**Setup**

**Task**: Parse the sentence $x$ into Task Oriented Parse (TOP), a tree-based semantic representation with nested intents and slots [1].

- **IN:GET_DIRECTION** directions to
- **SL:DESTINATION**
- **IN:EVENT**
- **SL:ORGANIZER** $s_l$, **SL:CATEGORY** $p_l$

The hierarchical representation enables a dialog system to perform multi-step task fulfillment:

- **IN:EVENT**: Find the event’s address.
- **IN:DIRECTION**: Use the queried address to get the direction.

Previous span-based parsing algorithms [2, 3, 4] score the labels of each span independently, then decode a valid tree with the highest tree score ($\approx$ total scores of the labels).

**Contributions**

**Contribution 1**: We reformulate the tree score as log-likelihood of the tree.
⇒ Training becomes highly paralellizable + No need to run a slow decoder during training.
⇒ Faster training

**Contribution 2**: Instead of scoring span labels independently, we introduce edge scores that model label dependency between parent and child nodes.
⇒ Higher accuracy

**References**


