

## Philology

### Computer Aided Hyphenation for Italian and Modern Latin

Claudio Beccari

#### Abstract

After an essential historical sketch of the evolution of latin into italian and modern latin, the peculiarities of both languages are described so as to understand the philosophy of the hyphenation patterns. The latter is one of the few cases where the same set is suitable for two different languages.

#### Sommario

Dopo aver delineato brevemente l'evoluzione del latino verso l'italiano e il latino moderno, vengono descritte le caratteristiche delle due lingue in modo da capire la filosofia dei *pattern* di divisione in sillabe. Questi *pattern* costituiscono uno dei pochi esempi applicabile a due lingue differenti.

#### Summarium

Latini sermonis evolutione ad italianum et latinum modernum breviter exposita, utrius sermonis specietates descriptae sunt ut philosophia de *pattern* ad syllabas dividendum intelligatur. Isti *pattern* duobus differentibus sermonibus applicabile exemplum sunt.

#### 1 Outline of historical evolution

Classical latin, as we study it in schools and universities, is the language that was used, especially in written form, by the authors of the republican period and of the very beginning of the Roman empire. Common people used to speak a similar language that was open to the contribution of new words from other countries, to new constructs, and to a general simplification of the inflection of nouns, adjectives and verbs.

Cicero himself was complaining about the fact that common people (the *vulgus*) used to shorten the desinences leaving out the final consonants, and used to palatalize the 'c' and 'g' followed by the front vowels 'e' and 'i'. Those were the first signals of the autochthonous evolution of latin towards the modern language; in the other parts of the Roman empire similar evolutions were going on with a stronger influence of the native languages over which latin had superimposed itself; the invasions of the "bar-

barians" brought in peculiar pronunciations and a lot of lexical additions.

Latin decline was very slow because it was the scholar's, the chancellor's, the notary public's language for many centuries, and it was and still is the official language of the Roman Catholic Church; latin, in its modern form, is the official language of the Vatican State, and the daily Vatican newspaper, *L'Osservatore Romano*, is published mainly in italian, but with frequent contributions in latin, even commercial ads! Modern latin is used even for comic books; I suggest Snoopy [1], Mickey Mouse [2], Asterix [3]<sup>1</sup>.

Nowadays latin is studied in many countries as a regular subject in both high schools and universities; in Italy it is not classified as a "foreign" language and is a compulsory subject both in classical and scientific *licei* (high schools). In the past, latin was even more important in the education of young people; forty years ago I started latin in sixth grade and had eight years of it through junior high and high schools<sup>2</sup>.

From the common people's language of the first century several regional and local dialects evolved; in 960 A.D. there is the first document explicitly written in what we might already call italian [4]; several documents, mostly poems, were produced in the following centuries, and by the end of the thirteenth century the masterpiece of Dante Alighieri, the *Divina Commedia*, is considered the main landmark of the new language, that was already so mature as to be used in a poetic treatise of history, philosophy and theology.

The modernization of Dante's language took place during the past seven centuries, but compared to modern italian there is not such a great difference as between the language used by Chaucer in his *Canterbury Tales* and modern english; today's Italian high school students can read Dante's poem and other even older texts with no more difficulty than that required by any other conceptual text.

<sup>1</sup> The first two books are intended as didactic aids for teaching latin, and are fully accented with both prosodic and rhythmic marks.

<sup>2</sup> I frequented the *liceo classico* and had also five years of classical greek; now I have an engineering degree and I am a professor of electric circuit theory. I am very glad I had the opportunity of completing my education by studying humanities for so long, and I wish the new generation could have the same.

## 2 Alphabet

Italian and modern latin use the 26 letter alphabet that everybody knows with the name of *latin alphabet*; actually there are some fine points to consider with due attention.

*Italian.* The letters J, K, X, Y, and W are used only in technical terms and symbols, foreign names, and some very specialized words, such as the international word *taxi*. J, K and Y survive in toponyms, family names, and english style nicknames, such as Stefy for Stefania (Stephanie). The letter J (see also below) used to be employed in the past as a graphic device to distinguish the semivowel role of the letter I, so that you have *Ajmone* (family name) and you may write *Iugoslavia* (modern spelling), *Jugoslavia* (old fashioned spelling), or *Yugoslavia* (international spelling) according to your preference; in italian all three are correct and are pronounced exactly the same way.

Besides the above mentioned letters, there are five vowels, none of which is mute: *a, e, i, o, u*; fifteen consonants: *b, c, d, f, g, l, m, n, p, q, r, s, t, v, z*; and one diacritical letter: *h*. The latter does not correspond to any sound and is used only to mark half a dozen words in order to distinguish them from similar ones that sound the same but have a different meaning, to mark some interjections, and to mark the velar pronunciation of 'c' and 'g' when otherwise they would be palatalized.

Except for a dozen articles, prepositions and adverbs (that nevertheless are used quite often), all common words in italian end with a vowel; of course this statement does not apply to trade marks, unasimilated foreign words, technical terms, and the like.

Another peculiarity is that every consonant may occur in its doubled form, and this corresponds to its reinforcement when the double consonant is pronounced. There are rare instances of double vowels, but in this case, contrary to what happens in english, they form different syllables instead of a diphthong; for example, *zoologico* can be divided as *zo-o-lo-gi-co*.

*Latin.* Classical latin missed J, U, and W, while V was used throughout wherever U or V are now used. Since the very beginning this anomaly was passed by scholars on into the spelling and printing of all languages; capital V was used in all circumstances, while 'v' was used in printing at the beginning of words and 'u' in the middle or at the end. This confusing habit was common to all western languages but fortunately it was abandoned starting in Hol-

land during the sixteenth century; it lasted a little longer in Italy because of the wide use of latin, but was eventually done away by the end of the seventeenth century. When Knuth [5, p.106] cites Pacioli's *Divine Proportione*, published in Venice in 1509, he reports that title with the spelling of the original printing, but the pronunciation at that time already implied the consonant V instead of the vowel U.

In the middle ages and in the early times of printing it was the habit to use 'j' instead of 'i' in those cases where the letter 'i' formed a diphthong with the following vowel; it was just a graphic trick to distinguish the two roles of the letter 'i', and it was so successful that it was adopted also in other languages; this is the reason why even today we spell *junior* instead of *iunior*, although the latter is the formal latin spelling.

Modern latin uses both U and V in the proper positions, while J and W are used only in foreign names and toponyms.

There are six vowels: *a, e, i, o, u, y* and eighteen consonants: *b, c, d, f, g, h, k, l, m, n, p, q, r, s, t, v, x, z*. The ligatures *æ* and *œ* do not belong to latin; they were introduced in the sixteenth century in France and in England in order to replace the diphthongs *ae, oe*, and after that they enjoyed a certain popularity also in latin, but in modern usage, as well as in classical latin, these two diphthongs are spelled with separate letters.

## 3 Accents

*Italian.* In italian accents are used very sparingly; it is compulsory to mark with a suitable accent the last vowel of polysyllabic oxitone words (those that receive the stress on the last syllable), and to mark some well known and specified monosyllabic words that contain a diphthong. This is standardized by the Regulation UNI 6015 [7].

In contrast to spanish and portuguese, in italian there is no necessity to mark proparoxitone words with an accent, although the best grammars recommend doing so. In practice, if you exclude oxitone words (where accents are compulsory) and paroxitone words (where accents are not required); the other ones *may* be marked with an accent only when a different position of the stress might change the meaning; for example *lávati* means 'wash yourself' while *lavàti* is the masculine plural of 'washed'; in this circumstance it is advisable to mark the first case unless the meaning of the rest of the sentence does not make clear which case is implied. Although the 'Sommario' of this article contains five proparoxitone words, no accents were used.

The accent can be used also for denoting the open or closed nature of a vowel (only for tonic 'e' and 'o'), but this use is found only in dictionaries and grammars; a good grammar will certainly point out that *còlto* (picked up) is different from *cólto* (educated), but in practice the meaning is determined by the context while the actual pronunciation very strongly depends on the regional origin of the speaker.

The grave (̀) accent is used on any vowel, while the acute (´) accent may be used only on the vowel 'e' (and on the vowel 'o', but only in optional situations) when it has a closed sound. Most Italians are not even aware of this choice; when they hand write, they just put any kind of small surd on the vowel to be accented, and by so doing they intend to mark only the stress; the tonic value of the accent is used only in dictionaries and grammars, while in printing the difference is maintained only for the letter 'e' in oxitone words more as a tribute to the tradition than for an actual semantic necessity.

When the accent is compulsory and upper case letters are used, if the character set does not contain accented vowels, it is accepted to use an apostrophe: UNITA' (unity) in place of UNITÀ; this practice is considered bad style in typesetting, but is used quite often in advertising.

The dieresis (¨) and the circumflex (ˆ) are not used anymore; in the past the dieresis was used in poetry to split a diphthong, and the circumflex had several meanings such as, for example, to mark the contraction of two 'i' into one sign in those plurals that centuries ago were spelled with a double 'i': *studii* (studies, two centuries ago), *studî* (one century ago), *studi* (modern).

*Latin.* In latin no accents are used; the breve (˘) and the long (¯) accents are used only in dictionaries, grammars and where prosody is dealt with. The dieresis is sometimes used in grammars and in prosody to mark the splitting of a diphthong: *aër* (air), *poëta* (poet).

#### 4 Apocope and aphaeresis

*Italian.* In italian the dropping of one or more initial letters in a word (aphaeresis) takes place only in poetry and is marked with an apostrophe preceded by a white space.

The loss of one or more terminal letters in a word (apocope) either is not marked at all (see in the 'Sommario' *aver* in place of *avere*) or it is marked with an apostrophe when it corresponds to a vocalic elision before another vowel (see above *l'evoluzione* in place of *la evoluzione*) or to a complete syllabic

apocope. The latter case is very unusual, while the vocalic elision is very frequent, so that this case must be taken care of properly when dealing with hyphenation; the rules stated in the Regulation UNI 6461 [6] require that when a line ends with an apostrophe, this *must not* be replaced again with the vowel it originally replaced. In the past, not too long ago, for example when I was in elementary school, the opposite rule was in use, so that there are occasional discussions between the old styled generation and the new one. Nevertheless even today it is considered bad style to end a line with an apostrophe, and in typography this practice is tolerated only when the line width is quite small, as in the daily newspapers' narrow columns.

*Latin.* I do not know of any case where apocope or aphaeresis are marked in any visible way; actually I am almost sure that these two spelling behaviours are not legal in latin.

#### 5 Diphthongs

*Italian.* In italian a diphthong is formed by any vowel preceded or followed by an *unstressed* closed vowel ('i' or 'u'); so we have:

*ia, ie, io, ai, ei, oi*  
*ua, ue, uo, au, eu, ou*  
*iu, ui*

Italian diphthongs are always pronounced maintaining the sounds of the individual vowels, and the closed vowel plays the role of a semivowel or a glide.

There are also groups of three vowels that contain two semivowels or a semivowel and a glide:

*iuo, uie*  
*ieu, uoi, iei*

An 'i' (possibly also a 'u', but I can't find examples) sandwiched between two other vowels behaves always as a semivowel, so it always starts a new syllable.

*Latin.* In latin there are more or less the same diphthongs as in italian with the addition of

*ae, oe*

that one or two centuries ago were replaced with the corresponding ligatures *æ, œ*; in modern latin the pronunciation of both these diphthongs is given by a single open 'e'<sup>3</sup>.

<sup>3</sup> I have seen a reproduction of an italian book printed in Venice in the sixteen century where both these diphthongs were consistently replaced by their sound given by the letter 'e'.



b-d	b-n	b-s	c-m	c-n
c-s	c-t	c-z	d-g	d-m
d-v	f-t	g-m	p-n	p-s
p-t	p-z	t-m	t-n	z-t
g-fr	ld-m	ld-sp	l-st	mb-d
mp-s	nc-n	ng-st	n-scr	n-st
n-str	r-st	r-str	st-m	

Table 1: Groups of consonants that can be split across syllables

The Italian Standards Institute, in order to avoid confusion in this matter, established the Regulation UNI 6461 [6] that lists the groups of consonants that must be divided, table 1. This table does not list the normal consonant divisions, that is:

- digraphs and trigraphs can *never* be divided, except *gn* when it appears in a foreign word or in a word that derives from a foreign one and where the two letters are pronounced individually, such as *Wagner* → *wagneriano* → *wag-ne-ria-no*;
- geminated (double) consonants and *cq* must *always* be split;
- a liquid ('l', 'r') or a nasal ('m', 'n') is *always* separated from a following consonant except for the cases shown in table 1;
- any consonant is *never* separated from the following liquid except for the cases considered in the previous rule;
- the letter 's' is *never* separated from any following consonant (unless it is another 's').

The Regulation UNI 6461 states also the rules for the apostrophe, i.e. it behaves as the vowel it replaces; line breaking (without hyphen) is allowed after it when the line is very short, but it is bad style to do it<sup>8</sup>.

Italian hyphenation for T<sub>E</sub>X has already been explained by Désarménien [8], but, although I wish I knew french as well as he knows italian, the 88 patterns that he created for italian were good only for consonants while completely ignoring diphthongs and 'triphthongs'; in a previous version I prepared for T<sub>E</sub>X 2.xx, 150 patterns were needed to perform italian hyphenation correctly.

For the rest the regulation is already made in such a way as to synthesize the hyphenation patterns T<sub>E</sub>X requires, without the need of running `patgen`; of course some care must be exercised in

<sup>8</sup> For line breaking after an apostrophe the new symbol `<cwm>` of the T<sub>E</sub>X 3+ extended character set may become useful.

order to avoid strange situations and in order to replace T<sub>E</sub>X's inability to distinguish vowels from consonants.

With the advent of Version 3.xx of T<sub>E</sub>X it is better to set `\righthyphenmin` to the value 2, because there is no need to protect the hyphenation algorithm from the mute vowels ('e') that are so frequent in english; of course it is not good style to go to a new line with just two letters, but this is so rare that it is much better to give T<sub>E</sub>X more chances to find suitable line break points than to protect it from situations that in italian never take place.

Another reason for choosing this reduced value for `\righthyphenmin` is due to the accents; it was pointed out that in practice italian has accents, if any, only on the last ending vowel of a word. It is known that T<sub>E</sub>X does not hyphenate a word after an accent control sequence, but this drawback has a negligible influence on italian since after the accent control sequence the word may have just one letter; the accented letters found their way into the 256 symbol extended character set of T<sub>E</sub>X 3+ so that this simple drawback is eliminated, but even with the limitations of the 128 symbol character set (unless virtual fonts are used) this T<sub>E</sub>X peculiarity is of negligible influence.

With the reduced character set I admit that `virt\`u` → *virtù* (virtue) cannot be hyphenated because is too short, while with the extended set `virtù` could be hyphenated as *vir-tù*, but there are no problems with longer words, for example `qualit\`a` → *qualità* (quality) is hyphenated by T<sub>E</sub>X as *qualità*, the full possibility with the extended set being *qualità* → *qua-li-tà*. But with both character sets T<sub>E</sub>X gives correctly *per-ché* (because), *af-fin-ché* (so that), and so on.

There are no known problems with the synthesized patterns listed at the end; the only point that leaves me partially unsatisfied, but is grammatically perfectly correct, is the fact that technical prefixes such as *dis-*, *post-*, *sub-*, *trans-* must be explicitly separated with `\-` if one wants to stress their specific prefix nature. See below the solution for the same problem in latin.

*Latin.* The patterns that are listed at the end include a subset that was originally designed just for italian; with a little thought and a few additions the pattern set was extended so as to include also modern latin.

For what concerns diphthongs, italian and latin diphthongs were merged together under the assumption that T<sub>E</sub>X is not supposed to find every possible break point but only legal break points, so that if

two vowels are treated as a diphthong even if they belong to two different syllables, the only drawback is that you miss a legal break point but you do not make any wrong division. Moreover, most Italian readers feel uncomfortable when a break point is taken such that the new line starts with a vowel (this is certainly not the case with anglophone readers) so that the extension of the set of diphthongs of either language bothers neither Italian readers nor Latin ones. The declaration of  $\mathfrak{a}$  and  $\mathfrak{o}$  as letters with their `\lccode` allows also the hyphenation of words containing such ligatures.

Concerning consonant groups there is no regulation as for Italian; my grammar [9] claims that Latin hyphenation is done as in Italian (except for what concerns prefixes and suffixes that must be divided etymologically) but in Latin there are consonant groups that never occur in Italian. Another book, [10], reports hyphenation rules for Italian, classical Latin, classical Greek, French, German, English, and Spanish; for Latin the rules are drawn from a German source [11], which I was not able to reach, that apparently reports the hyphenation rules that were used in the middle ages. In classical times, as well as today, Latin hyphenation is more similar to the Italian than to what is reported in [10].

In order to find out how unusual consonant groups are treated in Latin I examined an important scholar's book [12], the bilingual New Testament in Greek and Latin "apparato critico instructum", reprinted as a "reeditio photomechanica ex typographia . . . , Romae" and for which "omnia iura reservantur"; clearly this is modern Latin, although the book's contents, the Latin part, contains the well known text that was translated from Greek and Aramaic by several authors across several centuries and copied by different copyists in many codices that are preserved all over the world. This critical edition is intended as a study material and is particularly cured in the language and the spelling for the very purpose of the book.

By examining the hyphenations of this book I could list a series of consonant groups, and I could realize that the digraph *gn* (which is such in Italian but it is not supposed to be one in Latin) was not treated in a uniform way, so as to have both *reg-num* and *re-gnum*. I decided to choose the second form of hyphenation for two reasons: a) it does not conflict with the Italian rule, and b) the pronunciation recommended to the clergy and that is being used in the Catholic universities, seminaries, monasteries, etc., corresponds to the Italian digraph *gn*.

Also the letter 's' is not treated uniformly; it is generally treated as in Italian, but there are cases

where it is treated as in English; for example *blasphemia* (blasphemy) is hyphenated as *blas-phe-mia*. Since this does not conflict with the Italian rule (in this language the group 'sph' is missing) a suitable pattern was generated in order to cope with such situations.

Some attention was given to prefixes and suffixes in order to find a way to separate them correctly according to their etymology; for what concerns prefixes, these must be separated regardless of the groups of letters that get split away, provided that the prefix did not lose its final vowel by elision with the initial vowel of the compound word's second element. For example the prefix *paene-* (almost) loses the last 'e' in *paeninsula* and therefore the whole word is treated as a single word and is hyphenated *paen-in-su-la*.

It was possible to find suitable patterns for certain instances of *ab-*, *ad-*, *ob-*, *trans-*, for the prefixes *abs-*, *dis-*, *circum-*, *sub-*, and for the suffixes *-dem*, *-que* but the problem remains, although it shows up not so often.

The solution to this problem is to define a soft discretionary break that does not inhibit hyphenation in the rest of the word as does the plain definition `\-`. I chose to redefine the underscore character in such a way that in math mode it maintains the usual meaning of a subscript character, while in text mode it performs as a soft break.<sup>9</sup>

```
%
% New definition for the underscore
%
% Note that plain.tex and lplain.tex
% already \let\sb=_
%
\catcode'\@=11 % 'at' is a letter
\catcode'\_ =13 % Active underscore
\def\soft@break{\penalty\@M\hskip\z@\-
\penalty\@M\hskip\z@}
\def_{\ifmmode \sb \else \soft@break \fi}
%
% With TeX 3+ use instead:
% \def_{\ifmmode \sb \else \cwm\cwm \fi}
%
```

Therefore, if wrong prefix or suffix hyphenations are found in the drafts, it is possible to correct (or to write it that way from the beginning) `con_iungo`, `ob_iurgo` so that the possible hyphenation points are *con-iun-go*, *ob-iur-go*.

<sup>9</sup> Editor's note: The active underscore must be treated with care in both  $\text{T}_{\text{E}}\text{X}$  and  $\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ ; it cannot safely be used in `\labels` or in file names to be `\input` or `\included`.

## 8 Generation of the format file

In the appendix the file `italat.tex` is listed and the patterns may be checked against the rules that have been stated in the previous sections. Special attention was given to the groups *ps* and *pn*, because table 1 states that they must be separated, but the compound words with *psic-* (example *parapsicologia*) and *pneum-* (example *pseudopneumococco*) must not be hyphenated after the ‘p’.

The ligatures ‘æ’ and ‘œ’ have been included with the `^^` notation and `\let` to the familiar control sequences `\ae` and `\oe` so that the pattern table is easily readable. If one has access to a  $\TeX$  3+ version, that allows the use of the 256 character code scheme published in *TUGboat*, [14], these ligatures have different codes so that suitable lines must be commented or uncommented.

The pattern list is preceded by some definitions:

- the category, lower case and upper case code definitions for the ligatures ‘æ’ and ‘œ’ so that they can be used in latin text; I stress again that these ligatures should not be used, except when quoting verbatim some text where they have been used.
- the new definition of the underscore character so as to produce a “soft” discretionary break; the  $\TeX$  3+ extended character codes described in [14], include the special invisible character `<cwmm>` that can be used in the definition of such soft break, provided that the pattern table contains a suitable pattern.
- the pattern scheme was developed and tested with existing versions of  $\TeX$  3.0, 3.1, and 3.14<sup>10</sup>, none of which accepts extended codes; if a version of  $\TeX$  3+ that accesses the extended character codes is available, the accented letters `à, è, é, ì, ò, ù` (and the corresponding uppercase letters) can be declared with their `\lccodes` by `initex`, so that the patterns require only simple control sequences in order to include such letters while remaining completely transportable.
- the definition of the new language “italian” with the command `(\italiano)` that invokes all the auxiliary definitions; the apostrophe character must be given its `\lccode` so as to treat it as a normal letter and as the vowel it replaces. Remembering that with the non-extended seven-bit ASCII and internal  $\TeX$  codes, the apostrophe is used also as a single quote or as the first element of the ligature of

the double quote, by treating the apostrophe as a letter, one might encounter rare instances where closing quote(s) introduce possible hyphen positions in the wrong places depending on the value of `\righthyphenmin`; every effort was spent to preview such cases, so that when apostrophes are present there are suitable patterns that allow or disallow hyphenation. Up to now no wrong hyphenations were reported in these cases.

- the command for latin (`\latino`, ablative and short for “latino sermone”) is defined so as to catcode the æ and œ ligatures, and to restore the apostrophe to its original setting;
- the same is done with english (`\english`) so that you can interchange the three languages with the assurance of maintaining the correct settings for each one of them.

The patterns are enclosed within a group so that the `\lccode` of the apostrophe and the codes for the ligatures ‘æ’, ‘œ’, and accented vowels remain local and do not mix things up with the default language and/or with the previously defined languages.

Adding these hyphenation patterns to the format that has one or more languages already defined is not a heavy overhead; if you add italian and latin to the default language ‘english’ you do not need a large version of  $\TeX$ ; the statistics, after running `initex`, say that the hyphenation trie is of size 6359 with 223 ops, 181 of which are used for english and 42 for italian and latin; italo-latin hyphenation requires just 209 patterns (some of which probably never occur in practice) against the 4447 needed in english<sup>11</sup>.

## 9 Conclusion

The hyphenation patterns valid for both italian and latin have been generated directly from the grammar hyphenation rules; for italian the set of patterns (a subset of that shown in the file `italat.tex` reported in the appendix) has been in use for two years in the Institution where I work, and after a short period of careful observation and debugging it performed absolutely without errors of any kind. Although the italian rules allow hyphenation of a compound word as if it were a simple one, some prefixes that are mainly used in technical terms may be explicitly hyphenated with the help of the new meaning of the underscore character.

<sup>11</sup> These figures were obtained after an `initex` run with the `italat.tex` file in the appendix and no extended character set.

<sup>10</sup> I have access to Turbo $\TeX$  3.0, to SB $\TeX$  3.1 and to North Lake Software  $\TeX$  3.14a.

La lingua italiana e le lingue cosiddette romanze o neolatine, cioè lingue derivate anch'esse dal latino (francese, spagnolo, portoghese, rumeno ed altre minori), si fanno risalire all'idioma, che al tempo dell'impero romano

era parlato nella penisola italiana, nelle regioni del Mediterraneo occidentale e nella Dacia, l'odierna Romania.

Tracce evidenti si osservano ancor oggi non soltanto nel lessico e nella morfologia del gruppo lingu-

stico neolatino, ma anche in altre lingue europee, quelle del gruppo anglo-sassone, come conseguenza dell'influsso diretto o indiretto esercitato dalla lingua di Roma sugli idiomi particolari dei popoli nordici.

Per quel che riguarda la lingua italiana, essa si collega direttamente al *sermo vulgaris latinus*, cioè al latino parlato comunemente dalle famiglie e in pubblico nei quotidiani rapporti di commercio e di affari.

Figure 1: Example of italian text typeset in narrow columns (from [9])

Et sicut Moyses exaltavit serpentem in deserto, ita exaltari oportet Filium hominis, ut omnis, qui credit in ipsum, non pereat, sed habeat vitam aeternam. Sic enim Deus dilexit mundum, ut Filium suum unigenitum daret,

ut omnis qui credit in eum non pereat, sed habeat vitam aeternam. Non enim misit Deus Filium suum in mundum, ut iudicet mundum, sed ut salvetur mundus per ipsum. Qui credit in eum, non iudicatur; qui autem

non credit, iam iudicatus est, quia non credit in nomine unigeniti Filii Dei. Hoc est autem iudicium, quia lux venit in mundum, et dilexerunt homines magis tenebras quam lucem; erant enim eorum mala opera. Om-

nis enim, qui male agit, odit lucem et non venit ad lucem, ut non arguantur opera eius; qui autem facit veritatem, venit ad lucem, ut manifestentur opera eius, quia in Deo sunt facta.

Figure 2: Example of latin text typeset in narrow columns (J 3,14-21)

For latin there is less experience but the impression is that also in this language there are no hyphenation errors; anyhow the author is grateful to anyone who might report suggestions and corrections. The new meaning of the underscore character is very useful for prefixes and suffixes and must be used whenever unusual consonant clusters are generated by the apposition of a prefix or a suffix.

In Figures 1 and 2 two examples show the performance of the hyphenation algorithm in italian and in latin when the line width is very small; you may notice that in such narrow columns italian gets some advantage thanks to the possibility of having two-letter final syllables.

I am pleased to express my thanks to the Nuns of the Benedictine Monastery of Viboldone in S. Giuliano Milanese (Milano), Italy, who assisted me with their experience in typesetting latin and other ancient languages.

## References

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◇ Claudio Beccari  
Dipartimento di Elettronica  
Politecnico di Torino  
I-10129 Turin, Italy  
beccari@polito.it

## Appendix A The italat.tex file

This file must be input after the last line of the file plain.tex (or lplain.tex for L<sup>A</sup>T<sub>E</sub>X); the definitions given before the pattern table are better located in the format file, so they are valid for any style and there is no possibility to forget them. If this file is used with T<sub>E</sub>X 2.xx, comment out the lines that contain the commands \newlanguage and \language. Similarly, move the comment character as indicated if you use this file with T<sub>E</sub>X 3+ and the extended character set.

```

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%
%                               F I L E   I T A L A T . T E X
%
%                               Hyphenation patterns for Italian and Latin
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%                               Prepared by Claudio Beccari, Politecnico di Torino, Italy
%                               e-mail beccari@polito.it
%
% Version date 10 January 1992
%
% \catcode'\@=11                               % @ is a letter
% Useful definitions
%
% Ligatures \ae, \AE, \oe and \OE
%
% If TeX 2.xx is used, or no extended character set is available,
% the macro \specialcodes is correct; comment it if you use TeX 3+
%
% %%% \ae = 26 \AE = 29 \oe = 27 \OE = 30
%
% \def\specialcodes{%
%   \catcode 26=11 \catcode 29=11 \lccode 29=26   % Ligatures \ae,\AE
%   \uccode 29=29 \lccode 26=26 \uccode 26=29
%   \catcode 27=11 \catcode 30=11 \lccode 30=27   % Ligatures \oe,\OE
%   \uccode 30=30 \lccode 27=27 \uccode 27=30}
%
% If TeX 3+ is used, and assuming that lccodes and uccodes are already
% established, the following \specialcodes macro must be uncommented:
%
% %%% \'a=^^e0 \'e=^^e8 \'e=^^e9 \'i=^^ec \'o=^^f2 \'u=^^f9
% %%% \'A=^^c0 \'E=^^c8 \'E=^^c9 \'I=^^cc \'O=^^d2 \'U=^^d9
%
% \def\@namelet#1{\expandafter\let\csname#1\endcsname=}
% \def\specialcodes{\@namelet{@gr@a}^^e0 \@namelet{@gr@A}^^c0
% \@namelet{@gr@e}^^e8 \@namelet{@gr@E}^^c8
% \@namelet{@ac@e}^^e9 \@namelet{@ac@E}^^c9

```

```

%           \@namelet{@gr@i}^^ec   \@namelet{@gr@I}^^cc
%           \@namelet{@gr@o}^^f2   \@namelet{@gr@O}^^d2
%           \@namelet{@gr@u}^^f9   \@namelet{@gr@U}^^d9
%           \let\cwm^^17 \lccode{'^^17="17}   % Compound word marker
%
% Languages
%
% A number is given to italian/latin hyphenation
%
\newlanguage\italian
%
% New definition for the underscore
%
% Note that plain.tex and lplain.tex already \let\sb=_
%
\catcode'\_ =13                               % Active underscore
\def\soft@break{\penalty\@M\hskip\z@\-\penalty\@M\hskip\z@}
\def_{\ifmode \sb \else \soft@break \fi}
%
% With TeX 3+ use instead:
% \def_{\ifmode \sb \else \cwm\cwm \fi}
%
% Definition of the commands \italiano and \latino
%
\def\italiano{\language=\italian \specialcodes
              \righthyphenmin=2 \lccode{'\}'='\'}}
%
\def\latino{\language=\italian \specialcodes
            \righthyphenmin=2 \lccode{'\}'=0}}
%
\def\english{\language=0 \righthyphenmin=3 \lccode{'\}'=0} % Needed in order
%                   to restore the english settings when you revert to english
%
%
%                   % Beginning of the group
%
% With TeX version 3 or lower use:
\let\ae^^1a \let\oe^^1b                               % Comment with TeX 3+
% and with TeX 3+ use
\let\ae^^e6 \let\oe^^f7                               % Uncomment with TeX 3+
% and
% \def\#1{\csname @gr@#1\endcsname}                   % Uncomment with TeX 3+
% \def\#1{\csname @ac@#1\endcsname}                   % Uncomment with TeX 3+
%
\language\italian \specialcodes
\lccode{'\}'='\'                                     % Apostrophe catcoded to lower case
\patterns{
.a2b2s3 .a2b3l
.o2b3l .o2b3m .o2b3r .o2b3s
.an1ti3 .an1ti3m4n
.di2s3ci3ne .cir1cu2m3
.wa2g3n .a2p3n .ca4p5s
.pre3i .pro3i
.ri3a .ri3e .re3i .ri3o .ri3u
.su4b3lu .su4b3r
2s3que. 2s3dem.
3p4si3c4 3p4neu1
a1a a2e a2i a2j a1o a2u a2y                               % Diphthongs and hiati
a2y3o a3i2a a3i2e a3i2o a3i2u ae3u
e1a e1e e2i e2j e2o e2u e2y e3iu

```

```

i2a i2e i1i i2o i2u io3i
o1a o2e o2i o2j o1o o2u o2y
o3i2a o3i2e o3i2o o3i2u
u2a u2e u2i u2o u1u uo3u u3i2a u3i2o
\ae1 \oe1
%i2\'a0 i2\'e0 i2\'e0 i2\'o0 i2\'u0 % Uncomment with TeX 3+
%u2\'a0 u2\'e0 u2\'e0 u2\'i0 u2\'o0 % Uncomment with TeX 3+
1b2 2b3b 4b3d 2b3n 2b3t % Consonant groups
      2b3s4a 2b3s4e 2b3s4i 2b3s4o 2b3s4u 2b3s4t u2b3s4c
1c2 2c3c 2c3m 2c3n 2c3q 2c3s 2c3t 2c3z 2ch3h
1d2 2d3d 2d3g 2d3m 2d3s 2d3v 4d3w
1f2 2f3f 2f3t
1g2 2g3g 2g3d 2g3f 2g3m 2g3s
1h2 1j2 2j3j 1k2 2k3k
1l2a 1l2e 1l2i 1l2j 1l2o 1l2u 1l2y
      2l3l 13f4t 2l4l3m 1l' 1l\ae1 1l2\oe1
%i12\'a0 1l2\'e0 1l2\'e0 1l2\'i0 1l2\'o0 1l2\'u0 % Uncomment with TeX 3+
1m2 2m3m 2m3b 2m3p 2m3l 2m3n 2m3r 2m4p3s
      2m4p3t 4m3w
1n2a 1n2e 1n2i 1n2j 1n2o 1n2u 1n2y 2n3n n2c1n 2n1l
      n2g3n 2n1r n2s3m n2s3f 2n' 1n2\ae1 1n2\oe1
%i1n2\'a0 1n2\'e0 1n2\'e0 1n2\'i0 1n2\'o0 1n2\'u0 % Uncomment with TeX 3+
1p2 2p3p 2p3s 2p3n 2p3t 2p3z 2ph3p 2ph3t 2s3p2h
1q2 2q3q
1r2a 1r2e 1r2i 1r2j 1r2o 1r2u 1r2y 1r2h 1r2\ae1 1r2\oe1
%i1r2\'a0 1r2\'e0 1r2\'e0 1r2\'i0 1r2\'o0 1r2\'u0 % Uncomment with TeX 3+
1s2 2s3s 2st3m 2s'
1t2 2t3t 4t3m 2t3n 1t' 4t3w
1v2 2v3v 1w2 2w3w wa4r
1x2a 1x2e 1x2i 1x2o 1x2u 1x2y 2x3x 1x2\ae1 1x2\oe1
%i1x2\'a0 1x2\'e0 1x2\'e0 1x2\'i0 1x2\'o0 1x2\'u0 % Uncomment with TeX 3+
y2a y2e y2i y2o y2u
1z2 2z3z 2z3t 1z'
%\cwm1\cwm0 % Uncomment with TeX 3+
}
} % End of the group
% At this point it might be necessary to restore the at sign catcode
%\catcode'\@=12 % Uncomment if necessary

```