# NARS Project 2: Diagnosis

Overview

In this project, students are required to generate a car diagnostic system with OpenNARS.
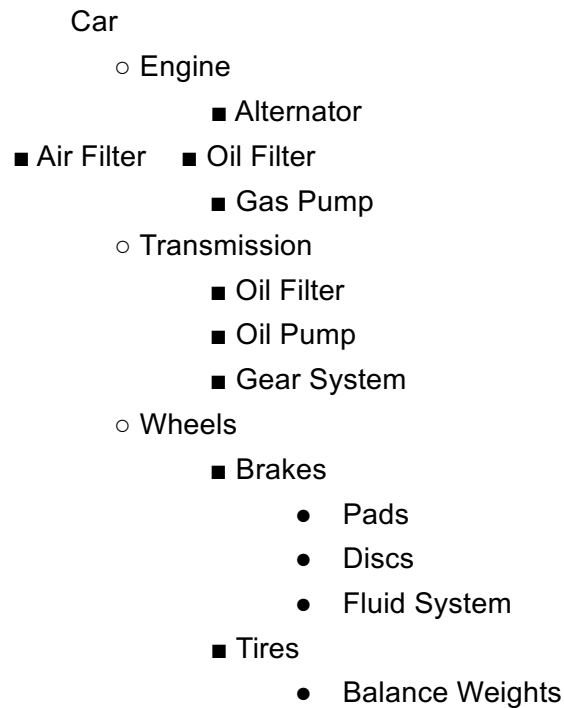
The detailed car use case breaks down the object to be diagnosed, the car, according to the following diagram. In this diagram, two types of nodes exist, one denoting a component, and one denoting a 'observation'. These nodes represent items that would be 'sensed' by a user of the vehicle. This list was created from the point of view of a lay user describing issues to a mechanic, and try to reflect the high level indicators that exist on common dashboards.
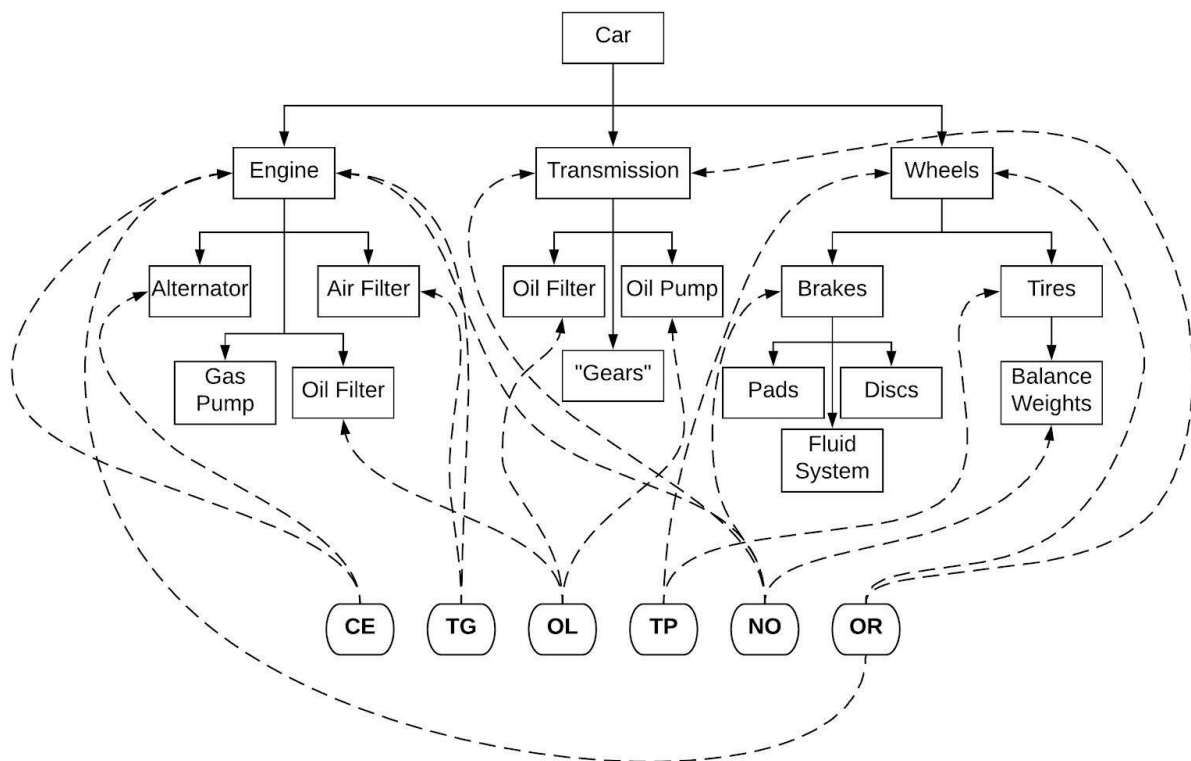
The goal with this graph is to capture enough complexity for the system to have fodder for interesting and useful derived inferences. A key part of this complexity is ensuring that there are many-to-one relationships between components and the indicators. In addition, there is a

deeper hierarchy of components, where the relationships with indicator nodes can span multiple levels.

The component hierarchy understood by the system is:

Car
- ○ Engine
    - ■ Alternator
- ■ Air Filter   ■ Oil Filter
    - ■ Gas Pump
- ○ Transmission
    - ■ Oil Filter
    - ■ Oil Pump
    - ■ Gear System
- ○ Wheels
    - ■ Brakes
        - ● Pads
        - ● Discs
        - ● Fluid System
    - ■ Tires
        - ● Balance Weights

The links between components (solid lines) indicate the relevant "required by" or "composed of" relations. These are implemented with the inheritance operator. A higher level component inherits its lower level constituent components.

There is a second type of edge/relationship in the graph; the relation between a component and a sensible thing (dashed lines). These represent the possible relations between an indicator and the components it might 'indicate' a problem for.

The sensible indicators understood by the system:

- ● Check Engine Light
    - ○ **CE**
    - ○ Boolean
- ● Temperature Indicator
    - ○ **TG**
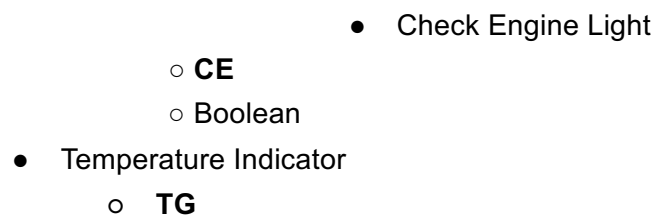
- ○ Range value?
- ● Oil Light
  - ○ **OL**
    - ○ Boolean
- ● Tire Pressure Indicator
  - ○ **TP**
    - ○ Boolean
- ● Presence of 'unnatural' noise
  - ○ **NO**
    - ○ Boolean at first
      - ■ yes/no is there 'weird noise'?
    - ○ Could be extended to multiple types of noise.
      - ■ {normal, grinding, rhythmic}
- ● Odometer Reading
  - ○ **OR**
    - ○ Range value? Could be a set of terms {new, low, normal, high, old}

Example

The following example is a medical diagnostic system for human being, try to run it with OpenNARS and see what the output you will get. The comment may help you to understand the meaning of different statements.

// HIV Brain Infection, flu are illness
<{HIV,Brain_Infection, Flu} --> Illness>.

//Fever headache … are symptoms
<{Fever, Headache, Tiredness, Lack_Of_Energy, Weight_Loss, Vomiting, Chills, Decreased_Speech, Diarrhea} --> Symptom>.

<{Children, Adult, Senior} --> Age_Group>.
<{Male, Female} --> Gender>.

//==
// Fever is a symptom of HIV <HIV
--> [Fever]>.

<HIV --> [Tiredness]>.
<HIV --> [Lack_Of_Energy]>.
<HIV --> [Weight_Loss] >.
<HIV --> [Diarrhea]>.
//==
<Brain_Infection --> [Fever]>.
<Brain_Infection --> [Tiredness]>.
<Brain_Infection --> [Headache]>.
<Brain_Infection --> [Vomiting]>.
<Brain_Infection --> [Chills]>.
<Brain_Infection --> [Decreased_Speech]>.
//==
<Flu --> [Fever]>.
<Flu --> [Tiredness]>.
<Flu --> [Chills]>.
//==

// The possibility of people from different age group to have HIV
<Children --> [HIV]>. %0.1;0.85%
<Adult --> [HIV]>. %0.6; 0.74%
<Senior --> [HIV]>. %0.3; 0.67%
//==
<Male --> [HIV]>. %0.4;0.86%
<Female --> [HIV]>. %0.6; 0.74%
//==
<Children --> [Brain_Infection]>. %0.23;0.67%
<Adult --> [Brain_Infection]>. %0.32; 0.87%
<Senior --> [Brain_Infection]>. %0.45; 0.77%
//==
<Male --> [Brain_Infection]>. %0.55;0.88%
<Female --> [Brain_Infection]>. %0.45; 0.73%
//==
<Children --> [Flu]>. %0.42;0.85%
<Adult --> [Flu]>. %0.25; 0.74%
<Senior --> [Flu]>. %0.33; 0.67%
//==

<Male --> [Flu]>. %0.32;0.86%

<Female --> [Flu]>. %0.68; 0.74%

//===

// John is an Adult

<{John} --> Adult>.

<{John} --> Male>.

// John has fever <{John}

--> [Fever]>.

<{John} --> [Tiredness]>.

// What possible disease John has <John

--> [John_Disease]>.

<{John_Disease} --> Illness>.

<John_Disease <-> ?x>?

YOUR TASK

Use the medical diagnostic example and the description about the Car diagnostic system as hints to design a diagnostic system for Cars, test it with OpenNARS, here are some interesting things you may want to try in your own system.

1. Different type of cars (Sedan, Sport, Truck) may have different possibility of having different problems when same symptoms show up, for instance, in the previous example, adult have higher possibility to have HIV than children, if Dan has same symptom with John but Dan is a child, will Dan have same disease with John?

2. In the medical diagnostic example, default truth values (f = 1.0, c = 0.9) are attached to all the statements of John's symptoms, if we change those statements to statements where true to the degree, for example

<center>

<{John} --> [Fever]>. %0.32; 0.73%

<{John} --> [Tiredness]>. %0.78; 0.73% <{John}

--> [Chills]>. %0.21; 0.73%

</center>

Will John have the same disease with previous disease?

3. If we already know what disease that John has, and also some symptoms, try to generate a question to display what gender that John possibly is as well as the age group.