

# Gurobify

**Gurobify provides an interface to Gurobi  
from GAP.**

0.1

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## **Abstract**

TODO

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## **Acknowledgements**

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# Chapter 1

## Introduction

### 1.1 Introducing Gurobify

Gurobify is a GAP package which provides an interface to the optimisation software Gurobi.

### 1.2 Installation

TODO

## Chapter 2

# Getting Started

### 2.1 Getting Started

TODO

### 2.2 Minimal working example?

TODO

Example

```
gap> LoadPackage("Gurobify");
-----
Loading Gurobify 0.1 (Gurobify provides an interface to Gurobi from GAP.)
by Jesse Lansdown (www.jesselansdown.com).
Homepage: https://github.com/jesselansdown/Gurobify/
-----
true
```

Example

```
gap> model := GurobiNewModel(["BINARY", "BINARY", "BINARY"], [1.,2.,1.]);
<object>
gap> GurobiSetIntegerAttribute(model, "ModelSense", -1);
gap> GurobiAddConstraint(model, [2, 2, 2], "<", 6, "Initial Constraint");
gap> GurobiAddConstraint(model, [1, 2, 3], ">", 5, "Initial Constraint");
gap> GurobiOptimizeModel(model);
2
gap> GetSolution(model);
[ 1., 1., 1. ]
gap> GurobiReset(model);
gap> GurobiSetIntegerAttribute(model, "ModelSense", 1);
gap> GurobiOptimizeModel(model);
2
gap> GetSolution(model);
[ 0., 1., 1. ]
gap> GurobiWriteToFile(model, "test.lp");
gap> re_model := GurobiReadModel("test.lp");
<object>
gap> GurobiAddConstraint(re_model, [1, 1, 1], ">", 3, "Other Constraint");
gap> GurobiOptimizeModel(re_model);
```

```
2
gap> GetSolution(re_model);
[ 1., 1., 1. ]
gap> GurobiAddConstraint(re_model, [0, 1, 1], "<", 1, "Other Constraint");
gap> GurobiOptimizeModel(re_model);
3
gap> GurobiDeleteAllConstraintsWithName(re_model, "Other Constraint");
gap> GurobiOptimizeModel(re_model);
2
gap> GetSolution(re_model);
[ 0., 1., 1. ]
gap> SetTimeLimit(re_model, 0.0001);
true
gap> GurobiOptimizeModel(re_model);
9
gap> SetTimeLimit(re_model, 0.01);
true
gap> GurobiOptimizeModel(re_model);
2
```

## Chapter 3

# Using Gurobify

### 3.1 Creating or reading a model

TODO intro to section

#### 3.1.1 GurobiReadModel

▷ `GurobiReadModel(ModelFile)` (function)

**Returns:** a Gurobi model.

Takes a model file, reads it and creates a Gurobi model from it. *ModelFile* is the name of the file as a string, with the appropriate extension, and including the path if the file is not located in the current GAP working directory. Gurobi accepts files of type `.mps`, `.rew`, `.lp`, `.rlp`, `.ilp`, or `.opb`. Refer to the gurobi documentation for more information on which file types can be read.

#### 3.1.2 GurobiNewModel

▷ `GurobiNewModel(VariableTypes, ObjectiveFunction)` (function)

**Returns:** a Gurobi model.

Creates a gurobi model with variables defined by *VariableTypes* and an objective function given by *ObjectiveFunction*. *VariableTypes* must be a list, with entries indexed by the set of variables, and entries corresponding to the type of variable, as a string. Accepted variable types are "CONTINUOUS", "BINARY", "INTEGER", "SEMICONT", or "SEMIINT". Refer to the Gurobi documentation for more information on the variable types. *ObjectiveFunction* is a list, with entries indexed by the set of variables, where each entry corresponds to the coefficient of the variable in the objective function. *ObjectiveFunction* takes only double values.

### 3.2 Adding and deleting constraints

TODO

#### 3.2.1 GurobiAddConstraint

▷ `GurobiAddConstraint(Model, ConstraintEquation, ConstraintSense, ConstraintRHSValue, ConstraintName)` (function)

**Returns:**

Adds a constraint to a gurobi model. `ConstraintEquation` must be a list, with entries indexed by the variable set, such that each entry is the coefficient of the corresponding variable in the constraint equation. The `ConstraintSense` must be one of "<", ">" or "=", where Gurobi interprets < as ≤ and > as ≥. The `ConstraintRHSValue` is the value on the right hand side of the constraint. A constraint may also be given a name, which helps to identify the constraint if it is to be deleted at some point. May also take an empty string "" if no name is needed. Note that a model must be updated or optimised before any additional constraints become effective.

### 3.2.2 GurobiDeleteAllConstraintsWithName

▷ `GurobiDeleteAllConstraintsWithName(Model, ConstraintName)` (function)

**Returns:**

Deletes all constraints from a model with the name `ConstraintName`. Returns the updated model.

## 3.3 Optimizing a model

TODO

### 3.3.1 GurobiOptimizeModel

▷ `GurobiOptimizeModel(Model)` (function)

**Returns:** Optimisation status.

Takes a Gurobi model and optimises it. Returns the optimisation status code which indicates the outcome of the optimisation. A status code of 2 indicates that a feasible solution was found, a status code of 3 indicates the model is infeasible. There a number of other status codes. Refer to the Gurobi documentation for more information about status codes. The model itself is altered to reflect the optimisation, and more information about can be obtained using other functions, in particular the `GurobiGetAttribute` and `GurobiGetAttributeArray` functions.

### 3.3.2 GurobiReset

▷ `GurobiReset(Model)` (function)

**Returns:**

Reset all information associated with a solution for the model.

### 3.3.3 GetSolution (for IsGurobiModel)

▷ `GetSolution(Model)` (operation)

**Returns:** Solution

Display the solution found for a successfully optimised model.

## 3.4 Querying attributes and parameters

TODO



### 3.5 Querying other attributes and parameters

In addition to these specific queries given in the previous section, all other gurobi parameters and attributes which take integer or double values can be queried using `GurobiGetIntegerParameter("ParameterName")`, `GurobiGetDoubleParameter("ParameterName")`, `GurobiGetIntegerAttribute("AttributeName")` or `GurobiGetDoubleAttribute("AttributeName")` respectively, where "ParameterName" and "AttributeName" are strings given exactly as in the Gurobi documentation. See the Appendix for links to the relevant documentation.

#### 3.5.1 GurobiGetIntegerParameter

▷ `GurobiGetIntegerParameter(Model, ParameterName)` (function)

**Returns:** parameter value

Takes a Gurobi model and retrieve the value of a integer-valued parameter. Refer to the Gurobi documentation for a list of parameters and their types.

#### 3.5.2 GurobiGetDoubleParameter

▷ `GurobiGetDoubleParameter(Model, ParameterName)` (function)

**Returns:** parameter value

Takes a Gurobi model and retrieve the value of a double-valued parameter. Refer to the Gurobi documentation for a list of parameters and their types.

#### 3.5.3 GurobiGetIntegerAttribute

▷ `GurobiGetIntegerAttribute(Model, AttributeName)` (function)

**Returns:** attribute value

Takes a Gurobi model and retrieve the value of an integer-valued attribute. Refer to the Gurobi documentation for a list of attributes and their types.

#### 3.5.4 GurobiGetDoubleAttribute

▷ `GurobiGetDoubleAttribute(Model, AttributeName)` (function)

**Returns:** attribute value

Takes a Gurobi model and retrieve the value of a double-valued attribute. Refer to the Gurobi documentation for a list of attributes and their types.

#### 3.5.5 GurobiGetAttributeArray

▷ `GurobiGetAttributeArray(Model, AttributeName)` (function)

**Returns:** attribute array

Takes a Gurobi model and retrieve an attribute array. Can only get value of attributes arrays which take integer or double values, Refer to the Gurobi documentation for a list of attributes and their types.

### 3.6 Modifying attributes and parameters

TODO

### 3.6.1 SetTimeLimit (for IsGurobiModel, IsFloat)

▷ `SetTimeLimit(Model, TimeLimit)` (operation)

**Returns:** true

Set a time limit for a Gurobi model. Note that `TimeLimit` should be a float, however an integer value can be given which will be automatically converted to a float.

### 3.6.2 SetBestObjectiveBoundStop (for IsGurobiModel, IsFloat)

▷ `SetBestObjectiveBoundStop(Model, BestObjectiveBoundStop)` (operation)

**Returns:** true

Optimisation will terminate if a feasible solution is found with objective value at least as good as `BestObjectiveBoundStop`. Note that `BestObjectiveBoundStop` should be a float, however an integer value can be given which will be automatically converted to a float.

### 3.6.3 SetCutOff (for IsGurobiModel, IsFloat)

▷ `SetCutOff(Model, CutOff)` (operation)

**Returns:** true

Optimisation will terminate if the objective value is worse than `CutOff`. Note that `CutOff` should be a float, an integer value can be given which will be automatically converted to a float.

## 3.7 Modifying other attributes and parameters

### 3.7.1 GurobiSetIntegerParameter

▷ `GurobiSetIntegerParameter(Model, ParameterName, ParameterValue)` (function)

**Returns:**

Takes a Gurobi model and assigns a value to a given integer-valued parameter. `ParameterValue` must be an integer value. Refer to the Gurobi documentation for a list of parameters and their types.

### 3.7.2 GurobiSetDoubleParameter

▷ `GurobiSetDoubleParameter(Model, ParameterName, ParameterValue)` (function)

**Returns:**

Takes a Gurobi model and assigns a value to a given double-valued parameter. `ParameterValue` must be a double value. Refer to the Gurobi documentation for a list of parameters and their types.

### 3.7.3 GurobiSetIntegerAttribute

▷ `GurobiSetIntegerAttribute(Model, AttributeName, AttributeValue)` (function)

**Returns:**

Takes a Gurobi model and assigns a value to a given integer-valued attribute. `AttributeValue` must be a double value Refer to the Gurobi documentation for a list of attributes and their types.

### 3.7.4 GurobiSetDoubleAttribute

▷ `GurobiSetDoubleAttribute(Model, AttributeName, AttributeValue)` (function)

**Returns:**

Takes a Gurobi model and assigns a value to a given double-valued attribute. `AttributeValue` must be a double value Refer to the Gurobi documentation for a list of attributes and their types.

## 3.8 Other

### 3.8.1 GurobiWriteToFile

▷ `GurobiWriteToFile(Model, FileName)` (function)

**Returns:**

Takes a model and writes it to a file. File type written is determined by the `FileName` suffix. File types include `.mps`, `.rew`, `.lp`, `.rlp`, `.ilp`, `.sol`, or `.prm` Refer to the gurobi documentation for more information on which file types can be read.

### 3.8.2 GurobiUpdateModel

▷ `GurobiUpdateModel(Model)` (function)

**Returns:**

Takes a model and updates it. Changes to parameters or constraints are not processed until the model is either updated or optimised.

## **Chapter 4**

# **Examples**

### **4.1 Examples**

TODO

## Chapter 5

# Appendix

### 5.1 Links to some Gurobi documentation

For more information on Gurobi parameters, attributes, and status codes, see the following links:

- Attributes: <http://www.gurobi.com/documentation/7.0/refman/attributes.html>
- Parameters: <http://www.gurobi.com/documentation/7.0/refman/parameters.html>
- Status codes: [https://www.gurobi.com/documentation/7.0/refman/optimization\\_status\\_codes.html](https://www.gurobi.com/documentation/7.0/refman/optimization_status_codes.html)

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