Chapter 16

Algorithmic Indigeneity, Indigenous textiles and future imaginaries

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Algorithmic logic in Indigenous cultures

Currently, with the omnipresent use of social media and the rampant spread of Artificial Intelligence, the term 'algorithm' has shifted from being a basic back-office function of digital programming to being something that is much more in the public eye, seen to function as a control mechanism aimed at satisfying personal preferences and driven by the ideological and economic imperatives of the companies that control them. This transforms the idea of an algorithm into an instrument of manipulation to which one is exposed when using contemporary digital tools. However, the word 'algorithm' has its roots in the Islamic world: it derives from the Latinisation of the name of the Persian mathematician Muhammad Ibn Musa al-Khwarizmi, who formulated step-by-step rules for operations with decimal numbers. An algorithm is basically just a series of organised steps – a system – that describes the process to follow to solve a specific problem (Galanter 2016). In this chapter, we start by arguing that Indigenous cultures have developed complex cosmotechnical (Hui 2021) systems of coding, repetition, variation and other rules in their artistic, textile, oral and epistemological practices. Algorithms, understood in the original sense of the word as sets of instructions, are nothing new to them.

For example, in Andean textiles, the designs are a form of coded visual language where patterns follow regulated compositional structures that can be interpreted as algorithmic in nature. The use of modularity in textile

language is not (purely) for decorative purposes but is the trace of reasoning processes that operate through visual 'alphabets' composed of minimal units. These elements are combined following specific rules of binary or ternary coding, as can be seen in Huari, Nazca or Shipibo-Conibo textiles, among others (Milla Euribe 1990). These sets of instructions also incorporate 'data' passed down by elders that combine collective memory, ecological knowledge, temporal cycles and community relationships as generative principles – that is, sets of simple rules that can generate a wide range of complex outcomes. They constitute algorithmic reasoning processes and logical sequences, a topological model of order that weavers can use as a database.

This algorithmic logic that underpins the production of Indigenous textiles is analogous to a finite system of symbols and grammatical rules, such as we see in computer programming.[1] Symmetry, translation and rotation determine not only the aesthetics but also the structure of knowledge itself. Recursive structures, similar to fractals, that are seen in Indigenous textiles are principles that also appear in oral culture, in the structure of myths or in the spatial organisation of Indigenous territories. These are alternative epistemologies of complexity: they are non-linear and non-decontextualised ways of processing information, beyond what is 'representable'; they are performative acts of networked knowledge.

So, if algorithms are ancient and as much a part of Indigenous culture as they are of any other,[2] there is no inherent reason why Indigenous people would struggle with contemporary algorithmically based tools as a concept. To a large extent, the problems, of course, lie in the data that these tools are trained on and who designs the algorithms such that the results produced do not offer sufficiently accurate or unbiased representations of Indigenous cultures, but they also lie in the way prompts are designed and the extent to which a person chooses to experiment with the tools. In this chapter, we will look briefly at two key topics of image generation where we can see these factors at play: attempts to generate images of Indigenous textiles and attempts to imagine Indigenous futures.[3]

Indigenous textiles in AI

Several of the artists involved in the AIAI project were textile artists, not least aruma but also Aymar Ccopacatty, Lucian de Silenttio, Osvaldo Guineo and Loreto Millalén, so the inclination to experiment with the generation of

textile patterns and textures is hardly surprising. For most others, however, the presence of Indigenous textiles and their patterns in their daily lives, both in textiles and on objects such as ceramics or in bodypainting, also meant that this was a key element of Indigenous aesthetics and meaning-making that they wanted to see reproduced faithfully in the images they generated. While frustration was often noted in terms of the verisimilitude of the patterns generated by AI and the accuracy of the context in which they were being depicted (see Lucian's image of his friend, Bernal Capchiri, Fig. 8.1, top), experiments with uploading images of textile samples as a basis for image generation eventually led to satisfyingly creative, though not always directly representational, results with Midjourney for some (see, for example, Lucian's *Futuristic Indigenous Person*, Fig 8.4, right). Once the artists were able to work with the IndigenIA prototype, the choice to upload textile samples in order to train a model that would influence the algorithm so that it more accurately integrated Indigenous textile patterns and textures in its outputs was a popular one and generated some fruitful results (see, for example, Haylly Zamora Aray's *Wichí Dragon*, Fig. 9.3, bottom left).

Although aruma's work in relation to the AIAI project was primarily as an academic team member and facilitator of the focus groups, being able to work with the IndigenIA prototype using her own handwoven textiles offered an opportunity to deepen the possibilities of her artistic work in a generative AI environment. As an artist, she was not interested in using images of textiles woven by others as the base images on which to train her own models, but rather she selected images of her own textile works that reinterpret traditional Andean textiles with new materials and experimental designs. With guidance from Dave Lynch of the Immersive Networks collective, she managed to train a number of different models. One of them, 'eawayo', was trained on her *Night Dependent Textiles* series of interactive textiles that respond to audience proximity by glowing in the dark (aruma|Sandra De Berduccy 2017; see Fig. 16.1 for results and Fig 15.2, top, for the training process).

A second model, 'TU-PA', was trained on materials stemming from a previous collaboration with Selma Batista Ferreira of the Camacam-Imboré community in southern Bahia as part of Thydêwá's Arte Electrônica Indígena project in 2018. Together, aruma and Selma crocheted a fibre-optic lace textile consisting of the word *tupã* ('god' in the Tupi-Guarani language) illuminated with red LEDs (Fig 16.2, top). Using the TU-PA model, this small

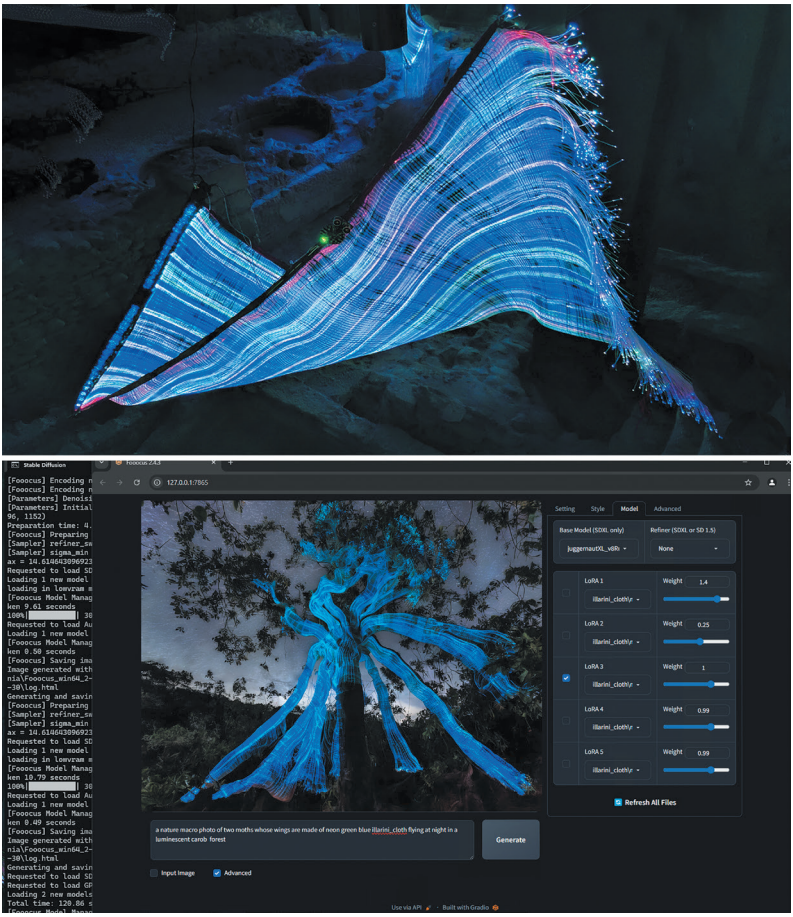


Fig. 16.1. aruma|Sandra De Berduccy, two examples of work in progress made with the 'eawayo' model on the IndigenIA prototype, May–June 2024.

fibre-optic fabric could be transformed into a tree with the luminous texture of lace, for example (Fig. 16.2, bottom).

After sharing the experience of training models with Lucian and Haylly and, in particular, exploring and testing the process of using 'seeds' – digital identifiers that allow the user to select a given image in order to make variations on it – some really interesting results were achieved. It was noteworthy that the images generated by the AI model did not directly reproduce or

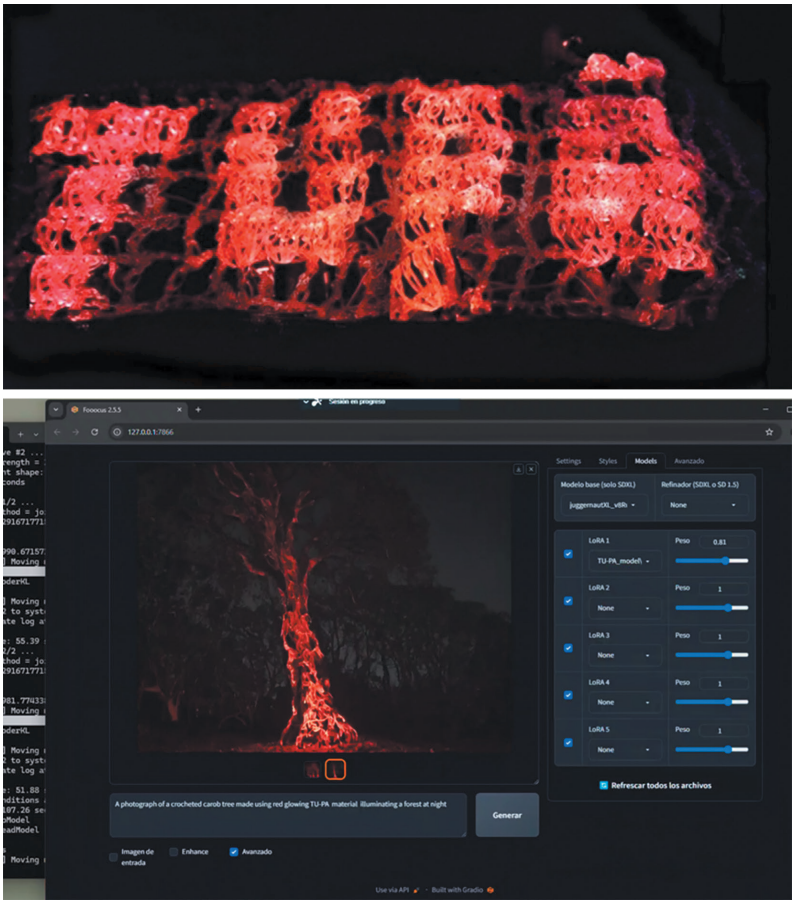


Fig. 16.2. Top: aruma|Sandra De Berduccy and Selma Batista Ferreira, *Tupã*, malleable fibre-optic cable and LEDs, original work made for the Arte Eletrônica Indígena project, 2018. Bottom: aruma|Sandra De Berduccy, an example of the results achieved using the IndigenIA prototype with the TU-PA model trained on the original *Tupã* artwork, May–June 2024. Prompt: 'A photograph of a crocheted carob tree made using red glowing TU-PA material illuminating a forest at night'.

replicate the original images used in training. Instead, the resultant images demonstrated a kind of evolution, developing in new dimensions and generating a wide range of complex and unexpected outcomes in line with the aforementioned generative principles. For example, with the 'illarini_cloth' model, once its workings were better understood, fairly simple prompts

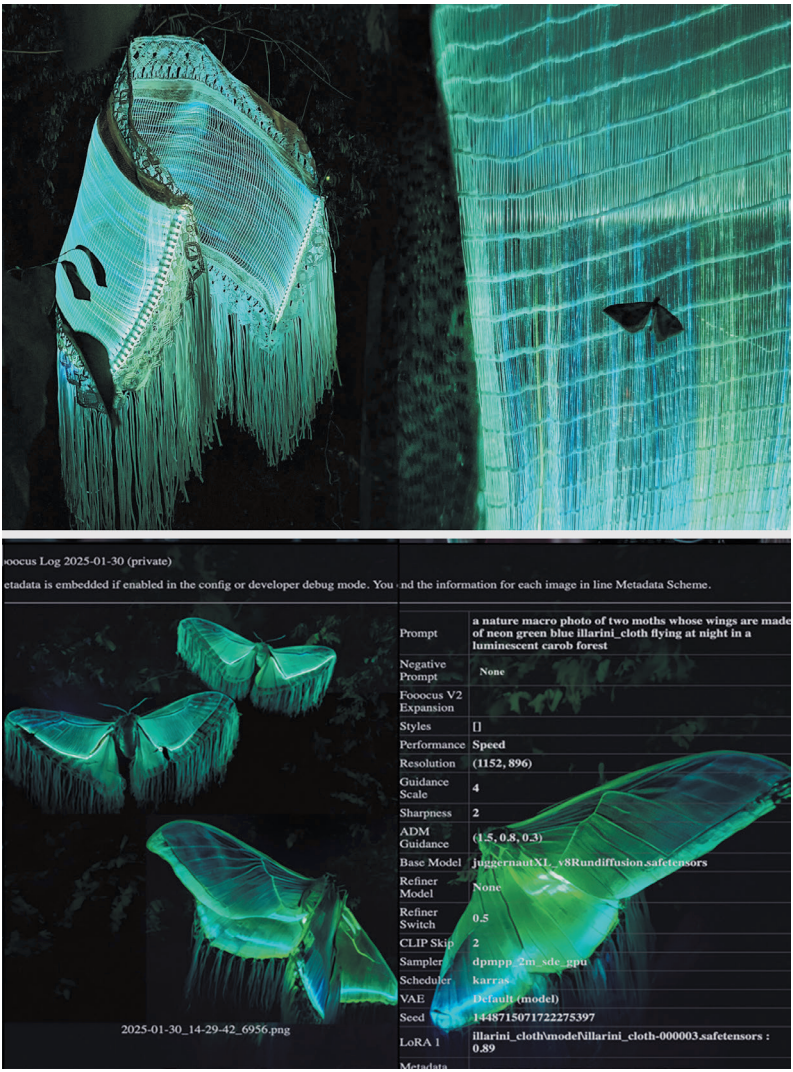


Fig. 16.3. Top: aruma|Sandra De Berduccy, *Illarini* (2018), luminous interactive textile installation attracting moths and nocturnal butterflies while exhibited in a forest near Cochabamba, Bolivia. Bottom: aruma|Sandra De Berduccy, an example of the results achieved using the IndigenIA prototype with the 'illarini_cloth' model, May–June 2024. Prompt: 'a nature macro photo of two moths whose wings are made of neon green blue illarini_cloth flying at night in a luminescent carob forest'.

were sufficient to get it to produce results that were never imagined in relation to the original work. For example, the original textile – a shawl that is characteristic of the clothing of urban Aymara women in La Paz, Bolivia – was transformed into nocturnal birds and moths illuminating a carob forest at night, thus referencing the actual environment where the original piece was woven (Fig. 16.3).

From aruma's perspective, this experimental process really demonstrates the importance of taking our time and training our own models, which can yield very satisfactory and creative results. It also allows us to understand AI tools as a territory to be explored, where they have the potential to magnify works we create with our hands and envision futures where our practices are amplified generatively rather than merely reproduced.

Indigenous future imaginaries in AI

As noted elsewhere, another of the key frustrations with AI image-generation tools in relation to the representation of Indigeneity was its 'white default' (Park 2024) if no specific instruction regarding an ethnoracial identity was given, and yet, as soon as the word 'Indigenous' was included in a prompt, the resultant imagery showed a strong tendency to disconnect Indigenous people from the present day and from urban settings, casting them back into the distant past or at least into the colonial era, and into the furthest reaches of the rainforest, as seen in both the pictorial content and the aesthetics of the images generated by Hangorroy Ymboré (Fig. 16.4, top) and Tadeu Kaingang (see Figs. 10.1–10.4). (Hangorroy's image arguably provokes the rural setting by mentioning forests and rivers, but the scene is still temporally Edenic, rather than responding to the contemporary challenge to show Indigenous people reforesting or cleaning trash out of polluted rivers as can be seen in artworks by Kichwa artist Gustavo Toaquiza Ugsha, for example.) Where Indigenous people are represented in contemporary urban settings, which do seem to balance nature and the urban as requested, they are still more often represented as somehow set apart from it, not 'on the road' but on a rustic pedestrian pathway, as in Wera Moru Tupi-Guarani's image (Fig. 16.4, bottom).

Perhaps because these new generative AI tools seem like something straight out of science fiction and because we tend to imagine that they have the potential to function as a kind of oracle, able to show us scenarios



Fig. 16.4. Top: Ayra Ymboré, *Multiethnic Conservation of the Planet*, image generated with Midjourney v.5.1, May 2023. Prompt: 'Indigenous, black, white, asian peoples together and united for the conservation of the planet. A group doing reforestation work. A group cleaning a river. A group taking care of animals. People sharing knowledge and teaching each other in peace'. Bottom: Wera Moru Tupi-Guarani, *Tupi-Guarani People in the City*, image generated with Midjourney v.5.1, May 2023. Prompt: 'In the foreground, the side view of an elevated road along which 3 Brazilian Tupi Guarani indigenous people walk. In the background, in perspective, a city of tall buildings suspended in the middle of the Jungle, Nature preserved. Happyness'.

of what the future might look like beyond our wildest dreams (despite the fact that, like science fiction, they are really based on mash-ups of what we have already experienced in our imperfect pasts and are more likely to reproduce our nightmares and haunt us with things we had hoped to forget), our first experiment in the first phase of the AIAI project was to try to get Midjourney to create images of what Indigenous communities might look like in the near future. We were not thinking in terms of the 'seven generations' principle commonly found in Native American (Haudenosaunee) decision-making in relation to environmental stewardship and cultural preservation, which seeks to consider the impact of the decisions we make today seven generations into the future (cf. Clarkson, Morrissette and Regallet 1992). It was more a case of prompting the image-generation tool to overcome its tendency to situate Indigenous people in the past by asking it to represent them at a point just in the future, where a few things might be different but society would still most likely look quite familiar to us. It also sought to engage with the concept of 'Indigenous Futurism', a global movement in the arts, first described by Anishinaabe academic Grace L. Dillon (2012), to use creative means to ensure Indigenous 'survivance' (Vizenor 1999 [1994]) by purposefully imagining Indigenous people in future scenarios. It is practised in Brazil most notably by the artists Denilson Bainwá and Paulo Desana; Piratapuya fashion designer, Sioduhi; and one of the project team members, Kadu Tapuya (Paiva 2022, 109–33). As Gama and Garcia (2020, 59) write,

> The Indigenous futurist movement is filled with all the many diverse things that Indigenous creators and fans care about: it is a movement of collective and individual self-fashioning and self-expression through creation, interpretation and consumption of culture, a worldmaking activity through which Indigenous people and non-Indigenous allies reveal themselves and connect with one-another.

In Brazil, Indigenous Futurism overlaps with a current of potentially more Indigenist 'Amazofuturism', a term coined by artist João Queiroz and also practised by writer Rogério Pietro (Machado and Lontra 2024).

When the Indigenous team members in the AIAI project first saw the images generated with their prompts and selected their 'favourites' (or rather, those most worthy of discussion in the focus groups), they tended to interpret the images as showing what they imagined they would show

and to select the ones that evidenced that most clearly – that is, if a person imagined that the results would be biased in their representation of aspects of Indigeneity, that is what they tried to identify in the resultant images. Conversely, if they imagined that the tool was a kind of non-human kin that had the power to open a portal to an Indigenous unconscious, then they found ways to interpret the images in accordance with this vision. This is not to say that anyone's interpretation is 'wrong' so much as it is a way of registering fascination at the degree to which people's perspectives and dispositions influenced the way they apprehended the results. It is also the case that so much depends on how a prompt is phrased and, at that early stage, we were all on a very steep learning curve in terms of how to write prompts that would deliver the results we wanted. (Arguably, the results themselves are hardly scientific – this was not a research project into 'the way generative AI tools work' so much as a project exploring how a certain group of people approached it and what they thought about it.) It is equally fascinating to look back at the prompts that were used and the interpretations that were made of various images, to work out whether something in, or omitted from, the prompt inadvertently led to undesirable or unexpected results.

The preceding paragraph serves to prepare the reader for the conclusion that, while frustration was expressed at the difficulty team members had in generating images representing Indigenous futures, a significant part of this is down to the way the prompts were written and the way people responded to, and selected from, the images generated. It may well be the case that the image-generation tool being used – Midjourney – had a tendency to keep visual markers of Indigeneity separate from the depiction of contemporary and futuristic technologies because of the way those elements are represented in the model's training data, but this is not something that we can really prove based on our results, and some of our early analysis of images is simply confounded by details in the way the prompts were written.

For example, in a prompt by Haylly which specified the combination of Indigenous elements with modern technologies, the references to 'a small satellite' and a 'small screen of a cell phone', alongside a whole host of other items relating to the more local natural phenomena and the traditional side of Indigenous village life, mean that it is unsurprising that they were either omitted or represented very weakly. When asked, Haylly also selected as her preferred image one that performed less well in terms of combining the traditional with the futuristic (Fig. 16.5).



Fig. 16.5. Haylly Zamora Aray, *Indigenous Village Scene at Night*, image generated with Midjourney v.5.1, May 2023. Prompt: 'A scene with trees including a mango tree, a white silk floss tree, a pink quebracho tree, a kapok tree with red flowers. In a clearing in the middle there is a circular wooden house. In the foreground, an indigenous grandfather and grandmother sitting outside at night, telling stories to 5 children of different ages, with colorful clothes. In the night sky there are stars and a small satellite. In the trees there are owls, toucans, cardinals. At the foot of the trees there is a Chaco fox, 3 capybaras, an alligator, a ñandú, an anteater and a Southern tamandua. To one side of the children there are 5 indigenous adults watching the small screen of a cell phone'.

Similarly, in a sequence of images generated by Horacio Montes de Oca Ayala, it is no surprise that the futuristic landscape that he selected as 'favourite' offers no evidence of anything that might relate to an Indigenous presence because that was not specified in the prompt (Fig. 16.6, top). As soon as he included the words 'Aymara' and 'Indigenous', as well as more specific cultural details in his prompt, alongside the request for 'collective flying cars' and robots, those elements started to appear more strongly in the results (Fig. 16.6, bottom).

Overall, the success of this experiment with the generation of images of Indigenous Futurist scenes and scenarios is down to careful prompting. The prompts that worked best were careful to be explicit about Indigeneity or a specific ethnic group and/or geographical location alongside giving equal weight to the request to show images of futuristic technologies, and they also used key terms, such as 'neon' or 'Moebius style'[4] or 'surrealist', to achieve a sci-fi aesthetic. Almost inevitably, those project members who were most successful in achieving this were the younger artists, such as Kadu Tapuya and Kuenan Mayu, who undoubtedly had the most exposure to contemporary mainstream forms of science fiction (manga,



Fig. 16.6. Horacio Montes de Oca Ayala, images generated with Midjourney v.5.0, May 2023. Top: *Futuristic Landscape*. Prompt: 'A community working in the fields, a very wide space like a meadow. Lots of different kinds of crops. Lots of people working. But also a technological environment with robots, flying collective cars. Some cities visible in the distance. A sky half orange, half red. ar 2:1'. Bottom: *Futuristic Aymara Landscape*. Prompt: 'A lot of Aymara people working the land, traditional indigenous agriculture, in a very wide space like a meadow with monoliths, sundials, inca ruins. But also a technological environment with robots and flying collective cars. Some cities visible in the distance. A sky half orange, half red. ar 2:1'.

anime, videogames, films) and/or to currents of Indigenous Futurism and of Amazofuturism in Brazilian art.

For example, the prompts that Kuenan used to generate the images in Fig 16.7 tick all the boxes for achieving Indigenous and Amazofuturist outputs, and they are reminiscent of the description of an endangered Indigenous town in the Amazon in Brazilian science fiction writer Joca

Reiners Terron's *A morte e o meteoro* [Death and the Meteorite] (2019), where the town comprises treehouses suspended in the canopy and held aloft by vines, combined with a wide array of more modern technologies such as elevators (Gama and Garcia 2020, 61–62). The request for a specifically 'non-Eurocentric' aesthetic in Fig 16.7 (top) is also interesting in terms of the challenge it poses to the image-generation tool, and it would have been really productive for the artist to follow this up with a more extensive practice of image generation to see what future results it might have delivered. For now, one might surmise that the 'non-Eurocentric' request perhaps tilted the results more firmly towards a manga/anime style, although American director James Cameron's *Avatar* series of blockbuster films springs most readily to mind, and while all of these styles might be 'non-Eurocentric', they perhaps do not offer up the decolonial, Amazonian, futurist vision that Kuenan had in mind. When that 'non-Eurocentric' request is excluded from the subsequent prompt (Fig 16.7, bottom), the aesthetics clearly tend more towards the style of sixteenth-century European painting and its ways of imagining what was to be found in the Americas that we have seen in images generated by Tadeu Kaingang, for example.

Kadu Tapuya's approach is very different in that he only used image prompts rather than gave any textual instructions. In the image shown in Fig 16.8 (top), he has produced a long series of iterations of images that can be traced back to his uploading of a digital photograph of a sixteenth-century engraving by Theodore de Bry showing Tupinambá women preparing a potion (see Fig 14.6, top). Over the course of those iterations, Kadu has selected the more 'oddball' results and hallucinations, showing extraneous objects floating in the sky, until he has ended up with an Indigenous Futurist aesthetic very similar to the work he produces through his normal digital-collage techniques (see, for example, Fig 16.7, bottom). While Kadu did not choose to follow this up and did not select this particular image for further consideration beyond upscaling it once, this is a promising way of working with the image-generation tool that deserves further exploration and reflection.

All in all, what this chapter demonstrates is some of the potential of image-generation tools to respond to the imaginations of Indigenous artists. While frustration may abound and while clearly there are biases baked into these tools, they can also be worked with through careful prompt design and the training of bespoke models and/or through



Fig. 16.7. Kuenan Mayu, *Amazonian Indigenous Futurist Scenes*, images generated with Midjourney v.5.1, May–June 2023. Upper images, prompt in Portuguese: 'A coexistência entre seres encantados, humanos e animais com uma estética indigena da amazonia futurista/surrealista e nao-eurocentrica em cidades submersas/flutuantes ligadas por raizes e casas em árvores gigantes' [The coexistence of enchanted beings, humans and animals with an Indigenous aesthetic of a futurist/surrealist and non-Eurocentric Amazon, in submerged/floating cities connected by roots and houses in giant trees]. Lower images, prompt in English: 'The coexistence of enchanted beings, humans and animals with a futuristic and caboclo aesthetic in submerged/floating cities connected by roots and houses in giant trees. People being transported by giant beetles'.



Fig. 16.8. Kadu Tapuya. Top: *Indigenous Futurist Scene*, image generated with Midjourney v.5.2, based on a series of image prompts, characteristic of Kadu's Indigenous Futurist aesthetic, September 2023. Bottom: *A dança dos cabocos* [The Dance of the Cabocos],[5] digital collage with Photoshop, 2019.

iterative practices to amplify the less predictable results. Some of these AI-generated images may even come to be adopted by the artists who create them as part of their oeuvre.

Notes

1 Indeed, the original link between the development of the first computer by Ada Lovelace and the inspiration provided by the Jacquard loom and its punch cards is well known (cf. Plant 1997).

2 See also Montero and De Berduccy (2021) and Pitman (2018) for more context in this regard.

3 This is in addition to the representation of Indigenous people per se, as discussed across several chapters in Part 2 and in Chapter 13.

4 Moebius style refers to the depiction of surreal, sci-fi and fantasy content in a style that uses bold outlines. It is similar in style to manga and anime drawings.

5 'Caboclo' or 'caboco' is a term for Indigenous people of mixed heritage or those who have been acculturated and have lost contact with their original Indigenous ethnicity. It is often used in a pejorative way by non-Indigenous people and is consequently an act of purposeful reclamation when used by Indigenous people.