



GÖTEBORGS UNIVERSITET

Masters Programme in Language Technology

INTRODUCTION TO FORMAL LINGUISTICS LT2112

AUTUMN SEMESTER 2015

Wednesday, 28th October 2015, 13:30am–16:30am

Viktoriagatan 30, Göteborg

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

Candidate number: _____

Name: _____

Personnummer: _____

Write your answers on 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.

If you are re-taking this exam, **answer only questions from those parts that you are re-taking**. You have 3 hours to complete the exam. You should spend 45 minutes on each part.

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

PART 1: PHONETICS AND PHONOLOGY

1. In a periodic sound, you measured T to be 0.001, what is the frequency in Hz? Show your calculation. [2 marks]
2. A. Write down 2 alveolar plosives with phonetic notation.
B. Write down an open unrounded front vowel with phonetic notation. [4 marks]
3. Give an example of a minimal pair in English, which phoneme distinguishes them? Write the phonemes using IPA. [2 marks]
4. What is the articulatory terminology for [2 marks]
 - A. Teeth
 - B. Soft palate
 - C. Lips
 - D. Tongue

PART 2: MORPHOLOGY

1. What are the following morphological concepts: *Free morpheme*, *allomorph*, *suffix*? Explain and provide examples. [3 marks]
2. What is the difference between *derivation* and *inflection*? Explain and provide examples. [3 marks]
3. In language typology languages are often divided into groups based on morphological properties. Name two such categories and their signifying features. Also, for each type, give one example of a language which is of that type. [4 marks]
4. Below are some words and phrases in Czech and English translations.

nesu = 'I carry'
ponese 'He will carry'
povedete = 'You (pl) will lead'
poplavu 'I will swim'
priplavesh 'You will swim here'
priyedou 'They will drive here'
odvedeme 'We will lead away'
odyede 'He will drive away'
poyede 'He will drive'
nesou 'They carry'
plavou 'They swim'
vedeme 'We lead'
yedu 'I drive'
ponesu 'I will carry'
yede 'He drives'
nese 'He carries'
odnesou 'They will carry away'
odplavete 'You (pl.) will swim away'
poplaveme 'We will swim'
prineseme 'We will bring here'
prinese 'He will bring here'
odvedu 'I will lead away'

odnesesh 'You carry away'

- (a) Identify the Czech morphemes that correspond to the following English translations:
- i. Verbs: carry, drive, lead, bring, swim
 - ii. Pronouns: I, you(SG), they, he, we, you(PL)
 - iii. Tense, Location: here, away, will
- [4 marks]
- (b) What is the order of these morphemes in Czech (in terms of verbs, pronouns, tense, location)?
- [2 marks]
- (c) Provide Czech translations for the following English sentences:
- i. He will swim.
 - ii. They drive away.
 - iii. You lead away.
 - iv. I will bring here.
- [4 marks]

PART 3: SYNTAX

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). [4 marks]

Dark streaks on crater slopes on Mars have been identified as salt deposits. The presence of salt could be the strongest evidence of liquid water on the surface of the Red Planet.

Discuss any problems you may have encountered. [1 mark]

2. What do we mean by the statement that “grammars should be formal”. What properties must a grammar have to model natural language? [2.5 marks]
3. Provide a syntactic parse of the following sentence. You may use either bracketing or trees. [4 marks]

(a) US researchers studied the sleeping patterns of traditional societies in Africa and South America, whose lifestyles closely resemble ancient hunter gatherers.

Discuss any problems you may have encountered. [1 mark]

4. Draw a feature structure FS_0 that *subsumes* the feature structure FS_1 , hence $FS_0 \sqsubseteq FS_1$. [2.5 marks]

$$FS_1 = \left[\begin{array}{l} \text{Agreement} \\ \text{Subject} \end{array} \left[\begin{array}{l} \left[\begin{array}{ll} \text{Number} & \text{sing} \\ \text{Person} & 3 \end{array} \right] \\ \left[\text{Agreement} \left[\begin{array}{ll} \text{Number} & \text{plur} \\ \text{Person} & 3 \end{array} \right] \right] \end{array} \right] \right]$$

5. Why are sentences (a) and (b) grammatical but (c) is not? Explain with reference to the implementation of *wh*-movement with slash categories. [5 marks]
 - (a) Who do you think that George claims that Lydia saw?
 - (b) Who do you think that George claims that Lydia saw when?
 - (c) *Who do you think that George claims when that Lydia saw?

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.	VCN	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

1. **If you took the course in HT2015:** For each of the following arguments determine whether they are valid or invalid using one of the two methods presented in the lectures. (See the next page for some useful logical equivalences.)

If you took the course in HT2014 and earlier: For each group of sentences, determine whether premises entail the conclusion using the definition of entailment from the lectures and justify your answer as well as you can.

- (1) a. If the moon is made of blue cheese, then cows jump over it.
 b. The moon is made of blue cheese.
 c. Therefore, cows jump over the moon.
- (2) a. If I move my knight, Lydia will take my knight.
 b. If I move my queen, Lydia will take my knight.
 c. Therefore, if I move my knight, then I move my queen. [8 marks]

2. What are truth conditions as opposed to truth values? Illustrate with an example. [4 marks]
3. When interpreting quantified expressions of First Order Logic we introduced an assignment function g . Using an example explain its purpose. [4 marks]
4. Evaluate the following expressions with respect to \mathcal{M}_3 using a method where you represent the results of the evaluation in a truth table. [8 marks]

- (3) a. $\exists y \forall x [\text{likes}(x, y)]$
 b. $\forall x [[\text{cat}(x) \vee \text{human}(x)] \rightarrow [\text{cat}(\text{sibling_of}(x)) \vee \text{human}(\text{sibling_of}(x))]]$

$\mathcal{M}_3 \langle U_3, V_3 \rangle$

$U_3 = \{l, a, g, b\}$

$V_3(\text{Lydia}) = l; V_3(\text{Alex}) = a; V_3(\text{George}) = g; V_3(\text{Bertie}) = b$

$V_3(\text{likes}) = \{\langle l, a \rangle, \langle l, b \rangle, \langle a, g \rangle, \langle l, g \rangle\}$

$V_3(\text{runs}) = \{l, b\}$

$V_3(\text{human}) = \{l, a\}$

$V_3(\text{cat}) = \{g, b\}$

$V_3(\text{owns}) = \{\langle l, b \rangle, \langle a, g \rangle\}$

$V_3(\text{sibling_of}) = \{\langle l, a \rangle, \langle a, l \rangle, \langle g, b \rangle, \langle b, g \rangle\}$

Logical equivalences

1. $\neg(P \wedge Q) \equiv \neg P \vee \neg Q$ (De Morgan's law)
2. $\neg(P \vee Q) \equiv \neg P \wedge \neg Q$ (De Morgan's law)
3. $P \rightarrow Q \equiv \neg P \vee Q$
4. $P \rightarrow Q \equiv \neg Q \rightarrow \neg P$ (Contrapositive)
5. $P \wedge Q \equiv Q \wedge P$
6. $P \vee Q \equiv Q \vee P$
7. $P \equiv \neg\neg P$
8. $P \wedge (Q \vee R) \equiv (P \wedge Q) \vee (P \wedge R)$ (Distributivity)
9. $P \vee (Q \wedge R) \equiv (P \vee Q) \wedge (P \vee R)$ (Distributivity)