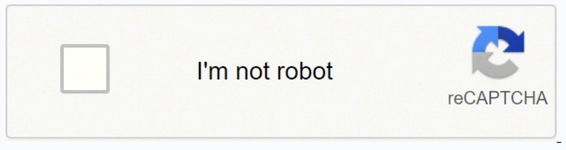

Continue

Personality vocabulary test pdf template microsoft

If a keyword starts something on background, there should be another keyword that checks the status of the worker thread and reports gathered information accordingly. Basically, that means using docstrings as in the example below. These kind of dependencies may create hard-to-debug problems, for example, when new test cases are added and they use the library inconsistently. 16:18:42.123 INFO This is a new message. good hyvä (converted to hyv\xe4) \x00 (the null byte) bytearray str, bytes Same conversion as with bytes but the result is a bytearray. Basically, all arguments at the end of the keyword call that use the named argument syntax name=value, and that do not match any other arguments, are passed to the keyword as kwargs. Using the syntax works based on the argument names and default values got from the library using the get_keyword_arguments method. class MyFatalError(RuntimeError): ROBOT_EXIT_ON_FAILURE = True Exception messages are not the only way to give information to the users. *** Test Cases *** Defaults One Default One Default argument Multiple Defaults required arg Multiple Defaults required arg optional Multiple Defaults required arg optional 1 optional 2 Robot Framework supports also keywords that take any number of arguments. def parse_fi_date(value): day, month, year = value.split('.') return date(int(year), int(month), int(day)) # Register converter function for the specified type. Methods that have the robot_name attribute also create keywords even if the method name itself would start with an underscore. Notice that this feature needs to be used with care, because, for example, one badly placed tag can ruin the log file quite badly. Libraries can also log during the test library import and initialization. See the Supported conversions section below for a list of types that are automatically converted and what values these types accept. Note The @not_keyword decorator is new in Robot Framework 3.2. Keyword names used in the test data are compared with method names to find the method implementing these keywords. This can be accomplished by setting the robot_name attribute on the method to the desired custom name: def login(username, password): # ... The @keyword decorator can also be used for setting a custom name, tags and argument types to the keyword. See the Skipping tests section below for more information. See the Continuable failures section below for more information. 42 (42 seconds) 1 minute 2 seconds 01:02 (same as above) Enum str The specified type must be an enumeration (a subclass of Enum or Flag) and given arguments must match its member names. When such a package is installed using pip or other tools, it is automatically in the module search path. It does not matter for Robot Framework how these libraries are actually implemented (for example, how calls to the run_keyword method are mapped to a correct keyword implementation), and many different approaches are possible. For example, ['first keyword', 'second keyword'], ['first_keyword', 'second_keyword'], and ['firstKeyword', 'secondKeyword'] would all be mapped to keywords First Keyword and Second Keyword. Setting types to None like @keyword(types=None) disables type conversion altogether so that also type information got from default values is ignored. If the type hint is generic Sequence, sequences are used without conversion. ['**named'], ['a', 'b=42', '**c'], ['*varargs', '**kwargs'] Named-only arguments Arguments after varargs or a lone * if there are no varargs. For example, if converting to an integer fails, float conversion is attempted. It is also possible to have HTML formatted error messages by starting the message with text *HTML*: raise AssertionError("*HTML* Robot Framework rulez!!") This method can be used both when raising an exception in a library, like in the example above, and when users provide an error message in the test data. For information about packaging and distributing Python code see . Setting the documentation format is illustrated by the following example that uses reStructuredText format. With generic exceptions (for example, AssertionError, Exception, and RuntimeError), only the exception message is used, and with others, the message is created in the format ExceptionType: Actual message. Test libraries can control when new libraries are created with a class attribute ROBOT_LIBRARY_SCOPE . If not explicitly specified, type can be got implicitly from argument default values. When attributes are set, they override possible existing class attributes. Converters are registered for libraries by setting ROBOT_LIBRARY_CONVERTERS attribute (case-sensitive) to a dictionary mapping desired types to converts. For example, if you have a Python module MyLibrary (that is, file MyLibrary.py), it will create a library with name MyLibrary. Python classes are always inside a module. First of all your new library will have same keywords as the original meaning that there is always conflict. How the documentation is presented is best tested with Libdoc in practice. For a real world example of using a signature exactly like in the above example, see Run Process and Start Keyword keywords in the Process library. Because all unrecognized values are considered same as TEST, both values work with all versions. See the Supported conversions section for more information about supported types and how to specify them. dict Mapping dictionary, map str, Mapping Same as list, but string arguments must be dictionary literals. In addition to using the robot.api.FatalError exception, it is possible create a custom exception that has a special ROBOT_EXIT_ON_FAILURE attribute set to a True value. A possible suite setup and suite teardown share yet another instance. If the argument type is incompatible with the expected type, conversion fails. The Accepts column specifies which given argument types are converted. Regardless of the approach that is used, it is not necessarily to specify types for all arguments. For example, if the following keyword is executed, there will be a warning like shown below in the log file. In simple cases this means using int() or float() to convert arguments to numbers, but other kind of conversion is possible as well. Example 1 ${None} # Argument is `None`. Starting from RF 4.1, spaces and underscores can be used as visual separators for digit grouping purposes. Repackaging the library may also be a big extra task. Extends an existing type but that is not required. Version information is read from attribute ROBOT_LIBRARY_VERSION, similarly as library scope is read from ROBOT_LIBRARY_SCOPE. To ease maintenance, it is highly recommended that library documentation is included in the source code and generated from it. class DynamicExample: def get_keyword_names(self): return ['first keyword', 'second keyword'] def run_keyword(self, name, args, kwargs): print("Running keyword '%s' with positional arguments %s and named arguments %s." % (name, args, kwargs)) If a dynamic library only implements the get_keyword_names and run_keyword methods, Robot Framework does not have any information about the arguments that the implemented keywords accept. If the converter can accept multiple types, it is possible to specify types as a Union. Prior to Robot Framework 3.2 this value was TEST CASE, but nowadays TEST is recommended. from robot.libraries.BuiltIn import BuiltIn def title_should_start_with(expected): seleniumlib = BuiltIn().get_library_instance('SeleniumLibrary') title = seleniumlib.get_title() if not title.startswith(expected): raise AssertionError("Title '%s' did not start with '%s'" % (title, expected)) This approach is clearly better than importing the library directly and using it when the library has a state. Python users may also find the PythonLibCore project useful. It is an error if an argument having one of the supported types is given a value that cannot be converted. For example, a method implementing a keyword with no arguments takes no arguments either, a method implementing a keyword with one argument also takes one argument, and so on. class MySkippingError(RuntimeError): ROBOT_SKIP_EXECUTION = True It is possible to fail a test case so that the whole test execution is stopped. Doing it requires only adding appropriate type hint to the converter: def parse_fi_date(value: str): # ... 16:18:42.123 INFO This is normal text. and has rest of the short documentation after the deprecation marker, if any, afterwards. Similarly both the do_nothing and doNothing methods can be used as the Do Nothing keyword in the test data. In this special case conversion based on the default value is strict and a conversion failure causes an error. The returned values can be assigned to variables in the test data and then used as inputs for other keywords, even from different test libraries. Decimal is recommended over float when decimal numbers need to be represented exactly. In addition to a programmatic interface being a lot cleaner to use, this API has a benefit that the log messages have accurate timestamps. For example, trying to use it with argument ${42} would fail like this: ValueError: Argument 'arg' got value '42' (integer) that cannot be converted to date: TypeError: expected string or bytes-like object This error situation could naturally handled in the converter code by checking the value type, but if the converter only accepts certain types, it is typically easier to just restrict the value to that type. The final way for keywords to communicate back to the core framework is returning information retrieved from the system under test or generated by some other means. When a keyword from a dynamic library is used in the test data, Robot Framework uses the run_keyword method to get it executed. As already discussed, warnings and all messages written to the standard error stream are written both to the log file and to the console. The following example illustrates how normal arguments, varargs, and kwargs work together: def various_args(arg=None, *varargs, **kwargs): if arg is not None: print('arg:', arg) for value in varargs: print('vararg:', value) for name, value in sorted(kwargs.items()): print('kwarg:', name, value) *** Test Cases *** Positional Various Args hello world # Logs 'arg: hello' and 'vararg: world'. ['*varargs'], ['argument', '*rest'], ['a', 'b=42', '*c'] Free named arguments (kwargs) Last arguments has ** prefix. Robot Framework cannot provide more information automatically, but the converter itself can be enhanced to validate the input. Representing different arguments with get_keyword_arguments Argument type How to represent Examples No arguments Empty list. The syntax how to represent all these different variables is derived from how they are specified in Python and explained in the following table. When using the public logging API, various logging methods have optional html attribute that can be set to True to enable logging in HTML format. Whether to use a unit- or acceptance-level testing approach depends on the context. """A library for *documentation format* demonstration purposes. These messages do not appear in the log file like the normal log messages, but are instead written to the syslog. Logging during the import and initialization is possible both using the standard output and error streams and the programmatic logging APIs. Both of these are demonstrated below. Example 1 ${10} # Argument is an integer. It is possible to use also HTML, plain text and reStructuredText formats. Longer documentation continues here and it can contain multiple lines or paragraphs. Setting a custom keyword name can also enable library keywords to accept arguments using the embedded arguments syntax. Robot Framework's actual testing capabilities are provided by test libraries. When using other objects than strings, Robot Framework can do automatic argument conversion based on them. Others may find it easier to consult Python Reference Manual first. With the above addition calling the keyword with ${42} would fail like this: ValueError: Argument 'arg' got value '42' (integer) that cannot be converted to date. Converter is got based on argument type. If the module name and class name are different, libraries must be taken into use using both module and class names, such as mymodule.MyLibrary or parent.submodule.MyLib. *** Settings *** Library SeleniumLibrary Library SeLibExtensions *** Test Cases *** Example Open Browser # SeleniumLibrary Title Should Start With Example # SeLibExtensions Test libraries that use the dynamic or hybrid library API often have their own systems how to extend them. Additionally, only the date part is mandatory, all possibly missing time components are considered to be zeros. This is especially problematic when creating library documentation with Libdoc and when using external tools like RIDE. Instead, Robot Framework uses reflection to find methods implementing keywords, similarly as with the static API. 3.14 10 000.000 01 10_000.000_01 str string, unicode Any All arguments are converted to Unicode strings. Messages logged using the WARN or ERROR levels are also visible in the test execution errors section in the log file. The robot.api.deco.keyword decorator allows an easy way to do this since it creates a custom 'robot_name' attribute on the decorated method. Of course, this testing should be automated to make it easy to rerun tests when libraries are changed. If it is used, only the listed functions can be keywords. In other words, users do not need to know what APIs their libraries use. This means that the timestamps are not accurate and debugging problems especially with longer running keywords can be problematic. Converted to a float. There is no practical difference in using this exception compared to using the standard AssertionError. @keyword(types=[int, bool]) def example_keyword(count, case_insensitive=True): if case_insensitive: # ... """ return do_something(argument) 20080911 16:00:22.650 WARN Keyword 'SomeLibrary.Example Keyword' is deprecated. Sometimes getting such notifications is also useful for test libraries, and they can register a custom listener by using ROBOT_LIBRARY_LISTENER attribute. In this example count and case_insensitive get types int and bool, respectively: def example_keyword(count=-1, case_insensitive=True): if case_insensitive: # ... Reporting keyword status is done simply using exceptions. Example 1 10 # Argument is a string. With simple libraries consisting of a single file, it is often enough to ask the users to copy that file somewhere and set the module search path accordingly. See the Stopping test execution section below for more information. The ROBOT_AUTO_KEYWORDS attribute is set always. If the third argument is missing, free named arguments and named-only arguments are not supported, and other named arguments are mapped to positional arguments. class MyLibrary: """This is an example library with some documentation.""" def keyword_with_short_documentation(self, argument): """This keyword has only a short documentation""" pass def keyword_with_longer_documentation(self): """First line of the documentation is here. Another alternative is using Robot Framework's own documentation tool Libdoc. This approach works extremely well if the enhancements are generic and you plan to submit them back to the original developers. If no type information is specified to Robot Framework, all arguments not passed as variables are given to keywords as Unicode strings. Library logging using the logging API during import: from robot.api import logger logger.debug("Importing library") def keyword(): # ... It is also possible to set new variables from libraries using set_test_variable, set_suite_variable and set_global_variable. For example, if the length argument gets value 1.5 as a float, it would not be converted to an integer. Positional-only arguments are specified before normal arguments and a special / marker must be used after them: def keyword(posonly, /, normal): print(f"Got positional-only argument {posonly} and normal argument {normal}.") The above keyword could be used like this: *** Test Cases *** Example # Positional-only and normal argument used as positional arguments. Values can be given as actual integers and as strings that can be converted to integers. Using this decorator without an argument will have no effect on the exposed keyword name, but will still set the robot_name attribute. The returned documentation is used similarly as the keyword documentation string with static libraries. If no individual conversion succeeds, the whole conversion fails. The following examples clarify how logging with different levels works. When developing libraries, it is often a good idea to run tests using --loglevel DEBUG. Named and kwargs Various Args arg=value hello=world # Logs 'arg: value' and 'kwarg: hello world'. All these usages require that returned values are lists or list-like objects. Because test libraries are technically just classes or modules, a simple way to use another library is importing it and using its methods. When implementing a library as a module, all functions in the module namespace become keywords. The @keyword decorator can be used to create a custom keyword name for the keyword which includes the desired syntax. If the used type hint is list (e.g. arg: list), sequences that are not lists are converted to lists. As the following examples giving different values to the padding argument demonstrate, also in these cases passing other types is possible using variables: *** Test Cases *** Conversion Example 1 big # Argument is a string. The lowest-level test suites, created from test case files and containing test cases, have instances of their own, and higher-level suites all get their own instances for their possible setups and teardowns. This tool can create a library documentation from libraries using the static library API, such as the ones above, but it also handles libraries using the dynamic library API and hybrid library API. TEST is also the default value if the ROBOT_LIBRARY_SCOPE attribute is not set. The @library decorator also disables the automatic keyword discovery by setting the ROBOT_AUTO_KEYWORDS argument to False by default. Only differences between static and dynamic libraries are how Robot Framework discovers what keywords a library implements, what arguments and documentation these keywords have, and how the keywords are actually executed. def example_keyword(): print('Running in thread "%s".' % current_thread().name) @not_keyword def this_is_not_keyword(): pass Using the @not_keyword decorator is pretty much the opposite way to avoid functions or methods becoming keywords compared to disabling the automatic keyword discovery with the @library decorator or by setting the ROBOT_AUTO_KEYWORDS to a false value. ['one', 'two'] [('one', 1), ('two', 2)] tuple str, Sequence Same as list, but string arguments must tuple literals. If argument conversion based on default values is not desired, the whole argument conversion can be disabled with the @keyword decorator like @keyword(types=None). This deprecation system works with most test libraries and also with user keywords. The easiest way to do that is using the provided robot.api.SkipExecution exception: from robot.api import SkipExecution def example_keyword(): if test_should_be_skipped(): raise SkipExecution('Cannot proceed, skipping test.') ... This task is not too complicated because, as this chapter illustrates, Robot Framework's library API is simple and straightforward. The full error message is always shown in the log message of the failed keyword. If you want to try this yourself, make sure that the library is in the module search path. 16:18:42.123 INFO Robot Framework Programmatic APIs provide somewhat cleaner way to log information than using the standard output and error streams. Everything normally logged by the library will be converted into a format that can be safely represented as HTML. Just as with the dynamic API, it is possible to implement a library using the hybrid API only as a class. 16:18:42.123 INFO Hello again!This will be part of the previous message. It could be a normal # function as well, but this way all code is in the same class. ROBOT_LIBRARY_CONVERTERS = {date: parse_fi_date} # Keyword using custom converter. Robot Framework provides some exceptions that libraries can use for reporting failures and other events. This section explains different approaches how to add new functionality to existing test libraries and how to use them in your own libraries otherwise. If the type is got based on a default value, the given argument is used as-is. @keyword(types=[None, float]) def example2(first, second, third): # ... Name comparison is case-insensitive, and also spaces and underscores are ignored. In the argument specification returned by the get_keyword_arguments method named-only arguments are specified after possible variable number of arguments (*varargs) or a lone asterisk (*) if the keyword does not accept varargs. If a specified type is not recognized by Robot Framework, then the original value is used as-is. Another straightforward way to extend an existing library is using inheritance. This rule only applies if the positional-only argument is used in its correct position without other arguments using the name argument syntax before it, though. For users it may also be confusing to use a library that has different functionality than the original one. Note Prior to Robot Framework 4.0 conversion was done based on the default value only if the argument did not have an explict type. Library documentation tool Libdoc also writes this information into the keyword documentations it generates. timedelta str, int , float Strings are expected to represent a time interval in one of the time formats Robot Framework supports: time as number, time as time string or time as "timer" string. Note Support to specify arguments as tuples like ('name', 'default') is new in Robot Framework 3.2. Robot Framework 3.1 introduced support for automatic argument conversion and the dynamic library API supports that as well. This means using exceptions for reporting keyword status, logging by writing to the standard output or by using the provided logging APIs, and using the return statement in run_keyword for returning something. If you cannot decide, of course it is possible to use both the approaches. There are plenty of useful keywords in the BuiltIn library for this purpose. If a worker thread has, for example, a failure to report or something to log, it should pass the information first to the main thread, which can then use exceptions or other mechanisms explained in this section for communication with the framework. These attributes must be class or module attributes, depending whether the library is implemented as a class or a module. The former is got by calling get_keyword_documentation with special value __intro__, and the latter is got using value __init__. Named-only arguments can have default values, and the order of arguments with and without default values does not matter. Not even in the table below. The actual argument names and default values that are returned are also important. Python has excellent unit testing tools, and they suite very well for testing libraries. This is problematic, because most real keywords expect a certain number of keywords, and under these circumstances they would need to check the argument counts themselves. With generics also the subscription syntax (e.g. List[int]) works, but no validation is done for container contents. The easiest way to do that is using the provided robot.api.ContinuableFailure exception: from robot.api import ContinuableFailure def example_keyword(): if something_is_wrong(): raise ContinuableFailure('Something is wrong but execution can continue.') ... Alternatively functions could be given an alias starting with an underscore at the import time (e.g. from threading import current_thread as _current_thread). One worth mentioning specifically is Run Keyword And Expect Error, which is useful for testing that keywords report errors correctly. Keyword foo normal=bar If a positional-only argument is used with a value that contains an equal sign like example=usage, it is not considered to mean named argument syntax even if the part before the = would match the argument name. 42 -1 0xFF 0o777 0b1010 10 000 000 0xBAD_C0FFEE ${1} ${1.0} float Real double str, Real Conversion is done using the float built-in. All the examples use a keyword Dynamic that has been specified to have argument specification [positional=default, *varargs, named, named2=default, **free]. With the static API, you must have all keywords in one class or module, whereas with the dynamic API, you can, for example, implement each keyword as a separate class. Messages with ERROR or WARN level are automatically written to the console and a separate Test Execution Errors section in the log files. Matching member names is case-, space- and underscore-insensitive. Example library implemented as a module in the MyLibrary.py file: def hello(name): print("Hello, %s!" % name) def do_nothing(): pass The example below illustrates how the example library above can be used. Arguments passed to the library, as well as the library name itself, can be specified using variables, so it is possible to alter them, for example, from the command line. Hybrid API This is a hybrid between the static and the dynamic API. A test library without documentation about what keywords it contains and what those keywords do is rather useless. All test libraries implemented as classes can take arguments. 16:18:42.123 INFO This is bold. This includes cases like this: *** Test Cases *** Example Example Keyword 42 False It is always possible to convert arguments passed as strings insider keywords. Also this API produces log messages with accurate timestamps, but logging HTML messages or writing messages to the console are not supported. In the hybrid API, there is no run_keyword method for executing keywords. It is also possible to implement libraries with C using Python C API, although it is often easier to interact with C code from Python libraries using ctypes module. For the same reason it is possible to also use value TASK if the library is targeted for RPA usage more than testing. keywords = [(name, value) for name, value in attributes if hasattr(value, 'robot_name')] # Return value of 'robot_name', if given, or the original 'name'. 2022-02-09T16:39:43.632269 2022-02-09 16:39 2022-02-09 ${1644417583.632269} (Epoch time) date str Same string conversion as with datetime but all time components are expected to be omitted or to be zeros. It takes a keyword name as an argument and, as the method name implies, returns its documentation as a string. For example, if the module below would be used as a library, it would contain a keyword Example Keyword, as expected, but also a keyword Current Thread. Arguments defined in Robot Framework test data are, by default, passed to keywords as Unicode strings. This requires that the run_keyword method takes three arguments: the third getting the named-only arguments along with the other named arguments. For example, a level between INFO and WARNING is mapped to Robot Framework's INFO level. The table below lists the types that Robot Framework 3.1 and newer convert arguments to. Changes to keywords are rare and they are always done so that old usage is first deprecated. With libraries implemented as classes, it is also possible to use the converters argument with the @library decorator. An example module using __version__: __version__ = '0.1' def keyword(): pass Library documentation tool Libdoc supports documentation in multiple formats. This works so that all messages that are received by the root logger of the module are automatically propagated to Robot Framework's log file. This simple format allows often used styles like *bold* and _italic_, tables, lists, links, etc. Other strings and other accepted values are passed as-is, allowing keywords to handle them specially if needed. This is especially important when threads are run on background while other keywords are running. Named Various Args arg=value # Logs 'arg: value'. Keywords can be deprecated by starting their documentation with text *DEPRECATED, case-sensitive, and having a closing * also on the first line of the documentation. When using function annotations, the natural syntax to specify that argument has multiple possible types is using Union: from typing import Union def example(length: Union[int, float], padding: Union[int, str, None] = None): # ... For example, with this keyword conversion would first be attempted to an integer but if that fails the keyword would get the original given argument: def example(argument: Union[int, MyCustomType]): # ... In this situation argument conversion is attempted based on each type and the whole conversion fails if none of these conversions succeed. It is possible to continue test execution even when there are failures. Messages written into the standard error are handled similarly otherwise, but they are echoed back to the original stderr after the keyword execution has finished. Here is a link to the only \`Keyword\`. After getting keyword name and arguments, the library can execute the keyword freely, but it must use the same mechanism to communicate with the framework as static libraries. When a library is implemented as a module, this decorator can also be used to avoid imported functions becoming keywords. Sometimes there is a need to replace existing keywords with new ones or remove them altogether. SkipExecution Mark the executed test or task skipped. These exceptions are exposed via the robot.api package and contain the following: Failure Report failed validation. If dynamic libraries want to provide keyword documentation, they can implement the get_keyword_documentation method (alias getKeywordDocumentation). This information includes the name of the type, accepted values (if specified using type hints) and documentation. The comment shows the arguments that the run_keyword method is actually called with. @keyword def any(self, arg: Union[FiDate, UsDate, date]): print(f'year: {arg.year}, month: {arg.month}, day: {arg.day}') Information about converters is added to outputs produced by Libdoc automatically. 16:18:42.123 ERROR Something unexpected happen that may indicate a problem in the test. In addition to them, methods can also send messages to log files simply by writing to the standard output stream (stdout) or to the standard error stream (stderr), and they can even use different log levels. Keywords also take the same arguments as the methods implementing them. This section explains how to prevent methods and functions becoming keywords. This is demonstrated by the example below. What arguments a keyword accepts depends on what get_keyword_arguments returns for it. Libraries are classes with a method telling what keywords they implement, but those keywords must be available directly. The type to use can be specified either using concrete types (e.g. list), by using Abstract Base Classes (ABC) (e.g. Sequence), or by using sub classes of these types (e.g. MutableSequence). Prior to Robot Framework 4.0, automatic conversion was done only if the given argument was a string. This method cannot take any arguments, and it must return a list or array of strings containing the names of the keywords that the library implements. The @library decorator only sets class attributes ROBOT_LIBRARY_SCOPE, ROBOT_LIBRARY_VERSION, ROBOT_LIBRARY_CONVERTERS, ROBOT_LIBRARY_DOC_FORMAT and ROBOT_LIBRARY_LISTENER if the respective arguments scope, version, converters, doc_format and listener are used. To use other log levels than INFO, or to create several messages, specify the log level explicitly by embedding the level into the message in the format *LEVEL* Actual log message, where *LEVEL* must be in the beginning of a line and LEVEL is one of the available logging levels TRACE, DEBUG, INFO, WARN, ERROR and HTML. GLOBAL Only one instance is created during the whole test execution and it is shared by all test cases and test suites. If any conversion succeeds, the resulting value is used without attempting remaining conversions. Note Custom argument converters are new in Robot Framework 5.0. Let's assume we wanted to create a keyword that accepts date objects for users in Finland where the commonly used date format is dd.mm.yyyy. Accepted as-is. The example below shows the basic functionality: def example_keyword(**stuff): for name, value in stuff.items(): print(name, value) *** Test Cases *** Keyword Arguments Example Keyword hello=world # Logs 'hello world'. Keyword posonly=foo normal=bar # This fails. Python supports methods accepting any number of arguments. For example, both of these keywords specify the type only for the second argument: @keyword(types={'second': float}) def example1(first, second, third): # ... See Documenting libraries section and Libdoc chapter for more information about documenting test libraries in general. An alternative is creating a custom exception that has a special ROBOT_SKIP_EXECUTION attribute set to a True value. Dynamic libraries can also support free named arguments (**named). The library instance you use in your library will not be the same as the framework uses, and thus changes done by executed keywords are not visible to your library. Note Automatic type conversion is new in Robot Framework 3.1. After a method implementing a keyword is called, it can use any mechanism to communicate with the system under test. One of the benefits of the dynamic API is that you have more flexibility in organizing your library. This allows generating the list of keywords just by checking for the robot_name attribute on every method in the library during get_keyword_names. Dynamic libraries can provide both general library documentation and documentation related to taking the library into use. If it is missing, or if calling it fails for some reason, the library is considered a static library. Custom log levels are mapped to the closest standard level smaller than the custom level. The traceback of the exception is also logged using DEBUG log level. With the above examples the length argument would first be converted to an integer and if that fails then to a float. However, outputs from these tools can be slightly technical for some users. Other solutions include using external modules like decorator and wrapt that allow creating fully signature-preserving decorators. All the examples use a keyword Dynamic that has an argument specification [a=d1, b=d2, **named]. It is possible to avoid adding the exception type as a prefix to failure message also with non generic exceptions. Using the named-only argument syntax with dynamic libraries is illustrated by the following examples. Libraries implemented as a module cannot take any arguments, so trying to use those results in an error. Using the named argument syntax with dynamic libraries is illustrated by the following examples. In practice, the library needs to have the get_keyword_names or getKeywordNames method returning a list of keyword names that the library implements. In the latter case, if a keyword has multiple arguments with default values and only some of the latter ones are given, the framework fills the skipped optional arguments based on the default values returned by the get_keyword_arguments method. If any types are specified using the @keyword decorator, type information got from annotations is ignored with that keyword. It caused various problems and was changed in Robot Framework 4.0.1. In addition to doing argument conversion automatically as explained in the previous sections, Robot Framework supports custom argument conversion. Starting from Robot Framework 3.1, arguments passed to keywords are automatically converted if argument type information is available and the type is recognized. New in RF 4.0. bytes ByteString str, bytearray Strings are converted to bytes so that each Unicode code point below 256 is directly mapped to a matching byte. Starting from Robot Framework 3.1, dynamic libraries can have named-only arguments. There are many existing libraries, some of which are even bundled with the core framework, but there is still often a need to create new ones. The library instance returned by this keyword is the same as the framework itself uses, and thus there is no problem seeing the correct library state. Supported argument conversions Type ABC Aliases Accepts Explanation Examples bool boolean str, int , float, None Strings TRUE, YES, ON and 1 are converted to True, the empty string as well as FALSE, NO, OFF and 0 are converted to False, and the string NONE is converted to None. If libraries want to use formatting, links, display images and so on, they can use a special pseudo log level HTML. It is not recommended with annotations, because that syntax is not supported by other tools, but it works well with the @keyword decorator: from robot.api.deco import keyword @keyword(types={'length': (int, float), 'padding': (int, str, None)}) def example(length, padding=None): # ... It can return types using a list or a dictionary exactly like types can be specified when using the @keyword decorator. Using the reST format requires the docutils module to be installed when documentation is generated. The second argument is a list of positional arguments given to the keyword in the test data, and the optional third argument is a dictionary containing named arguments. if isinstance(value, int): return date.fromtimestamp(value) match = re.match(r'(\d{1,2})\.(\d{1,2})\.(\d{4})$', value) if not match: raise ValueError(f"Expected date in format 'dd.mm.yyyy', got '{value}'.") day, month, year = match.groups() return date(int(year), int(month), int(day)) ROBOT_LIBRARY_CONVERTERS = {date: parse_fi_date} def keyword(arg: date): print(f'year: {arg.year}, month: {arg.month}, day: {arg.day}') A problem with the earlier example is that date objects could only be given in dd.mm.yyyy format. The biggest problem of this approach is that it can be hard for you to update the original library without affecting your changes. After a library is implemented, documented, and tested, it still needs to be distributed to the users. import time def example_keyword(): print('*INFO:%d* Message with timestamp' % (time.time()*1000)) If libraries need to write something to the console they have several options. If ROBOT_LIBRARY_VERSION does not exist, information is tried to be read from __version__ attribute. Messages logged by non-main threads using the normal logging methods from programmatic logging APIs are silently ignored. Note Prior to Robot Framework 3.1, normal named arguments were mapped to positional arguments regardless did run_keyword accept two or three arguments. If it accepts only two arguments, named arguments are mapped to positional arguments. Dynamic libraries tell what keywords they implement with the get_keyword_names method. There are also situations where keywords are created when not expected. The most common and also the simplest situation is when a keyword needs an exact number of arguments. Another, and often better, logging possibility is using the programmatic logging APIs. By default, everything written by a method into the standard output is written to the log file as a single entry with the log level INFO. The names of the keywords to implement, as well as how they are executed, can be determined dynamically at runtime, but reporting the status, logging and returning values is done similarly as in the static API. This means that it is mandatory to decorate methods with the @keyword decorator to expose them as keywords. Note In Robot Framework 4.0 argument conversion was done always, regardless of the type of the given argument. These characteristics apply to all conversions: Type can be explicitly specified using function annotations or the @keyword decorator. @keyword def iso_8601(self, arg: date): print(f'year: {arg.year}, month: {arg.month}, day: {arg.day}') # Accepts date in different formats. If an executed method raises an exception, the keyword status is FAIL, and if it returns normally, the status is PASS. If the run_keyword method accepts three arguments, the second argument gets all positional arguments as a list and the last arguments gets all named arguments as a mapping. This method's documentation explains why this needs to be done and obviously also how to do it. Its levels DEBUG, INFO, WARNING and ERROR are mapped directly to the matching Robot Framework log levels, and CRITICAL is mapped to ERROR. *** Settings *** Library MyLibrary 10.0.0.1 8080 Library AnotherLib ${VAR} Example implementations for the libraries used in the above example: from example import Connection class MyLibrary: def __init__(self, host, port=80): self._conn = Connection(host, int(port)) def send_message(self, message): self._conn.send(message) class AnotherLib: def __init__(self, environment): self.environment = environment def do_something(self): if self.environment == 'test': # do something in test environment else: # do something in other environments Libraries implemented as classes can have an internal state, which can be altered by keywords and with arguments to the constructor of the library. This makes these messages more visible than others and allows using them for reporting important but non-critical problems to users. Normal logging methods will ignore messages from other than main thread, but the BackgroundLogger will save the background messages so that they can be later logged to Robot's log. For example, when implementing a library as class, it can be a surprise that also methods in possible base classes are considered keywords. This keyword does something to given ``argument`` and returns results. Keyword foo bar # Normal argument can also be named. Notice that this type hint is not used for converting the value before calling the converter, it is used for strictly restricting which types can be used. __ """ ROBOT_LIBRARY_DOC_FORMAT = 'reST' def keyword(): """**Nothing** to see here. There is no practical difference, other than consistent naming with other provided exceptions, compared to using this exception and the standard RuntimeError. The first logical line of a keyword documentation, until the first empty line, is used for a special purpose and should contain a short overall description of the keyword. In addition to the new public logging API, Robot Framework offers a built-in support to Python's standard logging module. Although the ROBOT_AUTO_KEYWORDS attribute can be set to the class explicitly, it is more convenient to use the @library decorator that sets it to False by default: from robot.api.deco import keyword, library @library class Example: @keyword def this_is_keyword(self): pass @keyword('This is keyword with custom name') def xxx(self): pass def this_is_not_keyword(self): pass Note Both limiting what methods become keywords using the ROBOT_AUTO_KEYWORDS attribute and the @library decorator are new in Robot Framework 3.2. Another way to explicitly specify what keywords a library implements is using the dynamic or the hybrid library API. When implementing a library as a module, functions imported into the module namespace becoming keywords is probably even a bigger surprise. For example, foo will be displayed in the log exactly like that and not as foo. from robot.api.deco import keyword @keyword('Add ${quantity:\d+} copies of ${item} to cart') def add_copies_to_cart(quantity, item): # ... The conversion logic works exactly like with static libraries, but how the type information is specified is naturally different. The next section explains how to get an access to the same library instance that the framework uses. Adding documentation is in general recommended to provide users more information about conversion. {'a': 1, 'b': 2} {'key': 1, 'nested': {'key': 2}} set Set str, Container Same as list, but string arguments must be set literals or set() to create an empty set. Additionally, all libraries do not have a state and creating new instances of them is simply not needed. For consistency reasons, also arguments that do not accept default values can be specified as one item tuples. In all these cases the argument is converted to the concrete type. ======= ===== ===== Table here has nothing to see. When working with Boolean values, care must be taken because all non-empty strings, including string False, are considered true by Python. The main benefit of using this exception is that its name is consistent with other provided exceptions. Because the state can affect how keywords actually behave, it is important to make sure that changes in one test case do not accidentally affect other test cases. The developers familiar with these tools do not need to learn anything new, and the developers not familiar with them should learn them anyway. A benefit is that you can easily tell that you are using a custom library, but a big problem is that you cannot easily use the new library with the original. This allows logging any kind of useful debug information about the library initialization. For example, SeleniumLibrary uses the GLOBAL scope to enable using the same browser in different test cases without having to reopen it, and it also has the Close All Browsers keyword for easily closing all opened browsers. If a keyword is used with invalid arguments, an error occurs and run_keyword is not even called. These approaches are shown below implementing the same keyword as in earlier examples: from robot.api.deco import keyword @keyword(types={'count': int, 'case_insensitive': bool}) def example_keyword(count, case_insensitive=True): if case_insensitive: # ... In this case, the method simply take exactly those arguments. For example, the method hello maps to the keyword name Hello, hello or even h e l l o. Example 1 ${1.5} # Argument is a float. To support that, Robot Framework has a capability to mark keywords deprecated. Note If you log something during initialization, i.e. in Python __init__, the messages may be logged multiple times depending on the library scope. This support is provided by Python's keyword-only arguments. The easiest way to accomplish this is using the provided robot.api.FatalError exception: from robot.api import FatalError def example_keyword(): if system_is_not_running(): raise FatalError('System is not running!') ... If your changes are applied to the original library, they are included in the future releases and all the problems discussed above are mitigated. A good example of this approach is the Remote library, and another widely used approaches is running external scripts or tools as separate processes. *** Test Cases *** # args, kwargs Named-only only Dynamic named=value # [], {named: value} Dynamic named=value named2=2 # [], {named: value, named2: 2} Named-only with positional and varargs Dynamic argument named=xxx # [argument], {named: xxx} Dynamic a1 a2 named=3 # [a1, a2], {named: 3} Named-only with normal named Dynamic named=foo positional=bar # [], {positional: bar, named: foo} Named-only with free named Dynamic named=value foo=bar # [], {named: value, foo=bar} Dynamic named2=2 third=3 named=1 # [], {named: 1, named2: 2, third: 3} The hybrid library API is, as its name implies, a hybrid between the static API and the dynamic API. Any non-trivial test library needs to be thoroughly tested to prevent bugs in them. Matching types to names and aliases is case-insensitive. See the Documentation format section for information how to set the format in the library source code and Libdoc chapter for more information about the formats in general. It can then also send messages to Robot Framework's log file, return information that can be saved to variables and, most importantly, report if the keyword passed or not. A mandatory precondition for this support is that the run_keyword method takes three arguments: the third one will get the free named arguments along with possible other named arguments. Robot Framework attempts to keep test cases independent from each other: by default, it creates new instances of test libraries for every test case. New in Robot Framework 3.2. ['name=default'], ['a', 'b=1', 'c=2'] [('name', 'default')], ['a', ('b', 1), ('c', 2)] Variable number of arguments (varargs) Argument after possible positional arguments and their defaults has * prefix. Since libraries are normal programming code, they can be packaged using normal packaging tools. When implementing a library as a module, this attribute must be set on the module level, and with class based libraries it must be a class attribute. Libraries created from modules are always global. If get_keyword_arguments is missing or returns Python None for a certain keyword, that keyword gets an argument specification accepting all arguments. When a deprecated keyword is executed, a deprecation warning is logged and the warning is shown also in the console and the Test Execution Errors section in log files. class MyContinuableError(RuntimeError): ROBOT_CONTINUE_ON_FAILURE = True It is possible to skip tests with a library keyword. The levels below it, DEBUG and TRACE, are useful for writing debug information. The dynamic API is in most ways similar to the static API. This keyword can then be used, for example, in a suite setup or teardown to ensure that test cases in the next test suites can start from a known state. Possible **kwargs are specified after keyword-only arguments. return [value.robot_name or name for name, value in keywords] def helper_method(self): # ... This powerful mechanism to communicate with the framework should be used with care, though, because all Robot Framework's APIs are not meant to be used by externally and they might change radically between different framework versions. This also works with submodules so that if, for example, parent.MyLib module has class MyLib, importing it using just parent.MyLib works. With dynamic libraries types can be returned using the optional get_keyword_types method (alias getKeywordTypes). For example, class MyLib in MyLib.py file can be used as a library with just name MyLib. The timestamp must be given as milliseconds since the Unix epoch and it must be placed after the log level separated from it with a colon: *INFO:1308435758660* Message with timestamp *HTML:1308435758661* HTML message with timestamp As illustrated by the examples below, adding the timestamp is easy. It allows configuring library's scope, version, custom argument converters, documentation format and listener with optional arguments scope, version, converter, doc_format and listener, respectively. @keyword def us(self, arg: UsDate): print(f'year: {arg.year}, month: {arg.month}, day: {arg.day}') # Uses IS0-8601 compatible default conversion. Another problem is that the libraries do not share their state. Dynamic libraries have a special run_keyword (alias runKeyword) method for executing their keywords. When a library is implemented as a class, it is possible to tell Robot Framework not to automatically expose methods as keywords by setting the ROBOT_AUTO_KEYWORDS attribute to the class with a false value: class Example: ROBOT_AUTO_KEYWORDS = False When the ROBOT_AUTO_KEYWORDS attribute is set like this, only methods that have explicitly been decorated with the @keyword decorator or otherwise have the robot_name attribute become keywords. class FiDate(date): # Converter function implemented as a classmethod. Note Support for "unwrapping" decorators decorated with functools.wraps is a new feature in Robot Framework 3.2. Library keywords can also accept arguments which are passed using the embedded argument syntax. import logging def my_keyword(arg): logging.debug('Got argument %s' % arg) do_something() logging.info('This is a boring example') The logging module has slightly different log levels than Robot Framework. The example below shows a working, albeit trivial, dynamic library. Example library using the SUITE scope: class ExampleLibrary: ROBOT_LIBRARY_SCOPE = 'SUITE' def __init__(self): self._counter = 0 def count(self): self._counter += 1 print(self._counter) def clear_counter(self): self._counter = 0 When a test library is taken into use, Robot Framework tries to determine its version. Integers and floats are considered to represent seconds since the Unix epoch. If the given argument does not have any of the accepted types, conversion is attempted in the order types are specified. Adding argument conversion for custom types and for other types not supported out-of-the-box. The comment shows the arguments that the run_keyword method is actually called with. def example_keyword(argument): """*DEPRECATED!!* Use keyword `Other Keyword` instead. In the second example, one argument is always required, but the second and the third one have default values, so it is possible to use the keyword with one to three arguments. An alternative is creating a custom exception that has a special ROBOT_CONTINUE_ON_FAILURE attribute set to a True value. attributes = [(name, getattr(self, name)) for name in dir(self)] # Filter out attributes that do not have 'robot_name' set. Normal execution failures and errors can be reported using the standard exceptions such as AssertionError, ValueError and RuntimeError. Starting from RF 4.1, it is possible to use hexadecimal, octal and binary numbers by prefixing values with 0x, 0o and 0b, respectively. When type information is got implicitly based on the default values, argument conversion itself is not as strict as when the information is got explicitly: Conversion may be attempted also to other "similar" types. Starting from RF 3.2.2, matching member names is case-, space- and underscore-insensitive. After getting a reference to the method, it searches for arguments and documentation from it, in the same way as when using the static API. These arguments are passed to the keyword as a mapping. Another point to be noted is that Robot Framework uses the same names that are returned from get_keyword_names for finding the methods implementing them. As a tuple with the name and the default as separate items. Integers and floats are considered to be seconds. This documentation is not used when tests are executed, but it can make the documentation generated by Libdoc much better. Note Starting from Robot Framework 5.0, types that are automatically converted are automatically shown in Libdoc outputs. Used documentation is got from the converter function by default. If an argument has an explicit type and a default value, conversion is first attempted based on the explicit type. This allows marking methods to expose as keywords without actually changing keyword names. The default values and variable number of arguments work similarly as with keyword arguments. For example, also this library implements only one keyword Example Keyword: from threading import current_thread from robot.api.deco import keyword ROBOT_AUTO_KEYWORDS = False @keyword def example_keyword(): print('Running in thread "%s".' % current_thread().name) def this_is_not_keyword(): pass Note Limiting what functions become keywords using ROBOT_AUTO_KEYWORDS is a new feature in Robot Framework 3.2. Functions in modules and methods in classes can be explicitly marked as "not keywords" by using the @not_keyword decorator. ['argument'], ['arg1', 'arg2', 'arg3'] Default values Two ways how to represent the argument name and the default value: As a string where the name and the default are separated with =. A solution is creating a custom converter and registering it to handle date conversion: from datetime import date # Converter function. Converted to an integer. A more explicit way to limit what functions become keywords is using the module level __all__ attribute that Python itself uses for similar purposes. This means that if the earlier example keyword would be used with a variable containing something else than a string, conversion code would fail in the re.match call. That support has been removed and None conversion is only done if an argument has None as an explicit type or as a default value. [] One or more positional argument List of strings containing argument names. Note Prior to Robot Framework 3.1, the short documentation contained only the first physical line of the keyword documentation. Various Args hello=world arg=value # Same as above. If the library has state, however, things may not work as you would hope. Use keyword `Other Keyword` instead. An alternative way to specify explicit argument types is using the @keyword decorator. frozenset str, Container Same conversion as with set, but the result is a frozenset. Although this functionality is available as a keyword, it is typically used in test libraries directly by importing the BuiltIn library class as discussed earlier. In this particular case there would be several ways to validate the input, but using regular expressions makes it possible to validate both that the input has dots (.) in correct places and that date parts contain correct amount of digits: from datetime import date import re def parse_fi_date(value): # Validate input using regular expression and raise ValueError if not valid. class UsDate(date): @classmethod def from_string(cls, value: str): match = re.match(r'(\d{1,2})/(\d{1,2})/(\d{4})$', value) if not match: raise ValueError(f"Expected date in format 'mm/dd/yyyy', got '{value}'.") month, day, year = match.groups() return cls(int(year), int(month), int(day)) # Register converters using '@library' decorator. The first argument is a string containing the name of the keyword to be executed in the same format as returned by get_keyword_names. One of the most useful methods is replace_variables which allows accessing currently available variables. When this API is used, Robot Framework uses reflection to find the methods implementing keywords, similarly as with the static API. Also the dynamic library API supports the named argument syntax. If the name of a class implementing a library is the same as the name of the module, Robot Framework allows dropping the class name when importing the library. Robot Framework has a Python based logging API for writing messages to the log file and to the console. They are called, for example, when suites, tests, and keywords start and end. Example keywords taking different numbers of arguments: def no_arguments(): print("Keyword got no arguments.") def one_argument(arg): print("Keyword got one argument '%s'." % arg) def three_arguments(a1, a2, a3): print("Keyword got three arguments '%s', '%s' and '%s'." % (a1, a2, a3)) It is often useful that some of the arguments that a keyword uses have default values. Failures related to the system not behaving as expected should typically be reported using the Failure exception or the standard AssertionError. If it does not have any documentation, documentation is got from the type. When specifying types as a list, it is possible to use None to mark that a certain argument does not have a type, and arguments at the end can be omitted altogether. All string comparisons are case-insensitive. With the static API, all this is done using reflection, but dynamic libraries have special methods that are used for these purposes. Test libraries can use Robot Framework's internal modules, for example, to get information about the executed tests and the settings that are used. class Direction(Enum): NORTH = auto() NORTH_WEST = auto() NORTH (Direction.NORTH) north west (Direction.NORTH_WEST) IntEnum str, int The specified type must be an integer based enumeration (a subclass of IntEnum or IntFlag) and given arguments must match its member names or values. As discussed in the previous section, this was changed in Robot Framework 3.2 and nowadays default values returned like ('example', True) are automatically used for this purpose. This is true also with imported functions, and that can cause nasty surprises. That value still works, but SUITE is recommended with libraries targeting Robot Framework 3.2 and newer. How to use use keywords that accept free keyword arguments, also known as free named arguments, is discussed under the Creating test cases section. An alternative is specifying types as a tuple. Example ${1.5} # Argument is a float. BuiltIn keyword Get Library Instance can be used to get the currently active library instance from the framework itself. Thus there is no need for special methods for getting arguments and documentation like there is with the dynamic API. The value of this attribute should be an instance of the listener to use, possibly the library itself. match = re.match(r'(\d{1,2})\.(\d{1,2})\.(\d{4})$', value) if not match: raise ValueError(f"Expected date in format 'dd.mm.yyyy', got '{value}'.") day, month, year = match.groups() return date(int(year), int(month), int(day)) ROBOT_LIBRARY_CONVERTERS = {date: parse_fi_date} def keyword(arg: date): print(f'year: {arg.year}, month: {arg.month}, day: {arg.day}') With the above converter code, using the keyword with argument invalid fails with a lot more helpful error message: ValueError: Argument 'arg' got value 'invalid' that cannot be converted to date: Expected date in format 'dd.mm.yyyy', got 'invalid'. When the SUITE or GLOBAL scopes are used with libraries that have a state, it is recommended that libraries have some special keyword for cleaning up the state. That is demonstrated in the example below where the code from the previous examples is expected to be available in a new library SeLibExtensions. Example Keyword foo=1 bar=42 # Logs 'foo 1' and 'bar 42'. A library using the hybrid API can either have those methods implemented directly or, more importantly, it can handle them dynamically. For more information and examples see Libraries as listeners section. 3.14 2.9979e8 10 000.000 01 10_000.000_01 Decimal str, int , float Conversion is done using the Decimal class. Keyword-only arguments are specified after possible *varargs or after a dedicated * marker when *varargs are not needed. Example 1.5 # Argument is a string. In addition to using the actual types (e.g. int), it is possible to specify the type using type names as a string (e.g. 'int') and some types also have aliases (e.g. 'integer'). Robot Framework will write these messages directly into the log with the INFO level, so they can use any HTML syntax they want. On the other hand, acceptance tests ensure that keywords do work through Robot Framework. @keyword def keyword_method(self): # ... To avoid using a literal value like foo=quux as a free keyword argument, it must be escaped like foo\=quux. Annotating arguments with other than the supported types is not an error, and it is also possible to use annotations for other than typing purposes. This attribute must be a string and it can have the following three values: TEST A new instance is created for every test case. Nowadays it is done regardless the argument type. Values are returned using the return statement in methods. Note All these exceptions are new in Robot Framework 4.0. Other features than skipping tests, which is also new in Robot Framework 4.0, are available by other means in earlier versions. The main use case is getting keywords' documentations into a library documentation generated by Libdoc. Below is a simple usage example: from robot.api import logger def my_keyword(arg): logger.debug('Got argument %s' % arg) do_something() logger.info('This is a boring example', html=True) logger.console('Hello, console!') An obvious limitation is that test libraries using this logging API have a dependency to Robot Framework. For example, *DEPRECATED*, *DEPRECATED.*, and *DEPRECATED in version 1.5.* are all valid markers. A big benefit, illustrated also by the simple example below, is that using this logging API creates no dependency to Robot Framework. This functionality has two main use cases: Overriding the standard argument converters provided by the framework. When this attribute is set to a false value, only functions explicitly decorated with the @keyword decorator become keywords. All the examples use a keyword Dynamic that has an argument specification [a, b=d1, c=d2]. *** Settings *** Library MyLibrary *** Test Cases *** My Test Do Nothing Hello world It is possible to expose a different name for a keyword instead of the default keyword name which maps to the method name. Just informing the users about the change may not always be enough, and it is more efficient to get warnings at runtime. If you are already familiar how kwargs work with Python, understanding how they work with Robot Framework test libraries is rather simple. If there is one argument, arg gets that value, and calling the keyword with more than one argument fails. These messages are not visible in log files by default because they are very rarely interesting for normal users. print('Hello from a library.') print('*WARN* Warning from a library.') print('*ERROR* Something unexpected happen that may indicate a problem in the test.') print('*INFO* Hello again!') print('This will be part of the previous message.') print('*INFO* This is a new message.') print('*INFO* This is normal text.') print('*HTML* This is bold.') print('*HTML* Robot Framework') 16:18:42.123 INFO Hello from a library. However, this behavior is not always desirable, because sometimes test cases should be able to share a common state. In this section we take a look at how to create such keywords. Every dynamic library must have both the get_keyword_names and run_keyword methods but rest of the methods in the dynamic API are optional. This automatic argument spec is either [*varargs, **kwargs] or [*varargs], depending does run_keyword support free named arguments or not. 16:18:42.123 WARN Warning from a library. The deprecation warning starts with text Keyword '' is deprecated. For example, 1.0 is accepted and 1.1 is not. This is illustrated by the example below. This approach works great when the methods are static and do not depend on the library state. @library(converters={FiDate: FiDate.from_string, UsDate: UsDate.from_string}) class Library: # Uses custom converter supporting 'dd.mm.yyyy' format. The usage could look something like this: *** Test Cases *** Example Keyword 25.1.2022 Automatic argument conversion supports dates, but it expects them to be in yyyy-mm-dd format so it will not work. There are, however, several ways to use non-string values as well: Automatic argument conversion based on function annotations, types specified using the @keyword decorator, and argument default values are all new features in Robot Framework 3.1. The Supported conversions section specifies which argument conversion are supported in these cases. Keyword names are got in the exactly same way as with the dynamic API. Note If a library is imported multiple times with different arguments, a new instance is created every time regardless the scope. This exception can be used, for example, if the keyword is used incorrectly. Example ${10} # Argument is an integer. SUITE A new instance is created for every test suite. Earlier this did not work with the dynamic API because it was possible to specify arguments only as strings. This special method is probably familiar to most Python programmers and they can immediately understand the following example. When these arguments are used, they set the matching ROBOT_LIBRARY_SCOPE, ROBOT_LIBRARY_VERSION, ROBOT_LIBRARY_CONVERTERS, ROBOT_LIBRARY_DOC_FORMAT and ROBOT_LIBRARY_LISTENER attributes automatically: from robot.api.deco import library from example import Listener @library(scope='GLOBAL',

version='3.2b1', doc_format='reST', listener=Listener()) class Example: # ... *** Test Cases *** My Test Add 7 copies of coffee to cart By default arguments are passed to implementing keywords as strings, but automatic argument conversion works if type information is specified somehow. If a dynamic library should contain both methods which are meant to be keywords and methods which are meant to be private helper methods, it may be wise to mark the keyword methods as such so it is easier to implement get_keyword_names. Higher code points are not allowed. For example, both First Keyword and Second Keyword in the example above could be used with any arguments. Everything is based on how the static API works, so its functions are discussed first. If converting a string to an integer fails and the type is got implicitly based on a default value, conversion to float is attempted as well. This method gets the name of a keyword as an argument, and it must return a list of strings containing the arguments accepted by that keyword. Type information is automatically linked to all keywords using these types. If type information is not got explicitly using annotations or the @keyword decorator, Robot Framework 3.1 and newer tries to get it based on possible argument default value. Dynamic libraries can also specify the general library documentation directly in the code as the docstring of the library class and its __init__ method. For example, the keyword in the previous example could be implemented as follows and arguments would be converted automatically: def example_keyword(count: int, case_insensitive: bool = True): if case_insensitive: # ... Both of these options have a limitation that the messages end up to the console only after the currently executing keyword finishes. Notice that with Robot Framework 3.1 and newer is_truthy is not needed in the above example because argument type would be got based on the default value. Both of these approaches to add documentation to converters in the previous example thus produce the same result: class FiDate(date): @classmethod def from_string(cls, value: str): """Date in ``dd.mm.yyyy`` format.""" # ... Keywords report failures with exceptions, log by writing to standard output and can return values using the return statement. Keywords have a possibility to add an accurate timestamp to the messages they log if there is a need. """ pass Python has tools for creating an API documentation of a library documented as above. With these libraries you need to ask guidance from the library developers or consult the library documentation or source code. @classmethod def from_string(cls, value: str): match = re.match(r'(\d{1,2})\.(\d{1,2})\.(\d{4})$', value) if not match: raise ValueError(f"Expected date in format 'dd.mm.yyyy', got '{value}'.") day, month, year = match.groups() return cls(int(year), int(month), int(day)) # Another custom type. This example uses annotations: @keyword('Add ${quantity:\d+} copies of ${item} to cart') def add_copies_to_cart(quantity: int, item): # ... More complicated libraries should be packaged to make the installation easier. Additionally, the first line of the documentation (until the first) is shown in test logs. These arguments are specified in the Setting section after the library name, and when Robot Framework creates an instance of the imported library, it passes them to its constructor. Other types cause conversion failures. They are needed for named argument support and the Libdoc tool needs them to be able to create a meaningful library documentation. The WARN or ERROR level can be used to make messages more visible and HTML is useful if any kind of formatting is needed. The syntax, which is familiar to all Python programmers, is illustrated below: def one_default(arg='default'): print("Argument has value %s" % arg) def multiple_defaults(arg1, arg2='default 1', arg3='default 2'): print("Got arguments %s, %s and %s" % (arg1, arg2, arg3)) The first example keyword above can be used either with zero or one arguments. This is illustrated by the earlier example that uses Robot Framework's BuiltIn library. The biggest benefit over inheritance is that you can use the original library normally and use the new library in addition to it when needed. This kind of a proxy library can be very thin, and because keyword names and all other information is got dynamically, there is no need to update the proxy when new keywords are added to the actual library. Positional and kwargs Various Args 1 2 kw=3 # Logs 'arg: 1', 'vararg: 2' and 'kwarg: kw 3'. login.robot_name = 'Login via user panel' *** Test Cases *** My Test Login Via User Panel ${username} ${password} Instead of explicitly setting the robot_name attribute like in the above example, it is typically easiest to use the @keyword decorator: from robot.api.deco import keyword @keyword('Login via user panel') def login(username, password): # ... This makes it easier to find old keywords from the test data and remove or replace them. This information is then written into the syslog to provide debugging information. This documentation is created using reStructuredText__. If you want to use something else than Robot Framework's own documentation formatting, you can specify the format in the source code using ROBOT_LIBRARY_DOC_FORMAT attribute similarly as scope and version are set with their own ROBOT_LIBRARY_* attributes. Similarly as other keywords, dynamic keywords can require any number of positional arguments, have default values, accept variable number of arguments, accept free named arguments and have named-only arguments. The number of arguments needed by the library is the same as the number of arguments accepted by the library's constructor. The get_keyword_documentation method can also be used for specifying overall library documentation. Conversion failures are not errors, keywords get the original value in these cases instead. Both of these approaches are illustrated by examples in the following sections. It is especially important to document converter functions registered for existing types, because their own documentation is likely not very useful in this context. Starting from Robot Framework 4.0, it is possible to specify that an argument has multiple possible types. datetime str, int , float Strings are expected to be timestamps in ISO 8601 like format YYYY-MM-DD hh:mm:ss.mmmmmm, where any non-digit character can be used as a separator or separators can be omitted altogether. The padding would be first converted to an integer, then to a string, and finally to None. Note The @library decorator is new in Robot Framework 3.2 and converters argument is new in Robot Framework 5.0. Automatically considering all public methods and functions keywords typically works well, but there are cases where it is not desired. Using the free named argument syntax with dynamic libraries is illustrated by the following examples. Dynamic libraries must always have this method. @keyword def finnish(self, arg: FiDate): print(f'year: {arg.year}, month: {arg.month}, day: {arg.day}') # Uses custom converter supporting 'mm/dd/yyyy' format. The comment on each row shows how run_keyword would be called in these cases if it has two arguments (i.e. signature is name, args) and if it has three arguments (i.e. name, args, kwargs). Test libraries can use this API like logger.info('My message') instead of logging through the standard output like print('*INFO* My message'). For example, if we wanted to enhance our keyword to accept also integers so that they would be considered seconds since the Unix epoch, we could change the converter like this: from datetime import date import re from typing import Union # Accept both strings and integers. Error Report error in execution. However, decorators often modify function signatures and can thus confuse Robot Framework's introspection when determining which arguments keywords accept. ======= ===== ===== """ pass Listener interface allows external listeners to get notifications about test execution. def keyword(arg: date): print(f'year: {arg.year}, month: {arg.month}, day: {arg.day}') If we try using the above keyword with invalid argument like invalid, it fails with this error: ValueError: Argument 'arg' got value 'invalid' that cannot be converted to date: not enough values to unpack (expected 3, got 1) This error is not too informative and does not tell anything about the expected format. They can contain any values ast.literal_eval supports, including lists and other containers. By default Robot Framework tries to use converters with all given arguments regardless their type. Kwargs Various Args a=1 b=2 c=3 # Logs 'kwarg: a 1', 'kwarg: b 2' and 'kwarg: c 3'. *** Test Cases *** # args, kwargs No arguments Dynamic # [], {} Positional only Dynamic x # [x], {} Dynamic x y # [x, y], {} Free named only Dynamic x=1 # [], {x: 1} Dynamic x=1 y=2 z=3 # [], {x: 1, y: 2, z: 3} Free named with positional Dynamic x y=2 # [x], {y: 2} Dynamic x y=2 z=3 # [x], {y: 2, z: 3} Free named with normal named Dynamic a=1 x=1 # [], {a: 1, x: 1} Dynamic b=2 x=1 a=1 # [], {a: 1, b: 2, x: 1} Note Prior to Robot Framework 3.1, normal named arguments were mapped to positional arguments but nowadays they are part of the kwargs along with the free named arguments. For example, ['a', 'b=c', '*d'] and [('a',), ('b', 'c'), ('*d',)] are equivalent. If the returned keyword names contain several words, they can be returned separated with spaces or underscores, or in the camelCase format. Also types in in the typing module that map to the supported concrete types or ABCs (e.g. List) are supported. If needed, the automatic keyword discovery can be enabled by using the auto_keywords argument: from robot.api.deco import library @library(scope='GLOBAL', auto_keywords=True) class Example: # ... from threading import current_thread from robot.api.deco import not_keyword not_keyword(current_thread) # Don't expose `current_thread` as a keyword. import os.path from robot.libraries.BuiltIn import BuiltIn def do_something(argument): output = do_something_that_creates_a_lot_of_output(argument) outputdir = BuiltIn().replace_variables('${OUTPUTDIR}') path = os.path.join(outputdir, 'results.txt') f = open(path, 'w') f.write(output) f.close() print('*HTML* Output written to results.txt') The only catch with using methods from BuiltIn is that all run_keyword method variants must be handled specially. Most importantly, there are no differences in importing dynamic libraries and using their keywords compared to other libraries. Normally, one value is assigned into one scalar variable, as illustrated in the example below. Order does not matter. def parse_fi_date(value: Union[str, int]): # Integers are converted separately. There is also a BackgroundLogger in separate robotbackgroundlogger project, with a similar API as the standard robot.api.logger. Annotating only some of the arguments is fine. Note Prior to Robot Framework 4.0, most types supported converting string NONE (case-insensitively) to Python None. This section explains how the dynamic API works between Robot Framework and dynamic libraries. Other values cause an error. FatalError Report error that stops the whole execution. For example, reporting the keyword status, logging, and returning values works exactly the same way. The possible case-insensitive values for documentation format are ROBOT (default), HTML, TEXT (plain text), and reST (reStructuredText). Argument converters are functions or other callables that get arguments used in data and convert them to desired format before arguments are passed to keywords. Conversion failures cause an error if the type has been specified explicitly. Notice that using non-string values like floats as an argument requires using variables as these examples giving different values to the length argument demonstrate: *** Test Cases *** Conversion Example 10 # Argument is a string. By default messages logged via the standard output or error streams get their timestamps when the executed keyword ends. The safest API to use are methods implementing keywords in the BuiltIn library. If no arguments are given, arg gets the value default. It is also easy to use Robot Framework itself for testing libraries and that way have actual end-to-end acceptance tests for them. Support for IntEnum and IntFlag is new in RF 4.1. class PowerState(IntEnum): OFF = 0 ON = 1 OFF (PowerState.OFF) 1 (PowerState.ON) None NoneType str String NONE (case-insensitive) is converted to the Python None object. Robot Framework itself is written with Python and naturally test libraries extending it can be implemented using the same language. When using this approach, messages are written to the console immediately and are not written to the log file at all: import sys def my_keyword(arg): sys.__stdout__.write('Got arg %s' % arg) The final option is using the public logging API: from robot.api import logger def log_to_console(arg): logger.console('Got arg %s' % arg) def log_to_console_and_log_file(arg): logger.info('Got arg %s' % arg, also_console=True) In most cases, the INFO level is adequate. The easiest way to avoid this problem is decorating the decorator itself using functools.wraps. ContinuableFailure Report failed validation but allow continuing execution. Results of communicating with the framework in that case are undefined and can in the worst case cause a crash or a corrupted output file. It is, however, even easier to get accurate timestamps using the programmatic logging APIs. A big benefit of adding timestamps explicitly is that this approach works also with the remote library interface. If there is a need to simulate the actual system under test, it is often easier on the unit level. Libraries implemented using Python can also act as wrappers to functionality implemented using other programming languages. In those cases no conversion is done, but annotations are nevertheless shown in the documentation generated by Libdoc. How the dynamic library API and the hybrid library API differ from it is then discussed in sections of their own. With a static and hybrid API, the information on how many arguments a keyword needs is got directly from the method that implements it. All these APIs are described in this chapter. For example, the library below implements only one keyword Example Keyword: from threading import current_thread __all__ = ['example_keyword'] def example_keyword(): print('Running in thread "%s".' % current_thread().name) def this_is_not_keyword(): pass If the library is big, maintaining the __all__ attribute when keywords are added, removed or renamed can be a somewhat big task. If the last argument starts with **, that keyword is recognized to accept free named arguments. In Python, it is easy to handle missing methods dynamically with the __getattr__ method. from threading import current_thread def example_keyword(): print('Running in thread "%s".' % current_thread().name) A simple way to avoid imported functions becoming keywords is to only import modules (e.g. import threading) and to use functions via the module (e.g threading.current_thread()). Robot Framework does automatic argument conversion also based on the argument default values. With the above examples run_keyword was always called like it is nowadays called if it does not support kwargs. The third argument only got possible free named arguments. Test libraries can be implemented as Python modules or classes. Another major use case for the dynamic API is implementing a library so that it works as proxy for an actual library possibly running on some other process or even on another machine. It would not work if there was a need to support dates in different formats like in this example: *** Test Cases *** Example Finnish 25.1.2022 US 1/25/2022 ISO 8601 2022-01-22 A solution to this problem is creating custom types instead of overriding the default date conversion: from datetime import date import re from typing import Union from robot.api.deco import keyword, library # Custom type. from SeleniumLibrary import SeleniumLibrary class ExtendedSeleniumLibrary(SeleniumLibrary): def title_should_start_with(self, expected): title = self.get_title() if not title.startswith(expected): raise AssertionError("Title '%s' did not start with '%s'" % (title, expected)) A big difference with this approach compared to modifying the original library is that the new library has a different name than the original. *** Test Cases *** # args # args, kwargs Positional only Dynamic x # [x] # [x], {} Dynamic x y # [x, y] # [x, y], {} Dynamic x y z # [x, y, z] # [x, y, z], {} Named only Dynamic a=x # [x] # [], {a: x} Dynamic c=z a=x b=y # [x, y, z] # [], {a: x, b: y, c: z} Positional and named Dynamic x b=y # [x, y] # [x], {b: y} Dynamic x y c=z # [x, y, z] # [x, y], {c: z} Dynamic x b=y c=z # [x, y, z] # [x], {y: b, c: z} Intermediate missing Dynamic x c=z # [x, d1, z] # [x], {c: z} Note Prior to Robot Framework 3.1, all normal named arguments were mapped to positional arguments and the optional kwargs was only used with free named arguments. from robot.api.deco import keyword class DynamicExample: def get_keyword_names(self): # Get all attributes and their values from the library. Otherwise other mechanisms explained in this section are probably better. class UsDate(date): """Date in ``mm/dd/yyyy`` format.""" @classmethod def from_string(cls, value: str): # ... TRUE (converted to True) off (converted to False) example (used as-is) int Integral integer, long str, float Conversion is done using the int built-in function. This approach works well when you start to use a new library and want to add custom enhancements to it from the beginning. The name of a test library that is used when a library is imported is the same as the name of the module or class implementing it. Python: class MyError(RuntimeError): ROBOT_SUPPRESS_NAME = True In all cases, it is important for the users that the exception message is as informative as possible. Type information can be specified using actual types like int, but especially if a dynamic library gets this information from external systems, using strings like 'int' or 'integer' may be easier. It is thus possible to use the stderr if you need some messages to be visible on the console where tests are executed. Another option is writing messages to sys.__stdout__ or sys.__stderr__. When implementing keywords, it is sometimes useful to modify them with Python decorators. If Robot Framework is not running, the messages are redirected automatically to Python's standard logging module. If the input is invalid, the converter should raise a ValueError with an appropriate message. For example, the library above would not work correctly, if get_keyword_names returned My Keyword instead of my_keyword. This is done by adding a special ROBOT_SUPPRESS_NAME attribute with value True to your exception. Requires run_keyword to support free named arguments. By default documentation is considered to follow Robot Framework's documentation formatting rules. The public logging API is thoroughly documented as part of the API documentation at . Tip If the library name is really long, it is recommended to give the library a simpler alias by using the WITH NAME syntax. There are no major differences in using them for this purpose compared to using them for some other testing. Instead, it only returns a callable object that is then executed by Robot Framework. They are converted to actual lists using the ast.literal_eval function. Conversion is done regardless of the type of the given argument. Thus the names of the methods that are implemented in the class itself must be returned in the same format as they are defined. The following example illustrates how to implement the same Title Should Start With keyword as in the earlier example about using inheritance. Starting from Robot Framework 3.1, it is possible to use named-only arguments with different keywords. The main problem with the former syntax is that all default values are considered strings whereas the latter syntax allows using all objects like ('inteter', 1) or ('boolean', True). list Sequence str, Sequence Strings must be Python list literals. def return_two_values(): return 'first value', 'second value' def return_multiple_values(): return ['a', 'list', 'of', 'strings'] *** Test Cases *** Returning multiple values ${var1} ${var2} = Return Two Values Should Be Equal ${var1} first value Should Be Equal ${var2} second value @{list} = Return Two Values Should Be Equal @{list}[0] first value Should Be Equal @{list}[1] second value ${s1} ${s2} @{li} = Return Multiple Values Should Be Equal ${s1} ${s2} a list Should Be Equal @{li}[0] @{li}[1] of strings If a library uses threads, it should generally communicate with the framework only from the main thread. There are, however, some special cases explained in the subsequent sections where special exceptions are needed. If the given argument has one of the accepted types, then no conversion is done and the argument is used as-is. When using Python 3.10 or newer, it is possible to use the native type1 | type2 syntax instead: def example(length: int | float, padding: int | str | None = None): # ... This example also illustrates that it is possible to return any objects and to use extended variable syntax to access object attributes. With or without defaults. It is used as a short documentation by Libdoc (for example, as a tool tip) and also shown in the test logs. If one of the accepted types is string, then no conversion is done if the given argument is a string. from mymodule import MyObject def return_string(): return "Hello, world!" def return_object(name): return MyObject(name) *** Test Cases *** Returning one value ${string} = Return String Should Be Equal ${string} Hello, world! ${object} = Return Object Robot Should Be Equal ${object.name} Robot Keywords can also return values so that they can be assigned into several scalar variables at once, into a list variable, or into scalar variables and a list variable. Methods that use run_keyword methods have to be registered as run keywords themselves using register_run_keyword method in BuiltIn module. Libraries using the dynamic library API have other means for sharing this information, so this section is not relevant to them. Requires run_keyword to support named-only arguments. An easy way to configure libraries implemented as classes is using the robot.api.deco.library class decorator. If the given argument already has the expected type, no conversion is done. Robot Framework's own robot.utils.is_truthy() utility handles this nicely as it considers strings like FALSE, NO and NONE (case-insensitively) to be false: def example_keyword(count, case_insensitive=True): count = int(count) if is_truthy(case_insensitive): # ... This use case is not so important with Python, though, because its dynamic capabilities and multi-inheritance already give plenty of flexibility, and there is also possibility to use the hybrid library API. If you have access to the source code of the library you want to extend, you can naturally modify the source code directly. If only that behavior is desired and no further configuration is needed, the decorator can also be used without parenthesis like: from robot.api.deco import library @library class Example: # ... Another way to explicitly mark what functions are keywords is using the ROBOT_AUTO_KEYWORDS attribute similarly as it can be used with class based libraries. The most natural way to specify types is using Python function annotations. The following example demonstrates how to get ${OUTPUT_DIR} which is one of the many handy automatic variables. Which one to use depends on the context. Floats are accepted only if they can be represented as integers exactly. These messages are normally not shown, but they can facilitate debugging possible problems in the library itself. As explained in the above table, default values can be specified with argument names either as a string like 'name=default' or as a tuple like ('name', 'default'). This method takes two or three arguments. It is convenient to use function annotations, and alternatively it is possible to pass types to the @keyword decorator. Various Args c=3 a=1 b=2 # Same as above. If that fails, then conversion is attempted based on the default value. Starting from Robot Framework 3.1, it accepts an optional types argument that can be used to specify argument types either as a dictionary mapping argument names to types or as a list mapping arguments to types based on position. In Python a method has always exactly one implementation and possible default values are specified in the method signature. Prior to Robot Framework 3.2 this value was TEST SUITE. Robot Framework has three different test library APIs. Static API The simplest approach is having a module or a class with functions/methods which map directly to keyword names. *** Test Cases *** Example # Positional-only argument gets literal value `posonly=foo` in this case. Keyword normal=bar posonly=foo Positional-only arguments are fully supported starting from Robot Framework 4.0. Using them as positional arguments works also with earlier versions, but using them as named arguments causes an error on Python side. If changes are non-generic, or you for some other reason cannot submit them back, the approaches explained in the subsequent sections probably work better. Dynamic API Dynamic libraries are classes that implement a method to get the names of the keywords they implement, and another method to execute a named keyword with given arguments. If the error message is longer than 40 lines, it will be automatically cut from the middle to prevent reports from getting too long and difficult to read. Everything else except discovering what keywords are implemented is similar as in the static API. If a non-empty documentation is got both directly from the code and from the get_keyword_documentation method, the latter has precedence. Example: def sort_words(*words, case_sensitive=False): key = str.lower if case_sensitive else None return sorted(words, key=key) def strip_spaces(word, *, left=True, right=True): if left: word = word.lstrip() if right: word = word.rstrip() return word *** Test Cases *** Example Sort Words Foo bar baZ Sort Words Foo bar baZ case_sensitive=True Strip Spaces ${word} left=False Python 3.8 introduced positional-only arguments that make it possible to specify that an argument can only be given as a positional argument, not as a named argument like name=value. The error message shown in logs, reports and the console is created from the exception type and its message. from somewhere import external_keyword class HybridExample: def get_keyword_names(self): return ['my_keyword', 'external_keyword'] def my_keyword(self, arg): print("My Keyword called with '%s'" % arg) def __getattr__(self, name): if name == 'external_keyword': return external_keyword raise AttributeError("Non-existing attribute '%s'" % name) Note that __getattr__ does not execute the actual keyword like run_keyword does with the dynamic API. This is illustrated by the example below that adds new Title Should Start With keyword to the SeleniumLibrary. Dynamic libraries can communicate what arguments their keywords expect by using the get_keyword_arguments (alias getKeywordArguments) method. The same syntax works in libraries and, as the examples below show, it can also be combined with other ways of specifying arguments: def any_arguments(*args): print("Got arguments:") for arg in args: print(arg) def one_required(required, *others): print("Required: %sOthers:" % required) for arg in others: print(arg) def also_defaults(req, def1="default 1", def2="default 2", *rest): print(req, def1, def2, rest) *** Test Cases *** Varargs Any Arguments Any Arguments argument Any Arguments arg 1 arg 2 arg 3 arg 4 arg 5 One Required required arg One Required required arg another arg yet another Also Defaults required Also Defaults required these two have defaults Also Defaults 1 2 3 4 5 6 Robot Framework supports Python's **kwargs syntax. New in Robot Framework 3.1. ['*varargs', 'named'], ['*', 'named'], `['*', 'x', 'y=default'], ['a', '*b', 'c', '**d'] When the get_keyword_arguments is used, Robot Framework automatically calculates how many positional arguments the keyword requires and does it support free named arguments or not.

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