Gradient Descent Expert System

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Overview

This file defines and describes the commands that are used to operate the gradient descent expert system software. The use of these commands is demonstrated in the 'Demo Script' and 'Training Demo' files.

Network Creation

Networks are created with rules and facts. Facts are created with the following command:

F####:{FGUID}=000.000:Description (VAR)

F	####	:	{FGUID}	=	000.000	:	Description (VAR)
1 CHAR	4 CHARs	1 CHAR	38 CHARs	1 CHAR	7 CHARs	1 CHAR	Variable
Denotes Fact	Fact Number	Delimiter for parsing	Unique Identifier of Fact	Delimiter for parsing	Fact Value	Delimiter for parsing	Description of Fact
'F'	4 numbers	':'	Generated GUID	':'	Must be 7 characters, have decimal point and at least one character before and after decimal	':'	Up to 100 alphanumeric characters, cannot contain punctuation or symbols

Example GUID:

{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}

Example Command:

F0001:{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}=000.000:Description

Facts should be declared before rules. As a convention, a line with "***" indicates that fact declaration is complete; then rules can be declared. Rules are created with the following command:

R####:{R1GUID}:{F1GUID}=0.000+{F2GUID}=0.000>>{F3GUID}:Description (VAR)

R	####	{R1GUID}	:
1 CHAR	4 CHARs	38 CHARs	1 CHAR
Denotes Rule	Rule Number	Unique Identifier of Rule	Delimiter for parsing
'R'	4 numbers	Generated GUID	':'

{F1GUID}	=	0.000	+	{F2GUID}	=	0.000
38 CHARs	1 CHAR	5 CHARs	1 CHAR	38 CHARs	1 CHAR	5 CHARs

Unique Identifier of Fact	Delimiter for parsing	Weighting of Rule 1	Delimiter for parsing	Unique Identifier of Fact	Delimiter for parsing	Weighting of Rule 2
GUID	'='	Weightings must add to 1.000	'+'	GUID	'='	Weightings must add to 1.000

>>	{F3GUID}	:	Description (VAR)
2 CHARs	38 CHARs	1 CHAR	Variable
Delimiter for parsing	Unique Identifier of Fact	Delimiter for parsing	Description of Rule
'>>'	GUID	':'	Up to 100 alphanumeric characters, cannot contain punctuation or symbols

Example Command:

R0001:{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}:{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}=0.100+{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}=0.900>>{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}:Description

Typically, networks will be created with the basic pattern show in Figure 1, where a rule will have two input facts and one output fact (along with associated weighting values). This same basic construct can be used in other ways, as well. For example, setting the two inputs of a rule to the same fact (with any combination of weightings, as weightings must add to 1) will produce an action to set the output fact to be the same as the input fact. More complex arrangements can also be created through the use of set/known value rules (for example a fact with a value of 0) and rules and through careful decisions as to how to define facts.
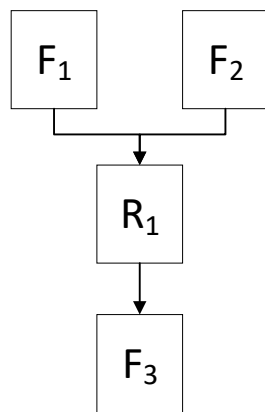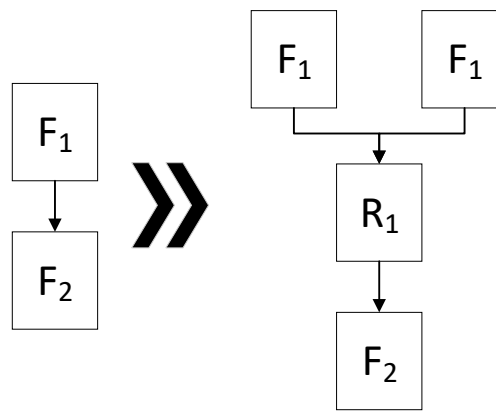

Figure 1. Typical Rule.   Figure 2. Rule for setting fact to another fact's value

Notably, multiple rules can have the same output fact. In this case, the value of the output fact will be set based upon the last rule to run (i.e., the new value overwrites any existing one). This is depicted in Figure 3.
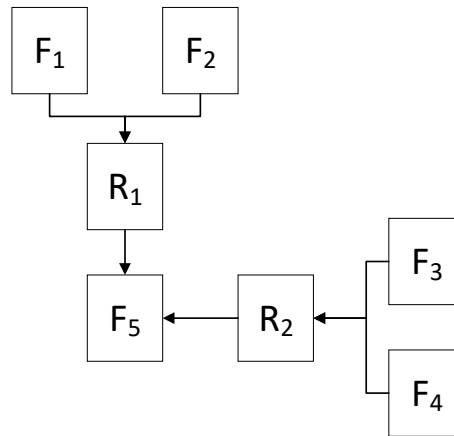
Figure 3. Two Rules with the same output fact.

Training

Training is used to optimize the network's rule weightings. It is conducted between an identified starting and ending fact. If training commands are to be placed in a file with fact and rule creation, a line with "***" must be included to indicate that rule declaration is complete; then training commands can be provided. Training is conducted with the following command:

TR:{FGUID}=000.000>####:0.00>{FGUID}=000.000

Example Command:

TR:{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}=000.000>0001:0.05>{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}=000.000

TR	:	{FGUID}	=	000.000	>
2 CHARs	1 CHAR	38 CHARs	1 CHAR	7 CHARs	1 CHAR
Transaction Identifier for Training	Delimiter for parsing	Unique Identifier of Fact	Delimiter for parsing	Fact value that is set for starting fact at start of training	Delimiter for parsing
'TR'	':'	GUID	'='	Must be 7 characters, have decimal point and at least one character before and after decimal	'>'

####	:	0.00	>	{FGUID}	=	000.000
4 CHARs	1 CHAR	4 Chars	1 CHAR	38 CHARs	1 CHAR	7 CHARs
Number of iterations to run for this training	Delimiter for parsing	Velocity Value	Delimiter for parsing	Unique Identifier of Fact	Delimiter for parsing	Ideal output of final fact value that is used for reinforcement learning training

Must be integer value between 1 and 9999	':'	Must be less than 1	'>'	GUID	'='	Must be 7 characters, have decimal point and at least one character before and after decimal

Training can be conducted between any two facts in the network, as shown in Figures 4 and 5. The weightings of any rules between these facts will be optimized.
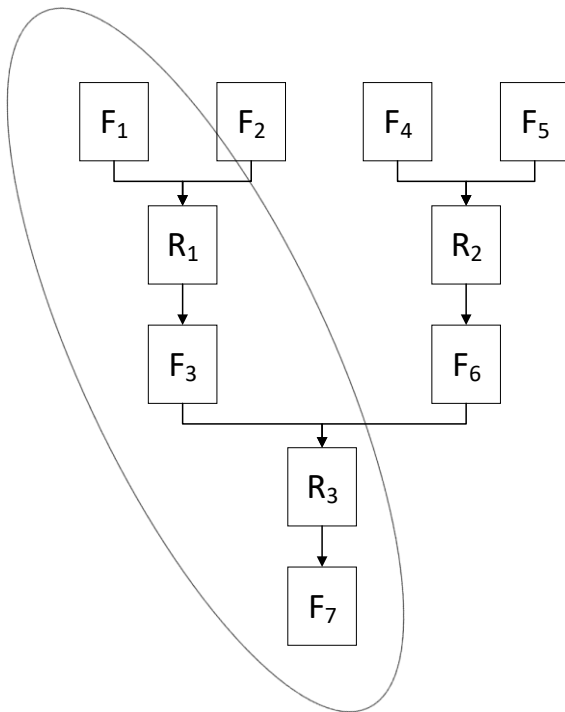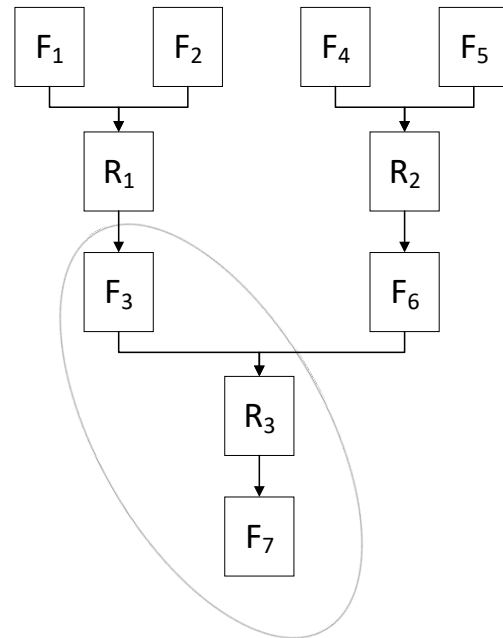

Figure 4. Training Network.   Figure 5. Training Part of Network.

Presentation for Evaluation

To assess the efficacy of the optimization or to use the trained network, it can be used in presentation mode. In this mode, the network is run in forward-only mode to ascertain what the value of the target fact is. The command for presentation is:

PR:{FGUID}=000.000>>{FGUID}

Example Command:

PR:{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}=000.000>>{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}

PR	:	{FGUID}	=	000.000	>>	{FGUID}
2 CHARs	1 CHAR	38 CHARs	1 CHAR	7 CHARs	2 CHARs	38 CHARs

Transaction Identifier for Training	Delimiter for parsing	Unique Identifier of Starting Fact	Delimiter for parsing	Fact value that is set for starting fact at start of network run	Delimiter for parsing	Unique Identifier of Target Fact
'PR'	':'	GUID	'='	Must be 7 characters, have decimal point and at least one character before and after decimal	'>>'	GUID

Example Command:

PR:{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}=000.000>>{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}

Running this command will issue a result in the format:

R:{FGUID}>>{FGUID}:000.000

R	:	{FGUID}	>>	{FGUID}	:	000.000
1 CHAR	1 CHAR	38 CHARs	2 CHARs	38 CHARs	1 CHAR	7 CHARs
Result identifier	Delimiter for parsing	Unique Identifier of Starting Fact	Delimiter for parsing	Unique Identifier of Target Fact	Delimiter for parsing	Fact value of result fact
'R'	':'	GUID	'>>'	GUID	':'	Will be 7 characters, have decimal point and at least one character before and after decimal

Example Result:

R:{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}>>{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}:123.456

Set Fact

In addition, if more complex presentation is required, additional fact values can be set with the command:

SF: {FGUID}=000.000

SF	:	{FGUID}	=	000.000
2 CHARs	1 CHAR	38 CHARs	1 CHAR	7 CHARs
Transaction Identifier for Set Fact	Delimiter for parsing	Unique Identifier of Fact	Delimiter for parsing	Fact value that is being set
'SF'	':'	GUID	'='	Must be 7 characters, have decimal point and at least one character before and after decimal

Set fact (SF) commands must be issued before the presentation (PR) command that they are being set for. The final fact value setting should only be included in the PR command (i.e., don't make a SF command for this as well). The PR command will immediately start the network with the current values, set the initial fact value indicated in the PR command and return a result.

Query Fact

The query fact command provides the current value of a fact. The command is:

QF: {FGUID}

QF	:	{FGUID}
2 CHAR	1 CHAR	38 CHARs
Transaction identifier for query fact	Delimiter for parsing	Unique Identifier of fact queried
'QF'	':'	GUID

Example Command:

QF:{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12f}

It returns the fact ID and fact value in the following format:

FV:{FGUID}:000.000

Comments

A line that starts with a "*" is considered to be a comment and is ignored by the command processor.

Syntax

The system stops processing commands when a blank line is encountered. A single "*" can be used to insert 'white space' and allow the lines following the 'white space' to be processed.

Error Messages

In the event that the system detects an error, an error message will be returned.

FORMAT ERROR [Line] – a format error exits on line number [Line]

UNIQUE ERROR [Line] – a GUID is detected as being reused to create another fact or rule with the same GUID on line number [Line]

Command Results

The number of facts and rules are stated on the bottom of the application screen.

When a presentation command is run, the resulting value of the final fact is stated. The command processing time is also stated.

Example

The following creates three facts and a rule and processes the network to use the rule to set the value of the third fact.

F0001:{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}=000.500:Description
F0001:{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12e}=000.700:Description
F0001:{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12f}=000.000:Description
*
R0001:{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12a}:{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}=0.100+{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12e}=0.900>>{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12f}:Description
*
PR:{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12d}=000.500>>{a8e6fc6d-cfe6-4358-a36a-2b56aac7d12f}