LING5702: Problem Set 5

Due via Carmen dropbox at 11:59 PM 3/31.

1. Surprisal has been used to explain 'filled gap' effects, in which gaps appear to be filled as quickly as possible. Using the following grammatical and lexical rule probabilities:

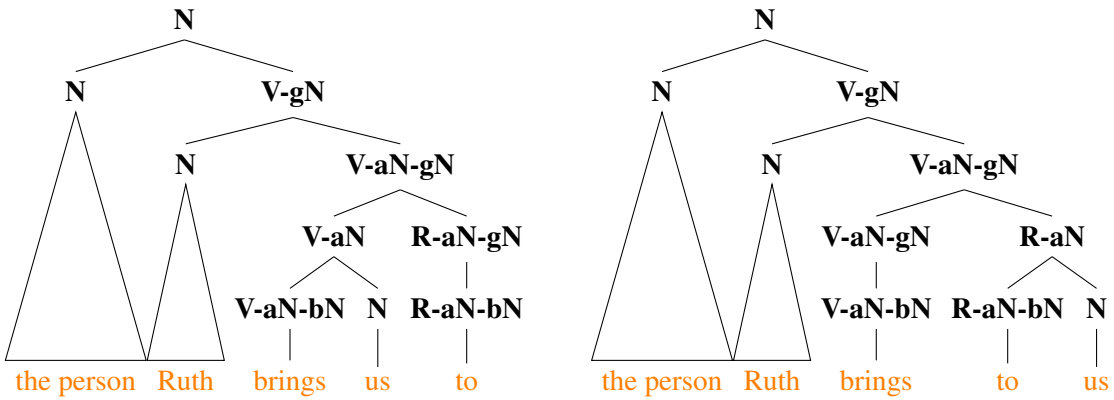
grammatical rules:

$P(\textbf{N} \rightarrow \textbf{D N-aD} \mid \textbf{N}) = .5$	– noun phrase is determiner, common noun
$P(\textbf{N} \rightarrow \textbf{N V-gN} \mid \textbf{N}) = .1$	– noun phrase is noun phrase, relative clause
$P(\textbf{V-gN} \rightarrow \textbf{N V-aN-gN} \mid \textbf{V-gN}) = 1.0$	– relative clause is noun phrase, gapped verb phrase
$P(\textbf{V-aN-gN} \rightarrow \textbf{V-aN-gN R-aN} \mid ...) = .15$	– gapped verb phrase is verb phrase, gapped adv phrase
$P(\textbf{V-aN-gN} \rightarrow \textbf{V-aN R-aN-gN} \mid ...) = .01$	– gapped verb phrase is gapped verb phrase, adv phrase
$P(\textbf{V-aN} \rightarrow \textbf{V-aN-bN N} \mid \textbf{V-aN}) = .5$	– verb phrase is trans verb, noun phrase
$P(\textbf{V-aN-gN} \rightarrow \textbf{V-aN-bN} \mid \textbf{V-aN-gN}) = 1.0$	– gapped verb phrase is transitive verb
$P(\textbf{R-aN-gN} \rightarrow \textbf{R-aN-bN} \mid \textbf{R-aN-gN}) = 1.0$	– gapped adverbial phrase is preposition
$P(\textbf{R-aN} \rightarrow \textbf{R-aN-bN N} \mid \textbf{R-aN}) = .5$	– adv phrase is preposition, noun phrase

lexical rules:

$P(\textbf{V-aN-bN} \rightarrow \textbf{brings} \mid \textbf{V-aN-bN}) = .001$	– transitive verb is 'brings'
$P(\textbf{D} \rightarrow \textbf{the} \mid \textbf{D}) = .5$	– determiner is 'the'
$P(\textbf{N-aD} \rightarrow \textbf{person} \mid \textbf{N-aD}) = .001$	– common noun is 'person'
$P(\textbf{N} \rightarrow \textbf{Ruth} \mid \textbf{N}) = .001$	– noun phrase is 'Ruth'
$P(\textbf{N} \rightarrow \textbf{us} \mid \textbf{N}) = .001$	– noun phrase is 'us'
$P(\textbf{R-aN-bN} \rightarrow \textbf{to} \mid \textbf{R-aN-bN}) = .1$	– an adverbial preposition is 'to'

and the following trees:



please answer:

(a) [3 pts] What is the probability of the first tree according to the grammar and lexicon?

(b) [3 pts] What is the probability of the second tree according to the grammar and lexicon?

(c) [4 pts] What fraction of probability remains after the word 'us' in the first sentence? (You may limit your consideration to just the above two trees.)

2. Surprisal has also been used to explain observations of 'anti-locality' in case-marked languages, where verbs following longer lists of noun phrases are facilitated (processed faster). Using the following grammatical and lexical rule probabilities:

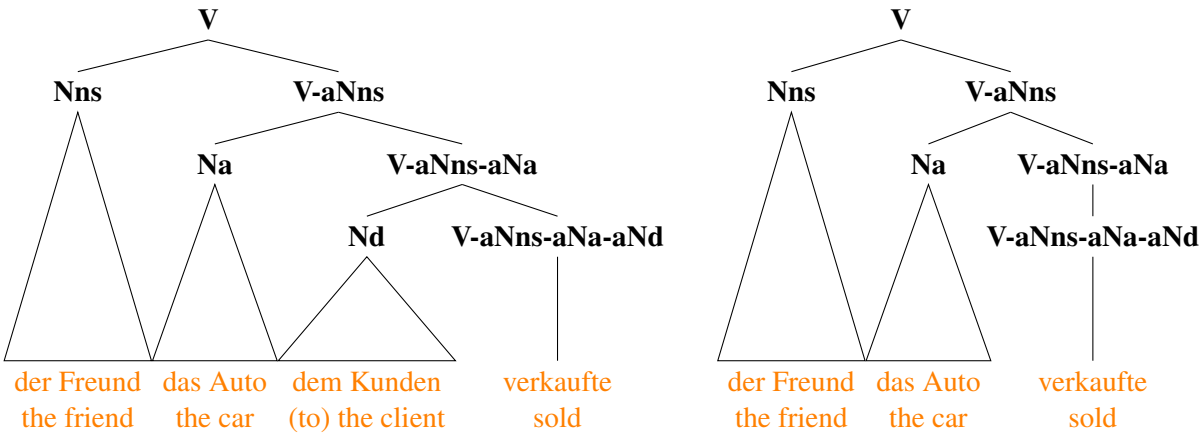
grammatical rules:

$P(\textbf{V} \rightarrow \textbf{Nns V-aNns} \mid \textbf{V}) = 1.0$	– sentence is nom. singular phrase, verb phrase
$P(\textbf{V-aNns} \rightarrow \textbf{Na V-aNns-aNa} \mid \textbf{V-aNns}) = 1.0$	– verb phrase is acc. phrase, verb transitive
$P(\textbf{V-aNns-aNa} \rightarrow \textbf{Nd V-aNns-aNa-aNd} \mid ...) = .3$	– verb transitive is dat. phrase, verb ditransitive
$P(\textbf{V-aNns-aNa} \rightarrow \textbf{V-aNns-aNa-aNd} \mid ...) = .1$	– verb transitive is verb ditransitive
$P(\textbf{Nns} \rightarrow \textbf{Dnsm Nns-aDnsm} \mid \textbf{Nns}) = .5$	– noun phrase is determiner, common noun
$P(\textbf{Na} \rightarrow \textbf{Dasn Na-aDasn} \mid \textbf{Nas}) = .5$	– noun phrase is determiner, common noun
$P(\textbf{Nd} \rightarrow \textbf{Ddpm Nd-aDdpm} \mid \textbf{Ndp}) = .5$	– noun phrase is determiner, common noun

lexical rules:

$P(\textbf{V-aNns-bNa-bNd} \rightarrow \textbf{verkaufte} \mid \textbf{V-aNns-bNa-bNd}) = .001$	– ditransitive verb is 'verkaufte'
$P(\textbf{Dnsm} \rightarrow \textbf{der} \mid \textbf{Dnsm}) = .5$	– nom. singular masc. determiner is 'der'
$P(\textbf{Dasn} \rightarrow \textbf{das} \mid \textbf{Dasn}) = .5$	– acc. singular neut. determiner is 'das'
$P(\textbf{Ddpm} \rightarrow \textbf{dem} \mid \textbf{Ddpm}) = .5$	– dat. plural masc. determiner is 'dem'
$P(\textbf{Nns-aDnsm} \rightarrow \textbf{Freund} \mid \textbf{Nns-aDnsm}) = .001$	– masc. singular noun is 'Freund'
$P(\textbf{Na-aDasn} \rightarrow \textbf{Auto} \mid \textbf{Na-aDasn}) = .001$	– neut. singular noun is 'Auto'
$P(\textbf{Nd-aDdpm} \rightarrow \textbf{Kunden} \mid \textbf{Nd-aDdpm}) = .001$	– masc. plural noun is 'Kunden'

and the following trees:



please answer:

(a) [3 pts] What is the probability of the first tree according to the grammar and lexicon?

(b) [3 pts] What is the probability of the second tree according to the grammar and lexicon?

(c) [2 pts] What fraction of probability remains after 'verkaufte' in the first sentence?
(You may limit your consideration to just the above two trees.)

(d) [2 pts] What fraction of probability remains after 'verkaufte' in the second sentence?
(You may limit your consideration to just the above two trees.)
(Note that the first tree contains all words before 'verkaufte' in the second sentence.)

3. Surprisal has also been used to explain 'facilitation due to ambiguity,' in which globally syntactically ambiguous sentences are read more quickly than locally syntactically ambiguous sentences. Using the following grammatical and lexical rule probabilities:

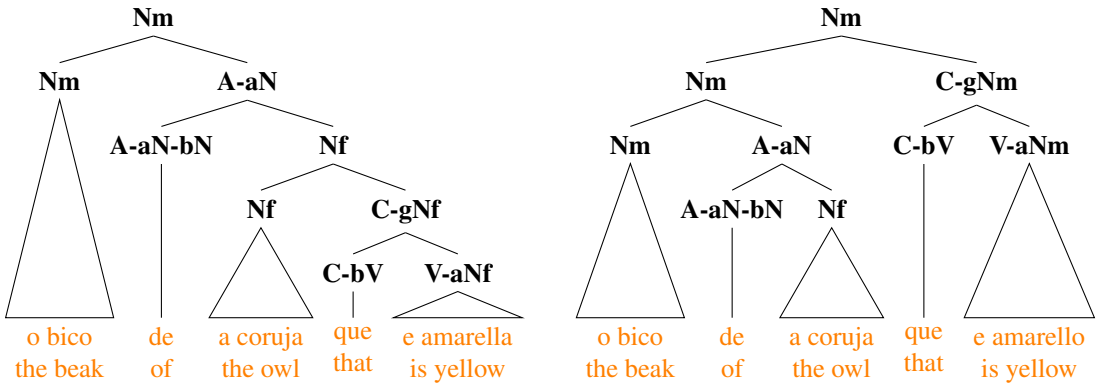
grammatical rules:

$P(\textbf{Nf} \rightarrow \textbf{Df Nf-aDf} \mid \textbf{Nf}) = .5$	– fem. noun phrase is determiner, noun
$P(\textbf{Nm} \rightarrow \textbf{Dm Nm-aDm} \mid \textbf{Nm}) = .5$	– masc. noun phrase is determiner, noun
$P(\textbf{Nf} \rightarrow \textbf{Nf A-aN} \mid \textbf{Nf}) = .1$	– fem. noun phrase modified by adj phrase
$P(\textbf{Nm} \rightarrow \textbf{Nm A-aN} \mid \textbf{Nm}) = .1$	– masc. noun phrase modified by adj phrase
$P(\textbf{Nf} \rightarrow \textbf{Nf C-gNf} \mid \textbf{Nf}) = .1$	– fem. noun phrase modified by rel clause
$P(\textbf{Nm} \rightarrow \textbf{Nm C-gNm} \mid \textbf{Nm}) = .1$	– masc. noun phrase modified by rel clause
$P(\textbf{C-gNf} \rightarrow \textbf{C-bV V-aNf} \mid \textbf{C-gNf}) = 1.0$	– fem. rel clause is complementized
$P(\textbf{C-gNm} \rightarrow \textbf{C-bV V-aNm} \mid \textbf{C-gNm}) = 1.0$	– masc. rel clause is complementized
$P(\textbf{A-aN} \rightarrow \textbf{A-aN-bN Nf} \mid \textbf{A-aN}) = .1$	– prepositional phrase gets noun phrase
$P(\textbf{V-aNf} \rightarrow \textbf{V-aNf-b(A-aNf) A-aNf} \mid \textbf{V-aNf}) = .2$	– fem. verb phrase gets auxiliary
$P(\textbf{V-aNm} \rightarrow \textbf{V-aNm-b(A-aNm) A-aNm} \mid \textbf{V-aNm}) = .2$	– masc. verb phrase gets auxiliary

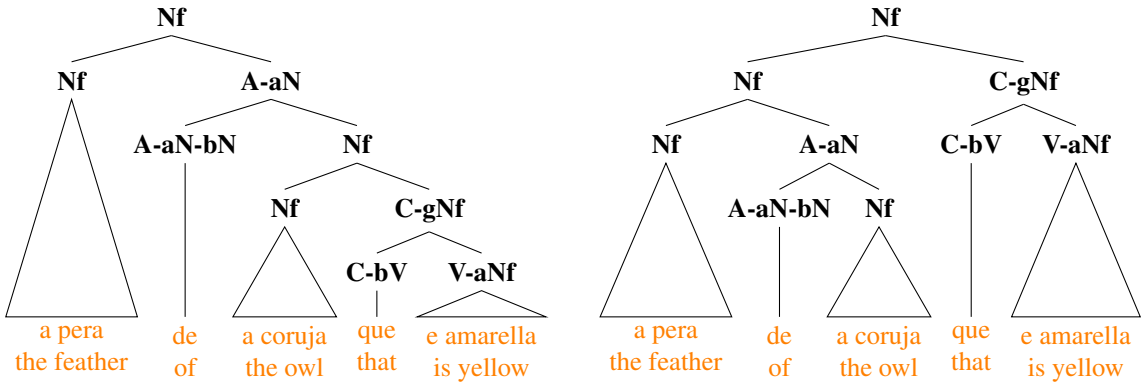
lexical rules:

$P(\textbf{V-aNf-b(A-aNf)} \rightarrow \textbf{e} \mid \textbf{V-aNf-b(A-aNf)}) = 1.0$	– fem. auxiliary verb is 'e'
$P(\textbf{V-aNm-b(A-aNm)} \rightarrow \textbf{e} \mid \textbf{V-aNm-b(A-aNm)}) = 1.0$	– masc. auxiliary verb is 'e'
$P(\textbf{A-aN-bN} \rightarrow \textbf{de} \mid \textbf{A-aN-bN}) = .1$	– preposition is 'de'
$P(\textbf{A-aNf} \rightarrow \textbf{amarella} \mid \textbf{V-aNf}) = .001$	– fem. adjective is 'amarella'
$P(\textbf{A-aNm} \rightarrow \textbf{amarello} \mid \textbf{V-aNm}) = .001$	– masc. adjective is 'amarello'
$P(\textbf{C-bV} \rightarrow \textbf{que} \mid \textbf{C-bV}) = 1.0$	– complementizer is 'que'
$P(\textbf{Df} \rightarrow \textbf{a} \mid \textbf{Df}) = .5$	– fem. determiner is 'a'
$P(\textbf{Dm} \rightarrow \textbf{o} \mid \textbf{Dm}) = .5$	– masc. determiner is 'o'
$P(\textbf{Nf-aDf} \rightarrow \textbf{coruja} \mid \textbf{Nf-aDf}) = .001$	– fem. noun is 'coruja'
$P(\textbf{Nf-aDf} \rightarrow \textbf{pera} \mid \textbf{Nf-aDf}) = .001$	– fem. noun is 'pera'
$P(\textbf{Nm-aDm} \rightarrow \textbf{bico} \mid \textbf{Nm-aDm}) = .001$	– masc. noun is 'bico'

and the following 'beak' trees, with different final adjectives to match the nouns' genders:



and the following ‘feather’ trees, with the same final adjective matching both nouns’ gender:



please answer:

(a) [3 pts] What is the probability of the first ‘beak’ tree according to the above rules?

(b) [3 pts] What is the probability of the second ‘beak’ tree according to the above rules?

(c) [3 pts] What is the probability of the first ‘feather’ tree according to the above rules?

(d) [3 pts] What is the probability of the second ‘feather’ tree according to the above rules?

(e) [2 pts] What fraction of probability remains after ‘amarella’ in the first ‘beak’ sentence? (You may limit your consideration to just the above two trees.)

(f) [2 pts] What fraction of probability remains after ‘amarella’ in the ‘feather’ sentence? (You may limit your consideration to just the above two trees.)