A Commonsense Approach to Emotionally Responsive Storytelling UIs

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Agenda

- Overview
- Motivation from psychology
- Approach to automatic emotion sensing from story text
- Application: EmpathyBuddy
- Next steps / Brainstorming Session
Overview

- **Premise:** People tell stories with computers
  - email, webpages, weblogs, IMs, etc.
  - by stories, we mean *everyday stories*
- **Problem:** Storytelling UIs lack social aspects
  - no feedback
  - no emotional acknowledgement, understanding, empathy
- **Challenge:** How can we transform **static** storytelling UIs into **interactive, emotionally responsive** UIs?
Overview

- **Meeting the Challenge:**
  - Emotus Ponens: A Textual Emotion Sensing Engine
  - Senses broad emotional qualities of story text (on the sentence-level)
  - Premised on commonality of human emotional response to everyday situations

- **POC Application: EmpathyBuddy**
  - Uses EP for an emotionally responsive storytelling UI (email client)
Motivation from Psychology

- Emotions Literature:
  - Emotions as part of Consciousness
    - Plato, Aristotle, Descartes, Spinoza, Hume, etc.
  - Physiology of Emotions
    - James-Lange Theory (emotions after body changes)
    - Cannon-Bard Theory (emotions during body changes)
    - Schacter’s Two-Factor Theory
      - Physiological arousal (intensity) + Cognitive label (quality)
      = Emotion.
Motivation from Psychology

- Sartre’s Phenomenological Theory
  - Examines emotions as experience
  - Two crucial points:
    - Emotions are always about something, which is often a situation, object, or person in the world.
      - everyday situations trigger and sustain emotions
    - Rather than being first perceived as a state of consciousness, "Emotional consciousness is, at first, consciousness of the world".
      - emotional response is somewhat natural and automatic
      - influenced only by pre-conscious biases: COMMONSENSE ABOUT THE WORLD!
Motivation from Psychology

- **Hypothesis:** There is (much) commonality in human emotional response to everyday situations.
  - Emotional response biased by commonsense
  - Commonsense shared across a culture/population

- **Or! An appeal to intuition:**
  - Commonality in our emotional attitudes toward everyday situations enables a person to feel empathy for another person’s situation.
  - Without it, social communication would be very hard!
Approach

- How can we leverage commonality of human emotions to sense broad emotional overtones of text?
- Common emotional attitudes are a part of commonsense knowledge
- Use emotional commonsense to reason about story text and “sense” emotions.
Approach

- So, let’s use a large-scale generic knowledge base of commonsense.

- Caveat: will only be able to sense emotions in stories about everyday life and the everyday world.
  - Generalizing to arbitrary stories i.e. fictional worlds would require very good analogy-based reasoning.
Approach - Phases

1) mine “emotional commonsense” out of a generic commonsense knowledge base;

2) build a “commonsense emotion 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 emotionally annotate story text (emotion sensing engine)
Phase I – mining...

- Task: choose a generic commonsense knowledge base.
  - 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, ½ 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 \(\leftrightarrow\) 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 facial expressions

- Why use these?
  - Like the RGB of emotions!
  - A good starting point
## What’s Basic?

- **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 ↔ CONCEPT ↔ EMOTION

- Used to evaluate text
  - TEXT → models → EMOTION

- Models statistically trained from commonsense corpus (OMCS)

- Need a diversity of models for robustness
  - 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] → Tragedy [0,0.5,0,0,0,0] → 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
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→
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)
  - sentences
  - parsed & processed sentences
  - Linguistic Processing Suite:
    - POS tagging,
    - phrase chunking,
    - constituent parsing,
    - SVOO identification,
    - Semantic Class Generalizer
  - Sampled & processed sentences
  - annotated sentences
  - re-annotated sentences
  - Smoother
  - re-annotated sentences
  - Expressor (???)
  - Meta-sentiment Patterns
  - Trained Models
Application: EmpathyBuddy

- Emotion sensing engine incorporated into a proof-of-concept application
- EmpathyBuddy
  - Emotes in response to user’s story
  - “An empathetic ear”
Demo Time
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 1</th>
<th>Score 2</th>
<th>Score 3</th>
<th>Score 4</th>
<th>Score 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>The program was entertaining</td>
<td>4.2</td>
<td>4.6</td>
<td>5.3</td>
<td>5.8</td>
<td>6.2</td>
</tr>
<tr>
<td>The program was interactive</td>
<td>4.2</td>
<td>4.6</td>
<td>5.3</td>
<td>5.8</td>
<td>6.2</td>
</tr>
<tr>
<td>The program behaved intelligently</td>
<td>3.6</td>
<td>4.1</td>
<td>5.2</td>
<td>5.6</td>
<td>5.8</td>
</tr>
<tr>
<td>Overall I was pleased with the program and would use it to write emails.</td>
<td>3.6</td>
<td>4.1</td>
<td>5.2</td>
<td>5.6</td>
<td>5.8</td>
</tr>
</tbody>
</table>
Next Steps / Brainstorming

- Other applications:
  - Emotional prosody, context-sensitive agents, multi-user dungeons

- Open Questions:
  - Extensibility to other storytelling domains i.e. fictional worlds
    - How much more reasoning do we need (?)
  - Can we do sub-sentential annotations (?)
  - Dynamic feedback capability to correct mistakes (?)
  - Which models can benefit from external corpora?
Info / Pointers

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