Trees of Knowledge: Designing with Artificial Intelligence in the Urban Landscape

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Abstract

In our ongoing speculative design project entitled *Topos*, we propose a public-facing, tangible user interface (TUI) that makes legible and accessible the AI systems embedded in near-future urban landscapes. By imagining AI as a public service, *Topos* interrogates the creation of *public trust* between people and AI systems through the medium of physical structures in public space.

Topos was originally developed in "The Internet of Enlightened Things", a class devised and mentored by Ben Hooker and Philip van Allen in the Media Design Practices program at ArtCenter College of Design in the Spring of 2017. In May 2017, *Topos* was presented at the *Post-Internet Cities* conference at the Museum of Art, Architecture, and Technology (MAAT) in Lisbon, Portugal. In September 2017, *Topos* was exhibited at Ars Electronica under the umbrella of "The Internet of Enlightened Things: AI in the Neighborhood".

AI-embedded Urbanism

Artificial intelligence (AI) is everywhere, and sooner rather than later, it will control a city near you. When a city's infrastructure is embedded with autonomous AI systems that can track pedestrians on the sidewalk, redirect driverless cars, and predict the rate of gentrification, the machine-readable city will become increasingly illegible and inaccessible to humans. *Could the city know itself better than you—the citizen—could ever know it*?

This question is at the center of *Topos*, which addresses the possibility of ubiquitous AI systems, and anticipates the shadows they might throw on the urban landscape. If the inner-workings of AI systems that drive the city are neither visible nor tangible, then how we design AI interfaces can illuminate the algorithmic dimension of the city for the people living in it. *Topos* imagines that the hidden intelligent systems controlling the city are made open and legible to citizens in the form of physical, manipulable, tree-like structures. How might *pruning* and *tending* these civic interfaces—these *trees of knowledge*—literally and figuratively reshape the urban landscape?

Designing AI Into Public Spaces

We propose a new typology of public space that combines the mechanical qualities of urban dashboards with the permeable and spatial qualities of public parks. These new "AI-parks" contain *trees of knowledge* that physicalize what is otherwise invisible to citizens: the algorithms, decision trees, and neural nets that have taken on the responsibilities of city departments and bureaus.

AI-parks are maintained by civic workers, who tend, prune, and shape *trees of knowledge* so that the AI-embedded city can reflect public interests and, ideally, the public good. *Trees of knowledge* provide public insight to how civic data is being transformed by the various AI dimensions of the city.

If AI-parks are where civic affairs are conducted in plain sight and in real time, then *trees of knowledge* are tangible user interfaces (TUIs) that form a relationship between civic AI systems and the humans they are meant to support. Through the TUI, citizens and civic workers are able to *read* and *revise* these AI systems by interacting with them through the physical environment.

Informed by Shannon Mattern's survey of city control systems, we determined that these *trees of knowledge*

would function as AI-interfaces, civic symbols, and platforms of alternative governance. Although *trees of knowledge* do the same work as urban dashboards by "render[ing] a city's infrastructures visible and mak[ing] tangible...various hard-to-grasp aspects of urban quality-of-life," they are not slick graphical summaries of the variables and metrics that describe the city from one quantifiable moment to the next. *Trees of knowledge* have tangled branches and gnarled roots—they are complex and non-reductive interfaces that embody what Mattern would call "dirty (un-'cleaned') data".

As a project, *Topos* is still answering the question of what these branching interfaces actually look and feel like, but moving away from reductive screen representations and toward more information-rich physical forms is central to our design motivations.

Design no.1: Experiential and Spatial Prototype

In order to play out our proposed human-to-AI interaction, we created an experiential prototype that simulated the reading and revision experience that our *trees of knowledge* would enable. Because AI systems don't naturally lend themselves to a tangible form, we confronted the reality that it is impossible to capture something as complex as a neural net in a determinate form.

Our first prototypes for the *trees of knowledge* were civic monument-scaled forms that manually contract and expand. The outer faces of this form serve as input layers and output layers for the neural nets that learn from city data in different ways; by unfolding and expanding the form, citizens and civic workers can respectively read and revise the hidden layers—where AI systems transform city data into intelligence.

Editable *trees of knowledge* enable citizens to add, subtract, emphasize, or de-emphasize elements on input layers in order to create different short- or long-term outcomes on civic matters—ranging from self-driving car congestion to urban green space development. Civic workers take these citizen annotations into account as they modify learning pathways in the hidden layers.

Design no.2: Visual and Animated Prototype

In the second iteration of *Topos*, we focused our energies not on what the human-to-AI interaction itself would look like, but rather how the act of "pruning" these *trees of knowledge* would affect the urban landscape at large.

In addition to producing an illustration that allowed us to rethink and redesign the *trees of knowledge* physically and structurally, we illustrated what a city full of AI-parks and their corresponding *trees of knowledge* might look like. To understand how these representations would lend themselves to our proposed human-to-AI interaction, we developed a short animated video wherein an anonymous citizen prunes a *tree of knowledge*, and the effects of their inputs to the physicalized AI system are simulated in an abstracted cityscape.

AI and The "Right to the City"

At its core, *Topos* envisions a model of AI-embedded urbanism that guarantees what Henri Lefebvre calls the "right to the city"—an idea and social movement that advocates for the participation of individual and collective agents alike to shape the city. It is in this image that cities have attempted to model initiatives to formalize and concretize "the right to the city" for their inhabitants.

Knowing that an urban landscape unmodified by AI systems can ultimately sacrifice "the right to the city" to the hyper-present demands of privatization and capital, it is imperative for designers to take on the problem of designing civic AI interfaces that will not allow this human right to recede into the shadows. It is easy for AI systems to reproduce more of the world we already have, but it will be up to designers to bring the complexities and contradictions of human-to-city interaction to the surface. When the intelligence of city government is outsourced to or augmented by artificial intelligence, designers must ensure that all citizens are still guaranteed the right to reshape their cities *in collaboration with* AI systems.

Taking *Topos* Into The Real World

We want to take this symposium as an opportunity to bring our speculative design proposition about creating trust between humans and AI systems into conversation with more practical applications of interaction design and user experience strategy for AI. We will use the poster format as a space to trace the pathways that our project has already taken, as well as stake out new territories and questions that we want to address with *Topos* as an ongoing inquiry. The poster will also serve as a way for us to connect this speculative vision of human-to-AI interaction with emerging practical applications of AI in civic contexts.

About the Designers

Xiaoxuan (Sally) Liu is a designer passionate about using new media and technology to investigate the future of nature and urban spaces. Prior to ArtCenter, she studied Communication and Psychology at Syracuse University. **Godiva Veliganilao Reisenbichler** is a designer and artist who produces critical knowledge through visual, interactive, spatial, and written media. At ArtCenter, she investigates how technological interfaces form relationships between people and physical space. Godiva received a BFA in Painting and Art History from Washington University in St. Louis.

References

Mattern, Shannon. 2015. Mission Control: A History of the Urban Dashboard. *Places Journal*. Accessed May 3, 2017. https://placesjournal.org/article/mission-control-a-history-of-the-urban-dashboard/.

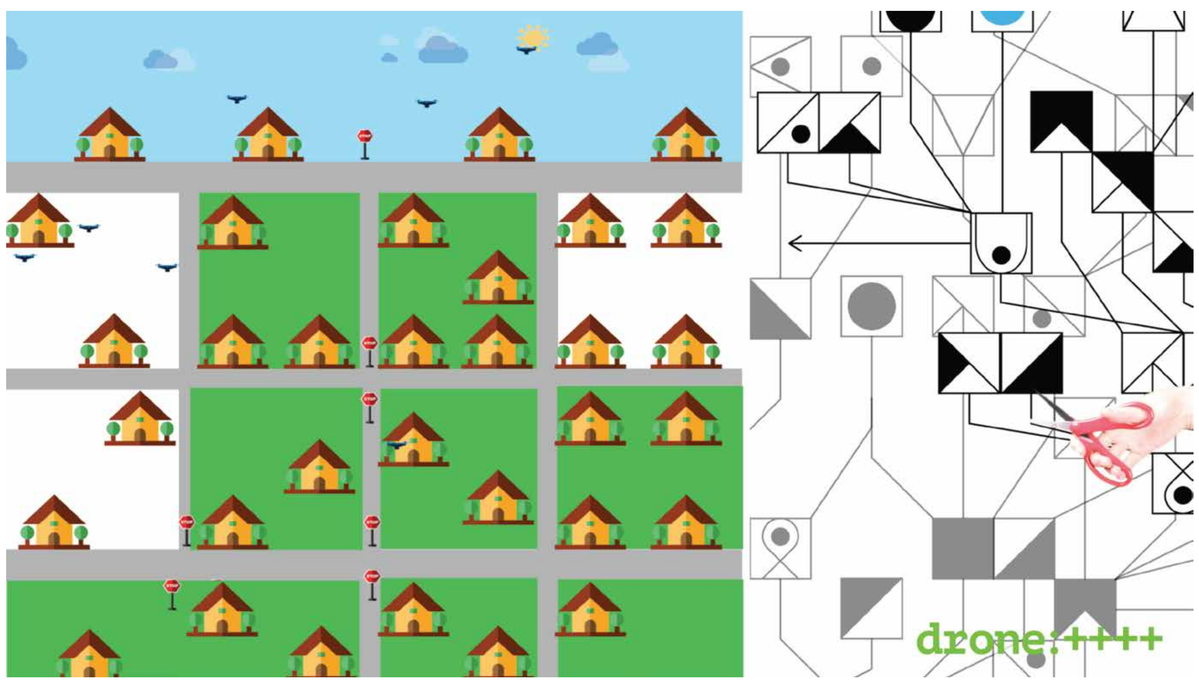
Installation view of trees of knowledge in a topia.

CyberSyn operations room meets public park space. What if you could walk through an AI-mediated urban dashboard?

A speculation of the distribution of AI parks within a neighborhood. Each park contains trees of knowledge that perform specific civic functions.

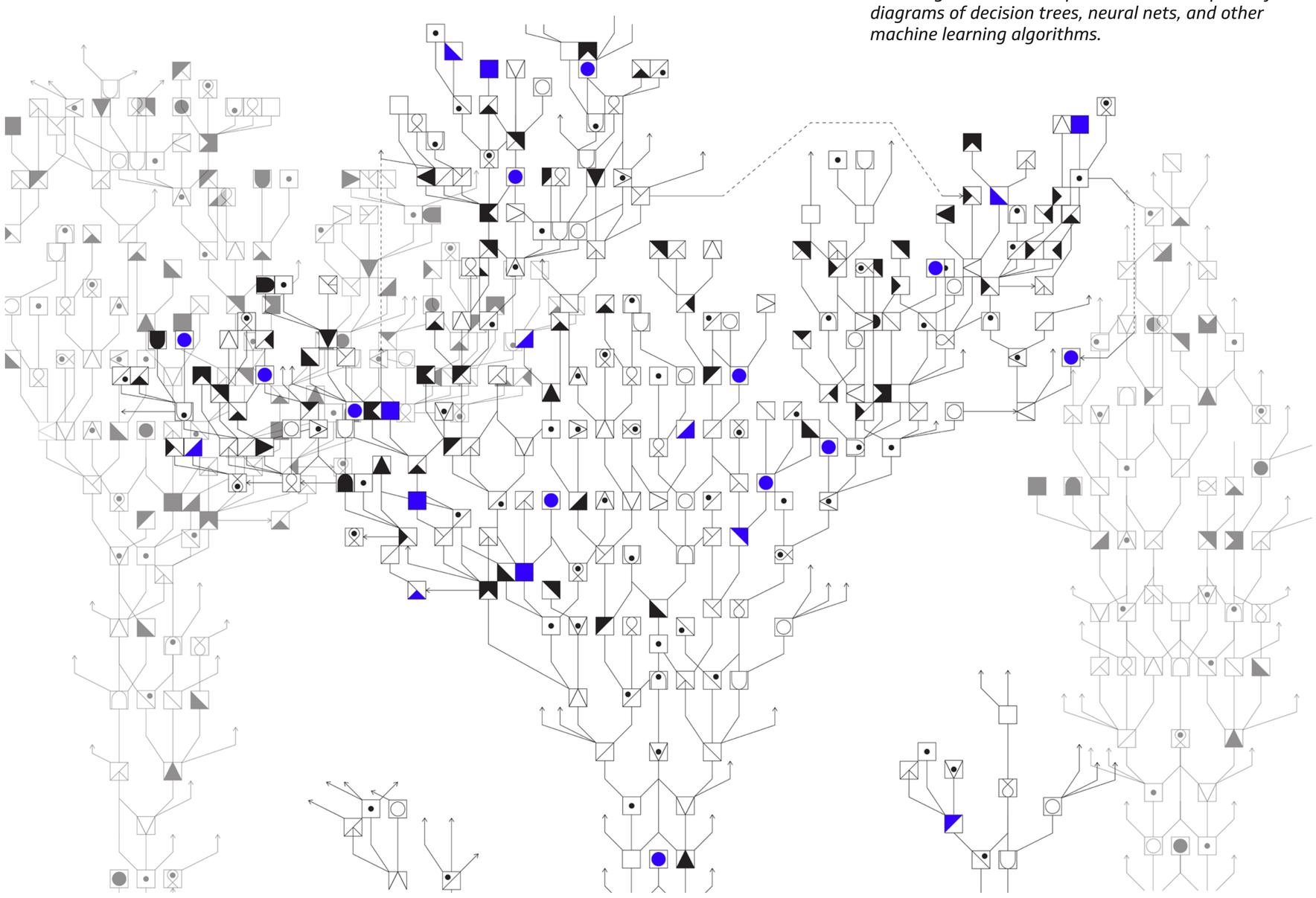
Diagram of first formal iteration for the trees of knowledge; in order to model AI systems, we created civic monument-scaled forms that manually contract and expand. The outer faces of this form serve as input layers and output layers for the neural nets that learn from city data in different ways; by unfolding and expanding the form, citizens and civic workers can respectively read and revise the hidden layers—where AI systems transform city data into intelligence.

Editable trees of knowledge enable citizens to add, subtract, emphasize, or de-emphasize elements on input layers in order to create different short- or long-term outcomes on matters—ranging from self-driving car congestion to urban green space development. Here, a citizen annotates an input layer in order to change the training data for this particular AI system. Civic workers take these changes into account as they modify learning pathways in the hidden layers. (Photo credit: Philip Van Allen.)



Animation demonstrating how pruning trees of knowledge would affect the neighborhood and the city over time.

The second formal iteration for the trees of knowledge. This visual representation is inspired by diagrams of decision trees, neural nets, and other machine learning algorithms.



topos

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Topos explores how public space can be used to demystify civic AI and ML for citizens living in an AI-embedded city. We propose a new typology of public space that combines the mechanical qualities of urban dashboards with the permeable and spatial qualities of public parks. These new “parks”, which we call topia, contain trees of knowledge that physicalize what is otherwise invisible to citizens: the decision trees, random forests, and neural nets that are involved in the public decision-making and sense-making that literally and figuratively shape an AI-embedded city. If the topia is where civic affairs are conducted in plain sight and in real time, then tress of knowledge are both tangible user interfaces and civic symbols. Trees of knowledge provide public insight to how neighborhood data is being transformed by the various AI dimensions of the city. By externalizing civic AI systems into public space, Topos aims to create active and participatory modes of collecting data used to train these systems, as opposed to passive accumulation and infinite siloing of data.