Computational Phronesis as a Possible Path toward Machine Emotional Integrity

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Integrity

- **Integrity** (/ɪnˈtɛɡrɪti/, noun)
  
  Definition from the Oxford dictionary
Integrity

- The quality of being honest and having strong moral principle (*a gentleman of complete integrity*)
Integrity

• The quality of being honest and having strong moral principle (a gentleman of complete integrity)

• The state of being whole and undivided (By invading Crimea Russia disturbed integrity of Ukraine)
Integrity

• The quality of being honest and having strong moral principle \( (a\ \text{gentleman\ of\ complete\ integrity}) \)

• The state of being whole and undivided \( (By\ \text{invading\ Crimea\ Russia\ disturbed\ integrity\ of\ Ukraine}) \)

• The condition of being unified or sound in construction \( (the\ \text{structural\ integrity\ of\ the\ novel}) \)
Integrity

• The quality of **being honest** and having strong moral principle (*a gentleman of complete integrity*)

• The state of being **whole** and **undivided** (*By invading Crimea Russia disturbed integrity of Ukraine*)

• The condition of being **unified** or sound in construction (*the structural integrity of the novel*)

• **Internal consistency** or lack of corruption in data (*integrity checking*)
Integrity

• Being honest, whole, undivided, unified, in state of internal consistency with oneself
Emotional integrity

- Being honest, whole, undivided, unified, in state of internal consistency with one's emotions.
Emotional integrity

Bob Solomon (1942-2007)

To be in emotional integrity with oneself means to be able to use one's emotions to enhance one's life
Emotional integrity

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To be in emotional integrity with oneself means to be able to use one's emotions to enhance one's life.

Use = be aware of and consciously live with one's own and others' emotions.
Emotional integrity

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Fear - negative? But helps us stay away from predators.
Emotional integrity

To be in emotional integrity with oneself means to be able to use one's emotions to enhance one's life.

Anger - negative?

But when somebody insults you, it's appropriate to get angry.
Emotional integrity

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Emotional integrity

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Use = be aware of and consciously live with one's own and others' emotions

Emotional strategies

* Ability to use emotions according to situation (context)
Emotional integrity

• It would be great to have a computational model of emotional integrity
  • To study humans
  • Train robots to understand our real needs (and enhance our lives)

• But how?
Emotional integrity

• Need a framework to work on
• One general concept of "Intelligence"? - too much.
Intelligence

Intelligence - one or many?

1983. Howard Gardner - “IQ tells you nothing!”.
(Theory of multiple intelligences)
There are many kinds of intelligence: logical, linguistic, spatial, musical, kinesthetic, naturalist, intrapersonal and interpersonal...

1990. Peter Salovey & John D. Mayer - Emotional Intelligence
The ability to recognize, monitor one's own and others' emotions, to discriminate among them and to use this information to guide one's thinking and actions.

Intelligence

Emotional Intelligence Framework

I Perception, appraisal, and expression of emotion
- Ability to recognize emotion in one's physical and psychological states, in other people and objects.
- Ability to discriminate between accurate and inaccurate, appropriate and inappropriate, honest and dishonest, expressions of emotions.
- Ability to express emotions accurately, and to express needs related to them.

II Emotional facilitation of thinking
- Ability to redirect and prioritize one's thinking based on the feelings associated with objects, events, and other people.
- Ability to generate or emulate vivid emotions to facilitate judgments and memories concerning feelings.
- Ability to capitalize on mood swings to take multiple points of view; ability to integrate these mood-induced perspectives.
- Ability to use emotional states to facilitate problem solving and creativity.

III Understanding and analyzing emotional information; employing emotional knowledge
- Ability to understand how different emotions are related.
- Ability to perceive the causes and consequences of emotions.
- Ability to interpret complex emotions, such as emotional blends and contradictory feeling states.
- Ability to understand and predict likely transitions between emotions.

IV Regulation of emotion
- Ability to be open to feelings, both those that are pleasant and those that are unpleasant.
- Ability to monitor and reflect on emotions.
- Ability to engage, prolong, or detach from an emotional state, depending upon its judged informativeness or utility.
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Emotional integrity assumes obtaining all abilities till the last one.

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- Ability to manage emotion in oneself and others.

The abilities are difficult to formalize computationally.
Intelligence

• Need something else that would suffice

• When you start looking for answers you usually look at...
Intelligence

Ancient Greece

Know thyself!

Aristotle
384 – 322 BCE
Intelligence

3 types of intelligence

• **Techne**: specific/expert knowledge

• **Sophia**: theoretical wisdom acquired by pure study/learning

• **Phronesis**: practical wisdom, practical judgment, prudence

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Phronesis

- **good judgment**, knowledge on how to express oneself, towards whom to express oneself, in which situations, and when it is appropriate to express oneself.
Phronesis

• **good judgment**, knowledge on how to express oneself, towards whom to express oneself, in which situations, and when it is appropriate to express oneself.

And with regards to emotions...
Phronesis

• good judgment, knowledge on how to express ones emotions, towards whom they ought to be expressed, in which situations, and when it is appropriate to express them.
Phronesis

Research questions
1. Who expresses the emotion?
2. Why they express the emotion?
3. Is the expression of emotion appropriate to the situation/context?
4. Is the degree of expression appropriate to the situation/context?
5. If the expression is not appropriate, what would be the appropriate one?
Phronesis

Tasks
1. Determination of emotion subject;
2. Determination of emotion object;
3. Verification of contextual appropriateness of emotions;
4. Verification of appropriateness of the degree/intensity of the expressed emotion;
5. Emotion-related behavioral pattern modeling.
Phronesis

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We can do that!!
Phronesis

Tasks

1. Determination of emotion subject;
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5. Emotion-related behavioral pattern modeling.

Combinations of those tasks give emotional strategies. Good strategies give emotional integrity.
Computational Phronesis

What we have done already?
1. Emotion subject;
2. Emotion object;
3. Verification of contextual appropriateness of emotions;
4. Verification of degree appropriateness;
5. Emotion-related behavioral patterns.
Computational Phronesis

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Context of Emotions

• Do we even need it? (And why?)
Context of Emotions

Typical errors of affect analysis systems.

• Facial expressions

• Expression:
  Eyebrows together, mouth open, finger pointing at listener;

• Output:
  User is angry;
Context of Emotions

- Facial expressions
  - Expression:
    - Eyebrows together, mouth open, finger pointing at listener;
  - Assumption: User is angry;

Context:
1. Praise
2. Warning
3. Anger
Context of Emotions

• Facial expressions

• Expression:
  User is crying
  – (presence of tears and facial expression);

• Output:
  User is sad;
Context of Emotions

• Facial expressions

• Expression: User is crying (presence of tears and facial expression);

• Context: The user is cutting an onion in the kitchen;

• Assumption: User is sad;
Context of Emotions

- Speech signals
- **Expression:** User speaks with a loud voice;
- **Output:** User is angry;
Context of Emotions

• Speech signals

**Context:** The user listening to the music with her headphones on and cannot hear well;

• Expression: User speaks with a loud voice;

• Assumption: User is angry;
Context of Emotions

- Physiological signals

- **Expression**: User has a high blood pressure;

- **Output**: User is excited;
Context of Emotions

• Physiological signals

• Expression: User has a high blood pressure;
• Assumption: User is excited;
• Context: The user has a hypertension or arrhythmia;
Context of Emotions

• Language

• Expression: User has used the word “happy”;

• Output: User is happy;
Context of Emotions

• Language

Context:

• Expression: User has used the word "happy";

1. “I’m not happy“

• Assumption: User is happy;
Context of Emotions

- Language

**Context:**
- **Expression:** User has used the word "happy";
- **Assumption:** User is happy;

1. “I’m not happy“
2. "I'm so happy that bastard was hit by a car!“
Contextual Appropriateness of Emotions
Contextual Appropriateness of Emotions

Typical affect analysis systems provide information on the expression of emotion in utterance.

- “Oh, I’m so happy!” [joy, happiness]

- “Oh, I’m so depressed...” [depression]
Contextual Appropriateness of Emotions

As long as the sentence is not too sophisticated, it's ok.

– “Oh, I’m so happy (because) I passed the exam!”  
[joy, happiness]

– “Oh, I’m is so depressed (because) my girlfriend left...”  
[depression]
Contextual Appropriateness of Emotions

When the context gets convoluted it gets messy.

– “Oh, I’m so happy (because) I passed the exam!” [joy, happiness]
– “Oh, I’m so happy (because) that bastard was hit by a car!” [joy, happiness]
– “Oh, I’m is so depressed (because) my girlfriend left...” [depression]
– “Oh, I’m so depressed (because) the Valentine’s Day is coming...” [depression]
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Contextual Appropriateness of Emotions

Let's take a closer look at how context is realized in emotional sentences.

– 試験に合格してうれしい！
  “Oh, I’m so happy (because) I passed the exam!”

– バレンタイン・デーが来るから悲しいね...
  “Oh, I’m so depressed (because) the Valentine’s Day is coming...”

**cause of emotion** = context of expression of emotion

makes the expression either **Appropriate** or **Inappropriate**
Contextual Appropriateness of Emotions

“Oh, I’m so happy (because) I passed the exam!” [joy, happiness], 試験に合格してうれしい！

“Oh, I’m so happy (because) that bastard was hit by a car!”

“Oh, I’m so depressed (because) my girlfriend left…”

“Oh, I’m so depressed (because) the Valentine’s Day is coming…”

| Original utterance                                    | Aa, pasokon ga kowarete shimatta… (Oh no, the PC has broken…)
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>longest n-gram (here: hexagram)</td>
<td>Aa pasokon ga kowarete te shimau</td>
</tr>
<tr>
<td>[interjection] [noun] [particle] [verb] [verb connector] [perfect form]</td>
<td></td>
</tr>
<tr>
<td>pentagram</td>
<td>pasokon ga kowarete te shimau</td>
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<tr>
<td>[depression]</td>
<td></td>
</tr>
<tr>
<td>tetragram</td>
<td>Aa, pasokon ga kowareru</td>
</tr>
<tr>
<td>trigrams</td>
<td>pasokon ga kowareru</td>
</tr>
<tr>
<td></td>
<td>koware te shimau</td>
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</table>
Contextual Appropriateness of Emotions

“...(because) I passed the exam!”
“I’m so happy…”
“I’m so glad…”
“He looked so happy…”
“My mom was so happy…”

WEB MINING

context of expression of emotion

<table>
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<tr>
<th>Original n-gram</th>
<th>pasokon ga koware te shimaΔ- tte</th>
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<tr>
<td>/-te/</td>
<td>pasokon ga koware te shimaΔ-tte</td>
</tr>
<tr>
<td>/-to/</td>
<td>pasokon ga koware te shimaΔ-to</td>
</tr>
<tr>
<td>/-node/</td>
<td>pasokon ga koware te shimaΔ-node</td>
</tr>
<tr>
<td>/-kara/</td>
<td>pasokon ga koware te shimaΔ-kara</td>
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morphemes of causality: -te, -to, -node, -kara, -tara
Contextual Appropriateness of Emotions

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“My mom was so happy…”

“...that bastard was hit by a car!”

“...because my girlfriend left…”

“...because the Valentine’s Day is coming…”

List of emotions appearing most often = appropriate / natural/ for this context

<table>
<thead>
<tr>
<th>Extracted emotion type</th>
<th>Type extracted / all extracted types</th>
<th>Ratio</th>
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<tr>
<td>[fear]</td>
<td>28/133</td>
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WEB MINING

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Confront expression from the sentence with the list

“I’m so happy (because) I passed the exam!”
Contextual Appropriateness of Emotions

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WEB MINING

List of emotions appearing most often = appropriate / natural for this context

User says: HAPPY [JOY, HAPPINESS]

It is natural / appropriate to be happy in this context

“I’m so happy (because) I passed the exam!”
Contextual Appropriateness of Emotions

<table>
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<th>Negative</th>
<th>Positive</th>
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<td><strong>Appropriate</strong></td>
<td><strong>Inappropriate</strong></td>
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<tr>
<td>User: I hate him for making a fool of me in front of everyone. ML-Ask: dislike; Web mining: anger, dislike Agent: Yeah, you have a reason to be angry. [empathy]</td>
<td>User: I’m so happy I passed the exam! ML-Ask: joy; Web mining: joy, excitement Agent: Yeah! That’s great! [sympathy]</td>
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<tr>
<td>User: I’m so depressed because St. Valentine’s day is coming. ML-Ask: dislike, depression; Web mining: excitement, joy Agent: You should be happy! [consolation]</td>
<td>User: I’d be happy if that bastard was hit by a car! ML-Ask: joy; Web mining: fear, sadness Agent: Are you sure this is what you really feel? [counsel]</td>
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Every emotion can be either appropriate or not.
Contextual Appropriateness of Emotions

Minimal number of people who agreed with the system

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<tr>
<th>Versions of the System</th>
<th>Baseline vs CVS</th>
<th>Baseline vs Blogs</th>
<th>CVS vs CVS+Blogs</th>
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<td>Statistical Significance (p Value)</td>
<td>0.1599 (p&gt;5%)</td>
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Computational Phronesis

What we have done already?
1. emotion subject;
2. emotion object;
3. Verification of contextual appropriateness of emotions;
4. Verification of degree appropriateness;
5. behavioral pattern (reaction)
Computational Phronesis

What we have done already?
1. emotion subject;
2. emotion object;
3. Verification of contextual appropriateness of emotions;
4. Verification of degree appropriateness;
5. behavioral pattern (reaction)

That's what we still have to do...
Computational Phronesis

What we have done already?
1. emotion subject;
2. emotion object;
3. Verification of contextual appropriateness of emotions;
4. Verification of degree appropriateness of emotions;
5. behavioral pattern (reaction)

In the meanwhile ...

Computational Phronesis

What we have done already?
1. emotion subject;
2. emotion object;
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4. Verification of degree appropriateness;
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A long way toward machine emotional integrity...

In the meanwhile...
What we have done already?
1. emotion subject;
2. emotion object;
3. Verification of contextual appropriateness of emotions;
4. Verification of degree appropriateness;
5. behavioral pattern (reaction)

But it seems at last we know the direction.

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Thank you for your attention!

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