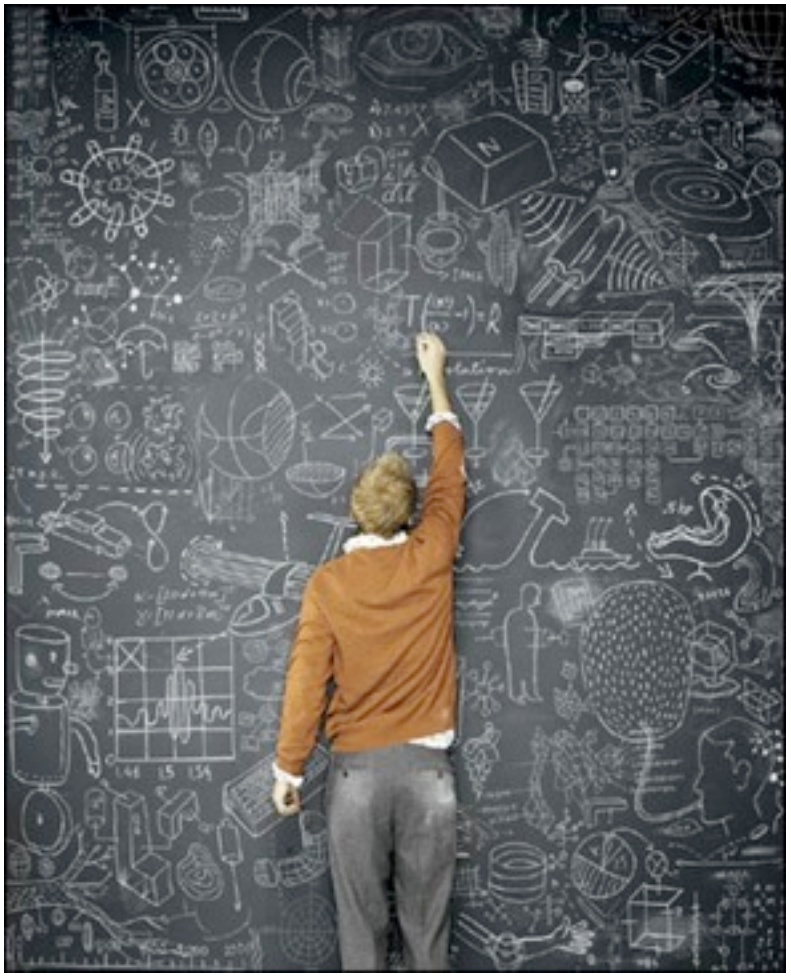
Algorithms and **Generative Music**

"What I cannot
create, I do not
understand."

Richard Feynman, on his blackboard at time of death in 1988



New York Times
Photograph from the
Year in Ideas by
Zachary Scott
December 12, 2004.

Richard Hoadley
2007-9
v0.3

Note

This presentation is available in **pdf** format at
rhoadley.net/algo

Further information is available at
rhoadley.net/cmp

Most of the audio and video examples are available separately on the WebCT implementation of this presentation:
http://webct.anglia.ac.uk/

Technology and **Algorithms**

It's what computer technology is for.
Algorithms are what make technology go.
Things work because stuff happens to them.
The stuff can be thought of as an algorithm.

(See Focus on Robots...)
(Batch processing as simple algorithm...)

Dionysius and Apollo: Two **foci** of **music**?

from Nietzsche **The Birth of Tragedy**

Apollo

inventor of **music, poems and oratory**

god of all art

contemplative and subjective

depicted, not so much **things as they were, as things as they had been**

exhibited **repose** as its chief quality as **sculpture**, architecture, painting or epic poetry: a **painting of a man running, no matter how vividly it suggests the vitality and activity of the runner, is itself a thing inert and lifeless**.

Architecture is itself a thing immovable.

Poetry, so long as it takes the form of the epic and is thus merely a chronicle of past actions, is as lifeless, at bottom, as a tax list.

Bacchus (**Dionysius**)

rude, boisterous

god of wine

he stood for **a whole system of art and a whole notion of civilization**

Dionysus represented the **life strenuous**

god of life in process of actual being

stood for those forms of art which are not mere records or reflections of past existence, but brief snatches of present existence itself - **dancing, singing, music** and the **drama**.

The Philosophy of Friedrich Nietzsche Henry Louis Mencken 1908

Algorithm **Definition**

[a. OFr. *augorisme*, *algorisme*, *augorime*; ad. med.L. *algorism-us* (cf. Sp. *guarismo* cipher), f. Arab. *al-Khowrazm*, the *native of Khwrazm* (*Khiva*), surname of the Arab mathematician Abu Ja'far Mohammed Ben Musa, who flourished early in the 9th c., and through the translation of whose work on Algebra, the Arabic numerals became generally known in Europe. (Cf. '*Euclid*' = plane geometry.) *Algorisme* being popularly reduced in OFr. to *augorime*, English also shows two forms, the popular *augrime*, ending in *agrim*, *agrum*, and the learned *algorism* which passed through many pseudo-etymological perversions, including a recent *algorithm* in which it is learnedly confused with Gr. 'number.']

1. a. The Arabic, or decimal system of numeration; *hence*, arithmetic. ***numbers of algorism***, the Arabic or Indian numerals. ***cypher in algorism***, the figure 0; a 'mere cipher,' a dummy.

Oxford English Dictionary

Algorithm **Definition**

2. *Math.* A process, or set of rules, usually one expressed in algebraic notation, now used esp. in computing, machine translation and linguistics.

1938 HARDY & WRIGHT *Introd. Theory of Numbers* x. 135 The system of equations..is known as Euclid's algorithm. **1960** E. DELAVENAY *Introd. Machine Transl.* 129 *Algorithm* or *algorism*.., used by computer programmers to designate the numerical or algebraic notations which express a given sequence of computer operations, define a programme or routine conceived to solve a given type of problem. **1964** F. L. WESTWATER *Electronic Computers* ix. 146 An Algorithm is a set of rules for performing a calculation. **1966** OWEN & ROSS tr. *Revzin's Models of Lang.* ii. 22 A..more convenient way of arranging the phonemes is suggested. It is given by an instruction (an 'algorithm') consisting of six points.

Oxford English Dictionary

Algorithm **Definition**

3. *Med.* A step-by-step procedure for reaching a clinical decision or diagnosis, often set out in the form of a flow chart, in which the answer to each question determines the next question to be asked.

[**1968** L. B. LUSTED *Introd. Med. Decision Making* iii. 70 Two..[studies] show that an algorithm in terms of a computer program can be developed for a computer based medical history system.] **1970** *Scottish Med. Jrnl.* XV. 378 (*heading*) Flow charts, diagnostic keys and algorithms in the diagnosis of dysphagia. **1985** *Brit. Med. Jrnl.* 23 Mar. 916/1 The algorithm illustrates the steps towards establishing a functional and aetiological diagnosis.

Oxford English Dictionary

The Industrial Revolution... what did it do for us

The **Industrial Revolution** was a period in the late 18th and early 19th centuries when major changes in agriculture, manufacturing, and transportation had a profound effect on **socio-economic** and **cultural conditions** in **Britain** and subsequently spread throughout the world, a process that continues as **industrialisation**. The onset of the Industrial Revolution marked a **major turning point** in **human social history**, comparable to **the invention of farming** or **the rise of the first city-states**; almost every aspect of daily life and human society was eventually influenced in some way.

Wikipedia: http://en.wikipedia.org/wiki/Industrial_revolution

The Industrial Revolution **Automation**

Automation (ancient Greek: = self dictated), **roboticisation**[1] or industrial automation or **numerical control** is the use of **control systems** such as **computers** to control **industrial machinery** and **processes, replacing human operators**. In the scope of **industrialisation**, it is a step beyond **mechanisation**. Whereas mechanisation provided human operators with machinery to assist them with the physical requirements of work, **automation greatly reduces** the **need** for **human sensory** and **mental requirements** as well.

Wikipedia: http://en.wikipedia.org/wiki/Automation

KUKA Industrial robots engaged in vehicle underbody assembly

The Industrial Revolution **The Jacquard Loom**

Wikipedia: http://en.wikipedia.org/wiki/Jacquard_loom

The Jacquard Loom

Close-up view of the punch cards used by Jacquard loom on display at the museum of science and industry

The Industrial Revolution **Babbage and Lovelace**

Babbage and Lovelace

...

Link...

means a gradual phasing out: if you look in the computing department of any multinational corporation you'll find very few people over the age of thirty.

With word processors – the so-called lower levels of intellectual work – work rate is already being measured. At the end of a day management can have a print-out that tells them how often and how many keys were depressed during the day and how many mistakes were made. While you were using the delete button because you'd thought of a more elegant sentence, the machine would be taking it as a measure of your errors.

There was a conference in London recently at which one of the leading word processor manufacturers said: 'Your secretary will be required to be more productive. There will be no more walking, talking, thinking or dreaming.'

Yet these are the most precious attributes of human beings. The same manufacturer went on to say that the new technology will provide a basis for introducing Taylorism into the field of intellectual work.

What is Taylorism?

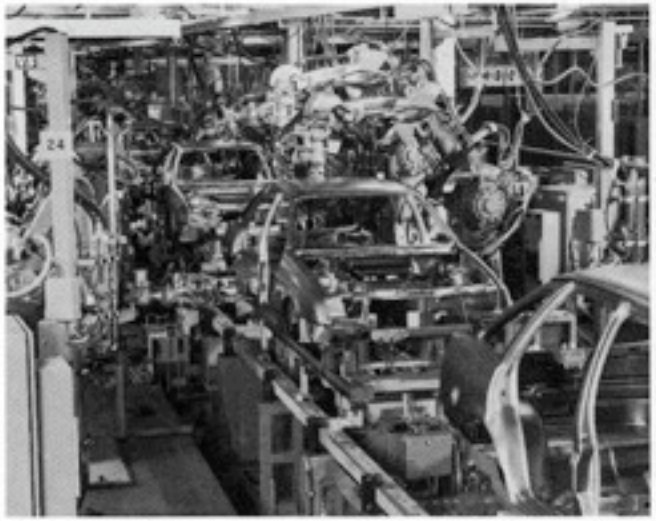
Taylor was an American industrial engineer working at the turn of the century. He believed that it was possible to organise industry in a much more rational and efficient way, by eliminating movements and activities in the work process that were superfluous to the end result.

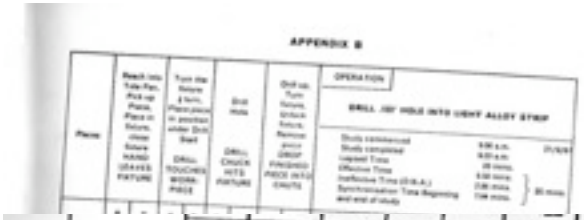
In his book, *Scientific Management*, the famous example he gives is shovelling pig-iron. He worked out the optimum way of shovelling it: the minimum number of motions with the maximum amount in each shovel-load in relation to the capacities of the worker.

The idea was that it would be both to the advantage of management and workers. Management would get higher productivity and a higher rate of profit; and through producing more workers would be compensated through higher earnings.

Taylor thought he was doing something helpful for both parties. But frequently something that starts out as a benevolent idea is transformed into its opposite. Taylor ignored the fact that there are conflicts of interest in industry, and that there are human requirements that transcend the requirements of the machine.

Taylor's ideas were first implemented on a large scale in the motor industry. At Ford's, for example, the worker no longer had the freedom to walk around the static vehicle as he assembled its different parts. Instead, he was restricted to a repetitive task in a fixed position as vehicle after vehicle passed him on the production line.





The time of a work cycle, according to the work study people, is the time taken from the beginning to the end of a given task. This could be putting the wheels on a car, or spot welding certain components together.

But the elements that make up this particular agreement are unbelievable: "trips to the lavatory . . . 1.62 minutes (not 1.6 or 1.7 because this is computer precise!) . . .

SELECTION OF RELAXATION ALLOWANCES

APPENDIX C

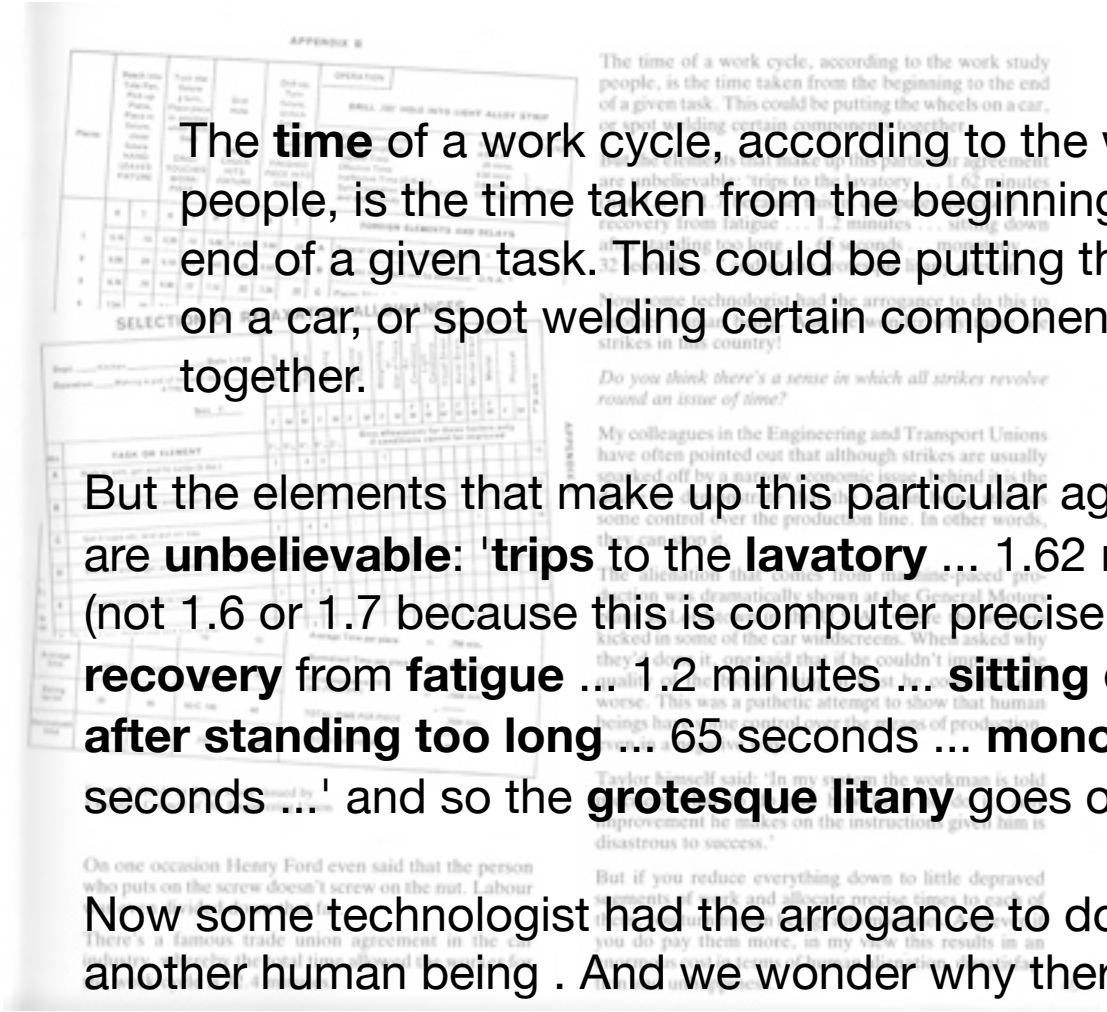
Dept. Kitchen Date 1-1-68

Operation Making a pot of tea and laying a tray

Sex F.

No.	TASK OR ELEMENT	Personal Needs		Minimum Fatigue	Standing		Abnormal Position		Weightlifting or Use of Force		Air Conditions	Light Conditions	Visual Strain	Aural Strain	Mental Strain	Monotony		TOTAL
		F	M	F M	F	M	F	M	F	M	F M	F M	F M	F M	F M	Mental F M	Physical F M	
		7%	5%	4%	4%	2%	Give allowances for these factors only if conditions cannot be improved											
A	Walk to sink, get and fill kettle (5 lbs.)	7		4	4				1									16
B	Walk to cooker, light and put on kettle	7		4	4				1									16
C	Get 2 cups etc. and put on tray	7		4	4										1			16
D	Get milk and sugar and put on tray	7		4	4													15
E	Get tea-pot and walk to cooker	7		4	4													15
F	[illegible] fill tea-pot and put on tray	7		4	4										1			16

Average Time per piece = .758 min.



The **time** of a work cycle, according to the work study people, is the time taken from the beginning to the end of a given task. This could be putting the wheels on a car, or spot welding certain components together.

But the elements that make up this particular agreement are **unbelievable**: '**trips** to the **lavatory** ... 1.62 minutes (not 1.6 or 1.7 because this is computer precise!) ... **recovery** from **fatigue** ... 1.2 minutes ... **sitting down after standing too long** ... 65 seconds ... **monotony** ... 32 seconds ...' and so the **grotesque litany** goes on.

Now some technologist had the arrogance to do this to another human being . And we wonder why there are strikes in this country!

The Industrial Revolution **Automation**

Automation plays an **increasingly important role** in the global economy and in **daily experience**. Engineers strive to combine automated devices with mathematical and organisational tools to **create complex systems** for a rapidly expanding range of applications and human activities.

There are still many jobs which are in **no immediate danger** of automation. No device has been invented which can **match the human eye for accuracy** and precision in many tasks; **nor the human ear**. Even the admittedly handicapped human is able to identify and distinguish among far more scents than any automated device. **Human pattern recognition, language recognition, and language production ability is well beyond anything currently envisioned by automation engineers**.

Specialised computers, referred to as programmable logic controllers (**PLCs**), are frequently used to **synchronise** the flow of inputs from **(physical) sensors** and **events** with the flow of outputs to actuators and events. This leads to **precisely controlled actions** that permit a **tight control** of almost any **industrial process**.

Human-machine interfaces (HMI) or **computer human interfaces** (CHI) are usually employed to communicate with PLCs and other computers, such as entering and monitoring temperatures or pressures for further automated control or emergency response. Service personnel who monitor and control these interfaces are often referred to as stationary engineers.

Issues in Computing and Philosophy

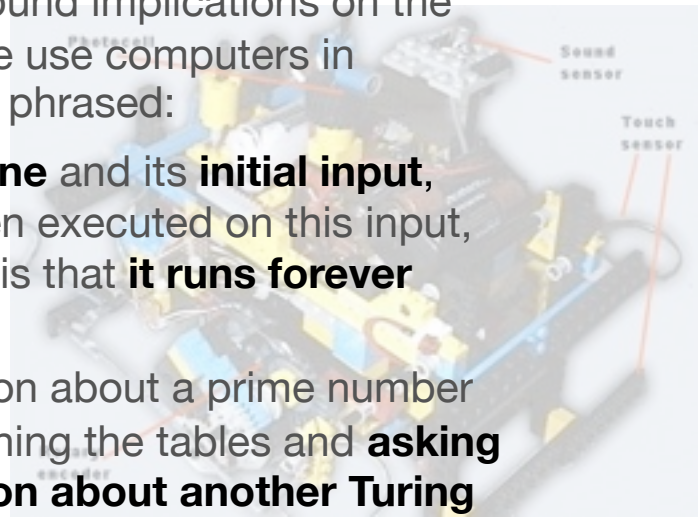
Alan Turing
Bertrand Russell's Chicken

Alan **Turing**: **Computability**, **recursion** and the **halting problem**

The **halting problem** is one of the most famous problems in computer science, because it has profound implications on the theory of **computability** and on how we use computers in everyday practice. The problem can be phrased:

"Given a description of a **Turing machine** and its **initial input**, **determine whether the program**, when executed on this input, **ever halts** (completes). The alternative is that **it runs forever without halting"**.

Here we are asking not a simple question about a prime number or a palindrome, but we are instead turning the tables and **asking a Turing machine to answer a question about another Turing machine**. It can be shown that **it is not possible to construct a Turing machine that can answer this question in all cases**.



Alan **Turing** The **Halting Problem**

That is, the only general way to know for sure if a given program will **halt** on a particular input in all cases is simply **to run it** and **see if it stops**. If it does halt, then you know it halts. If it doesn't halt, however, you may never know if it will eventually halt. The language consisting of all Turing machine descriptions paired with all possible input streams on which those Turing machines will eventually halt, is not recursive. The halting problem is therefore called non-computable or **undecidable**.

http://simonwoodside.com/weblog/images/2005/turing.gif

Alan **Turing**, **computability**, **recursion** and the **halting** problem

In **computability theory** the halting problem is a **decision problem** which can be stated as follows:

Given a description of a program and a finite input, decide whether the program finishes running or will run forever, given that input.

Alan Turing proved in 1936 that a **general algorithm** to **solve** the halting problem for all possible program-input pairs **cannot exist**. We say that the halting problem is **undecidable** over **Turing machines.**

The **Halting** Problem and **Wondrousness**

if (**x** is **even**)
    then (**x** = **x/2**)
else
    (**x** =(**(x*3)+1**))

end if **x = 1**

How can you **tell** whether the **programme** will ever stop?

Douglas **Hofstadter** and David **Cope** **Sounds Like Bach**

But the day when music is finally and irrevocably reduced to syntactic pattern and pattern alone will be, to my old-fashioned way of looking at things, a very dark day indeed.

http://www.unc.edu/%7Emumukshu/gandhi/gandhi/hofstadter.htm

What worries me about computer simulations is not the idea that we ourselves might be machines; I have long been convinced of the truth of that. What troubles me is the notion that things that touch me at my deepest core -- pieces of music most of all, which I have always taken as direct soul-to-soul messages -- might be effectively produced by mechanisms thousands if not millions of times simpler than the intricate biological machinery that gives rise to a human soul.

Douglas **Hofstadter** and David **Cope** **Sounds Like Bach**

This prospect, rendered most vivid and perhaps even near-seeming by the development of EMI, worries me enormously, and in my more gloomy moods, I have articulated three causes for pessimism:

(1) Chopin (for example) is a lot shallower than I had ever thought.
(2) Music is a lot shallower than I had ever thought.
(3) The human soul/mind is a lot shallower than I had ever thought.

See **slide 50**

Kurt **Gödel Incompleteness**

On Formally Undecidable Propositions:

Lots of nice summaries!

Eliza

http://www.tex-edit.com/index.html#Eliza

http://chayden.net/eliza/Eliza.html

Background

History of Electronic and Computer Music Including Automatic Instruments and Composition Machines
compiled and annotated by **Dr. Kristine H. Burns**

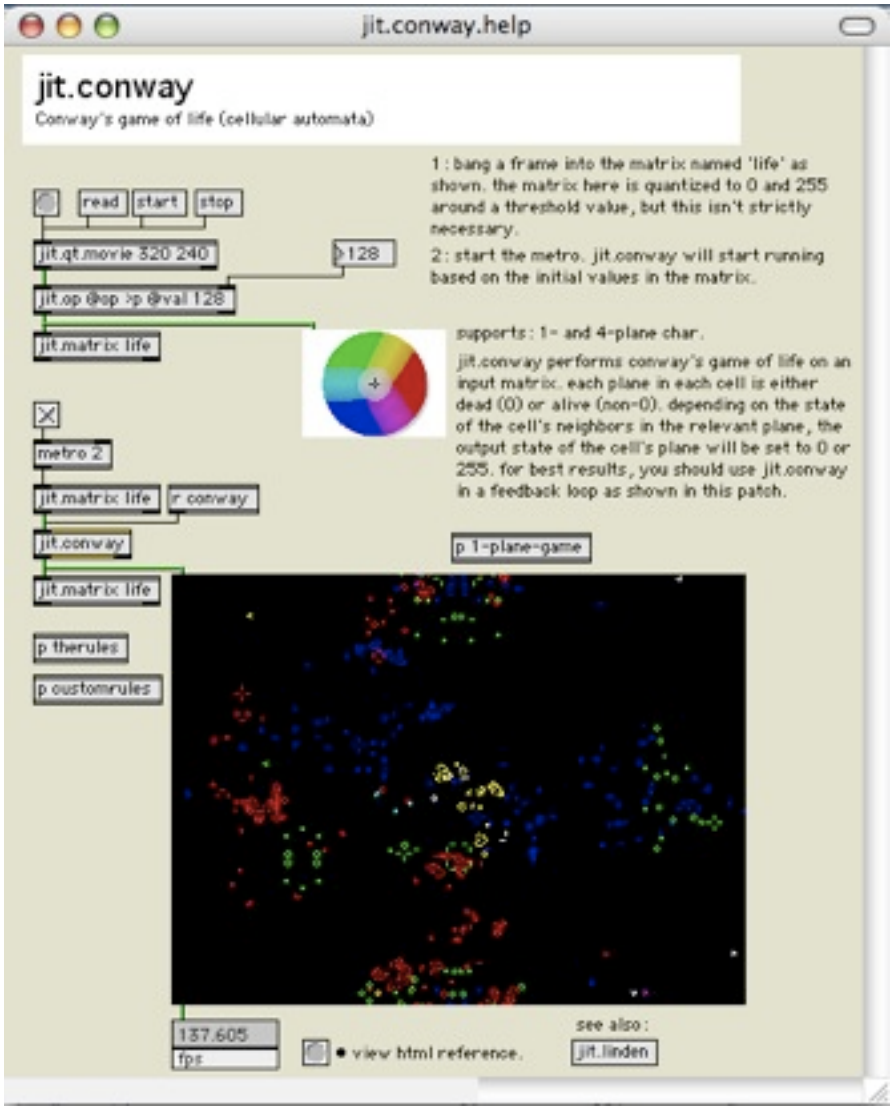
http://eamusic.dartmouth.edu/~wowem/electronmedia/music/eamhistory.html

Example **John Conway - Game of Life**

The Game

The Game of Life is not your typical computer game. It is a 'cellular automaton', and was invented by Cambridge mathematician John Conway.

This game became widely known when it was mentioned in an article published by Scientific American in 1970. It consists of a collection of cells which, based on a few mathematical rules, can live, die or multiply. Depending on the initial conditions, the cells form various patterns throughout the course of the game.



see jit.conway

Under the window somebody was singing. Winston peeped out, secure in the protection of the muslin curtain. The June sun was still high in the sky, and in the sun–filled court below, a monstrous woman, solid as a Norman pillar, with brawny red forearms and a sacking apron strapped about her middle, was stumping to and fro between a washtub and a clothes line, pegging out a series of square white things which Winston recognized as babies' diapers. Whenever her mouth was not corked with clothes pegs she was singing in a powerful contralto:

It was only an 'opeless fancy.
It passed like an Ipril dye,
But a look an' a word an' the dreams they stirred!
They 'ave stolen my 'eart awye!

The tune had been haunting London for weeks past. It was one of countless similar songs published for the benefit of the proles by a sub–section of the Music Department. The words of these songs were composed without any human intervention whatever on an instrument known as a versificator. But the woman sang so tunefully as to turn the dreadful rubbish into an almost pleasant sound. He could hear the woman singing and the scrape of her shoes on the flagstones, and the cries of the children in the street, and somewhere in the far distance a faint roar of traffic, and yet the room seemed curiously silent, thanks to the absence of a telescreen.

Other examples from history/literature: Jonathan Swift: Gulliver's Travels

Every one knew how laborious the usual method is of attaining to arts and sciences; whereas, by his contrivance, the most ignorant person, at a reasonable charge, and with a little bodily labour, might write books in philosophy, poetry, politics, laws, mathematics, and theology, without the least assistance from genius or study." He then led me to the frame, about the sides, whereof all his pupils stood in ranks. It was twenty feet square, placed in the middle of the room. The superfices was composed of several bits of wood, about the bigness of a die, but some larger than others. They were all linked together by slender wires. These bits of wood were covered, on every square, with paper pasted on them; and on these papers were written all the words of their language, in their several moods, tenses, and declensions; but without any order. The professor then desired me "to observe; for he was going to set his engine at work." The pupils, at his command, took each of them hold of an iron handle, whereof there were forty fixed round the edges of the frame; and giving them a sudden turn, the whole disposition of the words was entirely changed. He then commanded six-and-thirty of the lads, to read the several lines softly, as they appeared upon the frame; and where they found three or four words together that might make part of a sentence, they dictated to the four remaining boys, who were scribes. This work was repeated three or four times, and at every turn, the engine was so contrived, that the words shifted into new places, as the square bits of wood moved upside down.
From Gulliver's Travels, by Jonathan Swift.

Other examples from history/literature

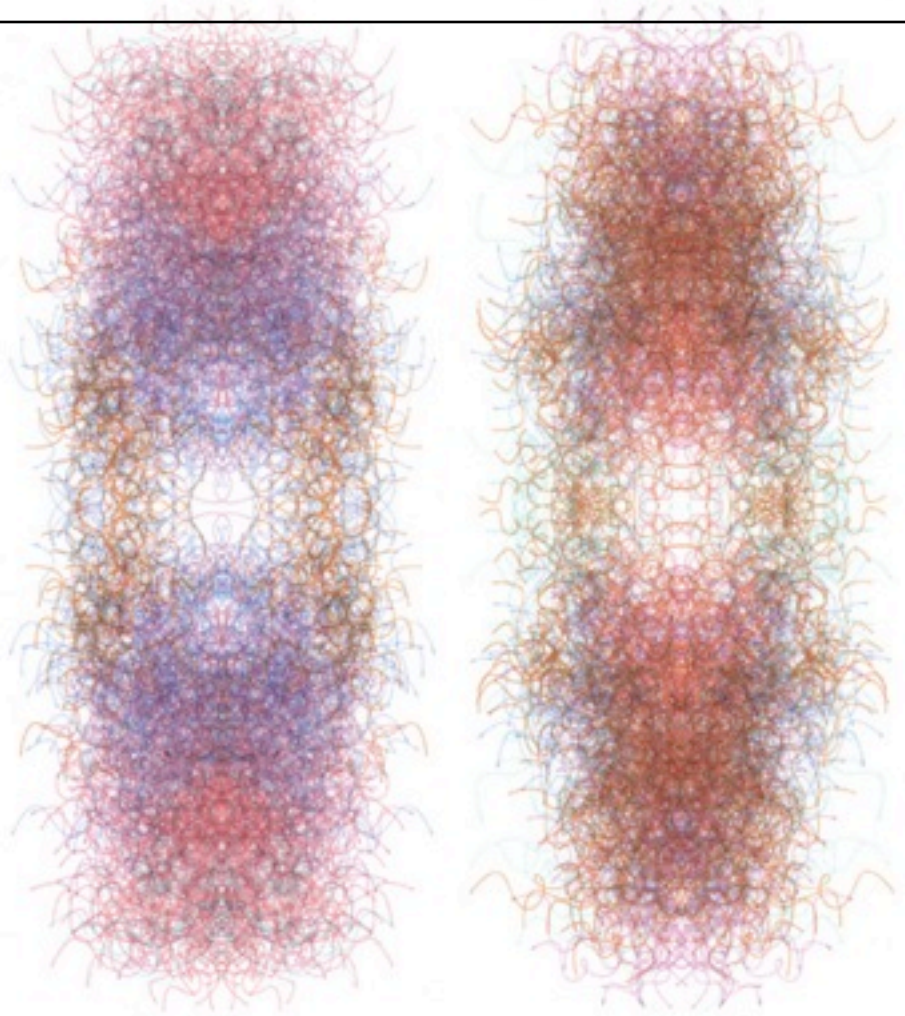
Shakespeare - Rude mechanicals

Other examples from history/literature: Francis Bacon *The New Atlantis*

We also have sound-houses, where we practise and demonstrate all sounds and their generation. We have harmony which you have not, of quarter-sounds and lesser slides of sounds. Divers instruments of music likewise to you unknown, some sweeter than any you have; with bells and rings that are dainty and sweet. We represent small sounds as great and deep, likewise great sound extenuate and sharp; we make divers tremblings and warblings of sounds, which in their origin are entire. We represent and imitate all articulate sounds and letters, and the voices and notes of beasts and birds. We have certain helps which, set to the ear, do further the hearing greatly; we also have divers strange and artificial echoes, reflecting the voice back many times, and, as it were, tossing it; and some that give back the voice louder than it came, some shriller and deeper; yea, some rendering the voice, differing in the letters or articulate sound from that they receive. We have all means to convey sounds in trunks and pipes, in strange lines and distances.

The Last Word **Algorithms in other art forms**

http://www.verostko.com/gallery.html



The Last Word **Algorithms in other art forms**

http://www.vgallery.co.za/hirst.htm

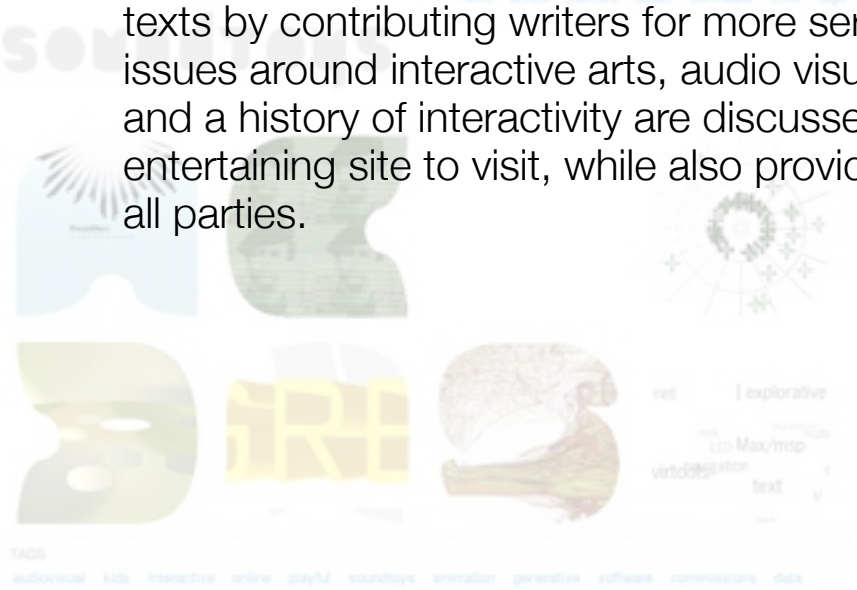
Examples

A good example of what's not so good:
http://www.geocities.com/Vienna/9349/index.html

More interesting:
http://www.stanza.co.uk/

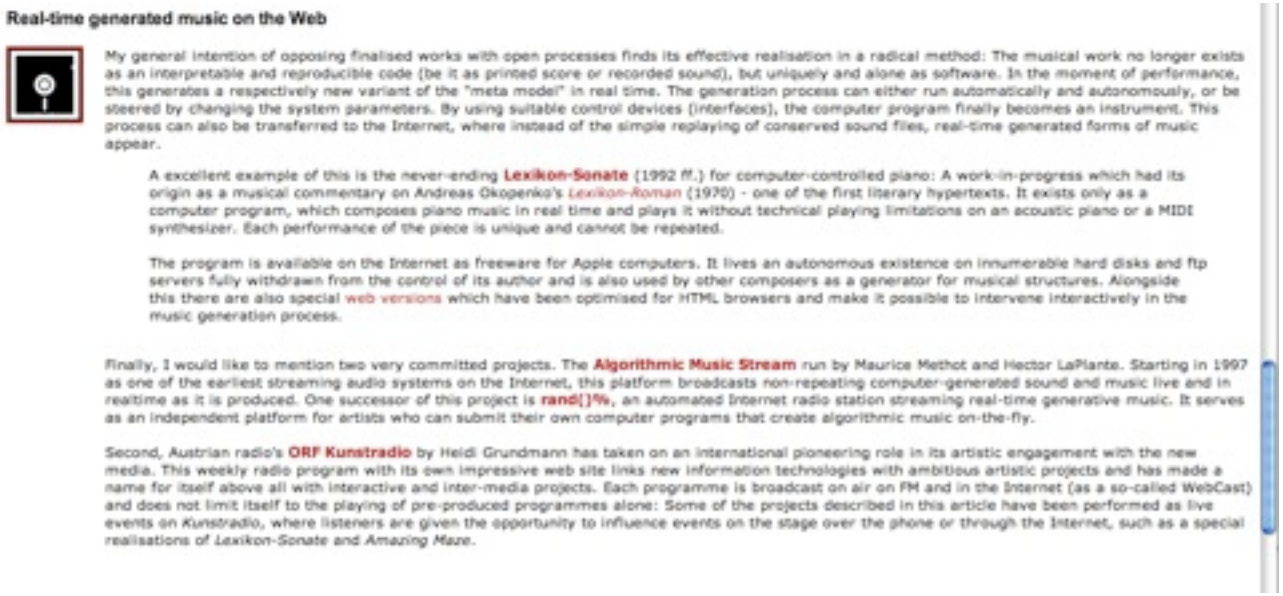
Examples **SoundToys**

http://www.soundtoys.net/ is the internets leading space for the exhibition of exciting new works by of audio visual artists. The site is a meeting point for this growing community of artists and its audience. In addition to the exhibition of audio visual projects, the site contains areas for artists interviews, links to resources, and texts by contributing writers for more serious and educational issues around interactive arts, audio visual synthesis, generative art, and a history of interactivity are discussed. Hopefully it is a fun and entertaining site to visit, while also providing valuable information for all parties.



Examples **Karlheinz Essl**

http://www.essl.at/bibliogr/cyberkomp-e.html



Real-time generated music on the Web

My general intention of opposing finalised works with open processes finds its effective realisation in a radical method: The musical work no longer exists as an interpretable and reproducible code (be it as printed score or recorded sound), but uniquely and alone as software. In the moment of performance, this generates a respectively new variant of the "meta model" in real time. The generation process can either run automatically and autonomously, or be steered by changing the system parameters. By using suitable control devices (interfaces), the computer program finally becomes an instrument. This process can also be transferred to the Internet, where instead of the simple replaying of conserved sound files, real-time generated forms of music appear.

A excellent example of this is the never-ending **Lexikon-Sonate** (1992 ff.) for computer-controlled piano: A work-in-progress which had its origin as a musical commentary on Andreas Okopenko's *Lexikon-Roman* (1970) - one of the first literary hypertexts. It exists only as a computer program, which composes piano music in real time and plays it without technical playing limitations on an acoustic piano or a MIDI synthesizer. Each performance of the piece is unique and cannot be repeated.

The program is available on the Internet as freeware for Apple computers. It lives an autonomous existence on innumerable hard disks and ftp servers fully withdrawn from the control of its author and is also used by other composers as a generator for musical structures. Alongside this there are also special web versions which have been optimised for HTML browsers and make it possible to intervene interactively in the music generation process.

finally, I would like to mention two very committed projects. The **Algorithmic Music Stream** run by Maurice Methot and Hector LaPlante. Starting in 1997 as one of the earliest streaming audio systems on the Internet, this platform broadcasts non-repeating computer-generated sound and music live and in realtime as it is produced. One successor of this project is **rand[]%**, an automated Internet radio station streaming real-time generative music. It serves as an independent platform for artists who can submit their own computer programs that create algorithmic music on-the-fly.

Second, Austrian radio's **ORF Kunstradio** by Heidi Grundmann has taken on an international pioneering role in its artistic engagement with the new media. This weekly radio program with its own impressive web site links new information technologies with ambitious artistic projects and has made a name for itself above all with interactive and inter-media projects. Each programme is broadcast on air on FM and in the Internet (as a so-called WebCast) and does not limit itself to the playing of pre-produced programmes alone: Some of the projects described in this article have been performed as live events on *Kunstradio*, where listeners are given the opportunity to influence events on the stage over the phone or through the Internet, such as a special realisations of *Lexikon-Sonate* and *Amazing Maze*.

Examples **Types** and **Techniques**

Randomness and **Chance** – see separate presentation

Natural Processes (fractals, cellula automata, genetic algorithms...)

Mathematical Processes (fractals, golden section...)

Invented Processes (Fontana Mix)

Real Live **Examples** for you to **try**!

Fontana Mix (Essl/Cage)

Streams in SC (**McCartney**)

Sound Sculpture (**Athinasiou**)

Formulator, **Telephony** etc.

Long Player

Examples **SuperCollider** and **Streams**

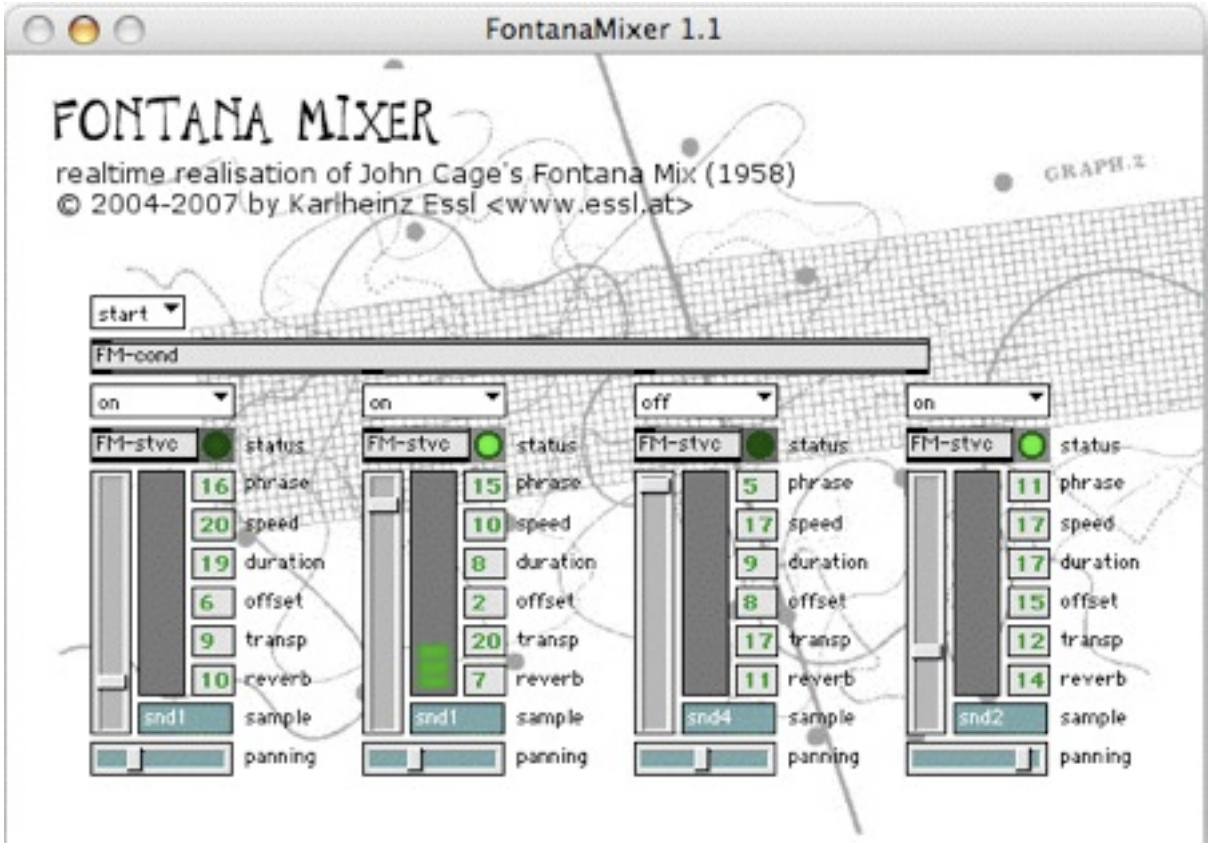
- First, a nice **simple** example, which you've probably come across. Open **SuperCollider** and go to the introductory help page (shift-command-?).
- Find the item **Streams** and click on it.
- Click on the very first link: **[Streams-Patterns-Events1]**.
- Run the example at the bottom of the page, from where it says: **Making Music with Streams**.

Examples **SuperCollider** and **Streams**

- **Keep the original and make copies to work with**.
- Study the way in which the patch works. Notice how the **Synth** works with the **Sequence**.
- Play with the patch until you feel you **understand** it a bit. Then attempt to add a second 'idea', even if it's just a version of the first (but make it clearly and identifiably different).
- Use some sort of **algorithmic** method to choose which 'version' happens when.

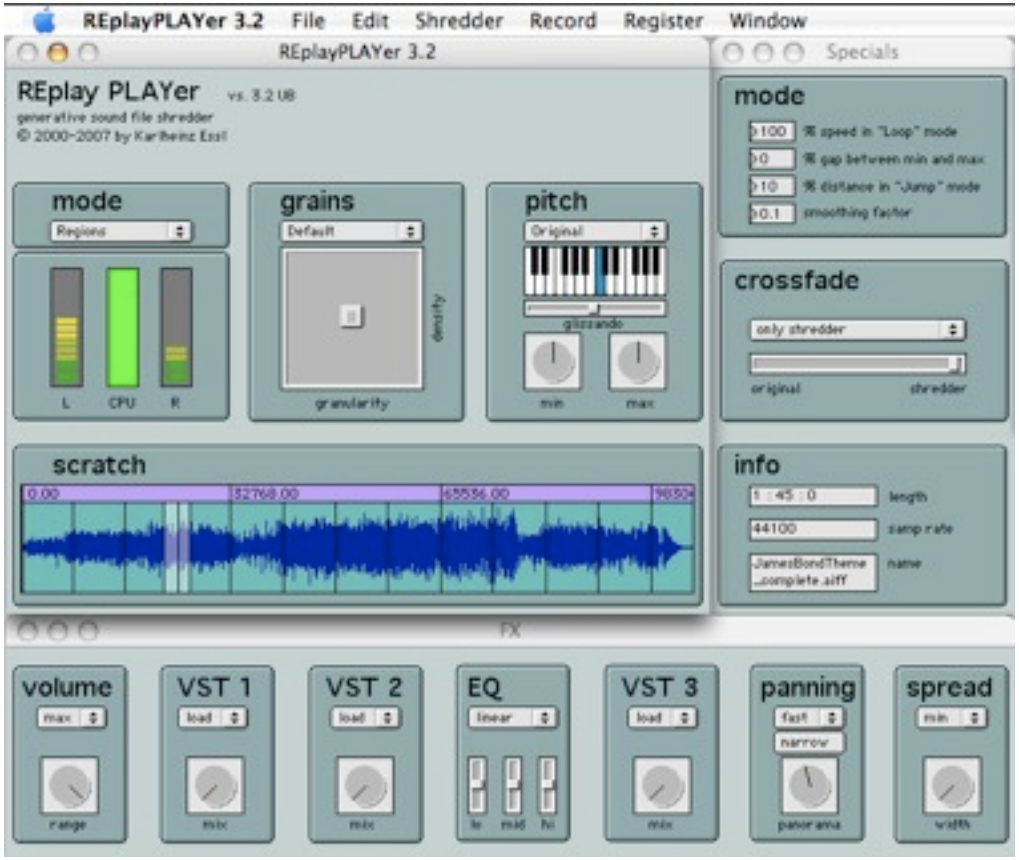
Examples **Fontana Mix Cage/Essl**

http://www.essl.at/works/fontana-mixer/download.html



Examples **Granular Composer**

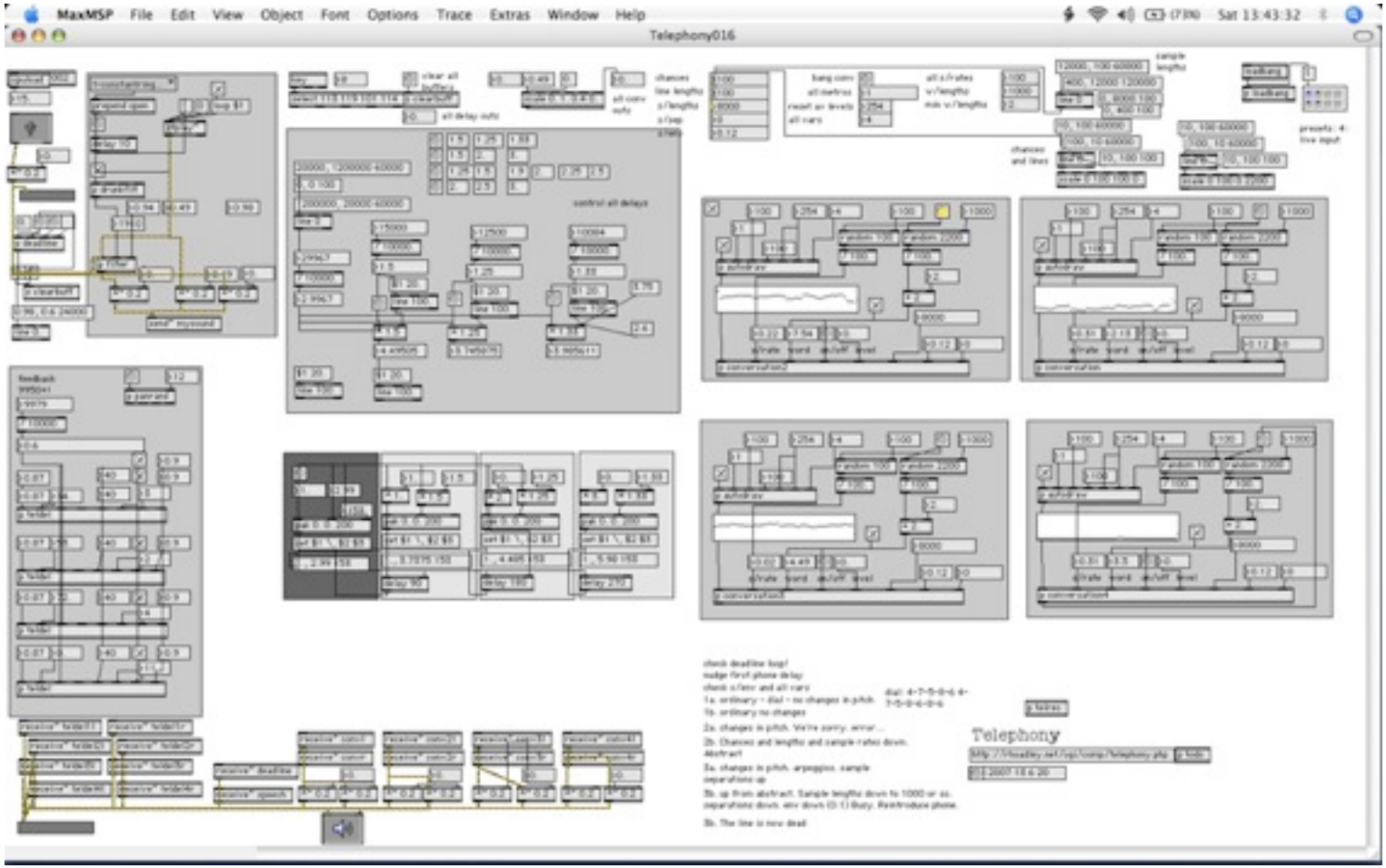
http://www.essl.at/works/replay.html#download



Examples **Dionysius Athinasiou Major Project**

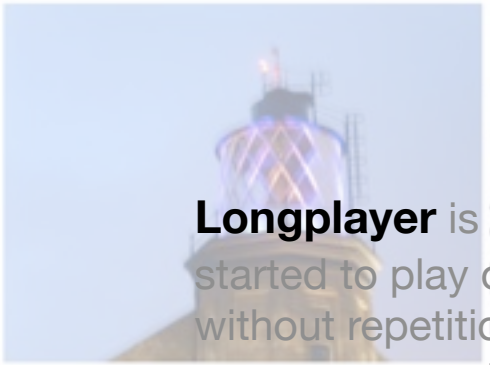
Dionysius, who graduated in 2007, undertook for his **major project** a study in **algorithmic composition**. The result was a **sonic installation** that provides an **infinite** number of combinations of provided sounds. While the music sounds recognisable, it is different at all times. Or at least the probability of it producing precisely the same sequence of notes is very remote.

Telephony, etc.



Telephony (2007)

Examples **Long Player**



Longplayer is a **1000 year long piece of music** which started to play on the **1st January 2000** and will continue to play, without repetition, until the **31st December 2999**, when it will come back to **the point at which it began - and begin again...**

http://longplayer.org/
http://longplayer.org/lp_new_site/what/what.html

Example **David Cope - EMS**

Computer Generated Compositions, programmed by David Cope

- **'Bach'** Invention
  - **'Beethoven'** Sonata Movement
    - **'Chopin'** Mazurka
      - **'Joplin'** Rag

Back to slide 25

http://arts.ucsc.edu/faculty/cope/mp3page.htm

Control

Consider how you want to control your **creation** - is it **another algorithm**, or do you want to maintain **physical control**? Or both: an **algorithm** to decide the order in which things happen, but you decide the **duration** of each section?

Control

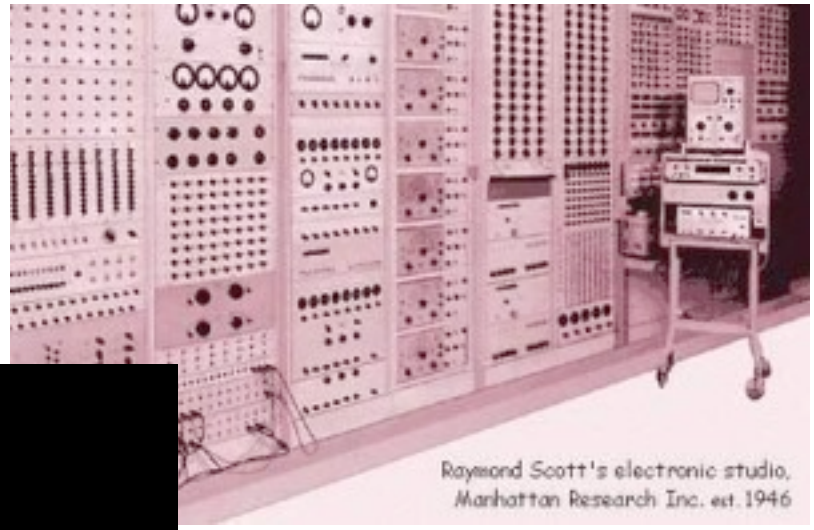
william burroughs and brion gysin

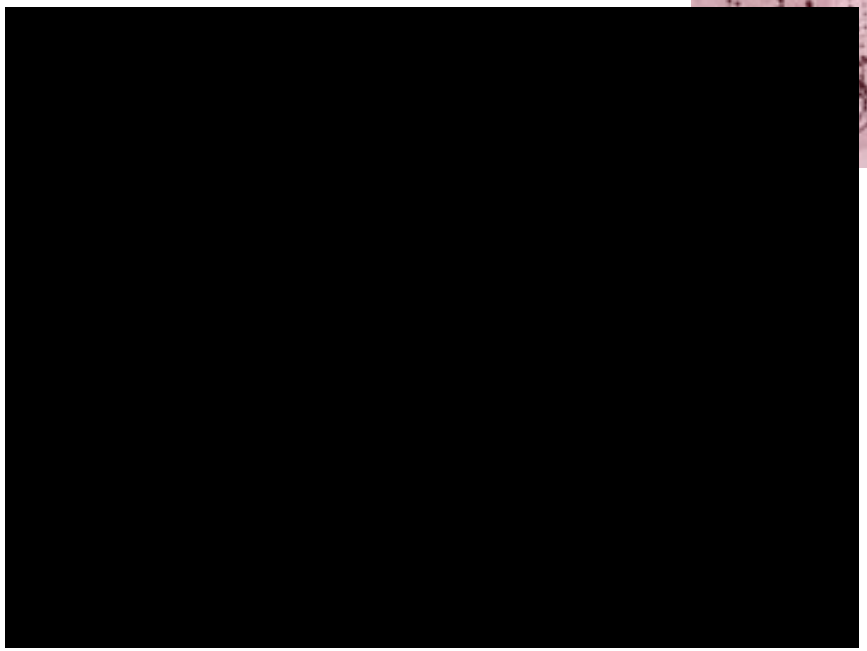
BBC
Documentary
about William
Burroughs

History

http://raymondscott.com/mripr.html

Raymond Scott Machines





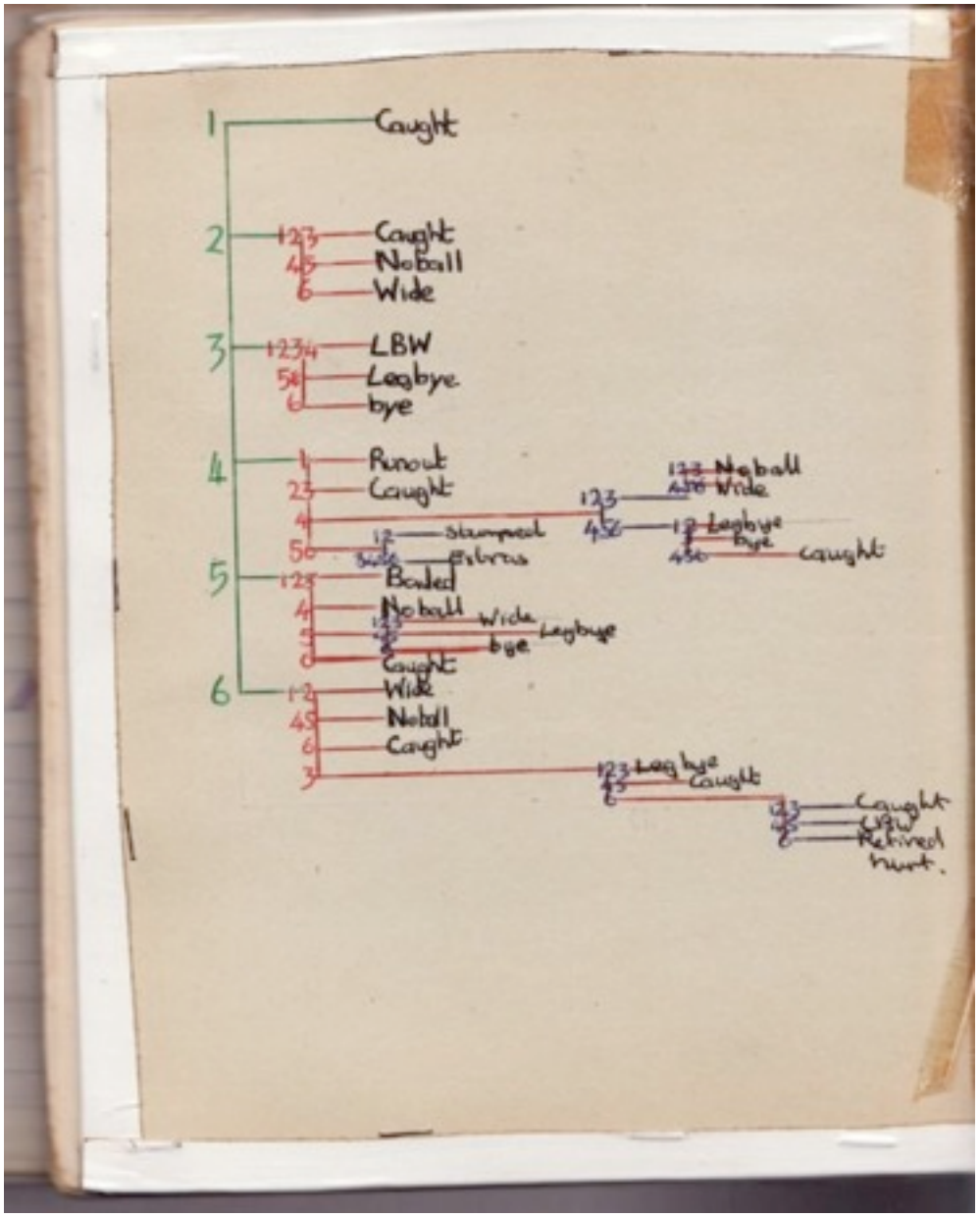
Mapping is the use of one set of **data** to control **another** - or the replacement of one set for another. A simple example of this is **scaling** - using the screen position of the mouse, for example, to control a MIDI note. There might be 1000 values in one part of a mouse's co-ordinates, but you only want 127, so you scale 1000 to 127.

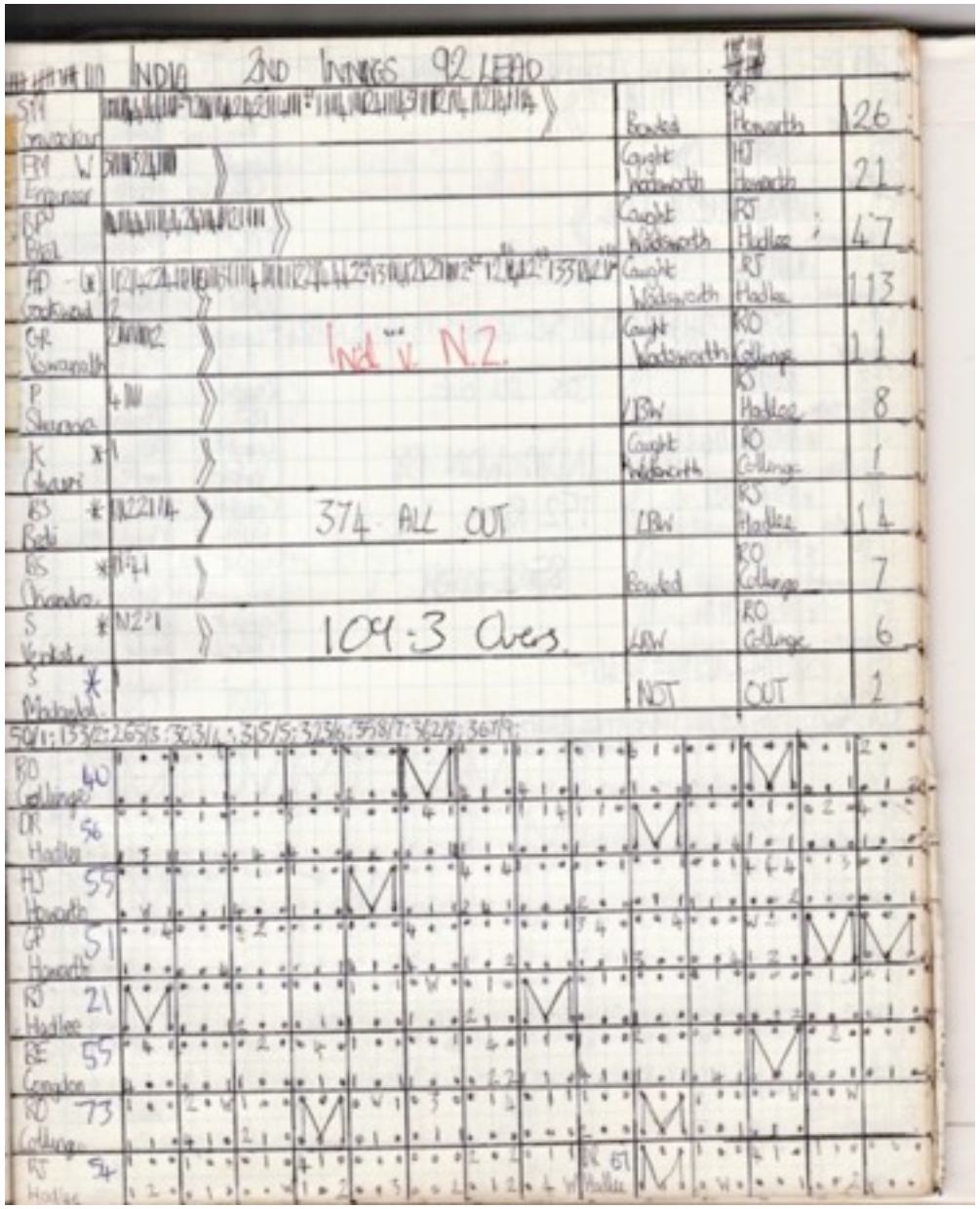
Similarly, if you want to use the **colour** of a particular area of an image to control the **frequency** of an audio wave, you'll need to scale it. Where the original data and the place where it ends up are perceived as being very different, this is sometimes called mapping.

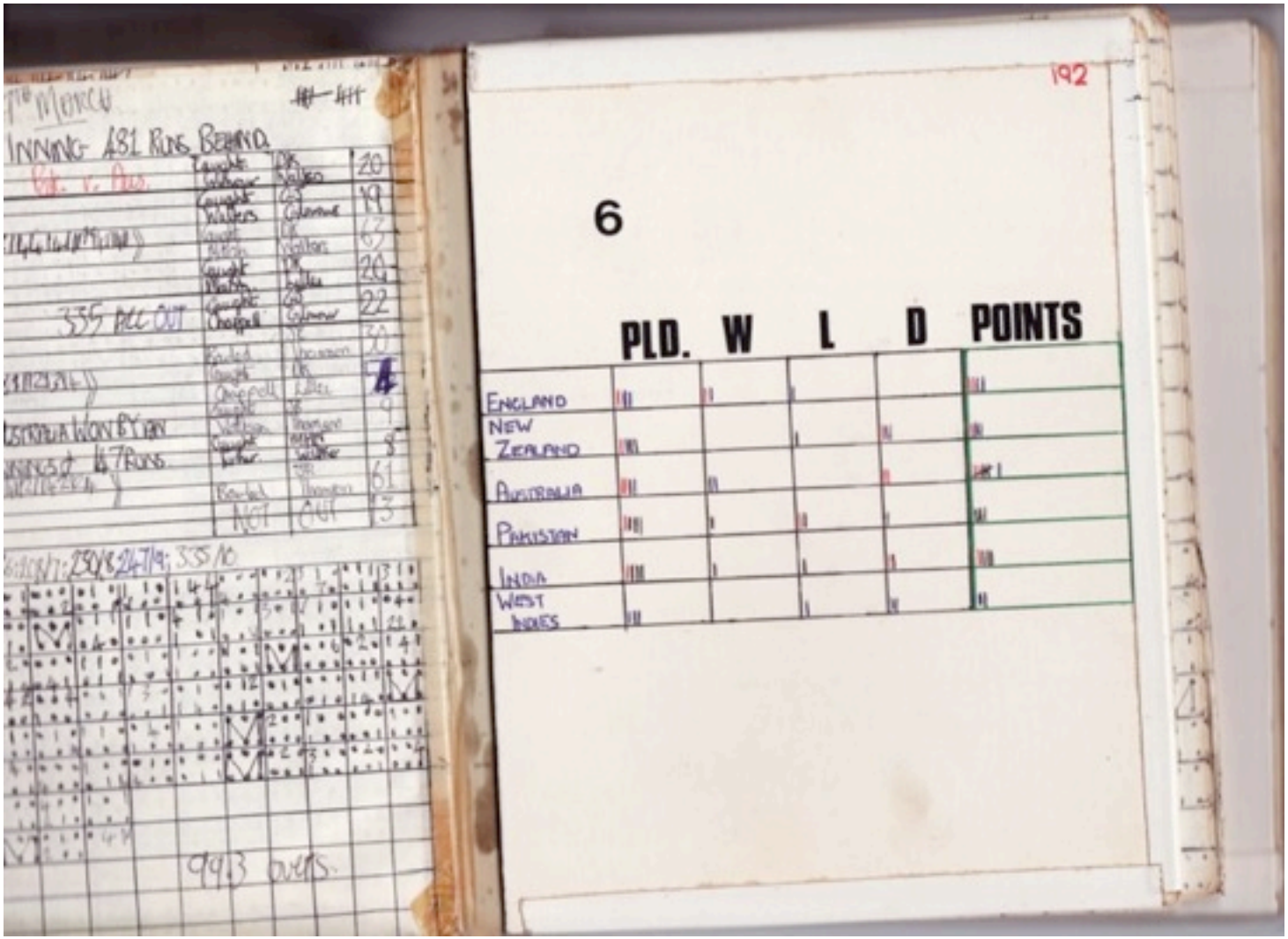
Think of some examples, and how you might implement them technically.

Negative Aspects

Similarity of result: there's a tendency for algorithmic material to have similar characteristics, no matter what algorithm you use. However, David Cope's work suggests that this is not necessarily the case.


1
Caught
2
123
Caught
45
Noball
6
Wide
3
1234
LBW
5
Legbye
6
bye
4
1
Runout
23
Caught
4
123
Noball
456
Wide
5
12
Legbye
3
bye
456
caught
5
123
Bowled
4
Noball
Wide
Legbye
bye
Caught
6
12
Wide
45
Noball
6
Caught
3
123
Legbye
Caught
Caught
LBW
Retired
hurt.


INDIA 2ND INNINGS 92 LEAD
Ind v N.Z.
374 ALL OUT
109.3 Overs
NOT OUT


INNING 481 RUNS BEHIND
335 ALL OUT
NOT OUT
993 overs
192
6
PLD. W L D POINTS
ENGLAND
NEW ZEALAND
AUSTRALIA
PAKISTAN
INDIA
WEST INDIES

Range of Possibilities

- SuperCollider
- Cottle, page 258+
- Streams, Patterns and Events - relationship to Environments and Live Coding
- Control Structures (inc Scheduler)
- rhoadley2008
- Dionysius's Sound Sculpture - a little more detail

- SPE7-task
- PBind-task

What and **How**?

You **need** to **think about** the following:

What do you want to control - for instance when sounds happen OR what the sounds are - you might try both but it's difficult!**?**

How do you want to control it - set it going and let it go, or set it going and tweak it, or perform it**?**

If you want to **perform** it, how do you want to do this**?**

The Last Word **Algorithms in other art forms**

Random Surrealism Generator:
http://www.ravenblack.net/random/surreal.html

Postmodernism Generator:
http://www.elsewhere.org/pomo

Wired's Patent-Pending Big Idea Book Generator:
http://www.wired.com/culture/culturereviews/magazine/15-10/st_bigidea

Eliza

Links

http://en.wikipedia.org/wiki/Algorithmic_music

http://www.music.sc.edu/fs/bain/atmi03/bain-atmi03.pdf

http://www.weathersongs.org/welcome/welcome.htm

http://emusician.com/tutorials/emusic_game_chance/

Quotations

"...composers have celebrated music's link with the logic of mathematics by introducing **parametric systems of organisation** (primarily in the pitch domain), which are **largely unrelated to aural perception**. In the Middle Ages these techniques were invariably hidden, existing below a surface that conformed to stylistic norms.."

Jon Appleton, **Machine Songs III**

Quotations

"...it seems important to preserve the idea that the computer is just a tools for carrying out a particular notion of how to compose music."

Otto Laske, **Algorithmic Composition in the New Century**

“An algorithm may describe a set of rules or give a sequence of operations for accomplishing some task, or solving some problem."

Gareth Loy, **Composing with Computers**

Bibliography All available in Library

- Roads, C. (2004), **Microsound**, Cambridge, Mass, London: MIT
- Miranda, E. R. (2002), **Computer Sound Design: Synthesis Techniques and Programming**, Oxford: Focal Press
- Taube, H. (2004), **Notes from the Metalevel : introduction to algorithmic music composition**, London, New York: Taylor & Francis Group
- Rowe, R. (2004), **Machine Musicianship**, Cambridge, Mass; London: MIT
- Cope, David (2005), **Computer Models of Music Creativity**, Cambridge, Mass; London: MIT

- Journals:
  Computer Music Journal
  Organised Sound

Bibliography All available in Library

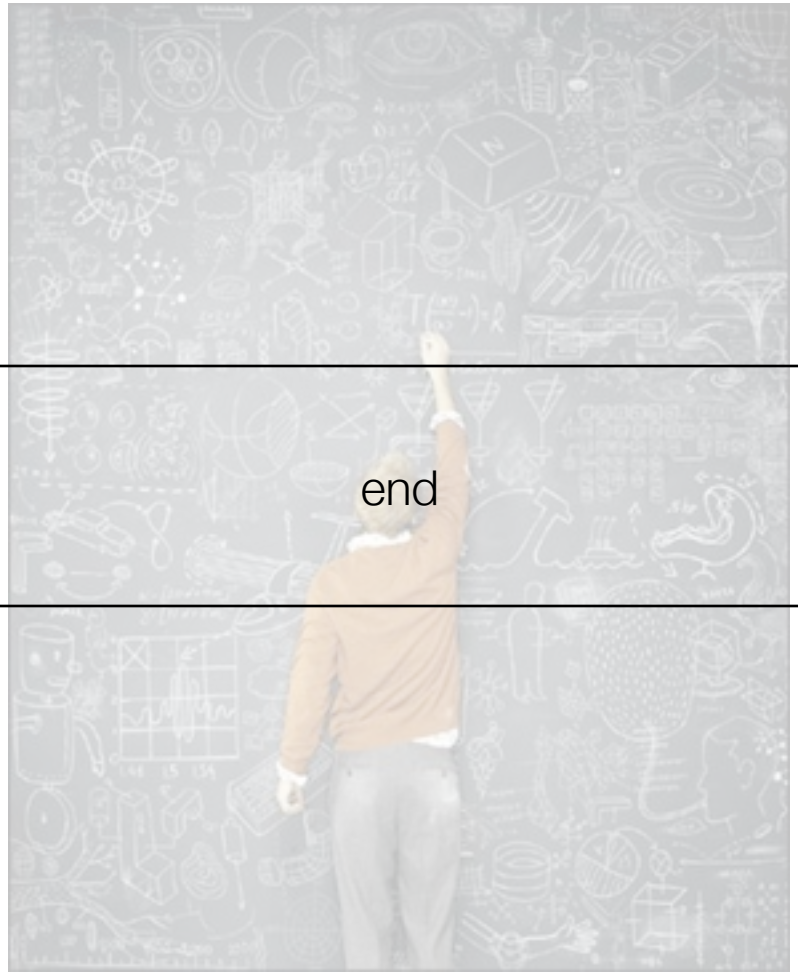
- **The Philosophy of Friedrich Nietzsche** Henry Louis Mencken 1908
- Nietzsche **The Birth of Tragedy**
- **Oxford English Dictionary**

Papers/Internet

- Dobrian...
- Rawlence, Christopher (Ed.), 1985, **About Time** (London: Jonathan Cape)
- Wikipedia: **http://en.wikipedia.org/wiki/Industrial_revolution**
- Wikipedia: **http://en.wikipedia.org/wiki/Automation**
- http://simonwoodside.com/weblog/images/2005/turing.gif
- h**ttp://www.unc.edu/%7Emumukshu/gandhi/gandhi/hofstadter.htm**

Other **Presentations**

rhoadley.org/presentations



end