

# MemBrain Revision Level History

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## Version History

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### Changes up to MemBrain version 11.05.02.00

**Release date: 2020-10-03**

1. Usability: When Lesson Editor is changed to have the identical selection for training and net error lesson then do not automatically switch display to "Training Lesson" in Pattern Error Viewer anymore.
2. Bug fix: Lessons where sometimes not correctly synched to the net in case they were loaded from script Lesson objects
3. Bug fix in C-Code library: Input function 'AVG' caused build to fail with some exported nets
4. Improved syntax highlighting in debugger
5. Improved documentation in help file

### Changes up to MemBrain version 11.05.01.00

**Release date: 2020-04-25**

1. BP Teacher: Corrected training of round robin links in online mode (also for dll)

### Changes up to MemBrain version 11.05.00.00

**Release date: 2020-03-22**

1. Added lesson based multi threading. Increases training speed by factors for most of the teachers, especially with large lessons and large nets.
2. Massively improved speed for loading large nets from file (up to factor 10, both MemBrain and the MemBrain dll)
3. Added new button to Lesson Editor: <Think On L. + Winner)
4. Allow the net to have more inputs and outputs than the current lesson has in order to allow teach/think steps based on lesson (both MemBrain and the MemBrain dll)
5. Expanded script command ThinkOnLesson (added rename winner option)
6. During training of a sub net only the selected sub net is drawn. This allows to focus on the currently relevant sub net and improved drawing performance.
7. Improved performance of RPROP based teachers in combination with shared thresholds of neurons (convolutions, both MemBrain and the MemBrain dll).
8. Improved performance when connecting to WebLink
9. Randomize Recommendation dialog now has a 'don't show again option'
10. Bug Fix: MemBrain sometimes did not exit when the application was closed during active teaching
11. Bug Fix: When a relation/sub net was selected and the teach process did not succeed due to an error message then the Lesson Editor stayed disabled

### Changes up to MemBrain version 11.04.02.00

**Release date: 2020-02-07**

1. Improved backprop based training algorithms when running in batch mode (adaptation of output neuron thresholds)  
(for both MemBrain and the MemBrain dll)

### Changes up to MemBrain version 11.04.01.00

**Release date: 2020-02-03**

1. Bug Fix: Adding convolutional layer may incorrectly tie some shared link weights to shared thresholds of created neurons
2. Cosmetic improvements, textual corrections in menus and dialogs

### **Changes up to MemBrain version 11.04.00.00**

**Release date: 2020-01-15**

The following changes have been made to MemBrain, between version 11.03.01.00 and 11.04.00.00

1. Added script command to select neuron(s) by their name
2. Ignore pattern recording option in Lesson Editor during teach process
3. Added dll interface to select neuron(s) by their name
4. Updated VBA, Java and C# dll interfaces accordingly
5. VBA Declarations to dll:
  1. Corrected neuron and link property struct for compatibility with Excel/VBA
  2. Added declarations file for 64 bit office versions to dll installation folder
  3. Added Office 2019/64 bit example for VBA dll access to homepage download section
  4. Corrected Office 2007/32 bit example homepage download section

### **Changes up to MemBrain version 11.03.01.00**

**Release date: 2020-01-03**

The following changes have been made to MemBrain, between version 11.03.00.00 and 11.03.01.00

1. Bug Fix: MemBrain could crash if <Teach><Evaluate Net Error> was executed before a first Think Step on the net was performed
2. Bug Fix: MemBrain could crash if a Teach Step on a sub net was executed before a first Think Step on the net was performed
3. Bug Fix: In the end of the teach process the screen was sometimes not properly refreshed

### **Changes up to MemBrain version 11.03.00.00**

**Release date: 2019-12-29**

The following changes have been made to MemBrain, between version 11.02.03.00 and 11.03.00.00

1. Added Softmax activation function
2. Performance improvement for dll: TeachAnalysis was called unnecessarily often
3. Improvement for dll: Automatically disable Floating Point Exceptions (FPEs) when loading dll. Restore previous FPE enable state when dll is unloaded.
4. Improvement for dll: Report 32 bit / 64 bit as part of version string

### **Changes up to MemBrain version 11.02.03.00**

**Release date: 2019-11-20**

The following changes have been made to MemBrain, between version 11.02.02.00 and 11.02.03.00

1. Bug Fix: No error or reason details provided when teacher exits automatically
2. MemBrain dll: Returned incorrect version string

### **Changes up to MemBrain version 11.02.02.00**

**Release date: 2019-11-12**

The following changes have been made to MemBrain, between version 11.02.01.00 and 11.02.02.00

1. Bug Fix: MemBrain was unable to load nets created with older versions

**Changes up to MemBrain version 11.02.01.00**

**Release date: 2019-11-10**

The following changes have been made to MemBrain, between version 11.02.00.00 and 11.02.01.00

1. Fixed version number info in about dialog

**Changes up to MemBrain version 11.02.00.00**

**Release date: 2019-11-10**

The following changes have been made to MemBrain, between version 11.01.00.00 and 11.02.00.00

1. Added function to add new rectangular neuron matrices in one shot
2. Added function to add new rectangular neuron layers in one shot including arbitrary connection schemes including Convolutional connections
3. Usability:
  1. Moved several items from <Extras> menu to <Insert> menu
  2. Added more context menu options

**Changes up to MemBrain version 11.01.00.00**

**Release date: 2019-10-05**

The following changes have been made to MemBrain, between version 11.00.00.00 and 11.01.00.00

1. Prevent computer from entering standby mode when MemBrain is busy with some background operation.  
The feature is configurable separately for different background operation tasks and certainly can also be turned off.
2. Bug fix: A net that uses the <RAND> input function for one or more of its neurons was classified as 'time variant' in MemBrain.  
Although such a net actually does not always produce the same calculations during a 'Think Step' and as such may be called time variant, it is still not depending on the order of applied patterns and thus better be dealt with as time invariant.

**Changes up to MemBrain version 11.00.00.00**

**Release date: 2019-09-26**

The following changes have been made to MemBrain, between version 10.00.01.00 and 11.00.00.00

1. Introduced support for convolutional neural nets (shared weights/thresholds)
2. Added new neuron input functions
  1. MAX
  2. AVG
  3. RAND
3. Usability:

- Moved whole <Select...> menu group from menu <Extras> to menu <Edit>
- Moved menu item <Select All> into menu group <Edit><Select...>
- 4. Performance: Improved object selection performance for large nets
- 5. Scripting: Incorporated latest AngelScript scripting engine 2.34.0
- 6. Bug Fix: When MemBrain was opened by double-clicking on a MemBrain net file then the Teacher pull down list was not filled until the Teacher Manager was opened at least once.
- 7. Bug Fix (DLL only): Incorrect handling of leakage parameter for MB\_AF\_IDENTICAL\_M11 and MB\_AF\_IDENTICAL\_0\_1
- 8. Bug Fix C-Code library did not correctly handle leakage parameters for hidden neurons
- 9. Bug Fix: When ungrouping objects the selection was visually reset but the elements still were functionally selected neurons until something else was actively selected.

### **Changes up to MemBrain version 10.00.00.00**

**Release date: 2019-07-01**

The following changes have been made to MemBrain between version 09.00.03.00 and 10.00.00.00

1. Implemented unsupervised\_pre-training/training of sub nets (e.g. autoencoders)
2. Expanded examples in download section of homepage to cover autoencoder sub net training
3. Added script command bool ChooseSubNet(const string& in relationName)
4. Added tool bar button for teacher manager
5. Added tool bar drop-down control for quickly selecting the active teacher
6. Replaced status bar 'Teacher Name' display by display selection/objects in net
7. Added new menu and context menu option: Edit Owing Groups
8. Added toolbar button for shotgun
9. Added possibility to edit width of groups and set default width for groups to 100.
10. Random Connection feature: Improved algorithm to ensure better compliance with maximum added links count entered by user.
11. Improved colours for group names display
12. Split Lesson dialog: Allow full range 0.0 .. 100.0 %
13. Re-arranged/grouped some menu items
14. Performance optimizations
15. Bug Fix: On-The-Fly net error calculation setting for teacher could lead to un plausible net error calculation in case the same lesson was used for training and net error calculation
16. Bug Fix: Dialog for editing randomization method did not always work correctly
17. Bug Fix: Docking all toolbars did not correctly respect window size
18. Bug fix (DLL only): Corrected LM Teachers, Correct RPROP Teachers w.r.t. multiply input function
19. Bug fix: Collapsing/uncollapsing groups did not correctly update screen in case there were uncollapsed groups in the group hierarchy
20. Bug fix: Ungrouping elements did not correctly remove all invisible groups in the group hierarchy

### **Changes up to MemBrain version 09.00.03.00**

**Release date: 2019-03-23**

The following changes have been made to MemBrain between version 09.00.02.00 and 09.00.03.00

1. Cascade Correlation Teacher: Allow to add neurons with new activation functions
2. When holding down the Ctrl key during selection via rectangle then selection of enclosed elements is toggled rather than being added to the selection
3. Hidden neurons now also provide normalization.  
Note: Not yet supported by MemBrain dll
4. Bug Fix: MemBrain could crash upon compilation of certain script code snippets
5. Bug Fix: MemBrain would crash when single groups are renamed and other groups were in the net.
6. Bug Fix: When a single teach step was performed via the 'Teach Step' menu or tool bar command then the displayed number of performed lesson runs after the teach step in the Error Viewer and in MemBrain's status bar was always multiplied by a factor of two.

7. Bug Fix: In file 'VBDeclarations.txt' that comes with the dll, corrected alias declaration for function MB\_GetHiddenCount

### **Changes up to MemBrain version 09.00.02.00**

**Release date: 2019-01-25**

The following changes have been made to MemBrain between version 09.00.01.00 and 09.00.02.00

1. Bug fix: Window size of Tool Bar 'Operate' was too large

### **Changes up to MemBrain version 09.00.01.00**

**Release date: 2019-01-24**

The following changes have been made to MemBrain between version 09.00.00.00 and 09.00.01.00

1. Bug fix: Short cuts did not work anymore

### **Changes up to MemBrain version 09.00.00.00 and MemBrain DLL 07.00.00.00**

**Release date: 2019-01-08**

The following changes have been made to MemBrain between version 08.01.01.00 and 09.00.00.00, including changes in the MemBrain DLL version 06.00.01.00 to 07.00.00.00, the MemBrain C.Code Library version 03.00.00 to 04.00.00 and the MemBrain Script Debugger 02.00.12.00 to 02.00.13.00.

1. Added new activation functions:
  1. RELU (Rectified Linear Unit)
  2. SOFTPLUS
  3. BIN DIFF (Differentiable Binary)
2. Added leakage parameter for the following activation functions:
  1. IDENT\_0\_1
  2. IDENT\_M1\_1
  3. RELU
  4. BIN\_DIFF
3. Made randomization function configurable with respect to range and offset of distribution
4. Made randomization function configurable separately for weights (of links) and thresholds (of neurons)
5. Added choice for randomization feature: Standard random or Gauss distribution
6. Made randomization configuration part of net specific settings. These settings are saved/loaded together with every net.
7. Added script commands for configuration of randomization function
8. Incorporated newest AngelScript scripting engine 2.33.0
9. Bug fix: On some installations the teacher editor did not work correctly (refused to accept certain number values for learn rate)
10. Bug fix: Some Lesson Editor menu commands were enabled during teaching: MemBrain could crash when these were used.
11. Bug fix: If more than one group object was deleted at once then this action could not be undone.

### **Changes up to MemBrain version 08.01.01.00**

**Release date: 2018-04-30**

The following changes have been made to MemBrain between version 08.01.00.00 and 08.01.01.00:

1. Bug Fix: Script class Lesson: Methods 'Load' and 'Save' did not work correctly anymore since

encryption option was introduced

2. Script class Lesson: Added methods 'SetPwd' and 'RemovePwd'.
3. In help file added sections about new script commands RemoveDefaultFilePwd, SetDefaultPwd, RemoveNetFilePwd, SetNetFilePwd, RemoveLessonFilePwd, SetNetFilePwd
4. Improved syntax highlighting in script debugger
5. Added Group Count to net analysis
6. Improved speed when loading large nets
7. Added warning message in case the SW updater finds an update and a valid license file is installed whose validity period may be already expired.  
Note: This feature will only kick in after this MemBrain version has been installed, i.e. only for the next potential SW update!

### Changes up to MemBrain version 08.01.00.00 and MemBrain DLL 06.00.01.00

**Release date: 2018-03-28**

The following changes have been made to MemBrain between version 08.00.00.00 and 08.01.00.00 and the MemBrain DLL version 06.00.00.00 to 06.00.01.00:

1. Added automatic software update checker
2. Incorporated newest AngelScript scripting engine 2.32.0
3. Added new script module 'datetime'
4. Added possibility to adjust the number of significant decimal places displayed for neuron activations and link weights. Default is set to 7 for activations, 3 for weights.
5. Display file name of last script on fly-out of 'Play' toolbar button
6. Script debugger: Add watch variable always to next empty line upon drag/drop
7. Script debugger: Do not add watch variable if it is already in the list
8. Bug Fix: After clicking 'Full Lesson' in the Pattern Error Viewer zooming with the mouse was not working anymore until 'Apply' was clicked again.
9. Bug Fix: Pattern Error Viewer: Selecting Net Error Lesson from script did not always update Pattern Error Viewer and radio button selection in viewer was disabled then.
10. Adapted declarations of 64 Bit dll version: Added `_NO_STDCALL` to all 64 bit configurations
11. Removed MemBrainDll64\_NoStdCall from installer. Not needed since 64 bit compiler ignores stdcall anyway.
12. Added 'MB\_AF\_IDENTICAL\_M11' to enumeration in dll header MemBrain\_inc.h and to MBDIIWrapper.java
13. Bug Fix: Dll could crash upon exiting
14. Bug Fix: 64 bit version of dll could crash when using encryption
15. Corrections in help file

### Changes up to MemBrain version 08.00.00.00 and MemBrain DLL 06.00.00.00

**Release date: 2017-04-17**

The following changes have been made to MemBrain between version 07.03.00.00 and 08.00.00.00 and the MemBrain DLL version 05.01.00.00 to 06.00.00.00:

1. Added Levenberg-Marquardt training algorithm (Single Precision and Double Precision version)
2. Added Lesson Editor menu <Image Files> which allows to directly read in image files from a large variety of formats as gray scales into the active lesson.
3. Added command **ReadPatternInputsFromImageFile** to script engine to read in pictures from various file formats.
4. Added method **ReadInputsFromImageFile** to Lesson script class to read in pictures from various file formats.
5. Bug Fix: Move selected neurons out of MemBrain drawing area via mouse: Positioning errors could occur
6. Bug: Trace upwards/downwards selection didn't work properly with groups.
7. Added Levenberg-Marquardt (Single Precision and Double Precision version) and Trial-And-Error training algorithms to DLL.



### **Changes up to MemBrain version 07.03.00.00, Script Debugger 02.00.10.00**

**Release date: 2017-01-17**

The following changes have been made to MemBrain between version 07.02.00.00 and 07.03.00.00:

1. Added export feature to Error Graph: Export error graph to CSV file with a simple button click
2. Added export feature to Pattern Error Viewer: Export current view to CSV file with a simple button click
3. Added export feature to Pattern Error Viewer: Export complete net validation data to CSV file with a simple button click
4. Added script commands for all three export functions above so that they can also be used from within MemBrain scripts
5. Added option to split off part of a lesson in Lesson Editor not only by random pattern selection but also by moving the tail of a lesson off to a new lesson. This is the required splitting method for time variant nets.
6. Expanded the script command 'SplitLesson' by an optional boolean parameter to also allow splitting off the tail of a lesson instead of splitting off by random pattern selection.
7. Incorporated newest AngelScript scripting engine 2.31.2

### **Changes up to MemBrain version 07.02.00.00, Script Debugger 02.00.09.00**

**Release date: 2016-12-10**

The following changes have been made to MemBrain between version 07.01.00.00 and 07.02.00.00:

1. Added multi core support to increase processing of large nets
2. Incorporated newest AngelScript scripting engine 2.31.1
3. Added debugger watch output for 'Lesson' type in scripts
4. Added number of neurons in net and number of hidden neurons in to Net Analysis result screen and removed menu item <Net><Statistics> in turn
5. Script debugger editor window: Added from-to selection when clicking while holding down the SHIFT key.
6. Expanded functionality of built-in script string type and string utility functions.
7. Bug fix: Values of strings in scripts were not output in script debugger watch window

### **Changes up to MemBrain version 07.01.00.00 and MemBrain DLL 05.01.00.00, Script Debugger 02.00.08.00**

**Release date: 2016-06-17**

The following changes have been made to MemBrain between version 07.00.00.00 and 07.01.00.00:

1. Added password driven 256 bit AES encryption for neural nets and lessons (both MemBrain and MemBrain DLL)
2. Bug Fix: Scripting had issues with getting/setting neuron properties (introduced in 07.00.00.00)
3. Bug Fix: MemBrain DLL has issues with getting/setting neuron properties (introduced in 05.00.00.00)
4. Bug Fix: Pixel neurons got darker again when activation was set > 1.
5. Bug Fix: When changing activation function to IDENTICAL and change activation simultaneously to a value > 1 in the neuron properties editor, then the activation value was not taken over and a second edit step had to be performed.

### **Changes up to MemBrain version 07.00.00.00 and MemBrain DLL 05.00.00.00, Script Debugger 02.00.07.00, MemBrain C-Code Generator Library 03.00.00.00**

**Release date: 2016-05-08**

The following changes have been made to MemBrain between version 06.01.03.00 and 07.00.00.00:

1. Added hierarchical grouping of elements with collapse/uncollapse functions

2. Added multiplication function as option for input function to neurons: Users now can choose between SUM (sum of all input signals) and MUL (product of all input signals) to pre-process neuron inputs before they are subjected as argument to the activation function.
3. Activation function IDENTICAL now has an unlimited activation function range. The formerly limited activation function with range [-1..1] is still available als new option (IDENT. -1 TO 1).  
This means that proper input data normalization settings are not mandatory anymore for training and usage of the net (normalization option is still available if desired).  
Input data normalization always has been hard to deal with because it often is difficult to find proper normalization limits to a problem upfront.
4. Several algorithmic adaptations have been made to MemBrain, the MemBrain DLL and the MemBrain C source code generation library in order to deal with the now potentially unlimited output values of neurons, the new input function selection and the new set of activation functions.
5. When editing neuron and link properties then only the property tabs which can actually be used are displayed, depending on the selected object(s).
6. The MemBrain Script Debugger watch functionality has been enhanced to allow nested output of class properties down to the third level.
7. Incorporated newest AngelScript scripting engine 2.31.0
8. MemBrain DLL now also provided in a version without 'stdcall'. to improve compatibility with third party software (e.g. 'Origin').
9. Bug Fix: Normalization warning could occur twice when starting teacher
10. Bug Fix: Older MemBrain versions crashed when trying to read config files from newer ones
11. Bug Fix: Message about undo/redo buffer size = 0 had wrong title
12. Bug Fix: Error Graph Viewer could not display graph points smaller than 1e-20

### **Changes up to MemBrain version 06.01.03.00 and MemBrain DLL 04.02.01.00**

#### **Release date: 2016-02-11**

The following changes have been made to MemBrain between version 06.01.02.00 and 06.01.03.00:

1. Added feature to add integrator neurons
2. Significantly improved performance of backprop based leaning algorithms in combination with tanh neuron activation functions  
(both MemBrain and the MemBrain DLL)
3. Enable option <View><Update View During Teach> by default for fresh MemBrain installations
4. Cosmetic improvements when drawing connection rectangles of neurons
5. Expand allowed adjustment ranges for RPROP teacher settings
6. Bug Fix: Help-On feature did not work for - menu item <File><CSV file separator settings...>

### **Changes up to MemBrain version 06.01.02.00, Script Debugger 02.00.06.00 and MemBrain DLL 04.02.00.00**

#### **Release date: 2015-11-30**

The following changes have been made to MemBrain between version 06.01.01.00 and 06.01.02.00, to the MemBrain Script Debugger between version 02.00.05.00 and 02.00.06.00 and to the MemBrain

DLL between version 04.01.02.00 and 04.02.00.00:

1. Incorporated latest AngelScript scripting engine 2.30.2
2. Added FFT creation capabilities to MemBrain DLL
3. Added lesson averaging capabilities to DLL
4. CSV separators are now adjustable for both MemBrain and the MemBrain DLL
5. The script debugger now stores the expressions in the variable watch window persistently.
6. Added a menu command in the Script Debugger menu to clear the variable watch list
7. Improved MemBrain DLL Floating point unit error flags caused Excel VBA to report overflow error. Now the error flags are automatically reset after 'MB\_ThinkStep' has finished.
8. Bug Fix (MemBrain and DLL): Automatatic Net Analysis was missing after <Names to Net> Duplicate names were still assumed

9. Bug Fix: Absolute value FFT showed no inputs and outputs in case a net with already matching number of inputs was loaded when creating the FFT
10. Bug Fix: Script command SetNeuronProp(...): Not all activation function values were working.
11. Bug Fix: Hour glass was not shown for some Lesson Editor operations (create average lesson and create FFT lesson)
12. Bug Fix: Script Debugger still did not always update values for expressions in the variable watch window. Also, sometimes debug commands did not execute.

### **Changes up to MemBrain version 06.01.01.00, Script Debugger 02.00.05.00**

**Release date: 2015-05-28**

The following changes have been made to MemBrain between version 06.01.00.00 and 06.01.01.00 and the MemBrain Script Debugger between version 02.00.04.00 and 02.00.05.00.

1. Bug Fix: Debugger did not always update watch variables
2. Bug Fix: MemBrain could hang in case of too length build message texts being sent to debugger
3. Bug Fix: Script execution kept being slower as if debugger was connected although debugger had already been closed again.  
Only restart of MemBrain restored original script execution speed.
4. Improvement: Floating point values were shown with only few decimal places in debugger watch window
5. Added horizontal scroll bar to debugger output and build window

### **Changes up to MemBrain version 06.01.00.00, Script Debugger 02.00.04.00 and MemBrain DLL 04.01.02.00**

**Release date: 2015-05-23**

The following changes have been made to MemBrain between version 06.00.04.00 and 06.01.00.00.

1. Added new option to create layerwise full downwards linkage in a net with one click
2. Added Lesson class as script object. With this feature, data manipulation and lesson data creation in scripts is simplified and can be achieved with much better performance since the Lesson Editor with its graphical data representation is not involved anymore. All existing Lesson Editor commands are still available, however.
3. Added tool bar button for 'Randomize Net' function
4. Fly-out when hovering mouse over Undo/Redo toolbar symbol: Provide text of action to be undone/redone
5. Improved automatic net analysis in background (screen update)
6. Grouped <Connect> commands in sub menu 'Connect...' of Edit menu
7. Incorporated latest AngelScript scripting engine 2.30.0
8. Added new script add-on: filesystem: It is now possible to scan for files and directories in a script (e.g. obtain list of all files/directories as a script array)
9. Add new Skript function for Lesson Editor control: SetLessonSize(...)
10. Added new Skript function for Lesson Editor control: CopyPatterns(...)
11. Added uninstall entry to registry so that MemBrain can directly be uninstalled via the Windows software management in control, panel
12. <View><Show Layer Info> is enabled by default after a fresh installation
13. Included release dates in revision level history
14. Bug Fix: Some flyout help texts to toolbar buttons were not shown
15. Bug Fix: File name in Lesson Editor Title bar was not always displayed correctly.
16. Bug Fix: When importing Current Lesson Inputs then always a message about added output patterns was displayed even if number of outputs was 0 or if output selection box was disabled
17. Bug Fix: When importing Current Lesson Inputs or Outputs and the original lesson was already larger than the current lesson then the additional inputs were not set to 0.

18. Corrected example in help file for script method string::split

The following changes have been made to the MemBrain Script Debugger between version 02.00.03.00 and 02.00.04.00.

1. Added syntax highlighting for new script functions and for filesystem and Lesson script classes
2. Bug Fix: Debugger shrunk variable watch window table lines after each step

The following changes have been made to the MemBrain DLL between version 04.01.01.00 and 04.01.02.00.

1. Bug Fix: When importing Current Lesson Inputs or Outputs and the original lesson was already larger than the current lesson then the additional inputs were not set to 0.

### **Changes up to MemBrain version 06.00.04.00, Script Debugger 02.00.03.00 and MemBrain DLL 04.01.01.00**

**Release date: 2015-01-19**

The following changes have been made to MemBrain between version 06.00.03.00 and 06.00.04.00.

1. Massively increased speed of CSV data import via the Lesson Editor: More than 10 times faster now.
2. Increased maximum accepted CSV file size for lesson data import by approx. factor 3
3. Incorporated latest AngelScript scripting engine 2.29.2
4. Bug Fix: Incorrect error message was reported by the Lesson Editor when an out-of-memory situation occurred during lesson import from CSV files.
5. Bug Fix: MemBrain sometimes encountered an improper argument when splitting a lesson, especially on high split percentage numbers

The following changes have been made to the MemBrain Script Debugger between version 02.00.02.00 and 02.00.03.00.

1. Bug fix: Some scripting commands did not feature syntax highlighting
2. Uninstaller now also removes config files for MemBrain Script Debugger

The following changes have been made to the MemBrain DLL between version 04.01.00.00 and 04.01.01.00.

1. Massively increased speed of CSV data import via the Lesson Editor: More than 10 times faster now.
2. Increased maximum accepted CSV file size for lesson data import by approx. factor 3

### **Changes up to MemBrain version 06.00.03.00 and Script Debugger 02.00.02.00**

**Release date: 2014-23-08**

The following changes have been made to MemBrain between version 06.00.02.00 and 06.00.03.00.

1. Incorporated newest AngelScript version 2.29.1
2. 8 new script functions to set and get:
  - Lesson names
  - Lesson comments
  - Pattern names
  - Pattern comments
3. More intelligent normalization wizard: Assign overhead to input neurons, too, when numbers have

decimal places:

Even after using the Normalization Wizard, sometimes a problem with input range check persisted due to floating point handling mechanisms.

This has been resolved.

4. Modified FFT algorithm, now fully integrated in MemBrain.exe.  
Note: Marginally different FFT calculation results may be obtained with respect to previous MemBrain versions
5. Bug Fix: When creating FFT lesson the allowed max index in the dialog was too high by 1.
6. Uninstaller now cleans user specific MemBrain related config data as well as corresponding common data.

The following changes have been made to the MemBrain Script Debugger between version 02.00.01.00 and 02.00.02.00.

1. Added syntax highlighting for new script functions introduced by MemBrain 06.00.03.00

### **Changes up to MemBrain version 06.00.02.00 and Script Debugger 02.00.01.00**

#### **Release date: 2014-02-05**

The following changes have been made to MemBrain between version 06.00.01.00 and 06.00.02.00.

1. Incorporated newest AngelScript version 2.28.1
2. Changed default value when creating new teachers: 'Use On-The-Fly Net Error Calculation if possible' is now set to 'false' as default
3. Bug Fix: When a new net was opened then the question for saving the net stock was given if the net stock was unsaved. This is not required since the net stock is not affected from opening a new net.
4. Bug Fix: When 'On-The-Fly Net Error calculation' was activated then the Pattern Error Viewer indicated 'Training Lesson' as greyed option although it was showing the net error lesson data.
5. Bug Fix: When 'On-The-Fly Net Error calculation' was activated then the error plot showed only a green line, black line (for training error) was missing
6. Bug Fix: Reset net also before calculating net error during training if the option 'Reset Net before each Lesson' is activated in the teacher
7. Bug Fix: Robustness issue: MemBrain could crash when lesson was loaded from script under certain critical timing conditions
8. Bug Fix: Pattern Error Viewer Range-Fit did not properly work if both upper and low data boundary were negative
9. Bug Fix: Normalization Wizard did not correctly search for maximum value in case both upper and low data boundary were negative

The following changes have been made to the MemBrain Script Debugger between version 02.00.00.00 and 02.00.01.00.

1. Added syntax highlighting for pre-defined function 'OnAbortScript'

### **Changes up to MemBrain version 06.00.01.00**

#### **Release date: 2014-01-19**

The following changes have been made to MemBrain between version 06.00.00.00 and 06.00.01.00.

1. Bug Fix: Scripted Elements Net Error calculation functions did not properly return their result values to MemBrain.
2. Scripted Elements were not automatically re-compiled when teach process was started.
3. Corrected help text for script function 'GetAppExitCode'.

**Changes up to MemBrain version 06.00.00.00, Script Debugger 02.00.00.00 and MemBrain DLL 04.01.00.00**

**Release date: 2014-01-04**

The following changes have been made to MemBrain between version 05.00.04.00 and 06.00.00.00.

1. New feature: neural net stock manager
2. New feature: Store and load whole groups of neural nets via the neural net stock manager
3. Added powerful script command set to work with the stock during script operation
4. New feature: Automatically capture best performing net on stock during the training: Built-in function to avoid over-training
5. New feature: Option to select the lesson to be displayed in the Pattern Error Viewer
6. New feature: Display training and validation error at the same time in the Net Error Viewer
7. New feature: Option to calculate net error based on user defined activation ranges rather than on the basis of normalized values.
8. New feature: Horizontal mouse wheel tilting now supported in MemBrain's main window
9. New feature: Pressing <Ctrl> on the keyboard in conjunction with mouse wheel scrolling allows to zoom into and out of the current data set in the Pattern Error Viewer.
10. New feature: Horizontal mouse wheel tilting now supported in the Pattern Error Viewer
11. New script command: 'IsNetModified()'. Can be used to detect if modifications on the currently loaded net have not yet been saved to file.
12. New functionality: Script function 'ThinkOnLesson()' now also checks for normalization range violations like the manually called function from via the Lesson Editor does.
13. New optional parameter for script command 'ThinkOnLesson()': Option to suppress newly introduced normalization range check.  
This is to provide backwards compatibility of script behaviour in case this is desired.
14. New functionality: Script function 'StartTeaching()' now also checks for normalization range violations like the manually called function from via the Lesson Editor does.
15. New optional parameter for script command 'StartTeaching()': Option to suppress newly introduced normalization range check.  
This is to provide backwards compatibility of script behaviour in case this is desired.
16. New functionality: Script function 'TeachSTep()' now also checks for normalization range violations like the manually called function from via the Lesson Editor does.
17. New optional parameter for script command 'TeachStep()': Option to suppress newly introduced normalization range check.  
This is to provide backwards compatibility of script behaviour in case this is desired.
18. Added keyboard shortcut <Ctrl> + U for the menu option <Teach><Evaluate Net Error>
19. Incorporated newest AngelScript scripting language 2.28.0
20. Bug Fix: When scripting aborted due to a command execution error then sometimes 'User Abort' was shown in the script trace window.
21. Bug Fix: MemBrain could hang after debugger requests for expressions have been sent while MemBrain was not running a script.
22. Bug Fix: Improve error message when the script tries to import a lesson from CSV via 'LoadLesson' instead of 'ImportLessonRaw'.
23. Bug Fix: MemBrain could crash when trying to import a lesson from CSV via 'LoadLesson' instead of 'ImportLessonRaw' in the Lesson Editor.

The following changes have been made to the MemBrain Script Debugger between version 01.00.04.00 and 02.00.00.00.

1. Added new watch feature: Hover the mouse over a script variable while the script is halted in a breakpoint. The variable value will directly be shown in a fly-out window at the mouse cursor location
2. When a script is launched from MemBrain and the script debugger is open then the debugger's window will automatically be brought to foreground.
3. Added syntax highlighting support for new MemBrain script commands.

The following changes have been made to the MemBrain DLL between version 04.00.01.00 and 04.01.00.00.

1. Adapted loading and storing of MemBrain mbn files to stay in alignment with file format updates made by MemBrain 06.00.00.00.

### **Changes up to MemBrain version 05.00.04.00 and Script Debugger 01.00.04.00**

**Release date: 2013-09-20**

The following changes have been made to MemBrain between version 05.00.03.00 and 05.00.04.00.

1. Added logarithmic scaling of net error
2. Enlarged edit box for net error on Net Error Viewer
3. Bug Fix: Mouse wheel scrolling and zooming were not functional with certain mouse types.
4. Bug Fix: Some properties in neuron prop dialog were not editable when switching back and forth to/from Input neuron type
5. Bug Fix: Source code export configuration dialog: Unintended reset of settings when pressing Cancel on the export path dialog
6. Bug Fix: Source code export configuration dialog: A file must be selected in the export path dialog although only a folder is required

The following changes have been made to the MemBrain script debugger between version 01.00.03.00 and 01.00.04.00.

1. Bug Fix: Set breakpoint in method in another file doesn't work if other file is included via "\\" in path name.

### **Changes up to MemBrain version 05.00.03.00 and Script Debugger 01.00.03.00**

**Release date: 2013-08-16**

The following changes have been made to MemBrain between version 05.00.02.00 and 05.00.03.00.

1. - Added mouse wheel zooming for drawing area in combination with pressing and holding Ctrl-Key
2. - Added mouse wheel vertical scrolling in the drawing area
3. - Added mouse wheel pattern scrolling in the Lesson Editor
4. - Added mouse wheel controlled 'Think On Next Input' and 'Think On Previous Input' in the Lesson Editor with pressing and holding Ctrl-Key
5. - Incorporated latest AngelScript scripting engine 2.27.0
6. - Incorporated new script add-on functions for float to int conversion. Adapted help file math functions description.
7. - When splitting a lesson in the Lesson Editor by random selection the new lesson now keeps the original sorting of its patterns.
8. - When splitting a lesson in the Lesson Editor by random selection the patterns in the source lesson and in the newly generated split lesson are now automatically named according to their pattern numbers within the original lesson. This allows to identify which patterns have been moved over to the split lesson and which are remaining in the source lesson. Pattern auto naming is only performed if the pattern names are still at their default values, i.e. if the names have not already been assigned by the user manually or through data import.

The following changes have been made to the MemBrain script debugger between version 01.00.02.00 and 01.00.03.00.

1. Bug Fix: Debugger could not jump to code locations if file or folder contained spaces.

### **Changes up to MemBrain version 05.00.02.00 and Script Debugger 01.00.02.00**

#### **Release date: 2013-05-08**

The following changes have been made to MemBrain between version 05.00.01.00 and 05.00.02.00.

1. Added new teacher "Trial and Error" (mainly for research purposes)
2. Incorporated latest AngelScript scripting engine 2.26.2
3. Bug Fix: MemBrain could crash during script debugging
4. Bug Fix: If view update during teach is disabled then teach could sometimes not be properly stopped.
5. Added new script command to disable/re-enable screen refresh
6. Bug Fix: Debugger did not show lengthy debug output

The following changes have been made to the MemBrain script debugger between version 01.00.01.00 and 01.00.02.00.

2. Make debugger jump to code location even if the code is located in a different file which is already open but not the active file.
3. Added syntax highlighting for several script elements and keywords
4. Bug Fix: Debugger could crash during script debugging
5. Bug Fix: Debugger did not show lengthy debug output

### **Changes up to MemBrain version 05.00.01.00, DLL 04.00.01.00 and Script Debugger 01.00.01.00**

#### **Release date: 2012-09-08**

The following changes have been made to MemBrain between version 04.00.00.00 and 05.00.01.00.

1. Replaced internal command line script debugger by powerful external source-level debugger V01.00.01.00 including the following features:
  - Syntax highlighting
  - Fully featured text editor, including block indentation, copy/paste, search function, bookmarks...
  - Compile, build run and pause script remotely from within debugger
  - Build output window: See compiler messages directly in the debugger window, jump to code location via mouse click
  - Debug output window
  - Variable watch window
  - Graphical breakpoints
  - Step Into, Step Over, Step Out
  - Attach debugger to running script
  - Run debugger on the same machine as MemBrain or on an other machine within the LAN
  - Start debugger from within MemBrain
  - Start MemBrain from within debugger
2. Incorporated latest AngelScript scripting engine 2.24.1
3. Enlarged edit box for link weight in properties dialog for links

The following changes have been made to the MemBrain DLL between version 04.00.00.00 and 04.00.01.00.



1. The MemBrain DLL and the MemBrain JNI Wrapper DLL are now also available as 64 Bit versions. This allows to use the MemBrain DLL also in 64 Bit applications or with a 64 Bit Java VM.

### **Changes up to MemBrain version 04.00.00.00 and DLL 04.00.01.00**

**Release date: 2012-05-02**

1. The MemBrain DLL and the MemBrain JNI Wrapper DLL are now also available as 64 Bit versions. This allows to use the MemBrain DLL also in 64 Bit applications or under a 64 Bit Java VM.

### **Changes up to MemBrain version 04.00.00.00 and DLL 04.00.00.00**

The following changes have been made to MemBrain between version 03.08.02.00 and 04.00.00.00.

1. All calculations are now performed in 64 Bit arithmetic (former MemBrain versions internally worked with 32 Bit floating point arithmetic).  
Note that this also changed the function prototypes for the Scripted Elements and the script access to parameters for neurons and links (see Editing Neural Nets).
2. Code generation now can choose between 32 or 64 bit floating point precision.
3. Basic scripting function sub set can now be used in Scripted Elements (e.g. maths library)
4. Incorporated latest AngelScript scripting engine 2.23.1

The following changes have been made to the MemBrain DLL between version 03.02.01.00 and 04.00.00.00.

1. All calculations are now performed in 64 Bit arithmetic (former MemBrain DLL versions internally worked with 32 Bit floating point arithmetic).
2. The DLL has been equipped with 38 new interface functions to allow for editing neural nets. I.e. users of the DLL can now create and edit all aspects of new neural nets through the DLL inside their applications.

### **Changes up to MemBrain version 03.08.02.00 and DLL 03.02.01.00**

**Release date: 2012-02-12**

The following changes have been made to MemBrain between version 03.08.01.00 and 03.08.02.00.

1. Incorporated latest AngelScript scripting engine 2.22.2
2. Added integrated script debugger
3. Bug Fix: Check against invalid Window positions at startup, e.g. from previous use with multiple monitors.
4. Bug Fix: Normalization Wizard could assign same values for upper and lower limits

The following changes have been made to the MemBrain DLL between version 03.02.00.01 and 03.02.01.00.

1. Add Random-Seed to DLL during initialization derived from system time
2. Bug fix: Always run net analysis when loading a net that hasn't been analysed by MemBrain before

## Changes up to MemBrain version 03.08.01.00

### Release date: 2011-08-13

The following changes have been made to MemBrain between version 03.08.00.00 and 03.08.01.00.

1. Incorporated latest AngelScript scripting engine 2.21.0  
Please note that this change brings some changes with respect to the string class and the string utilities of the scripting language:  
The string class now has new methods which replace some of the old script utility functions:
  1. utility function 'substring' has been replaced by method 'substr' of the string class
  2. utility function 'findLast' has been replaced by method 'findLast' of the string class
  3. The functions 'findFirstOf', 'findLastOf', 'findFirstNotOf' and 'findLastNotOf' have been removed.  
These functions will hopefully also be replaced by string class methods in the future.
2. Bug fix: The Activation Function Graph on the neuron property editor tab did not work properly anymore.

## Changes up to MemBrain version 03.08.00.00 and DLL 03.02.00.00

### Release date: 2011-03-27

The following changes have been made to MemBrain between version 03.07.00.00 and 03.08.00.00.

1. Incorporated latest AngelScript scripting engine 2.20.2
2. Added scripting add-on 'ScriptMath3D'.
3. Improved network calculation approach when the network contains interconnection between neurons within the same layer:  
The calculation result depended on the calculation order and thus on screen position.  
Now the calculation is always correct, independent from these factors.
4. Added new feature for scripting:  
Perform multiple Teach Steps: Function TeachSteps() has been expanded to take an optional parameter: [TeachSteps\(uint stepCount\)](#). If this parameter is not provided the function will behave as the former version, i.e. perform one Teach Step.
5. Added new feature for scripting:  
New function [EvaluateNetError\(\)](#) allows to calculate the net error through scripting.
6. [Improved Shotgun feature](#): Shotgun can be configured to either use relative (i.e. percentaged) or absolute values.  
Additionally, it can be adjusted to either use a homogeneous or a gaussian distribution.
7. Revised [script commands used to configure the Shotgun feature](#).
8. Renamed menu item 'Teach Lesson' to 'Teach Step'
9. Added hyperlink to MemBrain homepage to MemBrain's Help/About Dialog.

The following changes have been made to the MemBrain DLL between version 03.01.01.00 and 03.02.00.00.

1. Improved network calculation approach when the network contains interconnection between neurons within the same layer:  
The calculation result depended on the calculation order and thus on screen position.  
Now the calculation is always correct, independent from these factors.
2. RPROP teacher is now also the default teacher for the DLL. This now is consistent with the MemBrain application.

## Changes up to MemBrain version 03.07.00.00

**Release date: 2010-12-05**

The following changes have been made to MemBrain between version 03.06.02.00 and 03.07.00.00.

1. Incorporated latest AngelScript scripting engine 2.20.0, SVN version 758
2. Added Angel Script script Add-Ons (see AngelScript documentation for more information):
  1. Data Type: Any
  2. Data Type: Array Template
  3. Data Type: Dictionary
3. Added 'Shotgun' functionality for adjustable, relative randomization
4. Added script functions to configure and use the Shotgun feature from within scripts
5. Added possibility to implement a script function that is called in case a script is aborted.
6. Added new Net Error function configuration capabilities:
  - Function to define the net error contribution of an output neuron on a single pattern as either:
    - Squared Deviation
    - Binary deviation by threshold
    - User Defined (Scripted)
  - Function to define the final net error calculation based on the sum of the single contributions as either
    - Mean of Sum
    - Root Mean of Sum
    - Identical (no calculations)
    - User Defined (Scripted)
7. Added Scripted Elements functionality:
  - User defined function to define the net error contribution of an output neuron on a single pattern.
  - User defined function to define the final net error calculation based on the sum of the single contributions.
8. Added script functions to compile and enable and to disabled Scripted Elements.
9. Added script functions to configure the net error function
10. Added script functions to convert strings into double and integer values
11. When a script is only compiled rather than launched MemBrain does not complain about the missing main() function anymore.
12. Modified license installation so that it also correctly works under Win7.
13. Widened the data entry fields in the Normalization Settings dialog.
14. Bug Fix: 'Unknown Teacher Error' was displayed in case the Net Error was attempted to be evaluated and if the current net error lesson was empty. Now the correct error message is displayed.
15. Added keywords to the help file.

**Changes up to MemBrain version 03.06.02.00 and DLL 03.01.01.00**

**Release date: 2010-07-21**

The following changes have been made to MemBrain between version 03.06.01.00 and 03.06.02.00.

1. Bug Fix: Cascade Correlation Teachers aborted with an incorrect message 'Target Net Error reached'.

The following changes have been made to the MemBrain DLL between version 03.01.00.00 and 03.01.01.00.

1. Bug Fix: Cascade Correlation Teachers aborted with an incorrect message 'Target Net Error reached'.

**Changes up to MemBrain version 03.06.01.00**

**Release date: 2010-07-04**

The following changes have been made to MemBrain between version 03.06.00.00 and 03.06.01.00.

1. Incorporated latest AngelScript scripting engine 2.19.0 which is most of all a bug fix release for the engine
2. Increased space for the data lines in Lesson Editor in order to improve Lesson Editor layout when large character fonts are selected in the Microsoft Windows settings.
3. Bug Fix: Pattern Error Viewer was not properly scrolling with horizontal scroll bar if there were more than 32768 patterns in the net error lesson.
4. Bug Fix: Script function 'ApplyInputAct' always returned false even if it succeeded. Additionally, It was documented to be void.
5. Bug Fix: Lesson Editor function 'Import Current Lesson Inputs (Raw CSV)' did not always work correctly.

**Changes up to MemBrain version 03.06.00.00 and DLL 03.01.00.00**

**Release date: 2010-01-30**

The following changes have been made to MemBrain between version 03.05.03.05 and 03.06.00.00.

1. The net error now is always the mean squared error per output neuron error, i.e. it is averaged over the whole net error lesson and all output neurons.  
This renders the net error independent from the size of the net error lesson and the number of the output neurons in the net: It is always the mean squared error for one single output neuron, calculated on basis of the normalized activation values.
2. When using RPROP based learning algorithms the training can now be stopped and resumed later without causing the net error to rise again: The currently used training parameters are saved together with the net so that the RPROP based teachers can resume the training in exactly the same situation it was stopped.
3. Added Script command to add multiple patterns to current lesson in one shot.
4. Massively increased speed of Lesson editing related script commands when Lesson Editor update is disabled.
5. Added menu command in Lesson Editor to average the inputs of a Lesson in order to create a new Lesson with a reduced number of input dimensions.
6. Added Script command to support the lesson input averaging also from within scripts.
7. Added Script command to delete a file.
8. Added Script command to create a directory
9. Added Script command to remove a directory.
10. Added Script command to get the working directory of the currently executed script.
11. Added report details when a script exception occurs (file/line/column/reason)
12. Enlarged the edit fields for the number of input and output columns in the Lesson Editor.
13. Harmonized arrangement of OK and Cancel buttons on several dialogs.
14. Incorporated latest AngelScript scripting engine 2.18.1 which brings bug fixes, speed improvements and refined compiler messages.
15. MemBrain now automatically comes up with process priority 'Below Normal' when it is installed for the first time on a computer.
16. Bug Fix: When teacher aborted due to some error then it could sometimes not be re-started.
17. Bug Fix: When a CSV import operation fails then the current lesson still could contain partial data from the imported file. Now the current lesson is cleared (all patterns deleted) in case an import operation fails.
18. Bug Fix: The script command 'CreateFftLesson' was not available in the version that features all four of the possible parameters.
19. Bug Fix: When appending a lesson to an empty lesson the counter for the currently active pattern

in the Lesson Editor was stuck at 0.

20. Bug Fix: When the number of outputs for a lesson was changed then the Pattern Error Viewer did not correctly show the data for this lesson.

The following changes have been made to the MemBrain DLL between version 03.00.05.00 and 03.01.00.00

1. The net error now is always the mean squared error per output neuron error, i.e. it is averaged over the whole net error lesson and all output neurons.  
This renders the net error independent from the size of the net error lesson and the number of the output neurons in the net: It is always the mean squared error for one single output neuron, calculated on basis of the normalized activation values.
2. When using RPROP based learning algorithms the training can now be stopped and resumed later without causing the net error to rise again: The currently used training parameters are saved together with the net so that the RPROP based teachers can resume the training in exactly the same situation it was stopped.
3. Bug Fix: When a CSV import operation fails then the current lesson still could contain partial data from the imported file. Now the current lesson is cleared (all patterns deleted) in case an import operation fails.

#### **Changes up to MemBrain version 03.05.03.05**

**Release date: 2009-12-14**

The following changes have been made to MemBrain between version 03.05.03.04 and 03.05.03.05.

1. Fixed bug: Script function 'SetLessonOutputCount' was not working correctly.

#### **Changes up to MemBrain version 03.05.03.04**

**Release date: 2009-11-04**

The following changes have been made to MemBrain between version 03.05.03.03 and 03.05.03.04.

1. Fixed bug: Some license files were detected as 'too old' although their corresponding data field 'Valid for MemBrain Release Dates up to:' indicated that the license should still be valid.

#### **Changes up to MemBrain version 03.05.03.03**

The following changes have been made to MemBrain between version 03.05.03.02 and 03.05.03.03.

1. Fixed bug: Visibility status of tool bars wasn't correctly displayed in menu
2. Modified startup dialog in case no license is found.

#### **Changes up to MemBrain version 03.05.03.02**

The following changes have been made to MemBrain between version 03.05.03.01 and 03.05.03.02.

1. Fixed bug: 'TCP Connection Manager' window size and position was remembered incorrectly and

thus was only visible partially.

### **Changes up to MemBrain version 03.05.03.01**

The following changes have been made to MemBrain between version 03.05.03.00 and 03.05.03.01.

1. Fixed bug in net analysis: Context neuron identification could be erroneous in certain situations.

### **Changes up to MemBrain version 03.05.03.00**

The following changes have been made to MemBrain between version 03.05.02.00 and 03.05.03.00.

1. Added FFT lesson creation capability to Lesson Editor.
2. Incorporated newest AngelScript version 2.17.1
3. Added script command 'SplitLesson'
4. Added script command 'CreateFftLesson'
5. Added script command 'GetFftFrequency'

### **Changes up to MemBrain version 03.05.02.00 and DLL 03.00.05.00**

The following changes have been made to MemBrain between version 03.05.01.01 and 03.05.02.00.

1. Incorporated newest AngelScript version 2.17.0
2. Added command line option /C which causes a pure compilation of a script without executing it.
3. Added script class 'SerialPort' to support access to a computer's COM ports through scripts.
4. Modified startup dialog in case no license is found.

The following changes have been made to the MemBrain DLL between version 03.00.04.00 and 03.00.05.00

1. Added interfaces to set the activation normalization range for input and output neurons:  
// Set the activation range of the given input neuron  
bool SetInputActRange(int idx, double actMin, double actMax);  
  
// Set the activation range of the given output neuron  
bool SetOutputActRange(int idx, double actMin, double actMax);

### **Changes up to MemBrain version 03.05.01.01**

The following changes have been made to MemBrain between version 03.05.01.00 and 03.05.01.01.

2. Bug Fix: When the following windows were minimized and MemBrain was exited and restarted, the windows could not be restored or maximized anymore:
  - Lesson Editor
  - Error Graph Viewer
  - Pattern Error Viewer
  - Script Trace Window
2. Big Fix: The position of the External Neurons Manager window was not remembered correctly after

- restart of MemBrain
- 3. The Lesson Editor now can be minimized, too.

### Changes up to MemBrain version 03.05.01.00

The following changes have been made to MemBrain between version 03.05.00.02 and 03.05.01.00.

1. The following windows now remember their last positions when MemBrain exits.
  - Lesson Editor
  - Error Graph Viewer
  - Pattern Error Viewer
  - Script Trace Window
  - External Neurons Manager

### Changes up to MemBrain version 03.05.00.02

The following changes have been made to MemBrain between version 03.05.00.01 and 03.05.00.02.

1. Important bug fix in scripting engine: Some of the math functions were not accessible in scripts.

### Changes up to MemBrain version 03.05.00.01

The following changes have been made to MemBrain between version 03.05.00.00 and 03.05.00.01.

1. Incorporated newest AngelScript version 2.16.3
2. Bug Fix: Scripts did not always report the correct net characteristics like names and numbers of neurons when the net was loaded manually, i.e. not loaded by the script itself.

### Changes up to MemBrain version 03.05.00.00

The following changes have been made to MemBrain between version 03.04.01.01 and 03.05.00.00.

1. Added a **counter** for the currently performed **lesson repetitions** during teaching. This counter is displayed instead of the Think Step counter in MemBrain's status bar when teaching is active. The counter can be reset through menu or script command and can also be evaluated in scripts.
2. **Added script function 'Now()'** that returns the current system time in seconds since 01 Jan 1970. Through this function the current time is always available in the script and time differences can be easily measured by subtracting time values returned from the function at different times during script execution.
3. **Added script function 'TimeToString(...)'** that converts a time value as returned by the function 'Now()' into a human readable time information string.
4. **Added** support for the **#include** directive. Through this scripts can now be spread over multiple files and the re-use of existing script modules is simplified.
5. **Added** support for the **following script functions** to allow full **net editing** capabilities in the script.

1. "void ClearSelection()", // Clear selection
2. "bool SelectInput(uint neuronNum, bool addToSelection)", // Select an input neuron

3.	"void SelectInput(bool addToSelection)", neurons	// Select all input
4.	"bool SelectOutput(uint neuronNum, bool addToSelection)", neuron	// Select an output
5.	"void SelectOutput(bool addToSelection)", neurons	// Select all output
6.	"bool SelectHidden(uint layerNum, uint neuronNum, bool addToSelection)", Select a hidden neuron	//
7.	"bool SelectHidden(uint layerNum, bool addToSelection)", hidden neurons	// Select a layer of
8.	"void SelectHidden(bool addToSelection)", all hidden layers	// Select all neurons in
9.	"bool SelectContext(uint neuronNum, bool addToSelection)", neuron	// Select a context
10.	"void SelectContext(bool addToSelection)", neurons	// Select all context
11.	"bool SelectUnresolved(uint neuronNum, bool addToSelection)", neuron	// Select an unresolved
12.	"void SelectUnresolved(bool addToSelection)", neurons	// Select all unresolved
13.	"uint GetHiddenLayerCount()", layers in the net	// Get number of hidden
14.	"uint GetHiddenCount(uint layerNum)", in a given hidden layer	// Get number of neurons
15.	"uint GetContextCount()", in the context layer	// Get number of neurons
16.	"uint GetUnresolvedCount()", in the unresolved layer	// Get number of neurons
17.	"void ClearExtraSelection()",	// Clear Extra Selection
18.	"void ExtraSelection()", to the current selection	// Apply Extra Selection
19.	"void ConnectFromExtra()", Selection	// Connect FROM Extra
20.	"void ConnectToExtra()", Selection	// Connect TO Extra
21.	"void AddInput(uint posX, uint posY, string &in name)",	// Add an input neuron
22.	"void AddOutput(uint posX, uint posY, string &in name)",	// Add an output neuron
23.	"void AddHidden(uint posX, uint posY, string &in name)", hidden neuron	// Add an (unresolved)
24.	"bool GetSelectedNeuronProp(SNeuronProp &out prop)", the currently selected neuron	// Get the properties of
25.	"void SetSelectedNeuronProp(SNeuronProp &in prop)", all selected neurons	// Set the properties of
26.	"void DeleteSelectedObjects()", objects	// Delete selected
27.	"void NewFile()",	// New file (net)
28.	"void SetSelectedNeuronName(string &in name)", selected neurons	// Set the name of the
29.	"bool GetSelectedNeuronPos(int16 & out x, int16 &out y)", selected neuron	// Get the position of the
30.	"void MoveSelectedNeurons(int16 deltaX, int16 deltaY)", neurons	// Move all selected
31.	"void SelectLinksFromExtra()", Extra Selection to Selection	// Select all links from
32.	"void SelectLinksToExtra()", Selection to Extra Selection	// Select all links from
33.	"bool GetSelectedLinkProp(SLinkProp &out prop)", the currently selected link	// Get the properties of
34.	"void SetSelectedLinkProp(SLinkProp &in prop)", the selected links	// Set the properties of



- 35. "void Select(uint16 x, uint16 y, bool addToSelection)", // Try to select  
an object using the given X/Y coordinate
  - 36. "void Select(uint16 l, uint16 t, uint16 r, uint16 b, bool addToSelection)", // Try to select  
objects using the given L/T/R/B coordinates
- 6. Added the following other script functions**
- 1. "uint GetLessonReps()", // Get lesson repetitions  
counter
  - 2. "void ResetLessonReps()", // Reset the lesson  
repetitions counter
  - 3. "void ZoomFit()", // Zoom fit
  - 4. "void ZoomIn()", // Zoom in
  - 5. "void ZoomOut()", // Zoom out
  - 6. "void AppendLesson", // Append a lesson to  
the currently active lesson
  - 7. "bool GetLessonInputMinMax(uint columnNum, double &out min, double &out max)",  
// Get minimum and maximum for a specified  
  
// input column of the active lesson
  - 8. "bool GetLessonOutputMinMax(uint columnNum, double &out min, double &out max)",  
// Get minimum and maximum for a specified  
  
// output column of the active lesson
  - 9. "void AppendLesson(string &in fileName)", // Append a lesson to  
the currently active lesson
  - 10. "void GetGridPoint(uint16 x, uint16 y, uint16 &out gridX, uint16 &out gridY)", // Get the  
nearest grid point to a given point
  - 11. "uint16 GetGridWidth()", // Get the currently  
adjusted grid width
  - 12. "float Random()", // Get a random value  
between 0 and 1
- 7. Include newest AngelScript scripting engine version 2.16.1 (Build ID 413)**

### Changes up to MemBrain version 03.04.01.01

The following changes have been made to MemBrain between version 03.04.01.00 and 03.04.01.01.

- 1. Bug fix with respect to scripting:  
Using the scripting commands 'StopThink', StopTeaching() and SleepExec() could bring the script execution out of sync with MemBrain. This was most likely to happen on Multi-Core machines as opposed to Single core machines where the problem was never observed.

### Changes up to MemBrain version 03.04.01.00 and DLL version 03.00.04.00

The following changes have been made to MemBrain between version 03.04.00.00 and 03.04.01.00.

- 1. Implemented optimization to speed up teaching process if all outputs in a lesson are set to the Activation Ignore Values of the corresponding output neurons and if all output neurons have the Activation Ignore Value feature enabled.
- 2. Incorporates newest version of AngelScript (2.16.0).
- 3. Bug Fix: Enabling data recording to a lesson from within the scripting language could destroy the currently active pattern in the recording target lesson.
- 4. Bug Fix: Too many user interface operations were still allowed during scripting. These could

conflict with the scripting.

5. Bug Fix: Suspend function for scripting did not always work correctly.

The following changes have been made to the MemBrain DLL between version 03.00.03.04 and 03.00.04.00

1. Implemented optimization to speed up teaching process if all outputs in a lesson are set to the Activation Ignore Values of the corresponding output neurons and if all output neurons have the Activation Ignore Value feature enabled.
2. Bug Fix: Enabling data recording to a lesson from within the scripting language could change the currently selected pattern in the recording target lesson.

### **Changes up to MemBrain version 03.04.00.00 and DLL Java wrapper version 03.00.03.05**

The following changes have been made to MemBrain between version 03.03.00.00 and 03.04.00.00.

1. Implemented AngelScript scripting language
2. Added several new scripting commands
3. Currently active teacher is now always displayed in the status line.
4. Bug Fix: The radio button 'Min Euclid Dist' on the 'Customize Activation Functions' property page was not disabled when editing only links.
5. Bug Fix: When recording output values instead of activation values this setting was also applied to the recorded input neuron values where it should only affect the recorded values of the output neurons.

The following changes have been made to the MemBrain DLL Java wrapper between version 03.00.03.04 and 03.00.03.05

1. The MemBrain Java DLL wrapper has now been included in a Java package called 'de.membrainminusn'.

### **Changes up to MemBrain version 03.03.00.00 and DLL version 03.00.03.04**

The following changes have been made to the MemBrain DLL between version 03.00.03.03 and 03.00.03.04

1. Bug Fix: When working with more than one net at a time then lesson handling and training didn't work properly.

### **Changes up to MemBrain version 03.03.00.00**

The following changes have been made to MemBrain between version 03.02.01.00 and 03.03.00.00.

1. New feature to help creating time variant networks (for time series prediction): Add decay neurons through dialog.
2. New feature to help creating time variant networks (for time series prediction): Add neurons with delay links through dialog.
3. New feature: Add differential neuron automatically.
4. The net analysis now also states if the net is time variant or not.
5. Added a 'Don't show again' warning if a time variant net shall be trained using a teacher that has the setting 'Lesson Pattern Selection' set with another value than 'ordered'.
6. Bug fix: MemBrain could crash under certain circumstances in combination with the Lesson Editor check box 'Output Data'.
7. Bug fix: Default path for loading and saving files in the lesson editor was not adapted upon

- saving the current net but only upon loading a net from file.
8. Bug Fix: When copying neurons to the clipboard and pasting them into some other application (as bitmap) then sometimes the winner neuron indicator was drawn unintentionally.

### **Changes up to MemBrain version 03.02.01.00**

The following changes have been made to MemBrain between version 03.02.00.01 and 03.02.01.00.

1. Added menu commands and tool bar buttons to add neurons to the Extra Selection and to remove them from the Extra Selection.
2. Added menu command and tool bar button to select the current Extra Selection.
3. Improved convenience when handling lesson files: The default path for opening and storing files in the Lesson Editor now is always the path of the currently opened net (mbn) file as long as the corresponding lesson has not been assigned a file name e.g. by loading or storing it from/to file.
4. When selecting 'Names To Net' from out the lesson editor then a message informed about warnings that occurred during the net analysis. However, this information is not of interest for this operation. --> Removed the message.
5. When the undo/redo buffer size was adjusted to '0' then MemBrain always prompted a warning at startup. This has now been changed to a 'don't show again dialog'.
6. Added 'don't show again' dialog to inform the user if MemBrain runs at 'Normal' or higher process priority. An information is given that the process priority can be reduced in MemBrain's 'Extras' menu.
7. Fixed bug in Pattern Error Viewer: Did not always update when button 'Apply' was clicked.

### **Changes up to MemBrain version 03.02.00.01**

The following changes have been made to MemBrain between version 03.02.00.00 and 03.02.00.01 and the MemBrain Code Generation library 01.00.00.00 and 01.00.00.01.

1. Fixed bug in C-Code generation feature that occurred with 64 bit activation and activated normalization (code was not compilable).
2. Fixed bugs in C-Code Generation Library. Improved code to not cause warnings with under certain configurations.

### **Changes up to MemBrain version 03.02.00.00 and DLL version 03.00.03.03**

The following changes have been made to MemBrain between version 03.01.04.00 and 03.02.00.00

1. Added C-Code generation feature for trained nets.
2. Changed to new installer due to problems on some machines. Added MemBrain specific uninstaller.
3. Improved Normalization Wizard: Now the wizard also works properly for small values. It does not round to the nearest integer value anymore and also incorporates +/-3% headroom when suggesting normalization ranges.
4. Prevent link weights to escalate during training: Link weights are now generally limited to +/-1000 in MemBrain.
5. Bug Fix: Prevent internal overflow when calculating TanHyp or Logistic activation functions with extreme arguments.
6. Bug Fix: Pattern Error Viewer could crash during training when invalid pattern indices were entered.

The following changes have been made to the MemBrain DLL between version 03.00.03.02 and 03.00.03.03

2. Bug Fix: Prevent internal overflow when calculating TanHyp or Logistic activation functions with extreme arguments.

### Changes up to MemBrain version 03.01.04.00

The following changes have been made to MemBrain between version 03.01.03.00 and 03.01.04.00

1. Added Shortcut <Ctrl> + L to show/hide links.
2. After first installation of MemBrain the default teacher is RPROP now.
3. Added 'Don't Show Again' messages to prevent common pitfalls.
4. When the Lesson Editor command 'Append Lesson to Current Lesson...' is executed then the Pattern Error Viewer is also updated if its contents are affected by this action.
5. When a new net is loaded then the Pattern Error Viewer and also the Net Error Viewer reset automatically.
6. Bug Fix: When starting MemBrain the painting of the toolbar could get delayed by some other actions, e.g. displaying the 'non-licensed copy' start dialog.
7. Bug Fix: MemBrain could crash when reducing the Lesson Count in the lesson editor or from out a script while the Pattern Error Viewer was displayed.
8. Bug Fix: The menu option <File><Add Net to Current Net...> is now only available when there is at least one neuron in the current net.

### Changes up to MemBrain version 03.01.03.00

The following changes have been made to MemBrain between version 03.01.02.00 and 03.01.03.00

1. Added 1:1 neuron connection tool
2. Added Matrix n:m neuron connection tool
3. Added feature of selecting all source or destination neurons of the currently selected links.
4. Added feature of selecting all next or previous neurons connected to the selected neurons.
5. Added feature of trace selection through the net's links. I.e. select a group of neurons or links and use the up and down arrow keys on the keypad to move the selection along the net following the interconnection logic of the net.
6. Added matrix based neuron selection: If multiple neurons are selected then pressing the left arrow key on the keypad selects the upper left neuron of the selection only. Pressing the right arrow key selects the lower right neuron of the selection. Then, using further arrow key presses the selection can be moved to left or right by one neuron within the matrix made up by the former selection
7. Split toolbar into several subsets that can be displayed/hidden separately.
8. Added some more toolbar buttons, especially for the matrix connection tool and the advanced selection tools.
9. Implemented best fit auto-arrangement of all toolbars when MemBrain is started for the first time or as menu command in case the user wants to restore the default toolbar arrangement. Thus, MemBrain's toolbars can now be used with all screen resolutions.
10. Implemented user dependent storage of toolbar configuration.
11. Think Step Counter now is automatically reset with every new 'Auto Think' or 'Auto Teach' process.
12. Increased width of red (= target value) line in the Pattern Error Viewer in order to better identify the two different lines (target and actual).
13. Default value for the option <Net><Set Simulation Speed> is '0' now (after first installation of MemBrain)
14. Bug Fix: Some lesson related script commands could cause a crash of MemBrain if they were executed before the Lesson Editor was shown at least once after MemBrain was started.

15. Bug Fix: Pattern Error Viewer did not show last pattern in lesson
16. Bug Fix: Pattern Error Viewer did not update automatically when patterns had been deleted using the Lesson Editor.
17. Reworked MemBrain help file in several sections.

### **Changes up to MemBrain version 03.01.02.00 and DLL version 03.00.03.02**

The following changes have been made to MemBrain between version 03.01.01.01 and 03.01.02.00

1. Split former <File> menu of Lesson Editor into several categorized menu entries.
2. Added Teacher File export functionality to the Teacher Manager in order to simplify the access to the Teacher File through the MemBrain DLL.
3. Added neuron auto naming feature
4. Implemented Undo/Redo capability for the Lesson Editor's function 'Names to Net'
5. Implemented 'Point and Click' help for Button and menu item '<Teach><Pattern Error Viewer>
6. After the initial installation of MemBrain on a computer the <View> menu options 'Show Fire Indicators' and 'Show Activation Spikes on Links' are disabled now.

The following changes have been made to the MemBrain DLL between version 03.00.03.01 and 03.00.03.02

3. Bug Fix: Corrected functions to export Lessons to MemBrain CSV and raw CSV: If parameter 'maxCols' was specified to be greater than the number of input neurons plus the number of output neurons then these functions inserted blank lines into the CSV files.

### **Changes up to MemBrain version 03.01.01.01 and DLL version 03.00.03.01**

The following changes have been made to MemBrain between version 03.01.01.00 and 03.01.01.01

1. Bug Fix: Selecting <Teach><Evaluate Net Error> did not update the Pattern Error Viewer
2. Bug Fix: When copying neurons then the setting for the optional 'Activation Ignore Value' was set randomly.

The following changes have been made to the MemBrain DLL between version 03.00.03.00 and 03.00.03.01

1. Bug Fix: When creating neurons through the cascade correlation teacher then the setting for the optional 'Activation Ignore Value' was set randomly.

### **Changes up to MemBrain version 03.01.01.00 and DLL version 03.00.03.00**

The following changes have been made to MemBrain between version 03.01.00.00 and 03.01.01.00

1. Implemented new functionality to view the target and actual output of the net over a complete lesson in graphical representation, even online during learning (so called Pattern Error Viewer). Added a new toolbar icon for this purpose. Removed the 'Print' and the 'About' toolbar icons since these were not used very frequently

- and the toolbar still shall fit on a 1024 pixel wide screen.
2. Implemented new functionality to support training based on incomplete data patterns: Single output values in single data patterns can be set to a special value that leads to ignoring of these output values during training.  
The special activation value to be used for this can be set for every output neuron independently together with the normalization settings.
  3. Improvement of link model when links have a logical length  $> 1$ : In former versions the spike signals along the links were stored with the weight of the links already taken into account. Thus, if a link weight changed (e.g. during training) this did not affect the spikes that were already stored in the link. Now the spikes are stored without being multiplied by the weight. Multiplication with the weight of the link happens directly before a spike enters the input of a neuron. Thus, changing link weight also immediately has effect on already stored activation spikes in links which better reflects the idea of the weight being a synapsis at the point where a link contacts a neuron.
  4. Improvement when editing links: If only links are edited then the corresponding tab on the properties dialog is automatically selected.
  5. Improvement in Lesson Editor: Path of file name of loaded lesson is not shown in dialog header anymore. Thus, the file name itself can be read now even if a long path is used.
  6. Bug Fix: Net Analysis did not always detect context neurons that had both output links to hidden layers and to the output layer.
  7. Bug Fix: Minor anomalies of UI controls when editing neuron properties.
  8. Bug Fix: Cascade Correlation RPROP teacher had the edit field for the learn rate enabled although this teacher does not have a learn rate.

The following changes have been made to the MemBrain DLL between version 03.00.02.00 and 03.00.03.00

1. Implemented new functionality to support training based on incomplete data patterns: Single output values in single patterns can be set to a special value that leads to ignoring of these outputs during training.  
The value to be used for this can be set for every output neuron independently.
2. Improvement of link model when links have a logical length  $> 1$ : In former versions the spike signals along the links were stored with the weight of the links already taken into account. Thus, if a link weight changed (e.g. during training) this did not affect the spikes that were already stored in the link. Now the spikes are stored without being multiplied by the weight. Multiplication with the weight of the link happens directly before a spike enters the input of a neuron. Thus, changing link weight also immediately has effect on already stored activation spikes in links which better reflects the idea of the weight being a synapsis at the point where a link contacts a neuron.
3. Bug Fix: Net Analysis did not always detect context neurons that had both output links to hidden layers and to the output layer.

### **Changes up to MemBrain version 03.01.00.00**

The following changes have been made to MemBrain between version 03.00.05.00 and 03.01.00.00

1. Changed method of storing several settings files: MemBrain now stores all settings separately for every Windows user. Thus, every user is automatically presented with his/her customized settings when working with MemBrain.

2. MemBrain now can be run without administrative rights. In former versions MemBrain was not able to store any user related settings if the user was not logged in with administrative rights.
3. Added a new menu 'License' that allows to install a MemBrain license directly from out MemBrain without the need of manually copying license files into the MemBrain directory structure.  
Note: You need to be logged in with administrative rights to successfully install a MemBrain license file under Windows XP. Under Windows Vista you will be able to install a license file even without being logged in as Administrator. However, if you are not logged in as the system administrator (user 'Administrator') then the license installation will only work for this login, i.e. you will have to perform the license installation once under every user login. If logged in as 'Administrator' under Windows Vista when installing the license file it will be detected under all user logins for this computer automatically.

### **Changes up to MemBrain version 03.00.05.00 and DLL version 03.00.02.00**

The following changes have been made to MemBrain between version 03.00.04.00 and 03.00.05.00

1. Added feature in the Lesson Editor to append a lesson to another lesson in order to combine multiple lessons into one single larger lesson.
2. Added feature to add the contents of a MemBrain neural net file to the currently open neural net in order to combine multiple nets into one single larger net.
3. When executing 'Think On Lesson' from the Lesson Editor or when starting the teacher then the currently active lesson is checked against the normalization ranges of the input and output neurons of the net. If a range violation is detected then a warning is prompted providing the option to either continue or abort the action.  
If the user chooses to abort then the neurons that conflicted with the lesson are automatically selected so that the user can immediately start the normalization wizard for these neurons if desired.
4. New Property for supervised teachers: On-The-Fly Error calculation can be suppressed even if it would be possible. This always provides the exact net error, however, is a bit slower than On-The-Fly Error calculation.
5. When pasting neurons from the clipboard then the original names are preserved.
6. Bug Fix: Sometimes loopback links were not trained due to corrupted net analysis
7. Bug Fix: When manually editing an input or output value in the Lesson Editor and then immediately clicking to the main window the data sometimes was not taken over.

The following changes have been made to the MemBrain DLL between version 03.00.01.00 and 03.00.02.00

1. Also supports new property for supervised teachers: On-The-Fly Error calculation can be suppressed even it would be possible. This always provides the exact net error, however, is a bit slower than On-The-Fly Error calculation.
2. Bug Fix: Sometimes loopback links were not trained due to corrupted net analysis

### **Changes up to MemBrain version 03.00.04.00 and DLL version 03.00.01.00**

The following changes have been made to MemBrain between version 03.00.03.00 and 03.00.04.00

1. Added RPROP Learning Algorithm (Teacher)
2. Added Cascade Correlation with RPROP Learning Algorithm (Teacher)
3. Enabled switching of the currently used net error Lesson during teaching from out the Lesson Editor. Thus, the Lesson that is used for calculating the the net error can be changed during teaching.
4. Fixed bug: The script command to start the teacher could cause a request Message Box that asked for optional randomization of th net. This let the script pause until the Message Box was acknowledged

by the user.

The following changes have been made to the MemBrain DLL between version 03.00.00.00 and 03.00.01.00

1. Implemented 'On The Fly' validation of nets during training: A net can be trained on basis of one lesson while the current net error is calculated on basis of another lesson. Thus, the net can be validated 'On The Fly' during training with respect to its reaction on not trained data.
2. Added RPROP Learning Algorithm (Teacher)
3. Added Cascade Correlation with RPROP Learning Algorithm (Teacher)

### **Changes up to MemBrain version 03.00.03.00**

The following changes have been made to MemBrain between version 03.00.02.00 and 03.00.03.00

1. Implemented 'On The Fly' validation of nets during training: A net can be trained on basis of one lesson while the current net error is calculated on basis of another lesson. Thus, the net can be validated 'On The Fly' during training with respect to its reaction on not trained data.  
See description of the Lesson Editor for more details on how to adjust the net error lesson.
2. Added new script command SET\_NET\_ERR\_LESSON to adjust the lesson number in the Lesson Editor that shall be used for the net error calculation from out MemBrain scripts.
3. Fixed bug: The script command SLEEP could cause a crash under certain circumstances.

Note that this new feature currently only is available to the MemBrain application but not to the MemBrain DLL.

### **Changes up to MemBrain version 03.00.02.00 and DLL version 03.00.00.00**

The following changes have been made to MemBrain between version 03.00.01.01 and 03.00.02.00

1. Implemented Normalization Wizard that simplifies adjusting the correct normalization limits to the input and output neurons.
2. Implemented new Lesson Editor feature 'Split Current Lesson': An adjustable part of a lesson can be split off into a new lesson using random Pattern selection.  
This greatly simplifies the generation of validation data.
3. Added new chapter 'Validating Your Net' to the help file together with a simple MemBrain script that greatly simplifies creation of validation output data.
4. Slightly modified handling of upper fire thresholds for neurons: Firing now is enabled if activation is  $\geq$  upper fire threshold. In previous versions the condition was only ' $>$  upper fire threshold'. This allows to set the lower and upper fire thresholds to the minimum possible value of the activation function of the neuron in order to allow the neuron to fire at every think step which is most often the desired behavior.
5. When changing the neuron activation function then the lower and upper fire thresholds are set to the new values mentioned above.  
Overall the changes 1. and 2. are just cosmetic, however it always caused confusion that for some activation functions these thresholds had to be set to -1.1 instead of -1.
6. Corrected bug when importing lesson output data from raw csv files.
7. Corrected eMail address in MemBrain's About... Window.

The following changes have been made to the MemBrain DLL between version 02.00.01.01 and 03.00.00.00



1. Implemented teaching including complete access to MemBrain Lesson's, csv files etc. The DLL now has comparable functionalities as the scripting for example, except for Weblink support.
2. Slightly modified handling of upper fire thresholds for neurons: Firing now is enabled if activation is  $\geq$  upper fire threshold. In previous versions the condition was only  $>$  upper fire threshold'.

#### **Changes up to MemBrain version 03.00.01.01 and DLL version 02.00.01.01**

The following changes have been made to MemBrain between version 03.00.01.00 and 03.00.01.01

1. Improved Cascade Correlation Learning Algorithm (Teacher). Training of Candidates is better and faster now.
2. Improved performance of teaching when using batch mode.

The following changes have been made to the MemBrain DLL between version 02.00.01.00 and 02.00.01.01

1. Adapted version number displayed in explorer when hovering mouse over DLL file.
2. Added Java Wrapper DLL and corresponding Java class to provide access to the MemBrain DLL from out Java programs.

#### **Changes up to MemBrain version 03.00.01.00 and DLL version 02.00.01.00**

The following changes have been made to MemBrain between version 03.00.00.00 and 03.00.01.00

1. Added Cascade Correlation Learning Algorithm (Teacher). This learning algorithm builds the hidden layer architecture of a network on its own, just from a set of interconnected input and output neurons.
2. Neurons now have an additional flag that gives the user the option to prevent that the neuron is connected by a teacher that modifies the net architecture as part of its learning algorithm. The first teacher that makes use of automatic net architecture changes in MemBrain is the Cascade Correlation Teacher.
3. Lesson Editor now also can import and export input and output data separately from/to raw csv. In former versions of MemBrain inputs and outputs could only be imported/exported together.
4. Added two new script commands to import/export input or output data separately through scripts.
5. Added indication to Teacher Manager and Teacher Editor dialogs to show if the currently selected teacher uses a supervised learning algorithm or not.
6. Significantly Improved teacher speed when parts of the net are locked. In former versions the teacher calculated all weight and threshold changes even if the links or neurons were locked. It just did not apply the new values. Now the teacher totally ignores locked elements, where possible. An automatic analysis determines the elements that can be ignored in the background whenever this information is needed.
7. Automated reset of Think Step Counter when teacher or Auto Think is started
8. Automated reset of Net Error Viewer when teacher is started or net is randomized.
9. Adapted default learn rate of teachers from 0.1 to 0.05
10. Bug Fix: The Competitive Momentum Teacher has been corrected to not do any training on hidden layers since this was not functional and doesn't make sense for SOM training either.

The following changes have been made to the MemBrain DLL between version 02.00.00.00 and 02.00.01.00

1. Adapted the MemBrain DLL to new file version of MemBrain. A new file version for MemBrain was necessary because new information has been added to the neuron objects (flag if teacher may connect links to a neuron or not).

### **Changes up to 03.00.00.00**

The following changes have been made to MemBrain between version 02.04.00.01 and 03.00.00.00

1. Bug Fix: When making neurons private and then perform a Think Step then MemBrain could crash.
2. Bug Fix: Copy/paste of extern neurons was not possible. When trying to copy and paste extern neurons MemBrain also could crash.
3. Added a start up screen that appears if the installation of MemBrain is not registered. Use of non-registered version is allowed as long as not used for commercial purpose.
4. Added license information screen available from MemBrain's Help menu.

### **Changes up to 02.04.00.01**

The following changes have been made to MemBrain between version 02.03.04.00 and 02.04.00.01

1. Bug Fix: Neurons with activation function 'MIN EUCLID DISTANCE' did not handle normalization of activation value correctly if this option was activated.
2. Bug Fix: Neurons with activation function 'MIN EUCLID DISTANCE' could be activated beyond their (normalized) activation limit range of -1 to 1.
3. Bug Fix: Backpropagation based teachers reported an error if the net contained a neuron with activation function 'MIN EUCLID DISTANCE'. Although the backpropagation teachers can not correctly train links to these neurons and the corresponding neuron thresholds by definition, the use of such neurons in a backprop trained net can be useful: These neurons and their input links could be locked, i.e. ignored by the teacher because an already trained and locked SOM could be part of a larger net that is then trained using backpropagation for example.
4. Bug Fix: Possible conversion errors when assigning activation values to neurons (loss of precision related to converting a double to a float number)

### **Changes up to 02.04.00.00**

The following changes have been made to MemBrain between version 02.03.04.00 and 02.04.00.00

1. Significantly improved Competitive Momentum Teacher for teaching Self Organizing Maps (SOMs).
2. Added new activation function that calculates the activation of a neuron according to the euclidian distance between the input signals of a neuron and the corresponding link weights. This is used for SOMs.
3. Added feature to show the winner of all output neurons after each think step. This can be used to quickly identify the winner neuron within a Self Organizing Map (SOM) for example.
4. Added script parameter to control the above mentioned setting also from out script files.
5. Added feature to rename the winner output neurons with the name of the corresponding pattern during teaching. This allows to observe how SOMs inflate during teaching and how the input patterns are finally located in the SOM.
6. Bug Fix: If the check box "Output Data:" on the Lesson Editor was not checked the Lesson Editor still reported an error when the button "Names to Net" was clicked and if the number of outputs in the Lesson Editor did not match the number of output neurons in the net.

### Changes up to 02.03.04.00

The following changes have been made to MemBrain between version 02.03.03.06 and 02.03.04.00

1. Implemented raw csv format for importing and exporting Lesson data. The existing 'Sectioned csv' file format is still available in parallel.  
The raw csv file format simplifies data exchange with spread-sheet programs.
2. Implemented new script commands for raw csv Lesson data import and export.
3. Implemented new script commands for synchronization between Lessons and neural nets: The names of the net's input and output neurons can now be copied to the currently active Lesson and vice versa. This functionality has been already available through the Lesson Editor in previous versions. Now it is also accessible from out MemBrain scripts.
4. Implemented new script commands for adjusting the number of input and output neurons of the currently active Lesson in the Lesson Editor. Since the raw csv file format can not specify this information as the Sectioned csv file can do for example, this is now also adjustable through MemBrain scripts. In previous versions this functionality was only accessible manually through the Lesson Editor.
5. Scripts now can also contain parameter strings with spaces: Quoting marks "" can be used in scripts now. This is useful to define file names with spaces in scripts for example.
6. Bug Fix: The optional parameter maxColumnCount of the script command EXPORT\_LESSON was not handled correctly. The parameter had been ignored by MemBrain.

### Changes up to 02.03.03.06

The following changes have been made to MemBrain between version 02.03.03.05 and 02.03.03.06

1. Bug Fix: Occasional crash when pressing OK in Teacher Manager.

### Changes up to 02.03.03.05

The following changes have been made to MemBrain between version 02.03.03.04 and 02.03.03.05

1. Improvement: When teaching is started manually then MemBrain asks if it shall randomize the net before teaching starts if either the net architecture or the teacher settings have changed.  
Randomizing has shown to often be forgotten by users which lead to bad training results.
2. Improvement: Whenever the type of a neuron is changed (e.g. from INPUT to OUTPUT) MemBrain automatically sets the most common default parameters for that neuron type. This helps to avoid typical pitfalls when adjusting neuron parameters.
3. Bug Fix: Net Analysis did not determine context neurons always in the same way: There was a dependency from previous Net Analysis runs.

### Changes up to 02.03.03.04

The following changes have been made to MemBrain between version 02.03.03.03 and 02.03.03.04

1. Bug Fix: Some properties ('Is Pixel' and 'Width') could not be assigned to extern input neurons under certain circumstances.

### **Changes up to 02.03.03.03**

The following changes have been made to MemBrain between version 02.03.03.02 and 02.03.03.03

1. Bug Fix: The activation function graph on the Properties dialog "Customize Activation Functions" didn't work correctly.

### **Changes up to 02.03.03.02**

The following changes have been made to MemBrain between version 02.03.03.01 and 02.03.03.02

1. Bug Fix on latest Improvement: When changing the activation function for one or more neurons then the fire thresholds are automatically set to useful defaults (so that the neuron is always firing which is the most common option): Didn't function under all circumstances.
2. Improvement: When type of a neuron is changed to 'INPUT' then all parameters are set to values normally appropriate for an input neuron. This helps avoiding mistakes in adjusting neuron parameters.
3. Improvement: Default activation function for input neurons is 'IDENT. 0 TO 1' now (Identical, range 0 to 1). Formerly the default was IDENTICAL which included negative numbers. As 0 ..1 is more common, this is the default now.

### **Changes up to 02.03.03.01**

The following changes have been made to MemBrain between version 02.03.03.00 and 02.03.03.01

1. Improvement: When changing the activation function for one or more neurons then the fire thresholds are automatically set to useful defaults (so that the neuron is always firing which is the most common option).
4. Bug Fix: Colouring of negative activation spikes along links was wrong.
5. Bug Fix: The MemBrain.exe showed a wrong version number when the mouse was hovered over the file in the Windows Explorer.

### **Changes up to 02.03.03.00**

The following changes have been made to MemBrain between version 02.03.02.00 and 02.03.03.00

1. Script execution via command line option now implemented.
2. MemBrain now can be equipped with a Startup Script. This script is always executed when MemBrain is started.
3. Bug Fix: When in the Lesson Editor the UP/DOWN arrows to change the current pattern were clicked while an empty lesson was active then the pattern index showed incorrect values.

### **Changes up to 02.03.02.00**

The following changes have been made to MemBrain between version 02.03.01.00 and 02.03.02.00

1. New feature: Reassign trained links from a group of neuron to another group of neurons. This makes it possible to merge trained sub-nets together to larger nets

with more complex behaviour.

### **Changes up to 02.03.01.00**

The following changes have been made to MemBrain between version 02.03.00.03 and 02.03.01.00

1. New option when recording patterns via lesson editor: It can be selected now if the current activations or the output signals of the output neurons shall be recorded. In former versions it was only possible to record the activations. This feature is especially useful if the meaning of the output neuron(s) in the net is binary: If you set up the neuron to output a '1' when firing instead of the activation value and if you adjust the fire threshold of the neurons accordingly then it is possible to record binary output data now, including the decision implied by the fire threshold:  
A '1' will be recorded if the fire thresholds of the neuron are exceeded, a '0' if not. this can simplify validation and evaluation of the net output.
2. Added new script command RECORDING\_TYPE. This allows to control the above mentioned setting also from out scripts.

### **Changes up to 02.03.00.03**

The following changes have been made to MemBrain between version 02.03.00.02 and 02.03.00.03

1. Bug Fix: Problems when loading nets from older version.

### **Changes up to 02.03.00.02**

The following changes have been made to MemBrain between version 02.03.00.01 and 02.03.00.02

2. Neurons use double values (8 bytes) internally now for activation value. These had been float values (4 bytes) only in former versions. Thus there had always been slight differences in recorded lesson data compared to the applied inputs.
3. Bug Fix: Problems when using script command VIEW\_SETTING in combination with parameter SHOW\_ACT\_SPIKES: Didn't work under certain circumstances.

### **Changes up to 02.03.00.01**

The following changes have been made to MemBrain between version 02.03.00.00 and 02.03.00.01

1. Bug Fix: Problems when using script command STOP\_RECORDING before the lesson editor has been shown at least once.
2. Bug Fix: When recording patterns to a lesson then the number of I/O neurons was adapted to the currently active lesson. E.g. when the currently active lesson had only input data it was not possible to record to a lesson with activated output data section.

### **Changes up to 02.03.00.00**

The following changes have been made to MemBrain between version 02.02.02.04 and 02.03.00.00

1. MemBrain now has a scripting language. This allows to combine often used command sequences into script files and to execute them in one shot.  
Also MemBrain features the possibility to execute script files remote controlled through a simple text file interface. Other applications can MemBrain cause to execute a script file and to report results back to them.  
The scripting language is described in a separate chapter in the helpfile.
2. Bug Fix: In the Lesson Editor deletion of first pattern lead to inconsistent behaviour and to crashes upon following actions.
3. Bug Fix: During import of csv files with invalid data section no warning was generated that no data was found in the imported file.
4. Bug Fix: First think step of newly created neurons or neurons in a net loaded from file was incorrect: They behaved like with an activation sustain factor of 1 for the first think step.
5. Bug Fix: If a Competitive Momentum Teacher is started over TCP/IP remote control it is not started in continuous mode anymore but in single lesson mode as this teacher does not support continuous mode.
6. Bug Fix: Wenn a net was opened from file through a double-click in the file open dialog then sometimes objects were selected on the screen inadvertently.

### **Changes up to 02.02.02.04**

The following changes have been made to MemBrain between version 02.02.02.03 and 02.02.02.04

1. New feature: During teaching, the net now can be resetted automatically before every new Lesson run. This is a new option that can be activated for every teacher.  
The option does not take influence when teaching Feed-Forward nets with link lengths of the value 1 only but when teaching nets with loopbacks or with link lengths > 1:  
At the beginning of a lesson run the teacher always starts with the same internal net state if the option is set, i.e. all neuron activations and all activation spikes along the links are resetted to 0.
2. Changing the active pattern in the Lesson Editor during teach process does not influence the teaching process anymore but only the pattern after which the view is updated during teach.  
In former versions teaching (with ordered pattern selection) always started with the pattern AFTER the currently active one in the Lesson Editor and ended with the currently active one so that the view was updated after teaching the active pattern in the lesson editor. This influenced the order of teaching when the active pattern was changed during teaching.
3. The Lesson Editor now supports wrap around of the active pattern number with the UP and DOWN buttons. Thus the last pattern in the lesson can be reached by clicking on the DOWN button from out pattern 1 resp. the first pattern can be reached by clicking the UP button from out the last pattern.

### **Changes up to 02.02.02.03**

The following changes have been made to MemBrain between version 02.02.02.02 and 02.02.02.03

1. Bug Fix: Menu item <Teach><Evaluate Net Error> was not undoable and did not set the document to be changed, so no save request was issued when MemBrain was closed without saving the net.
2. BugFix: Memory was unnecessarily allocated sometimes during TCP/IP communication.

### **Changes up to 02.02.02.02**

The following changes have been made to MemBrain between version 02.02.02.01 and 02.02.02.02

1. Bug Fix: When <File><Export Current Lesson...> is chosen from the Lesson Editor's menu then The latest data entry is captured before the lesson is exported. In former versions the missing capture operation could lead to the currently edited pattern losing data entered just before the menu command.
2. Reserved text width for link weight enlarged. With large weight value strings there were drawing errors on the screen when the neurons were moved.

### Changes up to 02.02.02.01

The following changes have been made to MemBrain between version 02.02.02.00 and 02.02.02.01

1. Reserved text width for neuron activation enlarged. With large activation value strings there were drawing errors on the screen when the neurons were moved.
2. Normalized neuron activation that is regarded to be zero ('snapped to zero') has been reduced from 1e-3 to 1e-7.
3. Bug Fix: Loss of precision when entering or importing data into Lesson Editor.

### Changes up to 02.02.02.00

The following changes have been made to MemBrain between version 02.02.01.00 and 02.02.02.00

1. The Lesson Editor now can handle more than one lesson at a time.
2. The logic of increasing and decreasing pattern number in Lesson Editor has been flipped (arrow 'UP' now increases pattern number, 'DOWN' decreases).
3. In Lesson editor when the mouse is held down on the up or down arrows the number stopped changing after some seconds. This has been changed now, the numbers change faster as mouse button down time increases.
4. The activation of public neurons now can be set over their external counterparts from out other software (or MemBrain instances) via the Weblink (TCP/IP).
5. MemBrain can now use weblink synchronisation during 'think' operations, too. In former versions this was only possible for teach operations.
6. New weblink (TCP/IP) interface commands introduced:
  1. EXT\_NR\_ACT (Transmit activation from external to public neuron).
  2. SVR\_THINK\_STEP\_COMPLETE (Report that a Think Step has been completed).
  3. SVR\_NOT\_THINKING (Report that device is currently not thinking)

This has been made to prepare MemBrain to being remote controlled from out a DLL that is to be developed as a next improvement. This DLL will then be available on the MemBrain homepage for download to remote control MemBrain from out other software.

7. New device capability flags introduced for weblink protocol:  
DEV\_CAPS\_PROVIDE\_THINK\_WEBLINK\_SYNC = 0x00000080;  
DEV\_CAPS\_EVALUATE\_THINK\_WEBLINK\_SYNC = 0x00000100;
8. New Feature: MemBrain can now suppress view update during Auto Think procedure. This can speed up network calculations if no realtime view update is needed.
9. Bug Fix: If Teacher Editor was opened the field 'Target Net Error' sometimes was not enabled. The check box 'Use Lesson' had to be un-checked and checked again to enable the window.
10. Bug Fix: A lesson with many patterns could lead to an internal overflow if the currently active teacher used random based pattern selection. This led to shutdown of MemBrain without any notice after the teaching had been started.
11. Improved Bug Fix: When a selection or zoom rectangle was drawn towards or beyond MemBrain's drawing area and the mouse button had been released outside the drawing area the

rectangle was processed when the user entered the drawing area again with the mouse while the left mouse button was not held down.

Now the rectangle is processed immediately if the mouse is released even if the mouse release is outside of MemBrain's drawing area.

### Changes up to 02.02.01.00

The following changes have been made to MemBrain between version 02.02.00.00 and 02.02.01.00

1. Bug Fix: Competitive Momentum Teacher ('winner takes it all') didn't modify learn rate and adaption radius correctly during teaching.
2. Implemented 'Mexican Hat' function for 'winner takes it all' teacher. the function can be visualized and its parameters can be adjusted.
3. End Adaption Radius for 'winner takes it all' is absolut now and not as percentage anymore.
4. When Lesson Editor is opened the first time after start of MemBrain and a non-supervised teacher is active in the Teacher Manager then the output data section in the Lesson Editor is deactivated.

### Changes up to 02.02.00.00

The following changes have been made to MemBrain between version 02.01.06.00 and 02.02.00.00

1. New feature: Competitive Momentum Teacher ('winner takes it all') for SOMs (Self-Organizing Maps).
2. New feature: Teachers now can use three different approaches of selecting patterns from the lesson during teaching:
  1. Ordered:  
The order of patterns picked for teaching is the same as defined by the lesson. The teaching starts with the pattern following the active one in the lesson editor. Thus the active pattern in the lesson editor always is the last one taught during one teach step (one 'epoche').
  2. Random Selection:  
Patterns are selected from the lesson randomly. There might be patterns taught multiple times while others may not be selected at all during one teach step.
  3. Random Order:  
Like Random Selection but every pattern of the lesson is picked exactly once during every teach step. Only the order of the patters is determined randomly.
3. New feature: Select links according to their weight similar as already existing function of selecting neurons according to their activation.
4. Reworked Teacher Editor with respect to enabling contradictory features.
5. Adapted Lesson Editor: Lessons now can be restricted to input data: Output data handling can be disabled. This is useful for handling lessons for non-supervised teachers because they don't need patterns with output data, they just need input data sets.
6. Option <View><Update View During Teach> improved: This setting now also causes a view update in between two lesson repetitions if repetition count in the corresp. teacher settings is > 1.
7. New keyboard shortcuts added:
  1. <Extras><Select Input Links> (Ctrl + Alt + I)
  2. <Extras><Select Output Links> (Ctrl + Alt + O)
8. Net error viewer can not be opened if a non-supervised teacher is active as this doesn't make sense. The net error viewer is automatically closed if it is open and if a non-supervised teacher is set to be active in the Teacher Manager.
9. Modified functionality: When neurons are selected according to their current activation using <Extras><Neuron Auto Selection> then all currently selected links are de-



selected.

10. Bug Fix: When a lesson was loaded by the Lesson Editor and the previous loaded lesson was already in sync with the net then sync had not been checked again for the new lesson.
11. Bug Fix: Teachers could not handle links with a weight of exactly zero. This resulted in invalid weight values.
12. Bug Fix:  
When the MemBrain window had been reduced in size the net went out of sight.
13. Bug Fix: When a selection or zoom rectangle was drawn towards or beyond MemBrain's drawing area and the mouse button had been released outside the drawing area the rectangle was processed when the user clicked into the drawing area the next time. Now such rectangles are processed immediately when the user enters the drawing area again with the mouse while the left mouse button is not held down.
14. Cosmetic Bug Fix: The <Net><Randomize Net> function also changed the activation thresholds of input neurons. Since the activation threshold is obsolete for input neurons this has been fixed.

### **Changes up to 02.01.06.00**

The following changes have been made to MemBrain between version 02.01.05.00 and 02.01.06.00

1. New feature added: Teachers now can use random pattern order when teaching a lesson.

### **Changes up to 02.01.05.00**

The following changes have been made to MemBrain between version 02.01.04.02 and 02.01.05.00

1. New feature added: Neural Nets now can be exported into csv files. The level of detail for the export is adjustable.

### **Changes up to 02.01.04.02**

The following changes have been made to MemBrain between version 02.01.04.01 and 02.01.04.02

1. Bug Fix: Single step network calculation didn't work correctly with strongly time dependent networks: Probabilities of neuron firing events were based on faulty random number generation.
2. Generally improved random number calculation.

### **Changes up to 02.01.04.01**

The following changes have been made to MemBrain between version 02.01.04.00 and 02.01.04.01

1. Bug Fix: If Activation Sustain Factor was set to another value than 0 in the default properties dialog then the visualization for the activation functions didn't work correctly.
2. Bug Fix: If only links were edited then the activation function property page hasn't been disabled correctly and showed erroneous data.

### **Changes to MemBrain up to version 02.01.04.00**

The following changes have been made to MemBrain between version 02.01.03.00 and 02.01.04.00

1. New feature: Adjustable normalization of the activations of input and output neurons

- according to real world data ranges.
2. Extended features: Input neurons can also have a fixed output level of 1 instead of the normalized activation value itself.
  3. Default learn rate of a newly created teacher reduced from 0.5 to 0.1
  4. Bug Fix: Drawing of neurons with long names resulted in incomplete screen refresh
  5. Bug Fix: Lesson editor could under certain conditions assign data to wrong neurons.

### **Changes up to 02.01.03.00**

The following changes have been made to MemBrain between version 02.01.00.09 and 02.01.03.00

1. Bug fix: Faulty link that sometimes appeared when clicking into the drawing area.
2. Reduced Undo/Redo command buffer size to the last 10 actions.
3. Undo/Redo command buffer size is adjustable now between 0 and 100
4. Optimized multithreading performance during Auto Think and during Teach.
5. Added help chapter "Getting Started" including a short Tutorial

### **Changes up to 02.01.02.09**

The following changes have been made to MemBrain between version 02.01.00.08 and 02.01.02.09

1. Bug fix: If neurons were moved during Auto Think or Auto Teach then the loop back state of the links connected to these neurons could have been corrupted, so that the teachers did not work properly anymore.
2. Bug fix: In some cases after undo or redo operations the net analysis was not resetted so MemBrain worked with an invalid net analysis during think and teach. This could lead to unexpected results.

### **Changes up to 02.01.02.08**

The following changes have been made to MemBrain between version 02.01.00.05 and 02.01.02.08

1. Several Bug fixes e.g. with respect to file handling in the Lesson Editor
2. Default Teach Speed Setting: 0ms Sleep Time between patterns now

### **Changes up to 02.01.02.05**

The following changes have been made to MemBrain between version 02.01.00.10 and 02.01.02.05

1. TCP Weblink  
The TCP protocol had to be slightly modified (see Weblink Protocol section):

The number of neurons that can be published by a MemBrain compatible device has been increased to 32 bit representation (only positive numbers are valid, so the protocol is now able to handle up to 2147483648 public neurons

When public neurons are requested from a device then a new command is used: The information about all public neurons from a connected device is requested in one shot. In former versions the information about every single public neuron was requested in a separate command sequence.

This change has improved request times significantly.

The timeout definition for commands has been increased from 10s to 30s in general.

Several bugs have been fixed and performance of the Weblink has been improved in general.

The commands affected by the changes are:

- SVR\_REQ\_PN (not supported anymore)
  - SVR\_REQ\_PN\_ALL (new, replaces SVR\_REQ\_PN)
  - SVR\_PN (neuron index is four bytes now instead of 2)
2. Pattern Recording  
Automatic recording of patterns in the Lesson Editor didn't work correctly. This has been fixed.
  3. Neurons have now an extra property 'Is Pixel'. If this property is set for a neuron it is displayed as a sharp edged rectangle that changes its colour from black (activation = 0) over grey to white (activation = 1). If such neurons are placed close together on the screen they appear as a monochrome bitmap.
  4. TCP Connections Dialog  
The TCP connections dialog now updates automatically if changes in connections occur. Although the "Refresh" button on the dialog should not be necessary anymore, it is still in place to provide a fall back option if the automatic update does not work properly in every situation.
  5. The dialog sheet for editing neuron properties has been modified:  
All visual aspects have been placed in a separate dialog now that is opened via a new button on the dialog.
  6. Minor other bug fixes
  7. Added homepage address to about dialog

### Changes up to 02.01.00.10

The following features have been added to MemBrain between version 02.00.00.08 and 02.01.00.10

1. TCP Weblink  
MemBrain now is able to connect with other MemBrain instances or devices that support the MemBrain TCP Weblink protocol in order to build larger nets spreaded over several Computers.  
It is also possible to include hardware I/O components into MemBrain neural nets by providing a TCP based service that serves as interface "driver" between MemBrain and the hardware.  
The complete MemBrain Weblink protocol is provided and explained here.
2. Display of Layer Information  
The information of the layer each neuron is placed in according to the net analysis can be displayed now. See here for details.
3. MemBrain's process priority within Windows is now adjustable.
4. Display Fire Indicators  
You can now display fire indicators on the neurons that get active every time a neuron fires
5. Record Lessons

The Lesson Editor now has an option to automatically record Patterns of the current Lesson from the net in definable intervals of Think Steps. Thus for example I/O data retrieved from an interface driver connected via the TCP Weblink can directly be recorded into lesson data and later on saved to disk as Lesson File.

6. Open File when Neurons Fire

You can assign a file (e.g. executable) and a command line argument to every neuron. The file will be opened (e.g. the executable be executed) every time the neuron fires.

The following features have changed between version 02.00.00.08 and 02.01.00.10

1. Input neurons do not allow to connect input links anymore. Also they always have an output range of "As Is" and an activation function IDENTICAL. Actually the activation function and the Activation Threshold are completely ignored for input neurons as they do not have inputs connected anymore. It has been confusing that input neurons could also have signals connected to their input and together with the new Weblink it would require every I/O driver to collect these input signals and perform propagation calculations on public input neurons.

If a net is loaded from an older MemBrain version that has links connected to one or more inputs of input neurons then a warning is given and these links are automatically deleted.

### Changes up to 02.00.00.06

MemBrain since version 02.00.00.06 includes significant changes with respect to older versions up to 01.00.00.XX

If you already know MemBrain from previous versions this chapter will be of good use for you to get a quick overview of what has been changed in MemBrain and what the new features are.

2. Enhanced Neuron Model

In former versions of MemBrain the neurons have been time invariant items: The activation of a neuron was determined by the current input signals only. Now a so-called *Activation Sustain Factor* has been introduced which preserves an adjustable portion of the activation for the next calculation step.

The output behaviour has been modified, too: There have been three additional parameters introduced which influence the output signal generated by a neuron:

- Lower Fire Threshold
- Upper Fire Threshold
- Output Recovery Time

For details on the new neuron model see [here](#).

**Important Note:** When nets that have been created with previous MemBrain versions are loaded from file the new parameters for the neurons are set in a way so that the net should behave exactly like it did with the old version. Nevertheless not all of the neuron properties are still supported by the new version: There is no output setting anymore that forces an output range of -1 to 1. This just has turned out to be not

very useful and actually confusing. Also the activation of neurons generally has been limited to a range of either  $[0..1]$  or  $[-1..1]$  depending on the activation function.

**Caution:** Once the net is saved with the new MemBrain version you will not be able to open it with the old one anymore!

## 2. Enhanced Link Model

Links in MemBrain now can be assigned arbitrary logical lengths. This causes signals to be delayed along the links according to their logical length what introduces a further component of time variant performance of the nets.

For details on the new link model see [here](#).

**Important Note:** When nets that have been created with previous MemBrain versions are loaded from file the logical length of all links is set to 1 automatically which causes the links to behave like in the old MemBrain version.

**Caution:** Once the net is saved with the new MemBrain version you will not be able to open it with the old one anymore!

## 3. Auto Link Length Adjustment Feature

Some or all of the links in MemBrain can automatically be assigned a logical length that is proportional to their geometric length on the screen.

For details see [here](#).

## 4. No Restrictions in Net Architecture Anymore

MemBrain can now simulate every net that has at least one neuron no matter if the net has input, output or hidden neurons. You don't even have to have any links in the net. The Net Analysis still provides you with detailed information about your net but there are no error messages anymore because there are just no errors defined for a net anymore. All you get is warnings to give you a hint what you might have forgotten in your net but this will not deter MemBrain from correctly calculating the activations and the signal flow in the net.

## 5. Input Neurons Have an Input Connector, too

Now the input neurons also have an input connector. This has been introduced to be able to feed back signals from the net to its input neurons.

## 6. Continuous Simulation Mode (Auto Think)

There is a new mode in MemBrain to start a continuous simulation of the network: The net repetitively performs Think Steps. After each Step the display is refreshed so that the net can be observed in "Real Time". The sleep time between the single Think Steps can be adjusted so that the simulation speed can be varied in a wide range.

## 7. Enhanced Display Features

MemBrain has been equipped with several new display features. For example you can make MemBrain display the activation spikes that propagate along the links. This is impressive especially in combination with the new Continuous Simulation Mode described

above and the possibility to switch to a flicker free display mode that uses an internal cache to make all changes appear simultaneously on the screen. With the flicker free display mode you can also change the background window color of MemBrain to be black instead of white if you like to.

When the display is configured to show no links then the connection ports on the neuron's top and bottom are now also hidden. Additionally you can configure every neuron to hide it's name. This is a useful feature because name display is most often only useful for input or output neurons but not for the hidden ones.

#### 8. Adjustable Speed During Teach Process

When a lengthy teach process was run with the former versions of MemBrain then the application took most of the calculation power of the computer so that it was difficult to run other programs in the mean time. Now it is possible to configure a sleep time that gives computation time to other processes between each and every teach step. Thus teaching can be run in background while other work can be performed on the computer.

#### 9. Enhanced Link Selection Capabilities

There are new possibilities to select links: You now can:

- Select all input or output links of all selected neurons
- Select all links between the current Selection and the Extra Selection in either direction.

These are useful features when a net with many links shall be edited.

#### 9. Improved Coloring

Active neurons and strong weighted links are now colored more intensive to provide more contrast with respect to the inactive net elements.

#### 10. Additional Free Configurable Quick Activation Value

In addition to the existing quick activation values -1, 0 and 1 there is now one free configurable activation value that can be assigned to the selected neurons by quick activation (single key press). See here for details.