CENTRE FOR LANGUAGE TECHNOLOGY
MACQUARIE UNIVERSITY ~ SYDNEY

Question Answering: What is the Best Scoring Mechanism?

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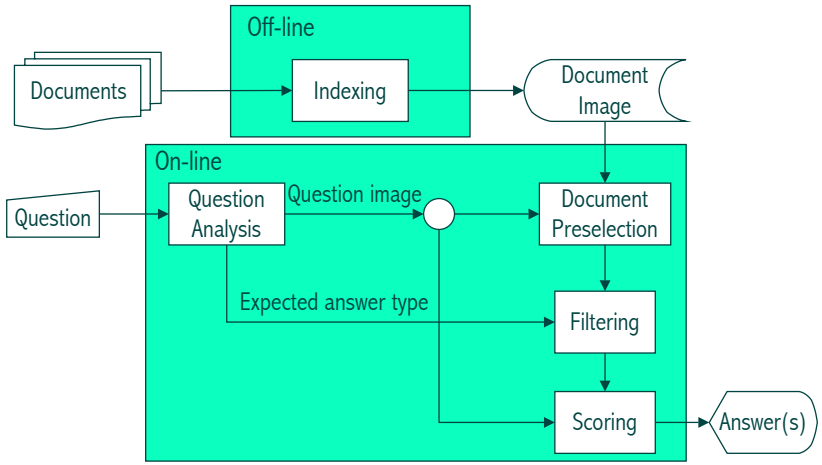
Outline

- Architecture of our QA system
- Scoring modules
- The scoring tyranny
- The effect of linguistic information
- Discussion

Architecture of a QA System



The Document Set

- Remedia Publications' Reading Comprehension Tests
- Levels 2, 3, 4, and 5
- Every document contains 5 questions (*who, what, when, where, why*)
- The answer is always in the text
- Files:
  - Original text (*.txt)
  - Coreferences (*.txt.coref)
  - Named Entities (*.txt.ne)
  - Answers marked-up (*.txt.snra)
  - Answers extracted (*.txt.wdra.xml)

Corpus Used – Sample of file rm4-16.txt

1989 Remedia Publications, Comprehension/5Ws-4
Watch Out for Sears!

(North Redwood, Minn., September, 1889) A man named Richard Sears has been playing a joke on shoppers.

Sears likes to sell items by mail. Not long ago, he ran an ad in some newspapers In small towns. The ad showed a drawing of lovely furniture. There was a sofa and two chairs.

The ad said the furniture was for sale. It said the pieces were made of fine metal frames and were beautiful to see. The ad said that for a short time only, these chairs would be shipped to all who paid 95 cents.

This message sounded too good to be true. Still, a lot of people sent in their money. Imagine their surprise when they received the furniture. The furniture was made for a doll house! They were tiny pieces.

Some people complained. That's when Sears showed them the tiny print in his ad.

In very small letters, he had included the word "miniature." That means the furniture was not full size. Sears says he did this to get attention.

1. Who played a joke on shoppers?
2. What does the Sears ad offer?
3. When did Sears play this joke?
4. Where is the word "miniature"?
5. Why did Sears play this joke?

Corpus Used – Sample of file rm4-16.txt.ne

1989 Remedia Publications, Comprehension/5Ws-4

Watch Out for <ENAMEX TYPE="PERSON">Sears</ENAMEX>!

(<ENAMEX TYPE="LOCATION">North Redwood</ENAMEX>, <ENAMEX TYPE="LOCATION">Minn.</ENAMEX>, <TIMEX TYPE="DATE">September, 1889</TIMEX>) A man named <ENAMEX TYPE="PERSON">Richard Sears</ENAMEX> has been playing a joke on shoppers.

<ENAMEX TYPE="PERSON">Sears</ENAMEX> likes to sell items by mail. Not long ago, he ran an ad in some newspapers In small towns. The ad showed a drawing of lovely furniture. There was a sofa and two chairs.

The ad said the furniture was for sale. It said the pieces were made of fine metal frames and were beautiful to see. The ad said that for a short time only, these chairs would be shipped to all who paid <NUMEX TYPE="MONEY">95 cents</NUMEX>.

This message sounded too good to be true. Still, a lot of people sent in their money. Imagine their surprise when they received the furniture. The furniture was made for a doll house! They were tiny pieces.

Some people complained. That's when <ENAMEX TYPE="PERSON">Sears</ENAMEX> showed them the tiny print in his ad.

In very small letters, he had included the word "miniature." That means the furniture was not full size. <ENAMEX TYPE="PERSON">Sears</ENAMEX> says he did this to get attention.

1. Who played a joke on shoppers?
2. What does the <ENAMEX TYPE="PERSON">Sears</ENAMEX> ad offer?
3. When did <ENAMEX TYPE="PERSON">Sears</ENAMEX> play this joke?
4. Where is the word "miniature"?
5. Why did <ENAMEX TYPE="PERSON">Sears</ENAMEX> play this joke?

Corpus Used – Sample of file rm4-16.txt.snra

1989 Remedia Publications, Comprehension/5Ws-4

Watch Out for Sears!

<ANSQ3>(North Redwood, Minn., September, 1889)</ANSQ3> <ANSQ1>A man named Richard Sears has been playing a joke on shoppers.</ANSQ1>

Sears likes to sell items by mail. <ANSQ3>Not long ago, he ran an ad in some newspapers In small towns.</ANSQ3> The ad showed a drawing of lovely furniture. There was a sofa and two chairs.

<ANSQ2>The ad said the furniture was for sale.</ANSQ2> It said the pieces were made of fine metal frames and were beautiful to see. <ANSQ2>The ad said that for a short time only, these chairs would be shipped to all who paid 95 cents.</ANSQ2>

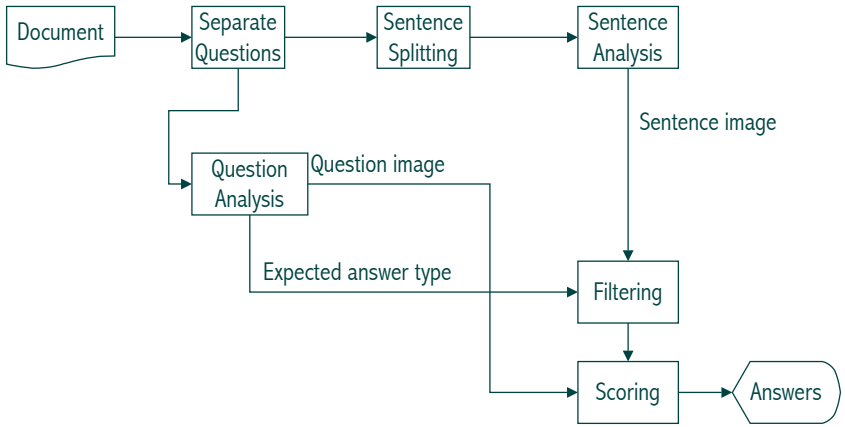
This message sounded too good to be true. Still, a lot of people sent in their money. Imagine their surprise when they received the furniture. The furniture was made for a doll house! They were tiny pieces.

Some people complained. That's when Sears showed them the tiny print in his ad.

In very small letters, he had included the word "miniature." That means the furniture was not full size. <ANSQ5>Sears says he did this to get attention.</ANSQ5>

1. Who played a joke on shoppers?
2. What does the Sears ad offer?
3. When did Sears play this joke?
4. Where is the word "miniature"?
5. Why did Sears play this joke?

Architecture of our QA system



Our QA Prototype

```
def answer_extraction(question_data,document_data):
    "Perform answer extraction"
    (question,expected_answer,question_analysed) = question_data
     scores = []
    for (sentence,sentence_analysed) in document_data:
        if ne_filtering(sentence,expected_answer):
            score = -100
        else:
            score = 0
        (sc,sc_justification) = call_scoring_method(question_analysed, sentence_analysed)
        score += sc
        scores += [(score,sc_justification,sentence)]
    scores.sort(lambda x,y: cmp(y[0],x[0]))
    return scores[0:5]
```


Outline

- Architecture of our QA system
- Scoring modules
- The scoring tyranny
- The effect of linguistic information
- Discussion

Word, Dependency Overlap

- Word overlap
  - With/without stop words
  - With/without stemming
- Dependency overlap
  - *A man named Richard Sears has been playing a joke on shoppers.*
    man>play, name>man, richard>sears, sears>name, joke>play, on>play, shopper>on
  - *Who played a joke on shoppers?*
    who>play, joke>play, on>play, shopper>on

Finding the Dependencies

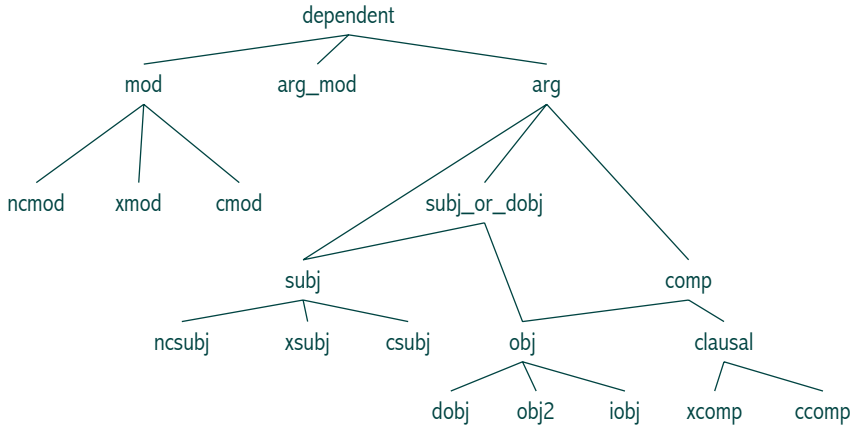
- Output of Conexor

1	A	a	det:>2	@DN>	%>N DET SG
2	man	man	subj:>5	@SUBJ	%NH N NOM SG
3	named	name	mod:>2	@-FMAINV	%VP EN
4	Richard	richard	obj:>3	@OBJ	%NH N NOM SG
5	Sears	sear	subj:>6	@+FMAINV	%VA V PRES SG3
6	has	have	v-ch:>7	@+FAUXV	%AUX V PRES SG3
7	been	be	v-ch:>8	@-FAUXV	%AUX EN
8	playing	play	main:>0	@-FMAINV	%VA ING
9	a	a	det:>10	@DN>	%>N DET SG
10	joke	joke	comp:>8	@PCOMPL-S	%NH N NOM SG
11	on	on	phr:>8	@ADVL	%EH PREP
12	shoppers	shopper	pcomp:>11	@<P	%NH N NOM PL
13	<s>	<s>			

Finding the Dependencies

- Dependencies:
  - a>man, man>sear, name>man, richard>name, sear>have, have>be, be>play, a>joke, joke>play, on>play, shopper>on
- Dependencies removing stop words (a, have, be):
  - man>sear, name>man, richard>name, sear>play, joke>play, on>play, shopper>on

Grammatical Relations (Carroll et al. 1998)



Grammatical Relations

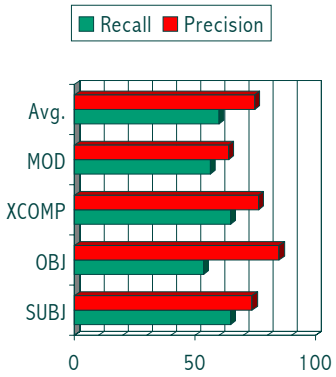
- *A man named Richard Sears has been playing a joke on shoppers.*
  (xmod _ man name), (detmod _ man a),
  (subj name man), (dobj name richard _),
  (detmod _ joke a), (subj sear man _), (subj play sear _),
  (aux _ play have), (aux _ play be), (ncmod _ play on),
  (xcomp _ play joke)
- *Who played a joke on shoppers?*
  (subj play who _), (dobj play joke _), (ncmod _ play on),
  (detmod _ joke a)

Minimal Logical Forms

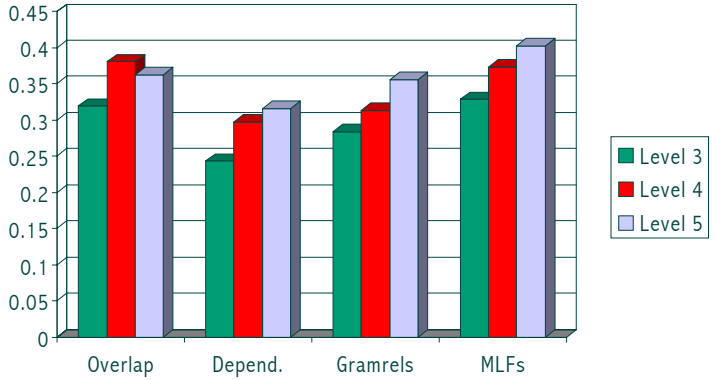
- *A man named Richard Sears has been playing a joke on shoppers.*
  holds(v_o10), object('man',v_o2,[v_x2]),
  evt('name',v_e3,[v_X3,v_x4,v_x2]),
  object('joke_on',v_o10,[v_e5,v_x12]),
  object('richard',v_o4,[v_x4]), evt('sear',v_e5,[v_x2]),
  object('shopper',v_o12,[v_x12])
- *Who played a joke on shoppers?*
  holds(v_e2), object('who',v_o1,[v_x1]),
  evt('play_on',v_e2,[v_x1,v_x4,v_x6]),
  object('joke',v_o4,[v_x4]), object('shopper',v_o6,[v_x6])

Parser Accuracy

- Corpus:
  - 500 sentences
  - 10,000 words
- Used in Carroll & Briscoe's parser evaluation



First Results



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- The effect of linguistic information
- Discussion

Best and Worst Cases

- The overlap scores in the gramrels and MLFs are very low
- The right answer is competing with other sentences

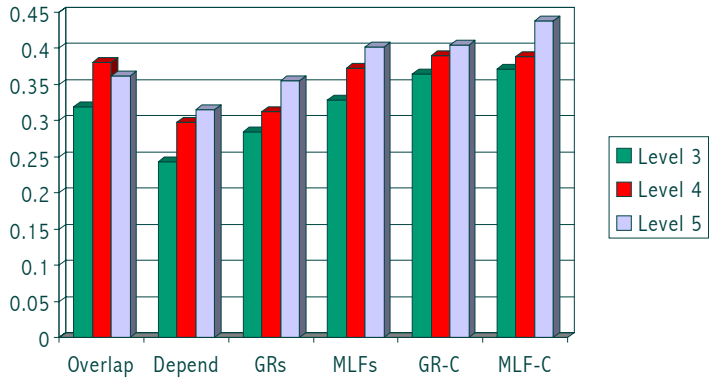
```
<Q2>
  <Q>What does the Sears ad offer?</Q>
  <ANS1 score="1" score_justification="[compound_noun(v_x2,v_x3)]" correct="no">1989
   Remedia Publications, Comprehension/5W<92>s-4</ANS1>
  <ANS2 score="1" score_justification="[compound_noun(v_x2,v_x3)]" correct="no">(North
   Redwood, Minn</ANS2>
  <ANS3 score="1" score_justification="[object(ad,v_o7,[v_x7])]" correct="no">Not long ago, he
   ran an ad in some newspapers In small towns</ANS3>
  <ANS4 score="1" score_justification="[object(ad,v_o2,[v_x2])]" correct="no">The ad showed a
   drawing of lovely furniture</ANS4>
  <ANS5 score="1" score_justification="[object(ad,v_o2,[v_x2])]" correct="yes">The ad said the
   furniture was for sale</ANS5>
</Q2>
```

Combination of Methodologies

```
def combo_overlap(q_data,s_data):
    "Combination of overlap scores"
    v_overlap = overlap(q_data[0],s_data[0])[0]
    v_dep_overlap = dep_overlap(q_data[1],s_data[1])[0]
    v_mlf_overlap = mlf_overlap(q_data[2],s_data[2])[0]
    v_gr_overlap = gramrel_overlap(q_data[3],s_data[3])[0]
    return v_overlap + v_dep_overlap*3 + v_mlf_overlap*9 + v_gr_overlap*27,''

def combo2_overlap(q_data,s_data):
    "Combination of overlap scores"
    v_overlap = overlap(q_data[0],s_data[0])[0]
    v_dep_overlap = dep_overlap(q_data[1],s_data[1])[0]
    v_mlf_overlap = mlf_overlap(q_data[2],s_data[2])[0]
    v_gr_overlap = gramrel_overlap(q_data[3],s_data[3])[0]
    return v_overlap + v_dep_overlap*3 + v_gr_overlap*9 + v_mlf_overlap*27,''
```


With Combined Methods

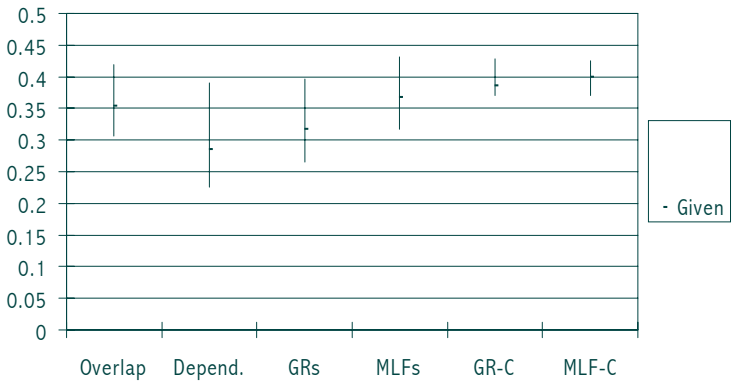


Detecting Best and Worst Cases

- The overlap scores in the gramrels and MLFs are very low
- The right answer is competing with other sentences

```
<Q2>
  <Q>What does the Sears ad offer?</Q>
  <ANS1 score="1" score_justification="[compound_noun(v_x2,v_x3)]" correct="no">1989
  Remedia Publications, Comprehension/5W<92>s-4</ANS1>
  <ANS2 score="1" score_justification="[compound_noun(v_x2,v_x3)]" correct="no">(North
  Redwood, Minn</ANS2>
  <ANS3 score="1" score_justification="[object(ad,v_o7,[v_x7])]" correct="no">Not long ago, he
  ran an ad in some newspapers In small towns</ANS3>
  <ANS4 score="1" score_justification="[object(ad,v_o2,[v_x2])]" correct="no">The ad showed a
  drawing of lovely furniture</ANS4>
  <ANS5 score="1" score_justification="[object(ad,v_o2,[v_x2])]" correct="yes">The ad said the
  furniture was for sale</ANS5>
 </Q2>
```


New Results (average of all levels)



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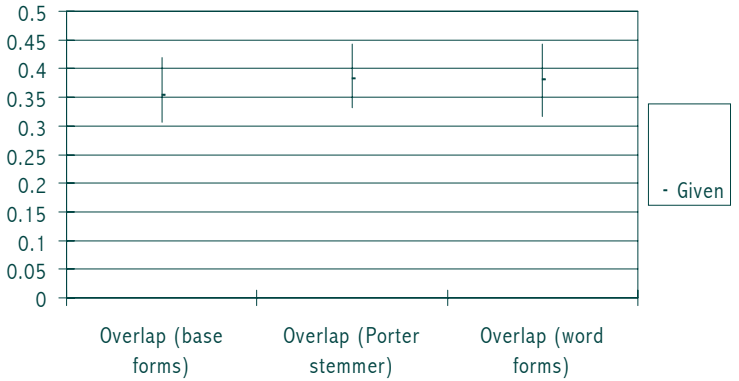
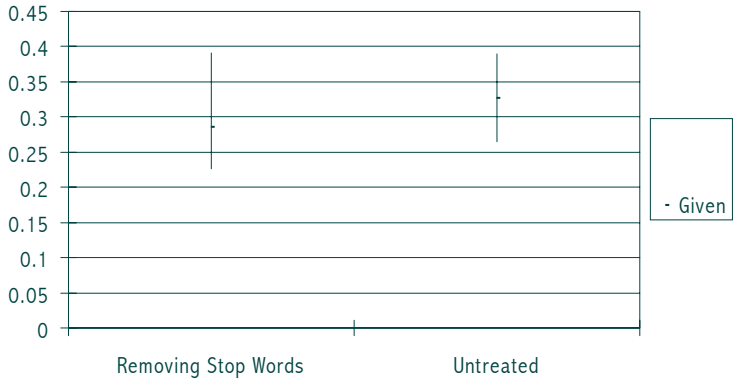
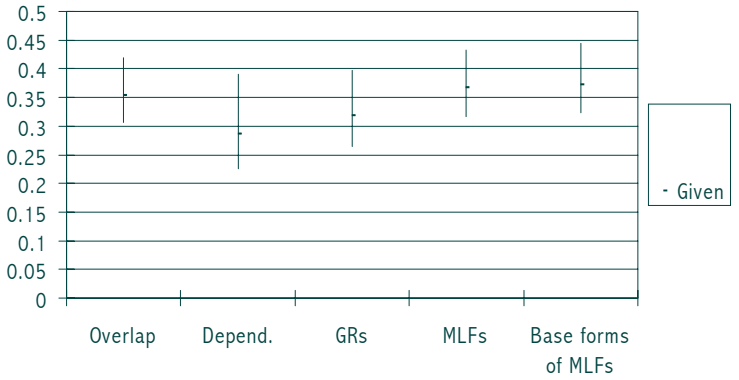
The Effect of Stemming



Stop Words or No Stop Words in the Dependencies?



What is the impact of the semantic dependences?



Why the negative impact of the semantic dependencies??

- Differences of scoring between the MLF and the MLF-base overlaps
  - *Q: When did Sears play this joke?*
    prop('when',v_p1,[v_e4]), evt('play',v_e4,[v_x3,v_x6]),
    object('sear',v_o3,[v_x3]), object('joke',v_o6,[v_x6])
    A: Watch Out for Sears
    evt('watch_out',v_e1,[v_X1]), evt('sear',v_e4,[v_X1])
    MLF overlap: []
    MLF base overlap: sear
- MLFs scored down wrongly: 5 + 9 +
- MLFs scored down rightly: 0 + 2 +

Why the negative impact of the semantic dependencies??

- *Q: Who had a dream to build a family park?*
  object('who',v_o1,[v_x1]), evt('have',v_e2,[v_x1,v_x4]),
  object('dream',v_o4,[v_x4]), evt('build',v_e6,[v_x4,v_x9]),
  object('family',v_o8,[v_x8]), object('park',v_o9,[v_x9]), compound_noun(v_x8,v_x9)

  A: He wanted to build a place where the whole family could have fun together
  olds(v_e2), object('he',v_o1,[v_x1]), evt('want',v_e2,[v_x1,v_e4]),
  object('family',v_o10,[v_x10]), evt('build',v_e4,[v_x1,v_x6]),
  evt('have',v_e12,[v_x10,v_x13,v_x6]), object('place',v_o6,[v_x6]),
  object('fun',v_o13,[v_x13]), prop('where',v_p7,[v_e12]),
  prop('together',v_p14,[v_e12]), prop('whole',v_p9,[v_x10])

  MLF overlap: [evt(build,v_e4,[v_x1,v_x6]),object(family,v_o10,[v_x10])]
  MLF base overlap: build have family

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Discussion

- One document per question, is that good for the evaluation?
- What is the impact of errors in parsing and semantic interpretation?
- Are the questions too simple?
- Is the text too simple?