Haskell Exercises 3: Floating-point Numbers

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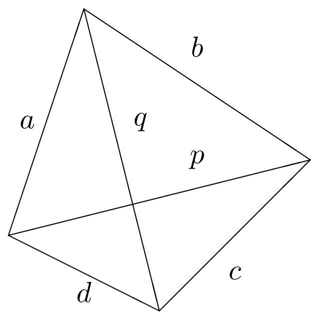
(1) The area of a general quadrilateral



is given by the formula

$$area = \frac{1}{4}\sqrt{4p^2q^2 - (b^2 + d^2 - a^2 - c^2)^2},$$

where a, b, c and d are the lengths of the sides and p and q are the lengths of the diagonals. Defines a Haskell function *area a b c d p q* which calculates the area of a general quadrilateral. Your function should return an error message if the arguments given to it are not those of a genuine quadrilateral. (Hint: test whether a, b and p really are the lengths of three sides of a triangle, etc.)

(2) The Fibonacci numbers are usually defined as follows:

$$\begin{aligned} f(1) &= 1, \\ f(2) &= 1, \\ f(i) &= f(i-1) + f(i-2), \text{if } i > 2. \end{aligned}$$

They can, however, be defined as follows:

$$f(i) = \frac{1}{\sqrt{5}}\left\{\left(\frac{1+\sqrt{5}}{2}\right)^i - \left(\frac{1-\sqrt{5}}{2}\right)^i\right\}.$$

Define a Haskell function *fd* (Fibonacci direct) that uses this formula. Use a local definition to avoid recalculation of $\sqrt{5}$ and ensure that the answer is an integer.

(3) To decide which weekday a certain date is, you can use the formula $v = A \mod 7$ where $A = \lfloor 2.6 \times m - 0.2 \rfloor + d + y + \lfloor \frac{y}{4} \rfloor + \lfloor \frac{c}{4} \rfloor - 2 \times c$. Here, $\lfloor x \rfloor$ is the integral part of x. For example, $\lfloor 2.7 \rfloor = 2$. Furthermore, v is the weekday (with Sunday as day 0), d is the day of the month, m is the month (with March being 1 and February 12), y is the last two digits of the year and c is the century. What is the weekday of the following dates: 10 July 1776, 16 April 1834 and 9 June 1901?

(4) The harmonic series is the following infinite series:

$$1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \ldots + \frac{1}{i} + \ldots .$$

Write a function *sumHarmonic* such that *sumHarmonic* i is the sum of the first i terms of this series. For example, *sumHarmonic* $4 = 1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} = 2.08333\ldots$.

(5) The logarithmic series is the following alternating series:

$$1 - \frac{x^2}{2} + \frac{x^3}{3} - \ldots + (-1)^{n-1}\frac{x^n}{n} + \ldots .$$

Write a function *sumLog* such that *sumLog* n x is the sum of the first n terms of this series.