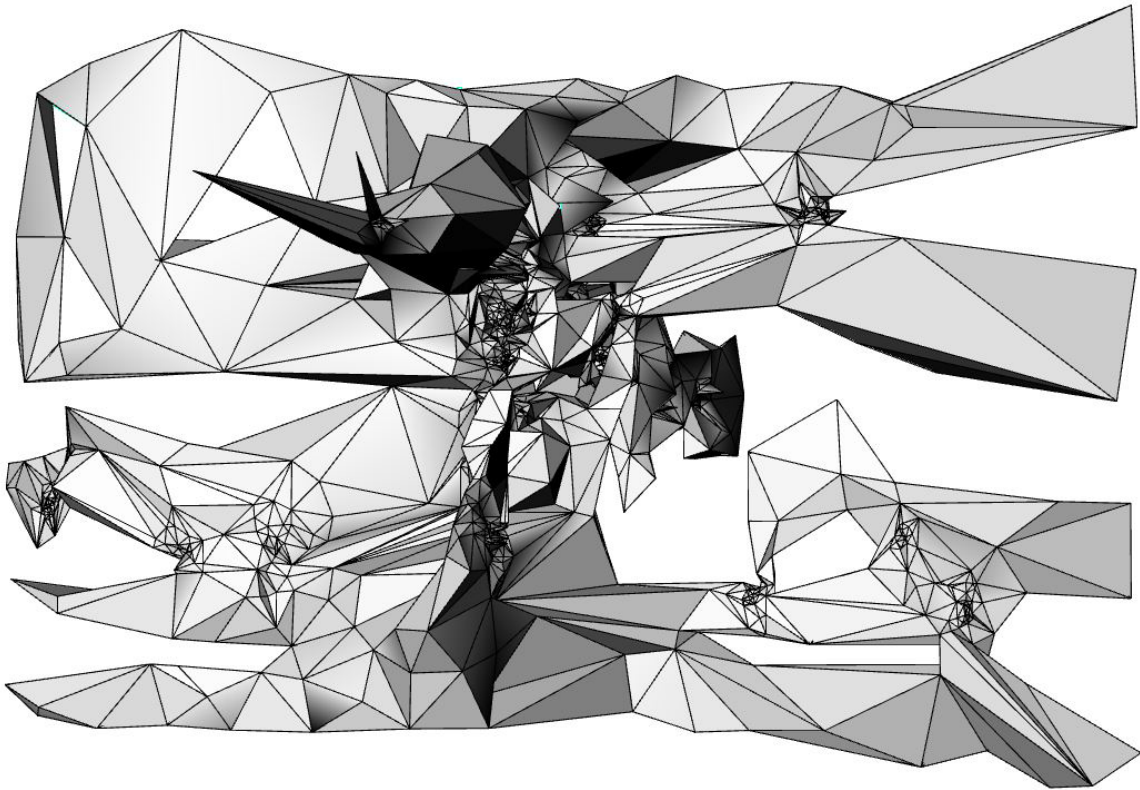


Object Americana

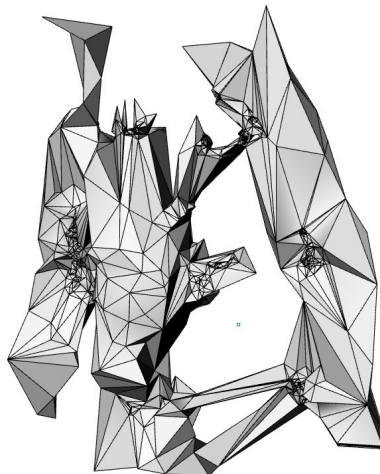
jeffrey geiringer, 2020



The New School
Parsons MFA Design + Technology Thesis

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Preface

I am an artist working at the intersection of Machine Intelligence, digital manufacturing, and 3D space. *Object Americana* is a project that seeks to define a new medium of sculpture. This genre is defined on the terms that exist between my self and the Machine agents I have created to partner with. I have spent over a year choreographing and refining the process by which we work together, with the ultimate goal to create pieces of physical material that are both fundamentally *of the Machine* and fundamentally *of the Human*.

§i. Introduction

Object Americana is a project primarily entailing a Machine-Human artistic partnership I have discovered, choreographed, and participated in over the past year. It began as an attempt to prove a philosophical point: the Machine can be creative. Indeed, capital-M ‘Machine’ in the sense of an intelligent silicon-microchip agent which is able to experiment and learn about data it is exposed to in a fashion neither linear nor fully understandable by its Human designers. Indeed, capital-H ‘Human’ in the sense of a corresponding intelligent organic agent which is able to experiment and learn about data it is exposed to in a fashion neither linear nor fully understandable by its fellow Human peers. The Human agent also happens to be the forerunner of the Machine agent from an evolutionary standpoint. These are the terms on which the partnership is forged, the dance is choreographed, and perhaps the point is proven.

§ii. Combination: Why?

The question of Machine creativity led me to think about how I view my own creativity. It is an essentially personal thing to contemplate with an essentially personal and thereby perhaps arbitrary framework: I view my creativity as primarily *synthetic*, literally in the mode of *synthesis*, the act of combining two opposing ideas to create a third, novel one. This construction has its roots in formal philosophic thought and is attributed to German Idealist Johann Fichte, who posited that a possible resolution to *thesis-antithesis* dialectic was to be found in the combined *synthesis*¹. To me, the *combinatory act* is one of the fundamental building blocks of creativity and happens to be the block I am most adept at. I felt that if I could show that the Machine could convincingly combine things, it would contribute toward not only the field of ‘AI art’ as it stands but hopefully, the nascent field of AI philosophy and ethics. I will leave it to the reader to decide whether this project succeeds at that goal, somewhat far afield from the concrete results We ended up with. (Indeed, capital-W ‘We’ and capital-U ‘Us;’ what other terms on which to speak of a partnership between equals?)

The second motivation for combining things is the enlightening perspective endowed by a working knowledge of the concept of *semiotics*. The base concept of semiotics (which is in fact several fields of research, generally considered to be a sibling to linguistics²) is that within a structure of understanding, such as language itself, *meaning* is generated as a relationship between a *signifier* and the thing it *signifies*. Semioticians generally hold that language does not function as a stream of pure concepts, rather, language is a set of carefully-constructed sign-pointers toward concepts which both participants in a conversation are assumed to both know about. If I type “I read a book today,” you, the reader, understand implicitly what *reading* and a *book* are; I can communicate to you how I spent my afternoon by using language to refer to concepts we hold between us. At no point do I need to find a book and pantomime reading it, because we both seem to be English speakers and this seems to be the written form of the language.

Semiotics has a way of breaking things down to their most basic level. In fact, one might say the purpose of semiotics is to allow people to look at the world and begin breaking it down into discrete

1 Breazeale, Dan, “Johann Gottlieb Fichte”, The Stanford Encyclopedia of Philosophy (Summer 2018 Edition), Edward N. Zalta (ed.), <https://plato.stanford.edu/archives/sum2018/entries/johann-fichte/>.

2 Atkin, Albert, “Peirce’s Theory of Signs”, The Stanford Encyclopedia of Philosophy (Summer 2013 Edition), Edward N. Zalta (ed.), <https://plato.stanford.edu/archives/sum2013/entries/peirce-semiotics/>.



concepts which might not be apparent at first glance. Many 20th century philosophers made careers doing just that! However, this project attempts to reverse-engineer this process. Instead of looking at signifiers and determining what they signify, *Object Americana* starts almost from the middle and works outward toward new signifiers and the signified concepts they might entail.

In this way, the true depth of the combinatory act is revealed: if one begins combining objects with well-understood symbolic value, one is necessarily creating *new symbols with open-ended interpretations*. Signposts that arise at the intersection of two streets but which point off perpendicular to both of them. The goal of *Object Americana* is to develop new ways of understanding the concept of the United States. It does this by combining agreed-upon signifiers of the country, in one gesture creating new semiotic pointer-objects which imply accompanying open-ended new concepts in the minds of their viewers, not-agreed-upon yet fundamentally American. In this way, I hope that the sculptures of *Object Americana* will be objects of contemplation literally and figuratively.

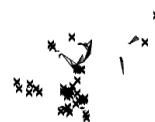
Siii. Machine Intelligence: Why?

I am lucky enough to live in interesting times. While the accursed aspect of this reality is apparent more often than not, as an artist and a person deeply interested in technology, I cannot help but feel grateful to witness the tumult of our world as it stands in this most accursed of years, 2020. This feeling stems from an unshakable faith in the concept of change. Francis Fukuyama's *End of History* is my worst enemy¹. I feel that not only has history not ended, in many ways it is just beginning, spurred by the invention of the internet and the radical social reorganizations it is instigating right outside (and inside) all of our windows.

Machine Intelligence is another major agent (so to speak) turning the wheel of history in the present moment. I should note here that in case it was not clear from § i, I refer to 'Machine Intelligence' to emphasize its parallel rather than subservient position to our own. Speaking especially of the wheel of history, I believe we as a species would do quite well to try and end our habit of thinking of silicon-based intelligence as something that exists solely to serve our needs, inevitably economic. That being said, in the vast grey area that lies between traditional algorithms and 'true' Machine Intelligence, the potential for the automation of labor should knock the wind out of Fukuyama and anyone else who would like to try their hand at predicting the next several decades of political and economic history.

That same grey area is what has given us insight into the beginnings of the Machines we are creating today. What intrigues me most about this process of discovery is what has already been apparent for many years: Machines have a totally different *perceptive ability* than humans. They use sensor data and mathematics to form impressions and opinions about the world around them. Their development in this regard has been wildly uneven; much has been written about the task of creating truly automated automobiles, and how difficult it has proven. Moreover, driving, a task which, for most Humans outside of the East Coast, is only moderately difficult, takes millions of Human-hours of programming, testing, and data-gathering to train a Machine to do. Conversely, there are countless tasks which involve similar, if less-integrated, types of perception that a Machine can be trained to accomplish with extreme ease and in many cases, once trained, can exceed Human capacity with little effort. Things like transcribing audio files of voices, spotting discrepancies in data, and sometimes

¹ Fukuyama, Francis. *The End of History and the Last Man*. Francis Fukuyama. New York: Perennial, 1992.



even judging the tone of written texts all fall into this category. There are even tasks which Humans could never hope to accomplish that a Machine can do with no difficulty. I do not expect any Human I know to learn how to decode the electrical signals produced by a brain-scanning EEG device any time soon, but Machine Intelligence has pushed that field forward in leaps and bounds².

The field of *Generative Machine Intelligence* describes to me an entirely new avenue of perception available to Machines and through them, us Humans. When a Machine agent learns a new thing, it develops something called a *latent space*. This novel region is literally a very high-dimensional space which encodes many variables about the data the Machine is learning about. As the Machine learns, it attempts to do something like graph the datapoints of each particular instance of the thing it is learning about upon this high-dimensional space. Once the locations of a large number of datapoints are understood, it can then develop inferences about a new datapoint, without knowing about it beforehand, by consulting the development of its latent space of knowledge and seeing where the new datapoint falls within it.

Generative Machine Intelligence takes this process and runs with it to its logical conclusion: the Machine is instructed to use its latent space to create *novel* datapoints that did not previously exist in the dataset. This single concept is deeply profound. It is the driving force behind everything from the now-famous text-generating Machines which can produce paragraphs that are the very definition of uncannily like something a Human would write to image-generating Machines that create 2D images of things which, while completely photorealistic in their quality, simply never existed in the physical world³. What is perhaps the most exciting thing about this incredible process is that a Machine may be trained to interpret many different things in its latent space and then generate examples of data *interpolated between existing things*. That is to say, you can give an image-generating Machine many pictures of cats and many pictures of dogs and tell it to generate an image of *something* that lies between the two animals. The image will exist just as surely as the cat images and dog images exist; what it depicts is something else entirely. This concept has endless potential, and I recommend immersing yourself in the world of Artbreeder⁴ for more in-depth experience. This ability to seamlessly interpolate between understood things is not at all one that comes naturally to Human agents. It is a truly novel perceptive ability, and it is the driving force behind *Object Americana*.

2 Roy, Yannick, Hubert Banville, Isabela Albuquerque, Alexandre Gramfort, Tiago H Falk, and Jocelyn Faubert. "Deep Learning-Based Electroencephalography Analysis: a Systematic Review." *Journal of Neural Engineering* 16, no. 5 (2019): 051001. <https://doi.org/10.1088/1741-2552/ab260c>.

3 "This Person Does Not Exist." This Person Does Not Exist. Accessed May 4, 2020. <https://www.thispersondoesnotexist.com/>.

4 "Artbreeder." Artbreeder. Accessed May 3, 2020. <http://www.artbreeder.com/>.

Siv. Sculpture: Why?

Well, I am a sculptor! I am a sculptor because 3D space has always been my primary means of expression. My undergraduate studies were first in architecture for two years, then in sculpture for two years. The reasons I left architecture are not within the scope of this paper, but suffice it to say that I found sculpture to be far more intimate and human. In the intervening years, I have worked a very wide variety of jobs but the one consistent factor has been the creative use of 3D space. I am also a self-taught expert 3D-printing engineer and designer. For me, 3D-printing is highly compelling not only for the economic implications of atomizing the means of production, but because it allows the creation of objects that simply cannot be



manufactured any other way. In fact, I try to promulgate a term I coined, ‘digifactoring,’¹ to describe this particular mode of creation.

This ability to create things never-before-seen in the world is important for many reasons, but most simply it allows objects which formerly could only be digital to come to life in the physical world. As a sculptor, this distinction is the entire world. For me it is a token of faith and experience that physical sculpture stands alone in the world of art for its tangible quality. Aside from scale and texture, which is plenty of a caveat to be sure, many paintings can be simulated on a screen. This is not to diminish their value or to say that the simulation will be a good one; it is merely to distinguish the fact that a sculpture simply cannot exist on a screen in a way that comes anywhere near to the experience of seeing it on the physical plane of existence. The ability to move one’s body around a sculpture, seeing it from all angles, and trying to ‘wrap one’s head around’ it, assuming it bears the scrutiny well, is a singular form of art experience. Perhaps a concomitant digital experience will be developed at some point in the realm of Virtual Reality, but I have yet to experience it. At the time of this writing, VR headsets still require very uncomfortable face-masks, usually tethers to a large computer, and have no practical solution to the problem of walking or otherwise moving around a space. For now at least, sculpture remains one of the few un-digitized realms of art.

Object Americana embraces this fact while turning it on its head. This project is an attempt to create a new genre of sculpture that is *fundamentally digital*. Using a generative Machine Intelligence to synthesize new American-signifying objects is an act of creation that can only occur in the digital realm; by using a 3D-printing machine to bring those objects into the real world, I complete the strange circle and establish a new quadrant in the realm of sculpture: fully digital, fully physical, and fully rooted in Machine Intelligence.

¹ “Doublehead Digifactoring.” doublehead digifactoring. Accessed May 3, 2020. <http://www.doublehead.digital/>.

§v. Americana: Why?

I have spoken already about the utterly bizarre political and economic realities we are all living through in the current moment. I feel it is my first duty as an artist to speak about them through my art. I am an American artist; even if I left the country and began life anew elsewhere, this would never change, especially since America sees itself as a global hegemony. Further, I am from a state called Michigan which embodies many of the most egregious qualities of my fair country and which bears the distinction of being the prototyping grounds for many of them. It is also a place of great natural beauty and inspiration, and it too has felt the wheels of history on its rough roads. Historically, it manufactured plenty of them. Being from that place created in me a deep sense of loss and tragedy. It is a region defined by how great it was about a generation and a half before I was born, and the sense of this was everywhere, even growing up in the affluent, laughable college town I hail from.

The United States of America is an empire in decline. I do not mourn the slow senescence of an empire. Rather, I am trying to observe it, comment on it, perhaps make sense of it, perhaps make confusion of it. This final piece of the artistic puzzle is mine and mine alone.



§vi. First Steps: *Object Alchemy* and the Wisdom of Crowds

With the foundation laid, the structure and methodology of *Object Americana* can be found here, beginning with the way in which the objects themselves were chosen. The project went through three distinct phases in this regard: first, I used a set of grimly American objects of my own choosing for the preliminary rudimentary algorithmic simulations of the object-combining process; second, I picked two very explicit and heavy-handed objects to practice the actual Machine-enabled process as I developed it; finally, I wrote a questionnaire aimed at people who grew up in other countries and released it into the world.

The initial phase of *Object Americana* was a project initially titled *Object Alchemy*. This beginning form was developed as a purely algorithmic exercise, using straightforward and linear methods in the parametric modeling program Grasshopper for McNeel Rhinoceros CAD program. The art of parametric modeling is a method by which 3D objects can be programmed much the same way as pieces of computer code; they have variables, inputs, and outputs; data flows from one sub-program to the next, finally resulting in an object which can be tweaked at any point along its path to reality [figure 1]. For *Object Alchemy*, I created a Grasshopper definition (the terminology for a parametric model of a particular object) that imported two separate 3D meshes and created something like an average of them. A 3D mesh, a digital file that is comprised of *points* and *faces*, is the basic unit of a 3D-rendering or 3D-printing program. The original *Object Alchemy* script generated two sets of random but similar points on the surfaces of each mesh, drew lines between them, and took the mid-points of each line to be a new

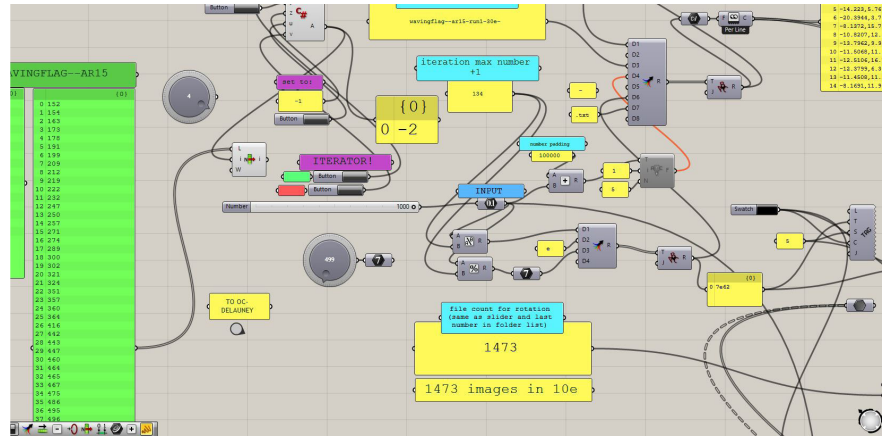


figure 1: the Grasshopper interface

point-cloud representing the average of the two meshes [figure 2]. This exercise was primarily a proof-of-concept of the combination-object sculpture idea I was developing. I knew that the ultimate form of the project was to heavily involve Machine Intelligence (MI), but at the time of *Object Alchemy* (Spring 2019), there were very few 3D-generative MI agents available for public or institutional use, and the scant ones existing were inscrutable to the point of being completely unusable for my purposes. *Object Alchemy* was a compromise with this reality, a *simulation* of the idea I was trying to get across.

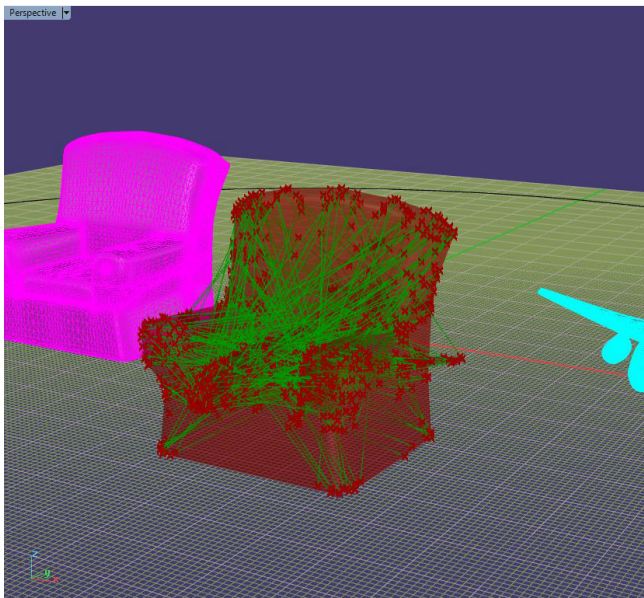


figure 2: *Object Alchemy* linear interpolation



Once the ‘Americana’ subject matter was settled upon and some form of methodology broached, I needed a physically-disparate group of objects to alchemize, and I simply picked them myself as a list of tongue-in-cheek things I saw as uniquely American:

- The Masonic pyramid with ‘All-Seeing Eye’ in the floating capstone, image of conspiracy theories real and imagined
- The AR-15 assault rifle, harbinger of death for millions of people at the hands of the USA’s military overseas as well as thousands at home at the hands of mass shooters
- The Black Hawk helicopter, modern form of the gunships used to slaughter civilians with conventional as well as chemical weapons in Vietnam
- The buffalo, apocryphal symbol of First Nations people, hunted nearly to extinction by invading Europeans countless years ago
- The Ford F-150 pickup truck, occasionally used for hauling loads in the many rural parts of the country but much more often simply another expensive suburban gesture toward an imagined independent lifestyle
- The TSA body scanner, unilaterally imposed on the civilian population in the wake of 9/11 and the equally unilateral PATRIOT ACT, notorious for observing genitals and failing to serve any perceivable purpose other than surveillance theatre
- The flatscreen TV, contemporary status symbol, opiate of the masses, and token of worldwide American media hegemony all rolled into one omnipresent device

These objects make sense to me, and I feel that they have their justification as the prototype set that *Object Alchemy* contended with, but ultimately they are simply a set of dark jokes: not exactly up to par for the final form. Any power and symbolism they have only flows from the off chance someone shares my sense of sad humor. Eventually, I realized that what I despaired most about this set was the fact that they are very much reflections of precisely that very personal humor. Conversely, **a central aspect of *Object Americana* and moreover the Machine-Intelligence-based object-combining alchemy at the heart of it is the palpable feeling I have of partnering with a force beyond my control or understanding.** Thus, the darkly maybe-clever prototype set of objects had to be eliminated and replaced with something better.

The solution to the problem, arrived at after many months of agonizing and working on other aspects of the project, was to create a questionnaire for people to respond to and to take their responses as a much more genuine reflection of the concept of “Americana” than anything I could personally come up with. Thus, the first step of *Object Americana* is a bit of crowd-sourced wisdom.

The poll took place among friends and peers, asking them about the objects they associate with the United States (see Appendix A: “Questionnaire Text”). It was also distributed throughout the Parsons MFADT mailing list. The poll was primarily focused on immigrants, people who were born in other countries and raised there for a significant portion of their life, and received 31 full respondent answer sets. Not a huge number but plenty for my purposes. The questions were divided into sections about the *past*, *present*, and *future*.

For the *past*, respondents were asked to recall their childhood impressions of the USA, which is taken to reflect media representations, things adults may have told them, and



received ‘common knowledge’ impressions of the country. The results were very illuminating; the objects people mentioned were split between relatively predictable and highly unexpected. As someone born and raised in the USA, perhaps the most interesting response for the *past* section was *candy*. Candy in various forms received 6 mentions among the 31 respondents, one of those interesting results that seems obvious in retrospect but would have been very hard for someone like me to come up with beforehand.

Other notable objects mentioned for the *past*/childhood section include things related to baseball (4 mentions), basketball (3), cars (5), flags (6), guns (4), hamburgers (5), McDonald’s (4), money (3), and finally, the Statue of Liberty (4). Combined, the two responses ‘hamburgers’ and ‘McDonald’s’ yields by far the most popular answer, with 9 mentions out of 31. Otherwise, the flag and candy tie for most-mentioned American object of the respondent’s childhood. Of this list, I chose candy, an old car, a ‘waving flag,’ the AR-15, the McDonald’s logo, and the Statue of Liberty to create combinations with.

At the end of the process described later in this paper, the object which ultimately came to represent America’s *past* was the hybrid Statue of Liberty—McDonald’s logo, described in more detail in § viii.

For the *present*, I asked whether the respondent currently resides in the USA or had for a significant period of time in their life, and, if so, how this experienced informed or changed their prior impressions of the country. The written answers to this were fascinating and highly varied (see Appendix B: “Questionnaire Responses”).

The questioning continued, asking for a list of objects they associate with their current lives here or the state of the country more generally. As with the *past* section, objects mentioned here were split between predictable and unexpected. If anything, the most popular responses were more highly clustered than in the prior section and this time, the most-mentioned object, President Donald Trump, won the vote with seven votes. The other common responses were the MTA/subway system (4 mentions), flags (5), guns (5), very large houses (5), and smartphones (4). To my mind, this section succeeded in creating a much more down-to-earth and representative reflection of peoples’ ideas about America as a real place than, for instance, my original list. I am particularly fond of the mention of large houses; as an American it can be easy to forget that this country’s suburbs are extremely bizarre among the nations of the world, and I feel that the suburban mindset is likewise a uniquely American path to political decay and destruction. Of the objects listed here, the ones chosen for combination were the waving flag (again), the AR-15 (again), a very large house which I took to naming a McMansion (for consistency!), and of course a bust of Donald Trump. The bust of Mr. Trump I found was chosen deliberately to be relatively neutral; I found a grotesque caricature of the man but that did not seem correct for this project.

The final object for the *present* moment of American history is the hybrid Trump—McMansion, novel icon of the defining leader of our times and the geographic constituency as well as rank solipsistic mindset responsible for putting him in office.

The survey wrapped up asking what the respondents think the *future* holds for the USA and then the identical question about objects they associate with this country’s future. This time, the responses were much less agreed-upon. The most popular objects only scored three mentions apiece, with many more fantastical or speculative responses than in the other two sections. The full list of objects with more than one mention is as follows: climate change (2 mentions), VR headsets (2), electric bicycle (3), sex robots (3), hand sanitizer (2), self-driving/Tesla cars (3), clothing including ‘more elaborate sneakers’ (2), health care for all (2), guns (3), money (2), oil (2), the class system in various forms including ‘death of the elite class’, ‘polarized’, and finally ‘eliminate the famous 1%’ (3 mentions of the same concept with different



phrasing), houses (3), predator drones (2, also mentioned in the present section 3 times), and smartphones (2). Further-afield individual responses included barbed wire, coffee, carbon zero zones, Donald Trump merchandise, genocide, trucks, tanks, toilet paper, sick trout, N95 masks, 'cigar-box guitar,' microchips, and finally my personal favorite, 'hip hop in space.' This wide-ranging list reflects the fertile soil of the imagination as well some very specific anxieties about the current times we are living through. This survey was conducted toward the beginning of the current COVID-19 lockdown, and answers like toilet paper, N95 masks, and hand sanitizer are direct references to that crisis, at the time of this writing still ongoing. Of these responses, the chosen combination objects were the e-bike, the Tesla electric car, the AR-15 (yet again), class warfare interpreted by me in the form of a guillotine, and the McMansion (for a second time).

The combination I chose to represent the future of America is the hybrid guillotine—e-bike. Perhaps slightly more silly than the other two objects, it nevertheless reflects a real perspective on the conflicting futures that lay ahead of us. Is the eco-consumerism of the e-bike made possibly only through the blood of the guillotine? Is it perhaps precisely the sort of band-aid that the American oligarchy allows to cover the gaping wounds of environmental devastation caused by the corporations they own? Do these two objects truly represent two opposing futures? Like any speculative exercise, the guillotine—e-bike poses more questions than it answers.

Finally, I must include a section on the truly exceptional objects that were mentioned in all three 'mental epochs' of Americana iconography. They clearly represent some sort of meta-image of the country and are as follows: **cars** (5 mentions past, 2 mentions present, 3 mentions future, for a total of 10 mentions), **clothing** (3 past, 3 present, 2 future, 8 total), the **flag** (6 past, 5 present, 1 future, 12 total), **guns** (4 past, 5 present, 3 future, 12 total), **money** (3 past, 3 present, 2 future, 8 total), **oil** (1 past, 2 present, 2 future, 5 total), **trucks** (1 past, 2 present, 1 future, 4 total), and **TVs** (2 past, 2 present, 1 future, 5 total). The undisputed *Object Americana* is the hybrid **flag—gun**.



§vii. Crescendo: Choreography of *Object Americana*

We have established the conceptual underpinnings and the crowd-sourced basis of the objects to be hybridized. It is time to begin the alchemy itself. This section will take the form of a list of the technical steps in the choreographed process that is the actual work of *Object Americana*. This process modifies and extends the work of Dong Wook Shu, Sung Woo Park, and Junseok Kwon in their paper “3D Point Cloud Generative Adversarial Network Based on Tree Structured Graph Convolutions,”¹ which is a 3D point-cloud GAN as the title implies. A GAN, *Generative Adversarial Network*, is a type of Machine agent that learns through trying to fool itself into believing the things it is generating are real examples of data, similar to the process described in § iii. A point-cloud is a set of point data in 3D space; this is a commonly produced data type of 3D scanners, but they can also be created algorithmically as I have done here. Generally, a single point-cloud represents the surface of a single object; the points in the cloud reside directly on the surface of the object.

The full steps of *Object Americana* are as follows, arranged as a description of the step followed by the parenthetical tool which is used to carry it out:

1. Pick objects (questionnaire data + Human intuition)
2. Generate point clouds (Grasshopper² for McNeel Rhinoceros³, a CAD program)
3. Make the point clouds into Machine-readable datasets (Python file processing using custom-written scripts)
4. Train new GAN Machine agent (TreeGAN⁴, a Machine Intelligence GAN program that runs on PyTorch⁵ for Python⁶)
5. Extract Machine-generated point clouds (Python)
6. Import and do preliminary algorithmic meshing of GAN training session point clouds (Grasshopper for McNeel Rhinoceros)
7. Compile training session meshes into a video showing the training process, in order to judge which object combinations result in viable sculptures (Grasshopper for McNeel Rhinoceros)
8. Fine-grain examination of generated meshes, picking ‘contenders’ to be the final, representative mesh for the given object combination; of the contenders, find the best (Grasshopper for McNeel Rhinoceros)
9. Manually edit and connect the algorithmic mesh fragments of the final contender into a single cohesive, comprehensible, and fully 3D-printable mesh (several hours of artistic labor in McNeel Rhinoceros)

1 Shu, Dongwook, Park, Sung Woo, and Kwon, Junseok. “3D Point Cloud Generative Adversarial Network Based on Tree Structured Graph Convolutions.” 2019 IEEE/CVF International Conference on Computer Vision (ICCV), 2019. <https://doi.org/10.1109/iccv.2019.00396>.

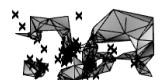
2 “Grasshopper.” Grasshopper. Accessed May 4, 2020. <https://www.grasshopper3d.com/>.

3 “Rhino 6 for Windows and Mac.” Rhino 6 for Windows and Mac. Accessed May 4, 2020. <https://www.rhino3d.com/>.

4 Shu, Park, and Kwon

5 “PyTorch.” PyTorch. Accessed May 4, 2020. <https://pytorch.org/>.

6 “Welcome to Python.org.” Python.org. Accessed May 3, 2020. <https://www.python.org/>.



[1] The first step of *Object Americana* is crowd-sourced wisdom. See § vi. for the full detail of the poll, and see the appendix for the full questionnaire text as well as the entirety of the responses collected. The poll was primarily focused on immigrants, people who were born in other countries and raised there for a significant portion of their life, and received 31 full respondent answer sets.

After a process of refinement, paring, and judgment described in step [7] below, the final objects chosen for production were:

- *past*: **Statue of Liberty—McDonald’s logo**
- *present*: **Donald Trump bust—suburban McMansion house**
- *future*: **class-warfare guillotine—electric motorcycle**

The objects were sourced from the website Thingiverse⁷, an open-source community where users submit 3D meshes for public use (see “Appendix D: Thingiverse Models” for list of 3D models that contributed to this project). They are all individually licensed for Creative Commons use, an organization that develops open licenses for “expanding the range of creative works available for others to build upon legally.”⁸

[2] Step number two is an algorithmic point-cloud generation process. *Grasshopper*, a parametric design program, runs through 1000 random seeds for the points on the surface of the individual object mesh and saves them to separate text files. In order to produce a properly alchemized object, a large dataset of randomized point clouds for each object to be combined is required. Currently, the combined datasets are 2000 files, each file an entire point-cloud of 5000 points residing on the surface of the same mesh. That is to say, only the two individual meshes are used, but each mesh contributes 1000 point-clouds to the final, combined dataset.

[3] Once the 2000 point-clouds are exported from Grasshopper in the form of CSV files, a custom piece of Python code is used to convert them into the full datasets that Tree-GAN is able to operate upon. This is essentially a form of data-cleaning, the task of preparing data to exist in a form that is readable by the Machine agent. One interesting note is that Tree-GAN, the Machine agent itself, is designed to intake and understand *segmentation* data about the point-clouds. For example, looking at a point-cloud of an aircraft, it can distinguish between points on the wing and points on the fuselage by intaking a separate data file that labels each point in the cloud with a segment number. Segmenting the point clouds is not needed for *Object Americana*, so part of producing these datasets was generating 1000 files which contain nothing but a ‘0’ for each point in their corresponding point-clouds. All points in all point-clouds are therefore part of the same, single segment.

[4] The Machine mind responsible for the sculptures of *Object Americana* finally makes its appearance at step four of the process. The Machine begins examining the point-clouds of the two objects. The process of Generative Adversarial Network learning entails a constant give-and-take between two halves of the Machine, hence the ‘adversarial.’ The *generator* looks at the dataset and tries to produce its own version of something that would make sense with it, which is subsequently shown to the *discriminator* for analysis. The discriminator must make a

7 Thingiverse.com. “Digital Designs for Physical Objects.” Thingiverse. Accessed May3, 2020. <https://www.thingiverse.com/>.

8 “When We Share, Everyone Wins.” Creative Commons. Accessed May 3, 2020. <https://creativecommons.org/>.



judgment call: is this piece of data part of the original dataset, or is it data that my other half created? If the discriminator is able to tell the novel generated data from the original, the generator tweaks itself and keeps trying. If the discriminator is fooled, the generator reinforces the parts of its generation process that it thinks contributed to the successful forgery⁹. At first, the generator is not very good at fooling the discriminator, but over time its self-tweaking adds up and eventually the discriminator is fooled a larger and larger percent of the time.

Tree-GAN provides a convenient visualization of its progress [figure 3]. The key element of the current version of *Object Americana* is using generated point-clouds

from relatively early on in the training process. I have not been able to crack the code of directly exploring the latent space discussed in § iii, much to my chagrin. Instead, I have created a successful alternative method for seeing the Machine's impression of object hybridization: trying to fool it. I do this by deliberately giving it a strange dataset which contains files from two separate objects. Effectively, I am handing the Machine two different objects and saying, "This is an object..please sculpt what it looks like!" This method works quite well for the first few *epochs* of training (see below), but alas the Machine is simply too smart for this to work long-term. As early as two or three epochs in, it begins to see through my canard and realizes that there are in fact two distinct objects it is being shown. It then starts shifting the generated point-clouds away from hybridized attempts at a combined object and toward generating highly-accurate point-cloud representations of either one object or the other. This is not an ideal state-of-play for the project, and in future iterations I hope to solve this problem with a proper ability to train the Machine's latent space and chart its interstitial parts.

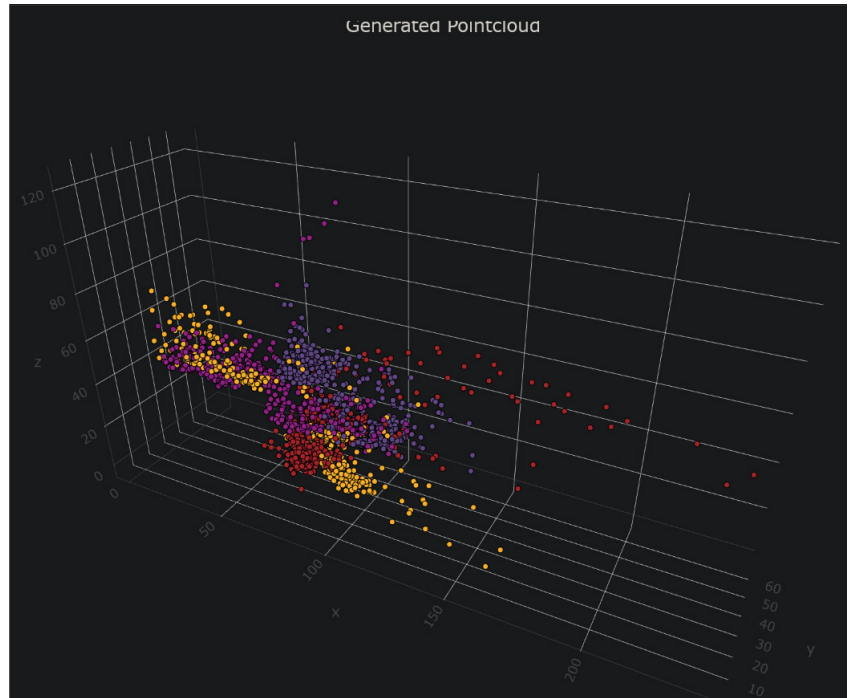
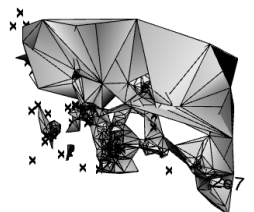


figure 3: Tree-GAN training visualization interface showing a point-cloud

[5] I have modified the original code of tree-GAN to export its generated point-cloud at every *iteration*. In Machine Learning terms, an iteration is a single analysis step; in the case of GANs, it is a single cycle of generation-discrimination (from a technical standpoint, step size is determined by batch size, which is determined by the hardware capacity). When the Machine has analyzed each piece of data in the dataset and responded accordingly, this is called an epoch. Depending on the application, the number of epochs required to train a Machine to a specific task can range from one to many hundreds, though for the most part less than fifty is usually very adequate.

[6] Once the Machine has been trained on the two-object dataset and has begun reliably picking apart the two objects instead of combining them, I know it is time to let it rest. It has exported all of the combined objects that will be good for our purposes. The next step is to import the generated point-clouds back into Grasshopper and use an algorithmic process to generate the preliminary mesh fragments. A mathematical form called an *octree* is used to group the points in each cloud into neighboring groups that are

⁹ "Introduction | Generative Adversarial Networks | Google Developers." Google. Google. Accessed May 4, 2020. <https://developers.google.com/machine-learning/gan>.



spatially close to one another. An octree is a recursively subdivided grouping using 3D boxes, aiming to get a constant number of points in each box. Larger boxes likewise correspond to more spread-out areas of the point cloud, and vice-versa. The grouping then becomes the basis for simple *Delauney* meshes, which use an average plane-of-best-fit to create triangular mesh faces between laterally-adjacent points. The final group of Delauney meshes is the basis on which subsequent decisions are made, as well as the contents of the animations produced in the next step.

[7] Grasshopper is then used to animate the full training process into short videos. These videos are used by the Human agent to judge which object combinations are working in a visually compelling way. This judgment call is alloyed with judgments about the semiotic and ideological content of the objects themselves to determine which objects from the *past*, *present*, and *future* object sets become the final representations of each of those categories. See step [1] for the final picks in each category, as well as the appendix for links to these training videos online (see Appendix C: “*Object Americana* Videos Online”).

[8] The final object combinations settled, each set of generated meshes are loaded into Grasshopper for fine-grained examination. For each object combination, there are over 1000 generated meshes that arise from the training process. These are arranged in order of the training process: not exactly linear, but roughly so. As described in step [4], the best hybrid objects are found after the Machine has learned how to produce a convincing object-like point cloud, but before it has learned that it is in fact being asked to analyze two different objects. For the various object combinations, the ‘sweet spot’ of Machine ignorance is a little different, and this step uses both the videos produced in [7] as well as a particular method in Grasshopper to flip through the generated files one at a time. The Human agent makes a list of strong contenders for the final object, then pares it down until a single one is anointed for full embodiment as a complete mesh.

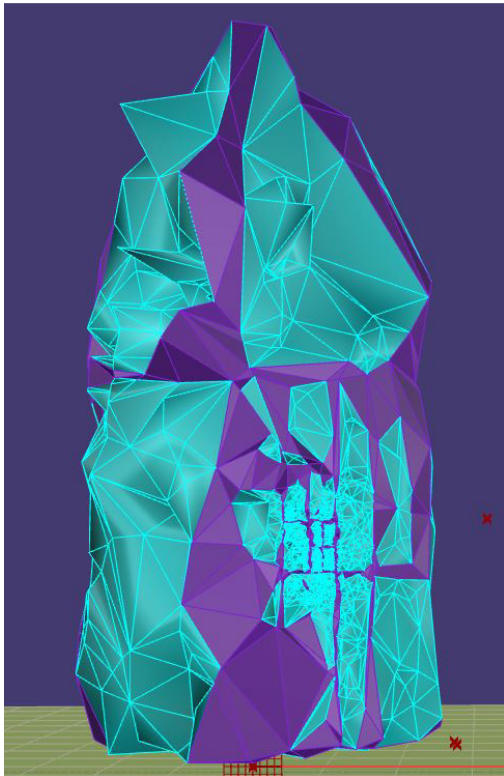


figure 4: simple Human gap-filling

[9] Finally! The last step of the process is a tedious but immensely enjoyable one. I, the Human, must decide what’s ‘in’ and what’s ‘out,’ quite literally. This step is an arduous process of manually editing the Delauney mesh fragments and drawing new triangular faces between them, using their point-vertices and the remaining free-floating points of the cloud that were not able to be incorporated into the Delauney fragments. The process of stitching the algorithm’s meshes together requires an idea of *where precisely the surface of the finished object will be*, exactly where in space will be inside the object and where will be outside.

For the Human, learning how to do this was a process unto itself. The first set of test objects that Object Americana’s choreography was practiced on was a series of algorithmically-generated crystals. For the crystals, the stitching step was relatively straightforward. [Figure 4] shows the Machine’s meshes in *cyan* and the Human’s mesh-gap-filling in *purple*. This clearly shows the contrast between the two agents in this dance, the Machine and the Human.

Later, for the first truly combined object, *skull--ar15-20e5{skullgun1}*, visible in [figures 5



and 6], the manual meshing process was a great deal more complicated and difficult for me to get my Human head around. The simple decision of where the physical boundary of the object was to be was quite complicated when trying to preserve the skull-ness and gun-ness of the thing while also creating something markedly different from either one.

Luckily, as time went on the Human was able to understand their Machine partner better and allowed the Machine to take more of the lead. This ultimately resulted in *skull--ar15-6e12{skullgun2}*, the object displayed in [figure 7, page 17]. While that meshing process was also arduous, I no longer needed to consciously preserve an element of uncanniness while creating the final sculpture. The uncanniness was unavoidable. The skull--AR-15 object combination was the focus of the second phase of Object Americana, the “two very explicit and heavy-handed objects” mentioned in the first paragraph of § vi. *skull--ar15-6e12{skullgun2}* was the first alchemized/hybridized object that I considered a true success of the overall project. It is deeply unnerving to behold, and both the skull and the assault rifle that generated it are clearly legible in the final object. It takes the form mostly of a rifle, but with a bulbous, cranium-like middle section with cavernous, empty eyes peering forward and the barrel transformed into a wicked, saw-toothed, long, triangular snout. The lower ammo clip, which normally comes down and forward

in a “C” shape on an AR-15, maintains this same geometry but contains a horrifically morphed mandible complete with jagged teeth and open front-to-back the way any organic mandible is.

By the time the results of the questionnaire were clear and the final objects were picked to mesh, creating the final forms of the objects out of their point clouds and corresponding Delauney fragments was a final step I looked forward to. It is a strange encapsulation of the whole project in microcosm; at the end of the process, the Human and the Machine are in a dialogue of creation.

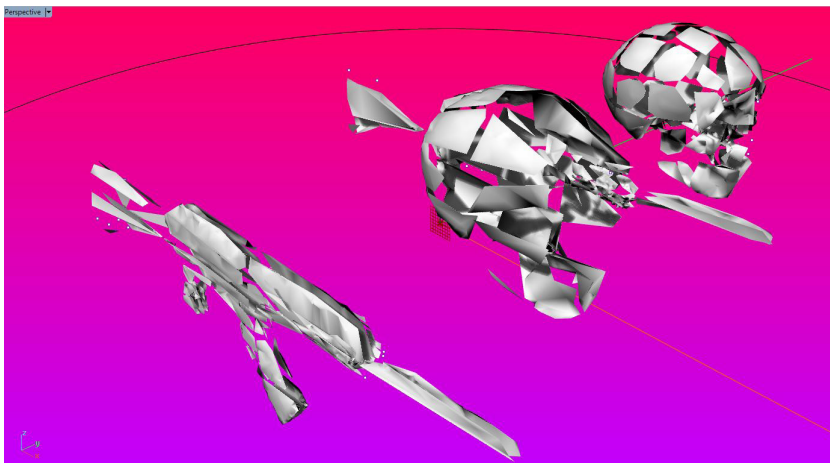


figure 5: *skull--ar15-20e5{skullgun1}*, un-meshed, in context with generated examples of its component antecedent objects

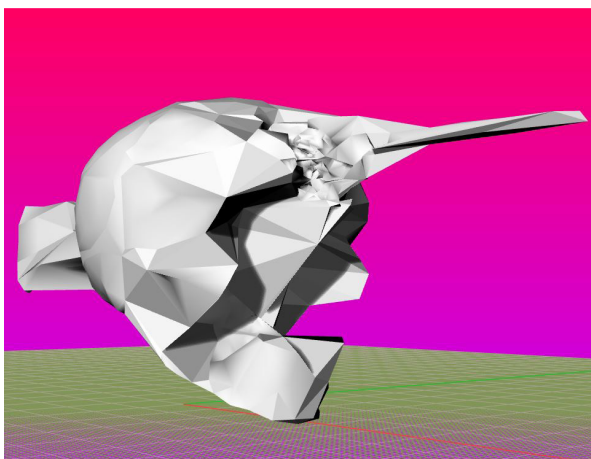


figure 6: *skull--ar15-20e5{skullgun1}*, after Human mesh completion



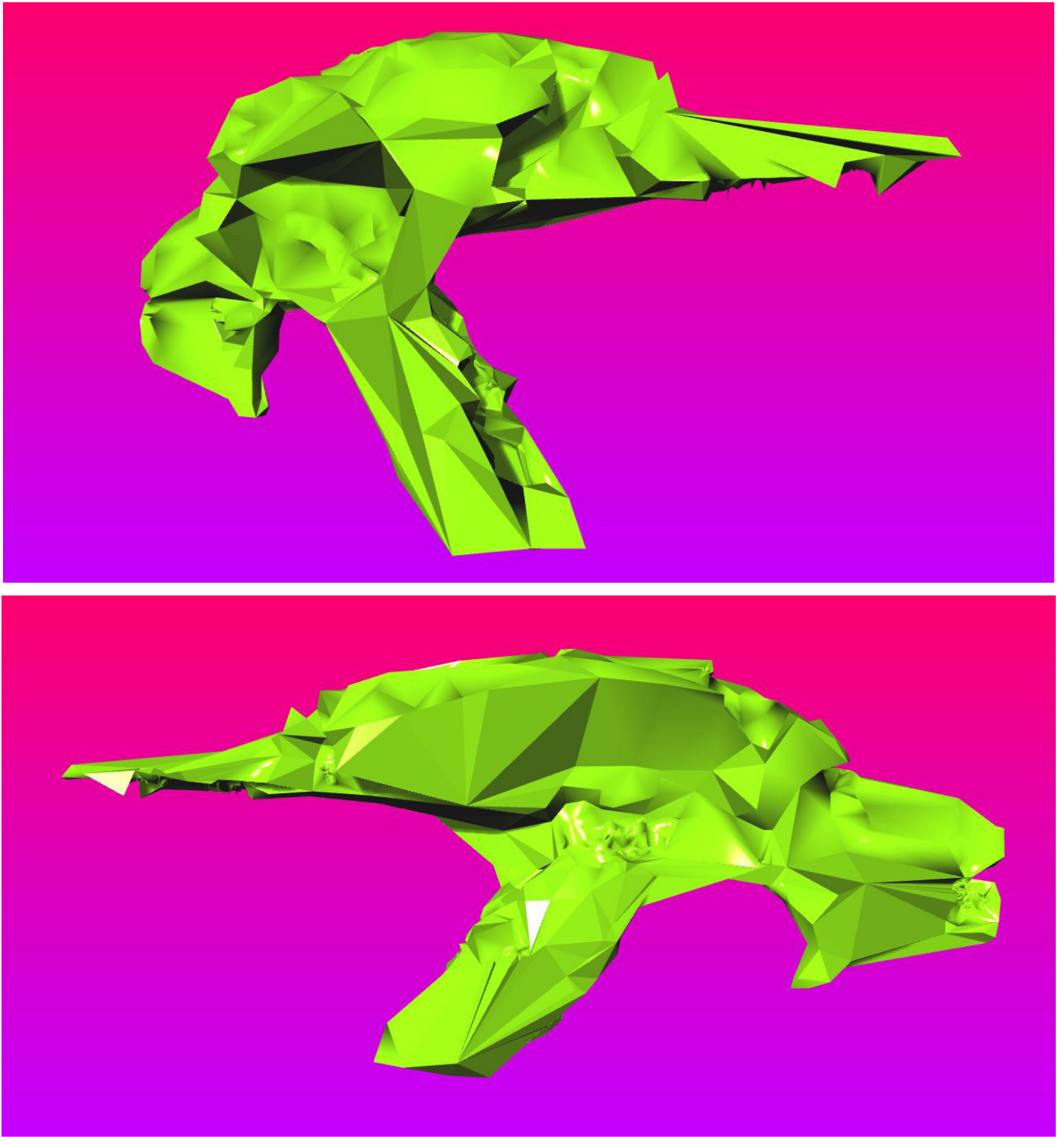


figure 7: skull--ar15-6e12{skullgun2}, left and right side views



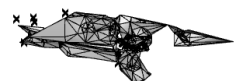
§viii. Finale: Completed *Object(s) Americana*

At the end of the choreography, We are left with the result of our dance. Four final sculptures were produced for this iteration of *Object Americana*. Here, I will describe them in depth both physically and conceptually. They all share a common nomenclature: *object1--object2-epoch#iteration#{chosen title}*. This is based on the file-naming convention developed for project management very early on. The titles are picked as a way of tipping the viewer toward understanding the two objects involved as well as hinting at my own thoughts about the particular semiotic weight of the object.

liberty--mclds-1e117{Our Lady Of Liberty And The Perpetual McDouble}

The object representing the *past* of *Object Americana* is gentle and enigmatic. It is 3D-printed in white plastic and takes the form of a rough approximation of the Statue of Liberty with large, angelic wings. The wings in fact trace the outline of the logo of the McDonald's fast-food chain [figure 8, page 19]. Upon further examination, the torch that the figure holds appears broad and flat at the top, almost like she is holding a serving tray aloft as in some post-war era diner. The *tabula* she famously holds in her left hand is clearly visible at her side, between her body and the left 'wing.' Her figure is not quite the same as the viewer is used to, however. Her head seems draped in a veil of some kind, though her radiant crown is clearly visible, if skewed [figure 9, page 19]. Her abdomen seems a bit distended, and she seems to be simultaneously standing tall and leaning sharply to the left due to a strange position of her left leg. There are two unexplained I-beam-like projections connecting the left side of her lower leg with her left wing; these look very much like glitchy digital artifacts. There are more artifacts on the middle sections of both 'wings,' and these almost resemble areas where paper has been crumpled in on itself. Finally, there is a projection emanating from her left shoulder area which, upon close examination, seems to be an echo of her very own upper body, complete with right arm held aloft and head with crown. This projection connects to the left 'wing,' and is an example of the fractal, ever-smaller nature of the level of detail in all of the sculptures produced for *Object Americana* [figure 9, page 19]. The McDonald's logo is apparent as the wings, but it takes a bit of time to realize that the lady of liberty is also occupying the middle stem of the "M" shape that the logo comprises. She is off-center in this regard, and the logo is further distorted with two sharp horns rising from its left apex. The back of the object is not quite as detailed, but it does bear another much larger echo of the lady's likeness: her entire back, shoulder area, and the projection from her left shoulder seem to make up another forehead and radiant crown [figure 10, page 20].

To my mind, this object represents the way in which the old notion of the American dream was, even at its root, wrapped up so strongly with base commercialism and the physical products this country has exported throughout its history. In many ways, the American liberty has always meant freedom to buy something; more often than not, something created under negative if not horrific circumstances. I think of the promise this country held in eras bygone, and how food security was a driving force behind many waves of immigration to this territory. How many people, arriving at Ellis Island with lady liberty in plain view, had their first meals in America on their minds? At the same time, in the contemporary era McDonald's has taken on a decidedly sinister hue: extremely unhealthy, extremely cheap food offered to the millions of the country's destitute residing in food deserts, in lieu of effective nutrition. This same food offered around the world as a primary symbol of the United States' soft-power cultural empire. As they say, "Billions and Billions Served!"



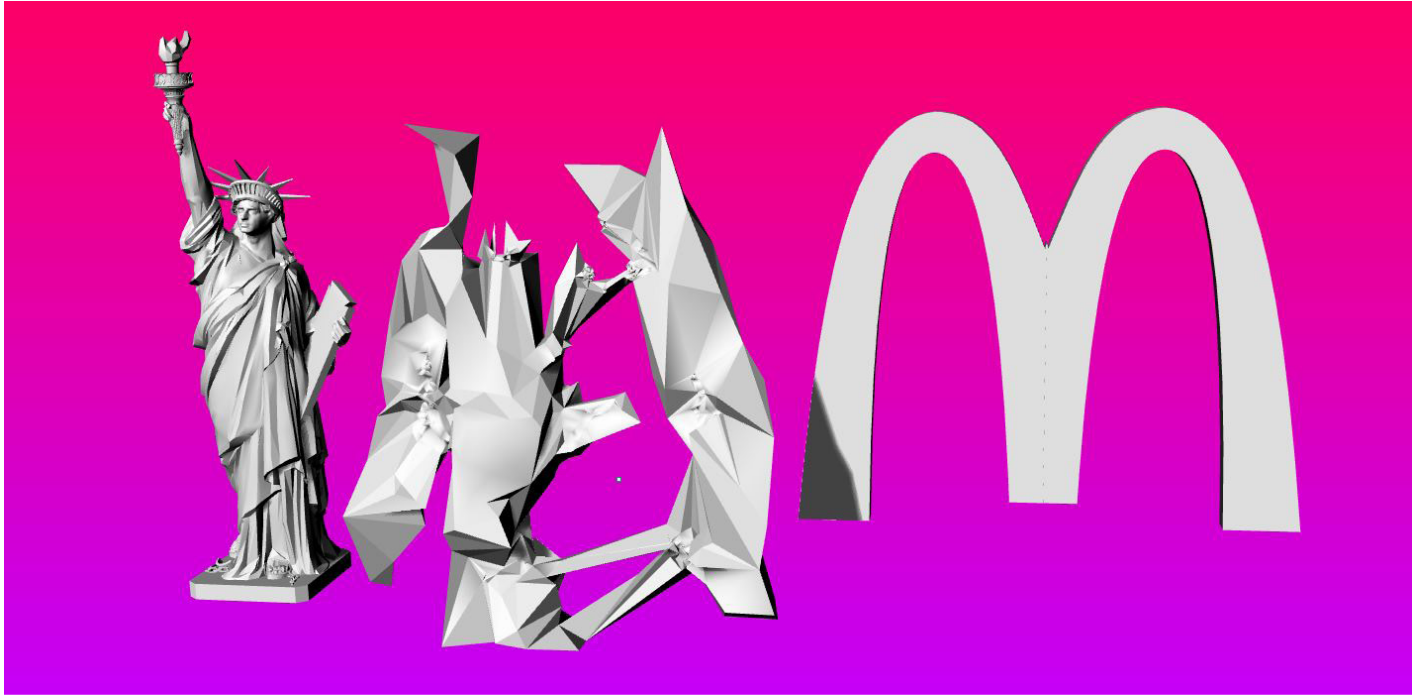


figure 8: liberty--mclds-1e117{Our Lady Of Liberty And The Perpetual McDouble}, center, with antecedent family

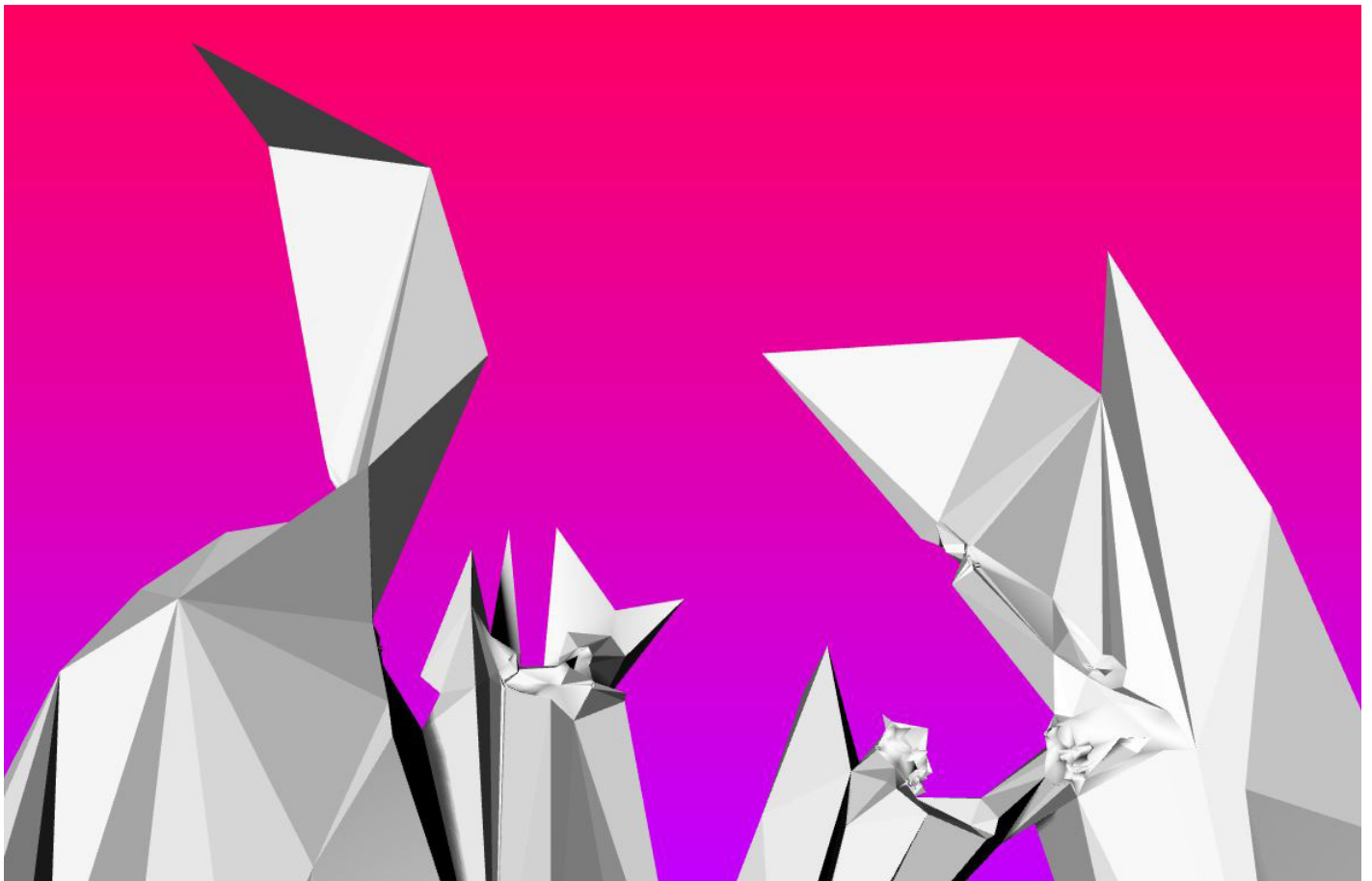


figure 9: liberty--mclds-1e117{Our Lady Of Liberty And The Perpetual McDouble}, detail



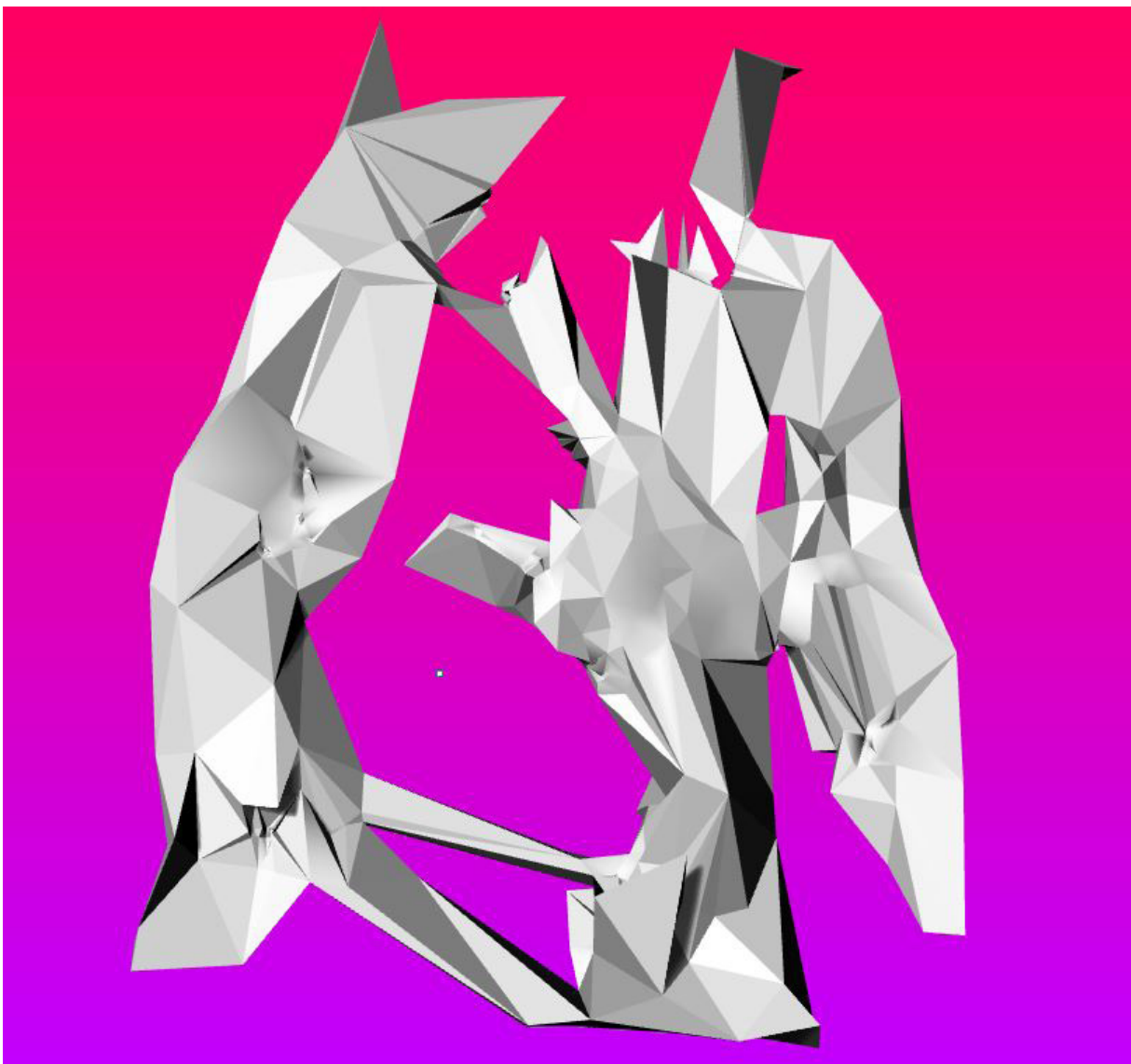


figure 10: liberty--mcds-1e117{Our Lady Of Liberty And The Perpetual McDouble}, posterior

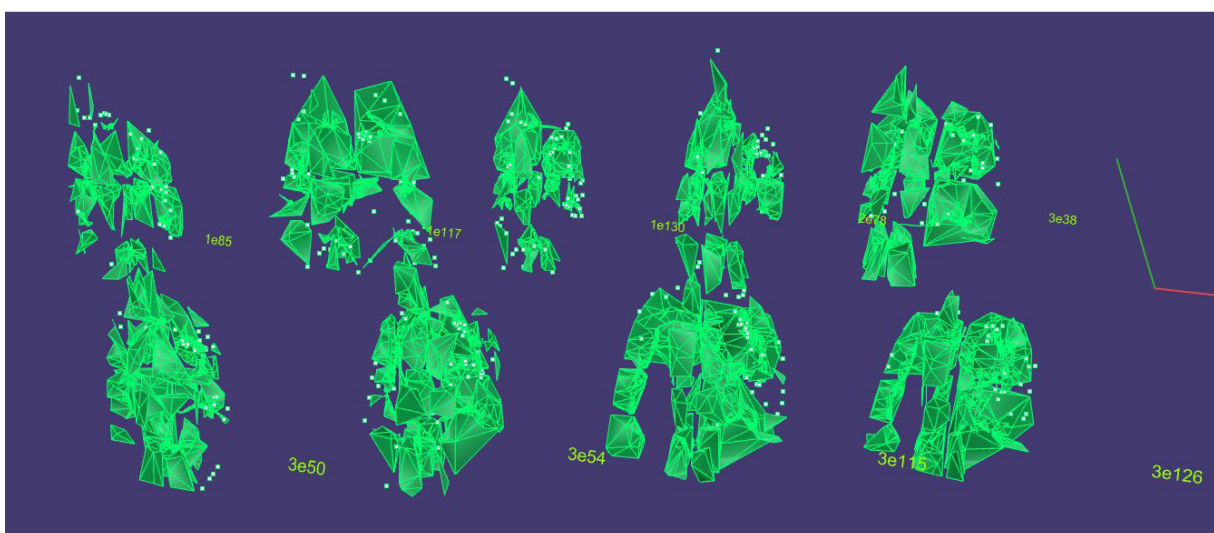
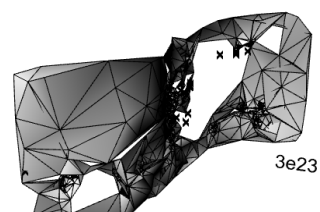


figure 11: liberty--mcds "contender" meshes arranged for examination; chosen mesh is back, second from left



The *present* of *Object Americana* is as grim and foreboding as the past several years have been for all of us. Printed in red plastic and taking the form of a shattered architectural ruin, the object at first resembles nothing so much as a squat, rectangular play-house. The would-be mansion is large, imposing itself horizontally across a nonexistent landscape with two wings spreading on either side. There appears a human head in the middle of the house, taking up what would likely be the largest section in the middle of the building. It faces forward and boasts a familiar toupee-like mess of swept-back hair, trademark look of the former boardroom dictator currently occupying the Oval Office [figure 12, page 22]. The head's right eye is recessed in a wall-like projection sweeping outward toward the adjacent wing of the building, complete with a similar floor-like projection from the cheekbone. The head's left eye is a gaping pit, dark to the daylight with a rectangular window admitting views into a twisted, empty room inside the cranium [figure 13, page 22]. On either side of the head, the two wings of the building are strikingly different. The left wing is house-like, with a triangular roof and rectangular window pits in its exterior side. The front has a rectangular projection that is nearly flat-roofed. The gap between this wing and the central head is prominent and resembles a jagged valley. The right wing appears as a bombed-out husk of a building, seeming to project upward from the neck of the figure and with many fragmented sections. There is a central cavity in this side, as though several walls have been dismantled, and visible in this cavity where a room should be is only chaos: a collection of crystalline points and dangerous recesses [figure 14, page 23]. Behind this section, an intact part of the building appears to have a vertical column standing at its far corner, still holding its section of roof aloft. This wing of the building is impacted into the side of the head, inseparable and a part of it. The only exception to this phenomenon lies in the rear of the building, where a small crevasse is visible separating the column section from the back of the head.

To my mind, this object bears the weight of recent American history heavy on its slumping shoulders. The political system in this country has been in a state of collapse for the entire span of my life, close to thirty years at the time of this writing. The governmental state of affairs has grown more cartoonish and grotesque with an unrelenting, inverted sense of progress. I have observed with an increasing sense of panic and absurdity as my fellow Americans have moved to embrace ever-more-ignorant ways of seeing the world around us as well as each other. It is a personal belief of mine that one root cause of this bewildering progression has been the suburban places set out for us as the ultimate goal of the American lifestyle. Single-family houses in endless suburbs, serviced by single-family automobiles, single-family lawns, and single-family dogs. As the personal lives of Americans has shrunk to some weak parody of a Libertarian fantasy, the meanness, militarism, and outright avarice of our politics has followed suit. It is clear that President Donald Trump is not an aberration.

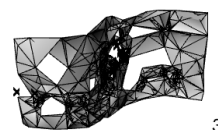




figure 12: trump1~mcmansion-2e49{Excavation Of The Contemporary Nero In The Ruins That Birthed Him}, top view

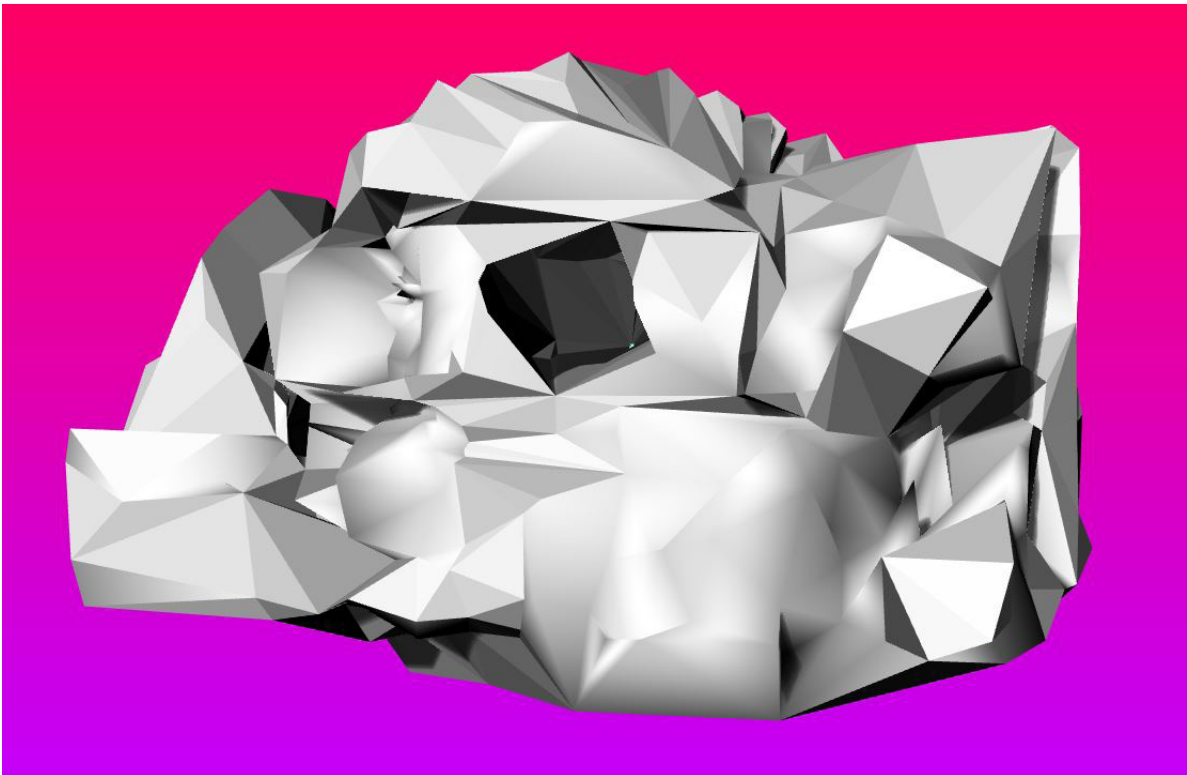


figure 13: trump1~mcmansion-2e49{Excavation Of The Contemporary Nero In The Ruins That Birthed Him}, front view



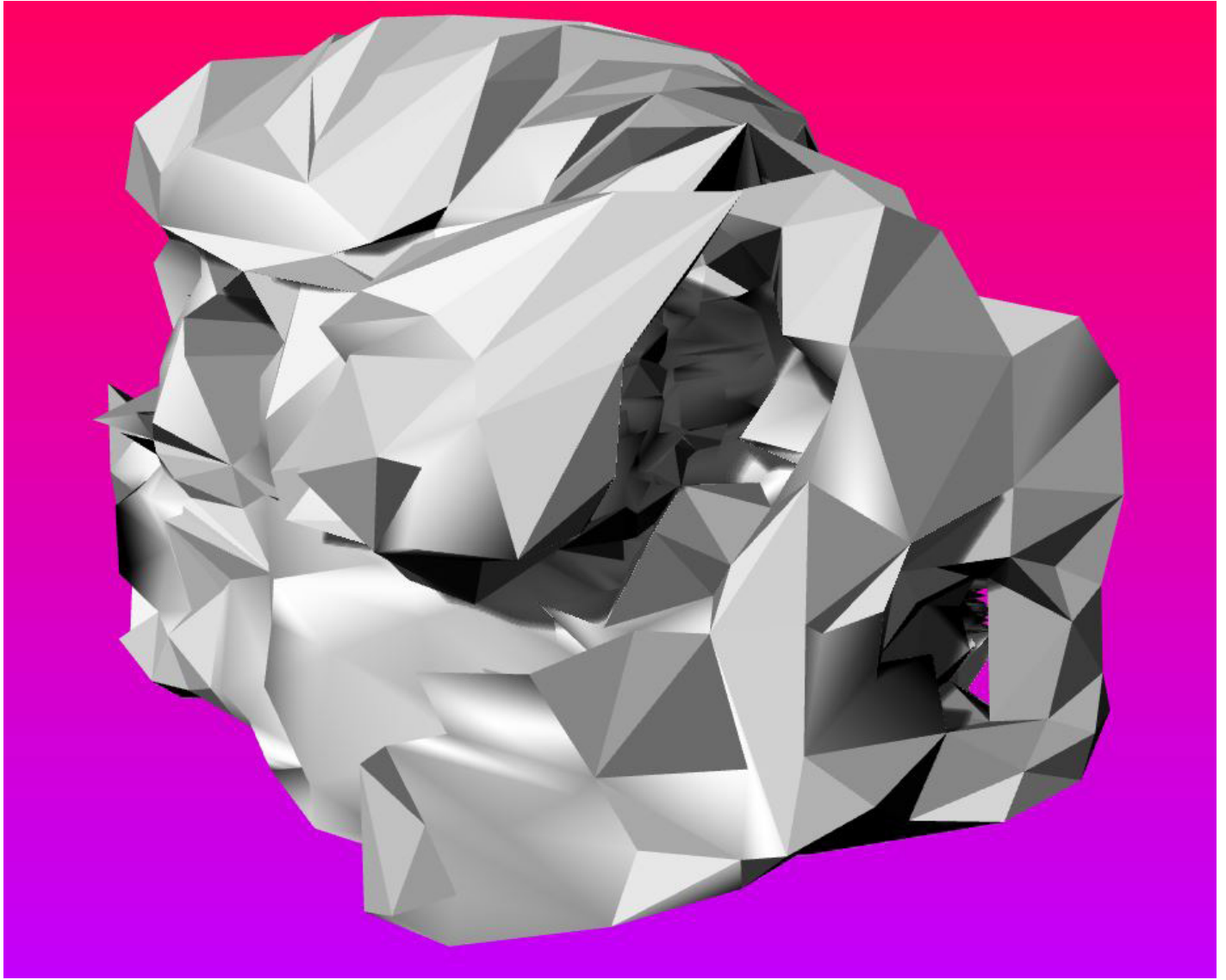


figure 14: trump|--mcmansion-2e49{Excavation Of The Contemporary Nero In The Ruins That Birthed Him}, right view



guillotine--ebike-2e125{Device Pertaining To The Situation We Find Ourselves In}

The form of the *future* of *Object Americana*. The last piece in the chronology of the project is printed in light blue plastic and takes the form of a futuristic electric motorcycle with swooping detailing, a very high seat similar to that of a penny farthing bicycle, and a pointed, stylized antenna projecting up and backwards from the left rear of the vehicle [figure 19, page 25]. The front half of the chassis has a large vertical appendage which rises just behind the front wheel. The wheels have what appears to be a molded fiberglass casing covering their hubs on either side, front and back, with the exception of the right rear, where the wheel covering appears more like a large, powerful muffler despite the supposed electric motors of the vehicle [figure 16, page 25]. Overall the geometry of the motorcycle is similar to the vehicles seen in the movie *Akira*¹. A powerful- yet playful-looking machine, this effect is somewhat enhanced by the highly-visible guillotine blade suspended in its cradle atop the appendage rising from the front of the vehicle [figure 15]. The blade itself is jagged-looking and frightful [figure 17, page 25], and the legs of the supporting construction are somewhat irregular but maintain their directionality with deadly consistency. The left leg of the support has a specific extra piece that swoops down to meet the hub of the front wheel; the overall design looks highly integrated and well-developed. The top of the guillotine appendage bears the classic keystone-shaped flare common to popular conceptions of the devices and seems as though it would be visible from a great distance were one to encounter this grisly vehicle on the road or elsewhere.

To my mind, this object is a blunt, mirthful take on the future of this country. The ‘class war’ responses in the questionnaire were as consistent as any other future-section answer, and it seemed only fitting to me to embody this in the tongue-in-cheek, perhaps alarmist form of the guillotine. The electric bike evokes the many tribulations of the New York City Citibike system², an unremarked-upon, unprecedented corporate project taking the place of a government service; this type of corporate takeover of the role the government traditionally plays in our lives is extremely characteristic of the late capitalist situation we find ourselves in. The guillotine responds to this. Ultimately, this object evokes the cyberpunk dystopias we have all come to know and tolerate on our screens and in our lives. While it may appear cartoonish at first, remember: the blade is sharp.

1 *Akira*, Toho, 1988.

2 Motivate International. Inc. Citi Bike NYC. Accessed May 04, 2020. <http://www.citibikenyc.com/>.



figure 15: guillotine--ebike{Device Pertaining To The Situation We Find Ourselves In}, front-left view





figure 16: guillotine~ebike{Device Pertaining To The Situation We Find Ourselves In}, back-left view



figure 17: guillotine~ebike{Device Pertaining To The Situation We Find Ourselves In}, detail

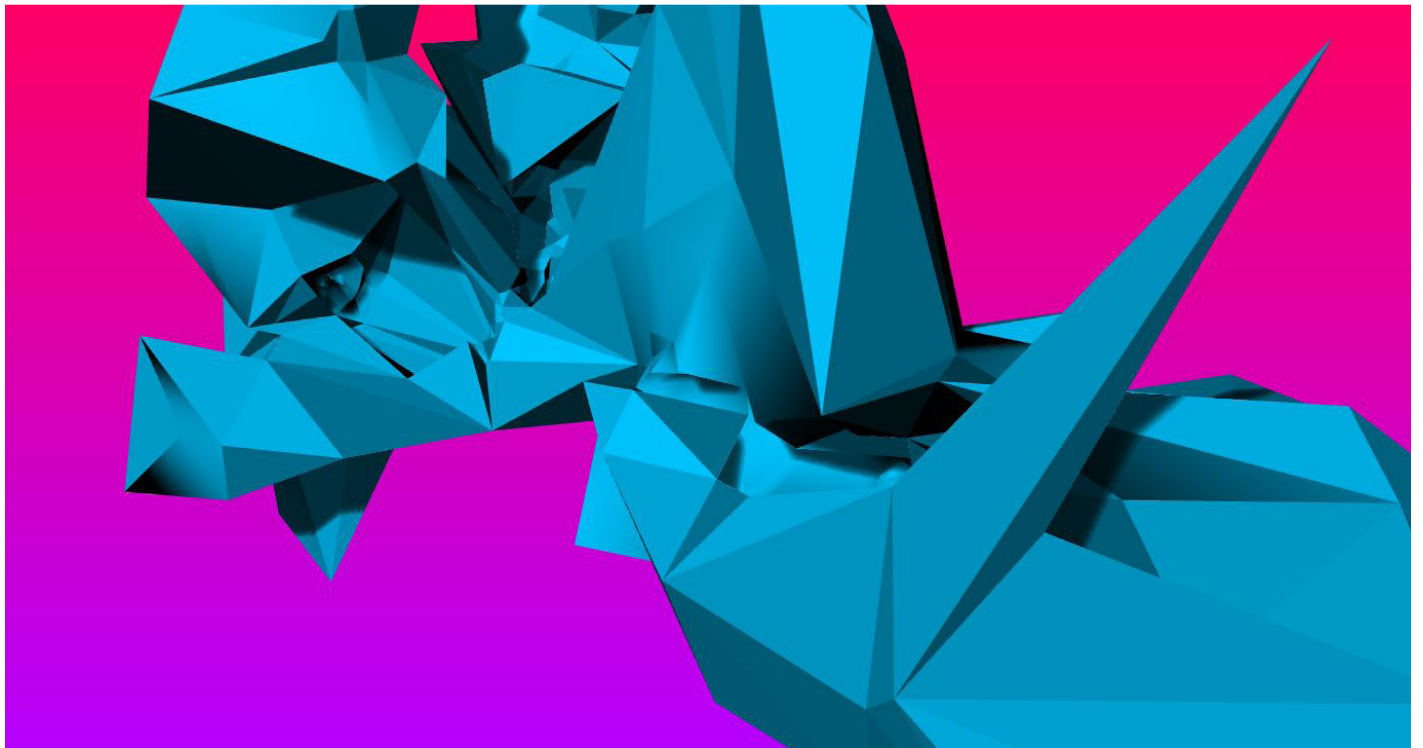


figure 18: guillotine~ebike{Device Pertaining To The Situation We Find Ourselves In}, detail



The *apotheosis Object Americana*, representing the totality of the project. A sad, tattered flag with an assault rifle bursting through its midsection, made of shining gold plastic. The object contains many small details and geometric sleights-of-hand. The flag itself is nearly flat, but it is unfurling in an unseen wind. The mesh-faces which make up the geometry of the flag are splinched nearly on top of each other, in order to give the shape some depth where nearly none exists. The flag exists only as the positive space of the red stripes and blue star-field of its origin; where the American flag is white, the object bears only void [figure 20, page 28]. The stripes project to either side of the form of the gun, which is perpendicular to the flag; both component objects are facing forward. The stripes are twisted and bent, resembling perhaps the images of steel girders in the wreckage of the World Trade Center. This distortion appears to have altered the total number of the stripes as well, and the ones that remain are sharp, dagger-like mutant appendages merging and separating with some logic not apparent to anyone. The star-field quadrant is of roughly correct size and proportion, but contains only hellacious empty triangles in place of stars, overgrown as if by metastasis and nearly running into one another. Some of these 'stars' are punched through the thin geometry of their field, exposing whatever lies beyond the object to the viewer. Some are only dark, anamorphic tunnels leading into and through the interior of the gun behind themselves [figure 24, page 29]. When viewed from the rear, these tunnels take on the quality of bullet holes entering and exiting the corpus of the object seemingly at random [figure 22, page 28]. There are several other such holes throughout the figure of the gun and the top of the flag. The area where the gun emerges from the front of the flag is highly complex and detailed, too detailed to be fully rendered in any besides a monumental sculpture, perhaps one day to be realized. The gun is distorted and sharp, its long, projecting barrel resembling a bayonet [figure 21, page 28]. It has a single horn growing out of the base of its barrel, as if as an aiming sight. In the rear, it has the shoulder-stock and grip of an assault rifle, with a melted quality about that geometry. It has a hole where the trigger would be. The descending, forward-sweeping ammo cartridge merges into the bottom of the flag and creates a sort of self-contained pedestal for the object. Despite all this, the whole thing is markedly recognizable.

To my mind, this object is a frightful visage of the reality of the American century. A country built perforce on the backs of slaves, compelling itself forward into the arc of history at the point of a gun. A country of self-taught myths and self-reinforcing hegemony. There is nothing quite so American as the insistence upon owning a deadly weapon. Believing that liberty itself, not political power, flows from the end of a gun. As the wheel of history grinds this empire under its inevitable path, we would do well to remember what brought us to this moment: perhaps more than anything, a belief in the healing power of *might*, economic and military. The door closes on the American empire, a process that may well take longer than the years any of us have left on this or any other planet. For the sake of Humanity, let us hope this chapter of history ends in a swift, peaceful way.





figure 19: wavingflag-ar15-3e107{Object Americana}, front-right view



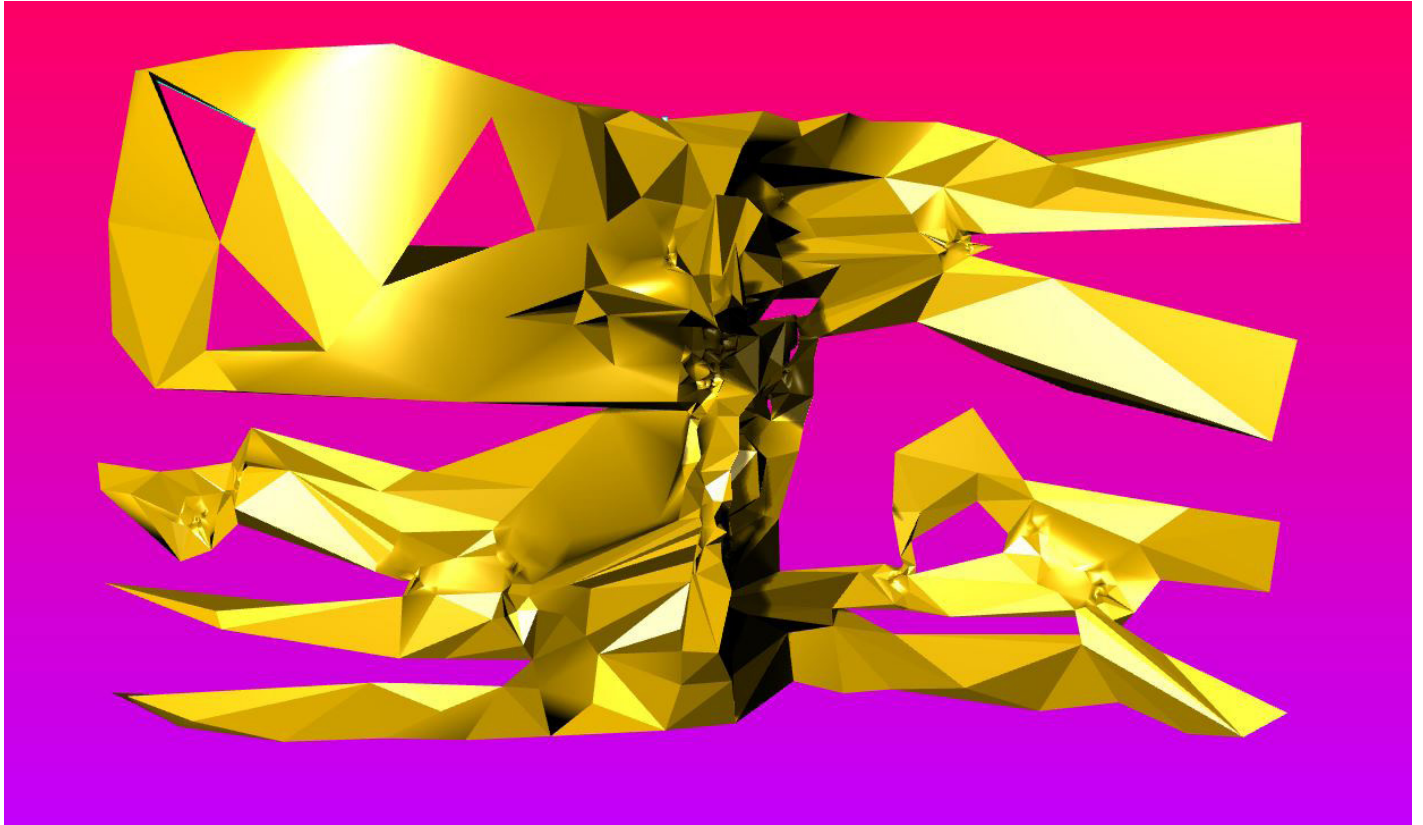


figure 20: wavingflag--ar15-3e107{Object Americana}, front view

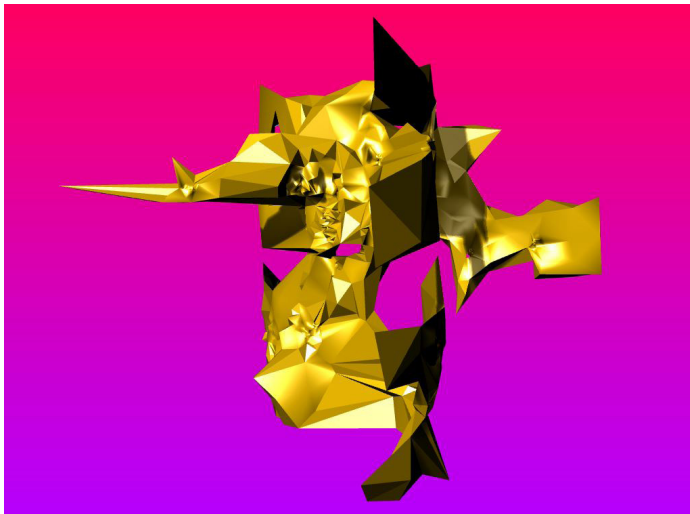


figure 21: wavingflag--ar15-3e107{Object Americana}, side view

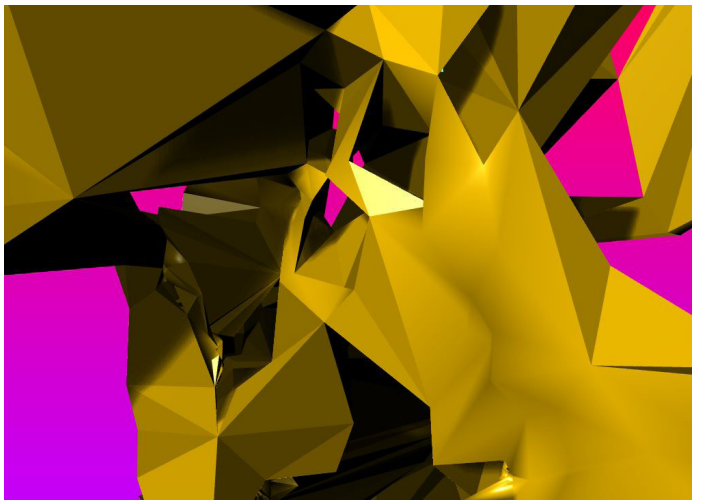


figure 22: wavingflag--ar15-3e107{Object Americana}, rear detail



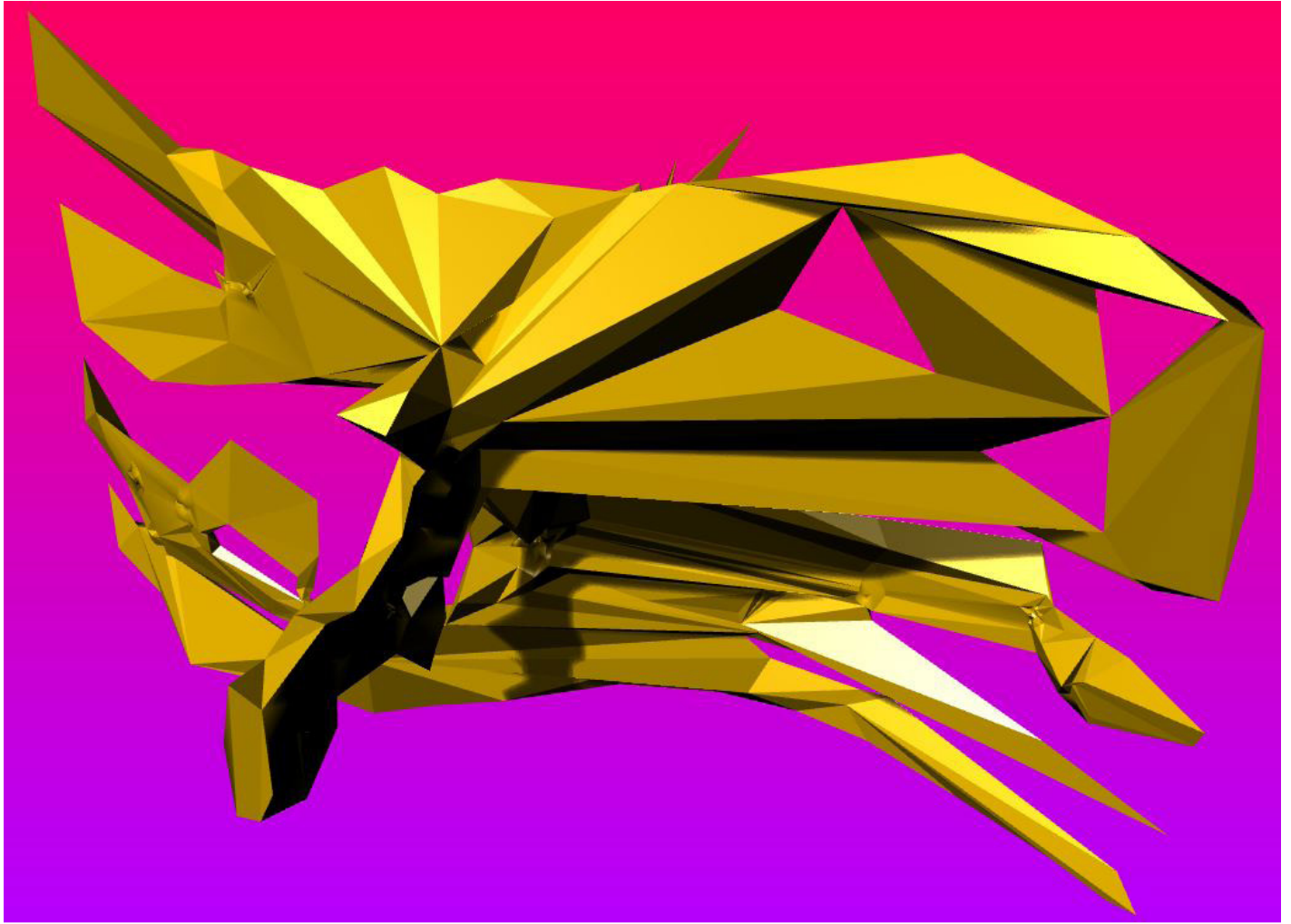


figure 23: wavingflag--ar15-3e107{Object Americana}, top-left view

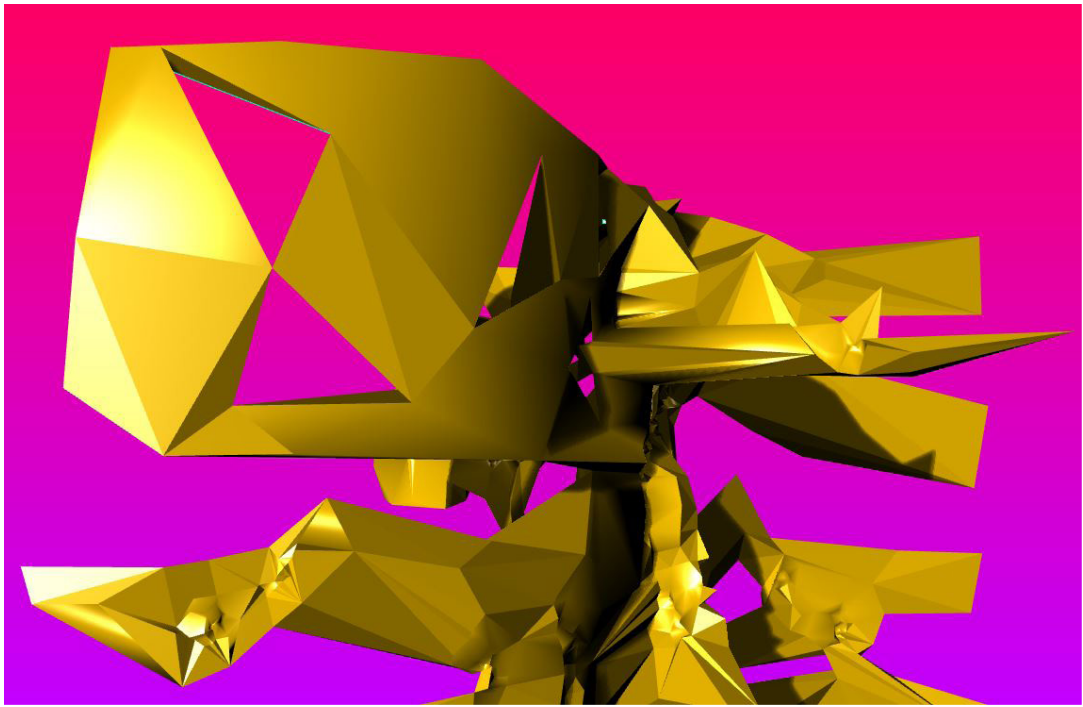
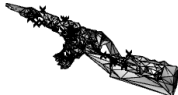


figure 24 wavingflag--ar15-3e107{Object Americana}, "star-field" detail with anamorphic star bullet-holes, center



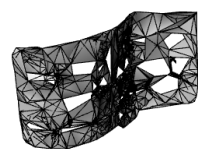
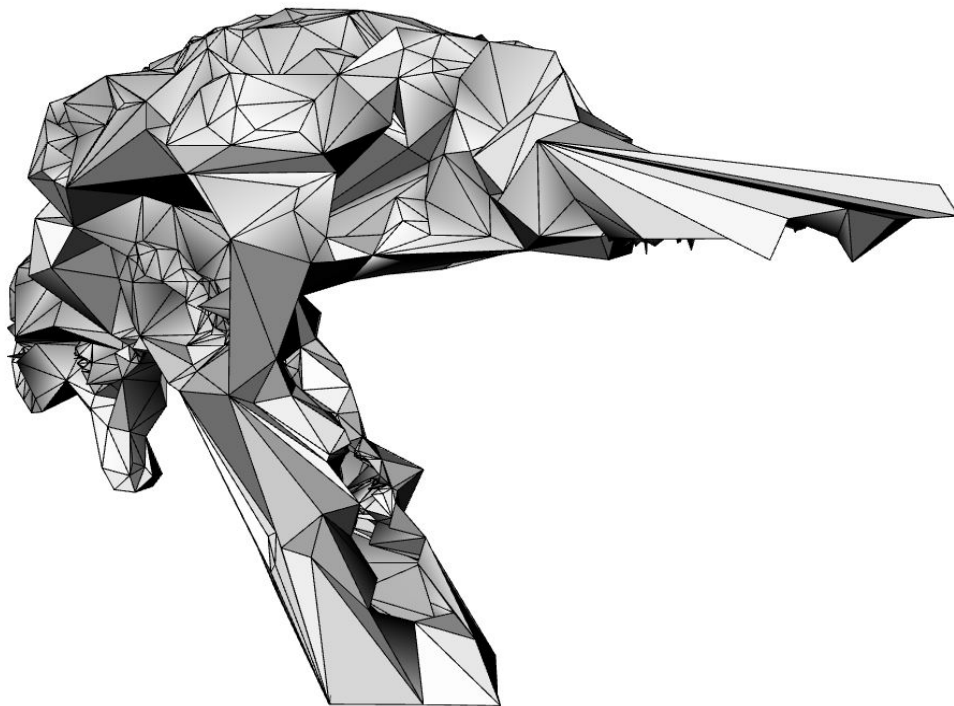
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Many thanks to the many friends and colleagues whose insight, good cheer, laughter, and criticism has shaped me in the past, present, and future.



Appendix A: Questionnaire Text

PERSONAL BACKGROUND

were you raised in the united states of america? (yes/no)

where were you born and/or raised? please include city/region/country. (short answer)

where do you live now? how long have you lived there? (short answer)

have you ever lived in the united states for more than a year? (yes/no)

if you answered 'yes' above, where did/do you live? (short answer)

CHILDHOOD

when you were a child, did you have an impression of the united states? what was your impression, and how was it formed? (long answer)

please list some OBJECTS that you associate with your childhood impression of the united states of america. these can be personal items, famous items, any physical object. (long answer)

PRESENT DAY

what is your current impression of the united states? how was it formed? if you live in the united states, how has residing there changed or helped to form your current impression of the country? (long answer)

please list some OBJECTS that you currently associate with the united states. again, these can be personal, political, famous, etc, any physical object. (long answer)

FUTURE

what do you believe the future holds for the united states of america? what makes you think this? your answer can be honest, silly, political, anything you think fits the question. (long answer)

please list some OBJECTS that you associate with the future of the united states. yet again, these can be personal, political, famous, etc, any physical object. (long answer)

THANK YOU!

if you have any questions or concerns, don't hesitate to email me at geiringer@newschool.edu

do you have any other comments about these questions? please, anything you have to say is extremely welcome! thanks again!! (long answer)



Appendix B: Questionnaire Responses

For the entire list of questionnaire responses, please refer to the webpage for this project, stable link is:
http://www.jjeffregeiringer.studio/pages/OA_1.html

Appendix C: *Object Americana* Videos Online

- Skull point-cloud generation video (3/4 view): <https://vimeo.com/406663314>
- Skull point-cloud generation video (front view): <https://vimeo.com/406663513>
- Skull-AR-15 point-cloud GAN training video (short): <https://vimeo.com/406663685>
- Skull-AR-15 point-cloud GAN training video (long): <https://vimeo.com/406662913>
- Special* “boneGAN” human skeleton point-cloud GAN training video (not mentioned): <https://vimeo.com/406663616>
- skull-ar-15-6e12{skullgun2} Human meshing video, 5 hours of meshing condensed: <https://vimeo.com/406663823>

Appendix D: Thingiverse Models

- “Statue of Liberty,” submitted by user ‘ghost3D,’ <https://www.thingiverse.com/thing:311351>
- “McDonald,” submitted by user ‘M3thyl,’ <https://www.thingiverse.com/thing:2987062>
- “Trump bust large,” submitted by user ‘dave12675,’ <https://www.thingiverse.com/thing:2808215>
- “JohnEsc McMansion,” submitted by user ‘johnesc,’ <https://www.thingiverse.com/thing:1340845>
- “Guillotine,” submitted by user ‘vintz,’ <https://www.thingiverse.com/thing:2664732>
- “croco-bike 2040” submitted by user ‘Gab_9,’ <https://www.thingiverse.com/thing:41206>
- “US Flag”(modified for this project), submitted by user ‘SuarezLuis,’
<https://www.thingiverse.com/thing:2303676>



thanks for reading!

