



BudgetFix: Budget Limited Crowdsourcing for Interdependent Task Allocation with Quality Guarantees

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1. Motivation

Crowdsourcing systems:

Use mass of human intelligence to solve hard AI problems

EPSRC Engineering and Physical Sciences Research Council





2. Problem Description (FFV)

Soylent System (Bernstein et al.):

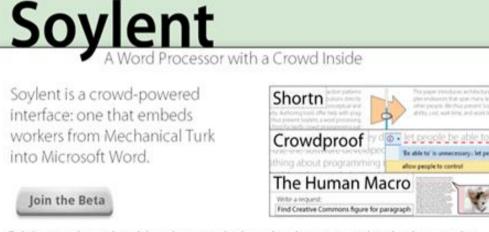
- *Find*: workers locate the position of mistake ($cost = c^x$)
- *Fix:* workers suggest corrections ($cost = c^y$)



Single response is *unreliable redundant task allocation*

How many responses/task are *sufficient* ?

- *users are paid* for their responses
- restricted budget limit
- *interdependent* subtasks: one task's input is another one's output



Today's user interfaces are limited: they only support tasks when we know how to write matching algorithms or interface designs. Microsoft Word is good at laying out your document, but poor at understanding writing and suggesting edits to it. But, it is now feasible to embed on-demand human computation within interactive systems. Crowd workers on services like Armazon Mechanical Turk will do tasks for very small amounts of money. Soylent is a word processor with a crowd inside: an add-in to Microsoft Word that uses crowd contributions to perform interactive document shortening, proofreading, and human-language macros. Underlying Soylent is a new programming design pattern called Find-Fix-Verify that splits tasks into a series of generation and review stages to control costs and increase quality.

Bernstein, M., Little, G., Miller, R.C., Hartmann, B., Aclerman, M., Karger, D.R., Crowell, D. and Panovich, K. Soylent: A Word Processor with a Crowd Inside. In Proc. UIST 2010. ACM Press. Best Student Paper awar

4. Performance Analysis

BudgetFix guarantees that the probability

• *Verify:* workers verify good corrections ($cost = c^z$)

Budget limit B

Allocate workers to different subtasks to achieve **maximal accuracy**

3. Solution Model

- The goal: Minimise the costs $B^x_{,} B^y_{,} B^z$ for each of FFV's three stages
- Let N^x, N^y, N^z model how many inputs are needed from the crowd for each stage
- Budget Constraint: $N^{x}c^{x} + N^{y}c^{y} + N^{z}c^{z} \le B$

of having the wrong find and fix candidates is equal to or less than:

$$\exp\left\{\frac{-(B-C_2)}{C_1} + \ln 3\right\}$$
 or $e^{-O(B)}$

Where B is the Budget limit amount and C₁ and C₂ are: $C_1 = \sum_j \frac{c^j}{W^j} \text{ and } C_2 = \sum_j c^j \frac{V^j + \ln \frac{W^j}{c^j}}{W^j}$

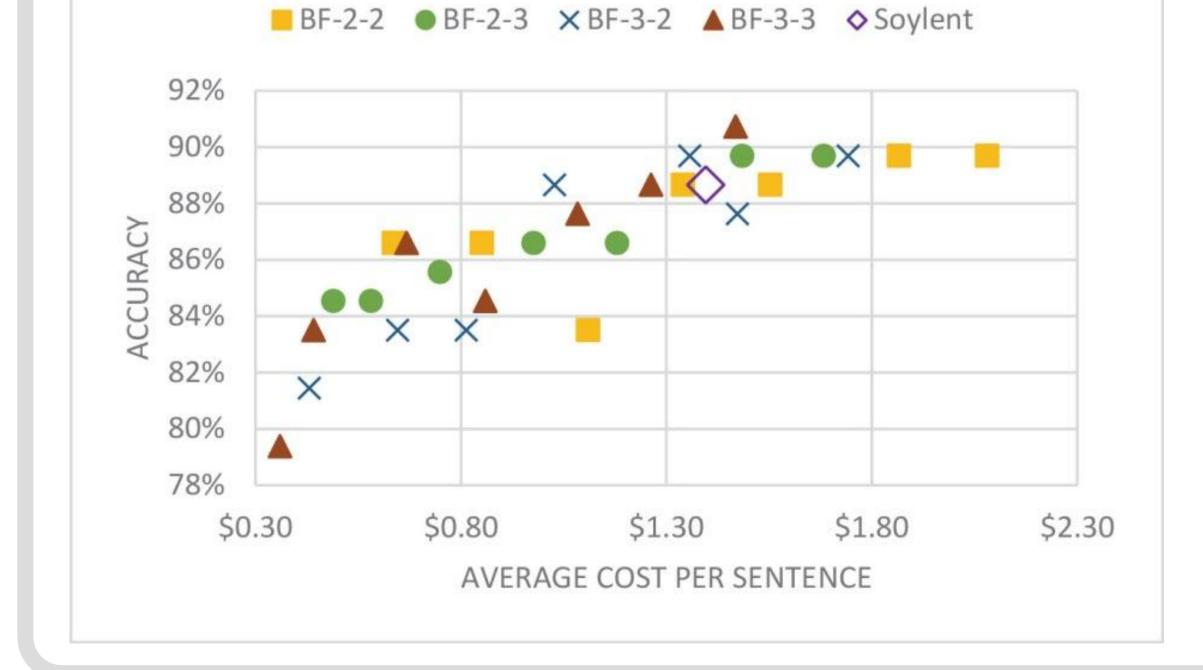
The Algorithm

- **Find** random sampling. Top epsilon candidates propagated
- **Fix** tournament of each round with eliminating weakest candidate and propagate the best
- Verify same as Fix

5. Empirical Evaluation

100 sentences: easy (children stories), moderate (textbooks), hard (AAMAS papers) – difficulty measure: Flesch-Kincaid

Soylent: \$1.40/ sentence on average (baseline)



BudgetFix













Crisis and Disaster Response