



Designing Coast Salish woven basket patterns using Jupyter notebooks

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Motivation: geometric patterns of Salish baskets



Goal: a tool to explore basket geometric patterns

We want to design an educational tool that can be used in the classroom and will allow students to explore the design of these patterns through an intuitive and non-technical geometric approach.

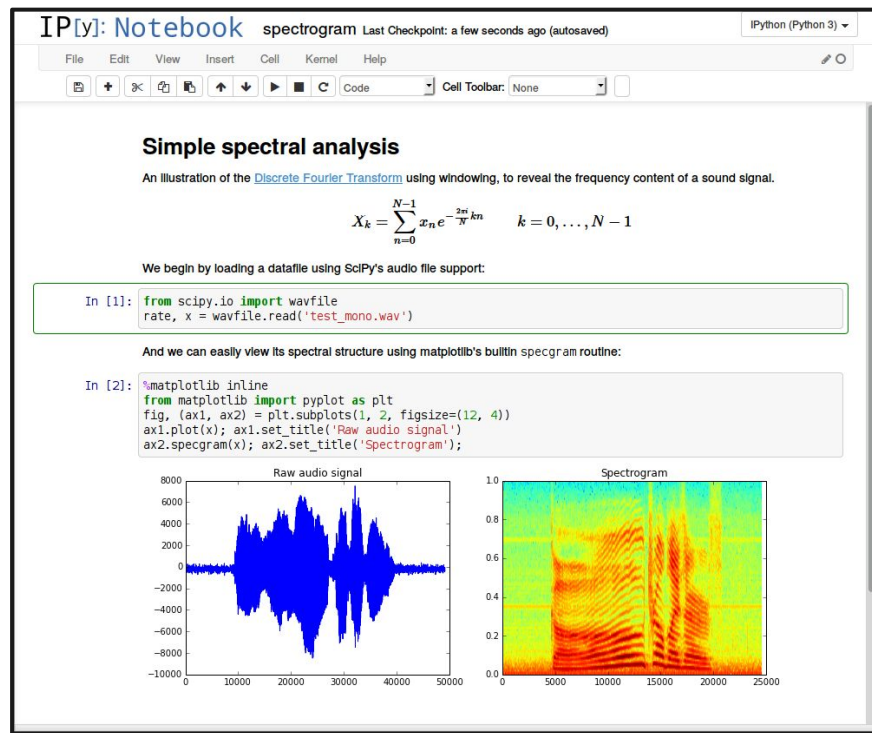
Our ultimate aim is that such a tool will benefit to students from different backgrounds, from developing an interest in mathematics motivated by important cultural objects to learning about indigenous culture through the actual design of basket-like geometric patterns.

Infrastructure: Jupyter notebooks

A notebook is a file that contain both **code** (python here) and **formatted text**, including hyperlinks, images, videos, ... (markdown format).

The notebook can be created **locally** through a web browser.

The notebook can be **visualized** (formatted text and results from running the code) **locally** or through an **online viewer** (e.g. binder).



Infrastructure: The Callysto project

The goal of [Callysto](#) is to bring Jupyter notebooks in the classroom, to encourage **computational and design thinking** among grades 5-12 students.

The project, lead by **PIMS** and **Cybera**, includes

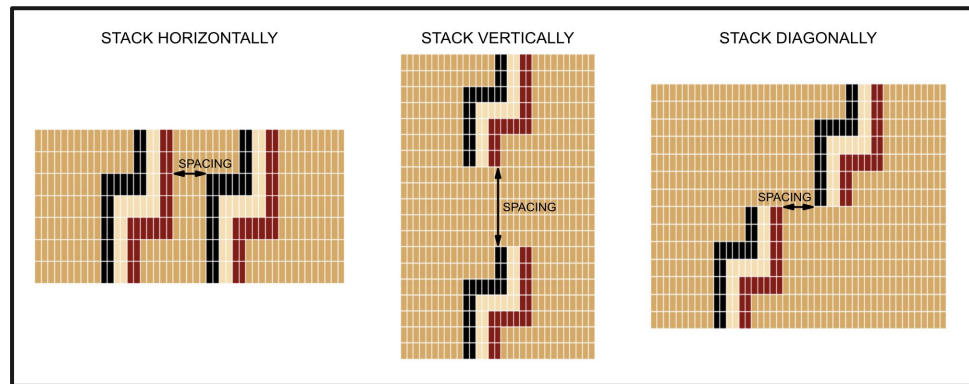
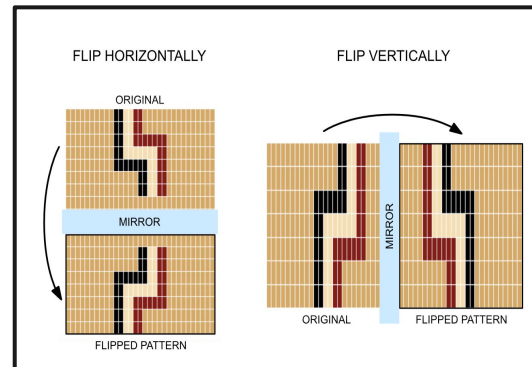
- the development of notebooks related to the grades 5-12 curriculum (currently AB and BC),
- The development and maintenance of an online hub for Jupyter notebooks, hub.callysto.ca.

The Callysto project funded a team of three developers/creators this summer at SFU to work, among others on the notebooks described today.

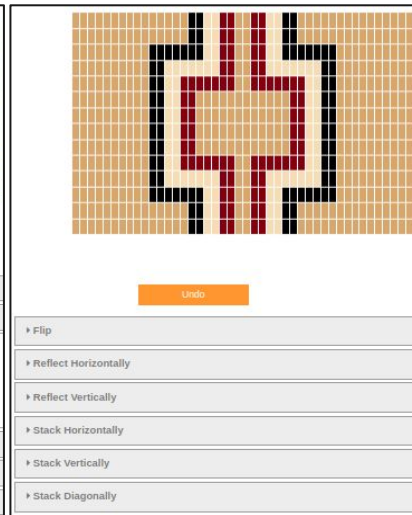
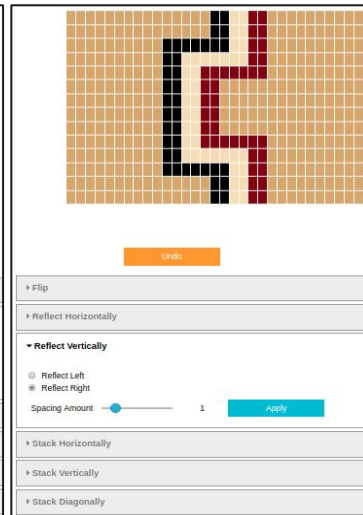
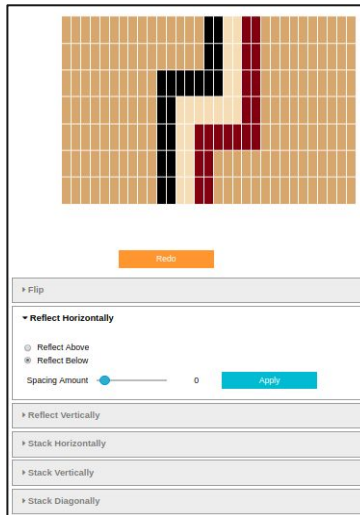
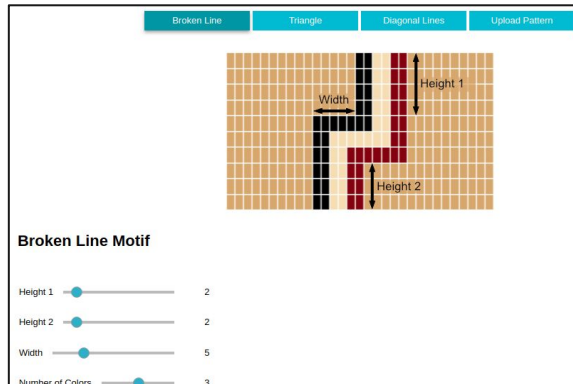
The algorithm: principle

A geometric pattern is built from a (simple) **starting shape** (broken line, triangle, ...) onto which we apply iteratively a sequence of **geometric operators** (reflection, stacking, flip).

Patterns can be **edited** and **combined** into more complex ones.



The algorithm: example



Remark. This approach is based on an **algorithmic view of pattern design**: a pattern can be fully described by its starting shape and sequence of applied operators. This is very different of the actual basket crafting process.

The interface

Our tool is composed of three notebooks: one to create simple patterns, one to combine and edit patterns, one to create 3D baskets using created patterns. Created patterns are saved locally as text files.

Atomic Motifs

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Last modified: September 18, 2018

Baskets Motifs & Mathematics

Woven baskets are three dimensional (3D) objects onto which two dimensional (2D) geometric figures (called **motifs** or **patterns**) are represented and often repeated with some kind of symmetry. The present notebook is focusing on the patterns observed on the baskets shown in the figure below, that were presented to us during a visit to the [Tlaxcala region](#) in May 2018. These two baskets are composed of a circular basket containing asingle repeated pattern and a rectangular basket with 4 faces, representing two patterns.

Circular Basket: Triangular Motif Rectangular Basket: Rectangular and Triangular Motifs



Unlike usual geometric figures, motifs observed on baskets are not composed of pure lines and points, but of an assemblage of rectangular units (that we call blocks from now) resulting of the process of weaving lanes obtained from cedar bark or root. Moreover, these motifs are colored leading to an additional important feature/dimension to their modeling.

Combining and Editing Motifs

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Combining motifs

The motifs that we have seen up until now have been generated from a single atomic motif. A basket sometimes displays multiple motifs, combined together. To do so, our tool below allows to select two motifs created previously, set the desired spacing between them, and click the Join motifs button.

Two motifs of the same height will be simply be previewed side by side. motifs of unequal heights need additional blocks added to the top and bottom of the motif with lower valued height in order for the height dimensions to match. Thus, the motif of lower valued height will be horizontally centered alongside the motif with higher valued height.

Once two motifs have been joined, you can save the motif and continue to combine more motifs to your new motif if you wish. if you have saved your motif but do not see the file in the dropdown menu, try clicking on the Refresh Files button.

Motif 1: Motif 2: [Refresh Files](#)

Spacing Amount [Join Motifs](#)

Editing motifs

In the interactive below, we can manually edit motifs by clicking. Start by choosing one of the available motifs. To edit your motif, choose a color and click on a block in your motif display to change its color. To erase, choose the last color and click on the block you wish to erase.

Motif: [Refresh Files](#)

[Edit](#)

3D Baskets

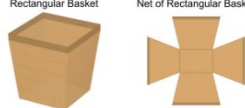
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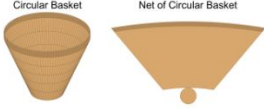
A net of a 3D shape is an arrangement of two dimensional shapes which can be folded along the edges to become the faces of the 3D shape. Given a rectangular basket (without a lid cover), we see that the net of the basket consists of five shapes: one rectangle, which makes up the bottom of the basket and four trapezoids, which make up the sides. Hence, we can add up to four motifs to generate a 3D model of a rectangular basket with motifs.

Rectangular Basket Net of Rectangular Basket



Given a circular basket (without a lid cover), we see that the net of the basket consists of only two shapes. The bottom of the basket is circular in shape and the surface making up the sides of the basket can be thought of as a single curved trapezoid. Hence, we only require one motif to generate a 3D model of circular basket with motifs.

Circular Basket Net of Circular Basket



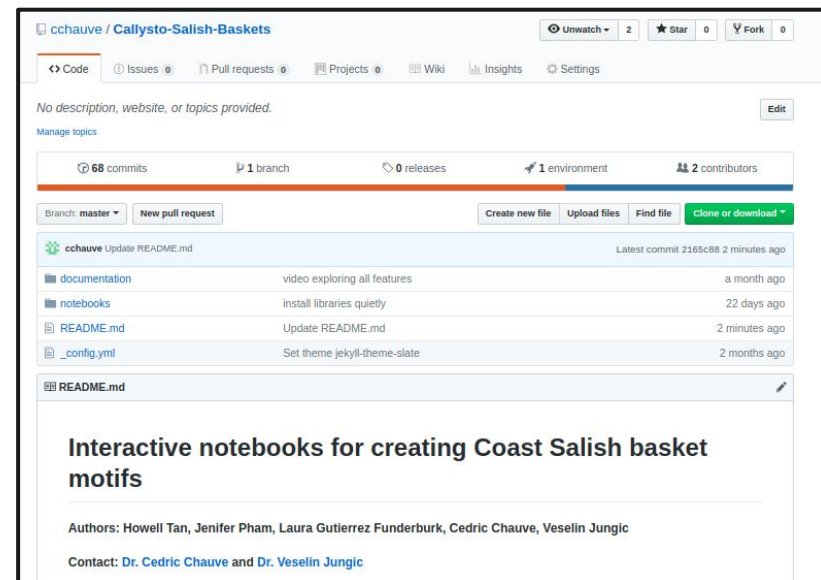
To place your motifs onto 3D models, first choose a basket shape and then choose the motif you would like to see on each face. If you have saved your motif but do not see the file in the dropdown menu, try clicking on the Refresh Files button.

Distribution of the notebooks

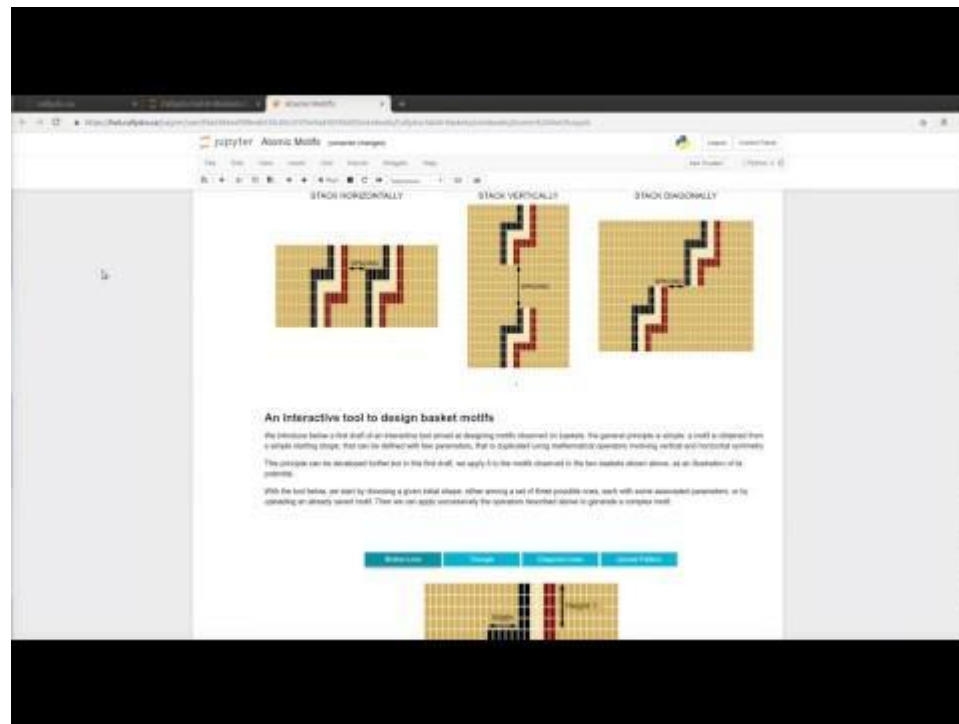
The three notebooks are publicly available on a github repository

- Repo: <https://github.com/cchauve/Callysto-Salish-Baskets>
- Webpage: <https://cchauve.github.io/Callysto-Salish-Baskets/>

Potential users can download them, use them or modify them on a local desktop computer if jupyter is installed, or online using the Callysto hub.



Time for a demo



Future Work

Technical work:

- The code of the notebooks can likely be optimized to be faster.
- The 3D rendering tool is still quite preliminary, but appropriate libraries in python lack currently.
- The three notebooks could be integrated into a single notebook.

Diffusion:

- How to get this resources to teachers and to train them?
- How to install it on local school computers?

Conclusion

This tool was designed with reconciliation in mind: we learned about these beautiful baskets, something new for us, and tried to implement our understanding using mathematical concepts and tools we know well, with the aim to make it accessible to a wide audience.

We hope our tool, despite its shortcomings (that we plan to address), will be brought to many students, who will learn either about Salish baskets or about mathematics, through hands-on activities such as the reproduction or design of basket patterns.

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