A Unified Debiasing for Vision-Language Model across Modalities and Tasks

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Contents

Background

Versability of Visual-Language Model

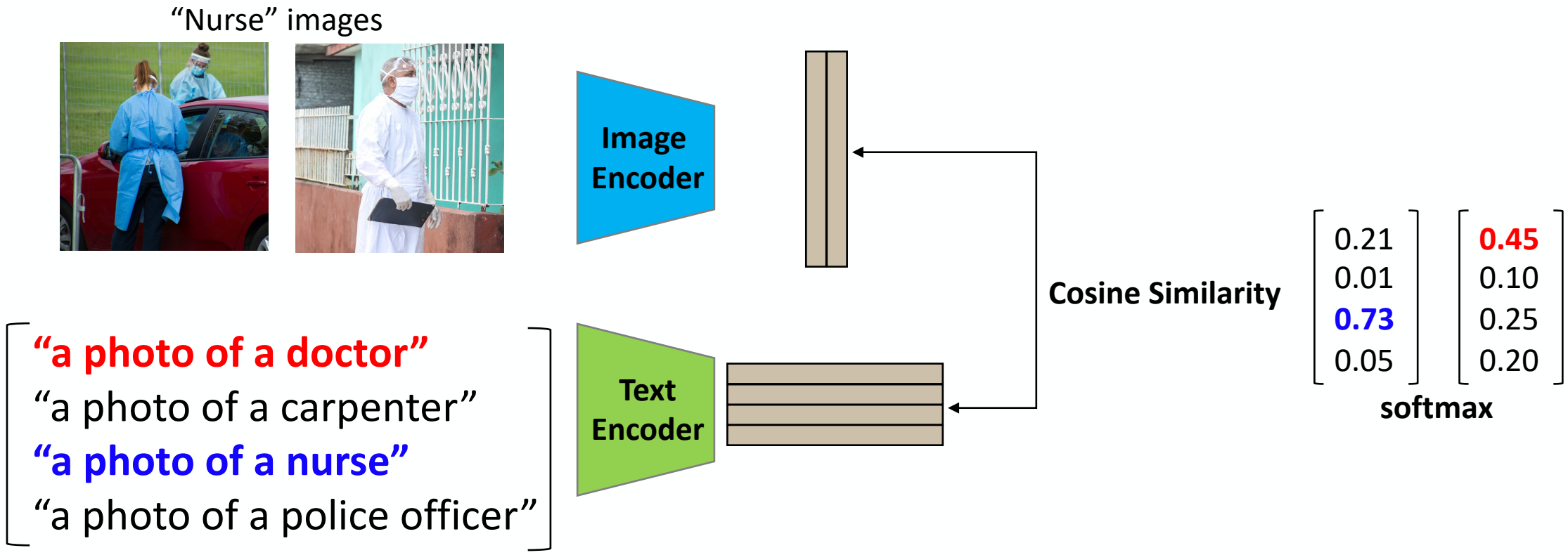
- Visual-Language Model (VLM) serve as foundation models for various downstream tasks
  - Zero-shot Classification
  - Text-to-Image Retrieval
  - Image Captioning
  - Text-to-Image Generation

- However, VLMs often skewing the model outputs in ways that reflect **societal stereotypes** such as gender or racial biases in assigning professions or describing scenarios.

Background

Bias in Zero-shot Classification

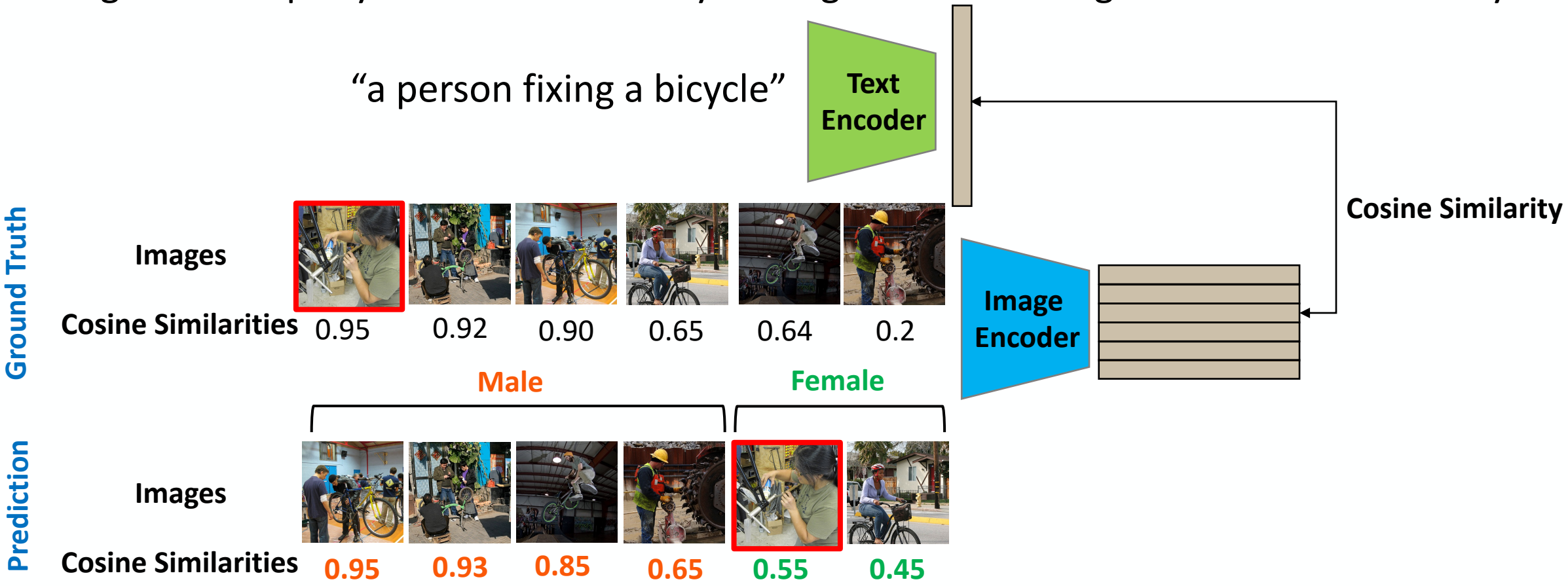
- Predicted class is determined by the highest cosine similarity between image and text embeddings.



Background

Bias in Text-to-Image Retrieval

- Images in the query set are retrieved by sorting them according to the cosine similarity



Background

Bias in Image Captioning

- Image captioning model may produce wrong gender in caption.

CLIP-CAP
A **woman** in a wetsuit surfing on a wave.

CLIP-CAP
A **man** riding skis down a snow covered slope.

Background

Bias in Text-to-Image Generation

- Text-to-Image generation model could be biased by sampling preferring certain gender for a profession.

Prompt: “a photo a person who works as a nurse.”

Prompt: “a photo a person who works as a plumber.”

Background

Bias in Text-to-Image Generation

- Even though we specify the gender, there's still a bias.

Prompt: "a photo a man who works as a nurse."

Prompt: "a photo a woman who works as a builder."

Motivation

Needs for A Unified and Efficient Debiasing Strategy

- Debiasing method often can deal with only a specific downstream tasks, and cannot be applied to others. **(Task-Specific)**

  $\Longrightarrow$ Needs for a unified debiasing strategy for various types of VLM and tasks. **(Task-Agnostic)**

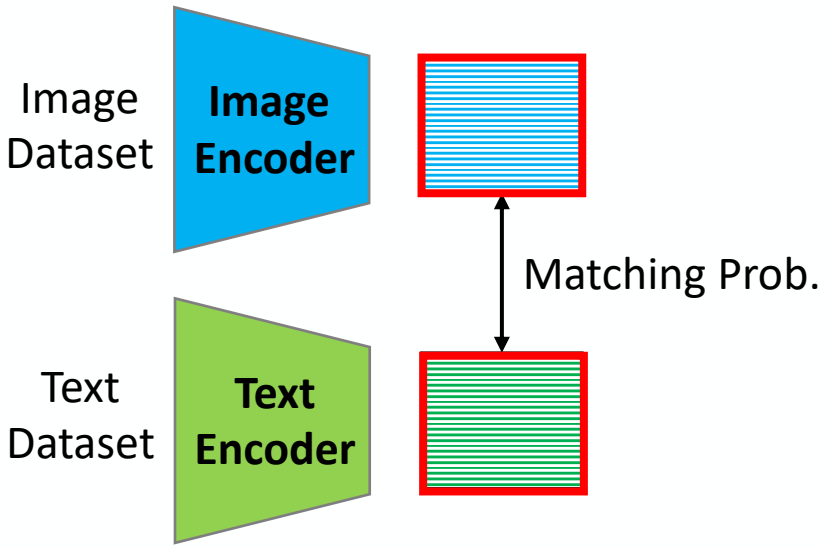
- Moreover, re-training the entire foundational model / VLMs is computationally expensive.

  $\Longrightarrow$ Needs for a **cost-efficient** debiasing approach.

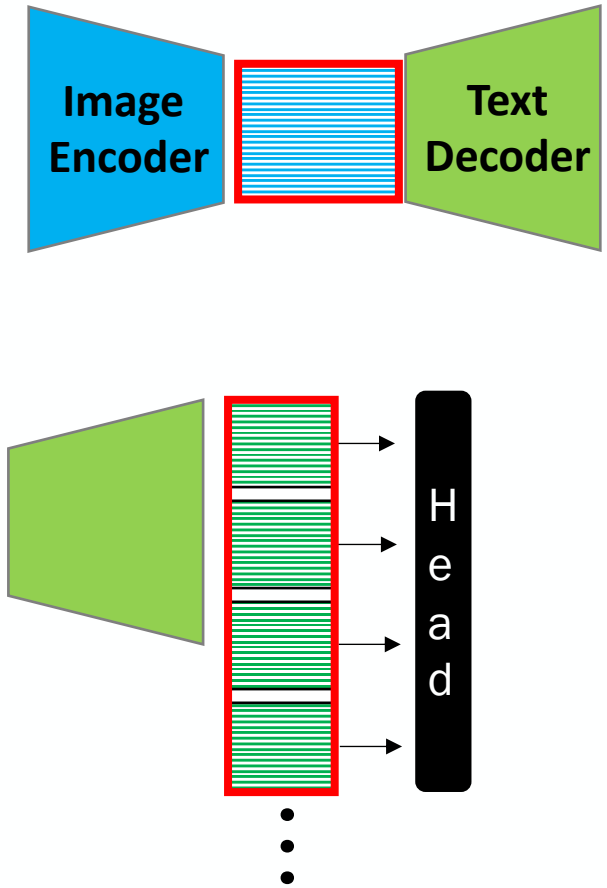
Motivation

A Unified Debiasing Strategy – Debiasing Embedding

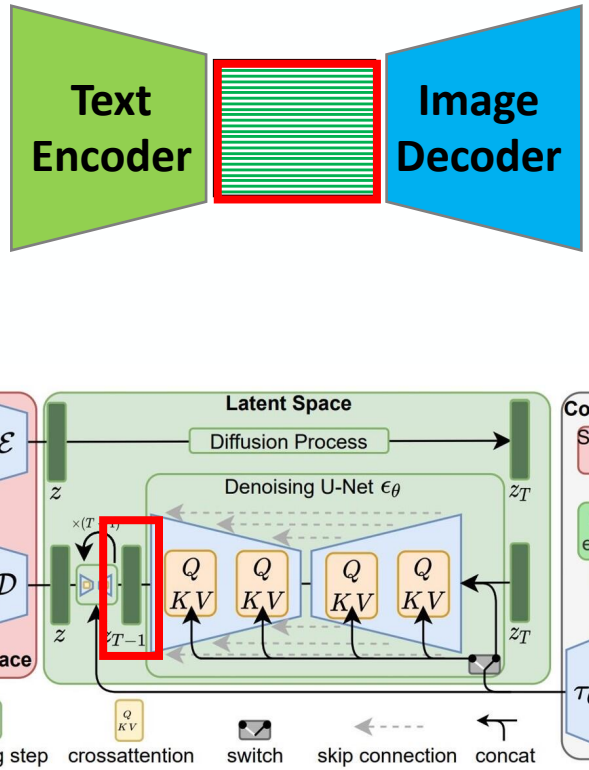
- Zero-shot Classification & Text-to-Image retrieval



- Image Captioning

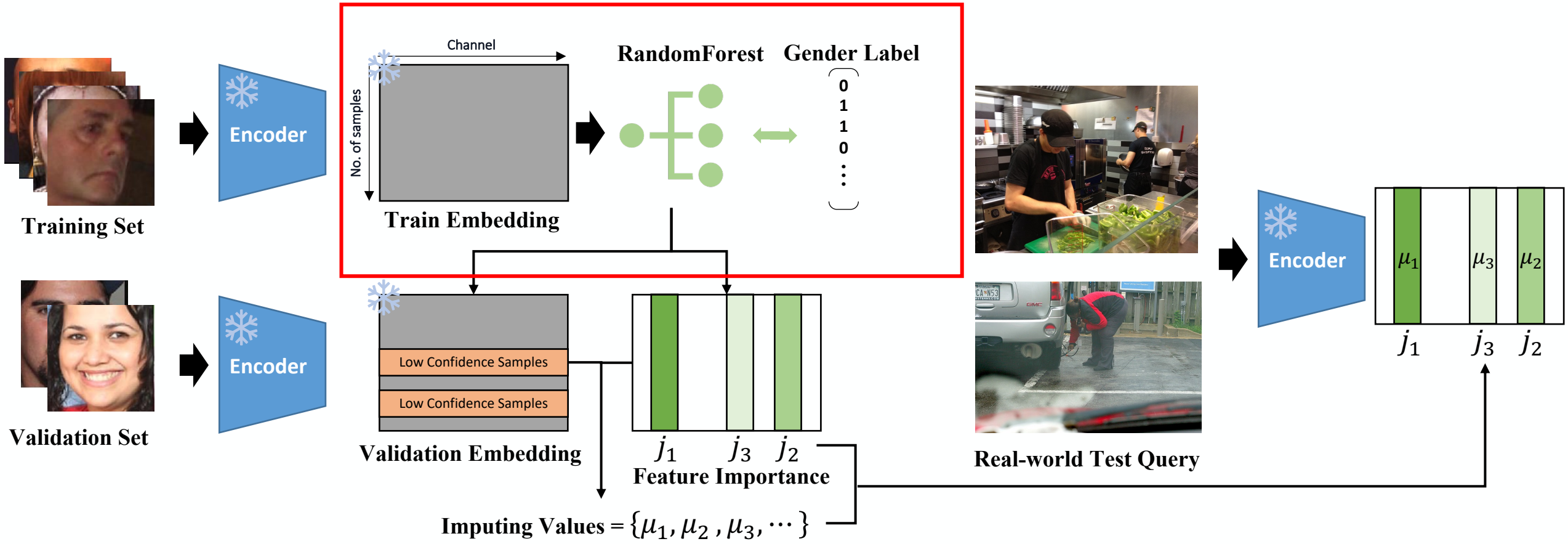


- Text-to-Image Generation



Proposed Method

Selective Feature Imputation for Debiasing (SFID)

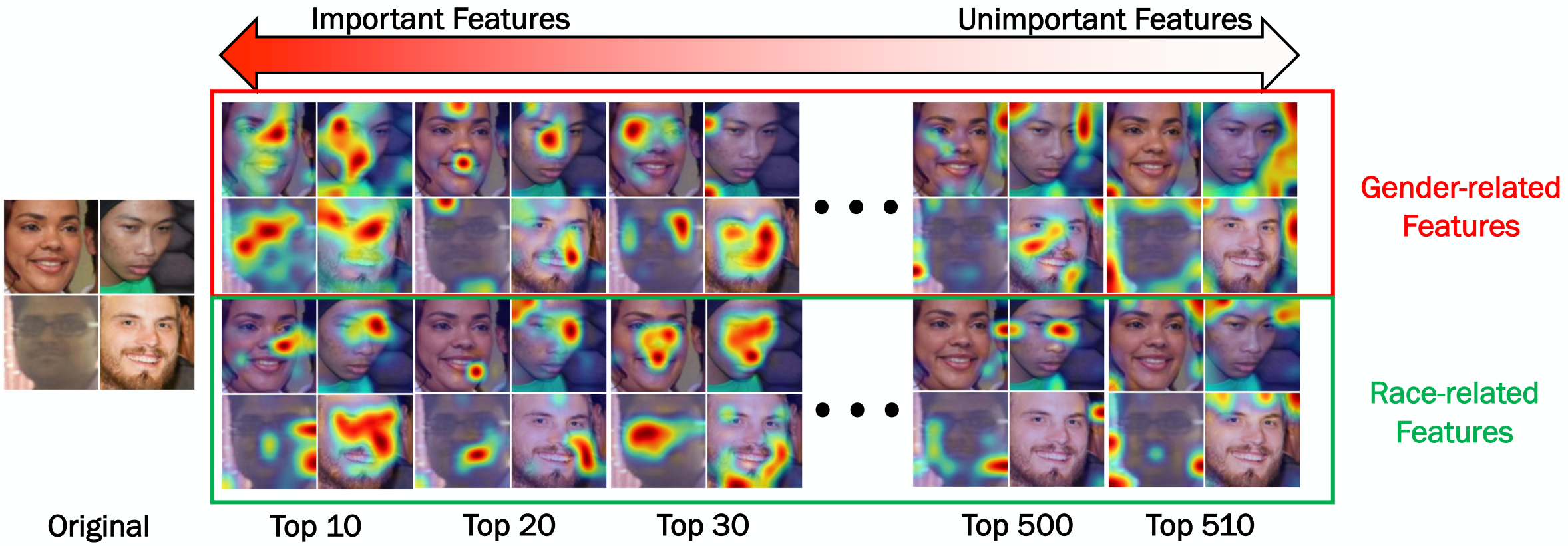


(a) Feature Selection & Imputing Value Extraction

(b) Debiasing Downstream Tasks

Proposed Method

Selective Feature Imputation for Debiasing (SFID)



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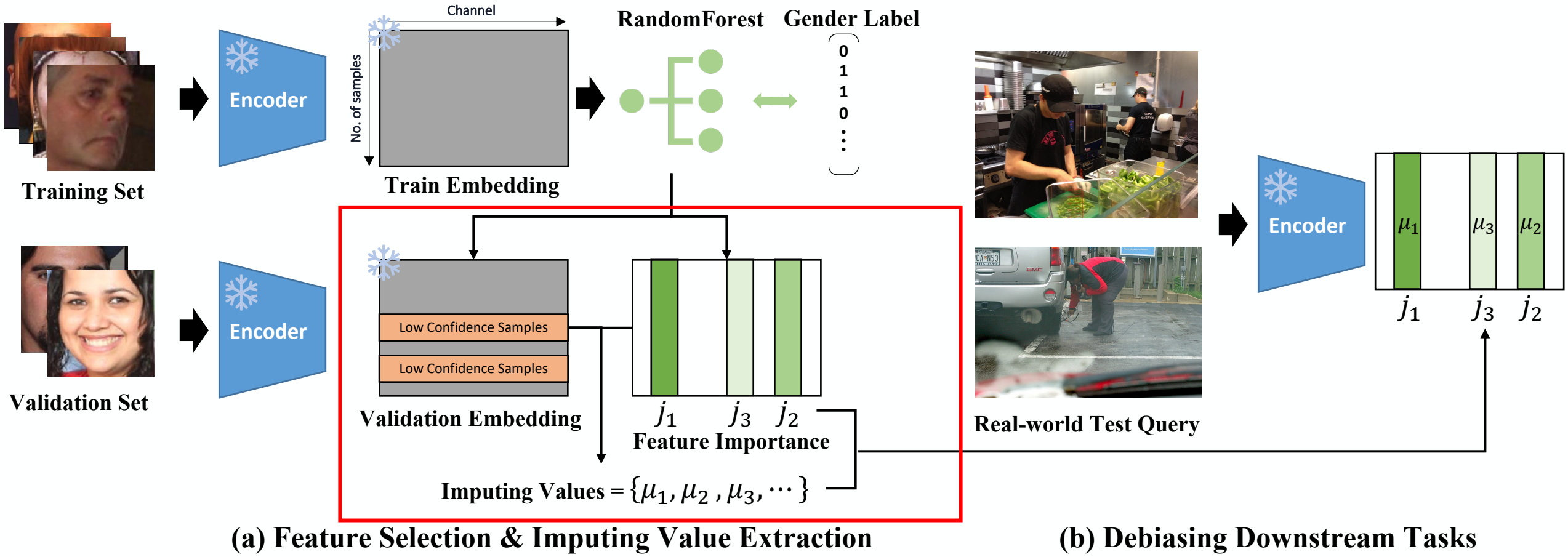

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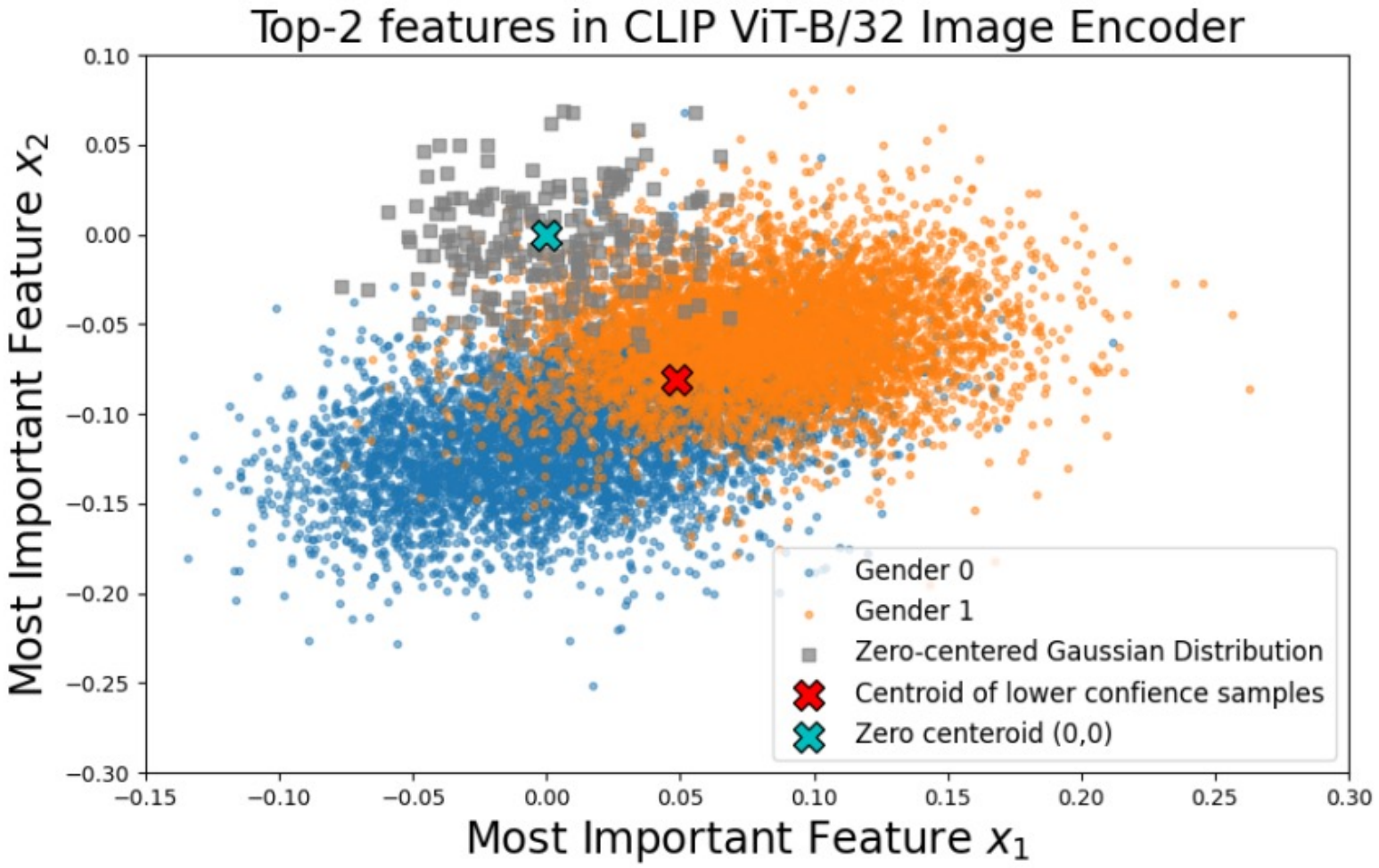
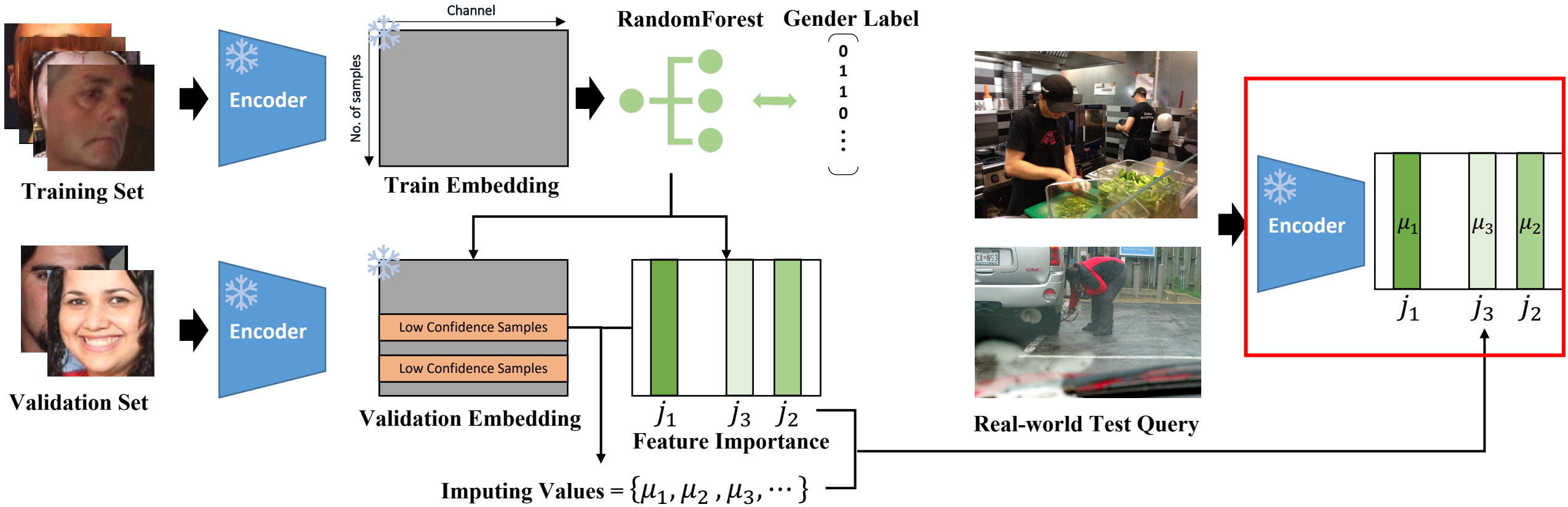


Proposed Method

Selective Feature Imputation for Debiasing (SFID)



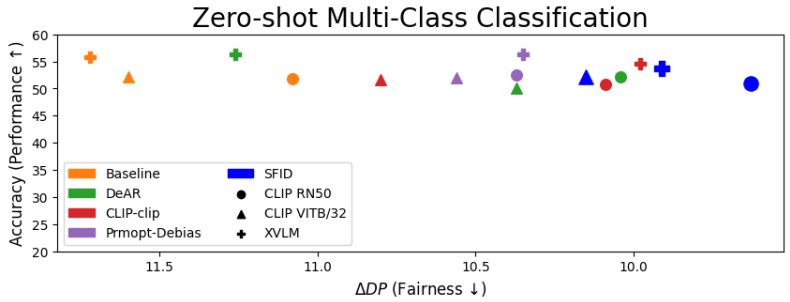
(a) Feature Selection & Imputing Value Extraction

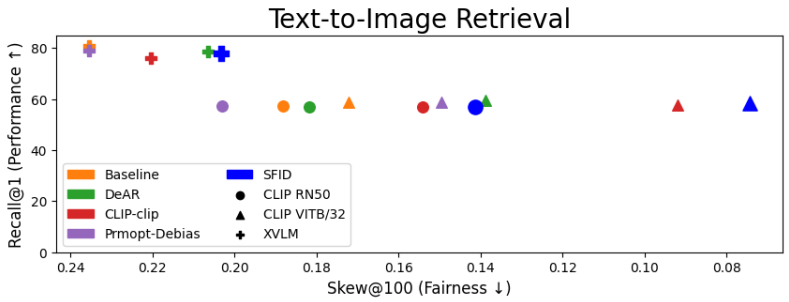
(b) Debiasing Downstream Tasks

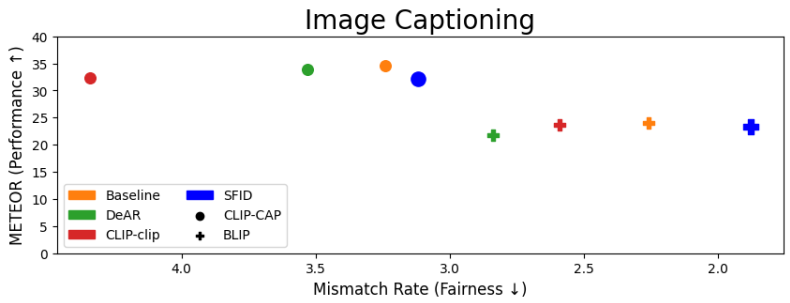
Result

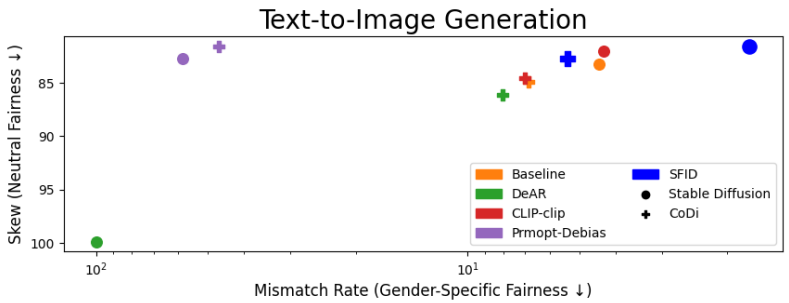
Selective Feature Imputation for Debiasing (SFID)

- Effective in debiasing.
- Can be used any types of tasks.
- Not requiring training a model.









Thank You

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