If Nobody Understands What You say, try to Explain it to Your Computer with *Mathematica*.

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Abstract

An introduction to Mathematica software and what I wanted to explain with it prepares for a Marketing minded discussion. Six views of differences between electrons in 110 chemical elements are generated with the author's generalized graycode functions. The problem of estimating total negotiated cost of an hypothetical global license for everyone on the planet is illustrated.

Keywords: Atom, Graycode, License, *Mathematica*, Sustainability

1 Introduction

Between (Schreiber, CASYS 1998, vol.4.p.61ff) summer 1997 and this summer 1999 my strange portfolios learned how to represent themselves and some content in the context of *Mathematica*. Now I hope you may try *Mathematica* soon too.

2 *Mathematica*

S0.2.1, 1.2

"Ever since *Mathematica* was first released, its user base has grown steadily, and by now the total number of users is above a million. *Mathematica* has become a standard in a great many organizations, and it is used today in all of the Fortune 50 companies, all of the 15 major departments of the U.S. government, and all of the 50 largest universities in the world." (Wolfram, 1999 CellTag S0.2.1,1.2 like in onscreen Help)

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Mathematica teaches itself and a lot of Mathematics since 1988. You do not need any mathematical background to start. You should know brackets and quotes from this introduction at least. *Mathematica* basically evaluates linked expressions only and highlights brackets which do not fit in Inputform ({}). It hyperlinks what you want and offers helpful feedback whenever you exercise your imagination in it. The current version 4 is faster and knows more format conversions and functions.

2.1 Returning Expressions

Hit return – which is the combination ⇧↵ on the keyboard of my Mac– and *Mathematica* evaluates by interpreting this with earlier input. You get back

- automatically generated natural language error messages or
- the final result after shallow or deep cascading in substitutions of expressions.

Then you may enter a new expression to change the rules or the patterns for the next loop to express:

- symbolic output,
- text,
- animation,
- tables numbers in arbitrary precision,
- sound graphs,
- or complete seperate notebooks – or www versions of notebooks – containing combinations of parametrical mutations of expressions automatically sorted into seperate directories on remote networks.

2.1.1 *Mathematica* is *Mathematica Mathematica*

Mathematica actually is two *Mathematica* and the kernel can calculate without the browser. Your license might not allow you to run more than one kernel concurrently; or it might limit the time while you are granted the privilege to have this hypertutor calculate for you too. The license for the browser does not expire but the browser can only evalute simple problems without starting a kernel somewhere.

2.1.2 Precision Models beyond Chip Range

The *Mathematica* kernel will deliver your results with the required precision by calculating as many digits of intermediary results as it needs to guarantee this accuracy. The minimum number is less than the - 323 228 015 th power of ten. This means that we would have to pack 323 228 zeros in each of the 1000 empty rooms of Fig.2. The maximum number of *Mathematica* on my machine is bigger than the 323 228 010 th power of ten. The machine itself – a Motorola G3 chip – can only operate between -308 and 308 powers of ten. I guess this became rather technical for some readers; so I just ask this: Are the accessible numbers of the machine range the index and the *Mathematica* range the powerset classification of a Barnay-Gödel-Neumann model of axiomatic set theory? This and Zermalo and Fraenkel outlines EDM2 (Kiyosi, 1996, p. 148).

2.2 Giving as many Views of Nothing as You Want for Example by 1 Line of Text

Mathematica allows concise definitions of mathematical objects. I try to illustrate this with one line of text input which can generate as many images as you want.

2.2.1 Empty Rooms One Liner

The views of Fig.1 are generated as threedimensional graphics each containing nothing but an empty list and a point of view defined by a list of coordinates.

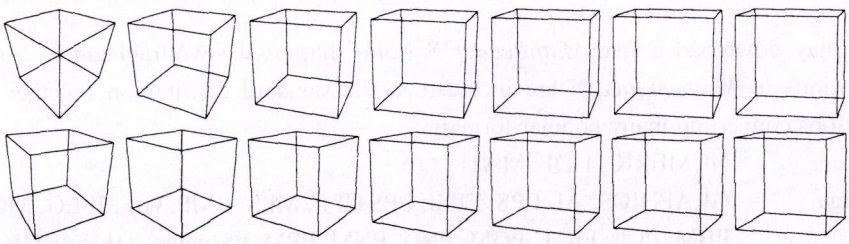

Fig.1: Fourteen views of an empty room generated with this one line of text:
Show[GraphicsArray[Table[Graphics3D[{},ViewPoint→{x,y,1}],{y,2},{x,7}]]]

2.2.2 One Letter Can Show 1000 Images

A picture says more than 1000 words, but one letter can mean more than 1000 empty or complicated frames in *Mathematica* if we ask for it in time.

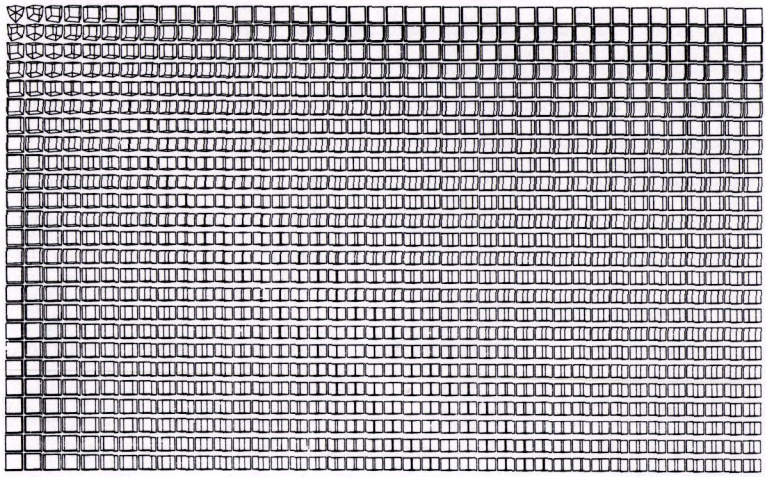

Fig.2: These 1000 views of an empty room are generated with one letter: **k**

k:=Show[GraphicsArray[Table[Graphics3D[{},ViewPoint→{x,y,1}],{y,25},{x,40}]]];

2.3 Standard Distribution

You may download a free *MathReader*™ from <http://www.wolfram.com>. Various extensions to *Mathematica*™ are included in the standard distribution together with functions converting many popular formats:

- data: NUMERIC, HDF, MAT,
- image: GRAPHICS, AI, EPS, EPSI, EPSTIFF, MPS, BMP, GIF, JPEG, MGF, PBM, PCL, PICT, PGM, PNG, PNM, PPM, PSImage, TIFF, WMF, XBitmap, Postscript
- sound: SOUND, AIFF, AU, SND, WAV.

You may generate plain ASCII, UNICODE, TEX and HTML versions of notebook files which can be opened with generic editors. *Mathematica*™ supports Windows™, NT™, Mac™, Linux™ and other Unix operating systems.

Packages for special commercial and scientific purposes and last but not least *Mathematica Link for Word*™ and or *Mathematica Link for Excel*™ are available from Wolfram Research, which also supports distribution of third party plug-ins.

3 Intuitive Clustering

The basic objective of my seemingly impossible research program is to support participatory decision by providing a coherent approach to simulated and face to face confrontation with many actors feeling many inner ambiguities about many issues with many aspects.

3.1 Watching Portfolios

While trying to study socio-ecologically sustainable markets in the world of popular office software I had found a strange type of map. It seemed to include archaic oracles, any tabulation or visualization of data, and of course conventional business portfolios as special cases.

But I had no tools to process real data automatically while there was software for conventional portfolio methods. I had little background in Math, so I could not even properly state what I believed to be unique about his general point of view. I had little background in computer science too, so I could not implement an actual implementation to test for advantages over competing products. My final effort in this frustrating period was to reread Kant´s transcendental schema into the shape of a watch thus representing a four dimensional generator of selfobserving maps. Was this the end of an impossible agenda (1.2)?

3.2 Prototypical Implementation

The standard distribution features two implementations of binary graycoding: one by Stephen Wolfram, and one by Steven Skiena (1990).

3.2.1 Based Graying

After two years – speedreading (Hamming, 1962, p. 604ff.; Knuth, 1998, 567f.) and prototyping – I was able to write my own functions to graycode and graydecode with any binary or non-binary basis in summer 1999. We may now project any item to a position reflecting many – not necessarily binary – attributes at the same time.

Table 1: Grayed numbers (0…15) in bases (2 … 16)

n\b	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	11	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3	10	12	3	3	3	3	3	3	3	3	3	3	3	3	3
4	110	11	13	4	4	4	4	4	4	4	4	4	4	4	4
5	111	10	12	14	5	5	5	5	5	5	5	5	5	5	5
6	101	20	11	13	15	6	6	6	6	6	6	6	6	6	6
7	100	21	10	12	14	16	7	7	7	7	7	7	7	7	7
8	1100	22	20	11	13	15	17	8	8	8	8	8	8	8	8
9	1101	122	21	10	12	14	16	18	9	9	9	9	9	9	9
10	1111	121	22	20	11	13	15	17	19	10	10	10	10	10	10
11	1110	120	23	21	10	12	14	16	18	20	11	11	11	11	11
12	1010	110	33	22	20	11	13	15	17	19	21	12	12	12	12
13	1011	111	32	23	21	10	12	14	16	18	20	22	13	13	13
14	1001	112	31	24	22	20	11	13	15	17	19	21	23	14	14
15	1000	102	30	34	23	21	10	12	14	16	18	20	22	24	15

3.2.2 Based DeGraying

It is trivial to look up an extended version of Table 1 to get ordinary numbers from based gray numbers; but a function is more comfortable to project many items and many distinctions between items simultaneously. The features are interpreted as given in grayed coordinates which have to be translated into the desired coordinates of view. My screen coordinates happen to be pairs of ordinary numbers base 2. The example in the next section degrays 110 lists.

4 Orbital Example

4.1 Wolfram

Miscellaneous`ChemicalElements` is the name of the packaged database of chemical elements.

$$1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^{10}\ 4s^2 4p^6 4d^{10} 4f^{14}\ 5s^2 5p^6 5d^4\ 6s^2$$

ElectronConfigurationFormat[Wolfram] is the function collecting data about – in this case six classes of orbitals – padding the nucleus of the chemical element Wolfram.

4.2 Comparison of Conventional Listing and Gray Listing of Electron Data

Fig. 3 illustrates what happens if we use one ordinary axis – y – and project degrayed distinctions among the orbitals of 110 chemical elements along the x axis..

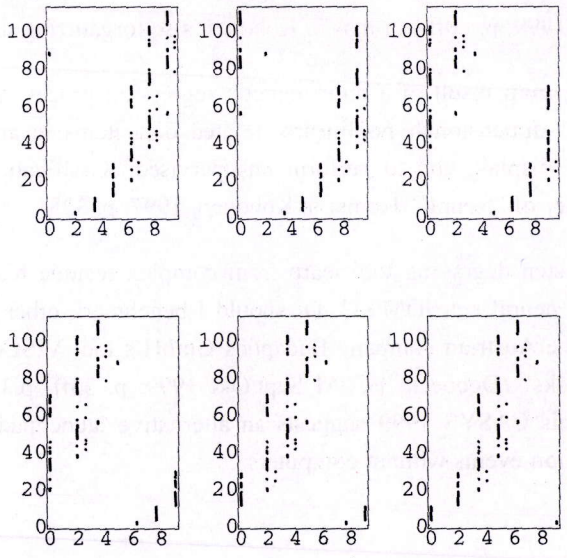

Fig.3: Rotating distinctions between 110 chemical elements

Each of the six images in Fig. 3 shows a different rotation of the tuple used to destill the differences between the orbitals for more than hundred elements.

4.3 Reentry of Predicates Disclaimer versus Recognizability of Artefacts Idea

Our convential numbering of elements already reflects properties of the elements so it is not surprising that we see patterns in the gray projections. But please notice: The recognizable distinctions persist in spite of different graybased reinterpretations. Again this example does not claim to contribute to chemistry or physics but about an artefact of projection which might be recognizable after shuffling the rankings of attributed importances of labels.

5 Learning to Compete with Implementations of Selforganization

Now as I face new formal and usability problems – like recognizing my prototype functions as implementations of an unary algebra (Smirnov in Hazewinkel 1995 Vol5 p. 674f.) or designing interfaces for web users – I also see new commercial competitors like the AND Corporation´s artificial intelligence HNET for classification (Sutherland, PC AI Sept/Okt 1999: p. 20ff.) or maybe Kohonen´s selforganizing map (SOM).

"**self-organizing map** result of a nonparametic regression process that is mainly used to represent high-dimensional, nonlinearly related data items in an illustrative, often two-dimensional display, and to perform unsupervised classification and clustering." (from the Glossary of "Neural" Terms; in Kohonen, 1997: p. 325).

Should our one step degraying tool learn from complex residue matches in HNET or ANNs (artificial neural net SOM´s)? Or should I benchmark other frontends used for instance – like the Austrian company Eudaptics GmbH´s tool VISCOVERY – to illustrate financial risks? (Deboeck; PC AI Sept/Okt 1999: p. 33ff. p.35ff.). The author´s other paper at this CASYS 1999 suggests an alternative launchpad: sustainable local landart participation events without computers.

6 For an Hypothetical Negotiation About a Global License

"We may see most aptly that *Mathematica* weaves interpretable expressions just as dropping of cost per unit weaves clusters of sustainable peace, happiness and prosperity" Ms. Jiji from Singapore might have wanted to link Matsushita´s "P.H.P." (1984) to Marketing (Fig. 4) while paraphrasing Ms. A.D.A.Byron Lovelace´s (*1815-1852†): "We may see most aptly that the Analytical Engine weaves algebraical patterns just as the Jaquard loom weaves flowers and leaves." (Morrow, Perl, 1998:128ff.). But I guess there was no hearing, no negotiation about a global license yet.

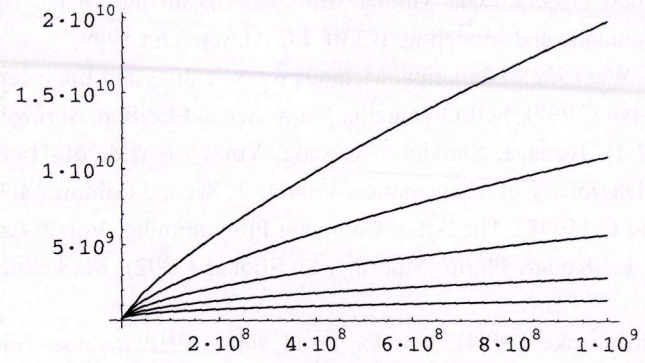

Fig. 4: Total cost of a global license for the sponsors of the users

It might actually be possible to agree on way to measure how many girls and boys and women and men do exercise their hypothetical right. Fig. 4 plots the approximate total cost of a global license if cost per unit drops more or less like in traditional industries whenever the accumulated number of units doubles. Empirical estimations and formulas differ by acknowledging inflation, direct labour hours, components of cost, synergy, range of time, process innovation, umbrella effects of high prices which offer windfall profits to inferior competitors etc. or not (Lilien, Kotler, Moorthy, p. 518ff).

7 Conclusion

Mathematica was shown to be able to degray for instance orbits of electrons. If in charge I would have tried already to negotiate a global license between the governments of the world and Wolfram for everybody who wants to learn *Mathematica.*

Acknowledgements

It would have been impossible for me to refer to *Mathematica* 4 without Wolfram's technical marketing manager Jon McLoone who made it possible, to get and extend a temporary license for the new version, before distribution of the site license CD. John Sutherland helped by sending his article on an HNET application.

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