Modul:ConvertNumeric

Usage

{{#invoke:ConvertNumeric|*function_name*}}

See also

- Vorlage:Tl
- Vorlage:Tl
- Module:StripToNumbers - extract a number from a string (supports negatives and decimals) and return it, or optionally return a halved value

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```
-- Module for converting between different representations of numbers. See talk page for user docu
-- For unit tests see: [[Module:ConvertNumeric/testcases]]
-- When editing, preview with: [[Module_talk:ConvertNumeric/testcases]]
-- First, edit [[Module:ConvertNumeric/sandbox]], then preview with [[Module_talk:ConvertNumeric/s

local ones_position = {
        [0] = 'zero',
        [1] = 'one',
        [2] = 'two',
        [3] = 'three',
        [4] = 'four',
        [5] = 'five',
        [6] = 'six',
        [7] = 'seven',
        [8] = 'eight',
        [9] = 'nine',
        [10] = 'ten',
        [11] = 'eleven',
        [12] = 'twelve',
        [13] = 'thirteen',
        [14] = 'fourteen',
        [15] = 'fifteen',
        [16] = 'sixteen',
        [17] = 'seventeen',
        [18] = 'eighteen',
        [19] = 'nineteen'
}

local ones_position_ord = {
        [0] = 'zeroth',
        [1] = 'first',
        [2] = 'second',
        [3] = 'third',
```

```
        [4] = 'fourth',
        [5] = 'fifth',
        [6] = 'sixth',
        [7] = 'seventh',
        [8] = 'eighth',
        [9] = 'ninth',
        [10] = 'tenth',
        [11] = 'eleventh',
        [12] = 'twelfth',
        [13] = 'thirteenth',
        [14] = 'fourteenth',
        [15] = 'fifteenth',
        [16] = 'sixteenth',
        [17] = 'seventeenth',
        [18] = 'eighteenth',
        [19] = 'nineteenth'
}

local ones_position_plural = {
        [0] = 'zeros',
        [1] = 'ones',
        [2] = 'twos',
        [3] = 'threes',
        [4] = 'fours',
        [5] = 'fives',
        [6] = 'sixes',
        [7] = 'sevens',
        [8] = 'eights',
        [9] = 'nines',
        [10] = 'tens',
        [11] = 'elevens',
        [12] = 'twelves',
        [13] = 'thirteens',
        [14] = 'fourteens',
        [15] = 'fifteens',
        [16] = 'sixteens',
        [17] = 'seventeens',
        [18] = 'eighteens',
        [19] = 'nineteens'
}

local tens_position = {
        [2] = 'twenty',
        [3] = 'thirty',
        [4] = 'forty',
        [5] = 'fifty',
        [6] = 'sixty',
        [7] = 'seventy',
        [8] = 'eighty',
        [9] = 'ninety'
}
```

```
local tens_position_ord = {
        [2] = 'twentieth',
        [3] = 'thirtieth',
        [4] = 'fortieth',
        [5] = 'fiftieth',
        [6] = 'sixtieth',
        [7] = 'seventieth',
        [8] = 'eightieth',
        [9] = 'ninetieth'
}

local tens_position_plural = {
        [2] = 'twenties',
        [3] = 'thirties',
        [4] = 'forties',
        [5] = 'fifties',
        [6] = 'sixties',
        [7] = 'seventies',
        [8] = 'eighties',
        [9] = 'nineties'
}

local groups = {
        [1] = 'thousand',
        [2] = 'million',
        [3] = 'billion',
        [4] = 'trillion',
        [5] = 'quadrillion',
        [6] = 'quintillion',
        [7] = 'sextillion',
        [8] = 'septillion',
        [9] = 'octillion',
        [10] = 'nonillion',
        [11] = 'decillion',
        [12] = 'undecillion',
        [13] = 'duodecillion',
        [14] = 'tredecillion',
        [15] = 'quattuordecillion',
        [16] = 'quindecillion',
        [17] = 'sexdecillion',
        [18] = 'septendecillion',
        [19] = 'octodecillion',
        [20] = 'novemdecillion',
        [21] = 'vigintillion',
        [22] = 'unvigintillion',
        [23] = 'duovigintillion',
        [24] = 'tresvigintillion',
        [25] = 'quattuorvigintillion',
        [26] = 'quinquavigintillion',
        [27] = 'sesvigintillion',
        [28] = 'septemvigintillion',
        [29] = 'octovigintillion',
```

```
        [30] = 'novemvigintillion',
        [31] = 'trigintillion',
        [32] = 'untrigintillion',
        [33] = 'duotrigintillion',
        [34] = 'trestrigintillion',
        [35] = 'quattuortrigintillion',
        [36] = 'quinquatrigintillion',
        [37] = 'sestrigintillion',
        [38] = 'septentrigintillion',
        [39] = 'octotrigintillion',
        [40] = 'noventrigintillion',
        [41] = 'quadragintillion',
        [51] = 'quinquagintillion',
        [61] = 'sexagintillion',
        [71] = 'septuagintillion',
        [81] = 'octogintillion',
        [91] = 'nonagintillion',
        [101] = 'centillion',
        [102] = 'uncentillion',
        [103] = 'duocentillion',
        [104] = 'trescentillion',
        [111] = 'decicentillion',
        [112] = 'undecicentillion',
        [121] = 'viginticentillion',
        [122] = 'unviginticentillion',
        [131] = 'trigintacentillion',
        [141] = 'quadragintacentillion',
        [151] = 'quinquagintacentillion',
        [161] = 'sexagintacentillion',
        [171] = 'septuagintacentillion',
        [181] = 'octogintacentillion',
        [191] = 'nonagintacentillion',
        [201] = 'ducentillion',
        [301] = 'trecentillion',
        [401] = 'quadringentillion',
        [501] = 'quingentillion',
        [601] = 'sescentillion',
        [701] = 'septingentillion',
        [801] = 'octingentillion',
        [901] = 'nongentillion',
        [1001] = 'millinillion',
}

local roman_numerals = {
        I = 1,
        V = 5,
        X = 10,
        L = 50,
        C = 100,
        D = 500,
        M = 1000
}
```

```
local engord_tens_end  = {
        ['twentieth']        = 20,
        ['thirtieth']        = 30,
        ['fortieth']        = 40,
        ['fiftieth']        = 50,
        ['sixtieth']        = 60,
        ['seventieth']        = 70,
        ['eightieth']        = 80,
        ['ninetieth']        = 90,
}

local eng_tens_cont = {
        ['twenty']        = 20,
        ['thirty']        = 30,
        ['forty']        = 40,
        ['fifty']        = 50,
        ['sixty']        = 60,
        ['seventy']        = 70,
        ['eighty']        = 80,
        ['ninety']        = 90,
}

-- Converts a given valid roman numeral (and some invalid roman numerals) to a number. Returns { ·
local function roman_to_numeral(roman)
        if type(roman) ~= "string" then return -1, "roman numeral not a string" end
        local rev = roman:reverse()
        local raising = true
        local last = 0
        local result = 0
        for i = 1, #rev do
                local c = rev:sub(i, i)
                local next = roman_numerals[c]
                if next == nil then return -1, "roman numeral contains illegal character " .. c er
                if next > last then
                        result = result + next
                        raising = true
                elseif next < last then
                        result = result - next
                        raising = false
                elseif raising then
                        result = result + next
                else
                        result = result - next
                end
                last = next
        end
        return result
end

-- Converts a given integer between 0 and 100 to English text (e.g. 47 -> forty-seven).
local function numeral_to_english_less_100(num, ordinal, plural, zero)
```

```
	local terminal_ones, terminal_tens
	if ordinal then
		terminal_ones = ones_position_ord
		terminal_tens = tens_position_ord
	elseif plural then
		terminal_ones = ones_position_plural
		terminal_tens = tens_position_plural
	else
		terminal_ones = ones_position
		terminal_tens = tens_position
	end

	if num == 0 and zero ~= nil then
		return zero
	elseif num < 20 then
		return terminal_ones[num]
	elseif num % 10 == 0 then
		return terminal_tens[num / 10]
	else
		return tens_position[math.floor(num / 10)] .. '-' .. terminal_ones[num % 10]
	end
end

local function standard_suffix(ordinal, plural)
	if ordinal then return 'th' end
	if plural then return 's' end
	return ''
end

-- Converts a given integer (in string form) between 0 and 1000 to English text (e.g. 47 -> forty-
local function numeral_to_english_less_1000(num, use_and, ordinal, plural, zero)
	num = tonumber(num)
	if num < 100 then
		return numeral_to_english_less_100(num, ordinal, plural, zero)
	elseif num % 100 == 0 then
		return ones_position[num/100] .. ' hundred' .. standard_suffix(ordinal, plural)
	else
		return ones_position[math.floor(num/100)] .. ' hundred ' .. (use_and and 'and ' or
	end
end

-- Converts an ordinal in English text from 'zeroth' to 'ninety-ninth' inclusive to a number [0–99
local function english_to_ordinal(english)
	local eng = string.lower(english or '')

	local engord_lt20 = {} -- ones_position_ord{} keys & values swapped
	for k, v in pairs( ones_position_ord ) do
		engord_lt20[v] = k
	end

	if engord_lt20[eng] then
		return engord_lt20[eng] -- e.g. first -> 1
```

```
        elseif engord_tens_end[eng] then
                return engord_tens_end[eng] -- e.g. ninetieth -> 90
        else
                local tens, ones = string.match(eng, '^([a-z]+)[%s%-]+([a-z]+)$')
                if tens and ones then
                        local tens_cont = eng_tens_cont[tens]
                        local ones_end  = engord_lt20[ones]
                        if tens_cont and ones_end then
                                return tens_cont + ones_end -- e.g. ninety-ninth -> 99
                        end
                end
        end
        return -1 -- Failed
end

-- Converts a number in English text from 'zero' to 'ninety-nine' inclusive to a number [0–99], el
local function english_to_numeral(english)
        local eng = string.lower(english or '')

        local eng_lt20 = { ['single'] = 1 } -- ones_position{} keys & values swapped
        for k, v in pairs( ones_position ) do
                eng_lt20[v] = k
        end

        if eng_lt20[eng] then
                return eng_lt20[eng] -- e.g. one -> 1
        elseif eng_tens_cont[eng] then
                return eng_tens_cont[eng] -- e.g. ninety -> 90
        else
                local tens, ones = string.match(eng, '^([a-z]+)[%s%-]+([a-z]+)$')
                if tens and ones then
                        local tens_cont = eng_tens_cont[tens]
                        local ones_end  = eng_lt20[ones]
                        if tens_cont and ones_end then
                                return tens_cont + ones_end -- e.g. ninety-nine -> 99
                        end
                end
        end
        return -1 -- Failed
end

-- Converts a number expressed as a string in scientific notation to a string in standard decimal
-- e.g. 1.23E5 -> 123000, 1.23E-5 = .0000123. Conversion is exact, no rounding is performed.
local function scientific_notation_to_decimal(num)
        local exponent, subs = num:gsub("^%-?%d*%.?%d*%-?[Ee]([+%-]?%d+)$", "%1")
        if subs == 0 then return num end  -- Input not in scientific notation, just return unmodi
        exponent = tonumber(exponent)

        local negative = num:find("^%-")
        local _, decimal_pos = num:find("%.")
        -- Mantissa will consist of all decimal digits with no decimal point
        local mantissa = num:gsub("^%-?(%d*)%.?(%d*)%-?[Ee][+%-]?%d+$", "%1%2")
```

```
        if negative and decimal_pos then decimal_pos = decimal_pos - 1 end
        if not decimal_pos then decimal_pos = #mantissa + 1 end

        -- Remove leading zeros unless decimal point is in first position
        while decimal_pos > 1 and mantissa:sub(1,1) == '0' do
                mantissa = mantissa:sub(2)
                decimal_pos = decimal_pos - 1
        end
        -- Shift decimal point right for exponent > 0
        while exponent > 0 do
                decimal_pos = decimal_pos + 1
                exponent = exponent - 1
                if decimal_pos > #mantissa + 1 then mantissa = mantissa .. '0' end
                -- Remove leading zeros unless decimal point is in first position
                while decimal_pos > 1 and mantissa:sub(1,1) == '0' do
                        mantissa = mantissa:sub(2)
                        decimal_pos = decimal_pos - 1
                end
        end
        -- Shift decimal point left for exponent < 0
        while exponent < 0 do
                if decimal_pos == 1 then
                        mantissa = '0' .. mantissa
                else
                        decimal_pos = decimal_pos - 1
                end
                exponent = exponent + 1
        end

        -- Insert decimal point in correct position and return
        return (negative and '-' or '') .. mantissa:sub(1, decimal_pos - 1) .. '.' .. mantissa:sub
end

-- Rounds a number to the nearest integer (NOT USED)
local function round_num(x)
        if x%1 >= 0.5 then
                return math.ceil(x)
        else
                return math.floor(x)
        end
end

-- Rounds a number to the nearest two-word number (round = up, down, or "on" for round to nearest)
-- Numbers with two digits before the decimal will be rounded to an integer as specified by round.
-- Larger numbers will be rounded to a number with only one nonzero digit in front and all other d
-- Negative sign is preserved and does not count towards word limit.
local function round_for_english(num, round)
        -- If an integer with at most two digits, just return
        if num:find("^%-?%d?%d%.?$") then return num end

        local negative = num:find("^%-")
        if negative then
```

```
                -- We're rounding magnitude so flip it
                if round == 'up' then round = 'down' elseif round == 'down' then round = 'up' end
        end

        -- If at most two digits before decimal, round to integer and return
        local _, _, small_int, trailing_digits, round_digit = num:find("^%-?(%d?%d?)%.((%d)%d*)$")
        if small_int then
                if small_int == '' then small_int = '0' end
                if (round == 'up' and trailing_digits:find('[1-9]')) or (round == 'on' and tonumbe
                        small_int = tostring(tonumber(small_int) + 1)
                end
                return (negative and '-' or '') .. small_int
        end

        -- When rounding up, any number with > 1 nonzero digit will round up (e.g. 1000000.001 rou
        local nonzero_digits = 0
        for digit in num:gfind("[1-9]") do
                nonzero_digits = nonzero_digits + 1
        end

        num = num:gsub("%.%d*$", "") -- Remove decimal part
        -- Second digit used to determine which way to round lead digit
        local _, _, lead_digit, round_digit, round_digit_2, rest = num:find("^%-?(%d)(%d)(%d)(%d*)
        if tonumber(lead_digit .. round_digit) < 20 and (1 + #rest) % 3 == 0 then
                -- In English numbers < 20 are one word so put 2 digits in lead and round based on
                lead_digit = lead_digit .. round_digit
                round_digit = round_digit_2
        else
                rest = round_digit_2 .. rest
        end

        if (round == 'up' and nonzero_digits > 1) or (round == 'on' and tonumber(round_digit) >= 5
                lead_digit = tostring(tonumber(lead_digit) + 1)
        end
        -- All digits but lead digit will turn to zero
        rest = rest:gsub("%d", "0")
        return (negative and '-' or '') .. lead_digit .. '0' .. rest
end

local denominators = {
        [2] = { 'half', plural = 'halves' },
        [3] = { 'third' },
        [4] = { 'quarter', us = 'fourth' },
        [5] = { 'fifth' },
        [6] = { 'sixth' },
        [8] = { 'eighth' },
        [9] = { 'ninth' },
        [10] = { 'tenth' },
        [16] = { 'sixteenth' },
}

-- Return status, fraction where:
```

```
-- status is a string:
--     "finished" if there is a fraction with no whole number;
--     "ok" if fraction is empty or valid;
--     "unsupported" if bad fraction;
-- fraction is a string giving (numerator / denominator) as English text, or is "".
-- Only unsigned fractions with a very limited range of values are supported,
-- except that if whole is empty, the numerator can use "-" to indicate negative.
-- whole (string or nil): nil or "" if no number before the fraction
-- numerator (string or nil): numerator, if any (default = 1 if a denominator is given)
-- denominator (string or nil): denominator, if any
-- sp_us (boolean): true if sp=us
-- negative_word (string): word to use for negative sign, if whole is empty
-- use_one (boolean): false: 2+1/2 → "two and a half"; true: "two and one-half"
local function fraction_to_english(whole, numerator, denominator, sp_us, negative_word, use_one)
        if numerator or denominator then
                local finished = (whole == nil or whole == '')
                local sign = ''
                if numerator then
                        if finished and numerator:sub(1, 1) == '-' then
                                numerator = numerator:sub(2)
                                sign = negative_word .. ' '
                        end
                else
                        numerator = '1'
                end
                if not numerator:match('^%d+$') or not denominator or not denominator:match('^%d+$
                        return 'unsupported', ''
                end
                numerator = tonumber(numerator)
                denominator = tonumber(denominator)
                local dendata = denominators[denominator]
                if not (dendata and 1 <= numerator and numerator <= 99) then
                        return 'unsupported', ''
                end
                local numstr, denstr
                local sep = '-'
                if numerator == 1 then
                        denstr = sp_us and dendata.us or dendata[1]
                        if finished or use_one then
                                numstr = 'one'
                        elseif denstr:match('^[aeiou]') then
                                numstr = 'an'
                                sep = ' '
                        else
                                numstr = 'a'
                                sep = ' '
                        end
                else
                        numstr = numeral_to_english_less_100(numerator)
                        denstr = dendata.plural
                        if not denstr then
                                denstr = (sp_us and dendata.us or dendata[1]) .. 's'
```

```
                        end
                end
                if finished then
                        return 'finished', sign .. numstr .. sep .. denstr
                end
                return 'ok', ' and ' .. numstr .. sep .. denstr
        end
        return 'ok', ''
end

-- Takes a decimal number and converts it to English text.
-- Return nil if a fraction cannot be converted (only some numbers are supported for fractions).
-- num (string or nil): the number to convert.
--      Can be an arbitrarily large decimal, such as "-123456789123456789.345", and
--      can use scientific notation (e.g. "1.23E5").
--      May fail for very large numbers not listed in "groups" such as "1E4000".
--      num is nil if there is no whole number before a fraction.
-- numerator (string or nil): numerator of fraction (nil if no fraction)
-- denominator (string or nil): denominator of fraction (nil if no fraction)
-- capitalize (boolean): whether to capitalize the result (e.g. 'One' instead of 'one')
-- use_and (boolean): whether to use the word 'and' between tens/ones place and higher places
-- hyphenate (boolean): whether to hyphenate all words in the result, useful as an adjective
-- ordinal (boolean): whether to produce an ordinal (e.g. 'first' instead of 'one')
-- plural (boolean): whether to pluralize the resulting number
-- links: nil: do not add any links; 'on': link "billion" and larger to Orders of magnitude articl
--        any other text: list of numbers to link (e.g. "billion,quadrillion")
-- negative_word: word to use for negative sign (typically 'negative' or 'minus'; nil to use defau
-- round: nil or '': no rounding; 'on': round to nearest two-word number; 'up'/'down': round up/do
-- zero: word to use for value '0' (nil to use default)
-- use_one (boolean): false: 2+1/2 → "two and a half"; true: "two and one-half"
local function _numeral_to_english(num, numerator, denominator, capitalize, use_and, hyphenate, or
        if not negative_word then
                if use_and then
                        -- TODO Should 'minus' be used when do not have sp=us?
                        --      If so, need to update testcases, and need to fix "minus zero".
                        -- negative_word = 'minus'
                        negative_word = 'negative'
                else
                        negative_word = 'negative'
                end
        end
        local status, fraction_text = fraction_to_english(num, numerator, denominator, not use_and
        if status == 'unsupported' then
                return nil
        end
        if status == 'finished' then
                -- Input is a fraction with no whole number.
                -- Hack to avoid executing stuff that depends on num being a number.
                local s = fraction_text
                if hyphenate then s = s:gsub("%s", "-") end
                if capitalize then s = s:gsub("^%l", string.upper) end
                return s
```

```
end
num = scientific_notation_to_decimal(num)
if round and round ~= '' then
	if round ~= 'on' and round ~= 'up' and round ~= 'down' then
		error("Invalid rounding mode")
	end
	num = round_for_english(num, round)
end

-- Separate into negative sign, num (digits before decimal), decimal_places (digits after
local MINUS = '−'  -- Unicode U+2212 MINUS SIGN (may be in values from [[Module:Convert]])
if num:sub(1, #MINUS) == MINUS then
	num = '-' .. num:sub(#MINUS + 1)  -- replace MINUS with '-'
elseif num:sub(1, 1) == '+' then
	num = num:sub(2)  -- ignore any '+'
end
local negative = num:find("^%-")
local decimal_places, subs = num:gsub("^%-?%d*%.(%d+)$", "%1")
if subs == 0 then decimal_places = nil end
num, subs = num:gsub("^%-?(%d*)%.?%d*$", "%1")
if num == '' and decimal_places then num = '0' end
if subs == 0 or num == '' then error("Invalid decimal numeral") end

-- For each group of 3 digits except the last one, print with appropriate group name (e.g.
local s = ''
while #num > 3 do
	if s ~= '' then s = s .. ' ' end
	local group_num = math.floor((#num - 1) / 3)
	local group = groups[group_num]
	local group_digits = #num - group_num*3
	s = s .. numeral_to_english_less_1000(num:sub(1, group_digits), false, false, fals
	if links and (((links == 'on' and group_num >= 3) or links:find(group)) and group_
		s = s .. '[[Orders_of_magnitude_(numbers)#10' .. group_num*3 .. '|' .. gro
	else
		s = s .. group
	end
	num = num:sub(1 + group_digits)
	num = num:gsub("^0*", "")  -- Trim leading zeros
end

-- Handle final three digits of integer part
if s ~= '' and num ~= '' then
	if #num <= 2 and use_and then
		s = s .. ' and '
	else
		s = s .. ' '
	end
end
if s == '' or num ~= '' then
	s = s .. numeral_to_english_less_1000(num, use_and, ordinal, plural, zero)
elseif ordinal or plural then
	-- Round numbers like "one million" take standard suffixes for ordinal/plural
```

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                s = s .. standard_suffix(ordinal, plural)
        end

        -- For decimal places (if any) output "point" followed by spelling out digit by digit
        if decimal_places then
                s = s .. ' point'
                for i = 1, #decimal_places do
                        s = s .. ' ' .. ones_position[tonumber(decimal_places:sub(i,i))]
                end
        end

        s = s:gsub("^%s*(.-)%s*$", "%1")   -- Trim whitespace
        if ordinal and plural then s = s .. 's' end  -- s suffix works for all ordinals
        if negative and s ~= zero then s = negative_word .. ' ' .. s end
        s = s:gsub("negative zero", "zero")
        s = s .. fraction_text
        if hyphenate then s = s:gsub("%s", "-") end
        if capitalize then s = s:gsub("^%l", string.upper) end
        return s
end

local function _numeral_to_english2(args)
        local num = args.num

        if (not tonumber(num)) then
                num = num:gsub("^%s*(.-)%s*$", "%1")   -- Trim whitespace
                num = num:gsub(",", "")   -- Remove commas
                num = num:gsub("^<span[^<>]*></span>", "") -- Generated by Template:age
                if num ~= '' then  -- a fraction may have an empty whole number
                        if not num:find("^%-?%d*%.?%d*%-?[Ee]?[+%-]?%d*$") then
                                -- Input not in a valid format, try to pass it through #expr to se
                                -- if that produces a number (e.g. "3 + 5" will become "8").
                                num = mw.getCurrentFrame():preprocess('{{#expr: ' .. num .. '}}')
                        end
                end
        end

        -- Pass args from frame to helper function
        return _numeral_to_english(
                num,
                args['numerator'],
                args['denominator'],
                args['capitalize'],
                args['use_and'],
                args['hyphenate'],
                args['ordinal'],
                args['plural'],
                args['links'],
                args['negative_word'],
                args['round'],
                args['zero'],
                args['use_one']
```

```
        ) or ''
end

local p = {  -- Functions that can be called from another module
        roman_to_numeral = roman_to_numeral,
        spell_number = _numeral_to_english,
        spell_number2 = _numeral_to_english2,
        english_to_ordinal = english_to_ordinal,
        english_to_numeral = english_to_numeral,
}

function p._roman_to_numeral(frame) -- Callable via {{#invoke:ConvertNumeric|_roman_to_numeral|VI}
        return roman_to_numeral(frame.args[1])
end

function p._english_to_ordinal(frame) -- callable via {{#invoke:ConvertNumeric|_english_to_ordinal
        return english_to_ordinal(frame.args[1])
end

function p._english_to_numeral(frame) -- callable via {{#invoke:ConvertNumeric|_english_to_numeral
        return english_to_numeral(frame.args[1])
end

function p.numeral_to_english(frame)
        local args = frame.args
        local num = args[1]
        num = num:gsub("^%s*(.-)%s*$", "%1")   -- Trim whitespace
        num = num:gsub(",", "")   -- Remove commas
        num = num:gsub("^<span[^<>]*></span>", "") -- Generated by Template:age
        if num ~= '' then  -- a fraction may have an empty whole number
                if not num:find("^%-?%d*%.?%d*%-?[Ee]?[+%-]?%d*$") then
                        -- Input not in a valid format, try to pass it through #expr to see
                        -- if that produces a number (e.g. "3 + 5" will become "8").
                        num = frame:preprocess('{{#expr: ' .. num .. '}}')
                end
        end

        -- Pass args from frame to helper function
        return _numeral_to_english(
                num,
                args['numerator'],
                args['denominator'],
                args['case'] == 'U' or args['case'] == 'u',
                args['sp'] ~= 'us',
                args['adj'] == 'on',
                args['ord'] == 'on',
                args['pl'] == 'on',
                args['lk'],
                args['negative'],
                args['round'],
                args['zero'],
                args['one'] == 'one'  -- experiment: using '|one=one' makes fraction 2+1/2 give "t
```

```
        ) or ''
end

---- recursive function for p.decToHex
local function decToHexDigit(dec)
        local dig = {"0","1","2","3","4","5","6","7","8","9","A","B","C","D","E","F"}
        local div = math.floor(dec/16)
        local mod = dec-(16*div)
        if div >= 1 then return decToHexDigit(div)..dig[mod+1] else return dig[mod+1] end
end -- I think this is supposed to be done with a tail call but first I want something that works

---- finds all the decimal numbers in the input text and hexes each of them
function p.decToHex(frame)
        local args=frame.args
        local parent=frame.getParent(frame)
        local pargs={}
        if parent then pargs=parent.args end
        local text=args[1] or pargs[1] or ""
        local minlength=args.minlength or pargs.minlength or 1
        minlength=tonumber(minlength)
        local prowl=mw.ustring.gmatch(text,"(.-)(%d+)")
        local output=""
        repeat
                local chaff,dec=prowl()
                if not(dec) then break end
                local hex=decToHexDigit(dec)
                while (mw.ustring.len(hex)<minlength) do hex="0"..hex end
                output=output..chaff..hex
        until false
        local chaff=mw.ustring.match(text,"(%D+)$") or ""
        return output..chaff
end

return p
```