

MPhil/PhD Transfer Report

anti-thesis: the dialectics of generative art (as praxis)

<<http://www.anti-thesis.net/>>

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```
>list
>10 let thesis$ = "1"
>20 let antithesis$ = "0"
>30 LET synthesis$ = (thesis$ + antithesis$) + synthesis$
>40 print synthesis$
>50 goto 30
>run
saved dialectics.bas
```

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anti-thesis: the dialectics of generative art (as praxis)

synopsis:

My research arises from a critical (Marxist) tradition that considers cultural and technological processes as inextricably linked. By examining the production of generative art, I aim to foreground the work of the artist-programmer and extend this to the software they produce. There is a wealth of history in applying this mode of analysis to the production of artwork, emphasising the process rather than end-product (literally the work not object of art). My concerns are specifically in recognition of considerable changes to the mode of production, making apparent the relative invisibility of the programmer and the consequences for the development of a critical practice in generative art. This approach challenges the usual relations of production when making art using computers, where the programme and technical apparatus as well as the effort of the programmer are often hidden, and on a cultural level, subordinate to that of the end-product or artist.

'Generative art' is a contested term but for my purposes refers to artwork that is broadly rule-based, a further understanding of which has been informed by the co-curation of the touring exhibition *Generator* (with Spacex Gallery, UK).¹ The exhibition title 'generator' describes the person, operating system or thing that generates the artwork, shifting attention to the interaction not separation of these productive processes. Significantly, once the rules have been set, the process of production is unsupervised, and appears self-organising, though only if knowledge of other aspects is suspended. As a result, although generative art might appear autonomous and out of control, my argument is that control is exerted through a complex and collaborative interrelation of producer/s, hardware and software. The relations of production within generative artwork are thus seen to be decidedly complex (its operations not open-ended or closed, as complexity theory and dialectics would verify). Like the programmer, the code that lies behind a generative artwork remains relatively hidden and consequently difficult to interpret.

Generativity seems to lend itself to the description of the mode of production under present cultural and technical conditions, wherein emergence and complexity have become the predominant metaphors. I wish to argue that the contemporary mode of production can usefully be articulated in terms of generative processes in lieu of the regenerative mechanisms built into the political economy. In its extreme perhaps, all contemporary production might be seen to be generative. To exemplify this, I wish to argue that dialectics is an appropriate methodology to understand how change is inherent to generative art produced on a computer, and that change might be prompted by those with a working understanding of how these systems operate.² To understand these complex and contradictory relations, dialectics presupposes that all elements of a system are part of an integrated totality of production. Dialectics suggests that nothing is finished or resolved but, in line with my argument, in a continual

¹ I will define 'generative art' more closely in the main text and explain how the exhibition relates to this by combining old and new media, instruction pieces and rule-based artworks.

² By 'system', I am simultaneously referring to social and technological operations.

state of change, appropriate to the emergent properties of generative artwork using computers.

In this way, my research suggests that socially-engaged contemporary artists might usefully produce work in the field of generative art as this lends itself to a description of current conditions and the transformation of the mode of production into an ever-more integrated self-regulating machine. To support this argument and to articulate a critique, I will construct a generative artwork in parallel to the thesis. Rather like looking at the source code of the PhD, the thesis will be embedded into the code of the software (as the practice-based PhD submission), supporting the integration of theory and practice, as 'praxis'.³ Thus, the research project will aim to demonstrate generative art as a form of praxis as something that is to be executed or that requires action, making a parallel between the production of the work itself (artwork/thesis) and the potential for generation (social transformation).

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1. introduction (technology and culture)

Practices that combine the fields of art and technology have a complex history and employ a contested range of terms such as 'media arts' (Schwarz, 1997). More recently, the term 'information arts' has gained some currency (Wilson 2002). The contemporary artistic preoccupation with software production or an interest in the aesthetics of code itself, as opposed to the commodity production of art, traces an art historical lineage (from Dada with its experiments in 'automatism'), to conceptual and performance art that have all mounted a challenge to art's commodity form.⁴ A history of generative art has yet to be compiled.

Historical change can be viewed as a 'continual process of anticipated futures and reconstructed pasts', generating 'spiral-like patterns', (Foster, 1995) making explicit reference to Freud's notion of 'deferred action' but more significantly to Benjamin's poetic notion that 'every epoch dreams the next'. In this way, any conception of the present is dynamic and unsettled (from 'Thesis on the Philosophy of History', 1992, written in 1940, explicating a 'historical materialist' position). Rather than accepting discrete epochs or periodisations (postmodernity for instance), this approach suggests that each period builds dialectically on the previous one and then releases new energies as a result of the contradictions that arise.⁵ In the context of

³ By the use of the term 'praxis', I refer generally to practice or action informed by theory in the Hegelian tradition. In this way, theory is made meaningful and is tested by practice (or vice versa). Thus, the opposition of theory and practice is surpassed and I hope it is clear why I am using the term praxis in the context of a practice-based PhD project.

⁴ Florian Cramer's essay 'Concepts, Notations, Software Art' (2002) provides a useful set of references in this regard.

⁵ In general, this can in many ways be seen to be the idea of the return of history (Jameson, 1991) rather than the proposed 'end of history' of Fukuyama (1992). Jameson offers the term 'late-capitalism' to counter the popular phrase that Bell called 'postindustrial society'. Jameson is drawing upon the work of the economist Mandel in *Late Capitalism* (1978) to suggest a corresponding series of cultural epochs. These periods are dialectical in that their expansion is in parallel to the previous period's stagnation. Jameson describes them as: (1) market capitalism; (2) monopoly capitalism, or the stage of imperialism; (3) multinational capitalism, or what some people wrongly call the postindustrial period (1991: 35). These periods expand capital's reach and further enhance commodification and cheap labour. Jameson relates these economic stages directly

technological change, these examples serve to emphasise that technology does not determine change but reflects the development and contradictions of global capital. Many reference texts cite Benjamin's famous essay 'The Work of Art in the Age of Mechanical Reproduction' written in 1935/6 (1999) in this regard to stress that culture and technology must be seen to be entwined. For Benjamin, industrial processes and mass reproduction suggested fundamental shifts in the nature of art production, and relations of production.⁶ This is not to say that this remains unchanged but that there is a distinct organisational logic related to technological change that currently relates to networking and the form of information technology (Castells, 1996). I aim to argue that these are material (and immaterial) changes, and might be better understood through dialectical thinking. The materialist position is important as this further emphasises the distinction between received 'mechanical materialism' and 'historical materialism' that includes human activity as a primary force. This was Marx's interest in human interaction; in the ways people 'work' on physical things and the relations they enter into when they do this.

In approaching issues related to technology, my critical method draws upon a tradition of historical and dialectical materialism. This resists the temptation to invent new terms (or neologisms) such as 'dialectical immaterialism' which Lunenfeld (2002) uses to characterise critical discussion about technology 'untethered to the constraints of production' as I see production as paramount to analysis (although as will be seen later in the report, I do accept the usefulness of the term 'immaterialism' in the work of Lazzarato, Hardt and Negri, 2000). The research aims to apply this approach to the production of generative art as a critical practice.

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2. artist-programmer

It has become a truism to argue that all texts (and any cultural phenomena for that matter) are subject to the historical and cultural conditions of their production. The creative subject - author, artist, computer programmer, software producer - is thus only ever part of the story. Here I make direct reference to what Burke has called 'the death

to cultural production, as follows: (1) realism - worldview of realist art; (2) modernism - abstraction of high modernist art; and (3) postmodernism - pastiche (as distinct from parody).

⁶ My previous collaborative work (1997) attempts more detail on this <<http://www.obsolete.com/artwork>>. The significance of this reference is emphasised in the number of commentators who have attempted to recast this argument in terms of contemporary technologies in keeping with the direct translation of the title itself: 'Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit' (1936) / 'The Artwork in the epoch of its Technical Reproducibility' (Berger, 1972; Nichols 1988; Leslie, 2000; to name but a few). Benjamin argued the subsequent loss of art's 'aura' had particular significance: 'But the instant the criterion of authenticity ceases to be applicable to artistic production, the total function of art is reversed. Instead of being based on ritual, it begins to be based on another practice - politics.' (1999: 218) In *The Transparent Society* (1992), Vattimo develops Benjamin's idea of the significance of the Dadaist aesthetics of shock (1992). My argument would suggest that radical aesthetics needs to be re-evaluated in the context of generative systems - where aura is disrupted in ways that are more appropriate to the technological and cultural conditions of late capitalism. In the digital age, Richard Wright thinks the revolutionary aesthetics of montage have been usurped by the aesthetics of transformation (1998). I would like to argue that montage (the coming together of radically opposing or contradictory forces), because of its dialectical oscillation, is still appropriate if defined more closely and in the spirit of generativity in resisting dry technicist automation; in other words, as part of a process that leads to transformation.

and return of the author' (1992, referring and upgrading Barthes's essay 'The Death of the Author' 1977, first written in 1968). I would argue that 'The Death of the Author' was meant strategically – to shift emphasis to the words on the page, or the nature of the surrounding language and discourse (Barthes, 1977) – and away from associated myths of originality and genius (Hutcheon, 1991). The corresponding 'birth of the reader' has been interpreted rather literally in the cultural field which is something I aim to address in my research (I will discuss this more in a later section on the linguistic metaphor, pp. 9-10).

Evidently, authors has not simply disappeared, but are recast in recognition of their own constructedness (Foucault, 1984). To state the obvious, even Barthes is the author of his own position on the author's disappearance. By this point in the study, 'The Death of the Author' appears far too literal (too final, morbid even) a metaphor to offer a critique of the productive apparatus by which contemporary creative operations are organised and regulated - perhaps in particular, when using computers.⁷ Whereas Burke (1992) argues that the author is not dead but is profoundly alive, through deconstruction, it might be argued that too much emphasis has been placed on discursive frameworks and subjectivity at the expense of an examination of the productive apparatus itself.

However, examining subjectivity remains an effective way of recognising that cultural products employ strategies to try to fix subject positions (to sell, interpellate, etc., Althusser, 1997/1969). This sentiment is forcibly stated in Zizek's *The Ticklish Subject* (1999) that lends currency to an engagement with the political economy. Zizek persuasively demands a 'recentring' of political consciousness despite its problems (as uncovered by the post-structuralist description of decentred subjectivity described earlier). In the context of what he calls a 'post-political' stance and the apparent failure of 'identity politics' (with its multiple forms of subjectivity), the 'absent centre' serves to obscure socio-economic forces (Zizek, 1999).⁸ With this in mind, what is perhaps required is to approach creative subjectivity in the manner that Benjamin suggested in his essay 'The Author as Producer' (1992/1934), in which he recommends that the artist (or cultural producer) actively intervene in the production process, in order to transform the apparatus.

In focussing on the productive apparatus, it is clear that things have changed enormously since the time of Benjamin's essay 'The Author as Producer' (written in 1934). Following Benjamin's cue, by setting the laboratory in opposition to the finished work of art (1992), production is foregrounded. I wish to maintain that critical work on the nature of digital culture (like the execution of computer code) should remain in progress and be subject to continual upgrade, proposing 'technical innovation and revolutionary use-value over mere modishness' (Benjamin, 1992/1934: 96). Benjamin stresses the point that it is simply not enough for artists to demonstrate political commitment however revolutionary it may seem, 'without at the same time being able to think through in a really revolutionary way the question of their own work, its relationship to the means of production and technique'

⁷ See appendix: Geoff Cox and Ade Ward (1999), 'The Authorship of Generative Art' develops some of these ideas.

⁸ See appendix: Geoff Cox and Tim Brennan (2000), 'Manifest: Reframing False Consciousness' develops some of these ideas. I am also using this logic to suspend the negative connotations of using the term 'artist'.

(1992/1934: 92). This remains a fundamental principle in this research project and something I aim to demonstrate by the form of the submission (see later section, p. 15).

On the surface, it seems that many contemporary net.artists and/or net.activists operate in this spirit, reworking the simplistic separation of theory and activism that Benjamin's essay opposes. A number of examples come to mind that appear to demonstrate new forms of 'immaterial subversion' (Mavor, Kluitenberg, 2002). Hacking (or hacktivism) would appear to be a perfect example of such a strategy. However, this is a rather imprecise term and we probably need to define which types of hacker are doing exactly what to whom. A hacker might equally be employed by Microsoft as be 'hacking' into its mainframe. In Benjamin's terms, an activity such as hacking could not be autonomous and must be seen as material rather than merely immaterial subversion, inserted into the context of lived social relations determined by production relations (1992; that remains the key site of struggle according to Hardt & Negri, 2000). What Benjamin proposes as author-producer, I suggest, is usefully recast as artist-programmer (despite the acknowledged problems associated with this 'centredness' – see earlier section, p. 6) to take account of and articulate these changed conditions. The figure of the artist-programmer (some might say 'software artist' and most likely more than one person) appears in a good insider position to be able to interfere with the operations of the system.⁹ I am partly examining the conditions in which this kind of generative production takes place (and producers produce).

Undoubtedly, the conditions and means of production have evolved, and it is now commonplace to construct works that are produced in collaboration with machines where the author-engineer (artist-programmer) distinction that Benjamin sought to collapse has become commonplace and furthermore extended to the creativity of the computer programme itself.

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3. generative art practice

'Generative art' has become a fashionable term currently being employed by academic, creative and commercial sectors, and the phrase appears to lend itself well to describe the conditions under which emergent technologies and creative processes using computers and networks are being realised.¹⁰ My research aims to examine generative art practice

⁹ There is an important issue here in whether criticism operates most effectively from within or outside the system. Post-Marxists (for instance, Deleuze, 1994; even Hardt and Negri, 2000) criticise dialectics for this reason, in that it can only ever operate within the very logic of the system it seeks to criticise. On the other hand, surely this is its strength as it seeks to negate all that is irrational within the system. Is it really possible to operate outside of the system?

Furthermore, I hope this also explains the irony of my (anti-)thesis title.

¹⁰ I organised a seminar at the University of Plymouth (11th April 2002, as part of the I-DATA event) that attempted to engage with some of these ideas: firstly, by articulating ideas around the emerging figure of the artist-programmer - Alex McLean (musician and perl programmer, State51), Joanna Walsh (writer and hacker, Zooleika) and Adrian Ward (software artist, Signwave); secondly, by looking at some possible contexts for this work in the arts and commercial sectors - Jon Pettigrew (Maxus Films, formerly Sseyo who produced the generative software that Brian Eno famously used), Tina Sotiriadi (independent curator working on Vivaria), and Tom Trevor (Artistic Director, Spacex). It was an attempt to demonstrate possibilities in relation to the [new] media sector, contemporary arts practice and the systems or institutional contexts in which these practices operate.

underwritten by the concern that this might be a further stage of the commodification of computer-based artwork, if a critical approach is not developed simultaneously.¹¹ The currency for the term is reflected in the ways in which practitioners are describing their work as generative, and the increased use of the term in media conferences and festivals. Two notable examples are the annual Generative Art conferences held in Milan <<http://www.generativeart.com>>, and the software art category as part of the transmediale festival, Berlin <<http://www.transmediale.de>>.¹²

The category of 'software art' has gained currency too but generative art suggests a wider classification in this context (see the exhibition *Generator* for more on this). There are a number of competing definitions for 'generative art' that serve to make links between systematic and procedural approaches to production across a variety of old and new media (for example, Galanter and Ward offer two definitions on the generative.net website resource <<http://www.generative.net>>). In broad terms, 'generative art' is applied to artwork that is automated by the use of a machine or computer, or by using instructions to define the rules by which the artwork is executed. After the initial parameters have been set by an artist-programmer the process of production is unsupervised, and as such, 'self-organising'. Work unfolds in 'real-time', according to the properties of the technology employed or the particular circumstances in which the instructions are carried out. The outcome of this process is thus unpredictable, and could be described as being integral to the apparatus or situation, rather than solely the product of individual human agency or authorship (this sentiment is in keeping with the earlier section 'artist-programmer', and a historical materialist approach).

The exhibition *Generator* (co-curated with Spacex Gallery), attempted to deal with some of these issues.¹³ It proposed that generative artworks have a useful analogical relation to the way computer systems (and systems in general) operate and the ways in which artist-programmers might interfere with these operations. This might also be extended to

¹¹ Again, this is in keeping with Benjamin's ideas that the productive apparatus was an essential part of the process (his example is Brecht's 'verfremdungseffekt' - alienation-effect). Nichols (1988) argues that this 'equipment-free aspect' is more pronounced with cybernetic systems, deeply embedded in code and operating systems. It is no longer merely a question of a suspension of disbelief but of our absorption into code; as our interest is diverted from products and objects to process and simulation.

¹² The most recent category definition from *transmediale 03* reads as follows: 'SOFTWARE > Generative Art: The Software category includes projects whose main artistic material is program code, or which deal with the cultural understanding of software. Thus, software is not understood as a functional tool serving the 'real' artistic work, but as a generative means for the creation of 'machinic' and social processes. Software art can be the result of an autonomous and formal creative practice, but it can also refer to the cultural and social meaning of software, or reflect on existing software through strategies like collage or critique.' (<http://www.transmediale.de>) This statement was written by Andreas Broeckmann and Florian Cramer.

¹³ *Generator*, May - June 2002, Spacex Gallery, with funding from the National Touring Fund of the Arts Council of England; touring to Fringe Liverpool Biennial, and First Site Gallery, Colchester, 2002-3. The exhibition presented a series of self-generating projects, incorporating digital media, instruction pieces, experimental literature, and music technologies. The intention of the exhibition was to act as a point of connection for different generative practices across disciplines, using old and new media, and drawing together a younger generation of artist-programmers with more established artists working in the conceptual tradition (such as Stuart Brisley, Tim Head, Jeff Instone, Sol LeWitt, Alex McLean, Yoko Ono, Joanna Walsh, and Adrian Ward). Documentation and further information on the exhibition is on the website <<http://www.generative.net/generator>>.

the mechanism (or 'generative matrix') that regulates these operations. Despite the appearance of order, the exhibition tried to suggest that disorder was just below the surface and this is where change could be found and prompted (especially by those with an understanding of rule-making and programming procedures). The exhibition title referred literally to the term 'generator' in *describing the person, operating system or thing that generates* the artwork, shifting attention to these productive processes, rather than end products or the commodity form.¹⁴ In such a scenario, the artist-programmer and machine can be seen to work in partnership to disrupt tired old mythologies of creativity - emphasising that art conforms to formal structures and constraints, and that computers might be used for manipulating these structures. It aimed to suggest a quite different sense of creative activity involving human/machine hybrids presenting new challenges and contradictions. *Generator* sought to comment allegorically upon the wider systems within which the artworks generate their meanings. In other words, meanings are not simply encoded into the work but generated by the complex interaction of artist-programmer, software, hardware, its reception and the context of the gallery system. In this way, the show hoped to reveal contradictions in the art and media worlds (a system in which the feedback loop is incomplete for the most part) and its relationship to other sites of cultural production. Thus, *Generator* asked: Does generative media offer a blueprint of contemporary forms of production? What do these approaches express about culture and the generative nature of the social system? These are questions that underpin my research.

According to many sources, the term 'generative art' is most likely derived from 'generative grammar', a linguistic theory Chomsky proposed (in *Syntactic Structures*, 1972) to refer to deep-seated rules by which language operates. In keeping with this, much recent generative work has been concerned with the linguistic qualities of code work (sometimes called 'code literature' or 'eliterature', or 'code poetry' demonstrating structural and syntactical ingenuity).¹⁵ This interest arguably owes much to the legacy of structuralism and semiotics in drawing attention to the wider systems within which the artworks generate their meanings - treating all cultural phenomena like a language.¹⁶ There is no doubt that using the linguistic metaphor in this way lends itself well to an understanding of generative procedures in emphasising that linguistics needs an abstract system (langue/competence) that generates the concrete event

¹⁴ It might be generally agreed that cultural production has moved from a model of 'product' to 'process', and from representation to simulation - what is sometimes and problematically referred to as the 'dematerialised artwork' (Lippard, 1997; or 'immaterialisation' in relation to the mode of production and labour practices (Hardt and Negri, 2000), and from being defined in relation to machines to cybernetic and generative systems influenced by the convergence of biological with technological systems (Castells, 1996).

¹⁵ There is much experimentation in this regard: Florian Cramer's *<nettime> unstable digest* is a current and pertinent example.

¹⁶ Structuralism, like Russian Formalism, reinforced the idea that things can only be understood in terms of the organisational structure of which they are a part. I am referring here to the work of Hawkes (1986), or more recently in describing *The Language of New Media*, Manovich (2001) or new language conditions of *The Second Media Age*, Poster (1995). 'Net.art' is often considered too 'formalist' - but, not in this sense. Formalism meant as a criticism is a reference to the ideas of the American art critic Clement Greenberg, in which structure and form are seen to be privileged to reveal the essence of the medium - at the expense of social context.

(parole/performance – to use Saussure's terms).¹⁷ Yet, as much as the linguistic approach is undoubtedly useful for criticism, my research is more concerned with the relations of production.¹⁸ This is reflected in my earlier discussion in preferring the materialist position adopted by Benjamin's 'The Author as Producer' than the post-structuralism of Barthes's 'The Death of the Author' (Note: I have indicated that the texts not the authors are responsible to show that I do not dismiss Barthes's essay out of hand).

Many examples of generative art employ ideas of constraint and randomness, making reference to abstract restriction and the use of algorithms (drawing upon the creative potential of mathematics).¹⁹ The term algorithm as an instruction for executing a task, has been used by many artists to describe procedural and instruction-based principles. The conceptual artist Sol LeWitt is a much-cited example of this tendency to produce instructions for the production of art works rather than produce the work itself (Lippard, 1997). A further example of rule-based systems for the production of art is the less well-known work of the 'algorists'. Verostko describes the working process of algorithmic art in the following algorithmic form:

```
if (creation && object of art && algorithm && one's own algorithm) {
include * an Algorist *
} elseif (!creation || !object of art || !algorithm || !one's own
algorithm) {
exclude * not an Algorist *
}
pathologies: excess of algorithms, lack of art, lack of objects ...
(Verostko, 1996)
```

This kind of referential code work at its extreme, might also transform itself at the level of code. For instance, a generative artwork might

¹⁷ Thus, it might be seen that all conventions of writing and reading (even of code) can be said to be part of a set of abstract (coded) systems and by which outputs are generated and understood. According to this way of thinking, it is as if the text is autonomous from the act of writing – writing writes rather than writers (even the reader is written into the story in Calvino's 'How I Wrote One of My Books', 1995). Evidently, if writing can be seen to be autonomous, it can also be seen to be self-organising or generative in this way. Calvino's 'How I Wrote One of My Books', (1995), referred to his popular book *If on a Winter's Night a Traveller*, (1981). It reads like a mathematical formula (or perhaps code), as an algorithmic description of the book's structure. For instance:

'The reader who is there (L) is reading the book that is there (l); The book that is there relates the story of the reader who is in the book (L'); The reader who is in the book does not succeed in reading the book in the book (l'); The book that is there does not relate the story of the reader who is there; The reader who is in the book claims to be the reader that is there...' (Calvino, 1995)).

¹⁸ This line of thinking is exemplified by Jameson in *The Prison-House of Language: A Critical Account of Structuralism and Russian Formalism* (1972) suggesting a 'new' dialectical criticism that combines formalist, structuralist and Marxist traditions.

¹⁹ In making comment upon the relationship between code and linguistic structures, the work of the OuLiPo (Ouvroir de Littérature Potentielle), a group of experimental writers and mathematicians (that included Calvino) interested in abstract restrictions and creative writing, should be mentioned briefly. There are many excellent examples but Raymond Queneau's *100,000,000,000,000 Poems* (with the assistance of Francois Le Lionnais) is a pertinent example (Mathews, 1998). In this, a series of 10 x 14-line sonnets are arranged in interchangeable lines – each constructed with uniform grammatical structure of rhymes. The possibilities of arrangement can be calculated as 10 to the power of 14. Queneau calculated it would take someone 190,258,751 years, 24 hours a day, to read it in full. The principle lends itself to machines for reading as well as machines for writing, and of course a computer would produce *100,000,000,000,000 Poems* much more efficiently. A program was written to do just this by Paul Braffort in 1975, using the reader's name and the time it took to type it, to determine the sequences of lines.

rewrite its outward and inward form in a thoroughly self-referential manner. An example of this, is an un-compiled c program from the 'International Obfuscated C Code Contest' where the actual source code forms a portrait of the author of the code.²⁰ But this is self-referentiality at a literal level. Form and content collapse into one another in a very limited manner and reveal little of consequence about the nature of authorship or the structural characteristics of the overall system itself, or the technologies being employed. Any sense of code's autonomy, of course, is always subject to its place within its operational structure.²¹

What I am proposing in the research is the production of generative code alongside critical reflection. For my purpose, what is important is to think of critical work as a kind of code for other processes taking place within society (rather like viewing its source code perhaps). In this way, the production of code follows the principle that it is to be considered in terms of its execution, as something that requires action, making a parallel between the production of the work itself and its potential in a social context.

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4. generativity and dialectics

Generativity seems to lend itself to the description of the mode of production under present cultural and technical conditions. For example, Hardt and Negri describe the dominant power structure (what they call 'Empire'; as a result of globalisation), in the following manner. It is: 'characterised by a fluidity of form - an ebb and flow of formation and deformation, generation and degeneration'. (2000: 202) In contrast, I would like to suggest that this is usefully described in dialectical terms (they prefer network and rhizomic metaphors in the tradition of Deleuze).²² My counter claim and understanding of this is informed by the correlation of dialectics and complexity theory.

In terms of the computer, my argument suggests that dialectics remains an appropriate critical method for the study of computer functionality because at a fundamental level of operation (of machine code), the computer works dialectically. In *The Digital Dialectic* (2000), Lunenfeld claims the digital system: 'never generates a true synthesis;

²⁰ *International Obfuscated C Code Contest*, un-compiled c prog that is self-referential, reproducing the logic of code <<http://www.loccc.org/2000/dhyang.c>> & read-me <<http://www.loccc.org/2000/dhyang.hint>>

²¹ See appendix: Geoff Cox, Alex McLean & Ade Ward (2000), 'The Aesthetics of Generative Code' develops some of these ideas.

Even the common example of Dadaist poetry is useful in this respect as it arguably reveals something lacking in many of the attempts to mimic its technique. Famously, Tristan Tzara advised aspiring poets to cut a newspaper article into words and make a poem by shaking them out of a bag at random, revealing the hidden possibilities of language, and clearly undermining established notions of creativity, genius and authority (1998/1918). This is not merely random, and it might be argued that there is a clear intention and purpose at work here to undermine established logic and aesthetic taste represented by the authority of the source.

²² Evidently, technology has not entirely infiltrated the old economy production (Hardt & Negri, 2000). A number of new terms have been suggested such as 'immaterial labour' (Lazzarato), to understand ways in which production is constituted in new forms that operate through networks and flows - no longer confined by the opaque walls of the factory. There is a larger argument here about the revolutionary subject and whether new more inclusive concepts like the 'multitude' (Hardt & Negri, 2000; combining Marxism and post-structuralist ideas of fragmentation) are useful in demonstrating how class conflict is realised under contemporary conditions, as opposed to the classical Marxist position that privileges the industrial working class (Callinicos, 2002; Marx, 1990/1867).

it merely impels the regeneration of the system' (2000: xviii). What Lunenfeld describes as this limited regeneration of the system (a lack of synthesis) I will argue is part of the dialectical process itself. The dynamic process of back and forth movement I prefer to regard as continuous as I am applying it to the production of generative art (therefore not with Hegelian resolution in mind, but a series of more modest but cumulative improvements).²³ Perhaps unsurprisingly (and rather unscientifically), I am not so much interested in the absolute viability of the Hegelian idea of reaching absolute knowledge as investigating the (generative) process of getting there - through dialectical thinking. I hope to emphasise the allegorical potential that change is built into the system through dialectical conflict.

Critical work on the nature of digital culture (like the execution of code) remains in progress and should therefore be applied with caution. It is an extremely important distinction with dialectics, that the movement is not from one extreme to the opposite extreme (yes or no, on or off)²⁴ and from there to 'higher unity' but rather a 'radicalisation' of the first position. (Zizek, 1999) As an example, the oppressed imagine themselves in a better world with the oppressor removed (workers without capitalists, and so on). It is clear that this logic fails to recognise how one political position is thoroughly infiltrated and mediated by the other (as a result of the capitalist production process for instance). In this way, the overall system is registered too. I would like to suggest that it is possible to extend the dialectical logic of *being* as thesis and *nothing* as antithesis - and to not simply reject the simplistic binary opposition of 1's and 0's - but to also end up with the synthesis of *becoming* - in other words, as the execution of computer code appropriate to the production of generative art.

These are undoubtedly complex arguments which attempt to combine systems theory and dialectical argument that make for an uneasy

²³ The term 'dialectics' itself has a rich history and varied application. Significantly for my argument, it is within German idealist philosophy that the notion of contradiction is extended, not only to the process of discussion (though its Greek etymological root), but to reality itself (Hegel, 1953/1823). The dialectical method peels back successive layers to discover the deep-seated laws of motion (like code). This, in turn, explains why phenomena evolve and perform in certain directions and in certain ways. The critical power of dialectical analyses are emphasised in the rejection of mere surface appearances, designed to hide critical depth, the system's inner workings and its contradictory forces. Contradictory tendencies unfold in every detail of the system, 'every one of its basic "cells"' according to Mandel. (1990/1976) The dialectic is a dynamic, even generative process, by which an argument (thesis) is posed, only to be disputed by another (antithesis) in order to bring about a combinatory resolution (synthesis). The dialectical movement results in a synthesis that is not just the conclusion, but can be seen to be part of a continuing critical process. With more reflection, the synthesis will reveal itself to be a thesis in some other respect and so require the same dialectical treatment, and so on, in order to continue a chain of better understanding - without reaching a final resolution. For Hegel, this contradictory principle is central to the dialectical process in the 'continuous unification of opposites, in the complex relation of parts to a whole' towards an ultimate 'reconciliation' of these opposing forces but there is considerable contention on this point - in the so-called 'Hegel debate'.

²⁴ A determinate negation is not simply negative. For instance, in mathematics, a zero is a definite negative number like the number one. In *The Book of Nothing*, (2001) Barlow traces many cultural and discursive traditions that accept non-being and being as equals in much more fluid terms - with nothing as a state from which we came and may return. In other words, the (existentialist) argument is whether nothing is the opposite of something, or whether it has nothing to do with something. The distinction should be made between mere difference - something is not something else - and the more fundamental claim that something is not something else but depends on it to exist - this is contradiction and the basis for the dialectical principle of 'negation of negation'.

relationship that requires more detailed discussion at the PhD stage. Yet, it is possible to engage with the material world in terms of dialectical-materialist thinking and systems theory in what Wu Jie calls 'Systems Dialectics' (1996).²⁵ One might expect to encounter the dialectical method in relation to the industrial mode of production. Undoubtedly capitalism has undergone dramatic transformations, characterised by flexibility, decentralisation and networking thought this does not simply mean that dialectics is outmoded. These new formations now form the material base for the global economy (Castells, 1996). The system has become fully mobile, with unpredictability and complexity as the predominant metaphors for both culture and economics. For Hardt and Negri, 'governance without government' (2000) indicates the structural logic that orders what appears to be disordered into a working orderly totality. However, it would be a mistake to simply think that disorder has become the new world order. To understand these new formulations and processes, it is generally thought that you need to combine economics with complexity theory.

On this issue, Castells (1996) characterises the recent interest in 'complexity theory' arising in turn out of 'chaos theory' (Gleick, 1998), as setting itself the task of developing scientific thought out of this new paradigm; understanding the emergence of self-organising systems that create complexity out of simplicity and superior order out of chaos. By its nature, complexity theory has no obvious organising structure, but can be thought of in terms of structure and rules all the same. Importantly, the rules are created and changed in complex ways (and thus have ideological consequences).

Even more relevant to my concerns is the contradictory phrase 'orderly disorder' (Hayles, 1989) as the perfect maxim for correlating ideas of complexity with dialectical thinking. According to Hayles complex systems become chaotic in predictable ways, not absolutely chaotic (or random) but expressing a complex structure of order and disorder. Thus systems, even social systems, are not closed but also sensitive to small changes. It would appear that old systems of measurement which assume that systems are linear, closed and fixed, are no longer appropriate to a vision of a networked society and technology that emphasises non-linearity, openness and mutability. The science of complexity refers to the potential for emergent order in complex phenomena (Goodwin, 1997) and draws upon cybernetic theory that sought to describe limits of self-regulating systems which display predetermined or coded parameters (Wiener 1962/1948). Nichols in 'The Work of Culture in the Age of Cybernetic Systems' (1988) situates the computer as not merely a part of these processes but also a metaphor for them, and as such the contemporary exemplar of the dialectical relation of control and resistance to control. For the final stage of the study, I am not so much interested in a precise scientific mapping or explanation of this as scientific phenomena, but its metaphoric potential: in that small changes can produce exponentially divergent behaviours.

Furthermore, and extending the metaphoric potential to the idea of synthesis, Prigogine suggests that (new) order might be generated through disorder (1985). Within systems and their sub-systems, positive feedback loops might generate the further development of a process to

²⁵ It might be significant to note that this book was written and published in Beijing, China.

the point of causing a fundamental and unforeseeable change of the existing system. By analogy, one could think of capitalism as one such system that contains the seeds of its own destruction (to paraphrase Marx). This is important as it emphasises the constructive positive role that disorder might play in creating order. According to this logic, at the 'bifurcation point', chance takes hold of determinism, and as a result either disorder or order may be generated.²⁶ In science, this is the theory of self-organising matter that Owens (1996) has adopted to explain the possibilities of a social system – wherein order is both expressed in disorder and might be generated out of disorder. Living systems (such as society itself) are determined by rules, but at the same time demonstrate emergent properties that are unpredictable and appear to break rules. The possibilities are large and complex, but not endless nor open-ended. Hence, bifurcation theory is a common explanation for how ordered structures can arise from disorder. In other words, synthesis arises from the bifurcation of thesis and anti-thesis, in endless reiteration. This transformative quality provides an unfashionable belief in the possibility of positive (social) change through collective human agency – at the point of bifurcation or revolution. Thus, it is possible to draw a parallel between the revolutionary moment and the bifurcation point as the point where dramatic change takes place. Along these lines of thinking, Owens would argue that recent critical theory exemplified by fragmentation (such as postmodernism and post-structuralism) rests on 'bad science' and 'bad history' - and I would add bad politics.²⁷

By the correlation of dialectics and complexity, it will be argued that change is inherent to rule-based systems but might also be prompted by those seeking to engage with the rules by which any system is generated. This is important for my argument, as once the system can be seen to be dialectical, the relations of production can be too. In Benjamin's terms, the author-artist might reflect upon their position within the production process like a technician-programmer, in so doing transforming them: 'from a supplier of the production apparatus, into

²⁶ If 'bifurcation' means splitting, as the point where within a system, one path or another must be followed, although the choice is limited to one of two, the decision is thoroughly unpredictable. With increased frequency, bifurcations can lead to chaotic systems.

²⁷ This would also be the basis of an argument against Hardt and Negri's rhizomic metaphor of the 'multitude' in preference to the classical Marxist position. There is a bigger question about whether generation itself can be seen to be dialectical. Yet, there is a broad agreement that politics needs to articulate itself in terms of generative processes in lieu of the regenerative mechanisms built into capitalism itself; in the sense that all production might be seen to be generative. Hardt and Negri's use of the term 'corruption' is interesting in this connection; (taken from Aristotle) - as complementary to generation. The violence of corruption is self-evident in the capitalist relations of production as exploitation. Dialectical thinking would suggest this is reversible, that corruption might be superseded by generation.

I have to limit myself here - to expand on this, it would be necessary to talk about concepts like 'immaterial labour' and in turn the formation of resistant subjectivities - in the work of Lazzarato, Hardt and Negri, et al - but I haven't the space in this report. But I should say that herein lies a crucial part of dialectical thinking - as it is as a result of the recognition of the exploitative relations of production that change is made possible. Hence my reliance on dialectical thinking. More generally, at this point in time, it might be agreed that all subjectivity (even resistant subjectivities) can be recognised as socially constructed and artificial. As the place of production becomes more and more place-less, subjectivities become correspondingly hard to place - still generated, but generated in new ways:

'The imperial social institutions might be seen, then, in a fluid process of the generation and corruption of subjectivity. [...] The Empire's institutional structure is like a software program that carries a virus along with it, so that it is continually modulating and corrupting the institutional forms around it.' (2000: 197-8)

an engineer who sees his task in adapting that apparatus'. (Benjamin, 1973/1934: 102) To adapt the apparatus in this manner, the artist-programmer therefore needs to reflect upon and take account of the generative possibilities of the system itself, in recognition of the transformation of the mode of production into a fully integrated self-regulating machine.²⁸

In the context of the production of generative art, this emphasises the ideological issue of who sets the criteria for setting the rules. In terms of rule-making (the basis of programming), there are three characterisations that need to be taken into account: those who make the rules, the participants who are involved in rule-making, and those who merely implement rules (adapted from Castells, 1996).²⁹ One can readily apply these formulations to programming and the production of hardware and software, and subsequently identify the relations of production. Combining artist and programmer into one figure as I have suggested, challenges the usual relations of production in making art using computers, where the effort of the programmer is often hidden, and on a cultural level, subordinate to that of the artist. The contradictory relations that arise are to be seen as an indication of the appropriateness of a dialectical method in presupposing that all elements of a system are part of an integrated totality of production.

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5. further development and form of submission

The short piece of code at the beginning of this report indicates how a dialectical logic might be translated to 'Chipmunk Basic' (see p. 2).³⁰ The example, although undeniably simple, represents a way of articulating what I find challenging about dialectics and the productive use of contradiction. I do not aim to become proficient in producing sophisticated code but rather want to reflect upon it, and work in collaboration with programmers, to develop a clearer understanding of how it works and might be applied in terms of my argument.³¹

This engagement with the production of code (through an understanding of different programming languages) has led me to think of its allegorical significance more closely. On one level, code is simply the textual description of the instructions that the computer will execute. What I wish to demonstrate at PhD level is the simultaneous dialectical relationships between code/output, and between theory/practice - in the lexicon of critical theory known as 'praxis'. Praxis might be expressed in the following manner:

```
class praxis
```

²⁸ See appendix: Geoff Cox (2002), 'Generating orderly disorder: after 'the author as producer''; Geoff Cox (2002), 'Generator: the dialectics of orderly disorder' - both essays develop these ideas.

²⁹ In other words, to demonstrate good 'technique', the artist-programmer combines the first and the last, on the behalf of the second - both conceive and implement rules as well as make them 'open source'.

³⁰ BASIC stands for 'Beginner's All-purpose Symbolic Instruction Code', and comes in many variations; Chipmunk BASIC is a particularly straightforward version as the title suggests.

³¹ I aim to continue developing a dialectical form through a basic understanding of code syntax and structure. I am currently gaining very basic knowledge of 'Real Basic' and 'Perl'; the first is object-orientated and the second has a linear linguistic structure.

```

dim theory as variant
dim practice as variant
function action() as variant
    return theory + practice
end function
end class

```

This second example explained on a technical level, articulates that praxis is a method of a coding object. This creates a 'praxis' object, which contains 'theory' and 'practice' properties. When you invoke the action method of 'praxis', it combines these two properties. In terms of critical theory, praxis is defined as a self-creating action, and is therefore thoroughly active and dynamic. In other words, it is action informed by theory (in the Hegelian tradition). In this way, theory is made meaningful and is tested by practice. Thus, the opposition of theory and practice is surpassed (I hope it is clear why I am using the term praxis in the context of a practice-based PhD project). My interest here is whether the parallel of this concept is productive for thinking about the role of code beyond its functionality to its aesthetic and political implications, as a form of embedded criticism. For instance, in the next example I have adapted Alex McLean's *forkbomb.pl* code (written in perl)³² to evoke Benjamin's essay, 'The Author as Producer' (1973/1934):

```

#!/usr/bin/

$production = 8;
sub function {
    fork or $author = 1;
    --$production if $author;
    if ($author) {
        exit unless --$production
    }
    return $author;
}
while (not &function) {
    print 0;
    works:
    while (&function) {
        print 1
    }
}
goto 'works';

```

(© slab - released under the terms of the GNU Public License, with my adjustments).

In this example, the program splits in two (bifurcates) with every iteration. The code is relatively lengthy but the basic instruction could just as well be reduced to one short line of code:

```
fork while 1;
```

The instruction is simply to 'split this process in two for ever' - thus, after the first iteration you get two processes, after the second

³² This can be seen through the relationship of code to its output through the example of Alex McLean's *forkbomb.pl* code and visualisation <<http://slab.org/>> (shown as part of the *Generator* exhibition).

you get four, then eight, and so on indefinitely. Any output derived from this would be a representation of the computer's performance during the program's execution and be an expression of the disorder embedded in the system. On a technical level, the computer is under such a high load that it fails to comply to its instructions - after a while the fork calls fail to split the process in two. The ordering in which the task scheduler does things becomes less-ordered the harder it is pushed. For example, the output would be expressed very differently on different computers, thus providing a 'signature' of the processor and operating system. The program and the resultant actions, the source code and the output, are intricately linked.³³ To my mind, this holds productive allegorical potential as it contains 'the seeds of its own destruction' given the system will eventually crash.

It is anticipated that the PhD submission will demonstrate how dialectical thinking is appropriate to an understanding of generative art, and what this implies about systems in general by the production of some software as an artwork (the PhD is partly submitted through practice in so much as this distinction between theory and practice is embedded in the PhD system itself). At this stage I anticipate the code of the work will effect the presentation of the written element of the PhD thesis, and by so doing exemplify the arguments contained in the thesis itself. It will embody its argument against the separation of form and content by being able to be run as software (albeit simple), thereby making comment upon itself and the conditions of its operation. Furthermore, this will demonstrate that theory can operate both as a critical tool and as a form of creative production - in the tradition of the term 'critical practice' (Belsey, 1992).

The text presentation software *Anagrammar* (software written by Adrian Ward) is an example of the kind of software that I may develop in the context of the thesis as a whole.³⁴ It operates a simple text presentation tool (like a corrupt version of Microsoft's popular 'Power Point') but contains two contradictory operations activated through sound input (above or below an ambience threshold). The text characters are either arranged out of order or in order (to generate or degenerate accordingly, and evoking Hardt and Negri's description of corruption mentioned earlier in that institutional forms such as language might be rearranged). Importantly, all the elements are in tact at all times and are the same on one level - they are simply in or out of order, or in a state of generation or degeneration depending on sound (of human presence perhaps). Below are the two dialectically opposed subroutines:

```
[1]
sub degenerate()

    dim c1, c2 as integer

    c1=1+(rnd*len(myString))
    c2=1+(rnd*len(myString))

    Zswapchars(c1, c2)
```

³³ This technical description is taken from the essay 'The Aesthetics of Generative Code', co-written with Alex McLean and Adrian Ward.

³⁴ *Anagrammar* can be downloaded from <<http://www.signwave.co.uk/products/anagrammar.sit>>. The software is based on similar principles to *ordure::real-time*, by Stuart Brisley and Adrian Ward (also shown as part of *Generator*) <<http://www.ordure.org>>.

```

end sub

[2]
sub regenerate()

    dim l as integer
    dim targetCharacter as string

    targetCharacter=mid(myOriginalString, regen, 1)

    if mid(myString, regen, 1) <>targetCharacter then

        l=regen

        while mid(myString, l, 1) <>targetCharacter
            l=l+1
            if l>len(myString)+1 then
                l=1
            end
        wend

        Zswapchars(regen, l)

    end

    regen=regen+1

    if regen>len(myString)+1 then
        regen=1
    end

end sub

```

It is my aim to produce a software artwork that will encapsulate the idea of a critical practice in this way. For instance, while the output of the software may display the thesis at a level of abstraction (or obfuscation), the thesis will be fully revealed and readable through its source code. It is anticipated that what is produced will encapsulate the claim that a radical aesthetic thoroughly suited to the times may be developed as critical practice in such a way. Clearly code can have aesthetic value, but can it also contain critical value? The title *anti-thesis: the dialectics of generative art* indicates this critical trajectory: the central idea of achieving something positive through negation unfolding in the paradox of the title itself.

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[5936 words]

6. TIMESCALE

March 2000 ->

Submission of RDC1.

-> Autumn 2002

Consolidation of ideas around dialectical materialism;
Conference presentations on the relationship of dialectics to ideas of complexity;
Submission of RDC2.

-> March 2003

Consolidation of ideas around programming languages and code;
Learn some basic principles of a linguistic language (perl) and object-orientated language (Real Basic);
Take more active part in CAiiA-STAR sessions and relevant conference presentations;
Case studies: exhibition 'Generator' continues to tour and 'Vivaria' is developed to production stage;
Continue review of relevant literature.

April 2003 -> September 2003

Make practice element prototype;
Take more active part in CAiiA-STAR sessions;
Identify external examiner, and negotiate sabbatical leave (January - March 2004)*;
Final reviews of literature, and begin the writing up process.

October 2003 -> March 2004

Writing up and submission of thesis and practical component (subject to negotiating term out of teaching).

-> September 2004

Anticipated completion.

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8. APPENDICES

APPENDIX A: conference papers

These related texts have been presented as conference papers. They are also available online <<http://www.anti-thesis.net/texts.html>>

Geoff Cox (2002) 'Generation and Corruption', conference paper as part of *Remaking Reality*, CAiiA-STAR (pre-ISEA), IAMAS, Gifu, Japan; alternative version (2002) delivered at 'Platforms', *Mediaterra* festival/conference, Athens, Greece.

Geoff Cox (2002) 'Generator: the dialectics of orderly disorder', conference paper, *Creativity & Cognition*, Loughborough University, Proceedings ISBN 1-58113-465-7, ACM Press, pp. 45-49.

Geoff Cox (2002) 'Generating Orderly Disorder: or, suggested upgrade of the author as producer', conference paper, *Marxism and the Visual Arts Now*, University College London, (in association with Birkbeck College & *Historical Materialism* journal).

Geoff Cox, Alex McLean & Adrian Ward (2000) 'The Aesthetics of Generative Code', with Adrian Ward & Alex McLean, *Generative Art 00*, international conference, Politecnico di Milano, Italy; alternative version (2001) 'How I Wrote One of My Perl Scripts, or, The Poetics of Generative Code' conference paper, *E-Naissance: New Configurations of Mind, Body, Space*, Galleria Civica d'Arte Moderna e Contemporanea, Torino, Italy; published in Eugene Thacker, ed, *Hard_Code: narrating the network society*, Alt-X Press, ISBN 1-931560-04-8, 24K, 22pp, <<http://www.altx.com/ebooks/download.cfm/hardcode.pdf>>

Geoff Cox & Tim Brennan (2000) 'Manifest: Reframing False Consciousness', with Tim Brennan, *Consciousness Reframed*, University College Newport, Wales, & *Phenomenology* conference, University College, Cork, Eire; alternative version (2001), 'Cover Versions', image/text, in *Cabinet* magazine, New York: Immaterial, Autumn issue, ISSN 1531-1430, pp. 85-7.

Geoff Cox & Adrian Ward (1999) '*How I Drew One of My Pictures, or the Authorship of Generative Art*', *Generative Art 99*, international conference, Politecnico di Milano, Italy. Proceedings published by Editrice Librerie Dedalo, Roma; published in Kestutis Andrasianas, ed, *agon [dotagon]* online journal [from Media Centre in Lithuania], <<http://www.o-o.lt/agon/>>

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APPENDIX B: further references

The following links are available online <<http://www.anti-thesis.net/map.html>>

algorithmic art

Harold Cohen, *Aaron*, drawing machine, robot artist, <<http://www.scinetphotos.com/aaron.html>>
Critical Art Ensemble, bio-tech projects as the so-called new frontier of pan-capitalism and its discontents, <<http://www.critical-art.net/>>, etc.
Hans Dehlinger, scribblings, searching for order in the code of generated drawings, using plotters and snobol (ancient computer language) <<http://www.generativeart.com/abst2000/abst100.htm>>
Ernest Edmonds et al, *Creativity + Cognition* conferences, <<http://creative.lboro.ac.uk/eae/>>
Steve Grand, *Lucy*, artificial lifeforms <<http://www.cyberlife-research.com>>
International Obfuscated C Code Contest, un-compiled c prog that is self-referential, reproducing the logic of code <<http://www.ioccc.org/2000/dhyang.c>> & read-me <<http://www.ioccc.org/2000/dhyang.hint>>
Tom Ray, *Tierra*, self-replicating program <<http://www.isd.atr.co.jp/~ray/tierra/>>
Santa Fe Institute, on complexity <<http://www.santafe.edu/sfi/research/focus/compPhysics/index.html>>
Antoine Schmitt, algorithmic art resource, process-centred art <<http://www.gratin.org/>>
Sonia Sheridan, Generative systems program at School of Art Institute of Chicago (1970s) <<http://www.swifsite.com/sonart/>>
Bogdan Soban, determinism and programming unique graphics <<http://www.soban-art.com>>
STAR et al, *Vivaria* <<http://www.vivaria.net>>
Roman Verostko et al, *algorists* <<http://www.verostko.com/>>

code literature

Florian Cramer, *Permutations*, combinatory writings (aka oulipean) <<http://userpage.fu-berlin.de/~cantsin/permutations/index.cgi>>; and his <*nettime*> *unstable digest*
Charles Hartman & Hugh Kenner, virtual muse poems <<http://www.dartmouth.edu/acadinst/upne/f9622a.html>>
Jeff Instone's *unRest*, OuLiPeau inspired computer works <<http://www.var.ndirect.co.uk/var/interruptus/>>
Ray Kurzweil, cybernetic poetics <<http://shakti.trincoll.edu/~akurd/e-poets.htm>>
Talan Memmott, *Lexia to Perplexia* <<http://www.memmott.org/talan/>>
OuLiPo (ouvrier littérature potentielle) creative constraints, especially poet raymond queneau + mathematician francois le lionnais <<http://www.nous.org.uk/oulipe.html>>
Perl journal, perl poetry <<http://www.itknowledge.com/tpj/contest-poetry.html>>
Quines, program source code that generates an exact copy of itself <<http://www.nyx.net/~gthompson/quine.htm>>
Eugene Thacker, ed., *hard_code*, collection of code-inspired texts <http://www.altx.com/ebooks/hard_code.html>
Joanna Walsh, *oulibot* <<http://www.zoolika.org.uk>>
Noah Wardrip-Fruin, hypertext fiction, the impermanence agent customises its story for each user <<http://www.impermanenceagent.com/agent/>>

hacktivism/net. activism

Chaos Computer Club, political activists (since the early 1980s), Germany <<http://www.ccc.de/>>
Richardo Dominguez, *Electronic Disturbance Theatre* <<http://www.thing.net/~rdom/>>
Electronic Civil Disobedience, <<http://www.thing.net/~rdom/ecd/ecd.html>>
Étoy, *toywar*, pseudo-corporate strategies <<http://www.toywar.com/>>
The Next Five Minutes, *Tactical Media* <<http://www.v2.nl/n5m/start.html>>
Hacktivism, <<http://hacktivism.tao.ca>>
hacktivism and the cult of the dead cow <<http://www.cultdeadcow.com>>
hal: hackers at large conference <http://www.infowar.com/conf/01/conf_032001a_j.shtml>
Hardt & Negri, cracked hardt + negri's empire pdf, the paradox of copyrighted political writing <<http://excess4all.com/empire>>
©TMark, anti-corporate corporation <<http://www.rtmrk.com>>
Reclaim the Streets, <<http://www.gn.apc.org/rts>>

net. art

Amy Alexander, interview yourself <<http://www.plagiarist.org/>>
antiorp, aka nm <<http://www.m9ndfukc.com/>>
backspace <<http://www.backspace.org/>>
Rachel Baker & Heath Bunting, *irrational.org* <<http://www.irrational.org>>
Andreas Broeckmann, old net.art references <<http://www.v2.nl/~andreas/links/netart.html>>

Vuk Cosic, ascii art <<http://www.ljudmila.org/~vuk/>>
I/O/D's webstalker, browser art <<http://www.backspace.org/i od>>
International browser day competition <<http://www.waag.org/browser/>>
Lisa Jevbratt, 1:1, perl art <<http://c5corp.com/1to1>>
jodi, map of net.art <<http://map.jodi.org/>>
jodi, noise signals <<http://wwwwwwwww.jodi.org/index.html>> jodi, %wrong browser
<<http://www.wrongbrowser.com>>
detritus.net, dedicated to recycled culture and recombinant art
<<http://detritus.net/rhizome.html>>
Olia Lialina, *teleportacia* <<http://www.teleportacia.org/>>
46.liverpoolst.org, *manifest* browser and user manual <<http://www.46liverpoolst.org/>>
Frederic Madre, *spam* <<http://pleine-peau.com/n8/spam/>>
mi-ga <http://www.oo.lt/mi_ga/>
Nullpointer, webtracer software <<http://www.nullpointer.co.uk/~webtracer/>>
Alexei Shulgin, ascii art <<http://www.easylife.org/>>
Alexei Shulgin, net.art introduction 1994-1999 <<http://www.easylife.org/netart/>>
V2_lab, (unstable media) alternative OS V2_OS <http://www.v2.nl/v2_os/>
0100101110101101.ORG, aka darko maver et al, data-nudism, about life_sharing
<[HTTP://WWW.0100101110101101.ORG](http://WWW.0100101110101101.ORG)>; also
Florian Cramer's 0100101110101101.org parody of above <<http://www.0100101110101101.org/>>

software art

Stuart Brisley & Adrian Ward with Geoff Cox, *Ordure*, curating virtual rubbish dump
<<http://www.ordure.org>>
CODE conference, collaboration and ownership, intellectual property rights
<http://www.cl.cam.ac.uk/CODE/rel_texts.html>
deKam, (re-mixing the American Memories Collections at the Library of Congress) *revision history v.3* <http://www.revisionhistory.org/data/Revision_History_3.hqx>
Ulrike Gabriel, codelab, dedicated to research in generative systems and code as artistic material <<http://www.codelab-berlin.de/codelabExp.html>>
netochka nezvanova, nn (nameless nobody), aka integer, antiorp or m9ndfuck -
<http://www.m9ndfuck.org/korporat/kode_macintosh.html>;
<<http://www.eusocial.com/nato.0+55+3d/242.0000.html>>; <<http://www.m9ndfuck.com/>>
Alex McLean, *forkbomb.pl*, CPU executing machine code as a microperformance,
<<http://slab.org/>>
Mongrel, *Linker* <<http://www.linker.org.uk/>>
Antoine Moreau, *copyleft_attitude*, hacking copyright into copyleft
<<http://www.artlibre.org>>
Mark Napier, *shredder* and *riot*, aesthetics of programming <<http://potatoland.org/>>
& interview <<http://www.afsnitp.dk/onoff/>>
Perl definition <<http://www.foldoc.org>>
Cornelia Sollfrank, *net.art generator* & *female extension*, 'a smart artist makes the machine do the work' <<http://www.obn.org/generator>> & interview with Florian Cramer, 'Hacking the art operating system' (see bibliography).
Richard Stallman, free software foundation, GNU license agreement <<http://www.gnu.org/>>
STAR et al, *Donald Rodney: Autoicon* <<http://www.iniva.org/autoicon/>>
Adrian Ward, *anagrammar*, download software
<<http://www.signwave.co.uk/products/anagrammar.sit>>
Adrian Ward, *auto-illustrator*, parody of commercial software <<http://www.auto-illustrator.com/>>
Adrian Ward, a portrait of netochka nezvanova 1.lg - special edition for Geoff Cox
<<http://stub.org/>>
0100101110101101.ORG, *Epidemic - biennale.py*, virus art
<http://www.0100101110101101.org/home/biennale_py/>

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APPENDIX C: website <<http://www.anti-thesis.net>>

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