

## Chapter A

# Scala Syntax Summary

The lexical syntax of Scala is given by the following grammar in EBNF form.

```
upper      ::= 'A' | ... | 'Z' | '$' | '_' and Unicode category Lu
lower      ::= 'a' | ... | 'z' and Unicode category Ll
letter     ::= upper | lower and Unicode categories Lo, Lt, Nl
digit      ::= '0' | ... | '9'
opchar     ::= "all other characters in \u0020-007F and Unicode
               categories Sm, So except parentheses ([]) and periods"

op         ::= opchar {opchar}
varid      ::= lower idrest
plainid    ::= upper idrest
            | varid
            | op
id         ::= plainid
            | ``stringLiteral ``
idrest     ::= {letter | digit} ['_' op]

integerLiteral ::= (decimalNumeral | hexNumeral) ['L' | 'l']
decimalNumeral ::= '0' | nonZeroDigit {digit}
hexNumeral    ::= '0' 'x' hexDigit {hexDigit}
digit         ::= '0' | nonZeroDigit
nonZeroDigit  ::= '1' | ... | '9'

floatingPointLiteral
            ::= digit {digit} '.' digit {digit} [exponentPart] [floatType]
            | '.' digit {digit} [exponentPart] [floatType]
            | digit {digit} exponentPart [floatType]
            | digit {digit} [exponentPart] floatType
exponentPart ::= ('E' | 'e') ['+' | '-'] digit {digit}
floatType    ::= 'F' | 'f' | 'D' | 'd'

booleanLiteral ::= 'true' | 'false'
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characterLiteral ::= ' printableChar '
                  | ' charEscapeSeq '

stringLiteral   ::= " {stringElement} "
                  | " multiLineChars "
stringElement   ::= printableCharNoDoubleQuote
                  | charEscapeSeq
multiLineChars  ::= {" [ " ] charNoDoubleQuote} {"}

symbolLiteral   ::= ' plainid

comment         ::= '/*' "any sequence of characters" '*/
                  | '//' "any sequence of characters up to end of line"

nl              ::= "new line character"
semi            ::= ';' | nl {nl}

```

The context-free syntax of Scala is given by the following EBNF grammar.

```

Literal         ::= [ '-' ] integerLiteral
                  | [ '-' ] floatingPointLiteral
                  | booleanLiteral
                  | characterLiteral
                  | stringLiteral
                  | symbolLiteral
                  | 'null'

QualId          ::= id { '.' id }
ids             ::= id { ',' id }

Path            ::= StableId
                  | [ id '.' ] 'this'
StableId        ::= id
                  | Path '.' id
                  | [ id '.' ] 'super' [ClassQualifier] '.' id
ClassQualifier  ::= '[ id ']'

Type            ::= FunctionArgTypes '=>' Type
                  | InfixType [ExistentialClause]
FunctionArgTypes ::= InfixType
                  | '( [ ParamType { ',' ParamType } ] ')'
ExistentialClause ::= 'forSome' '{' ExistentialDcl {semi ExistentialDcl} '}'
ExistentialDcl  ::= 'type' TypeDcl
                  | 'val' ValDcl
InfixType       ::= CompoundType {id [nl] CompoundType}
CompoundType    ::= AnnotType {'with' AnnotType} [Refinement]
                  | Refinement
AnnotType       ::= SimpleType {Annotation}

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SimpleType      ::= SimpleType TypeArgs
                  | SimpleType '#' id
                  | StableId
                  | Path '.' 'type'
                  | '(' Types ')'

TypeArgs        ::= '[' Types ']'
Types           ::= Type {' ',' Type}
Refinement      ::= [nl] '{' RefineStat {semi RefineStat} '}'
RefineStat      ::= Dcl
                  | 'type' TypeDef
                  |

TypePat         ::= Type

Ascription      ::= ':' InfixType
                  | ':' Annotation {Annotation}
                  | ':' '_' '*'

Expr            ::= (Bindings | ['implicit'] id | '_') '=>' Expr
                  | Expr1
Expr1           ::= 'if' '(' Expr ')' {nl} Expr [[semi] else Expr]
                  | 'while' '(' Expr ')' {nl} Expr
                  | 'try' '{' Block '}' ['catch' '{' CaseClauses '}']
                  | 'finally' Expr]
                  | 'do' Expr [semi] 'while' '(' Expr ')'
                  | 'for' '(' Enumerators ')' | '{' Enumerators '}'
                  | {nl} ['yield'] Expr
                  | 'throw' Expr
                  | 'return' [Expr]
                  | [SimpleExpr '.' ] id '=' Expr
                  | SimpleExpr1 ArgumentExprs '=' Expr
                  | PostfixExpr
                  | PostfixExpr Ascription
                  | PostfixExpr 'match' '{' CaseClauses '}'

PostfixExpr     ::= InfixExpr [id [nl]]
InfixExpr       ::= PrefixExpr
                  | InfixExpr id [nl] InfixExpr
PrefixExpr      ::= ['- ' | '+ ' | '~ ' | '!'] SimpleExpr
SimpleExpr      ::= 'new' (ClassTemplate | TemplateBody)
                  | BlockExpr
                  | SimpleExpr1 ['_']

SimpleExpr1     ::= Literal
                  | Path
                  | '_'
                  | '(' [Exprs] ')'
                  | SimpleExpr '.' id
                  | SimpleExpr TypeArgs
                  | SimpleExpr1 ArgumentExprs
                  | XmlExpr

Exprs           ::= Expr {' ',' Expr}

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ArgumentExprs ::= '(' [Exprs] ')'
               | '(' [Exprs ',' ] PostfixExpr ':' '_' '*' ')'
               | [nl] BlockExpr

BlockExpr      ::= '{' CaseClauses '}'
               | '{' Block '}'

Block          ::= {BlockStat semi} [ResultExpr]
BlockStat      ::= Import
               | {Annotation} ['implicit' | 'lazy'] Def
               | {Annotation} {LocalModifier} TmplDef
               | Expr1
               |

ResultExpr     ::= Expr1
               | (Bindings | (['implicit'] id | '_') ':' CompoundType) '=>' Block

Enumerators   ::= Generator {semi Enumerator}
Enumerator    ::= Generator
               | Guard
               | Pattern1 '=' Expr
Generator     ::= Pattern1 '<-' Expr [Guard]

CaseClauses   ::= CaseClause { CaseClause }
CaseClause    ::= 'case' Pattern [Guard] '=>' Block
Guard         ::= 'if' PostfixExpr

Pattern       ::= Pattern1 { '|' Pattern1 }
Pattern1      ::= varid ':' TypePat
               | '_' ':' TypePat
               | Pattern2
Pattern2      ::= varid ['@' Pattern3]
               | Pattern3
Pattern3      ::= SimplePattern
               | SimplePattern { id [nl] SimplePattern }
SimplePattern ::= '_'
               | varid
               | Literal
               | StableId
               | StableId '(' [Patterns ']'
               | StableId '(' [Patterns ','] [varid '@'] '_' '*' ')'
               | '(' [Patterns] ')'
               | XmlPattern
Patterns      ::= Pattern [',' Patterns]
               | '_' *

TypeParamClause ::= '[' VariantTypeParam {',' VariantTypeParam} ']'
FunTypeParamClause ::= '[' TypeParam {',' TypeParam} ']'
VariantTypeParam ::= {Annotation} ['+' | '-'] TypeParam
TypeParam        ::= (id | '_') [TypeParamClause] ['>:' Type] ['<:' Type]
                  { '<%' Type } { ':' Type }
ParamClauses     ::= {ParamClause} [[nl] '(' 'implicit' Params ')']

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ParamClause      ::= [nl] '(' [Params] ')'
Params           ::= Param {',' Param}
Param            ::= {Annotation} id [':' ParamType] ['=' Expr]
ParamType        ::= Type
                  | '=>' Type
                  | Type '*'
ClassParamClauses ::= {ClassParamClause}
                  [[nl] '(' 'implicit' ClassParams ')']
ClassParamClause ::= [nl] '(' [ClassParams] ')'
ClassParams      ::= ClassParam {',' ClassParam}
ClassParam       ::= {Annotation} [{Modifier} ('val' | 'var')]
                  id ':' ParamType ['=' Expr]
Bindings         ::= '(' Binding {',' Binding ')'
Binding          ::= (id | '_') [':' Type]

Modifier         ::= LocalModifier
                  | AccessModifier
                  | 'override'
LocalModifier    ::= 'abstract'
                  | 'final'
                  | 'sealed'
                  | 'implicit'
                  | 'lazy'
AccessModifier   ::= ('private' | 'protected') [AccessQualifier]
AccessQualifier  ::= '[' (id | 'this') ']'

Annotation       ::= '@' SimpleType {ArgumentExprs}
ConstrAnnotation ::= '@' SimpleType ArgumentExprs
NameValuePair    ::= 'val' id '=' PrefixExpr

TemplateBody     ::= [nl] '{' [SelfType] TemplateStat {semi TemplateStat} '}'
TemplateStat     ::= Import
                  | {Annotation [nl]} {Modifier} Def
                  | {Annotation [nl]} {Modifier} Dcl
                  | Expr
                  |
SelfType         ::= id [':' Type] '=>'
                  | 'this' ':' Type '=>'

Import           ::= 'import' ImportExpr {',' ImportExpr}
ImportExpr       ::= StableId '.' (id | '_' | ImportSelectors)
ImportSelectors  ::= '{' {ImportSelector ','} (ImportSelector | '_') '}'
ImportSelector   ::= id ['=>' id | '=>' '_']

Dcl              ::= 'val' ValDcl
                  | 'var' VarDcl
                  | 'def' FunDcl
                  | 'type' {nl} TypeDcl

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ValDcl	::=	ids ':' Type
VarDcl	::=	ids ':' Type
FunDcl	::=	FunSig [':' Type]
FunSig	::=	id [FunTypeParamClause] ParamClauses
TypeDcl	::=	id [TypeParamClause] ['>:' Type] ['<:' Type]
PatVarDef	::=	'val' PatDef   'var' VarDef
Def	::=	PatVarDef   'def' FunDef   'type' {nl} TypeDef   TmplDef
PatDef	::=	Pattern2 {' ,' Pattern2} [':' Type] '=' Expr
VarDef	::=	PatDef   ids ':' Type '=' '_'
FunDef	::=	FunSig [':' Type] '=' Expr   FunSig [nl] '{' Block '}'   'this' ParamClause ParamClauses ( '=' ConstrExpr   [nl] ConstrBlock)
TypeDef	::=	id [TypeParamClause] '=' Type
TmplDef	::=	['case'] 'class' ClassDef   ['case'] 'object' ObjectDef   'trait' TraitDef
ClassDef	::=	id [TypeParamClause] {ConstrAnnotation} [AccessModifier] ClassParamClauses ClassTemplateOpt
TraitDef	::=	id [TypeParamClause] TraitTemplateOpt
ObjectDef	::=	id ClassTemplateOpt
ClassTemplateOpt	::=	'extends' ClassTemplate   [['extends'] TemplateBody]
TraitTemplateOpt	::=	'extends' TraitTemplate   [['extends'] TemplateBody]
ClassTemplate	::=	[EarlyDefs] ClassParents [TemplateBody]
TraitTemplate	::=	[EarlyDefs] TraitParents [TemplateBody]
ClassParents	::=	Constr {'with' AnnotType}
TraitParents	::=	AnnotType {'with' AnnotType}
Constr	::=	AnnotType {ArgumentExprs}
EarlyDefs	::=	'{' [EarlyDef {semi EarlyDef}] '}' 'with'
EarlyDef	::=	{Annotation [nl]} {Modifier} PatVarDef
ConstrExpr	::=	SelfInvocation   ConstrBlock
ConstrBlock	::=	'{' SelfInvocation {semi BlockStat} '}'
SelfInvocation	::=	'this' ArgumentExprs {ArgumentExprs}
TopStatSeq	::=	TopStat {semi TopStat}
TopStat	::=	{Annotation [nl]} {Modifier} TmplDef   Import   Packaging   PackageObject 

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Packaging      ::= 'package' QualId [nl] '{' TopStatSeq '}'
PackageObject  ::= 'package' 'object' ObjectDef

CompilationUnit ::= {'package' QualId semi} TopStatSeq
```