Emotion and Interaction Processes in a Collaborative Online Network

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Introduction

- Self-Organized Collaboration:
  - social forces increasingly important
  - technological/social innovation, political problem-solving, creation of economic value occur:
    - in informal, flat organizations,
    - in emerging distributed economy and digital democracy,
    - enabled through cheap and ubiquitous ICT ([5, 11]).
- THEMIS.COG (`themis-cog.ca`):
  - Study the open, collaborative development of software.
  - GitHub (`github.com`): online social coding communities.
  - Explore collaboration dynamics in communities like GitHub.
  - Understand the social and psychological mechanisms of modern human collaboration.

Social Identity Dynamics

- People care about social relationships, and about individual (e.g. economic) gains.
- Identity dynamics explains interactions.
- A mathematical model to predict and test collaborative dynamics,
- based on interaction process (IP) model [4],
- implemented and simulated using the *BayesACT* sentiment and identity model of human dyadic and group interactions [15].
- General underlying assumption: humans strive for their social experiences to be coherent and consistent with cultural sense of self and values.

Software Collaborations

- Emotions and interaction processes play an important role in software collaborations:
  - positive (happiness): developers more creative[7],
  - negative (fear): developers refrain from changing/refactoring their code[2],
  - affect task quality, productivity, creativity, group rapport and job satisfaction [6].
- Software discussions data: openly available,
- the discussions can be of a technical nature (e.g. code),
- sentiment and emotional analysis needed.
- Previous attempts:
  - feasibility study of emotions mining using Parrott's framework on Apache issue reports[12],
  - lexical sentiment analysis of commit comments [8],
  - sentiment analysis of security related discussions on GitHub[13].

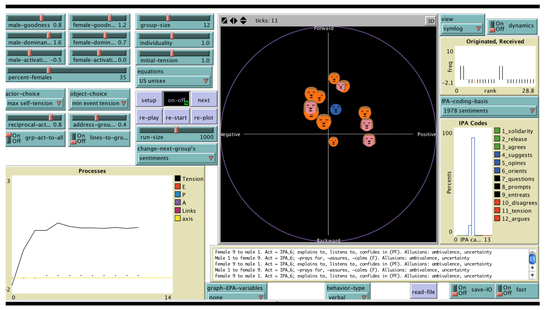
Affect Control Theory (ACT)[9]

- ACT basics:
  - sociological model of human interaction.
  - Humans have shared cultural *sentiments* about identities, behaviours, and interaction dynamics.
  - Cultural consistency: a keystone of intelligence.
  - Used to make predictions of other's behaviours,
  - and to guide action choices for an agent.
- ACT proposes affective prescriptions for action:
  - results in affective ecosystem of roles and behaviours,
  - an equilibrium that yields a social order.
- Bayesian Affect Control Theory (*BayesAct*)[15]:
  - sentiments are probability distributions,
  - propositional (non-affective) states,
  - explicit utility function.

Interaction Process Analysis (IP)[4]

- Interaction Process Analysis (IP): a method for the analysis of groups
- uses 12 behaviour categories based on observations of human groups [3],
- ten emotions related to IP categories by [10],
- used in group process simulations [10].

ACT+IP=Group Simulator[10]



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Examples

IP group	IP Category	Example pull request comment	Emotions
positive reactions	Shows solidarity	*im sure youll recover somehow*	Calm
	Shows tension release	*ooops sorry my mistake*	Sorry, Careless
	Agrees	*allright will do thanks for the feedback*	Thanks, Calm
attempted answers	Gives suggestion	*needs a metric tonne of docs*	Cautious
	Gives opinion	*love it*	Happy
	Gives orientation	*fucking hell im hungry now*	Agressive, Angry
questions	Asks for orientation	*what if the file does not exist*	Nervous, Cautious
	Asks for opinion	*what about filtering by type and tag*	Cautious
	Asks for suggestion	*how could i show the name of the fighter that wins the turn*	Calm, Cautious
negative reactions	Disagrees	*for me just says linux which is not very useful at all*	Agressive
	Shows tension	*um i dont know i dont remember changing that and probably did it by accident*	Nervous, Defensive
	Shows antagonism	*Kill this method with an axe and then burn its body*	Defensive, Agressive

IP categories used in the study, along with example comments and emotion ratings

Data and Methods

- 3000 pull request comments from GHTorrent's GitHub dump (Feb. 2017),
- from pull requests 41 open, 343 closed without being merged, 450 merged.
- Comments filtered to remove sections of code.
- 4 different MTurk annotations of 12 IP + 10 emotions,
- majority voting threshold ratings,
- averaged TF-IDF weighted Google word vectors for each comment,
- linear SVM (Logistic regression, metric learning, deep learning gave similar results [14]).
- F1-scores for a one-vs-all classification task,
- parameters were set by maximizing F1-score in a grid search,
- 5-fold cross validation,
- aggregated IP and emotion categories.

Results

IP Category	F1
Shows Solidarity	56.8
Shows tension release	10.0
Agrees	**64.0**
Gives Suggestion	33.4
Gives opinion	51.4
Gives orientation	58.6
Asks for orientation	36.2
Asks for opinion	22.9
Asks for suggestion	10.6
Disagrees	56.6
Shows Tension	30.0
Shows Antagonism	13.2

One vs. All IP categories

Emotion	F1
Thanks	54.7
Sorry	58.7
Calm	69.3
Nervous	23.6
Careless	15.7
Cautious	**69.8**
Aggressive	25.2
Defensive	16.7
Happy	2.5
Angry	0

One vs. All Emotions

Aggregated sets	F1-score
positive vs negative reactions	73.2
questions vs. attempted answers	81.0
positive vs negative emotions	80.5

F1 scores for Aggregated classes

Conclusions

- Subjective emotional and social interactions play a significant role in online software development.
- Automated detection: a significant challenge,
- requires more detailed emotional analysis [1].
- Current work:
  - fine-grained sentiment analysis,
  - further group process analysis,
  - develop artificial agents that catalyze more effective group processes online.

Thank you

Support from TransAtlantic Platform by NSERC, SSHRC (Canada), DFG (Germany), NSF (USA)

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