My Way

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Euler in ConTEXt

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The Euler math font was designed by Hermann Zapf. CONTEXT support was limited until now. We show how to use the Eulervm LATEX package in combination with some new math definitions and typescripts to give a more informal look to your equations.

1 Introduction

The Euler math font was designed by Hermann Zapf. The underlying philosophy of Zapf's Euler design was to "capture the flavor of mathematics as it might be written by a mathematician with excellent handwriting." ConTEXt support was limited until now. We show how to use the Eulervm LATEX package in combination with some new math definitions and typescripts to give a more informal look to your equations.

Typography can be very individual. I present the following possibilities as mere suggestions of how to get started. Please feel free to mix and match fonts and typescripts as you desire. . . I would hate for my peculiar tastes to be taken as some sort of dogma. My main motivation was to carry the freely available TEX fonts as far as possible.

Many thanks to Otared Kavian, who provided some of the source material that I liberally pilfered, and good beta-testing and initial feedback. Walter Schmidt created the Eulervm font package, without which this article would not be possible. Hans Hagen and Guy Worthington also provided advice, test material, and feedback at the early stages.

2 Basic installation

The Euler typescript requires the Eulervm virtual font package. The file `eulervm.tar.gz` is available at
http://www.ctan.org/tex-archive/help/Catalogue/entries/eulervm.html?action=/tex-archive/fonts/.
Once you `ungzip` and `untar` the file, examine the contents. It should contain, among others, two directories, `vf` and `tfm` the contents of the `vf` directory must be installed into the directory

```
$TEXMFFONT/fonts/vf/public/eulervm
```

and the contents of the `tfm` directory must be installed into the directory

```
$TEXMFFONT/fonts/tfm/public/eulervm
```

The new ConTEXt euler typescript definitions (`math-eul.tex` and `type-eul.tex`), if not installed, should be placed in

```
$TEXMFLOCAL/tex/context/third
```

After installing these files, don't forget to type `sudo texhash` or whatever you use to refresh your ls-R hash files.

In order to run the included typescripts, you should have the fonts mentioned herein. I obtained mine from the full TEXLIVE installation. For the last example, I used the TEXFONT utility to condense the free Courier and Avant Garde fonts.

The included typescripts also depend on the installation of Bitstream's Charter font for the use of text-like accents in math mode, as well as a couple characters like the dagger (†) that are better matched to Euler's stroke and weight than the characters brought in from Computer Roman.

3 The Euler font

math characters

α	1	alpha	Z	0	Zeta	$\exists$	2	exists
β	1	beta	H	0	Eta	$\neg$	2	neg
γ	1	gamma	Θ	0	Theta	$\flat$	1	flat
δ	1	delta	I	0	Iota	$\natural$	1	natural
ε	1	epsilon	K	0	Kappa	$\sharp$	1	sharp
ζ	1	zeta	Λ	0	Lambda	$\clubsuit$	2	clubsuit
η	1	eta	M	0	Mu	$\diamondsuit$	2	diamondsuit
θ	1	theta	N	0	Nu	$\heartsuit$	2	heartsuit
ι	1	iota	Ξ	0	Xi	$\spadesuit$	2	spadesuit
κ	1	kappa	O	0	Omicron	$\coprod$	3	coprod
λ	1	lambda	Π	0	Pi	$\bigvee$	3	bigvee
μ	1	mu	R	0	Rho	$\bigwedge$	3	bigwedge
ν	1	nu	Σ	0	Sigma	$\biguplus$	3	biguplus
ξ	1	xi	T	0	Tau	$\bigcap$	3	bigcap
o	1	omicron	Υ	0	Upsilon	$\bigcup$	3	bigcup
π	1	pi	Φ	0	Phi	$\int$	3	intop
ρ	1	rho	X	0	Chi	$\prod$	3	prod
σ	1	sigma	Ψ	0	Psi	$\sum$	3	sum
τ	1	tau	Ω	0	Omega	$\bigotimes$	3	bigotimes
υ	1	upsilon	$\aleph$	2	aleph	$\bigoplus$	3	bigoplus
ϕ	1	phi	$\imath$	1	imath	$\bigodot$	3	bigodot
χ	1	chi	$\jmath$	1	jmath	$\oint$	3	ointop
ψ	1	psi	ℓ	1	ell	$\bigsqcup$	3	bigsqcup
ω	1	omega	$\wp$	1	wp	$\int$	2	smallint
ϵ	1	varepsilon	$\Re$	2	Re	$\triangleleft$	1	triangleleft
ϑ	1	vartheta	$\Im$	2	Im	$\triangleright$	1	triangleright
ϖ	1	varpi	∂	1	partial	$\bigtriangleup$	2	bigtriangleup
ϱ	1	varrho	∞	2	infty	$\bigtriangledown$	2	bigtriangledown
ς	1	varsigma	$\prime$	2	prime	$\wedge$	2	wedge
φ	1	varphi	$\emptyset$	2	emptyset	$\vee$	2	vee
A	0	Alpha	∇	2	nabla	$\cap$	2	cap
B	0	Beta	$\top$	2	top	$\cup$	2	cup
Γ	0	Gamma	$\bot$	2	bot	$\ddagger$	2	ddagger
Δ	0	Delta	$\triangle$	2	triangle	$\dagger$	2	dagger
E	0	Epsilon	$\forall$	2	forall	$\sqcap$	2	sqcap

⊔	2	sqcup	≈	2	approx	̂	0	hat
⊎	2	uplus	≻	2	succeq	⃗	1	vec
∐	2	amalg	≺	2	preceq	̇	0	dot
⋄	2	diamond	⊃	2	supset	̃	3	widetilde
•	2	bullet	⊂	2	subset	̂	3	widehat
≀	2	wr	⊇	2	supseteq	⏜	3	lmoustache
÷	2	div	⊆	2	subseteq	⏝	3	rmoustache
⊙	2	odot	∈	2	in	(	0	lgroup
⊘	2	oslash	∋	2	ni	)	0	rgroup
⊗	2	otimes	≫	2	gg	|	2	arrowvert
⊖	2	ominus	≪	2	ll	‖	2	Arrowvert
⊕	2	oplus	/	2	not	⏐	3	bracevert
∓	2	mp	↔	2	leftrightarrow	‖	2	Vert
±	2	pm	←	2	leftarrow	|	2	vert
∘	2	circ	→	2	rightarrow	↑	2	uparrow
◯	2	bigcirc	↦	2	mapstochar	↓	2	downarrow
\	2	setminus	~	2	sim	↕	2	updownarrow
·	2	cdot	≃	2	simeq	⇑	2	Uparrow
∗	2	ast	⊥	2	perp	⇓	2	Downarrow
×	2	times	≡	2	equiv	⇕	2	Updownarrow
⋆	1	star	≍	2	asymp	\	2	backslash
∝	2	propto	⌣	1	smile	⟩	2	rangle
⊑	2	sqsubseteq	⌢	1	frown	⟨	2	langle
⊒	2	sqsupseteq	↼	1	leftharpoonup	}	2	rbrace
∥	2	parallel	↽	1	leftharpoondown	{	2	lbrace
∣	2	mid	⇀	1	rightharpoonup	⌉	2	rceil
⊣	2	dashv	⇁	1	rightharpoondown	⌈	2	lceil
⊢	2	vdash	‹	1	lhook	⌋	2	rfloor
↗	2	nearrow	›	1	rhook	⌊	2	lfloor
↘	2	searrow	.	1	ldotp	√	2	sqrt
↖	2	nwarrow	·	2	cdotp	†	2	dag
↙	2	swarrow	:	0	colon	‡	2	ddag
⇔	2	Leftrightarrow	´	0	acute	§	2	S
⇐	2	Leftarrow	`	0	grave	¶	2	P
⇒	2	Rightarrow	¨	0	ddot	◯	2	Orb
≤	2	leq	˜	0	tilde	.	1	mathperiod
≥	2	geq	¯	0	bar	.	1	textperiod
≻	2	succ	˘	0	breve	,	1	mathcomma
≺	2	prec	ˇ	0	check	,	1	textcomma

4 Palatino and Euler

Here are some of the simple operations we can do with the O-notation:

$$f(n) = O(f(n)), \tag{5}$$
$$c.O(f(n)) = O(f(n)), \qquad \text{if } c \text{ is a constant}, \tag{6}$$
$$O(f(n)) + O(f(n)) = O(f(n)), \tag{7}$$
$$O(O(f(n))) = O(f(n)), \tag{8}$$
$$O(f(n))O(g(n)) = O(f(n)g(n)), \tag{9}$$
$$O(f(n)g(n)) = f(n)O(g(n)). \tag{10}$$

The O-notation is also frequently used with functions of a complex variable z, in the neighborhood of $z = 0$. We write $O(f(z))$ to stand for any quantity $g(z)$ such that $|g(z)| \le M|f(z)|$ whenever $|z| < r$. (As before, M and r are unspecified constants, although we could specify them if we wanted to.) The context of O-notation should always identify the variable that is involved and the range of that variable. When the variable is called n, we implicitly assume that $O(f(n))$ refers to functions of a large integer n; when the variable is called z, we implicitly assume that $O(f(z))$ refers to functions of a small complex number z.

Suppose that $g(z)$ is a function given by an infinite power series

$$g(z) = \sum_{k\ge 0} a_k z^k$$

that converges for $z = z_0$. Then the sum of absolute values $\sum_{k\ge 0} |a_k z^k|$ also converges whenever $|z| < |z_0|$. If $z_0 \neq 0$, we can therefore always write

$$g(z) = a_0 + a_1 z + \cdots + a_m z^m + O(z^{m+1}). \tag{11}$$

For we have $g(z) = a_0 + a_1 z + \cdots + a_m z^m + z^{m+1}(a_{m+1} + a_{m+2} z + \cdots)$; we need only show that the parenthesized quantity is bounded when $|z| < r$, for some positive r, and it is easy to see that $|a_{m+1}| + |a_{m+2}|r + |a_{m+3}|r^2 + \cdots$ is an upper bound whenever $|z| \le r < |z_0|$.

For example, the generating functions listed in Section 1.2.9 give us many important asymptotic formulas valid when z is sufficiently small, including

$$e^z = 1 + \frac{1}{2!}z^2 + \cdots + \frac{1}{m!}z^m + O(z^{m+1}), \tag{12}$$
$$\ln(1+z) = z - \frac{1}{2}z^2 + \cdots + \frac{(-1)^{m+1}}{m}z^m + O(z^{m+1}) \tag{13}$$
$$(1+z)^\alpha = 1 + \alpha z + \binom{\alpha}{2} z^2 + \cdots + \binom{\alpha}{m} z^m + O(z^{m+1}), \tag{14}$$
$$\frac{1}{1-z} \ln \frac{1}{1-z} = z + H_2 z^2 + \cdots + H_m z^m + O(z^{m+1}), \tag{15}$$

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In order to demonstrate the current typeface combination, we show the current faces *in situ* with an unusual, perhaps inordinate amount of ***style* switching**, as well as using macros that switch faces in order to demonstrate key terms, such as those that might be used in a textbook. Naturally, this somewhat affected approach will yield a fairly *extreme* page, but it can be worthwhile to look at a worst–case scenario, as well as a more moderate case, as on the previous page.

Some of the most typographically offensive pages I have seen have been in international standards, with their `codeSnippets`, terminology, perhaps even mixed with a $\sqrt{x}$ radical function or two. Various typographers would certainly take issue with these practices, but on the other hand, certain conventions have been established.

4.2 Mono and Serif

The `AudioSpectrumSpread` descriptor describes the second moment of the log-frequency power spectrum. The XML Schema syntax is as follows:

```
<complexType name="AudioSpectrumSpreadType">
   <complexContent>
      <extension base="mpeg7:AudioLLDScalarType"/>
   </complexContent>
</complexType>
```

To be coherent with other descriptors, in particular `AudioSpectrumEnvelope`, the spectrum spread is defined as the RMS deviation of the log-frequency power spectrum with respect to its center of gravity. Details are similar to `AudioSpectrumCentroid`.

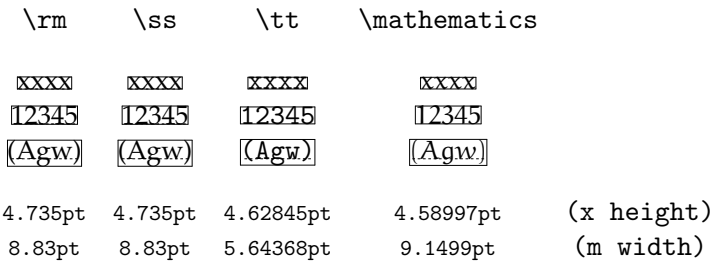
4.3 Mono and Serif and Math

To extract the spectrum spread:

1. Calculate the power spectrum, $P'_x(n)$, and corresponding frequencies, $f(n)$, of the waveform as for `AudioSpectrumCentroid` extraction, parts a–b.

2. Calculate the spectrum centroid, C, as described in `AudioSpectrumCentroid` extraction in part d.

3. Calculate the spectrum spread, S, as the RMS deviation with respect to the centroid, on an octave scale: $S = \sqrt{\frac{\sum_n \left(\log_2(\frac{f(n)}{1000}) - c\right)^2 \cdot P'_x(n)}{\sum_n P'_x(n)}}$



The previous pages were accomplished with a "mid–level" font switch. It does not define a whole combination of typescripts, but rather a single math font, `eul`, which is overlaid with the Palatino typescript. No sans serif is defined yet. There is no deliberate scaling of the different type faces. To establish Euler as the math font, the code at the beginning of this TEX file is:

```
\usetypescriptfile[type-eul]
\usetypescript[eul]
\switchtobodyfont[eul]
```

Since there is not yet a `\showmathfunctions` command in ConTEXt, we try a few of them here:

$$\cos^2(z) = 1 - \sin^2(z)$$
$$\cosh^2(z) = 1 + \sinh^2(z)$$
$$\log(\exp(z)) = \ln(\exp(z))$$
$$1 + \exp(i\pi) = 0$$

You may notice that Euler is fairly spaced out, which can be a detriment when setting math functions like $\sin$ (`$\sin$`). I prefer to change it so that math functions grab the *emphasized* version of a font. For many people, that means *slanted*, but I like my emphasis to be *italicized*. In some of the typescripts that follow, there is no *slanted* face defined, so the *italicized* face is substituted, using the fallback type definition. From this point in the document forwards, I redefine `\mfunction` as follows:

```
\def\mfunction#1{{\em#1}}
```

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5 Charter, Helvetica, and Euler

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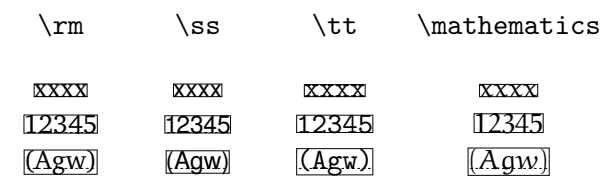


```
4.98993pt  4.94493pt  4.73497pt     4.81947pt     (x height)
8.42992pt  7.66354pt  5.77362pt     9.60742pt     (m width)
```

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$$log(exp(z)) = ln(exp(z))$$
$$1 + exp(i\pi) = 0$$

The previous pages used the typescript `Char`. This TEX file included the code:

```
\usetypescriptfile[ts-chart]
\usetypescript[Char]
\switchtobodyfont[Char]
```

which referred to the typescript file `ts-chart.tex`, which includes the following code:

```
% Char
% which includes:
%  Charter, Helvetica, euler math, & cmr-tt
%   low contrast but still modulated stroke, very even and pleasing,
dark-ish weight

\usetypescriptfile[type-buy]
\usetypescriptfile[type-eul]

\starttypescript [serif] [charter] [8r]
  \definefontsynonym [Charter-Roman]       [bchr8r]  [encoding=8r]
  \definefontsynonym [Charter-Bold]        [bchb8r]  [encoding=8r]
  \definefontsynonym [Charter-Italic]      [bchri8r] [encoding=8r]
  \definefontsynonym [Charter-Bold-Italic] [bchbi8r] [encoding=8r]
  \definefontsynonym [Charter-Slanted]    [bchr8a-slanted-167]
[encoding=8r]
  \definefontsynonym [Charter-BoldSlanted][bchb8a-slanted-167]
[encoding=8r]
```

```
  \definefontsynonym [Charter-Roman-Caps] [bchr8a-capitalized-
800] [encoding=8r]
\stoptypescript

\starttypescript [serif] [charter] [name]
  \usetypescript[serif][fallback]
  \definefontsynonym [Serif]           [Charter-Roman]
  \definefontsynonym [SerifBold]       [Charter-Bold]
  \definefontsynonym [SerifItalic]     [Charter-Italic]
  \definefontsynonym [SerifBoldItalic] [Charter-Bold-Italic]
\stoptypescript

\starttypescript [Char]
  \definetypeface [Char] [rm] [serif] [charter] [default] [encoding=8r]
  \definetypeface [Char] [ss]  [sans] [helvetica] [default]
[rscale=0.92,encoding=8r]
  \definetypeface [Char] [mm]  [math] [euler] [default] [rscale=1.05,encoding=defaul
  \definetypeface [Char] [tt] [mono]  [computer-modern] [default]
[rscale=1.1,encoding=ec]
\stoptypescript
```

6 Antykwa Poltawskiego, Avant Garde, and Euler

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for all nonnegative integers m. It is important to note that the hidden constants M and r implied by any particular O are related to each other. For ...

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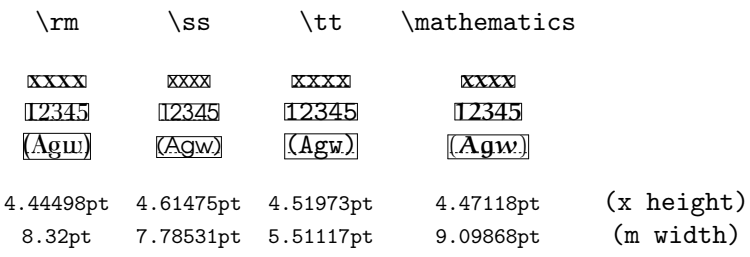
6.3 Mono and Serif and Math

To extract the spectrum spread:

1. Calculate the power spectrum, $\mathbf{P}'_{\mathbf{x}}(\mathbf{n})$, and corresponding frequencies, $\mathbf{f}(\mathbf{n})$, of the waveform as for `AudioSpectrumCentroid` extraction, parts a–b.

2. Calculate the spectrum centroid, $\mathbf{C}$, as described in `AudioSpectrumCentroid` extraction in part d.

3. Calculate the spectrum spread, $\mathbf{S}$, as the RMS deviation with respect to the centroid, on an octave scale: $\mathbf{S} = \sqrt{\frac{\sum_{\mathbf{n}} \left(log_2(\frac{\mathbf{f}(\mathbf{n})}{1000}) - \mathbf{c} \right)^2 \cdot \mathbf{P}'_{\mathbf{x}}(\mathbf{n})}{\sum_{\mathbf{n}} \mathbf{P}'_{\mathbf{x}}(\mathbf{n})}}$



Since there is not yet a \showmathfunctions command in ConTEXt, we try a few of them here:

$$cos^2(z) = 1 - sin^2(z)$$
$$cosh^2(z) = 1 + sinh^2(z)$$
$$log(exp(z)) = ln(exp(z))$$
$$1 + exp(i\pi) = 0$$

The previous pages used the typescript AntP. This TEX file included the code:

```
\usetypescriptfile[ts-antp]
\usetypescript[AntP]
\switchtobodyfont[AntP]
```

which referred to the typescript file ts-antp.tex. Because of the very heavy weight in the Antykwa Poltawskiego font, I included the Euler-Bold typescript. The main typescript for this example includes the following code:

```
% AntP
% which includes:
%  antykwa-poltawskiego, avantgarde, euler math, cmr-tt
%   higher contrast, still expressionist, but better suited
for a text font

\usetypescriptfile[type-buy]
\usetypescriptfile[type-eul]

\starttypescript[serif] [antykwa-poltawskiego][ec]
  \definefontsynonym [AntykwaPoltawskiego-Regular] [antpr]
[encoding=ec]
  \definefontsynonym [AntykwaPoltawskiego-Bold]    [antpb]
[encoding=ec]
  \definefontsynonym [AntykwaPoltawskiego-Italic]  [antpri]
[encoding=ec]
  \definefontsynonym [AntykwaPoltawskiego-BoldItalic]  [antpbi]
[encoding=ec]
\stoptypescript
```

```
\starttypescript [serif] [antykwa-poltawskiego] [name]
  \usetypescript[serif][fallback]
  \definefontsynonym [Serif]           [AntykwaPoltawskiego-
Regular]
  \definefontsynonym [SerifBold]       [AntykwaPoltawskiego-
Bold]
  \definefontsynonym [SerifItalic]     [AntykwaPoltawskiego-
Italic]
  \definefontsynonym [SerifBoldItalic] [AntykwaPoltawskiego-
BoldItalic]
\stoptypescript

\starttypescript [sans] [avantgarde] [ec]
  \definefontsynonym [URWGothicL-Book] [uagk8t] [encoding=ec]
  \definefontsynonym [URWGothicL-Demi] [uagd8t] [encoding= ec]
  \definefontsynonym [URWGothicL-BookObli] [uagko8t] [encoding=
ec]
  \definefontsynonym [URWGothicL-DemiObli] [uagdo8t] [encoding=ec]
\stoptypescript

\starttypescript [sans] [avantgarde] [name]
  \usetypescript[sans][fallback]
  \definefontsynonym [Sans]           [URWGothicL-Book]
  \definefontsynonym [SansBold]       [URWGothicL-Demi]
  \definefontsynonym [SansItalic]     [URWGothicL-BookObli]
  \definefontsynonym [SansBoldItalic] [URWGothicL-DemiObli]
\stoptypescript

\starttypescript [AntP]
  \usetypescript [berry] [ec]
   \definetypeface [AntP] [rm] [serif] [antykwa-poltawskiego]
[default] [encoding=ec]
  \definetypeface [AntP] [ss]  [sans] [avantgarde] [default]
[rscale=.83,encoding= ec]
  \definetypeface [AntP] [mm]  [math] [eulerbold] [default]
[rscale=.92]%,encoding=default]
  \definetypeface [AntP] [tt] [mono]  [computer-modern] [default]
[rscale=1.05,encoding=ec]
\stoptypescript
```

7 Literaturanaya, Avant Garde condensed, and Euler

Here are some of the simple operations we can do with the O-notation:

$$f(n) = O(f(n)), \tag{5}$$
$$c.O(f(n)) = O(f(n)), \qquad \text{if } c \text{ is a constant}, \tag{6}$$
$$O(f(n)) + O(f(n)) = O(f(n)), \tag{7}$$
$$O(O(f(n))) = O(f(n)), \tag{8}$$
$$O(f(n))O(g(n)) = O(f(n)g(n)), \tag{9}$$
$$O(f(n)g(n)) = f(n)O(g(n)). \tag{10}$$

The O-notation is also frequently used with functions of a complex variable z, in the neighborhood of $z = 0$. We write $O(f(z))$ to stand for any quantity $g(z)$ such that $|g(z)| \le M|f(z)|$ whenever $|z| < r$. (As before, M and r are unspecified constants, although we could specify them if we wanted to.) The context of O-notation should always identify the variable that is involved and the range of that variable. When the variable is called n, we implicitly assume that $O(f(n))$ refers to functions of a large integer n; when the variable is called z, we implicitly assume that $O(f(z))$ refers to functions of a small complex number z.

Suppose that $g(z)$ is a function given by an infinite power series

$$g(z) = \sum_{k\ge 0} a_k z^k$$

that converges for $z = z_0$. Then the sum of absolute values $\sum_{k\ge 0} |a_k z^k|$ also converges whenever $|z| < |z_0|$. If $z_0 \neq 0$, we can therefore always write

$$g(z) = a_0 + a_1 z + \cdots + a_m z^m + O(z^{m+1}). \tag{11}$$

For we have $g(z) = a_0 + a_1 z + \cdots + a_m z^m + z^{m+1}(a_{m+1} + a_{m+2} z + \cdots)$; we need only show that the parenthesized quantity is bounded when $|z| < r$, for some positive r, and it is easy to see that $|a_{m+1}| + |a_{m+2}|r + |a_{m+3}|r^2 + \cdots$ is an upper bound whenever $|z| \le r < |z_0|$.

For example, the generating functions listed in Section 1.2.9 give us many important asymptotic formulas valid when z is sufficiently small, including

$$e^z = 1 + \frac{1}{2!}z^2 + \cdots + \frac{1}{m!}z^m + O(z^{m+1}), \tag{12}$$
$$\ln(1+z) = z - \frac{1}{2}z^2 + \cdots + \frac{(-1)^{m+1}}{m}z^m + O(z^{m+1}) \tag{13}$$
$$(1+z)^\alpha = 1 + \alpha z + \binom{\alpha}{2} z^2 + \cdots + \binom{\alpha}{m} z^m + O(z^{m+1}), \tag{14}$$
$$\frac{1}{1-z}\ln\frac{1}{1-z} = z + H_2 z^2 + \cdots + H_m z^m + O(z^{m+1}), \tag{15}$$

for all nonnegative integers m. It is important to note that the hidden constants M and r implied by any particular O are related to each other. For ...

7.1 Mixed faces on a page

In order to demonstrate the current typeface combination, we show the current faces *in situ* with an unusual, perhaps inordinate amount of ***style* switching**, as well as using macros that switch faces in order to demonstrate **key terms**, such as those that might be used in a textbook. Naturally, this somewhat affected approach will yield a fairly *extreme* page, but it can be worthwhile to look at a worst–case scenario, as well as a more moderate case, as on the previous page.

Some of the most typographically offensive pages I have seen have been in international standards, with their `codeSnippets`, terminology, perhaps even mixed with a $\sqrt{x}$ radical function or two. Various typographers would certainly take issue with these practices, but on the other hand, certain conventions have been established.

7.2 Mono and Serif

The `AudioSpectrumSpread` descriptor describes the second moment of the log-frequency power spectrum. The XML Schema syntax is as follows:

```
<complexType name="AudioSpectrumSpreadType">
   <complexContent>
      <extension base="mpeg7:AudioLLDScalarType"/>
   </complexContent>
</complexType>
```

To be coherent with other descriptors, in particular `AudioSpectrumEnvelope`, the spectrum spread is defined as the RMS deviation of the log-frequency power spectrum with respect to its center of gravity. Details are similar to `AudioSpectrumCentroid`.

7.3 Mono and Serif and Math

To extract the spectrum spread:

1. Calculate the power spectrum, $P'_x(n)$, and corresponding frequencies, $f(n)$, of the waveform as for `AudioSpectrumCentroid` extraction, parts a–b.

2. Calculate the spectrum centroid, C, as described in `AudioSpectrumCentroid` extraction in part d.

3. Calculate the spectrum spread, S, as the RMS deviation with respect to the centroid, on an octave scale: $S = \sqrt{\frac{\sum_n \left(log_2(\frac{f(n)}{1000}) - c\right)^2 \cdot P'_x(n)}{\sum_n P'_x(n)}}$

```
  \rm       \ss       \tt     \mathematics

 xxxx      xxxx      xxxx       xxxx
 12345     12345     12345      12345
 (Agw)     (Agw)     (Agw)      (Agw)

  4.81pt    4.83122pt 4.70251pt     4.77353pt     (x height)
8.17993pt   6.60004pt  5.28001pt     9.51584pt     (m width)
```

Since there is not yet a `\showmathfunctions` command in ConTEXt, we try a few of them here:

$$cos^2(z) = 1 - sin^2(z)$$
$$cosh^2(z) = 1 + sinh^2(z)$$
$$log(exp(z)) = ln(exp(z))$$
$$1 + exp(i\pi) = 0$$

The previous pages used the typescript `Litr`. This TEX file included the code:

```
\usetypescriptfile[ts-litr]
\usetypescript[Litr]
\switchtobodyfont[Litr]
```

which referred to the typescript file `ts-litr.tex`. I used the new (to me) TEXFONT mechanisms to enable the condensed versions of Avant Garde and Courier. The typescript file includes the following code:

```
% Litr
% which includes:
%   Literaturnaya, Avant-garde, euler math, & courier
%    very light, but refined, avant-garde is actually slightly
heavier
% to take advantage of this, don't forget to include the following
lines before any pages are output:
\loadmapfile[texnansi-urw-avantgar.map]
\loadmapfile[texnansi-urw-courier.map]

\usetypescriptfile[type-buy]
\usetypescriptfile[type-eul]

\starttypescript [serif] [literate] [default]
  \definefontsynonym [Literate-Roman]        [tlir8t]  [encoding=ec]
  \definefontsynonym [Literate-Bold]         [tlib8t]  [encoding=ec]
  \definefontsynonym [Literate-Italic]       [tliri8t] [encoding=ec]
  \definefontsynonym [Literate-Oblique]      [tliro8t] [encoding=ec]
```

```
  \definefontsynonym [Literate-BoldItalic]   [tlibi8t] [encoding=ec]
  \definefontsynonym [Literate-BoldOblique]  [tlibo8t] [encoding=ec]
\stoptypescript

\starttypescript [serif] [literate] [name]
  \usetypescript[serif][fallback]
  \definefontsynonym [Serif]           [Literate-Roman]
  \definefontsynonym [SerifBold]       [Literate-Bold]
  \definefontsynonym [SerifItalic]     [Literate-Italic]
  \definefontsynonym [SerifSlanted]    [Literate-Oblique]
  \definefontsynonym [SerifBoldItalic] [Literate-BoldItalic]
  \definefontsynonym [SerifBoldSlanted][Literate-BoldOblique]
\stoptypescript

\starttypescript [sans] [avantgarde-cond] [texnansi]
  \definefontsynonym [URWGothicL-Book-Cond] [texnansi-uagk8a-
extended-800] [encoding=texnansi]
  \definefontsynonym [URWGothicL-Demi-Cond] [texnansi-uagd8a-
extended-800] [encoding=texnansi]
  \definefontsynonym [URWGothicL-BookObli-Cond] [texnansi-uagko8a-
extended-800] [encoding=texnansi]
  \definefontsynonym [URWGothicL-DemiObli-Cond] [texnansi-uagdo8a-
extended-800] [encoding= texnansi]
  \definefontsynonym [URWGothicL-Book-Caps-Cond][texnansi-uagk8a-
capitalized-800-extended-800][encoding=texnansi]
\stoptypescript

\starttypescript [sans] [avantgarde-cond] [name]
  \usetypescript[sans][fallback]
  \definefontsynonym [Sans]           [URWGothicL-Book-Cond]
  \definefontsynonym [SansBold]       [URWGothicL-Demi-Cond]
  \definefontsynonym [SansItalic]     [URWGothicL-BookObli-
Cond]
  \definefontsynonym [SansBoldItalic] [URWGothicL-DemiObli-
Cond]
  \definefontsynonym [SansCaps]  [URWGothicL-Book-Caps-Cond]
\stoptypescript

\starttypescript [mono] [courier-cond] [texnansi]
  \definefontsynonym[NimbusMonL-Regu-Condensed][texnansi-ucrr8a-
extended-800][encoding=texnansi]
  \definefontsynonym[NimbusMonL-ReguObli-Condensed][texnansi-
ucrro8a-extended-800][encoding=texnansi]
  \definefontsynonym[NimbusMonL-Bold-Condensed][texnansi-ucrb8a-
extended-800][encoding=texnansi]
```

```
  \definefontsynonym[NimbusMonL-BoldObli-Condensed][texnansi-
ucrbo8a-extended-800][encoding=texnansi]
\stoptypescript

\starttypescript [mono] [courier-cond] [name]
  \usetypescript[mono][fallback]
  \definefontsynonym [Mono] [NimbusMonL-Regu-Condensed]
  \definefontsynonym [MonoItalic][NimbusMonL-ReguObli-Condensed]
  \definefontsynonym [MonoBold][NimbusMonL-Bold-Condensed]
  \definefontsynonym [MonoBoldItalic][NimbusMonL-BoldObli-Condensed]
\stoptypescript

\starttypescript [Litr]
  \definetypeface [Litr] [rm] [serif] [literate] [default] [encoding=defaul
  \definetypeface [Litr] [ss]  [sans] [avantgarde-cond] [default]
[rscale=0.88,encoding=texnansi]
  \definetypeface [Litr] [mm]  [math] [euler] [default] [rscale=1.04,encodi
  \definetypeface [Litr] [tt] [mono]  [courier-cond] [default]
[rscale=1.1,encoding=texnansi]
\stoptypescript
```

The first sample page was provided by Otared Kavian. It is an excerpt from Donald E. Knuth's book "The Art of Computer Programming," volume 1 Chapter I, section 2.11.1, pp. 108–109

```
\let\phi=\varphi
\let\Bbb=\bf % in case the font \Bbb or Blackboard bold is not
defined
\def\choose#1#2{\left(#1 \atop #2 \right)}

% The following is an excerpt from Donald E. Knuth's book
% "The Art of Computer Programming", volume 1
% Chapter I, section 2.11.1, pp. 108--109
%

\starttext

Here are some of the simple operations we can do with the $O$-
notation:
\startformula
\eqalignno{
f(n) &= O(f(n)), & (5) \cr
c.O(f(n)) &= O(f(n)),\qquad \hbox{if } c \hbox{ is a constant},
& (6) \cr
O(f(n)) + O(f(n)) &= O(f(n)), & (7) \cr
O(O(f(n))) &= O(f(n)), & (8) \cr
O(f(n))O(g(n)) &= O(f(n)g(n)), & (9) \cr
O(f(n)g(n)) &= f(n)O(g(n)). & (10) \cr
}
\stopformula

The $O$-notation is also frequently used with functions of a
complex variable $z$, in the neighborhood of $z=0$. We write
$O(f(z))$ to stand for any quantity $g(z)$ such that $|g(z)|
\leq M |f(z)|$ whenever $|z| < r$. (As before, $M$ and $r$ are
unspecified constants, although we could specify them if we
wanted to.) The context of $O$-notation should always identify
the variable that is involved and the range of that variable.
When the variable is called $n$, we implicitly assume that $O(f(n))$
refers to functions of a large integer $n$; when the variable
is called $z$, we implicitly assume that $O(f(z))$ refers to
functions of a small complex number $z$.

Suppose that $g(z)$ is a function given by an infinite power
series
\startformula
```

```
g(z) = \sum_{k \geq 0} a_k z^k
\stopformula
that converges for $z = z_0$. Then the sum of absolute values
$\sum_{k\geq 0} |a_kz^k|$ also converges whenever $|z| < |z_0|$.
If $z_0 \neq 0$, we can therefore always write
\startformula
g(z) = a_0 + a_1z + \cdots + a_m z^m + O(z^{m+1}). \eqno(11)
\stopformula
For we have $g(z) = a_0 + a_1z + \cdots + a_m z^m + z^{m+1}(a_{m+1}
+ a_{m+2}z + \cdots)$; we need only show that the parenthesized
quantity is bounded when $|z| < r$, for some positive $r$, and
it is easy to see that $|a_{m+1}| + |a_{m+2}|r + |a_{m+3}|r^2
+ \cdots$ is an upper bound whenever $|z| \leq r < |z_0|$.

For example, the generating functions listed in Section 1.2.9
give us many important asymptotic formulas valid when $z$ is
sufficiently small, including
\startformula
\eqalignno{
e^z &= 1 + {1 \over 2!}z^2 + \cdots + {1 \over m!}z^m + O(z^{m+1}),
& (12) \cr
\ln(1+z) &= z - {1 \over 2}z^2 + \cdots + {(-1)^{m+1} \over
m}z^m + O(z^{m+1}) & (13) \cr
(1+z)^\alpha &= 1 + \alpha z + \choose{\alpha }{2} z^2 + \cdots
+ \choose{\alpha }{m} z^m + O(z^{m+1}), & (14) \cr
{1 \over 1 - z} \ln{1 \over 1 - z} &= z + H_2 z^2 + \cdots +
H_m z^m + O(z^{m+1}), & (15) \cr
}
\stopformula
for all nonnegative integers $m$. It is important to note that
the hidden constants $M$ and $r$ implied by any particular $O$
are related to each other. For example, the function $e^z$ is
obviously $O(1)$ when $|z| \leq r$, for any fixed $r$, since
$|e^z| \leq e^{|z|}$; but there is no constant $M$ such that
$|e^z| \leq M$ for all values of $z$. Therefore we need to use
larger and larger bounds $M$ as the range $r$ increases.

\stoptext
```

The second sample page was adapted from an early draft of the MPEG-7 Audio standard: ISO/IEC 15938-4:2001.

```
\def\Vocab#1{{\ss#1}}
\def\Keyterm#1{{\ssbf#1}}
\def\RMS{\kap{RMS}}
\def\XML{\kap{XML}}
\hyphenation{Audio-Spectrum-Centroid Audio-Spectrum-Envelope
Audio-Spectrum-Spread}
\setuphead
  [subsection]
  [before=\blank,
   after=,
   color=MainColor,
   style=\ssbfa]

\starttext
\subsection{Mixed faces on a page}
In order to demonstrate the current typeface combination, we
show the current faces {\it in situ} with an unusual, perhaps
inordinate
amount of {\bf{\em style} switching}, as well as using macros
that switch
\Vocab{faces} in order to demonstrate \Keyterm{key terms}, such
as
those that might be used in a textbook. Naturally, this somewhat
affected
approach will yield a fairly {\em extreme} page, but it can
be worthwhile to
look at a worst|--|case scenario, as well as a more moderate
case, as on the
previous page.

Some of the most typographically offensive pages I have seen
have been
in international standards, with their \typ{codeSnippets},
\Vocab{terminology}, perhaps even mixed with a $\sqrt{x}$
radical function or two. Various typographers would certainly
take
issue with these practices, but on the other hand, certain \Vocab{conventions}
have been established.

\subsection{Mono and Serif}
The \typ{AudioSpectrumSpread} descriptor describes the second
```

```
moment of the log|-|frequency power spectrum. The \XML\ Schema
syntax
is as follows:
\starttyping[XML]
<complexType name="AudioSpectrumSpreadType">
   <complexContent>
      <extension base="mpeg7:AudioLLDScalarType"/>
   </complexContent>
</complexType>
\stoptyping

To be coherent with other descriptors, in particular
\typ{AudioSpectrumEnvelope}, the spectrum spread
is defined as the \RMS\ deviation of the log|-|frequency
power spectrum with respect to its center of gravity. Details
are similar to
\typ{AudioSpectrumCentroid}.

\subsection{Mono and Serif and Math}
To extract the spectrum spread:
\startitemize[n]
\item Calculate the power spectrum, $P^{\prime}_{x}(n)$, and
corresponding frequencies, $f(n)$, of the waveform as for
\typ{AudioSpectrumCentroid} extraction, parts {\ss a--b}.
\item Calculate the spectrum centroid, $C$, as described in
\typ{AudioSpectrumCentroid} extraction in part  {\ss d}.
\item Calculate the spectrum spread, $S$, as the \RMS\ deviation
with respect
to the centroid, on an octave scale:
\gform{S=\sqrt{\frac{\sum_{n}{\left(\log_{2}(\frac{f(n)}{1000})
-c\right)^{2}\cdot P^{\prime}_{x}(n)}}{\sum_{n}P^{\prime}_{x}(n)}}}
\stoptext
```

source code of this document

```
% I need the following two map files because I don't load and
switch to their
% corresponding typescripts until later in the document:
\loadmapfile[texnansi-urw-avantgar.map]
\loadmapfile[texnansi-urw-courier.map]

\usemodule[mag-01]
\usemodule[abr-01]

\setvariables
  [magazine]
  [title={Euler in \ConTeXt},
   author=Adam Lindsay,
   affiliation=Lancaster University,
   number=0]

\startbuffer[eqns]
Since there is not yet a \typ{\showmathfunctions} command in
\ConTeXt,
we try a few of them here:
\startformula
\eqalign{
\cos^2(z)  &= 1 - \sin^2(z) \cr
\cosh^2(z)  &=1 + \sinh^2(z)\cr
\log(\exp(z)) &= \ln(\exp(z)) \cr
1 + \exp (i \pi) &= 0 \cr
}
\stopformula
\stopbuffer

\startbuffer[abstract]
The Euler math font was designed by Hermann Zapf. \CONTEXT\
support was
limited until now. We show how to use the Eulervm \LATEX\ package
in
combination with some new math definitions and typescripts to
give a more
informal look to your equations.

\stopbuffer
\startbuffer
\usetypescriptfile[type-eul]
\usetypescript[eul]
\switchtobodyfont[eul]
```

source code of this document

```
\stopbuffer
\getbuffer

\starttext \setups [titlepage] \setups [title]

\section{Introduction}
%improve introduction
The Euler math font was designed by Hermann Zapf. The underlying
philosophy
of Zapf's Euler design was to ``capture the flavor of
 mathematics as
it might be written by a mathematician with excellent handwriting.''
\ConTeXt\ support was
limited until now. We show how to use the Eulervm \LATEX\ package
in
combination with some new math definitions and typescripts to
give a more
informal look to your equations.

Typography can be very individual. I present the following possibilities
as
mere suggestions of how to get started. Please feel free to
mix and match
fonts and typescripts as you desire\dots I would hate for my
peculiar tastes
to be taken as some sort of dogma. My main motivation was to
carry the
freely available \TEX\ fonts as far as possible.

%give history
%acknowledge author of eulervm package
Many thanks to Otared Kavian, who provided some of the source
material that
I liberally pilfered, and good beta-testing and initial feedback.
Walter
Schmidt created the Eulervm font package, without which this
article
would not be possible. Hans Hagen and
Guy Worthington also provided advice, test material, and feedback
at the early
stages.

\section{Basic installation}
The Euler typescript requires the Eulervm virtual font package.
The file
```

source code of this document

```
\type{eulervm.tar.gz} is available at \crlf
\hyphenatedurl{http://www.ctan.org/tex-archive/help/Catalogue/entries/eulervm.html?act
archive/fonts/}. \crlf
Once you \type{ungzip} and \type{untar} the file, examine the
contents.
It should contain, among others, two directories, \type{vf}
and \type{tfm}
the contents of the \type{vf} directory must be installed into
the directory
\starttyping
 $TEXMFFONT/fonts/vf/public/eulervm
\stoptyping
and the contents of the \type{tfm} directory must be installed
into the
directory
\starttyping
 $TEXMFFONT/fonts/tfm/public/eulervm
\stoptyping

 The new \ConTeXt\ euler typescript definitions (\type{math-
eul.tex} and
 \type{type-eul.tex}), if not installed, should be placed in
 \starttyping
 $TEXMFLOCAL/tex/context/third
 \stoptyping
  After installing these files, don't forget to type \type{sudo
texhash} or
  whatever you use to refresh your ls-R hash files.

In order to run the included typescripts, you should have the
fonts
mentioned herein. I obtained mine from the full \TEXLIVE\ installation.
For the last example, I used the \TEXFONT\ utility to condense
the free
Courier and Avant Garde fonts.

The included typescripts also depend on the installation of
Bitstream's
Charter font for the use of text-like accents in math mode,
as well as a
couple characters like the dagger ($\dagger$) that are better
matched
to Euler's stroke and weight than the characters brought in
from Computer
Roman.
```

source code of this document

```
\section{The Euler font}
\showmathcharacters

\page[even]
\section{Palatino and Euler}

\input math-knuth-shorter
\page
\input sectioned-mathsample
\page
\showfontstrip

The previous pages were accomplished with a ``mid||level'' font
switch. It does not
define a whole combination of typescripts, but rather a single
math font,
\type{eul}, which is overlaid with the Palatino typescript.
No sans serif is defined
yet. There is no deliberate scaling of the different type faces.
To establish Euler
as the math font, the code at the beginning of this \TEX\ file
is:
\typebuffer

\getbuffer[eqns]
You may notice that Euler is fairly spaced out, which can be
a detriment when
setting math functions like $\sin$ (\type{$\sin$}). I prefer
to change it so that math functions grab the
{\em emphasized} version of a font. For many people, that means
{\sl slanted},
but I like my emphasis to be {\it italicized}. In some of the
typescripts that follow,
there is no {\sl slanted} face defined, so the {\it italicized}
face is substituted,
using the fallback type definition. From this point in the document
forwards,
I redefine \type{\mfunction} as follows:
\startbuffer
\def\mfunction#1{{\em#1}}
\stopbuffer
\getbuffer
\typebuffer
\getbuffer[eqns]
```

source code of this document

```
\page[even]
\startbuffer
\usetypescriptfile[ts-chart]
\usetypescript[Char]
\switchtobodyfont[Char]
\stopbuffer
\getbuffer
\section{Charter, Helvetica, and Euler}
\input math-knuth-shorter
\page
\input sectioned-mathsample
\page
\showfontstrip

\getbuffer[eqns]

The previous pages used the typescript \type{Char}. This \TEX\
file included
the code:
\typebuffer
which referred to the typescript file \type{ts-chart.tex}, which
includes the
following code:
\typefile[TEX]{ts-chart}

\page[even]
\startbuffer
\usetypescriptfile[ts-antp]
\usetypescript[AntP]
\switchtobodyfont[AntP]
\stopbuffer
\getbuffer
\section{Antykwa Poltawskiego, Avant Garde, and Euler}

\input math-knuth-shortest
\page
\input sectioned-mathsample
\page
\showfontstrip

\getbuffer[eqns]

The previous pages used the typescript \type{AntP}. This \TEX\
file included
the code:
```

source code of this document

```
\typebuffer
which referred to the typescript file \type{ts-antp.tex}. Because
of the very
heavy weight in the Antykwa Poltawskiego font, I included the
Euler-Bold
typescript. The main typescript for this example includes the
following code:
\typefile[TEX]{ts-antp}

\page[even]
\startbuffer
\usetypescriptfile[ts-litr]
\usetypescript[Litr]
\switchtobodyfont[Litr]
\stopbuffer
\getbuffer
\section{Literaturanaya, Avant Garde condensed, and Euler}
\input math-knuth-shortest
\page
\input sectioned-mathsample
\page
\showfontstrip

\getbuffer[eqns]

The previous pages used the typescript \type{Litr}. This \TEX\
file included
the code:
\typebuffer
which referred to the typescript file \type{ts-litr.tex}. I
used the new (to me)
\TEXFONT\ mechanisms to enable the condensed versions of Avant
Garde
and Courier. The typescript file includes the following code:
\typefile[TEX]{ts-litr}
\page
%\switchtobodyfont[palatino,10pt]

The first sample page was provided by Otared Kavian.
It is an excerpt from Donald E. Knuth's book
``The Art of Computer Programming,'' volume~1
Chapter~I, section~2.11.1, pp.~108--109
\typefile[TEX]{math-knuth-short}
\page
The second sample page was adapted from an early draft of the
```

source code of this document

```
\kap{MPEG-7} Audio standard: \kap{ISO/IEC 15938-4:2001}.
\typefile[TEX]{sectioned-mathsample}

\setups [listing] \setups [lastpage] \stoptext
```