The XCharter Font Package

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1 Package Features

The *XCharter* fonts are extensions of the Bitstream Charter fonts, adding oldstyle figures (proportionally spaced only), superior figures and small caps in all styles. The original Charter fonts were created by famed font designer Matthew Carter in the late 1980's to enhance legibility of the output from printers of that era (laser, dot matrix, thermal and inkjet) with resolutions that would now be considered low—not far from modern screen resolutions. Their low contrasts, high x-heights and use of piecewise linear outlines where possible may make them interesting again as fonts that will render well on small devices and perhaps projected slides. (It's worth noting that the same designer provided Georgia for Microsoft. It is widely considered to be one of the clearest serifed fonts for viewing on screen, and bears a number of similarities to Charter, though the latter is heavier.)

As of version 1.09 (2017-06-25) there is a new collection of Cyrillic glyphs in *XCharter*, copied from Andrey Panov's *Khartiya*, an extension of the free Charter fonts, with small caps included. Some new figure styles were also copied from *Khartiya*—inferiors, numerators and denominators. Along with these additions, there are now slanted versions for those who wish to have both slanted and italic text available to meet distinct semantic purposes. Note that figures and uppercase slanted and italic are almost identical (except for slanted *Q* and italic *Q*) but lower-case forms are distinct.

Support files are provided for T1, TS1, LY1, T2A and OT2 encodings, the latter being to support the Cyrillic component of *XCharter*. The package has a number of options:

- scaled=.98, for example, scales all text to 98% of specified size;
- lining (or just lf) makes lining figures (0123456789) the default for text—this is set automatically and does not need to be entered explicitly;
- oldstyle (or osf) sets the figure style in text mode to oldstyle (0123456789) with numeral one like a shortened 1, but math mode will always use lining figures;
- oldstyleI (or osfI) sets the figure style in text mode to oldstyle (0123456789) with numeral one like a shortened I, but math mode will always use lining figures;
- sups sets the style for superscript figures (eg, footnote markers) to XCharter's superior figures rather than using the default text inserts in mathematical superscripts. This option has no effect if a KOMA class is in force.
- scosf makes oldstyle figures the default in small cap text, no matter what the global figure setting may be.

Special Macros:

- \useosf (usable only in the preamble) may be used for changing the text figure style to osf though math mode will use lining figures.
- \useosfI (usable only in the preamble) may be used for changing the text figure style to osfI though math mode will use lining figures.
- \textsu prints its argument in superior figures, eg \textsu{12} results in ¹². The effect is the same with {\sustyle 12}.
- \textin prints its argument in inferior figures, eg \textin{12} results in ₁₂. The effect is the same with {\instyle 12}.
- \textlf prints its argument in lining figures, eg \textlf{12} results in 12. The effect is the same with {\lfstyle 12}.
- {\osfstyle 23} prints 23 using whatever oldstyle option is in force.
- \textosf prints its argument in oldstyle figures using, in effect, the osf option—e.g., \textosf{12} results in 12.
- \textosfI prints its argument in oldstyle figures using, in effect, the osfI option—e.g., \textosfI{12} results in 12.
- Numerators and denominators are normally used only for constructing fractions, but may if needed be called using \textnumerator and \textdenominator. They are about 7% smaller than superiors and inferiors. The \textfrac macro allows you to write, e.g., \textfrac{31}{32} to get ³¹/₃₂. You may use \textde and \textnu as abbreviations, though the latter will not be available if babel is loaded with greek option.

Three math packages seem to provide reasonable companions for XCharter. The first example uses Charter italics as math italics, but doesn't provide arbitrary scaling and doesn't sufficiently distinguish math italic v from mathematical Greek \nu. Moreover, it is not easy to redefine \mathcal to get a better math calligraphic alphabet—eg, the mathalfa package fails. The second uses libertine italics and Greek in math mode, which is a good match to Charter in style and weight after scaling up, is arbitrarily scalable, has distinct math italic v and mathematical Greek \nu, and is completely compatible with mathalfa. The third is a new revision of newtxmath with option charter (or, equivalently, xcharter), which substitutes Charter italics as math italics and uses a back-slanted version of its slanted Greek symbols. This version is scalable and has a math italic v (plus a matching w) distinct from \nu.

Example 1:

```
\usepackage[charter,expert]{mathdesign}
\usepackage[scaled=.96,osf]{XCharter}% matches the size used in math
\linespread{1.04}
```

Example 2:

```
\usepackage[scaled=.98,sups,osf]{XCharter}% lining figures in math, osf in text
\usepackage[scaled=1.04,varqu,varl]{inconsolata}% inconsolata typewriter
\usepackage[type1]{cabin}% sans serif
\usepackage[libertine,vvarbb,scaled=1.07]{newtxmath}
```

```
\usepackage[cal=boondoxo]{mathalfa}
\linespread{1.04}
```

Example 3:

```
\usepackage[scaled=.98,sups,osf]{XCharter}% lining figures in math, osf in text
\usepackage[scaled=1.04,varqu,varl]{inconsolata}% inconsolata typewriter
\usepackage[type1]{cabin}% sans serif
\usepackage[charter,vvarbb,scaled=1.07]{newtxmath}
\usepackage[cal=boondoxo]{mathalfa}
\linespread{1.04}
```

Example 4:

```
\usepackage[<specify babel languages>]{babel}% load before XCharter
\usepackage[scaled=.98,sups,osf]{XCharter}% osf in text, lining figures in math
\usepackage[scaled=1.04,varqu,varl]{inconsolata}% inconsolata typewriter
\usepackage[type1]{cabin}% sans serif
\usepackage[charter,vvarbb,scaled=1.07]{newtxmath}
\usepackage[cal=boondoxo]{mathalfa}
\linespread{1.04}
```

Here is a short sample based on the preamble of EXAMPLE 3:

The typeset math below follows the ISO recommendations that only variables be set in italic. Note the use of upright shapes for d, e and π . (The first two are entered as \mathrm{d} and \mathrm{e}, and in fonts derived from newtxmath or mtpro2, the latter is entered as \uppi.)

Simplest form of the Central Limit Theorem: Let X_1, X_2, \cdots be a sequence of iid random variables with mean 0 and variance 1 on a probability space $(\Omega, \mathcal{F}, \mathbb{P})$. Then

$$\mathbb{P}\left(\frac{X_1 + \dots + X_n}{\sqrt{n}} \le y\right) \to \Re(y) \coloneqq \int_{-\infty}^{y} \frac{e^{-v^2/2}}{\sqrt{2\pi}} dv \quad \text{as } n \to \infty,$$

or, equivalently, letting $S_n \coloneqq \sum_{i=1}^n X_k$,

$$\mathbb{E}f\left(S_n/\sqrt{n}\right) \to \int_{-\infty}^{\infty} f(v) \frac{\mathrm{e}^{-v^2/2}}{\sqrt{2\pi}} \,\mathrm{d}v \quad \text{as } n \to \infty, \,\text{for every } f \in \mathrm{b}\mathscr{C}(\mathbb{R}).$$

2 Text effects under fontaxes

This package loads the fontaxes package in order to access italic and slanted small caps. You should pay attention to the fact that fontaxes modifies the behavior of some basic $\mathbb{E}T_EX$ text macros such as \textsc and \textup. Under normal $\mathbb{E}T_EX$, some text effects are combined, so that, for example, \textbf{\textit{a}} produces bold italic a, while other effects are not, e.g., \textsc{\textup{a}} has the same effect as \textup{a}, producing the letter a in upright, not small cap, style. With fontaxes, \textsc{\textup{a}} produces instead upright small cap a. It offers a macro \textulc that undoes small caps, so that, eg, \textsc{\textulc{a}} produces a in non-small cap mode, with whatever other style choices were in force, such as bold or italics.

3 Usage with fontspec

Because the package supplies a file named XCharter.fontspec whose contents list the otf files that correspond to each of Regular, Bold, Italic, BoldItalic, Slanted and BoldSlanted, you may load XCharter with just

```
\usepackage{fontspec}
\setmainfont{XCharter}
```

With unicode-encoded text, you will, in particular, have complete access to the newly added Cyrillic glyphs.

4 Using Cyrillic with pdflatex

The OT2 encoding, now considered as obsolete because it is 7-bit, is nonetheless useful to scholars who wish to write short segments using a Cyrillic script from a Western keyboard. There are two means of doing this, one using control sequences for the characters (e.g., \CYRA for Cyrillic A) and the other using ligatures to access the characters. Tables setting out the substitutions available may be consulted at http://herbert.the-little-red-haired-girl.org/dvi/pdf/cyrillic.pdf.

Note that, while the OT2 encoded font is complete, there are many gaps in the T2A encoded version, so that only Modern Russian and Ukrainian are fully covered, along with a number of characters from Old Russian and other Slavic languages.

	΄ο	Ί	<i>'</i> 2	<i>'3</i>	<i>4</i>	<i>′</i> 5	6	<i>'7</i>	
<i>'oox</i>	Њ∘	Љ т	Ц ₂	Э 3	I 4	E 5	Ђ 6	Ћ 7	″0v
<i>'oix</i>	Њ 8	Љ 9	Џ 10	Эп	i 12	€ 13	₿ 14	ħ 15	0.7
'02X	Ю 16	Ж 17	Й 18	Ë 19	V 20	Θ 21	S 22	Я 23	″1v
́озх	Ю 24	Ж 25	Й 26	ë 27	V 28	θ 29	S 30	Я 31	IX
′04x	 32	! ₃₃	" 34	Ъ 35	36	% 37	38	, 39	″2v
′05x	(40) 41	* 42	Ъ 43	, 44	- 45	• 46	/ 47	2X
′06х	0 48	1 49	2 50	3 ₅₁	4 52	5 ₅₃	6 ₅₄	7 55	″2v
<i>`07x</i>	8 56	9 57	: 58	; 59	« 60	1 61	» 62	? 63	ЗX
'10X	64	A 65	Б 66	Ц 67	Д 68	E 69	Φ 70	$\Gamma_{7^{I}}$	″4×
'IIX	X 72	И 73	J 74	К 75	Λ 76	M 77	H 78	O 79	4.
<i>'12X</i>	П 80	Ч 81	P 82	C 83	T 84	У 85	B 86	Щ 87	″5v
′13x	Ш 88	Ы 89	3 90	[91	" 92] 93	Ь 94	Ъ 95	5.
′14x	6 96	a ₉₇	б 98	Ц 99	Д 100	е тот	ф 102	Γ 103	″6v
′15X	X 104	И 105	j 106	К 107	λ 108	M 109	Н по	O 111	
′16x	Π 112	Ч 113	р 114	C 115	T 116	У 117	B 118	Щ 119	″7v
<i>′17x</i>	Ш 120	Ы 121	3 122	- 123	124	Nº 125	b 126	Ъ 127	
	″8	″9	″A	″В	″C	″D	″Е	″F	

XCHARTER-ROMAN-TLF-OT2.TFM:

Example OT2 Preamble:

```
\documentclass{article}
\usepackage[OT2,T1]{fontenc} % loads ot2enc.def
\newcommand\cyrtext{%
\fontfamily{XCharter-TLF}\fontencoding{OT2}\selectfont} % declaration
\DeclareTextFontCommand{\textcyr}{\cyrtext} %macro with argument
```

The Russian part of the following sentence is entered as \textcyr{a e1to --- po-russki}.

This is text in English, then Russian: а это — по-русски.

Using T2A with T1:

Here's an example of using XCharter text and math, set up to allow the use of Russian with English as the main language.

```
\usepackage[0T2,T2A,T1]{fontenc} % spell out all text encodings to be used
\usepackage[utf8]{inputenc} %
\usepackage{substitutefont} % so we can use fonts other than those specified in babel
\usepackage[russian,english]{babel}
\usepackage{XCharter} %
\usepackage[charter,vvarbb,scaled=1.07]{newtxmath}
\useosf % use oldstyle figures except in math
\substitutefont{T2A}{\rmdefault}{XCharter} % use XCharter to render Russian
%\substitutefont{0T2}{\rmdefault}{XCharter} % poor man's version
```

Any utf8-encoded text typed outside of a \foreignlanguage{}{} block will be rendered as T1encoded XCharter, while that within \foreignlanguage{russian}{} will render as T2A-encoded Cyrillic.

XCHARTER-ROMAN-TLF-T2A.TFM:

	΄ο	Ί	<i>'</i> 2	<i>'</i> 3	<i>'</i> 4	<i>5</i>	<i>6</i>	<i>′</i> 7	
'oox	` 0	, 1	^ 2	~ 3	•• 4	″ 5	° 6	v 7	″0v
<i>'oıx</i>	5 8	- 9	• 10	¹¹	د ¹²	I 13	fb 14	fh 15	υx
<i>'02X</i>	" 16	" ₁₇	fj 18	fk 19	3 20	- 21	22	23	″1x
′o3x	24	1 25	J 26	ff 27	fi 28	fl 29	ffi 30	ffl 31	IX
'04x	L 32	! ₃₃	" 34	# 35	\$ 36	% ₃ ₇	& 38	' 39	″ ว ุ
′05x	(40) 41	* 42	+ 43	, 44	- 45	• 46	/ 47	۲۸
<i>′о6х</i>	0 48	1 49	2 50	3 ₅₁	4 52	5 ₅₃	6 ₅₄	7 55	″2v
<i>′07</i> x	8 56	9 57	: 58	; 59	< 60	= 61	> 62	? 63	2X
´10X	@ 64	A 65	B 66	C 67	D 68	E 69	F 70	G 71	″4x
<i>'IIX</i>	H 72	I 73	J 74	K 75	L 76	M 77	N 78	O 79	
<i>'12X</i>	P 80	Q 81	R 82	S 83	T 84	U 85	V 86	W 87	″5v
′13X	X 88	Y 89	Z 90	[9I	\ ₉₂] 93	∧ ₉₄	_ ⁹⁵	5X
′14x	6 96	a ₉₇	b 98	C 99	d 100	е тот	f 102	g 103	″6v
′15X	h 104	i 105	j 106	k 107	1 108	т 109	п по	О III	0.
′ібх	p 112	q 113	r 114	S 115	t 116	u 117	V 118	W 119	″7∨
<i>′17x</i>	X 120	У 121	Z 122	{ 123	124	} 125	~ 126	- 127	/ ~
,	L							_	
20x	I 128	129	Ђ 130	Ћ 131	132	133	134	Љ ₁35	″8v
20X 21X	I 128 I 136	129 137	Ђ ₁₃₀ 138	Ћ ₁₃₁ 139	132 Æ 140	133 141	134 142	Љ ₁₃₅ S ₁₄₃	″8x
20x 21x 22x	I 128 Ï 136 144	129 137 Ç 145	ђ ₁₃₀ ₁₃₈ Ў ₁₄₆	Ћ ₁₃₁ 139 Ү ₁₄₇	132 Æ 140 148	133 141 149	134 142 Ц 150	љ ₁₃₅ S ₁₄₃ 151	″8x
<u>20x</u> <u>21x</u> <u>22x</u> <u>22x</u> <u>23x</u>	I 128 I 136 144 152	129 137 Ç 145 Є 153	Ђ 130 138 Ў 146 154	Та 131 139 Ү 147 Њ 155	132 Æ 140 148 Ë 156	133 141 149 No 157	134 142 U 150 X 158	Ль 135 S 143 151 § 159	″8x ″9x
$ \begin{array}{r} \begin{array}{r} 20x \\ $	I 128 Ϊ 136 144 152 Γ΄ 160	129 137 Ç 145 € 153 161	Ђ 130 138 Ў 146 154 ђ 162	Та 131 139 У 147 Њ 155 ћ 163	132 Æ 140 148 Ё 156 h 164	133 141 149 No 157 165	¹³⁴ ¹⁴² ↓ 150 ¤ 158 166	Ло 135 S 143 151 Š 159 Ло 167	″8x ″9x
$ \begin{array}{r} \hline 20x \\ \hline 21x \\ \hline 22x \\ \hline 22x \\ \hline 23x \\ \hline 24x \\ \hline 25x \\ \end{array} $	Ι 128 Ϊ 136 144 152 Γ΄ 160 Ϊ 168	129 137 Ç 145 C 145 C 153 161 169	ђ 130 138 Ў 146 154 ђ 162 170	Н 131 139 Ү 147 Но 155 ћ 163 171	132 Æ 140 148 Ë 156 h 164 æ 172	133 141 149 № 157 165 173	134 142 147 150 X 158 166 174	Ло 135 S 143 151 S 159 Ло 167 S 175	″8x ″9x ″Ax
$ \begin{array}{r} \begin{array}{r} $	Ι 128 Ϊ 136 144 152 Γ΄ 160 Ϊ 168 176 176	129 137 Ç 145 E 153 161 169 Ç 177	ђ 130 138 Ў 146 154 ђ 162 170 Ў 178	Н 131 139 У 147 Нь 155 ћ 163 171 179	132 Æ 140 148 Ë 156 h 164 æ 172 180	I33 I4I I49 Nº 157 I65 I73 I8I	134 142 Ц 150 ス 158 166 174 Ц 182	Љ 135 Газа S 143 151 Š 159 Љ 167 S 175 183	″8x ″9x ″Ax
$ \begin{array}{r} \begin{array}{r} $	I 128 II 136 144 152 I' 160 II 168 176 184	129 137 Ç 145 C 153 161 169 Ç 177 C 185	ђ 130 138 Ў 146 154 ђ 162 170 Ў 178 186	Н 131 139 Y 147 HJ 155 ħ 163 171 179 HJ 187	132 Æ 140 148 Ë 156 h 164 æ 172 180 ë 188	I33 I41 I49 № 157 I65 I73 I81 "189	134 142 ↓↓ 150 □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□	λ 135 S 143 151 5 § 159 λ 167 S 175 183 191	″8x ″9x ″Ax ″Bx
$ \begin{array}{c} \begin{array}{c} $	l 128 Ï 136 144 152 I' 160 Ï 168 176 184 A 192	129 137 Ç 145 C 153 161 169 Ç 177 C 185 B 193	ђ 130 138 Ў 146 154 ђ 162 170 Ў 178 186 В 194	H 131 139 Y 147 H 155 h 163 171 179 H 187 Γ 195	132 Æ 140 148 Ë 156 h 164 æ 172 180 ë 188 Č 188 Д 196	133 141 149 Nº 157 165 173 181 " 189 E 197	134 142 ↓↓ 150 次 158 166 174 ↓↓ 182 « 190 ★ 198	Љ 135 S 143 151 Š 159 Љ 167 S 175 183 > 191 З 199	″8х ″9х ″Ах ″Вх
$ \begin{array}{c} \begin{array}{r} $	I 128 I 136 144 152 Г 160 I 168 176 184 А 192 И 200	129 137 Ç 145 C 153 161 169 Ç 177 C 185 Б 193 Й 201	ђ 130 138 Ў 146 154 ђ 162 170 Ў 178 186 В 194 К 202	H 131 139 Y 147 H 155 ħ 163 171 179 H 187 Γ 195 Λ 203	132 Æ 140 148 Ë 156 h 164 æ 172 180 ë 188 A 196 M 204	133 141 149 № 157 165 173 181 ,, 189 E 197 E 197 H 205	134 142 Ц 150 ¤ 158 166 174 Ц 182 « 190 Ж 198 О 206	λ 135 S 143 151 5 § 159 λ 167 S 175 183 191 3 199 Π 207	 "8x "9x "Ax "Bx "Cx
'20x '21x '22x '23x '24x '25x '26x '27x '30x '31x '32x	I 128 I 136 144 152 Г 160 I 168 176 184 А 192 И 200 Р 208	129 137 Ç 145 C 153 161 169 Ç 177 C 185 Б 193 Й 201 C 209	ђ 130 138 Ў 146 154 ђ 162 170 Ў 178 186 В 194 К 202 Т 210	H 131 139 Y 147 H 155 h 163 171 179 H 187 Γ 195 A 203 Y 211	132 Æ 140 148 Ë 156 h 164 æ 172 180 ë 188 A 196 M 204 Φ 212	I33 I41 I49 Nº 157 I65 I73 I81 ,, 189 E 197 H 205 X 213	134 142 150 2158 166 174 1182 « 190 Ж 198 О 206 Ц 214	λ 135 S 143 151 5 § 159 λ 167 S 175 183 191 3 199 Π 207 Ч 215	″8х ″9х ″Ах ″Вх ″Сх
$ \begin{array}{c} \begin{array}{r} $	I 128 I 136 144 152 Г 160 I 168 176 184 А 192 И 200 Р 208 Ш 216	129 137 Ç 145 C 153 161 169 Ç 177 C 185 Б 193 Й 201 C 209 Щ 217	Ђ 130 138 Ў 146 154 九 162 170 Ў 178 186 В 194 К 202 Т 210 Ъ 218	H 131 139 Y 147 H 155 ħ 163 171 179 H 187 Γ 195 Λ 203 Y 211 H 219	132 Æ 140 148 Ë 156 h 164 æ 172 180 ë 188 A 196 M 204 Φ 212 b 220	I33 I4I I49 Nº 157 I65 I73 I8I ,, 189 E 197 H 205 X 213 Э 221	134 142 150 X 158 166 174 1 182 « 190 Ж 198 О 206 Ц 214 Ю 222	λ 135 S 143 151 5 § 159 λ 167 S 175 183 191 3 199 Π 207 Ч 215 Я 223	<pre>%8x %9x %Ax %Bx %Cx %Dx</pre>
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² 20x ² 21x ² 22x ² 23x ² 24x ² 25x ² 26x ² 27x ² 30x ³ 31x ³ 32x ³ 32x ³ 32x ³ 35x ³ 35x ³ 36x	I 128 Ï 136 144 152 Г 160 Ï 168 176 184 А 192 И 200 Р 208 ШІ 216 а 224 И 232 Р 240	129 I37 Ç 145 E 153 161 169 Ç 177 E 185 B 193 Й 201 C 209 Щ 217 б 225 Й 233 C 241	Ђ 130 138 Ў 146 154 九 162 170 Ў 178 186 В 194 K 202 Т 210 Ъ 218 В 226 K 234 Т 242	H 131 139 Y 147 H 155 ħ 163 171 179 H 187 Γ 195 Λ 203 Y 211 H 219 Γ 227 Λ 235 Y 243	132 Æ 140 148 Ë 156 h 164 æ 172 180 ë 188 Å 196 M 204 Φ 212 b 220 A 228 M 236 Φ 244	133 141 149 Nº 157 165 173 181 ,, 189 E 197 H 205 X 213 Э 221 e 229 H 237 X 245	134 142 150 150 150 150 150 150 150 150 150 150 166 174 11 182 « 190 Ж 198 O 206 Ц 214 Ю 222 Ж 230 O 238 Ц 246	λ 135 S 143 151 § 159 λ 167 S 175 183 » 191 3 199 Π 207 Ч 215 Я 223 3 231 Π 239 Ч 247	 "8x "9x "Ax "Bx "Cx "Dx "Ex "Ex
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Note: Currently, the $\square T_E X$ support files for T2A encoded *XCharter* cover only the figure styles lining, oldstyle and superiors.