CS-6340, Written Assignment #3
Aishwarya Asesh (u1063384)

Question 1

1. **AGENT - John** cleared **THEME - the sidewalk** with his **INSTRUMENT - snow shovel**.
2. **THEME - A raffle** was held for **BENEFICIARY - the local charity.**
3. **AGENT - Joe** teamed up with **CO-AGENT - Susan** to learn how to **THEME - ski.**
4. **RECIPIENT - Tom** was given **THEME - a bike.**
5. **THEME - The dress** was purchased by **AGENT - Lisa** with **CO-THEME - matching shoes.**
6. **AGENT - Julie** mailed her **RECIPIENT - grandmother THEME - a letter.**
7. **EXPERIENCER - George** hopes that **THEME - his car** can be fixed.
8. **THEME - The image** was created with **INSTRUMENT - Adobe Photoshop** by **AGENT - a cartoonist.**

Question 2

$word1$: <9 2 8 0>
$word2$: <6 7 4 5>
$word3$: <1 3 9 2>

(a) Similarity($word1$, $word2$) using Manhattan Distance.

We know Manhattan Distance = $(\vec{X}, \vec{Y}) = \sum_{i=1}^{N} |x_i - y_i|$
Thus here Manhattan Distance = $|(9-6)| + |(2-7)| + |(8-4)| + |(0-5)|$
= 3 + 5 + 4 + 5
= 17

(b) Similarity($word2$, $word3$) using Manhattan Distance.

We know Manhattan Distance = $(\vec{X}, \vec{Y}) = \sum_{i=1}^{N} |x_i - y_i|$
Thus here Manhattan Distance = $|(6-1)| + |(7-3)| + |(4-9)| + |(5-2)|$
= 5 + 4 + 5 + 3
= 17

(c) Similarity($word1$, $word2$) using Jaccard Similarity.

We know Jaccard $(\vec{X}, \vec{Y}) = \frac{\sum_{i=1}^{N} \min(x_i, y_i)}{\sum_{i=1}^{N} \max(x_i, y_i)}$
Thus here Jaccard = 6 + 2 + 4 + 0 / 9 + 7 + 8 + 5
= 12 / 29

(d) Similarity($word2$, $word3$) using Jaccard Similarity.

We know Jaccard $(\vec{X}, \vec{Y}) = \frac{\sum_{i=1}^{N} \min(x_i, y_i)}{\sum_{i=1}^{N} \max(x_i, y_i)}$
Thus here Jaccard = 1 + 3 + 4 + 2 / 6 + 7 + 9 + 5
= 10 / 27

(e) Similarity($word1$, $word2$) using Cosine Similarity.

We know Cosine $(\vec{X}, \vec{Y}) = \frac{\sum_{i=1}^{N} (x_i * y_i)}{\sqrt{\sum_{i=1}^{N} x_i^2} \sqrt{\sum_{i=1}^{N} y_i^2}}$
Thus here Cosine = (9*6 + 2*7 + 8*4 + 0*5) / $(\sqrt{9^2 + 2^2 + 8^2 + 0^2} * \sqrt{6^2 + 7^2 + 4^2 + 5^2})$
= (100) / (12.20)*(11.22)
= (100) / (136.88)

(f) Similarity($word2$, $word3$) using Cosine Similarity.

We know Cosine $(\vec{X}, \vec{Y}) = \frac{\sum_{i=1}^{N} (x_i * y_i)}{\sqrt{\sum_{i=1}^{N} x_i^2} \sqrt{\sum_{i=1}^{N} y_i^2}}$
Thus here Cosine = (6*1 + 7*3 + 4*9 + 5*2) / $(\sqrt{6^2 + 7^2 + 4^2 + 5^2} * \sqrt{1^2 + 3^2 + 9^2 + 2^2})$

= (73) / (11.22)*(9.74)
= (73) / (109.28)

Question 3

NP	CONTEXT	CLASS
Apple tablet	mobile computer	PRODUCT
British tablet	computer tech	PRODUCT
Microsoft tablet	mobile computer	PRODUCT
Apple	tech giant	COMPANY
Apple Corporation	tech leader	COMPANY
Microsoft	leader	COMPANY
Microsoft Corporation	tech giant	COMPANY
British Tablet Corporation	mobile computer giant	COMPANY

For Part A:
Rules generated from NP present in the table above:

Noun Phrase - If contains (Apple), P (product) is 1/3, P (company) is 2/3
Noun Phrase - If contains (British), P (product) is 1/2, P (company) is 1/2
Noun Phrase - If contains (Corporation), P (product) is 0/3, P (company) is 3/3
Noun Phrase - If contains (Microsoft), P (product) is 1/3, P (company) is 2/3
Noun Phrase - If contains (Tablet), P (product) is 3/4, P (company) is 1/4

For Part B:
Rules generated for each contexts present in the table above:

Context - If contains (computer), P (product) is 3/4, P (company) is 1/4
Context - If contains (giant), P (product) is 0/3, P (company) is 3/3
Context - If contains (leader), P (product) is 0/2, P (company) is 2/2
Context - If contains (mobile), P (product) is 2/3, P (company) is 1/3
Context - If contains (tech), P (product) is 1/4, P (company) is 3/4

Question 4

S1: Trout can be found in many Utah rivers.
S2: The Utah Symphony hired a new bass player.
S3: John Smith plays an electric bass guitar.
S4: A soprano and bass will sing with the symphony.
S5: Ray Charles is learning to play the electric bass guitar.
S6: The Utah aquarium displays an electric eel, bass, and guitar fish.
S7: The Utah fisherman caught a river trout.

We know Salience (word, category) $=\frac{P(word/category)}{P(word)}$, So we will be using this for following proofs:

(a) salience(Utah, FISH)
P (Utah/fish) = (S1) (S6) (S7) / (S1) (S6) (S7) (S2) = 3/4
P (Utah) = (S1) (S6) (S7) (S2)/60 = 4/60
P (Utah/fish)/ P (Utah) = (3/4) / (4/60) = 45/4

(b) salience(electric, FISH)
P (electric/fish) = (S6) (S5) / (S1) (S5) (S6) (S7) = 2/4
P (electric) = (S3) (S6) (S5)/60 = 3/60
P (electric/fish)/ P (electric) = (2/4) / (3/60) = 10

(c) salience(bass, FISH)
P (bass/fish) = (S6) (S5) / (S1) (S5) (S6) (S7) = 2/4
P (bass) = (S2) (S3) (S4) (S5) (S6)/60 = 5/60
P (bass/fish)/ P (bass) = (2/4) / (5/60) = 6

(d) salience(Utah, MUSIC)
P (Utah/music) = (S6) (S2) / (S2) (S3) (S4) (S6) (S5) = 2/5
P (Utah) = (S2) (S1) (S6) (S7)/60 = 4/60
P (Utah/music)/ P (Utah) = (2/5) / (4/60) = 6

(e) salience(electric, MUSIC)
P (electric/music) = (S3) (S6) (S5) / (S2) (S3) (S4) (S6) (S5) = 3/5
P (electric) = (S3) (S6) (S5)/60 = 3/60
P (electric/music)/ P (electric) = (3/5) / (3/60) = 12

(f) salience(bass, MUSIC)
P (bass/music) =(S2) (S3) (S4) (S6) (S5) / (S2) (S3) (S6) (S5) (S4) = 5/5
P (bass) = (S2) (S3) (S6) (S5) (S4)/60 = 5/60
P (bass/music)/ P (bass) = (5/5) / (5/60) = 12

Question 5

(a) List all possible noun phrase (NP) antecedents for the first instance of "He" (underlined) that satisfy gender agreement.
John Smith, John

(b) List all possible noun phrase (NP) antecedents for "them" (underlined) that satisfy animacy agreement.
INANIMATE - groceries, oranges

(c) List all possible noun phrase (NP) antecedents for "them" (underlined) that satisfy number agreement.
too many groceries, 10 oranges

(d) List all of the reflexive pronouns in the story.
himself

(e) List all of the possessive pronouns in the story.
his, his, their, her

(f) List all of the pleonastic pronouns in the story.
it

(g) List all instances of appositives in the story.
Mary, his neighbor,
her husband, George, who was in the next aisle