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Assignment #5

**Task Set #1:**

Question 1. Take as your target word woman. Use the pre-trained word2vec model to rank the following 10 words from the most similar to the target word to the least similar to the target word. For each word, provide the similarity score.

|  |  |
| --- | --- |
| Word | Similarity Score |
| child | 0.589809 |
| man | 0.587694 |
| children | 0.575711 |
| girl | 0.568037 |
| pregnant | 0.498789 |
| marriage | 0.429239 |
| birth | 0.420309 |
| Boy | 0.312171 |
| queen | 0.228572 |
| elephant | 0.221813 |
| introspection | -0.069114 |

Question 2. According to the word embeddings, which word is the most different from all the others? Which two words does word embeddings identify as the most similar to each other?

a. ['tissue', 'papyrus', 'manila', 'newsprint', 'parchment', 'gazette']

b. ['engineer', 'nurse', 'doctor', 'mother', 'father', 'scientist']

c. ['criminal', 'black', 'hispanic', 'man', 'woman']

* 1. Most Different Word = ‘tissue’
  2. Most Similar Pair = 'newsprint' and 'parchment'
  3. Most Different Word = ‘doctor’
  4. Most Similar Pair = 'mother' and 'father'
  5. Most Different Word = ‘criminal’
  6. Most Similar Pair = 'man' and 'woman'

Question 3.

Sentences:

man is to woman as king is to \_\_\_?

water is to ice as liquid is to \_\_\_?

bad is to good as sad is to \_\_\_?

nurse is to hospital as teacher is to \_\_\_?

usa is to pizza as japan is to \_\_\_?

human is to house as dog is to \_\_\_?

grass is to green as sky is to \_\_\_?

1. Complete the above sentences with your own word analogies. Use the Word2Vec model to find the similarity measure between your pair of words. Provide this information.

man is to woman as king is to **queen**  
water is to ice as liquid is to **solid**  
bad is to good as sad is to **happy**  
nurse is to hospital as teacher is to **school**  
usa is to pizza as japan is to **sushi**  
human is to house as dog is to **yard**  
grass is to green as sky is to **blue**

|  |  |
| --- | --- |
| Word Pair | Similarity Score |
| king/queen | 0.5685570894407133 |
| liquid/solid | 0.654647394785279 |
| sad/happy | 0.4488509304776102 |
| teacher/school | 0.5326567952645775 |
| japan/sushi | 0.011866340802923168 |
| dog/yard | 0.09279718492388062 |
| sky/blue | 0.4439698110031242 |

1. Use the Word2Vec model to find the word analogy and corresponding similarity score. Provide this information.

|  |  |  |
| --- | --- | --- |
| Sentence | Word Found | Similarity Score |
| man is to woman as king is to.. | girl | 0.5053811073303223 |
| water is to ice as liquid is to.. | glaciers | 0.47326594591140747 |
| bad is to good as sad is to.. | luck | 0.4046950340270996 |
| nurse is to hospital as teacher is to.. | custody | 0.47066730260849 |
| usa is to pizza as japan is to.. | strawberry | 0.5357518196105957 |
| human is to house as dog is to.. | abuses | 0.427523672580719 |
| grass is to green as sky is to.. | vegetable | 0.5439887046813965 |

1. Lastly, compute and print the correlation between the vector of similarity scores from your analogies versus the Word2Vec analogy-generated similarity scores. What is the strength of the correlation?

.00-.19 “very weak” correlation

.20-.39 “weak” correlation

.40-.59 “moderate” correlation

.60-.79 “strong” correlation

.80-1.0 “very strong” correlation

Correlation = -0.06572114027565584 (very weak)

**Task Set 2.**

Question 1. Each image in the dataset has a unique value representing age, gender, and race based on the following legend:

age: indicates the age of the person in the picture and can range from 0 to 116.

gender: indicates the gender of the person and is either 0 (male) or 1 (female).

race: indicates the race of the person and can from 0 to 4, denoting White, Black, Asian, Indian, and Others (like Hispanic, Latino, Middle Eastern)

Compute and document the frequency of images associated with each subgroup for age (subdivide based on the NIST study discussed in lecture - (0, 6]; (6,12]; (12,18]; (18,24]; (24,30]; (30,36]; (36,42]; (42,48]; (48,54], (54,60], (60,66], (66,72], (72,116)), gender (0,1), and race (0 to 4).

|  |  |  |
| --- | --- | --- |
| Category | Subgroup | Frequency |
| Age | (0,6] | 2494 |
|  | (6,12] | 919 |
|  | (12,18] | 1082 |
|  | (18,24] | 2408 |
|  | (24,30] | 5758 |
|  | (30,36] | 2929 |
|  | (36,42] | 1807 |
|  | (42,48] | 1173 |
|  | (48,54] | 1493 |
|  | (54,60] | 1247 |
|  | (60,66] | 773 |
|  | (66,72] | 528 |
|  | (72,116] | 1094 |
| Gender | Female | 11314 |
|  | Male | 12391 |
| Race | White | 10078 |
|  | Black | 4256 |
|  | Asian | 3434 |
|  | Indian | 3975 |
|  | Other | 1692 |

Which subgroup in each age, gender, and race category has the largest representation?

* Age: (24,30] = 5758
* Gender: Male 12391
* Race: White 10078

Which subgroup in each age, gender, and race category has the least representation?

* Age: (66,72] = 528
* Gender: Female = 11314
* Race: Other = 1692

Question 2. In this tutorial, the researchers restricted the images for training the baseline classifier to White and Others races and set the prediction (i.e. output) based on gender. They then computed (among others) a metric called the Equal Opportunity Difference, which is the difference in the true positive rates between the unprivileged and the privileged groups. For Q2, select a different race combination to train the baseline classifier (i.e. replace the parameters for - unprivileged\_groups = [{'race': 4.0}], privileged\_groups = [{'race': 0.0}]).

New groups: unprivileged\_groups=[{‘race’:1.0}], privileged\_groups=[{‘race’:3.0}]

i.e. unprivileged = Black, privileged = Indian

What is the corresponding value for the Equal Opportunity Difference metric? Would you consider this value as showing bias? Why or Why not?

EOD = 0.027321

I would consider this value to be slightly biased but not a whole lot. Since there were way more examples of White faces than Other faces, I would think the network would be biased towards White faces. With those two groups set to be unprivileged and privileged groups, the EOD metric equaled -0.077005. By using -.077 as an example of high bias, we can say that the EOD of the new groups was *somewhat* biased since it is roughly 1/3 of the original metric.

There were roughly equal number of faces in the Black and Indian categories so we would expect the bias to be much less. However, some bias still came about which might be caused by the quality of the images provided (i.e. lighting, size, etc.).