Hey Robot, Why Don’t You Talk To Me?

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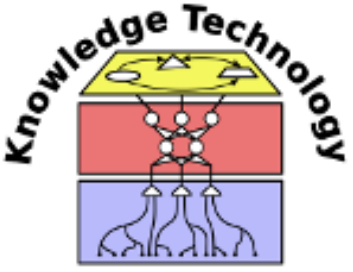

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Motivation

- Human-centric environment → sociable and interactive
  [Brooks et al., 1999] [Breazeal, 2003]
- Improves user's perception → overall competence [Duffy, 2003]
- Model effective and engaging interactions [Trajkovski and Collins, 2009]
- To present an interaction scenario with the NICO robot holding an engaging conversation with the users
  - Autonomous interaction
  - Personalization → increase likeability [Dautenhahn, 1995]
  - Object learning scenario: Humanoidly Speaking
    [Hinaut et al., 2015] [Twiefel et al., 2016]

Interaction Video (Part 1)

Outline

- About NICO
- Face Detection and Tracking
- Person Identification
- Speech Processing
- Conversation and Modeling

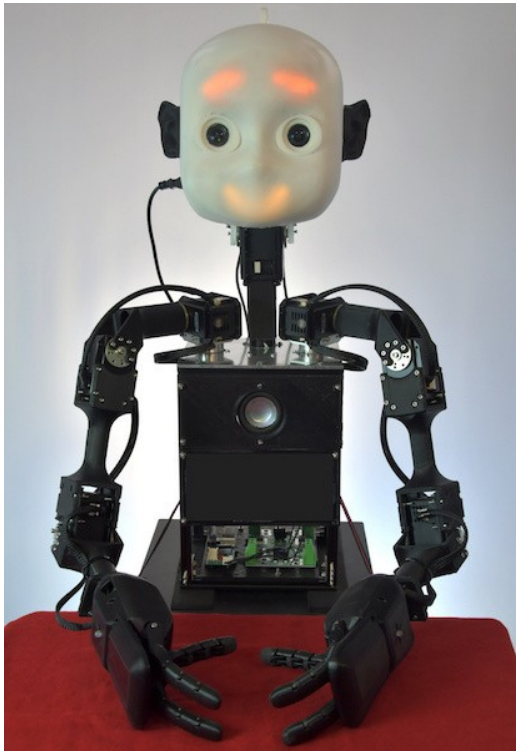


Figure: NICO robot

NICO

- Neuro-Inspired COmpanion Robot
  [Kerzel et al., 2017]
- Built for neuro-cognitive research
- Multi-modal capabilities:
  - Kinetic arms
  - Stereo vision
  - Speech
  - LED facial expressions
  - External microphone

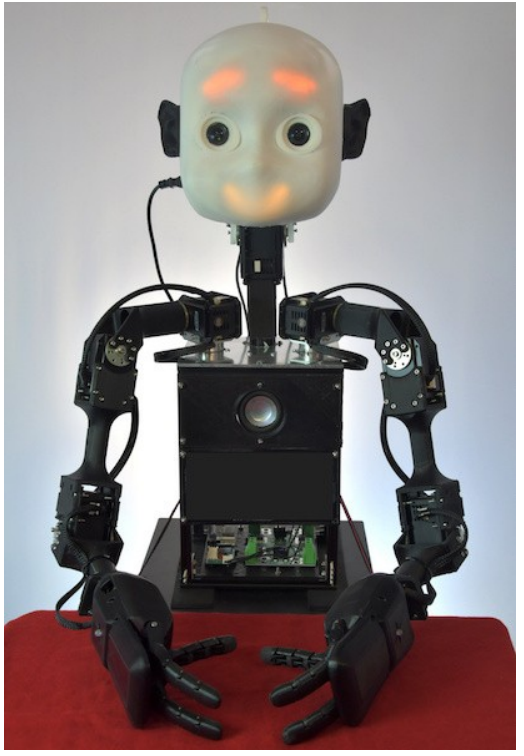
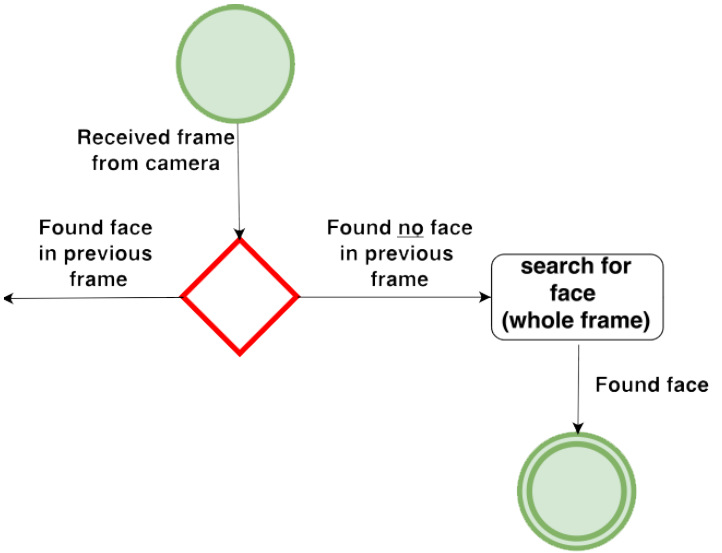


Figure: NICO robot

Face Detection and Tracking

- Haar-like cascades based face detection [Viola and Jones, 2001]
- Extended with template matching



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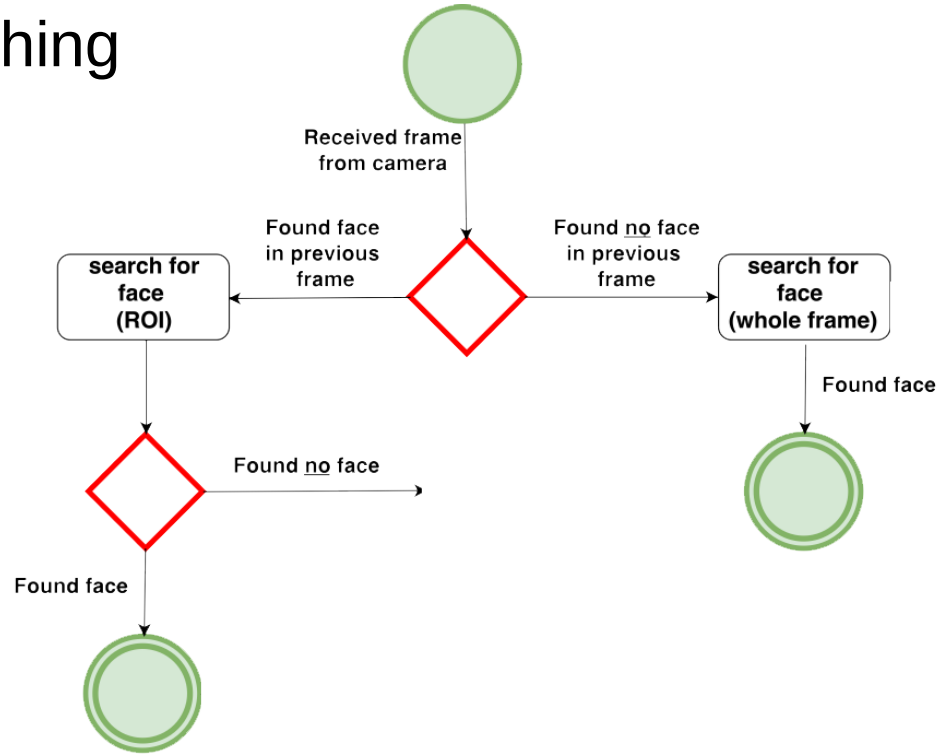

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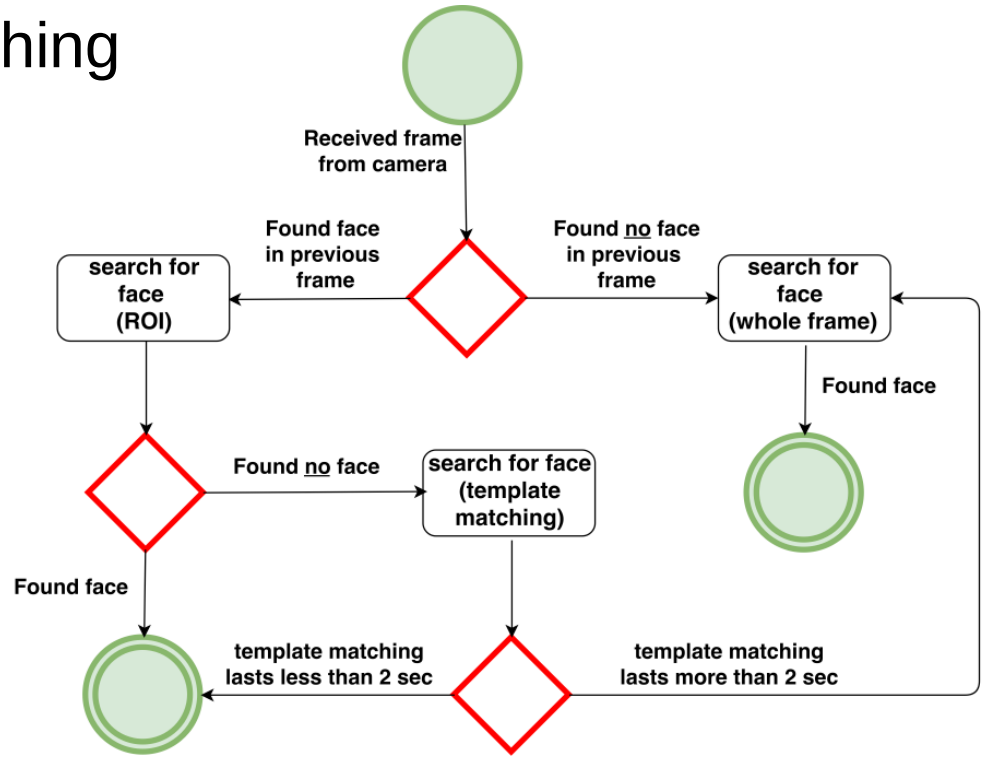
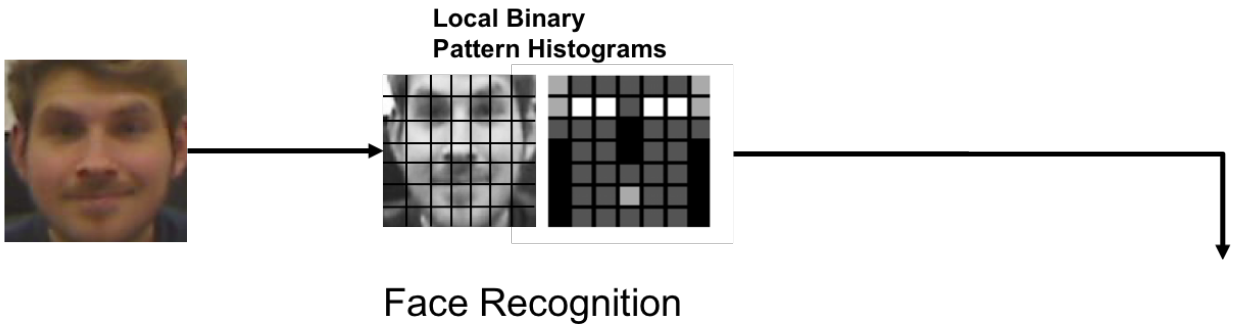


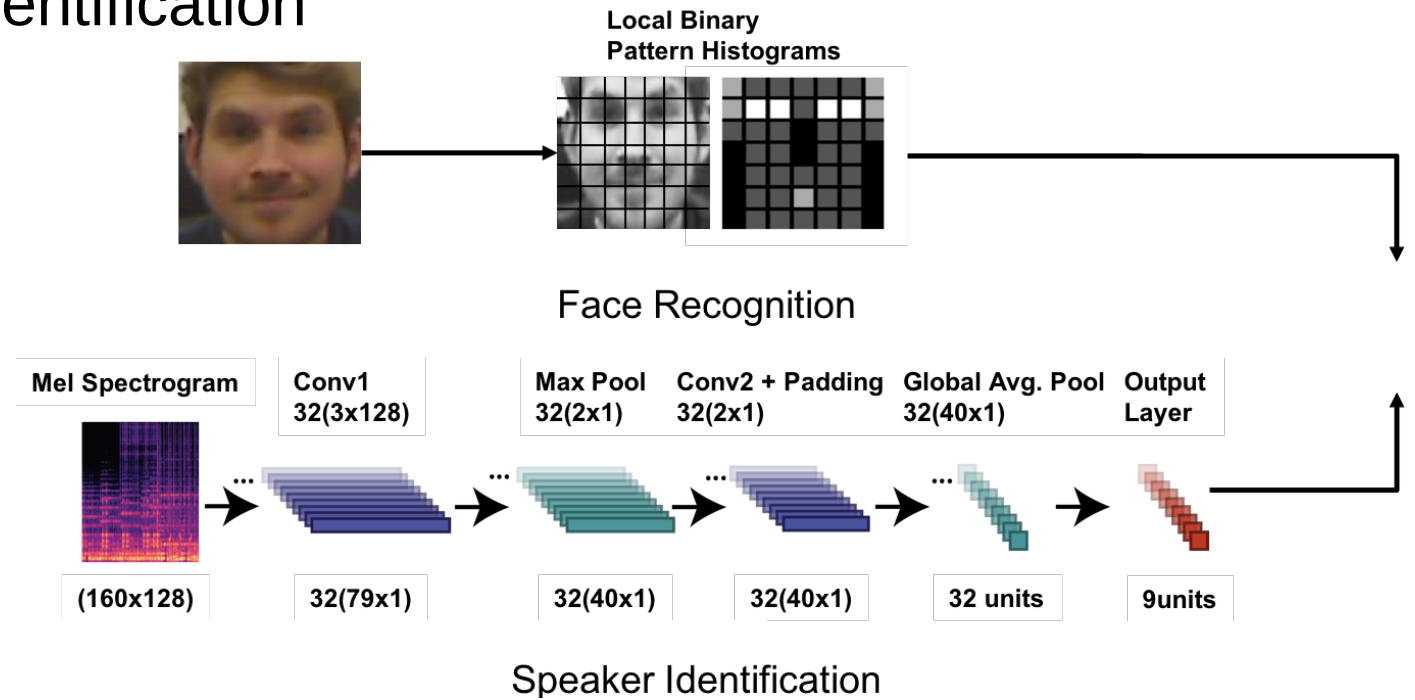
Person Identification

- Face recognition



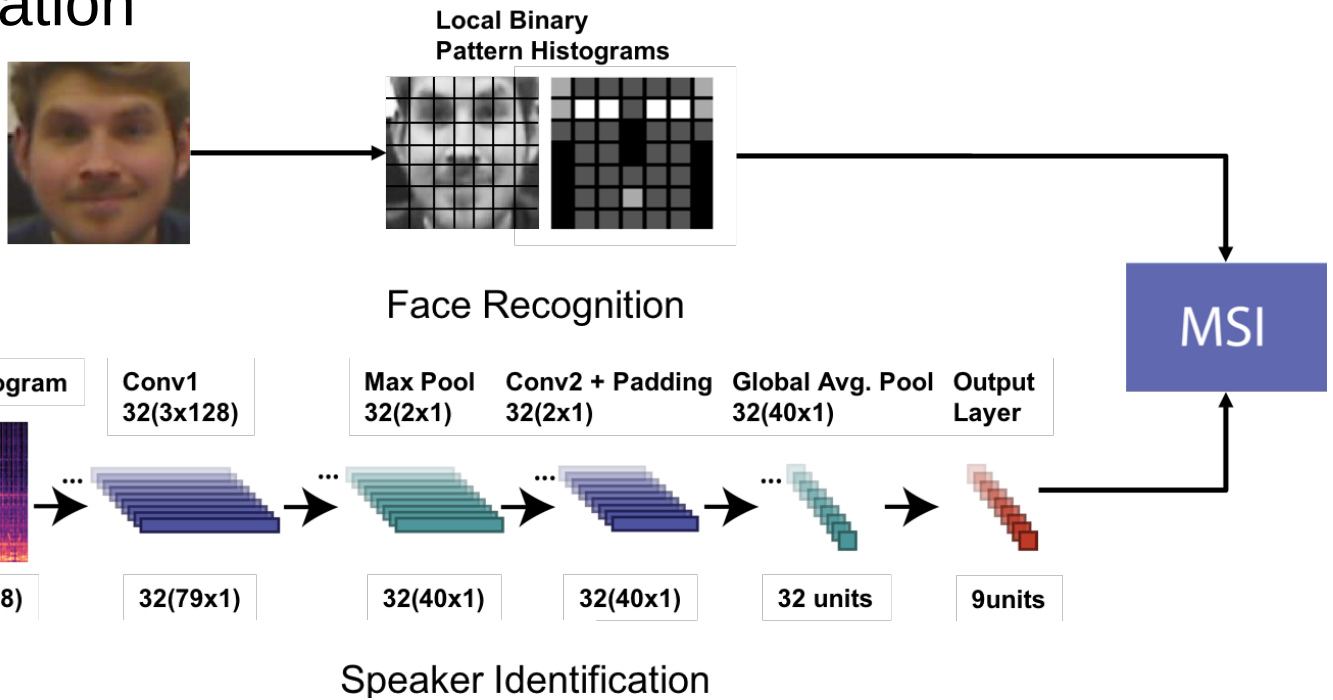
Person Identification

- Face recognition
- Speaker identification



Person Identification

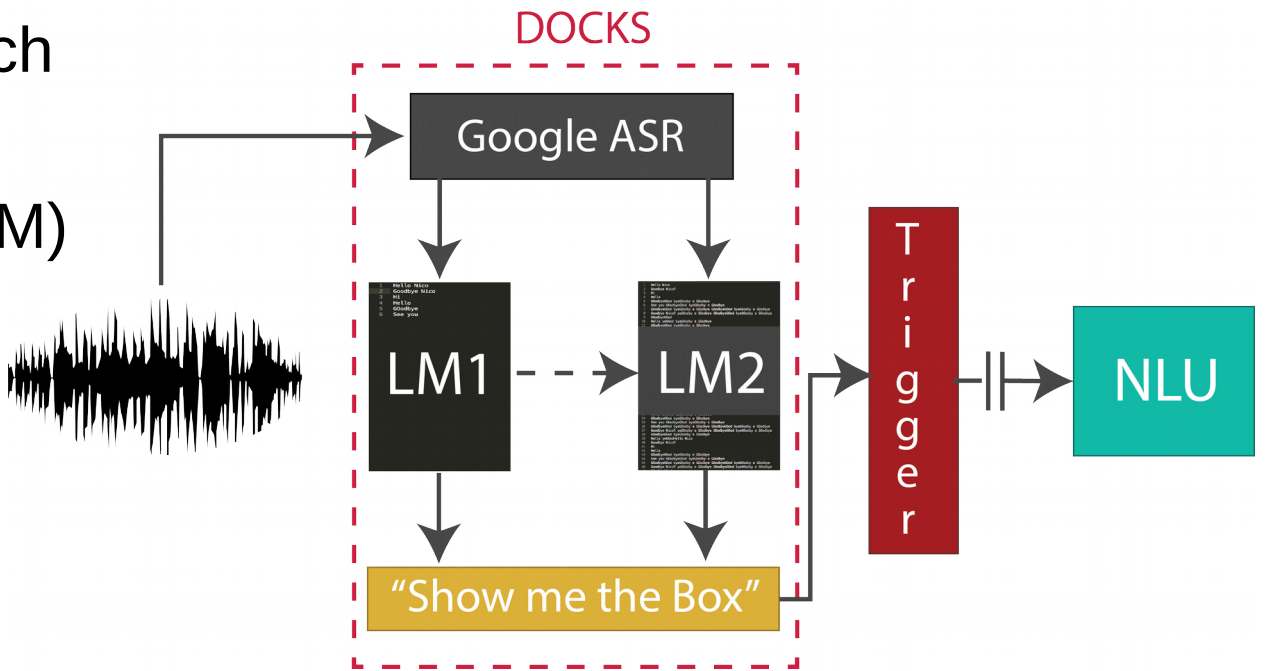
- Face recognition
- Speaker identification
- Multi-sensory integration



Speech Processing

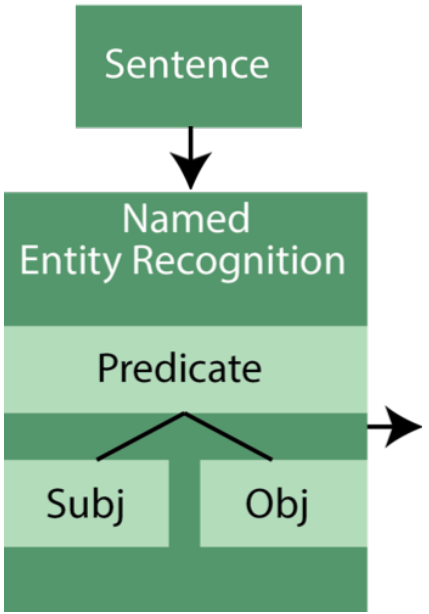
- Speech recognition using the DOCKS framework (DOmain- and Cloud-based Knowledge for Speech recognition) with Language Models (LM)

  [Twiefel et al., 2014]



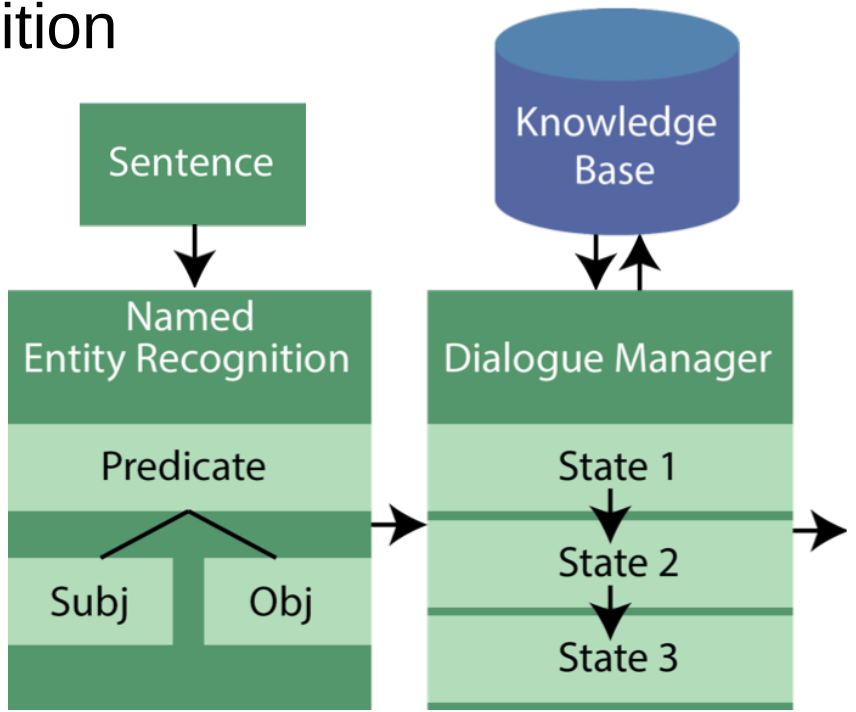
Conversation Modeling

- Natural Language Understanding:
  Named Entity Recognition



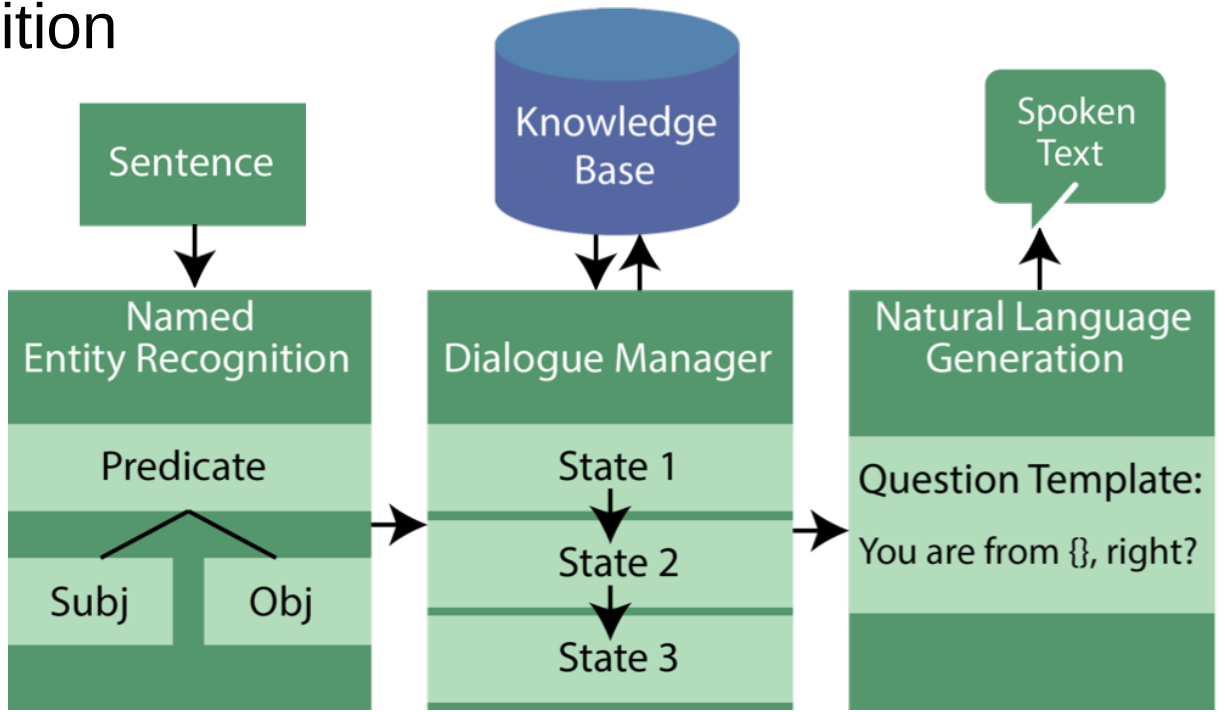
Conversation Modeling

- Natural Language Understanding: Named Entity Recognition
- Dialogue Manager
- Knowledge Base

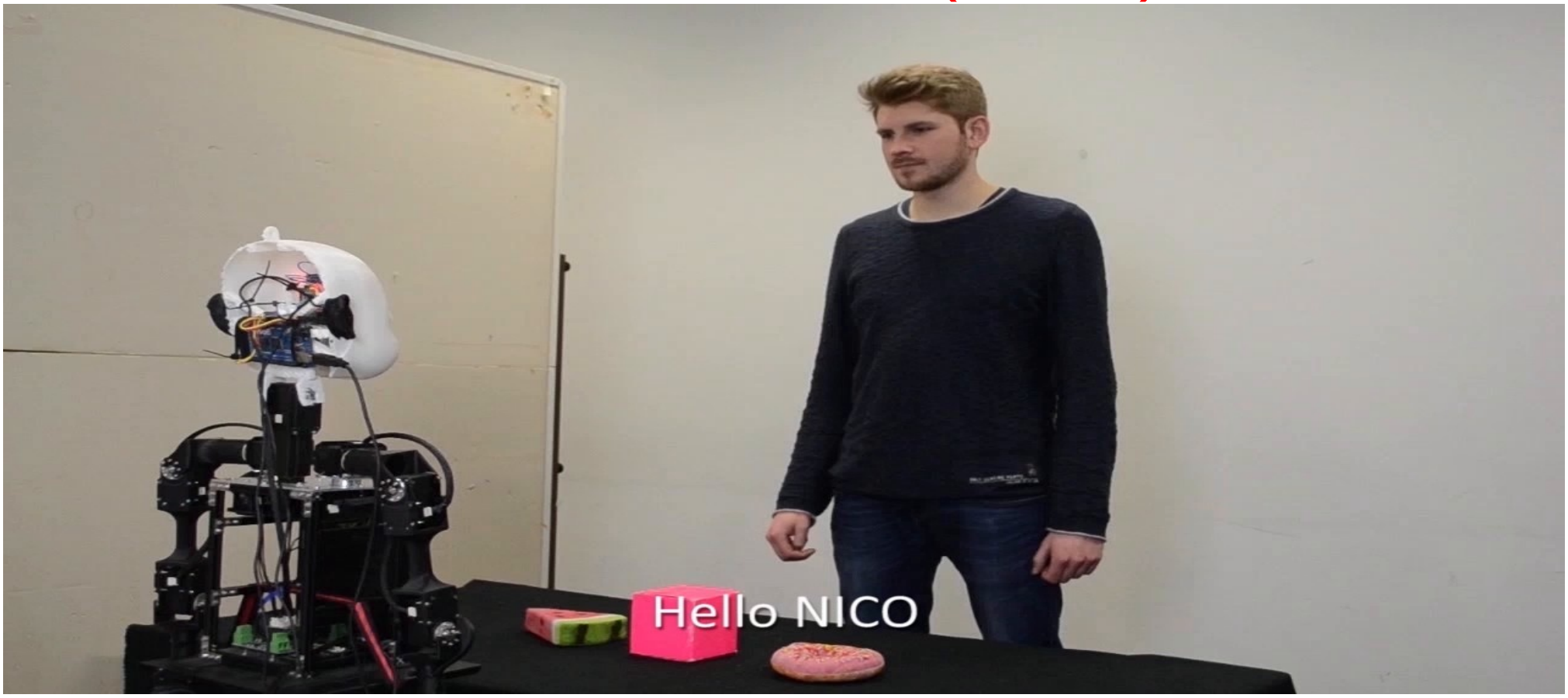


Conversation Modeling

- Natural Language Understanding: Named Entity Recognition
- Dialogue Manager
- Knowledge Base
- Natural Language Generation and text-to-speech synthesis



Interaction Video (Part 2)



Summary

- NICO as a personalised interactive social robot
  - Performs face recognition and tracking
  - Recognizes the user through vision and speech
  - Understands user's natural language
  - Generates replies through conversation modeling
- Autonomous and personalised interaction
- Further experiments presented in:

  "The Impact of Personalisation on Human-Robot Interaction in Learning Scenarios" [Churamani et al., HAI, Bielefeld, Germany, October 2017]

Thank You

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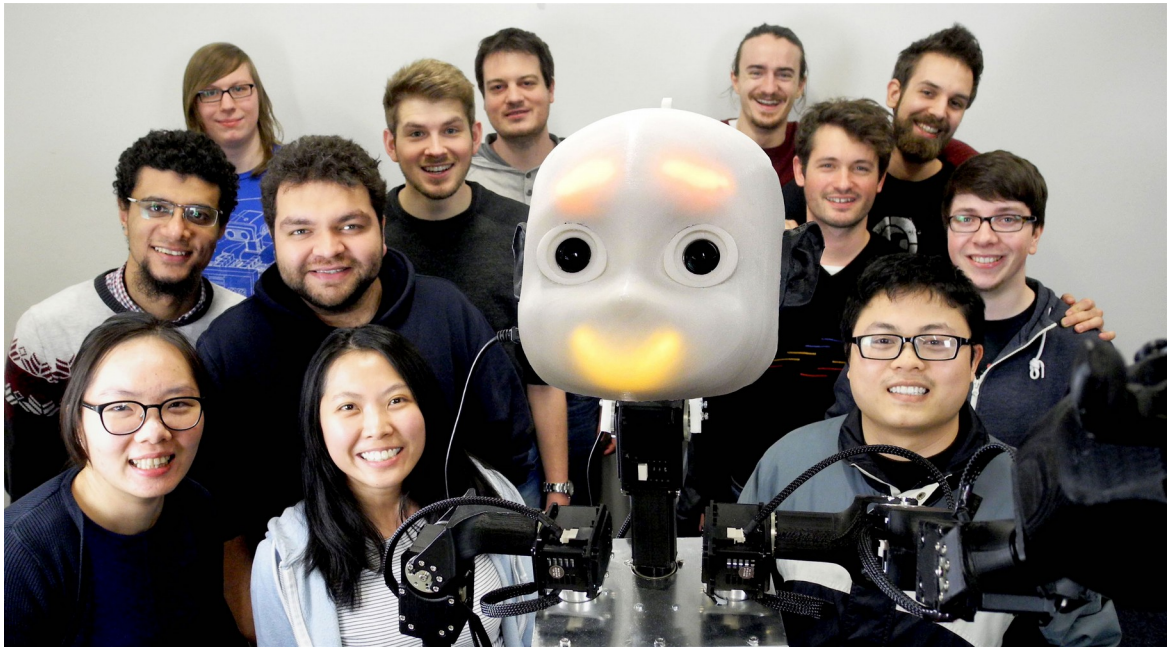

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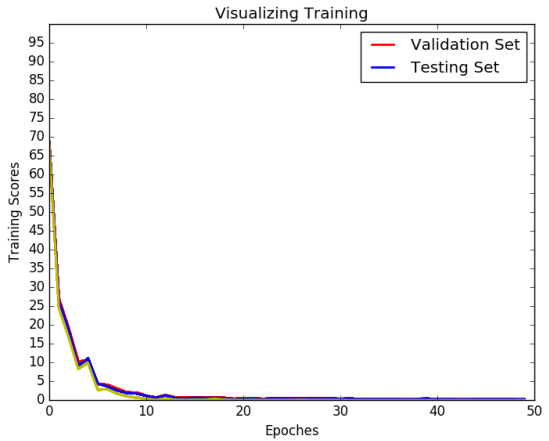
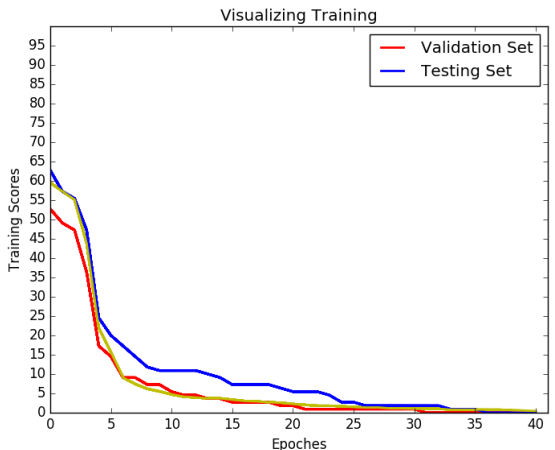
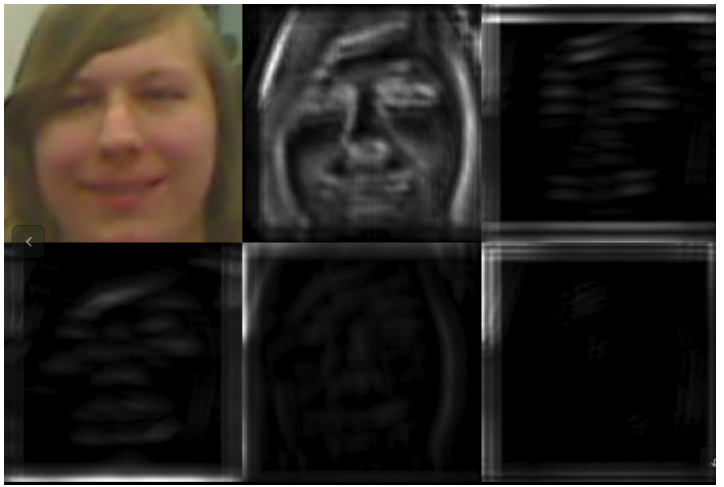
Face Recognition and Tracking using CNN



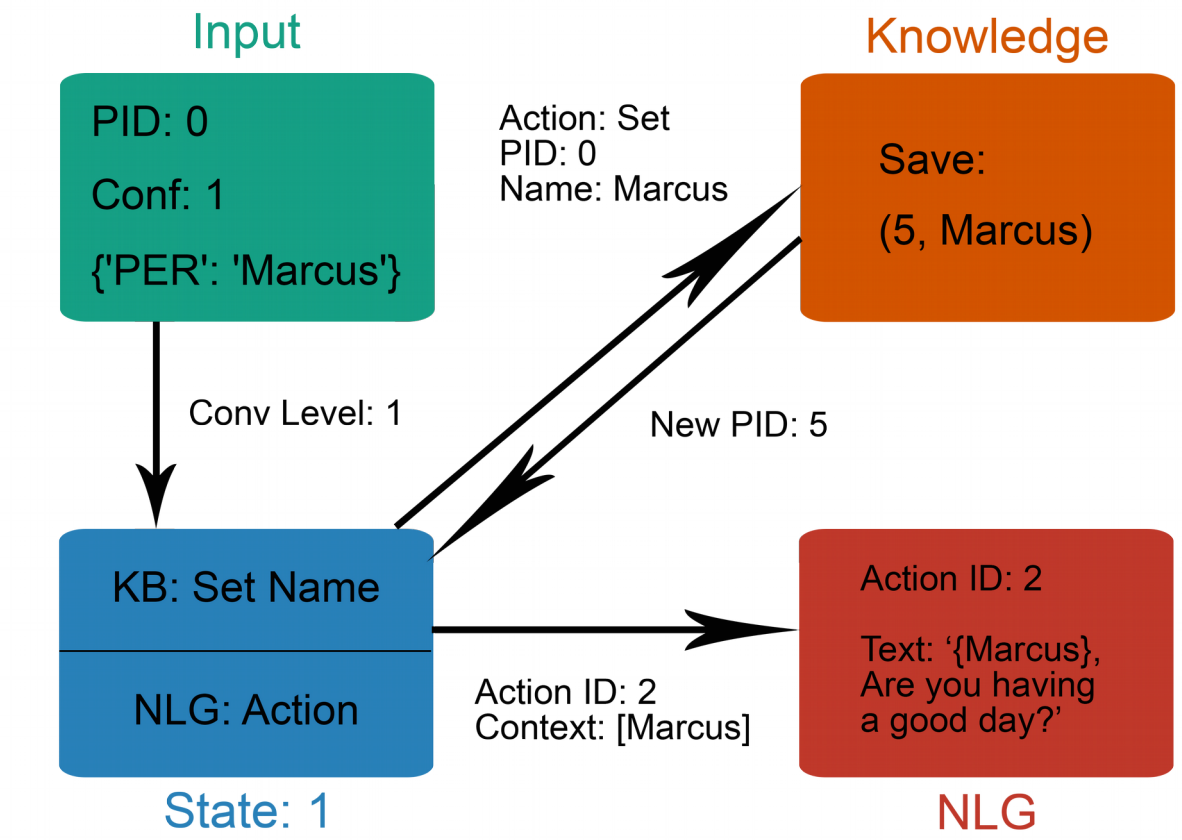




Speech Recognition

Method	Feature	Training Accuracy	Testing Accuracy
CNN	MFCCs	98%	76%
CNN	Mel-Spectogram	96%	94%
GMM using Fischer vectors and LDA	MFCCs	-	96%

Conversation Modeling



Conversation Modeling

User‘s Utterance	Input Received	Executed State	Actions Performed	Transition	Output Utterance
‘Hello NICO.’	ConvLvl: 0 PID: 0 Pred:{‘hello’: ‘’}	Hello	- If PID is unknown, set AID = 2	Set ConvLvl = 1	AID: 2, ‘Hello, what‘s your name?’
‘My name is Erik.’	ConvLvl: 1 PID: 0 Pred:{‘PER’:‘Erik’}	Name	- Set name to KB - Get PID: 1 - Set to known person - Set AID = 5 - NLG args: ‘Erik’	Set ConvLvl = 2	AID: 5, ‘That‘s a good name, {Erik}. I will remember it. Are you having a good day?’
‘Yes, I am.’	PID: 1 Pred: {‘INTERJECTION’:‘YES’}	Day	- If yes, set AID =7 - Save answer to KB	Set ConvLvl = 3	AID: 7, ‘I am so happy to hear that. Is this your first time participating in an experiment?’
…..					
‘Goodbye NICO.’	ConvLvl: 42 PID: 1 Pred:{‘goodbye’: ‘’}	Demo_1	- If goodbye, set AID = 1 - NLG args: ‘Erik’	Set ConvLvl = 0	AID:1, ‘Ok, {Erik}, I really enjoyed our conversation today, but let‘s take a break and I will see you soon.’

Preliminary Results

- Experiments:
  - Perceived intelligence
  - Social acceptance
  - Likeability
- Results:
  - More intelligent
  - More likeable
  - More engaged in conversation