CrochetCraft User Manual

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Chapter 1

Introduction

1.1 Product Overview

Crochet is a method to turn yarn into textiles. It is a form of art that uses a crochet hook to knot the yarn in such a way to produce a three-dimensional product, which can range from clothing and toys to bags and public art displays. A crochet pattern is a list of steps to produce a specific product, analogous to a cooking recipe. The design of crochet patterns typically involve many iterations of producing, refining, and experimenting, and the CrochetCraft app attempts to simplify this process.

CrochetCraft is a web application that produces real-time 3D visualizations of crochet patterns. It allows designers to input their textual pattern and view the simulated product resulting from the pattern. Designers can refine and iterate on their pattern without the time-consuming process of constructing the design in the real world each time.

1.2 First Sample Run

Start the CrochetCraft application by opening crochetcraft.jtai.ca in your web browser. Once loaded, the application's *Screen Layout* is shown in figure 1.1. Left mouse click anywhere in the pattern text box, and type or copy-and-paste the following pattern:

0. ch 11
1. sc 10
2-10. ch 1, turn, sc 10
ch 1

After all of the above text has been inserted, a 3D visualization of the pattern will be displayed in the rendering area. Next, use the mouse to highlight the text 2-10 in the pattern text box, and overwrite it by typing 2-20. The modified pattern will be visualized in the rendering area.
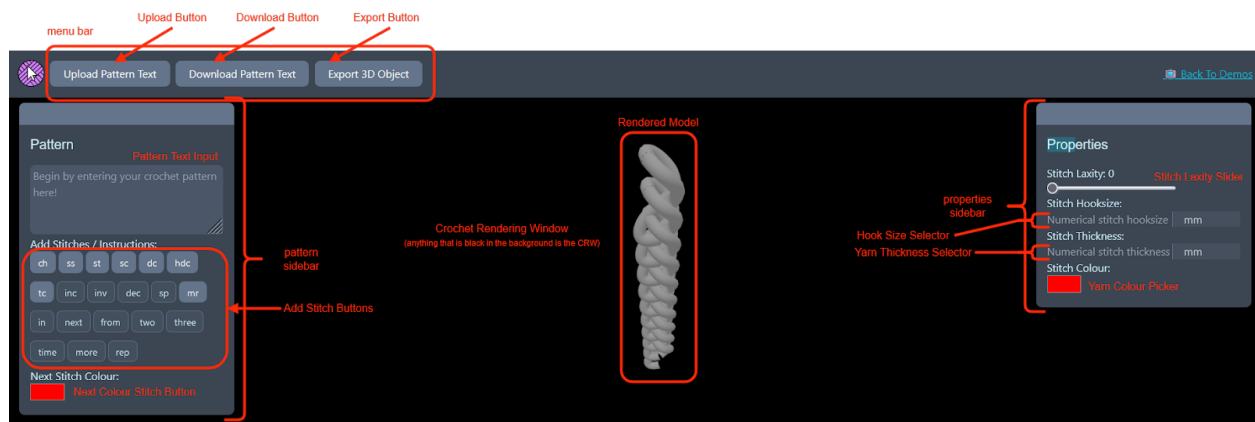
Figure 1.1: *Screen Layout* of CrochetCraft.

Chapter 2

Conventions

2.1   User Assumptions

You, the user of CrochetCraft, are assumed to understand American crochet terminology, and be competent in the basic usage of the device that is running CrochetCraft.

2.2   Computer System Assumptions

CrochetCraft runs in a browser, so it is assumed that you are using a browser that is up-to-date, and has not been tampered with. It is assumed that you are using a device with a keyboard and mouse. If you wish to use any features of the computer filesystem, it is assumed that there is sufficient space for these features.

2.3   Notational Conventions

The following text conventions are used in this manual:

- Libertine is used for normal text.
- *Libertine italicized* is used for emphasis and new terms in normal text.
- **Libertine bolded** is used for emphasis in figures and tables.
- Noto Sans is used for program names and user interface input/output.
- *Noto Sans italicized* is used for widget names.
- `Bitstream Vera Sans Mono` is used for internal representation contents.
- `Bitstream Vera Sans Mono italicized` is used for variables of internal representation syntax.

2.4 Terms

Listing 1 details the basic grammar used when parsing the pattern text. Furthermore, table 2.1 contains the list of keywords. In each row, the keywords listed next to each other can be used interchangeably. For example, ss has the same meaning as slst, so whenever the grammar includes "slst," ss can also be used.

```
pattern := (line? NEWLINE)* line?
line := row_number? foundation? instructions

row_number := INTEGER ("-" INTEGER)? "."
foundation := "mr" ","

instructions := (instruction "," | COLOR ":")* instruction
instruction := "turn" | stitches | repeat

stitches := stitch | stitch count | count stitch
stitch := "inv"? "dec" | stitch_type "st"? "inc"?
stitch_type := "ch" | "slst" | "sc" | "dc" | "tr"

repeat := "(" instructions ")" count
        | count "(" instructions ")"
        | "*" instructions "," "rep" count "from"? "*"
        | "*" instructions "," "rep" "from"? "*" count

count := "x"? (INTEGER | "twice" | "thrice") "x"? "times"? "more"? "times"?
```

Listing 1: The pattern grammar understood by CrochetCraft.

The following terms are used throughout the manual:

- CrochetCraft - the name of the web application / program.

- user - the person who uses CrochetCraft, addressed by "you".

- crochet - this refers to the "process of creating textiles by using a crochet hook to interlock loops of yarn, thread, or strands of other materials".

- yarn - this refers to "a long continuous length of interlocked fibres, used in sewing, crocheting, knitting, weaving, embroidery, ropemaking, and the production of textiles".

- pattern text - this refers to a set of textual instructions that detail how to create a crochet project.

- stitch - a simple, indivisible knot built on top of previous stitches, used to build patterns. See Figure 2 for a list of acceptable stitches.

- foundation - this is the initial loop used to start a pattern. See the table above for a list of acceptable foundations.

Keywords	Meaning
stitch, st	stitch
mr, mc	magic ring
chain, ch	chain
slip, sl, slst, ss	slip stitch
single, sc	single crochet
double, dc	double crochet
hdc	half double crochet
treble, triple, tr, tc	treble crochet
increase, inc	increase
invisible, inv	invisible
decrease, dec	decrease
turn	turn
repeat, rep	repeat
from	from
twice, two	two times
thrice, three	three times
times, time, x	times
more	more

Table 2.1: The keywords and their meanings, as recognized by CrochetCraft.

- *Rendered Model* - this refers to the 3D object created and shown based on the inputted pattern text.

- *Crochet Rendering Window* - this refers to the area of the screen used for displaying the *Rendered Model*.

- hook - "A crochet hook, or crochet needle, is an implement used to make loops in thread or yarn and to interlock them into crochet stitches".

- attribute - a characteristic of a stitch, where the characteristics are:

    - colour - the pigmentation of the stitch
    - thickness - the diameter of the yarn that constitutes the stitch
    - laxity - the looseness of the stitch. In other words, the spacing between stitches
    - hook size - used to determine the scale of the render model

- internal representation - refers to CrochetCraft code responsible for drawing the *Rendered Model* in the *Crochet Rendering Window*.

- session - an invocation of CrochetCraft.

- *Pattern Sidebar* - this refers to the user interface widget on the left side of the *Crochet Rendering Window*, which contains the *Pattern Text Input*, the *Add Stitch Buttons*, and the *Next Colour Stitch Button*. The *Pattern Sidebar* is used for causing input to the IR. The content changes in the *Pattern Sidebar* affect the *Rendered Model* and the *Crochet Rendering Window*.

- *Pattern Text Input* - this refers to the text box which holds your input pattern text.

- *Add Stitch Buttons* - this refers to the set of buttons below of the *Pattern Text Input* where each button corresponds to a different type of stitch that is supported by the grammar.

- *Next Colour Stitch Button* - this refers to the button below the *Add Stitch Buttons* which opens up a colour picker to set the colour for the next added stitch.

- *Properties Sidebar* - this refers to the user interface widget on the right side of the *Crochet Rendering Window*, which contains the *Yarn Colour Picker*, *Yarn Thickness Selector*, *Stitch Laxity Selector*, and the *Hook Size Selector*. This sidebar causes input to the internal representation. The content changes in the *Properties Sidebar* affect the *Rendered Model* and the *Crochet Rendering Window*. The content changes in the *Properties Sidebar* will update the *Pattern Text Input* in the *Pattern Sidebar*.

- *Yarn Colour Picker* - this refers to the button on the *Properties Sidebar* which opens up a colour picker to set the colour for the selected stitch on the *Rendered Model*.

- *Yarn Thickness Selector* - this refers to the input box on the *Properties Sidebar* that changes the thickness of the yarn for the selected stitch on the *Rendered Model*.

- *Stitch Laxity Selector* - this refers to the slider on the *Properties Sidebar* that changes the laxity of the selected stitch on the *Rendered Model*.

- *Hook Size Selector* - this refers to the input box on the *Properties Sidebar* that changes the hook size of the selected stitch on the *Rendered Model*.

- *Menu Bar* - this refers to the user interface component at the top of the *Crochet Rendering Window*, which contains the *Upload Button*, *Download Button*, and *Export Button*.

- *Upload Button* - this refers to the button in the *Menu Bar* that when pressed allows you to select a text file from your local device such that the contents of that text file populate the *Pattern Text Input*.

- *Download Button* - this refers to the button in the *Menu Bar* that when pressed allows you to download your pattern text with some metadata as a text file to your local device.

- *Export Button* - this refers to the button in the *Menu Bar* that when pressed allows you to download your *Rendered Model* as a .OBJ file to your local device.

- OBJ - "a geometry definition file format first developed by Wavefront Technologies for its Advanced Visualizer animation package".

- *Screen Layout* - made up of a *Menu Bar*, *Pattern Sidebar*, *Properties Sidebar*, *Crochet Rendering Window*, and potentially a *Rendered Model*, if there is a valid pattern text to render.

- *left mouse click* (LMC) - a left mouse click.

- *right mouse click* (RMC) - a right mouse click.

- *what you see is what you get* (WYSIWYG) - this refers to "software that allows content to be edited in a form that resembles its appearance when printed or displayed as a finished product".

- device - this refers to whatever CrochetCraft is currently running on, inclusive of hardware and operating system.

- amigurumi - this refers to the "Japanese art of knitting or crocheting small, stuffed yarn creatures".

2.5   Other Abbreviations

- GUI - Graphical User Interface

2.6   Basic User Interface Goals

CrochetCraft aims to be a friendly GUI for crochet amateurs and enthusiasts. Not much crochet modelling software exists, and most of this software does not provide fast and accessible rendering. The main appeal of CrochetCraft is from the benefits of WYSIWYG and the ability to view the *Rendered Model* from any angle. Some other basic goals for the GUI of CrochetCraft are:

- Specifying the attributes of a stitch can be done from within the *Pattern Text Input*, before rendering, as well as after rendering.

- There is no need to confirm the end of a *Pattern Text Input*.

- It is easy for you to minimize, open, and move sidebars such that the *Rendered Model* on the *Crochet Rendering Window* is easily visible.

- It is simple for you to import your crochet pattern text into the *Pattern Text Input*, and it is simple for you to export a 3D object of the *Rendered Model* in OBJ format.

2.7   Organization of this Manual

The remainder of this manual is organized primarily on use cases. The Use Cases chapter describes the basic use cases, including the possible GUI interactions in depth. After the Use Cases chapter, the Troubleshooting & Tips chapter describes what you should do if you encounter common errors as well as how to use CrochetCraft effectively. Lastly, the Limitations chapter describes the restrictions on the current version of CrochetCraft.

Chapter 3

Use Cases

The use cases of CrochetCraft are classified by the section of the GUI your initial interaction occurs in.

3.1   Crochet Pattern Entry

Crochet patterns may be entered in two ways - using the *Pattern Text Input* or the *Add Stitch Button*.

You may enter the pattern text in the *Pattern Text Input*:

1. Any text may be typed into the *Pattern Text Input*, but only text that satisfies the grammar shall be considered valid.

2. If the resulting text within the *Pattern Text Input* is considered to be a valid pattern, the *Crochet Rendering Window* will update to display a new *Rendered Model* corresponding to the updated pattern text.

You may consider alternative methods of direct text entry into the *Pattern Text Input*:

- You may copy or paste text into the *Pattern Text Input*. This is done using the copy or past shortcuts of the underlying device.

- You may use speech-to-text to input the pattern text into the *Pattern Text Input* box.

Regardless of the method of text entry, the *Crochet Rendering Window* will update to display a new *Rendered Model* corresponding to the updated pattern, if it is valid.

You may add one stitch to the end of a pattern using one of the *Add Stitch Buttons*. Each *Add Stitch Button* is labelled with the stitch that it will add to the *Rendered Model*, and each button corresponds to a different stitch.

1. You press the appropriate *Add Stitch Button*. For example, to add a chain stitch, press the button labelled *ch*.

2. The text corresponding to that stitch is added to the end of the *Pattern Text Input*.

3. If the resulting pattern text is valid, the *Crochet Rendering Window* will update to display a new *Rendered Model* corresponding to the updated pattern text.

As an alternative to traditional text input, you may press any of the *Add Stitch Button* multiple times to add multiple stitches. After each button press, the *Pattern Text Input* will update, and if the pattern text is still valid, the *Crochet Rendering Window* will update too.

In the case that the resultant text in the *Pattern Text Input* is invalid, the *Crochet Rendering Window* will not update, and will continue to display the same *Rendered Model* corresponding to the last valid pattern text.

3.2 Viewing Crochet Pattern

You may view the *Rendered Model* in the *Crochet Rendering Window*. Typically, no additional input is required to view the *Rendered Model*; the *Rendered Model* will be readily displayed on the screen under normal usage in the absence of your input.

You may interact with the *Crochet Rendering Window* using your mouse and keyboard to change the perspective that the *Rendered Model* is viewed from.

Panning the camera:

1. You may pan the camera by holding Shift and LMC and moving your mouse in a direction over the *Crochet Rendering Window*.

2. The *Crochet Rendering Window*'s perspective will shift in the direction that the mouse moves in.

Rotating the camera:

1. You may rotate the camera by holding LMC and moving your mouse in a direction.

2. The *Crochet Rendering Window*'s perspective will rotate around the centre of the *Rendered Model* along the direction the mouse moves in.

Zooming the camera:

1. You may zoom the camera in or out by scrolling the mouse wheel up or down.

2. The *Crochet Rendering Window*'s perspective will zoom in or out depending on the scroll direction. Scrolling down zooms the camera out, and scrolling up zooms the camera in.

In the case that the *Rendered Model* is no longer visible in the *Crochet Rendering Window* after the viewing perspective is changed, the CrochetCraft system shall take no further action; CrochetCraft does not interfere with your changes to the viewing perspective. Even if the *Rendered Model* is not visible within the *Crochet Rendering Window*, it shall update the *Rendered Model* with every change to the pattern text. It is recommended, but not necessary that you pan, zoom, or rotate the camera so the *Rendered Model* is visible again.

3.3   Interacting with the *Rendered Model*

You may interact with the *Rendered Model* using your mouse to either hover or select the individual stitches of the *Rendered Model*.

Hovering:

1. You may hover over an individual stitch by moving the mouse pointer so it is over one of the stitches within the *Rendered Model*.

2. The *Crochet Rendering Window* will update, so the stitch that is under the mouse pointer will be displayed with an outline around it.

If the mouse pointer is over empty space, and there is no stitch under the pointer, no action is taken, and the *Crochet Rendering Window* will not change what is displayed.

If, for some reason, the stitches in the *Rendered Model* are the same colour as the background, and the mouse pointer moves over a stitch that is the same colour as the background, that stitch will still be highlighted.

Selecting:

1. First, a stitch in the *Rendered Model* must be hovered over.

2. You may then do a LMC to select the hovered stitch.

In any use case involving a selected stitch, the stitch involved in Step 2 shall be the one that is affected. For example, interactions with the *Properties Sidebar* will affect the stitch that was selected in Step 2.

If a long press is performed, the hovered stitch will only be selected if the mouse pointer still lies on top of the stitch in the *Rendered Model* when the LMC is released.

If no stitch is being hovered over, but an LMC is performed within the *Crochet Rendering Window*, CrochetCraft shall either:

- Do nothing, if there is no selected stitch.

- Deselect the selected stitch, if there is a selected stitch.

3.4   Modifying Crochet Stitches

After a stitch has been selected, as described in the Interacting with the *Rendered Model* section, the *Properties Sidebar* will display several attributes belonging to the stitch. By changing these attributes, you can change the stitch's colour, thickness, hook size, and laxity.

Changing the colour of a stitch:

1. After selecting the desired stitch, LMC the *Yarn Colour Picker*.

2. In the resulting dialog, select the desired colour. The dialog may vary depending on your device's operating system or web browser.

Changing the thickness of a stitch:

1. After selecting the desired stitch, LMC and drag on the *Yarn Thickness Selector*. Drag toward the left to make the stitch thinner, and drag toward the right to make it thicker. Once the stitch has the desired thickness, release the LMC.

Changing the hook size of a stitch:

1. After selecting the desired stitch, LMC and drag on the *Hook Size Selector*. Drag toward the left to make the hook size smaller, and drag toward the right to make it larger. Once the stitch has the desired hook size, release the LMC.

Changing the laxity of a stitch:

1. After selecting the desired stitch, LMC and drag on the *Stitch Laxity Selector*. Drag toward the left to decrease the laxity, and drag toward the right to increase it. Once the stitch has the desired laxity, release the LMC.

3.5   Loading and Saving Crochet Patterns

You can save your crochet pattern into a file on your device and load it later. This allows you to resume your work at a later time or share your work with others.

Saving your crochet pattern:

1. LMC the *Download Button* in the *Menu Bar*.

2. The current contents of the *Pattern Text Input* will be saved as a file onto your device. Depending on your device's operating system or web browser, the file may be saved in a standard location, or you may be prompted for a location to save the file.

Loading a saved crochet pattern:

1. LMC the *Upload Button* in the *Menu Bar*.

2. In the dialog box, select the file which was previously saved with the *Download* function. The dialog box may vary depending on your device's operating system or web browser.

In the case that the selected file is not a valid file that was previously saved with the *Download* function, the error File format not recognized will appear, and the file will not be loaded.

You can export the rendered pattern as a 3D model file, which can be opened in third-party applications.

Exporting your crochet pattern:

1. Once the *Crochet Rendering Window* displays the desired 3D model, LMC the *Export Button* in the *Menu Bar*.

2. The 3D model currently displayed in the *Crochet Rendering Window* will be saved as a file onto your device in OBJ format. Depending on your device's operating system or web browser, the file may be saved in a standard location, or you may be prompted for a location

to save the file. The file can be opened in a variety of third-party software that supports loading files in OBJ format. Please consult the user manual for the third-party software to ensure it is capable of loading such files.

Chapter 4

Troubleshooting & Tips

4.1   Troubleshooting

You input a pattern with an unrecognized stitch name.

→ Modify the pattern to change or remove the unrecognized stitch name. The recognized stitches are listed in the Terms section.

You input a pattern with invalid or unrecognized syntax.

→ Modify the pattern to conform to the grammar laid out in the Terms section.

You try to load a file that is not a crochet pattern.

→ Open a plain text file instead, or open the desired file with the appropriate software and copy and paste the pattern text into the CrochetCraft application.

You input a pattern with an excessively large amount of stitches.

→ Reduce the number of stitches in the pattern. See the Limitations chapter for more details.

You enter an invalid value in the settings panel. For example, a non-number when a number is required.

→ Enter a valid number without spaces, thousands separators, or other symbols.

You open the app in an outdated/incompatible browser.

→ Use a device that satisfies the requirements listed in the Computer System Assumptions section.

You close the window without saving the pattern being typed.

→ Ensure you have used the *Download* function to save your work before closing the web browser window.

You add more than one foundation stitch.

→ Remove the additional foundation stitches. CrochetCraft is only designed to render one crochet part at a time; different parts which are intended to be sewn together must be rendered separately.

4.2 Tips

- Below are some sample patterns which you can copy-and-paste into the *Pattern Text Input*, to help you get started:

    - Disk:
        1. MR, sc 6
        2. 6 (sc, inc)
        3. 6 (2 sc, inc)
        4. 6 (3 sc, inc)
        5. 6 (4 sc, inc)
        6. 6 (5 sc, inc)

    - Sphere:
        1. MR, sc 6
        2. 6 (sc, inc)
        3. 6 (2 sc, inc)
        4. 6 (3 sc, inc)
        5. 6 (4 sc, inc)
        6-10. 36 sc
        11. 6 (4 sc, dec)
        12. 6 (3 sc, dec)
        13. 6 (2 sc, dec)
        14. 6 (sc, dec)
        15. 6 dec

- Amigurumi patterns typically start with a magic circle, while clothing and similar textiles typically start with a slip knot and chain stitches.

- Use the *Download* function often to avoid losing your work.

Chapter 5

Limitations

These are the limitations that apply to the pattern text:

- The crochet pattern text input is not inclusive of all terminology recognized by American crochet terminology, or other natural language. The crochet pattern text input is limited to what is included in the table describing the grammar used by the *Pattern Text Input*.

- Supported crochet pattern text is limited to the list of acceptable tokens only. Invisible characters, combining characters, or other Unicode characters that interfere with normal text display shall not be supported.

Limitations on the crochet pattern text input apply to uploaded pattern texts too.

For performance reasons, there are limitations on the number of stitches that CrochetCraft can render. CrochetCraft supports patterns with up to 20 000 stitches before user interactions have unreasonable delays of above 300 ms.

The CrochetCraft application makes a few assumptions about real-world crochet patterns, which limits what crochet patterns can be rendered satisfactorily. Here are the following assumptions:

- Crochet patterns in the real world only contain one foundation stitch.

- Crochet patterns in the real world do not contain yarn threads intersecting through each other.

- Crochet patterns in the real world are composed of a common set of well-defined stitches.

- Crochet patterns in the real world are constructed one stitch at a time.

- Crochet patterns in the real world are constructed, so each stitch connects to the previous one in the pattern and possibly to other even early stitches in the pattern.

- In the real world, crochet patterns are continuous.

The assumptions and resulting limitations on stitch attributes within CrochetCraft are as follows:

- Yarn colour is limited by the underlying browser. It is likely that this limitation will be 24-bit RGB, and there is no support for transparency.

- Crochet hook size in the real world is assumed to fit into the range of values from 5 mm to 25 mm supported by CrochetCraft.

- Yarn thickness in the real world is assumed to fit into the range of values from 5 mm to 25 mm supported by CrochetCraft.

- Yarn looseness, or laxity, in the real world is assumed to fit neatly into the range of values from 0–1.5 supported by CrochetCraft.

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