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The `l3str-format` package: formatting strings of characters*

The L^AT_EX3 Project[†]

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1 Format specifications

In this module, we introduce the notion of a string $\langle format \rangle$. The syntax follows that of Python's `format` built-in function. A $\langle format specification \rangle$ is a string of the form

$$\langle format specification \rangle = [[\langle fill \rangle] \langle alignment \rangle][\langle sign \rangle][\langle width \rangle][.\langle precision \rangle][\langle style \rangle]$$

where each [...] denotes an independent optional part.

- $\langle fill \rangle$ can be any character: it is assumed to be present whenever the second character of the $\langle format specification \rangle$ is a valid $\langle alignment \rangle$ character.
- $\langle alignment \rangle$ can be `<` (left alignment), `>` (right alignment), `^` (centering), or `=` (for numeric types only).
- $\langle sign \rangle$ is allowed for numeric types; it can be `+` (show a sign for positive and negative numbers), `-` (only put a sign for negative numbers), or a space (show a space or a `-`).
- $\langle width \rangle$ is the minimum number of characters of the result: if the result is naturally shorter than this $\langle width \rangle$, then it is padded with copies of the character $\langle fill \rangle$, with a position depending on the choice of $\langle alignment \rangle$. If the result is naturally longer, it is not truncated.
- $\langle precision \rangle$, whose presence is indicated by a period, can have different meanings depending on the type.
- $\langle style \rangle$ is one character, which controls how the given data should be formatted. The list of allowed $\langle styles \rangle$ depends on the type.

The choice of $\langle alignment \rangle =$ is not implemented yet.

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2 Formatting various data-types

<hr/> <code>\tl_format:Nn</code> ★	<code>\tl_format:nn {<token list>} {<format specification>}</code>
<code>\tl_format:(cn nn)</code> ★	Converts the <i><token list></i> to a string according to the <i><format specification></i> . The <i><style></i> , if present, must be s . If <i><precision></i> is given, all characters of the string representation of the <i><token list></i> beyond the first <i><precision></i> characters are discarded.
<hr/> <code>\seq_format:Nn</code> ★	<code>\seq_format:Nn {<sequence>} {<format specification>}</code>
<code>\seq_format:cn</code> ★	Converts each item in the <i><sequence></i> to a string according to the <i><format specification></i> , and concatenates the results.
<hr/> <code>\int_format:nn</code> ★	<code>\int_format:nn {<intexpr>} {<format specification>}</code>
	Evaluates the <i><integer expression></i> and converts the result to a string according to the <i><format specification></i> . The <i><precision></i> argument is not allowed. The <i><style></i> can be b for binary output, d for decimal output (this is the default), o for octal output, X for hexadecimal output (using capital letters).
<hr/> <code>\fp_format:nn</code> ★	<code>\fp_format:nn {<fpexpr>} {<format specification>}</code>
	Evaluates the <i><floating point expression></i> and converts the result to a string according to the <i><format specification></i> . The <i><precision></i> defaults to 6. The <i><style></i> can be <ul style="list-style-type: none"> • e for scientific notation, with one digit before and <i><precision></i> digits after the decimal separator, and an integer exponent, following e; • f for a fixed point notation, with <i><precision></i> digits after the decimal separator and no exponent; • g for a general format, which uses style f for numbers in the range $[10^{-4}, 10^{<precision>})$ and style e otherwise.

3 Possibilities, and things to do

- Provide a token list formatting *<style>* which keeps the last *<precision>* characters rather than the first *<precision>*.

4 l3str-format implementation

```

1 <*initex | package>
2 <@@=str>
3 <*package>
4 \ProvidesExplPackage
5   {\ExplFileName}{\ExplFileDate}{\ExplFileVersion}{\ExplFileDescription}

```

```

6 \RequirePackage{l3str}
7 </package>

```

4.1 Helpers

```

\use:nf A simple variant.
\use:fnf
8 \cs_generate_variant:Nn \use:nn { nf }
9 \cs_generate_variant:Nn \use:nnn { fnf }
(End definition for \use:nf and \use:fnf)

```

```

\tl_to_str:f A simple variant.
10 \cs_generate_variant:Nn \tl_to_str:n { f }
(End definition for \tl_to_str:f)

```

```

\__str_format_if_digit:NTF Here we expect #1 to be a character with category other, or \s__stop.
11 \prg_new_conditional:Npnn \__str_format_if_digit:N #1 { TF }
12 {
13   \if_int_compare:w \c_nine < 1 #1 \exp_stop_f:
14   \prg_return_true: \else: \prg_return_false: \fi:
15 }
(End definition for \__str_format_if_digit:NTF)

```

```

\__str_format_put:nw Put #1 after an \s__stop delimiter.
\__str_format_put:ow
\__str_format_put:fw
16 \cs_new:Npn \__str_format_put:nw #1 #2 \s__stop { #2 \s__stop #1 }
17 \cs_generate_variant:Nn \__str_format_put:nw { o , f }
(End definition for \__str_format_put:nw, \__str_format_put:ow, and \__str_format_put:fw)

```

4.2 Parsing a format specification

```

\__str_format_parse:n The goal is to parse
\__str_format_parse_i:NN
\__str_format_parse_ii:nN
\__str_format_parse_iii:nN
\__str_format_parse_iv:nwN
\__str_format_parse_v:nN
\__str_format_parse_vi:nwN
\__str_format_parse_vii:nN
\__str_format_parse_end:nwn
28 \cs_new:Npn \__str_format_parse:n #1
29 {
30   \exp_last_unbraced:Nf \__str_format_parse_i:NN
31   \__str_to_other:n {#1} \s__stop \s__stop {#1}
32 }
23 \cs_new:Npx \__str_format_parse_i:NN #1#2
24 {
25   \exp_not:N \__str_if_contains_char:nNTF { < > = ^ } #2
26   { \exp_not:N \__str_format_parse_iii:nN { #1 #2 } }
27   {
28     \exp_not:N \__str_format_parse_ii:nN
29     { \c_catcode_other_space_tl } #1 #2
30   }
31 }
32 \cs_new:Npn \__str_format_parse_ii:nN #1#2
33 {

```

```

34   \_str_if_contains_char:nNTF { < > = ^ } #2
35   { \_str_format_parse_iii:nN { #1 #2 } }
36   { \_str_format_parse_iii:nN { #1 ? } #2 }
37 }
38 \cs_new:Npx \_str_format_parse_iii:nN #1#2
39 {
40   \exp_not:N \_str_if_contains_char:nNTF
41   { + - \c_catcode_other_space_tl }
42   #2
43   { \exp_not:N \_str_format_parse_iv:nwN { #1 #2 } ; }
44   { \exp_not:N \_str_format_parse_iv:nwN { #1 ? } ; #2 }
45 }
46 \cs_new:Npn \_str_format_parse_iv:nwN #1#2; #3
47 {
48   \_str_format_if_digit:NTF #3
49   { \_str_format_parse_iv:nwN {#1} #2 #3 ; }
50   { \_str_format_parse_v:nN { #1 {#2} } #3 }
51 }
52 \cs_new:Npn \_str_format_parse_v:nN #1#2
53 {
54   \token_if_eq_charcode:NNTF . #2
55   { \_str_format_parse_vi:nwN {#1} 0 ; }
56   { \_str_format_parse_vii:nN { #1 { } } #2 }
57 }
58 \cs_new:Npn \_str_format_parse_vi:nwN #1#2; #3
59 {
60   \_str_format_if_digit:NTF #3
61   { \_str_format_parse_vi:nwN {#1} #2 #3 ; }
62   { \_str_format_parse_vii:nN { #1 {#2} } #3 }
63 }
64 \cs_new:Npn \_str_format_parse_vii:nN #1#2
65 {
66   \token_if_eq_meaning:NNTF \s__stop #2
67   { \_str_format_parse_end:nwn { #1 ? } #2 }
68   { \_str_format_parse_end:nwn { #1 #2 } }
69 }
70 \cs_new:Npn \_str_format_parse_end:nwn #1 #2 \s__stop \s__stop #3
71 {
72   \tl_if_empty:nF {#2}
73   { \_msg_kernel_expandable_error:nnn { str } { invalid-format } {#3} }
74   #1
75 }

```

(End definition for `_str_format_parse:n` This function is documented on page ??.)

4.3 Alignment

The 4 functions in this section receive an $\langle body \rangle$, a $\langle sign \rangle$, a $\langle width \rangle$ and a $\langle fill \rangle$ character (exactly one character). For non-numeric types, the $\langle sign \rangle$ is empty and the $\langle body \rangle$ is the (other) string we want to format. For numeric types, we wish to format $\langle sign \rangle \langle body \rangle$

(both are other strings). The alignment types <, > and ^ keep $\langle sign \rangle$ and $\langle body \rangle$ together. The = alignment type, however, inserts the padding between the $\langle sign \rangle$ and the $\langle body \rangle$, hence the need to keep those separate.

`__str_format_align_<:nnnN`

`__str_format_align_<:nnnN { $\langle body \rangle$ } { $\langle sign \rangle$ } { $\langle width \rangle$ } $\langle fill \rangle$`

Aligning “ $\langle sign \rangle$ $\langle body \rangle$ ” to the left entails appending #4 the correct number of times.

Then convert the result to a string.

```

76 \cs_new:cpn { __str_format_align_<:nnnN } #1#2#3#4
77 {
78   \use:nf { #2 #1 }
79   {
80     \prg_replicate:nn
81       { \int_max:nn { #3 - \__str_count_unsafe:n { #2 #1 } } { 0 } }
82       {#4}
83   }
84 }

```

(End definition for `__str_format_align_<:nnnN`)

`__str_format_align_>:nnnN`

`__str_format_align_>:nnnN { $\langle body \rangle$ } { $\langle sign \rangle$ } { $\langle width \rangle$ } $\langle fill \rangle$`

Aligning an “ $\langle sign \rangle$ $\langle body \rangle$ ” to the right entails prepending #4 the correct number of times. Then convert the result to a string.

```

85 \cs_new:cpn { __str_format_align_>:nnnN } #1#2#3#4
86 {
87   \prg_replicate:nn
88     { \int_max:nn { #3 - \__str_count_unsafe:n { #2 #1 } } { 0 } }
89     {#4}
90   #2 #1
91 }

```

(End definition for `__str_format_align_>:nnnN`)

`__str_format_align_^:nnnN`

`__str_format_align_^:nnnN { $\langle body \rangle$ } { $\langle sign \rangle$ } { $\langle width \rangle$ } $\langle fill \rangle$`

Centering “ $\langle sign \rangle$ $\langle body \rangle$ ” entails prepending and appending #4 the correct number of times. If the number of #4 to be added is odd, we add one more after than before.

```

92 \cs_new:cpn { __str_format_align_^:nnnN } #1#2#3#4
93 {
94   \use:fnf
95   {
96     \prg_replicate:nn
97       {
98         \int_max:nn \c_zero
99         { #3 - \__str_count_unsafe:n { #2 #1 } - \c_one }
100       / \c_two
101     }
102     {#4}
103   }
104   { #2 #1 }
105   {
106     \prg_replicate:nn

```

```

107     {
108         \int_max:nn \c_zero
109         { #3 - \__str_count_unsafe:n { #2 #1 } }
110         / \c_two
111     }
112     {#4}
113 }
114 }

```

`__str_format_align=:nnnN`

`__str_format_align=:nnnN {<body>} {<sign>} {<width>} <fill>`

The special numeric alignment = means that we insert the appropriate number of copies of #4 between the <sign> and the <body>. Then convert the result to a string.

```

115 \cs_new:cpn { __str_format_align=:nnnN } #1#2#3#4
116 {
117     \use:nf {#2}
118     {
119         \prg_replicate:nn
120         { \int_max:nn { #3 - \__str_count_unsafe:n { #2 #1 } } { 0 } }
121         {#4}
122     }
123     #1
124 }

```

(End definition for `__str_format_align=:nnnN`)

4.4 Formatting token lists

`\tl_format:Nn` Call `__str_format_tl:NNNnnNn` to read the parsed <format specification>. Then convert the result to a string.

```

\tl_format:cn
\tl_format:nn
125 \cs_new_nopar:Npn \tl_format:Nn { \exp_args:No \tl_format:nn }
126 \cs_generate_variant:Nn \tl_format:Nn { c }
127 \cs_new:Npn \tl_format:nn #1#2
128 {
129     \tl_to_str:f
130     {
131         \exp_last_unbraced:Nf \__str_format_tl:NNNnnNn
132         { \__str_format_parse:n {#2} }
133         {#1}
134     }
135 }

```

(End definition for `\tl_format:Nn`, `\tl_format:cn`, and `\tl_format:nn` These functions are documented on page ??.)

`__str_format_tl:NNNnnNn`

`__str_format_tl:NNNnnNn <fill> <alignment> <sign> {<width>} {<precision>} <style> {<token list>}`

First check that the <alignment> is not =, and set the default alignment ? to <. Place the modified information after a trailing `\s__stop` for later retrieval. Then check that there was no <sign>. The width will be useful later, store it after `\s__stop`. Afterwards, check the <precision>: if it is empty, we will eventually use the whole string, otherwise we

will only use a substring, starting at the index 1, and ending at #5. There is a need to use the “unsafe” function, as otherwise leading spaces would get stripped by f-expansion. Finally, check that the $\langle style \rangle$ is ? or s.

```

136 \cs_new:Npn \__str_format_tl:NNNnnNn #1#2#3#4#5#6
137 {
138   \token_if_eq_charcode:NNTF #2 =
139   {
140     \__msg_kernel_expandable_error:nnnn
141     { str } { invalid-align-format } {#2} {tl}
142     \__str_format_put:nw { #1 < }
143   }
144   {
145     \token_if_eq_charcode:NNTF #2 ?
146     { \__str_format_put:nw { #1 < } }
147     { \__str_format_put:nw { #1 #2 } }
148   }
149   \token_if_eq_charcode:NNTF #3 ?
150   {
151     \__msg_kernel_expandable_error:nnnn
152     { str } { invalid-sign-format } {#3} {tl}
153   }
154   \__str_format_put:nw { {#4} }
155   \tl_if_empty:nTF {#5}
156   { \__str_format_put:nw { \use:n { } } }
157   { \__str_format_put:nw { \__str_substr_unsafe:nnn { {1} {#5} } } }
158   \token_if_eq_charcode:NNTF #6 s
159   {
160     \token_if_eq_charcode:NNTF #6 ?
161     {
162       \__msg_kernel_expandable_error:nnnn
163       { str } { invalid-style-format } {#6} {tl}
164     }
165   }
166   \__str_format_tl_s:NNnnNNn
167   \s__stop
168 }

```

(End definition for __str_format_tl:NNNnnNn)

```

\__str_format_tl_s:NNnnNNn \__str_format_tl_s:NNnnNNn \s__stop <function> {<arguments>} {<width>}
<fill> <alignment> {<token list>}

```

The $\langle function \rangle$ and $\langle arguments \rangle$ are built in such a way that f-expanding $\langle function \rangle$ { $\langle other string \rangle$ } $\langle arguments \rangle$ yields the piece of the $\langle other string \rangle$ that we want to output. The $\langle other string \rangle$ is built from the $\langle token list \rangle$ by f-expanding __str_to_other:n.

```

169 \cs_new:Npn \__str_format_tl_s:NNnnNNn #1#2#3#4#5#6#7
170 {
171   \exp_args:Nc \exp_args:Nf
172   { \__str_format_align_#6:nnnN }
173   { \exp_args:Nf #2 { \__str_to_other:n {#7} } #3 }
174   { }

```



```

175         {#4} #5
176     }
(End definition for \_str_format_tl_s:NNnnNNn)

```

4.5 Formatting sequences

`\seq_format:Nn` Each item is formatted as a token list according to the specification. First parse the
`\seq_format:cn` format and expand the sequence, then loop through the items. Eventually, convert to a string.

```

177 \cs_new:Npn \seq_format:Nn #1#2
178 {
179     \tl_to_str:f
180     { \_str_format_seq:of {#1} { \_str_format_parse:n {#2} } }
181 }
182 \cs_generate_variant:Nn \seq_format:Nn { c }
(End definition for \seq_format:Nn and \seq_format:cn These functions are documented on page ??.)

```

`_str_format_seq:nn` The first argument is the contents of a `seq` variable. The second is a parsed *format specification*. Set up the loop.

```

183 \cs_new:Npn \_str_format_seq:nn #1#2
184 {
185     \_str_format_seq_loop:nnNn { } {#2}
186     #1
187     { ? \_str_format_seq_end:w } { }
188 }
189 \cs_generate_variant:Nn \_str_format_seq:nn { of }
(End definition for \_str_format_seq:nn and \_str_format_seq:of)

```

```

\_str_format_seq_loop:nnNn \_str_format_seq_loop:nnNn {<done>} {<parsed format>} \_seq_item:n
{<item>}

```

The first argument is the result of formatting the items read so far. The third argument is a single token (`_seq_item:n`), until we reach the end of the sequence, where `\use_none:n #3` ends the loop.

```

190 \cs_new:Npn \_str_format_seq_loop:nnNn #1#2#3#4
191 {
192     \use_none:n #3
193     \exp_args:Nf \_str_format_seq_loop:nnNn
194     { \use:nf {#1} { \_str_format_tl:NNnnNNn #2 {#4} } }
195     {#2}
196 }
(End definition for \_str_format_seq_loop:nnNn)

```

`_str_format_seq_end:w` Pick the right piece in the loop above.

```

197 \cs_new:Npn \_str_format_seq_end:w #1#2#3#4 { \use_ii:nnn #3 }
(End definition for \_str_format_seq_end:w)

```

4.6 Formatting integers

`\int_format:nn` Evaluate the first argument and feed it to `__str_format_int:nn`.

```
198 \cs_new:Npn \int_format:nn #1
199   { \exp_args:Nf \__str_format_int:nn { \int_eval:n {#1} } }
(End definition for \int_format:nn This function is documented on page 3.)
```

`__str_format_int:nn` Parse the *<format specification>* and feed it to `__str_format_int:NNNnnNn`. Then convert the result to a string

```
200 \cs_new:Npn \__str_format_int:nn #1#2
201   {
202     \tl_to_str:f
203     {
204       \exp_last_unbraced:Nf \__str_format_int:NNNnnNn
205       { \__str_format_parse:n {#2} }
206       {#1}
207     }
208   }
(End definition for \__str_format_int:nn)
```

`__str_format_int:NNNnnNn` `__str_format_int:NNNnnNn <fill> <alignment> <sign> {<width>} {<precision>} <style> {<integer>}`

First set the default alignment ? to >. Place the modified information after a trailing `\s__stop` for later retrieval. Then check the *<sign>*: if the integer is negative, always put -. Otherwise, if the format's *<sign>* is ~, put a space (with category "other"); if it is + put +; if it is - (default), put nothing, represented as a brace group. The width #4 will be useful later, store it after `\s__stop`. Afterwards, check that the *<precision>* was absent. Finally, dispatch depending on the *<style>*.

```
209 \cs_new:Npn \__str_format_int:NNNnnNn #1#2#3#4#5#6#7
210   {
211     \token_if_eq_charcode:NNTF #2 ?
212     { \__str_format_put:nw { #1 > } }
213     { \__str_format_put:nw { #1 #2 } }
214     \int_compare:nNnTF {#7} < \c_zero
215     { \__str_format_put:nw { - } }
216     {
217       \str_case:nnn {#3}
218       {
219         { ~ } { \__str_format_put:ow { \c_catcode_other_space_tl } }
220         { + } { \__str_format_put:nw { + } }
221       }
222       { \__str_format_put:nw { { } } }
223     }
224     \__str_format_put:nw { {#4} }
225     \tl_if_empty:nF {#5}
226     {
227       \__msg_kernel_expandable_error:nnnn
228       { str } { invalid-precision-format } {#5} {int}
229     }
```

```

230 \str_case:nnn {#6}
231 {
232   { ? } { \__str_format_int:NwnnNNn \use:n }
233   { d } { \__str_format_int:NwnnNNn \use:n }
234   { b } { \__str_format_int:NwnnNNn \int_to_binary:n }
235   { o } { \__str_format_int:NwnnNNn \int_to_octal:n }
236   { X } { \__str_format_int:NwnnNNn \int_to_hexadecimal:n }
237 }
238 {
239   \__msg_kernel_expandable_error:nnnn
240   { str } { invalid-style-format } {#6} { int }
241   \__str_format_int:NwnnNNn \use:n
242 }
243 \s__stop {#7}
244 }

```

(End definition for __str_format_int:NwnnNNn)

```

\__str_format_int:NwnnNNn \__str_format_int:NwnnNNn <function> \s__stop {<width>} {<sign>} <fill>
<alignment> {<integer>}

```

Use the `format_align` function corresponding to the *<alignment>*, with the following arguments:

- the string formed by combining the sign *#4* with the result of converting the absolute value of the *<integer>* *#7* according to the conversion function *#1*;
- the *<width>*;
- the *<fill>* character.

```

245 \cs_new:Npn \__str_format_int:NwnnNNn #1#2 \s__stop #3#4#5#6#7
246 {
247   \exp_args:Nc \exp_args:Nf
248   { \__str_format_align_#6:nnnN }
249   { #1 { \int_abs:n {#7} } }
250   {#4}
251   {#3} #5
252 }

```

(End definition for __str_format_int:NwnnNNn)

4.7 Formatting floating points

\fp_format:nn Evaluate the first argument to an internal floating point number, and feed it to `__str_format_fp:nn`.

```

253 \cs_new:Npn \fp_format:nn #1
254 { \exp_args:Nf \__str_format_fp:nn { \__fp_parse:n {#1} } }

```

(End definition for \fp_format:nn This function is documented on page 3.)

`__str_format_fp:nn` Parse the $\langle format\ specification \rangle$ and feed it to `__str_format_fp:NNNnnNn`. Then convert the result to a string

```

255 \cs_new:Npn \__str_format_fp:nn #1#2
256 {
257   \tl_to_str:f
258   {
259     \exp_last_unbraced:Nf \__str_format_fp:NNNnnNw
260     { \__str_format_parse:n {#2} }
261     #1
262   }
263 }

```

(End definition for `__str_format_fp:nn`)

`__str_format_fp:NNNnnNw` `__str_format_fp:NNNnnNw` $\langle fill \rangle$ $\langle alignment \rangle$ $\langle format\ sign \rangle$ $\{ \langle width \rangle \}$ $\{ \langle precision \rangle \}$ $\langle style \rangle$ `\s_fp` `__fp_chk:w` $\langle fp\ type \rangle$ $\langle fp\ sign \rangle$ $\langle fp\ body \rangle$;

First set the default alignment ? to >. Place the modified information after a trailing `\s__stop` for later retrieval. Then check the $\langle format\ sign \rangle$ and the $\langle fp\ sign \rangle$: if the floating point is negative, always put -. Otherwise (including nan), if the format's $\langle sign \rangle$ is ~, put a space (with category "other"); if it is + put +; if it is - (default), put nothing, represented as a brace group. The width #4 will be useful later, store it after `\s__stop`. Afterwards, check the $\langle precision \rangle$: if it was not given, replace it by 6 (default precision). Finally, dispatch depending on the $\langle style \rangle$.

```

264 \cs_new:Npn \__str_format_fp:NNNnnNw
265   #1#2#3#4#5#6 \s_fp \__fp_chk:w #7 #8
266 {
267   \token_if_eq_charcode:NNTF #2 ?
268   { \__str_format_put:nw { #1 > } }
269   { \__str_format_put:nw { #1 #2 } }
270   \token_if_eq_meaning:NNTF 2 #8
271   { \__str_format_put:nw { - } }
272   {
273     \str_case:nnn {#3}
274     {
275       { ~ } { \__str_format_put:ow { \c_catcode_other_space_tl } }
276       { + } { \__str_format_put:nw { + } }
277     }
278     { \__str_format_put:nw { { } } }
279   }
280   \__str_format_put:nw { {#4} }
281   \tl_if_empty:nTF {#5}
282   { \__str_format_put:nw { { 6} } }
283   { \__str_format_put:nw { {#5} } }
284   \str_case:nnn {#6}
285   {
286     { e } { \__str_format_fp:wnnnNNw \__str_format_fp_e:wn }
287     { f } { \__str_format_fp:wnnnNNw \__str_format_fp_f:wn }
288     { g } { \__str_format_fp:wnnnNNw \__str_format_fp_g:wn }
289     { ? } { \__str_format_fp:wnnnNNw \__str_format_fp_g:wn }

```

```

290     }
291     {
292         \__msg_kernel_expandable_error:nnnn
293         { str } { invalid-style-format } {#6} { fp }
294         \__str_format_fp:wnnnNNw \__str_format_fp_g:wn
295     }
296     \s__stop
297     \s__fp \__fp_chk:w #7 #8
298 }

```

(End definition for __str_format_fp:NNnnNNw)

```

\__str_format_fp:wnnnNNw \__str_format_fp:wnnnNNw <formatting function> \s__stop {<precision>}
{<width>} {<sign>} <fill> <alignment> \s__fp \__fp_chk:w <fp type> <fp sign>
<fp body> ;

```

```

299 \cs_new:Npn \__str_format_fp:wnnnNNw
300     #1 \s__stop #2 #3 #4 #5#6 #7 ;
301 {
302     \exp_args:Nc \exp_args:Nf
303     { \__str_format_align_#6:nnnN }
304     { #1 #7 ; {#2} }
305     {#4}
306     {#3} #5
307 }

```

(End definition for __str_format_fp:wnnnNNw)

__str_format_fp_round:wn Round the given floating point (not its absolute value, to play nicely with unusual rounding modes).

```

308 \cs_new:Npn \__str_format_fp_round:wn #1 ; #2
309 { \__fp_parse:n { round ( #1; , #2 - \__fp_exponent:w #1; ) } }

```

(End definition for __str_format_fp_round:wn)

__str_format_fp_e:wn __str_format_fp_e_ii:wn With the e type, first filter out special cases. In the normal case, round to #4+1 significant figures (one before the decimal separator, #4 after).

```

310 \group_begin:
311 \char_set_catcode_other:N E
312 \tl_to_lowercase:n
313 {
314     \group_end:
315     \cs_new:Npn \__str_format_fp_e:wn \s__fp \__fp_chk:w #1#2#3 ; #4
316     {
317         \int_case:nnn {#1}
318         {
319             {0} { \use:nf { 0 . } { \prg_replicate:nn {#4} { 0 } } e 0 }
320             {2} { inf }
321             {3} { nan }
322         }
323         {
324             \exp_last_unbraced:Nf \__str_format_fp_e_ii:wn

```

```

325         \_str_format_fp_round:wn \s__fp \_fp_chk:w #1#2#3 ; { #4 + 1 }
326         {#4}
327     }
328 }
329 \cs_new:Npn \_str_format_fp_e_ii:wn
330   \s__fp \_fp_chk:w #1#2 #3 #4#5#6#7 ; #8
331   {
332     \_str_format_put:fw { \int_eval:n { #3 - 1 } }
333     \_str_format_put:nw { e }
334     \int_compare:nNnTF {#8} > \c_sixteen
335     {
336       \_str_format_put:fw { \prg_replicate:nn { #8 - \c_fifteen } {0} }
337       \_str_format_put:fw { \use_none:n #4#5#6#7 }
338     }
339     {
340       \_str_format_put:fw
341       { \str_substr:nnn { #4#5#6#7 0 } { 2 } { #8 + 1 } }
342     }
343     \_str_format_put:fw { \use_i:nnnn #4 . }
344     \use_none:n \s__stop
345   }
346 }

```

(End definition for _str_format_fp_e:wn This function is documented on page 3.)

_str_format_fp_f:wn
_str_format_fp_f_ii:wwn

With the **f** type, first filter out special cases. In the normal case, round to #4 (absolute) decimal places.

```

347 \cs_new:Npn \_str_format_fp_f:wn \s__fp \_fp_chk:w #1#2#3 ; #4
348   {
349     \int_case:nnn {#1}
350     {
351       {0} { \use:nf { 0 . } { \prg_replicate:nn {#4} { 0 } } }
352       {2} { inf }
353       {3} { nan }
354     }
355     {
356       \exp_last_unbraced:Nf \_str_format_fp_f_ii:wwwn
357       \fp_to_decimal:n
358       { abs ( round ( \s__fp \_fp_chk:w #1#2#3 ; , #4 ) ) }
359       . . ;
360       {#4}
361     }
362   }
363 \cs_new:Npn \_str_format_fp_f_ii:wwwn #1 . #2 . #3 ; #4
364   {
365     \use:nf
366     { #1 . #2 }
367     { \prg_replicate:nn { #4 - \_str_count_unsafe:n {#2} } {0} }
368   }

```

(End definition for _str_format_fp_f:wn This function is documented on page 3.)

`_str_format_fp_g:wn` With the `g` type, first filter out special cases. In the normal case, round to **#4** significant figures, then test the exponent: if $-4 \leq \langle exponent \rangle < \langle precision \rangle$, use the presentation type `f`, otherwise use the presentation type `e`. Also, a $\langle precision \rangle$ of 0 is treated like a precision of 1. Actually, we don't reuse the `e` and `f` auxiliaries, because we want to trim trailing zeros. Thankfully, this is done by `\fp_to_decimal:n` and `\fp_to_scientific:n`, acting on the (absolute value of the) rounded value.

```

369 \cs_new:Npn \_str_format_fp_g:wn \s__fp \_fp_chk:w #1#2 ; #3
370 {
371   \int_case:nnn {#1}
372   {
373     {0} { 0 }
374     {2} { inf }
375     {3} { nan }
376   }
377   {
378     \exp_last_unbraced:Nf \_str_format_fp_g_ii:wn
379     \_str_format_fp_round:wn \s__fp \_fp_chk:w #1#2 ;
380     { \int_max:nn {1} {#3} }
381     { \int_max:nn {1} {#3} }
382   }
383 }
384 \cs_new:Npn \_str_format_fp_g_ii:wn #1; #2
385 {
386   \int_compare:nNnTF { \_fp_exponent:w #1; } < { -3 }
387   { \fp_to_scientific:n }
388   {
389     \int_compare:nNnTF { \_fp_exponent:w #1; } > {#2}
390     { \fp_to_scientific:n }
391     { \fp_to_decimal:n }
392   }
393   { \_fp_abs_o:w #1; \prg_do_nothing: }
394 }

```

(End definition for `_str_format_fp_g:wn` This function is documented on page 3.)

4.8 Messages

All of the messages are produced expandably, so there is no need for an extra-text.

```

395 \_msg_kernel_new:nnn { str } { invalid-format }
396 { Invalid~format~'#1'. }
397 \_msg_kernel_new:nnn { str } { invalid-align-format }
398 { Invalid~alignment~'#1'~for~type~'#2'. }
399 \_msg_kernel_new:nnn { str } { invalid-sign-format }
400 { Invalid~sign~'#1'~for~type~'#2'. }
401 \_msg_kernel_new:nnn { str } { invalid-precision-format }
402 { Invalid~precision~'#1'~for~type~'#2'. }
403 \_msg_kernel_new:nnn { str } { invalid-style-format }
404 { Invalid~style~'#1'~for~type~'#2'. }

```

4.9 Todos

- Check what happens during floating point formatting when a number is rounded to 0 or ∞ . I think the `e` and `f` types break horribly.

405 `</initex | package>`

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