

Generation of Manual Rules

The zero-shot experiments required to define rules to link the reference datasets’ labels to that of LARa. This document describes how these rules were obtained from the datasets’ documentations, i.e. without the use of any data.

For AndyLab, there are three sets of rules, as detailed in Table 1:

1. Rules that have a LARa label as body and AndyLab categories in the head,
2. Rules that have an Andylab category as body and LARa labels in the head,
3. Both of the above.

We treat the rule choice as hyperparameter, along with the rule probability, which is the same for all rules and in $\{0.6, 0.9\}$. Hence, it is tuned on validation data with respect to the weighted F1-Score, see below.

The transfer for RealDisp poses challenges as its categories are domain-foreign to LARa. Hence, we propose to include a mid-layer of latent attributes that describe which body parts are in motion in different categories of RealDisp and LARa. As all sports activities in RealDisp are performed symmetrically on both sides of the body, we give descriptions for pairs of limbs, that is both arms and both legs. Since the activities are conducted both back and forth, we only distinguish the planes in which the motion is conducted and not their direction, divided into vertical (up and down), horizontal (left and right), and saggital (front and back) movement, as binary attributes for each limb pair. Additionally, we included a binary attribute for torso rotation. Overall, movements are described with seven binary attributes.

To describe RealDisp’s categories with these attributes, we corresponded with RealDisp’s authors who provided protocols describing each sports exercise. This allowed to derive which movements are actively conducted in each exercise, yielding Table 2. Table 3 analogously gives the representation for LARa’s attributes for legs, upper body and torso rotations. Arms and the item pose could not be described due to the symmetric nature of the latent attributes. To cast these tables into rules, we used six strategies:

1. Use the category of each row as head, and combine all attributes in their positive or negated form in a conjunction to form the body,
2. Use the category of each row as head, and combine all positive attributes in a conjunction to form the body,
3. Use the latent attribute of each column as body, and create a disjunction of all categories for which is it positive as head,
4. Analogue to (3), but add rules for each latent label in its negated form,
5. Use the category of each row as body, and combine all attributes in their positive or negated form in conjunction to form the head,
6. Use the category of each row as body, and combine all positive attributes in a conjunction to form the head.

The rule type used to link the RealDisp categories to the latent labels is allowed to be different than the rule type for the LARa labels. Again, we treated the type choices as hyperparameters. They were tuned on validation data along with the rule probability which is varied in $\{0.6, 0.9\}$.

In addition to the above described rules, pRSL was supplied with rules describing the XOR relation between right, left, and no hand. No rules describing within-dataset inter-label relations were defined, as they are seen as orthogonal.

Table 1: Rules Used to Link LARa Labels ("L:") with AndyLab Categories ("A:").

Set 1
L:Gait \rightarrow A:Walk
L:Stand \rightarrow (A:Standing \vee A:Kneeling \vee A:Crouching)
L:Step \rightarrow A:Standing
L:Centered \rightarrow A:Upright
L:Downwards \rightarrow (A:Bent Forward \vee A:Strongly Bent Forward)
L:Upwards \rightarrow (A:Shoulder Level \vee A:Overhead)
L:No Motion \rightarrow A:Upright
L:Right Hand $\rightarrow \neg$ A:Idle
L:Left Hand $\rightarrow \neg$ A:Idle
L:No Hand \rightarrow A:Idle
L:Bulky Unit \rightarrow (A:Reach \vee A:Pick \vee A:Place \vee A:Release \vee A:Carry)
L:Handy Unit \rightarrow (A:Reach \vee A:Pick \vee A:Place \vee A:Release \vee A:Carry)
Set 2
A:Standing \rightarrow (L:Stand \vee L:Step)
A:Walking \rightarrow (L:Gait \vee L:Step)
A:Kneeling \rightarrow L:Stand
A:Crouching \rightarrow L:Stand
A:Upright \rightarrow (L:Centered \vee L:No Motion)
A:Bent Forward \rightarrow L:Downwards
A:Bent Strongly Forward \rightarrow L:Downwards
A:Shoulder Level \rightarrow L:Upwards
A:Overhead \rightarrow L:Upwards
A:Reach \rightarrow (L:Bulky Unit \vee L:Handy Unit \vee L:Utility \vee L:Cart)
A:Reach \rightarrow (L:Right Hand \vee L:Left Hand)
A:Pick \rightarrow (L:Bulky Unit \vee L:Handy Unit \vee L:Utility \vee L:Cart)
A:Pick \rightarrow (L:Right Hand \vee L:Left Hand)
A:Place \rightarrow (L:Bulky Unit \vee L:Handy Unit \vee L:Utility \vee L:Cart)
A:Place \rightarrow (L:Right Hand \vee L:Left Hand)
A:Release \rightarrow (L:Bulky Unit \vee L:Handy Unit \vee L:Utility \vee L:Cart)
A:Release \rightarrow (L:Right Hand \vee L:Left Hand)
A:Carry \rightarrow (L:Bulky Unit \vee L:Handy Unit \vee L:Utility \vee L:Cart)
A:Carry \rightarrow (L:Right Hand \vee L:Left Hand)
A:Fine Manipulation \rightarrow (L:Utility \vee L:Cart)
A:Screw \rightarrow (L:Utility \vee L:Cart)

Table 2: Description of the Actively Moved Body Parts and their Direction of Motion for each Sports Exercise in RealDisp. "1" Indicates an Active Movement, "0" a Rest in the Corresponding Body Part and Movement Plane.

	Arms Vertical	Arms Horizontal	Arms Saggital	Legs Vertical	Legs Horizontal	Legs Saggital	Torso Rotation
Walking	0	0	0	0	0	1	0
Jogging	0	0	1	0	0	1	0
Running	0	0	1	0	0	1	0
Jump Up	0	1	0	1	0	0	0
Jump Front and Back	0	0	0	0	0	1	0
Jump Sideways	0	0	0	0	1	0	0
Jumping Jacks	1	1	0	0	1	0	0
Rope Jumping	0	0	0	1	0	0	0
Trunk Twists with Outstretched Arms	0	0	0	0	0	0	1
Trunk Twists with Bended Elbows	0	0	0	0	0	0	1
Bend Waist Forward	1	0	0	0	0	0	0
Rotate Waist	0	0	0	0	0	0	0
Cross-directional Waist Bends	1	0	0	0	0	0	1
Reach Heel	0	0	1	0	0	0	0
Lateral Bend	1	0	0	0	0	0	0
Lateral Bend with Arms Up	1	1	0	0	0	0	0
Stretch Forward	0	0	1	0	0	0	0
Twists	0	0	0	0	0	0	1
Lateral Arm Elevation	1	1	0	0	0	0	0
Frontal Arm Elevation	1	0	1	0	0	0	0
Claps	0	1	1	0	0	0	0
Frontal Arm Crosses	0	1	1	0	0	0	0
High-Amplitude Shoulder Rotations	1	0	1	0	0	0	0
Low-Amplitude Shoulder Rotations	0	0	0	0	0	0	0
Inner Arm Rotations	0	0	0	0	0	0	0
Knee to Torso	0	0	0	1	0	0	0
Heel to Bottom	0	0	0	1	0	0	0
Squat	0	0	0	1	0	0	0
Lunge	0	0	0	1	0	1	0
Knee Rotations	0	0	0	0	1	1	0
Rowing	0	0	1	0	0	1	0
Elliptical Bike	0	0	1	1	0	1	0
Cycling	0	0	0	1	0	1	0

Table 3: Description of the Actively Moved Body Parts and their Direction of Motion for each Logistics Action in LARa. "1" Indicates an Active Movement, "0" a Rest in the Corresponding Body Part and Movement Plane. An Empty Cell Indicates that the Attributes are not Directly Related.

	Arms Vertical	Arms Horizontal	Arms Sagittal	Legs Vertical	Legs Horizontal	Legs Sagittal	Torso Rotation
Gait Cycle				0	0	1	
Step				0	1	1	
Standing Still					0	0	
Upwards	1			0			
Centered	0	1	1				
Downwards	1			1			
No Motion	0	0	0				
\neg Torso Rotation							0
Torso Rotation							1