

CPS 521 - DSMP Project
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Given Algorithms

Similarity
K-Means
SVM
MLP
Doc2Vec
Common-Neighbors
K-meansEuclidean

1 Node

Algorithm 1: Similarity

```
===== Simulation Iteration 1 =====
hughcscanlon to Reducer1: 226153 ms
Message Passing: 226947 ms
MAX Message Passing: 226947 ms
Messages Cost: 19800626 bytes
TOTAL Messages Cost: 19800626 bytes
Recommender-ServiceAgent1completionTimeTextProcessing: 21117 ms
Recommender-ServiceAgent1After processing, tweets: 94444
Recommender-ServiceAgent1 completionTimeTFIDF: 809 ms
Recommender-ServiceAgent1
Total Tweets Processed: 94547 TP: 21117 ms TFIDF: 809 ms CosSim: 105999 r
```

Performance Measurement of Simulated Recommen...

Number of Nodes:	1	Number of Latest Tw...	0
Begin date:	2007-01-01	End date:	2025-02-12
Top Recommendation...	3	Algorithm:	Similarity ▼
Iteration Number:	0 ▼		

Text Processing Parameters

☒ Remove #'s ☒ Remove RT's ☒ Remove Stop Words

Recommendations for User: hughscanlon

```
===== Recommendations for hughscanlon =====  
Recommendation 1: MMonline101  
Recommendation 2: under_foot  
Recommendation 3: talkingfrog
```

Algorithm 2: K-Means

Multi-Agent System Simulator for Distributed Recommender System

File

DSMP Lab

List of Real Users

- hughscanlon
- Thuncker
- alimbhart
- teachmesocial
- WoodbineRacing
- MMonline101
- ThLeWilliams
- GATPS13
- EliasTheodorou
- KylePentecost
- jzahr
- kalicat2
- wishkatsgirl
- HRBlockCanada
- under_foot
- CBCcathyalex
- MykeUEstes
- HemlingwayCats
- leftdog
- WeightLossDrinks
- ruthvenb
- yumcute
- falingthog
- ATeam164
- writersblock08
- Thepregguy
- jamestakeo
- callinmush
- MarshallJulius
- FromPhDtoLife
- CindyVien
- USBCanada
- michael_cruises
- onlytrash
- hughscans24
- InclusionPress

Performance Measurement of Simulated Recommender System

Number of Nodes: 1

Number of Latest Tweets: 0

Begin date: 2007-01-01

End date: 2025-02-12

Top Recommendations: 3

Algorithm: K-Means

Iteration Number: 0

Text Processing Parameters

☒ Remove #s ☒ Remove RT's ☒ Remove Stop Words

Recommendations for User: hughscanlon

Recommendation 1: talkingfrog
Recommendation 2: jzahr
Recommendation 3: HemlingwayCats

Timing Results

Simulation Iteration 2

hughscanlon to Reducer1: 226065 ms
Message Passing: 226910 ms
MAX Message Passing: 226910 ms
Messages Cost: 19800626 bytes
TOTAL Messages Cost: 19800626 bytes
Recommender-ServiceAgent1completionTimeTextProcessing: 16300 ms
Recommender-ServiceAgent1After processing, tweets: 94444
Recommender-ServiceAgent1 completionTimeTFIDF: 411 ms
Mapper1- Total Tweets Processed: 94547 TP: 16300 ms TFIDF: 411 ms Reducer
Improvements - TP: 22.81% TFIDF: 49.2% Algorithm: -633.69%

Previous Timing Results

Simulation Iteration 1

hughscanlon to Reducer1: 226153 ms
Message Passing: 226947 ms
MAX Message Passing: 226947 ms
Messages Cost: 19800626 bytes
TOTAL Messages Cost: 19800626 bytes
Recommender-ServiceAgent1completionTimeTextProcessing: 21117 ms
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Mapper1- Total Tweets Processed: 94547 TP: 16300 ms TFIDF: 411 ms Reducer
Improvements - TP: 22.81% TFIDF: 49.2% Algorithm: -633.69%
  
```

2 Nodes

Algorithm 1: Similarity

The screenshot displays the Multi-Agent System Simulator for Distributed Recommender System interface. The main window is titled "DSMP Lab" and contains several sections:

- List of Real Users:** A scrollable list of users including hughscanlon, Thuncher, akimboart, teachmesocial, WoodbineRacing, MMonline101, TheLeeWilliams, EMP513, EliasTheodorou, KylePentecost, jahr, kaical2, wichtaksgirl, HRBlockCanada, under_foot, CBCCanalex, NyxelUEstes, HemingwayCats, leftdog, WeighLossDrinks, nufvenb, ymicufe, talkingfrog, ATeamMIA, writersblock08, Therpeggy, jamestaleo, callinush, MarshalJulius, FromPhiDioLife, CindyVien, USBCanada, michael_cruises, onlyfnabl, lucyheaps24, InclusionPress, Rversoru, TheCatTwelving, weathernetwork, and TorontoStar.
- Performance Measurement of Simulated Recommender System:**
 - Number of Nodes: 2
 - Number of Latest Tweets: 0
 - Begin date: 2007-01-01
 - End date: 2025-02-12
 - Top Recommendations: 3
 - Algorithm: Similarity
 - Iteration Number: 0
- Text Processing Parameters:**
 - ☒ Remove P's
 - ☒ Remove RT's
 - ☒ Remove Stop Words
- Recommendations for User: hughscanlon**
 - Recommendation 1: MMonline101
 - Recommendation 2: under_foot
 - Recommendation 3: jahr
- Commands:**
 - 1. Get Users
 - 2. Initialize
 - 3. Run Simulation
 - Quit
 - Number of Simulations
 - Return to User Sim
- Timing Results:**
 - Simulation Iteration 3
 - hughscanlon to Reducer1: 226092 ms
 - hughscanlon to Reducer2: 226140 ms
 - Message Passing: 226405 ms
 - Message Passing: 226882 ms
 - MAX Message Passing: 226882 ms
 - Messages Cost: 1035388 bytes
 - Messages Cost: 1005524 bytes
 - TOTAL Messages Cost: 20418912 bytes
 - Reducer-ServiceAgentCompletionTimeTailProcessing: 11129 ms
 - Reducer-ServiceAgent1After processing, tweets: 48021
 - Reducer-ServiceAgent2CompletionTimeTailProcessing: 11447 ms
 - Reducer-ServiceAgent2After processing, tweets: 49530
 - Reducer-ServiceAgent1 completionTimeTFIDF: 200 ms
 - Reducer-ServiceAgent2 completionTimeTFIDF: 238 ms
 - Reducer-ServiceAgent1
 - Total Tweets Processed: 48046 TP: 11129 ms TFIDF: 200 ms CosSim: 109542
 - Reducer-ServiceAgent2
 - Total Tweets Processed: 49708 TP: 11447 ms TFIDF: 238 ms CosSim: 115652
 - Merge Message Time: 6223 ms
 - Merge Message Time: 622150000 ns
 - Improvements - TP: 20.77% TFIDF: 42.03% Algorithm: 85.13%
- Previous Timing Results:**
 - Simulation Iteration 1
 - hughscanlon to Reducer1: 226153 ms
 - Message Passing: 226947 ms
 - MAX Message Passing: 226947 ms
 - Messages Cost: 1800626 bytes
 - TOTAL Messages Cost: 1800626 bytes
 - Reducer-ServiceAgentCompletionTimeTailProcessing: 21117 ms
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 - Reducer-ServiceAgent1 completionTimeTFIDF: 809 ms
 - Reducer-ServiceAgent1
 - Total Tweets Processed: 94547 TP: 21117 ms TFIDF: 809 ms CosSim: 105999
 - Simulation Iteration 2
 - hughscanlon to Reducer1: 226095 ms
 - Message Passing: 226910 ms
 - MAX Message Passing: 226910 ms
 - Messages Cost: 1800626 bytes
 - TOTAL Messages Cost: 1800626 bytes
 - Reducer-ServiceAgentCompletionTimeTailProcessing: 16300 ms
 - Reducer-ServiceAgent1After processing, tweets: 94444
 - Reducer-ServiceAgent1 completionTimeTFIDF: 411 ms
 - Mapper1- Total Tweets Processed: 94547 TP: 16300 ms TFIDF: 411 ms Reduc
 - Improvements - TP: 22.81% TFIDF: 49.2% Algorithm: -53.89%

Algorithm 2: K-Means

The screenshot displays the Multi-Agent System Simulator for Distributed Recommender System interface. The main window is titled "DSMP Lab" and contains several sections:

- List of Real Users:** A scrollable list of users including hughscanlon, Thuncher, akimboart, teachmesocial, WoodbineRacing, MMonline101, TheLeeWilliams, EMP513, EliasTheodorou, KylePentecost, jahr, kaical2, wichtaksgirl, HRBlockCanada, under_foot, CBCCanalex, NyxelUEstes, HemingwayCats, leftdog, WeighLossDrinks, nufvenb, ymicufe, talkingfrog, ATeamMIA, writersblock08, Therpeggy, jamestaleo, callinush, MarshalJulius, FromPhiDioLife, CindyVien, USBCanada, michael_cruises, onlyfnabl, lucyheaps24, InclusionPress, Rversoru, TheCatTwelving, weathernetwork, and TorontoStar.
- Performance Measurement of Simulated Recommender System:**
 - Number of Nodes: 2
 - Number of Latest Tweets: 0
 - Begin date: 2007-01-01
 - End date: 2025-02-12
 - Top Recommendations: 3
 - Algorithm: K-Means
 - Iteration Number: 0
- Text Processing Parameters:**
 - ☒ Remove P's
 - ☒ Remove RT's
 - ☒ Remove Stop Words
- Recommendations for User: hughscanlon**
 - Recommendation 1: weathernetwork
 - Recommendation 2: jahr
 - Recommendation 3: talkingfrog
- Commands:**
 - 1. Get Users
 - 2. Initialize
 - 3. Run Simulation
 - Quit
 - Number of Simulations
 - Return to User Sim
- Timing Results:**
 - Simulation Iteration 4
 - hughscanlon to Reducer2: 226126 ms
 - hughscanlon to Reducer1: 226171 ms
 - Message Passing: 226396 ms
 - Message Passing: 226806 ms
 - MAX Message Passing: 226806 ms
 - Messages Cost: 11283262 bytes
 - Messages Cost: 1098933 bytes
 - TOTAL Messages Cost: 2277500 bytes
 - Reducer-ServiceAgentCompletionTimeTailProcessing: 11976 ms
 - Reducer-ServiceAgent1After processing, tweets: 52321
 - Reducer-ServiceAgent2CompletionTimeTailProcessing: 12188 ms
 - Reducer-ServiceAgent2After processing, tweets: 53566
 - Reducer-ServiceAgent1 completionTimeTFIDF: 253 ms
 - Reducer-ServiceAgent2 completionTimeTFIDF: 295 ms
 - Mapper1- Total Tweets Processed: 53645 TP: 12188 ms TFIDF: 295 ms Reduc
 - Mapper2- Total Tweets Processed: 53645 TP: 12188 ms TFIDF: 295 ms Reduc
 - Mapper1- Total Tweets Processed: 53645 TP: 12188 ms TFIDF: 295 ms Reduc
 - Mapper2- Total Tweets Processed: 53645 TP: 12188 ms TFIDF: 295 ms Reduc
 - Merge Message Time: 27571 ms
 - Merge Message Time: 27571407400 ns
 - Improvements - TP: -4.47% TFIDF: -23.91% Algorithm: -436.98%
- Previous Timing Results:**
 - Simulation Iteration 1
 - hughscanlon to Reducer1: 226153 ms
 - Message Passing: 226947 ms
 - MAX Message Passing: 226947 ms
 - Messages Cost: 1800626 bytes
 - TOTAL Messages Cost: 1800626 bytes
 - Reducer-ServiceAgentCompletionTimeTailProcessing: 21117 ms
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 - Reducer-ServiceAgent1 completionTimeTFIDF: 809 ms
 - Reducer-ServiceAgent1
 - Total Tweets Processed: 94547 TP: 21117 ms TFIDF: 809 ms CosSim: 105999
 - Simulation Iteration 2
 - hughscanlon to Reducer1: 226095 ms
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 - Reducer-ServiceAgent1After processing, tweets: 94444
 - Reducer-ServiceAgent1 completionTimeTFIDF: 411 ms
 - Mapper1- Total Tweets Processed: 94547 TP: 16300 ms TFIDF: 411 ms Redu
 - Improvements - TP: 22.81% TFIDF: 49.2% Algorithm: -53.89%
 - Simulation Iteration 3
 - hughscanlon to Reducer1: 226092 ms
 - Message Passing: 226405 ms
 - Message Passing: 226882 ms

4 Nodes

Algorithm 1: Similarity

Multi-Agent System Simulator for Distributed Recommender System

File

DSMP Lab

List of Real Users

- hughscanlon
- thunder
- kimboart
- achmesocial
- woodbineRacing
- Monline101
- TheLewWilliams
- EMTP513
- EliasTheodorou
- KylePentecost
- zahr
- kalica2
- wichtaksgirl
- HRBlockCanada
- under_foot
- CBChathalee
- MyxellEllis
- HemingwayCats
- lefdog
- WeightLossDrinks
- ruthevb
- ymicute
- talkingfrog
- ATeamMIA
- wintersblock08
- Therpreygy
- jamestakeo
- callitnush
- MarshallJulius
- FromPhDtoLife
- CindyVien
- USBCanada
- michael_cruises
- onlyfrail
- lucyheaps24
- IndusionPress
- RyersonU
- TheCatWeeing
- wasathenetwork
- TorontoStar

Performance Measurement of Simulated Recommender System

Number of Nodes: 4

Number of Latest Tweets: 0

Begin date: 2007-01-01

End date: 2025-02-12

Top Recommendations: 3

Algorithm: Similarity

Iteration Number: 0

Text Processing Parameters

☒ Remove #'s ☒ Remove RT's ☒ Remove Stop Words

Recommendations for User: hughscanlon

Recommendation 1: MikeMiller101
Recommendation 2: under_foot
Recommendation 3: talkingfrog

Commands

1. Get Users

2. Initialize

3. Run Simulation

Quit

Number of Simulations

Return to User Sim

Current Progress

Timing Results

Simulation Iteration 5

hughscanlon to Reducer1: 226073 ms
hughscanlon to Reducer3: 226121 ms
hughscanlon to Reducer2: 226107 ms
hughscanlon to Reducer4: 226212 ms
Message Passing: 226097 ms
Message Passing: 226096 ms
Message Passing: 226103 ms
Message Passing: 226023 ms
MAX Message Passing: 226023 ms
Messages Cost: 5211768 bytes
Messages Cost: 5227628 bytes
Messages Cost: 5050290 bytes
Messages Cost: 6065798 bytes
TOTAL Messages Cost: 21055484 bytes
Recommender-ServiceAgent3completionTimeTextProcessing: 7965 ms
Recommender-ServiceAgent3After processing, tweets: 25472
Recommender-ServiceAgent3completionTimeTextProcessing: 8137 ms
Recommender-ServiceAgent1After processing, tweets: 25212
Recommender-ServiceAgent2completionTimeTextProcessing: 8482 ms
Recommender-ServiceAgent2After processing, tweets: 25620
Recommender-ServiceAgent4completionTimeTextProcessing: 8603 ms
Recommender-ServiceAgent4After processing, tweets: 27562
Recommender-ServiceAgent1 completionTimeTFIDF: 143 ms
Recommender-ServiceAgent2 completionTimeTFIDF: 144 ms
Recommender-ServiceAgent3 completionTimeTFIDF: 143 ms
Recommender-ServiceAgent4 completionTimeTFIDF: 149 ms

Previous Timing Results

Simulation Iteration 1

hughscanlon to Reducer1: 226153 ms
Message Passing: 226047 ms
MAX Message Passing: 226947 ms
Messages Cost: 19800626 bytes
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Recommender-ServiceAgent1completionTimeTextProcessing: 21117 ms
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Recommender-ServiceAgent1 completionTimeTFIDF: 411 ms
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Total Tweets Processed: 94547 TP: 21117 ms TFIDF: 809 ms CosSim: 105999

Simulation Iteration 2

hughscanlon to Reducer1: 226065 ms
Message Passing: 226910 ms
MAX Message Passing: 226910 ms
Messages Cost: 19800626 bytes
TOTAL Messages Cost: 19800626 bytes
Recommender-ServiceAgent1completionTimeTextProcessing: 16300 ms
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Recommender-ServiceAgent1 completionTimeTFIDF: 411 ms
Mapper1- Total Tweets Processed: 94547 TP: 16300 ms TFIDF: 411 ms Reducer
improvements - TP: 22.81% TFIDF: 49.2% Algorithm: -633.69%

Simulation Iteration 3

hughscanlon to Reducer1: 226092 ms
hughscanlon to Reducer2: 226140 ms
Message Passing: 226405 ms
Message Passing: 226882 ms

Algorithm 2: K-Means

Multi-Agent System Simulator for Distributed Recommender System

File

DSMP Lab

List of Real Users

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- woodbineRacing
- Monline101
- TheLewWilliams
- EMTP513
- EliasTheodorou
- KylePentecost
- zahr
- kalica2
- wichtaksgirl
- HRBlockCanada
- under_foot
- CBChathalee
- MyxellEllis
- HemingwayCats
- lefdog
- WeightLossDrinks
- ruthevb
- ymicute
- talkingfrog
- ATeamMIA
- wintersblock08
- Therpreygy
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- MarshallJulius
- FromPhDtoLife
- CindyVien
- USBCanada
- michael_cruises
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- lucyheaps24
- IndusionPress
- RyersonU
- TheCatWeeing
- wasathenetwork
- TorontoStar

Performance Measurement of Simulated Recommender System

Number of Nodes: 4

Number of Latest Tweets: 0

Begin date: 2007-01-01

End date: 2025-02-12

Top Recommendations: 3

Algorithm: K-Means

Iteration Number: 0

Text Processing Parameters

☒ Remove #'s ☒ Remove RT's ☒ Remove Stop Words

Recommendations for User: hughscanlon

Recommendation 1: weathernetwork
Recommendation 2: TorontoStar
Recommendation 3: talkingfrog

Commands

1. Get Users

2. Initialize

3. Run Simulation

Quit

Number of Simulations

Return to User Sim

Current Progress

Timing Results

Simulation Iteration 6

hughscanlon to Reducer3: 226137 ms
hughscanlon to Reducer2: 226181 ms
hughscanlon to Reducer1: 226228 ms
hughscanlon to Reducer4: 226276 ms
Message Passing: 226148 ms
Message Passing: 226148 ms
Message Passing: 226086 ms
MAX Message Passing: 226886 ms
Messages Cost: 6574640 bytes
Messages Cost: 6783378 bytes
Messages Cost: 6903978 bytes
Messages Cost: 6999612 bytes
TOTAL Messages Cost: 27216548 bytes
Recommender-ServiceAgent1completionTimeTextProcessing: 9882 ms
Recommender-ServiceAgent1After processing, tweets: 31226
Recommender-ServiceAgent1 completionTimeTextProcessing: 10309 ms
Recommender-ServiceAgent3After processing, tweets: 33708
Recommender-ServiceAgent2completionTimeTextProcessing: 10452 ms
Recommender-ServiceAgent2After processing, tweets: 32351
Recommender-ServiceAgent4completionTimeTextProcessing: 9681 ms
Recommender-ServiceAgent4After processing, tweets: 31486
Recommender-ServiceAgent3 completionTimeTFIDF: 188 ms
Recommender-ServiceAgent2 completionTimeTFIDF: 192 ms
Recommender-ServiceAgent1 completionTimeTFIDF: 200 ms
Recommender-ServiceAgent4 completionTimeTFIDF: 213 ms

Previous Timing Results

Simulation Iteration 1

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Simulation Iteration 2

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improvements - TP: 22.81% TFIDF: 49.2% Algorithm: -633.69%

Simulation Iteration 3

hughscanlon to Reducer1: 226092 ms
hughscanlon to Reducer2: 226140 ms
Message Passing: 226405 ms
Message Passing: 226882 ms

8 Nodes

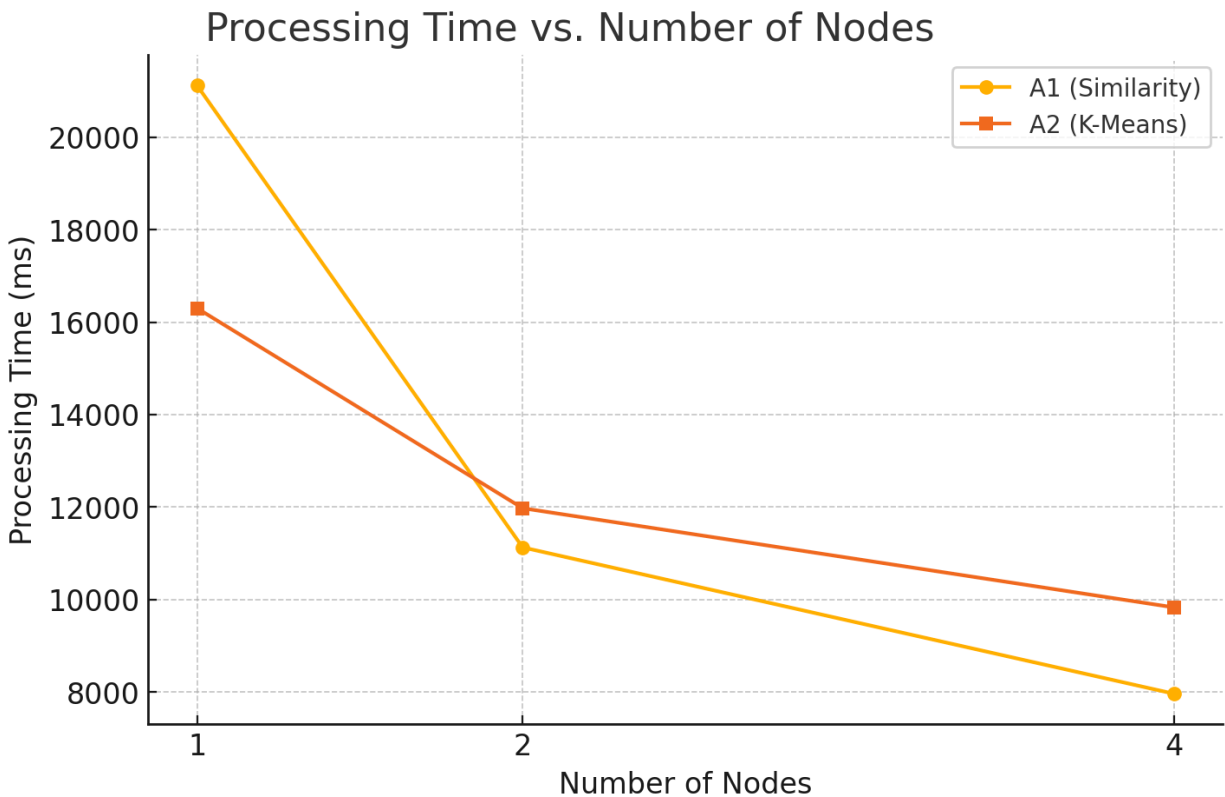
Algorithm 1: Similarity

APP DID NOT WORK

Algorithm 2: K-Means

APP DID NOT WORK

a. Plot the timing vs. nodes for each algorithm (you will plot 2 curves).



The code used to plot the table:

```
import matplotlib.pyplot as plt

nodes = [1, 2, 4]

A1_timing = [21117, 11129, 7965] # A1 (Similarity) Processing Times
A2_timing = [16300, 9196, 9832]  # A2 (K-Means) Text Processing Times

plt.figure(figsize=(8, 5))
plt.plot(nodes, A1_timing, marker='o', linestyle='-', label="A1 (Similarity)")
plt.plot(nodes, A2_timing, marker='s', linestyle='-', label="A2 (K-Means)")

plt.xlabel("Number of Nodes")
plt.ylabel("Processing Time (ms)")
plt.title("Processing Time vs. Number of Nodes")
plt.xticks(nodes)
plt.legend()
plt.grid(True)

plt.show()
```

b. How do you determine the processing time gain for any number of nodes used in any algorithm? Write this in a formula.

$T(N_1)$ is the processing time with N_1 nodes.

$T(N_2)$ is the processing time with N_2 nodes.

G represents the percentage gain in processing efficiency

$$G = \left(\frac{T(N_1) - T(N_2)}{T(N_1)} \right) \times 100$$

Nodes	A1 (Similarity) Processing Time (ms)	A1 Speedup	A1 Gain (%)	A2 (K-Means) Processing Time (ms)	A2 Speedup	A2 Gain (%)
1	21117	1.00	0.00	16300	1.00	0.00
2	11129	1.90	47.29	11976	1.36	26.51
4	7965	2.65	62.26	9832	1.66	39.67

The total time gain is calculated as:

$$\text{Total Gain} = G1 + G2 + G3 + G4$$

Where:

- G_n represents the parallelization gain at each node count compared to the previous count.
- Since we only have data for 1, 2, and 4 nodes, we calculate:

$$\text{Total Gain (so far)} = G1 + G2 + G3$$

Since we do not have the 8-node data, $G4$ is missing, meaning our total time gain is only approximate up to 4 nodes.

Algorithm	Total Gain (%)
A1 (Similarity)	131.15460132369276
A2 (K-Means)	141.29559537845648

c. Which algorithm yields the best timing?

A2 (K-Means) has a slightly higher overall time gain (141.30%) than A1 (Similarity) (131.15%).

A2 (K-Means) yields the best timing.