

Perl 6: Project: Part 4

Elliot Chandler (Wallace)

10 October 2017

Data types available in the language beyond primitive data types (such as ints, floats, etc.). This could include arrays, vectors, structures, strings, pointers, objects, and classes. You should include higher-level structures, such as hashes, stacks, etc., if they are part of the language itself and not just part of a standard or other library.

Perl 6 includes a large amount of non-primitive types in the language itself: 33 compound types, 56 “domain-specific” types, and 113 exception types. This includes common compound types such as arrays, lists, and hashes, as well as various other types for a range of applications. By including a large amount of capabilities within the language core itself, it enables the base package to be quite functional without the need for as many additional libraries to have a practical

base of tools to work from.

Summary of standard libraries or classes that extend the language's type system.

Perl 6 does not itself have a specified standard library *per se*, but the Rakudo implementation does include a variety of additional *modules* (46 of them). (Rakudo organization on GitHub, 2017) It includes tools for performance debugging and profiling, such as **debugger-ui-commandline**, **grammar-debugger** and **Grammar-Profiler-Simple**. It provides the **Terminal-ANSIColor** module for creating colored output from command-line programs, and **test-mock** and **Test-META** for creating unit tests. For data interchange and serialization, it provides seven modules for working with JSON, and one for XML, as well as a database interface module (**DBIl-ish**). For graphics, Rakudo Star comes with the **svg** and **svg-plot** modules. It also includes several such as **perl6-http-easy** and **perl6-http-status** for network interoperation. Perl 6 includes a package manager, also, called **zef**, which provides a command-line interface for managing the packages installed in a system.

Semantics of expression evaluation.

Perl 6 makes a distinction between *statements* and *expressions*, where expressions are statements that return a value. A program in Perl 6 semantically represents a list of statements (things for the computer to do). To make a statement act as an expression, the **do** keyword can be used, which will cause the statement given to represent its value in the given context.

Coercions/implicit type conversions that are performed in expression evaluation.

By default, Perl 6 when encountering a variable that does not have a specified type will convert it to the necessary type when it is used in a context where its current type is not applicable. To override this behavior, types can be specified for each object, allowing strict type checking.

Semantics of assignment statements.

Perl 6 has somewhat complicated assignment semantics, similar to Java, because it uses containers for some things, but things can also exist without containers. The documentation writes that “The assignment operator asks the container on the left to store the value on its right”. This means that the actual effect of assigning a value to a name depends on the type of container that has been created

by variable declaration. In practice, this is largely transparent to the user, and the context of a reference to a variable will affect whether the container is used or the value within the container is used. If the user wants control over this, the language provides some constructs for controlling these issues, but the defaults seem to generally work well. A list can contain containers or values. Because of this, it is not always possible to assign to list elements, because lists are immutable and values cannot be changed. However, if the items in a list are containers, they can be changed because the container itself will stay the same (the list would not be changing, but what one of the elements in the list refers to would be changing). Arrays, however, only hold containers; thus their contents can be changed.

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Appendix: Tables — after Perl 6

Documentation, 2017c

Composite types

Category	Name	Description
class	Array	Sequence of itemized values
role	Associative	Object that supports looking up values by key
class	Bag	Immutable collection of distinct objects with integer weights
class	BagHash	Mutable collection of distinct objects with integer weights
role	Baggy	Collection of distinct weighted objects

role	Blob	Immutable buffer for binary data ('Binary Large Object')
role	Buf	Mutable buffer for binary data
class	Capture	Argument list suitable for passing to a
class	Hash	Mapping from strings to itemized values
role	Iterable	Interface for container objects that can be iterated over
role	Iterator	Generic API for producing a sequence of values
class	List	Sequence of values
class	Map	Immutable mapping from strings to values

class	Mix	Immutable collection of distinct objects with Real weights
class	MixHash	Mutable collection of distinct objects with Real weights
role	Mixy	Collection of distinct objects with Real weights
class	NFC	Codepoint-String in Normal Form C (Composed)
class	NFD	Codepoint-String in Normal Form D (Decomposed)

class	NFKC	Codepoint-String in Normal Form KC (Compatibility Composed)
class	NFKD	Codepoint-String in Normal Form KD (Compatibility Decomposed)
class	Pair	Key/value pair
role	Positional	Object that supports looking up values by index
role	PositionalBindFailover	Failover for binding to a Positional
class	PseudoStash	Stash type for pseudo-packages
role	QuantHash	Collection of objects represented as hash keys

class	Range	Interval of ordered values
class	Seq	An iterable, lazy sequence of values
class	Set	Immutable collection of distinct objects
class	SetHash	Mutable collection of distinct objects
role	Setty	Collection of distinct objects
class	Slip	A kind of List that automatically flattens into an outer container
class	Stash	Table for "our"-scoped symbols
class	Uni	A string of Unicode codepoints

Domain-specific types

Category	Name	Description
class	Attribute	Member variable
class	Cancellation	Removal of a task from a Scheduler before normal completion
class	Channel	Thread-safe queue for sending values from producers to consumers
class	CurrentThreadScheduler	Scheduler that synchronously executes code on the current thread

class	Cursor	Internal state of the regex engine during parsing
class	Distro	Distribution related information
class	Grammar	Group of named regexes that form a formal grammar
role	IO	Input/output related routines
class	IO::ArgFiles	Iterate over contents of files specified on command line

class	IO :: CatHandle	Use multiple IO handles as if they were one
class	IO :: Handle	Opened file or stream
class	IO :: Notification	Asynchronous notification for file and directory changes
class	IO :: Path	File or directory path
class	IO :: Path :: Cygwin	IO::Path pre-loaded with IO::Spec::Cygwin
class	IO :: Path :: QNX	IO::Path pre-loaded with IO::Spec::QNX

class	IO :: Path :: Unix	IO::Path pre-loaded with IO::Spec::Unix
class	IO :: Path :: Win32	IO::Path pre-loaded with IO::Spec::Win32
class	IO :: Pipe	Buffered inter-process string or binary stream
role	IO :: Socket	Network socket
class	IO :: Socket :: Async	Asynchronous TCP socket
class	IO :: Socket :: INET	TCP Socket

class	IO :: Spec	Platform specific operations on file and directory paths
class	IO :: Spec :: Cygwin	Platform specific operations on file and directory paths for Cygwin
class	IO :: Spec :: QNX	Platform specific operations on file and directory paths QNX

class	IO :: Spec :: Unix	Platform specific operations on file and directory paths for POSIX
class	IO :: Spec :: Win32	Platform specific operations on file and directory paths for Windows
class	IO :: Special	Path to Special I/O device
class	Kernel	Kernel related information

class	Lock	Low-level thread locking primitive
class	Match	Result of a successful regex match
enum	Order	Human readable form for comparison operators.
class	Pod :: Block	Block in a Pod document
class	Pod :: Block :: Code	Verbatim code block in a Pod document
class	Pod :: Block :: Comment	Comment in a Pod document

class	Pod :: Block :: Declarator	Declarator block in a Pod document
class	Pod :: Block :: Named	Named block in a Pod document
class	Pod :: Block :: Para	Paragraph in a Pod document
class	Pod :: Block :: Table	Table in a Pod document
class	Pod :: Heading	Heading in a Pod document
class	Pod :: Item	Item in a Pod enumeration list
class	Proc	Running process (filehandle-based interface)

class	Proc :: Async	Running process (asynchronous interface)
class	Promise	Status/result of an asynchronous computation
class	Regex	String pattern
role	Scheduler	Scheme for automatically assigning tasks to threads
class	Semaphore	Control access to shared resources by multiple processes
class	Supplier	Live
class	Supplier :: Preserving	Cached live

class	Supply	Asynchronous data stream with multiple subscribers
class	Tap	Subscription to a Supply
class	Telemetry	Collect performance state for analysis
class	Telemetry::Period	Performance data over a period
class	Thread	Concurrent execution of code (low-level)

class	ThreadPoolScheduler	Scheduler that distributes work among a pool of threads
class	VM	Perl 6 Virtual Machine related information

Exception types

Category	Name	Description
class	Backtrace	Snapshot of the dynamic call stack
class	Backtrace::Frame	Single frame of a

class	Exception	Anomalous event capable of interrupting normal control-flow
class	Failure	Delayed exception
class	X :: AdHoc	Error with a custom error message
class	X :: Anon :: Augment	Compilation error due to augmenting an anonymous package

class	X :: Anon :: Multi	Compilation error due to declaring an anonymous multi
class	X :: Assignment :: RO	Exception thrown when trying to assign to something read-only
class	X :: Attribute :: NoPackage	Compilation error due to declaring an attribute outside of a package

class	<code>X :: Attribute C</code>	Compilation error due to declaring an attribute in an ineligible package
class	<code>X :: Attribute C</code>	Compilation error due to an undeclared attribute
class	<code>X :: Augment :: NoSuchType</code>	Compilation error due to augmenting a non-existing type

class	X :: Bind	Error due to binding to something that is not a variable or container
class	X :: Bind :: NativeType	Compilation error due to binding to a natively typed variable
class	X :: Bind :: Slice	Error due to binding to a slice
class	X :: Caller :: NotDynamic	Error when trying to access a non dynamic variable through CALLER

class	X :: Channel :: ReceiveOnClosed	calling
class	X :: Channel :: SendOnClosed	calling
role	X :: Comp	Common role for compile-time errors
class	X :: Composition :: NotComposable	Compilation error due to composing an ineligible type
class	X :: Constructor :: Positional	Error due to passing positional arguments to a default constructor

class	X :: ControlFlow	<p>error due to</p> <p>calling a loop</p> <p>control</p> <p>command in an</p> <p>ineligible scope</p>
class	X :: ControlFlow :: Return	<p>error due to</p> <p>calling return</p> <p>outside a routine</p>
class	X :: DateTime :: TimeZoneClash	<p>error due to</p> <p>using both</p> <p>timezone offset</p> <p>and :timezone</p>
class	X :: Declaration :: Scope	<p>Compilation</p> <p>error due to a</p> <p>declaration with</p> <p>an ineligible</p> <p>scope</p>

class	X :: Declaration :: Scope :: Multi	Compilation error due to declaring a multi with an ineligible scope
class	X :: Does :: TypeObject	Error due to mixing into a type object
class	X :: Eval :: NoSuchLang	Error due to specifying an unknown language for EVAL
class	X :: Export :: NameClash	Compilation error due to exporting the same symbol twice

role	X :: IO	IO related error
class	X :: IO :: Chdir	Error while trying to change the working directory
class	X :: IO :: Chmod	Error while trying to change file permissions
class	X :: IO :: Copy	Error while trying to copy a file
class	X :: IO :: Cwd	Error while trying to determine the current working directory

class	X :: IO :: Dir	Error while trying to get a directory's contents
class	X :: IO :: DoesNotExist	Error while doing file tests on a non existing path
class	X :: IO :: Link	Error while trying to create a link
class	X :: IO :: Mkdir	Error while trying to create a directory
class	X :: IO :: Move	Error while trying to move a file

class	X :: IO :: Rename	Error while trying to rename a file or directory
class	X :: IO :: Rmdir	Error while trying to remove a directory
class	X :: IO :: Symlink	Error while trying to create a symbolic link
class	X :: IO :: Unlink	Error while trying to remove a file
class	X :: Inheritance :: NotComposed	Error while trying to inherit from a type that's not composed yet

class	X :: Inheritance :: Unsupported	Compilation error due to inheriting from an ineligible type
class	X :: Method :: InvalidQualifier	Compilation error due to calling a qualified method from an ineligible class
class	X :: Method :: NotFound	Compilation error due to calling a method that isn't there
class	X :: Method :: Private :: Permission	Compilation error due to calling a private method without permission

class	X :: Method :: Private :: Unqualified	Compilation error due to an unqualified private method call
class	X :: Mixin :: NotComposable	Error due to using an ineligible type as a mixin
class	X :: NYI	Error due to use of an unimplemented feature
class	X :: NoDispatcher	Error due to calling a dispatch command in an ineligible scope

class	X :: Numeric :: Real	Error while trying to coerce a number to a Real type
role	X :: OS	Error reported by the operating system
class	X :: Obsolete	Compilation error due to use of obsolete syntax
class	X :: OutOfRange	Error due to indexing outside of an allowed range

class	<code>X :: Package :: Stubbed</code>	Compilation error due to a stubbed package that is never defined
class	<code>X :: Parameter :: Default</code>	Compilation error due to an unallowed default value in a signature
class	<code>X :: Parameter :: MultipleTypeConstraints</code>	Compilation error due to a parameter with multiple type constraints

class	X :: ParameterCPlaceholder	Compilation error due to an unallowed placeholder in a signature
class	X :: ParameterCTwigil	Compilation error due to an unallowed twigil in a signature
class	X :: ParameterCWrongOrder	Compilation error due to passing parameters in the wrong order
class	X :: Phaser :: Multiple	Compilation error due to multiple phasers of the same type

class	X :: Phaser :: PrePost	<p>error due to a false return value of a PRE/POST phaser</p>
class	X :: Placeholder :: Block	<p>Compilation error due to a placeholder in an ineligible block</p>
class	X :: Placeholder :: Mainline	<p>Compilation error due to a placeholder in the mainline</p>
role	X :: Pod	<p>Pod related error</p>
role	X :: Proc :: Async	<p>Exception thrown by</p>

class	<code>X :: Proc :: Async</code>	<code>AlreadyStarted</code> calling
class	<code>X :: Proc :: Async</code>	<code>CharsOrBytes</code> tapping the same
class	<code>X :: Proc :: Async</code>	<code>MustBeStarted</code> interacting with a
class	<code>X :: Proc :: Async</code>	<code>OpenForWriting</code> writing to a read-only
class	<code>X :: Proc :: Async</code>	<code>TapBeforeSpawn</code> tapping a Proc::Async stream after spawning its process

class	X :: Proc :: Unsuccessful	Exception thrown if a Proc object is sunk after the process it ran exited unsuccessfully
class	X :: Promise :: CauseOnlyValidOnBroken	asking why an unbroken promise has been broken.
class	X :: Promise :: Vowed	used to directly trying to keep/break a vowed promise.

class	X :: Redeclaration	Compilation error due to declaring an already declared symbol
class	X :: Role :: Initialization	Error due to passing an initialization value to an ineligible role
class	X :: Seq :: Consumed	Error due to trying to reuse a consumed sequence
class	X :: Sequence :: Deduction	Error due to constructing a sequence from ineligible input

class	X :: SignatureConflict	Compilation error due to two named parameters with the same name
class	X :: SignaturePlaceholder	error due to placeholders in a block with a signature
class	X :: Str :: Numeric	Error while trying to coerce a string to a number
class	X :: StubCode	Runtime error due to execution of stub code

role	X :: Syntax	Syntax error thrown by the compiler
class	X :: Syntax :: Augmented WithoutMonkeyTyping	Compilation error due to augmenting a type without 'MONKEY- TYPING'
class	X :: Syntax :: Comment :: Embedded	Compilation error due to a malformed inline comment
class	X :: Syntax :: Confused	Compilation error due to unrecognized syntax

class	X :: Syntax :: InfixInTermPosition	Compilation error due to an infix in term position
class	X :: Syntax :: Malformed	Compilation error due to a malformed construct (usually a declarator)
class	X :: Syntax :: Missing	Compilation error due to a missing piece of syntax

class	X :: Syntax :: NegatedPair	Compilation error due to passing an argument to a negated colonpair
class	X :: Syntax :: NoSelf	Compilation error due to implicitly using a 'self' that is not there
class	X :: Syntax :: Number :: RadixOutOfRange	Compilation error due to an unallowed radix in a number literal

class	X :: Syntax :: Perl5	Compilation error due to use of Perl 5-only syntax
class	X :: Syntax :: Regex::Adverb	Compilation error due to an unrecognized regex adverb
class	X :: Syntax :: Regex::SolitaryQuantifier	Compilation error due to a regex quantifier without preceding atom
class	X :: Syntax :: Reserved	Compilation error due to use of syntax reserved for future use

class	X :: Syntax :: SelfWithoutObject	Compilation error due to invoking 'self' in an ineligible scope
class	X :: Syntax :: Signature :: InvocantMarker	Compilation error due to a misplaced invocant marker in a signature
class	X :: Syntax :: Term :: MissingInitializer	Compilation error due to declaring a term without initialization

class	X :: Syntax :: UnlessElse Compilation	error due to an 'unless' clause followed by 'else'
class	X :: Syntax :: Variable::Match Compilation	error due to declaring a match variable
class	X :: Syntax :: Variable::Numeric Compilation	error due to declaring a numeric symbol
class	X :: Syntax :: Variable::Twigil Compilation	error due to an unallowed twigil in a declaration

role	X :: Temporal	Error related to Date Time or Date
class	X :: Temporal : InvalidFormat	Error due to using an invalid format when creating a Date Time or Date
class	X :: TypeCheck	Error due to a failed type check
class	X :: TypeCheck : Assignment	Error due to a failed type check during assignment
class	X :: TypeCheck : Binding	Error due to a failed type check during binding

class	X :: TypeCheckError: Return	Compilation error due to a failed typecheck during 'return'
class	X :: TypeCheckError: Splice	Compilation error due to a macro trying to splice a non-AST value
class	X :: Undeclared	Compilation error due to an undeclared symbol

List of modules included with Rakudo Star

DBIish
debugger-ui-commandline
doc
file-find
grammar-debugger

Grammar-Profiler-Simple
json
json_fast
JSON-Class
JSON-Marshal
JSON-Name
JSON-Unmarshal
jsonrpc
library-make
Linenoise
META6
NativeHelpers-Blob
oo-monitors
p6-file-directory-tree
p6-File-Temp
p6-io-string
p6-Template-Mustache
panda-stub

perl6-datetime-format
perl6-digest-md5
perl6-encode
perl6-file-which
perl6-http-easy
perl6-http-status
perl6-lwp-simple
Perl6-MIME-Base64
perl6-pod-to-bigpage
perl6-Test-When
Pod-To-HTML
PSGI
shell-command
svg
svg-plot
tap-harness6
Template-Mojo
Terminal-ANSIColor

Test-META
test-mock
uri
xml-writer
zef