GÖTEBORGS UNIVERSITET

Masters Programme in Language Technology

INTRODUCTION TO FORMAL LINGUISTICS LT2112

AUTUMN SEMESTER 2014

Friday, 30th January 2015, 9:00am–13:00am

Viktoriagatan 30, Göteborg

Course organiser: Simon Dobnik (Tel. 0317866917, 0721927949)

Candidate number: _____

Name: _____

Personnummer: _____

Write your answers an separate sheets of paper. On each page write your candidate number in the top right corner. Start each part on a new sheet of paper indicating clearly the name of that part. Mark clearly the number of the question that you are answering. To ensure that the examination is anonymous do not include any other personal information on the answer sheets.

Answer only questions from those parts that you are re-taking. You have 4 hours to complete the exam. You should spend 1 hour on each part.

Do not turn over until told that you may do so.

PART 1: PHONETICS AND PHONOLOGY

1. Describe epigrammatically the speech chain, i.e., all the steps that are taking place so that two human beings can communicate with spoken language. (10%)

2. What does the vowel quadrilateral show? How much information can we gain by just observing it? (10%)

3. What is a sound? Do humans perceive all sounds? What is the range of human hearing? (10%)

4. What is the fundamental frequency? What is pitch? Is there any difference between these two? (10%)

5. Which phenomenon tries to model the source-filter model? Describe what do you know about the source-filter model. (10%)

6. What type of features are used in phonology? (10%)

7. How would you describe a consonant sound? What properties would you mention? (10%)

8. Which one DOES NOT play role in speech perception? (10%)
   a) The nature of speech sounds themselves.
   b) The native language of the perceiver.
   c) The visual information present as a person speaks.
   d) The bone density of the speaker's jaw.

9. Describe the purpose of the International Phonetic Alphabet (IPA) and its use. (10%)

10. Is there any difference between phonemes and phones? If yes, please describe shortly. If no, please explain why. (10%)

PART 2: MORPHOLOGY AND LEXICON

A: Morphology

The exam gives a maximum of 34 points.

For **pass/godkänt** you should have a minimum of 18 points.
For **exellent/väl godkänt** you should have a minimum of 26 points.

Good luck!

Karin Friberg Heppin

M1)
Make a morphological analysis of the fragment of Turkish shown below by identifying the morphological constituents and their meanings.

1. *deniz*	an ocean	9. *evjikden*	from a little house
2. *denize*	to an ocean	10. *denizen*	of an ocean
3. *eller*	hands	11. *dishler*	teeth
4. *eve*	to a house	12. *dishiminiz*	of our tooth
5. *evden*	from a house	13. *dishleriminiz*	of our teeth
6. *elim*	my hand	14. *denizjikde*	in a little ocean
7. *eljike*	to a little hand	15. *denizlerimizde*	in our oceans
8. *elde*	in a hand	16. *evjiklerimizde*	in our little houses

a. Give the Turkish morpheme which corresponds to each of the following English translations. (6p)

ocean:	in:	my:
house:	to:	our:
tooth:	of:	little:
hand:	from:	[plural]:

b. What is the order of morphemes in a Turkish word in terms of noun, plural marker, etc? (2)

M2)
Name the word-formation process exemplified in each of the following cases. (6p)

1. **C**ompact **D**isc → CD
2. telephone → phone
3. information + commercial → infomercial
4. un- + rely + -able → unreliable
5. flower + pot → flowerpot
6. a process → to process

M3)
Show the morphological structure of the words below using a tree structure. Indicate which morpheme is the root of the word. For each branching in the structure, explain what is the morphological process at hand and which is the resulting part of speech at that point. (6 p)

a) *unbuttoned* (= 'with its buttons open')

b) *unbuttoned* (= 'having no buttons')

B: Lexicon

L1)
Give pairs of words which stand in the following relations to each other. Also give a short explanation of what each relation implies. (3 p)

a) polar antonymy
b) polysemy
c) hyponymy

2) Write two sentences which both contain a word which is an example of 'regular polysemy'. It should be the same polysemous word in both sentences, but with different meanings. Describe the relationship between these two meanings. (2 p)

L2)

Give a short description of the terms below. (3 p)

a) bilingual bidirectional dictionary
b) thesaurus
c) descriptive dictionary

L3)
On the following page you will find the definition of the FrameNet frame `Commerce_sell`. The most important frame elements are also described. Use this description of the `Commerce_sell` frame to annotate the sentences at the bottom of the page. The lexical unit evoking the frame should be annotated with the tag [LU] and the frame elements should be annotated with the tags given in the descriptions. For example:

[A Robin] [LU sold] [G the car].

Note: If a preposition phrase constitutes a frame element, the preposition is always included in the frame element. You do not have to tag auxiliary verbs like 'would'. All words will not be annotated. (6 p)

Commerce_sell

Definition:

These are words describing basic commercial transactions involving a BUYER and a SELLER exchanging MONEY and GOODS, taking the perspective of the seller. The words vary individually in the patterns of frame element realization they allow. For example, the typical patterns for SELL: SELLER sells GOODS to BUYER for MONEY.

Frame elements:

BUYER [B]

The BUYER has the MONEY and wants the GOODS.

GOODS [G]

The FE GOODS is anything (including labor or time, for example) which is exchanged for MONEY in a transaction.

SELLER [S]

The SELLER has possession of the GOODS and exchanges them for MONEY from a BUYER.

MONEY [M]

MONEY is the thing given in exchange for GOODS in a transaction.

Annotate the following sentences:

a) Marie sold the bike for $120 .

b) Peter's mother would never auction off her paintings to the highest bidder .

c) One example was the 1998 sale by Norway to Sweden of 40,000 barrels of oil .

PART 3: SYNTAX

There are a maximum of 100 marks on this section. In order to obtain a G you need at least 50 marks and for a VG at least 75 marks.

1. Assign each word in the following sentences the appropriate lexical category using the / notation and the tag-set from Penn Treebank, for example *likes/VBZ* (for a list of tags see Table 1). [15 marks]

   I once heard a story about a young student who landed a doctorate to study giant pandas in the wild. After two years in the field, he still hadn't seen one. Even if it's only apocryphal, this tale captures an undeniable truth: giant pandas are incredibly elusive, which makes them incredibly hard to count.

   Discuss any problems you may have encountered. [5 marks]

2. Provide a definition of Context Free Grammars (CFGs). [20 marks]

3. Provide a syntactic parse for the following sentences. You may use either bracketing or trees. [15 marks]

   (a) China's State Council is expected to update its estimate of the number of pandas left in the wild.

   (b) What about analysis of DNA in panda scats, I hear you ask?

   Discuss any problems you may have encountered. [5 marks]

4. Why do we use features in syntactic representations? [10 marks]

   What is the result of unifying these two feature structures? [10 marks]

$$\begin{bmatrix} \text{Agreement} & \boxed{1}\begin{bmatrix}\text{Number} & \text{sing}\\ \text{Person} & 3\end{bmatrix} \\ \text{Subject} & \begin{bmatrix}\text{Agreement} & \boxed{1}\end{bmatrix} \end{bmatrix} \sqcup \begin{bmatrix} \text{Agreement} & \begin{bmatrix}\text{Number} & \text{sing}\\ \text{Person} & 3\end{bmatrix} \\ \text{Subject} & \begin{bmatrix}\text{Agreement} & \begin{bmatrix}\text{Number} & \text{plur}\\ \text{Person} & 3\end{bmatrix}\end{bmatrix} \end{bmatrix}$$

5. What is the difference between the following sentences? What challenges it may present to computational processing of language? Can you find the same difference in a language other than English that you know? [20 marks]

   (a) The pirate sank the ship.

   (b) The ship was sunk (by the pirate).

   (c) The ship sank (*by the pirate).

Table 1: Penn Treebank Tags

Number	Tag	Description
1.	CC	Coordinating conjunction
2.	CD	Cardinal number
3.	DT	Determiner
4.	EX	Existential there
5.	FW	Foreign word
6.	IN	Preposition or subordinating conjunction
7.	JJ	Adjective
8.	JJR	Adjective, comparative
9.	JJS	Adjective, superlative
10.	LS	List item marker
11.	MD	Modal
12.	NN	Noun, singular or mass
13.	NNS	Noun, plural
14.	NNP	Proper noun, singular
15.	NNPS	Proper noun, plural
16.	PDT	Predeterminer
17.	POS	Possessive ending
18.	PRP	Personal pronoun
19.	PRP$	Possessive pronoun
20.	RB	Adverb
21.	RBR	Adverb, comparative
22.	RBS	Adverb, superlative
23.	RP	Particle
24.	SYM	Symbol
25.	TO	to
26.	UH	Interjection
27.	VB	Verb, base form
28.	VBD	Verb, past tense
29.	VBG	Verb, gerund or present participle
30.	VBN	Verb, past participle
31.	VBP	Verb, non-3rd person singular present
32.	VBZ	Verb, 3rd person singular present
33.	WDT	Wh-determiner
34.	WP	Wh-pronoun
35.	WP$	Possessive wh-pronoun
36.	WRB	Wh-adverb

PART 4: SEMANTICS

There are a maximum of 100 marks on this section. In order to obtain a G you need at least 50 marks and for a VG at least 75 marks.

1. For each group of sentences, say whether a sentence in (a) entail the sentence in (b). Briefly justify your answers.

   (1) a. Roberta and Carlos are married.
   b. Roberta and Carlos are married to each other. [5 marks]

   (2) a. Some Italian will not sing an aria.
   b. Not every Italian will sing an aria. [5 marks]

   (3) a. At most two tenors will contribute their fees to charity.
   b. There are tenors who will contribute their fees to charity. [5 marks]

   (4) a. Tina is a Slovenian skier.
   b. Some Slovenian is a skier. [5 marks]

2. Show that the relation between the sentence (a) and (b) is both defeasible and reinforcable.

   (5) a. If you arrive early, you may get a good seat.
   b. If you don't arrive early, you won't get a good seat. [5 marks]

   (6) a. Blanca used to ski every winter.
   b. Blanca no longer skies every winter. [5 marks]

   (7) a. Anita doesn't believe that the meeting will be at 5pm.
   b. Anita believes that the meeting will not be at 5pm. [5 marks]

   (8) a. Lorenzo likes some of his paintings.
   b. Lorenzo doesn't like all of his paintings. [5 marks]

3. When interpreting quantified expressions of First Order Logic we introduced an assignment function g. Demonstrating on an example explain its purpose. [20 marks]

4. Evaluate $\forall x_1[\neg sings(x_1) \rightarrow [x_1 = t] \wedge \exists x_2[knows(x_1, x_2)]]$ in $\mathcal{M}_2$ with respect to g_2. If applicable, for each evaluation step assert which rule have you applied in that step and on which previous step, for example "By step (3) and rule(b)." [40 marks]

The model, the assignment function, and interpretation rules

The model $\mathcal{M}_2 = \langle U_2, V_2 \rangle$

1. U_2 = {Anita, Blanca, Lorenzo, Carlos, Roberto, Tina}
2. $V_2(a)$ = Anita
3. $V_2(b)$ = Blanca
4. $V_2(l)$ = Lorenzo
5. $V_2(c)$ = Carlos
6. $V_2(r)$ = Roberto
7. $V_2(t)$ = Tina
8. $V_2(skier)$ = {Blanca, Tina, Roberto}
9. $V_2(opera\_singer)$ = {Anita, Lorenzo, Carlos}
10. $V_2(sings)$ = {Roberto, Lorenzo, Carlos }
11. $V_2(knows)$ = {⟨Blanca,Tina⟩, ⟨Lorenzo,Anita⟩, ⟨Anita,Carlos⟩, ⟨Carlos,Anita⟩}

Evaluation function g_2

$$g_2 = \begin{bmatrix} x_1 & \rightarrow & \text{Carlos} \\ x_2 & \rightarrow & \text{Anita} \\ x_3 & \rightarrow & \text{Roberto} \\ x_4 & \rightarrow & \text{Tina; where } n \geq 4 \end{bmatrix}$$

Interpretation rules

If A is either a predicate or a constant, then $[\![A]\!]^{\mathcal{M}_2,g_2} = V_2(A)$.

If A is a variable, $[\![A]\!]^{\mathcal{M}_2,g_2} = g_2(A)$.

For any formulae A, B, any $\text{Pred}_n R$, and any terms $t_1, \ldots, t_n$,

a. $[\![R(t_1, \ldots, t_n)]\!]^{\mathcal{M}_2,g_2} = 1$ iff $\langle [\![t_1]\!]^{\mathcal{M}_2,g_2}, \ldots, [\![t_n]\!]^{\mathcal{M}_2,g_2} \rangle \in [\![R]\!]^{\mathcal{M}_2,g_2}$

b. $[\![A \wedge B]\!]^{\mathcal{M}_2,g_2} = 1$ iff $[\![A]\!]^{\mathcal{M}_2,g_2} = 1$ and $[\![B]\!]^{\mathcal{M}_2,g_2} = 1$

c. $[\![A \vee B]\!]^{\mathcal{M}_2,g_2} = 1$ iff $[\![A]\!]^{\mathcal{M}_2,g_2} = 1$ or $[\![B]\!]^{\mathcal{M}_2,g_2} = 1$

d. $[\![A \rightarrow B]\!]^{\mathcal{M}_2,g_2} = 1$ iff $[\![A]\!]^{\mathcal{M}_2,g_2} = 0$ or $[\![B]\!]^{\mathcal{M}_2,g_2} = 1$

e. $[\![A \leftrightarrow B]\!]^{\mathcal{M}_2,g_2} = 1$ iff $[\![A]\!]^{\mathcal{M}_2,g_2} = [\![B]\!]^{\mathcal{M}_2,g_2}$

f. $[\![\neg A]\!]^{\mathcal{M}_2,g_2} = 1$ iff $[\![A]\!]^{\mathcal{M}_2,g_2} = 0$

g. $[\![t_1 = t_j]\!]^{\mathcal{M}_2,g_2} = 1$ iff $[\![t_1]\!]^{\mathcal{M}_2,g_2}$ is the same as $[\![t_j]\!]^{\mathcal{M}_2,g_2}$

h. $[\![A]\!]^{\mathcal{M}_i,g_i[u/x_n]}$ stands for a donation of A where u is assigned to every occurrence of x_n in A.

i. $[\![\forall x_n A]\!]^{\mathcal{M}_2,g_2} = 1$ iff for all $u \in U$, $[\![A]\!]^{\mathcal{M}_2,g_2[u/x_n]} = 1$, where $g_1[u/x_n] = g_1$, except that $g_1[u/x_n](x_n) = u$

j. $[\![\exists x_n A]\!]^{\mathcal{M}_2,g_2} = 1$ iff for some $u \in U$, $[\![A]\!]^{\mathcal{M}_2,g_2[u/x_n]} = 1$