

Hands-on tutorial on Linear Programming and Integer Linear Programming modeling

Installation Guide

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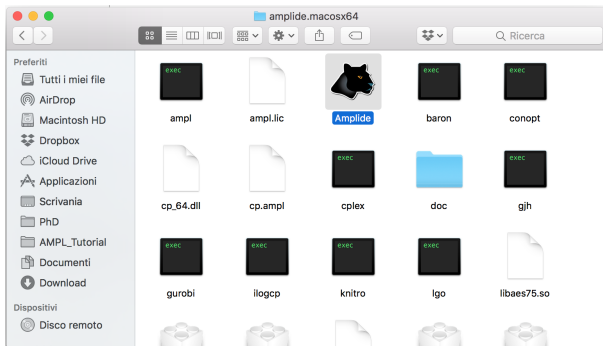
How to install AMPL

- The free size-limited AMPL Demo Version (500 variables and 500 constraints for linear problems, 300 for nonlinear ones)
- Available versions for most common platforms (Windows, Linux, Mac OS X) at the following link:
<http://ampl.com/try-ampl/download-a-free-demo/>
- Two modeling environments:
 - AMPL IDE
 - Command-line AMPL
- AMPL Demo Version already includes, among others, the following solvers:
 - CPLEX and Gurobi for linear and quadratic problems in both continuous and discrete variables;
 - CONOPT and MINOS for nonlinear problems in continuous variables.

AMPL Demo Version for Mac OS X

1. Please check to already have Java installed on your pc;
2. Download the distribution archive file named **amplide.macosx64.tgz** at this link:
<http://ampl.com/try-ampl/download-a-free-demo/#macosx>
3. Extract its contents; by default the package will be extracted into a folder named **amplide.macosx64** that will be in your *Download* folder.
4. This will be your AMPL folder but eventually you can rename it or move it to another location, for example into the Desktop.

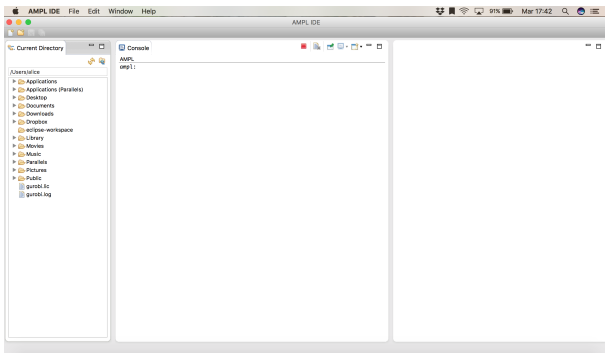
5. To run, you have to double click the **Amplide** file icon in the AMPL folder:



6. Loading files and workspace:

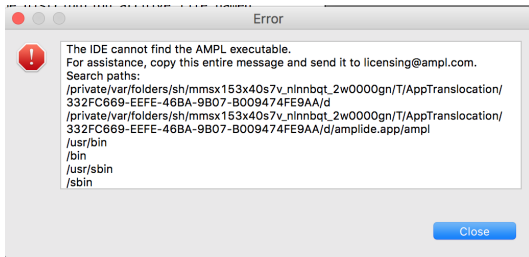


7. Finally the IDE appears:



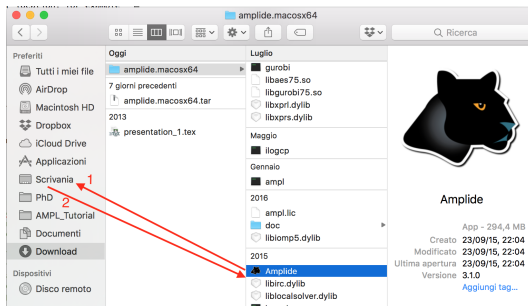
Important note for users of Mac OS X 10.12 Sierra

- It may happen that the first time you launch the AMPL IDE, during loading of files, you get the following error message:



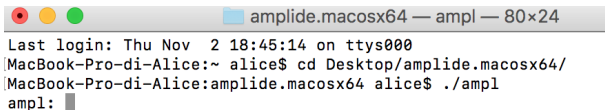
- It is a security issue due to the new security features introduced with Sierra, but it seems fixed in other versions of Mac OS X.

- To quickly solve it, you just need to drag the Amplide file icon and drop it to the Desktop; then drag and drop it again into the AMPL folder:



Command-line AMPL for Mac OS X

1. Open a new terminal window and go to the AMPL folder
2. Type **./ampl** and press enter: the AMPL prompt will appear

A screenshot of a macOS terminal window. The title bar shows three colored window control buttons (red, yellow, green) on the left, followed by a blue folder icon and the text "amplide.macosx64 — ampl — 80×24". The terminal content shows the login history: "Last login: Thu Nov 2 18:45:14 on ttys000", the current directory change: "MacBook-Pro-di-Alice:~ alice\$ cd Desktop/amplide.macosx64/", and the execution of the AMPL command: "MacBook-Pro-di-Alice:amplide.macosx64 alice\$./ampl". The prompt has changed from the shell prompt to "ampl:", followed by a small grey cursor block.

```
Last login: Thu Nov 2 18:45:14 on ttys000
MacBook-Pro-di-Alice:~ alice$ cd Desktop/amplide.macosx64/
MacBook-Pro-di-Alice:amplide.macosx64 alice$ ./ampl
ampl: █
```

3. Now you can start using AMPL commands.

- If you want to use AMPL from every directory, you need to edit the environment variable name \$PATH. To do so, open a new terminal in your home directory.
- Write **nano .bash_profile** to create a bash profile where to put your standard environment variables and the AMPL one.

```

alice — nano .bash_profile — 80x24
GNU nano 2.0.6      File: .bash_profile
export PATH="/Users/alice/Desktop/amplide.macosx64:$PATH"

```

```

[ Read 1 line ]
^G Get Help  ^O WriteOut  ^R Read File ^Y Prev Page ^K Cut Text  ^C Cur Pos
^X Exit      ^J Justify   ^W Where Is  ^V Next Page ^U UnCut Text ^T To Spell

```

- Save the file pressing CTRL-X and force the script to be executed: **source ~/.bash_profile**;
- Print the environment variable to check the edit:

```

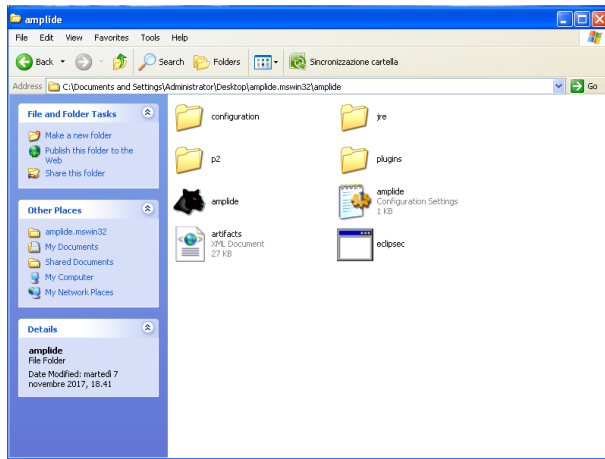
alice — -bash — 80x24
Last login: Sat Nov 18 10:49:14 on ttys000
MacBook-Pro-di-Alice:~ alice$ nano .bash_profile
MacBook-Pro-di-Alice:~ alice$ echo $PATH
/Users/alice/Desktop/amplide.macosx64:/usr/local/bin:/usr/bin:/bin:/usr/sbin:/sbin:/Library/TeX/texbin
MacBook-Pro-di-Alice:~ alice$

```

AMPL Demo Version for Windows

1. Download the distribution archive file named **amplide.mswin32.zip** or **amplide.mswin64.zip**, according to the version of your operative system, at this link:
<http://ampl.com/try-ampl/download-a-free-demo/#windows>
2. Extract contents of the main folder and also of the subfolders; by default the package will be extracted into a folder named **amplide.mswinXX** that will be in your *Download* folder.
3. This will be your AMPL folder but eventually you can rename it or move it to another location, for example into your Desktop.

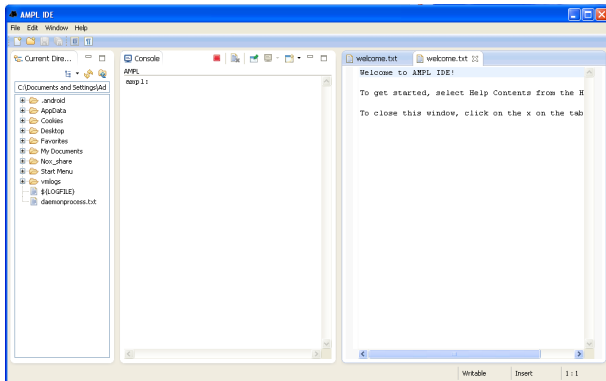
4. To run, you have to double click the **Amplide** file icon in the following path: `\amplide.mswinXX\amplide`



5. Loading files and workspace:

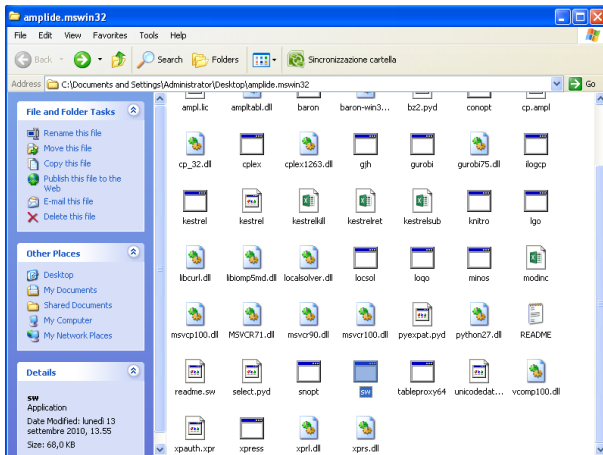


6. Finally the IDE appears:

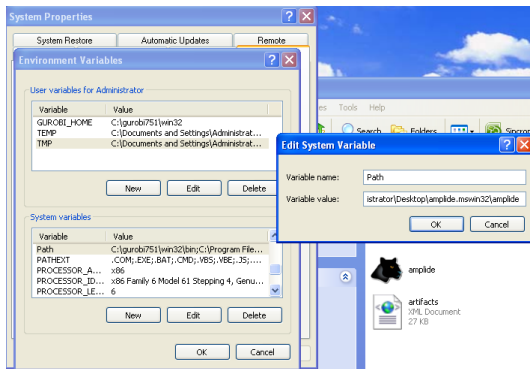


Command-line AMPL for Windows

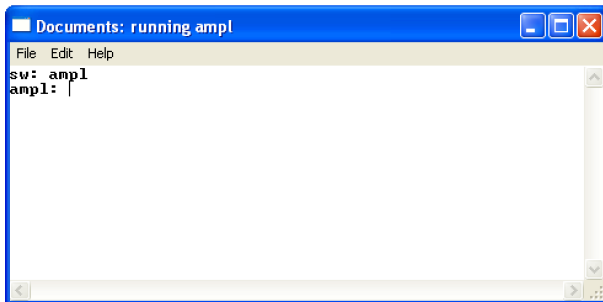
1. In your AMPL folder, look for **sw.exe** and double-click on it to make a prompt window appear:



2. To be able to run ampl from every directory (and not just from its one), go to Start → Computer → View system information → Advanced tab → "Environment Variables".
3. Look for "Path", click "Edit", do not erase anything but just add at the end the path to the directory where you have put ampl.exe and sw.exe.



4. Open a command prompt and try to type **sw.exe** or **ampl.exe** and press enter: the AMPL prompt will appear



5. Now you can start using AMPL commands.

Introduction to GLPK



- GLPK (i.e., GNU Linear Programming Kit) is a software package developed in ANSI C by Andrew Makhorin (Department for Applied Informatics, Moscow Aviation Institute) for solving large-scale LP and MIP problems.
- Part of the GNU Project, actually it is a library.
- The package contains several components:
 - For LP problems: revised simplex method and primal-dual interior point method;
 - For IP problems: Branch-and-bound method and cut routines;
 - Others: translator for GNU MathProg modeling language; API; stand-alone LP/MIP solver **glpsol**






glpsol and GMPL

- Since GLPK is a library, it needs a client software where can be run exploiting GLPK APIs → The default client is the glpsol solver (GNU Linear Program Solver).
- glpsol can take **GMPL** model and data as inputs and it finds a solution as output.
- **GMPL** (i.e., GNU Math Programming Language) is a modeling language intended for describing linear mathematical programming models:
 - Like in AMPL, the model is described through **model objects** such as sets, parameters, variables, constraints and objectives;
 - The model description is composed of two parts:
 - the model section
 - the data section
 - GMPL syntax is basically the same as AMPL

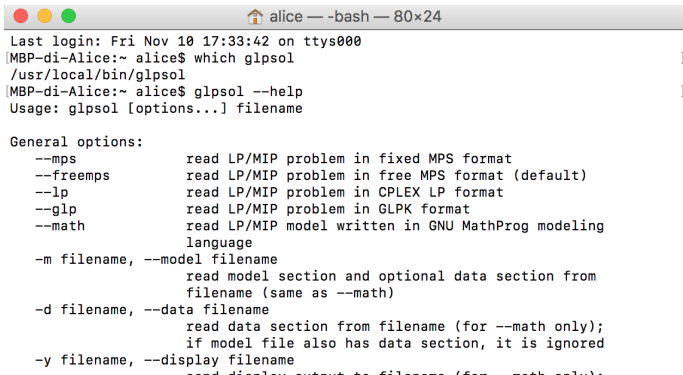
GLPK for Mac OS X and Linux

1. Main page: <https://www.gnu.org/software/glpk/>
2. Download the latest version of GLPK (4.65) from this link:
<http://ftp.gnu.org/gnu/glpk/>
3. Extract the package

Index of /gnu/glpk

<u>Name</u>	<u>Last modified</u>	<u>Size</u>	<u>Description</u>
 Parent Directory	-		
 glpk-4.63.tar.gz.sig	2017-07-25 04:17	65	
 glpk-4.63.tar.gz	2017-07-25 04:17	3.9M	
 glpk-4.62.tar.gz.sig	2017-06-14 05:30	65	
 glpk-4.62.tar.gz	2017-06-14 05:30	3.9M	
 glpk-4.61.tar.gz.sig	2017-01-22 07:56	65	

4. Open a new terminal window, go to the folder where you have extracted files and then type **./configure --prefix=/usr/local** to launch the installation on your system
5. Type **make**
6. When it is finished, type **sudo make install**
7. To verify GLPK is installed, type **which glpsol** and you should get something like this: **/usr/local/bin/glpsol**
8. Try also GLPK help: **glpsol - -help**



```

alice — -bash — 80x24
Last login: Fri Nov 10 17:33:42 on ttys000
[MBP-di-Alice:~ alice$ which glpsol
/usr/local/bin/glpsol
[MBP-di-Alice:~ alice$ glpsol --help
Usage: glpsol [options...] filename

General options:
  --mps           read LP/MIP problem in fixed MPS format
  --freemps       read LP/MIP problem in free MPS format (default)
  --lp            read LP/MIP problem in CPLEX LP format
  --glp           read LP/MIP problem in GLPK format
  --math          read LP/MIP model written in GNU MathProg modeling
                  language
  -m filename, --model filename
                  read model section and optional data section from
                  filename (same as --math)
  -d filename, --data filename
                  read data section from filename (for --math only);
                  if model file also has data section, it is ignored
  -y filename, --display filename
                  read display output to filename (for --math only);

```

GLPK for Windows

1. Main page: <http://winglpk.sourceforge.net>
2. Download the latest version of GLPK (4.63) from this link:
<https://sourceforge.net/projects/winglpk/>
3. Extract the package

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GLPK for Windows

Windows binaries for the GNU Linear Programming Kit (GLPK)
Brought to you by: [xypron](#)

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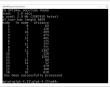
★ 5.0 Stars (9)
↓ 270 Downloads (This Week)
📅 Last Update: 2017-07-25

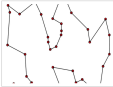
[Download](#)
winglpk-4.63.zip

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```
GNU GLPK 4.63.0
Copyright (C) 2007-2017 by Alexander M. Glebov, Nikolay V. Shmelev, and
Sergey A. Tsvetkov. All rights reserved.
This program is free software: you can redistribute it and/or modify
it under the terms of the GNU General Public License as published by
the Free Software Foundation, either version 3 of the License, or
(at your option) any later version.
This program is distributed in the hope that it will be useful,
but WITHOUT ANY WARRANTY; without even the implied warranty of
MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
GNU General Public License for more details.
You should have received a copy of the GNU General Public License
along with this program. If not, see <http://www.gnu.org/licenses/>.
```





Description

GLPK 4.63 (GNU Linear Programming Kit, <http://www.gnu.org/software/glpk/>) is a solver for large-scale linear programming (LP), and mixed integer programming (MIP). This project supplies the most recent Windows executables - 2017-07-25

Linux and OSX users should download the source distribution from <http://ftp.gnu.org/gnu/glpk>

4. The executables and dynamic link libraries for 32 bit (or 64 bit) Windows can be found in directory w32 (or w64).
5. Now, to be able to run `glpsol`, go to the folder where you have just extracted the package and then double-click on the folder *winXX* (according to your operative system version); you have two options:
 - You can copy all .dll files into %SystemRoot%\%nsystem32 (for example, C:\windows\system32);
 - Otherwise, you can add the path to this *winXX* folder into the environment variable *PATH* (as you did before for AMPL).
6. If you open a command prompt, typing **glpsol** you should get information about the version (it means that the link to the dynamic libraries is working).
7. For more information:
https://en.wikibooks.org/wiki/GLPK/Windows_executables

References



AMPL

<http://ampl.com>



AMPL: A Modeling Language for Mathematical Programming R. Fourer, D.M. Gay, B. Kernighan

<http://ampl.com/resources/the-ampl-book/>



GLPK

<https://en.wikibooks.org/wiki/GLPK>



GLPK/GMPL

[https://en.wikibooks.org/wiki/GLPK/GMPL_\(MathProg\)](https://en.wikibooks.org/wiki/GLPK/GMPL_(MathProg))