Crowdsourcing: (a bit of) theory and ((quite) some) practice

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enetCollect, September 7th, 2017
Where I’m talking from

Main research interests (http://karenfort.org/)

- Language resources creation for natural language processing

- Ethics in natural language processing (NLP)
Where I’m talking from

Related actions

Games (with a purpose) I participated in creating:

- **Zombilingo**
- **Bisame**
- **Krik!**
- **Sex Fit**

Language games portal and recurring workshop:

- **Lingo Boingo**

Games4NLP
Crowdsourcing: back to basics

Games with a purpose (GWAPs)

GWAP-ing in practice: ZombiLingo

Conclusion
Crowdsourcing: back to basics

Definition
Crowdsourcing
Beyond the myths: "Crowdsourcing is recent"
Beyond the myths: "Crowdsourcing implies a crowd"
Beyond the myths: "Crowdsourcing implies non-experts"

Games with a purpose (GWAPs)

GWAP-ing in practice: ZombiLingo

Conclusion
Crowdsourcing is "the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call." [Howe, 2006]

- no a priori identification or selection of the participants ("open call")
Crowdsourcing is "the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call." [Howe, 2006]

- no *a priori* identification or selection of the participants ("open call")
- massive (in production and participation)
Crowdsourcing is “the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call.” [Howe, 2006]

- no *a priori* identification or selection of the participants (“open call”)
- massive (in production and participation)
- (relatively) cheap
Some remarkable achievements

Wikipedia\(^1\) (September 2017):

- more than **45 million articles** in **241** languages
- more than 8 million views per hour for the English version (2014 - could not find more recent data)

Distributed Proofreaders (Gutenberg Project)\(^2\):

- nearly **40,000** digitalized and corrected books

JeuxDeMots [Lafourcade, 2007]\(^3\):

- more than **150 million** relations in the lexical network
- more than 2 million terms added by the players

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\(^1\) [http://stats.wikimedia.org/EN/Sitemap.htm](http://stats.wikimedia.org/EN/Sitemap.htm)

\(^2\) [http://www.pgdp.net/c/stats/stats_central.php](http://www.pgdp.net/c/stats/stats_central.php)

\(^3\) [http://www.jeuxdemots.org](http://www.jeuxdemots.org)
A simplified taxonomy (more in [Geiger et al., 2011])

- Direct
- Indirect
- Not remunerated
- Remunerated
A simplified taxonomy (more in [Geiger et al., 2011])
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A simplified taxonomy (more in [Geiger et al., 2011])
Myth #1: “Crowdsourcing is recent”

*Instructions pour les voyageurs et les employés des colonies*

Citizen science:
- published by the Museum National d’Histoire Naturelle (Paris, France)
- for the travellers and the colonies’ employees:
  
  "to share the results of their own experiences, to benefit themselves and the scientific world"

- first published in **1824**
Other examples

- Ligue de Protection des Oiseaux (birds protection league)\(^4\):
  - monitoring of the birds populations
  - created more than a century ago
  - 5,000 active participants

- Longitude Prize\(^5\) (1714):
  - awarded by the British government to whoever would invent a simple and practical method allowing to determine a ship’s longitude
  - still exists: in 2014 the theme was ”Global antibiotics resistance”

\(^4\)https://www.lpo.fr
\(^5\)https://longitudeprize.org/
Myth #2: "Crowdsourcing implies a crowd of participants"

Number of players on *Phrase Detectives* according to the number of points gained in the game (February 2011 - February 2012)
A crowd of participants? JeuxDeMots

Number of players on JeuxDeMots according to their ranking in the game
(source: http://www.jeuxdemots.org/generateRanking-4.php)
A crowd of participants? ZombiLingo

Annotations

[Graph showing annotations for various names]
Number of active *Turkers* on Amazon Mechanical Turk:

- number of workers registered on the website: more than 500,000
- 80% of the tasks (HIT) are performed by the 20% most active *Turkers* [Deneme, 2009]

⇒ really active workers: between 15,059 and 42,912
Experts vs non-experts

Example of the annotation of named entities in a microbiology corpus:

- experts of the domain?
  - of the corpus (microbiology)?
  - of the application (NLP)?
Experts vs non-experts

Example of the annotation of named entities in a microbiology corpus:

- experts of the domain?
  - of the corpus (microbiology)?
  - of the application (NLP)?

→ experts of the task
Crowdsourcing

Using a crowd of "non-experts"?
Crowdsourcing

Using a crowd of "non-experts"?

→ Finding/training experts (of the task) in the crowd
Crowdsourcing: back to basics

Games with a purpose (GWAPs)
  Using the (basic) knowledge of the crowd
  Using the basic education of the crowd
  Using the learning capabilities of the crowd

GWAP-ing in practice: ZombiLingo

Conclusion
Games with a purpose (GWAPs)

Allow to benefit from:

1. the knowledge of the "world"
2. the basic education
3. the learning capabilities

of the participants (seldom a crowd)
JeuxDeMots: playing association of ideas... to create a lexical network [Lafourcade and Joubert, 2008]

More than 154 million relations (created by approx. 6,000 players), that are constantly updated

- play by pairs
- more and more complex, typed relations
- challenges
- lawsuits
- etc.
Phrase Detectives: playing detective...

...to annotate co-reference [Chamberlain et al., 2008]

3.5M decisions from 45k players
▶ pre-annotated corpus
▶ detailed instructions
▶ training
▶ 2 different playing modes
  ▶ annotation
  ▶ validation (correction of annotations)
FoldIt: playing proteins folding...  
...to solve scientific issues [Khatib et al., 2011]

Solution to the crystal structure of a monomeric retroviral protease (simian AIDS-causing monkey virus)

Solution to an issue unsolved for over a decade
- found in a couple of weeks
- by a team of players
- that will allow for the creation of antiretroviral drugs
FoldIt: playing proteins folding...

...without any prior knowledge in biochemistry [Cooper et al., 2010]

Step-by-step training

- tutorial decomposed by concepts
- puzzles for each concept
- access to the following puzzles is given only if your level is sufficient
Crowdsourcing: back to basics

Games with a purpose (GWAPs)

GWAP-ing in practice: ZombiLingo
  Overview of the game
  Motivating players
  Behind the curtain
  Ensuring quality
  Results

Conclusion
A complex annotation task

- annotation guidelines
  - 29 relation types
  - approx. 50 pages
- counter-intuitive decisions (not school grammar, linguistics):
  \[ \text{aobj} = \text{au} \]
  
  \[ [...] \text{avoir recours au type de mesures} [...] \]

  i.e. head of the PP is the preposition

  \[ \rightarrow \text{decompose} \text{ the complexity of the task} \text{ [Fort et al., 2012], not simplify it!} \]
http://zombilingo.org/

ZOMBI LINGO
BIENVENUE À TOI, JEUNE ZOMBIE!

LE MONDE EST CONDAMNE, TA TRANSFORMATION EN ZOMBIE A COMMENCE.
POUR SURVivre, SUIS MES REGLES, IDENTIFIE LES BETES ET MANGE-LES.
ATTENTION AUX PIES, ILS SONT NOMBREUX!

Jouer
Pas de limite pour toi!
Tu accedes a toutes les options, bonus cachés!

Karen
Retrouve ici tes statistiques, et compare ton score avec celui de tes amis!

SIGNÉ
Prof. Freunkenspoor
MES ENNEMIS

CHALLENGE

Noir TOTAL

1 NICOZOMBI : 323 393
2 CHOUCHOU : 307 339
3 METHOS31 : 290 225
4 LYCO : 143 137
5 MARLIEBO : 45 990
6 FIREY : 18 932
7 LULU666 : 16 300
8 YEONWOO : 16 152
9 NO5 : 14 930
10 KAREN : 14 634
11 NEWSK : 14 406

MES DUELS
Duels gagnés : 4
Matchs nuls : 8
Duels perdus : 5

NEWS

Les Pokémon se cachent aussi chez les Zombis ! Depuis ce matin, nous v... lire la suite...

MON COMPTE

Modifiez mon mot de passe.
Envoi des e-mails.
Supprimez mon compte.

STATISTIQUES

Parties gagnées : 171
Parties parfaites : 118
Nombre d'objets trouvés : 159
Trouve le complément (objet indirect introduit par "à") du verbe indiqué !

Très jeune, il a fait preuve d'initiative et de courage pour **PARTICIPER** à un sauvetage lors d'inondations.
General features

Bring the fun through:

▶ zombie design
▶ use of (crazy) objects
▶ regular challenges (specific corpus and design) on a trendy topic:
  ▶ Star Wars (when the movie was playing)
  ▶ soccer (during the Euro)
  ▶ Pokemon (well...)
LeaderboardS (for achievers)

Criteria:

- number of annotations or points
- in total, during the month, during the challenge
Hidden features (for explorers)

- appearing randomly
- with different effects: objects, other game, etc.
## Duels (for socializers (and killers?))

- **select an enemy**
- **challenge them on a specific type of relation**

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### Duels

- **Nouveau duel**

### Mes duels en cours

<table>
<thead>
<tr>
<th>Karen vs. JYA</th>
<th>JYA gagne 5956 points</th>
<th>Complément en « de » duel en 20 en tours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1420 vs. 1558</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Karen vs. bruno</th>
<th>Karen gagne 660 points</th>
<th>Auxiliaire causatif duel en 20 en tours</th>
</tr>
</thead>
<tbody>
<tr>
<td>660 vs. 660</td>
<td>bruno gagne 660 points</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Karen vs. JYA</th>
<th>Karen gagne 3424 points</th>
<th>Complément en « de » duel en 20 en tours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1754 vs. 1670</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Badges (?) (for collectors)

- play all the sentences for a relation type, for a corpus
- play all the sentences from a corpus
Organizing quality assurance
Preprocessing data (freely available corpora)

- **Ref corpus (Sequoia)**
  - REF<sub>Train & Control</sub>
  - REF<sub>Eval</sub>

- **Unannotated corpus (Wikipedia)**
  - Raw text

- **Training phase**
  - TRAINING (feedback)

- **Play phase**
  - CONTROL (feedback)
  - EVAL (no feedback)

- **Pre annotation** with 2 parsers

- **Exp**
  - EXP<sub>Game</sub>
  - EXP<sub>Eval</sub>

- Player’s confidence
Preprocessing data (freely available corpora)

Pre-annotation with two parsers

1. a statistical parser: Talismane [Urieli, 2013]
2. a symbolic parser, based on graph rewriting: FrDep-Parse [Guillaume and Perrier, 2015]

→ play the items for which the two parsers give different annotations
Training, control and evaluation

Reference: 3,099 sentences of the Sequoia corpus [Candito and Seddah, 2012]

REF_train & Control is used to train the players

REF_eval is used like a raw corpus, to evaluate the produced annotations
Training the players

Compulsory for each dependency relation

- sentences are taken from the REF Train&Control corpus
- a feedback is given in case of error
Dealing with cognitive fatigue and long-term players

Control mechanism

Sentences from the REF\textsubscript{Train} & \textsubscript{Control} corpus are proposed regularly

1. if the player fails to find the right answer, a feedback with the solution is given

\begin{quote}
Ils ont été reçus à la boulangerie Leroy \textit{pour} visiter le fournil et \textit{surtout} pétrir la pâte afin de confectionner de délicieux pains au chocolat qu’ils ont dégusté à l’heure du goûter avec un verre de jus de fruit.
\end{quote}

\begin{quote}
Tu as répondu \textit{surtout} et il fallait répondre \textit{visiter}.
Il te reste 2 essais avant de devoir refaire le tutoriel de ce phénomène.
\end{quote}
Dealing with cognitive fatigue and long-term players

Control mechanism

Sentences from the REF $Train\&Control$ corpus are proposed regularly

1. if the player fails to find the right answer, a feedback with the solution is given
2. after a given number of failures on the same relation, the player cannot play anymore and has to redo the corresponding training

- 1er FÉVRIER 1995 : Jean-Paul Schimpf, un ami intime de Didier Schuller, est arrêté sur un parking, alors que la dirigeante d'une entreprise d'assainissement disait vouloir lui remettre une somme d'argent en liquide.

Tu as répondu une et il fallait répondre arrêté

Tu as un peu oublié comment jouer ce phénomène. Pour continuer à jouer sur celui-ci, tu vas devoir refaire le tutoriel correspondant.
Dealing with cognitive fatigue and long-term players

Control mechanism

Sentences from the $\text{REF}_{\text{Train&Control}}$ corpus are proposed regularly:

1. if the player fails to find the right answer, a feedback with the solution is given
2. after a given number of failures on the same relation, the player cannot play anymore and has to redo the corresponding training

→ we deduce a level of confidence for the player on this relation
Production: game corpus size
compared to other existing French dependency syntax corpora

As of July 10, 2016
▶ 647 players (1,150 as of Sept. 5th, 2017)
▶ who produced 107,719 annotations (more than 390,000 as of Sept. 5th, 2017)

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Sent.</th>
<th>Tok.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequoia 7.0</td>
<td>3,099</td>
<td>67,038</td>
</tr>
<tr>
<td>UD-French 1.3</td>
<td>16,448</td>
<td>401,960</td>
</tr>
<tr>
<td>FTB-UC</td>
<td>12,351</td>
<td>350,947</td>
</tr>
<tr>
<td>FTB-SPMRL</td>
<td>18,535</td>
<td>557,149</td>
</tr>
<tr>
<td>Game</td>
<td>5,221</td>
<td>128,046</td>
</tr>
</tbody>
</table>

+ (ever)growing resource!

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6 ZL 1.0, July 2014 vs UD 1.0 January 2015.
Evaluating quality on the REF$_{Eval}$ corpus

![Bar chart showing F-measure for different linguistic categories. The chart compares Talismane, FrDep-Parse, and Game.]
Annotation density
on the $\text{REF}_{\text{Eval}}$ corpus

→ need more annotations on some relations
Next steps
Expand to new languages and new annotation types

New languages
▶ English
▶ less-resourced languages

New annotation types
▶ part-of-speech (POS),
▶ corpus building,
▶ etc.

Alice Millour (PhD student)
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Conclusion
Crowdsourcing for language resources creation

Achievements

▶ surprisingly good results in terms of quantity and quality
▶ we demonstrated that we can train people on a complex task

Difficulties

▶ motivating people → language learning could work (?\textsuperscript{7})
▶ communication / advertisement
▶ gamification

\[\text{\textsuperscript{7}There is no (yet) scientific evidence that it does.}\]
THANK YOU

https://github.com/zombilingo

http://zombilingo.org/export
ZombiLingo’s team and fundings

Bruno Guillaume (researcher)

Nicolas Lefèbvre (engineer)
Appendix

Amazon Mechanical Turk: a platform of legends
Ethical issues
Varying costs
Complexity of the tasks

Bibliographie
History: von Kempelen’s Mechanical Turk

A mechanical chess player created by J. W. von Kempelen in 1770
History: von Kempelen’s Mechanical Turk

In fact, a human chess master was hiding inside to operate the machine.
History: von Kempelen’s Mechanical Turk

It’s artificial artificial intelligence!
And Amazon created AMT

Amazon created for its own needs a microworking platform and opened it to everyone in 2005 (taking 10% of the transactions (20% now))
Cheap and Fast — But is it Good?
Evaluating Non-Expert Annotations for Natural Language Tasks

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[Snow et al., 2008]
AMT: the dream come true?
for NLP

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[Snow et al., 2008]

It’s very cheap, fast, good quality work
and it’s a hobby for the Turkers!
Amazon Mechanical Turk (AMT)

MTurk
Amazon Mechanical Turk (AMT)

MTurk is a **crowdsourcing** system: work *outsourced* via the Web, done by many people (the *crowd*), here, the **Turkers**
Amazon Mechanical Turk (AMT)

MTurk is a crowdsourcing, microworking system: tasks are cut into small pieces (HITs) and their execution is paid for by the Requesters.
MTurk is a **crowdsourcing**, **microworking** system: tasks are cut into small pieces (HITs) and their execution is **paid for**.
Amazon Mechanical Turk (AMT)

MTurk is a crowdsourcing, microworking system: tasks are cut into small pieces (HITs) and their execution is paid for.
Is AMT Ethical and/or legal?

Ethics:

- No identification: no relation between Requesters and Turkers and among Turkers
- No possibility to unionize, to protest against wrongdoings or to go to court.
- No minimal wage (< 2$/hr in average)
- Possibility to refuse to pay the Turkers
Is AMT Ethical and/or legal?
AMT: a hobby for the *Turkers*?

[Ross et al., 2010, Ipeirotis, 2010] show that:

- *Turkers* are primarily financially motivated (91%):
  - 20% use AMT as their primary source of income;
  - 50% as their secondary source of income;
  - leisure is important for only a minority (30%).
- 20% of the *Turkers* spend more than 15 hours a week on AMT, and contribute to 80% of the tasks.
- observed mean hourly wages is below US$ 2.

[Gupta et al., 2014]: given that training the workers is impossible on AMT, an important part of the work of the *Turkers* is hidden
Turkers are not anonymous [Lease et al., 2013]
The Turkers’ id corresponds to their Amazon client id
AMT allows to reduce costs

Very low wages $\Rightarrow$ low costs? Yes, but...

- UI development
- creation of protections against spammers
- validation and post-processing costs

Some tasks (for example, in less-resourced languages) generate costs that are similar to the usual costs in the domain, due to a lack of qualified Turkers [Novotney and Callison-Burch, 2010].
Depending on an external platform

Impossible to control:

- the costs
- the participants’ working conditions
- the selection of participants
- the conditions of the experiment
HITs (Human Intelligence Tasks): simplified tasks

AMT does not allow for the training of the workers:

- quality is not satisfactory for complexe tasks (for example, summarizing [Gillick and Liu, 2010])
- for some simple tasks, NLP tools produce better results than AMT [Wais et al., 2010].

⇒ Simplification of the tasks:
  - a real textual entailment annotation task (inference, neutral, contradiction) is reduced to 2 phases and 1 question: "Would most people say that if the first sentence is true, then the second sentence must be true?" [Bowman et al., 2015]


Deneme (2009).
How many turkers are there?
http://groups.csail.mit.edu/uid/deneme/.


Modeling the complexity of manual annotation tasks: a grid of analysis.


Crystal structure of a monomeric retroviral protease solved by protein folding game players.

Making people play for lexical acquisition.
In *7th Symposium on Natural Language Processing (SNLP 2007)*, Pattaya, Thailand.

JeuxDeMots : un prototype ludique pour l’émergence de relations entre termes.
In *Proceedings of the Journées internationales d’Analyse statistique des Données Textuelles (JADT)*, Lyon, France.


