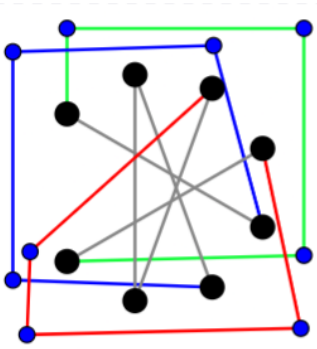

Crocuco Tool

User Manual

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Contents

1 Introduction

Welcome to the **Crocuco Tool**. This manual provides detailed instructions on how to use all the features of the application, including creating, editing, importing and exporting graphs, inspecting crossings and curve complexity and running layout algorithms for the displayed graphs.

Quick Tip

You can access the user manual anytime from within the application by clicking the *User Manual* button.

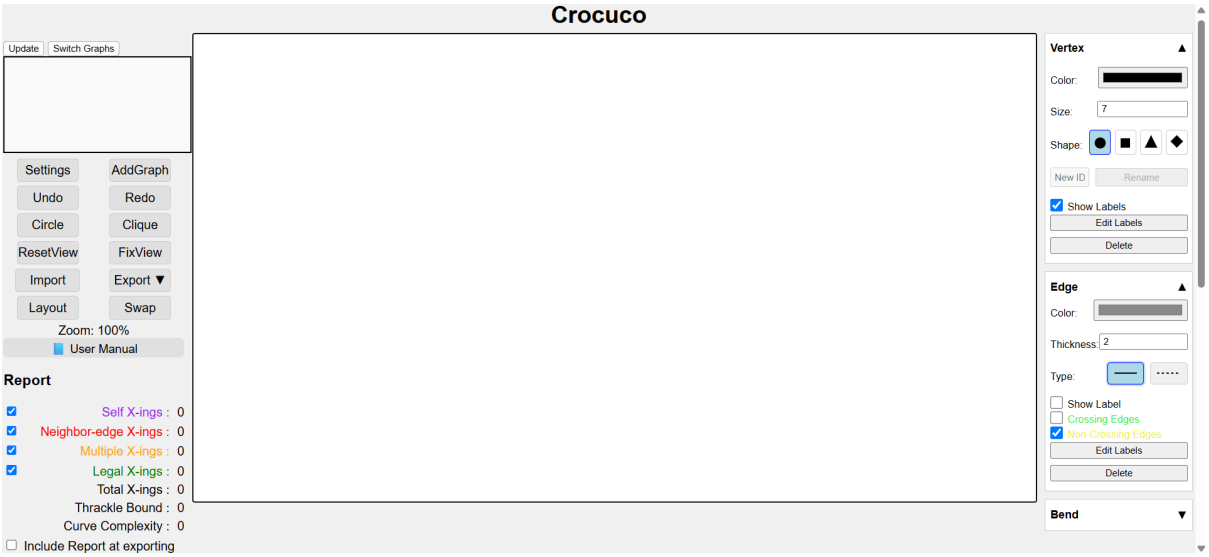

Figure 1: Tool's main screen

2 Installation and Setup

Open the application in your web browser by navigating to one of the following links:

1. `http://aarg.math.ntua.gr/demos/thrackles/`
2. `https://marioavraamidis.github.io/Graph-Editor/#`

No installation is required. All major browsers (Chrome, Firefox, Edge) are supported.

3 Create graph

3.1 Vertex creation

To create a new vertex, just click on a blank point in the main canvas.

3.2 Edge creation

With this app, you can create two kinds of edges: straight line edges and polyline edges, i.e. edges represented as chains of straight-line segments such that any consecutive segments of each chain have different slopes. The creation of each type of kind is described below. You can also discard an edge before completing its creation.

3.2.1 Straight line edge

1. Move your cursor over the first vertex.
2. **Press and hold** the left mouse button (`mousedown`).
3. **Drag** the cursor towards the second vertex.
4. **Release** the mouse button (`mouseup`) over the second vertex.

3.2.2 Polyline edge

1. Move your cursor over the first vertex.
2. **Press and hold** the left mouse button (`mousedown`).
3. **Drag** the cursor towards the (blank) point you want to place the first bend.
4. **Release** the mouse button (`mouseup`) over the desired point.
5. **Click** at any blank point to add a new bend to the creating edge.
6. **Click** at the second vertex to complete edge creation.

3.2.3 Stop edge creation

While creating an edge, a rubbish bin appears on the upper right corner of the main canvas. Click on it to stop edge creation.

4 Add a new graph

1. Click the **AddGraph** button.
2. Choose a graph type (e.g., Path, Circle, Binary Tree).

3. Adjust parameters (length or height).
4. Click **OK**.
5. The new graph will be added to the existing one.

5 Import a saved graph

1. Click on the `Import` button.
2. Select a JSON file containing a valid graph structure.
3. The imported graph will replace the existing graph.

6 Edit graph

The main features of the application for editing the existing graph are listed below:

6.1 Select objects

You can select graph items (vertices, edges and bends) to edit, delete, drag, copy/paste them etc. There are 2 ways to do it:

6.1.1 Selection box

1. Move your cursor to a blank point on the canvas.
2. Press and hold the left mouse button.
3. Drag the cursor to extend the selection rectangle.
4. Release the mouse button when you include all the desired objects in the rectangle.
5. All the object in the rectangle are now selected (highlighted in orange).

NOTICE: For an edge to be selected via the selection box, all its points (i.e. its vertices and all its bends) must be located in the selection box.

6.1.2 Manual selection

1. Click on the first object you want to select or select some items using the selection rectangle.
2. Ctrl+click on each other object you want to select.

6.2 Drag objects

1. Select the objects you want to move (see selection process above)
2. Move your cursor over one of the selected items.
3. Press and hold the left mouse button.
4. Drag the cursor to move the objects.
5. Release the mouse button when the objects are at the desired position.

6.3 Copy/paste objects

1. Select the objects you want to move (see selection process above).
2. Move your cursor over one of the selected items (item X).
3. Press the **right mouse button**.
4. Choose `Copy Selected`.
5. Move your cursor over the point you want to paste item X.
6. Press the **right mouse button**.
7. Choose `Paste`.

NOTICE: Copy/paste can also be used via shortcuts ctrl+C, ctrl+V.

6.4 Delete objects

1. Select the objects you want to move (see selection process above).
2. Move your cursor over one of the selected items.
3. Press the **right mouse button**.
4. Choose `Delete Selected`.

NOTICE: You can also delete only the selected vertices from the selected objects by clicking the `Delete` button on the Vertex palette. Same holds for edges or bends. Notice that if a vertex is deleted, all its adjacent edges are also deleted.

Shortcut for deletion: Delete key or backspace key.

7 Export graph

7.1 Export the entire graph

1. Move the cursor over the Export button.
2. Select the type of the export file (JSON, PDF or PNG).
3. Save your graph.
4. If the check box *Include Report at exporting* (at the bottom of the Report area) is checked, the exported pdf or png file will include the report.

7.2 Export a part of the canvas as image

You can also export as PNG image the content of the selection rectangle. After selecting an area, the button `Export selected rectangle as image` appears for 3 seconds. By clicking on it before disappearing, you can instantly export only the content of the selection rectangle.

8 Edit objects

You can use the 3 palettes at the right side of the main screen to edit the vertices, edges and bends of your graph.

8.1 Vertex palette

Via the vertex palette, you can:

1. Change the color, size and shape of the selected vertices.
2. Choose the color, size and shape of a new vertex before adding it to the graph.
3. Rename a vertex (only one vertex must be selected).
4. Show/hide the labels of the selected vertices.
5. Edit the labels of the selected vertices.
6. Delete the selected vertices (and their corresponding edges). Other selected items (edges, bends) that are not related to the selected vertices are not deleted.

8.2 Edge palette

Via the edge palette, you can:

1. Change the color, thickness and type (continuous or dotted) of the selected edges.
2. Show/hide the labels of the selected edges.
3. Highlight the crossing edges of the selected vertices. An edge is highlighted if it crosses at least one of the selected edges.
4. Highlight the non-crossing edges of the selected edges. An edge is highlighted only if it does not have any common point with any selected edge (neither vertex nor crossing).
5. Edit the labels of the selected edges.
6. Delete the selected edges (and their bends). Other items selected (vertices, bends) that are not related to the selected edges are not deleted.

8.3 Bend palette

Via the bend palette, you can:

1. Change the color and size of the selected bends.
2. Show/hide the labels of the selected bends.
3. Edit the labels of the selected bends.
4. Delete the selected bends. Other items selected (vertices, edges) are not deleted.

9 Labels

9.1 Show/Hide Label

You can show or hide the labels of the hovered or selected items by right clicking on them and choosing the option `Show Label / Hide Label`.

9.2 Edit Label

To edit the label of a graph item (vertex, edge, bend or crossing):

1. Move your cursor over the item.
2. Right click on it.
3. Click on the option `Edit Label`.

4. Choose the desired font size and label content.
5. Click the Save button.

NOTICE: The label content can be changed only if the item is a bend or an edge. For vertices, the label content is always the ID of the vertex. To change the ID of a vertex, use the vertex palette.

9.3 Move Label

You can move the label of a graph point (vertex, bend or crossing) as described below:

1. Move your cursor over the label of an item (the label's color becomes red).
2. Press and hold the left mouse click.
3. Drag the label.
4. Release the mouse button when the label is placed at the desired location.

NOTICE: The label of an item cannot be place too far from the item.

10 Zoom and Pan

You can zoom in and out by mouse wheeling. You can also move around in the canvas using the keyboard arrows.

11 Overlay Canvas

You can use the overlay canvas on the upper left side of the main screen to store a graph's drawing before processing it. The overlay canvas can grow on mouse hovering if this feature is selected in the settings.

11.1 Update button

By clicking on the `Update` button, the content of the main canvas is copied into the overlay canvas. Now overlay canvas stores a copy of the graph in the main canvas. The content of the main canvas does not change.

11.2 Switch graphs button

By clicking on the `Switch graphs` button, the contents of the two canvas are switched.

12 Layout

Using the `Layout` button in the button section of the application, you can run layout algorithms for the displayed graph. The graph (if path or circle) can be drawn with the desired number of crossings and with different curve complexities. On each layout option, there is a reference for the paper from which the algorithm was chosen.

12.1 Path - Linear Layout

Draw a path with the desired number of crossings and its vertices placed along a straight line. The curve complexity of this drawing is ≤ 1.

12.2 Path - Circular Layout

Draw a path with the desired number of crossings and its vertices placed on the circumference of a circle. The curve complexity of this drawing is 0.

12.3 Circle - Max Rectilinear Layout

Draw a circle with curve complexity equal to 0 and with the maximum possible number of crossings. If the circle is odd, the maximum possible number is the thrackle bound of the circle. If the circle is even, the maximum number is n(n-4)/2+1, as described in the referenced paper.

12.4 Circle - Circular Layout

Draw a circle with the desired number of crossings and its vertices placed on the circumference of a circle. The curve complexity of the drawing is ≤ 3.

12.5 Circle - Thrackle with cc=2

Draw a thrackle of the circle with curve complexity ≤ 2.

13 Settings

You can have access to the app's settings by clicking on the `Settings` button. From there, you can set your preferences for:

1. The colors of all the kinds of crossings.
2. The colors of the highlighted crossing edges.
3. The colors of the new edges when using the `Clique` button.

4. The default label font size.
5. Showing or not information of an item when hovering over it.
6. Growing or not of the secondary canvas when hovering over it.
7. Highlighting the bended edges when using Layout algorithms.

14 Buttons

There are 12 buttons in the button section of the app. Their descriptions are the following:

Settings: Give access to the app's settings. See section *Settings*.

AddGraph: Add a new graph (path, circle or binary tree) to the existing graph. See section *Add a new graph*

Undo/Redo: Undoing/Redoing.

Circle: If no vertex is selected, place all the vertices of the graph on the circumference of a circle. If one or more vertices are selected, place only the selected vertices on the circumference of a circle. In every case, the bends of the graph keep their positions

Clique: Add all the remaining edges to the graph so that now it becomes a clique graph. The added vertices are drawn with the color selected from settings.

ResetView: Set zoom back to 100% and return to the center of the canvas (coordinate (0,0)).

FixView: If no item is selected, show the entire graph and place it in the center of the canvas. If items are selected, place them in the center and focus on them.

Import: Import a graph stored as a JSON file. See section *Import a saved graph*.

Export: Export the graph. See section *Export graph*.

Layout: See section *Layout*.

Swap: Swap the coordinates of two points of the graph. The points can be two vertices, two bends or a vertex and a bend. To perform a swap, only 2 points of the graph must be selected. If more or less points are selected, the swap will not take place.

15 Report

The report section is placed on the bottom left of the main screen. It contains the following information for the drawing of the graph:

1. Number of crossings of each kind.
2. Total number of crossings.
3. Thrackle bound of the drawn graph.
4. Curve complexity of the drawing.

From the check boxes in the report section, you can choose which kinds of crossings you want to be highlighted or not in the canvas.

16 Keyboard Shortcuts

Shortcut	**Action**
Ctrl + Z	Undo
Ctrl + Y	Redo
Ctrl + Click	Select multiple items
Ctrl + C	Copy
Ctrl + V	Paste
Ctrl + A	Select all the items
Arrow Keys	Pan the canvas
Mouse wheeling	Zoom in and out
Delete/Backspace key	Delete selected items

17 Contact and Support

For questions or bug reports, contact:

`mavraamides1001@gmail.com`