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Hierarchical Active Inference for Language

Nested hierarchies of structures using Active inference for language recognition and reading

Description

Each level of the hierarchy has a default structure if the lowest observable is a letter o(1)=letter a simple hierarchy can be described level 1 two factor: states = [composition of letters (e.g. word), locations of letters in the word] obs = [letter, locations of letters in the word] than level 2 states = [composition of words (e.g. sentence), locations of words in the sentence] obs = [word, locations of words in the sentence]

Extending the composition and the meaning of the composition it is possible to iterate this structure on N-levels

It is, also, possible to add classes for each level, that gives a context for each state recognized. For example for level 2 becomes: states = [sentence, locations of words in the sentence, context] obs = [word, locations of words in the sentence, report]

Getting started

Type HAI_LANGUAGE_pathsLoad; in main the directory to add necessary subpaths. then choose one of the main in directory "MAINS" to see a demonstration of code features

Code

(1) HAI_LANGUAGE_DICTIONARY_v0_sample_main.m

simple example with a simple dictionary 2-level hierarchy level 1 states = [word, locations of letters in the word] obs = [letter, locations of letters in the word] level 2 states = [sentence, locations of words in the sentence] obs = [word, locations of words in the sentence]

DICTIONARY: Simple dictionary of 6 words composed by A B C D

(2) HAI_LANGUAGE_DICTIONARY_v1_sample_main.m

2-level hierarchy level 1 states = [word, locations of letters in the word] obs = [letter, locations of letters in the word] level 2 states = [sentence, locations of words in the sentence] obs = [word, locations of words in the sentence]

DICTIONARY: Simple dictonary of English words (two syllable words of six letters)

(3) HAI_LANGUAGE_DICTIONARY_v2_sample_main.m

3-level hierarchy level 1 states = [syllable, locations of letters in the syllable] obs = [letter, locations of letters in the syllable] level 2 states = [word, locations of syllable in the sentence] obs = [syllable, locations of syllable in the sentence] level 2 states = [sentence, locations of word in the sentence] obs = [word, locations of word in the sentence]

DICTIONARY: Simple dictonary of English words (two syllable words of six letters)

(4) HAI_LANGUAGE_DICTIONARY_v3_sample_main.m

2-level hierarchy level 1 states = [syllable, locations of letters in the syllable] obs = [letter, locations of letters in the syllable] level 2 states = [word, locations of syllable in the sentence] obs = [syllable, locations of syllable in the sentence]

DICTIONARY: Simple dictionary of English words (two syllable words of six letters)

TRANSFORMES IN THE LOOP

(5) HAI_LANGUAGE_BERT_LOOP_sample_01_main.m,

three level structure, Dictionary provided by BERT

Read the produced BERT sentence 'THIS PAPER IS ALSO MENTIONED IN THE FAMOUS ENGLISH HISTORICAL NOVEL BY SIR ROBERT DE LA HAY'

level 1 states = [syllable, locations of letters in the syllable] obs = [letter, locations of letters in the syllable] level 2 states = [word, locations of syllables in the word] obs = [syllable, locations of syllables in the word] level 3 states = [sentence, locations of words in the sentence] obs = [word, locations of words in the sentence]

(6) HAI_LANGUAGE_BERT_LOOP_sample_02_main.m,

Same as previous but given a context "We present a novel computational model that uses hierarchical active inference to simulate the reading process and eye movements during reading." read the BERT produced sentence:

THE COMPUTATIONAL MODEL IS ABLE TO PREDICT A TIME HORIZON FOR READING DURING A GIVEN TIME OR PLACE PERIOD

(7) HAI_LANGUAGE_BERT_LOOP_sample_03_main.m

Loop with BERT reading a sentence that has a word (BUTTER) that BERT does not provide

LOOP of HAI Code on a DICTIONARY predicted by BERT https://it.mathworks.com/matlabcentral/fileexchange/107375-transformer-models?s_tid=FX_rc3_behav add the corresponding path to use BERT model git clone https://github.com/matlab-deep-learning/transformer-models

(8) main_chatGPT_SampleSentence.m

provided an API-KEY.txt for OPEN-AI chatGPT, given the same context of (6) "We present a novel computational model that uses hierarchical active inference to simulate the reading process and eye movements during reading."

produce a random sentence: e.g. THIS MODEL HAS BEEN DESIGNED TO ENABLE THE ACCOMMODATION OF A COMPREHENSIVE SET OF ADAPTIVE BEHAVIORS TO ACHIEVE BEST ACCURACY

Package needed

To enable tree visualization and computation on MDP add matlab-tree package https://tinevez.github.io/matlab-tree/index.html

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