

Variability in digital typography:

Limitations and
opportunities for variable
fonts in contemporary
type implementations

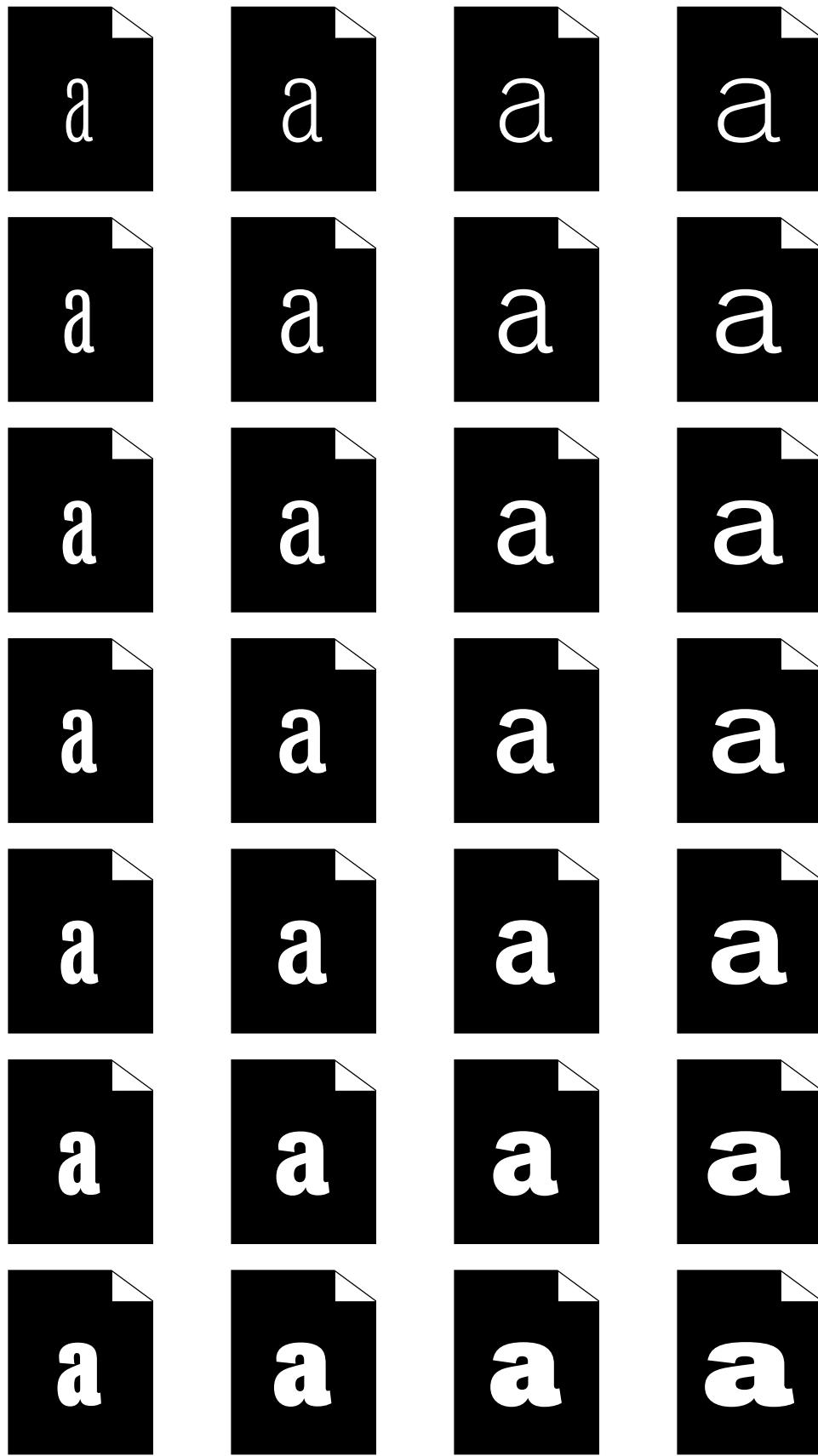
What is a variable font?

ATypI Warsaw 2016

Adobe, Apple, Google, and Microsoft
jointly announced OpenType variations,
a sub-component of the
OpenType 1.8 specification.

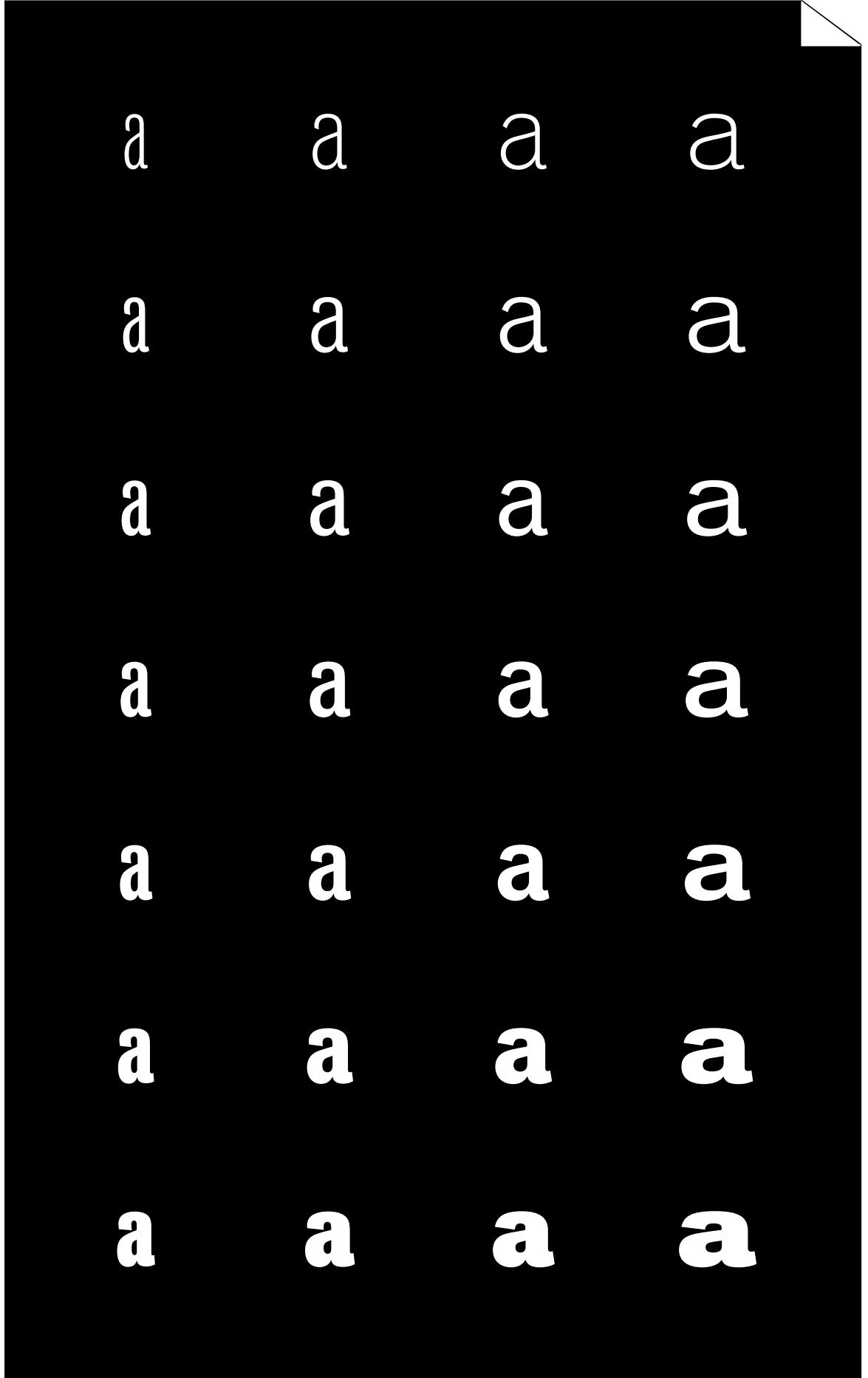
‘An OpenType variable font is a
single typeface file that behaves
like multiple typeface files’

John Hudson



CLASSIC GROTESQUE PRO

- ☞ 28 individual fonts
- ☞ When including italics, the total number of fonts in the type family reaches 56.
- ☞ Hypothetically, if optical grades between text and display were introduced, it could double these figures.



a a a a

a a a a

a a a a

a a a a

a a a a

a a a a

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a a a a

a a a a

a a a a

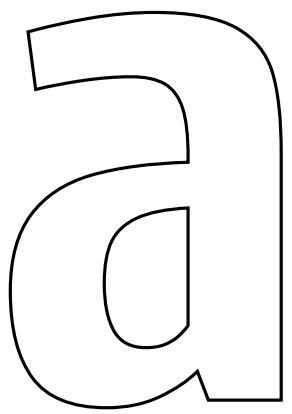
CLASSIC GROTESQUE VARIABLE

- ☞ In a variable font design space, the 28 fonts – comprising weights and widths – can be packaged into one font file. The italics would need to be a separate file, and would reduce 56 total font files down to two.
- ☞ In this file, not only the static instances of weight and width are accessible, but also all of the intervals inbetween.

More specifically, a variable font file contains one set of glyph outlines, which have specifications programmed by the type designer as to how that one set of outlines should behave within the design space.

weight

210

A large, stylized lowercase letter 'a' is centered on the page. It has a thick black outline and a slightly irregular, hand-drawn appearance. The top curve of the 'a' is higher on the left than on the right, and the vertical stem is slightly angled.

width

55

optical size

75

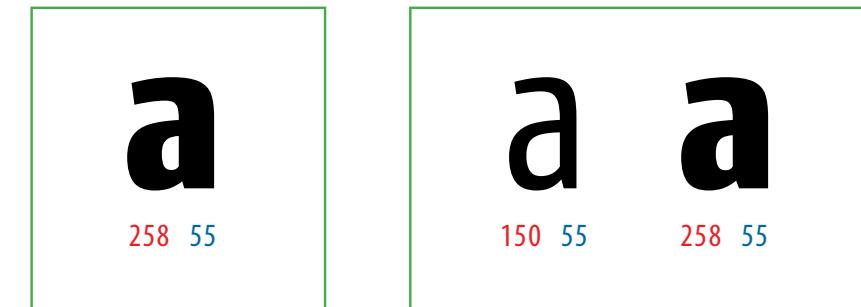
weight

210

a

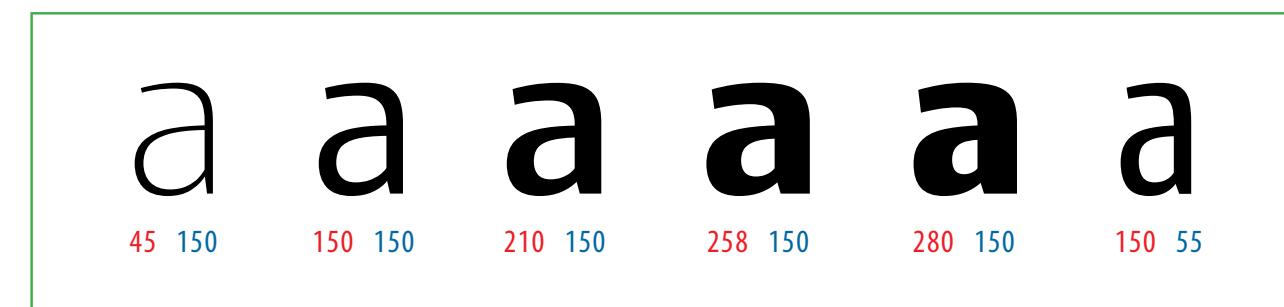
width

55



0 5 POINT TEXT

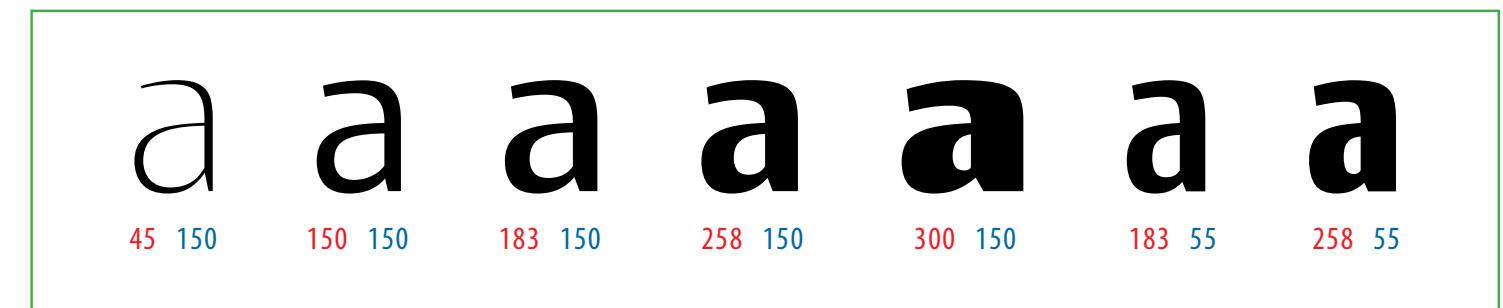
25 6 POINT TEXT



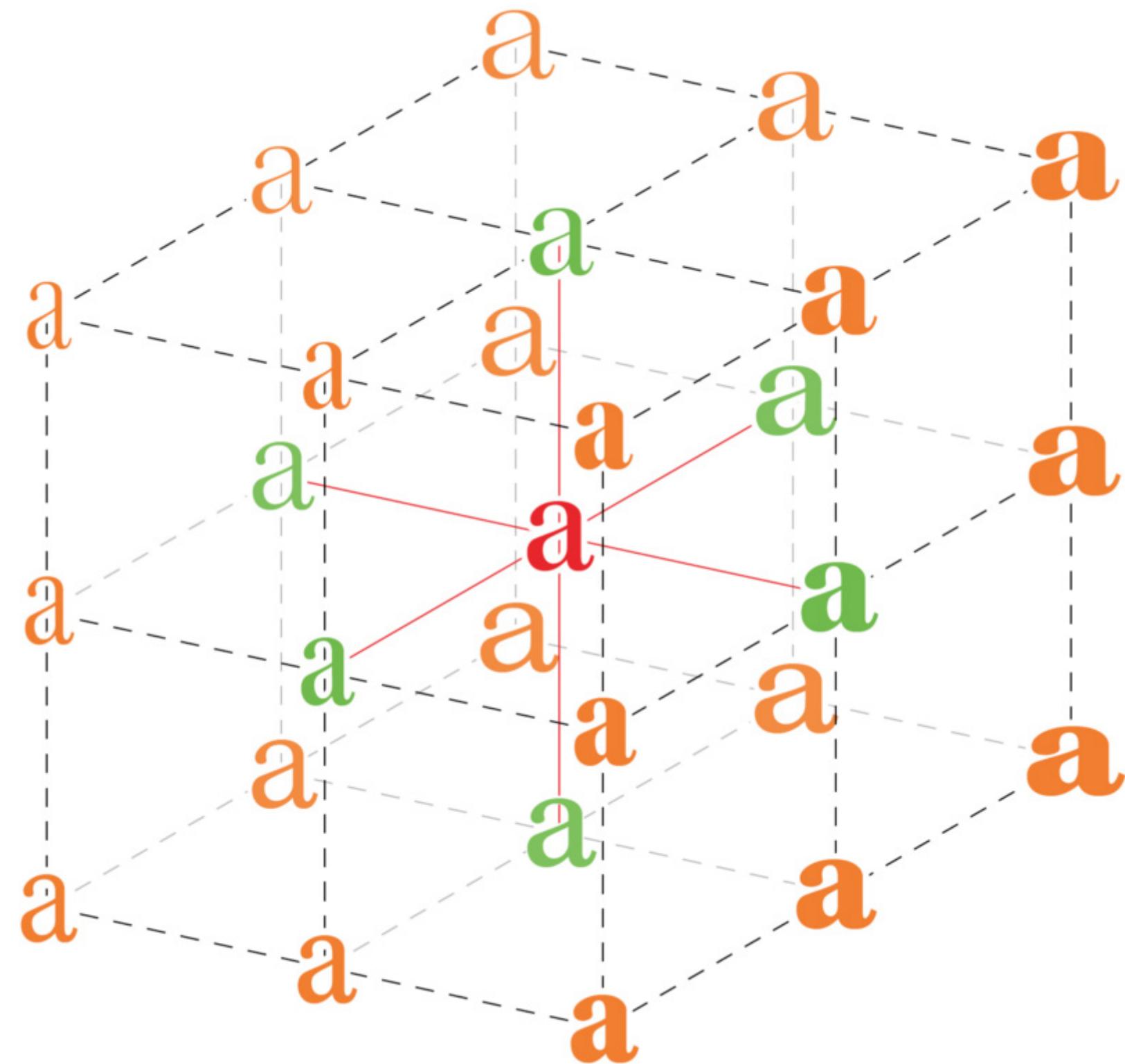
75 12 POINT TEXT

optical size

75



150 HEADLINE POINT SIZES



```
1  <!DOCTYPE html>
2  <html>
3  <head>
4  <meta charset="UTF-8">
5  <style>
6  @font-face {
7      font-family: Muybridge;
8      src: url(MuybridgeGX.woff2);
9  }
10 @keyframes Gallop {
11     from {
12         font-variation-settings: "TIME" 0;
13     }
14     to {
15         font-variation-settings: "TIME" 1000;
16     }
17 }
18 body {
19     font-family: Muybridge;
20     font-size: 320px;
21     animation: Gallop 0.5s linear 0 infinite;
22 }
23 </style>
24 </head>
25 <body>🐎</body>
26 </html>
```

But how are variable fonts useful
to type users today?

What are the benefits and opportunities?

**To answer these questions we
need to do two things:**

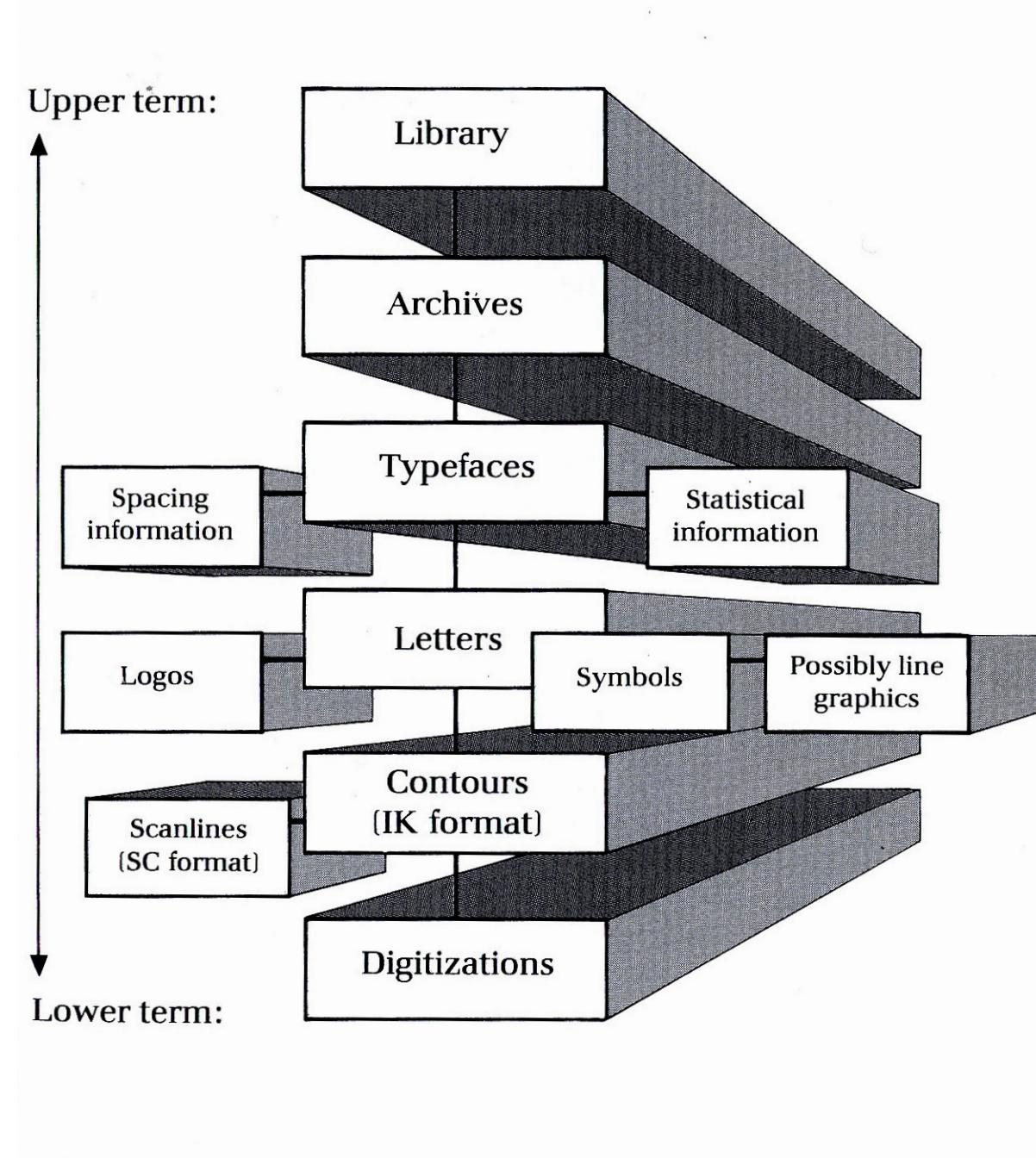
- (1)** Reflect on the history of variability in digital typeface formats; *what motivated variable functionality in these formats?*
- (2)** Reflect on where and how document designers use typeface families today, the technical limitations they face, and what opportunities exist.

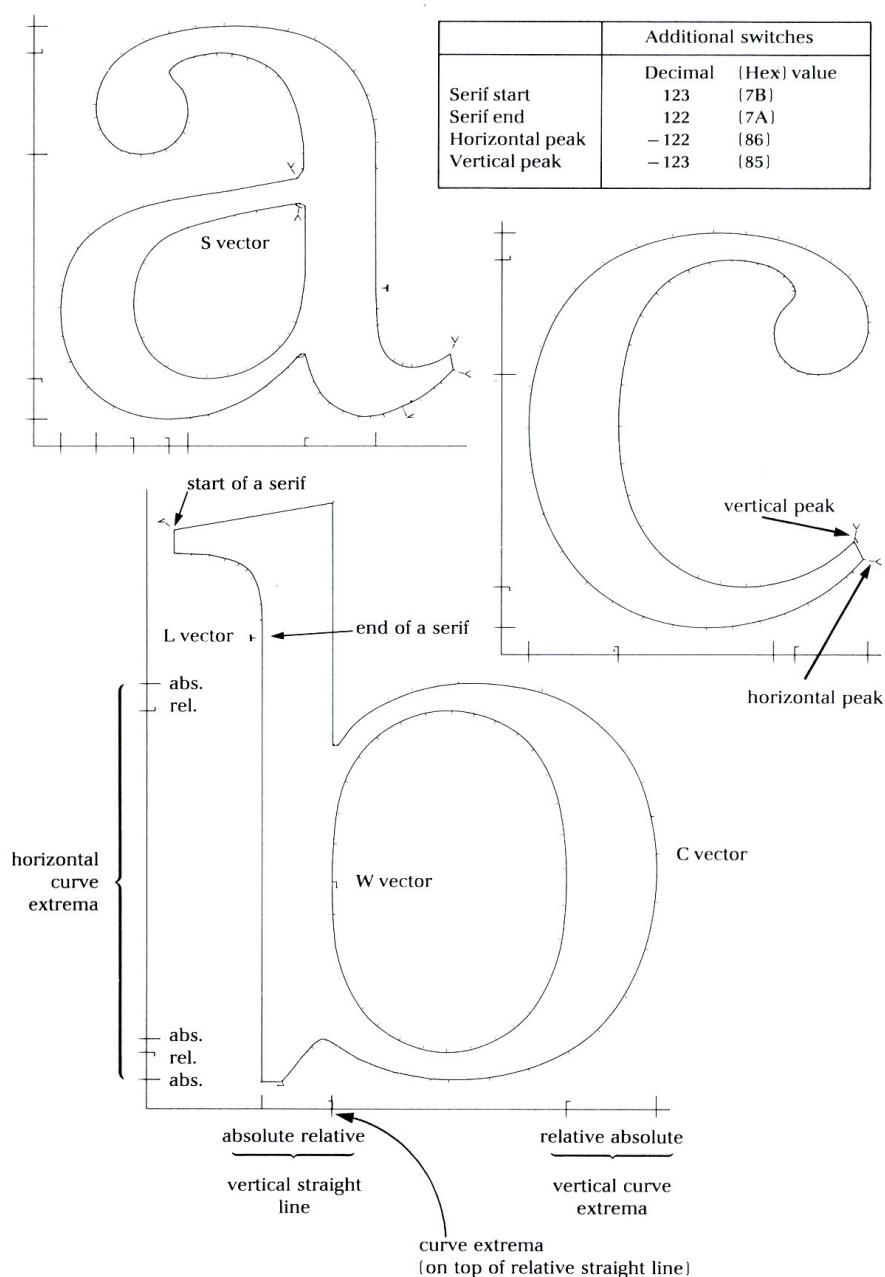
History of variability in digital font technologies

Ikarus; 1972

Developed by Peter Karow as the backbone
of the URW digital typesetting system;

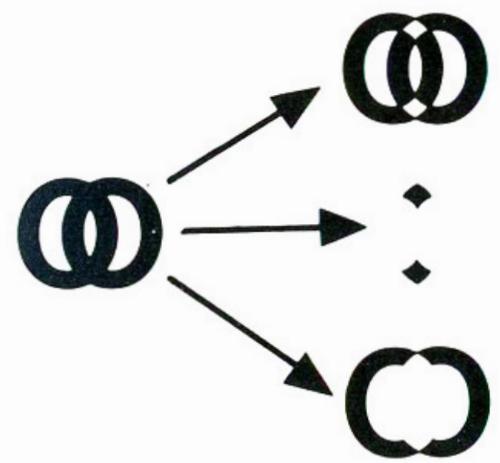
URW, Germany





Additional switches	
Serif start	Decimal (Hex) value
123 [7B]	
Serif end	122 [7A]
Horizontal peak	-122 [86]
Vertical peak	-123 [85]

AN201512.VS		5-MAR-87	PAGE 1
WORDNO.	CONTENT	COMMENT	
1	484	Length of font header	
NAME SECTION			
2	55	Length of name section	
3	825	Number on URW list	
4 - 10	AN201512.VS	File name (ASCII)	
11 - 49	URW-Antiqua 2000 normal	Font name (ASCII)	
50	VS	Data format (ASCII)	
51 - 53	26 2 87	Production date: 26-Feb-87	
54 - 56	26 2 87	Date of last change: 26-Feb-87	
FONT INFORMATION			
57	19	Length of font information	
58	1	Indicator for font	
59	135	Number of characters	
60	720	Cap height (in pixels)	
61	1080	Body size (in pixels)	
62	504	x-height (in pixels)	
63	270	Distance: base line - lower body line (in pixels)	
64	1080	Text line distance for setting (in pixels)	
65	108	Stem thickness (in pixels)	
66	0	Angle of italicisation (in 1/10 degree)	
67	12	Optimum point size for setting (in p)	
68	469	Average character width (in pixels)	
69	139	X-extension of a pixel (in 1/1000mm)	
70	139	Y-extension of a pixel (in 1/1000mm)	
71	1080	Em-resolution in X-direction (in pixels)	
72	1080	Em-resolution in Y-direction (in pixels)	
73	21	Scan indicator of image data	
74	1080	Width of printing window (in pixels)	
75	1080	Height of printing window (in pixels)	
HIERARCHY SECTION			
76	1	No hierarchy section in this format	
CHARACTER INDEX			
77	408	Length of character index	
78	11	LENGTH OF FONT IN PHYSICAL RECORDS	
79	1000	Last word of last record	
80	101	Character number: 1	
81	1	Pointer to record containing start of character	
82	485	Word pointer to start of character	
83	102	Ch. no.: 2	
84	1	Record pointer	
85	622	Word pointer	
86- 88	103 1 842	No., record pointer, word pointer of ch.: 3	
89- 91	104 1 991	No., record pointer, word pointer of ch.: 4	
92- 94	105 1 1145	No., record pointer, word pointer of ch.: 5	



a a
a a
a a
a a

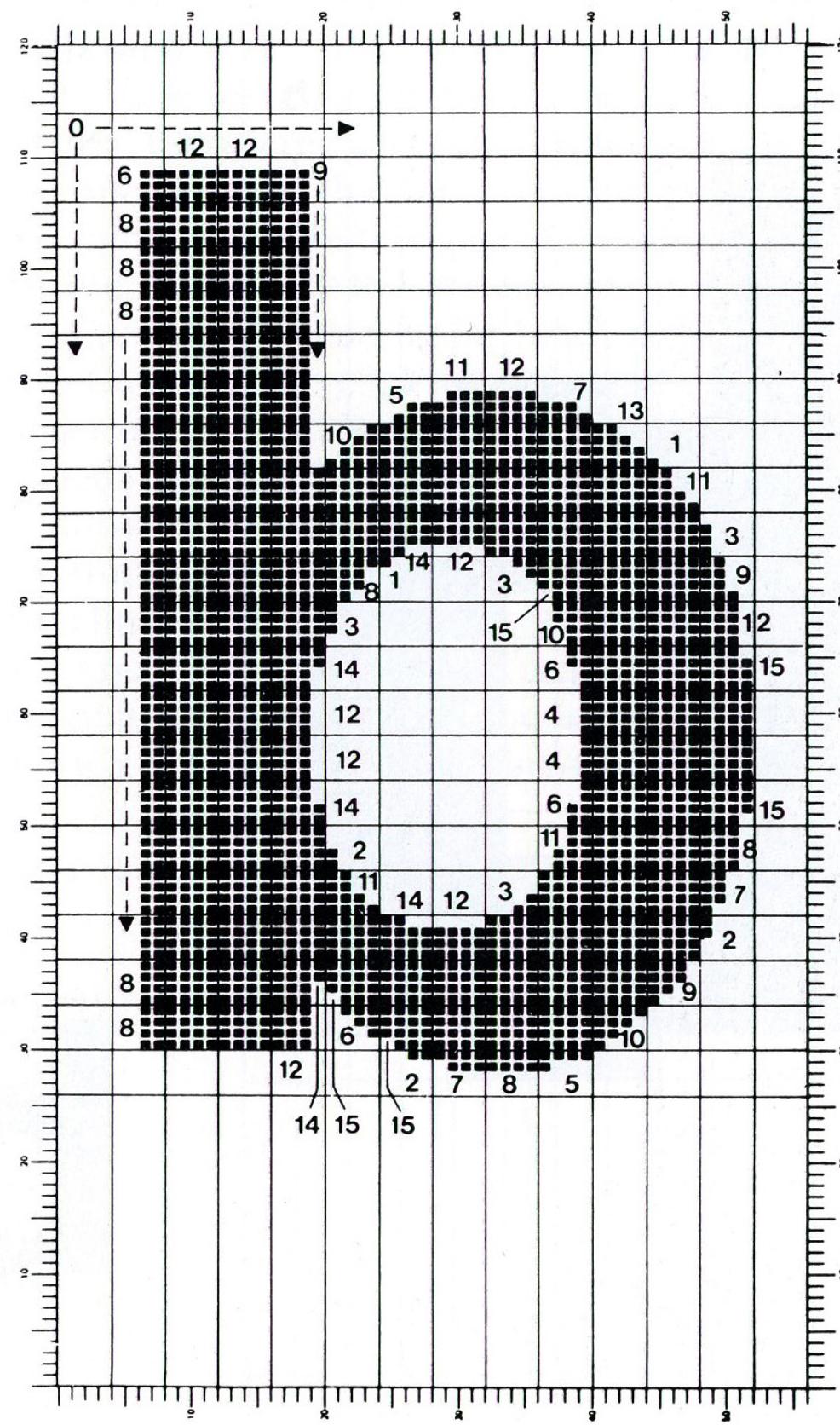
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SIGNS US
GRAPHIC

TROPFEN

FORELLE

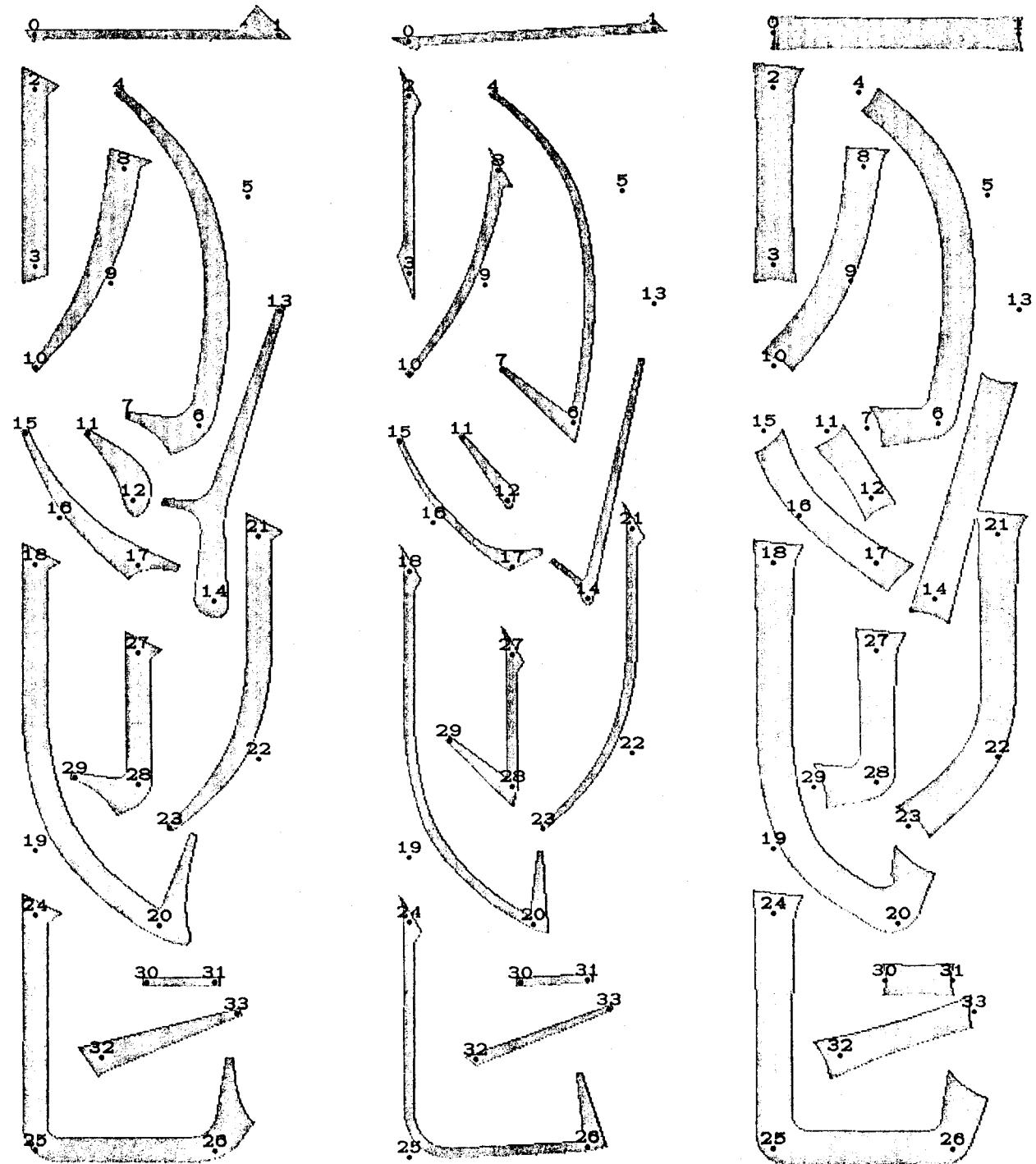
FORELLE



Metafont; 1977

Developed by Donald Knuth for
his TEX typesetting software;

Stanford University, California

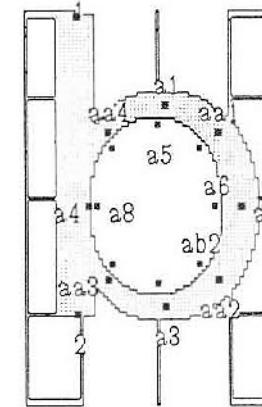
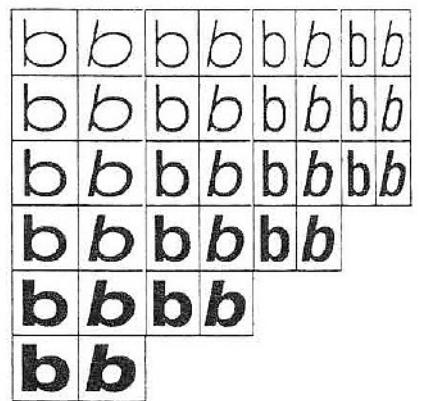
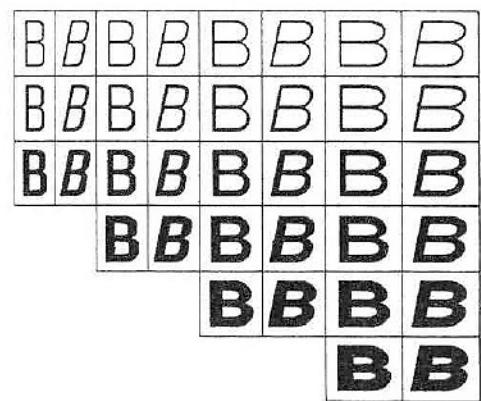
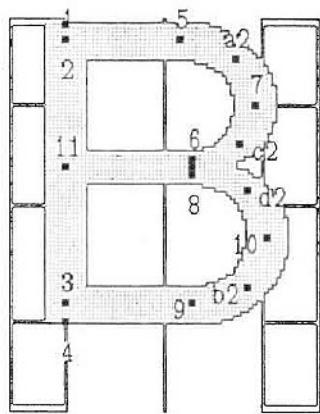


(a) Song (b) Long Son
Figure 9. The basic strokes in all three styles.

(c) Bold

:aight, another for thick
her for the bulbs on let-
at gives the thickness in
e of these measurements
ct circles.

o choices of the pen-size
esirable blotches appear
the stems; and the type
hen its curved stems are
ight ones. A font **cannot**
rtions of the letters run
e meta-fonts will be set
nensions from a smaller
since the proper widths
other; at the moment,
a compatible set of pen
I shed some light on this



```
"The letter B";
call charbegin( 'B, 2, .78, ph, 0, ½[pz, ph]slant);
open;
x1=x2=x3=x4=x11; lft19x1=ucin;
y1=h; y4=0;
new topindent, botaftop, topo/bot, w99;
topindent=round(½r);
w99=⅓[w15, w15];
botaftop=round(⅔[bota9chbar, topo9chbar]);
topo/bot=round(⅔[bota9chbar, topo9chbar]);
r19x10=round(r-ucin+ho); r19x7=r19x10-topindent;
x5=⅓|r19x1, lft19x7|; x9=⅓|r19x1, lft19x10|;
x6=x5=x9;
top11y2=h; y5=y2; bot11y6=0; y9=y6;
new w98, w97;
w98=round(top9chbar-botaftop); call checkpen(98);
w97=round(topo/bot-bota9chbar); call checkpen(97);
top9y5=top9chbar; bot9y8=bot9chbar;
if bot9y6>top9y5 : new w98; w98=w98; new w98;
w98=w98+1; fi;
y7=⅓[bota11y5, top9chbar]; y10=⅓[top11y6, bot9chbar];
y11=y12=chbar; z12=x6;
vpen; vpenwd 1;
w11 draw 2..5;
draw 8..9;
w98 draw 11..12;
hpen; hpenht 1;
w10 draw 1..4;
call 'a ngarc(5,7,w11,w10);
call 'b ngarc(9,10,w11,w10);
call 'c ngarc(8,7,w98,w10);
call 'd ngarc(8,10,w97,w10);

% italic corr high for condensed
% indent top even on condensed
% a slow-grow pen for middle bar
% bottom of top outer arc
% top of lower outer arc
% based on counter widths
% used for top and bottom arcs
% to control thinning
% of arcs at center
% ½ of counters
% height of bar same as cap H
% top level
% bot level
% mid level
% stem
% upper upper
% lower lower
% lower upper
% upper lower
```

```
"The letter b";
call charbegin( 'b, 2, 0.65, ph, 0, ¾px-slant);
x1=x2=lchoff;
y1=h; y2=0;
hpenht 1; hpen;
w17 draw 1..2;
call 'a smallbowl(left).

% stem
```

PostScript Type 1; 1984

Developed as the outline font format to work within Adobe's PostScript page description language, which is at the core of the Adobe document design applications;

Adobe Systems, California

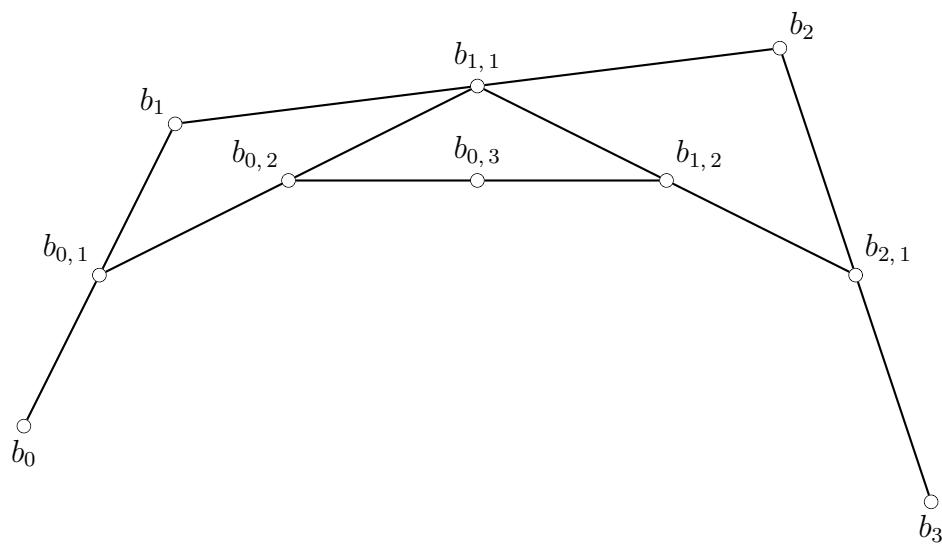


Figure 3.18: A de Casteljau diagram

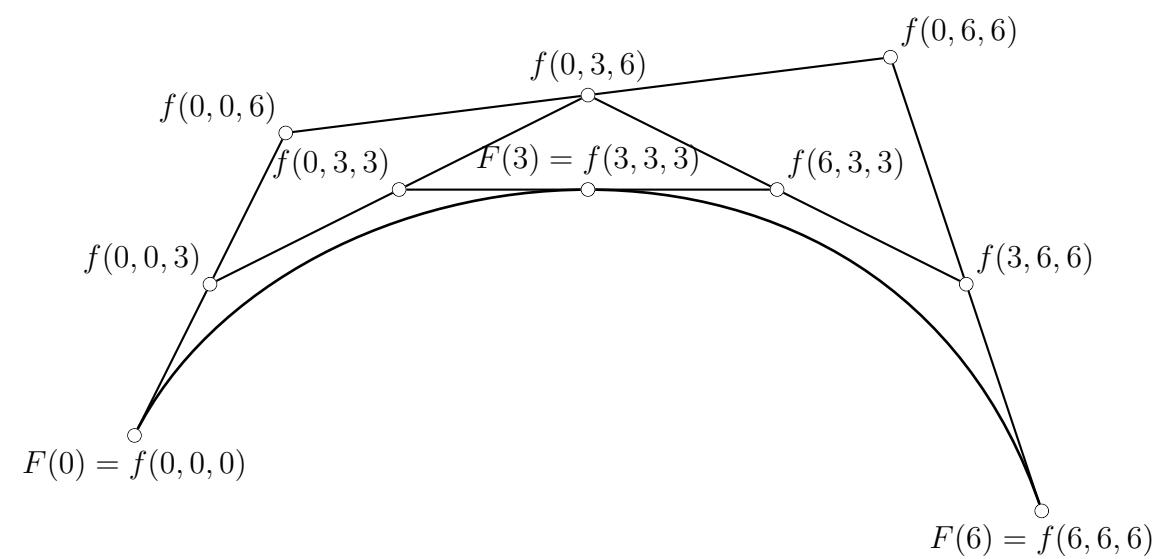
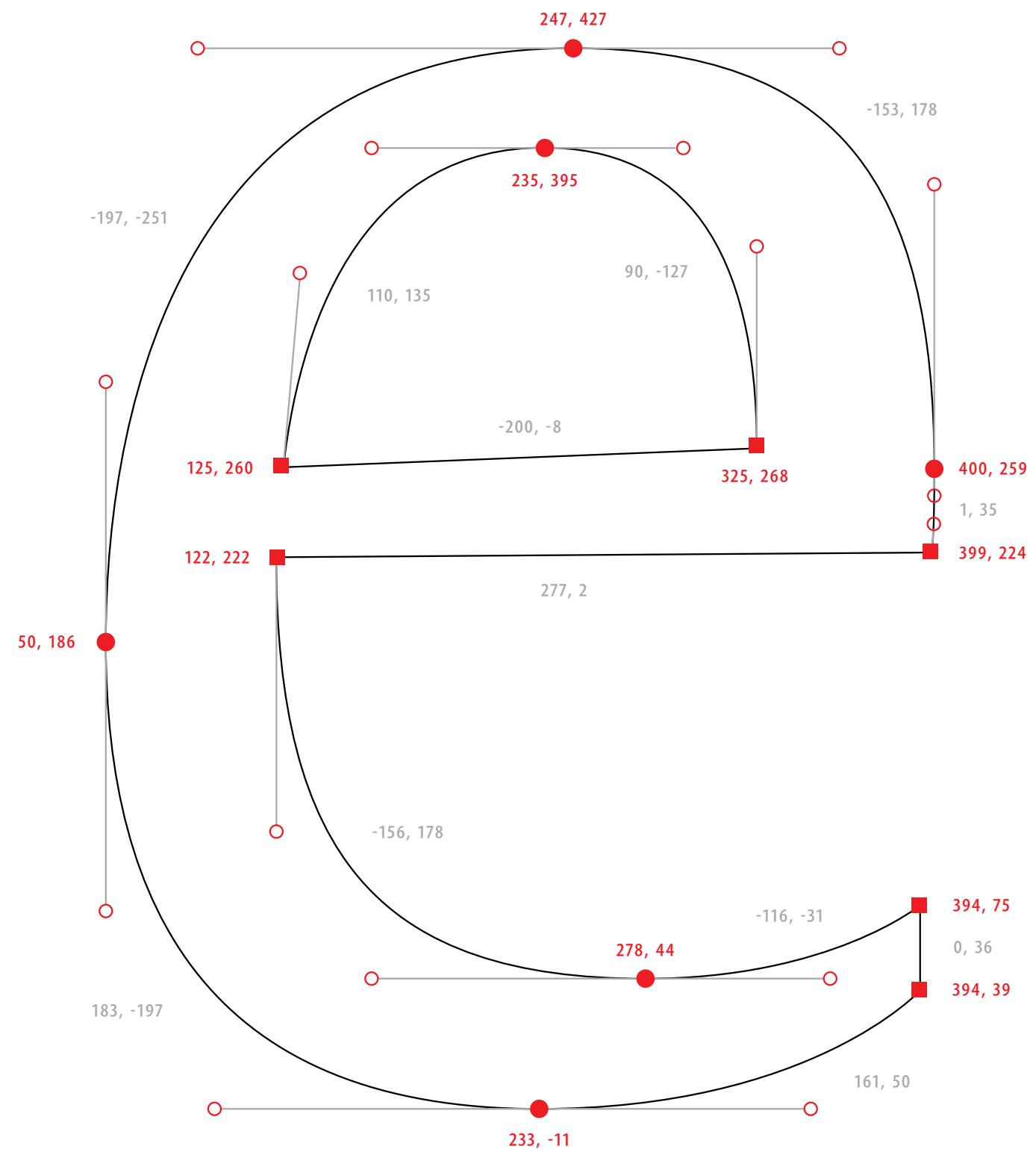


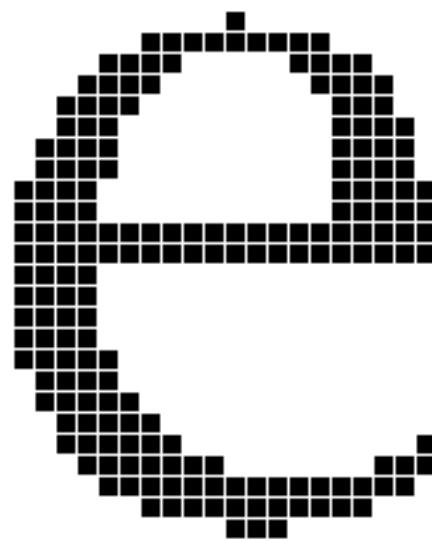
Figure 3.19: The de Casteljau algorithm for $t = 3$



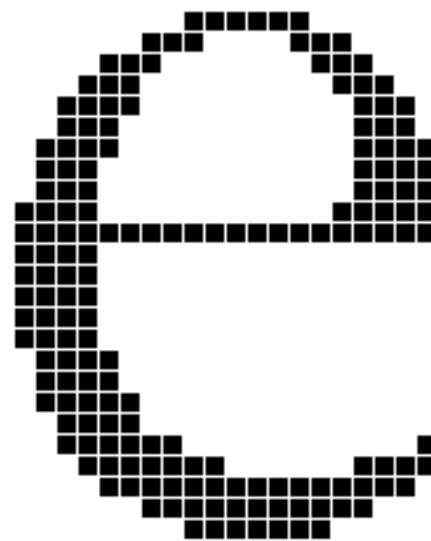
TrueType; 1991

A system-level font format intended to provide better functionality within operating system environments: efficiency in font data storage, ability to instruct letterform properties (hinting);

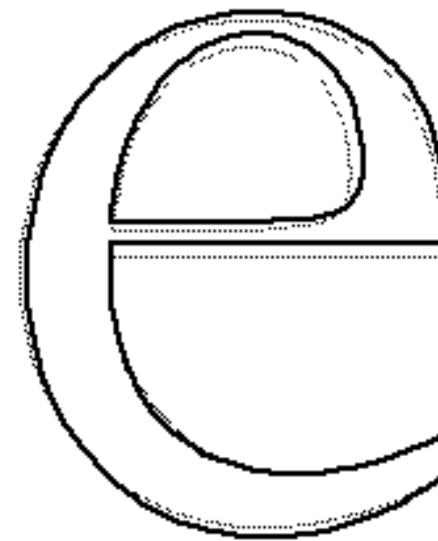
Apple & Microsoft, California/Seattle



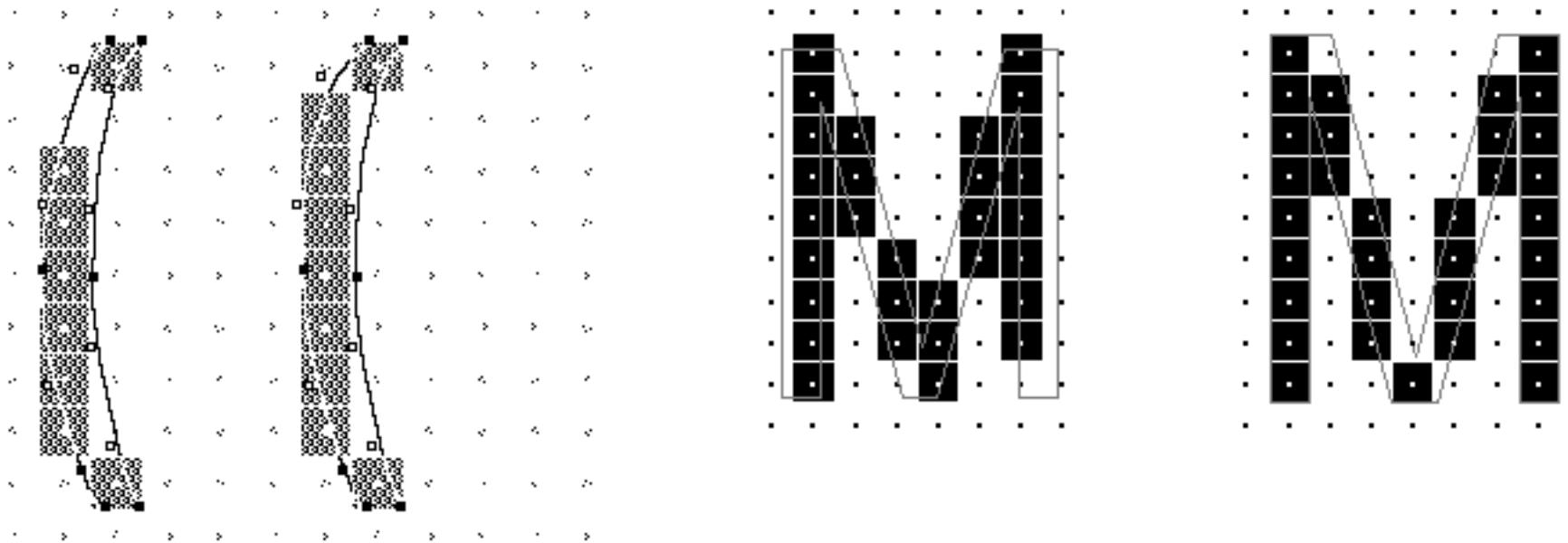
(1) Uninstructed



(2) Instructed



(3) Hinted outline



Of the greatest **and most useful** of all
with too much complacency. *He seem*
mind as the use of the go-cart in lea

Figure 7b. Alignment across a family. PostScript versions of Helvetica, **+**
and Helvetica Bold Italic rendered by Adobe Type Manager v3.01 at 12

Of the greatest **and most useful** of
with too much complacency. *He se*
mind as the use of the go-cart in h

Georgia
Georgia
Georgia
Georgia

9px

10px

11px

12px

Georgia
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Georgia
Georgia

Adobe Multiple Master; early 1990s

Developed by Adobe's type team for use
within Adobe page layout software and PDFs;

Adobe Systems, California

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GGGGGG



The graphic signs called letters
are so completely blended with
the stream of written thought
that their presence therein is as

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are so completely blended with
the stream of written thought
that their presence therein is as

The shapes of letters
The shapes of letters

*Above: The weight of Minion has been
increased to compensate for ink spread in
reversed type. Below: Thirteen instances
showing a sampling of the dynamic range
of the Minion multiple master weight axis.*

Apple GX variations; 1991

Developed by Apple as a component of the TrueType GX format, an extension of the TrueType format to work within Apple's QuickDraw GX rendering environment;

Apple Inc., California

So why is it coming back?

The short answer is: minimizing webfont bandwidth.

Google benefits when **websites load faster**, so is keen to promote technologies that make this happen. **As we know**, webfonts can be a significant load. Since a GX font offering multiple weights is only a little larger than a standard regular font, **it saves data as soon as the bold is used**. The savings increase the more one exploits the variations in the font. **Google**, measuring savings in milliseconds, is very keen on savings on this scale.

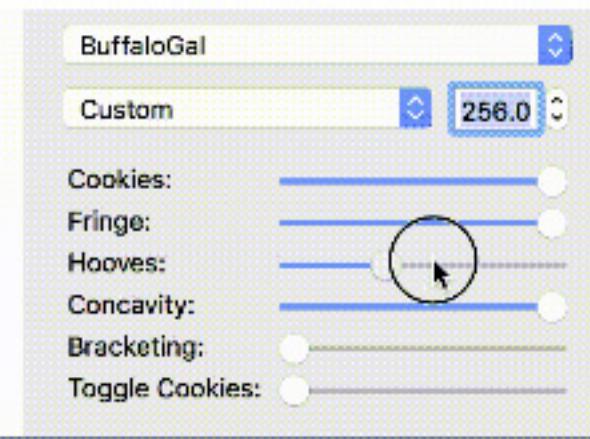
Adobe MM

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e e e e e e e

Apple GX

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Variations!



Buffalo Gal was one of the first GX sample fonts, built more than 25 years ago. This demo shows the limitless possibilities of variables, beyond styles and weight.

OpenType; 1997

The second major collaboration between two font tech leaders produced a cross-platform format that bundled the best of TrueType and PostScript Type 1;

Adobe Systems & Microsoft, California/Seattle

POSTSCRIPT EXPERT FONTS

Garamond Regular

Garamond Expert Regular

Garamond Alt Regular

OPENTYPE PRO FONTS

Garamond Pro Regular


```
feature locl {  
    script latn;  
  
    language NLD exclude_dflt;  
    lookup DutchIJ {  
        sub IJ by IJ.dutch;  
    } DutchIJ;  
}  
} locl;
```

قِيَمٌ مَعَ الْأَبْحَاثِ

sub beh-ar by beh-ar.init;
sub teh-ar by teh-ar.init;
sub theh-ar by theh-ar.init;
sub jeem-ar by jeem-ar.init;
sub hah-ar by hah-ar.init;
sub khah-ar by khah-ar.init;
sub seen-ar by seen-ar.init;

مع المحب المعميق

Randomization

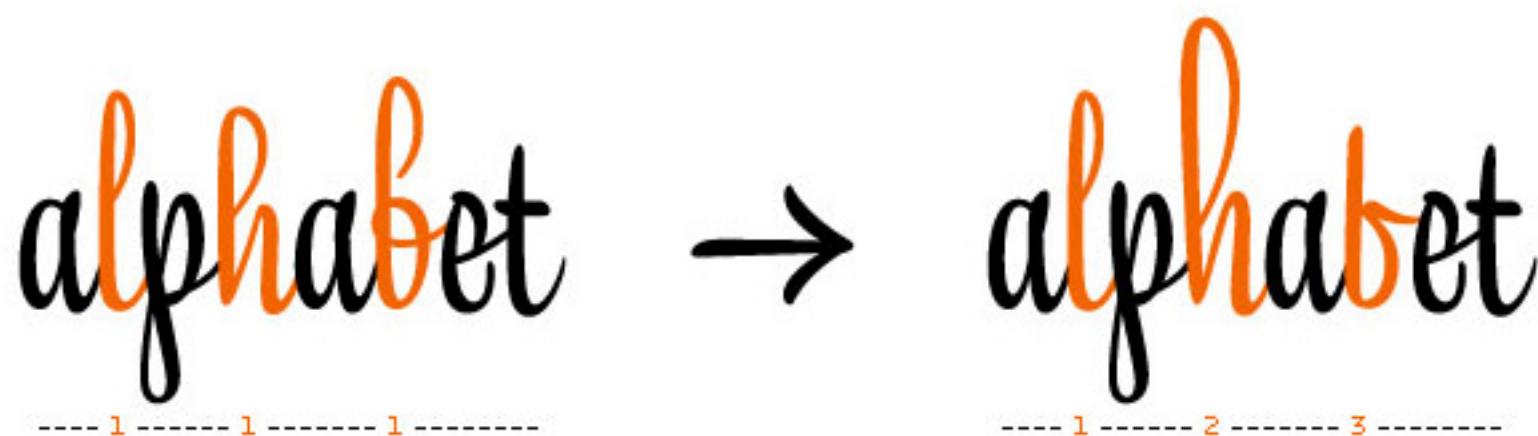
EXAMPLE #1: ONLY 1-2-3 ROTATOR — LUCKY SHOT WITH 'L'



The word "stylistically excellences" is written in a black cursive font. Orange highlights are placed on the letters 'l', 'i', 't', 'i', 'c', 'a', 'l', 'l', 'e', 'x', 'c', 'e', 'l', 'l', 'e', 'n', 'c', 'e', 's'. The letter 'l' at the beginning of "stylistically" has a long vertical stroke.

1 -- 2 - 3 -- 1 - 2 - 3 - 1 - 2 - 3 - 1 -- 2 - 3 - 1 ---- 2 -- 3 -- 1 - 2 - 3 - 1 - 2 -- 3 -- 1 -- 2 -- 3

EXAMPLE #3: A SYSTEM WHICH ONLY SWAPS COMPARABLE ASCENDERS



Two instances of the word "alphabet" are shown side-by-side. The first instance is in a black cursive font, and the second is in an orange cursive font. Below each word is a dashed horizontal line with three orange numbers (1, 2, 3) indicating the position of ascenders. In the first word, the ascenders are at positions 1, 1, and 1. In the second word, the ascenders are swapped to positions 1, 2, and 3, demonstrating a swap of comparable ascenders.

TYPE AND COLOR DATA VALUES

c+67+22+39+100+43+68+12+5+33+82



controls grid increments

TURN ON "STYLISTIC ALTERNATES"



Width automatically adjusts to fill the circle,
based on number of values provided

Working with variable fonts today

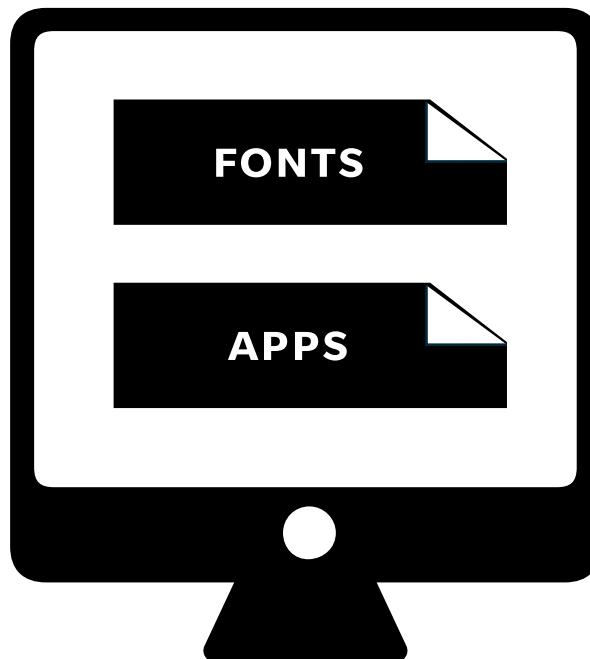
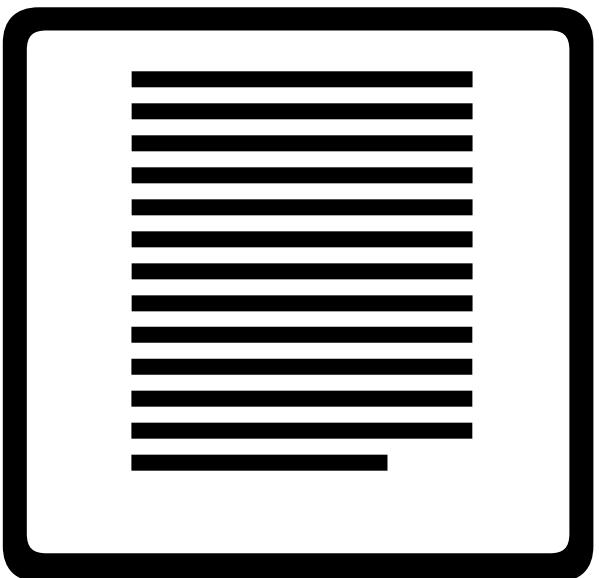
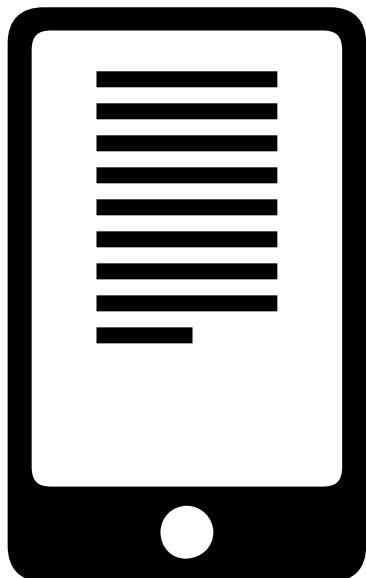
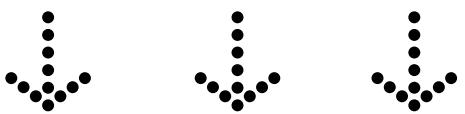
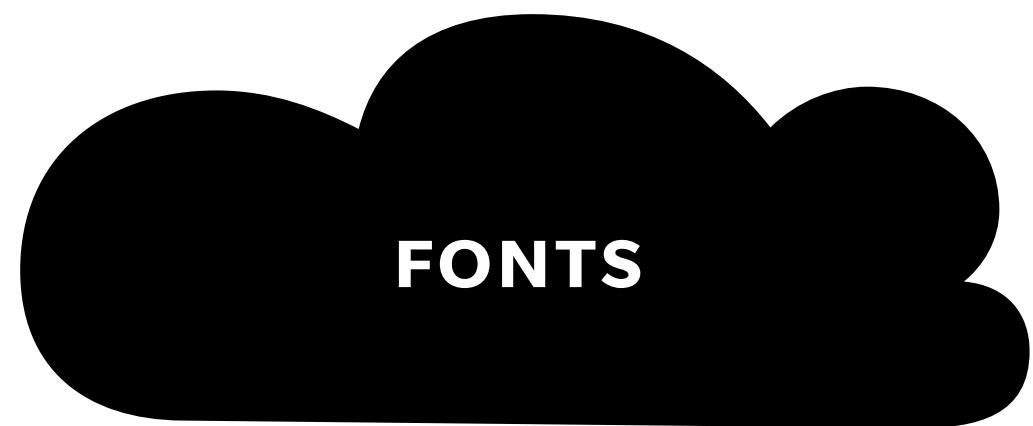
A major difference between the usefulness of variable digital font formats of the past and that of today is the shift from the dominance of digital typefaces being used to compose static printed matter, towards digital typefaces being heavily used and influenced by non-static, digital environments (websites, user interfaces, experiential environments on screen outputs.)

A major difference between the usefulness of variable digital font formats of the past and that of today is the shift from the dominance of digital typefaces being used to compose **static printed** matter, towards digital typefaces being heavily used and influenced by **non-static, digital** environments (websites, user interfaces, experiential environments on screen outputs.)

There is one key difference between these two composition spaces:

Typeface used for *print* applications are localized to the native device being used for composition, from which static copies are output by an output device (e.g. a printer).

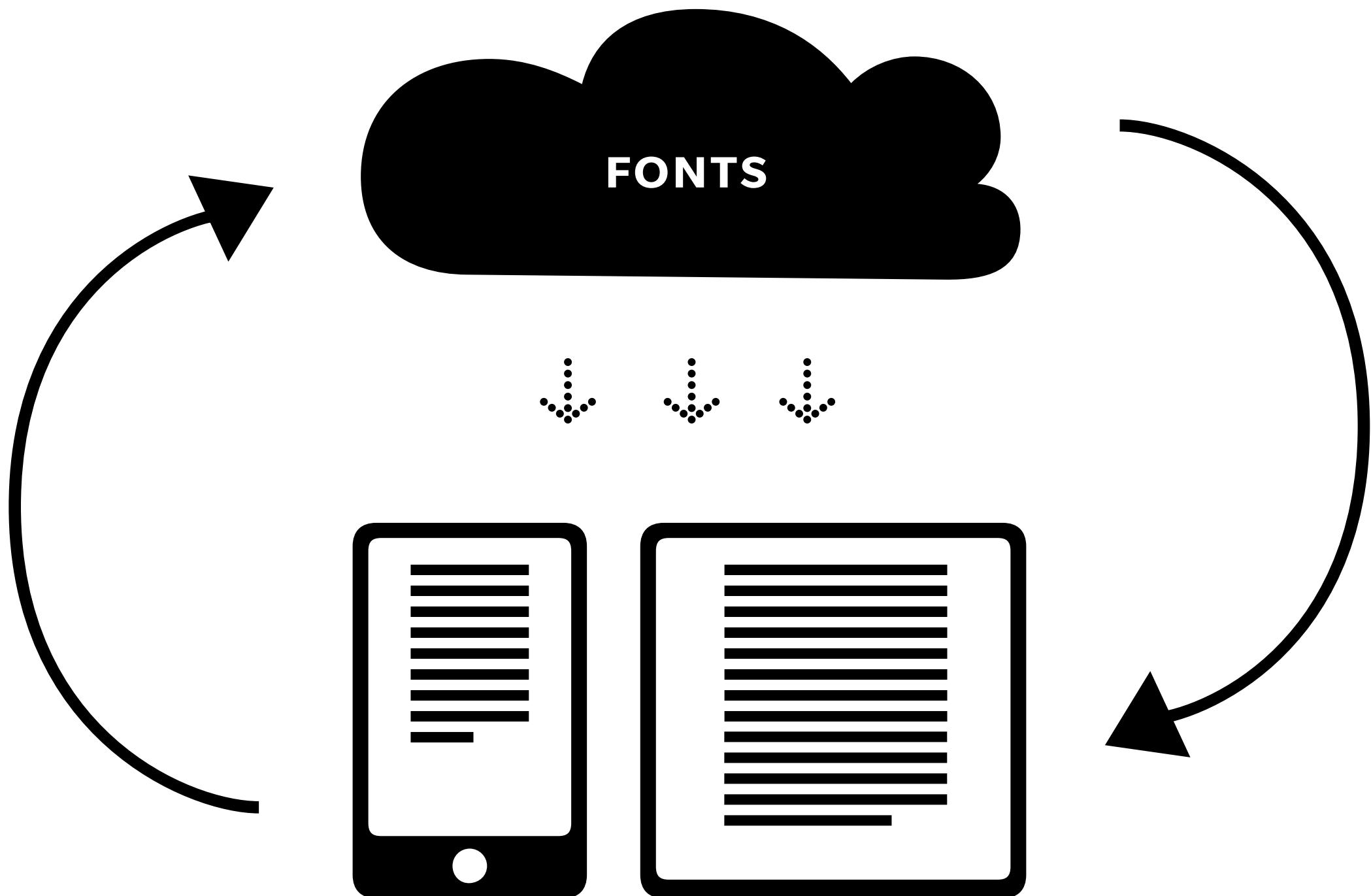
Typefaces used for digital screen documents must be served each time the given text is accessed by a user.



PRINTERS

LASER CUTTER

3D PRINTER



This means that when a typeface and all of its weights are used for print, all of the weights and widths are stored on one composition device, as they are output by a separate device.

For typography on screen documents, each style, weight or width must be loaded each time the file is accessed, which can really slow down loading times.

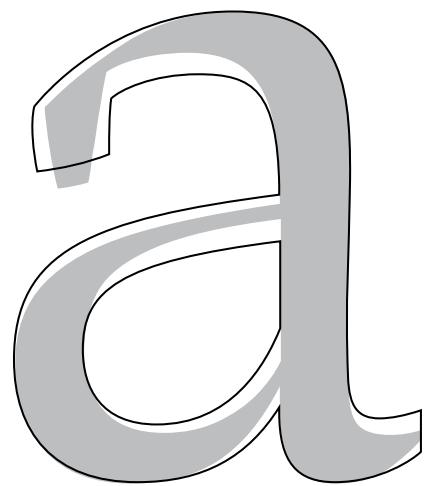
The following case study demonstrates this by comparing the typographic palettes of *the Guardian* and Google Maps:

(1) WEIGHT



A stylized lowercase letter 'a' where the stroke thickness varies along the curve of the bowl. The stroke is thickest at the top and bottom curves and thinnest at the middle.

(2) OPTICAL SIZE



A stylized lowercase letter 'a' where the overall size appears larger than the one in (1). The bowl is wider and the stem is thicker, giving it a more robust appearance.

(3) WIDTH



A stylized lowercase letter 'a' where the bowl is extremely wide compared to the stem. The bowl's width is nearly equal to the height of the letter.

The Guardian

Guardian Agate Sans

THE UNFUNDED DEBT HAS BEEN STATED AT £13, 927,589:2:2. But the expense occasioned by the war did not end with the conclusion of the peace; SO THAT, THOUGH ON THE 5TH OF JANUARY 1764, the funded debt was increased (partly by a new loan, and partly by funding a part of the UNFUNDED DEBT) TO £129, 586,789:10:13 $\frac{1}{4}$, there still remained (according to the very well informed author of Considerations on the TRADE AND FINANCES OF GREAT BRITAIN) AN unfunded debt, which was brought to account in that and the following year, of £9,975,017:

Newton Abbott 13:20 Thursday 5 March, 2015
Pericles Financial Services Bridport Handicap Hurdle (Jockey Club Gr.
 £11000.00 added, 4yo plus, 2m 6f, Class 3 WINNER £6393 2ND £2584
 15 runners GOING: Soft

NO.	FORM	HORSE	AGE	WT	TRAINER	JO
1	411-007	Yankee Del (IRE)	27	7	11-12	Claude Garam Ma
2	32-3U53	Adams & Eves (IRE)	27	6	11-9 pt	R Granjon Ni
3	011-012	Waterboys 52	6	11-9	Johnny Bask T	S
4	650-0P2	Sulk (IRE)	21	7	11-7 p	Dickie Aust Br
5	2321-6	Rainy Trout (IRE)	71	6	11-5 t	Billie Caslon Da
7	4-15512	Danielle Emil (IRE)	16	8	11-4	Mrs Catherine Mi
8	4-21466	Library Card (IRE)	35	6	11-3 p	J T Vergen A
9	32/41-9	Rude Boys (IRE)	52	9	11-1 p1	D Right M

Guardian Agate Sans 1, 6pt, Guardian Agate Sans 1D, 5pt

Designed by
 Paul Barnes and
 Christian Schwartz, 2009
 40 styles
 2 weights with italics
 in 4 grades
 2 additional weights
 with italics
 All in standard and
 duplexed versions
 Tabular lining figures
 Fractions
 Superscript/subscript

Compensating for the worst
 possible printing conditions,
 Guardian Agate Sans is
 designed for maximum
 legibility at 6 point and
 below on newsprint.

The family features four
 subtly different weights,
 or "grades", allowing users
 to find the perfect weight
 for a particular situation,
 from 1, the lightest, to 4,
 the heaviest. The Medium
 weight can be used for
 reversing out of a dark
 background, subheads, and
 other places where an extra
 level of hierarchy is needed.

Guardian Agate Sans
 also features two kinds of
 bolds. The standard Bolds
 are wider than the Regulars,
 and the Duplex Bolds which
 are exactly the same widths
 as the Regulars, useful for
 classified ads and stock
 listings where line length is
 at a premium.

12: 2 15/44D. IN 1764, THEREFORE, THE PUBLIC
 debt of Great Britain, funded and unfunded
 together, amounted, according to this author, to
 £139,561,807:2:4. THE ANNUITIES FOR LIVES,
 too, which had been granted as premiums to the
 subscribers to the new loans in 1757, estimated at
 FOURTEEN YEARS PURCHASE, WERE VALUED AT
 £472,500; and the annuities for long terms of
 years, granted as premiums likewise, in 1761
 AND 1762, ESTIMATED AT TWENTY-SEVEN AND
 a-half years purchase, were valued at £6,826,
 875. During a peace of about seven years

JAGUAR E-TYPE 2+2 series II 4.2,
 \$45000 ONO 2 door, one owner,
 1969. 50,000 miles, manual, Petrol,
 Metallic Yellow. Full service history.
 Leather interior. Wire wheels. Must
 view to believe. CONTACT VIA EMAIL
 JENSEN INTERCEPTOR 6.3
 \$21000 Very Low mileage;
 12630 miles on clock. Chassis
 Number 893/4137. First registered
 May 1972, tax exempt, pro
 dry stored, and with only 2
 owners, the first owning for
 Finished in the original light
 metallic with full original
 leather interior. Must sell q

Guardian Agate Sans 2, 6pt, Guardian Agate Sans 2D, 5pt

CONTINUANCE, THE PRUDENT AND TRULY
 patriotic administration of Mr. Pelham was not
 able to pay off an old debt of six millions. During a
 WAR OF NEARLY THE SAME CONTINUANCE, A
 new debt of more than seventy-five millions was
 contracted. On the 5th of January 1775, the
 FUNDED DEBT OF GREAT BRITAIN AMOUNTED
 to £124,996,086, 1:6 $\frac{1}{4}$ d. The unfunded,
 exclusive of a large civil-list debt, to
 £4,150,236:3:11 $\frac{1}{4}$. BOTH TOGETHER, TO
 £129,146,322:5:6. According to this account,
 the whole debt paid off, during eleven years of

Asia Pacific

	\$1 BUYS	CHANGE	%	52 WR
Japanese Yen	97.31500	-0.24100	-0.25	103.22
Australian Dollar	1.10430	+0.00700	+0.61	1.12
New Zealand Dollar	1.25290	+0.01330	+1.07	1.29
Hong Kong Dollar	7.75480	0.00000	+0.00	7.76
Singapore Dollar	1.27840	+0.00100	+0.07	1.28
Taiwanese Dollar	29.97700	+0.02700	+0.09	30.20
Thai Baht	31.65500	+0.23000	+0.73	31.52
Malaysian Ringgit	3.29950	+0.01400	+0.43	3.28
Indonesian Rupiah	10490.00000	-23.00000	-0.22	10513.00
South Korean Won	1123.11000	+3.46000	+0.31	1160.75
Philippine Peso	43.84000	+0.07000	+0.16	43.91
Vietnamese Dong	21075.00000	-18.00000	-0.09	21245.00
Chinese Yuan	6.12580	0.00000	-0.01	6.36

Guardian Agate Sans 3, 6pt, Guardian Agate Sans 3D, 5pt

PROFOUND PEACE, AMOUNTED ONLY TO £10,415,
 476:16:9 $\frac{1}{4}$ d. Even this small reduction of debt,
 however, has not been all made from the savings
 OUT OF THE ORDINARY REVENUE OF THE STATE.
 Several extraneous sums, altogether independent
 of that ordinary revenue, have contributed towards
 IT. AMONGST THESE WE MAY RECKON AN
 additional shilling in the pound land tax, for
 three years; the two millions received from the
 EAST-INDIA COMPANY, AS INDEMNIFICATION
 for their territorial acquisitions; and the one
 hundred and ten thousand pounds received

SEGMENT DIST ELEV SPEED POWER VAI

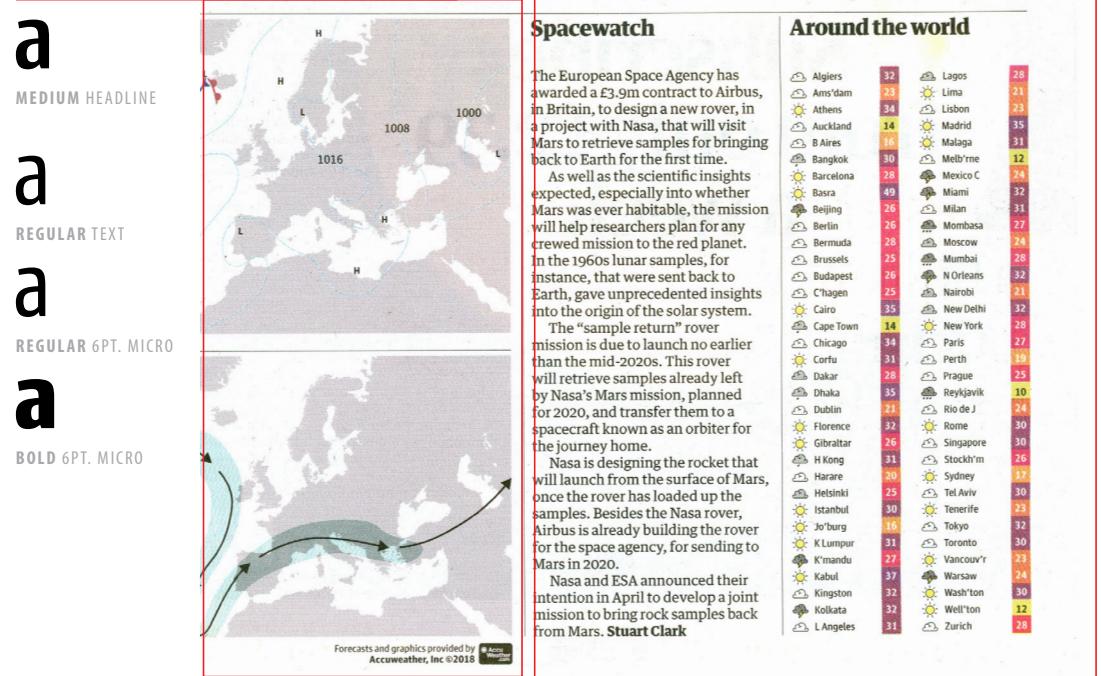
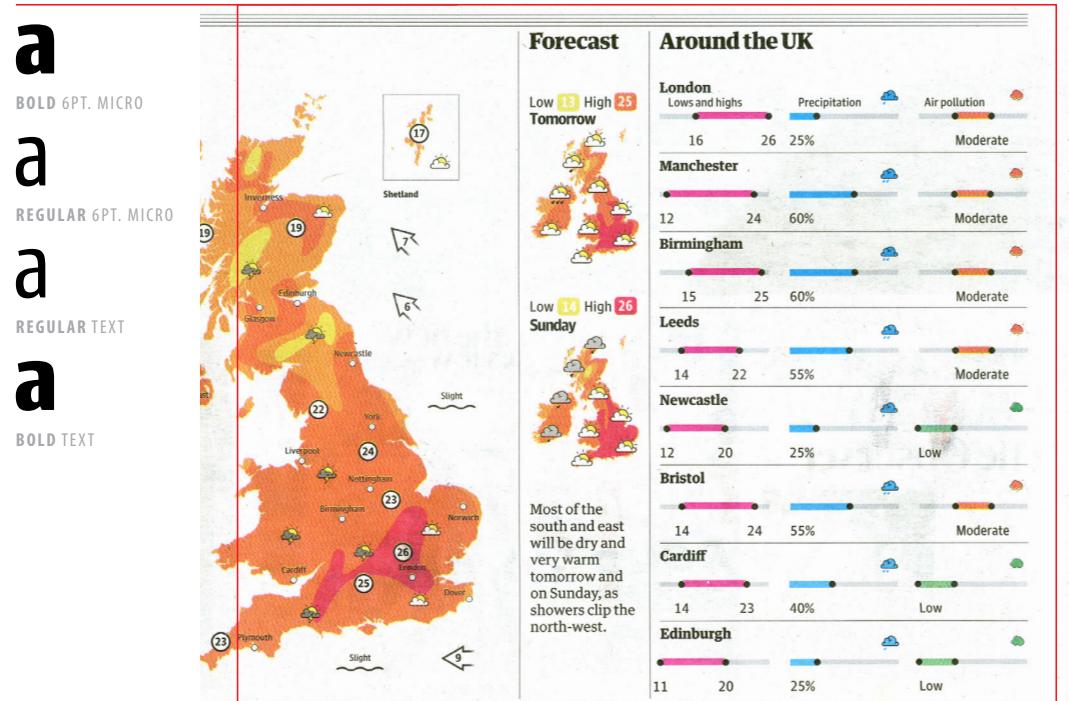
Barrières Climb	1.1mi	315ft	13.6mi/h	305W	97
Descente	1.6mi	527ft	18.4mi/h	148W	-
Le Gour Climb	1.8mi	308ft	12.8mi/h	232W	66
Rue Du Coquillon	0.7mi	314ft	11.7mi/h	165W	52
Col d'Ey	3.3mi	953ft	8.9mi/h	289W	79
Col d'Ey	3.4mi	960ft	9.0mi/h	288W	79
Descente	3.2mi	1009ft	24.1mi/h	203W	-
Col d'Ey					
Barrières Climb	1.6mi	533ft	8.3mi/h	263W	85
Descente Route d'Entrechaux	2.2mi	382ft	37.0mi/h	360W	-

Guardian Agate Sans 4, 6pt, Guardian Agate Sans 4D, 5pt

IN 1755, BEFORE THE BREAKING OUT OF THE LATE
 war, the funded debt of Great Britain amounted to
 £72,289,675. On the 5th of January 1763, at the
 CONCLUSION OF THE PEACE, THE FUNDED DEBT
 amounted debt to £122,603,336:8:2 $\frac{1}{4}$. The
 unfunded debt has been stated at £13,927,
 589:2:2. BUT THE EXPENSE OCCASIONED BY THE
 war did not end with the conclusion of the
 peace; so that, though on the 5th of January
 1764, THE FUNDED DEBT WAS INCREASED
 (partly by a new loan, and partly by funding a
 part of the unfunded debt) to £129,586,789:

POS	COUNTRY	INT. GOALS	CAPS	GOALS PER GAM
1 Abby Wambach	F USA	183	228	0.776
2 Mia Hamm	F USA	158	275	0.57
3 Christine Sinclair	F/AM Canada	155	224	0.69
4 Kristine Lilly	F/M USA	130	352	0.36
5 Birgit Prinz	F Germany	128	214	0.59
6 Julie Fleeting	F Scotland	116	120	0.97
7 Patrizia Panico	F Italy	110	204	0.54
8 Elisabetta Vignotto ¹	F Italy	107	110	0.97
9 Sun Wen	F China PR	106	152	0.69
10 Michelle Akers	F/M USA	105	153	0.68
11 Carolina Morace ²	F Italy	105	153	0.68
12 Han Duan ³	F China PR	101	188	0.53

Guardian Agate Sans Medium/Black, 6pt Guardian Agate Sans Medium/BlackD, 5pt



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2

The World Cup has united the nation: enjoy it while it lasts

Gaby Hinsliff

← Continued from front



England's past few World Cup runs have been all about expectation, followed by sour inquisitions when the team failed to meet it. But this one was made magical by the fact that we no longer expected anything. We'd resigned ourselves to being rubbish again and then somehow miraculously managed not to be, which is why defeat, when it came, was far once more sad than enraged. Like the freak June heatwave, it has had that genuinely dreamlike quality: a sense that any minute now we're going to wake up, because this can't be real.

Summers aren't normally like this. Football isn't normally like this. The only thing resolutely living down to expectations now is politics, but the blessed respite of not having to think about that while the football was on was a gift in itself. Even people who don't give a stuff about sport normally have been sucked in, because like the 2012 Olympics it was about much more than sport.

Fandoms can be exclusive at times, resenting those who jump on the bandwagon. But this tournament has been different. As manager Gareth Southgate said, his was a diverse squad in which kids from every race and background can see themselves. But the inclusivity doesn't stop there. Something about Southgate himself, tenderly hugging his young players and earnestly discussing their feelings, made it all right for those normally put off by all the testosterone.

Here was more than one definition of Englishness: St George's flags and God Save the Queen for some, but also waistcoats and self-deprecating jokes and pictures of the team playing like big kids on blow-up unicorns in a swimming pool. It's this kind of English identity that has lately become lost in the shouting, something elastic and generous enough to be whatever the English need it to be.

But if the football really didn't move you after all this, then this extraordinary summer has also given us the British cave-divers in Thailand. Rick Stanton and John Volanthen were middle-aged men you wouldn't look twice at in a crowd, yet possessed of such extraordinary skill and valour that a nation glowed with borrowed pride when they helped turn what looked like inevitable disaster into success. Both the rescue effort and the football were a reminder of the astonishing power of teamwork, of humility and mucking in rather than letting egos run rampant.

And that spirit of togetherness was infectious. How often do 30 million of us gather around the telly all at once? Yet the semi-final lured even surly teens from their bedrooms to the family sofa, and gave little ones the illicit thrill of staying up long past bedtime. For once, the devices we're used to blaming for stressed and fragmented lives helped make it an even more genuinely collective experience. Family WhatsApp groups pinged like crazy through the match, strangers shared every tense moment on Twitter.

And when Kieran Trippier scored, prompting thousands at open-air screenings to hurl their drinks into the sky, images of exuberant crowds lit up phone screens. Even when we lost, people hesitated before piling in to criticise: "but they're still so young"; "they tried so hard". The morning after felt punctured but wistful, like coming home from a beach holiday with sand still just about between your toes. (It all began this

The Guardian

Founded 1821 Independently owned
'Comment is free... but facts are sacred'

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Presidential visit

Donald Trump says the UK likes him a lot. We don't. He is an unwelcome visitor

The first sitting president of the United States to visit Britain arrived here 100 years ago. President Woodrow Wilson came to Britain in 1918 on his way to the Versailles peace conference following the first world war. He came with the most noble of objectives: to help make peace in war-ravaged Europe and to lead the construction of a liberal international order based on laws and rights. Although the global order he was decisive in establishing was rejected at home and later challenged to within an inch of its life by fascism, it survived and was rebuilt more strongly. We are all the beneficiaries.

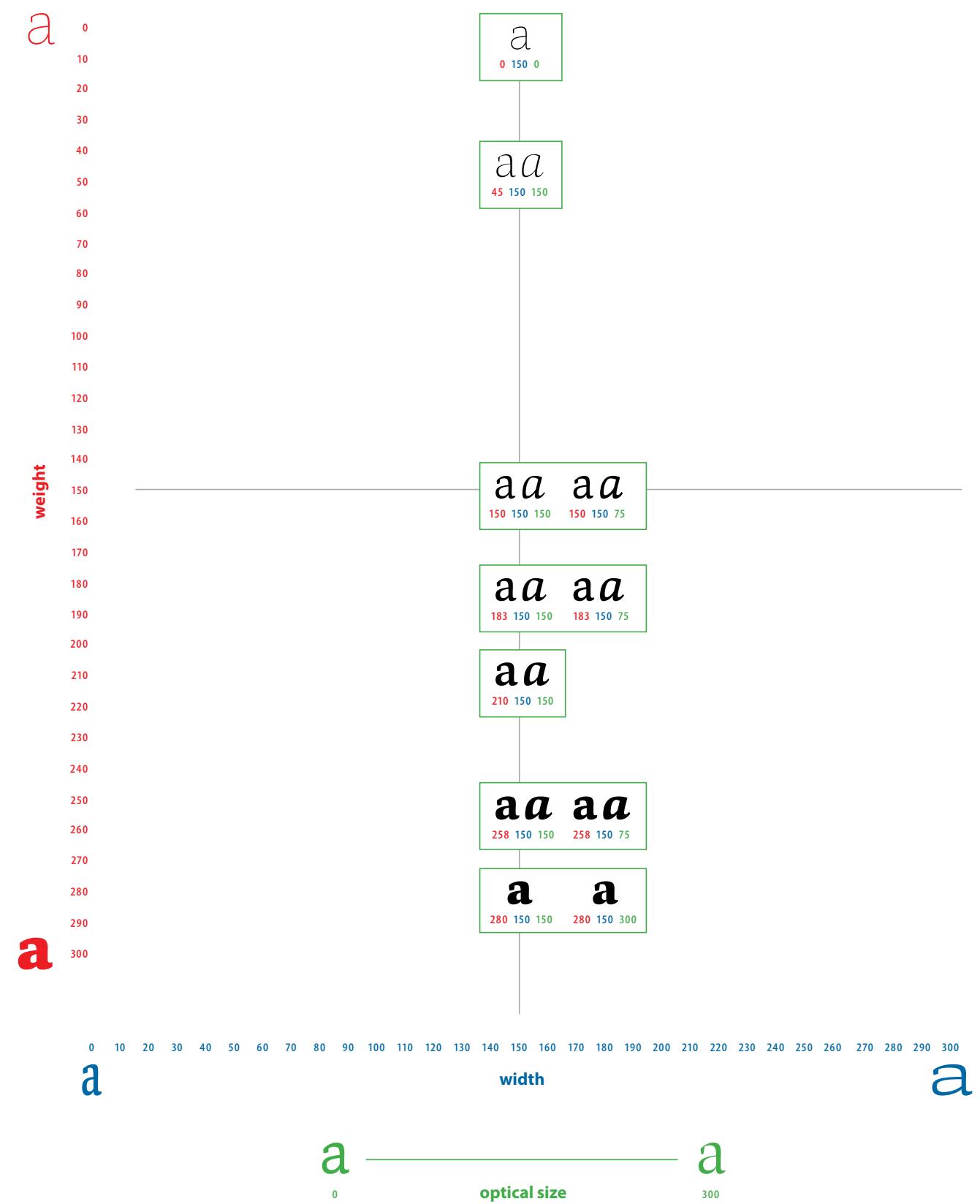
The contrast between that first presidential visit and the visit of Donald Trump a century later could not be more eloquent of the changing global role of the United States. Mr Trump does not come with a message of peace, as Wilson did, but with messages of conflict and disruption. He arrives not as the optimistic upholder of an international order but as its casual potential destroyer. Where Wilson spoke during his visit of his wish to make right and justice the "controlling force of the world", Mr Trump arrives in 2018 as the vengeful tribune of might and injustice.

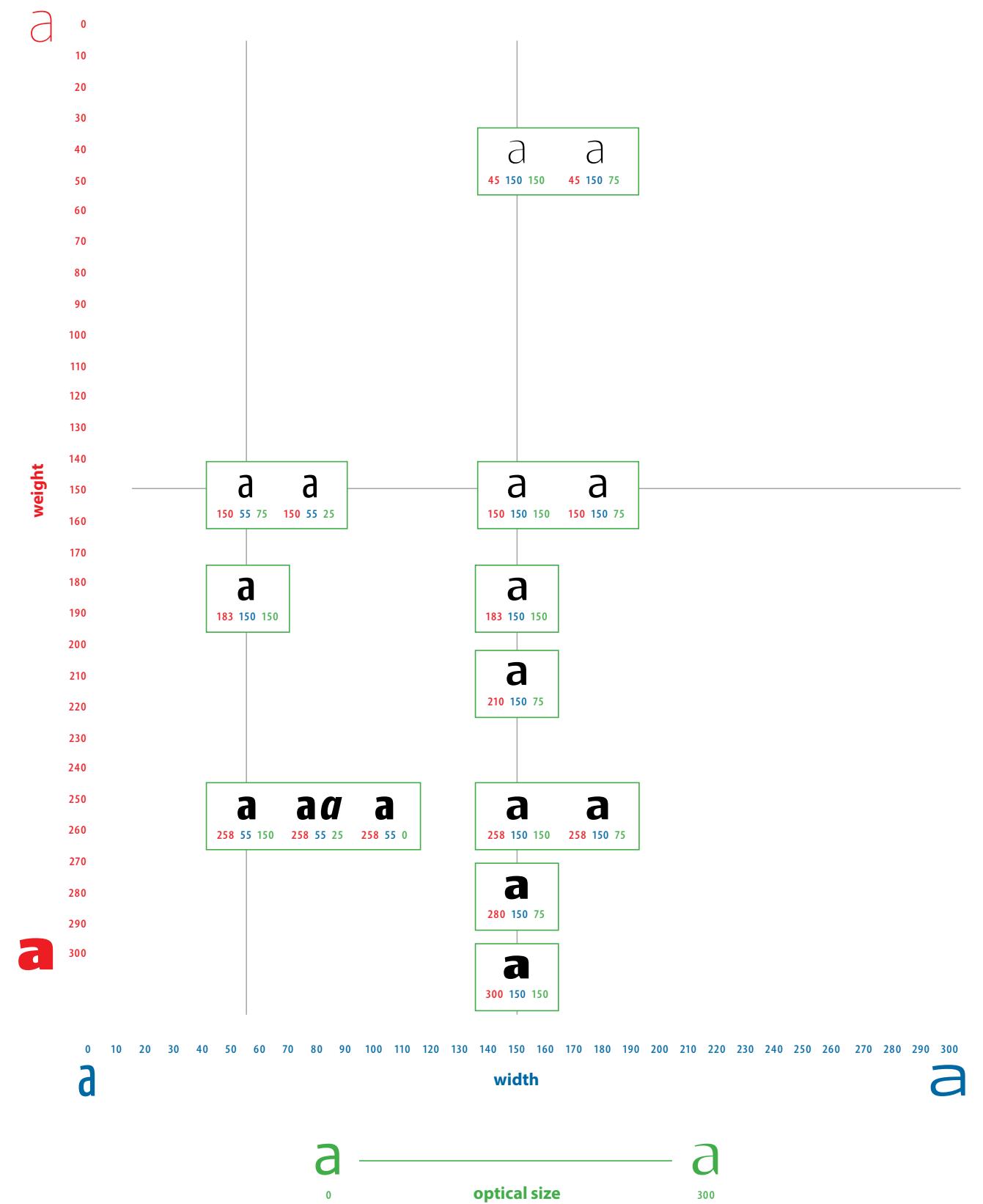
During his 1918 stay, Wilson made a point of travelling to his mother's birthplace in Carlisle. He also went to Manchester, where he was met by cheering crowds, received the freedom of the city, addressed a lunch in the Midland Hotel, spoke at a public meeting in the Free Trade Hall – and even invited CP Scott, editor and owner of the Manchester Guardian, for an hour's discussion, a scoop that caused consternation in the US press. It is a sign of changing times that the White House in 1918 could assure Scott that the president "relied on the Guardian's wholehearted support".

Better off without it

Mr Trump is never going to get that support today. He is the elected leader of a very great nation, but his arrival here this week is a visit that this country would be better off without. It shames those who offered it so prematurely and foolishly. Little good and much difficulty is likely to come of it. There are many reasons for feeling the unusual sense of outrage and violation that attach to the Trump visit to Britain. Mr Trump's personal character and behaviour are more than enough reason for many. They certainly belong on any list of objections to his presence here, for he is one of the most unsuitable people to hold his great democratic office in American history. But it is Mr Trump's politics, his expressed views, his actual actions, and above all his effect and his intentions that are the fundamental issues.

The charge list against Mr Trump is long, unignorable and impossible to tolerate. Morally, it is headed by the racism of the immigration policies he was so proud of in Brussels yesterday, the cruelty of their enforcement,





THE GUARDIAN

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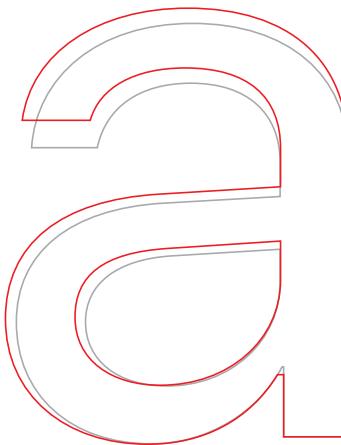
Google Maps

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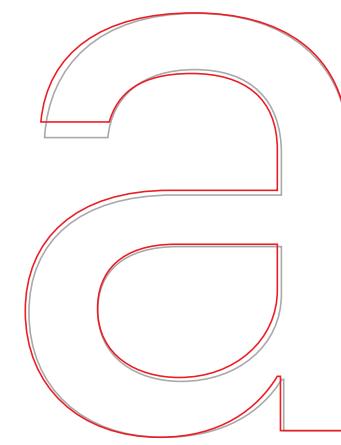
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SF COMPACT TEXT

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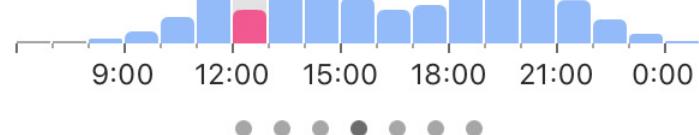
Suggest an edit

Popular times: Wednesday



Live 12 p.m.: Not too busy

Usually up to 15 min. wait



Plan your visit

Peak wait up to **15 min.** from 12:00 a.m. – 12:00 a.m.People typically spend **45 min** here**a**

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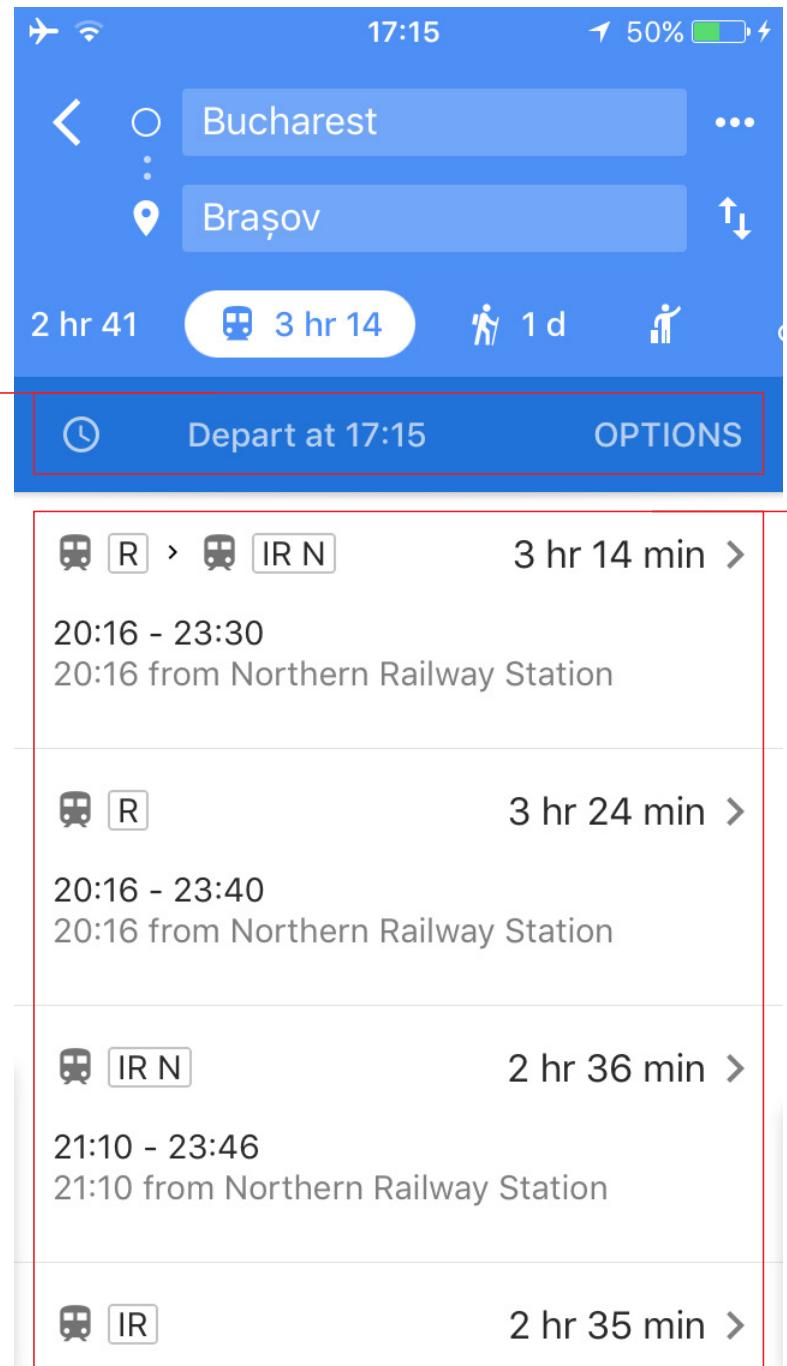
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On these lists

The Best Foods to Eat in Montreal ·
tastingtable.com



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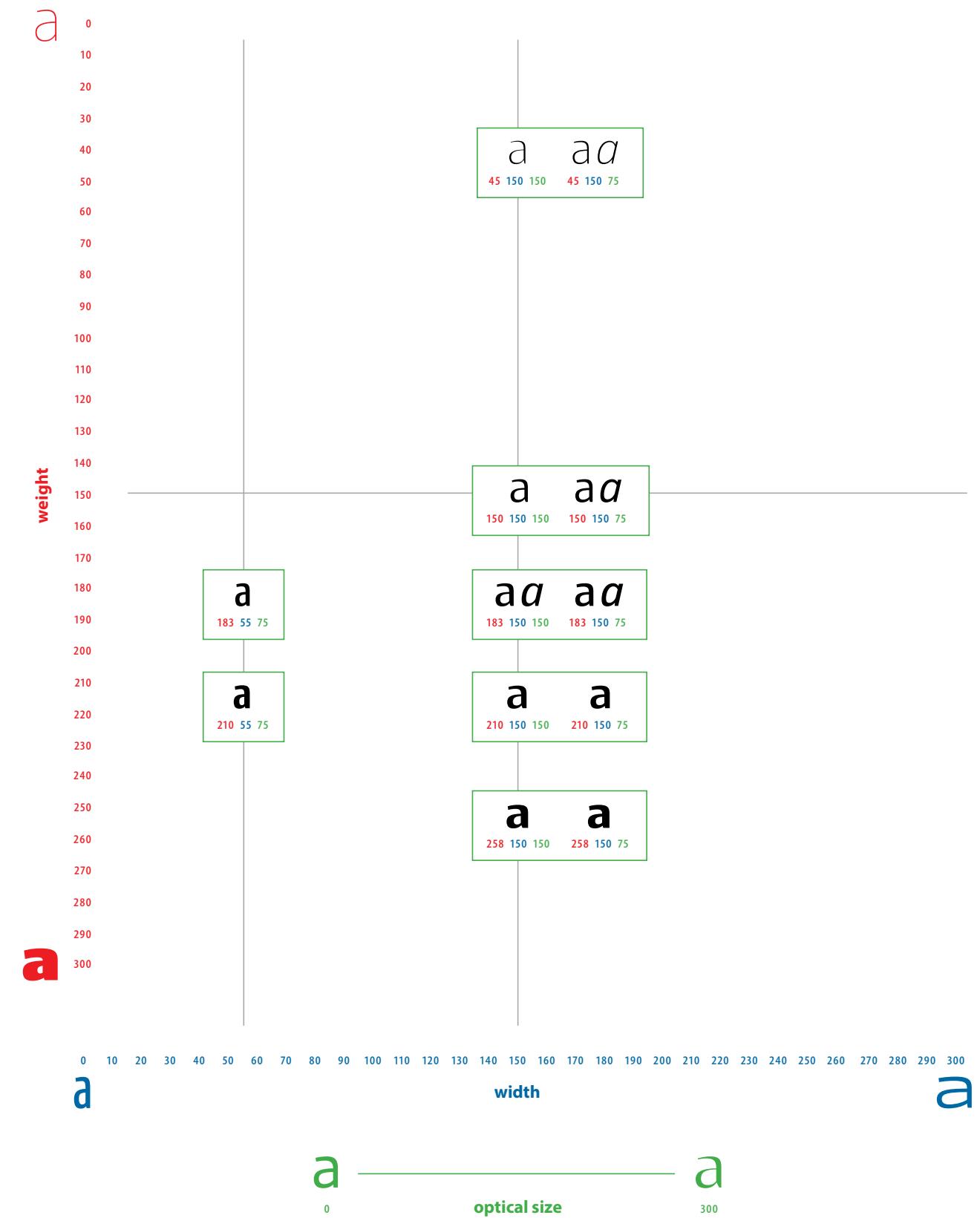
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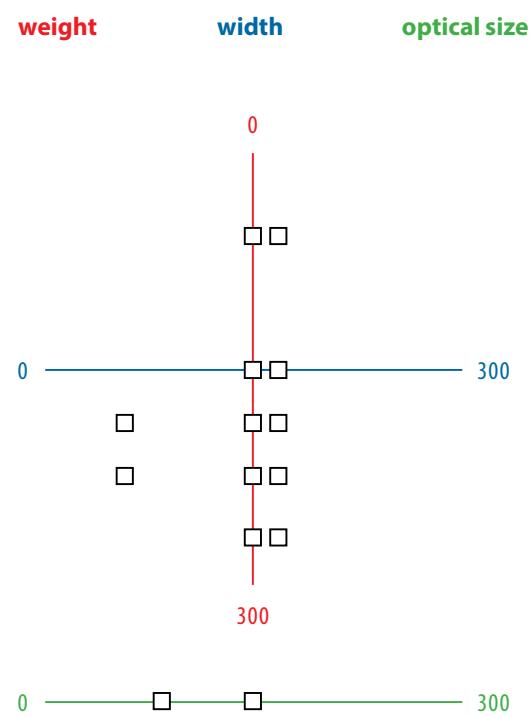
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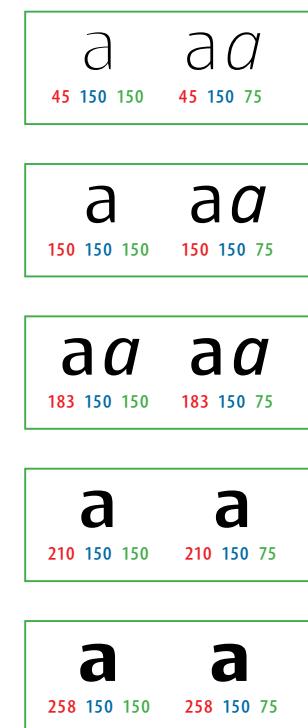
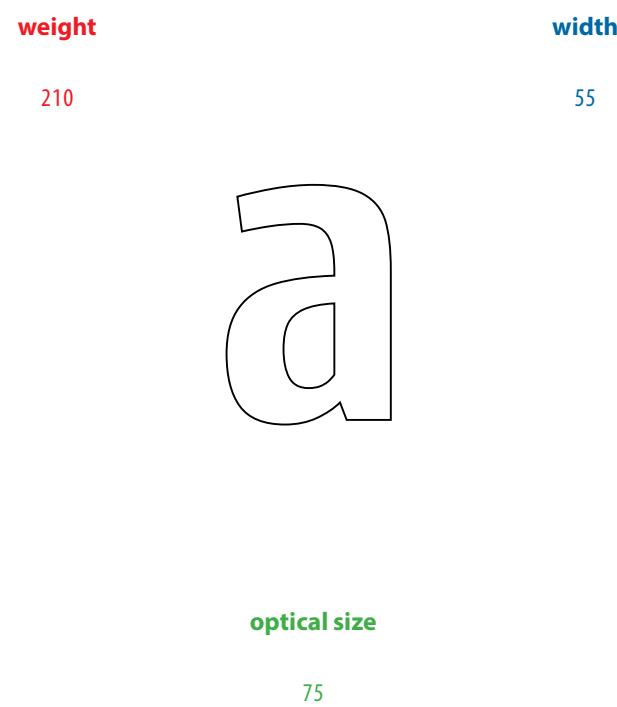
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GOOGLE MAPS | DESIGN SPACE DATA

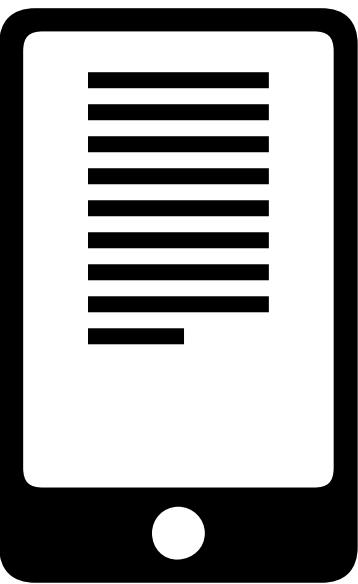
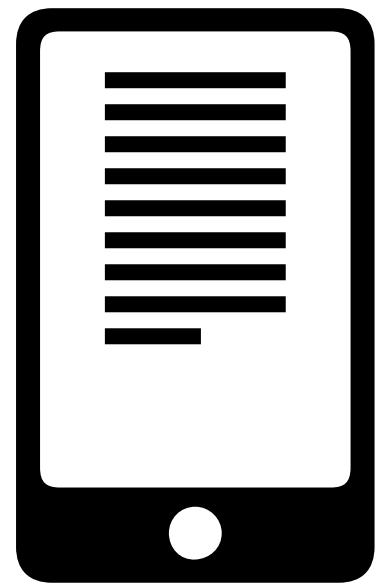
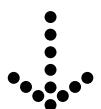
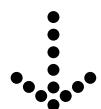
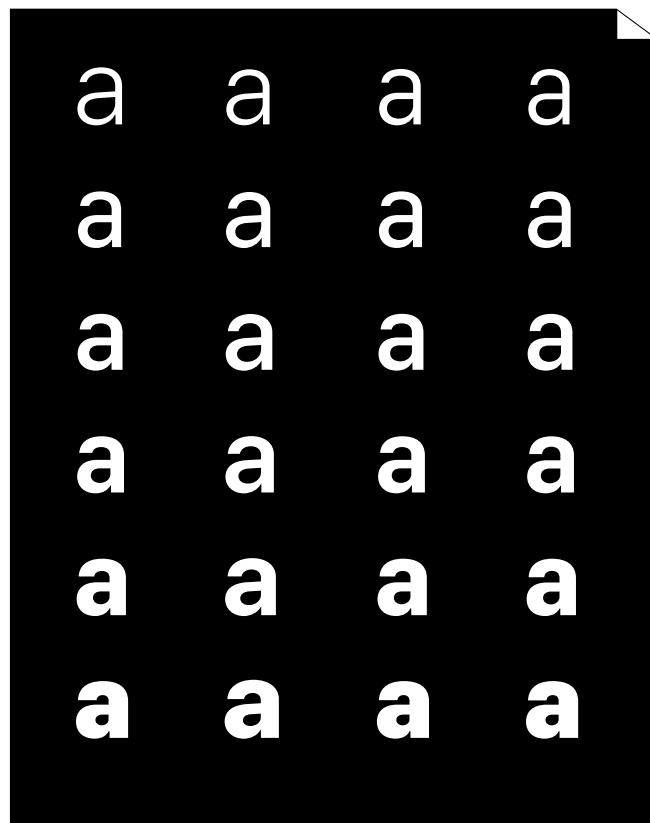
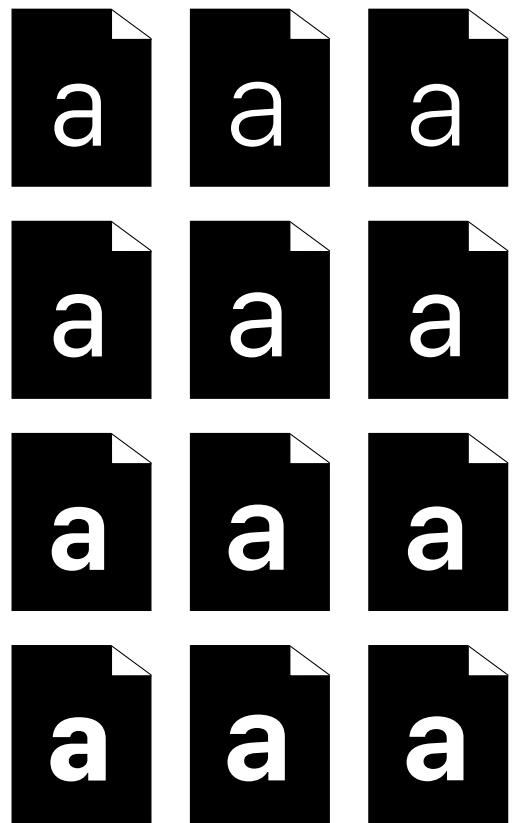


GOOGLE MAPS | VARIABLE DESIGN SPACE

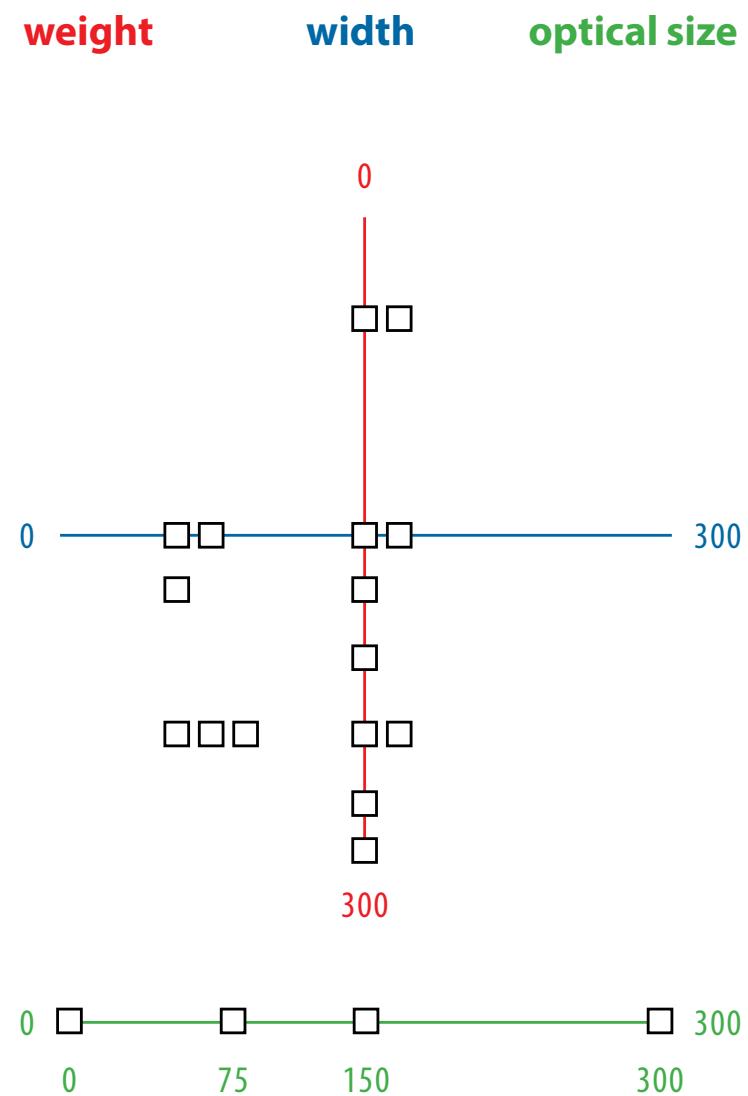


So, *the Guardian*'s typographic palette can contain as many optical styles, weights and widths as the designers deem necessary to achieve optimal typography.

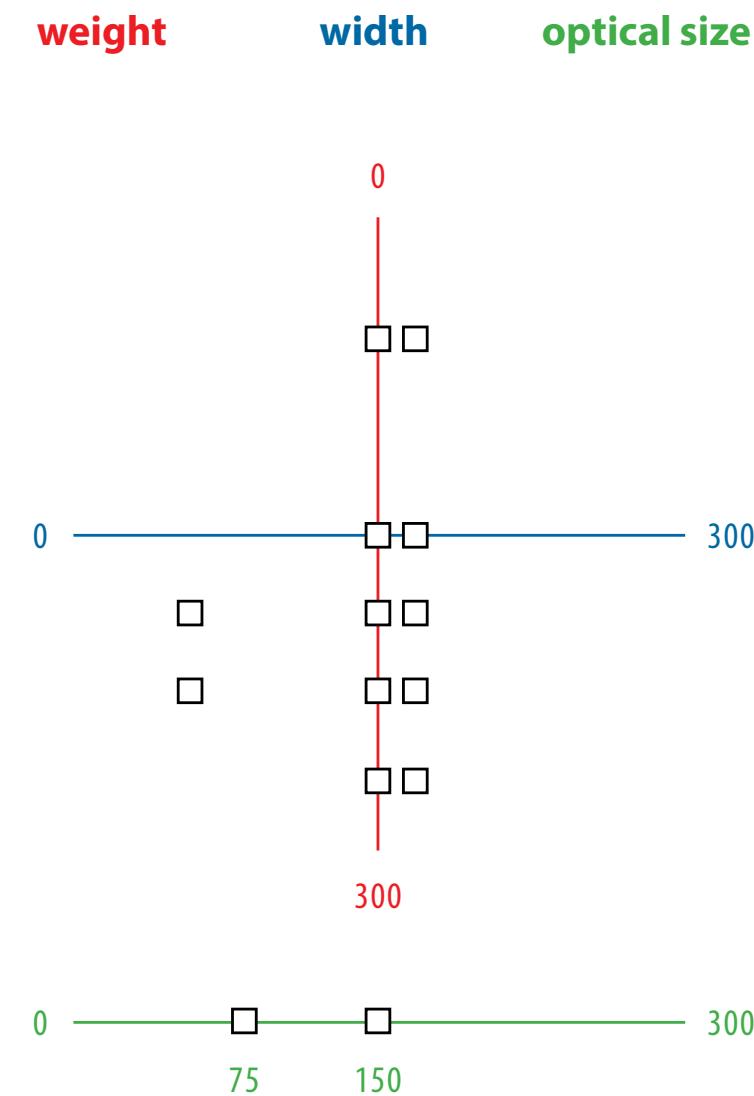
Google Maps, by contrast, has a limited typographic palette due to the fact that it must load content quickly and in real-time. We can see that its typography would be improved if more weight variety was available. **This could be overcome by using a variable font.**



THE GUARDIAN



GOOGLE MAPS



Therefore, *the Guardian* can achieve typography that satisfies the needs of the document with greater ease with traditional static fonts because there are less barriers preventing the designer from using the typeface “cuts” they require.

Variable fonts, allowing access to the total design space in one file, remove these barriers in non-static environments.

WEBSITE USING VARIABLE FONTS



René Descartes

BORN
31 March 1596
La Haye en Touraine,
Kingdom of France

DIED
11 February 1650 (aged 53)
Stockholm,
Swedish Empire

NATIONALITY
French

EDUCATION
Collège Royal Henry-Le-Grand
(1607–1614)
University of Poitiers
(LL.B., 1616)
University of Franeker
Leiden University

ERA
17th-century philosophy

REGION
Western philosophy

SCHOOL
Rationalism
Cartesianism
Mechanism
Innatism¹
Foundationalism²
Conceptualism³

René Descartes (UK: /deɪ.kɑ:t, deɪkɑ:t/; -us: /deɪkɑ:t/;¹⁴ ¹⁵ ¹⁶ French: [ʁəne dekaʁt]; Latinized: *Renatus Cartesius*; adjectival form: *Cartesian*¹⁷ (/ka:(r) t'i:z.i.ən, -zən/)¹⁴; 31 March 1596 – 11 February 1650) was a French philosopher, mathematician, and scientist. A native of the Kingdom of France, he spent about 20 years (1629–1649) of his life in the Dutch Republic after serving for a while in the Dutch States Army of Maurice of Nassau, Prince of Orange and the Stadtholder of the United Provinces. One of the most notable intellectual figures of the Dutch Golden Age,¹⁸ Descartes is also widely regarded as one of the founders of modern philosophy.

Many elements of Descartes' philosophy have precedents in late Aristotelianism, the revived Stoicism of the 16th century, or in earlier philosophers like Augustine. In his natural philosophy, he differed from the schools on two major points: first, he rejected the splitting of corporeal substance into matter and form; second, he rejected any appeal to final ends, divine or natural, in explaining natural phenomena.¹⁹ In his theology, he insists on the absolute freedom of God's act of creation. Refusing to accept the authority of previous philosophers, Descartes frequently set his views apart from those of his predecessors. In the opening section of the *Passions of the soul*, an early modern treatise on emotions, Descartes goes so far as to assert that he will write on this topic 'as if no one had written on these matters before'. His best known philosophical statement is 'I think, therefore I am' (French: *Je pense, donc je suis*; Latin: *Ego cogito, ergo sum*), found in *Discourse on the method* (1637; written in French and Latin) and *Principles of philosophy* (1644; written in Latin).²⁰

Descartes laid the foundation for 17th-century continental rationalism, later advocated by Spinoza and Leibniz, and was later opposed by the empiricist school of thought consisting of Hobbes, Locke, Berkeley, and Hume. Leibniz,

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WEBSITE USING VARIABLE FONTS

Cartesian coordinate system
Mind-body problem
Cartesian dualism (interactionism)
Foundationalism
Mathesis universalis
Folium of Descartes
Dream argument
Evil demon
Conservation of momentum
(*quantitas motus*)⁸
Balloonist theory
Wax argument
Trademark argument
Causal adequacy principle
Res cogitans/res extensa distinction
Conatus

INFLUENCES
Plato, Aristotle, Archimedes, Alhazen, Al-Ghazali,⁹
Averroes, Avicenna, Anselm, Elisabeth of the
Palatinate, Augustine, Stoics, Aquinas, Ockham,
Suárez, Mersenne, Sextus, Empiricus, Montaigne,
Golius, Beeckman, Harvey,¹⁰ Viète,¹¹ Duns Scotus,⁷
Teresa of Ávila¹²

INFLUENCED
Virtually all subsequent Western philosophy,
especially Spinoza, Leibniz, John Locke, Nicolas
Malebranche, Antoine Arnauld, Jacques-Bénigne
Bossuet,¹³ Blaise Pascal, Isaac Newton, Immanuel
Kant, Johann Gottlieb Fichte, Edmund Husserl,
Noam Chomsky, Slavoj Zizek, David Chalmers,
Claude Levi-Strauss

CONTENTS
1 Life

1 LIFE

1.1 EARLY LIFE

René Descartes was born in La Haye en Touraine (now Descartes, Indre-et-Loire), France, on 31 March 1596.²³ His mother, Jeanne Brochard, died soon after giving birth to him, and so he was not expected to survive.²³ Descartes's father, Joachim, was a member of the Parlement of Brittany at Rennes.²⁴ René lived with his grandmother and with his great-uncle. Although the Descartes family was Roman Catholic, the Poitou region was controlled by the Protestant Huguenots.²⁵ In 1607, late because of his fragile health, he entered the Jesuit Collège Royal Henry-Le-Grand at La Flèche,^{26 27} where he was introduced to mathematics and physics, including Galileo's work.^{26 28} After graduation in 1614, he studied for two years (1615 – 16) at the University of Poitiers, earning a *Baccalauréat* and *Licence* in canon and civil law in 1616,²⁶ in accordance with his father's wishes that he should become a lawyer.²⁹ From there he moved to Paris.

In *Discourse on the Method*, Descartes recalls,

I entirely abandoned the study of letters. Resolving to seek no knowledge other than that of which could be found in myself or else in the great book of the world, I spent the rest of my youth traveling, visiting courts and armies, mixing with people of diverse temperaments and ranks, gathering various experiences, testing myself in the situations which fortune offered me, and at all times reflecting upon whatever came my way so as to derive some profit from it.^{30:20–21}

Given his ambition to become a professional military officer, in 1618, Descartes joined, as a mercenary, the Protestant Dutch States Army in Breda under the command of Maurice of Nassau,²⁶ and undertook a formal study of military engineering, as established by Simon Stevin. Descartes, therefore, received

Source sans variable

Source serif variable

Source serif italic variable

WEBSITE USING STATIC FONTS

Analytic geometry
Cartesian coordinate system
Mind-body problem
Cartesian dualism (interactionism)
Foundationalism
Mathesis universalis
Folium of Descartes
Dream argument
Evil demon
Conservation of momentum
(*quantitas motus*)⁸
Balloonist theory
Wax argument
Trademark argument
Causal adequacy principle
Res cogitans/res extensa distinction
Conatus

INFLUENCES
Plato, Aristotle, Archimedes, Alhazen, Al-Ghazali,⁹
Averroes, Avicenna, Anselm, Elisabeth of the
Palatinate, Augustine, Stoics, Aquinas, Ockham,
Suárez, Mersenne, Sextus, Empiricus, Montaigne,
Golius, Beeckman, Harvey,¹⁰ Viète,¹¹ Duns Scotus,⁷
Teresa of Ávila¹²

INFLUENCED
Virtually all subsequent Western philosophy,
especially Spinoza, Leibniz, John Locke, Nicolas
Malebranche, Antoine Arnauld, Jacques-Bénigne
Bossuet,¹³ Blaise Pascal, Isaac Newton, Immanuel
Kant, Johann Gottlieb Fichte, Edmund Husserl,
Noam Chomsky, Slavoj Zizek, David Chalmers,
Claude Levi-Strauss

CONTENTS
1 Life

1 LIFE

1.1 EARLY LIFE

René Descartes was born in La Haye en Touraine (now Descartes, Indre-et-Loire), France, on 31 March 1596.²³ His mother, Jeanne Brochard, died soon after giving birth to him, and so he was not expected to survive.²³ Descartes's father, Joachim, was a member of the Parlement of Brittany at Rennes.²⁴ René lived with his grandmother and with his great-uncle. Although the Descartes family was Roman Catholic, the Poitou region was controlled by the Protestant Huguenots.²⁵ In 1607, late because of his fragile health, he entered the Jesuit Collège Royal Henry-Le-Grand at La Flèche,^{26 27} where he was introduced to mathematics and physics, including Galileo's work.^{26 28} After graduation in 1614, he studied for two years (1615 – 16) at the University of Poitiers, earning a *Baccalauréat* and *Licence* in canon and civil law in 1616,²⁶ in accordance with his father's wishes that he should become a lawyer.²⁹ From there he moved to Paris.

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Source sans light

Source serif regular

Source serif italic regular

css/design.css (rené-descartes) — Brackets

```
124     font-family: SourceSansVF, Verdana, sans-serif;
125     font-size: .8em;
126     line-height: 2em;
127     margin: 0;
128     padding-left: 0px;
129     text-align: left;
130     font-variation-settings: "wght" 310;
131 }
132 ▼ ul {
133     font-family: SourceSansVF, Georgia, serif;
134     font-size: .9em;
135     line-height: 1.6em;
136     margin: 0;
137     text-align: left;
138     padding-top: 10px;
139     padding-bottom: 0px;
140     padding-left: 0px;
141     hyphens: manual;
142     hyphenate-limit-chars: 10 4 4;
143     font-variation-settings: "wght" 280;
144 }
145 /* ^ for contents text */
146
147 ▼ blockquote {
148     font-family: SourceSerifVF, Georgia, serif;
149     font-size: 1em;
150     line-height: 1.7em;
151     padding-left: 2em;
152     padding-top: 0px;
153     padding-bottom: 1px;
154     margin: 0;
155     hyphens: manual;
156     hyphenate-limit-chars: 10 4 4;
157     text-align: left;
158     font-variation-settings: "wght" 270;
159 }
160 ▼ p {
161     font-family: SourceSerifVF, Georgia, serif;
162     font-size: 1em;
163     line-height: 1.9em;
164     margin: 0;
165     text-align: left;
166     padding-top: 0px;
167     padding-bottom: 0px;
168     hyphens: manual;
169     hyphenate-limit-chars: 10 4 4;
170     font-variation-settings: "wght" 400;
171 }
```

css/design.css (rené-descartes) — Brackets

```
71     letter-spacing: .09em;
72 }
73 ▼ h5 {
74     font-family: SourceSansVF, Verdana, sans-serif;
75     font-size: 1.6em;
76     line-height: 1em;
77     margin: 0;
78     padding-bottom: 8px;
79     padding-top: 25px;
80     font-variation-settings: "wght" 200;
81     font-feature-settings: "smcp";
82     letter-spacing: .07em;
83 }
84 ▼ h6 {
85     font-family: SourceSansVF, Verdana, sans-serif;
86     font-size: .8em;
87     line-height: 1.5em;
88     margin: 0;
89     padding-top: 9px;
90     padding-bottom: 0px;
91     font-variation-settings: "wght" 320;
92 }
93
94 /* ^ footnotes text */
95
96 ▼ h7 {
97     font-family: SourceSansVF, Georgia, serif;
98     font-size: .9em;
99     line-height: 1.7em;
100    margin: 0;
101   text-align: left;
102   padding-top: 0px;
103   padding-bottom: 0px;
104   hyphens: manual;
105   hyphenate-limit-chars: 10 4 4;
106   font-variation-settings: "wght" 400;
107 }
108 ▼ h8 {
109     font-family: SourceSansVF, Georgia, serif;
110     font-size: .9em;
111     line-height: 1.7em;
112     margin: 0;
113     text-align: left;
114     padding-top: 0px;
115     padding-bottom: 0px;
116     hyphens: manual;
117     hyphenate-limit-chars: 10 4 4;
118     font-variation-settings: "wght" 280;
119 }
```

css/design.css (rené-descartes) — Brackets

```
31     -moz-osx-font-smoothing: grayscale;
32 }
33 ▼ h1 {
34     font-family: SourceSansVF, Verdana, sans-serif;
35     font-size: 3em;
36     line-height: .9em;
37     margin: 0;
38     padding-top: 0px;
39     padding-bottom: 10px;
40     font-variation-settings: "wght" 780;
41 }
42 ▼ h2 {
43     font-family: SourceSansVF, Verdana, sans-serif;
44     font-size: .8em;
45     line-height: 1em;
46     padding-bottom: 3px;
47     padding-top: 12px;
48     margin: 0;
49     font-variation-settings: "wght" 650;
50     font-feature-settings: "smcp";
51     letter-spacing: .14em;
52 }
53 ▼ h3 {
54     font-family: SourceSansVF, Verdana, sans-serif;
55     font-size: .8em;
56     line-height: 1.7em;
57     margin: 0;
58     padding-top: 0px;
59     padding-bottom: 0px;
60     font-variation-settings: "wght" 280;
61 }
62 ▼ h4 {
63     font-family: SourceSansVF, Verdana, sans-serif;
64     font-size: 1.6em;
65     line-height: 1em;
66     margin: 0;
67     padding-top: 50px;
68     padding-bottom: 0px;
69     font-variation-settings: "wght" 650;
70     font-feature-settings: "smcp";
71     letter-spacing: .09em;
72 }
73 ▼ h5 {
74     font-family: SourceSansVF, Verdana, sans-serif;
75     font-size: 1.6em;
76     line-height: 1em;
77     margin: 0;
78     padding-bottom: 8px;
79     padding-top: 25px;
80 }
```

7 instances of Source Sans is used in the css, which would require 7 static version of Source Sans otherwise to be served each time the site is loaded.

Variable fonts also benefit css responsive environments by allowing the designer to implement different specifications of the typeface to optimize readability across varying screen sizes.

SMARTPHONE

René Descartes (UK: /deɪ.kɑ:t, derkɑ:t/; -US: /der'ka:rt/;^{14 15 16} French: [ʁəne dekaʁt]; Latinized: Renatus Cartesius; adjectival form: Cartesian¹⁷ (/ka:(r) t'i:z.i.ən, -ʒən/)¹⁴; 31 March 1596 – 11 February 1650) was a French philosopher, mathematician, and scientist. A native of the Kingdom of France, he spent about 20 years (1629–1649) of his life in the Dutch Republic after serving for a while in the Dutch States Army of Maurice of Nassau, Prince of Orange and the Stadholder of the United Provinces. One of the most notable intellectual figures of the Dutch Golden Age,¹⁸ Descartes is also widely regarded as one of the founders of modern philosophy.

Many elements of Descartes' philosophy have precedents in late Aristotelianism, the revived Stoicism of the 16th century, or in earlier philosophers like Augustine. In his natural philosophy, he differed from the schools on two major points: first, he rejected the splitting of corporeal substance into matter and form; second, he rejected any appeal to final ends, divine or natural, in explaining natural phenomena.¹⁹ In his theology, he insists on the absolute freedom of God's act of creation. Refusing to accept the authority of previous philosophers, Descartes frequently set his views apart from those of his predecessors. In the opening section of the *Passions of the soul*, an early modern treatise on emotions, Descartes goes so far as to assert that he will write on this topic 'as if no one had written on these matters before'. His best known philosophical statement is 'I think, therefore I am' (French: *Je pense, donc je suis*; Latin: *Ego cogito, ergo sum*), found in *Discourse on the method* (1637; written in French and Latin) and *Principles of philosophy* (1644; written in Latin).²⁰

TABLET

René Descartes (UK: /deɪ.kɑ:t, derkɑ:t/; -US: /der'ka:rt/;^{14 15 16} French: [ʁəne dekaʁt]; Latinized: Renatus Cartesius; adjectival form: Cartesian¹⁷ (/ka:(r) t'i:z.i.ən, -ʒən/)¹⁴; 31 March 1596 – 11 February 1650) was a French philosopher, mathematician, and scientist. A native of the Kingdom of France, he spent about 20 years (1629–1649) of his life in the Dutch Republic after serving for a while in the Dutch States Army of Maurice of Nassau, Prince of Orange and the Stadholder of the United Provinces. One of the most notable intellectual figures of the Dutch Golden Age,¹⁸ Descartes is also widely regarded as one of the founders of modern philosophy.

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DESKTOP

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```
243 /* target mobile screens under 600px */
244
245 @media only screen and (max-width: 600px) {
246   .padded {
247     padding: 5px 0px;
248   }
249   .twothird {
250     grid-column-end: span 5;
251     padding: 0 20px;
252     padding-right: 0px;
253   }
254   .grid {
255     grid-gap: 60px;
256   }
257   p {
258     font-size: .8em;
259     line-height: 1.9em;
260     font-variation-settings: "wght" 330;
261   }
262   h1 {
263     font-size: 3.6em;
264     line-height: 1em;
265     padding-bottom: 3px;
266   }

```

```
331 /* target tablet/mid-size screens between 601-1024px */
332
333 @media only screen and (min-width: 601px) {
334   .padded {
335     padding: 25px 0px;
336   }
337   .twothird {
338     grid-column-end: span 3;
339     padding: 0 20px;
340     padding-right: 0px;
341   }
342   .grid {
343     grid-gap: 60px;
344   }
345   p {
346     font-size: 1em;
347     line-height: 1.7em;
348     font-variation-settings: "wght" 350;
349   }
350   h1 {
351     font-size: 1.7em;
352     line-height: 1em;
353     padding-bottom: 3px;
354   }

```

```
411 /* target desktop screens over 1024px */
412
413 @media only screen and (min-width: 1025px) {
414   h3 {
415     font-size: .8em;
416     line-height: 1.7em;
417     padding-right: 20px;
418   }
419   p {
420     font-size: 1em;
421     line-height: 1.7em;
422     font-variation-settings: "wght" 400;
423   }
424   h1 {
425     font-size: 3em;
426     line-height: .9em;
427     padding-bottom: 8px;
428   }
429   h2 {
430     font-size: .8em;
431     line-height: 1em;
432     padding-bottom: 3px;
433     padding-top: 12px;
434   }

```

A series of CSS responsive screen size specifications where a different instance of the variable font's weight axis has been used to adjust the text appearance to enhance the reading experience in each screen environment.

One font acting like many static fonts equals larger benefits to functionality and atmosphere in screen-based typographic documents.

It is also possible to achieve better typography with these new tools as it is possible to develop more subtle hierarchy devices within the single font to organize content and navigate the reader through the content.

Typeface interfacing with content

Through the use of JavaScript and the camera and microphone input sensors on our computer and smartphone devices, variable fonts allow for experiential data to be represented in real-time.

This means that typefaces as tools are able to fully integrate with the textual content they are rendering.

JavaScript + variable font examples:

<https://www.instagram.com/p/BtQNS2FhSLv/>

<http://very-able-fonts.com/>

<https://www.instagram.com/p/BmTEyejjmlz/>

<https://www.instagram.com/p/BuMFauzBrBd/>

<https://www.instagram.com/p/Bp13eCGh5Sn/>

<https://www.instagram.com/p/BeGG5X6AtQo/>

[https://www.behance.net/gallery/70995465/
Dancing-Typefaces-Other-Variable-Experiments](https://www.behance.net/gallery/70995465/Dancing-Typefaces-Other-Variable-Experiments)

https://www.instagram.com/p/BsN_DZJFk4Y/

So, what benefits do variable fonts provide?

- ☞ Faster website and app loading times
- ☞ Interfacing with sensory input data
- ☞ Enables better typography in screen environments by reducing files to be served to one, while subsequently providing access to all weight, width and optical type family variables within that single file, creating richer typography.

Variable font resources:

Websites to explore variable fonts:

<https://www.axis-praxis.org/specimens/> __ DEFAULT __

<https://codepen.io/lorp/pen/PRdNYq>

<https://v-fonts.com/>

Microsoft Typography variable font table and spec documentation:

<https://docs.microsoft.com/en-us/typography/opentype/spec/dvaraxisreg>

<https://docs.microsoft.com/en-us/typography/opentype/spec/otvaroverview>