BCCNet: Bayesian classifier combination neural network

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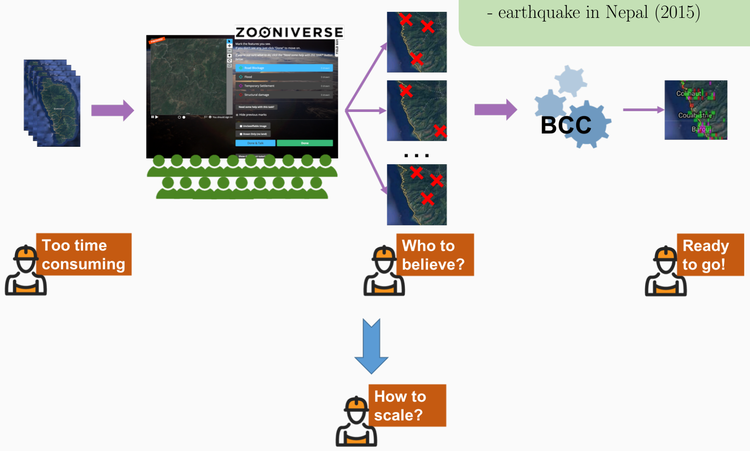
1. Introduction

A sample machine learning problem for developing countries

Work with
- Rescue Global
- Royal Botanic Gardens, Kew

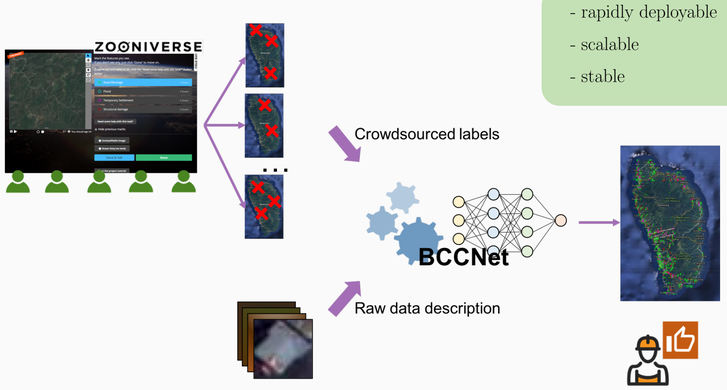
Our solution for previous operations

- hurricanes Irma and Maria (2017)
- earthquake in Ecuador (2016)
- earthquake in Nepal (2015)

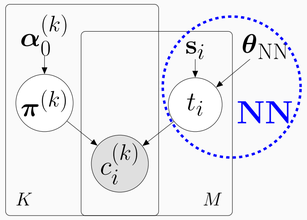


Proposed solution

- rapidly deployable
- scalable
- stable



2. BCCNet



$p(t_i|\mathbf{s}_i, \boldsymbol{\theta}_{\text{NN}})$ – NN output

$c_i^{(k)} \sim \text{Mult}\left(\boldsymbol{\pi}_{t_i}^{(k)}\right)$

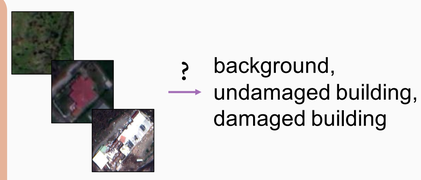
$\boldsymbol{\pi}_j^{(k)} \sim \text{Dir}\left(\boldsymbol{\alpha}_{0j}^{(k)}\right)$

Inference

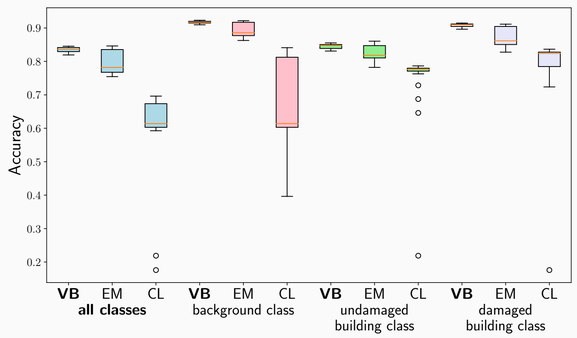
$$\text{ELBO} \longrightarrow \max_{q(\mathbf{t},\boldsymbol{\pi}),\, \boldsymbol{\theta}_{\text{NN}}}$$

3. Case study 1: damage detection for disaster response

Data properties:
- few crowd members with high reliability
- relatively dense matrix of crowd members' answers
- high discrepancy between crowd members' answers



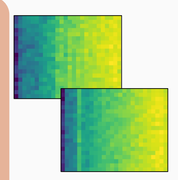
? → background, undamaged building, damaged building



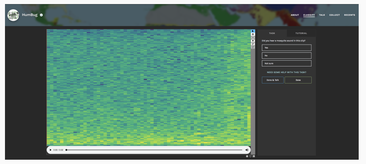
Box plots for accuracy on the damage detection data

4. Case study 2: mosquito detection for malaria prevention

Data properties:
- many crowd members with varied reliability
- very sparse matrix of crowd members' answers
- heavily imbalanced classes



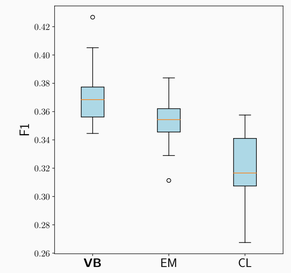
? → mosquito sound, no mosquito sound



Ongoing crowdsourcing project

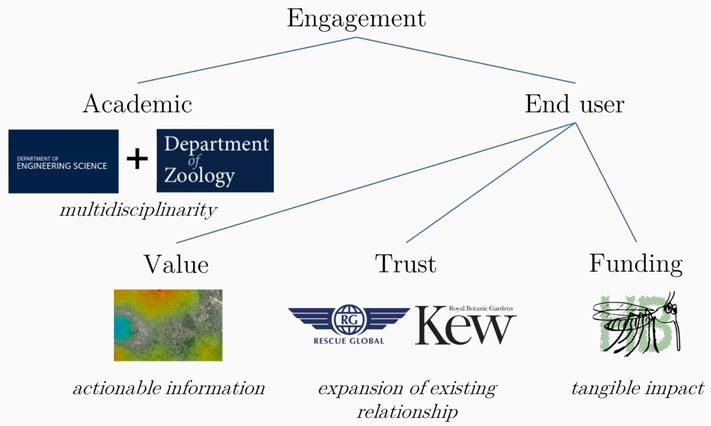
https://www.zooniverse.org/projects/yli/humbug/

HumBug project http://humbug.ac.uk



Box plots for F1 measure on the mosquito detection data

5. Achieving sustainability



References:

VB – proposed algorithm

EM – EM-algorithm extended from Albarqouni et al. 2016

CL – crowd layer network from Rodrigues & Pereira 2018