MO-SHW: Hierarchy-Aware Multi-Objective Optimization for Open-World Segmentation

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Introduction

Goal: Investigate the usage of hierarchical information of classes in open-wrold semantic segmentation. **Motivation**: The exploitation of semantic hierarchies by vision models has shown significant benefits in various segmentation tasks. However, this remains largely unexplored in open-world scenarios, where models must cope with unknown, evolving, and underrepresented labeled class spaces. **Challenges**:

1. Existing hierarchy-aware segmentation approaches are not readily applicable to open-world settings, as they rely on architectural modifications that are incompatible with the design constraints of open-world models.
2. Moreover, hierarchy-aware losses are challenging to integrate into open-world pipelines, as they often conflict with task-specific objectives and exacerbate optimization complexity as these models already include several loss terms.

Contributions

1. **Main**: Enables the exploitation of class hierarchies in open-world segmentation pipelines, and shows it improves segmentation performance in several sub-tasks.
2. Shows that gradient-based multi-objective optimization methods (e.g. MOGD), are well-suited for jointly optimizing hierarchical and task-specific objectives, by better balancing competing objectives and leading to better overall performance.
3. Proposes a novel wassertein-based hierarchy-aware loss function (SHW) for open-world models that enforces hierarchical consistency among pixel embeddings.
4. Introduces a plugplay framework (MO-SHW) that augments open-world segmentation pipelines with hierarchy-awareness. MO-SHW is model-agnostic, lightweight and easily integrable into existing open-world pipelines requiring no architectural modifications.

Methodology Overview