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# GPdotNET v2.0 User Guide

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# GPdotNET v2.0

## Project description

GPdotNET is artificial intelligence tool for applying Genetic Programming and Genetic Algorithm in modeling and optimization of various engineering problems. It is .NET (Mono) application written in C# programming language which can run on both Windows and Linux based OS. Project started in 2006 within postgraduate project for modeling and optimization with evolutionary algorithms. As open source project, GPdotNET is first published on November 5 2009 on codeplex.com. GPdotNET is very easy to use. Even if you have no deep knowledge of GP and GA, you can apply those methods in finding solution. The project can be used modelling any kind of engineering process, which can be described with discrete data, as well as in education during teaching students about evolutionary methods, mainly GP and GA. The project is licensed under GNU Library General Public License (LGPL). For information about license and other kind of copyright please see http://gpdotnet.codeplex.com/license.

The project is hosted at http://gpdotnet.codeplex.com for Windows users, as well as http://code.google.com/p/gpdotnet for Linux users. Main place for all news, documentation and code changes is my blog site at http://bhrnjica.wordpress.com/gpdotnet.

If you have never heard about GP and GA, recommendation for getting basic information about GP is http://en.wikipedia.org/wiki/Genetic_programming. The wiki page also contains some links to other web sites about GP. For GA there is wiki page which contains a basic information about GA at this link http://en.wikipedia.org/wiki/Genetic_algorithm.

GPdotNET v2.0 supports the following types of modeling and optimizations:

1. Modeling with or without prediction of discrete data by using SymbolicRegression modeling with GP
2. Modeling with or without prediction of discrete data by using SymbolicRegression with GP and Optimizing calculated GPmode by using GA
3. Time Series modeling and prediction data by using SymbolicRegression with GP
4. Optimization of analytical defined function by using GA

# Introduction to GPdotNET v2

During implementation of GPdotNET v2.0 I have tried to post as much information as I could, trying to provide all relevant information to the users. This user guide mostly contains my blog posts, I was writing during implementations. Comparing to the previous version, this version is completely rewritten, and it is not compatible with version 1.0 in any segment. General logic of applying evolutionary methods in solving engineering problem remain the same. In the following text, it is listed the main feature in GPdotNEt v2.0.

- **Cross OS and Cross platform software (new  in v2)**

One of the main requirement for GPdotNET v2.0 is ability to run on multiple OS, by using .NET and Mono framework. So GPdotNET v2 can run on all OS where Mono is implemented. During the implementation every piece of code is tested against Mono. When code is not compatible with Mono, it was replaced with the code available in Mono. I can say that the whole implementation is done using Visual Studio and MonoDevelop, working on Windows and Fedora 17. I didn't have much time to test GPdotNET on OS other that Windows 7 and Fedora 1, so every bug report would be appreciated.

- **New text based file format   \*.gpa (new  in v2)**

GPdotNET V1.0 supported binary file format, and for large population size the file size was also big. On the other hand, with text file format you have possibility to modify file outside the GPdotNET. For example you can see whole population chromosomes, and see other data you are interesting in. You can also perform some manual modification if you like, by modifying training or testing data as well as parameters. In general manual modification file is not recommended.

- **Support for Excel and CSV export (new  in v2)**

Exporting in GPdotNET v2 is based on openXML file format, but there is some compatibility issue in Mono, so you cannot use Excel exporting in Mono. While you ruinning GPdotNET v2 on Mono you can export data in CSV file format. This is only one feature which is not running in both Mono and .NET.

- **Optimization of GPModels (new  in v2)**

 GPdotNET v2 can run optimization of calculated gpmodel. Optimization is very important for any engineering system.You can perform optimization after you perform modelling and got result. In fact you can run optimization and modeling as much as you want with only one constrains: You cannot run Optimization and Modelling at the same time.

- **Optimization of analytically defined function (new  in v2)**

GPdotNET v2 now supports optimization of any analytically defined function. You can defined function in Tree expression designed, define constrains and perform optimization.

**- Info tab in Model (new in v2)**

When you start with modelling and/or optimization a new Info Tab is created as well. Info tab contains rich edit control in which you can paste or load any rich text content from text to picture.  On this way, you can attach textual information of you model.

**- New Look& Feel (new win V2)**

Unlike previous version, GPdotNET v2 has new simplified GUI with only one big toolbar containing all available options, by removing all unnecessary options. Commands are split in to 4 major groups: Model, Modelling, Export and Common. It is very simple and gives you all options directly on the screen. Run, Stop and Optimize commands are shifted to main toolbar, in order to give use ability to stop or run programs from any tab page, not only from run page.

# Working with GPdotNET v2

If you are new to GPdotNET v2, you can try one of the predefined and recalculated samples from the start page. Samples are split in 3 major groups (see picture 1):

1. Modelling and predictions
2. Modelling and Optimization
3. Time Series modelling

Note: This version doesn't support persisting Optimization of analytic function, so there is no samples for it.

## Modelling and prediction

We are going through Simple Case sample, to see what you need to define in order to run calculation. On the other hand we will defined