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# Chapter 1

## Basic Utilities

### 1.1 config – setting features

All constants in the module can be set in user's config file. See the [User Settings](#) section for more detailed description.

#### 1.1.1 Default Settings

##### 1.1.1.1 Dependencies

Some third party / platform dependent modules are possibly used, and they are configurable.

**HAVE\_MPMATH** `mpmath` is a package providing multiprecision math. See its [project page](#). This package is used in **ecpp** module.

**HAVE\_SQLITE3** `sqlite3` is the default database module for `Python`, but it need to be enabled at the build time.

##### 1.1.1.2 Plug-ins

**PLUGIN\_MATH** `Python` standard float/complex types and `math/cmath` modules only provide fixed precision (double precision), but sometimes multi-precision floating point is needed.

##### 1.1.1.3 Assumptions

Some conjectures are useful for assuring the validity of a faster algorithm.

All assumptions are default to `False`, but you can set them `True` if you believe them.

**GRH** Generalized Riemann Hypothesis. For example, primality test is  $O((\log n)^2)$  if GRH is true while  $O((\log n)^6)$  or something without it.

#### 1.1.1.4 Files

**DATADIR** The directory where `NZMATH` (static) data files are stored. The default will be `os.path.join(sys.prefix, 'share', 'nzmatah')` or `os.path.join(sys.prefix, 'Data', 'nzmatah')` on Windows.

### 1.1.2 Automatic Configuration

The items above can be set automatically by testing the environment.

#### 1.1.2.1 Checks

Here are check functions.

The constants accompanying the check functions which enable the check if it is `True`, can be overridden in user settings.

Both check functions and constants are not exposed.

**check\_mpmath()** Check whether `mpmath` is available or not.  
constant: `CHECK_MPMATH`

**check\_sqlite3()** Check if `sqlite3` is importable or not. `pysqlite2` may be a substitution.  
constant: `CHECK_SQLITE3`

**check\_plugin\_math()** Check which math plug-in is available.  
constant: `CHECK_PLUGIN_MATH`

**default\_datadir()** Return default value for `DATADIR`.

This function selects the value from various candidates. If this function is called with `DATADIR` set, the value of (previously-defined) `DATADIR` is the first candidate to be returned. Other possibilities are, `sys.prefix + 'Data/nzmatah'` on Windows, or `sys.prefix + 'share/nzmatah'` on other platforms.

Be careful that all the above paths do not exist, the function returns `None`.  
constant: `CHECK_DATADIR`

### 1.1.3 User Settings

The module tries to load the user's config file named *nzmatahconf.py*. The search path is the following:

1. The directory which is specified by an environment variable `NZMATHCONFDIR`.
2. If the platform is Windows, then

- (a) If an environment variable APPDATA is set, APPDATA/nzmath.
  - (b) If, alternatively, an environment variable USERPROFILE is set, USERPROFILE/Application Data/nzmath.
3. On other platforms, if an environment variable HOME is set, HOME/.nzmath.d.

*nzmathconf.py* is a `Python` script. Users can set the constants like `HAVE_MPMATH`, which will override the default settings. These constants, except assumption ones, are automatically set, unless constants accompanying the check functions are false (see the [Automatic Configuration](#) section above).