



OpenDial: A Toolkit for Developing Spoken Dialogue Systems with Probabilistic Rules

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Dialogue modelling

- Hybrid, logical/probabilistic approach to dialogue modelling based on probabilistic rules
- The rules are structured as if...then...else constructions mapping logical conditions to probabilistic effects
- They can be used to express both conditional probability distributions and utility functions
- Each rule may contain unknown parameters
 (probabilities or utilities) to estimate from interaction data via supervised or reinforcement learning
- The formalism provides a (logic-based) abstraction layer on top of classical probabilistic models
- Benefits: reduced size of parameter space, integration of expert knowledge into the domain models

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Architecture Language Dialogue Generation Understanding management V.... User dialogue System System utterance um action a_m User utterance uu Speech Speech Dialogue recognition synthesis state Extra-verbal Situation modalities awareness

- Blackboard design centered on the dialogue state (represented as a Bayesian Network)
- Dialogue domain (encoded in XML format) =
 - 1. initial dialogue state
 - 2. list of domain models (collections of rules)
 - 3. settings for the external modules

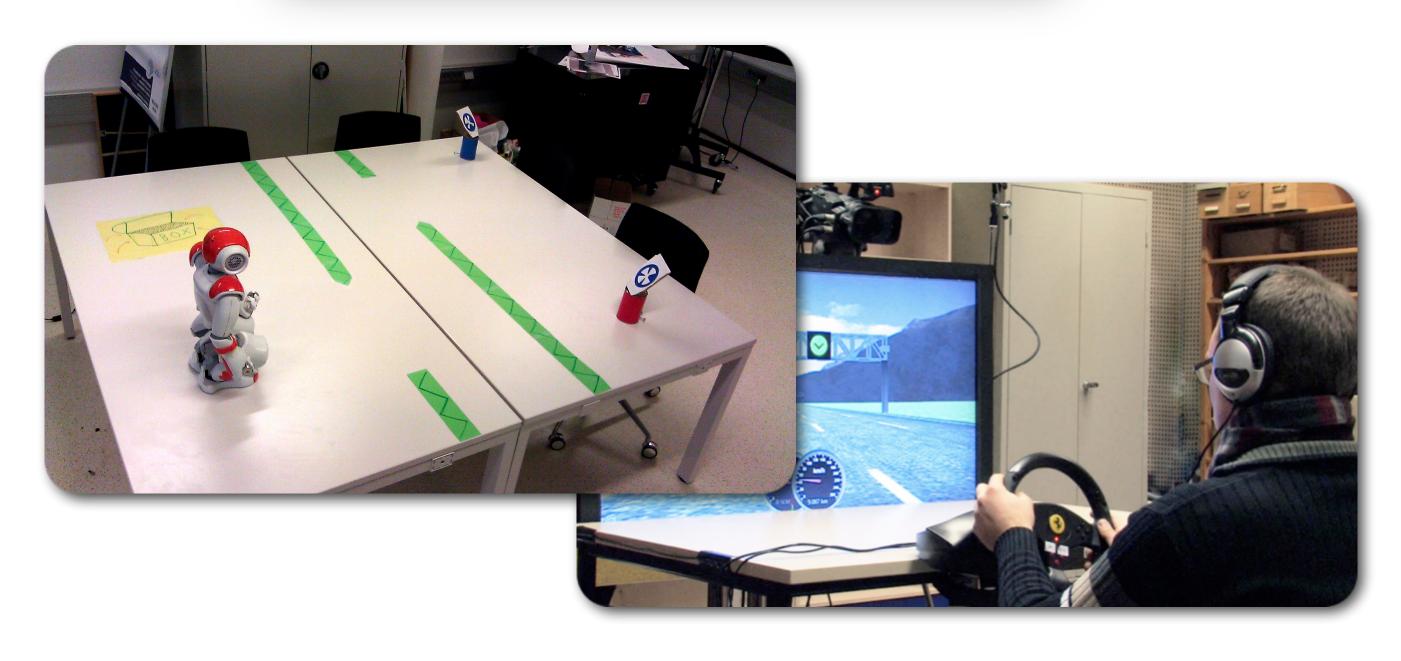
Implementation

- Developed in Java, MIT open-source license
- Algorithms for exact & approximate inference, parameter estimation and forward planning
- User interface to easily develop, evaluate and monitor spoken dialogue systems
- Plugins for external components (CMU Sphinx, Mary TTS, MaltParser, Nuance Speech API, etc.)

OpenDial toolkit - domain: esslli2015.xml Domain Interaction Options Help State Monitor Domain editor OpenDial toolkit - domain: esslli2015.xm Options Help Domain Interaction What can I offer you? [system] Interaction State Monitor [user] Chocolate bar please (0.5455) The chocolate bar please (0.2727) XML File(s): l< dom ain> Barclays (0.1818) esslli2015.xml <initialstate> OK, here is your chocolate bar And what (0.5455) < variable id="u_m"> And what about (0.2727) <value prob="1"> What can I offer you?</value> At what (0.1818) OpenDial toolkit - domain: esslli2015.xml Sorry, could you repeat? Domain Interaction id="Nb(WaterBottle)"> Water bottle (0.5455) ue prob="1">6</value> Domain editor What about (0.2727) What you bought (0.1818) Dialogue states: le id="Nb(ChocolateBar)"> Current state OK, here is your water bottle lue prob="1">3</value> Updating a_u^p Updating u_m,Nb(WaterBottle) Updating a_u le id="param"> Press & hold to re Voice Activity Detection Nb(ChocolateBar)

Application domains

- Experiments in human-robot interaction with unknown parameters learned from Wizard-of-Oz data (Kennington et al, 2014, Lison 2015)
- Dialogue manager for a multimodal, in-car driver assistant (Kennington et al, 2014), a cooking coach (Wolf et al, 2015) and a multimedia system for cultural exhibits (Sorgente et al, 2016)
- Current work on integrating OpenDial for intelligent tutoring systems and web-based chatbots
- Teaching platform for courses on spoken dialogue systems at several universities in Europe & the U.S.



For details, check the toolkit website at http://opendial-toolkit.net

[release packages, user docs, step-by-step examples]