Exam: 201

CS4740/CS5740
Introduction to Natural Language Processing

Midterm
October 6, 2015

Name:

Netid:

Instructions (****PLEASE PLEASE PLEASE READ****):

- GIVEN THE TIGHT SEATING FOR THE TEST (AND THE FACT THAT YOUR SCORE ON THE TEST DOES NOT MATTER), NO QUESTIONS WILL BE ENTERTAINED DURING THE EXAM.
- IF YOU HAVE ANY QUESTIONS ABOUT A QUESTION ON THE TEST, PLEASE JUST INDICATE THIS IN YOUR ANSWER. STATE ANY ASSUMPTIONS THAT YOU NEED TO MAKE IN ORDER TO ANSWER THE QUESTION AND THEN JUST ANSWER THE QUESTION AS BEST AS YOU CAN.
- WE ASK THAT YOU DO NOT LEAVE THE CLASSROOM DURING THE FINAL 10 MINUTES OF THE EXAM...FROM 2:30PM ONWARD.

There are 3 questions on the test.

This page will be used ONLY DURING GRADING

GRADER Name:

GRADER Netid:

#	topic	score	max score
1	ambiguity in NLP		25
2	WSD and evaluation		25
3	language modeling		30
	Total score:		80

1 Ambiguity in NLP (25 points)

Consider the following sentence:

I wanted to plant some trees in our yard to block the view of our neighbors' driveway, but they were too expensive.

1. There are a number of **part-of-speech** ambiguities that affect the interpretation of the sentence above.

   (a) (5 pts) Describe one such instance of a part-of-speech ambiguity that involves a **function word** (i.e. a **closed class** word) from the sentence.

   (b) (5 pts) Describe a second part-of-speech ambiguity in the sentence, this time one that involves a **content word**.

2. (5 pts) Describe one **discourse-level** ambiguity that occurs in the sentence.

3. (5 pts) Consider the task of constructing a lexicon to be used for an arbitrary NLP task in English. Show what the **lexeme(s)** for the **noun** *block* might look like.

4. (5 pts) What does it mean to say that *Zipf's Law applies to verbs and their word senses*?

2 Word Sense Disambiguation and Evaluation (25 points)

	POS	sense-id	
time	n	5	(the continuum of experience in which events pass from the future through the present to the past)
time	v	1	(measure the time or duration of an event or action or the person who performs an action in a certain period of time)
flies	n	1	(two-winged insects characterized by active flight)
flies	v	8	(pass away rapidly)
like	v	4	(feel about or towards; consider, evaluate, or regard)
like	a	1	(resembling or similar; having the same or some of the same characteristics; often used in combination)
arrow	n	1	(a mark to indicate a direction or relation)
arrow	n	2	(a projectile with a straight thin shaft and an arrowhead on one end and stabilizing vanes on the other; intended to be shot from a bow)

1. (15 pts) Assume the subset of WordNet senses provided above. Simulate the **Lesk word sense disambiguation algorithm** for the word **flies** given the context: *Time* **flies** *like an arrow.*

   Be sure to show the score the algorithm would assign to each of the senses for the target word. For the computations, assume that no part-of-speech disambiguation has been provided. State any additional assumptions needed.

2. (10 pts) Suppose that two WSD systems are evaluated on a test set of five examples and that the target word to be disambiguated in each example has two possible word senses, *s1* and *s2*. The following table shows the output for each system as well as the desired (gold standard) answers:

	WSD system 1	**WSD system 2**	**Answer key**
1	s1	s1	s1
2	s2	s2	s2
3	s1		s2
4	s1		s2
5	s1	s1	s1

Compute the **Precision**, **Recall** and **F-measure (F1 score)** for each WSD system.

3 Language Modeling (30 points)

> I like traffic lights , I like traffic lights , I like traffic lights , no matter where they 've been . I like traffic lights , I like traffic lights , I like traffic lights , I like traffic lights , I like traffic lights , but only when they 're green .

Assume that the above text (actual lyrics from the Monty Python song, *I Like Traffic Lights*) is provided as the (entire) training corpus for a **bigram language model**. For preprocessing: assume that **all words are converted to lower case**; do not add beginning (or end) of sentence markers. No unknown word handling is required.

1. (7 pts) Using **Maximum Likelihood Estimation** and the **bigram model** derived from the above training data, compute *P(only green traffic lights)*.

2. (13 pts) Now using **add-one (Laplacian) smoothing** and the **bigram model** derived from the above training data, compute the same thing: *P(only green traffic lights)*.

3. (4 pts) How many unseen bigrams are there for the *I Like Traffic Lights* corpus?

4. (6 pts) Given a test corpus $W = w_1 w_2 w_3 \ldots w_N$, show the formula (i.e. equation) for computing the **perplexity** of a **trigram language model** (trained on some corpus) on W. (Note: this question has nothing to do with the *I Like Traffic Lights* corpus. We do not expect to see any actual perplexity scores.)