HP Solve 2023 (ROUND-1)

Submission deadline date : 28th March

CASE STUDY

Knowledge Graph using Social Media Posts

- Problem Statement:
  - Understanding customer sentiments about products is of utmost priority for any product company including HP. Consumers are more vocal on social media platforms and expressing their feedback and experience about any product. HP too need to know consumer sentiments first-hand so that it can make better products with great user experience and resolve customer issue faster. We need a one stop knowledge store, which can store reviews, suggestions, complaint and sentiments for all HP consumer printers/PC/laptop. This will help HP understand the consumers better and improve brand value and NPS score.
- Outcome:
  - The solution should be able to crawl social media platforms such as (facebook, twitter, LinkedIn etc.) for posts talking about HP PC and Printers.
  - It should be able to classify/tag posts with a HP PC/printer brand or model, detect feature or problem the post is talking about and identify sentiments (complaint, suggestion or appreciation).
  - The output should be in the form of a **knowledge graph** which can be queried by stakeholders for better customer service, product improvement and faster resolution. The query can be like « List all posts talking about wifi issue in printer model X or brand Y ».
- Skills required : Web Data Mining, NLP, ML/DL, Web API

HP SOLVE 2023 GUIDELINES

SUBMISSION FORMAT

- In round 1, participants only need to submit a summary of their approach to solving the problem statement in the case study
- Students must submit the summary in a pdf word document/ppt only

SUBMISSION LINK

- Students are expected to upload their pdfs in the google form in step 2 (submit your response) along with some basic details.

You can find the link to the google form here as well

NEXT STEPS

After 1st round, shortlisted students will be communicated via email for the details of round 2

- **NOTE: No excel sheet allowed.**

Series Formulas

1. Arithmetic and Geometric Series

Definitions:

First term: a_1
Nth term: a_n
Number of terms in the series: n
Sum of the first n terms: S_n
Difference between successive terms: d
Common ratio: q
Sum to infinity: S

Arithmetic Series Formulas:

$$a_n = a_1 + (n-1)d$$

$$a_i = \frac{a_{i-1} + a_{i+1}}{2}$$

$$S_n = \frac{a_1 + a_n}{2} \cdot n$$

$$S_n = \frac{2a_1 + (n-1)d}{2} \cdot n$$

Geometric Series Formulas:

$$a_n = a_1 \cdot q^{n-1}$$

$$a_i = \sqrt{a_{i-1} \cdot a_{i+1}}$$

$$S_n = \frac{a_n q - a_1}{q-1}$$

$$S_n = \frac{a_1 (q^n - 1)}{q-1}$$

$$S = \frac{a_1}{1-q} \qquad \text{for} \quad -1 < q < 1$$

2. Special Power Series

Powers of Natural Numbers

$$\sum_{k=1}^{n} k = \frac{1}{2} n (n+1)$$

$$\sum_{k=1}^{n} k^2 = \frac{1}{6} n (n+1)(2n+1)$$

$$\sum_{k=1}^{n} k^3 = \frac{1}{4} n^2 (n+1)^2$$

Special Power Series

$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + \ldots \qquad (\text{for}: -1 < x < 1)$$

$$\frac{1}{1+x} = 1 - x + x^2 - x^3 + \ldots \qquad (\text{for}: -1 < x < 1)$$

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots$$

$$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5} \ldots \qquad (\text{for}: -1 < x < 1)$$

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \frac{x^9}{9!} \ldots$$

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \frac{x^8}{8!} \ldots$$

$$\tan x = x + \frac{x^3}{3} + \frac{2x^5}{15} + \frac{17x^7}{315} + \ldots \qquad \left(\text{for}: -\frac{\pi}{2} < x < \frac{\pi}{2}\right)$$

$$\sinh x = x + \frac{x^3}{3!} + \frac{x^5}{5!} + \frac{x^7}{7!} + \frac{x^9}{9!} \ldots$$

$$\cosh x = 1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} + \frac{x^8}{8!} \ldots$$

$$\tan x = x - \frac{x^3}{3} + \frac{2x^5}{15} - \frac{17x^7}{315} + \ldots \qquad \left(\text{for}: -\frac{\pi}{2} < x < \frac{\pi}{2}\right)$$

3. Taylor and Maclaurin Series

Definition:

$$f(x)=f(a)+f'(a)(x-a)+\frac{f''(a)(x-a)^2}{2!}+\ldots+\frac{f^{(n-1)}(a)(x-a)^{n-1}}{(n-1)!}+R_n$$

$$R_n=\frac{f^{(n)}(\xi)(x-a)^n}{n!} \qquad Lagrange's\ form \qquad a\le\xi\le x$$

$$R_n=\frac{f^{(n)}(\xi)(x-\xi)^{n-1}(x-a)}{(n-1)!} \qquad Cauch's\ form \qquad a\le\xi\le x$$

This result holds if f(x) has continuous derivatives of order n at last. If $\lim\limits_{n\to\infty}R_n=0$, the infinite series obtained is called Taylor series for f(x) about x = a. If a = 0 the series is often called a Maclaurin series.

Binomial series

$$(a+x)^n=a^n+na^{n-1}x+\frac{n(n-1)}{2!}a^{n-2}x^2+\frac{n(n-1)(n-2)}{3!}a^{n-3}x^3+\ldots$$

$$=a^n+\binom{n}{1}a^{n-1}x+\binom{n}{2}a^{n-2}x^2+\binom{n}{3}a^{n-3}x^3+\ldots$$

Special cases:

$$(1+x)^{-1}=1-x+x^2-x^3+x^4-\ldots \qquad -1<x<1$$

$$(1+x)^{-2}=1-2x+3x^2-4x^3+5x^4-\ldots \qquad -1<x<1$$

$$(1+x)^{-3}=1-3x+6x^2-10x^3+15x^4-\ldots \qquad -1<x<1$$

$$(1+x)^{-\frac{1}{2}}=1-\frac{1}{2}x+\frac{1\cdot3}{2\cdot4}x^2-\frac{1\cdot3\cdot5}{2\cdot4\cdot6}x^3+\ldots \qquad -1<x\le1$$

$$(1+x)^{\frac{1}{2}}=1+\frac{1}{2}x-\frac{1}{2\cdot4}x^2+\frac{1\cdot3}{2\cdot4\cdot6}x^3+\ldots \qquad -1<x\le1$$

Series for exponential and logarithmic functions

$$e^x=1+x+\frac{x^2}{2!}+\frac{x^3}{3!}+\ldots$$

$$a^x=1+x\ln a+\frac{(x\ln a)^2}{2!}+\frac{(x\ln a)^3}{3!}+\ldots$$

$$\ln(1+x)=x-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}\ldots \qquad -1<x\le1$$

$$\ln(1+x)=\left(\frac{x-1}{x}\right)+\frac{1}{2}\left(\frac{x-1}{x}\right)^2+\frac{1}{3}\left(\frac{x-1}{x}\right)^3+\ldots \qquad x\ge\frac{1}{2}$$

Series for trigonometric functions

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \ldots$$

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \ldots$$

$$\tan x = x + \frac{x^3}{3} + \frac{2x^5}{15} + \frac{17x^7}{315} + \ldots + \frac{2^{2n}\left(2^{2n}-1\right)B_n x^{2n-1}}{(2n)!} \qquad -\frac{\pi}{2} < x < \frac{\pi}{2}$$

$$\cot x = \frac{1}{x} - \frac{x}{3} - \frac{x^3}{45} - \frac{2x^5}{945} - \ldots - \frac{2^{2n} B_n x^{2n-1}}{(2n)!} \qquad 0 < x < \pi$$

$$\sec x = 1 + \frac{x^2}{2} + \frac{5x^4}{24} + \frac{61x^6}{720} + \ldots + \frac{E_n x^{2n}}{(2n)!} + \ldots \qquad -\frac{\pi}{2} < x < \frac{\pi}{2}$$

$$\csc x = \frac{1}{x} + \frac{x}{6} + \frac{7x^3}{360} + \ldots + \frac{2\left(2^{2n}-1\right)E_n x^{2n}}{(2n)!} + \ldots \qquad 0 < x < \pi$$

$$\sin^{-1} x = x + \frac{1}{2}\cdot\frac{x^3}{3} + \frac{1\cdot 3}{2\cdot 4}\cdot\frac{x^5}{5} + \frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6}\frac{x^7}{7} + \ldots \qquad -1 < x < 1$$

$$\cos^{-1} x = \frac{\pi}{2} - \sin^{-1} x = \frac{\pi}{2} - \left(x + \frac{1}{2}\cdot\frac{x^3}{3} + \frac{1\cdot 3}{2\cdot 4}\cdot\frac{x^5}{5} + \ldots\right) \qquad -1 < x < 1$$

$$\tan^{-1} x = \begin{cases} x - \frac{x^3}{3} + \frac{x^2}{5} - \frac{x^3}{7} + \ldots & if\ \ -1 < x < 1 \\ \frac{\pi}{2} - \frac{1}{x} + \frac{1}{3x^3} - \frac{1}{5x^5} + \ldots & if\ \ x \ge 1 \\ -\frac{\pi}{2} - \frac{1}{x} + \frac{1}{3x^3} - \frac{1}{5x^5} + \ldots & if\ \ x < 1 \end{cases}$$

$$\cot^{-1} x = \frac{\pi}{2} - \tan^{-1} x = \begin{cases} \frac{\pi}{2} - \left(x - \frac{x^3}{3} + \frac{x^2}{5} - \frac{x^3}{7} + ..\right). & if\ \ -1 < x < 1 \\ \frac{1}{x} - \frac{1}{3x^3} + \frac{1}{5x^5} - \frac{1}{7x^7} + \ldots & if\ \ x \ge 1 \\ \pi + \frac{1}{x} - \frac{1}{3x^3} + \frac{1}{5x^5} - \frac{1}{7x^7} + \ldots & if\ \ x < 1 \end{cases}$$

Series for hyperbolic functions

$$\sinh x = x + \frac{x^3}{3!} + \frac{x^5}{5!} + \frac{x^7}{7!} + \ldots$$

$$\cosh x = 1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} + \ldots$$

$$\tanh x = x - \frac{x^3}{3} + \frac{2x^5}{15} - \frac{17x^7}{315} + \ldots + \frac{(-1)^{n-1} 2^{2n}\left(2^{2n}-1\right)B_n x^{2n-1}}{(2n)!} + \ldots \qquad if -\frac{\pi}{2} < x < \frac{\pi}{2}$$

$$\coth x = \frac{1}{x} + \frac{x}{3} - \frac{x^3}{45} + \frac{2x^7}{945} + \ldots + \frac{(-1)^{n-1} 2^{2n} B_n x^{2n-1}}{(2n)!} + \ldots \qquad if\ \ 0 < |x| < \pi$$