



Handling sign language transcription system with the computer-friendly numerical multilabels

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HearAI project

 chai-workshop.github.io

 24th of July 2022

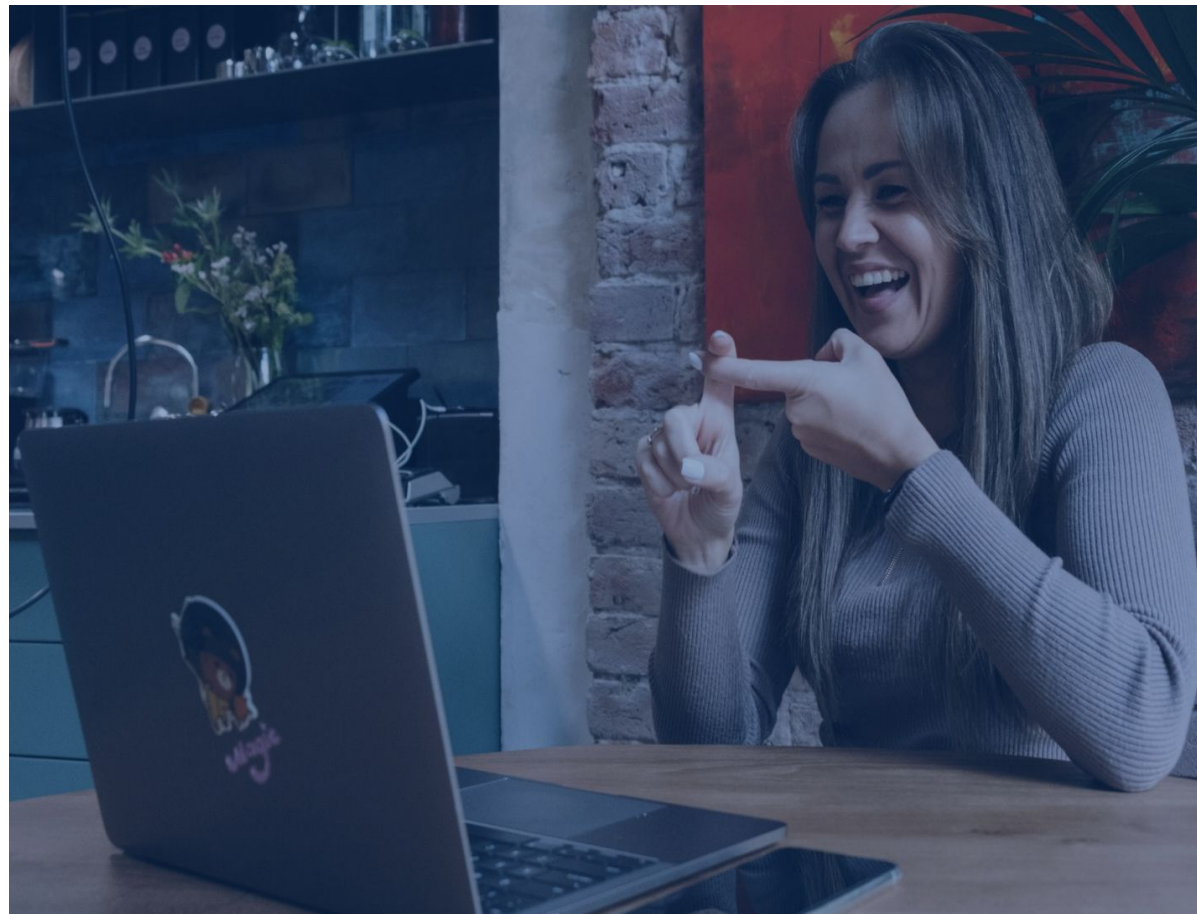
 Vienna



Communication in
Human-AI Interaction
Workshop

AGENDA

- Presenters
- Background
- Parser schema of action
- HamNoSys annotations
- Detected inconsistencies
- Backward decoding into glosses
- Takeaway message
- Project & Team
- Sponsors



Presenters



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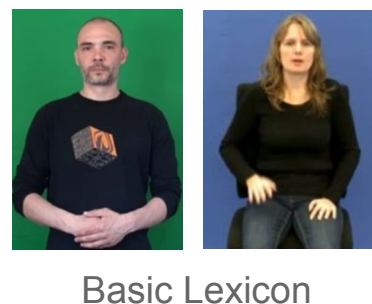
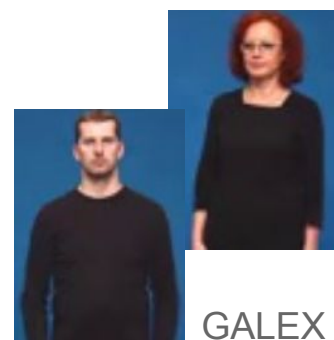
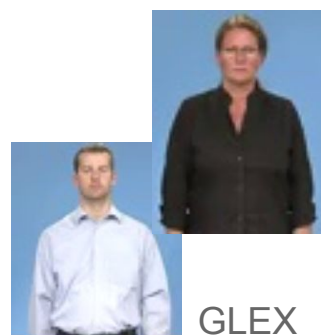


Milena Olech

Intel Technology Poland

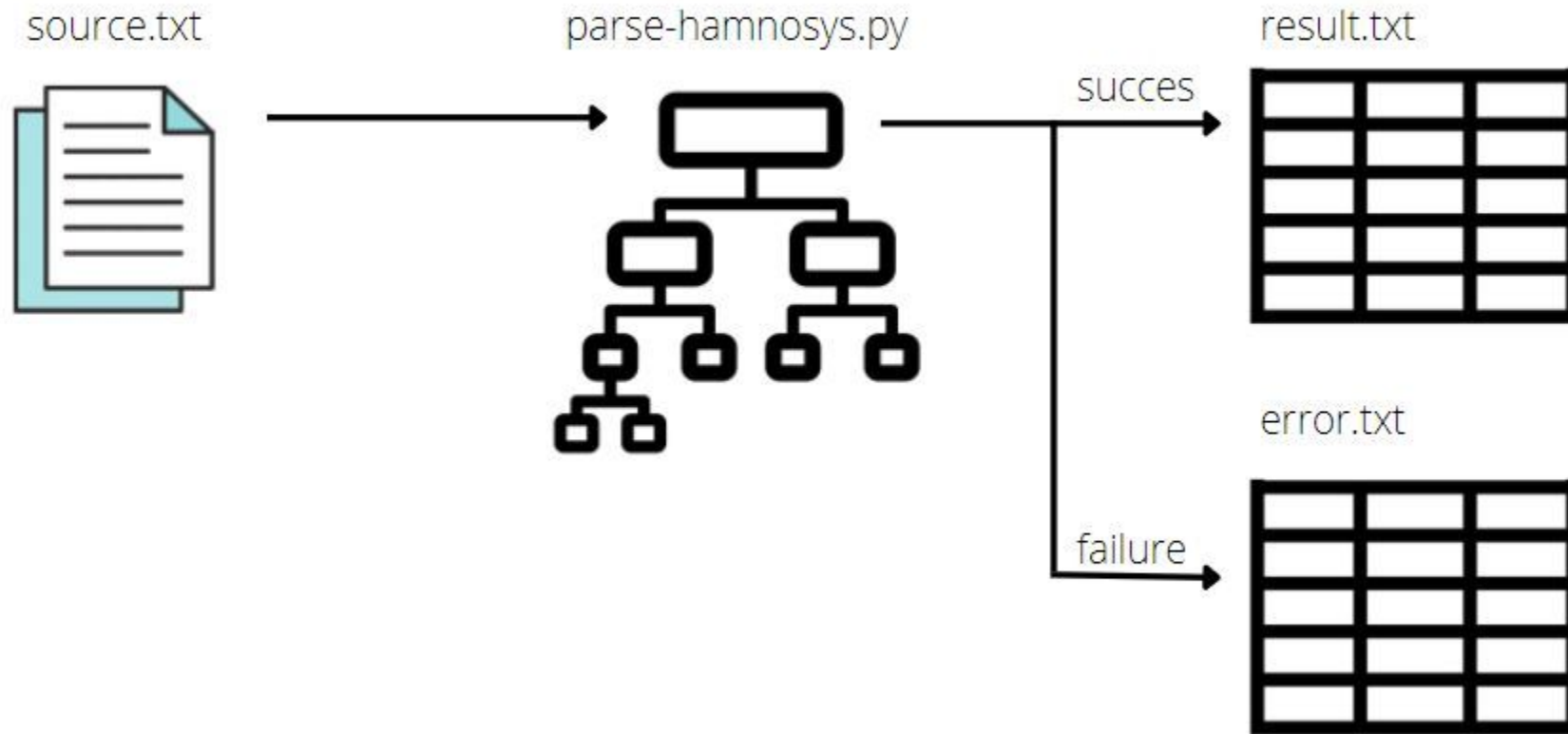
milena.w.olech@gmail.com

Multilingual databases



Dataset	Year	Languages	Topics	# glosses	# videos	# signers
GLEX	2004-2007	DGS	health	723	829	2
GALEX	2006-2009	DGS	landscaping	514	568	2
Basic Lexicon	2009-2012	BSL, DGS, GSL, LSF	traveling	3078	4123	6
CDPSL	2012-2014	PJM	everyday use	2480	2835	2
GSLL	2009-2021	GSL	everyday use	300	3476	2

Encoding HamNoSys into numbers



HamNoSys

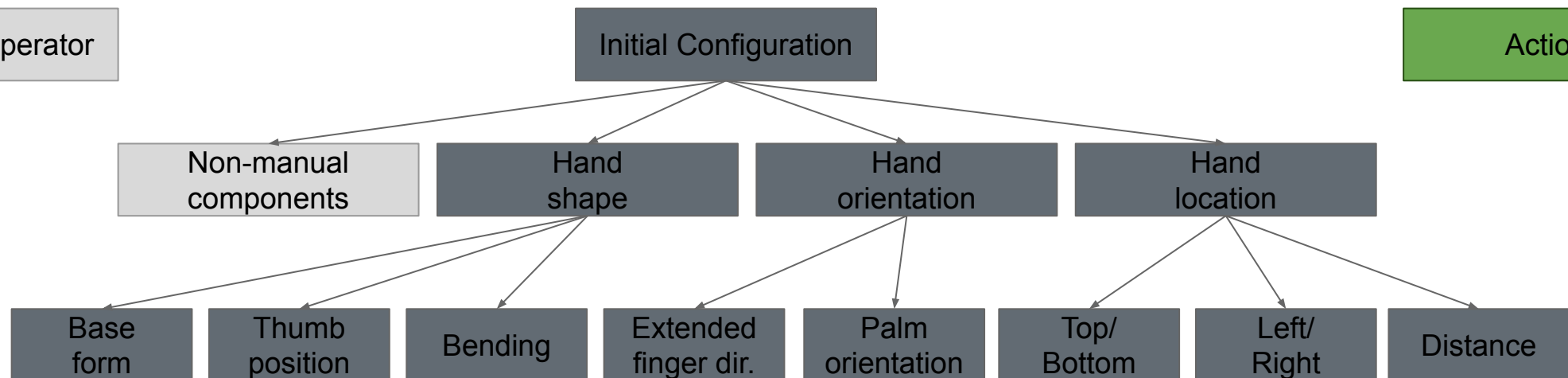


Initial Configuration



Actions

Symmetry operator



Actions

Base Form:

- Fist
- Flat
- ∩ Finger 2
- ∩ Finger 23
- ∩ Finger 23 spread
- ∩ Finger 2345
- ∩ Pinch 12
- ∩ Pinch all
- ∩ Pinch 12 open
- ∩ Cee 12
- ∩ Cee all
- ∩ Cee open

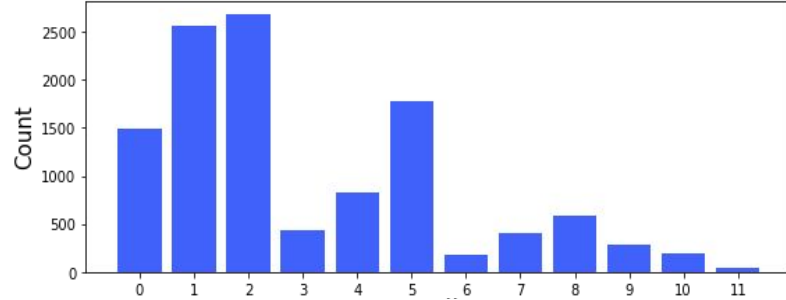
Thumb position:

- Not defined
- ∩ Thumb out
- ∩ Thumb cross
- ∩ Thumb open

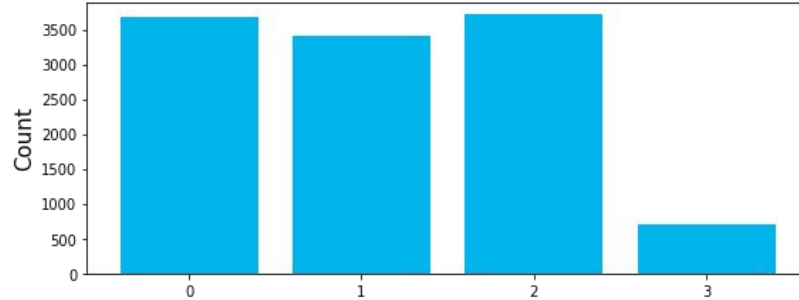
Bending

- Not defined
- ∩ Double bent
- ∩ Fingers straight
- ∩ Finger bend
- ∩ Finger hook
- ∩ Double hooked

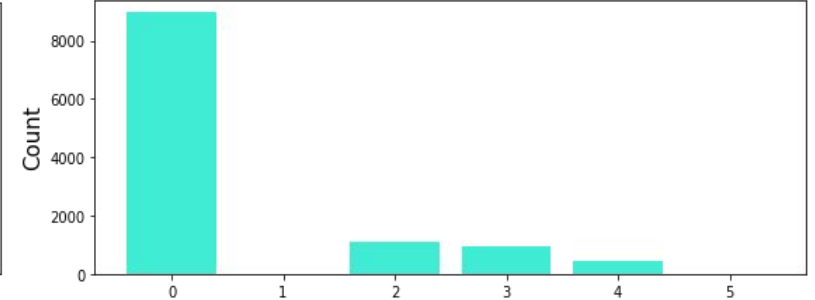
Base form



Thumb position



Bending



Unanalyzed features

Actions: Path movement buildings can be straight lines, curved and zigzag lines, circles and similar forms. For every movement, the hand being the default articulator can be substituted by other body parts, as the symbols appear very rare we discarded them.

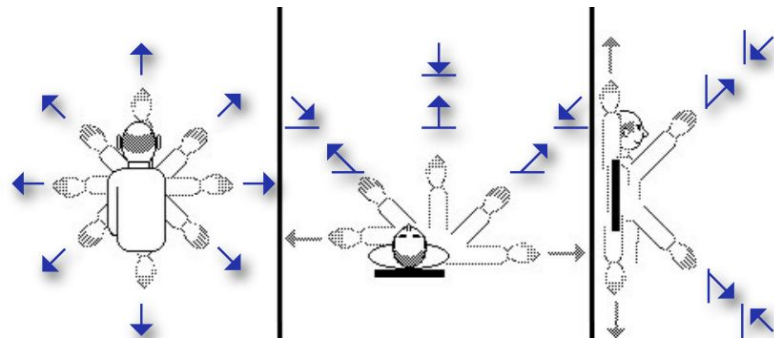
Non-manual components: HamNoSys codes schemes defined for eye gaze, facial expression or mouth gestures and mouth pictures, but they were not analysed.



cheeks puffed



tongue pushed into cheek



Finger details: In HamNoSys non default fingers are encoded by number. We skipped that part.



○



○ 2 \ 3



○ 3 \ 4



○ 4 \ 5

Detected inconsistencies

Dataset	Languages	Topics	#glosses	#errors	#parsing efficiency
GLEX	DGS	health	723	7	98.77%
GALEX	DGS	landscaping	514	51	93.85%
Basic Lexicon	BSL, DGS, GSL, LSF	traveling	3078	216	94.76%
CDPSL	PJM	everyday use	2480	7	94.76%
GSLL	GSL	everyday use	300	160	95.40%

Detected incompatibility

Initial configuration - Hand location - top/bottom



Chin



Below chin



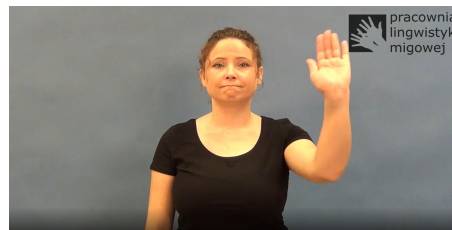
Head



Above the head



Eyes



“Wolać” (*call*)



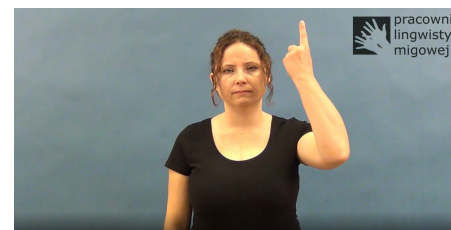
“Borsuk” (*badger*)



“Czarny” (*black*)



“Zerwać” (*break*)



“Najwyższy” (*the highest*)



“Życzenie” (*wish*)



“Mówić” (*speak*)



“Czytać” (*read*)



“Płakać” (*cry*)

Backward encoding into gloss

*Proposed computer-friendly numeric **multilabels** greatly **simplify** the structure of the language-agnostic HamNoSys **without significant impact** of gloss meaning*

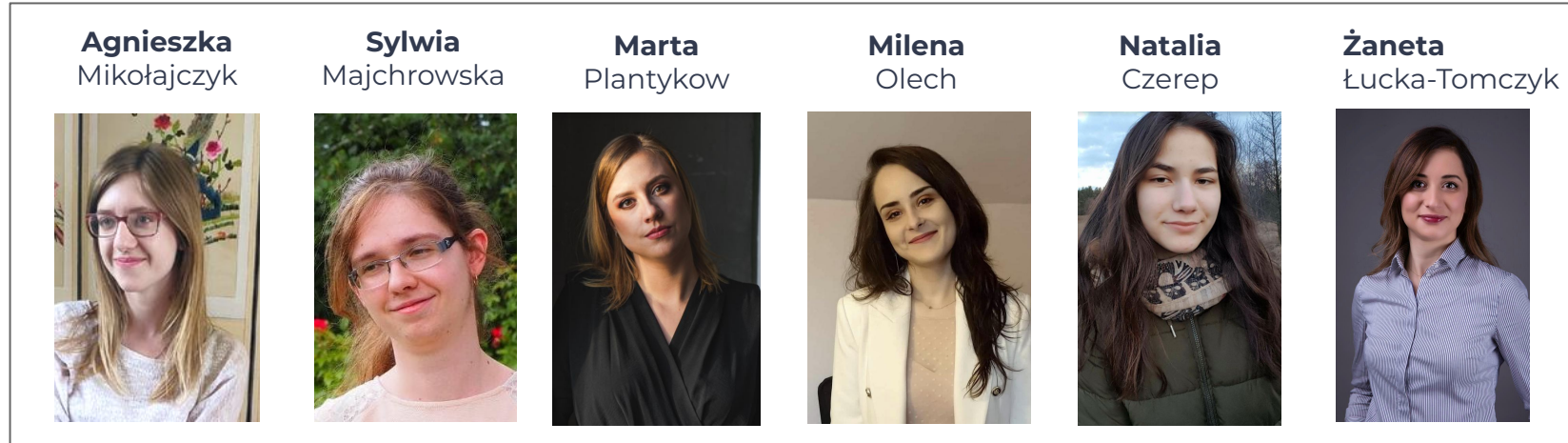
Dataset	Languages	Topics	#glosses	#singly decoded	#decoding efficiency
GLEX	DGS	health	723	684	94.61%
GALEX	DGS	landscaping	514	484	94.16%
Basic Lexicon	BSL, DGS, GSL, LSF	traveling	3078	2580	83.82%
CDPSL	PJM	everyday use	2480	2259	91.09%
GSL	GSL	everyday use	300	283	94.33%

Takeaway message

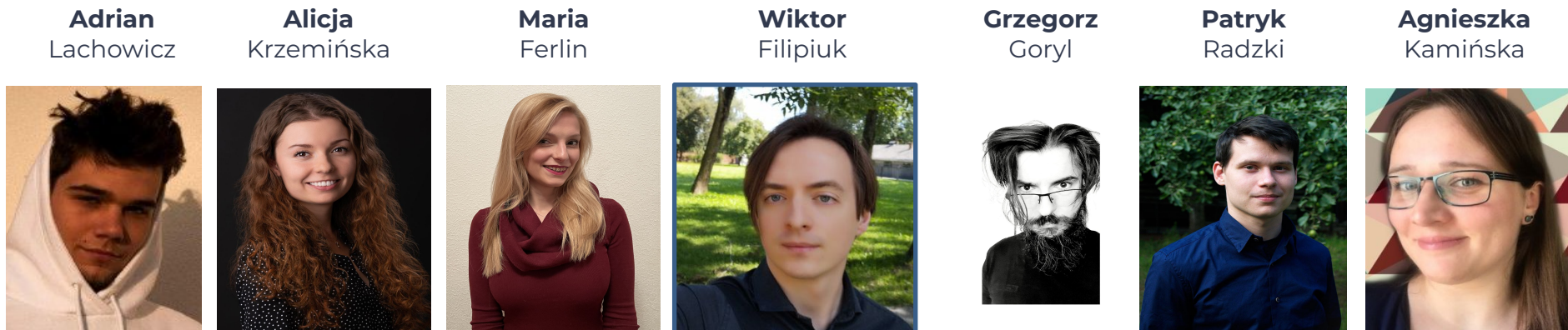
- A major limitation in the development of a sign language recognition system is **limited access to the data**.
- There is no universal sign language, but there are **language-agnostic notations**, such as **HamNoSys**.
- Non-uniform way of HamNoSys labeling make this notation **hard to utilise** for automatic sign language recognition.

HAI Team

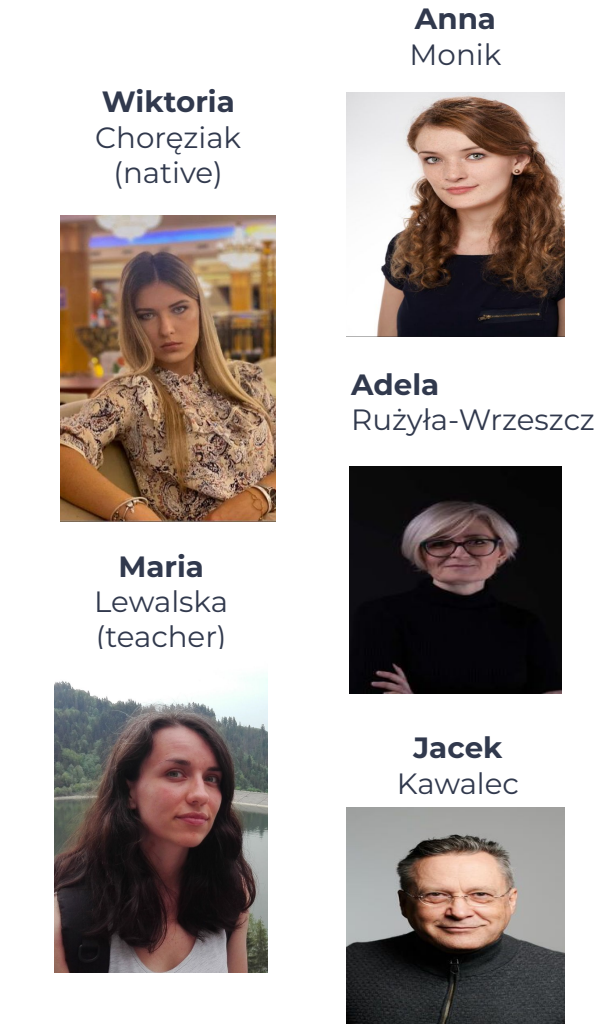
Organizers



Recruited ML Researchers



SL Experts





Digital Innovation Hub
Gdańsk



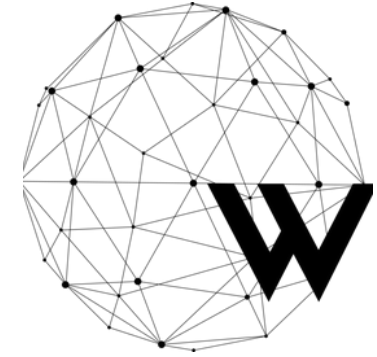
VoiceLab.AI
Conversational Intelligence



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MIGAM
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WAI
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SPONSORS



Toucan Systems



Stenograf is a brand of
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Fundacja Polskiego
Funduszu Rozwoju



Intel Technology Poland



Neptune.ai
Experiment management tool

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HearAI
AI FOR SIGN LANGUAGE

A stylized graphic of two hands in yellow, positioned to form the letter 'A'.

Signer's view:

- ^ Up
- ↗ Up right
- > Right
- ↘ Down right
- ∨ Down
- ↙ Down Left
- < Left
- ↖ Up left

Bird's view:

- △ O
- ↖ OR
- ⊥ IR
- ∨ RI
- ⊥ IL
- ↗ OL

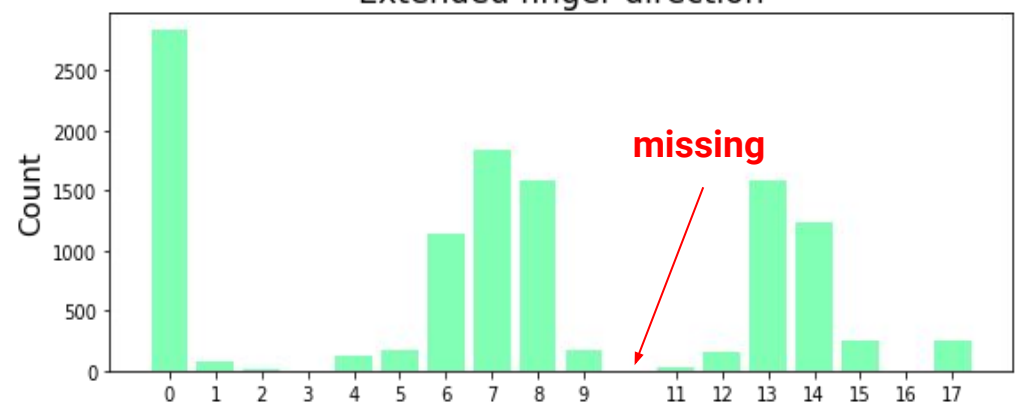
From-the-right view:

- ⊥ IL
- ⊥ OL
- ↖ UO
- ↙ DO

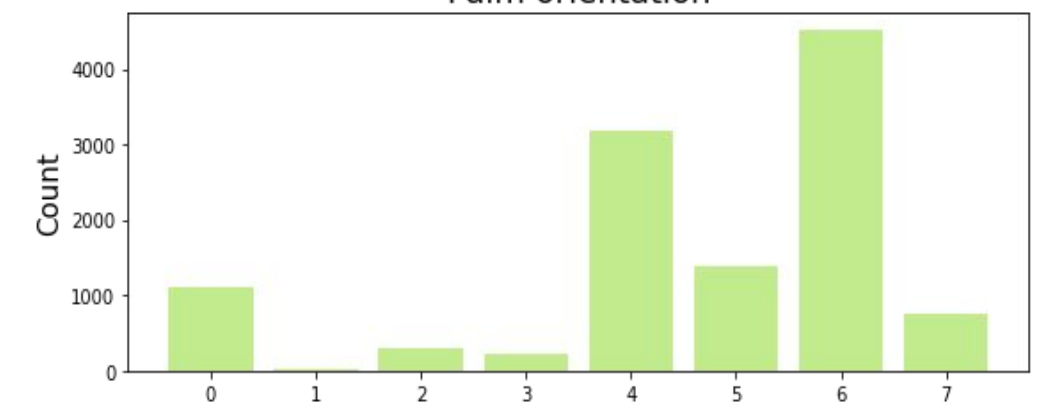
Palm orientation:

- Up
- ↘ Up right
- Right
- ↙ Down right
- Down
- ↖ Down left
- Left
- ↗ Up left

Extended finger direction



Palm orientation



Frontal plane (top/down):

- Head top
- Head
- ∩ Forehead
- ⋈ Nose
- ⊥ Nostrils
- Lips
- ⊖ Tongue
- ⊖ Teeth
- ∪ Chin
- ∪ Underchin
- ∪ Neck
- ∪ Shoulder top
- ∪ Shoulders
- ∪ Chest
- ∪ Stomach
- ∪ Below stomach
- ∞ Eyebrows
- ∞ Eyes
- ∩ Ear
- ∩ Earlobe
- ∩ Cheek

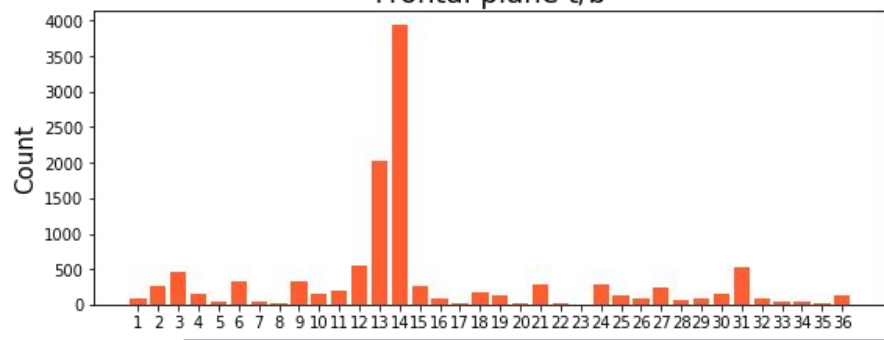
Frontal plane (top/down):

- ◌○ Left to
- ◌○ Left side of
- Center
- ◌ Right side of
- ◌ Right to

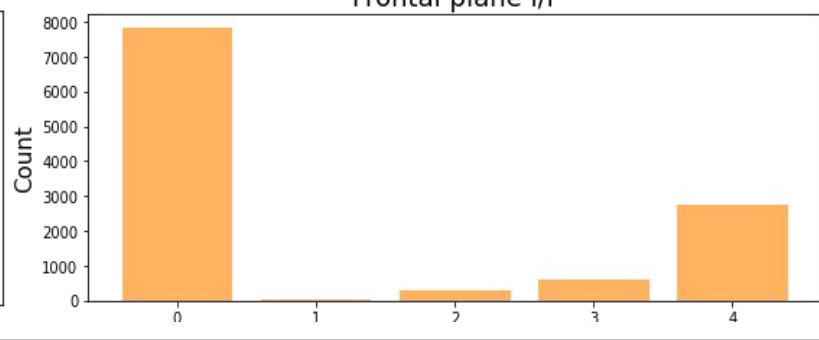
Distance from the body:

- ⌞ Behind the body
- ∩ Contact with body part
- ∩ Close to body part
- Standard
- ↪ Max (extended arm)

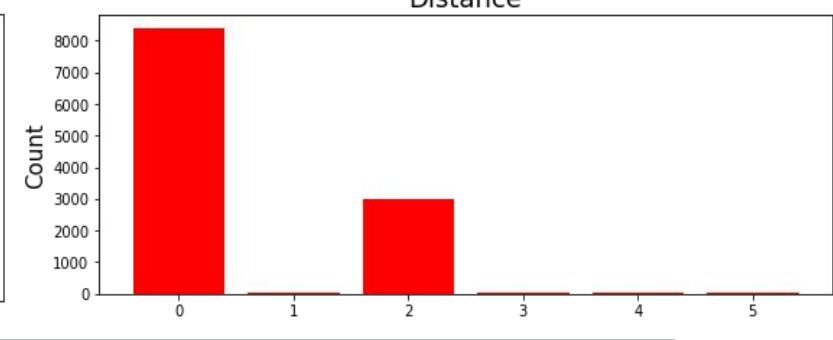
Frontal plane t/b



Frontal plane l/r



Distance

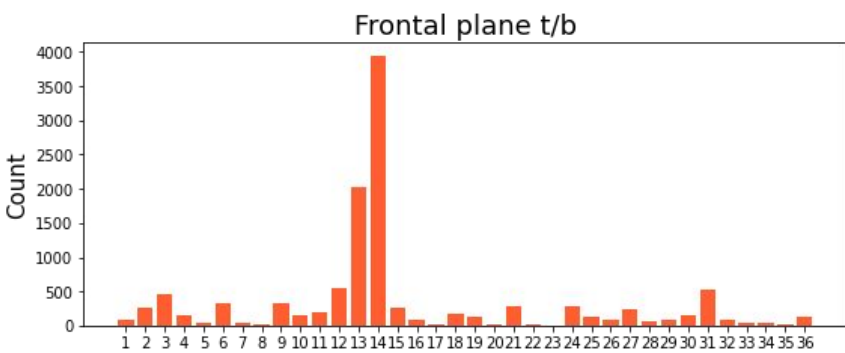


Frontal plane (top/down):

- Head top
- Head
- ∩ Forehead
- ⋈ Nose
- ⊥ Nostrils
- Lips
- ⊖ Tongue
- ⊖ Teeth
- ∪ Chin
- ∪ Underchin
- ∩ Neck
- ∩ Shoulder top
- ∩ Shoulders
- ∩ Chest
- ∩ Stomach
- ∩ Below stomach
- ∩ Eyebrows
- ∞ Eyes
- ∩ Ear
- ∩ Earlobe
- ∩ Cheek

		Front side	Back side	Right side	Left side
∩	Upper arm	∩	∩ ↶	∩ □	□ ∩
∩	Elbow	∩	∩ ↶	∩ □	□ ∩

		Right and left hand		Right hand		Left hand	
		Hand back side	Palm side	Ulnar side	Radial side	Ulnar side	Radial side
∩	Finger tip	∩					
∩	Fingernail, Finger pad	∩ ~	∩ ~	∩ □	□ ∩	□ ∩	∩ □
∩	Middle joint of finger	∩ ~	∩ ~	∩ □	□ ∩	□ ∩	∩ □
∩	Base joint of finger	∩ ~	∩ ~	∩ □	□ ∩	□ ∩	∩ □
	Hand	∩	∩	∩	∩	∩	∩
∩	Ball of thumb	∩ ~	∩ ~	∩ □	□ ∩	□ ∩	∩ □
∩	Wrist joint	∩ ~	∩ ~	∩ □	□ ∩	□ ∩	∩ □
∩	Forearm	∩ ~	∩ ~	∩ □	□ ∩	□ ∩	∩ □



Two-handed signs

symbol flips the marked directions:	left/right	up/down	away from / towards body
⋮			
⋯	✓		
⋮ •		✓	
⋯ •	✓	✓	
⋮ —			✓
⋯ —	✓		✓
⋮ • —		✓	✓
⋯ • —	✓	✓	✓

