

**National University of Computer & Emerging Sciences**  
**Karachi Campus**



**PROJECT IMPLEMENTATION SNIPPETS**

**Learning Latent Personas of Film Characters**

**Course Name: EL-2003 INFORMATION RETRIEVAL**

**Section: 6-H**

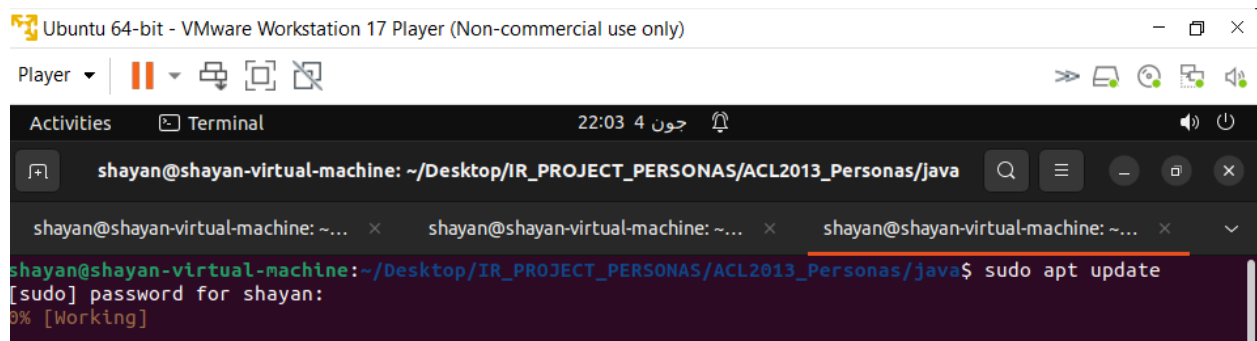
**Group Members:**

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- 22K-4320 Marium Arif

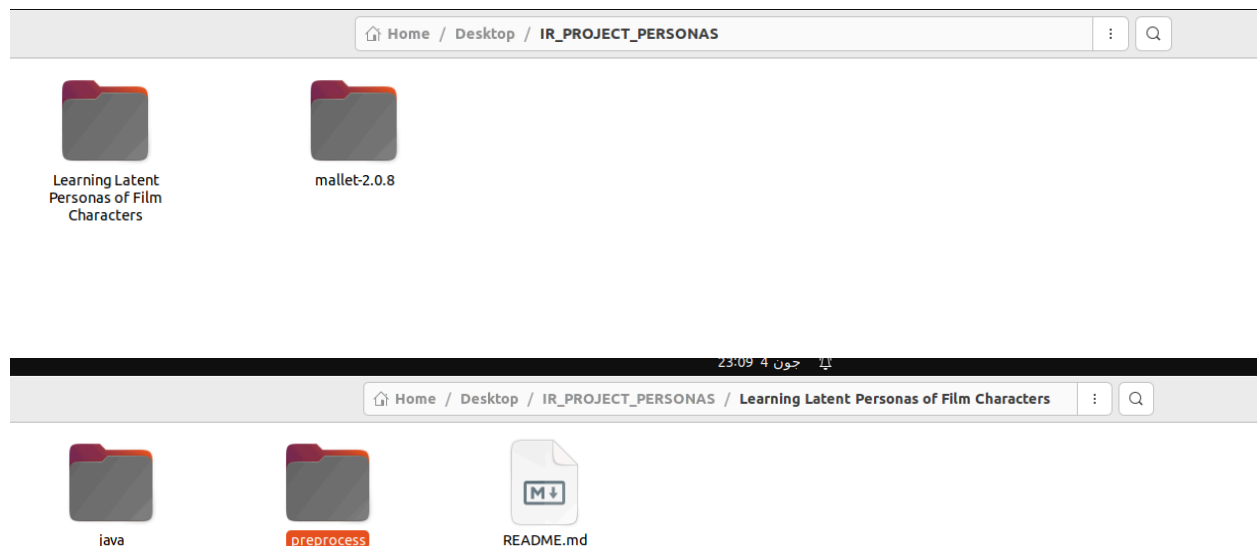
## 1. OVERVIEW:

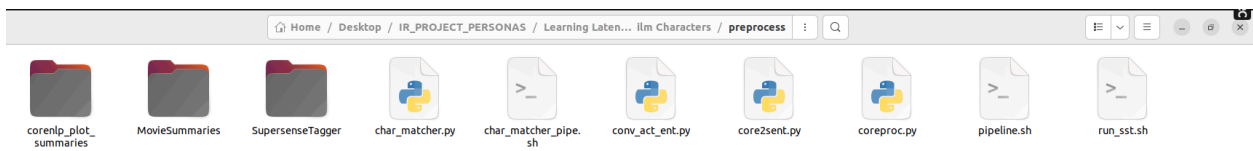
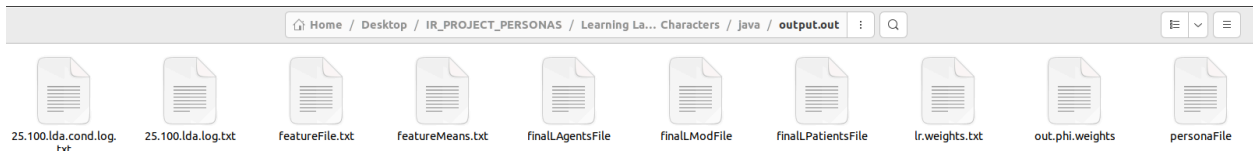
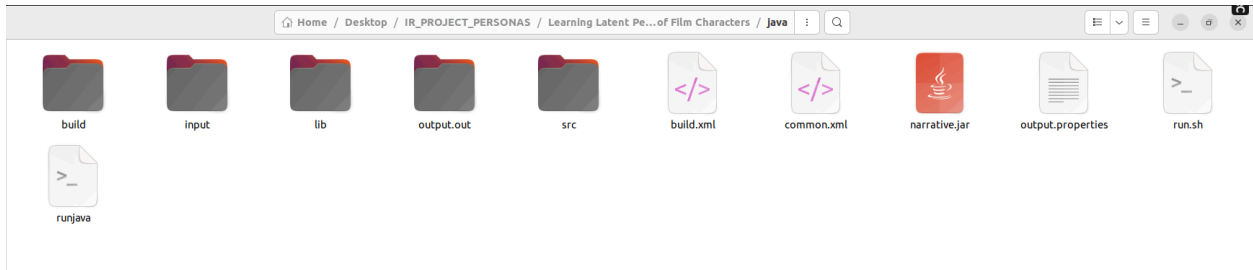
This project implements a Persona-based topic modeling framework for learning latent personas of film characters using dialogue and metadata. It leverages a Dirichlet persona model with regression.

## 2. ENVIRONMENT SETUP:



## 3. FILE STRUCTURE:





## 4. MODEL SETUP AND TRAINING:

### 4.1 INITIAL MODEL PROTOTYPING AND EVALUATION:

```
(persona) shayan@shayan-virtual-machine:~/Desktop/IR$ python minimal_train.py
Analyzing 8 documents with 29 unique terms
Auto-assigning NUTS sampler...
Initializing NUTS using jitter+adapt_diag...
Multiprocess sampling (2 chains in 2 jobs)
NUTS: [theta, phi]
Sampling 2 chains for 300 tune and 500 draw iterations (600 + 1_000 draws total)
took 126 seconds.
We recommend running at least 4 chains for robust computation of convergence diagnostics

=== Identified Personas ===
Persona 1:
person 0.856
```

=== Identified Personas ===

Persona 1:  
money: 0.056  
profit: 0.054  
market: 0.052  
stocks: 0.051  
hero: 0.050

Persona 2:  
wedding: 0.066  
romance: 0.066  
love: 0.064  
kiss: 0.063  
flowers: 0.060

Persona 3:  
stocks: 0.074  
profit: 0.073  
money: 0.069  
market: 0.069  
science: 0.065

Persona 4:  
action: 0.065  
love: 0.062  
kiss: 0.061  
wedding: 0.061  
romance: 0.060

Visualization saved to personas.png

=== Document Assignments ===

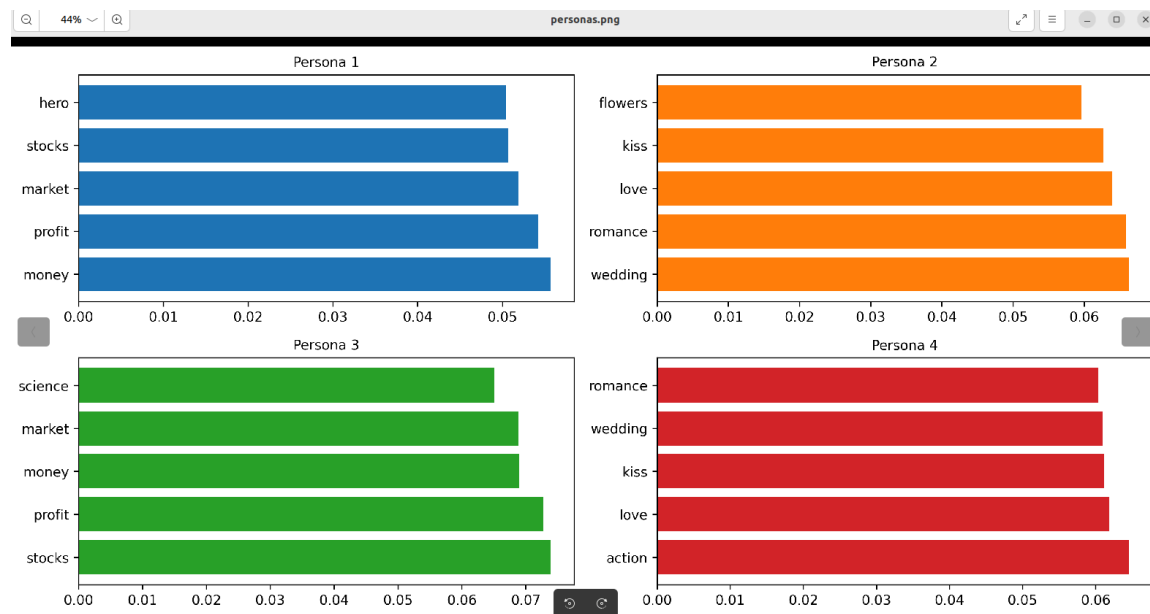
Doc 1: guns shoot bullets action hero fight...  
P(Persona 1): 0.261  
P(Persona 2): 0.197  
P(Persona 3): 0.220  
P(Persona 4): 0.322

Doc 2: science physics research quantum theory...  
P(Persona 1): 0.254  
P(Persona 2): 0.228  
P(Persona 3): 0.309  
P(Persona 4): 0.209

Doc 3: love romance heart flowers kiss wedding...  
P(Persona 1): 0.205  
P(Persona 2): 0.375  
P(Persona 3): 0.056  
P(Persona 4): 0.365

Doc 4: money business stocks market profit...  
P(Persona 1): 0.306  
P(Persona 2): 0.194  
P(Persona 3): 0.405  
P(Persona 4): 0.095

Doc 5: gunfight action explosion hero villain...  
P(Persona 1): 0.245  
P(Persona 3): 0.385



## 4.2 ELICITED MODEL TRAINING AND OUTPUT:

### 4.2.1 DOWNLOADING DEPENDENCIES

```
shayan@shayan-virtual-machine:~/Desktop$ mkdir IR
mkdir: cannot create directory 'IR': File exists
shayan@shayan-virtual-machine:~/Desktop$ mkdir IR_PROJECT_PERSONAS
shayan@shayan-virtual-machine:~/Desktop$ cd IR_PROJECT_PERSONAS/
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS$ wget http://mallet.cs.umass.edu/dist/mallet-2.0.8.zip
unzip mallet-2.0.8.zip
export MALLET_HOME=$(pwd)/mallet-2.0.8
echo "export MALLET_HOME=$(pwd)/mallet-2.0.8" >> ~/.bashrc
echo 'export PATH=$PATH:$MALLET_HOME/bin' >> ~/.bashrc
source ~/.bashrc
--2025-06-02 12:49:40-- http://mallet.cs.umass.edu/dist/mallet-2.0.8.zip
Resolving mallet.cs.umass.edu (mallet.cs.umass.edu)... 128.119.246.70
Connecting to mallet.cs.umass.edu (mallet.cs.umass.edu)|128.119.246.70|:80... connected.
HTTP request sent, awaiting response... 302 Found
Location: https://mallet.cs.umass.edu/dist/mallet-2.0.8.zip [following]
--2025-06-02 12:49:40-- https://mallet.cs.umass.edu/dist/mallet-2.0.8.zip
Connecting to mallet.cs.umass.edu (mallet.cs.umass.edu)|128.119.246.70|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 16184794 (15M) [application/zip]
Saving to: 'mallet-2.0.8.zip'

mallet-2.0.8.zip  100%[=====] 15.43M  1.58MB/s   in 10s

2025-06-02 12:49:51 (1.49 MB/s) - 'mallet-2.0.8.zip' saved [16184794/16184794]

Archive:  mallet-2.0.8.zip
```

### 4.2.2 UPDATING CONFIGS AND DOWNLOADING FURTHER DEPENDENCIES

```
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS$ sudo apt update && sudo apt install -y git python3 python3-pip openjdk-11-jdk unzip wget
Hit:1 http://pk.archive.ubuntu.com/ubuntu jammy InRelease
Hit:2 http://pk.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:3 http://pk.archive.ubuntu.com/ubuntu jammy-backports InRelease
Hit:4 https://packages.microsoft.com/repos/code stable InRelease
Hit:5 https://dl.google.com/linux/chrome/deb stable InRelease
Hit:6 http://security.ubuntu.com/ubuntu jammy-security InRelease
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
137 packages can be upgraded. Run 'apt list --upgradable' to see them.
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
python3 is already the newest version (3.10.6-1~22.04.1).
unzip is already the newest version (6.0-26ubuntu3.2).
wget is already the newest version (1.21.2-2ubuntu1.1).
git is already the newest version (1:2.34.1-1ubuntu1.12).
openjdk-11-jdk is already the newest version (11.0.27+6-us1-0ubuntu1~22.04).
python3-pip is already the newest version (22.0.2+dfsg-1ubuntu0.5).
The following packages were automatically installed and are no longer required:
  libpython2-stdlib python-pkg-resources python-setuptools python2
  python2-minimal
Use 'sudo apt autoremove' to remove them.
0 upgraded, 0 newly installed, 0 to remove and 137 not upgraded.
```

### 4.2.3 DOWNLOADING FURTHER DEPENDENCIES MODEL EVALUATION AND INITIATION

```
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS$ pip3 install numpy pandas nltk scikit-learn tqdm
python3 -c "import nltk; nltk.download('punkt')"
```

Defaulting to user installation because normal site-packages is not writeable

Requirement already satisfied: numpy in /home/shayan/.local/lib/python3.10/site-packages (2.2.6)

Requirement already satisfied: pandas in /home/shayan/.local/lib/python3.10/site-packages (2.2.3)

Requirement already satisfied: nltk in /home/shayan/.local/lib/python3.10/site-packages (3.9.1)

Requirement already satisfied: scikit-learn in /home/shayan/.local/lib/python3.10/site-packages (1.6.1)

Requirement already satisfied: tqdm in /home/shayan/.local/lib/python3.10/site-packages (4.67.1)

Requirement already satisfied: pytz>=2020.1 in /usr/lib/python3/dist-packages (from pandas) (2022.1)

Requirement already satisfied: python-dateutil>=2.8.2 in /home/shayan/.local/lib/python3.10/site-packages (from pandas) (2.9.0.post0)

Requirement already satisfied: tzdata>=2022.7 in /home/shayan/.local/lib/python3.10/site-packages (from pandas) (2025.2)

Requirement already satisfied: click in /usr/lib/python3/dist-packages (from nltk) (8.0.3)

Requirement already satisfied: joblib in /home/shayan/.local/lib/python3.10/site-packages (from nltk) (1.5.1)

Requirement already satisfied: regex>=2021.8.3 in /home/shayan/.local/lib/python3.10/site-packages (from nltk) (2024.11.6)

Requirement already satisfied: scipy>=1.6.0 in /usr/lib/python3/dist-packages (from scikit-learn) (1.8.0)

Requirement already satisfied: threadpoolctl>=3.1.0 in /home/shayan/.local/lib/python3.10/site-packages (from scikit-learn) (3.6.0)

Requirement already satisfied: six>=1.5 in /usr/lib/python3/dist-packages (from python-dateutil>=2.8.2->pandas) (1.16.0)

/usr/lib/python3/dist-packages/scipy/\_init\_.py:146: UserWarning: A Numpy version >=1.17.3 and <1.25.0 is required for this version of SciPy (detected version 2.2.6)

### 4.2.4 TUNING DEPENDENCIES VERSIONS FOR CONFIGURATION

```
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS$ pip3 uninstall -y numpy scipy
Found existing installation: numpy 2.2.6
Uninstalling numpy-2.2.6:
  Successfully uninstalled numpy-2.2.6
Found existing installation: scipy 1.8.0
Not uninstalling scipy at /usr/lib/python3/dist-packages, outside environment /usr
Can't uninstall 'scipy'. No files were found to uninstall.
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS$ pip3 install numpy==1.24.4 scipy==1.10.1
Defaulting to user installation because normal site-packages is not writeable
Collecting numpy==1.24.4
  Downloading numpy-1.24.4-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (17.3 MB)
    17.3/17.3 MB 1.5 MB/s eta 0:00:00
Collecting scipy==1.10.1
  Downloading scipy-1.10.1-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (34.4 MB)
    34.4/34.4 MB 1.5 MB/s eta 0:00:00
Installing collected packages: numpy, scipy
Successfully installed numpy-1.24.4 scipy-1.10.1
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS$ python3 -c "import nltk; nltk.download('punkt')"
```

[nltk\_data] Downloading package punkt to /home/shayan/nltk\_data...

[nltk\_data] Package punkt is already up-to-date!

```
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS$ wget http://mallet.cs.umass.edu/dist/mallet-2.0.8.zip
unzip mallet-2.0.8.zip
export MALLLET_HOME=$(pwd)/mallet-2.0.8
echo "export MALLLET_HOME=$(pwd)/mallet-2.0.8" >> ~/.bashrc
echo 'export PATH=$PATH:$MALLLET_HOME/bin' >> ~/.bashrc
source ~/.bashrc
```

## 4.2.5 FILE STRUCTURE

```
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS$ cd ACL2013_Personas/
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas$ ls
java preprocess README.md
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas$ ls
java preprocess README.md
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas$ cd preprocess/
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas/preprocess$ ls
all.data conv_act_ent.py coreproc.py run_sst.sh
char_matcher_pipe.sh core2sent.py MovieSummaries SupersenseTagger
char_matcher.py corenlp_plot_summaries pipeline.sh
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas/preprocess$ mv all.data java/input/
mv: cannot move 'all.data' to 'java/input/': No such file or directory
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas/preprocess$ mv all.data ../java/input/
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas/preprocess$ ls
char_matcher_pipe.sh core2sent.py MovieSummaries SupersenseTagger
char_matcher.py corenlp_plot_summaries pipeline.sh
conv_act_ent.py coreproc.py run_sst.sh
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas/preprocess$ cd ..
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas$ cd java
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas/java$ ld
ld: no input files
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas/java$ ls
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas/java$ ls
build build.xml common.xml input lib narrative.jar runjava run.sh src
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas/java$ cd input
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas/java/input$ ls
all.character.metadata all.data all.movies.metadata box.office.txt movies.data.gz
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas/java/input$ gunzip input/movies.data.gz # only if it sti
ll exists
gzip: input/movies.data.gz: No such file or directory
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas/java/input$ gunzip movies.data.gz
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas/java/input$ ls
all.character.metadata all.data all.movies.metadata box.office.txt movies.data
```

## 4.2.5 MODEL TRAINING FROM INPUT DATA

```
shayan@shayan-virtual-machine:~/Desktop/IR_PROJECT_PERSONAS/ACL2013_Personas/java$ ./run.sh output input/movies.data
Reading data...
done reading
Active vocab size: 1000
Total entities: 178734; w/ Age: 33302; w/ Gender: 37825; w/ Actor 0
Iter 0: runningLL 0 numchanges 0
gamma 1.00000 -> 0.319702
nuA 1.00000 -> 0.673399
nuP 1.00000 -> 0.716439
nuM 1.00000 -> 0.374898
gamma 0.319702 -> 0.116731
nuA 0.673399 -> 0.266685
nuP 0.716439 -> 0.281781
nuM 0.374898 -> 0.0419465
gamma 0.116731 -> 0.0738959
nuA 0.266685 -> 0.210952
nuP 0.281781 -> 0.197581
nuM 0.0419465 -> 0.0213818
gamma 0.0738959 -> 0.0559329
nuA 0.210952 -> 0.177048
nuP 0.197581 -> 0.184437
nuM 0.0213818 -> 0.0168515
gamma 0.0559329 -> 0.0473259
nuA 0.177048 -> 0.162761
nuP 0.184437 -> 0.162788
nuM 0.0168515 -> 0.0138724
gamma 0.0473259 -> 0.0420689
nuA 0.162761 -> 0.154997
nuP 0.162788 -> 0.163438
nuM 0.0138724 -> 0.0156273
Iter 100: runningTotalLL -20719713.508 numchanges 886617
```



## 4.2.5 MODEL TRAINING PROGRESSING USING DIRICHLET PERSONA MODEL

```
SparseMulticlassLogisticRegression with 40745 data points and 18850 50 376 features
Optimizing function of 18850 variables with OML-QN parameters:
  l1 regularization weight: 0.000000.
  L-BFGS memory parameter (m): 15
  Convergence tolerance: 0.000010
```

OptIter	n:	new_value	df	(conv_crit)	line_search
OptIter	0:	3.4261e+07		(*****)	
Iter	1:	3.4182e+07	18228	(wait for 10 iters)	
Iter	2:	3.4138e+07	18228	(wait for 10 iters)	
Iter	3:	3.4084e+07	18228	(wait for 10 iters)	
Iter	4:	3.4077e+07	18228	(wait for 10 iters)	
Iter	5:	3.4067e+07	18228	(wait for 10 iters)	
Iter	6:	3.4033e+07	18228	(wait for 10 iters)	
Iter	7:	3.4044e+07	18228	(wait for 10 iters)	
Iter	8:	3.4038e+07	18228	(wait for 10 iters)	
Iter	9:	3.4030e+07	18228	(wait for 10 iters)	
Iter	10:	3.4028e+07	18228	(7.6185e-04)	
Iter	11:	3.4024e+07	18228	(5.1590e-04)	
Iter	12:	3.4024e+07	18228	(3.7137e-04)	
Iter	13:	3.4020e+07	18228	(2.1212e-04)	
Iter	14:	3.4018e+07	18228	(1.9397e-04)	
Iter	15:	3.4016e+07	18228	(1.6786e-04)	
Iter	16:	3.4013e+07	18228	(1.3813e-04)	
Iter	17:	3.4012e+07	18228	(1.0582e-04)	
Iter	18:	3.4009e+07	18228	(9.6841e-05)	
Iter	19:	3.4008e+07	18228	(7.2876e-05)	
Iter	20:	3.4006e+07	18228	(7.0501e-05)	
Iter	21:	3.4005e+07	18228	(6.5055e-05)	
Iter	22:	3.4003e+07	18228	(6.8337e-05)	
Iter	23:	3.4002e+07	18228	(5.8883e-05)	
Iter	24:	3.4001e+07	18228	(5.5911e-05)	
Iter	25:	3.4000e+07	18228	(5.2493e-05)	
Iter	26:	3.3998e+07	18228	(4.8419e-05)	
Iter	27:	3.3997e+07	18228	(4.9576e-05)	
Iter	28:	3.3996e+07	18228	(4.3813e-05)	
Iter	29:	3.3995e+07	18228	(4.3516e-05)	
Iter	30:	3.3994e+07	18228	(4.1769e-05)	
Iter	31:	3.3992e+07	18228	(3.9539e-05)	
Iter	32:	3.3991e+07	18228	(4.0148e-05)	
Iter	33:	3.3990e+07	18228	(3.8528e-05)	
Iter	34:	3.3989e+07	18228	(3.7312e-05)	

```
verbs ratiorkank: 0 harass resist berate eliminate conclude switch toss identify transform greet pose rebuff control complain uncover avenge start smile pay sneak
verbs ratiorkank: 1 reply say overhear mention urge explain state beg instruct let pass encourage congratulate sit apologize come conspire struggle dance faint
verbs ratiorkank: 2 king maya dark warden monk inspector editor servant mate worker diner official journalist mercenary fairy magician mobster powerful citizen warrior
verbs ratiorkank: 3 tend grow adopt interrogate fend embrace recall nurse raise spot conduct strand shake eat cross calm dismiss encounter change date
verbs ratiorkank: 4 bug henchman bandit dog cousin author producer native fianc resident house rebel villain dancer captain hostage arm customer crime russian
verbs ratiorkank: 5 woo divorce stage flirt cheat manipulate love hurt elope court engage console rape forget seduce reunite inform mean reconcile share
verbs ratiorkank: 6 vanish rise stage appear tear tease proceed obtain rob corner torment target examine push bind emerge infiltrate conduct abuse murder
verbs ratiorkank: 7 note plot summon enter appoint admire reach operate annoy inject banish escape infiltrate reappear launch intercept destroy possess ignore set
verbs ratiorkank: 8 stare smash decapitate wear rip celebrate run walk pop scream approach split reach pull strand wander leap look fill search
verbs ratiorkank: 9 parent baby zombie princess mayor angel kid lady wife uncle doctor alien daughter student psychiatrist maid woman high college roommate
verbs ratiorkank: 10 soul childhood brother younger twin dad robber elder husband son bride prince soldier friend god sister youngest policeman client innate
verbs ratiorkank: 11 activate don dispose approve apply figure slip appoint hit back stand restore recommend abuse oppose shut open build cry close
verbs ratiorkank: 12 interrupt seize inject await lock command hide ain check retrieve play shout travel search wait place discover impale mention be
verbs ratiorkank: 13 admire like love spend accept come see go live miss read meet attend break change star walk move perform get
verbs ratiorkank: 14 crawl drink proclain frighten create possess hold surrender laugh snap consume display climb catch crash join kick pop panic split
verbs ratiorkank: 15 address check employ send replace testify stare approve tell accuse laugh record think accompany catch talk cut see stick spend
verbs ratiorkank: 16 spirit heir salesman evil long expert battle wonder rival order s politician teenage hitman team driver frame grant surgeon attractive
verbs ratiorkank: 17 please scare slap surprise withdraw admire invade punch recruit impress injure stick bully train mistake deal keep report surround leave
verbs ratiorkank: 18 relate kiss inspire advise resign interview encourage retire seduce mistake console reassure reject insult act embark display cover court lose
verbs ratiorkank: 19 swin lift grab transport include stalk assume bite recover rape knock drag ain gather leap cook climb fend taunt seize
verbs ratiorkank: 20 infatuate devastate sentence involve shock disturb disappoint congratulate addict attract marry obsess upset horrify convict please welcome express trust consist
verbs ratiorkank: 21 banish raise care spare blame dress instruct await prove observe teach allow add bribe execute harm clear introduce gather obtain
verbs ratiorkank: 22 devise seen remember finish explore investigate embark imagine disappear become sing refer realize wear read awake overcome perform stand produce
verbs ratiorkank: 23 study prefer feel respond share clean purchase quit express invite back pretend communicate complain think move embrace experience forget speak
verbs ratiorkank: 24 relent promise die insist refuse accept produce pretend humiliate vow commit feel intend answer change consider withdraw buy resign own
verbs ratiorkank: 25 suggest regret succumb conspire win notice claim plead deny organize intend wander panic beg regain have perform fear withdraw plan
verbs ratiorkank: 26 confirm announce best judge blow connect narrate revive maintain rise abduct bribe shut forgive bear base busy attach drop enlist
verbs ratiorkank: 27 thank pray invite wash bail graduate draw take fall sacrifice perform belong settle sing throw remove surround spot hear admit
verbs ratiorkank: 28 reply faint decline manage begin hear slap try fail imagine think wake decide start go hope regret realize swin participate
verbs ratiorkank: 29 retrieve burn recommend withdraw decline acquire avoid invade exist track surround threaten sail snap test arrive recognize lay demand accompany
verbs ratiorkank: 30 dragon werewolf governor narrator aunt terrorist assassin farmer nephew duck nun major guest queen teacher fighter classmate count commander sergeant
verbs ratiorkank: 31 serial killer landlord security knight vampire father guard gangster businessman witch proud alcoholic outlaw true ill real which hero murderer
verbs ratiorkank: 32 boy monster demon kidnapper child pirate thief man grandfather prisoner mom big patient survivor clone thug minister middle-aged old coach
verbs ratiorkank: 33 avoid introduce reassure sell admit imagine establish dream argue persuade prove fly examine welcome accompany dismiss console record sleep wake
verbs ratiorkank: 34 cure haunt infuriate support trick apprehend release anger expose defend imprison surround rule protect lock accuse result force injure strangle
verbs ratiorkank: 35 dig command participate miss sail dispatch plant crash jump flee fly atm stare commit determine hope refer report sneak reveal
verbs ratiorkank: 36 acquaint suppose revolve consist expel unite shock separate annoy frighten confuse disappoint humiliate determine tear feature impress refer speak fool
verbs ratiorkank: 37 insist complete testify add enjoy deduce remain pack quit win wander decide befriend dream celebrate cast leap trust confess attend
verbs ratiorkank: 38 suffer faint attempt demonstrate regain manage survive investigate collapse deduce react intervene succeed respond proceed try die don fail intend
verbs ratiorkank: 39 inherit listen sink compete result yell feature focus belong discuss disguise secure panic scream select bail convince fake cross earn
verbs ratiorkank: 40 mother sheriff villager grandmother officer passenger detective gang private president professor slave criminal priest deputy human police black chief superior
verbs ratiorkank: 41 intercept recruit restore pursue destroy challenge handle interrogate free surrender capture corner investigate fight fill defeat place spare wound send
verbs ratiorkank: 42 capture overpower tie communicate attack harm gun torture finish kidnap lure trap rescue imprison contain encounter rape shoot chase rid
verbs ratiorkank: 43 transfer trap assault promote taunt expect allow form drown reject hurt treat film deliver hate crush address provide strike bear
verbs ratiorkank: 44 assign decapitate assassinate summon sentence arrest separate protect murder conspire promote kill prevent blackmail testify imprison catch free transfer aid
verbs ratiorkank: 45 rejoin feed evade ambush defeat organize apprehend face declare subdue collect lay deliver punch stop disguise dispatch scold infuriate hunt
verbs ratiorkank: 46 forbid borrow reappear confess describe remind launch unite prevent drag drink deny demand oppose provide interrupt commit expel command mock
verbs ratiorkank: 47 wound bury horrify concern assist acquaint name punish bite accompany impale dispose seek locate injure execute thank cast manipulate subdue
verbs ratiorkank: 48 hope understand note succumb decide sail decline graduate realize accept participate write think agree wish beg learn imagine want expect
verbs ratiorkank: 49 employ direct assure present understand reconcile overcome represent owe dance deny touch punish persuade elope laugh alert talk select scold
```



```
wordLL -6654535.862

gamma 0.0420689 -> 0.0393839
nuA 0.154997 -> 0.148321
nuP 0.163438 -> 0.162007
nuM 0.0156273 -> 0.0142592
gamma 0.0393839 -> 0.0377851
nuA 0.148321 -> 0.143395
nuP 0.162007 -> 0.149758
nuM 0.0142592 -> 0.0139452
gamma 0.0377851 -> 0.0354799
nuA 0.143395 -> 0.131852
nuP 0.148758 -> 0.150851
nuM 0.0139452 -> 0.0132569
gamma 0.0354799 -> 0.0344787
nuA 0.131852 -> 0.126532
nuP 0.150851 -> 0.140211
nuM 0.0132569 -> 0.0158613
gamma 0.0344787 -> 0.0337133
nuA 0.126532 -> 0.126770
nuP 0.140211 -> 0.145171
nuM 0.0158613 -> 0.0146059
Iter 200: runningTotalLL -20053365.210 nunchanges 815724

SparseMulticlassLogisticRegression with 40745 data points and 18850 50 376 features
Optimizing function of 18850 variables with OML-QN parameters:
  L1 regularization weight: 0.000000,
  L-BFGS memory parameter (m): 15
  Convergence tolerance: 0.000010

OptIter  n:  new value      df      (conv_crit)  line_search
OptIter  0:  3.4261e+07      18228      (*****)
Iter      1:  3.4007e+07      18228      (wait for 10 iters)
Iter      2:  3.3767e+07      18228      (wait for 10 iters)
Iter      3:  3.3609e+07      18228      (wait for 10 iters)
Iter      4:  3.3607e+07      18228      (wait for 10 iters)
Iter      5:  3.3532e+07      18228      (wait for 10 iters)
Iter      6:  3.3512e+07      18228      (wait for 10 iters)
```

## 4.2.5 MODEL TRAINING PROGRESSING USING\ PERSONA REGRESSION

```
wordLL -6228875.358

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490
500 510 520 530 540 550 560 570 580 590 600 610 620 630 640 650 660 670 680 690 700 710 720 730 740 750 760 770 780 790 800 810 820 830 840 850 860 870 880 890 900 910 920 930 940 950 960
970 980 990

final ratiorkank: 0      note intervene recognize recommend suggest conclude figure recall deduce conduct embark dispose urge enlist believe draw complete observe refuse discover
final ratiorkank: 1      woo marry court elope attract unite propose engage impress devastate divorce reconcile heartbroken fall express seduce humiliate acquaint con touch
```

## 4.2.6 TRAINING OUTPUT

```
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490
500 510 520 530 540 550 560 570 580 590 600 610 620 630 640 650 660 670 680 690 700 710 720 730 740 750 760 770 780 790 800 810 820 830 840 850 860 870 880 890 900 910 920 930 940 950 960
970 980 990

final ratiorkank: 0      note intervene recognize recommend suggest conclude figure recall deduce conduct embark dispose urge enlist believe draw complete observe refuse discover
final ratiorkank: 1      woo marry court elope attract unite propose engage impress devastate divorce reconcile heartbroken fall express seduce humiliate acquaint con touch
final ratiorkank: 2      meet represent pack attend plead confide persuade receive write undergo learn report swear testify suspect return reconcile reunite graduate purchase
final ratiorkank: 3      diner dragon father alien angel uncle fairy man son killer serial client vampire lady clone grandson master old middle-aged rich
final ratiorkank: 4      confirm instruct promise congratulate discuss command withdraw mention advise explain describe need declare betray demand dismiss offer berate appoint smile
final ratiorkank: 5      admire write hate rent date understand go pray stay enjoy stand promise forgive sleep think notice accept sign meet get
final ratiorkank: 6      regret prefer feel want consider decline change move share agree act start attend react hope quit handle express refuse understand
final ratiorkank: 7      pretend overhear insist faint realize wonder remember seen beg decide rush go assume decline think ignore respond succumb become refuse
final ratiorkank: 8      relent die deny commit undergo react refuse claim vow drink demand agree insist swear plan proceed reply intend threaten disappear
final ratiorkank: 9      consist protect contain name alert wound prevent kill belong defend subdue murder identify aid eliminate bury spare execute imprison bind
final ratiorkank: 10     escort handle inform point threaten warn send bribe order hand switch interrogate accuse conspire wait remove contact train fire beat
final ratiorkank: 11     strangle decapitate stab impale bite bury possess drown blind haunt attack scream lure stalk seduce save rape drug witness torture
final ratiorkank: 12     examine rule lay abduct seize kidnap possess intend invade surrender command sail spare survive launch dispatch control plan lead plant
final ratiorkank: 13     trap rescue harm haunt kidnap cure abduct restore separate search assault torment reunite locate communicate tie force corner capture strand
final ratiorkank: 14     fail decide succeed resume don narrate acquire set hatch vow resolve recover end slip build struggle try await celebrate strike
final ratiorkank: 15     warden cop prisoner detective inmate nun murderer passenger criminal psychiatrist private driver outlaw resident official prostitute dark assassin partner roommate
final ratiorkank: 16     crawl scream pop climb swim run wake proceed grab dig stare sit smash leap spot yell laugh crash cry smile
final ratiorkank: 17     bandit governor robber slave de thief bank player customer character director main knight artist relative mobster manager employee producer dancer
final ratiorkank: 18     ruin insult beat drive fear lie lose get harass earn bind bail wear attend do inherit count wash buy sit
final ratiorkank: 19     include feature rob display play sing play cheer rejoin test expel join form volunteer manipulate follow greet star study establish
final ratiorkank: 20     capture inject transform summon ambush subdue fend imprison overpower evade invade sacrifice battle revive intercept transport attack finish destroy rule
final ratiorkank: 21     manage uncover deduce regain attempt survive dig leap investigate crash infiltrate proceed realize devise flee reach intervene vanish discover
final ratiorkank: 22     infuriate sentence base anger connect result recognize arrest mistake strike force interview involve blame concern keep portray fill contact charge
final ratiorkank: 23     disguise assassinate team trick oppose surrender sink dispatch operate work accompany organize serve trust obtain summon lure impress pose replace
final ratiorkank: 24     panic walk clean jump vanish slip faint climb try continue start miss stand hide wear stumble rush lay sneak smash
final ratiorkank: 25     forbid banish cast abuse console thank assault blame rape control proclaim choose reject address beg scold assure celebrate encourage fix
final ratiorkank: 26     adopt bear raise care avenge treat keep orphan live expect support tend teach have unite oppose provide separate welcome bring
final ratiorkank: 27     introduce sell recruit purchase offer pay invite hire buy split manipulate blackmail provide announce refer steal humiliate switch own hand
final ratiorkank: 28     frame apprehend arrest assign interrogate execute sentence gun question eliminate wound promote testify investigate evade blackmail assassinate injure hire clear
final ratiorkank: 29     hurt worry talk upset disappoint embrace cabt remember frighten ask confuse suppose listen dress look dance reassure remind thank cheer
final ratiorkank: 30     long embark suffer die experience imagine commit grow succumb live collapse settle spend inherit dream become struggle complete seem exist
final ratiorkank: 31     soul prince sheriff warrior big guest clerk hunter ghost witch hitman sailor town brother-in-law baby human arm god classmate dad
final ratiorkank: 32     give hate wish identify punish grant allow challenge plead dismiss anger fear buy bring remind put reassure awaken operate operate
final ratiorkank: 33     stick punch shake scare lift eat explode kick tie launch catch attach hit interrupt bite crush drop shut yell cook
final ratiorkank: 34     stalk grab hit drag disturb frighten stare knock chase pull push hang annoy blow awaken spot ignore throw trap strangle
final ratiorkank: 35     transfer deliver deal grant transport ride claim read hatch collect mock lock direct distract feed bring laugh confide back tend
final ratiorkank: 36     love cheat confess flirt like forgive slap date forget tease dance approve divorce break apologize reject confide lie sleep ball
final ratiorkank: 37     kill murder shoot torture target track overpower hunt confront ambush avenge ain identify wound inject stab rip locate draw abduct
final ratiorkank: 38     shock infatuate obsess acquaint horrify suppose concern revolve surprise focus devastate involve disappoint confuse accuse determine annoy attach attract expel
final ratiorkank: 39     wander explore stumble awake awaken flee encounter hear find discover run wake experience pray search panic cry begin remember burn
final ratiorkank: 40     zombie werewolf goon child twin brother mayor villain priest sibling patient sister younger native elder older guy spirit scientist president
final ratiorkank: 41     reply say answer complain mention narrate want ask sit apologize respond like listen pack smile state explain imagine seem tell
final ratiorkank: 42     reappear toss emerge snap appear exist split remove act disappear fix fire cause flee retrieve pull demand chase rise step
final ratiorkank: 43     inspector kidnapper soldier officer thug fighter major sergeant lieutenant accomplice japanese british superior attorney boss victim journalist crime pilot surgeon
final ratiorkank: 44     maya parent boy mother pregnant grandmother girl wife grandfather mom student monster woman childhood husband attractive daughter kid unhappy teacher
final ratiorkank: 45     call tell mention check drive go watch talk take borrow pick see cry hear point contact discuss trust flirt shout
final ratiorkank: 46     defeat activate locate destroy fly infiltrate depart battle restore free explore rescue rejoin guide create fight recover save aid launch
final ratiorkank: 47     villager demon narrator princess king landlord terrorist henchman doctor magician farmer monk survivor bride guard general coach hostage nurse security
final ratiorkank: 48     bug professor rebel maid dog minister home salesman nephew aunt spy party queen policenanc duck college mercenary author stranger chief
final ratiorkank: 49     compete select win resign quit sign perform portray appoint enjoy produce promote rent record train challenge earn bully devise encourage
```

```

final freqrank: 0 find give discover have arrive believe confront follow save recognize make enter go refuse let convince learn say suspect suggest
final freqrank: 1 marry fall propose engage attract love impress unite woo seduce save win reconcile arrange pursue express kidnap rescue support court
final freqrank: 2 meet learn return begin receive work visit discover write attend persuade reunite convince accept suspect buy pay propose encounter win
final freqrank: 3 father man son killer young old uncle vampire alien master lady dragon dead fairy client angel diner wealthy real own
final freqrank: 4 offer explain use reveal promise inform need stop declare betray force instruct discuss help hold admit invite confirm advise approach
final freqrank: 5 go meet take find get give see have make come live bring write stay leave accept promise think save send
final freqrank: 6 have want be get start learn decide do begin agree feel realize move know find make refuse accept return work
final freqrank: 7 go leave decide try realize ask find believe see come look refuse receive run turn confront think join end stay
final freqrank: 8 have be die take tell reveal make want try refuse arrive do leave show agree begin come attempt say claim
final freqrank: 9 kill find take name save meet stop leave protect shoot send see get go hold wound release show murder follow
final freqrank: 10 send tell inform give warn shoot kill bring have know ask beat lead order threaten pay put believe wait confront
final freqrank: 11 kill attack save find stab bite lure turn rape warn strangle lock possess bury believe murder follow seduce convince impale
final freqrank: 12 lead kidnap arrive send hold start learn join plan place kill possess engage use survive fly fall surrender hear prepare
final freqrank: 13 take rescue kidnap capture save catch force give attack reunite discover chase help look trap search lock pick place pursue
final freqrank: 14 take decide try fall meet set help end come kill work fail make continue plan turn succeed attempt live travel
final freqrank: 15 detective driver cop prisoner criminal other assassin partner passenger murderer inmate private warden suspect prostitute nun real dark worker resident
final freqrank: 16 run see get look grab make pull throw wake begin put do try hear come have use pick turn think
final freqrank: 17 character thief manager director worker robber player de bandit slave governor artist stranger actor reporter main producer hero knight bank
final freqrank: 18 get lose beat drive do stop return help buy lie arrive lead visit sell make pay have attend insult steal
final freqrank: 19 follow join play include begin get travel use rob sing carry greet break pick steal present remain direct form rejoin
final freqrank: 20 capture attack escape transform send kill turn fight destroy defeat pursue bring stop knock ambush lure reveal release transport imprison
final freqrank: 21 manage escape find attempt be discover use arrive get try realize return learn survive do reveal reach flee set break
final freqrank: 22 give tell meet call force arrest bring help confront be turn kill join reveal beat marry keep lead put recognize
final freqrank: 23 work disguise throw fight steal lure trick accompany sell present distract defeat encounter order impress surrender know cause assassinate replace
final freqrank: 24 go try be walk have start fall hide stop say continue hold jump enter let hear sneak watch stand wait
final freqrank: 25 visit rare send allow be choose catch push reject teach say blame appear invite watch pull drag offer banish forbid
final freqrank: 26 have live bring leave raise take bear marry adopt keep care want teach return lose treat save support visit reunite
final freqrank: 27 introduce offer invite sell give hire pay steal buy recruit have present admit provide arrive announce blackmail discover purchase fire
final freqrank: 28 shoot arrest catch capture hire get take assign release work force frame track pursue recruit knock execute hold wound question
final freqrank: 29 tell ask see talk look show confront invite lose visit wait believe give do hurt live walk name scare remind
final freqrank: 30 live die leave have fall find be come return spend learn grow begin start suffer discover work commit move lose
final freqrank: 31 baby sheriff witch human prince soul big guest warrior hunter hispan dad local clerk town count arm other evil sailor
final freqrank: 32 give bring return allow put lead buy convince hate kill warn challenge place identify begin teach play wish remind cause
final freqrank: 33 catch chase show hit stop eat scare throw tie drop kick stick call bite knock wake punch pursue launch lift
final freqrank: 34 chase knock hit find throw pull attack see grab shoot drag follow push leave carry look catch lead force approach
final freqrank: 35 bring deliver arrive lock deal transfer read ride claim steal visit distract knock transport sell reveal invite feed direct watch
final freqrank: 36 tell love meet marry fall be invite confess leave ask break like see help accept reveal lie stop come forgive
final freqrank: 37 kill shoot confront attack murder kidnap track go run escape stab lead pursue drive ambush arrive capture overpower stop torture
final freqrank: 38 leave tell send take see name introduce inform visit involve attract show shock marry follow reunite seduce accuse make end
final freqrank: 39 find discover see run begin have meet go make encounter be come hear return flee enter fall wake escape stay
final freqrank: 40 child brother sister baby priest younger zombie twin spirit scientist patient older member dad goon other pirate naylor werewolf villain
final freqrank: 41 tell say ask be want come have do know leave explain call see get love arrive reply invite give like
final freqrank: 42 take chase come leave appear turn catch arrive pull follow drive steal use enter hide hold begin fire flee escape
final freqrank: 43 officer soldier police boss leader able member former owner agent pilot one dead chief local victim gangster about unable american
final freqrank: 44 friend mother girl wife woman daughter boy young husband parent student kid girlfriend able old pregnant sister teacher man monster
final freqrank: 45 tell take find go see call leave get arrive drive show watch make explain follow give talk pick hear run
final freqrank: 46 defeat save rescue arrive destroy lead fight fly use join free follow confront leave make return go tell learn locate
final freqrank: 47 doctor guard king villager survivor demon princess henchman terrorist coach monk nurse narrator hostage farmer security s black witch general
final freqrank: 48 bug professor rebel spy minister nephew maid stranger dog human party policeman mercenary home aunt about leader queen salesman state
final freqrank: 49 win make play lose join receive perform use hire challenge agree convince lead face prove learn quit sign read teach

```

## 4.2.7 EVALUATION METRICS FOR ONGOING MEMORY AND CPU LOAD

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
1844	shayan	20	0	4618292	175568	79600	S	12.3	2.2	12:24.96	gnome-shell
2053	shayan	20	0	144392	29664	22240	S	0.7	0.4	0:52.88	vmtoolsd
13336	shayan	20	0	13836	4352	3328	R	0.7	0.1	0:47.13	top
409	root	-51	0	0	0	0	S	0.3	0.0	0:16.07	irq/16-vmwgfx
758	root	20	0	317800	8960	7424	S	0.3	0.1	0:55.70	vmtoolsd
2458	shayan	20	0	32.9g	299516	199344	S	0.3	3.7	8:12.84	chrome
6210	shayan	20	0	574200	65632	43432	S	0.3	0.8	3:06.38	gnome-terminal-
14294	root	20	0	0	0	0	I	0.3	0.0	0:01.69	kworker/u258:0-events_unbound
1	root	20	0	166828	10340	7396	S	0.0	0.1	0:04.98	systemd
2	root	20	0	0	0	0	S	0.0	0.0	0:00.11	kthreadd
3	root	20	0	0	0	0	S	0.0	0.0	0:00.00	pool_workqueue_release
4	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kworker/R-rcu_g
5	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kworker/R-rcu_p
6	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kworker/R-slub_
7	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kworker/R-netns
12	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kworker/R-mm_pe
13	root	20	0	0	0	0	I	0.0	0.0	0:00.00	rcu_tasks_kthread
14	root	20	0	0	0	0	I	0.0	0.0	0:00.00	rcu_tasks_rude_kthread
15	root	20	0	0	0	0	I	0.0	0.0	0:00.00	rcu_tasks_trace_kthread
16	root	20	0	0	0	0	S	0.0	0.0	0:00.15	ksoftirqd/0
17	root	20	0	0	0	0	I	0.0	0.0	0:10.00	rcu_preempt
18	root	rt	0	0	0	0	S	0.0	0.0	0:00.24	migration/0
19	root	-51	0	0	0	0	S	0.0	0.0	0:00.00	idle_inject/0
20	root	20	0	0	0	0	S	0.0	0.0	0:00.00	cpuhp/0
21	root	20	0	0	0	0	S	0.0	0.0	0:00.00	cpuhp/1
22	root	-51	0	0	0	0	S	0.0	0.0	0:00.00	idle_inject/1
23	root	rt	0	0	0	0	S	0.0	0.0	0:01.43	migration/1
24	root	20	0	0	0	0	S	0.0	0.0	0:00.14	ksoftirqd/1
26	root	0	-20	0	0	0	I	0.0	0.0	0:00.07	kworker/1:0H-kblockd
27	root	20	0	0	0	0	S	0.0	0.0	0:00.00	cpuhp/2
28	root	-51	0	0	0	0	S	0.0	0.0	0:00.00	idle_inject/2
29	root	rt	0	0	0	0	S	0.0	0.0	0:01.38	migration/2
30	root	20	0	0	0	0	S	0.0	0.0	0:00.14	ksoftirqd/2
32	root	0	-20	0	0	0	I	0.0	0.0	0:00.04	kworker/2:0H-kblockd