

instance provides little value as it simply calls the `execute(ParameterList)` method on the operation implementation. The operation instance is required to provide one-to-one mapping from an implementation to an instance. In child models of operation instance (like method instance), operation instances provide more value by holding event listeners. Some child models of operation instance may hold parameter values for the operation execution.

[0325] An operation instance has a one-to-one association relationship with an operation implementation that is the implementation for which the operation instance is an instance.

[0326] An operation instance includes an `execute(ParameterList)` operation that performs the execution.

[0327] An operation event is sent at the successful completion of the operation. An operation failure event is sent if a failure occurs during the execution of the operation that fails the operation.

[0328] Parameter implementations of the present invention are used by virtual operation implementations to check constraints applied to parameters. Precondition constraints, access constraints, and occurrence constraints are checked before the operation begins. Postcondition constraints are applied after the execution of the operation. A parameter can be assigned a default value if no value is passed in. A parameter implementation can also enforce “contractual constraints” which are not possible in any third generation programming language. Contractual programming specifies certain constraints about accessing parameters and about changing their values. To enforce contracts, a submodel of the default virtual parameter implementation can be created.

[0329] A parameter implementation has a zero-to-many association relationship with a parameter descriptor that is implemented by the parameter implementation. A parameter implementation has a zero-to-many association relationship with precondition constraints that are each an implementation of a constraint to restrict the values allowed to be held by the parameter before execution of the operation. A precondition constraint can also enforce a constraint, like a no modification constraint, by adding a wrapper around the parameter value. A parameter implementation has a zero-to-many association relationship with postcondition constraints that are each an implementation of a constraint to restrict the values allowed to be held by the parameter after execution of the operation. A post condition constraint may also remove wrappers added by precondition constraints as necessary. A parameter implementation has a zero-to-many association relationship with occurrence constraints that are each an implementation of a constraint to restrict the number of values assigned to the parameter.

[0330] A parameter implementation may include the following operations: `precheck(Value)` that perform a check of all precondition constraints against the given parameter value. Also perform a check of all occurrence and access constraints, and `postCheck(Value)` that perform a check of all postcondition constraints against the given parameter value.

[0331] A parameter implementation adds no additional events.

[0332] Parameter instances of the present invention are a data instance with the constraints imposed by the parameter

implementation. Parameter instances have a one-to-one association relationship with a parameter implementation that is the implementation for which the parameter instance is an instance. A parameter instance has a zero-to-many association relationship with value that are holders for instances of data that meet the constraints placed upon them.

[0333] A parameter instance serves only as a holder of data values

[0334] A parameter event is fired with the results of a precondition check. A second parameter event is fired with the results of the postcondition check, if the operation is successful enough to reach the post condition check.

[0335] A method implementation of the present invention extends an operation implementation. A method is an operation that is a feature of a model. A method implementation has a one-to-one association relationship with a method descriptor is the method descriptor for which the method implementation provides access to another implementation. A method implementation has a zero-to-many association relationship with a signal implementation that provides the mechanism to register an appropriate instance’s interest in receiving notification when the attribute generates an event. The signal implementation also provides the mechanism to remove interest in receiving notification for an event. The instance registering interest in receiving event notification must implement the appropriate interface to match the listener type described in the signal descriptor. A method implementation has a zero-to-many association relationship with precondition constraints that are each an implementation of a constraint to restrict some environmental condition or state of the model implementation before the execution of the method. These types of constraints might check for the installation of a security manager, the existence of a database connection, or some other environmental condition. These constraints might also check to see if a model implementation has entered into the correct state to allow the execution of this method. Constraints related to the parameter values are held by the parameter descriptors. A method implementation has a zero-to-many association relationship with postcondition constraints that are each an implementation of constraints to check for certain conditions at the end of the method. Similar to precondition constraints in checking for environmental and model related assumptions.

[0336] A method implementation may include an `execute(ParameterList)` operation that attempts to perform the operation by executing the operation implementation. First all access and precondition constraints are checked for the method implementation and parameter implementations. Then the method is attempted. If the method implementation is successful, the postcondition constraints are checked for the method implementation and parameter implementations.

[0337] A method implementation adds no additional events.

[0338] A method instance of the present invention extends an operation instance. A method instance is an instance of a method to store event listeners for that method. A method instance has a one-to-one association relationship with a method implementation that is the method descriptor for which this implementation provides access to an implementation. A method instance has a zero-to-many association relationship with a signal implementation that provides the