Two hours

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Dialogue Systems

Date: Wednesday 3rd June 2009
Time: 09:45 – 11:45

Please answer Question One and TWO other Questions from the remaining four questions provided

This is a CLOSED book examination

The use of electronic calculators is NOT permitted.
1. **Compulsory**

Outline the architecture of a typical dialogue system. Describe what each of the components of such a system is for, and specify the information that is exchanged between them. (30 marks)

2. a) The spectrograms below show someone saying ‘tepid’ and ‘nun’. What evidence would you use to decide which was which, and which choice would this evidence lead you to? (12 marks)

![Spectrogram of 'tepid' and 'nun']

b) What are formants? Explain their role, if any, in the recognition of vowels and consonants. (10 marks)

c) Explain the difference between phone-based and diphone-based synthesisers. What are the relative advantages and disadvantages of each approach? (13 marks)
3. a) What is the difference between a context-free grammar and a feature-based grammar? Illustrate your answer by describing a grammar of each sort to deal appropriately with the following sentences and non-sentences. (15 Marks)

1. He likes her.
2. They like her.
3. He like her.
4. He like she.

b) What is the fundamental rule of chart-parsing? (5 marks)

c) Show the edges that a bottom-up chart parser would construct when parsing the sentence ‘I saw her kiss him’ given the grammar and lexicon below: (15 marks)

```
S ==> [NP, VP] :-
    S <> s,
    NP <> np,
    VP <> vp.

NP ==> [PRONOUN] :-
    NP <> np,
    PRONOUN <> pronoun

VP ==> [TVERB, NP] :-
    VP <> vp,
    TVERB <> tverb,
    NP <> np.

VP ==> [SVERB, S] :-
    VP <> vp,
    SVERB <> sverb,
    S <> s.

word(‘I’, X) :-
    X <> pronoun.
word(him, X) :-
    X <> pronoun.
word(her, X) :-
    X <> pronoun.

word(saw, X) :-
    X <> tverb.
word(saw, X) :-
    X <> sverb.
word(kiss, X) :-
    X <> tverb.
```

[PTO]
4. a) What is the principle of compositionality? (5 marks)
   
b) Explain why (3) below is more problematic for this principle than (1) or (2). (10 marks)
   
   1. Glass jam jars break if you heat them up too quickly.
   2. I got caught in a very slow traffic jam.
   3. I’m looking for a bag of sugar.
   
c) What interpretation would the grammar below assign to the sentence ‘Every man will die.’? The answer should be in fully reduced form, and you should show the steps you went through to obtain this form. (20 marks)

```
S ==> [NP, VP] :-
   S <> s,
   NP <> np,
   VP <> vp,
   meaning@S -- (meaning@VP:meaning@NP).

NP ==> [DET, NOUN] :-
   NP <> np,
   NOUN <> noun,
   DET <> det,
   meaning@NP -- (meaning@DET:meaning@NOUN).

VP1 ==> [AUX, VP0] :-
   VP1 <> vp,
   AUX <> aux,
   VP0 <> vp,
   meaning@VP1 -- (meaning@AUX:meaning@VP0).

VP ==> [IVERB] :-
   VP <> vp,
   IVERB <> iverb,
   meaning@VP -- meaning@IVERB.

word(a, DET) :-
   DET <> det,
   meaning@DET -- lambda(Q, lambda(P, exists(X, (P:X) & (Q:X))))).

word(die, X) :-
   X <> iverb,
   meaning@X -- lambda(U, exists(V, die(V) & (U:lambda(W, exp(V, W))))).

word(will, X) :-
   X <> aux,
   meaning@X -- lambda(K, lambda(L, future(K:L))).

word(man, N) :-
   N <> noun,
   meaning@N -- lambda(M, man(M)).
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5. a) What are ‘indirect speech acts’? Illustrate your answer by considering different uses of the sentence ‘I’m sorry they’re not good enough.’ (15 marks)

b) Provide a description of the action of querying a proposition, using the STRIPS format for action specifications. Describe how your action might lead someone to say ‘Do you know the time?’ in a situation where what they actually wanted to do was to catch a train. You should illustrate your answer with descriptions of any other actions that are involved. (20 marks)