Code-breaking: curiosity through the critical examination of 'cultural software' in architectural education

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ABSTRACT

As computational technologies continue to proliferate in architectural education, from digital fabrication and parametric design to BIM, the underlying socio-political implications of the software used every day by students is rarely questioned. This paper will call for architectural educators and their students to examine where our reliance on software of all forms is leading the profession. Lev Manovich's writings on new media have exposed how the type of creative software packages we teach students to use, which he terms *cultural software*, have developed on a trajectory that both simulates and subsequently extends traditional modes of representation. Manovich defines how Photoshop has affected visual tradition, transforming the collage from a radical statement performed through pictorial juxtapositions to the smoothed and blended apolitical imagery we see in the contemporary architectural rendering. Likewise, the proliferation of software for leisure such as social media and videogames and the influence they have on the politics of the user has been discussed in the works of Manovich, Ian Bogost and Alexander Galloway, however not with a specific focus on their meaning for architectural education and practice.

This paper considers the ways in which architectural students can become more curious about the software they use to design, communicate and mediate the city around them, and how they can shape the politics of the profession through this attitude. The paper will introduce a series of case studies, outlining strategies for curiosity through reference to design projects including work produced by students of my studio. One case study involves investigations into popular mapping technologies such as Google Earth, and how the 'glitches' within the algorithmic application of photographic textures onto 3D geometry can be seen as a new digital vernacular. A further example will examine the role of Minecraft as a non-specialist tool for architectural design, and question what impact recent movements to use the game for public engagement with city planning processes might have on the profession. Other case studies explored in the paper include the potential role of free game engine software such as Unity3D and low-budget virtual reality systems including Google Cardboard in allowing architects to produce fully navigable virtual spaces and how this provokes curiosity through the enabling of spatial and atmospheric prototyping. The paper will argue that we can use the new media theories of Manovich, Bogost and Galloway to outline design methodologies for students promoting the curiosity to question, reject, or break the software and interfaces they are

typically trained to be proficient in. I argue that despite institutional drives towards the technological 'cutting-edge', much of today's most technically and politically engaged student work will come from those who seek to peel apart the technologies we might dismiss as every-day - our free tools for seeing the world around us, for consuming, generating and communicating pop culture or for creating interactive fictional spaces and stories.

PAPER

We can say with some certainty that any architectural student undertaking their education today will at some point produce work using software. Whether or not they choose an institution or studio that aligns itself with 'computational design', or instead pursue agendas that privilege say, hand drawing or live-site work, it is highly likely that some form of software will be learned and used in the production of a project. This might be an *Autocad* drawing for fabrication, a Photoshop visualisation, or the production of a portfolio on *Indesign*.

These applications are what media theorist Lev Manovich (Manovich, 2013) has termed *cultural software* – "certain types of software that support actions we normally associate with 'culture.'". This software does not necessarily require knowledge of code, and typically utilises a Graphic User Interface (GUI). Yet as Manovich points out: "Given that today the multi-billion dollar culture industry is enabled by media applications, it is interesting that there is no single accepted way to classify them." Manovich's attempts to categorise these programs and frame their impact might leave an impression on how we understand the relationship between architectural design and software. What I believe to be key for education is how we interrogate our day-to-day operation as designers today. As Manovich says, this concerns our use of software on many levels:

> "Therefore, if we want to understand how software has already re-shaped media both conceptually and practically, we have to take a close look at the everyday tools used by the great majority of both professional and non-professional users – i.e. application software, web based software, and, of course, mobile apps."

In looking at cultural software we may also be forced to admit that the energy of Internet communities and the creativity of 'amateur' designers (if that definition holds) challenges the boundaries of the profession. When the Smithsons (1956) said "But today we collect ads" they positioned themselves in the lineage of Gropius' interest in grain silos and Le Corbusier's fascination with aviation. But advertisements were different from industrial technology, representations designed to create impulses in popular culture. The Smithsons declared that architects could learn from the 'pace-setting' of the advertising industry and its engagement with ordinary people. Reyner Banham (1981) was similarly documenting the effects of mass produced pop cultural *gizmos* and media on our landscapes. Contemporary writers and artists such as Douglas Coupland and James Bridle give us some sense of the current situation – Coupland's *Generation X* (1996) and pixelated Orca whale statues and Bridle's blog-cum-art-movement *The New Aesthetic* (2011) becoming a repository for the collected debris of our digital realms, ironically brought together under one snappy title.

It seems none of these projects were necessarily defining the 'epochal' architectural style of our time but were about elucidating links between architecture and technology through everyday technologies that affect most people. *Reddit* can be a hive of questionable internet culture, and a platform via which the US President can communicate. The virtual city of *Los Santos* in *Grand Theft Auto V* can have over 54 million visitors in two years

(Loveridge, 2015) and 48 minute daily cycles. Do we as educators retreat from the intensity and diversity of activities taking place on blogs, feeds and forums, in free paint programs or in videogame worlds - or embrace them, like the Smithsons or Banham would have?
By fostering curiosity towards how such cultural software has altered traditional methods and media of architectural design, we can encourage learning that embraces all the contradictions and conflicts of our technological world, rather than aligning ourselves to one camp of 'digital design'. Drawing from the work of media theorists such as Manovich and Alexander Galloway, and game theorist and designer Ian Bogost, this paper will attempt to outline ways in which we might we encourage the curiosity to question and subvert the tools that mediate our modern cities. To do this I will introduce some case studies of student work that I feel is beginning to 'code-break' some of the logics of digital pop-culture and derive architectural agendas from it. These examples would not be considered 'digital design' in our typical understanding of the term - instead they peel apart cultural software conditions and discover how architecture might exploit these new situations.

REMEDIATING REPRESENTATION

In *Software Takes Command*, Lev Manovich outlines a history of 'cultural software'. He uses a set of pioneering computer engineers as reference points, in particular the *Sketchpad* work of Ivan Sutherland (Manovich, 2013) to create "a communication system between two entities: a human and an intelligent machine." He demonstrates software that first 'remediates' existing media (for instance, pen on paper) and then extends its capability (for instance repositioning vertex points along a line in CAD).

CAD remediates and extends the line drawing. *Photoshop* remediates and extends painterly and drawn effects, as well as photomontage and collage. 3D modelling software encompasses both planes and (in software such as *ZBrush*) a sculptural process of hewing form from a material, extending into rendering and fabrication. BIM remediates the organisation and interpretation of drawn materials and adds the functionality to quickly export further media from a master model.

Manovich makes clear that we cannot entirely divorce our work in cultural software from history:

> 'These new media would use as their raw "content" the older media which already served humans well for hundreds and thousands of years – written language, sound, line drawings, and design plans – and continuous tone images (i.e. paintings and photographs). But this does not compromise the newness of new media. Computational media uses these traditional human media simply as building blocks to create previously unimaginable representational and information structures, creative and thinking tools, and communication options.' (Manovich, 2013)

Every time a student or practitioner constructs a collaged view in Photoshop, or produces a site map using GIS data, we are utilising programs that take many of their principles and symbolism from non-digital media that came before. But this does not mean they have not changed them irrevocably – becoming tools of "permanent extendibility" (Manovich, 2013). Manovich questions whether Photoshop may have turned the photomontage from a political device into one that smooths over difference, the tool used by architects and students the world over to obfuscate undeveloped parts of the scheme that did not meet the deadline.

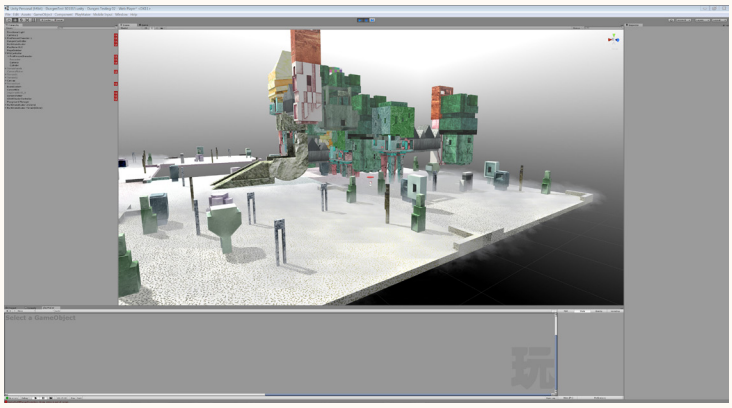


Figure 1 Author's own screenshot, Unity 3D Game Engine. 2015

To see the seductive images of an end-of-year show or in an international competition is often to see Photoshop wielded in such a way, a texture applied here, a contrast adjustment there, a generic tree or a person smoothed into the context and equalised. But can we encourage the use of these remediating and extending tools in different ways, to reintroduce idea of the rupture as a tactic? Being critical about software is doubly important when we use the same techniques in study or research as in commercial work.

Manovich has previously described virtual "navigable space" as a form of *new media*, and he holds off committing to whether this is a remediation of physical architecture or not. With the rise of easily obtainable game engine software, the ability to produce virtual spaces has become simpler, with engines able to import 3D models from standard architectural modelling programs. If game engines do remediate and extend architectural space, they do this through logic, physics and rendering systems. But if one makes a building model and uses a game engine for a *walkthrough*, it will appear differently on *Unity 3D*, *Unreal* or *Cryengine*.

We can also add rules and protocols to interactions in our virtual building that allow us to design the ways the user can engage with it. These are the rules can make arguments that Bogost (Bogost, 2007) terms "procedural rhetoric." The virtual navigable space allows us to extend architecture through the application of rules and representations directly into it. Clearly the simulated space is a representation in itself. But their internal collapse of the gap between representational rule and experiential space seems to open up new opportunities for design.

With low cost VR technologies such as Google Cardboard we can imagine this enmeshing becoming much more obvious, as one can have a 1:1 equivalent viewpoint into a 3D navigable space. Is there then the potential to 'inhabit' a space mediated by representational rules – do game engines offer us the chance to *live the drawing*?

I would suggest that the future of architectural 'code-breaking' might not be in photorealistic walkthroughs, but in students becoming curious to exploit the aesthetic possibilities of videogame space for speculation. By combining the procedural and representational, game engines appear to be the cultural software that may allow us to encode persuasion and politics into navigable space. But if this might be the preserve of new speculative projects to come, what does cultural software *currently* do to our physical world?

GLITCHING SPACE

Our conception of the 'site' is now under the pull of technologies for the 'remote viewing' of space. Student projects and competition submissions sited across the world utilise *facsimile* versions of the built environment, the spatial information brought to hand through various cultural software. These interfaces are undoubtedly useful, even liberating in the possibilities they offer to traverse and comprehend remote locations. But they are by no means devoid of politics or potential inconsistency. As Mark Dorrian (Dorrian, 2013) argues, if the famous 'Blue Marble' photograph of the earth taken by the Apollo 17 astronauts framed the planet as a "single organism", then the "suturing" of multiple images together into the Google Earth globe – as he puts it – demonstrates a globe under the logic of surveillance imagery and algorithmic processing.

While it may appear architects now have the ability to explore a site from wherever in the world, it is not without its errors. The 2012 release of Apple Maps was accompanied by copious screenshots detailing the glitches that saw freeways melt into hills, monuments become flattened and cities moved hundreds of miles. Sites such as http://theamazingios6maps.tumblr.com/ popped up to document this weird new urban realm of glitch and half-truth. As with much cultural software activity the identification and communication of these errors was firstly through Internet communities and social media users. Through their exposure of the everyday glitch these users opened up new lines for architectural curiosity that question the status of the site itself.

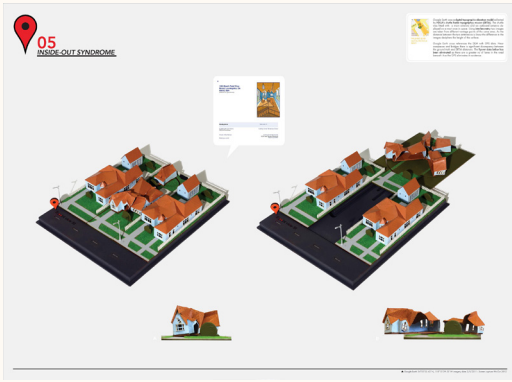
But as these slippages and meshes that take place in software are also clearly sited in reality – are there new hybrid sites with which to engage? Away from the rarefied atmosphere of the pavilion or prototype, cultural software such as Google Earth demands our curiosity because it reframes real places and turns layers of our cities into new sites. As Bogost points out, the algorithm does not work in a vacuum:

> "It's not just mapping software running via computer—it also involves geographical information systems, geolocation satellites and transponders, human-driven automobiles, roof-mounted panoramic optical recording systems, international recording and privacy law, physical- and data-network routing systems, and web/mobile presentational apparatuses." (Bogost, 2015)

We can see many layers to the real world that are being pushed and pulled by their virtual framing. Roofscapes become the primary elevations for architectures viewed by satellites. Dubai already expresses its economic and political hubris through buildings designed to be seen from space. To explore the aesthetics of *Google Earth* is to question these layers of digital "scrim" (Crandall, 1999) combining with physical sites. This is about new values placed upon our towns and cities by such cultural software. As educators it seems important to reflect that the computational and digital are *never* isolated from the world they inhabit.

My first case study is an undergraduate student Chiara Barrett, whose work tackled precisely these issues – that our built environment is being mapped and recorded in new ways, and that we, as architects should interrogate this.

Chiara's research was entitled *The Tenets of Google Picturesque*, and was produced as part of a project we ran called *Facsimile* in 2012. We asked students to critique the tools they would use to remotely understand a city and propose modes of engagement from afar before visiting it on a field trip. Her project sought to peel apart the ways in which



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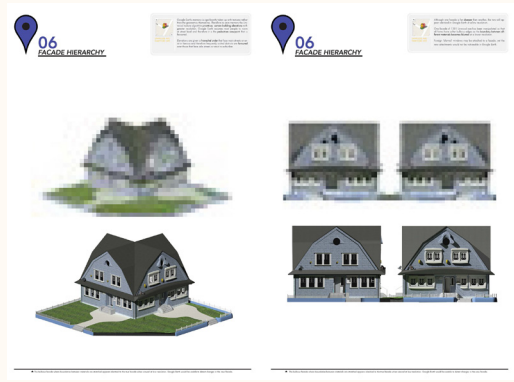


▲ Figure 3

Google Earth combined modelled geometry and texture mapping in its three dimensional cartographic representations. As explained by Clement Valla (2012), this combination is automated through a patented algorithm called *The Universal Texture*, and Chiara's research sought to unpeel how physical architecture placed into a city may provoke this algorithm into certain behaviours through its design. In this case then, an algorithm used by millions every day as part of a cultural software program is seen as something architecture could react to in physical space, a form of site context.

Studying the city of Los Angeles, Chiara developed a classification system for the different types of glitches that appeared while traversing a representation of the city using *Google Earth*. As an algorithm applied to representations of cities, she identified how *The Universal Texture* behaves in certain ways in particular situations, thereby establishing a series of typologies for cause-and-effect scenarios within which an architect might engage.

In one example of behaviour, *Façade Hierarchy*, [Figure 02], the quality of mapped imagery varied between the size and perceived importance of roadways – main roads had higher quality mapping, producing buildings that had 'slippages' between different resolutions across their facades. Taking a house in the Pico-Union district as a case study, she proposed disruptions to one face of the building, distorting and abstracting its joinery and ornamentation within a gap that Google Earth opened through the resolution slips of its texture mapping. Another typology *Inside-Out* [Figure 03] dealt with how the algorithm appeared to collapse buildings and turn them inside out producing strange interior conditions. And a further study, *Vessel Distortion* [Figure 04] explored how buildings might react to the precise height and position of the Google *Streetview* car photographing elevations. In these cases, the behaviour of the *Universal Texture* algorithm gave Chiara new sites for engagement, that slipped between virtual and the real.

The study trip becomes particularly important, allowing one to judge the situation on the ground and make comparisons with the represented version of a city viewed remotely. Being able to scale and record a site, seeing its cultural and physical context with our own eyes, allows us to remain critical of the mediated versions of reality that we are given by the proprietary systems of Google, Bing or Apple. For a curious student, perhaps there now exists three sites, the real site, the mediated equivalent, and the ruptures or gaps between the two. Of course, the glitches Chiara observed in 2012 have now most likely been smoothed over.

Figure 4

Figure 5

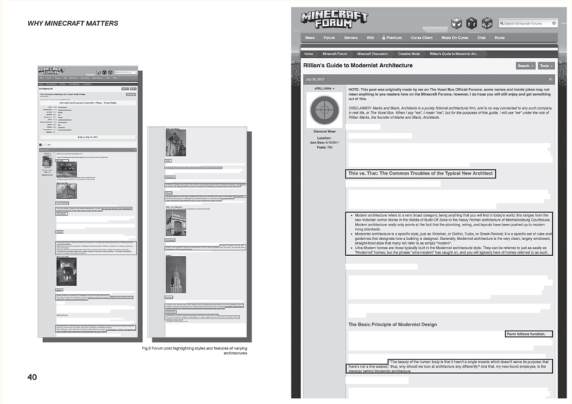


Figure 6

This was not a 'digital' project in the conventional sense yet it was predicated on exploiting the gaps between the version of reality we are presented by cultural software and physical conditions – drawing the algorithm out of its isolation and into a context. I believe our role as educators in this process is not to just dispense paradigmatic approaches towards the digital, but encourage a healthy desire to question what we are being offered by 'progress.' After all, nothing is free, Google's cultural software blurs boundaries between consumer and producer further by offering open services in exchange for monetising our personal information.

In Chiara's case, the exploitation of glitches became a methodology for the production of further projects, designing a governmental building and questioning ruptures between the illusion of transparency and security.

In blurring boundaries between a building and its facsimile, I believe she developed an architecture critiquing Galloway's (2012) version of our society of control: "Reflective surfaces have been overthrown by transparent thresholds. The metal detector arch, or the graphics frustrum."

If our perception of physical context has been changed by cultural software, and can offer new ways of thinking about digitality, then the next case study explores how a social context might grow and blur the divide between 'professional' and 'amateur' architectural practitioners.

CRAFTING COMMUNITY

When we examine how cultural software might affect architectural practice what sources might we draw from? Platforms such as *Tumblr* or *deviantART* provide the ability to showcase and transmit designs, being flexible enough to run from a blog of reposted memes to a primary portfolio of work. If cultural software such as *Google Earth* has given

us new gaps in space to exploit, then online communities may make us question our social context.

My second case study is a Masters Thesis student I supervised, Marcus Stockton, whose study *Importance of the Block: Why Minecraft Matters* (2015) attempted to outline what impact the popular videogame might have on architectural design. Minecraft (Mojang, 2011) is possibly the most well-known videogame in the world, a landscape of colourful blocks where one literally mines cubes of terrain and crafts using particular material combinations to produce a whole range of different built elements.

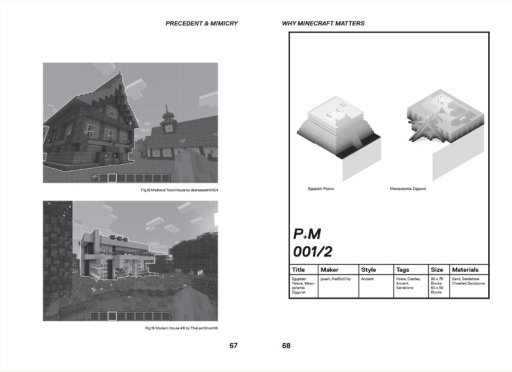
Its saturated visual style melds *generation Y* videogame nostalgia with the world of Lego, and has turned *voxelisation* into a trend reflected by cultural software such as *Qubicle* (Minddesk, 2015).

Minecraft has a 'Survival' mode that is notionally the 'story' where the player must make shelters in order to protect themselves from monsters emerging at night. But it is the free reign to build spaces and construct communities that has elevated it from a small-scale 'indie' game into a global phenomenon. Throughout this process the feature-set of the game has grown, as has the user base, and the wealth of its creator, Markus 'Notch' Persson. But many of the decisions on the feature set and logics of the game were developed through close conversation between Persson and the Minecraft community on internet forums.

The game spent two years from its initial release in Alpha and Beta as a growing, unfinished product. During this time the community expanded and participated in this testing process, contributing their ideas to the software. As such, in initial conversations with Marcus it became clear to us that the only way he could adequately judge the growth of this game, and its impact on architecture, was through using the websites on which they congregated as a source itself and participate in that community.

Minecraft has a large community exploring the possibilities the game offers as an ersatz architectural tool. As Marcus discovered, it was the second most searched term in Youtube in 2014 (Stockton, 2015), and there is a huge number of people sharing video tips and tricks for building structures within the game. Alongside this, there is a large number internet forums such as *Minecraft Builders Inc.* with complex manuals for the constructions of certain building typologies and strategies for success in exploiting the randomly generated environments that Minecraft provides at the start of the game.

Furthermore, Marcus' research utilised some of the gamut of *freeware* programs designed to transfer information to and from Minecraft itself. These modifications extend Minecraft from a game into a cultural software under Manovich's terms - for reading and writing information. *Chunky* is a freeware program for rendering within Minecraft giving users to the ability to create high quality imagery of their creations from multiple viewpoints. *Mineways* is another program for exporting terrain from the game into file formats for full colour 3D printing. This has since extended into *Printcraft*, which claims to be "the world's first 3D printing multi-player Minecraft server". Users can log onto a specific multiplayer server with a landscape cultivated for free building. Here, the cultural software extends into the built fabric of the navigable game space itself: "Build something inside the plot. When you are ready press the PRINT button on the control panel. This will send you model off to be processed and write a web link into the Minecraft chat. Click on this link to open the model on www.printcraft.org." (www.printcraft.org)



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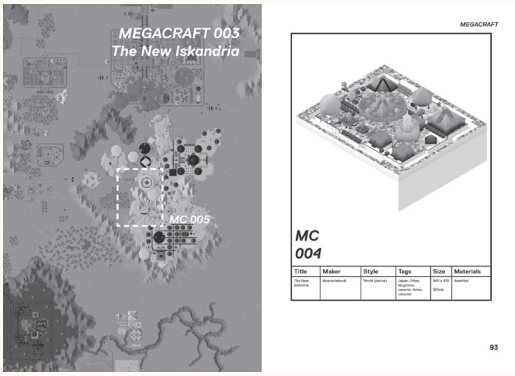

▲ Figure 8

Printcraft is but one collaborative system for the production of designs within Minecraft. Through participating in Minecraft communities and utilising their tools Marcus was able to build a system for categorising different types of behaviour within the community in order to understand how this cultural software worked for them. Identifying typologies allowed him to demonstrate certain approaches or techniques that players adopted in order to create structures within the game, offering insight into what their motives might be. In Marcus' case, these examples varied from small shacks designed to ward off monsters through to the "Precedent and Mimicry" [Figure 7] of real world structures (Stockton, 2015), and onto huge collaborative cityscapes, "Megacraft" [Figure 8] with their own laws and governments. Played in a first person perspective, Minecraft also relies on elaborate choreographies from the user, for instance jumping and placing blocks beneath oneself to act as a form of ladder. These techniques would be shared, as communities explored the limits of the game together. The locomotive constraints of the virtual avatar present architectural challenges within the game that the community has overcome in many creative ways.

As Marcus discovered, to delve into the Minecraft community was to reveal the game as a popular tool for ersatz architectural design – which he termed 'Rise of the Amateur' (Stockton, 2015). While Minecraft's voxelised world with its procedural generation sets the basis for its material composition - what can be *mined* - it is the creativity of its user base that has turned it into cultural software proper. Despite no statistical evidence, it is fair to assume that the vast proportion of Minecraft users (numbering over 100 million) are not qualified architects or training to be. What he ultimately found, is a large community of 'non-experts' producing structures that are communicated via web forums, *YouTube* or *Twitch* with a reach in terms of hits and views that an architect could only dream of. Indeed, a video of the very first build of Minecraft still sits on ***YouTube*** with 9.9m views (Persson, 2009).

We can already see Minecraft being adopted as a tool for architects and planners because it provides a very direct way to engage with people. Marcus cited the ***Blockholm*** initiative by the Swedish Centre for Architecture and Design in 2013, which used the game to engage with citizens having transcribed the city of Stockholm into the game. (ArkDes, 2014) Or *Block by Block* where Minecraft developer Mojang collaborated with the United Nations to provide a tool for residents to decide on changes to their villages and towns, beginning with a playground in Nairobi (Mojang, 2012).

It is clear then, that the game has grown and spread into a piece of cultural software that is being applied strategically by architects, but what was so interesting in Marcus' study from the position of an educator, was the curiosity to look into the emergent communities that effectively helped build the phenomenon in the first place. Within these places, Marcus found all manner of 'amateur' creativity taking place – computational pop culture growing into a social and spatial tool.

To turn again to the Smithsons (1956), here we see an incredible 'pace-setting' – large communities inventing and extending cultural software in order to use Minecraft as a tool for spatial design, whether or not they fit within the confines of the architectural profession. Marcus produced a thesis through virtual site work and reportage, exploring conditions on the ground so to speak. As educators surely we need to recognise that new generations of architects will be ever more familiar with cultural software and their online communities – what possibilities for creativity they present, how they challenge the notion of expert and push at the boundaries of what architecture might be.

CARICATURES AND COMMODITIES

One of the main powers of videogames as cultural software (or product of) is that they twist versions of reality under their rules, and those rules can say something – much as Minecraft's rules instigated a landscape of free creativity. Ian Bogost argues that all algorithms "take a complex system from the world and abstract it into processes that capture some of that system's logic and discard others" (Bogost, 2015). For Bogost, videogames are the sole type of algorithms which celebrate the fact they are caricatures, and this is their potential power as a critical tool. Indeed, Bogost himself has written at length in *Persuasive Games* (2007) about how videogame rules promote certain behaviours in players. So if we move on from Marcus' study of Minecraft as a platform for 'amateur' expression – are there other games that students might study for their persuasive qualities, and what it is that a computational caricature might give back to us as architects?

For my final case study I would like to introduce the work of Agostino Nickl which was produced as part of a 6-week workshop entitled *Pressure Drop* in 2015. For Agostino a first interest in the suburban drift of Chicago led to the search for studies or representations of these spatial conditions from which to develop a design agenda. One of the most culturally pervasive but curiously abstracted representations of suburban life - with its economy of mass production and commodification - is *The Sims* by Maxis – a 16 year old series of 'life simulator' games. In an autobiographical move, Agostino chose to analyse the original *The Sims* (2000) because it was a game he played as a child, a virtual dolls house for a new generation of architects.

The Sims is arguably a consumerism simulator, Sims work to make money, and their happiness metrics are determined by objects placed within their suburban homes. Although we see our Sims day to day lives, we never see the world from their perspective like Minecraft, but from a disembodied 'god' view. Watching a virtual life unfold from this close, yet detached view is – as Michael Nitsche (2008) argues – akin to our obsession with reality TV.

If The Sims is a caricature of suburban life, then Agostino was interested in how the suburban home and its objects contributed to these metrics of happiness, and how its cartoonish logics may be persuading us towards certain behaviours. In Bogost's terms, the game is *persuading* us to make our Sims into productive citizens, who get a better job, to earn more money, to consume more, and repeat. Because this is a videogame it wears its

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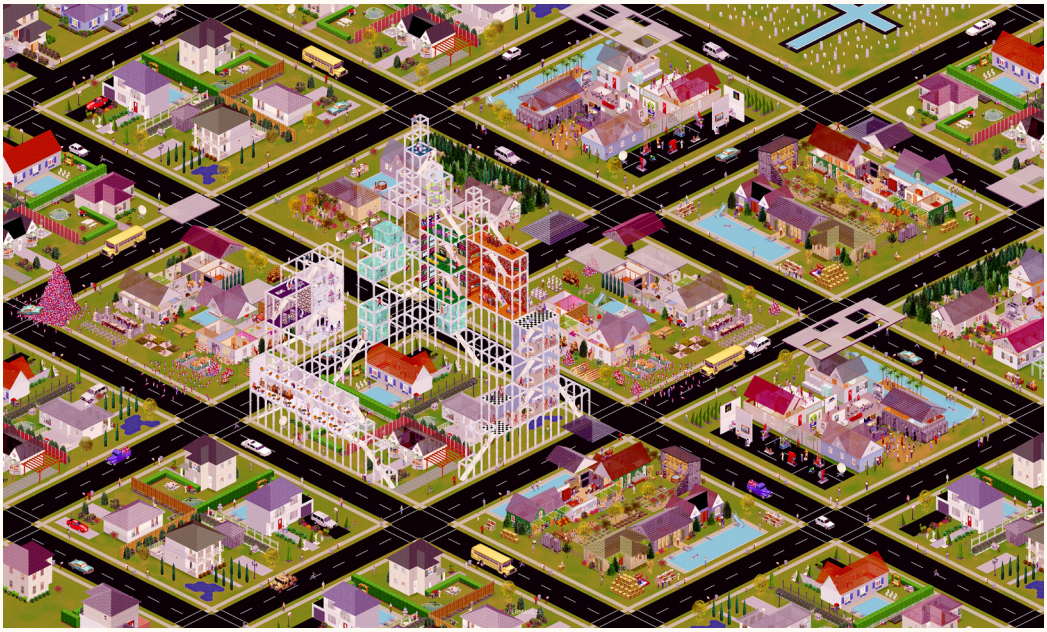

▲ Figure 11

caricature status on its sleeve (Bogost, 2015). Agostino developed a series of tactics for disrupting its systems – to the extent of exposing them to the physical world.

In order to draw out the suburban logics of *Pleasantville*, Agostino had to play it. And in doing so, he rediscovered its critical agency and relocated some of The Sims' *persuasive* (Bogost, 2007) aspects back into the real world. Through a series of calculations, Agostino revealed that the typical daily cycle of a Sim leaving for work to earn money and returning in the evening to spend it on commodities could be reversed. In fact, self-employment and working from home were more efficient ways to create wealth. He identified *garden gnomes* as Pleasantville's most efficient economic activity. Through playing the game Agostino found that a Sim at the maximum 'crafting level' could produce 21 gnomes per day, netting themselves an income of $2100.

Gnomes are a serious business. As they also are in the original town *The Sims* caricatures. On April 17th 2014 the Levittown police logged the theft of a *Philadelphia Eagles* themed

gnome (Sofield, 2014). With an estimated value of $25 in reality, one quarter of the in-game value, it appears *The Sim*s really has privileged the importance of gnomes to its economic system. As such, his proposal, entitled *Permaville*, sought to rebalance the spaces of suburbia through collective living predicated on the gnomic economy.

The gnome became emblematic of *The Sims*' economy – and ironically it seems, is not too dissimilar to our real working situations. As Galloway (2012) argues: "It is impossible to differentiate cleanly between non-productive leisure activity existing within the sphere of play and productive activity existing within the sphere of the workplace." This reinforces the fact that technology cannot be separated from politics or indeed frivolity – we might encourage students to marvel at Amazon's advanced algorithms for picking objects out of a warehouse, but as Bogost (2015) argues, to see how multitudes of people are involved in the chain we only have to look at the world. For instance, the CHINA photography of Edward Burtynsky, or recent revelations about *Sports Direct*. Having revealed gnome-making as a lucrative profession – Agostino set out to compare this digital caricature to reality, by becoming a gnome maker himself.

Agostino constructed three gnomes to compare with the material economy of The Sims. One was carved by hand from timber, one 3D printed and one CNC machined. [Figure 9] By producing a time lapse film, *Reality Check*, he was able to relate the rates of production between a handmade object, an object that requires formatting in cultural software in order to be machined, and how quickly a Sim would do an equivocal job. [Figure 10] The gnome becomes an artefact that straddles the digital and the hand crafted, each displaying a different quirk unique to its method of production. He then developed Permaville into a townscape [Figure 11], drawings composed using screenshots from the game - where suburban plots were allowed to develop in different directions according its logic of suburban productivity, a once idyllic landscape overflowing with gnomes. For Agostino, The Sims and its caricature of suburbia gave him a route into a critique of real logics of mass produced and commodified architecture.

If this seemed an ironic application of videogame logic onto a suburban townscape, writers such as Galloway (2012) remind us that it is not so different from reality. Young people in China genuinely do farm gold in *World of Warcraft* as a new form of networked menial labour. Agostino's application of the gnome reminds us that cultural software bridges the gap between the computer and the physical artefact, and that there might be embodied symbolism and politics in the objects that emerge through our fabrication machines – if we encourage students to look deep enough.

Code-Breaking

To teach, or study, architecture today, is to be implicitly engaged in the use of software. In the case studies I have shown, I have attempted to outline methods and projects set up to expose other avenues in which technology has had an impact. To ignore the massive changes in popular culture caused by computation, to chase the tail of the 'avant-garde', will miss the chaotic, contradictory, symbolic and emergent properties of digital culture today, from software *modders* to grandmothers on *Facebook*. Just as the Smithsons were attempting to code-break advertising in order to understand how desire was mainlined into the population, so today we should encourage our students to break their tools, to find glitches between digital and physical and to develop Frankenstein architectures that remix, mashup and caricature.

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