

Code Crafting with TurtleStitch

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ABSTRACT

A programmable embroidery machine is a kind of robot, and programmable machine embroidery is based on a rich heritage of textile crafting and computer coding. In this workshop participants will learn how computer science originated in hand-craft. Embroidery, tapestry, quilting, and weaving all embody principles of computation – and did so centuries (eons) before the Jacquard Loom was invented. We will introduce TurtleStitch (turtlestitch.org), a web-based platform to generate patterns for embroidery machines. It is useful for designers for experimenting with generative aesthetics and precision embroidery, but its pedagogic power is in gently introducing crafters of all ages to coding. This workshop will take participants through the basics of blocks-based coding, and introduce turtle geometry; an established field of mathematics, in which you navigate a space by driving a robot. Our robot controls an embroidery needle. Unlike expensive embroidery design software, TurtleStitch provides the crafter with an open-ended coding environment in which to build their own tools or explore the foundations of the craft, providing potential to extend the artistry of the medium in innovative directions. Novice designers will be introduced to some basic principles of machine embroidery and textile design. Novice coders will learn some foundational programming concepts and computing principles. The more skilled will have an opportunity to explore advanced concepts and skills from both the design and coding perspective. Participants will learn the process flow of the embroidery machines to appreciate how simulated perfection translates to real-time machine robotics. Participants may take away a small embroidery ‘patch’ of their own design, that may be incorporated into a collaborative tapestry-quilt that will be raffled off among the workshop participants.

CCS CONCEPTS

• Human-centered computing~Interaction design

KEYWORDS

Machine embroidery, creative computation, code crafting.

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1 Concept

This is a shorter version of a hisuccessful SIGCSE 2018 workshop [Wolz et al. 2018] that sold out at SIGCSE 2019. This 90 minute version is intended for the more diverse and digital design focused SIGGRAPH audience. It is also intended to supplement a proposed Studio installation (Programming Embroidery with TurtleStitch). The focus provides a novel perspective on skills that are often labeled ‘women’s work’, namely that the foundational principles of computer science developed from textile crafts. An overview of the ‘Code Crafters’ curriculum, will be introduced, using Andrea Mayer’s Snap-based TurtleStitch (turtlestitch.org). The environment employs turtle geometry [Abelson et al. 1981] to guide a robotic needle and is a descendent of the Scratch [Resnick et al. 2018].

The workshop will introduce participants to potential adaptations of this curriculum, and give participants hands-on experience in designing and rendering a machine embroidery pattern in TurtleStitch. Key concepts from the full curriculum will be demonstrated: (1) crocheting as a vehicle for learning about primitive operations, instruction codes for process control, and reading and writing patterns (algorithms); (2) programing machine embroidery provides exposure to agile design; (3) contrasting embroidery with quilting provides experience in abstraction and reuse; (4) weaving and tapestry provide concrete illustrations of manipulating two dimensional data structures; (5) studying embroidery machine file formats demonstrates how language translation takes place; (6) sharing a limited resource (a \$500 programmable, single thread machine) provides concrete experience in scheduling, and product testing; (7) collaborative crochet and quilted projects provide experience in team dynamics. Participants in this workshop will be invited to join an online community of mutual support at Turtlestitch.org

2 Novelty

Our novel approach resonates with both the digital design and computer science communities. At SIGGRAPH, where these communities merge enthusiastically, code crafting has a place in the Studio where attendees can explore it individually. The computer science community still tends to be centered on traditional methods of instruction for introducing beginners to the field, even when engaging in creative computation[4]. Both the Broadening Participation and Code.org movements emphasize

that if you are not an economically advantaged white male, you too can learn to code, and that you can be successful in joining the traditional community. The Code Crafters curriculum takes a different approach: empowering crafters (who are almost universally not economically advantaged white males) by suggesting that there is evidence that computer science grew out of textile crafts, and that coding is a craft that co-opted methods, skills, and concepts that, for centuries, have been embedded in textile crafting (and in the case of weaving, for millennia). The metaphors and deeply haptic experiences provided in this novel curriculum, directly address the reluctance of members of under-represented groups to put their feet in the water and learn to swim with enthusiasm both in design and coding.

The digital divide separates creators with computing from consumers of computing products. But all too often digital designers are given tools to consume that separate them from the essential creative power of algorithm and data design. The blocks programming paradigm embodied in Scratch [Resnick et al. 2018] provides a gentle vehicle for the math and coding averse to begin to embrace the power of quantification and computation. Our workshop model addresses this directly as shown in Figure 1.

Our experience to date has been to generate real excitement about coding, and with that, we’re seeing participants with professional agenda beyond the SIGGRAPH community becoming enthusiastic explorers of computer science and digital arts.

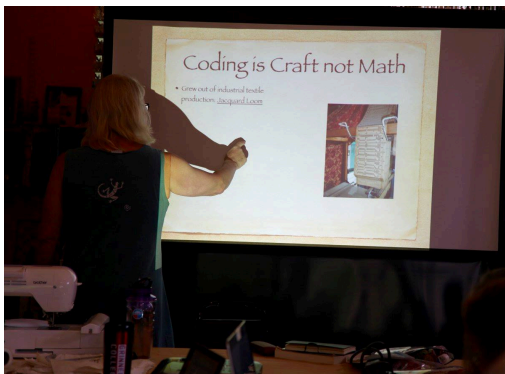


Figure 1: Coding as Craft not Math

2 Workshop Organization

A 90 minute workshop is very short indeed. Consequently the formal presentation is limited to the first 30 minutes, followed immediately by a 15 minute live coding demo of TurtleStitch. Demonstration of actual machine embroidery is presented as a video to mitigate Murphy’s principle regarding the reliability of mechanical devices in live demos. Figures 2 and 3 show still examples from video footage of the process flow of rendering on the embroidery machine.

The second 90 minutes are devoted to hands on challenges supported by the workshop leaders as well as web-based materials such as [reference cards](#) and [videos](#). In our experience, participants quickly master the basics of TurtleStitch without formal extended instruction. We will not offer the opportunity to render their

project on the embroidery machine during the workshop because of time constraints, but will encourage them to bring it to our proposed Studio installation. They can take their work with them after SIGGRAPH, and continue to explore code crafting by joining our online community and share their work.



Figure 2: Off Computer Machine Embroidery



Figure 3: Rendering Demonstration

To focus their 90 minutes, participants will be asked to contribute to a thematic tapestry-quilt. Individuals can contribute more than one piece, or use their piece more than once. We will arrange for them to take home a 4X6 inch pattern on material provided in the color(s) of their choice. We will embroidery these after the workshop. They can work further on their design in our proposed installation, or on their own laptop, and return to the installation to render it. They can arrange to have it rendered by us or commercial services after SIGGRAPH. The software and educational resources provided in the workshop are available on-line for free. Rendering to textile is fee-based after SIGGRAPH. Participants will receive raffle tickets commensurate with their contribution to win one of the completed tapestries.

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