

Geometric Tools Engine Version 1.4

Installation Manual and Release Notes

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1 Introduction

You are about to install Geometric Tools Engine 1.4 (GTE). Version 1.0 of the source code is the companion to the book [GPGPU Programming for Games and Science](#) and was developed on Microsoft Windows 8.1 using Microsoft Visual Studio 2013 and Direct3D 11.1. We are now using C++ 11 constructs, so it is necessary to use version 2013 of the compiler. A brief summary of the version modifications is listed next. You can find the file revision logs at the Updates page of our website.

- Version 1.1 involved porting the code *not including the graphics or application code* to Linux and to Macintosh OS X.
- Version 1.2 includes a design change to the `Window` class regarding automatic updating of transformations.
- Version 1.3 includes some new classes for automatic texture coordinate generation.
- Version 1.4 includes a new class to support passing information about available hardware to algorithm implementations. Two of the Wild Magic physics samples were ported, Rope and Cloth, which required porting mesh generation for tube surfaces and rectangle surfaces. Two folders had names starting with a hash symbol (`#`), which is not friendly to Linux because you have to escape the symbol. These folders were merged with those of the same name but without the hash symbol. The Numerics samples were merged into the Mathematics samples.

The graphics and application code for Linux and Macintosh platforms are in development, mainly requiring an OpenGL 4.x-based graphics engine.

You should visit our website regularly for updates, bug fixes, known problems, new features, and other materials. The update history page always has a date for the last modification, so you should be able to track what you have or have not downloaded. The source files themselves are labeled with a version number of the form *1.minor.revision*, where *minor* is the minor version in which the file shipped and where *revision* is the number of times the file has been revised. The source files in the initial distribution of Geometric Tools Engine 1.0 are labeled with 1.0.0.

2 License

The Geometric Tools Engine uses the [Boost License](#). The license in its entirety is listed next.

Boost Software License - Version 1.0 - August 17th, 2003

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3 Copying the Distribution to Your Machine

You may unzip the distribution to a folder of your choice. The top-level folder of the distribution is **GeometricTools** and the subfolder for the distribution is named **GTEngine**. The projects all use paths relative to **GTEngine** and they do not rely on the top-level directory being located at the root of a hard drive.

Some of the folder hierarchy is shown next. The **Include** and **Source** folders contain all the code for the engine. We chose to omit the post-build copy of header and inline files to an **SDK** folder (as done in Wild Magic). If you have projects outside the **GTEngine** hierarchy, you can add a search path in a Microsoft Visual Studio project for the header and inline files using `$(GTE_PATH)/Include`. We use Microsoft Visual Studio’s reference system in the project settings for the applications to find the libraries to link to.

```

GeometricTools
  GTEngine
    Include // Root folder for Geometric Tools Engine, set GTE_PATH to here.
    Source  // Location for *.h, *.inl, *.hlsl, and *.hlsli files.
    Samples // Location for *.cpp files.
    Data    // Sample applications, many discussed in the GPGPU book.
    Basics // A small number of data files for the samples.
    Geometrics // Basic tutorials for several HLSL concepts.
    Graphics  // Samples for computational geometry.
    Imagics   // Samples for graphics and video streams (parallel copy).
    Mathematics // Samples for 2D and 3D image processing.
    Physics   // Samples for mathematical algorithms and numerical methods.
    Tools     // Samples for 2D and 3D physics.
    BitmapFontCreator // Several convenient tools.
    GenerateApproximations // Generate .h/.cpp file to represent a graphics font.
    GenerateOpenGLWrapper // Used to generate the minimax approximations for common functions.
    GenerateProject // Source-code generator for gl* wrappers drive by glcorearb.h.
                  // Generate a skeleton (vcxproj, sln, h, cpp) for GTE applications.

```

The **Samples** subfolders are many. Listing them here would make the displayed hierarchy difficult to read.

4 Environment Variables

4.1 Microsoft Windows

Data files are found using an environment variable that you must create; its name must be **GTE_PATH** and its value must be the path to where you installed **GTEngine**. For example, if your user account is in the

default location and you installed the `GeometricTools` folder to your user account folder, you will create an environment variable

```
GTE_PATH = C:\Users\YourAccount\GeometricTools\GTEngine
```

To create an environment variable, you need to launch the System window that is accessible through the Control Panel. The simplest way to do this is via the Windows shortcut: `Windows Key + Pause/Break`. Figure 1 shows the top-half of the window.



Figure 1. The System dialog window.

Select `Advanced system settings` to launch the dialog shown in Figure 2(a).

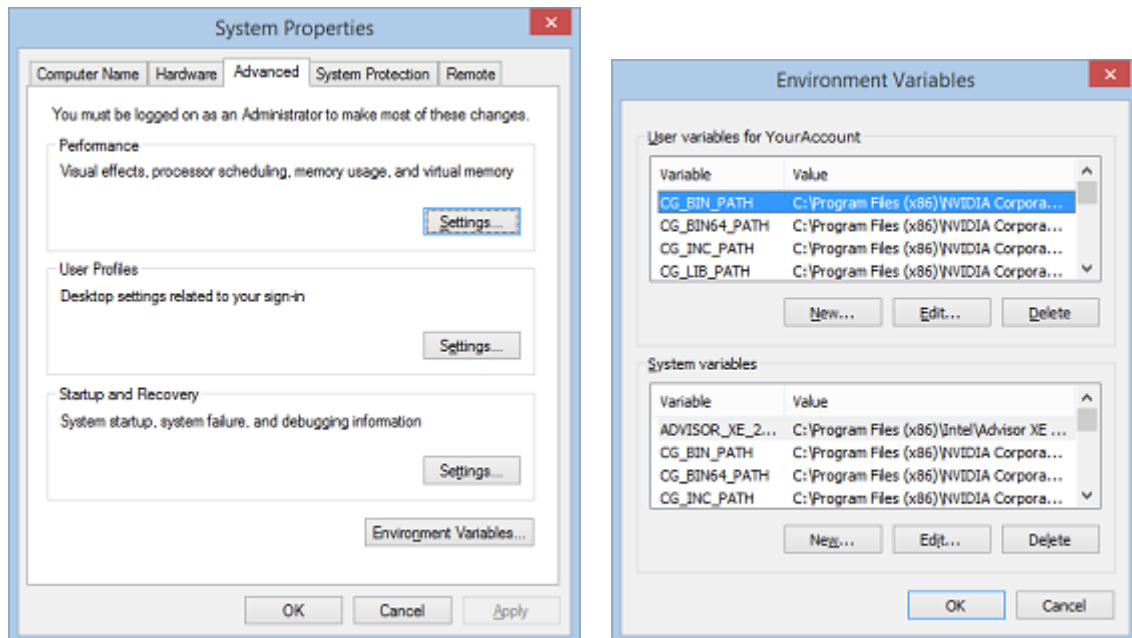


Figure 2. (a) The Advanced System Settings dialog window. (b) The Environment Variables dialog window.

Select the **Environment Variables ...** button to launch the dialog shown in Figure 2(b). Under **User variables for YourAccount**, select the **New ...** button to launch the dialog shown in Figure 3.

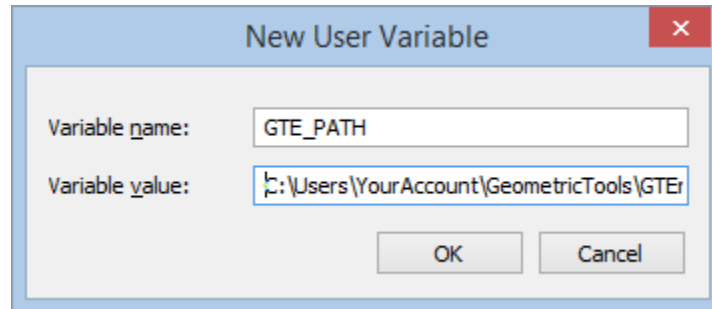


Figure 3. The New User Variable dialog window.

Enter the name and path as shown in the figure. Naturally, you will use the path to your installation. The dialog cannot be resize, so the environment variable value is not fully displayed. Press the **OK** button.

4.2 Linux

Until we port the application source code, there is no need for an environment variable named **GTE_PATH**. For now the Linux distribution is effectively a large mathematics library.

4.3 Macintosh OS X

Until we port the application source code, there is no need for an environment variable named **GTE_PATH**. For now the Macintosh OS X distribution is effectively a large mathematics library.

5 Compiling the Source Code

5.1 Microsoft Windows

The engine solution is **GeometricTools/GTEngine/GTEngine.sln**. Each sample application or tool has its own solution with all dependencies listed, so it is possible to open a sample application and compile and run it without explicitly building the engine solution first. The folder **GTEngine** contains the solution **GTBuildAll.sln** if you want to build the engine, samples, and tools rather than building the projects separately.

Currently, the engine solution generates static libraries. We have the hooks in place for dynamic libraries but have not yet created the build configurations. We will provide the dynamic library configurations eventually.

5.2 Linux

The makefile to build the GTEngine library is

```
GeometricTools/GTEngine/makefile.gte
```

Both static and shared library builds are supported. From a terminal window execute

```
make CFG=configuration -f makefile.gte
```

where `configuration` is `Debug` or `Release` for static libraries or is `DebugDynamic` or `ReleaseDynamic` for shared libraries.

5.3 Macintosh OS X

We have provides an Xcode project

```
GeometricTools/GTEngine/GTEngine.xcodeproj
```

that allows you to build any of four configurations. The `Debug` and `Release` configurations generate static libraries. The `Debug Dynamic` and `Release Dynamic` configurations generate shared libraries.

6 Running the Samples (Windows 8.x and Windows 7)

You can run the samples from within the Microsoft Visual Studio development environment. Samples that access data files use the `GTE_PATH` environment variable to locate those files; code is in place to assert when the environment variable is not set. If you run from Microsoft Windows, presumably double-clicking an executable via Windows Explorer, the environment variable is still necessary.

Many of the samples compile HLSL shaders at run time. This requires having `D3Dcompiler_47.dll` in your path. When running through Microsoft Visual Studio, the environment has a path to

```
C:\Program Files (x86)\Microsoft Visual Studio 12.0\VC\bin
```

that stores a copy of the DLL. It also has macros

```
$(WindowsSDK_ExecutablePath_x86), $(WindowsSDK_ExecutablePath_x65)
```

that contain paths to the Windows Kits that are part of Windows 8.x. These paths are

```
C:\Program Files (x86)\Windows Kits\8.x\bin\x86  
C:\Program Files (x86)\Windows Kits\8.x\bin\x64
```

where x is 0 or 1, depending on which version of the operating system is installed. Each has a D3D compiler DLL. Windows Kits are not installed by default on Windows 7, but they are created when you install Microsoft Visual Studio 2013.

When running from Windows Explorer or a command window, you need to have one of these DLL locations as part of your path; otherwise, you get an error dialog stating the DLL cannot be found. On our 64-bit machines, we have added to the system `PATH` environment variable the Windows Kits location for the `x64` binaries.

7 The Next Version of the Geometric Tools Engine

The following items are planned for the next version of the engine.

- We are working on an OpenGL 4.x-based engine so that the engine may be used for graphics applications on Linux or Macintosh OS X.
- Dynamic build configurations will be available.
- We are still writing unit tests for some of the core code and end-to-end tests for more complicated algorithms that were ported from Wild Magic 5. Although we could have shipped GTE without the tested files, we chose to do so anyway. If you run into problems with any of our code, please be patient and simply file a bug report. We will prioritize our testing so that bug reports get attention as soon as possible.
- Support 256-bit registers when AVX SIMD is available.
- Port most of the Wild Magic 5 sample applications.
- Add custom visualizers for the mathematics code.