

# 10. Full Grammar specification

This is the full Python grammar, as it is read by the parser generator and used to parse Python source files:

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# Grammar for Python

# NOTE WELL: You should also follow all the steps listed at
# https://devguide.python.org/grammar/

# Start symbols for the grammar:
#     single_input is a single interactive statement;
#     file_input is a module or sequence of commands read from an input
#     eval_input is the input for the eval() functions.
#     func_type_input is a PEP 484 Python 2 function type comment
# NB: compound_stmt in single_input is followed by extra NEWLINE!
# NB: due to the way TYPE_COMMENT is tokenized it will always be followed
single_input: NEWLINE | simple_stmt | compound_stmt NEWLINE
file_input: (NEWLINE | stmt)* ENDMARKER
eval_input: testlist NEWLINE* ENDMARKER

decorator: '@' dotted_name [ '(' [arglist] ')' ] NEWLINE
decorators: decorator+
decorated: decorators (classdef | funcdef | async_funcdef)

async_funcdef: ASYNC funcdef
funcdef: 'def' NAME parameters [ '->' test ] ':' [TYPE_COMMENT] func_body_suite
parameters: '(' [typedarglist] ')

# The following definition for typedarglist is equivalent to this set of rules
#
#     arguments = argument (',' [TYPE_COMMENT] argument)*
#     argument = tfpdef ['=' test]
#     kwargs = '**' tfpdef [',' [TYPE_COMMENT]]
#     args = '*' [tfpdef]
#     kwnonly_kwargs = (',' [TYPE_COMMENT] argument)* (TYPE_COMMENT | [',' [TYPE_COMMENT]]
#     args_kwnonly_kwargs = args kwnonly_kwargs | kwargs
#     poskeyword_args_kwnonly_kwargs = arguments ( TYPE_COMMENT | [',' [TYPE_COMMENT]]
#     typedarglist_no_posonly = poskeyword_args_kwnonly_kwargs | args_kwnonly_kwargs
#     typedarglist = (arguments ',' [TYPE_COMMENT] '/' [',' [TYPE_COMMENT]]
#
# It needs to be fully expanded to allow our LL(1) parser to work on it.

typedarglist: (
    (tfpdef ['=' test] (',' [TYPE_COMMENT] tfpdef ['=' test])* ',' [TYPE_COMMENT]
    | (tfpdef ['=' test] (',' [TYPE_COMMENT] tfpdef ['=' test])* (TYPE_COMMENT | [',' [TYPE_COMMENT]]
    | '*' [tfpdef] (',' [TYPE_COMMENT] tfpdef ['=' test])* (TYPE_COMMENT | [',' [TYPE_COMMENT]]
    | '**' tfpdef [',' [TYPE_COMMENT]]))
    | '*' [tfpdef] (',' [TYPE_COMMENT] tfpdef ['=' test])* (TYPE_COMMENT | [',' [TYPE_COMMENT]]
    | '**' tfpdef [',' [TYPE_COMMENT]] )
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| (tfpdef ['=' test] (',' [TYPE_COMMENT] tfpdef ['=' test]))* (TYPE_COMMENT | ['
  '*' [tfpdef] (',' [TYPE_COMMENT] tfpdef ['=' test]))* (TYPE_COMMENT | ['
  '**' tfpdef (',' [TYPE_COMMENT])])
| '*' [tfpdef] (',' [TYPE_COMMENT] tfpdef ['=' test]))* (TYPE_COMMENT | ['
  '**' tfpdef (',' [TYPE_COMMENT])])
)
tfpdef: NAME [':' test]

# The following definition for vararglist is equivalent to this set of ru
#
# arguments = argument (',' argument)*
# argument = vfpdef ['=' test]
# kwargs = '**' vfpdef (',' [kwargs])
# args = '*' [vfpdef]
# kwonly_kwargs = (',' argument)* (',' [kwargs])
# args_kwonly_kwargs = args kwonly_kwargs | kwargs
# poskeyword_args_kwonly_kwargs = arguments (',' [args_kwonly_kwargs])
# vararglist_no_posonly = poskeyword_args_kwonly_kwargs | args_kwonly_
# vararglist = arguments (',' '/' (',' [(vararglist_no_posonly)])) | (va
#
# It needs to be fully expanded to allow our LL(1) parser to work on it.

vararglist: vfpdef ['=' test] (',' vfpdef ['=' test]))* (',' '/' (',' (vf
  '*' [vfpdef] (',' vfpdef ['=' test]))* (',' ['**' vfpdef (',' [kwargs])])
  | '**' vfpdef (',' [kwargs])])
| '*' [vfpdef] (',' vfpdef ['=' test]))* (',' ['**' vfpdef (',' [kwargs])])
| '**' vfpdef (',' [kwargs]) (',' vfpdef ['=' test]))* (',' vfpdef ['=' test]))* (
  '*' [vfpdef] (',' vfpdef ['=' test]))* (',' ['**' vfpdef (',' [kwargs])])
  | '**' vfpdef (',' [kwargs])])
| '*' [vfpdef] (',' vfpdef ['=' test]))* (',' ['**' vfpdef (',' [kwargs])])
| '**' vfpdef (',' [kwargs])
)
vfpdef: NAME

stmt: simple_stmt | compound_stmt
simple_stmt: small_stmt (',' small_stmt)* (',' NEWLINE
small_stmt: (expr_stmt | del_stmt | pass_stmt | flow_stmt |
  import_stmt | global_stmt | nonlocal_stmt | assert_stmt)
expr_stmt: testlist_star_expr (annassign | augassign (yield_expr|testlist)
  [( '=' (yield_expr|testlist_star_expr)) + [TYPE_COMMENT]
annassign: ':' test ['=' (yield_expr|testlist_star_expr)]
testlist_star_expr: (test|star_expr) (',' (test|star_expr))* (','
augassign: ('+=' | '-=' | '*=' | '@=' | '/=' | '%=' | '&=' | '|=' | '^=' |
  '<=>' | '>=>' | '**=' | '//=')
# For normal and annotated assignments, additional restrictions enforced b
del_stmt: 'del' exprlist
pass_stmt: 'pass'
flow_stmt: break_stmt | continue_stmt | return_stmt | raise_stmt | yield_s
break_stmt: 'break'
continue_stmt: 'continue'
return_stmt: 'return' [testlist_star_expr]
yield_stmt: yield_expr
raise_stmt: 'raise' [test ['from' test]]
import_stmt: import_name | import_from

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import_name: 'import' dotted_as_names
# note below: the ('.' | '...') is necessary because '...' is tokenized as
import_from: ('from' (('.' | '...')* dotted_name | ('.' | '...')+
                    'import' ('*' | '(' import_as_names ')' | import_as_names))
import_as_name: NAME ['as' NAME]
dotted_as_name: dotted_name ['as' NAME]
import_as_names: import_as_name (',' import_as_name)* [',']
dotted_as_names: dotted_as_name (',' dotted_as_name)*
dotted_name: NAME ('.' NAME)*
global_stmt: 'global' NAME (',' NAME)*
nonlocal_stmt: 'nonlocal' NAME (',' NAME)*
assert_stmt: 'assert' test [',' test]

compound_stmt: if_stmt | while_stmt | for_stmt | try_stmt | with_stmt | fu
async_stmt: ASYNC (funcdef | with_stmt | for_stmt)
if_stmt: 'if' namedexpr_test ':' suite ('elif' namedexpr_test ':' suite)*
while_stmt: 'while' namedexpr_test ':' suite ['else' ':' suite]
for_stmt: 'for' exprlist 'in' testlist ':' [TYPE_COMMENT] suite ['else' ':
try_stmt: ('try' ':' suite
          ((except_clause ':' suite)+
           ['else' ':' suite]
           ['finally' ':' suite] |
           'finally' ':' suite))
with_stmt: 'with' with_item (',' with_item)* ':' [TYPE_COMMENT] suite
with_item: test ['as' expr]
# NB compile.c makes sure that the default except clause is last
except_clause: 'except' [test ['as' NAME]]
suite: simple_stmt | NEWLINE INDENT stmt+ DEDENT

namedexpr_test: test [':=' test]
test: or_test ['if' or_test 'else' test] | lambdef
test_nocond: or_test | lambdef_nocond
lambdef: 'lambda' [varargslist] ':' test
lambdef_nocond: 'lambda' [varargslist] ':' test_nocond
or_test: and_test ('or' and_test)*
and_test: not_test ('and' not_test)*
not_test: 'not' not_test | comparison
comparison: expr (comp_op expr)*
# <> isn't actually a valid comparison operator in Python. It's here for t
# sake of a __future__ import described in PEP 401 (which really works :-)
comp_op: '<' | '>' | '==' | '>=' | '<=' | '<>' | '!=' | 'in' | 'not in' | 'is' | 'is not'
star_expr: '*' expr
expr: xor_expr ('|' xor_expr)*
xor_expr: and_expr ('^' and_expr)*
and_expr: shift_expr ('&' shift_expr)*
shift_expr: arith_expr (('<<' | '>>') arith_expr)*
arith_expr: term (('+' | '-') term)*
term: factor (('*' | '@' | '/' | '%' | '//') factor)*
factor: ('+' | '-' | '~') factor | power
power: atom_expr ['**' factor]
atom_expr: [AWAIT] atom trailer*
atom: '(' [yield_expr|testlist_comp] ')' |
      '[' [testlist_comp] ']' |
      '{' [dictorsetmaker] '}' |

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NAME | NUMBER | STRING+ | '...' | 'None' | 'True' | 'False')
testlist_comp: (namedexpr_test|star_expr) ( comp_for | (',' (namedexpr_test
trailer: '(' [arglist] ')' | '[' subscriptlist ']' | '.' NAME
subscriptlist: subscript (',' subscript)* [',']
subscript: test | [test] ':' [test] [sliceop]
sliceop: ':' [test]
exprlist: (expr|star_expr) (',' (expr|star_expr))* [',']
testlist: test (',' test)* [',']
dictorsetmaker: ( ((test ':' test | '**' expr)
                   (comp_for | (',' (test ':' test | '**' expr))* [',']))
                 ((test | star_expr)
                  (comp_for | (',' (test | star_expr))* [','])) )

classdef: 'class' NAME ['(' [arglist] ')'] ':' suite

arglist: argument (',' argument)* [',']

# The reason that keywords are test nodes instead of NAME is that using NAME
# results in an ambiguity. ast.c makes sure it's a NAME.
# "test '=' test" is really "keyword '=' test", but we have no such token.
# These need to be in a single rule to avoid grammar that is ambiguous
# to our LL(1) parser. Even though 'test' includes '*expr' in star_expr,
# we explicitly match '*' here, too, to give it proper precedence.
# Illegal combinations and orderings are blocked in ast.c:
# multiple (test comp_for) arguments are blocked; keyword unpackings
# that precede iterable unpackings are blocked; etc.
argument: ( test [comp_for] |
            test ':=' test |
            test '=' test |
            '**' test |
            '*' test )

comp_iter: comp_for | comp_if
sync_comp_for: 'for' exprlist 'in' or_test [comp_iter]
comp_for: [ASYNC] sync_comp_for
comp_if: 'if' test_nocond [comp_iter]

# not used in grammar, but may appear in "node" passed from Parser to Compiler
encoding_decl: NAME

yield_expr: 'yield' [yield_arg]
yield_arg: 'from' test | testlist_star_expr

# the TYPE_COMMENT in suites is only parsed for funcdefs,
# but can't go elsewhere due to ambiguity
func_body_suite: simple_stmt | NEWLINE [TYPE_COMMENT NEWLINE] INDENT stmt+

func_type_input: func_type NEWLINE* ENDMARKER
func_type: '(' [typelist] ')' '->' test
# typelist is a modified typedargslist (see above)
typelist: (test (',' test)* [',',
               ['*' [test] (',' test)* [',', '**' test] | '**' test]]
          | '*' [test] (',' test)* [',', '**' test] | '**' test)

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