The **Kerkis** font family

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History

The history of the Greek language in TEX and "its friends" starts with the Greek fonts for the mathematics mode created by Donald Knuth. Many people (mainly Greek) being unable to typeset *essentially* in Greek they used the mathematics mode for short (and sometimes long) Greek passages. The first serious attempt for a Hellenized version of TEX was made by Silvio Levy and his Greek font based on Fermin Didot's Greek. Since then, several attempts have been made, not to forget among them Kostas Dryllerakis' and Yannis Haralambous' fonts. The latest and most widely used method for typesetting Greek is based on Babel and uses the fonts by Claudio Beccari. The fonts are again based on Didot Greek and the language support macros in Babel were created by Apostolos Syropoulos.

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All of these attempts were lacking in the same regard: they are all based on METAFONT fonts. And although METAFONT is, to my opinion, by far the best program for font design, sticking to it leaves excellent font families unavailable to the TEX world. In addition, users of the Greek language were not able to create a "decent" PDF file since METAFONT fonts render poorly on Acrobat Reader. There is more to say here; many colleagues in several mathematics departments around Greece were complaining that the Didot design, although excellent for philological work, was too cursive for mathematics.

This was the framework in which the *Kerkis* font family appeared. Since our main expertise is not in font design we did not concentrate on how beautiful the new font will be. The targets were

1. to provide a free font in the Type 1 format for LATEX supporting the Greek language through Babel,
2. to provide a design less cursive than the Didot Greek,
3. to provide the necessary tools for installing any Type 1 font that includes Greek (e.g., encoding vectors),
4. to enable users of the Greek language to create decent PDF files that include Greek (via `ps2pdf` or pdfLATEX),
5. to provide information on how to install fonts in other formats like TrueType or OpenType.

One could argue that it would be simpler to trace METAFONT fonts with programs such as Autotrace [5] and use the resulting Type 1 fonts for PDF generation. This may be true but such programs were not available when Kerkis started (at least in the open source community). More than that, I believe that the cb fonts (cb for Claudio Beccari) and the cmr fonts are very light for screen previewing. So we must add one more target to the above list

6. the new font must be heavier than cmr and cb and thus be optically compatible (from the weight point of view) with other Type 1 families, such as Times.

For context in the following detailed discussion, here are examples with both mathematics and text, in both serif and sans serif variants, of the Kerkis font in its current form:

If

$$f(q,n,r)=\sum_{r_1+\cdots+r_n=r}\frac{\Gamma(qr_1+1)\cdots\Gamma(qr_n+1)}{r_1!\cdots r_n!} \quad (1)$$

then

$$\int \|x_1+\cdots+x_s\|_q^{qr}\,d\mu \le c(n,r,s,q)f(n,q,r).$$

Figure 1: Kerkis serif example.

If

$$f(q,n,r)=\sum_{r_1+\cdots+r_n=r}\frac{\Gamma(qr_1+1)\cdots\Gamma(qr_n+1)}{r_1!\cdots r_n!} \quad (1)$$

then

$$\int \|x_1+\cdots+x_s\|_q^{qr}\,d\mu \le c(n,r,s,q)f(n,q,r).$$

Figure 2: Kerkis sans serif example.

The font's name

Kerkis (Κέρκης) is the name of the highest mountain of the Aegean sea. Its altitude is 1497 meters and it is located in West Samos, the island of Pythagoras, Aristarchus, Epicurus, Aesop and others. Samos is situated in the East Aegean Sea (just off the Turkish coast) and it is part of the Greek state. The island hosts the School of Sciences of the University of the Aegean.

Choice of base font

We looked around to see what Latin and freely distributed fonts were available. We thought that URW Bookman was a good choice, since we had seen Greek versions in print that looked compatible with the Latin ones, and satisfied items 2 and 6 above. Since we did not have the resources to redesign everything from scratch, we were pleased to find a suitable font with the Latin glyphs already done. We immediately contacted URW and they kindly gave us the permission to redistribute their Bookman inside Kerkis. Thus we could immediately start working on the Greek part.

The font's structure

Kerkis is a purely neoclassical font:

Its stroke is modulated that is, of uneven width.

The axis is rationalist that is, vertical.

The serifs are adnate that is, they stem out of the penstroke in a gradual way (look at the letters b, f in Figure 3 and α in Figure 4). This leads the reader's eye smoothely on the text line.

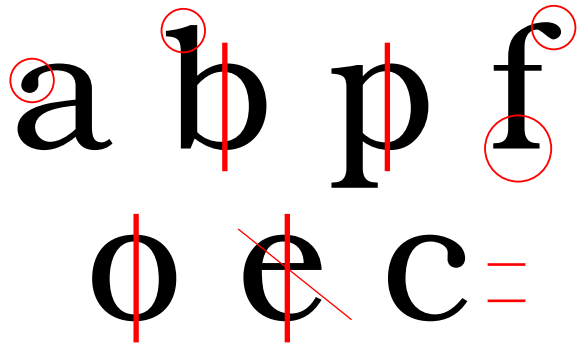

Figure 3: Sample of Latin letters: modulated penstroke (all letters), neoclassical (vertical) primary axis (axis of symmetry of the penstroke width), humanized (oblique) secondary axis for some letters (here the letter e), lachrymal terminals (here the letters a and top of f), adnate serifs (here the letters b and the bottom of f), moderate aperture (letter e and c)

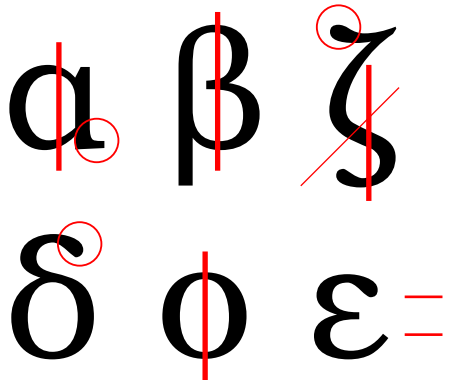

Figure 4: Sample of greek letters: modulated penstroke (all letters), neoclassical (vertical) primary axis (axis of symmetry of the penstroke width), humanized (oblique) secondary axis for some letters (here the letter ζ), lachrymal terminals (here the letters ζ and δ), adnate serifs (here the letters α), moderate aperture (letter ε)

The terminals are lachrymal that is, with teardrop shapes (look at the letters a, f in Figure 3 and δ, ζ in Figure 4).

The aperture is moderate (look at the letters c and e in Figure 3 and ε in Figure 4).

The italic is fully compatible with the roman. The serifs are on the baseline and at the x-height. Kerkis (as well as its predecessor Bookman) does not have serifs below the baseline with the only exceptions being the Greek letter chi (χ) and the Latin p and q.

The tools we used

Several Greek characters are the same as the Latin ones or close to some of them. For example the Greek omicron ο is identical to the Latin o o and thus there was no need to be redesigned. Similarly, the Latin κ can be transfered into the Greek kappa κ by lowering the top ascender of k. On the other hand letters like lambda λ or xi ξ have no counterpart in the Latin glyphs and had to be newly designed. All these letters were first drawn on paper and scanned with `sane` on a Linux machine. For templates we did use parts of the Latin font; for example the lachrymal terminals of the Latin part were used again for some of the Greek letters. Likewise with the serifs. The output was imported to the excellent program PfaEdit by George Williams [6] and traced there, either by hand or by the Autotrace program through the interface that PfaEdit provides. Then the splines were corrected by hand.

All of the functions one needs to create a font are provided by PfaEdit except one: the "change weight" function provided by commercial programs like Fontographer [7]. This is certainly a complex function, but absolutely useful for the creation of the bold and the small caps. For the small capitals we first apply a scaling with respect to the origin of the capitals at 75% (this can be done with PfaEdit). Then we apply the change weight function of Fontographer but we check the boxes "do not change the character's width" and "do not change the character's height". With these restrictions many characters acquire the wider penstroke required by small capitals. For example, think of the letter O. This is constructed with two elliptical curves. The effect of the above method is that the inner ellipse becomes smaller (smaller axes) and the outer ellipse remains the same. Other letters, such as ones with serifs need manual tuning after these transformations. Finally there are cases where the above fails. For example, the sans serif letter l. The above procedure will leave such characters unaltered, and then intervention by hand is required.

All the bold glyphs (except the ones already provided by URW) and the full set of small caps were edited by hand, glyph by glyph, to bring them to the right look. However, one must be careful with Fontographer, as it fails to save kerning information for glyphs after position 256.[1] This means that the

[1] If you buy a commercial font that includes Greek you should check if the company uses Fontographer for the font generation. If true, ask for both the TrueType and the Type 1 fonts. Fontographer saves the kerning pairs in the TrueType format and you will be able to extract this information with PfaEdit. The resulting `afm` file is the correct one that must be used with the supplied `pfb` file. It is better to stay with the provided `pfb` file, since transforming the TrueType to Type 1 results in information loss for the glyphs.

program was used only for the splines and we had to preserve the `afm` files that PfaEdit provided.

Many kerning pairs are defined in the Kerkis fonts and this was done with the metrics dialog of PfaEdit. This is for example the case for Greek capital letters like A, Y, Δ and Λ. Compare

ΑΥΛΟΣ, ΛΥΔΙΑ (kerned) with
ΑΥΛΟΣ, ΛΥΔΙΑ (unkerned).

More important are the kernings for accents in polytonic Greek. For example, although Kerkis contains the letter Ἀ pre-composed, Babel cannot use this pre-composed character (there is not enough space in the virtual font table) and so composes it by placing the letter A after the accent. At this point we again need to define a kerning pair otherwise the result is bad. Compare the kerned Ἀ with the unkerned Ἀ.

The provided glyphs

Let us begin with the Latin part. URW Bookman is by no means complete for the Latin part. For example, it does not contain standard ligatures like ff, ffi and ffl. These were added and provided by Kerkis. Even further, Kerkis provides fj, ij and the more exotic fij (for example "fiji"). In addition, Bookman does not provide true small caps (if you use the package bookman.sty you will get fake small capitals). Kerkis provides true small caps for the Latin characters too:

True Small Capitals
Fake Small Capitals
Αληθινα Πεζοκεφαλαια
Ψευτικα Πεζοκεφαλαια

(However, the metrics of the small capitals of Kerkis need to be loosened. They are too tight in the current release.)

Finally, the Latin part of Kerkis contains many pre-composed accented letters that do not exist in URW Bookman. All fonts are provided in three weights: normal, bold and semi-bold.

Let us go now to the Greek part. This part supports the Greek language fully. Both monotonic and polytonic support is provided for all shapes and series. Here is an example:

> Ἥρης, *θυμίαμα ἀρώματα.*
>
> Κυανέοις κόλποισιν ἐνημένη, ἀερόμορφε,
> Ἥρα παμβασίλεια, Διὸς σύλλεκτρε μάκαιρα,
> ψυχοτρόφους αὔρας θνητοῖς παρέχουσα προσηνεῖς,
> ὄμβρων μὲν μήτηρ, ἀνέμων τροφέ, παντογένεθλε
> χωρὶς γὰρ σέθεν οὐδὲν ὅλως ζωῆς φύσιν ἔγνω
> κοινωνεῖς γὰρ ἅπασι κεκραμένη ἠέρι σεμνῷ
> πάντων γὰρ κρατέεις μούνη πάντεσσί τ' ἀνάσσεις
> ἠερίοις ῥοίζοισι τινασσομένη κατὰ χεῦμα.
> ἀλλά, μάκαιρα θεά, πολυώνυμε, παμβασίλεια,
> ἔλθοις εὐμενέουσα καλῶι γήθοντι προσώπῳ.

The fonts inside comply to the third version of the Unicode standard. Moreover, there are some special features that need to be mentioned:

Greek numerals Kerkis supports all of Babel's commands for Greek numerals, such as `\greeknumeral` and `\Greeknumeral`. For example, `\greeknumeral{9999}` gives ͵θϡϙϑ′ and `\Greeknumeral{9999}` gives ͵ΘϡϘΘ′. Of course, these commands produce the numbers as they were written by the people in the Hellenistic era and not by ancient Greeks. Ancient Greeks wrote only in capitals using special glyphs — which Kerkis provides. They are accessible with the `\athnum` command provided by the package athnum[2] by A. Syropoulos; athnum is part of Babel. For example, the numbers 1, 2, 5, 10, 50, 100, 500, 1000, 5000, 10000 and 50000 are Ι, ΙΙ, Π, Δ, Ⅾ, Η, Ⱶ, Χ, Ⱝ, Μ, Ⱞ., while `\athnum{9999}` produces ⱝXXXXⱵHHHHⅮΔΔΔΔΠΙΙΙΙ.

For the numerals used after the Alexandrian grammarians, Kerkis tries to clean up a little bit. The letter ϟ from the cb fonts was added to Greek by the christian church (Hebrew letter "koph") and has nothing to do with the ancient Greek language. So this design was removed from Kerkis and replaced by the true qoppa which is ϙ and accessed with `\qoppa` (this glyph is also available by the cb fonts for the number 90, although not by default). The situation is similar for the number 6. cb fonts give ϛ. Again this symbol is non-existent in ancient Greek. The correct symbol for 6 is digamma and Kerkis provides this as the default: `\greeknumeral{6}` gives ϝ′.

Glyph variations This is a unique feature of the Kerkis family. Greek typography has some letters whose shape varies, depending upon their position in the word. One such is sigma. When a sigma is at

[2] There has been a confusion about the Greek numerals. For reasons not to be explained here (see [8]), the true Greek numbers are known as Athenian numbers and these are the ones accessed with the athnum package.

the end of a word it changes from σ to ς. The same is true for several other letters when they appear at the beginning of a word. Thus we have βϐ, ζζ, θϑ, ρϱ, φϕ plus two forms for π and ε. For example, compare

βιβλίο, ζιζάνιο, θυμήθηκα, ρόπτρο, φαφλατάς

with

βιϐλίο, ζιζάνιο, θυμήθηκα, ρόπτρο, φαφλατάς

The second form of ρ (the initial one) will be reworked as the difference with the first form is not clear in small sizes. The second form of π is under construction.

Finally, the second form of ε poses a "virtual font" problem that is worth being mentioned. This form is ϵ (compare with ε). This second form is used when epsilon was followed by iota or iota-tonos (iota-dashed). So we would like the combinations ει and εί to have the second form of epsilon, that is ϵι and ϵί. However, this appears to be impossible for the ϵί combination (in the previous lines ϵ is accessed directly with a `\symbol` command). The ligature mechanism provided by virtual fonts provides only the `=|>` and `=|>>` operators which make the mechanism skip letters forward. But we need to rescan for ligatures skipping to the left! An operator (denoted, say, by `=|<` and `=|<<`) would enable the ligature mechanism after constructing iota-tonos (as the ligature of tonos and iota) to skip backwards(!) and recognize εί as a new ligature to act upon. We think that this addition would help the installation of complex typefaces in TEX. We would welcome such an addition to the virtual font mechanism.

The small capitals series

As said before, Kerkis provides true small capitals for both the Latin alphabet and the Greek alphabet. When writing in capitals we do not write accents in Greek. However, Kerkis provides accented small capitals as a stylistic alternative: Α Ε Η Ι Ο Υ Ω and Ά Έ Ή Ί Ό Ύ Ώ.

The small capitals font includes the old style numbers. Thus 0123456789 are accessed with

```
\textsc{0123456789}.
```

Small capitals are available in oblique form as well: *0123456789αβγ*. kerkis.sty provides the commands `\scslshape` and `\textscsl{}` for accessing these glyphs.

The semi-bold series

The semi-bold series is as complete as the normal weight series. It is accessed by the commands `\sbseries` and `\textsb{}`. Here's an example showing the different weights:

Ἐκ Διός αρχόμεσθα	(normal)
Ἐκ Διός αρχόμεσθα	(semi-bold)
Ἐκ Διός αρχόμεσθα	(bold)

The italic shape is also available:

Ἐκ Διός αρχόμεσθα	(normal)
Ἐκ Διός αρχόμεσθα	(semi-bold)
Ἐκ Διός αρχόμεσθα	(bold)

The italic shape

Kerkis provides a true italic (not just the roman slanted). The Latin part is again based on URW Bookman but completed with missing glyphs such as the f-ligatures, as before. The Greek is also a true italic with the exception of *ορφω* which are essentially the roman slanted (this was easily done with PfaEdit). Nonetheless, those letters with two forms have a true italic for the second form: *ϱ ϕ*.

The upright italic shape

An upright italic shape is available through skewing. The shape can be called with the commands `\textui{}` and `\uishape`. It looks like this:

The brown fox jumps	(n/ui)
The brown fox jumps	(n/it)
The brown fox jumps	(sb/ui)
The brown fox jumps	(sb/it)
The brown fox jumps	(b/ui)
The brown fox jumps	(b/it)

The sans font

Kerkis Sans is the companion sans serif face that comes with Kerkis. The font is based on Avant Garde. The Latin part comes from a free font found on the Internet. We improved it considerably by simplifying curves and adding missing ligatures. The Greek part was again newly designed to match the Latin part. Again PfaEdit was the main tool plus Fontographer for its "change weight" function.

The choice was made on the basis of common elements in the structure of Avant Garde and Bookman. They are similar in spirit, aperture, eye size and, based on personal judgment, they go nicely together.

Kerkis Sans fully supports the Greek language through Babel. Here is an example:

Ἐκ Διοσ *ἀρχώμεσθα*, τὸν οὐδέποτ' ἄνδρες ἐῶμεν
ἄρρητον· μεσταὶ δὲ Διὸς πᾶσαι μὲν ἀγυιαί,
πᾶσαι δ' ἀνθρώπων ἀγοραί, μεστὴ τὲ θάλασσα
και λιμένες· πάντη δὲ Διὸς κεχρήμεθα πάντες.

The euro

The symbol for the Euro is provided with the `\euro` command while in Greek text (in the LGR encoding):

Roman	€	*€*	**€**	***€***
Sans	€	*€*	**€**	***€***

Usage tips

This section is set with Kerkis Roman and Kerkis Sans as a sample, using both fonts. If one uses Kerkis for mathematical texts s/he can use the Times math fonts (mathptm.sty) and still draw the math alphabet from the Kerkis Italic font (kmath.sty). For slides one can use the Kerkis Sans with mathematics from the cmbright.sty package. In both cases kerkis.sty and kmath.sty must be loaded *after* the above packages. Here is a sample with Greek:

Οι περίλαμπροι Ναοί, οι εκπληκτικοί κοινωνικοπολιτικοί θεσμοί των Αθηνών και της Σπάρτης, τα θεϊκά αγάλματα, η παιδευτική τραγωδία, η εξυψωτική Φιλοσοφία, ήσαν οι καρποί μιάς μακράς συνειδησιακής διεργασίας που επιτελέσθηκε στην *προχριστιανική* Ελλάδα. Όμως ο απλός θαυμασμός, η βαριά νοσταλγία, ή η διαλεκτική μόνο ενατένιση του παρελθόντος δεν οδηγούν παρά σε *στείρα* προγονολατρεία.

Αυτό που απορροφά το δικό μας ενδιαφέρον, είναι οι ρίζες των συλλήψεων που εδημιούργησαν το μεγαλείο του Ελληνικου Εθνους. Μας ενδιαφέρει ο τρόπος που ο κάθε «πολίτης» ή «όμοιος» αντιλαμβάνετο τη Φυση και τον εαυτό του, μας ενδιαφέρουν τα *συναισθήματα*, τα όνειρα και οι προθέσεις που οδήγησαν στη μυθοπλασία, τη λογική σύλληψη του *Κόσμου* και στο μεγαλείο της φιλοσοφικής διανοήσεως. (The text is from `http://www.diipetes.gr`.)

Conclusion

Kerkis was, and remains, an experiment of how a Type 1 font with Greek glyphs may be used with LaTeX. Of course there are still many design issues but all the necessary information for installing and using a Type 1 font is available to users of the Greek language. This also includes the encoding vectors. The project triggered several articles written in the journal of the Greek TeX users group Εὔτυπον [1, 2, 3].

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[3] A. Tsolomitis, Installing TrueType fonts for LaTeX 2_ε, Τὸ Εὔτυπον, to appear (in greek).

[4] A. Syropoulos, A. Tsolomitis and N. Sofroniou, Digital Typography using LaTeX, Springer Professional Computing, Springer-Verlag, 2002.

[5] `http://autotrace.sourceforge.net`

[6] `http://pfaedit.sourceforge.net`

[7] `http://www.macromedia.com/software/fontographer`

[8] Blasis Rassias, Adventures of the Greek alphabet and the Greek numbering system, Diipetes 44, 2003.

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