A Sequential Bayes Dialog Agent

For Computational Ethnography

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Goals and Motivation

- **Collect ethnographic data about natural language description of emotion using an emotion twenty questions (EMO20Q) dialog agent.**
- Model emotion description as a game-based social process.
- Robustly and naturally interact with speakers to acquire information about language usage and folk theories of emotion.
- Design an automated agent whose algorithm models a human interlocutor.
- Account for interpersonal similarities and differences in emotion description.

Sequential Bayes Model

- Naive Bayes

$$P(\varepsilon|f_1,...,f_t) = \frac{\prod_{i=1}^{t}[P(f_i|\varepsilon)]\,P(\varepsilon)}{\prod_{i=1}^{t}P(f_i)}$$

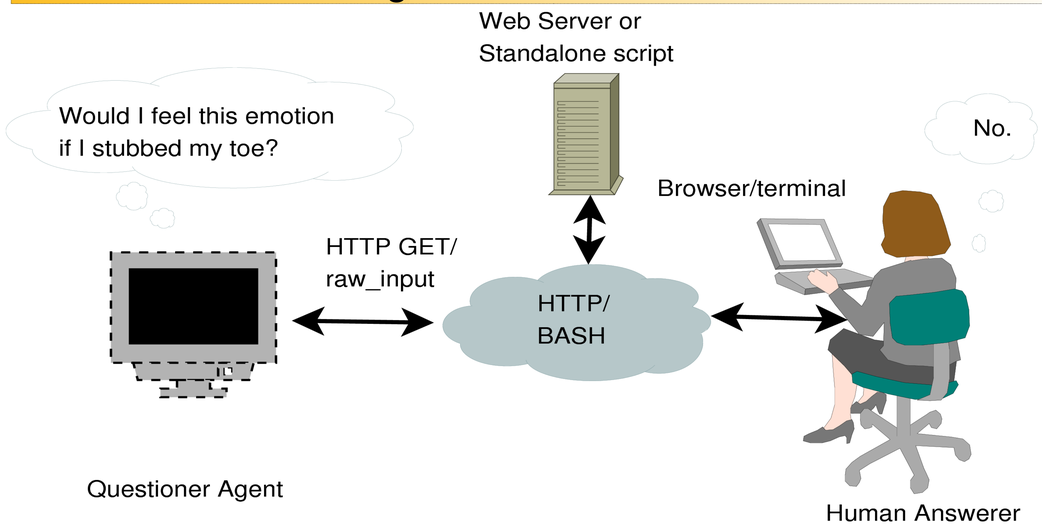
- Sequential Bayes

$$P(\varepsilon|f_1,...,f_t) = \frac{P(f_t|\varepsilon)P(\varepsilon|f_1,...,f_{t-1})}{P(f_t)}$$

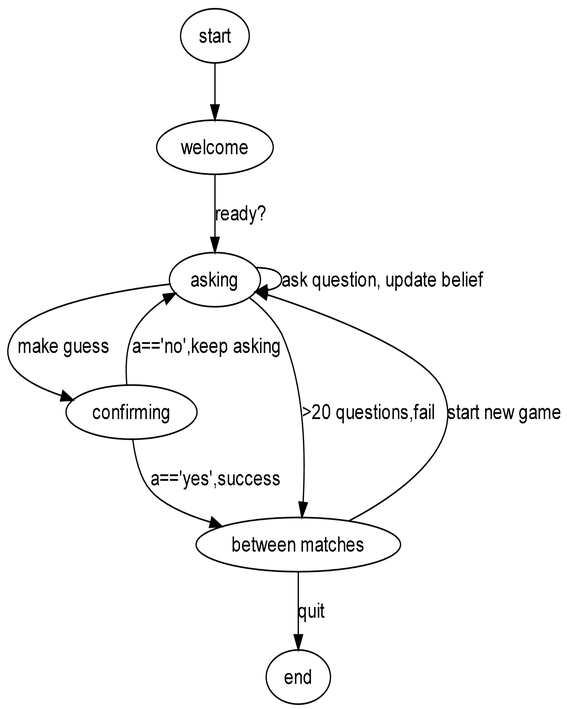
- Or, iteratively

$$\beta_{0,k} = P(\varepsilon = e_k) = 1/|E|$$
$$\beta_{1,k} = \frac{P(f_1|\varepsilon = e_k)}{P(f_1)}\beta_{0,k}$$
$$\vdots$$
$$\beta_{t,k} = \frac{P(f_t|\varepsilon = e_k)}{P(f_t)}\beta_{t-1,k}.$$

The EMO20Q Dialog Game Scenario



Dialog State Machine



Algorithm

Sequential Bayesian EMO20Q Agent
Input: $F = Q \times A$, E, and $P(f|\varepsilon)$
$\beta_{0,k} \leftarrow 1/|E|, \forall k = 1...|E|$
$i = 1$ **to** d
$q^{(i)} = \underset{q \in Q}{\text{argmax}} P((q, \text{'yes'})|\varepsilon)$
Print $q^{(i)}$
$a^{(i)} \leftarrow$ user's input answer
$f_i \leftarrow (q^{(i)}, a^{(i)})$
$\beta_{i,k} \leftarrow \beta_{i-1,k} \cdot P(f_i|\varepsilon = e_k)/P(f_i), \forall k = 1...|E|$
($q^{(i)}$ is identity question for $e_k \wedge a^{(i)} =$ 'yes')
Return: $e^* = e_k$
($q^{(i)}$ is identity question for $e_k \wedge a^{(i)} =$ 'no')
$\beta_{i,k} \leftarrow 0$
$k^* \leftarrow \underset{k \in 1...|E|}{\text{argmax}}[\beta_{i,k}]$
$e^* \leftarrow e_{k^*}$
Return: most likely emotion given observations: e^*

Results

- 15 subjects x 3 EMO20Q matches.

Table 1: Experimental results.

difficulty	% success	avg. turns	% in vocab.	naturalness
easy	73%	11.4	100%	6.9
medium	46%	17.3	93%	5.5
difficult	13%	18.2	60%	5.8
total	44%	15.6	84%	6.1

- C.f. 85% human-human performance.
- Naturalness was relatively constant → algorithm/model is good but needs more data.

Table 1: Emotion words and difficulty.

difficulty	examples
easy	happiness, anger, sadness, calm, confusion
medium	anger, confusion, contentment, curiosity, depression, disgust, excitement, fear, hate, irritation, love, melancholy, sorrow, surprise, tiredness
difficult	devastation, disgust, ecstasy, ennui, frustration, guilt, hope, irritation, jealousy, morose, proud, remorse, vindication, zealousness

- People do not agree on a strict ordering, but difficulty was useful for elicitation.

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