DRC-SEM

DRC-SEM is a simulator of the Dual-Route-Cascaded model of visual word recognition and reading aloud. It is based on DRC 1.2.1, and includes a semantic system. Please visit the website for more information:

https://maxcoltheart.wordpress.com/drc/

DRC-SEM is a command-line program. It should be used from within the *Terminal* application in Mac OS X, from the *shell* in Linux or from the *Command Prompt* in Windows.

Usage Examples

Simulate reading aloud of a single word:

```
drc-sem word
```

Save a log of activation levels during simulation:

```
drc-sem -a word
```

Simulate reading aloud the list of words in the file `wordlist.txt`:

```
drc-sem -b wordlist.txt
```

View a list of available command-line options:

```
drc-sem --help
```

Change Log

1.2.1.3: Minor fixes.

1.2.1.2: Unsupported decay removed. Explicit lateral links in the semantics layer now disable the general lateral inhibition of the target unit by the source unit.

1.2.1.1: The `SemanticsOnset` parameter has been removed and replaced with `SemanticsExternalOnset`. The new parameter only delays the commencement of the semantics layer's "external" excitation of a unit. All other semantics layer activity operates from the first cycle.

1.2.1: Initial public release of DRC-SEM, based on DRC 1.2.1.

Decay

Decay has been modified in DRC-SEM so that it does not occur until a unit in the relevant layer has reached an activation level specified by a new parameter. For example, decay does not occur in the orthographic lexicon until at least one unit has an activation level that meets or exceeds the level specified in the `OrthlexDecayTrigger` parameter. Once decay has been triggered it continues until the model is reset.

The amount of decay in each layer is controlled by the various decay parameters, such as `OrthlexDecay`. These parameters can be set to any value in the interval [0.0, 1.0] with 0.0 meaning no decay and 1.0 meaning 100% decay.

In the letter and phoneme layers there is a separate trigger for each position.

The application of decay has also been moved so that it reduces the new activation of a unit by a proportion of the new activation, rather than a proportion of the old activation from the end of the previous cycle.

The trigger parameters are: `LetterDecayTrigger`, `OrthlexDecayTrigger`, `PhonlexDecayTrigger`, `SemanticsDecayTrigger` and `StressDecayTrigger`.

Letter %

The `%` symbol has been added to the list of letters know by the model. There will be a unit for `%` in each position in the letter layer and the `%` sign can be used as an input letter to the model.

Semantic System

A Semantics layer has been added. It contains units for each of the items in the language `vocabulary` file that have the `S` flag in field 3. All words have the `S` flag in the accompanying language data.

The Semantics layer features imageability scaling, which operates in a similar fashion to frequency scaling in the lexicons. Imageability ratings are not available for all of the words in the vocabulary. When the `ImageabilityScale` parameter is non-zero DRC-SEM will refuse to simulate words that lack an imageability rating. Non-words may still be simulated, however.

The following parameters have been added to control the semantics layer. All are set to zero by default:

Parameters that control the strength of connections between the Semantics layer and the Orthographic and Phonological lexicons:

```
OrthlexSemanticsExcitation
OrthlexSemanticsInhibition

PhonlexSemanticsExcitation
PhonlexSemanticsInhibition

SemanticsOrthlexExcitation
SemanticsOrthlexInhibition

SemanticsPhonlexExcitation
SemanticsPhonlexInhibition
```

`SemanticsLateralInhibition` controls the strength of lateral inhibition in the Semantics layer.

`SemanticsExternalOnset` controls the starting cycle for external excitation of a specified semantics unit (see below).

`SemanticsExternalExcitation` controls the strength of excitation of a specified semantics unit (see below).

`ImageabilityScale` controls the strength of imageability scaling.

`SemanticsNoise` controls the level of noise in the Semantics layer.

`SemanticsDecay` controls the level of decay in the Semantics layer.

`SemanticsThreshold` controls the minimum activation level a Semantics layer unit must reach before it interacts with any other unit.

External Excitation of a Semantics Unit

A unit in the semantics layer can receive a constant amount of excitation per cycle. The amount of excitation is controlled by the `SemanticsExternalExcitation` parameter, and external excitation can be delayed until a specific cycle is reached using the `SemanticsExternalOnset` parameter.

The semantics unit that receives external excitation can be set with the use of the `-T` command line parameter. For example, the following command line would set the target for external excitation to red, and the input word to green.

```
drc-sem -T red green
```

In batch files, the target for external excitation can be set or changed with the `SemTarget` command, as in the following example:

```
! SemTarget blue
```

If the target for external excitation is a heterophonic homograph it can be disambiguated by adding a hyphen and then the pronunciation of the desired target. If, for example, the two forms of the word lead, /lEd/ and /lid/, are included in the semantics layer then the appropriate target can be selected with one of the following batch commands:

```
! SemTarget lead-lEd
! SemTarget lead-lid
```

If no pronunciation is specified DRC-SEM will select the form that appeared first in the vocabulary.

Specifying the pronunciation is not necessary when there is no ambiguity.

Lateral Semantic Links

The language data file `semantics` can be used to create a set of lateral links between the units in the semantics layer. These links can have varying strengths. For example, to create an excitatory lateral link from the `red` Semantics unit to the `green` Semantics unit, with a strength of 0.5, the following line should be added to the `semantics` file:

```
red green 0.5
```

A negative strength value can be used to establish an inhibitory link.

When such a link is created the source unit does not participate in the general lateral inhibition (i.e. the lateral inhibition that is controlled by the `SemanticsLateralInhibition` parameter) of the target unit. This means that creating a link with the strength set to zero will prevent the source unit from interacting with the target unit altogether.

To preserve the original language data, first make a copy of the entire `english-sem-1.1.7` language data folder and modify the `semantics` file in the copy. The `properties` file should also be modified so that the `name` and `version` properties are appropriate for the new language data. DRC-SEM can be instructed to use the new language data instead of the default one with the `-l` command line option, as in this example:

```
drc-sem -l my-english-sem-copy input-word
```

Derivation of Imageability Ratings

Imageability ratings were derived from MRC:

```
http://websites.psychology.uwa.edu.au/school/MRCDatabase/uwa_mrc.htm
```

For items with no MRC imageability rating the imageability rating was derived from:

Cortese, M. & Fugett, A. (2004). Imageability ratings for 3,000 monosyllabic words. *Behavior Research*

Since Cortese ratings are measured on a different scale from MRC ratings, the Cortese ratings were adjusted via the following formula.

```
Imageability = 214.80 + 58.94 * Cortese-Imageability
```

This formula was derived as follows:

There are 1603 DRC vocabulary words for which we have both MRC and Cortese imageability ratings. With this set of words, there is a very high positive correlation between the two imageability ratings: +0.896. That justifies treating them as measuring the same thing.

We calculated the linear regression of one variable on the other using the R command:

```
imag.lm=lm(Words$MRC.IMAG~Words$Cortese.IMAG)
```

This gave the regression coefficients:

```
        (Intercept)   VocabWithBoth$Cortese.IMAG
             214.80                        58.94
```