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

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1. Motivation

Crowdsourcing systems:

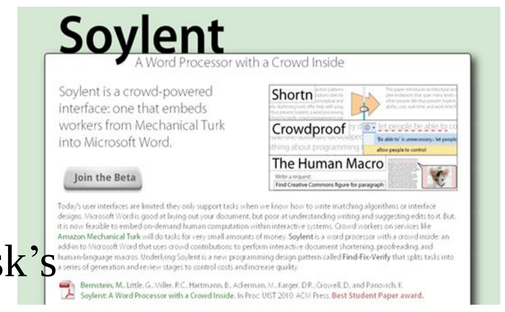
Use mass of human intelligence to solve hard AI problems

amazon mechanical turk™
Artificial Artificial Intelligence

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



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)
- *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: $N^x c^x + N^y c^y + N^z c^z <= B$

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

4. Performance Analysis

BudgetFix guarantees that the probability of having the wrong find and fix candidates is equal to or less than:

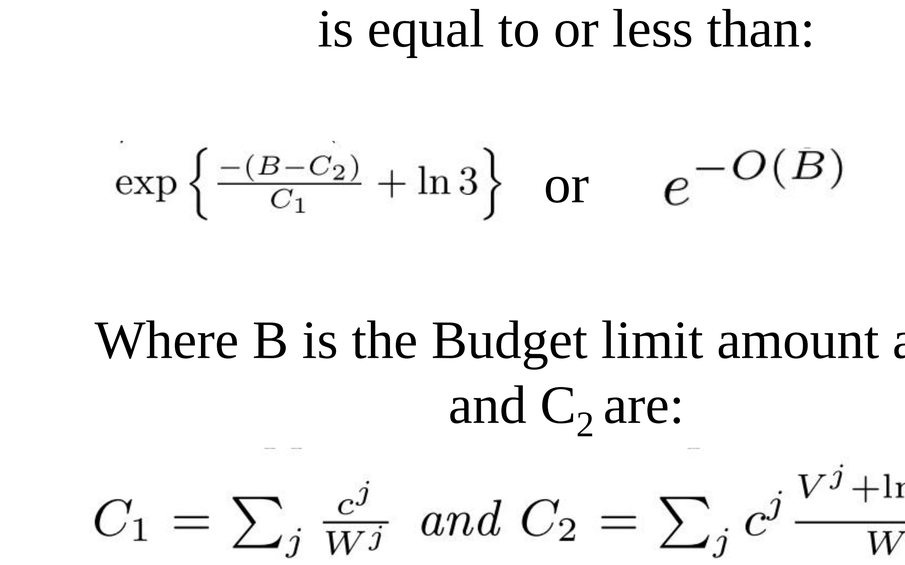
$$\exp\left\{\frac{-(B-C_2)}{C_1}+\ln 3\right\} \quad \text{or} \quad e^{-O(B)}$$

Where B is the Budget limit amount and C_1 and C_2 are:

$$C_1 = \sum_j \frac{c^j}{W^j} \quad and \quad C_2 = \sum_j c^j \frac{V^j + \ln \frac{W^j}{c^j}}{W^j}$$

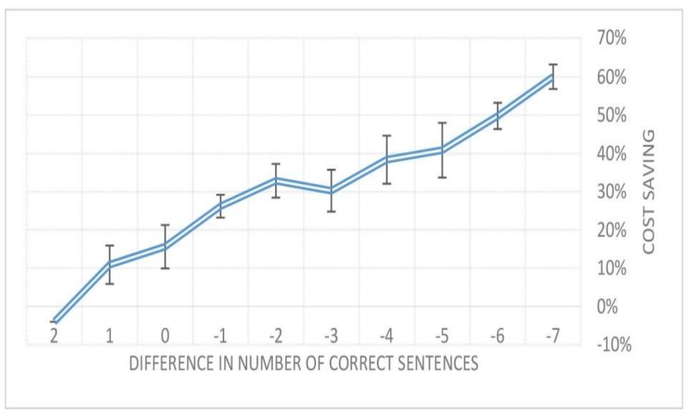
5. Empirical Evaluation

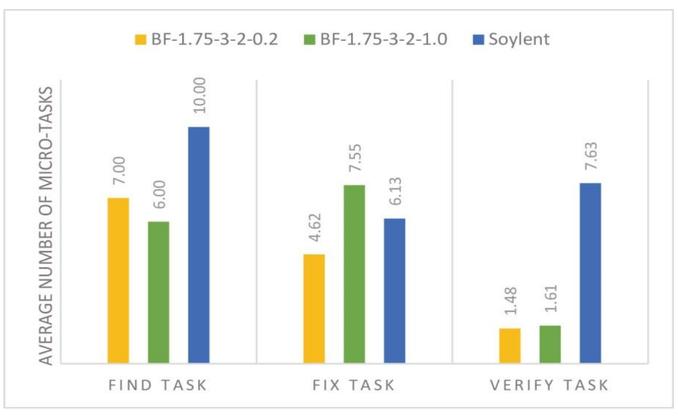
100 sentences: easy (children stories), moderate (textbooks), hard (AAMAS papers) – difficulty measure: Flesch-Kincaid



Soylent: $1.40/ sentence on average (baseline)

BudgetFix





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