Nico: An Environment for Mathematical Expression in Schools

Thank you for agreeing to participate in the user study for my Part II Project! *Nico* is a piece of educational software designed to aid learners in the visualisation of mathematical problems, by separating out the constituent parts of a calculation into distinct units on-screen.

The purpose of this study is to ascertain how well *Nico* achieves its goal of providing a clear, accessible, interactive means of calculation, and to gather feedback on how the application could be improved, by means of a few short exercises. Let us begin.

Welcome to *Nico*!

Introduction

Nico works by representing the constituent parts of a calculation as circles containing an operator with arguments orbiting it. The value of a circle can be passed to other circles to be used in further calculations, and this is indicated on-screen by means of a line going from from the edge of the argument circle to the centre of the circle using it (*Fig. 1*).
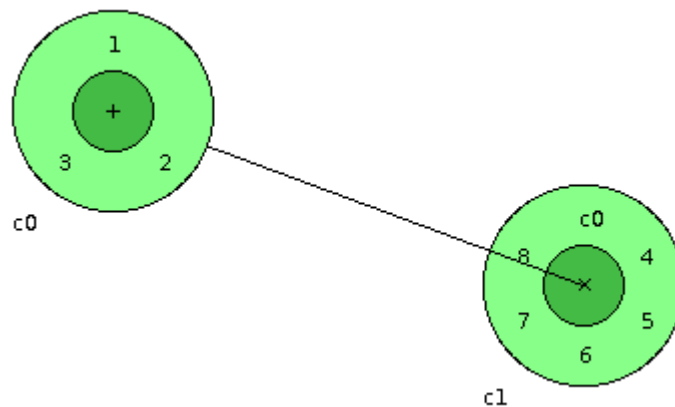

Figure 1: Nested circles, representing the calculation *(1+2+3)×4×5×6×7×8*.

As the user builds up a diagram, the **Answer** field in the top right-hand corner keeps a running total of the calculation, evaluating the circle that does not use any others as arguments as the root. Mousing-over a circle currently in the diagram highlights that circle, and the relevant part of the **Question** field that it represents, in blue.

Usage

Begin by executing either the `nico` (for UNIX-like systems) or `nico.bat` (for Microsoft Windows systems) file to open the application. Upon opening the application, you will be presented with a file-chooser dialogue. Use this to choose a set of questions (a file ending in `.nqs`) to complete using *Nico*.

You are then presented with a screen akin to the one below (*Fig. 2*).

To create a circle, right-click on a blank section of the canvas. A context menu will appear, with a **New circle** option. Select this option, and you will be presented with a dialogue box, as depicted in *Fig. 3*.

This dialogue box allows one to initialise a circle with up to eight arguments. The operator is chosen with the radio buttons in the **Operator** field. The arguments are then set using the **Argument** fields. Click on the **Enabled?** checkbox to use that argument in the circle. Choose either the radio button next to the slider or next to the list of existing circles to specify whether the argument should be a number or another circle. If you select the slider, set the slider to the number (limited to a minimum of -10 and a maximum of 10) you wish to use. If you select the list of existing circles, choose the radio button next to the label corresponding to the circle that you wish to use. Finally, click on the **OK** button to create your circle.

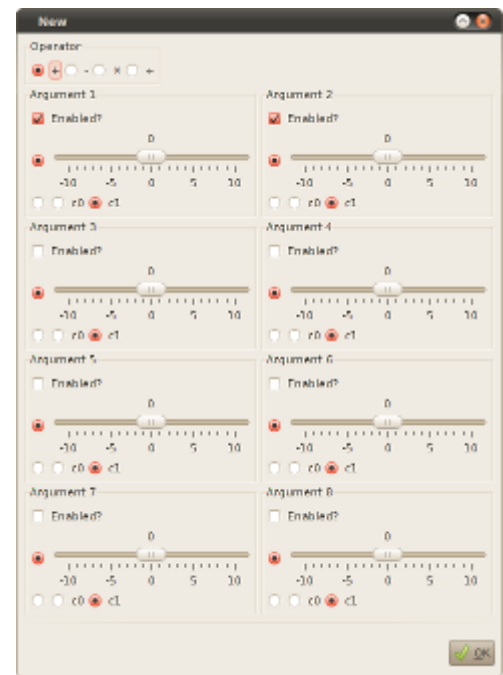Figure 2: The initial state of the application upon loading a new question set.

Figure 3: The dialogue box used for creating a new circle.

You can add other circles as extra arguments by left-clicking and dragging between the two circles: from the circle you wish to use to the circle you wish to use it in. To remove a circle, simply right-click on a circle and select **Remove circle**. Circles can be repositioned by left-clicking on a circle and dragging it to the desired new position.

To check your answer, click the **Check** button in the top right- hand corner of the window. If the answer is correct, the **Answer** text will turn green, a congratulatory message will pop up, and *Nico* will move on to the next question. If your answer is incorrect, the **Answer** text will turn red, and you will have the opportunity to resubmit.

Exercises

1. Open *Nico* by executing the appropriate file for your system (either `nico` or `nico.bat`). Open the question set `user-study.nqs`, which is in the subdirectory `qs/` of the main application directory.

2. Work through the ten questions in the question set.

3. On completion of the question set, you will be presented with another file-chooser dialogue. Close this, and exit the application.

4. Complete the following questions (and please show your working!):–

   (a) *2+3*

(b) *9÷3*

(c) *1+2+3+4+5*

(d) *(2×4)+(3-5)*

(e) *((3×4)÷(3+3))×8*

(f) *((1+2+3+4+5)+(2×4×6×8×10))×1×2×(1+2+3+4+5)*

(g) *12+14*

(h) *247×35*

(i) *120÷((2×10)+5+5)*

(j) *((2+5)×(6÷2)×(9-8))+((3+4)-(5×6))+120*

5. Fill out the feedback section below.

Feedback

1. Please circle on the scale below how easy-to-use you felt *Nico* was.

2. Please circle on the scale below how intuitive you found using *Nico* to be.

3. Did you prefer working with *Nico* to working the answers out on paper (circle as appropriate)?

<div align="center">Yes   No</div>

> Why?

4. Please circle on the scale below how clearly you felt the circle notation illustrated the flow of information throughout the calculation.

<div align="center">☹ • • • ☺</div>

5. How could *Nico* be improved? Would you add any features? Would you take any features away?

6. Any other thoughts?

Thank you very much for your help with my project! Your responses will remain confidential, although they are liable to appear in the final report, of which a copy will be retained by the University of Cambridge Computer Laboratory Library (`http://www.cl.cam.ac.uk/library/`). The final report will also be available via my repository at GitHub (`http://github.com/loomcore/nico`).