Programming as Practice: A Comparison of Old and New Media
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Programming lies at the heart of what has come to be called 'new media'. Whilst its significance is acknowledged, programming has long been presented as a technical practice that supports creativity rather than a cultural or creative practice in its own right. In part, this is due to programming being defined as a practice exclusively related to, and therefore defined by, computer technology. Here, I wish to outline an approach to understanding programming as an autonomous practice distinct from any specific medium. I shall begin by exploring the root etymology of the term, then demonstrate how forms of 'programmatic practice' are manifest in forms of non-digital media, and end by discussing how such a broadened understanding of programming as practice can inform the analysis of its role within new media arts.

Pro-gram

The word 'program' derives from the Greek programma, combining 'pro' and 'gramma'. 'Gramma' is a mark or inscribed line. The prefix 'pro' has various implications meaning that which comes in front, or in advance, of something, either spatially or temporally.[1] A program is therefore a set of marks that 'comes in advance', anticipates and provides for something. In relation to creative practice (poesis), programming can be understood as a form of mark-making that encodes and guides processes of production – marks which precede the realisation of an entity. As such it belongs amongst other notational, planning and instruction systems used by artists and craftspeople in the design and creation of works, such as architectural plans, music notation and textile patterns. Their use may be described collectively as 'programmatic' practices, in that all employ mark-making systems that encode processes through which particular artefacts are produced.

A set of architectural plans, for example, do not describe what a building will look like but rather how it should be built. A full set of plans not only contains information such as the spatial layout of a building but also how components fit together, how electrical and water supplies are incorporated into it, and also how the manufacture, delivery and assemblage of components can be integrated into the construction process. As well as describing processes of production, programs also, whether explicitly or not, convey particular aesthetics. The extent to which a given programmatic system is able to transmit a particular aesthetic is dependent on how well that aesthetic may be encoded

1 *The Oxford English Dictionary* states that the first use of 'program' in the English language dates from the 17th Century where it referred to a public written notice, a sign placed in front of people to inform them, in advance, of something that is to happen.

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within it. Western musical notation can encode the nuances of a Classical or Baroque performance with a reasonably high degree of accuracy, but can be problematic in accurately encoding musical styles for which it was not originally designed, such as Arabic or Hindu music. Programmatic systems may also give rise to new aesthetic forms that might be unthinkable without them, such as Schoenberg's twelve-tone composition technique.[2] Many modern composers, such as John Cage and Cornelius Cardew, have consciously created new notational systems to express new forms of musical process.[3] A programmatic system may, therefore, have significant impact on the evolution of a particular aesthetic. It may also, as in twelve-tone music, imprint aspects of its own formal character on the artefacts created from it. In such ways the aesthetic properties of the programmatic system are imbued in the artworks created from them. They may, in turn, become aesthetic media in their own right.[4] Daniel Libeskind's 'Micromegas', for example, are a folio of drawings which use the notational vocabulary of architectural plans but describe unbuildable structures, and are instead intended as expressions of ideas in their own right. Similarly, in the 'codeworks' of JODI, mez and Alan Sondheim, the syntax of computer programs, or the ascii representations of raw computer data, are used as an expressive medium in which to create forms of poetry or abstract visual structures.[5]

Programming as a self-reflexive, socially-directed activity
In encoding a production process, a program enables that process to be shared and communicated to others. Often this is a major impetus in the development of a particular programmatic system. In many cases the development of programmatic systems is tied to specific social structures within which they are employed, or new demarcations and relations between practitioners emerge as a result of their relationship to a programmatic system. Thus, the distinction between an architect and a builder, a composer and a performer, a designer and a weaver, is based on who creates the program and who follows it.[6]

Programmatic systems also enable dissemination of designs and production methods between larger social groupings, such as the spread of new styles and artforms internationally through pattern books. Mechanisms have also been developed to govern this, such as the guild systems of the Middle Ages or the use of copyright today. Such examples demonstrate the role of programmatic systems in the legitimation of creative practices and production methods. The choice of encoding becomes that which distinguishes one practice as 'authentic' or 'correct' from one that is not. An awareness of this has been crucial to the realisation of the Free Open Source Software movement. The GNU General Pubic License (GPL) is a legal document incorporated into open source code distributions which both encourages the code to be used in particular ways, remaining 'free' and open rather than closed, and legitimises the code as adhering to such principles of production, thereby separating it from proprietary code, such as that distributed under the End User License Agreement used by Microsoft.[7] The Debian

project's 'social contract' extends the GPL principle further, outlining a model of how the producers themselves envisage the larger scale social operation of the project and its contributors.[8]

Programming can be considered, therefore, a form of 'socially directed' mark-making.[9] It acknowledges the fact that cultural creativity is not the unique action of an isolated individual, but rather emerges from a dialogue with socially held ideas. This also introduces reflexivity into the process of creation. In encoding a process in an externalised, exchangeable form, it enables that process to be inspected, analysed and critically reviewed. Thus a programmatic system may be instrumental in the transition from poesis to praxis, from the immediate task of making to a more critically aware, self-reflexive interrogation of that task.[10]

Khatt: programmatic practices in Arab-Islamic arts

Kataba is the root from which words relating to writing are derived in Arabic, such as the verb *kitaba* 'to write', *kitab* 'book', and *maktab* 'office'. Sometime between the 7th and 9th centuries CE, a new term, *khatta*, came to be applied to the actual act of writing itself, from which

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2   Traditonally, Western music has been composed according to the harmonic balance of notes as they are heard, in Schoenberg's technique, however, a composition is developed from the use of all twelve notes of the chromatic scale used in fixed sequences in which no note can be repeated until all twelve have been used, processes such as inversion and reversal can be applied to the sequence in order to generate variations. Such structures can be difficult to perceive aurally and yet are very clear when written in notation and clearly derive from possibilities which the music notation suggests rather than the sound itself.

3   For an analysis and historical discussion of experimental notations systems see Paul Griffiths, "Sound-Code-Image," in *Eye Music: The Graphic Art of New Musical Notation*, exhibition catalogue (London: Arts Council of Great Britain, 1986), 5-11.

4   These drawings, whilst unbuildable in themselves, nevertheless influenced the design of his later buildings such as the Jewish Museum in Berlin.

5   For an analysis of 'codeworks' and the relationships between program code as text and experimental literature see Florian Cramer's essays at <www.userpage.fu-berlin. de/~cantsin/homepage>.

6   This distinction is evoked in Marx's famous story of the architect and the bee in *Capital* (book I): "A spider carries on operations resembling those of the weaver, and many a human architect is put to shame with which a bee constructs her cell. But what from the very first distinguishes the most incompetent architect from the best of bees, is that the architect has built a cell in his head before he constructs it in wax." For a critical discussion of this, and the notion of a "socially directed" practice, see Tim Ingold, "The architect and the bee: reflections on the work of animals and men", in *Man* (The Journal of the Royal Anthropological Institute), vol. 18, 1983, 1-20.

7   A copy of the GNU General Pubic License (GPL) is available at <www. fsf.org/licenses/gpl.html>. For some background on the ideas behind it see <www.fsf.org/philosophy/free-sw.html>.

8   <www.debian.org/social_contract>

9   This notion of 'socially directed' practice is discussed in Ingold, op. cit.

10   For a discussion of praxis in computer programming see Geoff Cox, Alex McLean, Adrian Ward, "Coding Praxis: Reconsidering the Aesthetics of Code", in *read_me: Software Art and Cultures* (Aarhus: Digital Aesthetics Research Group, 2004),160-175.

derives *khatt*, denoting a style of writing.[11] Its introduction suggests the development of a new attitude towards the practice of writing which accompanied the rise of more refined and standardised forms of Arabic script and the growth of Arab-Islamic culture under the early caliphates, which first culminated in the 10th century innovations of ibn Muqlah's *khatt al-mansub* (fig. 1).
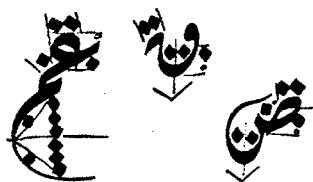

Fig. 1 Ibn Muglah *Letterforms*
Khatt al-mansab 10th Century

Khatt is often translated as 'calligraphy', but the term derives from its use in architecture, where it referred to the marking out of plots of land on the ground. It suggests, therefore, the notion of a marking that organises and structures. The *khatt al-mansub* ('proportional script' or marking) was a system in which the forms of letters were encoded according to a modular proportion based on a single dot. The creation of ibn Muqlah's system was contemporary with a wealth of innovations in the use of notational media that grew out of the introduction of paper-making into the Abbasid caliphate in the 9th Century. These included new forms of notating mathematics, geometry, music, architectural design, and textile patterns. Within mathematics the positional number systems from Sanskrit mathematics, the decimal system from which binary evolved, was adopted and a process of step-by-step mathematical reasoning developed which we now call an algorithm after the 9th Century Arab mathematician Muhammad ibn Musa al-Khwarizmi – 'algorithm' being a corruption of 'al-Khwarizmi'. His text, *al-Mukhtasar fi hisab al-djabr wa al-muhabda*, carried these concepts into European mathematics, along with the principles of algebra, a term which derives from the *al-djabr* of the title. Modern computing would be inconceivable without many of the concepts contained in this book.[12]

Ibn Muqlah's scripts were originally designed to facilitate the creation and use of written documents within the large bureaucratic system of the Abbasid empire. The modular forms of composition and construction on which they are based were designed to increase reliability and ease of reproduction. This facilitates the transference of designs across distance and their continuation in use over time. Similar methodologies were also adopted in architecture and textile manufacture. Where once craftsmen and architects would design directly into the artefacts they were creating, the introduction of programmatic practices enables designs to be produced in one location to be sent elsewhere and realised by other people. New forms, such as the highly complex *murquarnas*, were able to spread relatively fast across Islamic countries. Through the abstraction of design and plan from its realisation in any given medium, the transference of

designs between different media also becomes common, and indeed is characteristic of later Arab designers and craftsmen.[13] The nature of such design patterns is analogous to that of digital images, in which the form exists as encoded data, related to a 'program' through which it is realised. The material artefacts that render this data are each simply one instance of its realisation rather than a singular exclusive expression of it. The ability to reflect upon, and plan a design in advance leads to more sophisticated designs, such as the *murquarnas*, or the intricate textile patterns of the Ottoman era which were known as *saz* after the reed pens used to plot them out on paper.[14]

Two general tendencies are apparent in Arab-Islamic art that can be related to the use of programmatic practices. In one, the formal qualities of the notational system itself are imparted to the style of the resultant artefact. We can see this in geometric lettering styles and ornamental patterns that express something of the modular grid on which they are planned. In the other, the reflexivity enabled through 'marking-in-advance' supports the creation of highly sophisticated designs which may play against and obscure their underlying formalism, yet which rely upon that very formalism to achieve their sophistication. This can be seen in the comparison of figs. 2 and 3.
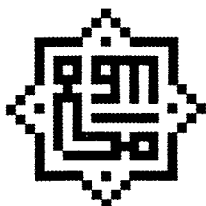

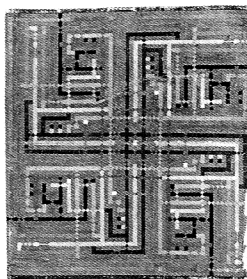Fig. 2 Islamic tile psttern with geometric lettering design

Fig. 3 Book painting, Iran, 15th Century

In the first example, the forms of the text can be seen to derive from an underlying grid structure that simplifies the forms of the letters without destroying their legibility. In the second, the possibility of even recognising that this is a text and not a purely abstract form is

11 This section draws on material from: Oleg Grabar, *The Mediation of Ornament* (Princeton: Princeton University Press, 1989); Jonathan M. Bloom, *Paper Before Print: the History and Impact of Paper in the Islamic World* (New Haven and London: Yale University Press, 2001); Valerie Gonzalez, *Beauty and Islam: Aesthetics in Islamic Art and Architecture* (London, New York: I.B. Taurus, 2001), and Renata Holod, "Text, Plan and Building: On the Transmission of Architectural Knowledge," in *Theories and Principles of Design in the Architecture of Islamic Societies,* edited by Margaret Bentley Sevcenko (Cambridge, Massachusetts: Aga Khan Program for Islamic Architecture, 1988), 8-24.

12 See Bloom, ibid., and Georges Ifrah, *The Universal History of Numbers* (London: Harvill Press, 1998).

13 J. Sourdel-Thoumine, in the entry for 'khatt', in *Encyclopaedia of Islam,* Leiden: Brill, notes that many Arabic craftsmen consciously explored the transference of designs across different media.

14 Jonathan Bloom, Sheila Blair, *Islamic Arts* (London: Phaidon, 1997), 374, see also 363-365.

put into question, and yet it derives from the repetition of a single word, the name 'Ali', constructed on a similar modular grid, but scaled, transformed and rotated multiple times in different colours creating an intricate lattice structure. Whilst the superficial appearance of such artefacts may seem quite divergent, they nevertheless derive from similar basic principles and practices.

Pattern books and practitioner communities
Weaving and knitting patterns are forms of program, they encode a process through which an artefact may be created. Anni Albers, in her classic text *On Weaving*, describes the notation system she uses, called 'drafts', in exactly this way: "The construction of a weave can be understood by reading the draft, instead of having to go through the lengthy process of actual execution."[15] And: "This is all that is needed to give an accurate account of the construction of a weave, although, of course, it does not give a naturalistic representation of it."[16]

Albers also describes the use of pattern notations as a means of 'reverse engineering' designs, for analysing existing textiles and working out how they were made by trying to create a notation for them, similar to the analysis of buildings through recreating their architectural plans, or in software through tools which convert compiled binary back into human-readable code. As is well known, the punch-cards used to program early computers of the 1950s were derived from a system of programming patterns into the automated Jaquard looms introduced in the 19th century.[17] In 1925 the Bauhaus purchased a Jaquard loom and the students learned to create their own punch-cards for it. Albers produced designs for her own Jaquard programs (fig. 4).[18] Arguably this made the Bauhaus the first modern art school to consciously teach programming skills to artists.
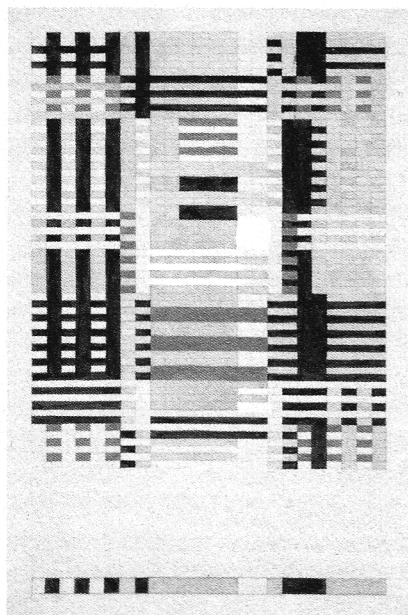
Anni Albers, Design for a Jacquard Weaving, 1926. Photo: David Matthews, copyright Presidents and Fellows of Harvard College

As in the case of computers and the Jaquard loom, programs may often be associated with, or support the development of the automation of a practice. This process is often linked with the de-skilling of human practitioners and the removal of creative and productive control away from those who make into the hands of those who manage. A counter-example can be found in the Fairisles, a small island community off the north of Scotland, one of the few rural knitting cultures to survive the mechanisation of textile manufacture in the Industrial Revolution, effectively resisting the very technologies that made Albers' work possible. Quiet yet successful Luddites, the establishment of the Fairisle Knitters Cooperative in 1980 was merely a formalisation of their long-standing independent and self-managed production methods.[19] The distinctive Fairisle patterns have evolved through processes of copy and recombination that, at least since the late 19th Century, have included the use of self-published pattern books. These have traditionally been hand-produced using matchstick heads to print dot-patterns onto the squared graph paper of school mathematics jotters, with different coloured dots indicating different wools. Local knitters and shop-owners produced and sold such pattern books whose pages would be stamped 'Genuine Fairisle.'[20] The Fairisle example demonstrates the development of a self-sustaining practitioner community that implements its own forms of legitimisation and distribution through the use of notational, programmatic media. Whilst not wrapped in the same strict legal framework as the General Public License (GPL) used in Free Software, they nevertheless represent comparable examples of the ways in which a practitioner community can maintain autonomous control of its production methods. This parallel has been captured in the work of Mandy McIntosh, a Glasgow-based artist who works both with knitting and new media. Internet projects such as *Woolworld* have explored the histories of autonomous knitting communities in the Fairisles, Newfoundland and elsewhere, whilst in others, *Radiant Circle* and *NY Vulture*, she has also adopted a GPL-style license under which she has distributed her own knitting patterns over the internet.[21]

Conclusion: distributed creativity
Programming is not unique to computing, but rather a practice found across many art forms and many of the principle methodologies we ascribe to new media are present in these art forms as well. We

15 Anni Albers, *On Weaving* (London: Studio Vista, 1965), 45.
16 Ibid. 44.
17 On the relationship between weaving and computing see Sadie Plant, *Zeros + Ones: Digital Women + the New Technoculture* (London: Fourth Estate, 1997).
18 Virginia Gardner Troy, *Anni Albers and Ancient American Textiles: From Bauhaus to Black Mountain* (Aldershott: Ashgate, 2002), 74.
19 I use 'Luddites' as defined in E. P.

Thompson's, *The Making of the English Working Class* (1963) (Harmondsworth: Penguin Books, 1991). As Thompson explains, the Luddites were not opposed to technology in itself but rather the way in which particularly manufacturers used it to disenfranchise skilled workers.
20 Mary Smith, "A Shetland Knitter's Notebook", photographs by Chris Bunyan, Lerwick: *The Shetland Times*, 1991, 34.
21 <www.hamandenos.com>.

can therefore, place certain developments within 'new media' in the context of a much longer and broader cultural-historical context. The significance to new media of programming as a practice is not so much the simple fact of its presence, therefore, but rather the way in which the media and practice relate. Computing technologies support our ability to work with and use programmatic methods to a far higher degree than previous technologies (such as paper). In this sense the distinction of 'new media' is that of acceleration and intensification of a particular practice, which would follow Virilio's model of technological development. Secondly, the distinction between program and artefact is dissolving, creating a reciprocal loop between creators and users through the medium itself. Whilst there is a clear difference between an architectural plan and a building, it is harder, and perhaps irrelevant, to define the point of distinction between a computer program and a digital artefact. As the arguments of the Free Open Source Software movement demonstrate, such a distinction is only artificially created through the act of packaging and licensing a piece of software. A key principle of licenses such as the GPL is to retain our awareness of this condition of continuous programmability, and, therefore, of continuous re-creation.

In place of the artefact as a discrete object, therefore, programming foregrounds practice as a site of ongoing production. In relation to non-digital media, Tim Ingold's exploration of the epistemic values historically attached to weaving is significant: "The notion of making, of course, defines an activity purely in terms of its capacity to yield a certain object, whereas weaving focuses on the character of the process by which that object comes into existence."[22] The possibility of endlessy modifying an artefact is not unique to digital media but has acquired greater affordance and opportunity. Of greater impact, however, is that the digital medium enables its own processes of production to be distributed and modified within itself, and this, in turn, supports a new type of social structure within which that takes place. Computer programming has not only enabled the emergence of new media, such as software applications and the internet, but these, in themselves, feed back into programming as cultural practice.[23]

The dominant paradigm of artistic production in Western culture, at least since Romanticism, has been that of the artwork as a unique artefact only achievable in an act of direct creation. The economics of the contemporary artworld are still largely based on the commodification of such unique acts of creation. The 'old' reprographic media (print, photography, film and video) challenged this to some extent in enabling such artefacts to be reproduced en masse, but did not really challenge its basic principles.[24] To present programming itself as an artistic practice, or to promote a programmatic basis for such practice, however, provides a far greater challenge. It does not simply make its products a reproducible medium, but rather enables the reproduction and distribution of the actual processes of production. The most significant shifts taking place in current 'new media' are not so much in the formal natures of the

artefacts, or their aesthetic styles, therefore, but the ways in which the practice is realised at a social level.

If new media are to have any significance on the development of contemporary culture it will not be in terms of the marvellous things we can get a machine to do, but rather in terms of changing our understanding of what creativity is, and re-socialising and 'distributing' this. Several projects are starting to explore how this might apply to fields beyond computing: the *Creative Commons* project is seeking to apply Free Open Source Software principles to other aspects of digital media and cultural production, *Oekonux* is exploring their application to larger-scale economic models, and *Open Architecture* applies them to urban planning.[25] Just as this has had a history prior to computing so too is it proving to have consequences beyond the technology.

22 Tim Ingold, "On Weaving a Basket",
    Perception of the Environment
    (London: Routledge, 2000), 346.
23 See, for example, Gabriella Coleman's
    analyses of the Free Software
    movement such as "The Social
    Production of Productive Freedom:
    Debian and Ethical Volunteerism",
    <www.mako.yukidoke.org/writing/
    foss_book_chapter_proposal-final.
    html>. See also the runme project,
    a repository for software art and
    related discussions: <www.runme.org>.
24 The classic text on the challenge of
    reprographics media to traditional
    art is Walter Benjamin's "The Work
    of Art in the Age of Mechanical
    Reproduction," Hannah Arendt (ed.)
    Illuminations (London: Fontana,
    1992), 211-244.
25 Creative Commons:
    <www.creativecommons.org>,
    Oekonux: <www.oekonux.org>, Open
    Architecture: <www.themaze.org>.