > 0.0 .
2. Care must be taken when evaluating certain mathematical expressions on a computer, as rounding errors can build up to become quite large. One well known example relates to the golden ratio, ϕ . This number is:

$$\phi = \frac{\sqrt{5} - 1}{2} = 0.61803398$$

The number has the useful property that:

$$\phi^n = \phi^{n-1} \phi \quad (1)$$

$$\phi^n = \phi^{n-2} - \phi^{n-1} \quad (2)$$

Thus, successive powers of ϕ can be conveniently calculated using either expression (1) or (2).

Starting with $\phi^0 = 1$ and ϕ^1 defined above, write an R program that fills an array with successive powers of ϕ using expression (1) and another array using expression (2). Plot both sets of results for $\phi^n = 1..80$. Which one appears more accurate? Why?