



**JAHANGIRNAGAR UNIVERSITY**  
**DEPARTMENT OF STATISTICS AND DATA SCIENCE**

**COURSE NAME: BIG DATA**

**“AnimeLens: A Hybrid Approach for Personalized  
Anime Recommendations using Deep Collaborative  
Filtering and TF-IDF Content Based Filtering”**

**PRESENTED BY**

**GROUP NAME: TROOPERS**

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# —● **OUTLINE**

## **❖ INTRODUCTION**

- WHAT IS RECOMMENDATION SYSTEM?
- HOW DOES THE SYSTEM WORKS?
- OBJECTIVES

## **❖ ANIME DATASET 2023**

## **❖ EXPLANATORY DATA ANALYSIS (EDA)**

## **❖ METHODOLOGY**

- PRE-PROCESSING STAGE
- ANALYSIS TECHNIQUES

## **❖ EXPERIMENTAL OBSERVATIONS**

## **❖ CONCLUSION & FUTURE SCOPES**

# WHAT IS RECOMMENDATION SYSTEM ?

- ❑ AI algorithms using machine learning and Big Data to suggest products.
- ❑ Enhance user experience and drive sales.
- ❑ Analyze past behavior for personalized recommendations.

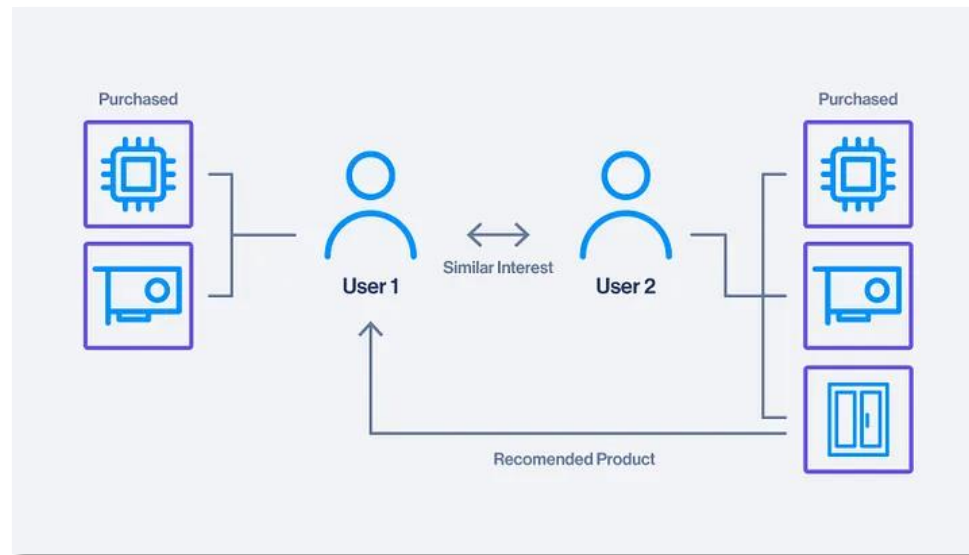


Figure 1: Architecture of the recommendation system

# HOW DOES THE SYSTEM WORKS ?

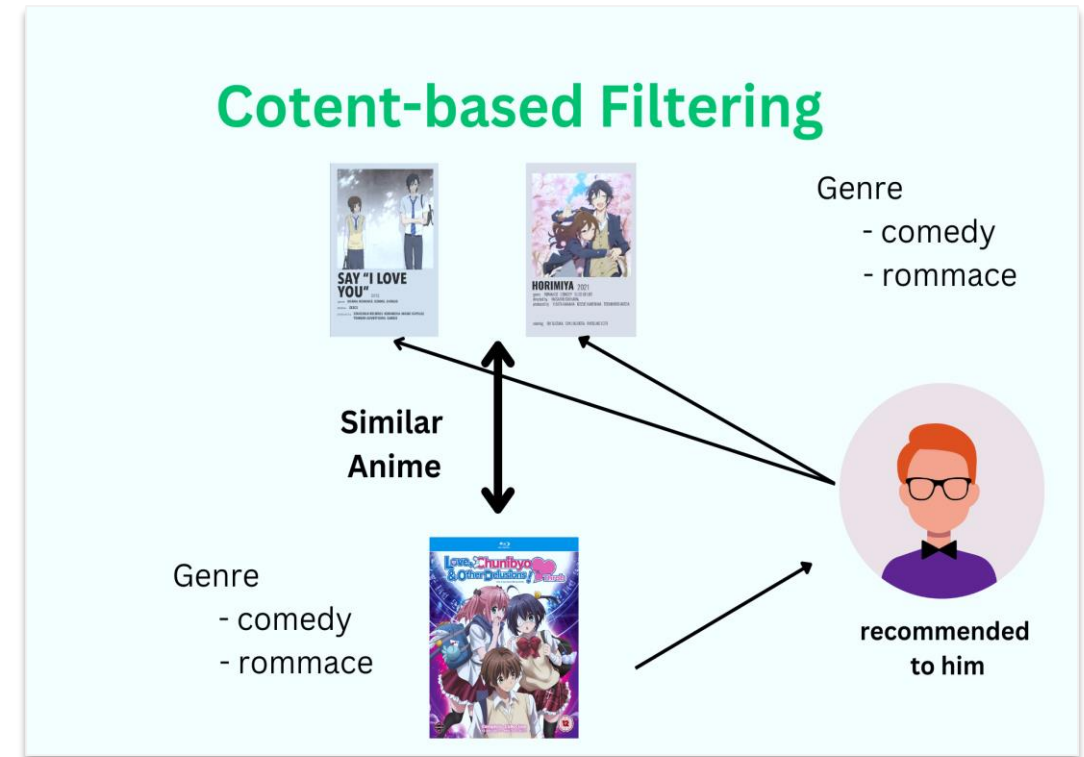
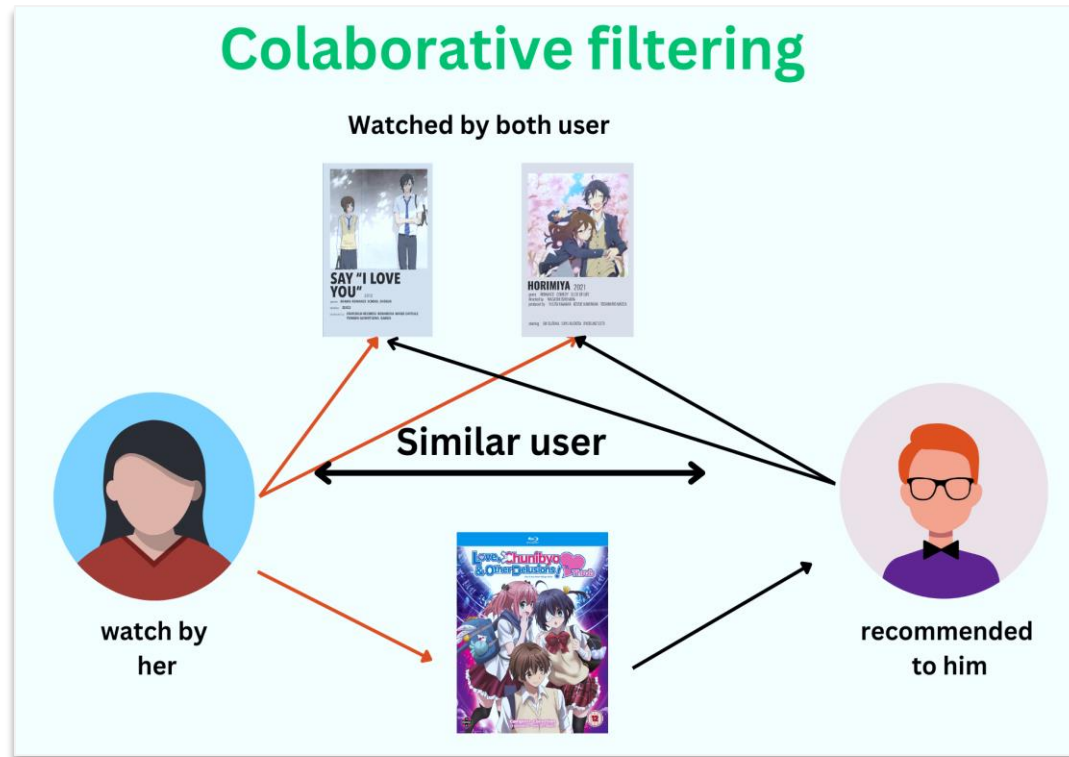


Figure 2: Techniques of recommendation system

# ● CHALLENGES

- ❖ Cold Start Problem
- ❖ Dynamic Preferences
- ❖ Scalability
- ❖ Ethical and Bias Concerns
- ❖ Privacy Concerns

## ● OBJECTIVES

- Providing Valuable Insights.
- Empowering Anime Fans.
- Utilizing Various Algorithms and Methodologies.
- Personalized Recommendations.



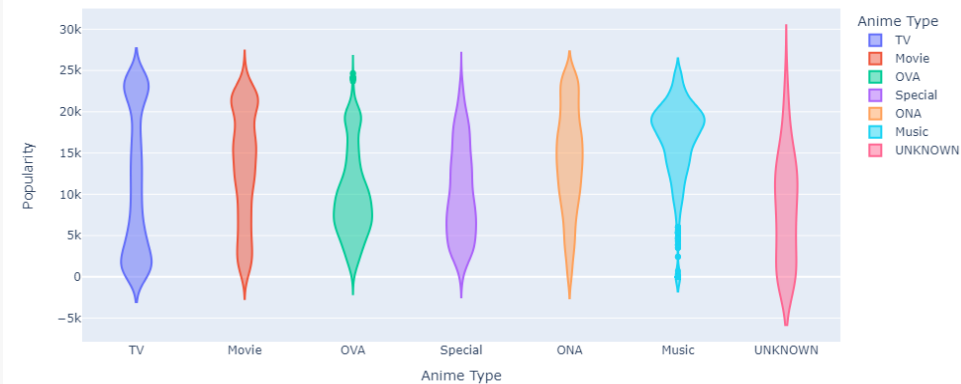
# ANIME RECOMMENDATION

- Anime: Diverse Japanese entertainment with unique art and storytelling.
- Recommendation systems crucial for enthusiasts to discover new shows based on preferences.
- Datasets Contains:
  - Anime Details
  - User Details
  - User Score

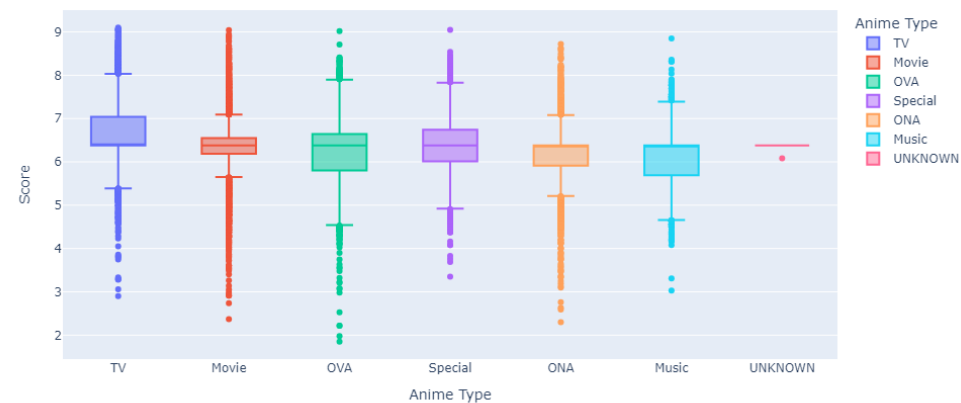


# EXPLANATORY DATA ANALYSIS

Distribution of Anime Popularity by Type



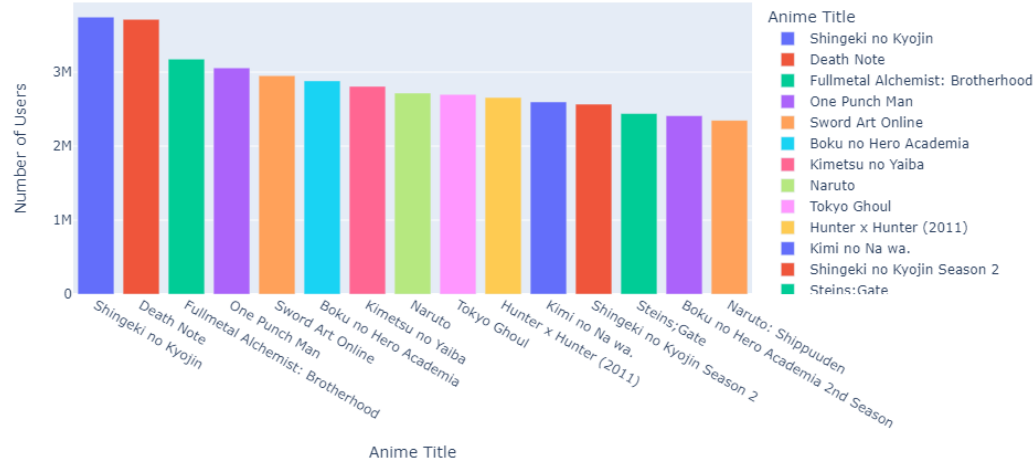
Distribution of Anime Scores by Type



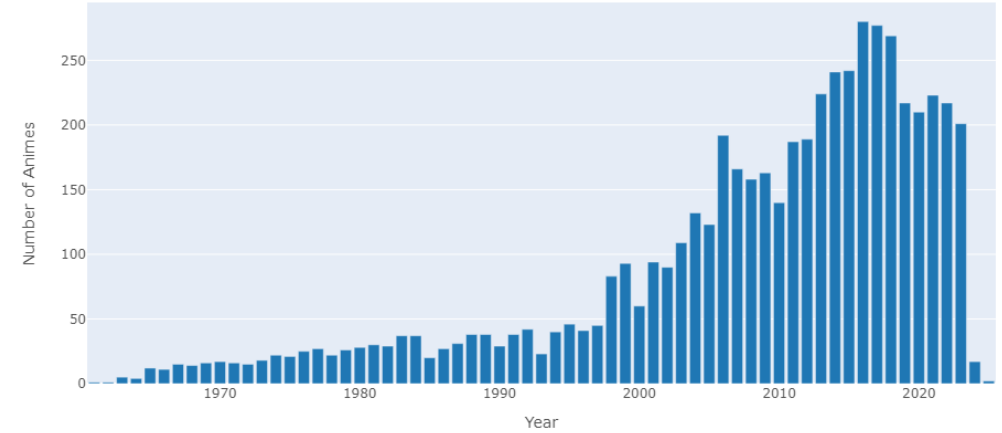


# EXPLANATORY DATA ANALYSIS

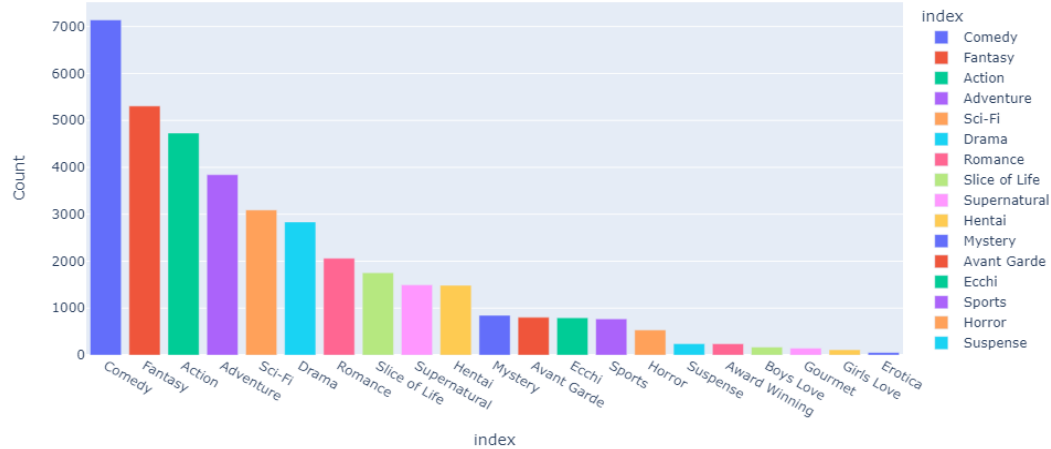
Top 15 Animes by Number of Users



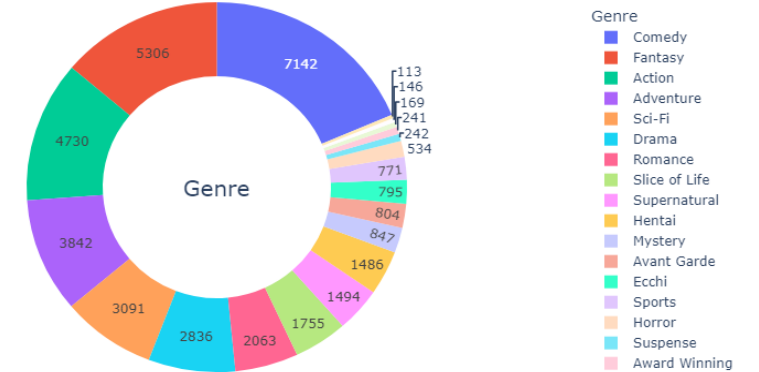
Number of Animes Premiered by Year



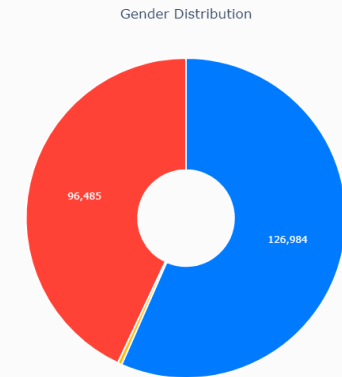
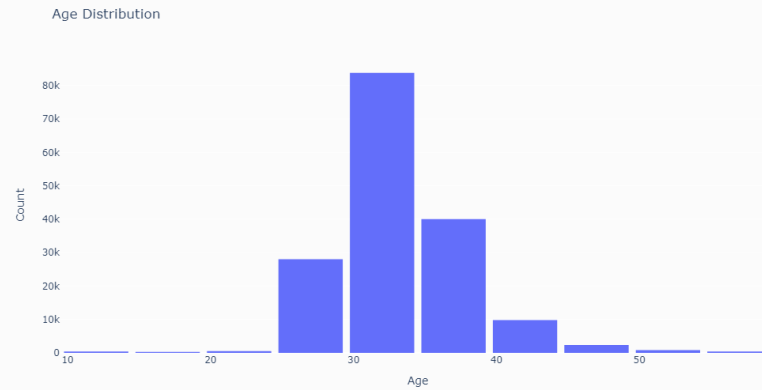
Count of Anime Titles by Genre



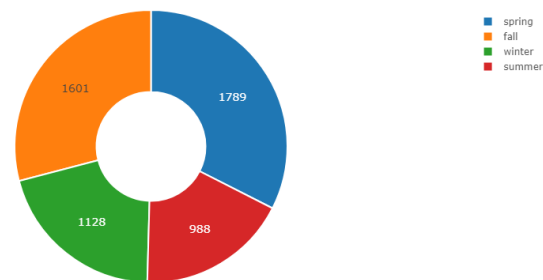
Distribution of Anime Genres



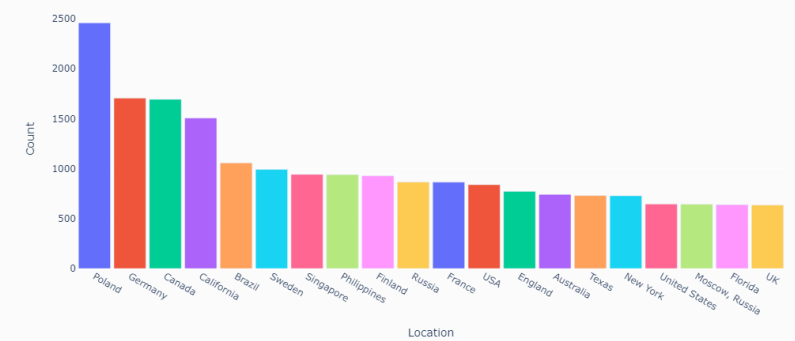
# EXPLANATORY DATA ANALYSIS



Distribution of Premiered Seasons

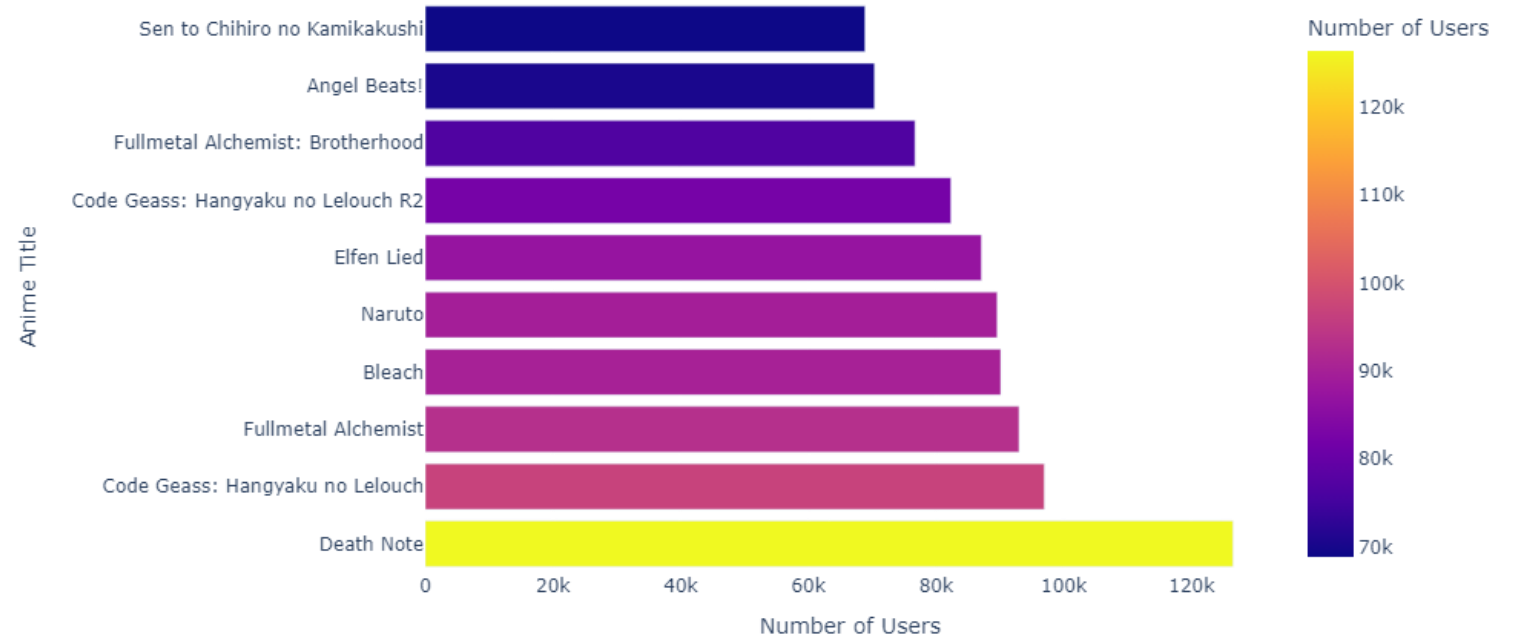


Top 20 User Locations



# EDA

Top 10 Anime Titles Watched by Most Users



## • PRE-PROCESSING STAGE

### Feature Scaling

- Min-Max Scaler

### Encoding

- Label Encoder

# ANALYSIS TECHNIQUES(1/3)

## COLLABORATIVE FILTERING

- ✓ Suggests animes to users based on the preferences of similar users or similar animes.
- ✓ Embeddings represent ‘users’ and ‘anime’, capturing preferences efficiently.
- ✓ Collaborative filtering model trained in TensorFlow predicts anime user ratings.

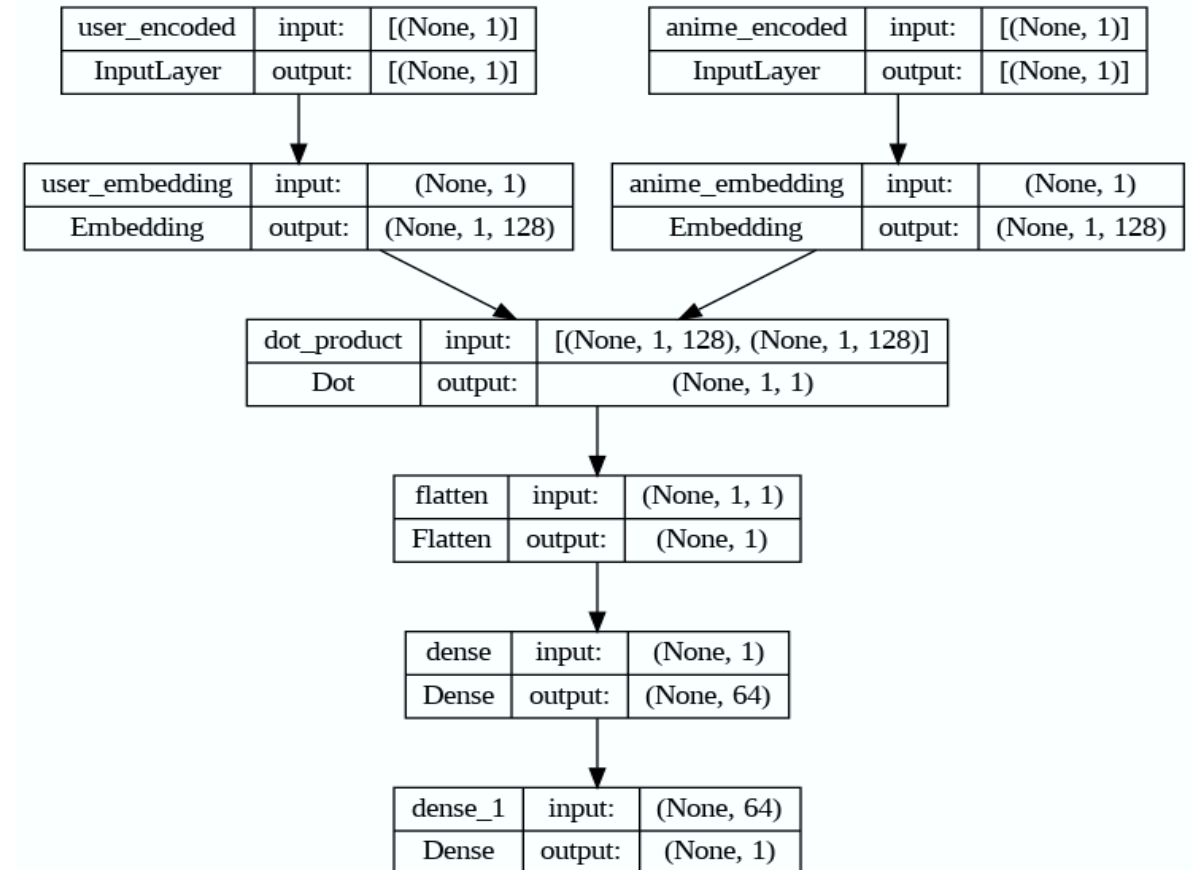


Figure 3: Architecture of the collaborative filtering model

## ANALYSIS TECHNIQUES(2/3)

### COLLABORATIVE FILTERING

- ✓ The optimization process ensures accurate recommendations by recognizing patterns.
- ✓ Similar animes and users can now be identified with the trained model.

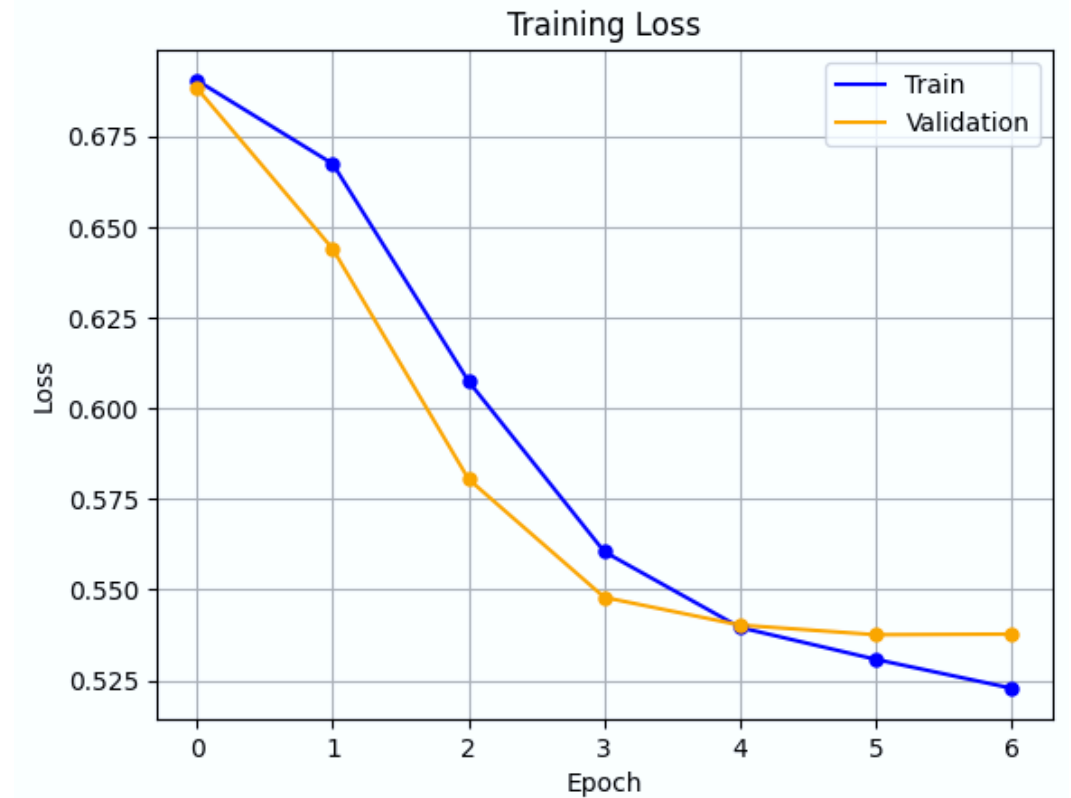


Figure 4: Loss vs. Epoch curve



# ANALYSIS TECHNIQUES(3/3)

## CONTENT BASED FILTERING

- ✓ Animes are recommended to users based on attributes like genres and ratings in content-based filtering.
- ✓ A TF-IDF matrix have created for anime genres to quantify their importance in each anime's description.
- ✓ The cosine similarity between animes based on their genre descriptions determines their similarity.
- ✓ Similarity scores and ratings can now recommend anime based on genre and score.

$$TF - IDF(t, d) = TF(t, d) * \log\left(\frac{N}{DF(t)}\right)$$

N: Total number of anime descriptions.

TF(t,d): Term frequency of term  $t$  in document  $d$  (anime genre description).

DF(t): Document frequency of term  $t$  (number of anime descriptions containing term  $t$ ).

$$\text{Cosine Similarity } (a, b) = \frac{a \cdot b}{\|a\| \|b\|} = \frac{a \cdot b}{\sqrt{\sum_{i=1}^n a_i^2} \sqrt{\sum_{i=1}^n b_i^2}}$$

$\|a\|$  and  $\|b\|$  denote the Euclidean norm (magnitude) of vector  $a$  and  $b$  respectively.

# EXPERIMENTAL OBSERVATIONS (1/3)

Recommendations for "Shingeki no Kyojin":

	Name	Genres	Score
5873	Mahou Shoujo Madoka★Magica	Award Winning, Drama, Suspense	8.36
3271	Evangelion: 3.0+1.0 Thrice Upon a Time	Action, Award Winning, Drama, Sci-Fi, Suspense	8.61
980	Sentou Yousei Yukikaze	Action, Award Winning, Drama, Sci-Fi, Suspense	7.2
6645	Mahou Shoujo Madoka★Magica Movie 3: Hangyaku no Monogatari	Award Winning, Drama, Mystery, Suspense	8.47
21814	Ikuta no Kita	Adventure, Award Winning, Fantasy, Suspense	6.22
2469	Hidamari no Ki	Action, Award Winning, Drama	7.06
4135	Birthday Boy	Action, Award Winning, Drama	5.65
24	Koukaku Kidoutai	Action, Award Winning, Mystery, Sci-Fi, Suspense	8.27
20	Neon Genesis Evangelion	Action, Avant Garde, Award Winning, Drama, Sci-Fi, Suspense	8.35
9854	Koe no Katachi	Award Winning, Drama	8.94

*Figure 5: Output of Item Based Collaborative Filtering: Top 10 Recommendation for “Shingeki no Kyojin”*

# EXPERIMENTAL OBSERVATIONS (1/5)

> Top recommendations for user: 1213175

	n	anime_name	Genres	Synopsis
0	22486	Ookami to Koushinryou II	Adventure, Fantasy, Romance	Traveling merchant Kraft Lawrence continues his northward journey with wolf goddess Holo, in search of her lost home of Yoitsu. Lawrence and his sharp-witted partner continue to make some small profits along the way, while slowly uncovering more information about Holo's hometown. However, the road to Yoitsu is a bumpy one filled with many troubles—Lawrence runs into a charming young fellow merchant who has his eyes set on the female wolf companion, and he begins to doubt if Holo will remain by his side; he and the goddess will also have to consider precarious and risky business deals as Lawrence strives to achieve his dream of becoming a shopowner. All the while, with his determination tested at every turn during his journey, Lawrence must question his relationship with Holo, take on business ventures, and ask himself whether it is time for him and Holo to go their separate ways.
1	20864	Ga-Rei: Zero	Action, Supernatural, Suspense	In Japan, there exists a government agency known as the Supernatural Disaster Countermeasures Division (SDCD), whose duty is to protect the citizens from creatures unseen. They are able to dispatch these monsters swiftly and without alerting the general public. But currently, they face a different challenge: the betrayal of one of their own.\n\nAfter the death of her mother several years ago, Kagura Tsuchimiya has been fostered by the Isayama family and forms a close sister-like bond with their daughter Yomi. The two become inseparable, and together they work for the SDCD as highly skilled exorcists. However, as the stress and consequences of their sacred duty weigh on them both, and family politics come into play, Kagura and Yomi begin to slowly drift apart. One of them grows earnestly into her role as an exorcist, and the other heads down a dark path from which there may be no redemption.
2	36094	Mirai Nikki (TV)	Action, Supernatural, Suspense	Yukiteru Amano is a shy middle schooler who regularly keeps track of what he does in his daily life by writing down all of his activities on his phone—a digital diary. Despite having no friends at school, Yukiteru is frequently seen talking to his supposedly imaginary friends Deus Ex Machina, the god of time and space; and Deus' servant, Mur Mur.\n\nOne day, Yukiteru wakes up and discovers that certain events of his day are preemptively displayed on his cellphone. While initially dismissing it as a coincidence, he slowly realizes that the incidents written in his phone actually take place in the near future. After spending the day benefitting from this new asset, Yukiteru learns that his classmate Yuno Gasai possesses a similar diary.\n\nAs the two team up to defeat an odd pursuer and head back to their respective homes, Deus Ex Machina explains that they—alongside 10 other contestants—have been drawn into a survival game whose victor will become the deity's successor. With no other options, Yukiteru and Yuno must use their cellphones—now called "Future Diaries"—to survive this unforgiving battle royale.
3	23222	Danshi Koukousei no Nichijou	Comedy	Roaming the halls of the all-boys Sanada North High School are three close comrades: the eccentric ringleader with a hyperactive imagination Hidenori, the passionate Yoshitake, and the rational and prudent Tadakuni. Their lives are filled with giant robots, true love, and intense drama... in their colorful imaginations, at least. In reality, they are just an everyday trio of ordinary guys trying to pass the time, but who said everyday life couldn't be interesting? Whether it's an intricate RPG reenactment or an unexpected romantic encounter on the riverbank at sunset, Danshi Koukousei no Nichijou is rife with bizarre yet hilariously relatable situations that are anything but mundane.
4	10129	Berserk: Ougon Jidai-hen I - Haou no Tamago	Action, Adventure, Drama, Fantasy, Horror	In the Kingdom of Midland, a mercenary named Guts wanders the land, preferring a life of conflict over a life of peace. Despite the odds never being in his favor, he is an unstoppable force that overcomes every opponent, wielding a massive sword larger than himself.\n\nOne day, Griffith, the mysterious leader of the mercenary group Band of the Hawk, witnesses the warrior's battle prowess and invites the wandering swordsman to join his squadron. Rejecting the offer, Guts challenges Griffith to a duel—and, much to the former's surprise, is subsequently defeated and forced to join.\n\nNow, Guts must fight alongside Griffith and his crew to help Midland defeat the Empire of Chuder. However, Griffith seems to harbor ulterior motives, desiring something much larger than just settling the war...
5	7531	Berserk: Ougon Jidai-hen III - Kourin	Action, Adventure, Drama, Fantasy, Horror	The Band of the Hawk has dwindled in the year since Guts left them on his journey to forge his own destiny. Unaware of their fate, Guts returns to the Hawks—now being led by his former ally Casca—after a rumor about them passes his way. Once the saviors of the kingdom of Midland, the Band of the Hawk are now hunted as they desperately fight for their lives while plotting to free their leader, Griffith, after he was imprisoned for committing treason. But the man they save is far from the Griffith they remember.\n\nGriffith is a shell of his former charismatic self after a year of continuous, horrific torture. No longer able to walk, speak, or even hold a sword, he has nothing but the small, strange trinket, the Crimson Behelit, that will not leave him. The entire Band of the Hawk want to rise to greatness once more, but how much are they willing to sacrifice to return to their past glory? It doesn't seem possible, but when Griffith's heart darkens and a solar eclipse blackens the sky, the Behelit offers a choice that will leave the Band of the Hawk with a blood-soaked fate that will haunt them for the rest of their days.

*Figure 6: Output of User Based Collaborative Filtering: Top 5 Recommendation for random user 1213175.*



# EXPERIMENTAL OBSERVATIONS (2/3)

Animes closest to Shingeki no Kyojin

	Name	Similarity	Genres	Synopsis
4	Death Note	84.29%	Supernatural, Suspense	Brutal murders, petty thefts, and senseless violence pollute the human world. In contrast, the realm of death gods is a humdrum, unchanging gambling den. The ingenious 17-year-old Japanese student Light Yagami and sadistic god of death Ryuk share one belief: their worlds are rotten. For his own amusement, Ryuk drops his Death Note into the human world. Light stumbles upon it, deeming the first of its rules ridiculous: the human whose name is written in this note shall die. However, the temptation is too great, and Light experiments by writing a felon's name, which disturbingly enacts his first murder. Aware of the terrifying godlike power that has fallen into his hands, Light—under the alias Kira—follows his wicked sense of justice with the ultimate goal of cleansing the world of all evil-doers. The meticulous mastermind detective L is already on his trail, but as Light's brilliance rivals L's, the grand chase for Kira turns into an intense battle of wits that can only end when one of them is dead.
3	Attack on Titan Season 2	83.19%	Action, Drama, Suspense	For centuries, humanity has been hunted by giant, mysterious predators known as the Titans. Three mighty walls—Wall Maria, Rose, and Sheena—provided peace and protection for humanity for over a hundred years. That peace, however, was shattered when the Colossal Titan and Armored Titan appeared and destroyed the outermost wall, Wall Maria. Forced to retreat behind Wall Rose, humanity waited with bated breath for the Titans to reappear and destroy their safe haven once more. In Shingeki no Kyojin Season 2, Eren Yeager and others of the 104th Training Corps have just begun to become full members of the Survey Corps. As they ready themselves to face the Titans once again, their preparations are interrupted by the invasion of Wall Rose—but all is not as it seems as more mysteries are unraveled. As the Survey Corps races to save the wall, they uncover more about the invading Titans and the dark secrets of their own members.
2	Code Geass: Lelouch of the Rebellion R2	81.95%	Action, Award Winning, Drama, Sci-Fi	One year has passed since the Black Rebellion, a failed uprising against the Holy Britannian Empire led by the masked vigilante Zero, who is now missing. At a loss without their revolutionary leader, Area 11's resistance group—the Black Knights—find themselves too powerless to combat the brutality inflicted upon the Elevens by Britannia, which has increased significantly in order to crush any hope of a future revolt. Lelouch Lamperouge, having lost all memory of his double life, is living peacefully alongside his friends as a high school student at Ashford Academy. His former partner C.C., unable to accept this turn of events, takes it upon herself to remind him of his past purpose, hoping that the mastermind Zero will rise once again to finish what he started, in this thrilling conclusion to the series.
1	Attack on Titan Season 3 Part 2	81.85%	Action, Drama	Seeking to restore humanity's diminishing hope, the Survey Corps embark on a mission to retake Wall Maria, where the battle against the merciless "Titans" takes the stage once again. Returning to the tattered Shiganshina District that was once his home, Eren Yeager and the Corps find the town oddly unoccupied by Titans. Even after the outer gate is plugged, they strangely encounter no opposition. The mission progresses smoothly until Armin Arlert, highly suspicious of the enemy's absence, discovers distressing signs of a potential scheme against them. Shingeki no Kyojin Season 3 Part 2 follows Eren as he vows to take back everything that was once his. Alongside him, the Survey Corps strive—through countless sacrifices—to carve a path towards victory and uncover the secrets locked away in the Yeager family's basement.
0	ERASED	80.92%	Mystery, Supernatural, Suspense	When tragedy is about to strike, Satoru Fujinuma finds himself sent back several minutes before the accident occurs. The detached, 29-year-old manga artist has taken advantage of this powerful yet mysterious phenomenon, which he calls "Revival," to save many lives. However, when he is wrongfully accused of murdering someone close to him, Satoru is sent back to the past once again, but this time to 1988, 18 years in the past. Soon, he realizes that the murder may be connected to the abduction and killing of one of his classmates, the solitary and mysterious Kayo Hinazuki, that took place when he was a child. This is his chance to make things right. Boku dake ga Inai Machi follows Satoru in his mission to uncover what truly transpired 18 years ago and prevent the death of his classmate while protecting those he cares about in the present.

*Figure 7: Output of Content based filtering: Top 5 Recommendation for “Shingeki no Kyojin”*

## ● CONCLUSION AND FUTURE SCOPES

- Implement Hybrid Recommendation System
- Include User Feedback and Reviews
- Explore Advanced Deep Learning Models
- Real-Time Recommendation Updates
- Interactive Web Interface
- Sentiment-Based Filtering
- Anime Popularity Trend Analysis

THANK YOU