¶ **Principles**

Book Design for TEX Users
Part 2: Practice

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Abstract

In the predecessor to this paper [1], three fundamental concepts of *uniformity*, *information* and *structure* were introduced, and general guidance given on each of them. In this paper, more practical advice is given, specifically in two areas: guidance on actual dimensions, proportions and layout; and guidance on implementing some of the ideas through the medium of the TEX language. Finally, some difficult (and even insoluble) problems in layout are discussed.

Keywords. Design, typography, layout

motto: Every book will have one figure that cannot be seen from its point of reference.

How big is a book?

Just as we are all familiar with the general concept of a book, we are also familiar with practical upper- and lower-bounds on its size; a book that measures 3 centimetres by 2 centimetres is of as little use to most of us as a book measuring 3 metres by 2 metres. Looking at my bookshelves as I write, and ignoring only those volumes whose dimensions lie beyond the 3 σ points of the distribution, I can safely suggest that the majority of 'normal' books lie in the range 18 cm × 10 cm to 35 cm × 25 cm. In terms of more traditional printers' units (picas), we can re-express this range as 42 pc × 24 pc to 80 pc × 64 pc (in all cases I have approximated rather than taking any exact measurements). What is more interesting, however, is the aspect ratio of each these books: almost without exception they are in portrait orientation rather than landscape. Why should this be?

There are, I suggest, two answers to this; one intensely practical, the other slightly theoretical. The practical answer is easily demonstrated: take any book that is *not* in portrait orientation (i.e. one that is in landscape orientation), hold it in one hand and attempt to open it: if the book is small, or tends to square rather than being overtly landscape, it will be reasonably stable in the hand, but if it is large, or markedly landscape in aspect ratio, it will tend to fold back on itself as the centres of gravity of the two halves fall outside the span of the opened hand. For certain classes of book (i.e. those intended to be read from a desk or lectern, or perhaps opened on the reader's lap), this is of little consequence; but for those books which are most likely to be read whilst being held in the hand (which includes the vast majority of books published), such instability would render them almost unreadable, and therefore such combinations of size and aspect ratio are generally avoided.

The theoretical reason hearkens back to material covered in the predecessor to this paper, and is concerned with the optimal length of line. In that paper it was suggested that between 40 and 70 characters per line is the target, with the ideal somewhere near the upper end of that range. Given that most normally sighted people can read without difficulty 9 point to 12 point typefaces at the normal distance associated with reading books, but find anything much smaller somewhat difficult to read (and tend to regard anything much larger as 'insulting', in the sense that it appears to have been intended for children), this suggests that most books will tend to have a *measure* somewhere in the approximate range 12 picas to 30 picas, but will tend to cluster nearer the upper end of that range. When we compare this with the range of book sizes cited above, these figures seem reasonable; the smallest book encountered was 24 pc in width, measured across the cover, whilst the largest was 64 pc, similarly measured. Allowing for trimmed pages fitting comfortably inside the cover, and 'sensible' margins (as yet to be defined), we find that the smallest book has a measure of 17 pc whilst the largest has a measure of 48 pc (and is set in an abnormally large font; it would be more usual to find a book of this size set in double-column format). Clearly there is a reasonable correspondence between theory and practice.

In practice, some sizes are more 'desirable' than others; traditionally, books were printed in a restricted range of sizes, and some of the terms used are still extant today; examples include 'quarto',

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1: Book Design for TEX Users; Part 1: Theory, Biuletyn GUST, zeszyt 4, wrzesień 1994.

'folio', etc. Others, for example 'elephant' and 'royal' have fallen into disuse, and there is today far greater freedom in choosing the final size of a book. However, practical realities intrude here, as everywhere else, and ultimately the printer will have to produce the pages of the book by sub-dividing a much larger sheet of paper; as such large sheets of paper are produced in a fixed range of sizes, it is obvious that some final page sizes will result in much less wastage than others, and such sizes are therefore to be preferred; your printer will give you advice on 'ideal' page sizes if asked, and will almost certainly tell you if your preferred size leads to gross wastage.

In determining the dimensions of a book, there are essentially three variables: the overall area of the text, including headers and footers; the margins; and the trimmed dimensions of the final page. Clearly at most two of these can be arbitrarily determined, and the third must follow by the simple rules of arithmetic and geometry. In practice one tends (if given total freedom) to determine the final page size and the text area first, and then to calculate the margins based on the difference; but in so doing it is important to remember that the margins are just as important as every other element of the made-up page, and cannot simply have arbitrary size. 'Sufficient, but not too much' is an excellent axiom to bear in mind when determining the size of margins; for example, a small book whose trimmed width is 23 pc might have an outer margin of 3 pc and a measure of 17 pc; the actual inner margin will therefore also be 3 pc, but the *perceived* inner margin will be somewhat less, as some portion of it is taken up by the binding. In general, the thicker the book the greater the apparent loss of inner margin, but binding technique is even more significant, and a well bound thick book may lose less space on the inner margin than a poorly bound thin book.

As the overall dimensions of the book increase, so may the margins; but they do not increase in direct proportion to the increase in page size: rather, if anything, they increase quite slowly, perhaps in proportion to the square root of the increase in page size, or to its logarithm. Once again, 'sufficient but not too much' is the key.

So far we have concentrated on the inner and outer margins, and it is worth pointing out before considering the top and bottom margins that, if symmetric perceived margins are required, this inherently requires asymmetric actual margins; but the asymmetry alternates between verso and recto pages. That is, in order to allow for the binding loss, the right margin on the verso page and the left margin on the recto page must each be increased by the binding loss. This is achieved automatically in the 'book' style of LaTeX, but plain TeX users will need a modified output routine. In order not to need any knowledge of the existing output routine, the following code hooks into the `\shipout` primitive, and can therefore be used in conjunction with *any* output routine, no matter how complex, unless it, too, adjusts `\hoffset` on the fly (in which case more sophisticated code would be required).

```
\newdimen \rectohoffset
\newdimen \versohoffset
\def \bindingloss {2 pc}
        %%% adjust to suit actual book
\let \Shipout = \shipout
        %%% need an alias so as
        %%% to steal primitive
\let \then = \relax
        %%% just syntactic sugar
        %%% (sorry, Kees!)
\rectohoffset = \hoffset
    \advance \rectohoffset
                        by  \bindingloss
\versohoffset = \hoffset
    \advance \versohoffset
                        by -\bindingloss
\def \shipout
    {\ifodd \count 0
         %%% can't use \pageno in LaTeX
     \then
            \hoffset = \rectohoffset
     \else
            \hoffset = \versohoffset
     \fi
     \Shipout
    }
```

Before considering actual dimensions for the vertical margins, it is worth considering the simpler question of proportion, and here, as in many elements of book design, two schools of thought obtain: the first would advocate that the top margin should be less than the bottom, the second just the converse! The argument in each case is based on visual balance: those who would place the text block asymmetrically towards the top of the page claim that, visually speaking, it 'sinks down under its own weight', whilst the alternative school claim that unless it is set asymmetrically towards the bottom of the page, it makes the page look top-heavy and therefore unstable. My own belief is that once the effects of head- and footlines are considered, the two schools can to a certain extent be reconciled; if, however, there are no head- and footlines, then my sympathies incline more towards the 'lower-is-better' school than towards its opponents.

The reason for considering the head- and footlines whilst discussing the margins is that whereas the left and right margins are what I will term 'simple' (that is, they each occupy a single band of white space), the top and bottom margins are effectively composite: there is white space above the headline, white space below the headline, and similarly white space above and below the footline (if present; if not, then the bottom margin is simple). But in terms of visual density, the footline is usually very light — frequently no more than an unornamented page number — whilst the headline is frequently quite dense (see the predecessor to this paper for a fuller discussion on the possible contents of a headline). The effect of this is that the two lower margins are perceived by the eye/mind as being a single band of white space, whilst the two upper margins are perceived as separate entities. The eye/mind therefore takes the sum of the two bottom margins as representing the white space at the bottom of the page, whilst more or less ignoring the lower of the two upper margins and seeing only the upper component as representing white space.

We must now attempt to summarise the preceding discussion and to come up with some firm recommendations. In general the space above the headline is significantly greater than the space below, and is of the same order of magnitude as the mean of the left and right margins (assuming for the moment that these are not exaggerated; discussion on exaggerated margins occurs later in this section). The space below the headline is fairly small: perhaps 1 pica or thereabouts. At the bottom of the page, the situation is reversed: there is relatively little space above the footline, but rather more space below. But here caution must prevail: if we were to leave the same space above the footline as below the headline (e.g., 1 pica), we would overconstrain the page makeup process, for although any page could still run one line light, it could not run one line over without interfering with the footline (or, worse, displacing the footline vertically downwards); it is therefore necessary to leave additional white space above the footline on a normally made-up page, so that an overrun of a single line can be permitted *in extremis*. Thus a gap above the footline of perhaps 2 picas is appropriate, with an additional margin of 3 or 4 picas below. Bear in mind that these figures represent only a first-order approximation, but that only relatively small adjustments would be needed for a fairly wide variation in page size.

All the discussion on margins up to this point has reflected a fairly traditional, orthodox and conservative perspective. But the size and symmetry of margins is one of those areas in which *avant garde* designers feel obliged to express their individuality. Until the advent of the so-called 'DTP revolution', most books had conservative margins of the order of magnitude suggested above; but at about the time when DTP was becoming widespread, a new generation of designers suddenly found the need to adopt quite enormous margins, sometimes out of all proportion to the other material on the page.[2] The reasons for this sudden interest in wide margins are probably quite interesting, but I suspect not well understood. I can think of several possible reasons: (1) Each generation of designers feels obliged to express its creativity in some overt manner; simply to follow the guidance of its predecessors is felt at best to be pastiche, and at worst plagiarism. (2) The liberating effect of what I will term 'Design through DTP'[3] allowed designers to experiment with designs that might previously have been consigned to the dustbin, either because the wasteful nature of their extremes became only too apparent as real paper models were made of the design, or because the

2: It is a sad reflection of our times that this also occurred during a period when awareness of the ecological effects of the loss of the world's forests was becoming increasingly widespread; thus on the one hand we had the environmentalists urging us to save trees, whilst on the other we had a generation of designers apparently hell-bent on destroying the world's forests purely to provide large asymmetric white borders for their books. . .

3: by which I mean the use of an Apple Macintosh or similar system to produce an on-screen mock-up of a proposed design without any need for a physical realisation to become available.

time which elapsed between the creation of a design and its first physical realisation allowed the designer time for retrospection; many, I am sure, toned down their own excesses during this cooling-off period. (3) Many of the realisations of these designs were accomplished using early DTP systems, which were themselves fairly limited in their page makeup ability; having large margins into which oversize elements could flow allowed the designers additional flexibility to work within the constraints of the DTP system.

But there is a fourth consideration, quite independent of the DTP revolution, which may also dictate the use of large margins, and this final discussion on margins concentrates solely on the page makeup problems associated therewith. Text, tables, graphics, equations and formulæ all have different, and sometimes conflicting, requirements — text, as we have seen, will normally fit best into a measure somewhere in the range 12 pc to 30 pc; tables possessing multiple columns may well not fit into such a restricted measure, a problem that also can affect complex graphics (which although generally scalable can become illegible if over-reduced); equations and formulæ may also require a measure well in excess of 30 pc if they are not to be split over more than one line. With the exception of equations and formulæ, the problems are not insoluble, or even difficult: where it is known in advance that a measure well in excess of 30 pc will be required, the text can be set in two columns whilst overwidth tables and graphics can be allowed to span both columns; as tables and graphics are generally regarded as 'floating' entities (that is, they can migrate in the text without causing the reader difficulty, as reference to them is almost invariable by name or by number rather than by implicit physical association), they can appear on a page in their own right, or at the top or bottom of the page on which they are referenced, without interrupting the flow of the text. But equations and formulæ (and similar entities, such as program fragments and algorithms) frequently *cannot* be allowed to float: the author will almost invariably write the text on the assumption that the equation/formula will always occur exactly where it does in the manuscript, and will simply allow his or her text to 'fall through' to the equation or formula; if such an equation/formula is overlong and cannot be wrapped, then both columns of the two-column text will need to be interrupted, to the great inconvenience of the reader, for it will not necessarily be at all apparent whether the text is to be read up to the equation/formula and then continued below in the same column, or the text is to be read up to the point of the equation/formula and then continued from the top of the next column. Worse, if the equation/formula occurs not in the first column of text but the second, as the reader progresses down the first column he/she is suddenly stopped dead in his/her tracks by a completely irrelevant equation/formula; not only does the reader now not know from where to continue, he/she also does not know why the interruption occurred in the first place. Only on reading down the second column does the reason for the interruption become clear.

Therefore, in such works, an alternative approach is required, and one such approach is the use of oversized margins: the text is set to a fairly wide single-column measure, but the trim dimensions of the page are such as to allow the longest equation or formula to extend out into the (usually right) margin as necessary. The designer is then faced with another problem: how to justify to the reader the presence of these margins on pages where no such equations or formulæ occur. It is by no means unusual to find section heads pushed out into the margins in these circumstances, nor to find marginal notes which might otherwise occur as foot- or even endnotes. Anything which can justify the presence of the anomalous margin is regarded as fair game!

Finally gutters: the internal 'margins' that separate columns from each other in multi-column formats. Generally speaking, a gutter should be no wider than the mean of the left and right margins; if anything, it can be somewhat narrower. Some designers prefer to divide their gutters vertically by a narrow rule; I would tend to avoid this unless rules were used elsewhere in the design. Here, as in many places, the desire for uniformity provides excellent guidance.

The elements of a book

Having established guidelines for the overall dimensions of our book, it is now appropriate to consider the various elements which make up that book. At the most superficial level (and ignoring the covers, spine and dustjacket), a book consists of the *front matter* (also referred to as 'prelims'), the *text*, and the *back matter* or *end matter* (the last is clearly ambiguous, as a book has two ends, but traditionally 'end matter' is used in preference to the less ambiguous 'back matter').

The front matter is composed of such elements as the half and full title pages; the copyright and cataloguing-in-publication data page; a table of contents (and sometimes other analogous tables); and perhaps a preface. Also frequently included in the front matter (particularly with the advent of the DTP revolution, since which we have all become far more aware of typefaces and typography in general) is a 'colophon', which strictly speaking should occur as the very last element of the book, but now more usually occupies space on the copyright and cataloguing-in-publication page; the colophon contains details of the typefaces and leading used, and may also give details of designer, printer, etc.

Amongst the end matter are found appendices; one or more indexes; a bibliography (if such is not associated with each chapter, or if an overall bibliography is desired as well as one per chapter); and perhaps a glossary or similar.

Finally, the text is composed of the body of the book; usually divided into chapters, it may also be divided at a higher level into parts.

It is fair to say that the boundaries between these three zones are not entirely rigid: an author may choose to regard a preface as a part of the text, rather than as a part of the front matter, and this will need to be reflected in the page numbering, as we shall see. Similarly some writers may regard their appendices as forming a part of the text; this may affect their page numbering but is less likely so to do. Indeed, an author may choose to write a preface, a prologue, an introduction, a conclusion, an epilogue, and one or more appendices; the designer and author will need to liaise carefully to ensure that each is appropriately classified.

The primary reason for this division concerns page numbering: front matter is traditionally numbered in *roman* style, using lower-case roman numerals (i, v, x, l, c, d, m) which are often set as dropped folios, whilst the text proper is usually numbered using *arabic* numerals (0, 1, 2, 3, 4, 5, 6, 7, 8, 9). Appendices and other end matter usually continue in the same sequence and style as the main text, but it is permissible to re-start the numbering for the appendices and prefix the page number with an letter 'A'; if this latter course is taken, the index (assuming that the index forms the very last element of the end matter) will need to have unnumbered pages, as it would clearly be inappropriate to continue using 'A'-style numbering whilst it would be equally inappropriate to resume the main numbering scheme. Fortunately indexes are not required to be self-referential (although I confess to once padding out an index that would otherwise not balance with an entirely spurious reference to 'loop, infinite', whose sole page number was that of the entry for 'loop, infinite' in the index. . .).

There are also conventions as to which elements are required to occur recto, which verso, and which require to be preceded or followed by a blank page. A typical book might be numbered as followed (remember that odd numbers indicate recto, whilst even numbers indicate verso):

- i. half title;
- ii. blank;
- iii. full title;
- iv. cataloguing-in-publication, copyright, colophon;
- v. preface to the edition;
- vi. general preface;
- vii. ditto, continued;
- viii. blank;
- ix. table of contents;
- x. ditto, continued;
- xi. glossary;
- xii. blank;
- 1. first chapter.

Of these, the half and full titles are required to occur recto, (whence the blank page between, which also affords a nice contrast to the complexity of the full title page); the copyright and c-i-p page frequently occurs on the reverse of the full title page; the preface is not required to start recto, but it may be the designer's wish that it should so appear; the table of contents is normally recto, as here; the first chapter invariably opens recto, and except in the most casual of styles all subsequent chapters must open recto as well. The page number of the first chapter page could equally well have been '13'; it is a design decision as to whether to continue the numbering sequence from the prelims or whether to start afresh with the main text.

There are fewer conventions concerning the end matter, but it would be normal for the *first* appendix to start recto; subsequent appendices may start recto or verso as necessary; and the index would also normally start recto.

Laying out the pages

Although by far the majority of pages in a book are 'normal' pages, it makes a certain amount of sense to start by considering the opening chapter pages, since these contribute a great deal to the book's visual identity and allow a fair degree of artistic licence in their creation. (It is also fair to say that one can waste an enormous amount of time trying to design them!)

When designing one's first book, it is by no means uncommon for people to align the main chapter header (be it 'Chapter 1' or 'Introduction') with the top of a normal page. For some books, particularly those with with very short (less than two pages) chapters, this makes enormous sense, for otherwise one can run to far more pages than are strictly necessary (there are also æsthetic reasons why such a design is to be preferred in these circumstances). However, the vast majority of books have chapters whose page count often runs into double figures, and for such books it is customary (although not essential) to start the opening chapter heading some way down the page. Typically a quarter to a third of the page depth may be reserved for the above-heading space.

There next comes the question of what to put in the heading. If chapters are numbered, one has to decide between 'Chapter 1', 'One', '1' or some similar variant; and if named, whether to also number or just to use the name (and if one uses both names and numbers, then which numbering style to use). It is thought that 'Chapter 1' is a little old-fashioned, but I do not hold to this view. If both numbers and names are used, and if just the arabic number is chosen, then there is also the option of placing the two on the same line, perhaps separated by a colon and the space of the line; if they are put on separate lines, then it is customary for the number line to precede the name line.

Next the question of font: in which font(s) are these headings to appear? In almost all cases, a large bold font will be used, but 'large' is very much in the eye of the beholder; it is probably safe to say that LaTeX uses rather larger fonts for this purpose than more conservative designers might choose. The use of a *sans serif* font for such headings is most certainly justifiable, but not essential.

Placement: should the headings be centered or ranged left (or even ranged right)? Generally speaking, centered headings are either slightly old-fashioned or are more suitable for works in the arts; modern scientific publications frequently adopt a ranged-left theme which runs throughout the book, including headings such as these. Ranged-right probably shrieks *avant garde*, but cannot be discounted on that score; if used, there should probably be other elements in the design which echo the ranged-right theme, or there should be a contrasting ranged-left theme to balance. If an epigram is used, it is probably better to have the headings ranged left and the epigram ranged right, as the converse would over-emphasise the epigram to the detriment of the chapter title.

There is another element to placement which also requires discussion: is the white space above the heading to be regarded as belonging to the heading or to the page? By this I mean the following: if the chapter title normally occupies n lines (typically one or two), but a pathologically long title for a particular chapter requires one or more additional lines, from where should the space for these lines be taken? Should the title be allowed to extend *up* the page, encroaching on the reserved white space, or *down* the page, displacing the starting point of the main text downwards? Neither is ideal, but if authors insist on writing pathologically long titles, one or other solution must be taken. Although the following is not cast in stone, it is perhaps worthy of consideration: if the opening chapter page starts with a line containing only the *number* of the chapter (or with the word 'Chapter' followed by the number), then that should *always* occur in the same vertical position (and thus the main text will get displaced downwards); but if the page starts with the *title* of the chapter, then that title may be allowed to extend upwards, thereby ensuring that the main text always starts at exactly the vertical position on the page.

And rules: should the headings be set off from the text by a horizontal rule? Here we probably need to return to the theme of uniformity: if rules form a recurring theme throughout the book, then a rule between heading and text is probably fine; if not, then it may seem intrusive.

Finally, before leaving the subject of opening chapter pages completely, it might be worth recapitulating on the advice given in the predecessor to this paper concerning running heads and folios: generally speaking, a running head has no place on an opening chapter page; the white space above the title should merge imperceptibly into the top margin. This means that the folio, if normally on the outer edge of the running head, must (on an opening chapter page) either be omitted completely, or must be relegated to the footline. Omitting the folio is highly undesirable, as it renders the table of contents virtually useless (and also reduces the usefulness of the index, if any entry in the index refers to an opening chapter page); the solution is therefore to set the page number as a dropped folio, centered in the footline. Sometimes such folios are given a little additional ornamentation, for example en-dashes on each side set off by a thin space; although this convention is taken directly from typewriter practice it does, in the opinion of the present author, render the folio a little more obvious, and therefore has something to commend it.

Having completed opening chapter pages, the next most significant element in the design of the book is the normal text page; such pages usually make up over 90% of the book, and it is therefore worth expending considerable effort ensuring that they look 'right'. We have already dealt with margins, gutters, head and footlines, so we may concentrate on the text proper, and in particular on the fonts and leading to be used.

Fonts and leading

As suggested above, the text will normally be set in a 10 pt *serif* font, often on a 12 pt leading (here, at least, plain TEX gives sensible defaults, except in the excessive measure used). There appears to be a widespread belief that Times Roman is the font of choice, yet this font, designed as it was for use in the exceptionally narrow measure of newspaper columns, has little to commend it apart from widespread availability. The font is too narrow for the generous measure of most books, and if it *must* be used can benefit enormously from being anamorphically scaled by a factor of 24/25 in the vertical direction. Such scaling, whilst anathema to purists, converts the somewhat narrow letterforms of Times Roman into rounder, softer, shapes, and enables a near optimal combination of font size and leading to be used on measures up to 27 pc and beyond. 11/12.5 Times Roman, when anamorphically scaled by a factor 24/25, yields 10.56/12 which in the opinion of the present author results in a highly readable text.

But far better than anamorphically scaling Times Roman is to select a font which already has the appropriate properties (rounded letterforms, suitability for use with wide measures, etc.); examples are legion, but amongst the most obvious candidates are Baskerville, Bembo, Caslon, Garamond, and Palatino. To be avoided are fonts which are highly idiosyncratic: it is to be remembered that the *sole* purpose of the font is to convey information; if the reader is distracted by the idiosyncratic nature of the font, information transfer will be less than optimal and the book's value reduced as a result.

It may be worth digressing at this stage to discuss briefly one particular book which I first encountered on being asked to review it, Knuth's *3:16 Bible Texts Illuminated.* My first reaction on opening this book was to ask myself rhetorically "why on earth did he set it in Computer Modern?". I was familiar with Computer Modern from the *Computers and Typesetting* quintology, and had, of course, set much of my own material in Computer Modern whilst learning about TEX; but I had reached the point where I felt that other fonts had much more to offer, and had not, for some time, typeset anything in Computer Modern at all; it therefore came as a nasty shock to find a book on Bible Study typeset entirely in Computer Modern, particularly by someone whose opinions I value so greatly.

And yet, the strange thing is that having read no more than half a dozen pages of *3:16* I suddenly discovered that I was no longer seeing the font at all; it had, to all intents and purposes, ceased to exist as a typeface, and become purely a medium for the communication of facts. Now Computer Modern, based as it is on Monotype 8a, is not everyone's ideal font; and particularly when rendered on low resolution devices such as laser printers can be quite unpleasant indeed, with the thin strokes breaking up or disappearing completely and the thick strokes somehow seeming out of proportion. Yet when rendered on a high resolution typesetter, the contrast between thick and thin contributes much to the æsthetics of the font, and the overall effect is to yield an unintrusive design, pleasantly devoid of idiosyncrasies, which suppresses its own personality and allows the information to shine through. Perhaps there is no such thing as a bad font; what we perceive as bad may simply be a good font used inappropriately, or rendered using inappropriate technology.

But to return to the question of design, and in particular to the design of the normal text pages of a book. Having selected our primary font and leading, we will need to select appropriate variants of that font for particular purposes (we may also need to select one or more other fonts for special purposes, but as a general rule the fewer fonts used in a document, the better the document will be). For emphasis, and for foreign words and phrases within the text, it is customary to use an italic variant of the font; the use of bold for emphasis is to be strongly deprecated, with such fonts being reserved for headers and similar. Italics may also be used for book titles, for the names of ships, and for other analogous entities. It goes without saying that underlining, too, has no place in the running text of a book, and very little place anywhere else either; just as the use of bold for emphasis is an artifact of early word-processing systems (which were incapable of italics and therefore had to create an alternative convention for achieving stress), underlining is an artifact of handwritten and typewritten text, and has no place in a typeset document.[4]

If it is necessary to stress a word or phrase within a longer structure that is already being typeset in italics, it is customary to revert to a roman font for the stressed section; but the present author can find no reason why in these circumstances the stressed section should not be set in bold italics, if such a font variant is available (and with the advent of PostScript fonts, such variants are usually to be found); if the bold stressed section is being compared or contrasted with another section of text in the book which is physically nearby, then it may be necessary to set that section too in bold italics, even if it occurs in a context in which italics are *not* being used; in that way, the reader will be given appropriate typographic cues as to which two sections are being compared or contrasted.

Italics (which are a highly stylised variant of a font) should not be confused with *slanted* or *oblique* variants, both of which involve no original design but result from a simple geometric transformation of the roman form of the font. Whereas italics and oblique forms both have an honourable ancestry (oblique normally being reserved for *sans serif* fonts whilst italics are normally a variant of a *serif* form), slanted fonts appear to be another artifact of the DTP revolution. In the opinion of the present author they have little to offer in the way of æsthetics, and even though they are sometimes used where it is deemed desirable to differentiate typographically between two entities which would otherwise both have to be rendered in italics, as a general rule I would caution against their use. Designers have managed for centuries to convey considerable amounts of information without having recourse to slanted fonts; it is to be hoped that future generations of designers will conclude that they represent no more than what Fowler might have termed ‘elegant variation’, and are therefore a luxury without which we can all happily do.

It is sometimes necessary, particularly in books on linguistics or other subjects in which language is both used and discussed, to differentiate typographically between the two uses. Sometimes simple quotations marks will suffice; sometimes italics; but there are also times when both of those forms are already reserved for other typographic differentiation, and some third form is needed to clarify which text is being discussed and which text is performing the discussion. In these circumstances (and in very few others), it is justifiable to introduce a new font which may be used as a part of the running text. If the main text is set in a *serif* font (as it almost invariably will be), then a second *serif* font would *not* be suitable; even though two *serif* faces may be as different as chalk and cheese, the risk of confusion is still too great (and the æsthetic

4: Of course, like almost every rule, these rules too admit of exceptions, and it would be a brave author indeed who wrote that *every* instance of underlining, or of the use of bold within running text for emphasis, was categorically wrong; the most that can be said is that generally speaking such (ab)uses are regarded as infelicitous or inappropriate, and that should the designer none the less decide to adopt such a convention, he or she should be aware of the ‘rules’ that are being flouted, and take a conscious decision to flout them rather than simply being unaware of their existence.

clash too severe) to permit two distinct *serif* faces to appear in juxtaposition. The second font must therefore be a *sans serif* face, chosen to blend in with, whilst being clearly differentiable from, the main text face. The second font will need to be matched for weight (visual density), ex-height and caps-height; and because of the variation in the semantics of *design size*, will probably need to be loaded at a fractional size.

Headings

The motto for the predecessor to this paper was "There can never be too little space below headings, only too much!", and in those few words can be summarised the bulk of the received wisdom concerning headings. As previously pointed out, a heading *must* be tied to the text with which it is associated, and that text is invariably the text which immediately follows. Headings are frequently hierarchical in nature, and lower-level headings are more closely bound to the following material than higher-level; thus the white space which separates low-level headings from the text is usually less (and never more) than the white space which separates higher-level headings and text. In the limiting case, the heading is *run in*, that is to say literally forms a part of the text and does not occupy a line in its own right. For run-in headings, it is essential that the author be consistent in usage, since such headings can either participate in the grammar of the text or remain a distinct grammatical entity; in the former case it is customary to indicate the extent of the heading by a change of font (italics, or bold, or even caps and small caps), but by no extra horizontal white space or punctuation; for headings which are grammatically distinct from the text which they introduce, a change of font is also indicated, but punctuation (e.g. a colon) or additional white space (e.g. one quad) is also frequently used. Such a heading might be set off by as little as 1 ex additional white space from the preceding text, and certainly by not more than one blank line.

At the next level in the hierarchy, the heading usually occurs on the immediately preceding line, and occupies a line in its own right. It is not set off by any additional vertical white space, but simply separated from the text by the normal leading for the paragraph. Again a change of font is indicated, and the font options applicable to run-in heads are equally applicable here, although the use of caps and small caps would be unusual. The extra vertical white space above the heading is of the same order of magnitude as for run-in headings.

A level higher and perhaps a larger font is indicated. Assuming a base setting of 10/12, a 12 pt font might be suitable for such a heading. If a bold font has been used for any lower level, then this font too must be bold, otherwise ambiguity will result (the same is true at *all* levels in the hierarchy: once a bold font has been used at a lower level, bold fonts must be used at all higher levels. In the same way, no font used in a higher level heading may be smaller than a font used in a lower level heading; it may be the same size, but only if it is bold and the lower level is not, or if there is other clear typographic indication of the hierarchy). Above such a heading a little extra white space might be allowed, perhaps between one and one-and-a-half blank lines.

Beyond this point, simple extrapolation is sufficient: as we move up the hierarchy, headings get bigger, bolder, more distinctive. The white space below them may increase, but only very slightly; the white space above increases, but not to ridiculous limits. Anything in excess of three blank lines is almost certainly excessive, and two blank lines are normally more than sufficient.

At this point it is appropriate to consider the implications of the above set of rules on TEX implementations. In order to allow successful page makeup in TEX, it is customary to allow the vertical white space associated with headings to be flexible (i.e., 'rubber lengths', in LATEX's quaint terminology); but TEX has two quite distinct rules when dealing with flexibility: if a dimension is given a negative flexibility (i.e., is allowed to shrink), then TEX will take advantage of the stated shrinkability if necessary to achieve optimal page makeup, but will never attempt to shrink it by more than the permitted amount; however, if a dimension is given *positive* flexibility (i.e., is allowed to stretch), then TEX will first of all take advantage of that flexibility to achieve optimal page makeup, and if that flexibility is insufficient, *will continue to stretch it until optimal page makeup has been achieved*, even if this involves stretching it by many times its stated stretchability. Of course in these circumstances TEX issues a warning, but by then it is too late: the evil deed has been done.

The implications of this behaviour for successful implementations of design are quite severe: TEX must *never* be given positive stretchability to use if it is required to exercise any automatic control over the upper bound by which white space will be stretched; shrinkability can be used, but TEX is noticeably asymmetric in this respect, and whereas `\vfil` and its friends can be used to pad out underfull pages whilst preventing embedded `... plus` n `pt` constructs from contributing white space, there is no equivalent which can be used to negatively pad pages whilst preventing `... minus` n `pt` constructs from shrinking (the reason is that TEX will not allow what it terms 'infinite glue shrinkage' to occur in unrestricted horizontal or vertical modes). Thus there are severe problems in inhibiting TEX from taking excessive advantage of permitted flexibility, and in the end only careful observation of the log file, and manual intervention where TEX has exceeded its brief, will be sufficient to keep matters under control.

But recalling for a moment the discussion on grid-based layouts which took place in the predecessor to this paper, it will be appreciated that simply preceding and following header lines by `\vskip` commands will not necessarily have the desired effect. A far more satisfactory method of placing headers, whilst ensuring that they occupy an integral number of blank lines (i.e. an integral multiple of `\baselineskip`) relies on a technique which I refer to as a 'pseudobox': this is a TEX construct which is in reality a box whilst behaving like glue; the following code fragment illustrates the technique in use.

```
\newbox \headerbox
\newdimen \headerheight
\newdimen \headerdepth
\def \header #{\afterassignment
           \afterheader \setbox
            \headerbox = \vtop}
\def \afterheader {\noindent
       \aftergroup \reallyafterheader}
\def \reallyafterheader
 {\headerheight = \ht \headerbox
 \headerdepth = \dp \headerbox
 \advance \headerheight by \headerdepth
    \headerdepth = \headerheight
    \ht \headerbox = 0 pt
    \dp \headerbox = 0 pt
    \advance \headerheight
                by 0.5\baselineskip
    \divide \headerheight
                by \baselineskip
    \multiply \headerheight
                by \baselineskip
    \ifdim \headerheight < \headerdepth
          \advance \headerheight
                by \baselineskip
    \fi
     \vskip 0 pt
     \box \headerbox
     \vskip \headerheight
     \noindent
     \ignorespaces
    }
```

If this code is used to typeset a large bold header within the text of this paragraph, as in `\header {\Huge Header}`, the effect *should* be to leave the remainder of the paragraph set on its natural grid; whether or not it has achieved this effect is left to the reader to see! Perhaps a brief explanation of the code is in order, as so far as the author is aware the technique has not previously been published. The `\header` macro takes no parameter, but the terminal hash of its parameter list causes it to require an open brace to immediately follow its use; on the assumption that the open brace is the open brace of a brace-delimited parameter (which it should be, if the macro has been properly used), the macro sets `\headerbox` to a `\vtop` containing the parameter. However, an additional token is introduced into the `\vtop` just prior to the parameter by means of the `\afterassignment`, that token being `\afterheader`. This token itself expands into three further tokens, `\noindent` (to prevent the parameter from being indented within the box), `\aftergroup` (to allow the following token to be expanded not within the box but outside it, once it has been set), and `\reallyafterheader`, which is the macro that does all the real work. Thus the combined effect of the `\afterassignment` and the `\aftergroup` is to inhibit any indentation of the parameter, and to cause `\reallyafterheader` to be expanded once the box has been set. `\reallyafterheader` commences its work by saving the height and depth of the box in which the header has been set, and then computes their sum; the height and depth are set to 0 pt. Using Knuth's algorithm from A15.8, the combined height + depth is rounded to the nearest integral multiple of `\baselineskip`, and if the result of this rounding is less than the original sum, a further increment of `\baselineskip` is added. The result of this computation is the smallest integral multiple of `\baselineskip` within which the entire contents of the box can be set. A vertical skip of 0 pt is carried out (to force TEX into vertical mode), and then the box is typeset (remembering that it has zero apparent height and depth, and therefore occupies no space), after which a further `\vskip` of the calculated integral multiple of `\baselineskip` is carried out to leave room for the contents of the box whilst not disturbing the regularity of the baseline grid, Finally `\noindent` and `\ignorespaces` ensure that the first paragraph following the header is typeset correctly.

A real-life instance of this code would require parameterisation to indicate the level of header, from which it could ascertain (by means of a look-up table) how to distribute any required additional space around the header; in addition, it would enable ragged-right setting within the header box, and would need to deal correctly with a header immediately followed by another header (the spacing should not be additive). Many other refinements are possible.

Paragraphs

In trying to make practical recommendations for real-life book design, it is necessary to alternate between those entities which occur fairly rarely (opening chapter pages, headers, etc.) and those which form the bulk of the book (regular pages, paragraphs, etc). Here we consider material which makes up the vast bulk of the book, to whit the paragraph.

Fortunately the 'rules' for paragraphs are fairly straightforward, but as so many examples may be seen which either blatantly ignore the rules or are simply unaware of them, some discussion is none the less necessary. It should be noted, however, that these rules are inherently culturally based, and I am advised by one eminent French authority [5] that the rule stated below concerning the first paragraph of any new section would be incorrect were it to be applied to material published in French.

- The first paragraph of a new section is not indented. This rule is so often more honoured in the breach than in the observance that I sometimes wonder whether its existence is widely known at all. For reasons entirely unclear to me, LATEX whilst doing its best to honour this rule indents abstracts, which seems to me at best inconsistent and at worst inexcusable. I am very pleased to see that these proceedings avoid that error.
- A paragraph is either indented, or is set off by vertical white space from preceding material. It is normally considered infelicitous to do both; it is a gross error to do neither. The reason why the latter is so severe a crime is that if paragraphs are neither indented nor set off by vertical white space, then any text in which a paragraph just happens to end flush with the right margin will be followed by a paragraph whose existence can barely be guessed at. There will be *no* typographic clues to indicate that a new paragraph has started.
- The leading and font within a paragraph are uniform. This may seem to go without saying, but if a document is set with the minimum leading necessary for unadorned text, then an accented capital letter may well be enough to force down the entire line on which it occurs. In such circumstances either the leading must be increased for the entire document, or special steps taken to conceal the height of the accented letter (whilst ensuring that it does not unfortunately co-incide with a descender from the line above). By 'uniform', when applied to the font, I do not suggest that every glyph in the paragraph must be set in the same font; clearly there may be a need for italics, or even for a *sans serif* font at points, as indicated above. But all the glyphs within the paragraph should *appear* uniform, and must therefore come from closely related or well chosen fonts. For example, the first phrase of each paragraph in a book may be set with an initial full cap and then small caps; provided that these blend in with the main text font, there can be no objection to this. Similarly the

5: Bernard Gaulle, past and future President of GUTenberg, the French-speaking TEX Users' Group.

first letter of the paragraph may be a dropped cap; provided that it too blends in with the main text font, that is a perfectly valid design decision (and sometimes very stylish, if I may express a personal opinion).

- A paragraph should not end with only a part-word on the last line. Assuming that hyphenation is permitted at all (which it will need to be if fully justified text is specified), then the last line of a paragraph should end with at least one full word and preferably more. Plain TEX's (and LATEX's) setting for `\parfillskip` do not encourage this; a more felicitous setting might be `\parfillskip = 0 pt plus 0.7\hsize`,
  which encourages longer last lines at the expense of setting some such lines slightly loose.

Graphics, figures, and other 'floating' entities

Although there is much more that can (and should) be said about book design in general, I feel that there is one area which must be treated before I close, and that is the whole area of insertions, or as LATEX terms them, 'floats'. These are, in some general sense, graphic entities, although they may turn out to be purely textual in content. What really typifies them, however, is that they are invariably indirectly referenced; that is, they are referenced by the author in terms of *see Fig. 1* or *See Table 2.4*, rather than being implicitly referenced by position in the text as in, for example, *as shewn below*. By virtue of the indirect nature of their reference, they can be physically remote from the point of reference, but one of the major skills of page makeup is the careful placement of such entities. The cardinal rule for these insertions is that *they must be capable of being seen from the point of reference*. One of the little appreciated strengths of TEX is how well it carries out this task for footnotes, which are a very simple instance of insertions; if you look carefully at TEX-set material which has many footnotes, you will probably be surprised at the number of times that a footnote reference occurs on the very last line of the page (before the footnotes themselves appear, that is). If you have not thought about this problem before, you may casually remark to yourself "that's lucky; another line and the footnote marker and its text would have appeared on different pages". But now try to find an instance where that has happened; try as you might, I suggest that you won't. And that surely suggests that it is more than luck that causes that particular juxtaposition of footnote marker and start of footnotes to occur so regularly, so reliably, and so consistently. And of course it *is* more than luck; all the while that TEX is accumulating material in galleys, it is carefully tracking how much space is occupied by footnotes and how much by the main text; and as soon as the combination of the two exceeds the available space on the page, TEX knows that it must cut the galley at or near that point and start a new page.

Now footnotes are, as I said, a particularly simple instance of such insertions; no-one minds if the text of a footnote is started on its page of reference but continued on the next (no-one but a pedant, that is). But figures, tables, graphics, etc., are a very different kettle of fish; they are essentially indivisible entities, and can therefore either appear on a given page or not appear on that page; there are no half measures which would allow a part of the figure/table/graphic to appear, and the remainder to appear on the next page.

So now put yourself in the position of TEX, this time not accumulating text and footnotes, but accumulating text and (say) figures. TEX continues to accrete material in its galley as before, and encounters a reference to a figure; say that the page is only a third full. If the figure is less than two-thirds the depth of the page, there is no problem: TEX simply adds the figure to the list of things that appear on that page and carries on. But now let there be a second figure reference, maybe two-thirds down the page: TEX looks to see how big the figure is, and discovers it needs a half a page to itself. What does TEX do? The first choice is trivially ruled out; you can't have the reference to the figure followed by the figure, because (a part of) the figure would fall off the bottom of the page. OK, what's the next choice? Remember that the figure can *float*. So, let's try floating the figure to the top of the page on which it was referenced: no problem there, the figure appears at the top of the page, pushing the textual material material down. Some of the textual material will fall off the bottom of the page, of course, because we already know that we have 2/3 of a page of text, and 1/2 of a page of graphics, so 1/6 of a page of text falls off the bottom. But that's no problem, because textual material can normally be split at almost any point: so TEX chooses the nearest valid breakpoint and carries the remaining material over to the next page.

Then what happens? Well, think about what is *on* the material that has been carried over: the reference to the figure that caused the trouble in the first place! So now we have the figure on page n, and the reference to the figure on page $n+1$. If $n+1 \equiv 1 \pmod 2$ (sorry, if $n+1$ is odd!), then there is no real problem, for the reference to the figure occurs on the recto half of the spread, and the figure itself occurs on the verso half of the spread, so all is well. But if $n+1$ is *even*, then all h@ll breaks loose: because the figure is on the recto half of a spread, and the reference to the figure is on the verso half of the next spread; and when the reader finally encounters the reference to the figure, the figure itself can no longer be seen. And no matter what TEX were to do in those circumstances, it would not be able to solve the problem without assistance.

So there are some problems in page makeup that simply *cannot* be solved by naïvely applying rules; rules are all very well, but eventually the time will come when the author's text and the rules of design are simply incompatible, and in those circumstances you will have little option but to liaise with the author and attempt to persuade him or her to re-write the offending portion of the text. If the author is dead, and the text is cast in tablets of stone, then you will have to do a lot of work by hand, maybe setting a whole series of paragraphs one line looser than ideal, just to force a reference onto a more appropriate page. But when you've done it, and the finished book is printed, and you look at it and *know* that there are no further improvements that you could have made, then a great warm glow will fill your body and you'll know that it's all been worthwhile. Good luck!

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Książki

LATEX: A Document Preparation System

W 1994 roku ukazało się drugie wydanie książki Leslie Lamporta *LATEX A Document Preparation System*. Pierwsze wydanie tego podręcznika jest znane w polskim tłumaczeniu P. Wyrostka. Wydanie drugie zostało zmienione i dostosowane do nowej wersji formatu, czyli LATEX2ε. Książka nadal pozostała przede wszystkim podręcznikiem dla *zwykłego użytkownika*. Zaawansowani użytkownicy są odsyłani do omawianej już w nr. 3 biuletynu GUST książki *The LATEX Companion*.

Pierwsze dwa rozdziały to łagodne wprowadzenie do LATEX-a. Są one w zasadzie nie zmienione w stosunku do wydania pierwszego.

W rozdziale trzecim, poświęconym bardziej skomplikowanym elementom dokumentów, opisano: formuły matematyczne, tablice, definiowanie własnych komend i środowisk, tabele, rysunki i inne elementy typu *float*. Zmianie uległ punkt 3.1 oraz 3.3.8, omawiające komendy przełączania fontów, również wewnątrz formuł matematycznych.

Rozdział czwarty omawia tworzenie spisu treści, odsyłacze, odsyłacze bibliograficzne, podział pliku na mniejsze części, skorowidze. Nowością jest dodanie punktu 4.7 opisującego komendy ułatwiające przesyłanie dokumentów vía e-mail (`filecontents`, `listfiles`).

W rozdziale piątym omówiono krótko klasy dokumentu `book`, `slide` i `letter`. W rozdziale szóstym opisano dokładniej m.in. opcje klas dokumentu, style strony, proste przykłady modyfikacji stylu, długości (*lenghts*), odstępy (*spaces*) i pudełka. Rozdział ten jest poszerzoną i zmienioną wersją z pierwszego wydania. Rozdział siódmy opisuje możliwości graficzne LATEX-a oraz bardzo ogólnie drukowanie w kolorze. Oprócz środowiska `picture`, autor omawia pakiet `graphics`. Rozdział ósmy zawiera opis błędów i ostrzeżeń LATEX-a.

Dodatek A omawia program *MakeIndex* do tworzenia skorowidzów, zaś dodatek B — tworzenie bibliograficznych baz danych z pomocą programu BIBTEX. Dodatek C, podobnie jak w pierwszym wydaniu zawiera szczegółowy opis wszystkich komend LATEX-a (podręcznik). Jest on oczywiście zmieniony i wzbogacony o komendy LATEX2ε. Dodatek D opisuje krótko różnice pomiędzy LATEX2εa starym LATEX-em (2.09). Dodatek E zawiera omówienie komend formatu `plain` dostępnych w LATEX-u. Książkę kończy, imponująco duży, 35-stronicowy skorowidz.

Leslie Lamport, *LATEX: A Document Preparation System*, wydanie drugie, 272 strony, Addison-Wesley 1994. ISBN 0-201-52983-1.

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