MoTiVML Guideline Document

This is a guideline document for the MoTiVML language and framework as a whole. This guideline document assists end users in modelling variability in robotic systems as well as implementing the features they have defined in their models. As a supporting artifact to the language, this document serves as a form of verification for the MoTiVML language and its capabilities.

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1 Prerequisites and Dependencies

- Ubuntu 20.04.3 LTS and above
- ROS installation. This application was developed and tested with ROS Neotic 1.15.9.
- Python3 installation
- C++ 11 or higher
- ROS Pluginlib

2 Framework Components

- Domain Specific Language
- Modeller
- Configurator
- Model visualizer
- Syntax and Semantics Validator
- Feature Plugin Interface

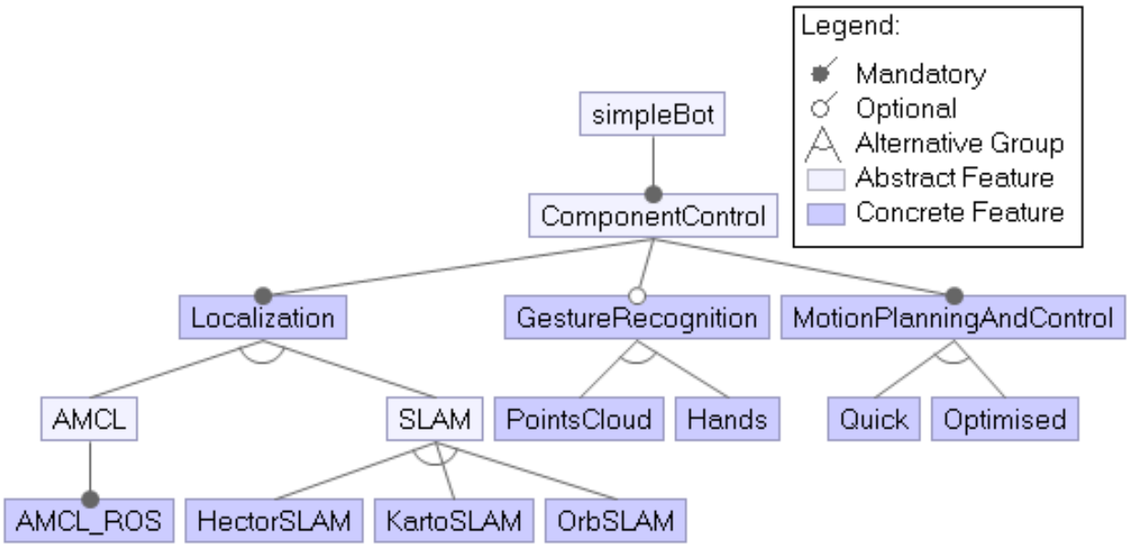
3 Setup and Installation of MoTiVML

- Clone MoTiVML from here into your catkin workspace.
- Go the MoTiVML workspace project directory and build the cloned project with the command catkin_make and press enter on your keyboard.

4 How To

This section gives a step-by-step walk-through of how MoTiVML can be used to instantiate a model or configuration, how it can be used to validate a model as well as the capability to link source code implementations with feature definitions. We also give a brief tutorial of our in-built MoTiVML console interface. Throughout our demonstrations in this guideline document, we use a sample model of a robotic system that is shown graphically in figure 1. This graphical representation of a simple robot model will also serve as our running example throughout this document.

Figure 1: Graphical Model of a Simple Robot



4.1 Instantiate a MoTiVML Model

- To create an instance of a model in MoTiVML, in the **src** folder of the cloned application, make a copy of the template folder provided and rename it to suit your product preference.
- In your new product instance folder, there is a **model.json** with an existing root feature, wrapped in a object.
- The model definition can be extended by appending sub features to the root feature. You can add nested feature objects according to your preferences.Note that each feature specification must have attributes such as **id**, **name**, **constraints**, **group**, **isMandatory**. The constraints attribute must contain sub attributes **featureIncluded**, **featureExcluded**, **bindingTimeAllowed**, **bindingModeAllowed**. Listing 1 shows a demonstrated example of an extended MoTiVML model instance, for the feature model captured in Figure 1.
- The value of each feature attribute in a model must conform to strict type systems defined within MoTiVML. A list of all the attributes together with their expected values is provided below in Table 1.

Table 1: Feature Attributes and Types

Attribute	Expected Value
id	Alphanumeric characters. No spaces allowed.
name	Alphanumeric characters. No spaces allowed.
constraints	Object containing attributes **featureIncluded**, **featureExcluded**, **bindingTimeAllowed**, **bindingModeAllowed**
featureIncluded	Array of existing feature "ids"
featureExcluded	Array of existing feature "ids"
bindingTimeAllowed	Early / Late / Any
bindingModeAllowed	Static / Dynamic / Any
group	XOR / OR
isMandatory	True or False

- To add a sub-feature to a defined feature, add the **sub** attribute to the feature and assign an array of sub-feature objects to it. However, the sub attribute is optional. Features that do not have sub-features can exist without a **sub** attribute.

Listing 1: SimpleRobot Model Instantiation in MoTiVML

```
1
2  {
3          "id": "root_feature",
4          "name": "SimpleBot",
5          "group": "",
6          "isMandatory": true,
7          "isSelected": true,
8          "sub": [
9          {
10                 "id": "compcontrol",
11                 "name": "ComponentControl",
```

```
                "constraints": {
                        "featuresIncluded": [],
                        "featuresExcluded": [],
                        "bindingTimeAllowed":"Early",
                        "bindingModeAllowed":"Static"
                },
                "group": "OR",
                "isMandatory": true,
                "sub":[
                {
                        "id": "localztn",
                        "name": "Localisation",
                        "constraints": {
                                "featuresIncluded": [],
                                "featuresExcluded": [],
                                "bindingTimeAllowed":"Early",
                                "bindingModeAllowed":"Static"
                        },
                        "group": "OR",
                        "isMandatory": true,
                        "sub":[
                        {
                                "id": "amcl",
                                "name": "AMCL",
                                "constraints": {
                                        "featuresIncluded": [],
                                        "featuresExcluded": [],
                                        "bindingTimeAllowed":"Early",
                                        "bindingModeAllowed":"Static"
                                },
                                "group": "XOR",
                                "isMandatory": false,
                                "sub":[
                                {
                                        "id": "amclros",
                                        "name": "AmclRos",
                                        "constraints": {
                                                "featuresIncluded": [],
                                                "featuresExcluded": [],
                                                "bindingTimeAllowed":"Early",
                                                "bindingModeAllowed":"Static"
                                        },
                                        "group": "OR",
                                        "isMandatory": true
                                }
                                ]
                        },
                        {
                                "id": "slam",
                                "name": "SLAM",
                                "constraints": {
                                        "featuresIncluded": [],
                                        "featuresExcluded": [],
                                        "bindingTimeAllowed":"Early",
                                        "bindingModeAllowed":"Static"
                                },
                                "group": "XOR",
                                "isMandatory": false,
                                "sub":[
                                {
                                        "id": "hectorslam",
                                        "name": "HectorSLAM",
                                        "constraints": {
                                                "featuresIncluded": [],
                                                "featuresExcluded": ["kartoslam", "orbslam"],
                                                "bindingTimeAllowed":"Late",
                                                "bindingModeAllowed":"Dynamic"
                                        },
                                        "group": "XOR",
                                        "isMandatory": false
                                },
                                {
                                        "id": "kartoslam",
                                        "name": "KartoSLAM",
                                        "constraints": {
```

```
                                        "featuresIncluded": [],
                                        "featuresExcluded": ["orbslam", "hectorslam"],
                                        "bindingTimeAllowed":"Late",
                                        "bindingModeAllowed":"Dynamic"
                                },
                                "group": "XOR",
                                "isMandatory": false
                        },
                        {
                                "id": "orbslam",
                                "name": "OrbSLAM",
                                "constraints": {
                                        "featuresIncluded": [],
                                        "featuresExcluded": ["kartoslam", "hectorslam"],
                                        "bindingTimeAllowed":"Late",
                                        "bindingModeAllowed":"Dynamic"
                                },
                                "group": "XOR",
                                "isMandatory": false
                        }
                        ]
                }
                ]
        },
        {
                "id": "gestrec",
                "name": "GestureRecognition",
                "constraints": {
                        "featuresIncluded": [],
                        "featuresExcluded": [],
                        "bindingTimeAllowed":"Early",
                        "bindingModeAllowed":"Static"
                },
                "group": "OR",
                "isMandatory": false,
                "sub":[
                {
                        "id": "hands",
                        "name": "Hands",
                        "constraints": {
                                "featuresIncluded": [],
                                "featuresExcluded": ["pointscloud"],
                                "bindingTimeAllowed":"Late",
                                "bindingModeAllowed":"Dynamic"
                        },
                        "group": "XOR",
                        "isMandatory": false
                },
                {
                        "id": "pointscloud",
                        "name": "PointsCloud",
                        "constraints": {
                                "featuresIncluded": [],
                                "featuresExcluded": ["hands"],
                                "bindingTimeAllowed":"Late",
                                "bindingModeAllowed":"Dynamic"
                        },
                        "group": "XOR",
                        "isMandatory": false
                }
                ]
        },
        {
                "id": "motplannctrl",
                "name": "MotionPlanningAndControl",
                "constraints": {
                        "featuresIncluded": [],
                        "featuresExcluded": [],
                        "bindingTimeAllowed":"Early",
                        "bindingModeAllowed":"Static"
                },
                "group": "OR",
                "isMandatory": true,
                "sub":[
                {
```

```
                                "id": "quick",
                                "name": "Quick",
                                "constraints": {
                                        "featuresIncluded": [],
                                        "featuresExcluded": ["optimised"],
                                        "bindingTimeAllowed":"Late",
                                        "bindingModeAllowed":"Dynamic"
                                },
                                "group": "XOR",
                                "isMandatory": false
                        },
                        {
                                "id": "optimised",
                                "name": "Optimised",
                                "constraints": {
                                        "featuresIncluded": [],
                                        "featuresExcluded": ["quick"],
                                        "bindingTimeAllowed":"Late",
                                        "bindingModeAllowed":"Dynamic"
                                },
                                "group": "XOR",
                                "isMandatory": false
                        }
                        ]
                }
                ]
        }
        ]
}

```

4.2 Instantiate a MoTiVML Configuration

- Again in your instance folder, there is a **config.json** with an empty **properties** array value.
- In the config.json file of your project, for every feature added in your model.json file, a corresponding configuration object must be added. For each feature configuration object, there must be an **id** attribute which references the **id** of a feature in your model.json file. The **props** attribute must contain **time** and **mode** attributes. Listing 2 shows a MoTiVML configuration translation of the features present in Figure 1.
- The values of each configuration attribute for your model must conform to strict type systems defined within MoTiVML. A list of all the configuration attributes together with their expected values is provided below in Table 2.

Table 2: Configuration Attributes and Types

Attribute	Expected Value
id	Alphanumeric characters. No spaces allowed.
props	Object containing attributes **time** and **mode**
time	Early / Late
mode	Static / Dynamic

Listing 2: SimpleRobot Model Configuration Instantiation in MoTiVML

```

{
        "properties": [
        {
                "id": "compcontrol",
                "props": {
                        "time":"Early",
                        "mode":"Static"
                }
        },
        {
                "id": "localztn",
                "props": {
                        "time":"Early",
                        "mode":"Static"
                }
        },
        {
                "id": "gestrec",
                "props": {
                        "time":"Early",
```

```
                        "mode":"Static"
                }
        },
        {
                "id": "motplannctrl",
                "props": {
                        "time":"Early",
                        "mode":"Static"
                }
        },
        {
                "id": "amcl",
                "props": {
                        "time":"Early",
                        "mode":"Static"
                }
        },
        {
                "id": "amclros",
                "props": {
                        "time":"Early",
                        "mode":"Static"
                }
        },
        {
                "id": "slam",
                "props": {
                        "time":"Early",
                        "mode":"Static"
                }
        },
        {
                "id": "hectorslam",
                "props": {
                        "time":"Late",
                        "mode":"Dynamic"
                }
        },
        {
                "id": "kartoslam",
                "props": {
                        "time":"Late",
                        "mode":"Dynamic"
                }
        },
        {
                "id": "orbslam",
                "props": {
                        "time":"Late",
                        "mode":"Dynamic"
                }
        },
        {
                "id": "hands",
                "props": {
                        "time":"late",
                        "mode":"Dynamic"
                }
        },
        {
                "id": "pointscloud",
                "props": {
                        "time":"Late",
                        "mode":"Dynamic"
                }
        },
        {
                "id": "quick",
                "props": {
                        "time":"Late",
                        "mode":"Dynamic"
                }
        },
        {
                "id": "optimised",
                "props": {
                        "time":"Late",
                        "mode":"Dynamic"
                }
        }
        ]
}
```

4.3 Use the Standalone Model Validator Tool

The inbuilt motivml model validator tool aids in validating models together with their corresponding configurations. To validate your model and its configuration, navigate to the **/src/motivml** directory and run

the following command in the ROS console:

Listing 3: MoTiVML Validation Command

```
python validator.py <project_directory_name>
```

All models created in the MoTiVML language are validated on two distinct levels. i.e. syntax validation and semantic validation. Syntactical validation has to do with feature and configuration schemas being evaluated for errors, while semantic validation has to do with modelling and binding constraints evaluation.

To demonstrate this we evaluate our constructed model and configuration shown in Listing 1 and 2 and discuss the results accordingly. A careful observation of the console output generated from the validation indicates the presence of zero errors.

When our in-built schema and constraint checker identify an error in either a model or a configuration, an error message is outputted to the console indicating where the error is located and why the language has flagged it as an error.

Figure 2: Simplebot Validation Output

```
C:\catkin_ws\src\motivml_ros\src\motivml>python motivml.py simplebot
Compiling simplebot
Generating Early Bindings
-------------------
Reading configuration: C:\catkin_ws\src\motivml_ros\src\simplebot\config.json
--------------Parsing Model----------------
[SUCCESS] Model Schema Has Zero Syntax Errors
--------------Model Parsing Ended-----------

--------------Parsing Binding-----------------
[SUCCESS] Model Binding Schema Has Zero Syntax Errors
-------------- Binding Parsing Ended-----------

--------------Constraint Checker Validation-----------------
[SUCCESS] Constraint Checker Found Zero Constraint Errors
```

4.4 Feature Class Implementation

Listing 4: Implementation of MoTiVML Feature Class

```
{
        namespace motivml_feature{

                enum BindingTimeAllowed{Early, Late, Any};
                enum BindingModeAllowed{Static, Dynamic, Any};

                class Feature{
                private:
                        std::string id;
                        std::string name;

                        std::vector<std::string> featuresIncluded;
                        std::vector<std::string> featuresExcluded;
                        BindingTimeAllowed bindingTimeAllowed{Early};
                        BindingModeAllowed bindingModeAllowed{Static};

                        std::string group;
                        bool isMandatory;
                        std::vector<Feature> sub;

                public:
                        Feature(){};

                        //setters
                        void setId(std::string id){
                                id = id;
                        }

                        void setName(std::string name){
                                name = name;
                        }

                        void setBindingTimeAllowed(BindingTimeAllowed bindingTimeAllowed){
                                bindingTimeAllowed = bindingTimeAllowed;
                        }
```

```
36
37                          void setBindingModeAllowed(BindingModeAllowed bindingModeAllowed){
38                                  bindingModeAllowed = bindingModeAllowed;
39                          }
40
41                          void setGroup(std::string group){
42                                  group = group;
43                          }
44
45                          void setIsMandatory(bool isMandatoory){
46                                  isMandatoory = isMandatoory;
47                          }
48
49                          void setFeaturesIncluded(std::vector<std::string> inclusions){
50                                  for(std::string &included : inclusions){
51                                          featuresIncluded.push_back(included);
52                                  }
53                          }
54
55                          void setFeaturesExcluded(std::vector<std::string> exclusions){
56                                  for(std::string &excluded : exclusions){
57                                          featuresExcluded.push_back(excluded);
58                                  }
59                          }
60
61                          //getters
62                          std::string getName(){
63                                  return name;
64                          }
65                  };
66          };
67
68  }
```

The a capabilities of a MoTiVML feature are wrapped in a **motivml_feature** name space with a set of private attributes abstracted through a bunch of getters and setters. Within a feature, we can identify both descriptive and constraint attributes, implemented using c++ constructs.

4.5 Configuration Class Implementation

Listing 5: Implementation of MoTiVML Configuration Class

```
1   {
2           class Configuration: public motivml_feature::Feature{
3           private:
4                   BindingTimes time;
5                   BindingModes mode;
6
7           public:
8                   Configuration(){}
9
10                  void setTimeBinding(BindingTimes time){
11                          time = time;
12                  }
13
14                  void setModeBinding(BindingModes mode){
15                          mode = mode;
16                  }
17          };
18  }
```

To decouple relevant features necessary for binding a feature, our time and mode binding attributes are encapsulated in a configuration class that inherits directly from our feature class. Just like we saw in the feature class structure, the binding time and bindimg mode date a hidden and abstracted with the help of getters and setters.

4.6 Implement a Statically Bound Feature

4.6.1 Static Early

- In the **featx** directory, create a static class in the namespace **static_integration** which inherits from the class **public static_base::StaticInterface**. NB: The feature id in your model must match your class name. For Example:

Listing 6: Sample Static Early Class

```
1
2   namespace static_integration{
3
4           class MyStaticEarlyClass: public static_base::StaticInterface{
5           private:
6                   std::vector<std::string> ex{"featureID_1"};
```

```
                std::vector<std::string> inc{"featureID_2"};

        public:
                MyStaticEarlyClass(){
                        Feature::setId("xxxx");
                        Feature::setName("JohnDoe");
                        Feature::setFeaturesExcluded(ex);
                        Feature::setFeaturesIncluded(inc);
                        Feature::setGroup("XOR");
                        Feature::setIsMandatory(false);

                        Configuration::setTimeBinding(Early);
                        Configuration::setModeBinding(Static);
                };

                void executeFeature(){
                        std::cout << Feature::getName() << "feature run successfully" << std::endl;
                };

        };

};

```

- Statically set the feature class attributes **id** to the same value as the **id** attribute in the MoTiVML model.
- Set configuration binding time and binding mode to **Early** and **Static** respectively.
- Set other class attributes to values of your choice that represent the feature you are implementing.
- For all included and excluded features in relation to the said feature, add their ids to a vector and pass them to the setter for either inclusion or exclusion constraints.
- Add the following preprocessor include above your class to include the static base interface class your class will be inheriting from:

Listing 7: Class Inclusion

```

#include "../include/motivml_ros/static_base.h"

```

- Define a static early feature constant at the top of **plugin_feature_loader.cpp**. For Example

Listing 8: Constant Definition

```

#define UNKOWNFEATURE

```

- In **static_feature_loader.h**, if the feature constant you created in the previous step is true, include your static class. See Listing 9 as an example

Listing 9: Including Static Early

```

#ifdef UNKOWNFEATURE
#include "../../featx/MyStaticClass.h"
#endif

```

- Extent the static early conditional block of the **callback_load_plugin_features** method in **plugin_feature_loader.cpp** to run a method in your static early class.
- Run the **catkin_make** command to build the project.

4.6.2 Static Late

- In the **featx** directory, create a static class in the namespace **static_integration** which inherits from the class **public static_base::StaticInterface**. NB: The feature id in your model must match your class name. For Example:

Listing 10: Sample Static Late Class

```

namespace static_integration{

        class MyStaticLateClass: public static_base::StaticInterface{

        private:
                std::vector<std::string> ex{"featureID_1"};
                std::vector<std::string> inc{"featureID_2"};

        public:
                MyStaticEarlyClass(){
                        Feature::setId("xxxx");
                        Feature::setName("JohnDoe");
                        Feature::setFeaturesExcluded(ex);
                        Feature::setFeaturesIncluded(inc);
                        Feature::setGroup("XOR");
                        Feature::setIsMandatory(false);

                        Configuration::setTimeBinding(Late);
                        Configuration::setModeBinding(Static);
                };

                void executeFeature(){
                        std::cout << Feature::getName() << "feature run successfully" << std::endl;
                };

        };

};

```

- Statically set the feature class attributes **id** to the same value as the **id** attribute in the MoTiVML model.
- Set configuration binding time and binding mode to **Late** and **Static** respectively.
- Set other class attributes to values of your choice that represent the feature you are implementing.
- For all included and excluded features in relation to the said feature, add their ids to a vector and pass them to the setter for either inclusion or exclusion constraints.
- Statically include the feature in the configuration by adding it to the **motivml_plugins.h** file. For Example

Listing 11: Sample Static Late Class

```

#include "../../featx/MyStaticLateClass.h"

```

- To get the feature to be loaded at runtime, use pluginlib to export your class to the static interface. For example

Listing 12: Sample Static Late Class

```

PLUGINLIB_EXPORT_CLASS(static_integration::MyStaticLateClass, static_base::StaticInterface)

```

- Provide meta-date about your static late feature to pluginlib, by registering the exported class in the **motivml_plugins.xml** file stating the class name and description of your class. For example

Listing 13: Sample Static Late Class

```

<class type="static_integration::MyStaticLateClass" base_class_type="static_base::StaticInterface">
        <description>Description of class goes here</description>
</class>

```

4.7 Implement a Dynamically Bound Feature

- In the **featx** directory, create a static class in the namespace **static_integration** which inherits from the class **public static_base::StaticInterface**. NB: The feature id in your model must match your class name. For Example:

Listing 14: Sample Dynamic Class

```

namespace motivml_plugins{

        class MyDynamicClass: public plugin_base::PluginInterface{
        private:
                std::vector<std::string> ex{"featureID_1"};
                std::vector<std::string> inc{"featureID_2"};

        public:
                MyStaticEarlyClass(){
                        Feature::setId("xxxx");
                        Feature::setName("JohnDoe");
                        Feature::setFeaturesExcluded(ex);
                        Feature::setFeaturesIncluded(inc);
                        Feature::setGroup("XOR");
                        Feature::setIsMandatory(false);

                        Configuration::setTimeBinding(Early);
                        Configuration::setModeBinding(Dynamic);
                };

                void executeFeature(){
                        std::cout << Feature::getName() << "feature run successfully" << std::endl;
                };
        };

};

```

- Set configuration binding time and binding mode to **Late** and **Static** respectively.
- Set other class attributes to values of your choice that represent the feature you are implementing.
- For all included and excluded features in relation to the said feature, add their ids to a vector and pass them to the setter for either inclusion or exclusion constraints.
- **Include Plugin**: Include the feature in the configuration by adding it to the **motivml_plugins.h** file. For Example

Listing 15: Sample Static Late Class

```

#include "../../featx/MyDynamicClass.h"

```

- **Encapsulate Feature As Plugin**: In order to allow a class to be dynamically loaded, it must be marked as an exported class. This is done through the special macro PLUGINLIB_EXPORT_CLASS [1]. For example

Listing 16: Sample Dynamic Class Export

```

PLUGINLIB_EXPORT_CLASS(motivml_plugins::MyDynamicClass, plugin_base::PluginInterface)

```

- **Add Plugin Description:** The plugin description file is an XML file that serves to store all the important information about a plugin in a machine readable format. It contains information about the library the plugin is in, the name of the plugin, the type of the plugin, etc [1]. Ihe plugin description file (motivml_plugin.xml), would look something like this:

Listing 17: Sample Static Late Class

```

<class type="motivml_plugins::MyDynamicClass" base_class_type="plugin_base::PluginInterface">
        <description>Description of class goes here</description>
</class>

```

4.8 MoTiVML Console Interface

To add some interactivity to our variability modelling language, we have provided an in-built console interface for interacting with models and features through MoTiVML specific commands.

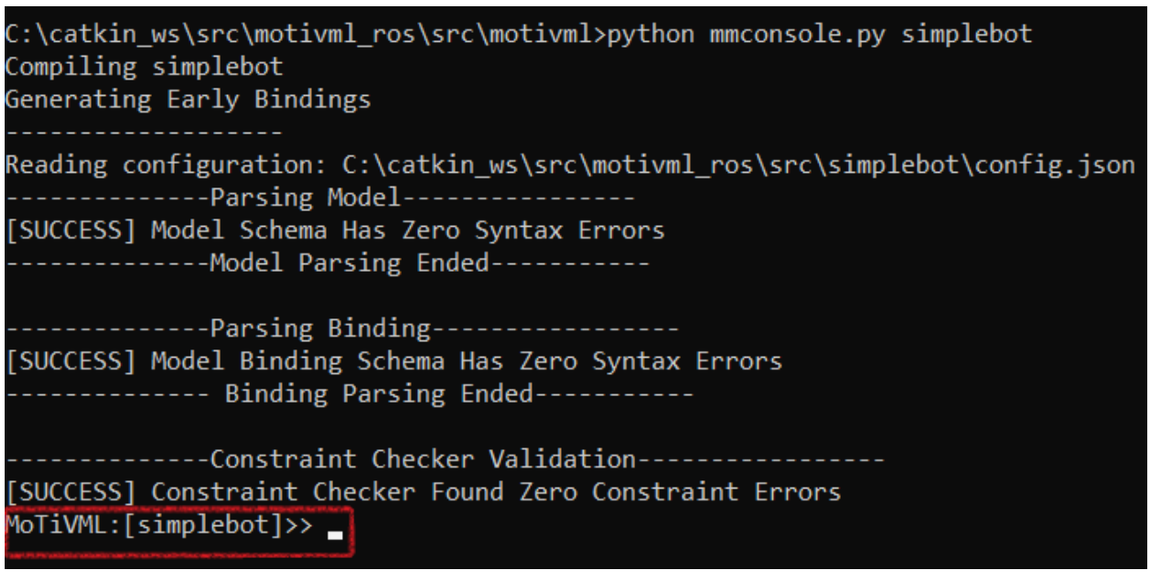
To launch the MoTiVML console interface, navigate to the **/src/motivml** directory and run the following command in Listing 18:

Listing 18: MoTiVML Console Launch Command

```
python mmconsole.py <project_directory_name>
```

When the above command is run, the model and configuration defined in the **project_directory_name** is compiled and validated, prior to the console interface being launched. If there are no errors detected, the console interface is then launched successfully.

Figure 3: Simplebot Console



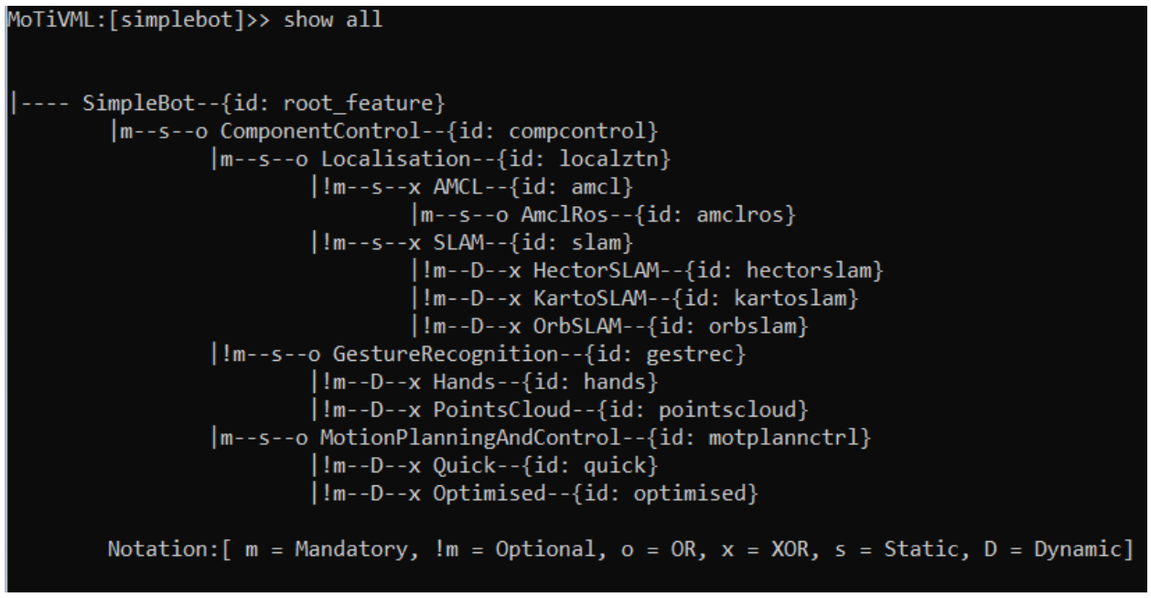
In Figure 3 we can observe the launched MoTiVML console. As highlighted in the figure above, the console prompt always bears the name of the project which was launched with the console. For this reason, all MoTiVML console commands that are run will be affiliated with the model highlighted in the console prompt.

4.9 MoTiVML Console Commands

- **show** < *parameter* >: The show command invokes the motivml model visualizer. The show command is used to display graphically a user constructed model. This command prints the hierarchical structure of a selected model while displaying details such as its mandatory status, group and binding mode. The show command takes a single parameter. This parameter can either be **all** or **config**.

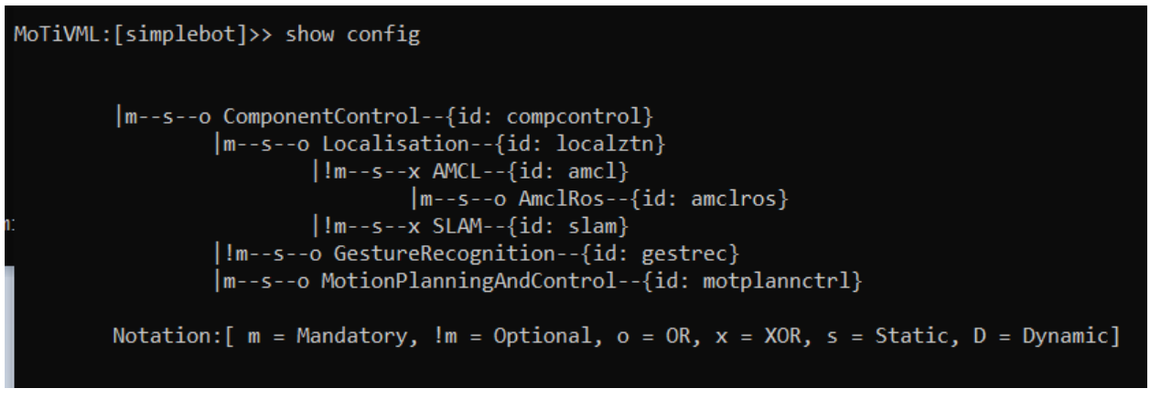
  The **show all** command only visualizes all selected features that exist in a model tree. By default all features are selected when instantiated. Thus, this command shows every single feature in the model tree.

Figure 4: show all Command



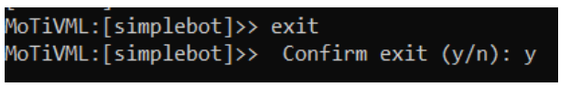
The **show config** command only visualizes currently selected or bound features. That is, unselected or unbound features in the model are excluded from the visualizer output.

Figure 5: show config Command



- **exit**: The exit command shuts down the console interface and returns back to the original ROS console. The exit command also asks for a yes or no confirmation before proceeding. Figure 6 shows an exit command execution and output.

Figure 6: Exit Command



- **load** $< featureid >$: The load command attempts to add a feature to the existing configuration. Once the feature is added successfully to the configuration, the feature is executed to show its existence.
- **unload** $< featureid >$:The unload command attempts to remove a feature from the existing configuration. Once the feature is removed successfully from the configuration, an output message is sent to the console. Like wise, if the unload attempt is unsuccessful, a prompt is printed in the console.
- **dump**: The dump configuration command the ids of all features that have been bound in the configuration, in the form a categorised list as a console output.

5 Launching a Configuration in the Framework

After modelling your robot with MoTiVML and implementing all the modelled features, the robot configuration can be launched to simulate loading and unloading of features. To launch the configuration, the following steps must be performed in the exact sequence presented.

The output of all commands executed in the console interface can be viewed in the plugin manager console.

1. **Launch Parameter Server:** To launch the server parameters responsible for dynamic binding, run the following command in your terminal/console. Using roslaunch, parameters for each binding combination are created on the ros parameter service

Listing 19: Application ROS Parameters Launch Command

```
roslaunch motivml_ros motivml.launch
```

2. **Launch User Interface:** The user interface needs to be launched next because in its start up sequence it generated all static features and binds them to the the already initialised ROS parameters. To this, run the following command in a separate console/terminal. To tun the command successfully, navigate to the "/src/motivml_ros/src/motivml" directory of the project.

Listing 20: Application Cole Interface Launch Command

```
python mmconsole.py <project_name>
```

3. **Launch Plugin Manager Interface:** The plugin interface represents the live version of the robot configuration defined in your MoTiVML model instance. In here users can display all statically and dynamically bound features. Users can also observe the output of feature load and unload attempts. To launch this interface, run the following ROS command.

Listing 21: Application Cole Interface Launch Command

```
rosrun motivml_ros plugin_feature_loader
```

References

[1] *"ROS Pluginlib Documentation,"* [Online] Available: http://wiki.ros.org/pluginlib.