Towards Task Understanding in Visual Settings

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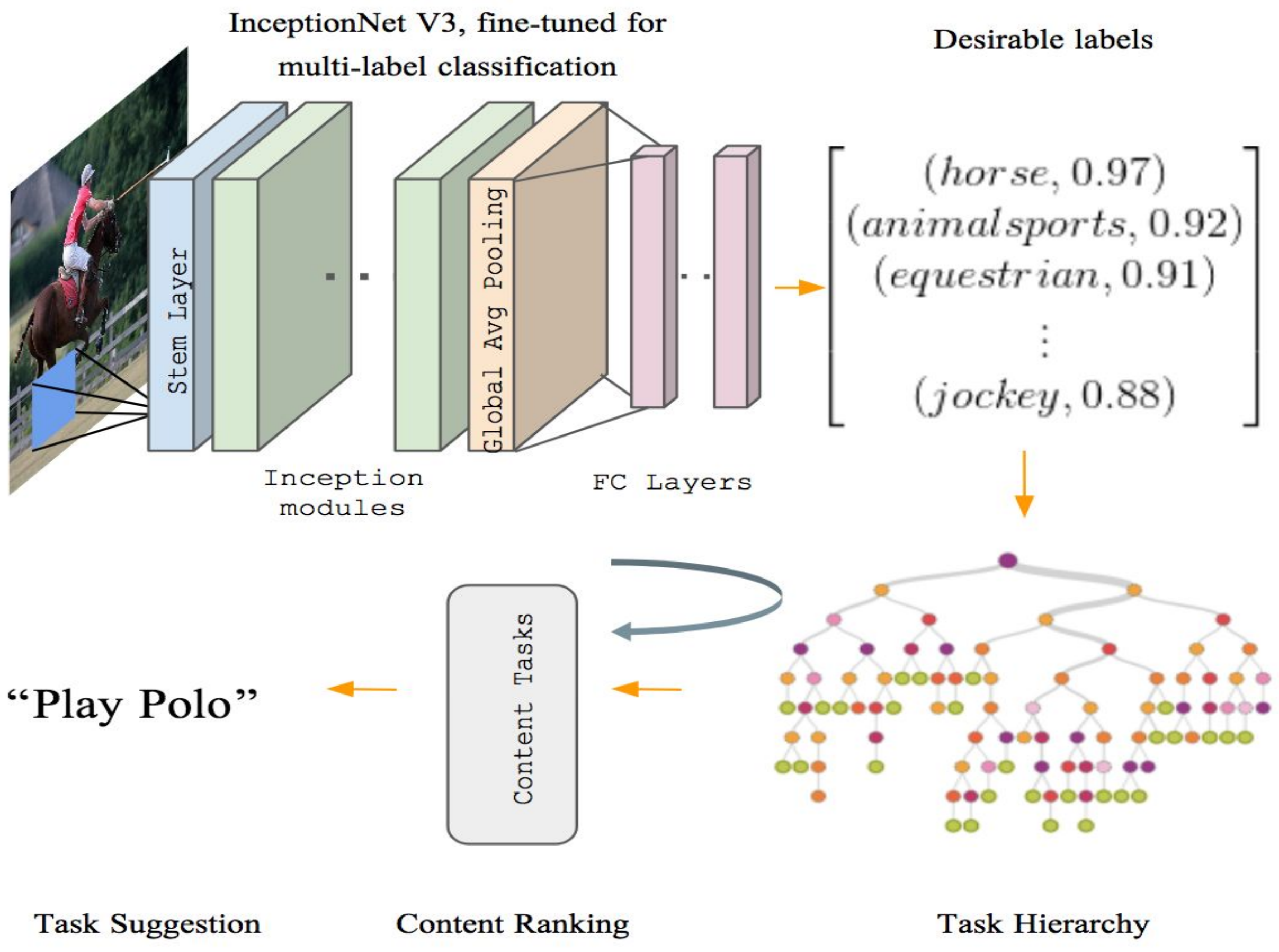
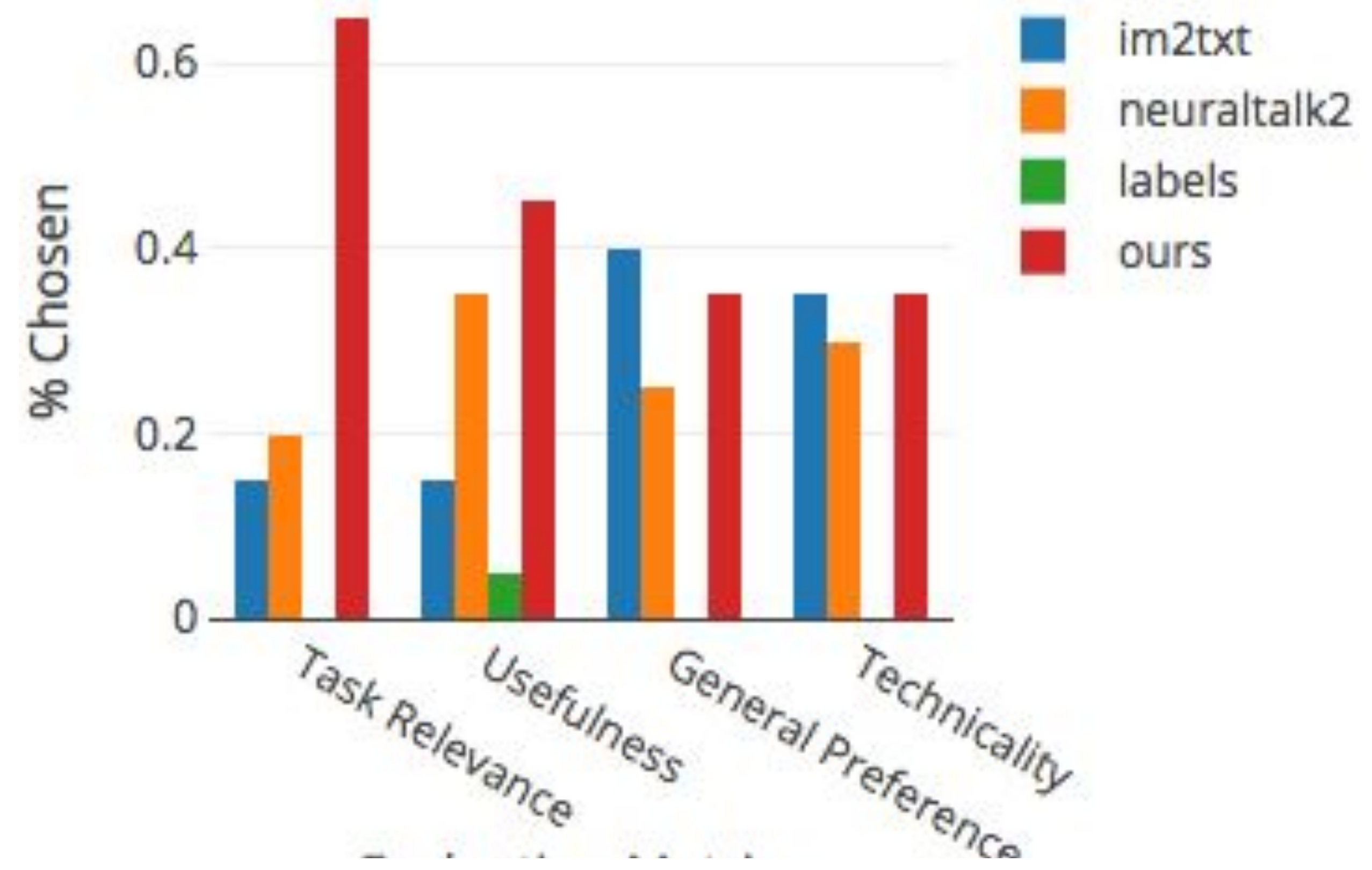
https://usercontext.github.io/SceneTask

Motivation

- Need for an understanding of the exact **task being undertaken** rather than a literal description of the scene.
- Leverage **insights from real world task understanding systems**, and propose a framework composed of convolutional neural networks, and an external hierarchical task ontology.
- Applications such as **Image alt text** generation.


InceptionNet V3, fine-tuned for multi-label classification
Stem Layer
Inception modules
Global Avg Pooling
FC Layers
Desirable labels
$\begin{bmatrix} (horse, 0.97) \\ (animal sports, 0.92) \\ (equestrian, 0.91) \\ \vdots \\ (jockey, 0.88) \end{bmatrix}$
"Play Polo"
Content Tasks
Task Suggestion
Content Ranking
Task Hierarchy

Architecture



Crowdsourced evaluation on 4 metrics

Results and Discussion

- A **crowd-sourced study** on Amazon Mechanical Turk. In the study, workers answer 10-randomly picked images along with image descriptions generated by NeuralTalk2, multi-label classifier (as baselines) and our method.
- We evaluate on the basis of 4 metrics: **Task Relevance, Usefulness, General Preference and Technicality**.
- Our method outweighs NeuralTalk2 and im2txt captions for t**ask relevance metric by a large margin**.

NeuralTalk2: "baseball player is throwing ball in game"
Our Method: "Pitch a Baseball"

NeuralTalk2: "two young girls are playing with lego toy."
Our Method: "Build a LEGO House"

NeuralTalk2: "a group of people playing a game of frisbee"
Our Method: "Make a Sports Team"

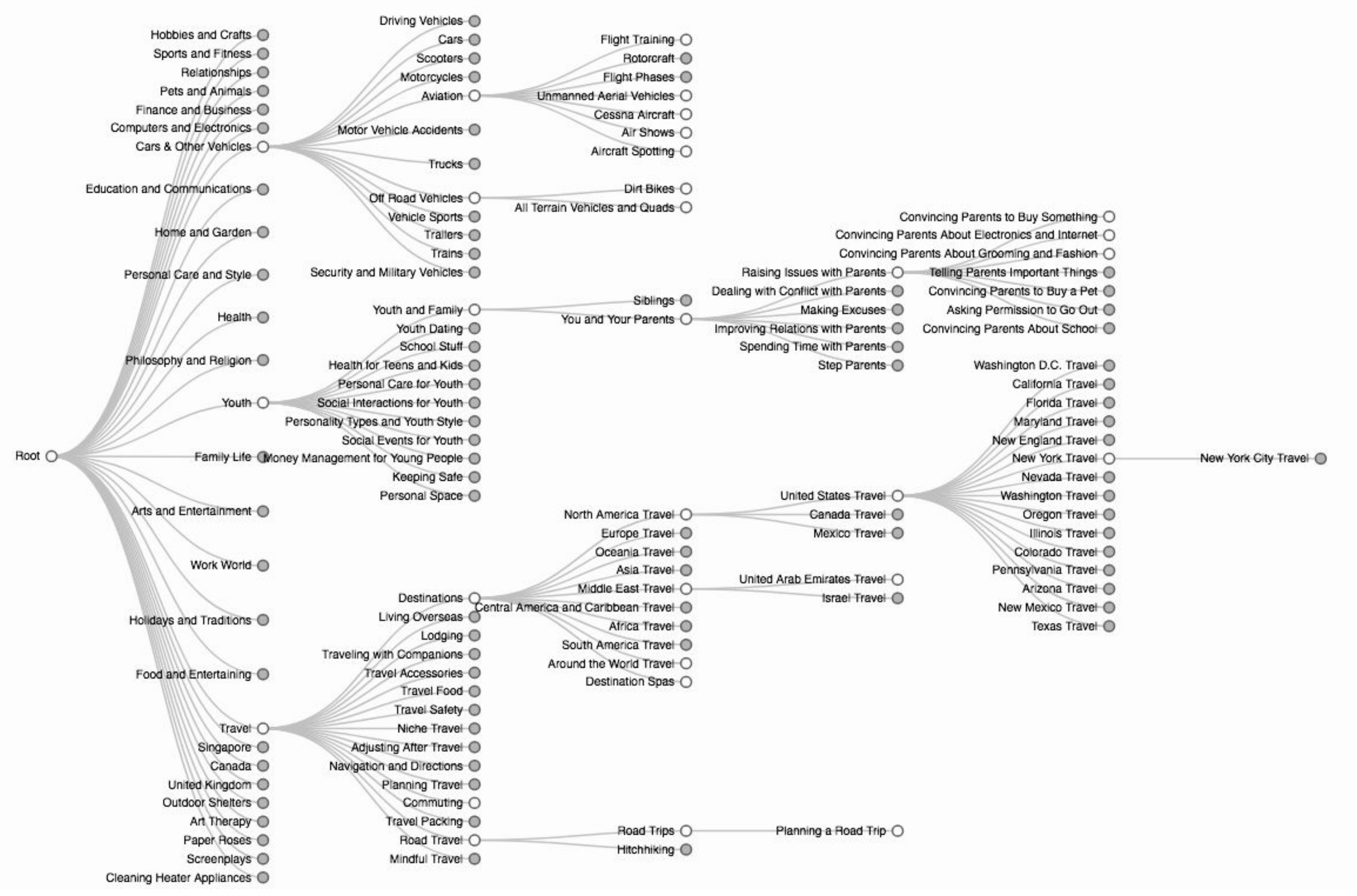
NeuralTalk2: "man in black shirt is playing guitar."
Our Method: "Play an Acoustic Guitar"

Comparisons of description between our work with NeuralTalk2

Approach

In order to extract the tasks depicted in an image, we propose a **two phased model**:

1. Multi-label classification of scenes to generate input labels for the task extractor:
   - **Inception Net** used to produce labels.
   - Modified for **multi-label classification**.
2. **Leveraging external hierarchical ontology** for **task identification** by task extractor.
   - Task Hierarchy contains tasks/categories from Wikihow
   - Modified with insertion of word2vec embeddings at different levels to help with trickling of produced labels. Two embeddings maintained at each node:
     - **Representative Embedding**: to describe the node characteristics in itself.
     - **Average Embedding:** to describe the children of a node. Calculated recursively on the representative embedding. Helps to avoid abstraction at higher levels of the hierarchy.
   - Trickling is based on the semantic similarity between the incoming labels and embeddings at each level.



Task Hierarchy 138K

Conclusion and Ongoing Work

In this work, we propose a novel method for a **scene task suggestion system**. These descriptions can be used for applications like image alt text generation or as priors to existing image description models to **build their descriptions upon**, rather than generating them base up. However, this kind of a system is **constrained to work on scenes where the task being done is a prominent part of it**. We intend to extend this work to aid in the existing dense image description generation, making models intrinsically **more task-aware by injecting task coherence scores** within their architecture.