Affective Text Classification with Commonsense

Hugo Liu
Commonsense Thinking Project
Software Agents Group
MIT Media Lab
Agenda

- Affective UIs
- Existing approaches
- Affective Classification using OMCS
- Experiment: EmpathyBuddy
- Limitations / Future
User Interfaces: Social?

- Nass et. al at Stanford (1994)
  - human-human interaction
    - → Social
    - → Affective communication NATURAL
  - human-computer interaction
    - → Social (!)
    - → Affective communication NATURAL (!)
Affective UIs

- Affective Communication
  - Picard / Affective Computing
- What technologies exist for affect sensing?
  - In facial expressions (Picard)
  - Speech (Fernandez)
  - Physiology (Vyzas)
  - Text (Ortony/ Elliott/ Batliner et al/ Schank et al)
Existing Approaches to Affect Classification in Text

- Keyword Spotting
  - I had a really bad day at work.
- Statistical NLP
  - i.e. SVM, LSA, co-occurrence counting
  - corpus-driven
- Lexical Affinity
  - Lexical valence: HURT $\Rightarrow$ .25 BAD
- Handcoded models
Existential Approaches: Failures

- **Keyword Spotting**
  - I had a *really bad* day at work. **OK**
  - I got fired today. **UH-OH (no affect keywords)**

- **Statistical NLP**
  - I had a really bad day at work because I got fired and the company has been going thru many rounds of layoffs because of the recent economic downturn and I had a really bad day at work because I got fired and the company has been going thru many rounds of layoffs because of the recent economic downturn and ... **OK**
  - I had a bad day. **UH-OH (input too short)**

- **Lexical Affinity**
  - I was hurt ➔ **BAD... OK**
  - I wasn’t hurt ➔ **BAD... UH-OH**

- **Handcoded models**
  - In model... **OK**
  - Outside model... **UH-OH**
Affective Commonsense about the World

- OMCS, Cyc, TT:
  - Large-scale knowledge about the world
  - Affective commonsense
    - A lot of people are scared of ghosts.
    - Getting into a car accident can be scary
  - Question: How can we exploit affective commonsense to build a common affect model?
  - Corollary: How can we circumvent some problems of other approaches?
Emotus Ponens: A first attempt

- **A Commonsensical Approach:**
  - Emotus Ponens: A Textual Affect Sensing Engine
  - Senses broad emotional qualities of story text
    - (on the sentence-level)
    - Limited domain (??)
  - Premised on common affect model grounded in commonsense

- **Experiment: EmpathyBuddy**
  - Uses EP for automatic affective feedback in an email browser via Chernov faces
Motivation from Psychology

- Emotions Literature:
  - Emotions as part of Consciousness
    - Plato, Aristotle, Descartes, Spinoza, Hume, etc.
  - Emotions are linked to physiology
    - James-Lange, Cannon-Bard, Schacter
  - Emotions in cognition
    - Aristotle’s Rhetoric, Ortony, Minsky, Damasio
  - Emotions and Culture
    - the recognition of emotion in language depends on traditions and cultures, so people may not necessarily understand the emotions of other cultures
$64,000 Question

- Marvin Minsky
  - Commonsense a part of cognition
  - Commonsense culture dependent
- William James
  - Affective understanding is culture dependent
- $64,000 question
  - Affective interpretation of everyday situations based largely in commonsense (?)
Circumventing Failures of Existing Approaches

Keyword Spotting
- I got fired today. **UH-OH (no affect keywords)**
- Look at semantic content of text, not only affect keywords

Statistical NLP
- I had a bad day. **UH-OH (input too short)**
- Statistical methods inherently semantically weaker but commonsense knowledge can operate on the sentence-level

Lexical Affinity
- I wasn’t hurt ➔ **BAD... UH-OH**
- **Model events: NOT(HURT(ME))**

Handcoded models
- Outside model... **UH-OH**
- **OMCS, Cyc, TT, etc.: Generic CSKBs are LARGE**
Emotus Ponens: 3 Phases

1) mine “affective commonsense” out of a generic commonsense knowledge base;
2) build a “commonsense affect model” by calculating mappings of everyday situations, things, people, and places into some combination of six primitive emotion categories;
3) use this constructed commonsense emotion model to analyze and annotate sentences
Phase I – mining...

- Task: choose a generic commonsense knowledge base (Cyc, OMCS, TT)
  - Cyc (Lenat, 2000)
    - Logical formulas, 3 million assertions
    - Pros: Good coverage, unambiguous
    - Cons: Tough to map into English, not “public”
  - Open Mind Commonsense (Singh, 2002)
    - Semi-structured English sentences, \( \frac{1}{2} \) million
    - Cons: ambiguous, spotty coverage
    - Pros: distributed teaching, already in English, “public”
Phase I – mining...

- From OMCS, extract emotion subset
  - Heuristic bag of words
- Define emotion bag of words as “emotion ground”
- Emotion grounds connect CONCEPTS ↔ with EMOTIONS
- Emotion grounds for canonical emotion in our system. So.. What’s canonical??
Six “Basic” Emotions

- surprise, happiness, fear, anger, disgust, and sadness
  - proposed by Ekman (1984) from research on universal facial expressions

- Why use these?
  - A good starting point
  - Easier to discern emotion-ground keywords
  - What else is out there?
### Proposals for Basic Emotions
(see Ortony, What’s Basic About Emotions?)

- **Arnold**
  - Anger, aversion, courage, dejection, desire, despair, fear, hate, hope, love, sadness
  - Relation to action tendencies
- **Ekman, Friesen, and Ellsworth**
  - Anger, disgust, fear, joy, sadness, surprise
  - Universal facial expressions
- **Frijda**
  - Desire, happiness, interest, surprise, wonder, sorrow
  - Forms of action readiness
- **Gray**
  - Rage and terror, anxiety, joy
  - Hardwired
- **Izard**
  - Anger, contempt, disgust, distress, fear, guilt, interest, joy, shame, surprise
  - Hardwired
- **James**
  - Fear, grief, love, rage
  - Bodily involvement
- **McDougall**
  - Anger, disgust, elation, fear, subjection, tender-emotion, wonder
  - Relation to instincts
- **Mowrer**
  - Pain, pleasure
  - Unlearned emotional states
- **Oatley and Johnson-Laird**
  - Anger, disgust, anxiety, happiness, sadness
  - Do not require propositional content
- **Panksepp**
  - Expectancy, fear, rage, panic
  - Hardwired
- **Plutchik**
  - Acceptance, anger, anticipation, disgust, joy, fear, sadness, surprise
  - Relation to adaptive biological processes
- **Tomkins**
  - Anger, interest, contempt, disgust, distress, fear, joy, shame, surprise
  - Density of neural firing
- **Watson**
  - Fear, love, rage
  - Hardwired
- **Weiner and Graham**
  - Happiness, sadness
  - Attribution independent

(This table is taken from Ortony and Turner, 1990.)
Phase II – training commonsense emotion models

- Models to encapsulate emotion links
  - CONCEPT $\leftrightarrow$ CONCEPT $\leftrightarrow$ EMOTION
- Used to evaluate text
  - TEXT $\rightarrow$ models $\rightarrow$ EMOTION
- Models statistically trained from commonsense corpus (OMCS)
- Need a diversity of models for robustness
A Society of Models

- Subject-Verb-Object-Object Model (best accuracy)
- Conceptual Unigrams (fall-back 1)
- Conceptual Valence “+/-” (fall-back 2)
- Modifier Unigrams (fall-back 3)
Phase II – Training by Propagation

- Propagate emotional valence
  - from “emotion grounds”
  - to concepts (event, noun phrase, modifier)
  - through commonsense relations

- Propagation simulates undirected inference
  - Extremely Naïve Example:
    - “Tragedy is saddening”, “Hamlet is a tragedy”
    - Sad [0,1,0,0,0,0] $\rightarrow$ Tragedy [0,0.5,0,0,0,0] $\rightarrow$ Hamlet [0,0.25,0,0,0,0]
Architecture I: Model Trainer

Linguistic Processing Suite:
- Ontology-based Parsing
- POS tagging,
- phrase chunking,
- constituent parsing,
- SVOO identification,
- Semantic Class Generalizer

Emotional Commonsense Filter & Grounder

Propagation Trainer (run twice)

Models:
- SVOO
- Concept Unigram
- Concept Valence
- Modifier Unigram

Emotion Ground Keywords

updated models
Phase III – using models

- Task: choose a basic story unit
  - Independent-clause level
    - Because: functions as sentence, most basic unit that can describe an event

- Model-driven analysis
  - For each sentence, each model return a score that looks like:
    - [a happy, b sad, c anger, d fear, e disgust, f surprise]
  - Scores are weighted (based on model precision) and combined with a scoring function

Continued→

Hugo Liu -- CSR for Interactive Applications -- 2002.09.26

10/23/2002
Phase III – using models

- Inter-sentence smoothing
  - Techniques (Pattern Recognition):
    - Decay:
      - ANGER NEUTRAL NEUTRAL
      - ANGER ANGER50% NEUTRAL
    - Interpolation
      - ANGER NEUTRAL ANGER
      - ANGER ANGER60% ANGER
    - Global Mood
      - Global mood: sad
      - ANGER ANGER+SAD20%
  - Meta-Emotions
    - FEAR HAPPY FEAR RELIEF HAPPY
Architecture II: Text Analyzer

Text Analyzer

raw story text
sentences
(independent clauses)

Segmenter

Linguistic Processing Suite:
POS tagging,
phrase chunking,
constituent parsing,
SVOO identification,
Semantic Class Generalizer

Story Interpreter

parsed & processed
sentences

Meta-
emotion
Patterns

Trained
Models

Expressor

(re-annotated
sentences)

Smoother

re-annotated
sentences

10/23/2002

Hugo Liu -- CSR for Interactive Applications -- 2002.09.26
Application: EmpathyBuddy

- Affect sensing engine incorporated into an experimental application
- EmpathyBuddy
  - Chernov avatar
  - Interactive
  - Affective Response
User Testing

- 20 person study
- Performed 9/16-9/18
- Three interfaces given in random order
- 5 ? Questionnaire
- Implicit counting

Performance Measurement

<table>
<thead>
<tr>
<th>Questionnaire Item</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>The program was entertaining</td>
<td>4.1-</td>
</tr>
<tr>
<td>The program was interactive</td>
<td>4.6-</td>
</tr>
<tr>
<td>The program behaved intelligently</td>
<td>5.2-</td>
</tr>
<tr>
<td>Overall I was pleased with the program and would use it to write emails</td>
<td>5-</td>
</tr>
</tbody>
</table>

The program was entertaining
The program was interactive
The program behaved intelligently
Overall I was pleased with the program and would use it to write emails.

Score
- Neutral face
- Alternating, Randomized faces
- EmpathyBuddy
Next Steps

- Other applications:
  - Affective TTS, context-sensitive agents, gaming

- Open Questions:
  - Extensibility (away from everyday events)
    - How much more reasoning do we need (?)
  - Can we do sub-sentential annotations (?)
  - Dynamic feedback to correct mistakes (?)
  - Which models can benefit from external corpora?
Limitations of Approach

- Using keywords for emotion grounds (limited to OMCS)
- Extensibility of Knowledge
- Cannot capture user-dependent affect models
- No context for processing
  - Sarcasm
Feedback
(Make your own slide)
Info / Pointers

- E15-320D x3-5334
- hugo@media.mit.edu
- http://web.media.mit.edu/~hugo