Complex Systems Science for Australia

Instructions to Authors

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1 Instructions

Ian G. Enting

Last update: 7/3/06.

Since we are still discussing publication, all these aspects may, in principle, be over-ruled by the publisher.

Source format The book is being produced in LaTeX. This means that authors need to supply chapters as ASCII text, using LaTeX markup. (It does not mean that authors have to own or run LaTeX, and places no restrictions on what tools the authors use to produce the LaTeX source files. In particular, LaTeX seems to be completely oblivious to the DOS/Unix difference over the definition of an end-of-line in etxt files.)

Further discussion of LaTeX markup is given later. Some key points are:

- markup commands begin with a backslash, Braces are used to delimit scope of commands.
- everything after % on a line is a comment (except for when \% is used to generate the % symbol).
- blank lines separate paragraphs.
- except for the two points above, line breaks are (largely) irrelevant - LaTeX does its own line-breaking.

Spelling As per Macquarie Dictionary.

Title Apart from acronyms, capitalise only first letters of main words, (i.e. pretty much everything except articles, prepositions, conjunctions.). The command is \CHAPTER1Actual title.

Short-title (This is for running head (and maybe for contents)). Please supply one if your full title is long.

Author We propose first name, optional middle initial, last name. (Or initial(s), preferred name, last name — actually whatever you want, it's just a suggestion). We plan to list affiliations in an appendix. The command is \AUTHOR{Author's Name(s)}

Abstract An abstract of 100–150 words is requested. This should use the command \Abstract{ xxx} with the actual text within the braces.

Glossary references We currently propose to have numerical references to a common complex systems glossary (and author-date for bibliography). Citations in chapters take the form \GR{key}, where 'key' is listed in square brackets at the end of the glossary entry (still in progress). Thus in the current version \GR{G:cess} generates [12].

References to bibliography Citations are created by reference to a bibliography file. These take the forms \cite{CS:wilson98}, (giving Wilson [1998]) or \citep{CS:wilson98}, (giving [Wilson, 1998]) where 'CS:wilson98' is a key defined in the entry in the bibliography file. Ian Enting's website has a listing of formatted references preceded by keys.

The main (and so far only) bibliography file for this book is **csb.bib**. Copies, updated from time to time, will be available via the internet. Also available (on Ian Enting's website) will be a formatted reference list (augmented by inclusion of the keys).

Graphics pdf or jpeg. Use jpeg for photographs, pdf for most other things. Supply them as separate files. Making the author initials the first part of the file name will be helpful.

Latex packages * *font* to be decided, (draft uses times), *amsmath*, for equations, *graphicx* for graphics, *natbib* for bibliography. (This information is mainly for those doing a lot of maths — others don't need to know about it.).

Author-defined cross-references Figures, tables and equations should use LaTeX automatic numbering (and so numbering within chapters will happen automatically). For referencing within you own chapter (and cross-referencing which we encourage) use a reference key such as F:IGE1, T:IGE1, E:IGE1 for figures tables and equations, using author initials to (hopefully) generate a disjoint set of keys).

indexing This uses the standard LaTeX command \index{term} or \index{term!subterm}. Where different authors use similar terms, the editors aim to broker a common term if appropriate.

Acknowledgments The format is \AuthorAck{acknowledgment text}

Open Resources: http://ms.unimelb.edu.au/∼enting/cssbook/cssbook.html

- Reference file: *csb.bib*
- File of incomplete references: *other.bib*
- Listing for contents of reference files (file *b-refs.pdf*), with keys to use in citing references.
- The source file *template.tex* (see chapter 4 for the output that it generates) to use as a template for typing chapters.
- Shell file *b-shell.tex* in which to include chapter.
- This document *a-book.tex*.

Resources on pass-worded ftp site

- Current draft of book *c-book.pdf* (subject to receiving author permission). **Not yet on-line.**
- source file for glossary *c-gloss.tex*. **Not yet on-line.**

Using the shell file

This requires you to have b-shell.tex, csb.tex and template.tex all in the same directory. Then a succession of commands need to be run to resolve cross-references:

- pdflatex b-shell
- bibtex b-shell

- pdflatex b-shell
- makeindex b-shell
- pdflatex b-shell (and maybe repeat this until cross-references are resolved).

The commands can be run from a command line. They can also be invoked through GUIs such as TeXShop on Macs. If you have no graphics in your chapter, latex can be used as an alternative to pdflatex, followed by dvips (or equivalent) to get postscript (although there seems to be no obvious reason to do so).

If you are using references to glossary, you need to either (a) ignore error messages and accept ?? as reference in output, or (b) get the file c-gloss.tex from the ftp site, put it in the directory with the other files and remove the % from in front of the \input c-gloss command in b-shell.tex

[*Note: File c-instruct.tex*]

2 Sample chapter

I. Enting

Abstract

This chapter gives instructions for preparing LaTeX files for chapters of this book. The following chapter gives the text-file listing that produced this chapter.

For a full description of typesetting mathematics, consult a manual. However, the main principle is that in-line mathematics is placed between two $ characters, so that π produces π. Display equations use two $ characters before and after the equation so that $$ f(p) = \int_0^\infty F(t)\,\exp(-pt)\,dt$$ produces

$$f(p) = \int_0^\infty F(t)\exp(-pt)\,dt$$

Author acknowledgments: IGE gratefully acknowledges the usual suspects.

[*Note: file c-sample.tex*]

3 Source file for sample chapter

```
 \CHAPTER{1}{Sample chapter}\label{Csample}

 \AUTHOR{I. Enting}

 \Abstract{This chapter gives instructions for
 preparing \LaTeX\ files for chapters of this book.
 The following chapter gives the text-file
 listing that produced this chapter.}

\providecommand{\BS}{$\backslash$}
For a full description of typesetting mathematics, consult
a manual. However, the main principle is that in-line
mathematics is placed between two \$\ characters,
so that \$\BS pi\$ produces $\pi$. Display
equations use two \$\ characters before and after the equation
so that
\$\$ f(p) = \BS int\_0\^\BS infty F(t)\BS,\BS exp(-pt)\BS,dt\$\$
produces
$$
f(p) = \int_0^\infty F(t)\exp(-pt)\,dt
$$

\AuthorAck{IGE gratefully acknowledges the usual suspects.}

 \NOTE{file c-sample.tex}
```

[*Note: file c-source.tex*]

4 File template.tex: version of 9/3/06

Type author names here

Abstract

The latex file template.tex, provides a framework into which authors can type their material to achieve consistent formatting, which can be refined during the publication process without reference to the individual files for the chapters. So, for example, you replace what is between the braces with your actual abstract.

The source file is available from Ian Enting's web-site.
Among the features that LaTeX automates are:

- equation numbering, including numbering within chapters
- Indexing , including indexing of sub-entries , as in this example.
- automated bibliographies, in our case with alternate forms for references Wilson [1998] and [Wilson, 1998].

The division of labour is:

- Computers do what computers are good at: the mechanical updating of cross-references;
- book designers do their thing and come up with good visual implementations of the layout;
- authors get on with writing.

Author acknowledgments: IGE wishes to acknowledge the usual suspects

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5 More references

I. Enting

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References to add 2nd editions of Biggs and Stauffer, 2nd edn latex books, erdos and renyi, albert and barabassi, shalizi in Jstatphys, Margulis

Last update: 2/2/06.

[*Note: file c-morefs.tex*] [*Note: File c-morefs.tex*]

Glossary

[*Note: The initial proposal is to make this section an encyclopedic glossary, produces as a collective enterprise, with individual contributions (when substantial) identified by initials, back-referenced to 'affiliation' section.*]

[*Note: The * denotes incomplete entries.*]

1. **abrupt climate change:** *
2. **agent-based modelling:**. *[G:ABM]
3. **anthropocene:** * A name proposed for the current period [**], characterised by a discernable human imprint on global-scale biogeochemistry.
4. **artificial life** (ALife) **[G:Alife]
5. **attractor:** .*** An attractor can be a **fixed point, q.v.**, a **limit cycle, q.v.** or a chaotic attractor.
6. **bifurcation:** * Crawford [1991].
7. **butterfly effect:** A metaphor for the sensitive dependence on initial conditions that characterises chaotic systems. The concept that the flap of the wings of a butterfly in Brazil/China etc. could 'cause' a tornado/hurricane in Texas etc. From the title of a talk by Ed Lorenz [1972]. [G:butterfly]
8. **catastrophe theory:** .* Arnold [1986]
9. **cellular automaton** * (plural: cellular automata) * .
10. **chaos:** * Lorenz [1993][G:chaos]
11. **closure:** *[G:closure]
12. **complex earth system science:**** [G:cess]
13. **consilience:** * unity of science (reductionism), Wilson's extension [Wilson, 1998], comments by Gould [2004]
14. **contingency:** * Gould [1989] emphasises the contingent nature of evolution. For a counter-argument see Conway Morris [1998]. The role of contingency in history is emphasised by Buchanan [2000].
15. **Conway's game of life:** A two-dimensional cellular automaton model, proposed by John Conway. ***
16. **critical exponent:** The exponent in a power-law relation, especially for thermodynamic variables near a critical point.
17. **critical point:** *
18. **critical fluctuation:** *

19. **CSIRO:** Commonwealth Scientific and Industrial Research Organisation.[G:CSIRO]

20. **data assimilation:** *

21. **discrete logistic map:** This is the transformation defined by $f_\lambda(x) = \lambda x(1-x)$ and is used to produce a sequence of numbers $x_{n+1} = f_\lambda(x_n)$. This model was used by May May [1974] to illustrate dynamics of a population with limited resources, to show that chaotic behaviour could arise from the intrinsic population dynamics without any need for chaotically-varying external forcing.

22. **DSTO:** Defence Science and Technology Organisation. (Australia).[G:DSTO]

23. **emergence:** The study of Emergence addresses the relation between different levels of representation of a Compel System. Informally, it refers to the arising of large scale patterns/dynamics which are not explicitly expressed at the smaller scale; for example, in computer simulations, it describes large scale behaviours which are not explicitly coded in the model. Attempts at a more formal approach address the arising, detection and use of information processing in a system for prediction and control of the system itself (Shalizi (2001) and Crutchfield (1994)) and the existence of down-ward causation from the large scale dynamics over the smaller scale one, thereby closing a two-way causal relation feedback loop (Goldstein 2002, Bickhard 2000, Heylighen, 1991). At a philosophical level though, emergence poses deeper challenges to our understanding of causality, reductionism and predictability, and the validity and necessity of the concept itself is questioned both by scientists and philosophers. [F.B.] [G:emerge]

24. **earth system science:** * The integrated science of the atmosphere, hydrosphere, biosphere and lithosphere. **** NASA [1986] in response to ozone hole Farman et al. [1985]

25. **first-order transitions:** * (thermodynamics)

26. **fixed point:** * The **discrete logistic map, q.v.** has a fixed point defined by $x^*_\lambda = f_\lambda(x^*_\lambda)$ which has the solution $x^*_\lambda = 1 - 1/\lambda$. *stable vs unstable

27. **fractal:** *. A term coined by Mandelbrot [1977] [G:fractal]

28. **Gaia:** * The hypothesis that the earth's biota act to regulate the physical climate system to maintain the planet as a suitable habitat for life [Lovelock, 1979, Lovelock and Margulis, 1974]. [G:Gaia]

29. **Gibbs probability distribution:** The principle underlying statistical mechanics where for a system of N variables x_1 to x_N the energy of any configuration is given by a function $E(x_1, \ldots, x_N)$ then the probability distribution in equilibrium at (absolute) temperature T is given by $\Pr \propto \exp[-E(x_1, \ldots, x_N)/k_\mathrm{B}T]$ where Boltzmann's constant, k_B, converts temperature units to energy units. [G:Gibbs]

30. **info-gap:** *

31. **intercomparison:** * a term used ...

32. **Ising model:** One of the simplest statistical mechanics models ** binary variables [G:Ising]

33. **Kalman Filter:** * [G:Kalman]

    - extended Kalman fitler
    - ensemble Kalman filter

34. **limit cycle:** ** an n-cycle is one the repeats after period n, but no shorter period.

35. **Lyapanov exponents:** *

36. **MASCOS:** The ARC Centre of Excellence for Mathematics and Statistics of Complex Systems, established in 2003. The research themes are: critical phenomena, Monte Carlo methods, dynamical systems, risk modelling, scientific computation, statistical modelling of complex systems, modelling and control of complex systems. ***

37. **mean field approximation:** *

38. **memes:** * A term coined by Dawkins [1989] to *** See also Blackmore [1999]. [G:meme]

39. **Monte Carlo:** .*

40. **percolation:** * A statistical model of network connectivity.

41. **power-law:** ** [G:power]

42. **reductionism:** * myth, features Cohen and Stewart [1994], consilience, and beyond.

43. **renormalisation group:** * A computational technqiue used in **statistical mechanics, q.v.** (and field theory) ***.Fisher [1974], Wilson [1983]

44. **sandpile model:** * A model, related to **cellular automata, q.v.**, proposed by Bak et al. Bak et al. [1987, 1988], notable for exhibiting **self-organised criticality, q.v.**. *** Experiments on real piles of sand suggest that the transitions are more like first-order [Nagel, 1992]. [G:sandpile]

45. **self-organised criticality:** Bak et al. [1987, 1988], Bak [1996]

46. **scaling:** ** Galileo, D'Arcy Thompson [Thompson, 1961], critical phenomena [G:scaling]

47. **statistical mechanics:** The field of physics based in the derivation of macroscopic **thermodynamic, q.v.** quantities from microscopic specifications of interaction energies. The main techniques for solving statistical mechanics models (i.e. calculating moments of the **Gibbs probability distribution, q.v.**) are:

    - exact solutions **
    - approximations based on statistical **closures, q.v.**;
    - **Monte Carlo, q.v.** simulations;
    - exact series expansions, perturbing about a trivial solution such as zero temperature (total order) or infinite temperature (total randomness);
    - **renormalisation group, q.v.** techniques.

The moments of the Gibbs distribution correspond to the bulk quantities in thermodynamics.

48. **thermodynamics:** * branch of physics

49. **Turing, Alan:** British mathematician 1912–1954 [Hodges, 1992]. Most famous for his wartime work on code-breaking, and subsequent pioneering work on digital computers. In the complex systems context, notable for the concept of the **Turing machine, q.v.** and his work on morphogenesis [Turing, 1952]. [G:Turing]

50. **Turing machine:** *

51. **universal computation:** *

52. **universal Darwinism:** This is the proposition that evolution will inevitably occur in any entities that have (a) reproduction without exact copying (b) reproduction of more new entities than can survive (c) differential survival probabilities depending on inherited characteristics.

53. **universality class:** A class of physical systems (or models thereof) whose respective critical points are characterised by the same set of critical exponents. The existence of universality classes provides an important justification for studying simplified model systems.

Unattributed glossary entries from IGE, ...
[*Note: file c-gloss.tex*]

[*Note: file c-notat.tex*]

Notation

[*Note: Common notation will presumable unachievable, but a few things should have standard meanings.*
Standard mathematical quantities e, π *etc. should not be used to mean something else.*]
[*Note: Some proposals for symbols shared across all chapters are:*]

$f(.)$ Generic functions.

t Time.

T Temperature, especially absolute temperature.

[*Note: For things that are more application-specific, consider the use of subscripting, to avoid clashes between application domains. (Note that if the subscript is an initial/abbreviation of a word, as opposed to a mathematical symbol, it should be in an upright font).*]
[*Note: Proposals so far are:*]

k_{B} Boltzmann's constant.

[*Note: Before final production, the lists will be merged.*]
[*Note: File c-notat.tex*]

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