

Bugs In The System (BITS): Procedural Patterns for Scarf Design

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Abstract

This pictorial presents BITS, an interactive procedural system for generating scarf patterns. Through interaction with the system, we explore how traditional design practices can be translated into computational workflows. Additionally, we present a brief case study investigating the integration of generative AI systems into the final stages of the design process, discussing how AI can augment, reinterpret, and co-create ornamental textile designs through human curation.

Keywords

Procedural Design, Computational Creativity, Textile Design, Human-AI Co-Creation

1. Introduction



Figure 1: Generative scarf pattern printed with dye-sublimation printing in satin tissue

This pictorial presents BITS (Bugs In The System), an interactive procedural system for generating scarf patterns. The system was presented during DCC Week, an event held between August 20 and 22, 2025, targeting undergraduate students in the Department of Computer Science at Universidade Federal de Minas Gerais, as part of an initiative to popularize science and technology, particularly in the field of Computational Creativity. As a contribution, this work documents a computational design workflow in which procedural generation, human curation, and generative AI interact

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throughout the development of textile artefacts, positioning this interaction, rather than any individual component, as the central contribution. By mapping the stages of discovery, definition, development, and delivery onto a computational workflow, the Double Diamond [9] framework provided a bridge between traditional design practices and computational design methods, offering a Research through Design (RtD) lens through which to document the evolution of the project from conceptual inspiration and procedural generation to physical fabrication and reflection.

While prior work has explored procedural generation, computational creativity, and generative approaches to textile and fashion design, whether through data-driven pattern generation [13], deep generative models [11], fractal and L-system algorithms [12], procedural texture authoring [14], or human-machine shared authorship in textile crafts [1], these approaches typically address isolated stages of the design process, focusing either on the generative method itself or on the final fabricated artefact. BITS distinguishes itself by documenting the complete journey across these stages within a single, cohesive workflow, combining procedural generation, human curation, and generative AI-assisted exploration in support of physical textile fabrication.

Following the Research through Design approach adopted in this work, this pictorial is organized according to the stages of the Double Diamond framework. Section 2 (Discover & Define) presents the conceptual inspiration and the development of the procedural system, while Section 3 (Develop & Deliver) documents the generation, refinement, and fabrication of the textile artefacts. Section 4 (Discussion & Conclusion) reflects on the insights obtained throughout the design process and on the role of procedural systems and generative AI (Artificial Intelligence) in textile design.

2. Discover & Define

Traditionally, the design process begins with establishing a concept to guide the project's visual development. In the case of BITS, the initial inspiration emerged from an article discussing how the world may be becoming less colorful [2], which motivated the search for a vibrant visual language combining elements of pop art, cyberpunk, urban style, graffiti, printed circuits, and glitch art, as illustrated in **Figure 2**. The intention was to construct an aesthetic directly connected to computational processes and to the procedural visuality of the generated patterns.



Figure 2: Moodboard featuring references from pop art, cyberpunk, and glitch aesthetics, respectively. (Source: [3],[4],[5])

Within this context, an interactive constructive procedural system [8] was developed, in which error becomes a visual and ornamental element. In order to reach the final version of the system, different constructive algorithms were explored, including Diffusion Limited Aggregation (DLA)², allowing the investigation of how distinct computational systems produce different visual languages and aesthetic meanings. It was observed that a single algorithm can generate substantial variability

² Diffusion Limited Aggregation (DLA) is a growth-based procedural algorithm in which randomly diffusing particles progressively attach to existing structures, often resembling natural growth patterns.

while preserving a coherent visual identity, whereas different algorithms tend to produce distinct ornamental narratives. In **Figure 3** we see the different algorithms tested before the final particle system and its variations. In **Figure 4** presents the system interface, which is available online and allows users to interact with a particle-based generative system through a set of controls and parameters. The interface includes three buttons: *Capture*, which saves the current pattern as an image; *Antidote*, which resets the system; and *Show Emojis*, which reveals the emotion associated with each particle cluster. Users can also manipulate several parameters: *Chaos*, which increases or decreases the system's entropy; *Velocity*, which controls particle speed through user interaction within the simulation area; *Walk*, which introduces random-walk behavior; *Personality*, which assigns emotional attributes to particles; and *Infection*, which governs the propagation of errors throughout the system. In **Figure 5** is presented a sample of BITS pattern variety, which can be enhanced as shown in the next session (3. Develop & Deliver), by human co-creation and generative AI.

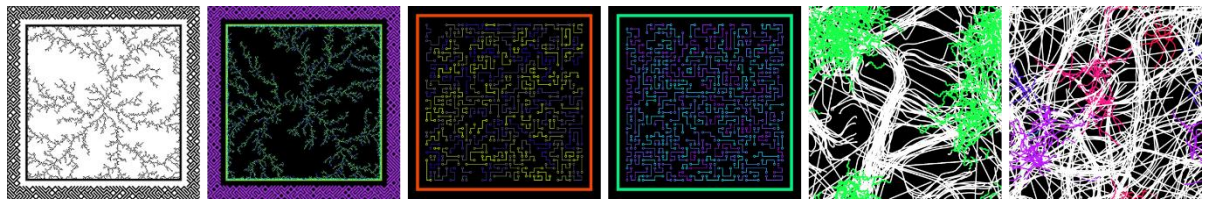


Figure 3: Results from the different tested algorithms, with some of their variations. Notice how the aesthetics remain consistent within each algorithm. Diffusion Limited Aggregation is presented in the left, in the center we have an algorithm that simulates integrated circuits and the one from the right another particle system implementation

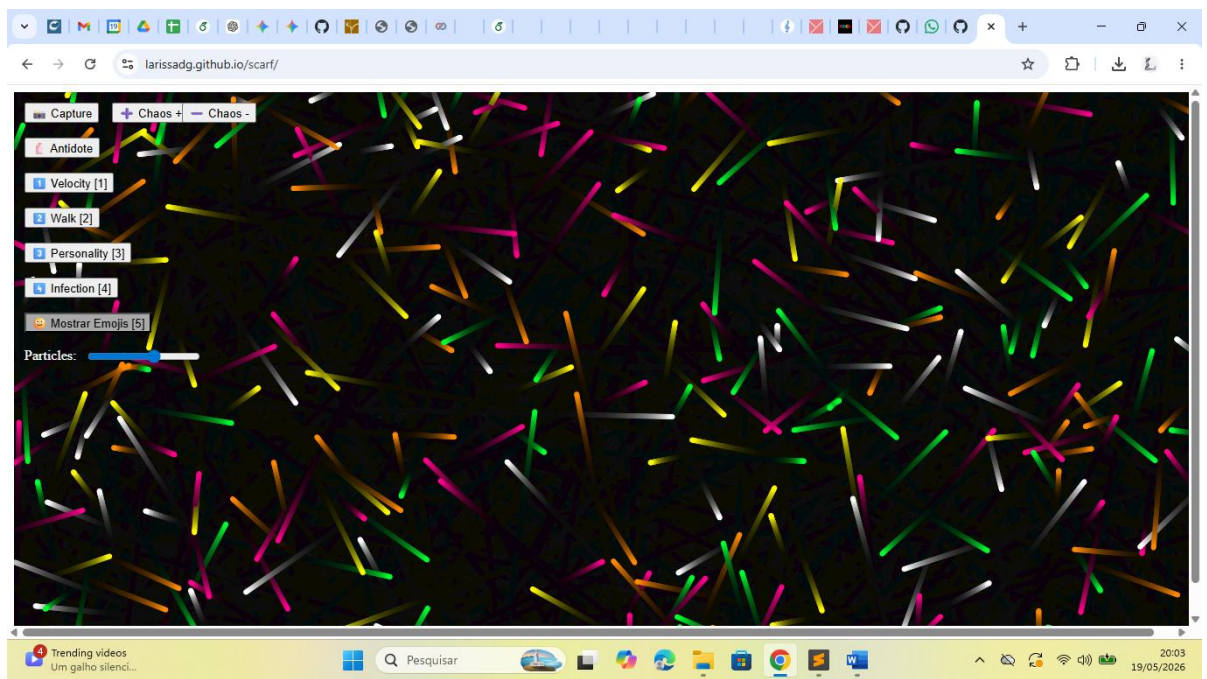


Figure 4: BITS interface

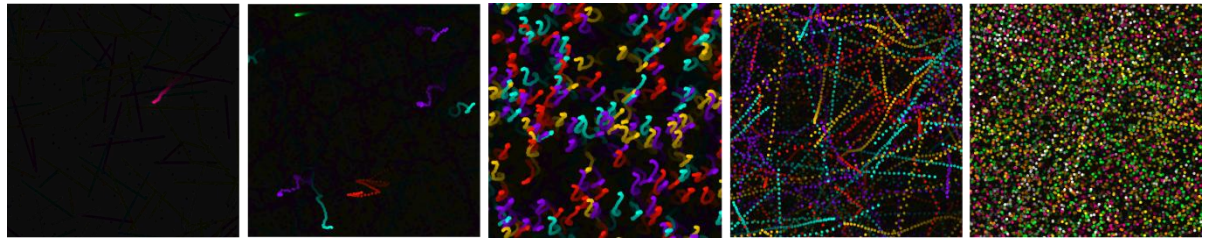


Figure 5: Range of texture generation of BITS particle algorithm.

3. Develop & Deliver

Once the system was implemented, users could interact with the particles through side buttons and direct touch interaction on the interface, generating different ornamental compositions in real time. Once satisfied with the results, users could automatically capture the generated images, which were then saved to their computers. Since the outputs preserved the rectangular framing of the screen, subsequent processes of framing, cropping, and resolution enhancement were required in order to adapt the compositions to the square format of the scarves and to textile printing constraints. The final result of this part is shown in **Figure 6**. This process highlights how traditional practices of visual composition and curation remain present even within computational workflows.

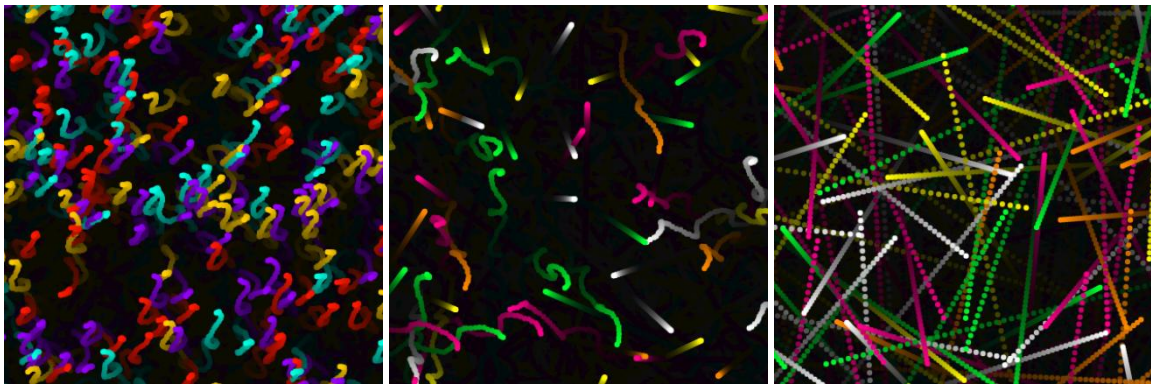


Figure 6: Cropped images retrieved through the interaction with the BITS' system (from left to right: Patterns I, II, and III).

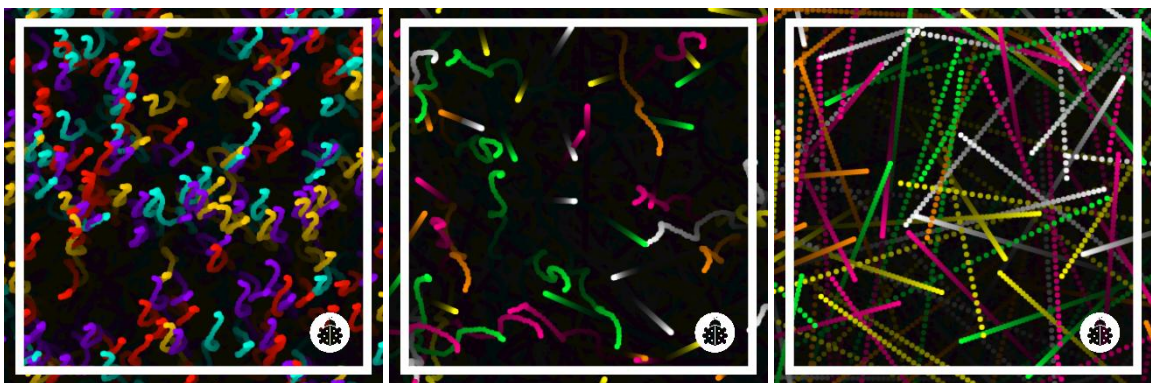


Figure 7: Finalized Images by manual edition through Inkscape from left to right: (Patterns I, II, and III).

Subsequently, experiments were conducted using GPT-4o and Nano Banana in order to investigate the ability of generative AI systems to reinterpret and expand procedurally generated patterns through the insertion of graphical elements and textile mockups. The experiments showed that the models were capable of incorporating visual references and ornamental styles, although in some cases the results approached direct reproduction rather than simple inspiration. However, the models often returned textile mockups instead of flat printable designs, making the outputs unsuitable for direct sublimation printing due to the simulated fabric lighting and shadows embedded in the image. In the article [1], the author discusses how computational systems and craftspeople share creative control during textile production. Similarly, in BITS the system defines visual and parametric structures, while final decisions regarding curation, refinement, and materialization remain dependent on human agency, with the scarves being manually refined in Inkscape (this part is illustrated by **Figure 7**, above), printed through satin sublimation, and finished through sewing. Some samples of the prototype can be seen in **Figure 1**.



Figure 8: These images are, made respectively by Chat GPT and Nano Banana, with the prompt: “A 50x50cm luxury satin scarf mockup, flat lay with elegant soft folds. The fabric has a glossy, silky texture with high shine. The pattern is on a dark black background, featuring cute neon glowing beetles (pink, green, yellow, and white) leaving bright neon light trails and scribbles behind them. High resolution, textile design, photorealistic.” Passing the second (II) pattern presented in **Figure 7** as context.

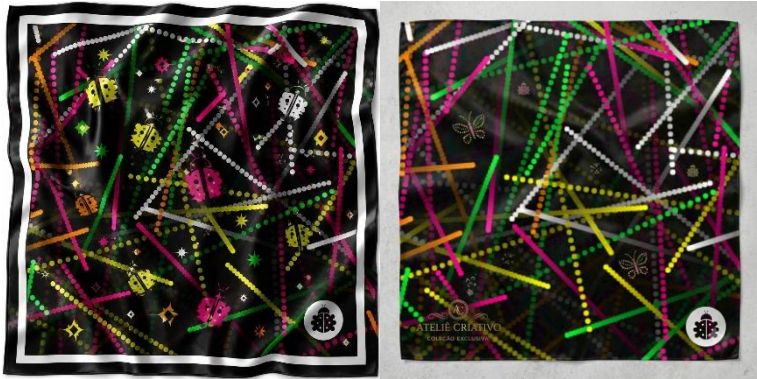


Figure 9: These images are, made respectively by Chat GPT and Nano Banana, with the prompt: “Add graphic elements to the design of this scarf, creating a new image of the scarf as a satin mock-up, which could be printed via sublimation. Keep the square shape.” Passing the third (III) pattern presented in **Figure 7** as context.



Figure 10: The first and the second images in this row are mockups, made respectively by Chat GPT and Nano Banana, the last one is the actual photo with a model using the prototype.

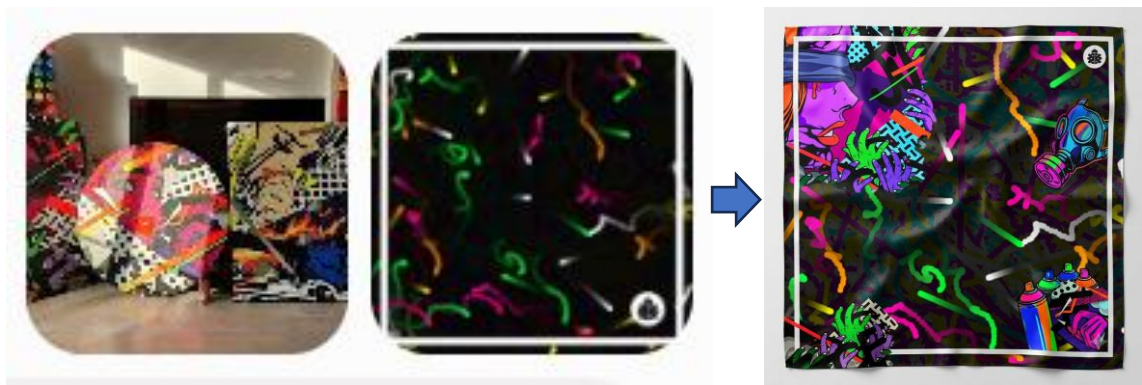


Figure 11: From left to right we see two images together after the arrow, which are the images passed as context to the prompt “Incorporate graphic elements into the scarf’s design, creating a new image of the scarf as a satin mock-up that could be printed via sublimation. Maintain the square shape. Draw inspiration from the pop art style of Monsieur Le Bleu. Add a neon/club/street vibe to the design.”. The image on the right represents the output of this prompt. Notice that some of the elements incorporated by the final design like the face in the left upper corner and the hand in the left bottom corner are present at the Monsieur Le Bleu art work. The following image emphasizes that. (Source: [6])

4. Discussion & Conclusion

The process developed in BITS reveals an intrinsically co-creative practice that explores different levels of agency between humans, procedural systems, and artificial intelligence. Although the AI experiments demonstrated potential for the insertion and expansion of ornamental elements, manual creation and human curation still offered greater control over visual identity, composition, and aesthetic intention. In this sense, the designer no longer acts solely as a direct creator, but also assumes the role of curator, selecting, recombining, and refining references and computational outputs. As argued by Austin Kleon, “The artist is a collector. Not a hoarder, mind you, there’s a difference: Hoarders collect indiscriminately, artists collect selectively. (...) Your job is to collect good ideas. The more good ideas you collect, the more you can choose from to be influenced by.” [10] and creativity emerges through the collection and recombination of references and ideas.

Throughout DCC Week, informal impressions of the design and of the overall process were largely positive, with several attendees suggesting that the results be donated to the laboratory or that the work be developed further into a commercial venture. However, a subsequent anonymous questionnaire answered by 20 participants (50% men and 50% women), mostly aged between 20 and

35, suggests a more nuanced picture. Familiarity with generative art and design remains limited among respondents. When asked to choose a preferred aesthetic for the development of a luxury scarf, 52.6% selected the Diffusion Limited Aggregation (DLA) pattern. Regarding the finished scarves, 65% considered them unattractive, rating the overall design as "average" in terms of visual appeal, while 75% stated they would not wear the piece and 70% said they would not purchase it. These results stand in clear contrast with the positive feedback received in person at the fair, suggesting that spontaneous, face-to-face reactions to novelty may not fully capture sustained aesthetic judgment or purchase intention. Thus, the project suggests that procedural systems and artificial intelligences do not replace the human creative process, but rather expand its exploratory space, enabling new forms of computational ornamentation and co-creative textile design.

For future work, the role of computational design and related techniques within textile design warrants continued exploration. In particular, integrating a scarf mock-up preview into the workflow could prove valuable, since a visually compelling pattern does not necessarily translate into an appealing scarf, and the reverse holds equally true; allowing users to preview the final garment earlier in the process may help bridge the gap between pattern-level aesthetic judgments and the perceived quality of the finished textile artefact.

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Declaration on Generative AI

Generative AI systems were used during different stages of this work. GPT-4o, Gemini, and Nano Banana were experimentally employed as part of the design exploration process in order to investigate their ability to augment, reinterpret, and expand procedurally generated ornamental patterns through the insertion of graphical elements and textile mockups. Additionally, generative AI tools were used to support text revision, grammar correction, translation, and organizational refinement of the manuscript structure and section topics. All conceptual decisions, procedural systems, visual curation, design directions, and final content remained under the authors' supervision and creative control.

References

- [1] Smith, Gillian. "Generative design for textiles: opportunities and challenges for entertainment AI." *Proceedings of the AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment*. Vol. 13. No. 1. 2017. Pages 115-121.
- [2] Science Museum Group, "Colour & shape: using computer vision to explore the Science Museum," 2021. URL: <https://lab.sciencemuseum.org.uk/colour-shape-using-computer-vision-to-explore-the-science-museum-c4b4f1cbd72c>.
- [3] San Diego Union-Tribune, "Warhol portrait of Michael Jackson up for auction," 2009. URL: <https://www.sandiegouniontribune.com/2009/10/23/warhol-portrait-of-michael-jackson-up-for-auction/>.
- [4] Pinterest, "Pop art and glitch visual reference," n.d. URL: <https://co.pinterest.com/pin/878201996093736170/>.

- [5] GlitchDimension, "Philosopher Glitch Art," Redbubble, n.d. URL: <https://www.redbubble.com/i/art-print/Philosopher-Glitch-Art-by-GlitchDimension/103489494/wqnt>.
- [6] POSCA, "Monsieur Lebleu – SSPARIS Focus," n.d. URL: <https://www.posca.com/en/communities/life-custom/monsieur-lebleu-ssparis-focus-2/>.
- [7] Scarf Me, "Lenço Double Face Solário em Cetim de Seda 90x90cm," n.d. URL: <https://scarfme.com.br/products/lenco-double-face-solario-em-cetim-de-seda-90x90cm>.
- [8] Liapis, A., G. N. Yannakakis, and J. Togelius, "Computational game creativity," in: Proceedings of the International Conference on Computational Creativity (ICCC), ICC, 2014.
- [9] Design Council, "The Double Diamond," n.d. URL: <https://www.designcouncil.org.uk/resources/the-double-diamond/>.
- [10] A. Kleon, *Steal Like an Artist: 10 Things Nobody Told You About Being Creative*, Hachette UK, 2012.
- [11] Yar, Ghulam Nabi Ahmad Hassan, Muhammad Taha, Zeshan Afzal, Farhan Zafar, Inam-Ur-Rehman Shahid, and Abubakar Noor-Ul-Hassan. "TexGAN: textile pattern generation using deep convolutional generative adversarial network (DCGAN)." Proceedings of the 2023 IEEE International Conference on Emerging Trends in Engineering, Sciences and Technology (ICES&T). IEEE, 2023. Pages 1-6.
- [12] Wang, Weijie, Gaopeng Zhang, Luming Yang, and Wei Wang. "Research on garment pattern design based on fractal graphics." EURASIP Journal on Image and Video Processing. Vol. 2019. No. 1. 2019. Page 29.
- [13] Ma, N., J. Kim, and J. H. Lee. "Exploring personalized fashion design process using an emotional data visualization method." Fashion and Textiles. Vol. 9. 2022. Article 44.
- [14] Koohnavar, Saina. "Authoring Fashion Materials: Procedural Generation as Design Method for Fashion Design." 2025.

A. Online Resources

The BITS system can be accessed through: <https://larissadg.github.io/scarf/>