

## Advanced AI Techniques

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### Exercise Sheet 12

Due: Tuesday, 6. Februar 2007

#### Exercise 12.1 (Game Theory)

The *multiplication game* is defined as follows: Two player choose a number from a set  $M$ . The reward of each player is the product of these two numbers.

- (a) Analyze the game for  $M = \{1, \dots, m\}$  ( $m \in \mathbb{N}_1$ ) with respect to
- iterated elimination of weakly dominated strategies,
  - iterated elimination of strictly dominated strategies
- (b) Analyze  $M = \mathbb{N}_1$ .
- (c) Analyze  $M = \mathbb{N}_0$ .

#### Exercise 12.2 (PCFG)

- (a) Is the following set of probabilistic rules a PCFG? Why or why not?  
Terminals:  $\{you, this, can, see, read, and, should\}$

Nonterminals:  $\{S, AUX, NP, VP, C, V\}$

Start symbol:  $S$

Rules and Probabilities:

$S \rightarrow NP VP$  (0.5)

$S \rightarrow AUX NP VP$  (0.2)

$S \rightarrow NP AUX VP$  (0.3)

$VP \rightarrow V NP$  (1.0)

$NP \rightarrow NP$  (0.8)

$NP \rightarrow NP C NP$  (0.2)

$NP \rightarrow you$  (0.6)

$NP \rightarrow this$  (0.4)

$AUX \rightarrow can$  (0.7)

$AUX \rightarrow should$  (0.3)

$V \rightarrow see$  (0.9)

$V \rightarrow read$  (0.1)

$C \rightarrow and$  (1.0)

- (b) Find a PCFG in CNF that can generate the same sentences.

#### Exercise 12.3 (PDCG)

Consider the following Probabilistic Definite Clause Grammar:

- 0.4 :  $S(X) \rightarrow P(X), P(X)$
- 0.6 :  $S(X) \rightarrow Q(X)$
- 0.3 :  $P(a) \rightarrow a$
- 0.7 :  $P(b) \rightarrow b$
- 0.2 :  $Q(a) \rightarrow a$
- 0.8 :  $Q(b) \rightarrow b$

and the sentence  $s = "aa"$ .

- (a) Find a derivation  $der$  in  $G$  for the non-terminal  $S(X)$  that yields the sentence  $s$ .
- (b) Compute the derivation probability  $P_D(der|G)$ .
- (c) Compute the refutation probability  $P_R(der|G)$ .
- (d) Compute the sentence probability  $P_S(s|G)$ .

Please hand in a joint solution of three students and write all names on the sheet.