

# Assignment #1: NARS

CS T-720

9 October, 2012

Answer the following questions by using NARS to develop a simple example based on diseases and treatments. For any question requiring NARS code, include all such code as part of your answer, including the truth values used for each statement.

If a question asks for the calculations used by NARS, give the inference rule and show the equation(s) used to compute the updated truth values.

1. Let us consider the following statements regarding the diagnosis and treatment of a particular set of diseases with associated symptoms and treatments.
  - People with flu suffer from flulike symptoms: sore throat, runny nose, muscle aches, and low-grade fever.
  - High-grade fevers may indicate a more severe illness, such as viral meningitis or West Nile virus.
  - 80% of West Nile sufferers have recently traveled abroad.
  - Vaccinations for the flu are available and prevent about 60% of those receiving the vaccine from contracting the flu.
  - Treatment for the flu are over-the-counter medications, rest, and fluids.
  - Treatment for meningitis or West Nile virus require hospitalization.

For each of the following exercises, show the Narsese statements and, if appropriate, the logical operations that NARS uses (induction, deduction, abduction, or exemplification) along with the calculations used to derive truth values.

- (a) Encode this knowledge into NARS. Note that you will need to supply some missing information (e.g., how likely is it that high-grade fever indicates West Nile rather than the flu?). Choose how to express this information as NARS experience.

- (b) Assume you encounter a patient with muscle aches and a low-grade fever. Give the truth value for the statement that the patient has the flu.
  - (c) Add the additional information that the patient has received a flu vaccine. How does this change the likelihood of the flu diagnosis?
  - (d) Repeat the previous exercises (starting from a clean slate in NARS) using different priors for your estimates of the missing information.
  - (e) Add some conflicting information. Show the truth values for the relevant statements before and after the conflicting information is added, and show the inference rule and/or truth value calculations NARS uses to perform the update.
2. To the previous examples, add a new disease, the common cold, which shares the symptoms of a sore throat and a runny nose with the flu (but not muscle aches or a fever).
- (a) Express this new information in Narsese.
  - (b) Let there be a drug  $d_1$  which treats the symptoms of sore throat and runny nose successfully with a truth value of your choosing. How does Nars estimate the truth value of the statement that  $d_1$  successfully treats the flu? (Hint: consider Nars' *comparison* operator in combination with the basic inference rules from the previous question.)
  - (c) Let there be a drug  $d_2$  which also treats the symptoms of sore throat and runny nose. Demonstrate how Nars uses analogy making to evaluate the statement that  $d_2$  successfully treats the flu.
  - (d) Note that there is a symmetry in the definitions for  $d_1$  and  $d_2$  in that both treat the same symptoms. Rewrite these rules using Nars' set-oriented copula.
3. Starting with NAL-5, the system can directly represent and reason about its own beliefs.
- (a) Let  $S_1$  be the statement "drug  $d_1$  treats the flu implies that  $d_1$  treats the symptom of a sore throat." Express this in Narsese.
  - (b) Express the negation of this statement in Narsese – in other words, state that "Nars believes that the statement: ' $d_1$  treats the flu implies that  $d_1$  treats a sore throat' is not true." with a lower frequency value than in part (a). Show the result of the query: " $d_1$  treats a sore throat".
  - (c) Formulate experience which triggers Nars' contrapositive rule to update the truth value of the statement made in part (a). Show the calculations Nars performs as part of this update.

4. NAL-6 introduces variables.

- (a) Briefly describe the three types of variables: query variables, dependent variables, and independent variables, and give an example of each.
- (b) Using variables, express the compound statement that anyone with a rash either has allergies or poison ivy.