

CS112 (Fall 2018) Homework 5  
Spatial Logic  
Due November 6, 2018

1. **Region Connection Calculus 8 (RCC8)**

The composition table for RCC8 is given in Figure 1 below.

<b>o</b>	<b>DC</b>	<b>EC</b>	<b>PO</b>	<b>TPP</b>	<b>NTPP</b>	<b>TPPi</b>	<b>NTPPi</b>	<b>EQ</b>
<b>DC</b>	*	DC,EC,PO,TPP,NTPP	DC,EC,PO,TPP,NTPP	DC,EC,PO,TPP,NTPP	DC,EC,PO,TPP,NTPP	DC	DC	DC
<b>EC</b>	DC,EC,PO,TPPi,NTPPi	DC,EC,PO,TPP,TPPi,EQ	DC,EC,PO,TPP,NTPP	EC,PO,TPP,NTPP	PO,TPP,NTPP	DC,EC	DC	EC
<b>PO</b>	DC,EC,PO,TPPi,NTPPi	DC,EC,PO,TPPi,NTPPi	*	PO,TPP,NTPP	PO,TPP,NTPP	DC,EC,PO,TPPi,NTPPi	DC,EC,PO,TPPi,NTPPi	PO
<b>TPP</b>	DC	DC,EC	DC,EC,PO,TPP,NTPP	TPP,NTPP	NTPP	DC,EC,PO,TPP,TPPi,EQ	DC,EC,PO,TPPi,NTPPi	TPP
<b>NTPP</b>	DC	DC	DC,EC,PO,TPP,NTPP	NTPP	NTPP	DC,EC,PO,TPP,NTPP	*	NTPP
<b>TPPi</b>	DC,EC,PO,TPPi,NTPPi	EC,PO,TPPi,NTPPi	PO,TPPi,NTPPi	PO,TPP,TPPi,EQ	PO,TPP,NTPP	TPPi,NTPPi	NTPPi	TPPi
<b>NTPPi</b>	DC,EC,PO,TPPi,NTPPi	PO,TPPi,NTPPi	PO,TPPi,NTPPi	PO,TPPi,NTPPi	PO,TPP,NTPP,TPPi,NTPPi,EQ	NTPPi	NTPPi	NTPPi
<b>EQ</b>	DC	EC	PO	TPP	NTPP	TPPi	NTPPi	EQ

Figure 1: RCC8 Composition Table

Using the somewhat formal strategy of proof that I've used in class, show the derivations for the values given above, for the following compositions:

- (a)  $NTPP \circ DC$
- (b)  $TPP \circ PO$
- (c)  $EC \circ TPP$

2. **Using RCC8 in Language** (*This is a speculative problem!*)

The expressions in RCC8 can be used to express mereotopological relations in 2D space. When expressing spatial configurations in language, however, there is often a painful mismatch or inadequacy of RCC8 relations for capturing linguistic meaning. You are to:

- (a) Give a first-order representation of a sentence. You can refer to definite descriptions as Skolem constants (e.g., *the dog*  $\mapsto D_1$ ).
- (b) Give as many of the RCC8 relations (listed in Table 1) as possible. The resulting "interpretation" will be underspecified semantically in many cases.

Here is an example worked out.

- (1) The shirt has a stain on it.
  - a.  $\exists x[shirt(D_1) \wedge stain(x) \wedge have(D_1, x)]$
  - b.  $TPP(x, D_1) \vee NTPP(x, D_1)$

Relation	Description
DC	Disconnected
EC	External Connection
PO	Partial Overlap
TPP	Tangential Proper Part
NTPP	Non-Tangential Proper Part
TPPi	Inverse of TPP
NTPPi	Inverse of NTPP
EQ	Equal

Table 1: RCC8 Relations

**A.** Now do this for the sentences below:

- (2) The car is in the street.
- (3) A table is in a room and an apple is on top of it.
- (4) The nail is nailed into the wall.
- (5) The milk is in a glass with a label on it.

**B.** What is missing in your interpretation will be many aspects of the semantics, including *orientation*, the expression of the regions as inhabiting *3D space*, as well as other subtle features. For each sentence above, state what is needed in order to better distinguish the meaning, and characterize the spatial configuration in the sentence. We discussed this in one of the classes when talking about orientation calculi.

For example, what if we put a Girl Scout patch on the above shirt.

- (6) The shirt has a Girl Scout patch on it.

You are to think about issues that are completely outside the scope of RCC8; e.g., where's the patch? On the inside or the outside? What does that even mean? Is it EC or NTPP? And so forth.

- (2)
- (3)
- (4)
- (5)