4.1.2. Reasoning using Subsumption

Overview

One of the fundamental benefits of SNOMED CT is its built-in polyhierarchy that specifies which concepts are subtypes of others. This hierarchy facilitates the automated grouping of health records which have been encoded using SNOMED CT. The 116680003 is a relationship in SNOMED CT form the basis of its subtype hierarchy.

For example, 54441004 Fracture of shaft of femur has an 116680003 is a relationship to 71620000 Fracture of femur, and therefore (as the diagram below illustrates), the concept 54441004 Fracture of shaft of femur is subsumed by 71620000 Fracture of femur.

![Example of subsumption](image1)

Figure 4.1.2-1: Example of subsumption

This also means that if a patient has a 54441004 Fracture of shaft of femur, then it is implied (i.e. it is also true) that they have a 71620000 Fracture of femur. We can use this principal to aggregate health records that have been encoded with SNOMED CT. By selecting any code that is a subtype of 71620000 Fracture of femur, we are selecting all the codes that imply that 71620000 Fracture of femur is true (given the appropriate context).

When testing for subsumption, we must also consider the transitivity of the 116680003 is a relationship. For example, the diagram below indicates that 426656000 Severe persistent asthma is a subtype of 370221004 Severe asthma which is a subtype of 195967001 Asthma. Therefore 426656000 Severe persistent asthma is also a subtype of 195967001 Asthma.

![Example of subsumption and transitivity](image2)

Figure 4.1.2-2: Example of subsumption and transitivity

As previously suggested in the section 1.4. SNOMED CT Features, the hierarchical relationships of SNOMED CT can be leveraged to enable clinical decision support. More specifically, we can apply subsumption testing to make additional determinations. For additional information on subsumption, please refer to 6.2 Subsumption in Data Analytics with SNOMED CT.

Example

CDS Rule

The diagram below shows a simple CDS rule based on the IF-condition-THEN-action pattern. This rule uses the descendant or self operator (<<) from the Expression Constraint Language - Specification and Guide to check if the diagnosis is in the set of concepts that includes 195967001 Asthma and all of its subtypes.

![CDS rule defined using subsumption](image3)

Figure 4.1.2-3: CDS rule defined using subsumption

Execution of Rule

When executing this rule, the inference engine tests if the given diagnosis is subsumed by the concept 195967001 Asthma. This subsumption testing can be performed using a range of approaches, including using a 7.5.2 Transitive closure implementation. A transitive closure table facilitates rapid testing of all possible 116680003 is a relationships, and provides a very effective way of testing concept subsumption in relational databases.

The diagram below illustrates the process followed by the inference engine in executing the CDS condition in the above rule, when the clinician selects a diagnosis of 426979002 Mild persistent asthma. The inference engine checks if this concept is a subtype of 195967001 Asthma, and determines that it is. As a result, the condition evaluates to true, and the action is triggered.
Figure 4.1.2-4: The inference engine checks if the diagnosis entered is a subtype of [Asthma].

- **Match:** Yes
- **Condition:** True
- **Action:** Triggered

<table>
<thead>
<tr>
<th>Subtype</th>
<th>Supertype</th>
</tr>
</thead>
<tbody>
<tr>
<td>304527002</td>
<td>195967001</td>
</tr>
<tr>
<td>389145006</td>
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<td>370221004</td>
<td>195967001</td>
</tr>
</tbody>
</table>

Diagram uses notation from Diagramming Guideline.