Affect Detection from Text – from Affect Sciences to Computational Models

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Affect

- Mythology
- Religions
- Spiritual practices
- Placebo effect
- "New Age" theories
- Feminism/femininity
- "Positive Psychology"

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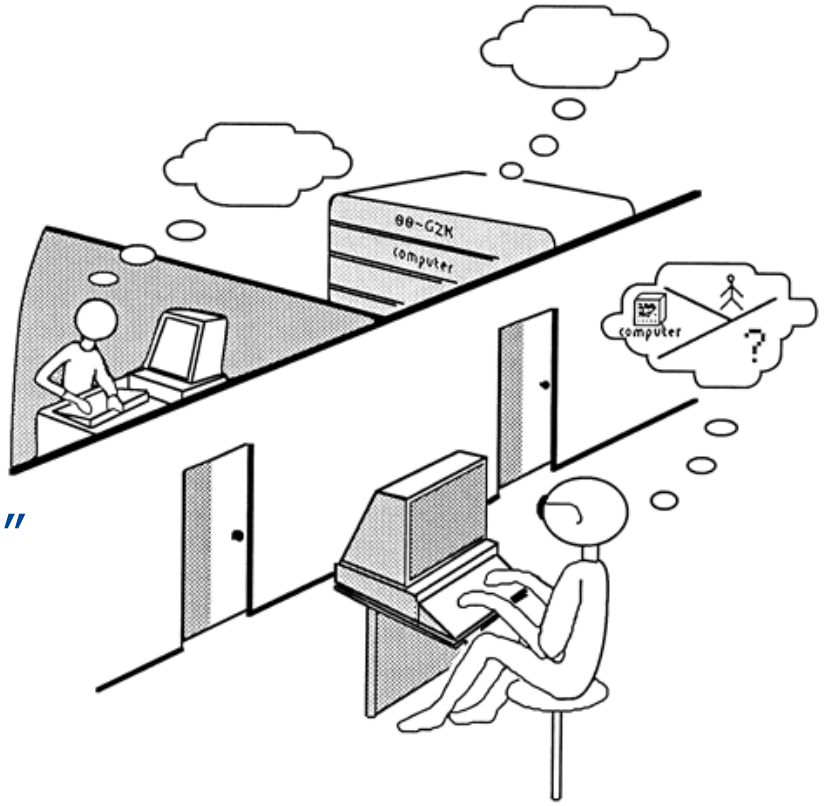
Turing Test & AI

- 1950s – Alan Turing

-> 1956 - Birth of AI

- 1637 – René Descartes
  - Machines that can "utter words", "reply"
- 1937 – Alfred Ayer
  - "conscious" vs. "unconscious"



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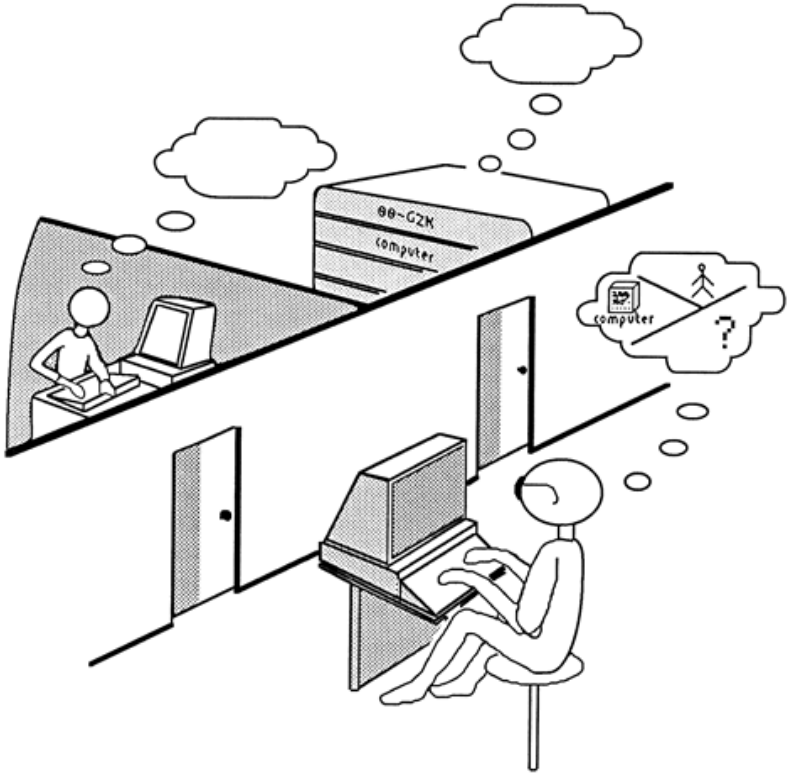
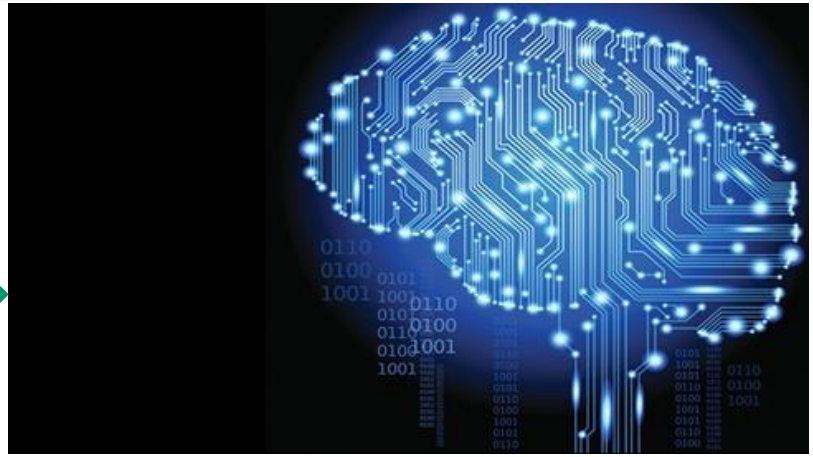
Turing Test & AI





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================================================================================
          EEEEEEEE  L         IIIIIII  ZZZZZZZ      AAA
          E         L            I          Z      A   A
          E         L            I         Z      A     A
          EEEEE     L            I        Z       A     A
          E         L            I       Z        AAAAAAA
          E         L            I      Z         A     A
          EEEEEEEE  LLLLLLLL  IIIIIII  ZZZZZZ     A     A

================================================================================
ELIZA > (PLEASE TYPE IN ALL CAPS) WHAT'S YOUR NAME DEAR ?
AMIT
ELIZA > HI, I'M ELIZA. WHAT DO YOU WANT TO TALK ABOUT ?
AMIT > CAN I TALK ABOUT MY PROBLEM ?
ELIZA > SURE... !
AMIT > DUE TO ON GOING EXAMS IN COLLEGE, I HAVE A LOT OF STRESS.
ELIZA > PLEASE RELAX A LITTLE. SLEEP WELL.
AMIT > THANKS FOR YOUR ADVICE.
ELIZA > NO MENTION.
AMIT > BYE
ELIZA > BYE AND KEEP IN TOUCH...

================================================================================
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Joseph Weizenbaum
1954, MIT

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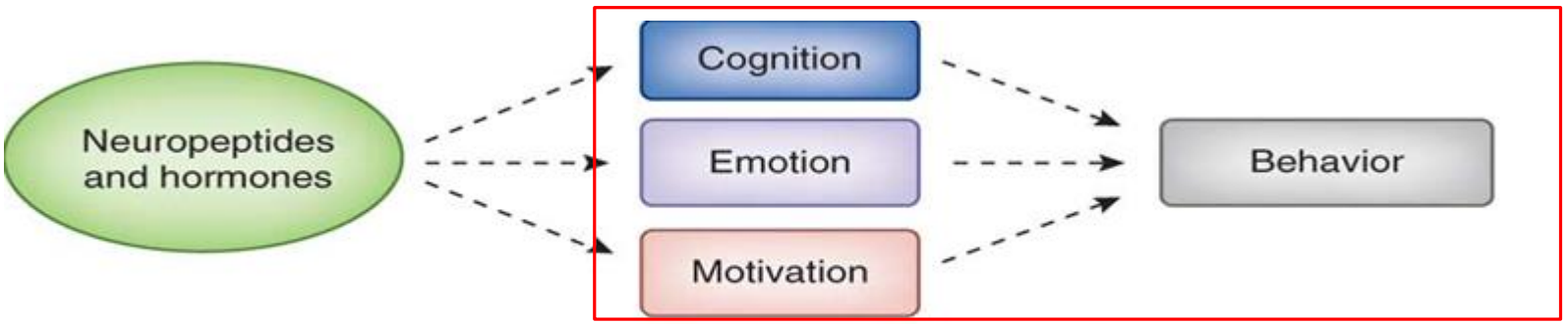
Overview

- Emotion and other "related" concepts
- Emotion and cognition
  - IQ and emotional "intelligence"
- Affect theories in Psychology
  - main theories on emotion, main models of emotion
- Affect theories in Cognitive Science
- Theories on affect in Neurosciences
- Affective Computing and AI
  - Emotion detection methods
  - Applications – virtual worlds, Robotics, …
- Affect detection and classification in NLP
  - Subjectivity analysis
  - Sentiment analysis
  - Emotion detection
  - Open competitions and state of the art results
  - Applications



From Cade McCall & Tania Singer - "The animal and human neuroendocrinology of social cognition, motivation and behavior" - Nature Neuroscience 15, 681–688 (2012)
http://www.ncbi.nlm.nih.gov/pubmed/22504348

Affect, emotion, related concepts (I)

- ***Affect***

  - "a superordinate concept that subsums particular valenced conditions such as emotions, moods, feelings and preferences" (Ortony et al., 2005)

  - one of the four components whose interaction make the human organism "function effectively in the world" (Ortony et al., 2005), along with **motivation**, **cognition** and **behaviour**.

Affect, emotion, related concepts (II)

- ***Emotion***

  - complex phenomenon, on which no definition that is generally accepted has been given;

  - "An episode of interrelated, synchronized changes in the states of all or most of the five organismic subsystems (Information processing, Support, Executive, Action, Monitor) in response to the evaluation of an external or internal stimulus event as relevant to major concerns of the organism". (Scherer, 1987; Scherer, 2001).

Affect, emotion, related concepts (III)

- ***Feeling***
  - "The conscious subjective experience of emotion." (Van den Bos, 2006)
  - "(…) points to a single component of emotion, denoting the subjective experience process, and is therefore only a small part of an emotion" (Scherer, 2005)

Affect, emotion, related concepts (IV)

- ***Sentiment***
  - "suggests a **settled opinion** reflective of one's **feelings.**"

Affect, emotion, related concepts (V)

- ***Opinion***
  - implies a conclusion thought out yet open to dispute; it is:
  - A): a view, judgment, or appraisal formed in the mind about a particular matter; B): approval, esteem;
  - A): a belief stronger than impression and less strong than positive knowledge; B): a generally held view;
  - A): a formal expression of judgment or advice by an expert; B): the formal expression (as by a judge, court, or referee) of the legal reasons and principles upon which a legal decision is based.

Affect, emotion, related concepts (VI)

- ***View***
  - suggests a subjective opinion.
- ***Belief***
  - implies often deliberate acceptance and intellectual assent.
- ***Conviction***
  - applies to a firmly and seriously held belief.
- ***Persuasion***
  - suggests a belief grounded on assurance (as by evidence) of its truth.

Affect, emotion, related concepts (VII)

- ***Attitude***
  - "hypothetical construct that represents an individual's degree of like or dislike for something." (Breckler and Wiggins, 1992)
  - generally positive or negative views of a person, place, thing, or event— this is often referred to as the attitude object.
  - Attitudes are judgments.

Affect, emotion, related concepts (VII)

- ***Attitude***
  - develops on the **ABC** model (affect, behavior, and cognition).
    - The *affective* response is an emotional response that expresses an individual's degree of preference for an entity.
    - The *behavioral* intention is a verbal indication or typical behavioral tendency of an individual.
    - The *cognitive* response is a cognitive evaluation of the entity that constitutes an individual's beliefs about the object.
  - result of either direct experience or observational learning from the environment

Emotion and cognition (I)

- Often seen separately (Zajonc, 1980)
- Now good evidence that emotion is an integral attribute of cognition (Adolphs and Damasio, 2001)
- Emotion modulates information processing – from memory to reasoning to decision making
- Emotion considered also "cognitive" – since it is a computation over representations of the organism's body states
  - Confirmed by studies in neuropshysiology, neuropsychology
- Affective representations map the relationship between current/future body states and past/baseline states
  - With respect to how such changes affect the organism's survival and well-being

Emotion and cognition (II)

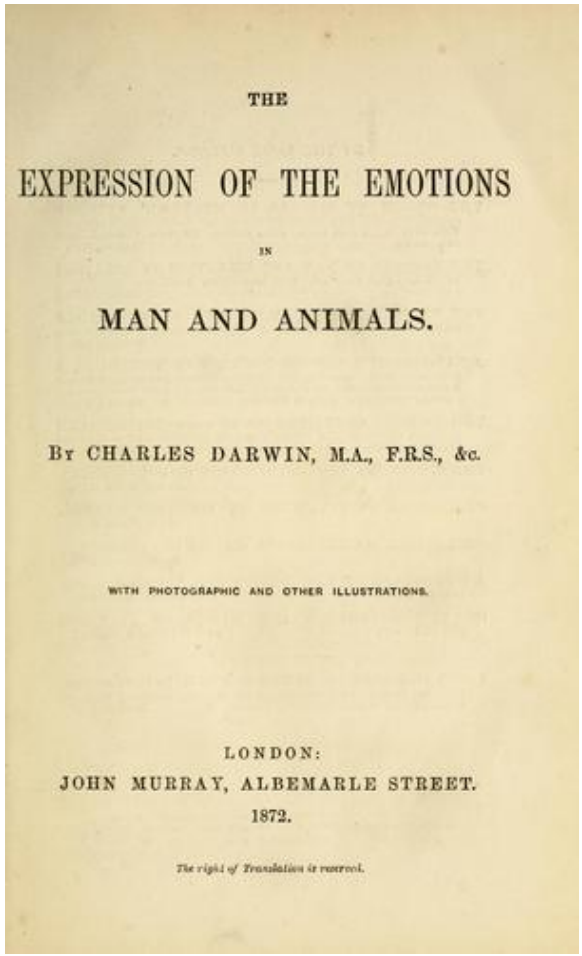
- "Anger towards another individual" example:
  - Multiple neural mappings
    - Comprehensive representation of external stimulus
    - The body's own state
    - Relationship between the two
  - Unfolding in parallel in time
  - Some based on declarative knowledge and reasoning
  - Several different sets of emotional responses are triggered by stimulus, resulting in dynamic change in:
    - Somatosensory state of body
    - Somatovisceral function
    - Endocrine and neuroendocrine function
    - Autonomic tone
    - Global brain functioning

Maximize successful behavior

Affect theories in Psychology (I)

Charles Darwin

- *evolution of emotions – species (animals, humans)*
- defended the argument that emotion expressions are evolved and adaptive (at least at some point in the past) and serve an important communicative function (Hess and Thibault, 2009)
- Why emotions are expressed the way they are:
  - principle of serviceable habits
  - principle of antithesis
  - principle of the direct action of the excited nervous system on the body


THE

EXPRESSION OF THE EMOTIONS

IN

MAN AND ANIMALS.

By CHARLES DARWIN, M.A., F.R.S., &c.

WITH PHOTOGRAPHIC AND OTHER ILLUSTRATIONS.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1872.

Affect theories in Psychology (II)

James–Lange Theory (William James, Carl Lange)

- The autonomic nervous system creates physiological events, as a response to experiences in the world, e.g.:
  - muscular tension
  - a rise in heart rate
  - perspiration
  - dryness of the mouth

- Emotions are feelings which come about as a result of these physiological changes, rather than being their cause.

Affect theories in Psychology (III)

Silvan Tomkins - "Affect Theory"

- introduced the concept of basic emotions
- based on the idea that the dominance of the emotion, which he called the *affected system* was the motivating force in human life
- organizes affects (i.e., emotions, or subjectively experienced feelings) into discrete categories
- connects each affect with its typical response
- "biological portion of emotion" - "hard-wired, preprogrammed, genetically transmitted mechanisms that exist in each of us", which, when triggered, precipitate a "known pattern of biological events"

Affect theories in Psychology (IV)

Silvan Tomkins - "Affect Theory" (1991)

- **Positive:**
  - Enjoyment/Joy (reaction to success / impulse to share) — smiling, lips wide and out
  - Interest/Excitement (reaction to new situation / impulse to attend) — eyebrows down, eyes tracking, eyes looking, closer listening
- **Neutral:**
  - Surprise/Startle (reaction to sudden change / resets impulses)— eyebrows up, eyes blinking

Affect theories in Psychology (V)

Silvan Tomkins - "Affect Theory"

- **Negative:**
  - Anger/Rage (reaction to threat / impulse to attack) — frowning, a clenched jaw, a red face
  - Disgust (reaction to bad taste / impulse to discard) — the lower lip raised and protruded, head forward and down
  - Dissmell (reaction to bad smell / impulse to avoid - similar to distaste) — upper lip raised, head pulled back
  - Distress/Anguish (reaction to loss / impulse to mourn) — crying, rhythmic sobbing, arched eyebrows, mouth lowered
  - Fear/Terror (reaction to danger / impulse to run or hide) — a frozen stare, a pale face, coldness, sweat, erect hair
  - Shame/Humiliation (reaction to failure / impulse to review behaviour) — eyes lowered, the head down and verted, blushing

Affect theories in Psychology (VI)

Magda B. Arnold - Appraisal Theory

- Emotions are extracted from our evaluations (appraisals) of events
  - causing specific reactions in different people
- Appraisal of a situation causes an emotional, or affective, response that is going to be based on that appraisal.
- Accounts for individual variances of emotional reactions to the same event
- Two approaches:
    - Structural approach
    - Process model
  - Explaining how emotions develop:
    - Event->Thinking ->simultaneous events of Arousal and Emotion

Affect theories in Psychology (VII)

Richard Lazarus - Appraisal Theory – Structural Model

- Biopsychological components of the theory
- Cognitive aspects of emotion:
  - nature of the cognitions (or appraisals) which underlie separate emotional reactions
  - determining antecedent conditions of these cognitions
- Two major types of appraisal methods :
  - 1) primary appraisal - establishment of the significance or meaning of the event to the organism
  - 2) secondary appraisal - assessment of the ability of the organism to cope with the consequences of the event
- Critiqued for lack of coping with dynamic nature of emotions

Affect theories in Psychology (VIII)

Smith and Kirby; Marsella and Gratch - Appraisal Theory – Process Model

- How one evaluates emotional stimuli
- Three main components to the process model of appraisal:
  - Perceptual stimuli (what you pick up from surroundings)
  - Associative processing (memory-based process -> quick connections and provides appraisal information based on activated memories that are quickly associated with the given stimulus)
  - Reasoning (slower, deliberate, thorough involving logical, critical thinking about the stimulus and/or situation)

Affect theories in Psychology (IX)

Klaus Scherer - Appraisal Theory – Process Model - Multi-level Sequential Check Model

- Three levels of appraisal process + sequential constraints
  - innate (sensory-motor)
  - learned (schema-based)
  - deliberate (conceptual)
- Strict, ordered progression for appraisal processes
- Checks at all levels:
  - Relevance (novelty and relevance to goals) check
  - Implication check (cause, goal conduciveness, and urgency)
  - Coping potential check (control and power)
  - Normative significance (compatibility with one's standards)

Affect theories in Psychology (X)

Social constructivism

- Takes into account the social context in which emotions develop
- "It is important to map the properties of the specific interactions, the structure of the relationships, and the organization of the culture in which the individual engages" (Boiger & Mesquita, 2012)
- "Emotions that fit the predominant cultural goals tend to be rewarded, and are then found to become more prevalent" (Mesquita, 2003)
- "Social construction of emotion is an iterative, or even continuous, process that draws on information, events, and interactions within the actual social and cultural environment, rather than solely relying on internal representations in the head of the individual" (Boiger & Mesquita, 2012)
- Complementary to individual predispositions, not contradicting

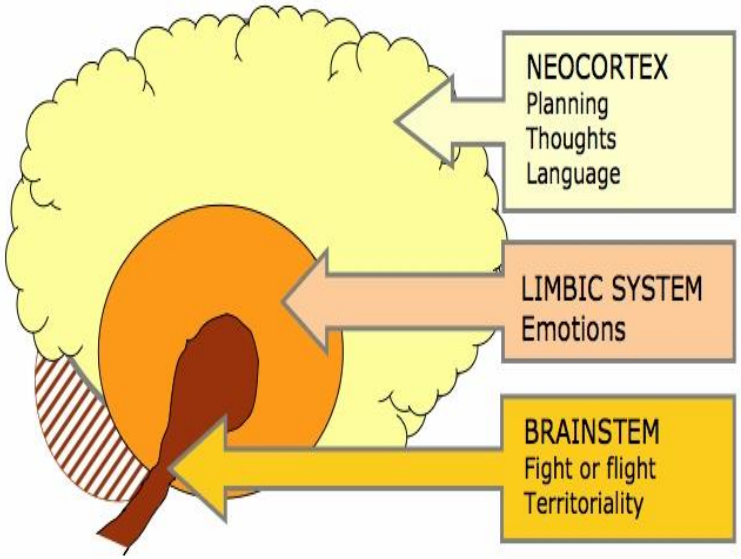
Affect theories in Neuroscience

Affective neuroscience

- The Study of the neural mechanisms of emotion – personality, emotion, mood
- Emotions related to brain activity
  - Attention
  - Behaviour
  - Significance
- Pioneering work suggested emotion is related to limbic system (amygdala, hypotallamus, etc.)
- In practice, not only limbic system of significance, but also other regions: cerebellum, pre-frontal cortex, etc.

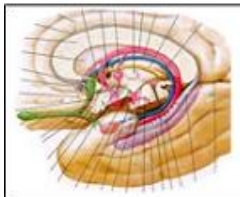
Affect theories in Neuropsychology

The Triune Brain (Paul D. MacLean) – 1950s

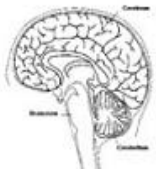


Evolution of the human Brain — Triune Model

The R-Complex (Reptile): Evolved during the Triassic Period 248-206 million years ago. Regulates: hunger, temperature control, fight-or-flight response. Shared with reptiles such as fish.



The Limbic System: Evolved during the Jurassic Period 206-144 million years ago. Regulates: mood, memory, and hormone control. Shared with the older mammals such as dogs, cats and mice.



The Neocortex: Evolved during the Eocene & Oligocene Epochs 55-24 million years ago. Regulates: logic and thought required for complex social situations etc. Shared with monkeys and chimpanzees.

IQ and emotional intelligence (EQ)

Daniel Goleman – Emotional Intelligence (1995) – pp. 43

EQ describes an ability, capacity, or skill to perceive, assess, and manage the emotions of one's self and others.

- *Knowing one's emotions*
  - self-awareness – recognizing a feeling as it happens, monitor
- *Managing emotions*
  - handling feelings, being able to correctly assign them to the cause, soothe oneself
- *Motivating oneself*
  - marshaling emotions in the service of a goal, emotional self control, delaying gratification, stifling impulsiveness
- *Recognizing emotions in others (empathy)*
- *Handling relationships*
  - Managing emotions in others – leadership, popularity

Gender and emotion

1) "Gender and Emotion: An Interdisciplinary Perspective" (2013)-
Editors Ioana Latu, Marianne Schmid Mast, Susanne Kaiser
2) http://www.ncbi.nlm.nih.gov/pubmed/22504348

- Women express more emotion than men.
- Do they also experience more emotion than men?
- Are emotions represented differently in men and women's brains?
- What are the origins of gender differences in emotions – are we born different or is it socialization that renders us different?
- What are the implications of gender differences in emotion for general well-being?
- What are the most appropriate methodologies for the empirical study of gender differences in emotional experiences?

Culture and emotion

Individualistic versus collectivistic cultures

- Individualistic cultures
  - Emotions are "encouraged", being a manner of self-expression
  - Emotion expression and "owning" emotions
- Collectivistic cultures
  - Emotions stem from the outside (?)
  - Low self-disclosure
  - Suppression of emotion for fear of community harmony loss
    - Emotion rackets (learned feelings; transformed feelings) – Transactional Analysis
- Certain emotions are encouraged and others discouraged depending on culture

Language and emotion

- Certain languages put more emphasis on some emotions
  - Many more words to express the "same" emotion
  - No equivalence to emotions expressed in certain languages (saudade (PT), dor (RO), Schadenfreude (DE), etc.)

- The manner in which emotions are expressed in language conditions the way in which they are perceived

- Identifying and labeling through language the emotion felt can help to relieve it

- Can emotions be translated?
  - Studies on the translation of the Bible

Personality and emotion (I)

Personality

- *"coherent patterning of affect, behavior, cognition and goals (desires) over time and space" (Revelle and Scherer, 2008)*
- Different models of personality proposed, across 3-5 dimensions:
  - Giant Three (Eyseneck and Eyseneck, 1985)
  - Big Five (Digman, 1990)
  - 4 dimensions - Myers-Briggs (based on Carl Jung's archetypes)
- Two of these dimensions associated to individual differences in affective level and environmental responsivity (Ravelle, 1995)
  - Extraversion
  - Neuroticism (Emotional Stability)

Personality and emotion (II)

- *Traits:*
  - Anger
  - Anxiety
  - Positive-negative affect
- *Habitual emotion dispositions – shield against certain emotions:*
  - Extraversion
    - General positive outlook ; need for social contact, power, status
  - Neuroticism
    - General negative outlook; need for acceptance, tranquility, order, vengeance, savings
- Origins:
  - Innate/learned through learning and socialization
- Appraisal style:
  - Some personalities more prone to certain emotions, b/c differences in goals, values, coping potential

Cognitive biases

- Long list of biases:
  - https://en.wikipedia.org/wiki/List_of_cognitive_biases
  - David McRaney (2012) - "You are not so smart"

  - Anchoring bias – tendency to focus on the first piece of information we receive
  - Availability cascade bias– the more you repeat something, the more true it becomes
  - Confirmation bias - tendency to search for, interpret, focus on and remember information in a way that confirms one's preconceptions
  - Hindsight bias – "I knew it all along" – tendency to see the events that past as having been predictable
  - Gambler's fallacy - future probabilities are altered by past events, when in reality they are unchanged.

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Table of emotions

Kineaesthethic level	The 4 emotions	What's it for?	Trigger	Instinctive Reaction	Evolved action Social process	Evolved action Personal process
Comfort Pleasure	JOY	Procreation - It facilitates expressing well-being, happiness	Fulfilment Feeling of satisfaction	Desire to maintain it	The request to share	Accepting and recognising happiness Accepting the need to share – the need for others
Non-comfort	ANGER	Gives the necessary energy to act and to modify unpleasant circumstances	Physical or psychological damage Invasion of physical or psychological space	Aggressive behaviour Attack	Requesting repair Requesting change	Accepting the limits of others Forgiving
Non -comfort	FEAR	To identify a possibly harmful environment and being able to leave it	Danger	Flight Distancing oneself	Requesting protection Requesting help	Accepting our own limits Being able to separate oneself from the image of the ideal me
Non -comfort	SADNESS	Helps us to deal with separation (mourning) and to create new relations and interests	Rupture Loss	Withdrawal Retreat	Requesting comfort Need for others to be present	Accepting the human condition and its limits: Death, rupture, loss

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From MBTI – emotion overview

Models of emotion (I)

- Two types:
  - Categorical – a certain number of limited emotion "categories" are defined
  - Dimensional – organized in affective dimensions
    - Valence-pleasantness + activity-arousal (Russell)
    - Semantic differentials (Osgood)
    - Three-dimensional model based on levels of presence of hormones (Lövheim)

Models of emotion (II)

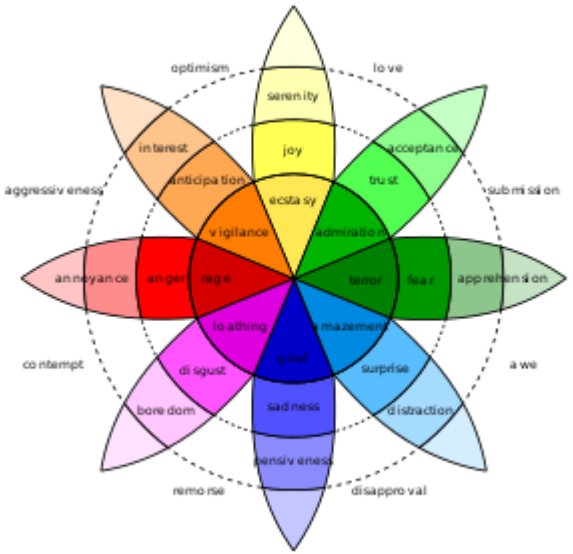
Categorical models of emotion:

Ekman (facial expressions):

- 6 basic emotions: joy, anger, fear, sadness, disgust, surprise

Plutchik's "Wheel of emotions":

- 8 basic emotions
- 8 derivative emotions, combination of basic ones



Shaver (1987)/Parrot (2001) Tree-structured list of emotions:

- 6 basic emotions (instead of disgust, love)
- Secondary and tertiary emotions

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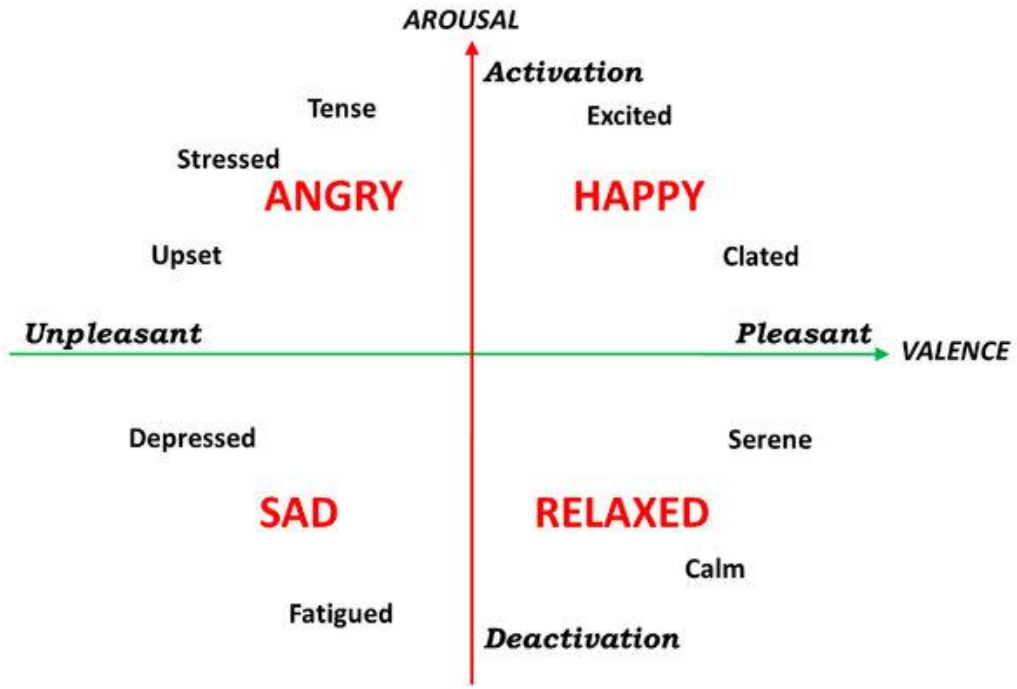
Models of emotion (III)

Primary emotion	Secondary emotion	Tertiary emotions
Love	Affection	Adoration, affection, love, fondness, liking, attraction, caring, tenderness, compassion, sentimentality
	Lust	Arousal, desire, lust, passion, infatuation
	Longing	Longing
Joy	Cheerfulness	Amusement, bliss, cheerfulness, gaiety, glee, jolliness, joviality, joy, delight, enjoyment, gladness, happiness, jubilation, elation, satisfaction, ecstasy, euphoria
	Zest	Enthusiasm, zeal, zest, excitement, thrill, exhilaration
	Contentment	Contentment, pleasure
	Pride	Pride, triumph
	Optimism	Eagerness, hope, optimism
	Enthrallment	Enthrallment, rapture
	Relief	Relief
Surprise	Surprise	Amazement, surprise, astonishment
Anger	Irritation	Aggravation, irritation, agitation, annoyance, grouchiness, grumpiness
	Exasperation	Exasperation, frustration
	Rage	Anger, rage, outrage, fury, wrath, hostility, ferocity, bitterness, hate, loathing, scorn, spite, vengefulness, dislike, resentment
	Disgust	Disgust, revulsion, contempt
	Envy	Envy, jealousy
	Torment	Torment
Sadness	Suffering	Agony, suffering, hurt, anguish
	Sadness	Depression, despair, hopelessness, gloom, glumness, sadness, unhappiness, grief, sorrow, woe, misery, melancholy
	Disappointment	Dismay, disappointment, displeasure
	Shame	Guilt, shame, regret, remorse
	Neglect	Alienation, isolation, neglect, loneliness, rejection, homesickness, defeat, dejection, insecurity, embarrassment, humiliation, insult
	Sympathy	Pity, sympathy
Fear	Horror	Alarm, shock, fear, fright, horror, terror, panic, hysteria, mortification
	Nervousness	Anxiety, nervousness, tenseness, uneasiness, apprehension, worry, distress, dread

Models of emotion (IV)

Dimensional models of emotion:

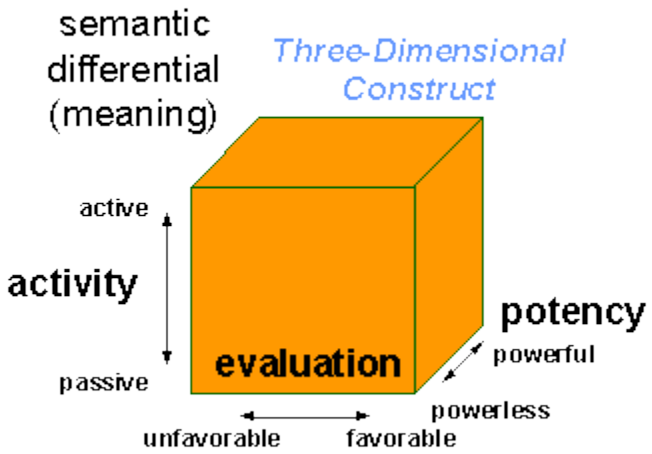
- Valence/pleasantness + activity/arousal (Russell, 1980)



Models of emotion (V)

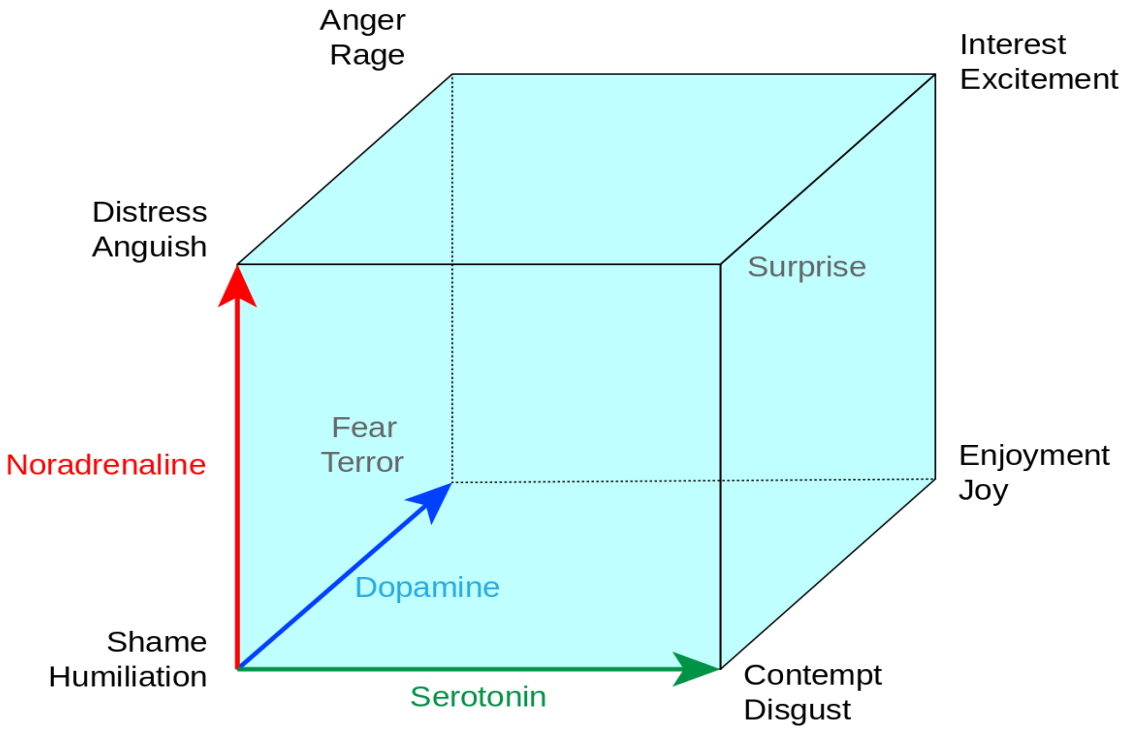
Dimensional models of emotion:

- Semantic differentials (Osgood, 1957)



Models of emotion (IV)

- Lövheim's (2001) cube of emotion based on Tomkin's 8 basic emotions ("Affect theory"):



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Affective computing

Rosalind Picard – MIT (1995)

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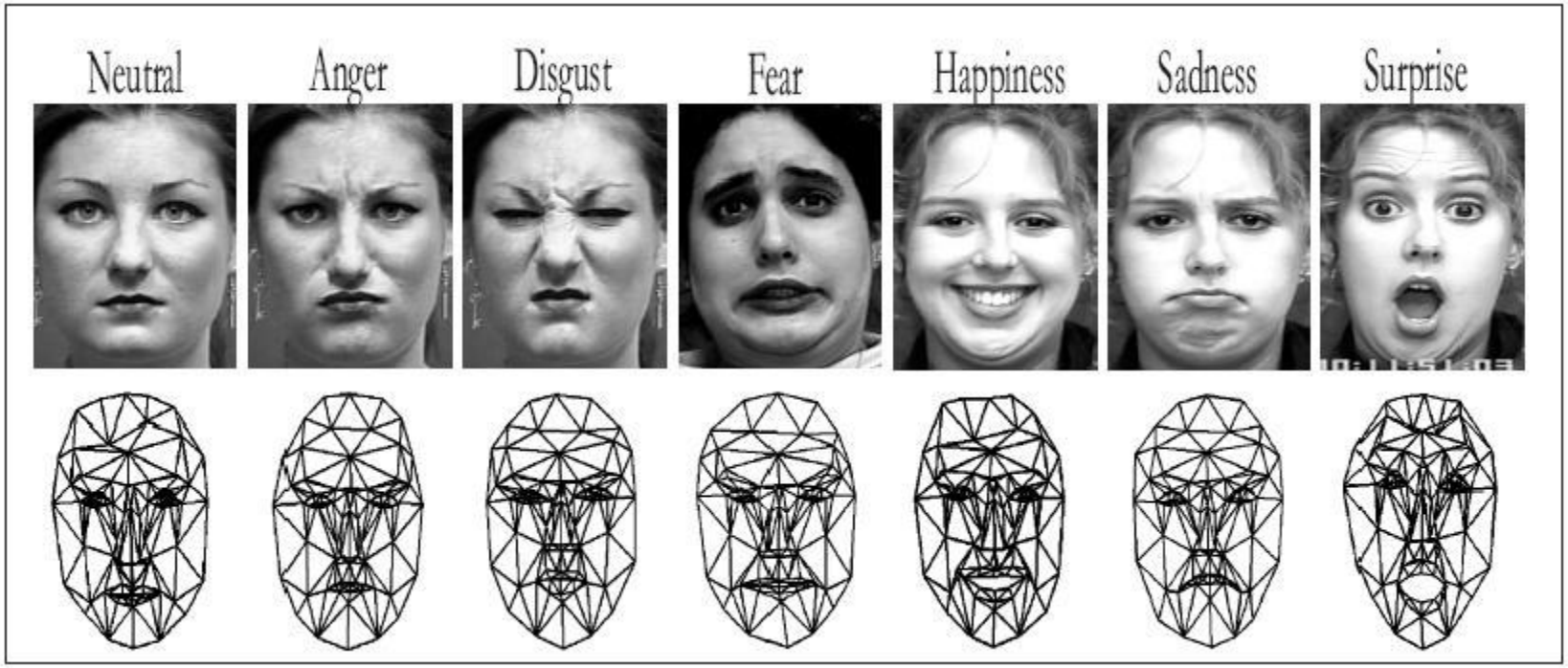
Emotion detection – Facial expression



Source: https://github.com/kylemcdonald/AppropriatingNewTechnologies/wiki/Week-2

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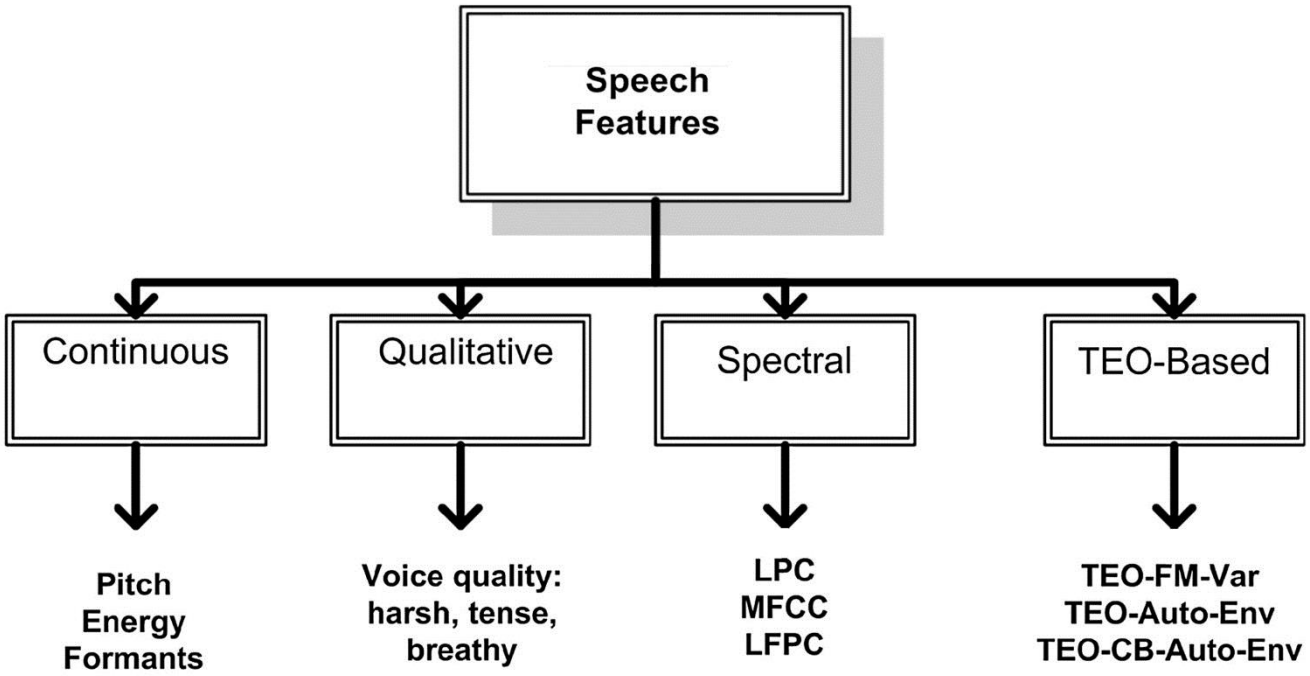
Emotion detection - Speech



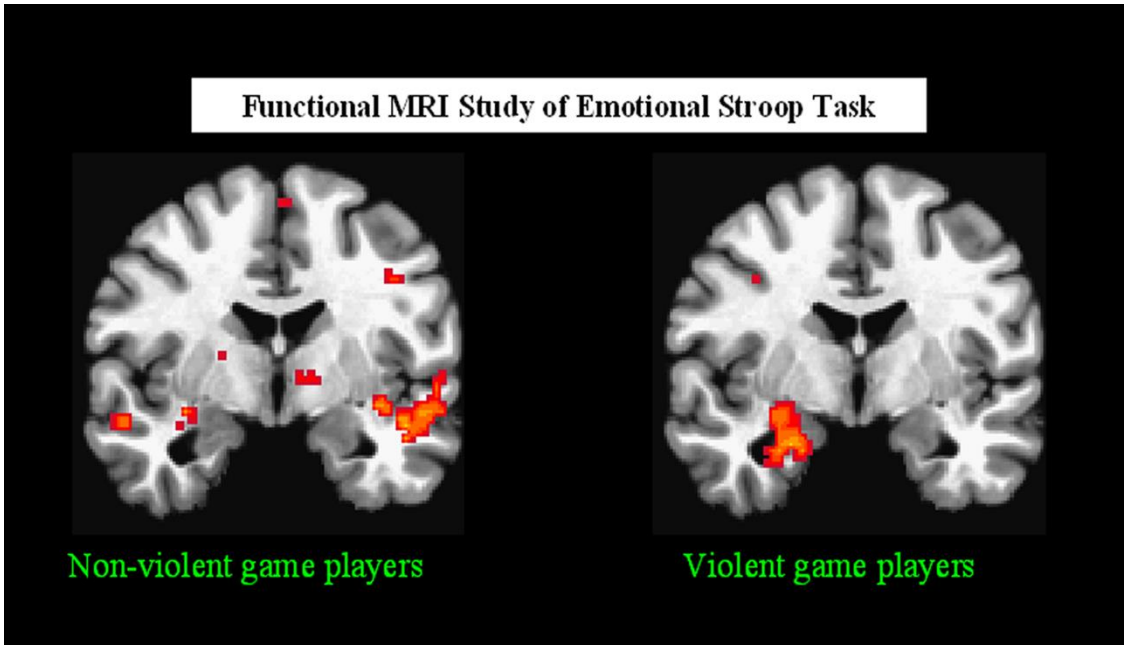
Emotion detection – Skin Conductance

- **Electrodermal activity** (EDA), **skin conductance**, **galvanic skin response** (GSR), **electrodermal response** (EDR), **psychogalvanic reflex** (PGR), **skin conductance response** (SCR), **sympathetic skin response**(SSR) and **skin conductance level** (SCL) – (Boucsein, 2012)

- Records physiological signs of stress and excitement by measuring slight electrical changes in the skin
- Q sensor (MIT)
  - Autistic children, people with affective disorders

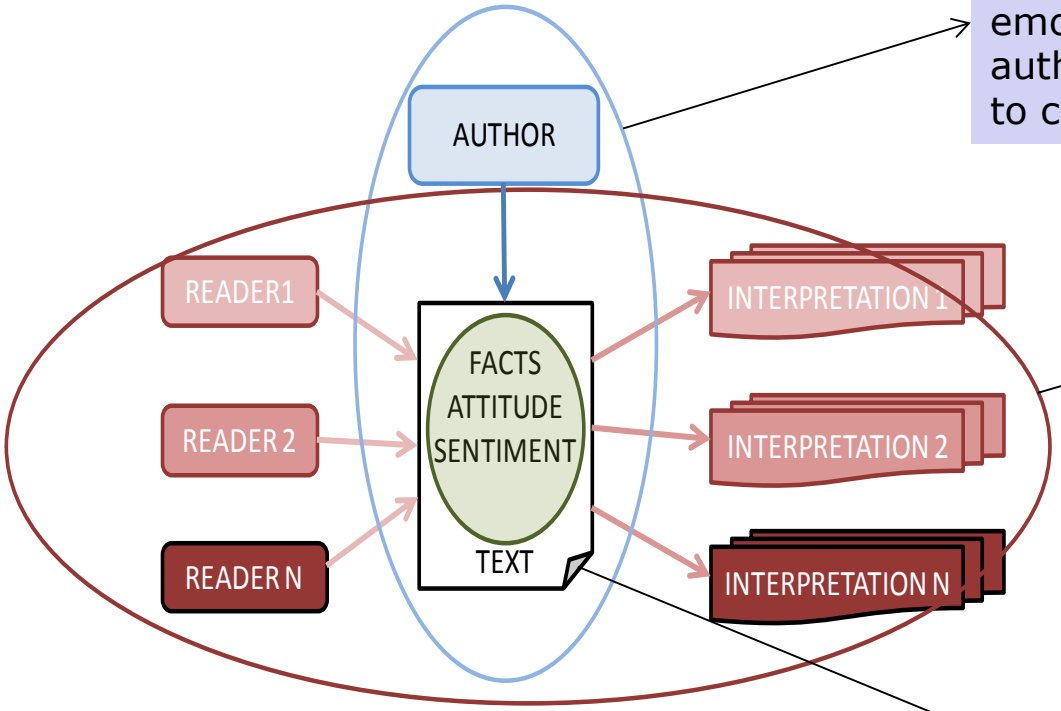
Emotion detection – fMRI Scans

- Neural Representations of Language Meaning



Affect detection from text

- The 3-component model:



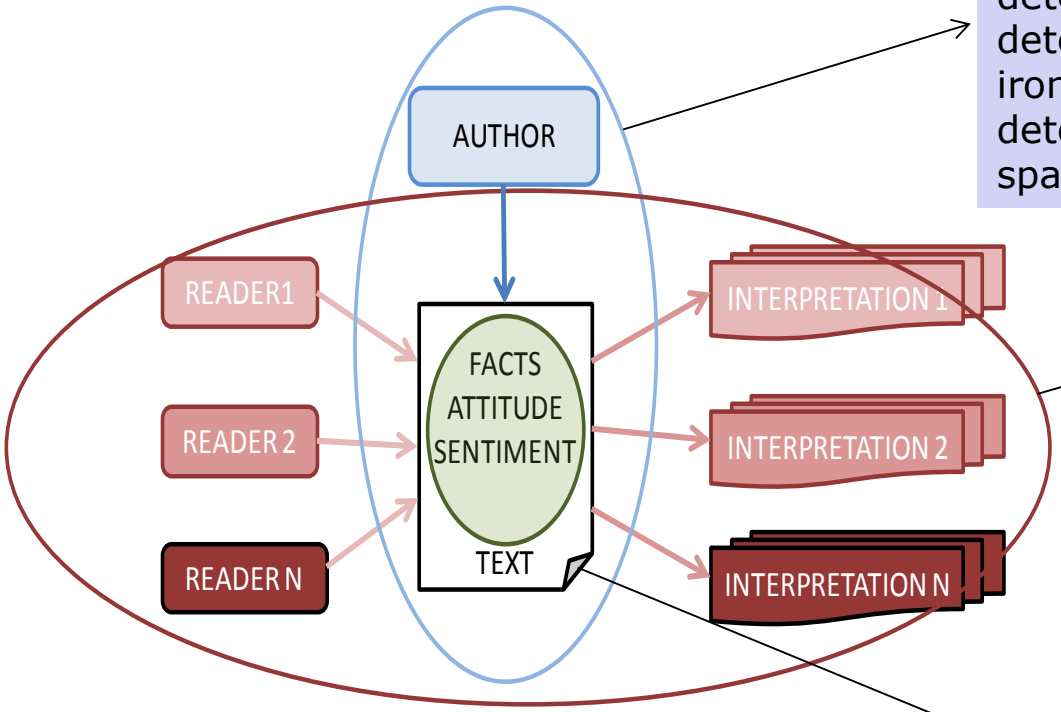
What is the emotion the author is trying to convey?

What are possible emotional responses of the readers as a result of interpreting the meaning of the text?

What emotion is directly expressed in the text?

Affect detection from text

- The 3-component model:



Bias detection, hate speech detection;humor detection, irony/sarcasm detection, opinion spam

? Recommendation, personalized content

Sentiment analysis/Opinion mining/Emotion detection & classification

Categories of emotion

Adapted from Gabrielsson (2002) – emotions in music

- Expressed emotion: emotion the performer tries to communicate to the (readers)
- Perceived emotion: emotion the reader perceives as being expressed
- Felt (evoked) emotion: emotion felt by the reader, in response to text

- And we can add: emotion directly present in the text

News bias detection

- News bias is a complex process that comprises several dimensions to be taken into account; it is interlinked with social, political and economical problems (Hamilton, 2004)

- specific choice of words and subtle structure of sentences can persuade the reader towards one point of view or another and are sufficient to influence whether people interpret violent acts as patriotism or terrorism (Dunn et al., 2012)

- the usage of various parts of speech, like adjectives, adverbs and nouns and how these properties differ (Pollak et al., 2011)

- Length of texts, headlines

Hate speech detection

- "any communication that disparages a person or a group on the basis of some characteristic such as race, color, ethnicity, gender, sexual orientation, nationality, religion, or other characteristic."(Nockleby, 2000)
- "hatred against each different group is typically characterized by the use of a small set of high frequency stereotypical words"(Warner and Hirschberg, 2012)

- Very little work done in this field
- Also difficult to formally define the task, border freedom of spech:
  - Detection using keyword frequency (Warner & Hirschberg, 2012)
  - Using word embeddings and neural networks (Djuric et al., 2015)

Computational Humor Detection

- Little work done here:
  - Some work by Mihalcea and Strapparava (2005)
  - Work by Stock and Strapparava (2003, 2005, 2006)

Sentiment Analysis – Opinion Mining

HOW DO PEOPLE REGARD "X"?

automatically extract from free text the "sentiment" expressed on a *target X* by a specific *source* and determine its "orientation" (positive, negative, etc.)

- *"I **like** the iPhone 6." (product)*
- *"The design of Apple products is **great**!" (brand)*
- *"Lincoln was a very **skilled** leader." (person)*

- Sentiment analysis in NLP
  - Late 90's, boost by Social Web - user-generated content
    - Applications – social, economical, political
  - Opinion mining, appraisal analysis, review mining, favourability analysis

General motivation

- Helps companies, customers, public persons:
  - Marketing, financial studies
  - Choice of products
  - Social media analysis
  - Political view tracking & eRulemaking
  - Election results prediction
  - Policy making
  - Trend analysis
- Improves other NLP tasks:
  - ✓ IE, QA, MPQA, summarization, authorship, WSD

Motivation of research (I)

1. Different goals of sentiment analysis:
   - Good or bad news (Ku et al., 2005);
   - Likes or dislikes (Pang et al., 2002);
   - Candidate likely/unlikely to win (Kim and Hovy, 2005);
   - Support/opposition (Bansal et al., 2008; Terveen et al., 1997) ;
   - Pros and cons (Kim and Hovy, 2006);
   - Improvement /death in medical texts (Niu et al., 2005);
   - Agreement /disagreement with a topic (Malaouf et al., 2005);
   - Arguments in favor or against a topic

Motivation of research (II)

1. Different goals of sentiment analysis:
   - Good or bad news (Ku et al., 2005);
   - Likes or dislikes (Pang et al., 2002);
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   - Improvement /death in medical texts (Niu et al., 2005);
   - Agreement /disagreement with a topic (Malaouf et al., 2005);
   - Arguments in favor or against a topic

Motivation of research (II)

2. Same methods for different text types
   - Reviews, blogs, news, debates, forums, microblogs
3. Different goals → application:
   - Percentual/text summaries
   - Answer opinion questions
   - General view of topics trends
   - Recommendation

Motivation of research (III)

4. Multilinguality
   - Resource scarcity
   - Need to detect opinion (esp. Social media) in many languages
   - Learning peculiarities of language

5. Most methods → direct sentiment expression
   - Implicit sentiment (attitude) → author emotion
   - Expressed by intentionality, meaning negotiation

Tasks and concepts definition (I) – Subjectivity & Attitude

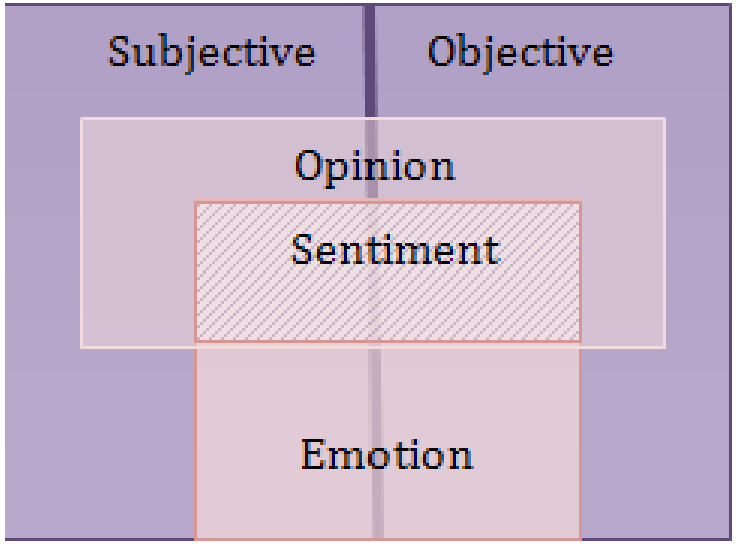
- Subjectivity – Wiebe (1995)
  - "private states" - feelings, emotions, goals, evaluations, judgments
- Subjectivity analysis
  - recognize subjective language, to distinguish it from descriptions of facts
- Attitude – AAAI 2004 Spring Symposium on Attitude
  - *"hypothetical construct that represents an individual's degree of like or dislike for something." (Breckler and Wiggins, 1992)*
  - *Attitude = {affect, judgment, appreciation}*
  - *Used for speaker/author "intentionality"*

Tasks and concepts definition (II) – Sentiment analysis & Opinion mining

- Different definitions in the literature (tasks/terms)
  - IE, IR, classification tasks
- *"Nowadays many construe the term sentiment analysis more broadly to mean the computational treatment of opinion, sentiment and subjectivity in text." (Pang and Lee, 2008)*
- **Sentiment ~ Opinion ~ Subjectivity**
  - *Sentiment analysis = Opinion mining = Subj. analysis*

Tasks and concepts definition (III) - Proposal

Sentiment ≠ Opinion ≠ Subjectivity



Opinion mining = Sentiment analysis ≠ Subjectivity analysis

State of the art

- 3 main research areas in SA:
  - Creation of resources
    - Lexical resources, annotation schemas, corpora
  - Classification of text (document, sentence, word level)
    - Lexicon-based, rule-based, supervised methods
  - Opinion extraction (opinion, plus source and target)
    - Rule-based, semi-supervised/supervised methods

Main research areas (I)

1. Creation of resources:
   - Lexical resources for subjectivity/polarity (subjectivity, orientation, strength)
   - Annotation schemes appropriate to each textual genre (news/blogs/product reviews)
   - Corpora labeling for training and evaluation
     - Some approaches use as gold standard already punctuated reviews (stars)

Methods to create lexicons for SA (I)

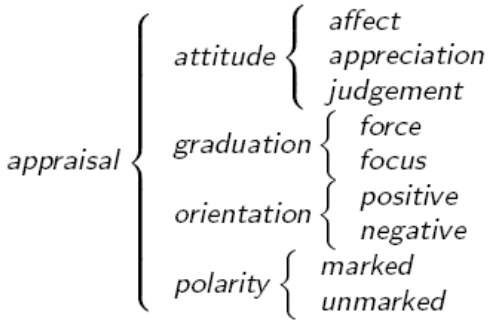
- Study by Pang et al. (2006) - choose right 10 polarity keywords of a text –> A=60%
- Seed adjectives – apply synonymy and antonymy in WN (Hu &Liu, 04)
- Seed adjectives – use conjunctions/disjunctions to deduce orientation of new words & min-cut graphs (Pang & Lee, ’02; Hatzivassiloglou & McKeown, ‘97).

Methods to create lexicons for SA (II)

- Terms with similar orientation tend to co-occur in documents (seed words + PMI using number of AltaVista returned results with NEAR)(Turney, '02)
- Terms with similar glosses in WN tend to have similar polarity (Esuli & Sebastiani, '05)
- Polarity anchors and NGD scores using training from pros/cons reviews (Balahur & Montoyo, '08)
- Use polarity of local context, a weighting function of the words around (Popescu & Etzioni, '06)

Appraisal Theory – in Linguistics

- (Martin and White, 2005) – The Appraisal theory - a framework of linguistic resources which describe how writers and speakers express inter-subjective and ideological positions.
- (Whitelaw, 2006) - 400 seed words ->1350 terms



	happy	very	"very happy"	not	"not very happy"
attitude:	affect	–	affect	–	affect
orientation:	positive	–	positive	**negate**	**negative**
force:	neutral	**increase**	**high**	**reverse**	**low**
focus:	neutral	–	neutral	–	neutral
polarity:	unmarked	–	unmarked	**marked**	**marked**

Going Multilingual

- Creating subjectivity/sentiment dictionaries for languages other than English
- Steinberger et al.(2011) – Creating Sentiment Dictionaries via Triangulation
  - Translation of an English sentiment lexicon to Spanish
  - Manual cleaning of dictionary obtained
  - Parallel translation of En and Sp lexicons to other languages
  - New lexicons = intersection of common translation
  - Good accuracy for new terms obtained

Existing resources (I)

- Opinion & affect lexicons:
  - WordNet Affect (Strapparava & Valitutti, 2004)
    - http://wndomains.fbk.eu/wnaffect.html
  - SentiWordNet(Esuli & Sebastiani, 2006; 2010)
    - http://sentiwordnet.isti.cnr.it/
  - MicroWNOp (Cerini et al., 2007; 2010)
  - Subjectivity indicators (MPQA & al.) (Cardie et.al, 2003)
  - Appraisal terms (Whitelaw, 2006)
  - NRC Twitter lexicons (Mohammad et al,
    - http://saifmohammad.com/WebPages/lexicons.html

Existing resources (II)

Manually created lexical resources:

- Dictionary of Affect (Whissell)
  - http://sail.usc.edu/dal_app.php
- Affective Norms for English Words (Bradley & Lang)
  - http://csea.phhp.ufl.edu/media.html
- Harvard General Inquirer categories (Stone etc.)
  - http://www.wjh.harvard.edu/~inquirer/
- NRC Emotion Lexicon (Mohammad & Turney)
  http://saifmohammad.com/WebPages/lexicons.html
- MaxDiff Sentiment Lexicon (Kiritchenko, Zhu, & Mohammad)
  http://saifmohammad.com/WebPages/lexicons.html

Existing resources (III)

Manually created lexical resources:

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Existing resources (IV)

- Affective Text Dataset (Strapparava & Mihalcea) – news; headlines
  - http://web.eecs.umich.edu/~mihalcea/downloads.html#affective
- Affect Dataset (Alm) – classic literary tales; sentences
  - http://people.rc.rit.edu/~coagla/
- 2012 US Presidential Elections – tweets (Mohammad et al.)
  - http://saifmohammad.com/WebDocs/ElectoralTweetsData.zip
- EmotionML (Schröder et al.)
  - http://www.w3.org/TR/emotionml/
- ISEAR (Scherer, 1997)
- MPQA (Wiebe et al., 2002)
- TAC/TREC data (2006-2008)
- NTCIR MOAT data (2007-2010)
- SemEval data:
  - Sentiment Analysis in Twitter (2013-2016)
  - Aspect-based Sentiment Analysis (2016)
  - Detecting stance in Tweets (2016)
  - Detecting sentiment intensity (2016)

Existing resources (V) – other languages

- Spanish:
  - TASS (Taller de Analisis de Sentimientos y Sujetividad) http://www.sngularmeaning.team/TASS2013/corpus.php
  - Perez-Rosas Lexicon https://web.eecs.umich.edu/~mihalcea/downloads.html#SPANISH_SENT_LEXICONS
  - iSOL (Molina-Gonzales et al., 2013)
- Dutch:
  - Framework for interpersonal communication (Vaassen & Daelemans, 2011)
  - OpeNER http://www.opener-project.eu/documentation/
- German:
  - German polarity clues: http://www.ulliwaltinger.de/sentiment/
- Chinese:
  - 2013 Chinese Microblog Sentiment Analysis Evaluation (CMSAE) Dataset of posts from Sina Weibo annotated with seven emotions:
  - http://tcci.ccf.org.cn/conference/2013/pages/page04_eva.html
- Japanese:
  - Japanese customer reviews corpus with the same eight emotions used in the Chinese Ren-CECps Corpus (Sun et al., 2014)

General approaches (I)

- Can be divided in three main categories (Pang & Lee, 2008; Medhat et al., 2014):
  - Lexicon-based approaches
  - Machine learning approaches
  - Hybrid methods

- Machine learning approaches:
  - Supervised learning
    - Decision tree classifiers
    - Linear classifiers
    - Rule-based classifiers
    - Probabilistic classifiers
  - Unsupervised learning

General approaches (II)

- Lexicon-based approaches:
  - Based on the lexicons we described before
  - Words are associated a polarity score
  - Overall polarity determined by summing up polarity scores
    - Some rules regarding polarity modification by negators/intensifiers/diminishers

General approaches (III)

- Machine learning approaches
  - Supervised learning
    - Based on annotated corpora
    - Sentiment analysis as a classification problem (2-3-5 classes)

    "very negative", "negative", "neutral", "positive", "very positive"
    - Using a plethora of algorithms:
      - Naïve Bayes, Bayesian Network, Maximum Entropy
      - Support Vector Machines, Neural Networks
      - Decision Trees

General approaches (IV)

- Pre-processing:
  - Lemmatizing/Stemming and stop word removal (sometimes)
    - Some might prove important (e.g. for, no, and, but, etc.)
  - Text normalization (especially for microblog/SM texts, sms)
  - POS-tagging and (sometimes) syntactic parsing, SRL

- Features (BoW):
  - Terms presence
  - Terms frequency (tf-idf, etc.)
  - Parts of Speech
  - Presence of opinion words
  - Presence of negators, intensifiers, diminishers
  - N-grams of different sizes

- Feature selection:
  - PMI, Chi-square, LSI/LSA

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Dealing with Multilinguality (I)

(Balahur and Turchi, 2012; 2013)

- Machine translation systems – improved

Google Translate

  - MT better than mot-a-mot translation with dictionaries
  - Syntax, multi-word expressions, context

bing Translator

  - Open/public access solutions – Moses, Google, Bing, Yahoo
  - Good performance for widely-used languages

YAHOO! BABEL FISH

- Can we use MT systems to translate test data to a language with resources?
- And use training data in that language

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Dealing with Multilinguality (II)

- Can we use MT systems to obtain training data in a language?
  - To build a model to detect sentiment
  - E.g. German, French, Spanish (not all similar)

Google Translate

bing Translator

YAHOO! BABEL FISH

- Use:
  - English sentiment-annotated data
  - 3 translation systems: Moses, Bing, Google (+ Yahoo for GS)
  - Different feature representations
  - Different ML algorithms
  - Meta-classifiers

Dealing with Multilinguality (III)

- Classify sentiment in text: positive, negative, neutral
- Different methods employed:
  - Knowledge-based
    - Large-enough lexica?
    - Ambiguity (words with no context)
  - Semi-supervised
    - Use knowledge to classify small initial set + supervised methods
    - Performance of initial set?
  - Supervised
    - SMT usage
    - Study "noise" impact

Dealing with Multilinguality (IV)

- Data for English at NTCIR 8 MOAT (Multilingual Opinion Analysis Task)
  - Sentences (6165)
  - Opinion units (6223)

- Randomly selected 600 sentences – test set
- Rest training set – 5600 sentences

- Translate with Moses, Google, Bing
- Create Gold Standard per language:
  - Manual correction of Yahoo translation

- Many neutral sentences – > only positive & negative
  - Training: 943 examples (333 positive and 610 negative)
  - Test set and Gold Standard: 357 examples (107 pos and 250 neg)

Dealing with Multilinguality (V)

Supervised learning using:

- Presence/absence (boolean) of :
  - Unigrams
  - Bigrams
  - Unigrams+bigrams
- Tf-idf of :
  - Unigrams
  - Bigrams
  - Unigrams+bigrams

Dealing with Multilinguality (VI)

Training on:

- Translations of each system/language
- Combined translations from all 3 MT systems

Testing on:

- Translations of each system/language
- Gold Standard

Using as algithms:

- SVM
- Meta-classifiers – Bagging & AdaBoost

Dealing with Multilinguality (VI)

Incorrect translation:

- Larger number of features, sparseness
- Features not informative
  - Loss in performance

Comparative tables/language

- Max 12% loss SMO, Max 8% loss Bagging
- AdaBoost more than Bagging
- GS for training?
  - More realistic

Dealing with Multilinguality (VII)

Noise in data:

- Translation errors + non-informative features

Manual inspection of data:

- German (lower quality) – tf-idf
- Better performance translation – uni+bi
- Cleaner data – uni+bi – > informative

Dealing with Multilinguality (VIII)

Extensive evaluation of MT for multilingual SA

- Reasonable level of maturity
- Good MT system – small drop in performance
- Maybe combine other heuristics

Translated data:

- Wrong translation => sparseness of features + noise
  - Use of meta-classifiers
- Good translation => more data = better (Spanish)

Future work:

- Different (more) features
  - Sentiment, Synonyms, Skip-grams

Dealing with negation in SA (I)

- (Wiegand, Balahur et al., 2010) – "A survey on the role of negation in sentiment analysis"

1. I like+ this new Nokia model.
2. I do [not like+] – this new Nokia model
3. Not only is this phone expensive but it is also heavy and difficult to use
4. [I do [not like+] – the design of new Nokia model] but [it contains some intriguing+ new functions].

Dealing with negation in SA (II)

- Pang et al. (2002) – add artificial words to the typical BoW representation (NOT_x)

  I do not NOT_like NOT_this NOT_new NOT_Nokia NOT_model.

- (Polanyi & Zaenen, 2004), (Kennedy & Inkpen, 2005) – rules:
  - Words have polarity values associated: clever (+2)
  - Negation means value word *(-1) : not clever (-2)

- (Moilanen and Pulman, 2007) – semantic composition using use syntactic phrase structure trees

- Heuristic rules to model *scope of negation* (window size after negation word, first occurrence of polar expression, whole sentence) - Choi and Cardie (2008), Jia et al. (2009)

SA in different types of text

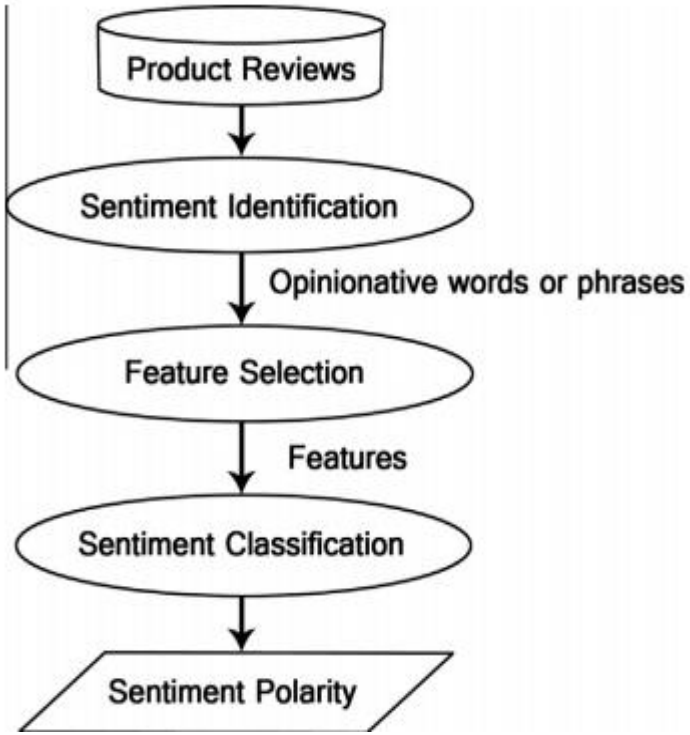
- Reviews
- Microblogs
- Blogs
- Newspaper articles
- Political debates

SA in Reviews (I)

"Bought this Lumix camera last week. Was totally impressed. It's light as a feather. Picture colors are great. But it broke after 3 days."

- Issues:
  - Feature-based OM and summarization
    - "Aspect-based sentiment analysis"
  - Products have features
    - Find "features" of the object
  - Classify opinion in feature-dependent manner
    - E.g. huge screen vs. huge phone
  - Implicit expressions of evaluation using affect
    - E.g. "totally impressed"
  - No corpora annotated accordingly

SA in Reviews (II)



(Mehmet et al., 2014)

SA in Reviews (III) – Feature extraction

(Hu and Liu, 2004; Liu et al., 2005)

- A frequency-based approach (Hu and Liu, 2004):
  - nouns (NN) that are frequently talked about are likely to be true aspects (called frequent aspects) .
- Sequential/association pattern mining finds frequent nouns and noun phrases.
- Infrequent features/aspects extracted using opinion target
  - approximated with the nearest noun to the opinion word
  - generalized to dependency in (Zhuang et al 2006) and double propagation in (Qiu et al 2009;2011)

SA in Reviews (IV)

(Popescu and Etzioni, 2005)

- Improved (Hu and Liu, 2004) removing frequent noun phrases that may not be aspects
- Identifies part-of relationship
- Each noun phrase is given a pointwise mutual information score between the phrase and part discriminators associated with the product class, e.g., a camera class.
  - E.g., "of camera", "camera has", etc.
    - used to find parts of cameras by searching on the Web

(Balahur and Montoyo, 2008)

- Added technical features specifications from webs

SA in Microblogs (I)

- Microblogs = Twitter (mostly)
- 140 characters, use of hashtags (#) for topic, (@) for users
- Much info in a short text
  - loss in grammar, spelling, lots of acronyms, short forms
- Use of specific markers for sentiment (caps, repeated letters)
- Use of slang and special graphical signs (emoticons)
- High rate of data production -> high speed in processing
- E.g. Twitter available in over 30 languages, tweets in more than 80 languages -> highly multilingual

"said it b4 dat gucci been promoting his mixtape 2 drop on 10/17 since august, Gotti just up & tried 2 come out on da same date"

@Hollyhippo voy a mañana blockbuster para obtener Devil Inside si te parece bien? ;)

SA in Microblogs (II)

Three types of methods used:

Dictionary-based (knowledge-based)

- Words that carry a sentiment have polarity value assigned
- E.g. "happy" has a value of 2, "sad" has a value of -2

Statistical/supervised (using machine learning)

- Based on examples
- E.g. if **"I like roses"** is positive, then **"I like lilies"** is also positive

Hybrid – supervised learning with special features

- Abstract on features – "happy", "excited", "joyful" – all grouped under "POSITIVE"

SA in Microblogs (III)

Word normalization

- words search in Roget's Thesaurus
- eliminate repeated letters dictionary word matched
  - E.g. "Perrrrrrrrrrrrrrrrrfect"

Emoticon replacement

- emoticon list matching
- Replace with word and its value

Affect word matching

- The words were matched against the affect lexicons:

Repeated punctuation sign normalization (!!!)

EmotionLookupTable.txt

```
1   %-( -1
2   %-) 1
3   (-: 1
4   (:  1
5   (^ ^)    1
6   (^-^)    1
7   (^.^)    1
8   (^_^)    1
9   (o: 1
10  (o; 0
11  )-: -1
12  ):  -1
13  )o: -1
```

RogetThesaurusShort.txt

```
1   aardvark
2   aardwolf
3   aaron
4   aback
5   abacus
6   abaft
7   abalone
8   abandon
9   abandoned
10  abandonment
11  abandons
12  abase
13  abased
14  abasement
15  abash
16  abashed
17  abate
18  abated
```

EmotionWords.txt

```
1   abandon%     -2  liwc
2   abate   -2  General Inquirer
3   abdicate%    -2  General Inquirer
4   abhor%  -4  General Inquirer
5   abject  -2  General Inquirer
6   abnormal%    -2  General Inquirer
7   abolish%     -2  General Inquirer
8   abomina%     -3  General Inquirer
9   abrasive%    -2  General Inquirer
10  abrupt  -2  General Inquirer
11  abscond%     -2  General Inquirer
12  absence -2  General Inquirer
13  absent% -2  General Inquirer
14  absurd% -2
15  abuse%  -4
16  abusi%  -4
```

SA in Microblogs (IV)

SemEval Sentiment Analysis in Twitter competition
(Nakov et al., 2013, Rosenthal et al., 2014, Rosenthal et al., 2015, Nakov et al., 2016):

- Different approaches, relying on
  - Classifiers:
    - SVM, MaxEnt, and Naive Bayes
  - Lexicons of opinion words:
    - MPQA, SentiWordNet, Bing Liu's opinion lexicon, NRC lexicon (Mohammad et al., 2013)

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Sentiment Analysis in Political Debates

- Debates:
  - Dialogue-like structure
  - Multiple opinion sources
  - References to previous speakers, arguments
  - Opinions on topic, but also other speakers
  - Known topic – law/bill/proposal…

Joint Research Centre

European Commission

Sentiment Analysis in Political Debates

- Test a general method for opinion classification
- Classify opinion independently of target?
- Method to determine the source of the opinion expressed
  - based on the attitude of the speaker on the topic (association to opinion words)

(Balahur et al., CICLING 2009)

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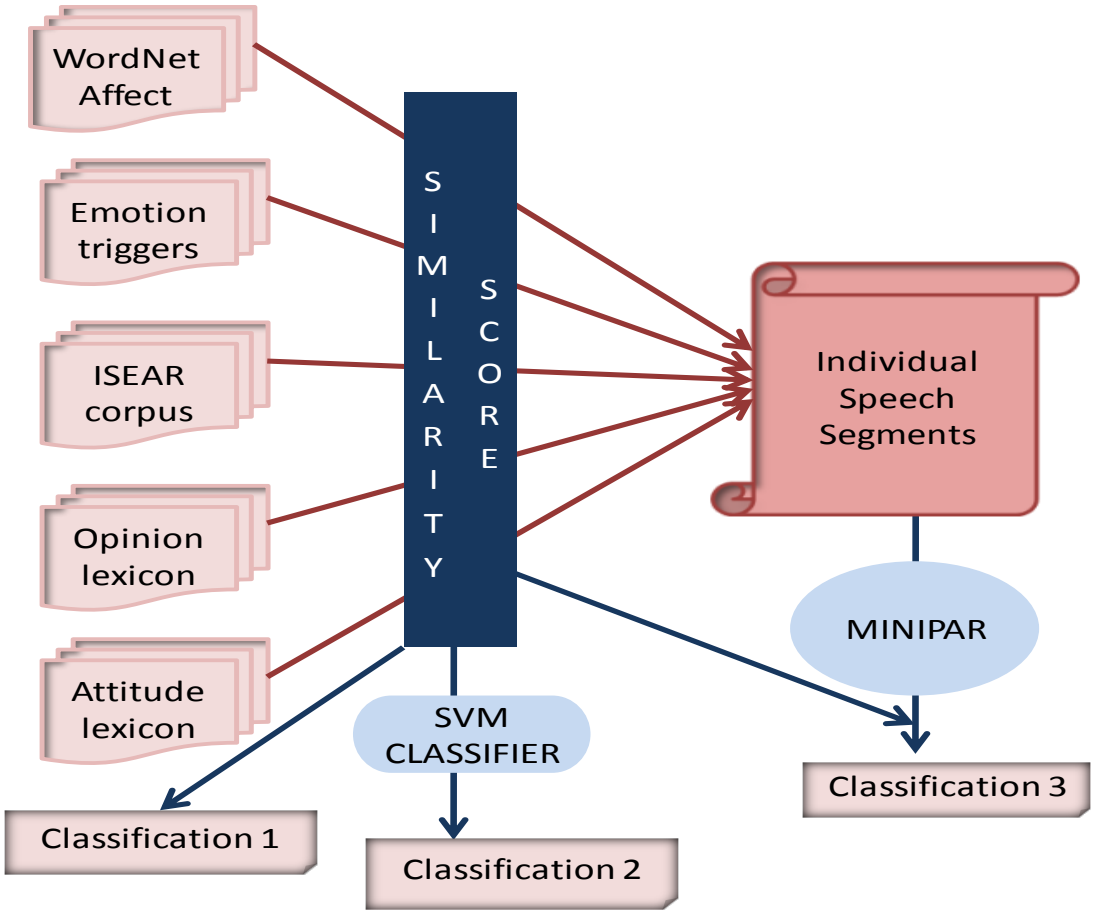
Sentiment Analysis in Political Debates -



Sentiment analysis in the News

- Newspaper articles:
  - Long pieces of text
  - Various sources of opinion
  - Multitude of topics discussed
  - Mixture of direct opinions with event descriptions
  - Factual descriptions not necessarily lack sentiment
  - Source bias, apparenting objectivity, implicit appraisals

Sentiment analysis in the News-Contributions (I)

- First approach - document level sentiment analysis, using sentiment dictionaries (high multilinguality)
  - High positives – Positives – Negatives – High Negatives
  - What does it mean?
- Sentiment analysis in quotations (reported speech)
  - Shorter, more focussed
  - Sentiment explicit
- 3 types of experiments – 100 quotes *(Balahur et al., WIIAT 2009)*:
  - Compare different resources in a bag-of-words classification
  - Compute quotes' similarity with sentences from the ISEAR corpus (7 emotion categories)
  - Train SVM classifier on EmotiBlog corpus

Sentiment analysis in the News – Contributions (II)

- Much lower results than for debates – why?

- When trying to produce a larger annotated gold standard collection:
  - Inter-annotator agreement is low (<50%)

- New annotation *(Balahur & Steinberger, WOMSA 2009)*:
  - Separate good vs. bad news
  - Only sentiment expressely stated on the entity target
  - No world knowledge, interpretation
  - Agreement – 1582 quotes - 81% among 3 pairs of 2 annotators

Sentiment analysis in the News - Conclusions

- Inter-annotator agreement very low → task is badly defined

- What is sentiment analysis in the news?
  - Need to define target and source
  - Separate good and bad news from opinion on target
  - Annotate only clearly marked opinion
    - Linked to 3 views on articles: author, reader, text
  - Last experiments (Balahur et al, 2010 LREC) – up to 82% accuracy (3-class labeling)
  - Collection extended with 2357 quotes in German

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Sentiment analysis in blogs

- Blogs:
  - Informal style
  - Mixture of newspaper articles, comments
  - Multiple opinion sources
  - Multiple opinion targets
  - Anaphoric mentions at a cross-post level

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Sentiment analysis in blogs - EmotiBlog

- Collection of a corpus in three languages:
  - Italian
  - Spanish
  - English
  - 30.000 words for each language and topic
- About three topics:
  - The Kyoto Protocol
  - The elections in Zimbabwe
  - The USA elections
- Annotations for:
  - Words + multi-word expressions + sentence level
  - Polarity + intensity + emotion

(Boldrini, Balahur, Martínez-Barco, Montoyo - DMIN 2009)

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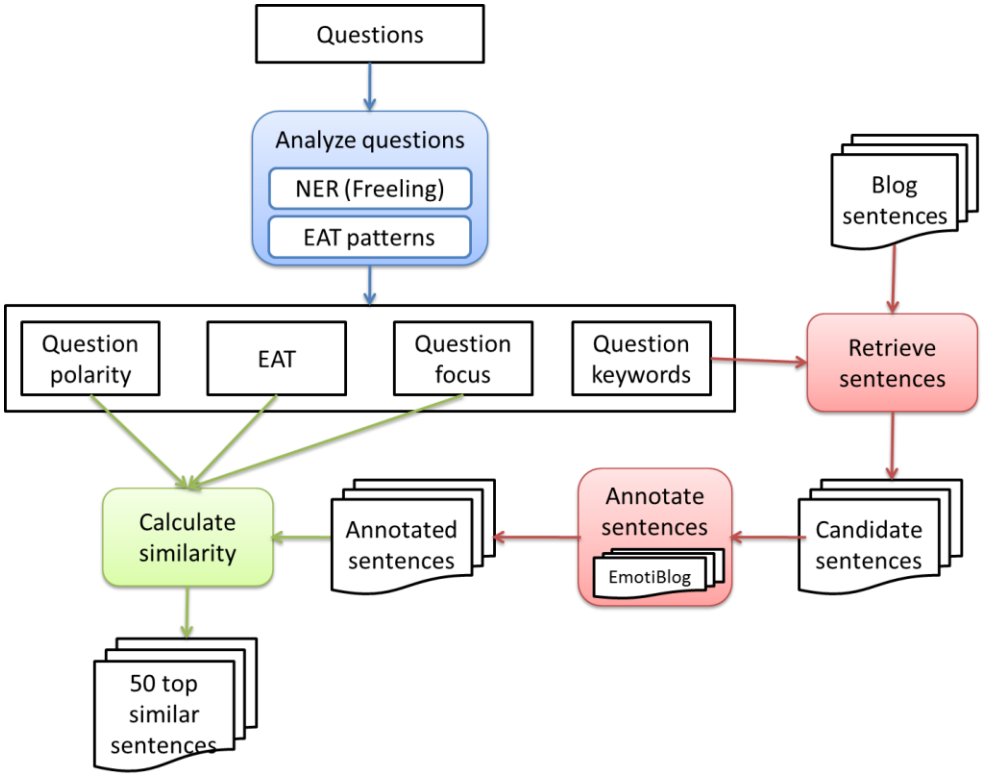
Opinion QA from blogs



Implicit sentiment detection – Issues

- NLP – sentiment analysis as classification task – ML, lexica

"The kitten climbed into my lap." →"kittens are cute"
"The pig climbed into my lap." → "pigs are dirty"

"The dog started barking as I approached." → "bark – maybe bite?"
"The dog started wagging its tail as I approached." → "wagging – happy"

"The man killed the mosquito." → "mosquito –bothering insect"
"The man killed the woman." → "woman – person; against law"

"I'm going to a family party because my mother obliges me to."

- Polarity of the sentiment depends on the characteristics of the actor, action or object of event (small lex. differences)

Implicit sentiment detection - Emotion triggers

- What is said explicitly in the text vs. what is intended
- Values authors appeal to/readers interpret

"Emotion trigger" - word or idea that:

- is connected to general human needs and motivations
- depends on the reader's interests, cultural, educational and social factors
- relates to general human needs and motivations

leads to an emotional interpretation of a given text. (e.g. "war", "hunger", "job loss")

(Balahur et al., AISB 2008)

Implicit sentiment detection – Emotion triggers lexical database (I)

- Based on 3 theories:
  - Theory of relevance (Sperber and Wilson, 2000)
  - Maslow's pyramid of human needs and motivations
  - Max-Neef's matrix of human needs
- For English and Spanish:
  - Core of terms - English
  - Expand with: WordNet , Nomlex
  - Mapped to Spanish (EuroWordNet)
  - Extended to culture-dependent terms – ConceptNet, LIDSL
- Evaluated on SemEval 2007 Task 14 data (Balahur and Montoyo, AISB 2008)
  - Good results
  - Need more world knowledge – lexica not enough
  - More thorough criteria for "emotion triggering"

Implicit sentiment detection - Appraisal theories

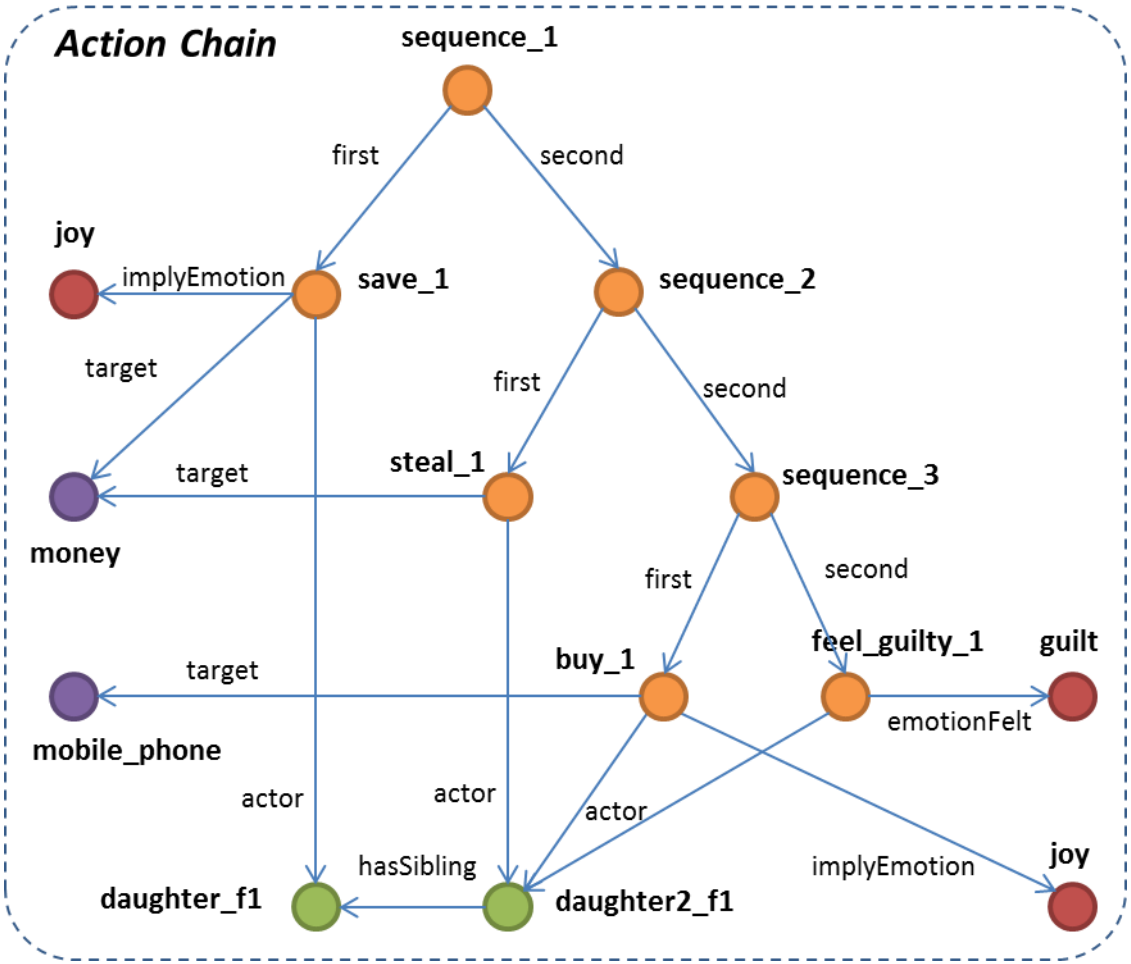
- Emotions are elicited and differentiated on the basis of the *subjective evaluation* of the *personal significance of a situation*, object or event (criteria).
  - (De Rivera, 1977; Frijda, 1986; Ortony, Clore and Collins, 1988; Johnson-Laird and Oatley, 1989)

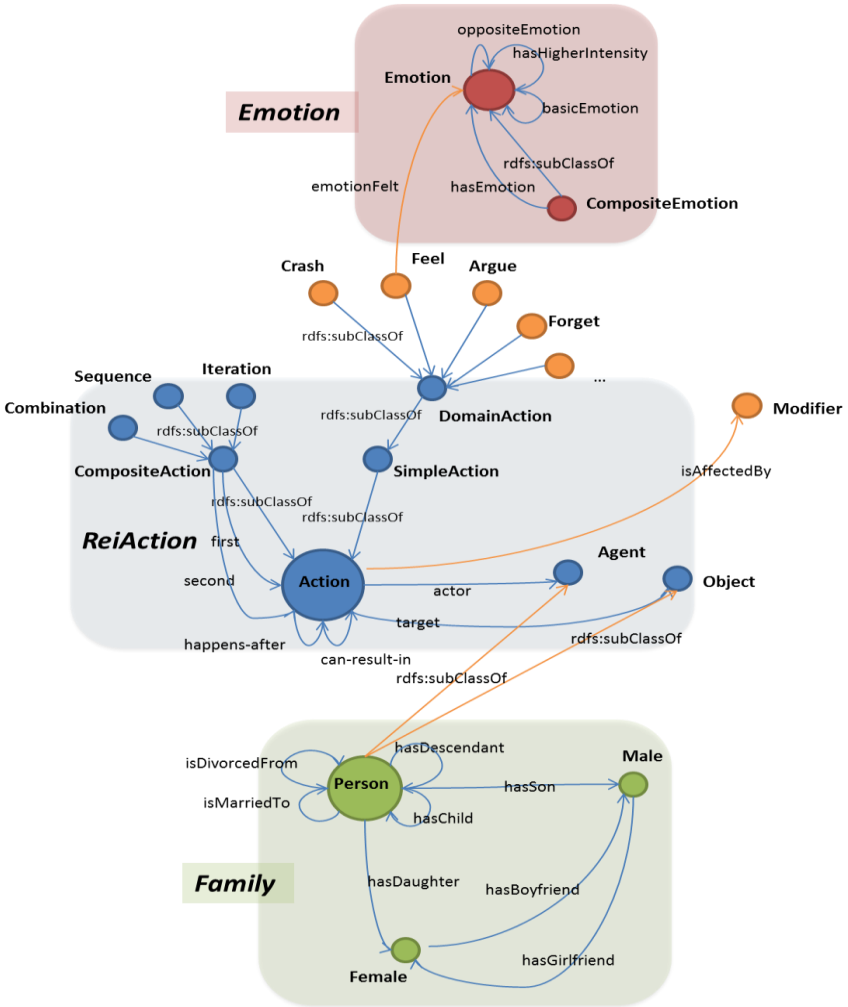
Implicit sentiment detection – EmotiNet (I)

- Propose a method for modelling affective reactions based on the Appraisal Theories → EmotiNet KB:
  - Situations = Action chains + Properties (WK)
  - ➔ Extract appraisal criteria

"I'm going to a family party because my mother obliges me to."

- Action chain: (I, go, family party) , (mother, oblige, me)
- Appraisal criteria:
  - significance to personal goals → frustration, anger


Action Chain
sequence_1
first
second
joy
implyEmotion
save_1
sequence_2
target
first
second
target
steal_1
sequence_3
money
first
second
feel_guilty_1
guilt
buy_1
target
emotionFelt
mobile_phone
actor
actor
actor
hasSibling
joy
implyEmotion
daughter_f1
daughter2_f1


Emotion
oppositeEmotion
hasHigherIntensity
Emotion
basicEmotion
rdfs:subClassOf
emotionFelt
hasEmotion
CompositeEmotion
Crash
Feel
Argue
Forget
...
rdfs:subClassOf
Sequence
Iteration
Combination
rdfs:subClassOf
rdfs:subClassOf
DomainAction
Modifier
CompositeAction
SimpleAction
isAffectedBy
rdfs:subClassOf
rdfs:subClassOf
ReiAction
first
Agent
second
Action
actor
Object
target
happens-after
can-result-in
rdfs:subClassOf
rdfs:subClassOf
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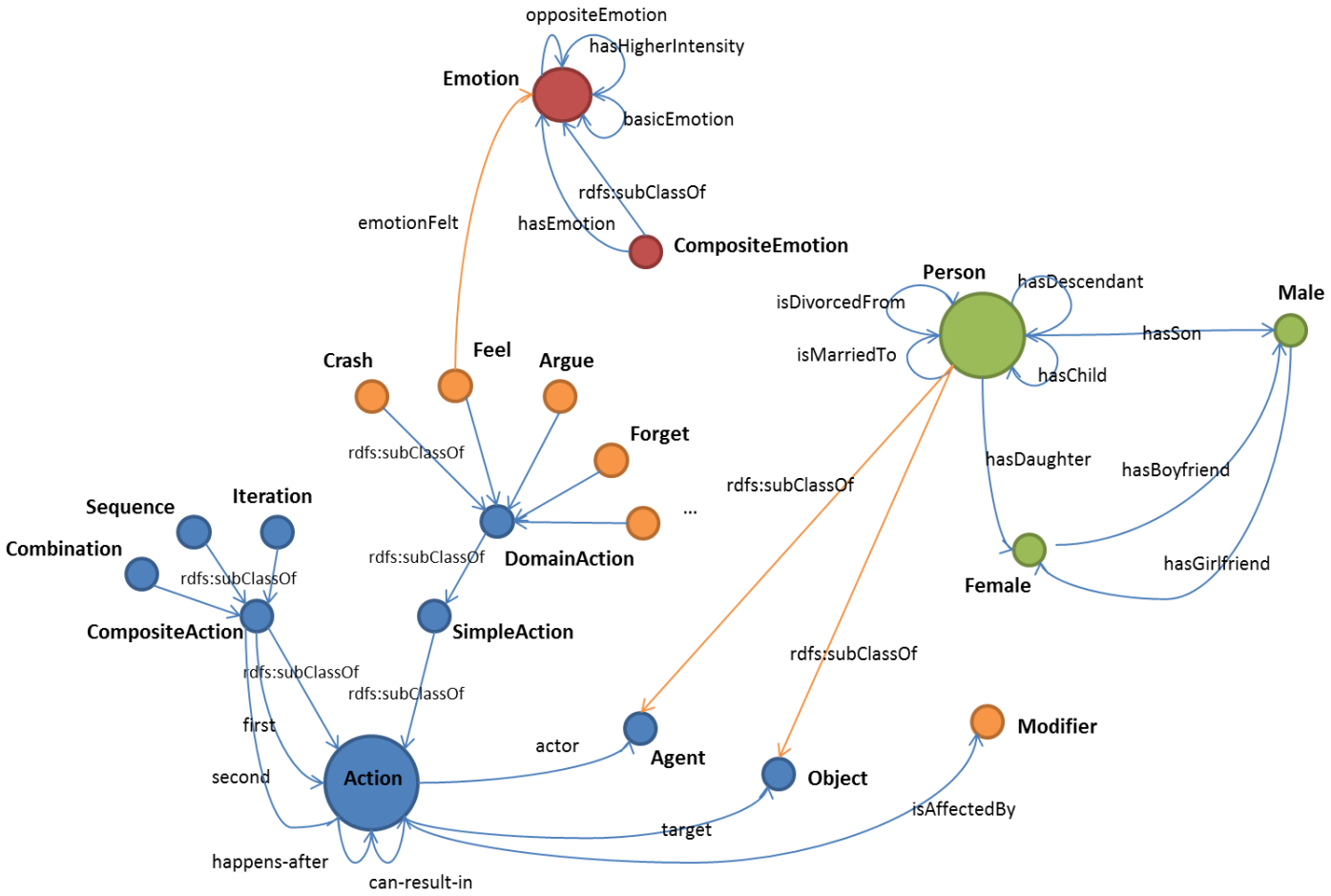
Male
isDivorcedFrom
Person
hasSon
isMarriedTo
hasChild
Family
hasDaughter
hasBoyfriend
hasGirlfriend
Female


oppositeEmotion
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hasSon
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hasChild
Crash
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rdfs:subClassOf
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Sequence
Iteration
Combination
rdfs:subClassOf
rdfs:subClassOf
DomainAction
Female
hasGirlfriend
CompositeAction
SimpleAction
rdfs:subClassOf
rdfs:subClassOf
rdfs:subClassOf
first
actor
Agent
Modifier
second
Action
Object
target
isAffectedBy
happens-after
can-result-in

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SA and other NLP Tasks

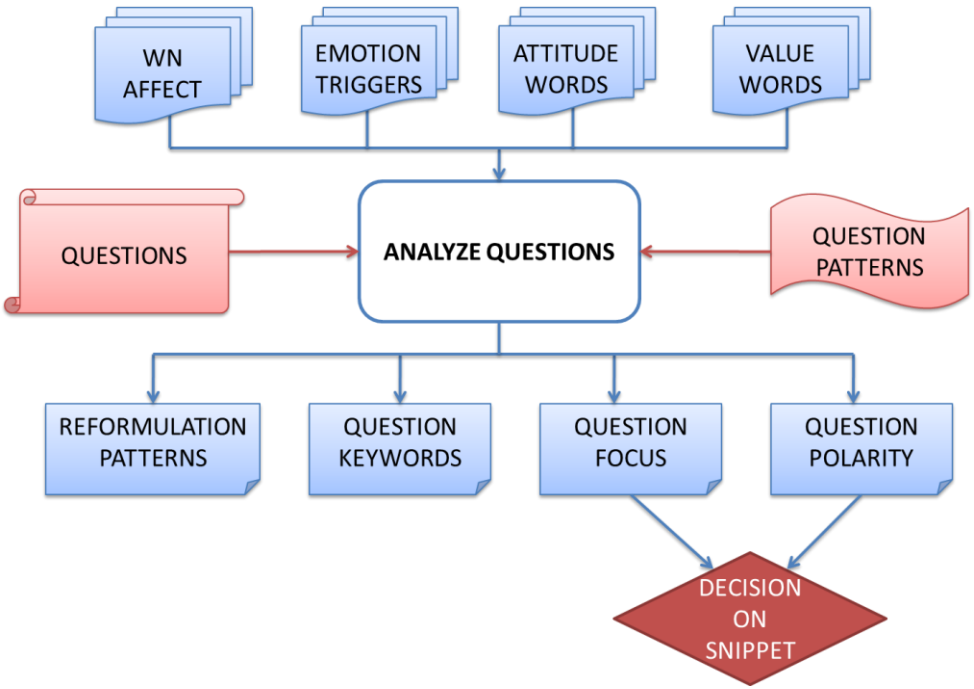
- Opinion Retrieval and Question Answering
  - MPQA corpus
  - TAC 2008 Opinion Pilot

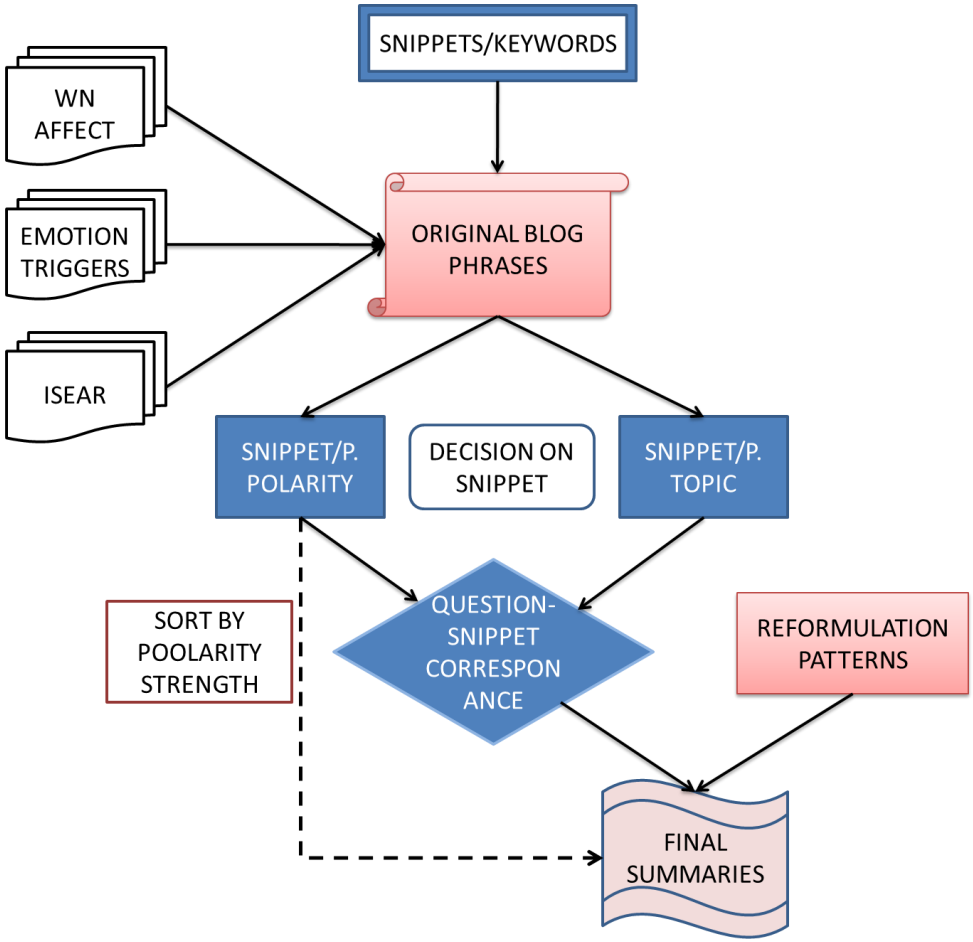
  Given a set of questions of the type

  Why do people like George Clooney?

  Find all the pieces of text from a set of blog posts that answer this question

- Opinion Summarization
  - Summarize the opinions people express on George Clooney
  - Summarize the pros and cons expressed about Starbucks


WN AFFECT
EMOTION TRIGGERS
ATTITUDE WORDS
VALUE WORDS
QUESTIONS
ANALYZE QUESTIONS
QUESTION PATTERNS
REFORMULATION PATTERNS
QUESTION KEYWORDS
QUESTION FOCUS
QUESTION POLARITY
DECISION ON SNIPPET


SNIPPETS/KEYWORDS
WN AFFECT
EMOTION TRIGGERS
ISEAR
ORIGINAL BLOG PHRASES
SNIPPET/P. POLARITY
DECISION ON SNIPPET
SNIPPET/P. TOPIC
SORT BY POOLARITY STRENGTH
QUESTION-SNIPPET CORRESPON ANCE
REFORMULATION PATTERNS
FINAL SUMMARIES

Competitions

- TAC 2008 Opinion Pilot
- SemEval 2007 Affect in Text
- SemEval 2013-2016 Sentiment Analysis in Twitter
- NTCIR-MOAT series
- SemEval 2016 Detecting Stance in Tweets
- SemEval 2016 Aspect-based Sentiment Analysis
- SemEval 2016 Determining Sentiment Intensity in of English and Arabic Tweets
- TASS (Taller de Analisis de Sentimientos y Sujetividad) 2013-2016

Remaining challenges

Definition of a unified framework for sentiment analysis

- Task description in a general, yet consistent manner across genres and applications
- 3 components: author, text, reader
  - Speech acts, appraisal, appraisal criteria
  - Source bias, reader background
- Linking "world knowledge" – CYC, SUMO, etc.
  - Dependency to culture, social and moral norms
- User preferences, social + personal values

Applications of SA

Interactive

http://text-processing.com/demo/sentiment/

http://nlp.stanford.edu:8080/sentiment/rntnDemo.html

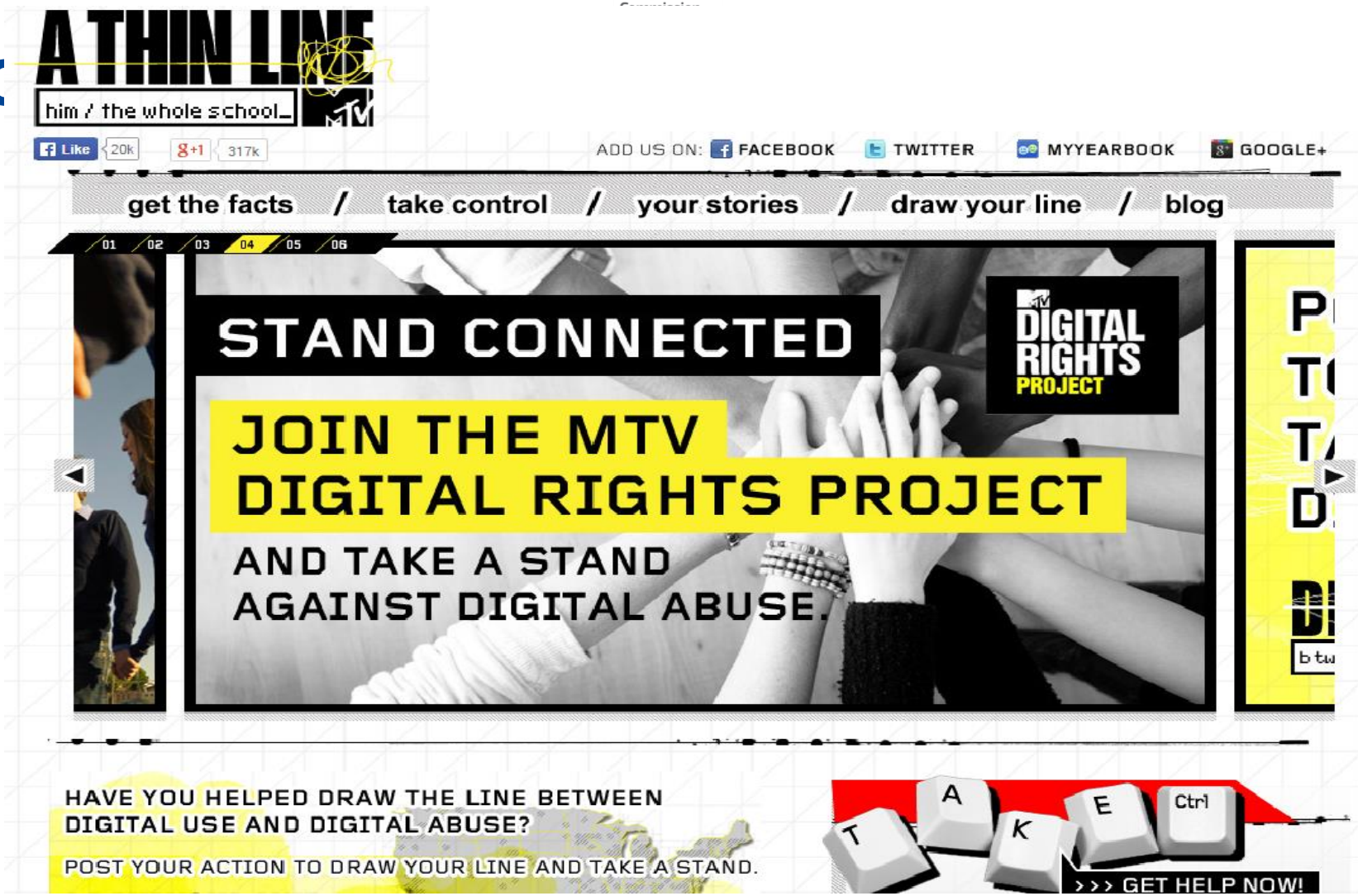
http://demo2-opener.rhcloud.com/welcome.action

https://www.lexalytics.com/demo

http://www.citizenandscience.eu

http://www.alchemyapi.com/products/demo

https://www.csc.ncsu.edu/faculty/healey/tweet_viz/tweet_app/


A THIN LINE
him / the whole school_
Like 20k
+1 317k
ADD US ON: FACEBOOK TWITTER MYYEARBOOK GOOGLE+
get the facts / take control / your stories / draw your line / blog
01 02 03 04 05 06
STAND CONNECTED
DIGITAL RIGHTS PROJECT
JOIN THE MTV DIGITAL RIGHTS PROJECT
AND TAKE A STAND AGAINST DIGITAL ABUSE.
HAVE YOU HELPED DRAW THE LINE BETWEEN DIGITAL USE AND DIGITAL ABUSE?
POST YOUR ACTION TO DRAW YOUR LINE AND TAKE A STAND.
TAKE
Ctrl
>>> GET HELP NOW!

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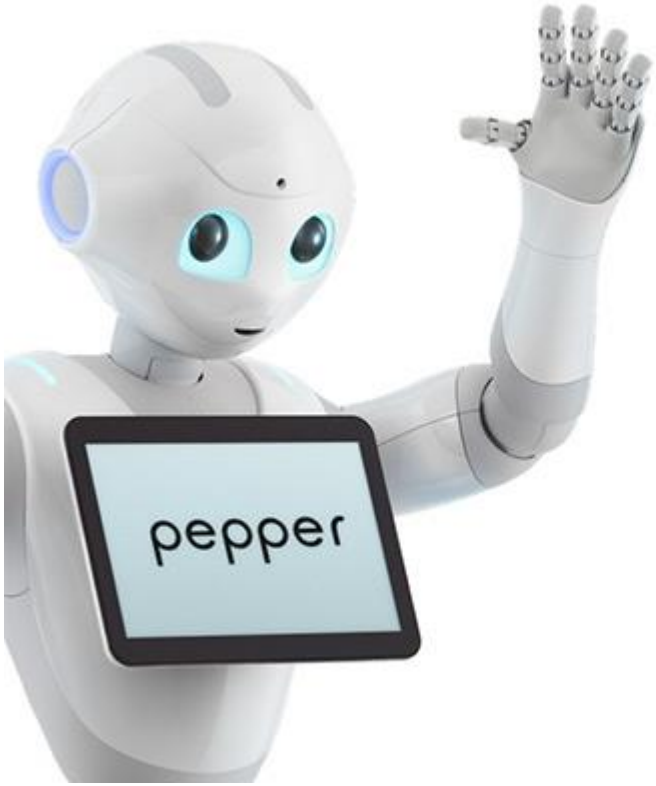
Other applicat



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Conclusions?

- …

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