Scales

Users Manual

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Content

Overview

The Scales program is thought to provide to every mathematican out there a easy to use program which can do the hard work in the Bachet's scales problem. The program itself is written in Java, offering a wide platform support, so everybody can use this software.

Bachet and his Scales

The Problem

Claude Gaspard Bachet de Méziriac is a quite popular mathematican who lived from 1581 until 1638. He made and solved the following combinatoric problem:

You have a Precision Scales and a limited set of weights G. How many weights can you measure with those? (You can put the weights on both sides of the Scales!)

The Solution

First you encode the states of the Scales: If you have more weight on the left side, you have the state -1, if you have more weight on the right side, you have 1 and if they are both the same, you have the state 0.

Now you can also encode every wheight which is on the Scales by using the same states. If the wheight is on the left side, you have the following expression: x^{-g} (g is your wheight) If it is on the right side you have this: x^g and if it isn't used, meaning it is in the middle, you have this: x^{g*0}

Now you take every wheight and create a Laurent Polynom from it: $\left(x^{-g}*x^{g*0}*x^g\right)$

After that you multiply them: e.g:

$$\left(x^{-1}*x^{1*0}*x^1\right)*\left(x^{-3}*x^{3*0}*x^3\right)*... \ =$$

$$x^{-1+(-3)}+x^{-1+3*0}+x^{-1+3}+x^{(1*0)+(-3)}+x^{((1*0)+(3*0))}+x^{((1*0)+3)}+... \ =$$

$$x^{-4}+x^1+x^2+x^{-3}+x^0+x^3+...$$

Now you can read in the exponent the following things:

- – the measured wheight (-g is for left wheight)
- – the way you measured it (g_1 + -g_2 means you have to put g_1 on the right and g_2 on the left side)

By the way, the coefficent of every summand is the number of ways you can measure the weight (in our case it's always one).

Run

This program runs on Java, so if you have a working Java setup, just double-click the Scales. to open the program. If this does not work for you, double-click run.

Functionality

Once you start the program, you are prompted with the main screen (Fig. 1), which looks like the picture below. On the top is the menu bar, containing the items "File" and "Weight".
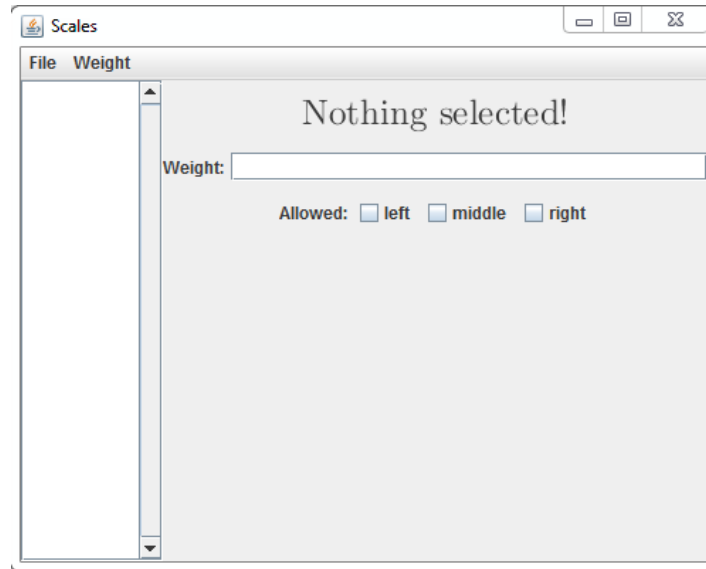

Fig. 1

Edit Weight Set

In the middle you can see a panel showing you information and configuration options for the current selected weight, but at the beginning you can only see "Nothing selected", so lets create a new weight. In order to do this, click on the menu "Weight" and then on "Add" . After that you will be prompted to enter the weight of the new item without unit and only natural numbers are allowed and 0 (Fig. 4).

Your weight should appear on the left and can now be selected with a simple mouse-click (Fig.3).

Now you can see at the top of the info panel (Fig. 2) the polynom of this weight (as described in section 2), underneath you can change the weight (again, without unit and only natural numbers and 0) and underneath that you can say, where the weight is allowed to be. A check means that the weight can be there and no check means that the weight must not be there (Where middle is not used).

In order to remove a weight select it on the left and click on the menu "Weight" and then on "Remove". You'll be prompted to confirm your decision, click "Yes" to do so.
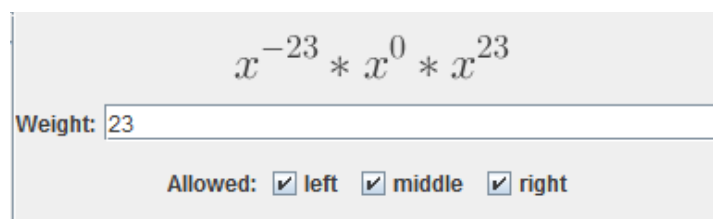

$$x^{-23} * x^0 * x^{23}$$

Weight: 23

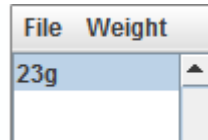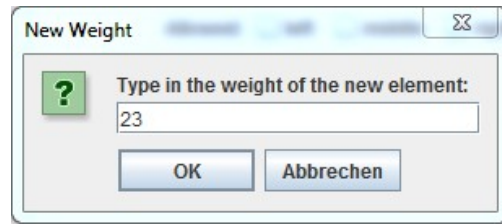Allowed: ☑ left ☑ middle ☑ right

Fig. 2

Fig. 3

Fig. 4

Save/Load Weight Set

In order to save or load a weight set, you click on the menu "File" and the or "Load" or if you want to save something on "Save". You will have to select the file the weight set should be loaded from/saved to. A weight set gets saved as .sca.

A new weight set is created with "File", "New".

Compute

To compute the possibilities or "do the magic" you first click on "File" and then on "Compute". You will get the screen shown in Fig. 5. On the top is the full polynom with all the coefficents and the exponents. Below you can see a list showing you all the possible weights (the exponent) and the number of possibilities to measure them (or the coefficient).
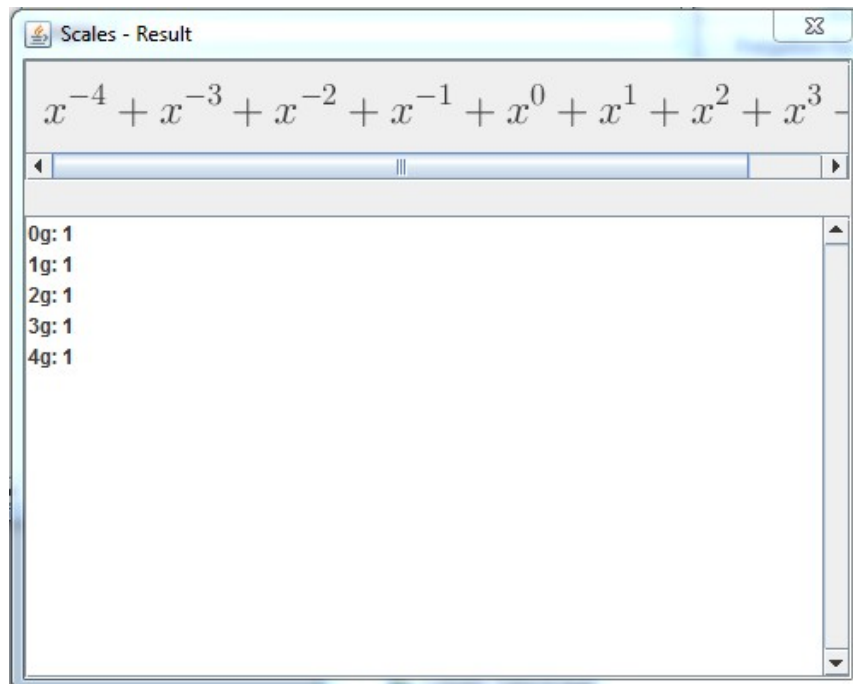

$$x^{-4} + x^{-3} + x^{-2} + x^{-1} + x^0 + x^1 + x^2 + x^3$$

0g: 1
1g: 1
2g: 1
3g: 1
4g: 1

Fig. 5

Source

Scales should be a program which should be available for everyone to use and modify for his uses, so it is an open source project under the GPL v2 license. It's source is available on GitHub.

Credits

Special thanks goes to Günther Zepf for teaching me the Scales problem and it's solution, but also for teaching me other interesting things. I also have to say thanks to the big Java Community out there, especially java-forum.org and byte-welt.de for the time they invested to help me learn Java.