The *universal* Font
Version v2.1

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2019/08/26

**Abstract**
This is my implementation of Herbert Bayer’s “universal” font in META-FONT for \TeX{} and \LaTeX{}. Extensive support for \LaTeX{} is supplied. This font is in no way intended to be a correct, not to mention a complete implementation of Herbert Bayer’s original design. This document describes how to use the font with \LaTeX{}, and also the source code for the characters of the font.

**Contents**

1 Introduction 2
2 The Font and it’s History 3
3 This META-FONT Implementation 4
  3.1 The META-FONT version versus the Original 5
  3.2 Features of the font 5
    3.2.1 Series, Shapes, Sizes, and Special Characters 6
    3.2.2 File Names for the META-FONT files 7
  3.3 The \LaTeX{} and NFSS Support 8
    3.3.1 Options to uni 9
    3.3.2 Font Selection Commands 9
    3.3.3 Special Character Commands 11
    3.3.4 Other Commands 11
    3.3.5 File Names for the \LaTeX{} files 12
  3.4 The Major differences between version 1.0 and 2.0 12
A Solution to the \texttt{bauhausforms} problem 14
  A.1 The Problem 14
  A.2 Joseph Collins’ Solution 15
B Copyrights — GNU General Public Lisence 16

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1 Introduction

This package contains the METAFONT source and driver files for the “universal” font, designed by Herbert Bayer, a teacher at the Bauhaus school in Weimar, plus a \LaTeX{} package to utilize this font, along with a number of font definition files, as required by the New Font Selection Scheme (NFSS).

About the Documentartion

The full documentation of this font is rather large, more then 80 pages actually. Most of it is the programs for the characters for this font, so if you don’t know the METAFONT language, or don’t care how the characters are created, you should insert \OnlyDescription into the preamble of \texttt{universa.dtx}.

Notice, that METAFONT macros are \emph{not} indexed in this documentation. This is because it would take a major rewrite of the \texttt{doc} package to do so, and I really didn’t want to do that.

Some of the macros of \texttt{doc} has been redefined, and if you want to see which, or how I generally did the documentation, please refer to appendix ??.

If you in some way are unsatisfied with some of the characters of the font, do please read the documentation of that character. There may be some notes on why the character looks the way it does. Some of the comments, however are a bit silly and should be skipped at high speed (pretend there is a conditional that says \texttt{if not silly ... fi}).

This Version

This new version of the \texttt{universal} font, provides a number of new features and improvements, both to the font itself and to the \LaTeX{} support macros. Also, a number of corrections has been made to the font programs.

The reason why I jumped one whole version number from 1.0 to 2.0, is that I have taken a whole new approach to the font programs and shapes of the \texttt{universal} font, plus I decided to put some more effort into the \LaTeX{} support.

Thanks and Other Stuff

To those of you who have had the (mixed) pleasure of using version 1.0 of this font, one of the most notaticable changes are to the symbol \texttt{\symbol{120}}. In the old documentation, I complained that I couldn’t find the exact solution to the problem this symbol possed. I also encouraged people to send me any solution they may have had — and guess what — somebody did! Therefore I would like to thanck Joseph Collins for providing me with the solution. If you like Joseph Collins and
I like Mathematical puzzles take a look in Appendix A to learn more about this problem and it’s solution.

I also direct your attention to Appendix B for the copyright notice on the universal package (it’s the Gnu General Public Lisence to those of you who know it).

If you in any way have gotten tempted to design your own font, or to implement some font into METAFONT, I feel obligated to bring you a warning, taken from the METAFONT book by Donald E. Knuth:

Warning: Type design can be hazardous to your other interests. Once you get hooked, you will develop intense feelings about letterforms: the medium will intrude the message that you read. And you will perpetually be thincking of improvements to the fonts that you see everywhere, especially those of your own design.

2 The Font and it’s History

Bauhaus

The Bauhaus school in germany originally located at Dessau, was a school for any kind of design, ranging from pottery to furniture, from painting to — what was considered the prime form of design — architecture. Many famous designers came from, or taught at Bauhaus, for example Mies van der Rhoe, Herbert Bayer, Kandinsky, Walter Gropius and Gerrit Rietveld. The style “die stiil” was explored here, and painters like Mondrian made large contributions to what today is known as “the Bauhaus style”.

The basic idea of the Bauhaus school, was to design items, which along with it’s aesthetic value, also had a high degree of functionality. Houses were meant to be suited for all kinds of living, while still keeping the beauty that make people glad to see thier house. Chairs should be comfortable for thier use, as well be able to fit–in in a normal house. All this should be done at a price that made it possible for everybody to own designer–furniture, houses, etc.

The political idea of Bauhaus, was that of a socialist one. Houses are for the people — they have to live in them, and that living should be a good as possible. Therefore the Bauhaus school saw it has its task to provide functional, beautiful everyday items that anybody could afford. Paintings and tapestery shouldn’t hang on museums or art galleries, but in peoples homes, where they would inrich thier everyday life.

Herbert Bayer and the “universal” Font

At Bauhaus typography was also studied, not just how written text should be typeset, and how printed characters should look like, but also what the essence of writing is, in it’s practical and design–wise sense. This led Herbert Bayer to formulate some principles of writing:
experiment with simplified way of writing:

1. this way of writing is recommended by all typographic designers as the future way of writing.
2. by writing in minuscules our writing loses nothing, but is easier to read, considerably more economical.
3. why must you for one sound have two tokens, e.g., A and a? why two alphabets for one word, why this double set of signs, when the half is enough.

herbert bayer 1925

On this principles, Herbert Bayer designed a font, which should have no majuscules (upper case letters), easy to print, and easy to read since it didn’t have any unusefull decoration, but communicated the bare meaning of characters through the simplest forms needed to reconigise a character. This font he called “universal”.

This font contained abolutly no majuscules, since Bayer believed them to be superflous, as it is clear form the quote above.

At the time Herbert Bayer formulated these principles and designed the “universal” font, most printers used Gothic letters, which is allmost overly decorated, so his font ofcourse made contraversy.

Later on, in the 1930’ies, the Bauhaus school drew the attention of Gestapo of Nazi Germany. The school was finally closed in 1936 by Gestapo, because they believed they were promoters of Jewish and Communist culture and propaganda.

In the aftermath of the closing of the school, most of it’s ideas were shundend by other designers, and the Bauhaus way of thinking died out. This is properly the reason why Herbert Bayers “universal” font is so little known today.

However, the “universal” font still stands as one of the most compelling developments in font designing. It represents an approach to designing where the functionallity is as vital as the expression, and as such I believ it to be one of the most important fonts in the world today.

3 This METAfont Implementation

This implementation of Herbert Bayers “universal” font, is not supposed to look exactly like the original design. Ofcourse I have tried to the best of my ability to mimic his design as far as I could. However, it is not an easy matter to find a complete, not to mention exact, sample or account of Bayers design.

This implementation is bassed on the samples I could find, and other implementaions of the “universal” font. Many of these other implementations do differ from the original samples, and include characters I couldn’t find in any of the original. So whenever I found disparities, I mainly leened on the original samples and my understanding of the original design.

---

1 Gehemligche Stats Polizi
2 Nationalsocializmus
3.1 The METAFONT version versus the Original

As mentioned above, Bayer never did design any majuscles for this font, but nonetheless, I have included them into this implementation. This I did, because I think most people will have a hard time writing in minuscles (lowercase letters) alone. Of course, if you agree with Bayer, you should simply not use them.

There are also some other differences, mostly due to the fact, that I never found a complete sample of the original font. The major differences between the original font and this implementation is summarized below:

- **Majuscles**: Majuscles are present, even though they weren’t in the original design.
- **Digits**: These are based on other implementations, and my general conception of the original design.
- **Punctuations**: As above.
- **Accents**: As above.
- **Symbols**: As above.
- **Bauhaus Symbols**: I have added some various symbols I have found in connection with Bauhaus to the font. The reason is I find them beautiful, and I had some space to fill.

- **Numerous Shapes and Weights**: I don’t think Bayer ever design slanted characters, a bold face version of the font, and he could never have design a small caps version of the font. However, these are present in this implementation. I included these features, because I believe them to be of general utility, and it makes the font conform more to the Computer Modern Roman font, and NFSS.

3.2 Features of the font

Rather then using cmbase.mf, and then redefine some macros, I chose to make a new base file myself, i.e., unibase.mf. This file contains a number of macros I have used in the character programs.

The macros of unibase.mf actually reflects my conception of the font. There are three basic drawing macros:

- **uniciar** which draws a circle,
- **uniarc** which draws a segment (arc) of a circle, and
- **uniline** which draws a straight line.

---

3. Computer Modern Roman base file
4. A better name for ‘base’ would be ‘library’, and then the file would be libuni.mf, but to conform to CM, I used ‘base’.
I believe, that Bayer intended the font to be made of these two basic shapes: the arc, and the line. Also, to keep things simple, and therefore easy to print, all shapes should be of the same thickness, i.e., as if drawn with a pen of equal thickness. I have made one deviation from this, however. All majuscles are drawn with a thicker ‘pen’, which makes the output nicer, I think.

Incidently, this made the programs of the characters much simpler, and shorter.

### 3.2.1 Series, Shapes, Sizes, and Special Characters

Below is a sample of each series/shape combination avaliable in this implementation of the font, along with the \texttt{\LaTeX} commands that drive them:

- **Medium upright (textuni):** The dazed brown fox quickly gave 1234-567890 jumps!
- **Medium slanted (textunisl):** The dazed brown fox quickly gave 1234-567890 jumps!
- **Medium small caps (textunisc):** The dazed brown fox quickly gave 1234-567890 jumps!
- **Medium strict (textunist):** The dazed brown fox quickly gave 1234-567890 jumps!
- **Bold face upright (textunibf):** The dazed brown fox quickly gave 1234-567890 jumps!
- **Bold face slanted (textunibsl):** The dazed brown fox quickly gave 1234-567890 jumps!
- **Bold face small caps (textunibsc):** The dazed brown fox quickly gave 1234-567890 jumps!
- **Bold face strict (textunibst):** The dazed brown fox quickly gave 1234-567890 jumps!

Everyone of these shapes are available in size 8, 9, 10, 12, 17 pt, and METAFONT can ofcourse create others.

Also a number of non–standard characters are available in the font. Below is a table of these characters along with the \texttt{\LaTeX} commands that drive them.

<table>
<thead>
<tr>
<th>Character</th>
<th>\texttt{\LaTeX} Command</th>
</tr>
</thead>
<tbody>
<tr>
<td><code> </code> and <code> </code></td>
<td>\texttt{\LaTeX}</td>
</tr>
</tbody>
</table>

Notice that “ and ” is present in the table. This is because these characters are not directly defined, but is supplied as ligatures. This can be done, because they are simple doubles of “ and ”.

A quick look on the table will also reveal some characters that generally isn’t present in the standard \texttt{OT1} encoding\(^5\), but generally present in the \texttt{T1} encoding\(^6\).

\(^5\)The \texttt{OT1} encoding is the 7 bit encoding of the Computer Modern fonts by Donald E. Knuth. 7 bit means it contain 128 (= \(2^7\)) characters.

\(^6\)The \texttt{T1} encoding is an encoding especially designed for the (western) European languages. It was founded by the \texttt{TeX} User’s Group, on a seminar in Cork, and is the basis of the dc fonts. \texttt{T1} is an 8 bit encoding, which means it has 256 (= \(2^8\)) characters.
I have done this, both to provide an (almost) complete font for the European languages, but also because I anticipate the universal font some time in the future will shift, or at least be available, in the T1 encoding\footnote{T1 is generally considered the encoding of the future, and in the long term, it is most likely the encoding of \LaTeX3.}. Please note, that in

\begin{table}[h]
\centering
\begin{tabular}{ll}
\textbackslash bausquare & \textbackslash baucircle \\
\textbackslash bautriangle & \textbackslash bauhead \\
\textbackslash bauforms & \textbackslash dh \\
\textbackslash dj & \textbackslash ng \\
\textbackslash th & \textbackslash varQ \\
\textbackslash DH & \textbackslash DJ \\
\textbackslash NG & \textbackslash TH \\
\textsection & \textbraceleft \\
\textbraceleft & \textbraceright \\
\guilsinglleft & \guilsinglright \\
\guillemoleft & \guillemoright \\
\textquotedblleft & \textquotedblright \\
\textogonek & \textunderscore \\
\end{tabular}
\caption{Non–standard characters in the universal font}
\end{table}

the small caps shaped fonts, \textbackslash dh does not give \textbackslash varQ, but a \textbackslash q, that is a small caps shaped version of \textbackslash varQ. Also there is no command \textbackslash varq defined.

In appendix \textit{D} is some charts showing the font in different series and shapes.

\subsection{File Names for the \texttt{METAFONT} files}

\textbf{Base File and Source Files} The base file and the files containing the code for the characters of the \texttt{universal} font, all starts with \texttt{uni}, to reflect the connection of the files. The next five possible letters reflects what kind of code is contained within the file, e.g., the base file ends in \texttt{base}, the file containing the code for the minuscles (lower case letters) end in \texttt{lower}, and so forth.

\textbf{Font Driver Files} The font driver filenames has been chosen to conform to the \texttt{fontname} scheme, because this scheme is used by most \texttt{\LaTeX}, \texttt{\LATEX}, and \texttt{METAFONT} systems (anyway those that use \texttt{kpathsea}, which is the most).

The filename all contain the three characters \texttt{ful}, where the \texttt{f} stands for \texttt{public} and \texttt{ul} for \texttt{universal}.

Next comes a letter which is one of \texttt{m} (medium) or \texttt{b} (bold), which represents the series of the font.

Then comes one or two letters, which are \texttt{r} (upright or roman), \texttt{o} (slanted, or oblique), \texttt{c} (small caps), or \texttt{st} (strict), which represent the shape of the font.

Finally the filename ends with the designsize in points.
Thus the complete syntax for the font driver file names is: The fontname

\[
\langle \text{filename} \rangle := \langle \text{supplier} \rangle \langle \text{face} \rangle \langle \text{series} \rangle \langle \text{shape} \rangle \langle \text{size} \rangle . \text{mf}
\]

\[
\langle \text{supplier} \rangle := f
\]

\[
\langle \text{face} \rangle := \text{ul}
\]

\[
\langle \text{series} \rangle := \text{m} | \text{b}
\]

\[
\langle \text{shape} \rangle := \text{r} | \text{o} | \text{c} | \text{st}
\]

\[
\langle \text{size} \rangle := | 8 | 9 | 10 | 12 | 17
\]

scheme actually says to put (encoding) information after the (shape), but since this is \texttt{8r} for \TeX\ Text, it would make filenames longer than 8 characters in the cases of \texttt{8} of 10, 12, and 17, so this information is left out (which is permissible in fontname, but unfortunate).

This way of naming the font driver files will, if you use \texttt{kpathsea}, put the full*.pk files in

\[
\langle \text{pk–base–dir} \rangle /\text{public/universa}/
\]

and the ful*.tfm files in

\[
\langle \text{tfm–base–dir} \rangle /\text{public/universa}/
\]

which I think is the intuitively correct place to put them. This also means, that the *.mf files provided with this package, should be placed in

\[
\langle \text{mf–source–base–dir} \rangle /\text{public/universa}/
\]

again very intuitive.

Below is a table of the usual directory names under Unix–like and MSDOS–like (including Windows95) systems. (mode) is \texttt{dvips}'s name for your printer.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unix–like systems</th>
<th>MSDOS–like systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>\langle \text{tfm–base–dir} \rangle</td>
<td>/var/spool/texmf/pk/\langle \text{mode} \rangle/</td>
<td>C:\FONTS\PK\langle \text{mode} \rangle/</td>
</tr>
<tr>
<td>\langle \text{tfm–base–dir} \rangle</td>
<td>/var/spool/texmf/tfm/</td>
<td>C:\FONTS\TFM/</td>
</tr>
<tr>
<td>\langle \text{tfm–base–dir} \rangle</td>
<td>/usr/local/lib/texmf/fonts/source/</td>
<td>C:\TEX\MFINPUTS/</td>
</tr>
</tbody>
</table>

Table 2: Common directory names.

3.3 The \LaTeX and NFSS Support

To use the universal font with \LaTeX 2ε8, you should load the package uni with the command

\[
\texttt{\usepackage[\langle \text{options} \rangle]{\text{uni}}}
\]

in your preamble (i.e., after \texttt{\documentclass} and before \texttt{\begin{document}}). \langle \text{options} \rangle can be any of the options described below, but no other.
3.3.1 Options to uni

The strict option is intended to facilitate typesetting of the universal font in a strict bauhaus fashion, that is only in minuscules.

In this font, only the series may be varied, that is, there is a bold series strict shaped font of any size, and a medium series strict shaped font of any size, in the universal family.

This option can be used in conjunction with options medium and bold. Please notice, that it doesn't make any sense to ask for a small caps or slanted shaped font, while using this option.

Notice that only \textuni and \uni is defined if option strict was given to uni package.

If you give the default option to the uni package, the default font of the document will be universal.

If you also used the option bold the default font will be the universal font in bold series. Otherwise it will be in medium series.

With this option, \textit, \it, and \itshape shifts to universal slanted font, i.e., there is no italic font available.

To make it possible to change back to Donald E. Knuth's Computer Modern Roman font, even when the default option is given, we define macros \textcmmr and \cmr, which switches the \fontfamily to cmr locally and globally respectively.

You should use this option with some care, since the universal font isn't very suited for longer texts, but rather for short letters, quotes, and other pieces of text where the graphical appearance is important.

When this option is given, command \textuni switches to medium series universal font, as do \uni. The other font selection commands behave as always (see below). This is the default option to uni, i.e., not normally needed.

If this option is given, commands \textuni and \uni switches to bold series universal font. Other font selection commands behave as always (see below). Notice that it makes no sense to give both option medium and option bold to the uni package.

3.3.2 Font Selection Commands

These two commands only change the current font family to uni and nothing else.

That means, that if you say for example

\begin{verbatim}
{\sl Hello \textuni{world}}
\end{verbatim}

you get both ‘Hello’ and ‘world’ in slanted shape, and the output would be

\begin{verbatim}
Hello world
\end{verbatim}

To put it in another way: Font encoding, shape, size, and baselineskip is preserved under \textuni and \uni, while font family is not.

\footnote{I have made no attempt to provide support for \LaTeX 2.09, since this format is obsolete, and those who do use it, will probably never bother to look at CTAN for new fonts anyway.}
Exceptions: If you gave the bold option to the uni package, then this command will always give you a bold series font. If you gave the strict option, then this command will always give you a strict shaped font.

These commands can be used in conjunction with \textbf, \textsl, and even \texttt, or \texttt{rm} to give different series and shapes. \textunirm If you in the previous example intended to shift to medium upright universal font you could instead have used \textunirm, since this command does not preserve font shape, i.e., the shape is always changed to upright, regardless of the previous shape. So if you said

\{\sl Hello \textunirm{world}}

you would get

Hello \texttt{world}

\textunisl Actually \textunirm and \texttt{unirm} isn't the only commands that aggresively changes most of the font parameters. \textunisl, \textunisc, and \textunist, \textunirm always gives you medium slanted, medium small caps, and medium strict \textunisc respectively no matter what the values of \texttt{fshape} was before.

\textunist In the same category is \textunibf, \textunibsl, \textunibsc, and \textunibst which always changes the font series to bold, along with change in shape (upright, slanted, small caps, and strict in that order).

\textunibf All of the 'aggresive' commands, do not however change the size and baselineskip of the font. This should be done by using \TeX\ commands such as \small, \Large, \texttt{\fontsize{⟨size⟩}{⟨lineskip⟩}}, etc.

\textunisc Notice that the 'aggresive' commands always changes to the appropriate font series. That is, even if you gave the bold option to uni, \textunirm will still give \textunisci a medium upright universal font. This particular instance illustrates the use of the aggressive commands quite well I think.

To summerize: The 'aggresive' commands doesn't preserve fammily, series and shapes, but does preserve encoding, size, and baslineskip.

Warning: The font shifting commands \textuni... and \uni... in this section is not defined if you gave the strict option to the uni package.

\textunifamily One can also use the rather primitive command \texttt{unifamily} in conjunction with \texttt{selectfont} as described in \texttt{\selectfont \texttt{Font Selection}}, to change the font family to universal if absolute control is preferd.

\textunifamily is used by all the other font switching commands, so if you redefine it, or \texttt{unifamilydefault}, you could get strange resault.

\textunifamilydefault This command normally expands to uni, which is the ‘family’ name of the universal package. If you redefine this command to be something else, e.g., cmr, \texttt{unifamily} will load another font.

\textuniseries If the bold option to uni is used this command will select the default series of the universal font, defined in \texttt{uniseriesdefault}, which ofcourse defaults to b, i.e., bold series. if you redefine \texttt{uniseriesdefault} to be m, then \texttt{uniseries} will select medium series fonts.
If **bold** option wasn’t given, then this expands to nothing, as do `\uniseriesdefault`. This command is used by `\textuni` and `\uni`.

If the **strict** option to `\uni` is used this command will select the default shape of the `universal` font, defined in `\unishapedefault`, which of course defaults to st, i.e., strict shape. If you redefine `\unishapedefault` to be n, then `\uniseries` will select upright shaped fonts.

If **strict** option wasn’t given, then this expands to nothing, as do `\unishapedefault`. This command is used by `\textuni` and `\uni`.

This command switches to **strict** shape, i.e., all majuscules will be typeset as minuscules. This makes it possible in a simple way to typeset text in the way Herbert Bayer thought it should, as evident from the citation above.

This command uses the command `\stdefault`, which defaults to st. If you redefine this to something else, e.g., sl you will get a slanted font.

This command is used by `\textunist`, `\textunibst`, `\unibst` and `\unist`, and is defined no matter what options you gave to the `uni` package.

**Warning:** Since **strict** is a non–standard shape, this command should not be used outside the `universal` font, since this may give you unexpected results.

### 3.3.3 Special Character Commands

For the individual commands that makes various special characters, please consult table 1 above.

### 3.3.4 Other Commands

`\k` The macro `\k` used in the `universal` font gives the accent ogenek, that is a reversed cedilla accent. It takes one argument, which should be a single letter, under which it puts the accent. For example, you could say `\textuni{\k{a}}` and get ą.

`\DeclareUniChar` Now you can configure the special character commands of the font, via the commands `\DeclareUniChar` and `\DeclareUniCommand`. The commands defined via these commands will only work in accordance with it’s definition inside the `universal` font, and if defined elsewhere according to it’s definition there, else it will give an error message.

`\DeclareUniChar` is used to define a command sequence representing a single character in the `universal` font, much like `\DeclareTextSymbol`, or in TeX `\chardef`, though the control sequence will produce an error message outside the `universal` font, and properly unexpected results outside the OT1 encoding\(^9\).

`\DeclareUniCommand` is used to define control sequences inside the `universal` font, representing many characters or doing complex maneuvers on characters and stuff. The optional argument to `\DeclareUniCommand` can be used to say how many arguments the control sequence should have, just like `\newcommand`. However, it is not possible to give a default first argument.

\(^9\)This should not be a problem.
The below definition uses the `color` package to typeset a square, circle, and triangle in different colours\textsuperscript{10}.

\begin{verbatim}
\DeclareUniCommand{\mybauforms}{\%}
  \lower.5ex\hbox{\color{blue}\bautriangle}\
  \kern-.5em\raise.5ex\hbox{\color{red}\baucircle}\
  \kern-.5em\lower.5ex\hbox{\color{yellow}\bausquare}}\%
\end{verbatim}

Yet another example, using arguments could be

\begin{verbatim}
\DeclareUniCommand{\mybaulogo}{1}{bauhead \ {Large #1}}
\end{verbatim}

so you could say \mybaulogo{Christian Holm} and get:

\begin{verbatim}
\end{verbatim}

Christian Holm

and I bet you can come up with some even more useful and complex commands.

The syntax of \DeclareUniChar and \DeclareUniCommand is

\begin{verbatim}
\DeclareUniChar{\langle cmd\rangle}{\langle slot\rangle}\
\DeclareUniCommand{\langle cmd\rangle}{\langle arg\rangle}{\langle definition\rangle}
\end{verbatim}

where \langle cmd\rangle is the user command defined, \langle slot\rangle is the number of the character in the font, \langle arg\rangle is the number of arguments and \langle definition\rangle is what \langle cmd\rangle does.

3.3.5 File Names for the \LaTeX files

All the \LaTeX files contain the three letters uni, to reflect the connectedness of the files. The font definition files all start with the letter code appropriate for the encoding.

To follow the scheme of the METAFONT files, it would be appropriate to place all \LaTeX files in

\begin{verbatim}
\langle tex–base–dir\rangle/\latex/universa
\end{verbatim}

3.4 The Major differences between version 1.0 and 2.0

First of: a lot of bugs and errors has been corrected. In version 1.0, I had made the (stupid) mistake of calling the macro `mode_setup` before I defined the unsharped units. Of course a quick look in the METAFONTbook showed be just how stupid this is. This made the font very vulnerable to mode specifications, which of course isn’t the idea.

\textsuperscript{10}Since the documentation should be available to all, I can not provide you with the outcome of this example, since it needs the color package which may not be available on all sites. I suggest you try it out, or something similar, if you can.

\textsuperscript{11}On Unix-like systems (\langle tex–base–dir\rangle) is usually something like /usr/local/lib/texmf/, and on MSDOS-like systems something like C:\TEX\. 
Secondly: I chose a completely new approach to the character programs, which resulted in `unibase.mf`. The idea is to define a few macros, and then utilize those in the character programs, so that these programs can be kept simple, efficient, and intuitive.

A quick look at `unibase.mf` will also reveal that I chose a new way of adjusting the characters. This means that the macros `bauhaus...` present in version 1.0 no longer is needed, and since they only tended to obscure things rather than simplify them, I went back to the plain `METAFONT` macro `beginchar`, which is much stronger.

All in all, `unibase.mf` provides a much stronger and uniform framework for character design, then did the old `universal.mf`.

Thirdly: The file names have been kept inside MSDOS conventions, that is first name of maximum 8 characters, and last name of maximum 3 characters. This does mean, however, that some file names are not intuitive, but I have tried to make them as much as I could.

Also, every file associated with this font, except the font definition files (`*uni.fd`), and font driver files (`ful*.*`) begins with the three letters `uni`, to emphasize the connection.

Fourthly: Some new font shapes are available, as explained above. I found out, during the design of the characters, that the base file `unibase.mf` kept showing new potentiality, and the extension of the font to include more shapes was very easy inside the frame of this base, so I thought “What the heck!”

Fifthly: Some of the `bauhaus` symbols available in version 1.0, has been taken out, and some new, more general characters have been added. Most of the absent symbols were not really of general use, so I decided to take them out, since I was never really satisfied with those anyway. This also made the font contain exactly 128 characters, just like a normal Computer Modern Roman font.

Sixthly: I improved the `\LaTeX` and NFSS support considerably. The changes are legion, but let me sum up the most important here.

1. Stronger font selection commands.
2. Command names that should be more intuitive.
3. Preparations for T1 encoding.
4. Conformations to `\LaTeX2e` style, and therefore a better chance to conform with the future `\LaTeX3` format.
5. More and better options.
A Solution to the \bauhausforms problem

A.1 The Problem

This I owe to Joseph Collins <collins@ARL.MIL>.

During the preparation of version 1.0 of this font, I was losing sleep over what I chose to call ‘The \bauhausforms problem’, after the problems the symbol \(\text{\ding{41}}\) gave me.

As can be seen from the symbol, the idea is to make a figure out of a circle, a square, and a triangle. From these three figures you can of course make infinitely many figures, even though the sizes are limited. The particular combination of the three figures I was looking, first seemed simple\(^\text{12}\), but turned out to be difficult. What I wanted to do was (see also figure 1):

Take a circle of some radius (e.g., 1). Inside this circle draw a isosceles triangle \(\triangle ABC\), with all vertices on the circle, the singular vertex \(A\) placed on the horizontal line traveling left from the center of the circle.

Now draw a square \(\square PQRS\) inside of the circle, having two vertices on the circle, and two on the triangle.

The wanted triangle and square are such that, the opposing side of the singular vertex \(BC\) should divide the square into two equal oblongs, i.e., intersect \(PQ\) midway between \(P\) and \(Q\).

\[\begin{array}{c}
A \\
\varphi \\
P' \\
P \\
\hline
S \quad O \quad B' \quad Q' \\
\hline
R \\
C \\
\hline
P \\
Q \\
B \\
\end{array}\]

Figure 1: The \bauforms problem.

This shouldn’t be too difficult, should it. Well I didn’t think so, but after many late evenings with pen, paper, ruler, compasses, and heavy use of trigonometric

\(^{12}\text{And after having seen Mr. Collins solution, it did again.}\)
relations, I found out that the half $\phi$ of the singular vertex should obey:

$$0 = \sin \left( \cos^{-1} \left( \frac{\cos 2\phi}{\sqrt{2}} \right) \right) - \frac{\cos 2\phi}{\sqrt{2}} - 2\sqrt{2} \frac{\cos^2 \phi \sin \phi}{\cos \phi + \sin \phi}$$

Now I dare you to find the exact solution to that.

Using numerical methods (Newton’s method), was of course no problem, and gave satisfactory result. If the expression on the right above is labelled $f$, $f'$ is:

$$f' = \frac{\sin 4\phi}{2\sqrt{\frac{3-\cos 4\phi}{4}}} + \sqrt{2} \sin 2\phi$$

Using these expressions for $f$ and $f'$ in a Fortran program, I reached results close to what Mr. Collins found.

### A.2 Joseph Collins’ Solution

In Mr. Collins notation, the points on figure 1 has the following coordinates:

- $A = (0, -1)$
- $B' = (x, 0)$
- $C = (x, y)$
- $O = (0, 0)$
- $P' = (x - h, 0)$
- $Q' = (x + h, 0)$
- $R = (x + h, h)$
- $S = (x - h, h)$

Below is what Mr. Collins wrote me — thank you very much.

On the unit circle

$$x^2 + y^2 = 1 \quad (1)$$

we have the vertices of a triangle at $(-1, 0), (x, y)$, and $(x, -y)$. A square has four vertices $(x \pm h, \pm h)$, where the two points $(x - h, \pm h)$ lie on the triangle (constraint A) and the two points $(x + h, \pm h)$ lie on the circle (constraint B). Thus, the vertical side of the triangle bisects the square. From constraint A, upon consideration of similar triangles, we have

$$\frac{y}{1 + x} = \frac{h}{1 + x - h}, \quad \text{so that} \quad h = \frac{(1 + x)y}{1 + x + y}.$$  

By (1), this is

$$h = \frac{(1 + x)\sqrt{1 - x^2}}{1 + x + \sqrt{1 - x^2}}. \quad (2)$$
From constraint B, we get
\[(x + h)^2 + h^2 = 1.\] (3)

Any simultaneous solution of (2) and (3) is also a solution of
\[8x^3 - 4x^2 - 3x + 1 = 0,\] (4)

the relevant solution being
\[x = \frac{1}{6} + \frac{\sqrt{11}}{18} \sin \left( \frac{\pi}{6} - \frac{1}{3} \arctan \left( \frac{3\sqrt{237}}{23} \right) \right).\] (5)

Equation (4) and solution (5) courtesy of Mathematica. We get \(y\) and \(h\) from (1) and (2), respectively. The angle at \((-1,0)\) is \(\varphi = 2 \arctan(y/(1 + x))\).

Approximate values are
\[x \approx 0.2865914\]
\[y \approx 0.9580529\]
\[h \approx 0.5491394\]
\[\varphi \approx 1.280129 (\approx 73.346^\circ)\]

B 

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Cambridge
MA 02139
USA

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C Wishlist

Below is a list of things I would like to do with the font and package. If anyone has any suggestions, ready-made code, or new ideas, please let me know.

If you would like to take on one or more of the tasks presented below, please do so, but send me a note so that I may coordinate with my own efforts, and perhaps have a constructive discourse.

I should however instruct you to read the complete documentation of the package and font, since this may give some reasons why I have chosen a particular approach.

- Make the font an 8-bit encoded (256 characters) font, conforming somewhat to the T1 encoding of the Cork fonts.

- Making a package (perhaps mfdoc), to make documentation of META Fountain sources, just like doc is fore LaTeX sources. This is of course a independent project, and I will properly not work on it.
D  Font Charts

Below are some charts of the universal font in different series and shapes (medium upright, slanted, small-caps, and strict, as well as bold upright, slanted, small caps, and strict), all in size 8pt.

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Figure 2: Letters and symbols in fulmr8.mf — medium, upright
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Figure 3: Letters and symbols in fulmo8.mf — medium, oblique
Figure 4: Letters and symbols in `fulmc8.mf` — medium, small-caps
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Figure 5: Letters and symbols in fulmst8.mf — medium, strict
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Figure 6: Letters and symbols in fulbr8.mf — bold, upright
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Figure 7: Letters and symbols in fulbo8.mf — bold, oblique
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Figure 8: Letters and symbols in fulbc8.mf — bold, small-caps
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Figure 9: Letters and symbols in fulbst8.mf — bold, strict
E Index

The Numbers written in italic refer to the pages, where a macros usage is described, while those in typewrite refer to line numbers in the files, mentioned before, where the definition is, while slanted shows the places it is used. Normal letters refer to pages, whether it be descriptions or usage.

B
Bauhaus style .................................. 3
Bayer, Herbert ................................. 2, 3
bold (Option) .................................. 9

M
medium (Option) ............................... 9
Mondrian ........................................ 3

R
Rhoe, Mies van der ............................ 3
Rietveld, Gerrit ............................... 3

G
Gropius, Walter ............................... 3

K
Kandinsky ....................................... 3

S
strict (Option) ................................. 9

U
unibase.mf .................................... 5

F Change History

Below is listed the changes made to the universal font and the \texttt{E}\texttt{T}\texttt{P}\texttt{X} support package \texttt{uni}, from version 1.0 to 2.0.

v1.0

General: Creation of the \texttt{universal} font .................. 2

v2.0

General: Added ‘slanted’ shape to 
the font. .................. 6
Added ‘small caps’ shape to the 
font. .................. 6
Added non–standard ‘strict’ 
shape to the font. .......... 6
Added option \texttt{default}. .......... 9
Added option \texttt{medium}. ......... 9
Added option \texttt{strict}. ......... 9

Configuration of \texttt{uni} package 
provided via the commands \texttt{\textbackslash DeclareUniChar} and \texttt{\textbackslash DeclareUniCommand}. ......... 11
Default series is changed to ‘medium’ to the font, ‘bold face’ support included. ......... 6
Defined \texttt{\textbackslash stshape} to make 
package conform to \texttt{E}\texttt{T}\texttt{P}\texttt{X} 2\texttt{E} 
better. .................. 11
Defined \texttt{\textbackslash unifamily} to facilitate 
easier and stronger font 
loading. .................. 10
Defined \texttt{\textbackslash uniseries} to facilitate 
easier and stronger font 
loading. .................. 10
Defined \texttt{\textbackslash unishape} to facilitate 
easier and stronger font 
loading. .................. 11
Some of the \texttt{bauhaus} symbols 
that where available in v1.0, 
has been taken out. .......... 6