Fashion Classification & Outfit recommender using Deep Learning

Hyperparameter Hunters

Problem statement

A deep learning model that:

- Classifies real-world clothing images with high accuracy, identifying individual clothing articles (like shirts, pants, jackets, etc.).
- Generates outfit recommendations by suggesting the best combinations of clothing articles to create stylish outfits.

Why is this important?

- Enhances online shopping by improving product tagging and personalized recommendations.
- Helps users put together well-matched outfits virtually
- Provides style guidance to people who may struggle with outfit coordination.
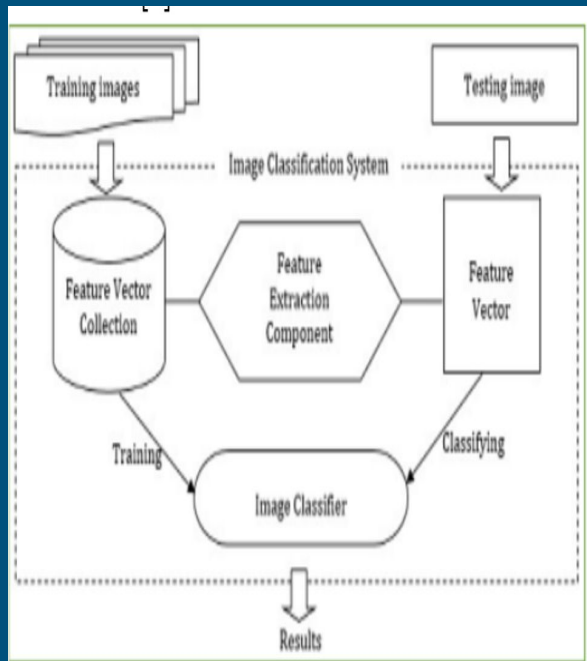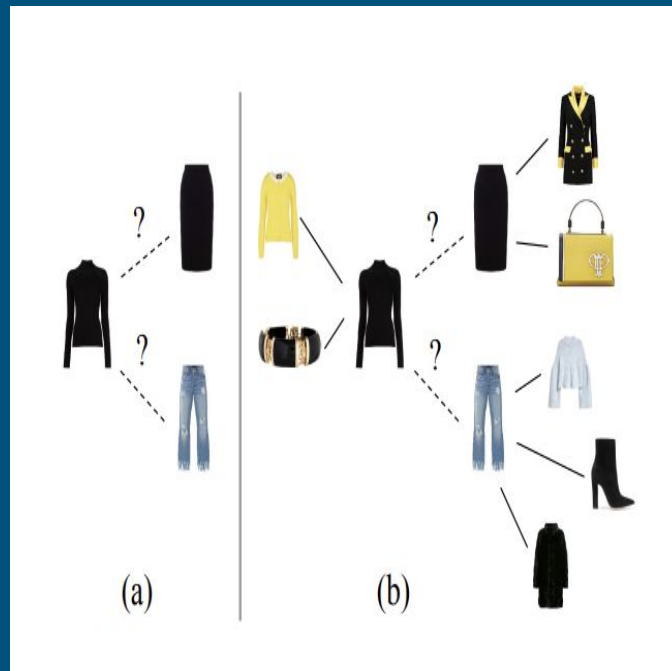
Previous Solutions

Fig: System Architecture

CNN + dropout

CNN + RNN

Advanced Fashion Recommendation System for Different Body Types using Deep Learning Models

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Abstract. The fashion industry is rapidly expanding and playing a critical role in driving global economies. Due to this ever-growing industry, application of computer science is rising rapidly to solve different problems in this industry. Many e-commerce sites around the world allow their customers to purchase clothing items over the internet predominantly using recommender systems for shoppers based on the customer's purchase history, similar buying patterns of other shoppers, items in the wishlists and latest trends. These recommendation models lack personalization based on the user's body demographics. Since fashion is a way, one chooses to express themselves, it is important that each piece is carefully selected to suit the buyer. In this paper, an improved recommendation system is developed using a deep learning model for customers with different body shapes/types. It helps users to select clothing items based on their body shape. Proposed system is evaluated with respect to multiple deep learning models as well as traditional machine learning approaches. Xception model out performed by achieving 94% accuracy and a loss of 0.02%.

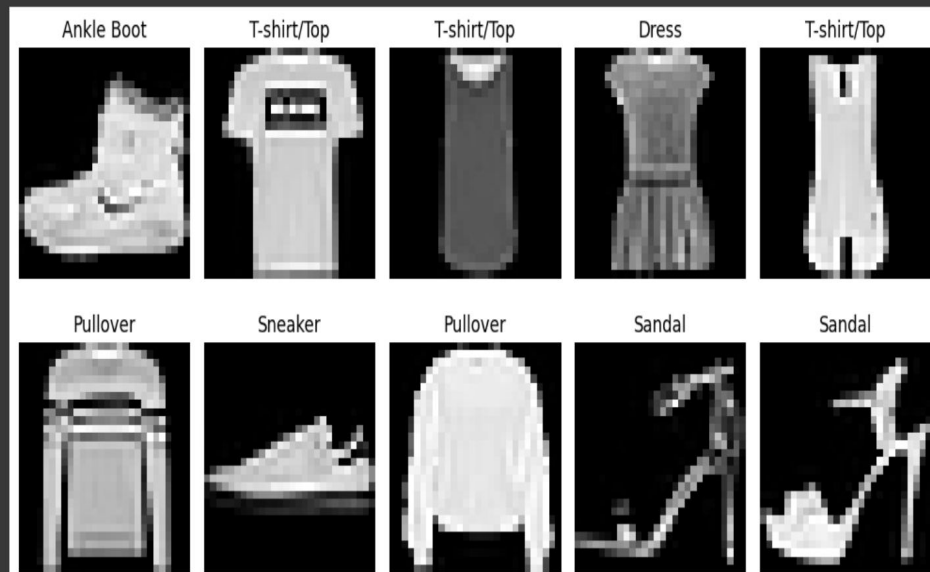**Keywords:** Fashion Recommendation, Deep Learning, Pre-trained CNN Models, Image dataset

CNN

Datasets

1) Fashion MNIST
2) Fashion Small
3) Polyvore Outfits

FMNIST Exploration

```
sns.barplot(x=class_labels, y=counts, palette="viridis")
```

Class Distribution in Training Data


```
plt.tight_layout()
plt.show()
```


- Well-balanced
- Equal number of samples
- No null values
- Fair model evaluation
- Same dimensions and grayscale
- No data augmentation needed

Fashion MNIST

Fashion Small Dataset

- 31136 data instances
- Use for image classification: colored images with high resolution
- X: input images, Y: article type.

10350.jpg

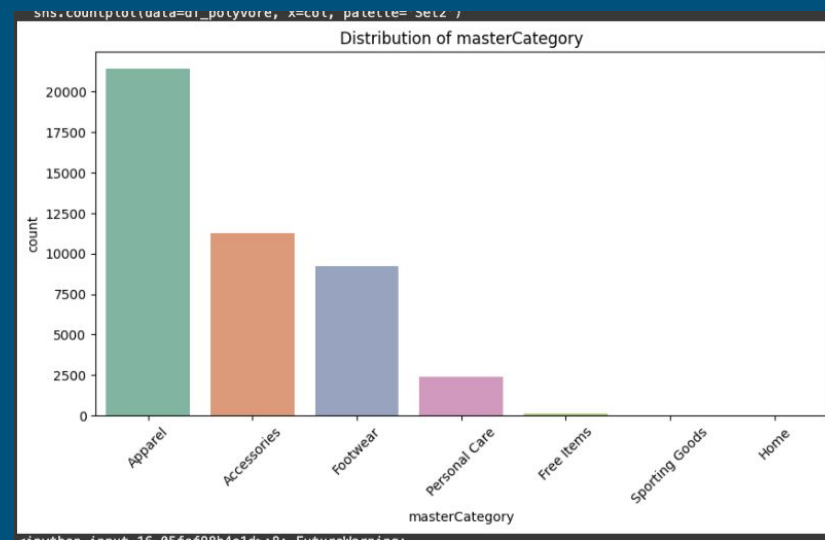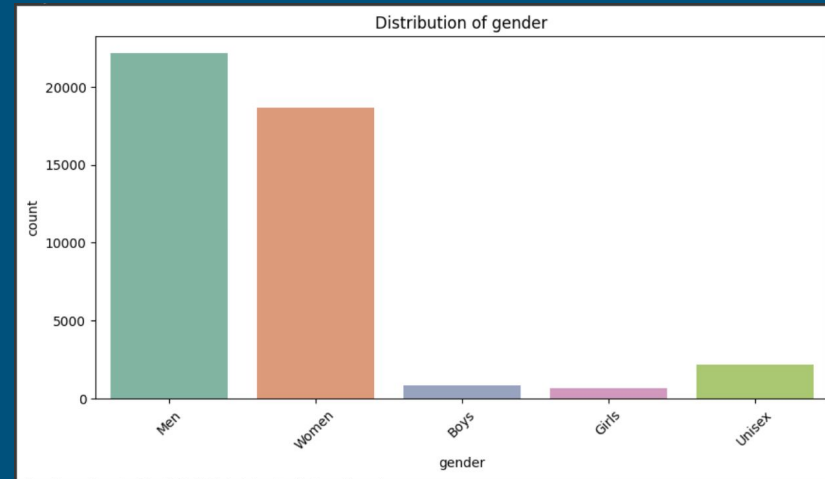|	id	gender	masterCategory	subCategory	articleType	baseColour	season	year	usage	productDisplayName
0	15970	Men	Apparel	Topwear	Shirts	Navy Blue	Fall	2011.0	Casual	Turtle Check Men Navy Blue Shirt
1	39386	Men	Apparel	Bottomwear	Jeans	Blue	Summer	2012.0	Casual	Peter England Men Party Blue Jeans
2	59263	Women	Accessories	Watches	Watches	Silver	Winter	2016.0	Casual	Titan Women Silver Watch
3	21379	Men	Apparel	Bottomwear	Track Pants	Black	Fall	2011.0	Casual	Manchester United Men Solid Black Track Pants
4	53759	Men	Apparel	Topwear	Tshirts	Grey	Summer	2012.0	Casual	Puma Men Grey T-shirt

Exploration and Cleaning

- Data imbalance → group together to create 2 categories: men and women
- Drop Year.
- Perform hot encodings on master category, gender, subcategory and articleType.

Polyvore Dataset

- **Polyvore Dataset** : A benchmark dataset for fashion recommendation tasks.
- **Source**: Collected from Polyvore, a social commerce website where users create and share outfit sets.
- **Outfit Compatibility**: Contains human-labeled outfit sets to help models learn clothing compatibility.
- **Rich Metadata**: Includes images, categories, and relationships between fashion items.
- **Use in Research**: Commonly used for training and evaluating recommendation models.
- **Visual & Textual Data**: Provides both image features and textual descriptions for fashion items.

Polyvore Dataset

```
{
    "name": Name of the outfit,
    "views": Number of views of the outfit,
    "items": [
        Fashion items in the outfit.
        {
            "index": Index of the fashion item in this outfit on Polyvore,
            "name": Description of the fashion item,
            "price": Price of the fashion item (usually in US dollars),
            "likes": Number of likes of the item,
            "image": Image url of the item,
            "categoryid": Category ID of the item,
        },
        {
            ...
        },
        ...
    ],
    "image": Outfit image url,
    "likes": Number of likes of the outfit,
    "date": Upload date of the outfit,
    "set_url": Outfit url,
    "set_id": Outfit ID,
    "desc": Outfit description.
}
```
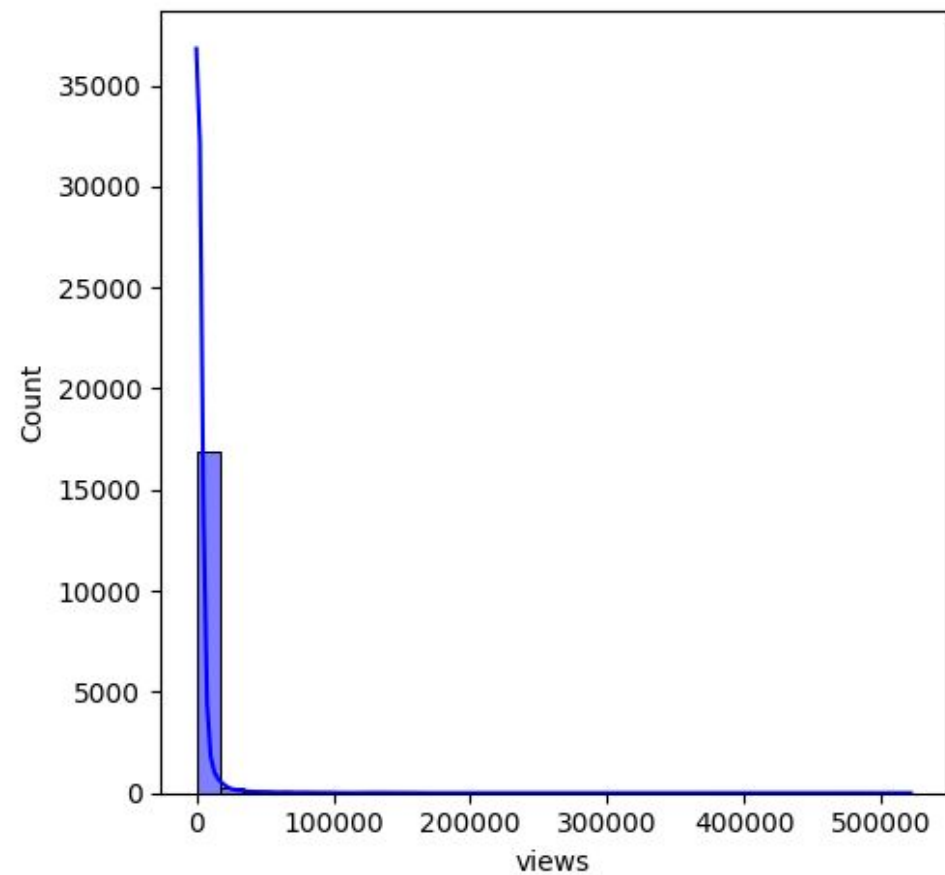
	name	views	items	image	likes	date	set_url	set_id	desc
0	Casual	8743	[{'index': 1, 'name': 'mock neck embroidery su...	http://ak1.polyvoreimg.com/cgi/img-set/cid/214...	394	One month	http://www.polyvore.com/casual/set?id=214181831	214181831	A fashion look from January 2017 by beebeely-l...
1	Being a Vans shoe model with Luke. Idk about t...	188	[{'index': 1, 'name': 'nirvana distressed t-sh...	http://ak1.polyvoreimg.com/cgi/img-set/cid/120...	9	Two years	http://www.polyvore.com/being_vans_shoe_model_...	120161271	A fashion look from April 2014 featuring destr...
2	These Chanel bags is a bad habit .x	562	[{'index': 1, 'name': 'monki singlet', 'price'...	http://ak1.polyvoreimg.com/cgi/img-set/cid/143...	32	Two years	http://www.polyvore.com/these_chanel_bags_is_b...	143656996	12.19.14
3	Avenger/Supernatural prp	2613	[{'index': 1, 'name': 'tops', 'price': 18.0, '...	http://ak2.polyvoreimg.com/cgi/img-set/cid/186...	88	One year	http://www.polyvore.com/avenger_supernatural_p...	186627934	A fashion look from January 2016 by alyssaclai...
4	Boho (39)	62	[{'index': 1, 'name': 'yoins leather sexy v-ne...	http://ak2.polyvoreimg.com/cgi/img-set/cid/206...	3	5 months	http://www.polyvore.com/boho_39/set?id=206969379	206969379	A fashion look from August 2016 by kate-goida ...
...	...	...	...	...	...	...	...	...	...
17311	2.15.17	183	[{'index': 1, 'name': 'raey deep v-neck silk c...	http://ak1.polyvoreimg.com/cgi/img-set/cid/216...	117	4 days	http://www.polyvore.com/15.17/set?id=216801059	216801059	A fashion look from February 2017 by kianahall...
17312	tweed	2428	[{'index': 1, 'name': 'michael kors printed bo...	http://ak1.polyvoreimg.com/cgi/img-set/cid/190...	382	One year	http://www.polyvore.com/tweed/set?id=190488700	190488700	A fashion look from February 2016 by drigomes ...
17313	TV Style: Pretty Little Liars	2184	[{'index': 1, 'name': 'color block fit flare m...	http://ak2.polyvoreimg.com/cgi/img-set/cid/187...	398	One year	http://www.polyvore.com/tv_style_pretty_little...	187504514	A fashion look from January 2016 by vanjazivad...
17314	60-Second Style: Work Wear	3147	[{'index': 1, 'name': 'patchwork fit flare dre...	http://ak2.polyvoreimg.com/cgi/img-set/cid/211...	440	Three months	http://www.polyvore.com/60-second_style_work_w...	211085207	A fashion look from November 2016 by beebeely-...
17315	Mini Dress: The Glamour Edition	111	[{'index': 1, 'name': 'burberry kensington lea...	http://ak1.polyvoreimg.com/cgi/img-set/cid/211...	21	Three months	http://www.polyvore.com/mini_dress_glamour_edi...	211686294	A fashion look from November 2016 by footsteps...

17316 rows × 9 columns

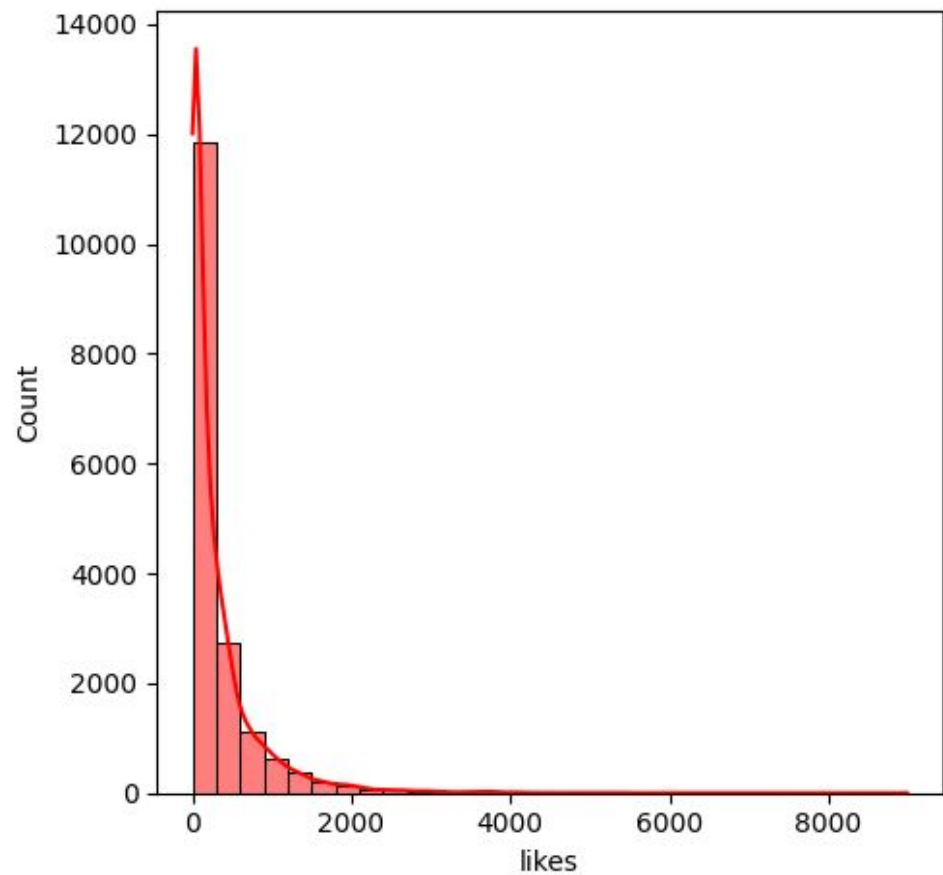# Polyvore Dataset

```
...                        views            likes
      count    17316.000000    17316.000000
      mean      3382.014669      318.642065
      std      18244.310050      513.926991
      min          4.000000        1.000000
      25%        163.000000       25.000000
      50%        620.000000      127.000000
      75%       2100.750000      392.000000
```
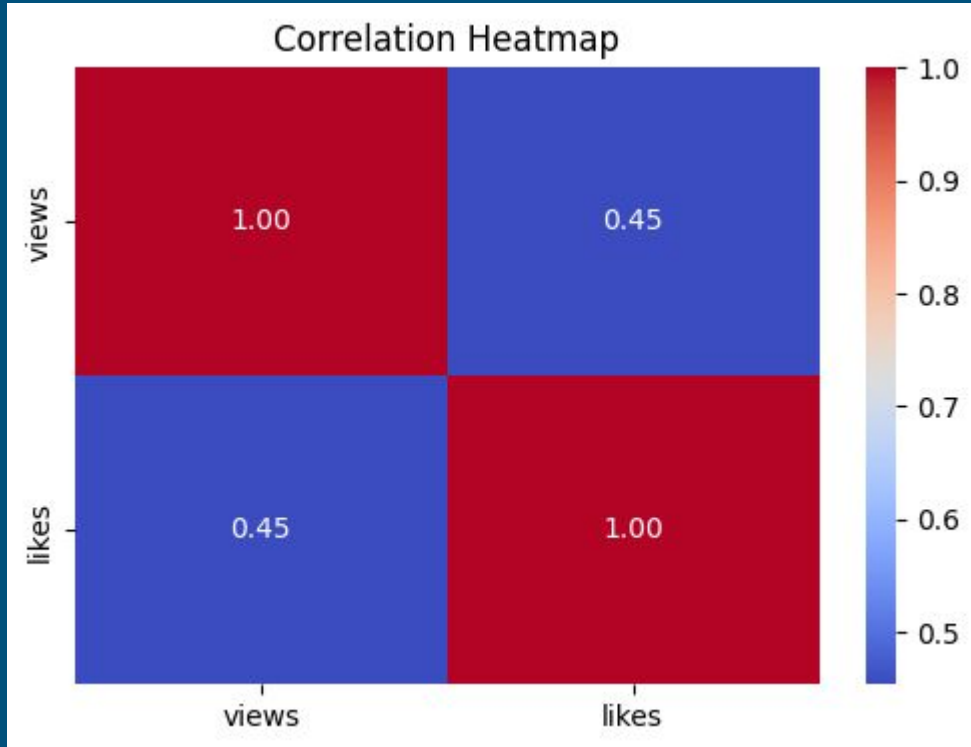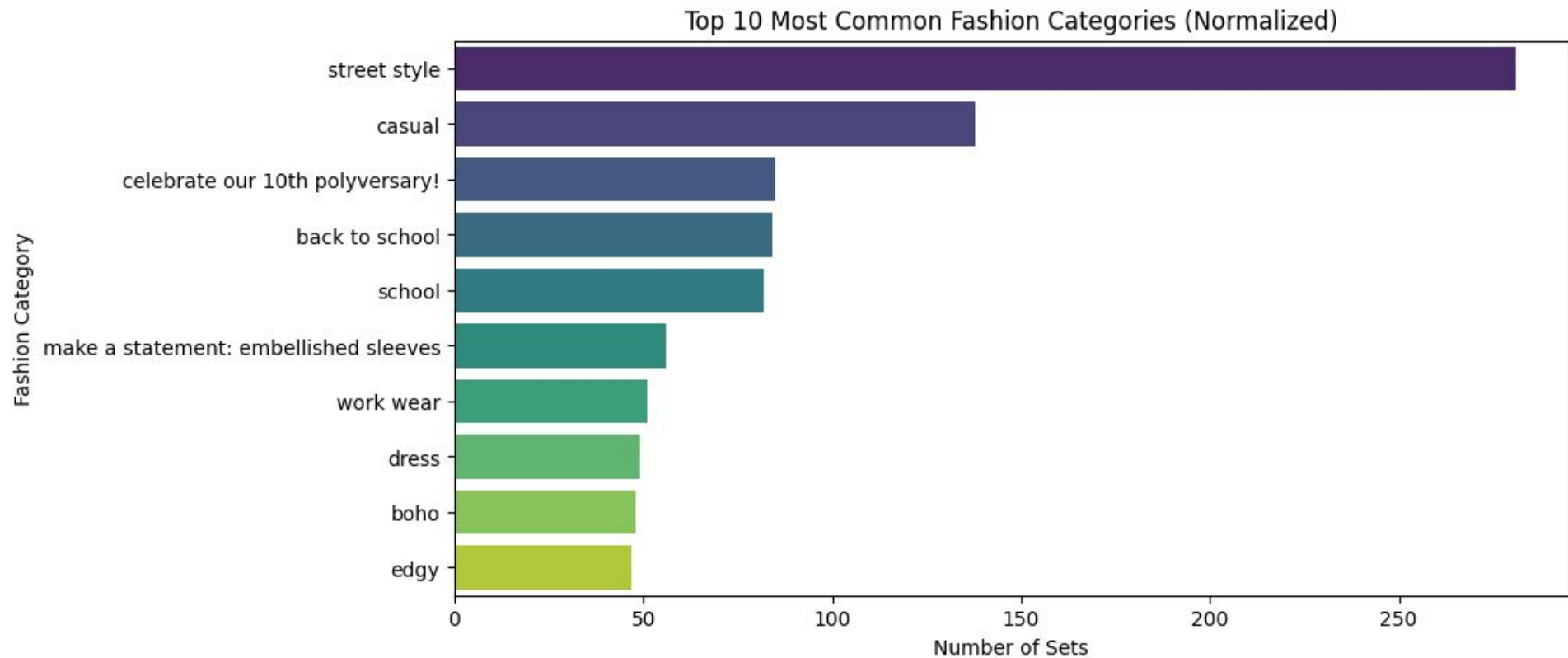
Distribution of Views

Distribution of Likes

Polyvore Dataset

Polyvore Dataset

Top 10 Most Common Fashion Categories (Normalized)

Polyvore Dataset

```python
import json

# Load datasets
def load_json(file_path):
    with open(file_path, "r") as f:
        return json.load(f)

train_data = load_json("polyvore/train_no_dup.json")
valid_data = load_json("polyvore/valid_no_dup.json")
test_data = load_json("polyvore/test_no_dup.json")

print(f"Training Set: {len(train_data)} entries")
print(f"Validation Set: {len(valid_data)} entries")
print(f"Test Set: {len(test_data)} entries")
```

[22] ✓ 0.4s   Python

```
Training Set: 17316 entries
Validation Set: 1497 entries
Test Set: 3076 entries
```

Challenges and Future Work

1. Web scraping to get the images data of the outfit sets from the urls provided in Polyvore Dataset.
2. The result from the classification model training on Fashion Small Dataset or FMNIST may not be good enough for the Outfit Recommendation System.
3. Defining "good" outfit compatibility is challenging due to personal and cultural preferences.
4. Combining visual and textual data effectively for accurate recommendations.
5. The Polyvore Dataset was collected around 2017, so some outfits may be outdated.

Citations

1. https://www.researchgate.net/publication/362086487_Advanced_Fashion_Recommendation_System_for_Different_Body_Types_using_Deep_Learning_Models
2. https://arxiv.org/pdf/1902.03646v2
3. https://github.com/zalandoresearch/fashion-mnist
4. https://paperswithcode.com/dataset/polyvore
5. https://github.com/xthan/polyvore-dataset