Knowledge-Driven Slot Constraints for Goal-Oriented Dialogue Systems
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Goal-Oriented Dialogue Systems
• Users provide information through slot values to achieve specific goals.
• The NLU component performs intent classification (IC) and slot labelling (SL)

Motivation: Invalid slot combinations
• Some combinations of slot values are not valid for the task based on the business logic

Constraint Representation
(A) Input utterance: Please add one XL tiles to my order.
Basic NLU output: Intent classification & Slot labelling:
- Intent: AddToOrder
- Slot labels: Please add one (Quantity): [XL:MenulItemSize] [Fries:MenulItem] to my order.
(B) Constraint: c_f (c_f, c_l) with c_f = (MenulItem, MenulItemSize, and c_l = (MenulItem, = 'Fries') AND (MenulItemSize, in, ['small', 'medium', 'large']))
OR (MenulItem, = 'Fries') AND (MenulItemSize, in, ['medium', 'large', 'extra large']))
OR (MenulItem, = 'Fries') AND (MenulItemSize, in, ['small', 'medium']

Slot Constraint Violation Detection Task
• Given: a bot schema with constraints, a current utterance, and a conversation history
• Predict: whether the current state of conversation violates any constraints or not and which constraints are violated

Approaches
• Deterministic Pipeline Approach
  • IC/SL: JointBERT (Chen et al., 2019)
  • (Open) Entity Linking: Also predict ‘None’ if the slot value cannot be linked to any known entity
  • Deterministic satisfiability check

Approaches (Cont’)
• Probabilistic Pipeline Approach
  • We use the probability distribution (via softmax) over the candidate entities (including None) to represent the slot value.
  • Violation score = 1 – Σ Prob of all valid entity combinations

Experiments & Results
• We modified two domains, insurance and fast food (turn-level annotation), of the MultiDoGO dataset (Peskov et al., 2019) to support violation detection.