# Data Science and NLP for Humanitarian and Social Impact Work

# about.me

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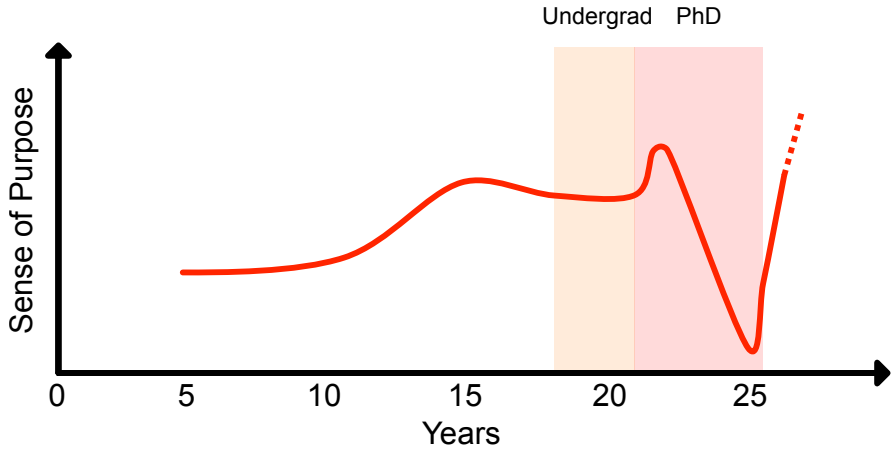
# A Life in Data



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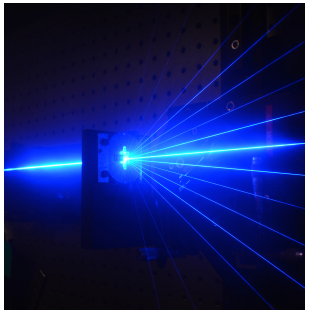
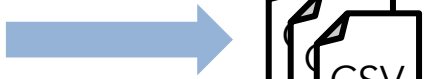
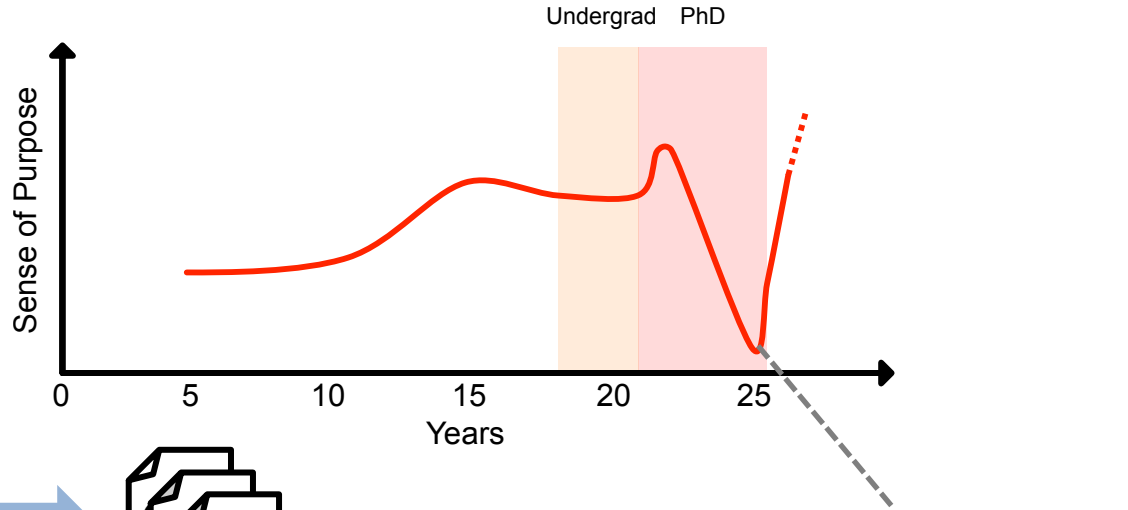
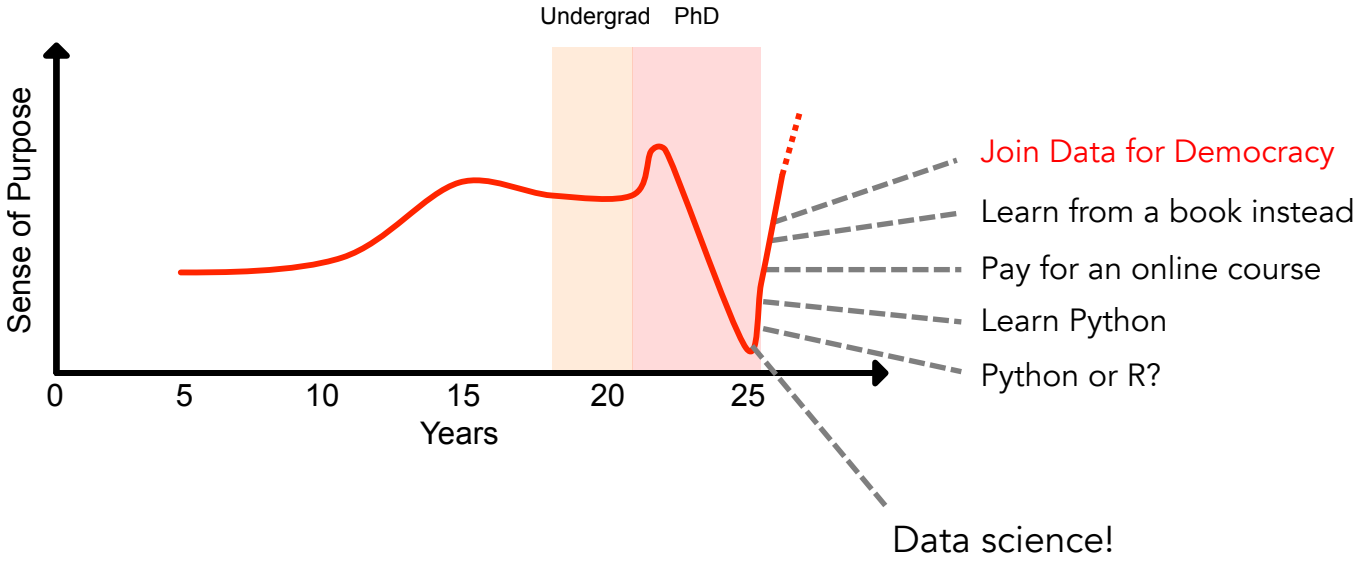





Data science!

# A Life in Data

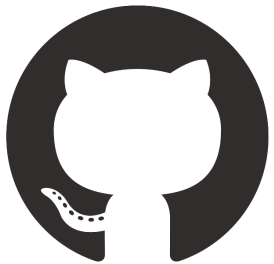


# Data for Democracy

# What is D4D?

DATA FOR DEMOCRACY

=



+


github.com/data4democracy

datafordemocracy.slack.com

# What is D4D?


gerrymandering election transparency government expenditures

hate speech fact checking open source tools immigration

# A Humanitarian Project

unite IDEAS

iDMC internal displacement monitoring centre


https://unite.un.org/ideas/content/idetect

# Monitoring Displacement

# Internally Displaced Persons

An internally displaced person (IDP) is **someone who is forced to flee his or her home but who remains within his or her country's borders**. They are often referred to as refugees, although they do not fall within the legal definitions of a refugee.

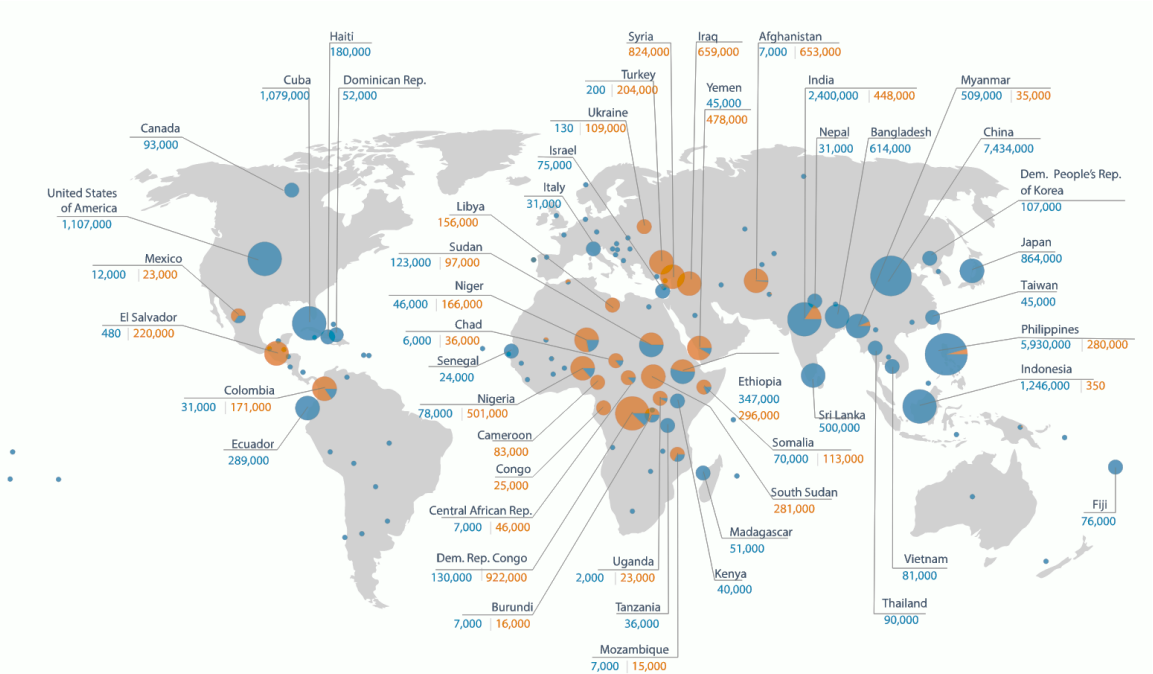
https://en.wikipedia.org/wiki/Internally_displaced_person

- Armed conflicts
- General violence
- Human rights abuses
- Slow onset disasters
- Sudden onset disasters
- Development investments

# IDPs - The Numbers

Total Number of IDPs in December 2016

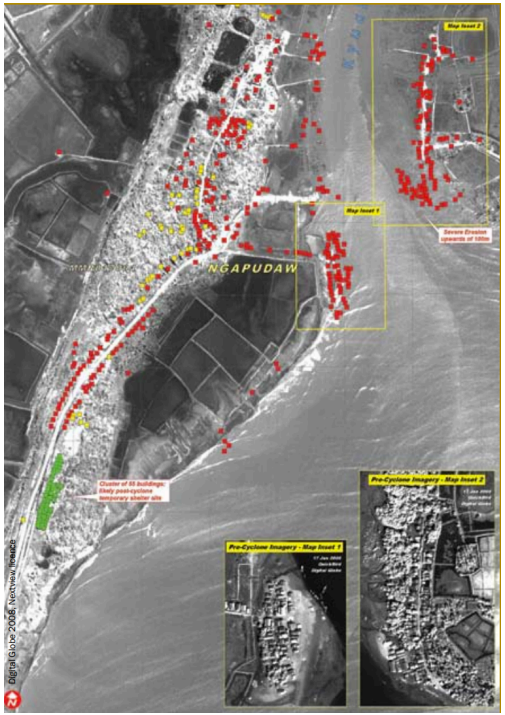
**40.3m**




New Displacements in 2016


http://www.internal-displacement.org/global-report/grid2017/

# Monitoring IDPs - The Current Approach




http://www.fmreview.org/sites/fmr/files/FMRdownloads/en/climatechange/bjorgo-pisano-lyons-heisig.pdf

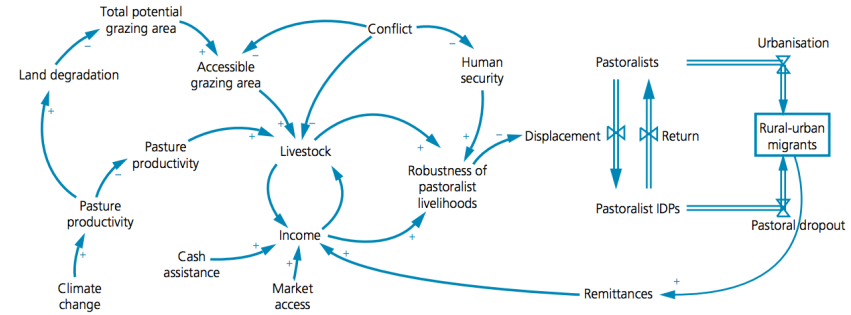
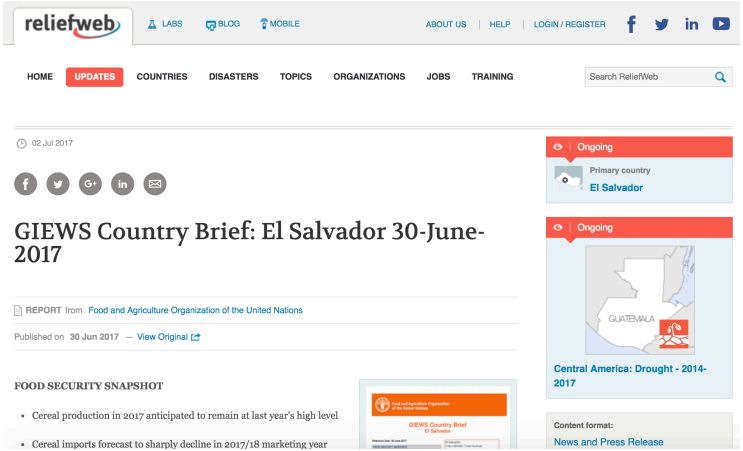
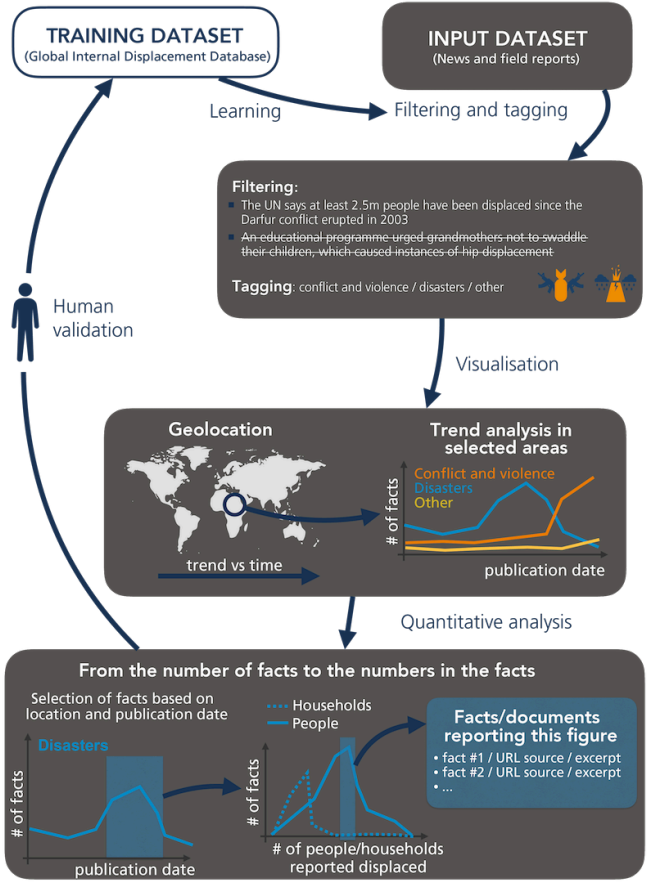



Figure 1: Pastoralist livelihoods and displacement dynamics

IDMC 2014 Annual Report



# #IDETECT




**Data Collection:**
Scrape content from incoming URLs

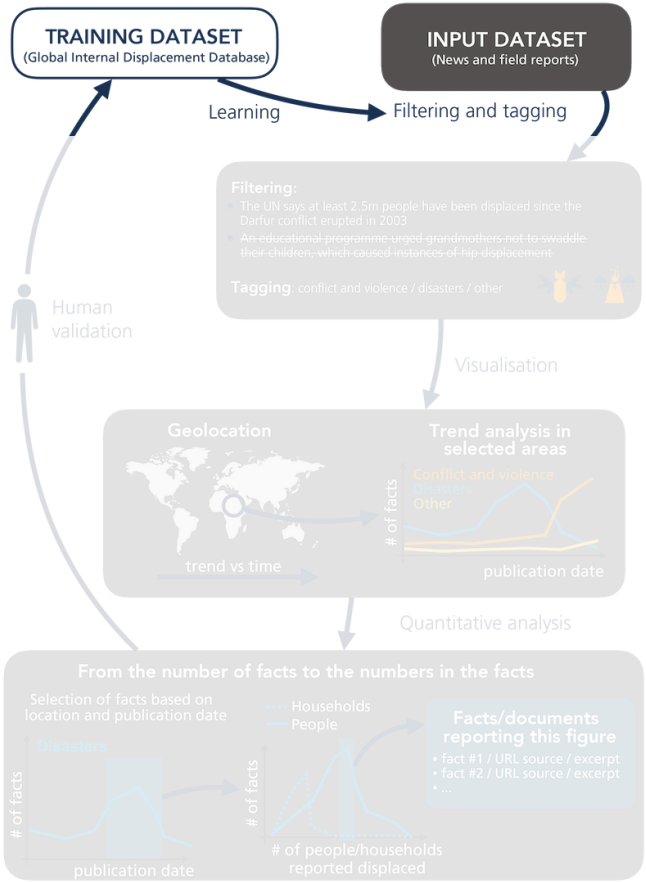
**Classification:**
Relevant or not relevant?
Conflict and violence or disaster?

**Information Extraction:**
Displacement figure, location, date, reporting term, reporting unit

https://unite.un.org/ideas/content/idetect

# Our Approach

# Part I – Content Retrieval

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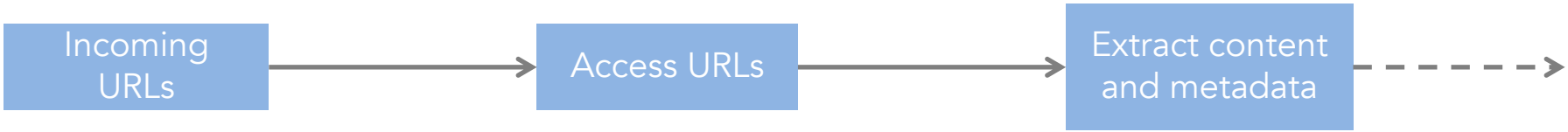
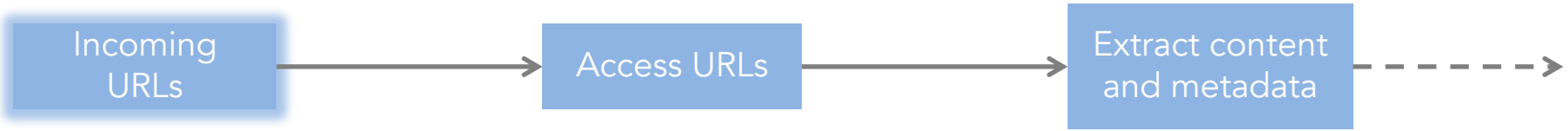
# Scraping



# Scraping

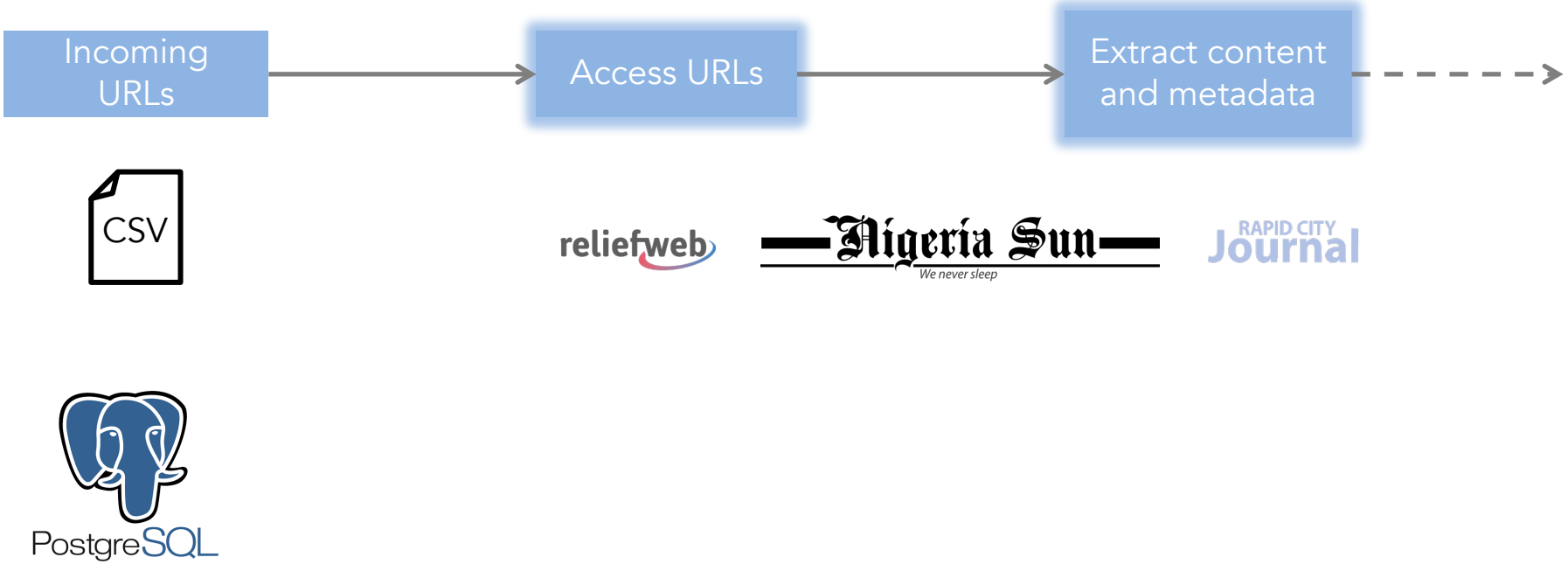

Incoming URLs
Access URLs
Extract content and metadata


CSV


PostgreSQL


SQLAlchemy

# Scraping


Incoming URLs
Access URLs
Extract content and metadata
CSV
reliefweb
Nigeria Sun
We never sleep
RAPID CITY Journal
PostgreSQL

# Scraping

Incoming URLs → Access URLs → Extract content and metadata → ...

CSV

reliefweb

Nigeria Sun — We never sleep

RAPID CITY Journal

PostgreSQL

```
$ pip install newspaper3k
```


Newspaper: Article scraping & curation

Release v0.1.2. (Installation).

Inspired by requests for its simplicity and powered by lxml for its speed.

# Newspaper – Content Grabbing for Lazy People

In [1]:
```
import newspaper
```

In [2]:
```
url = "http://utopiadispatch.com/episodes/episode-1-utopia-or-dispatch/"
a = newspaper.Article(url)
a.download()
a.parse()
```

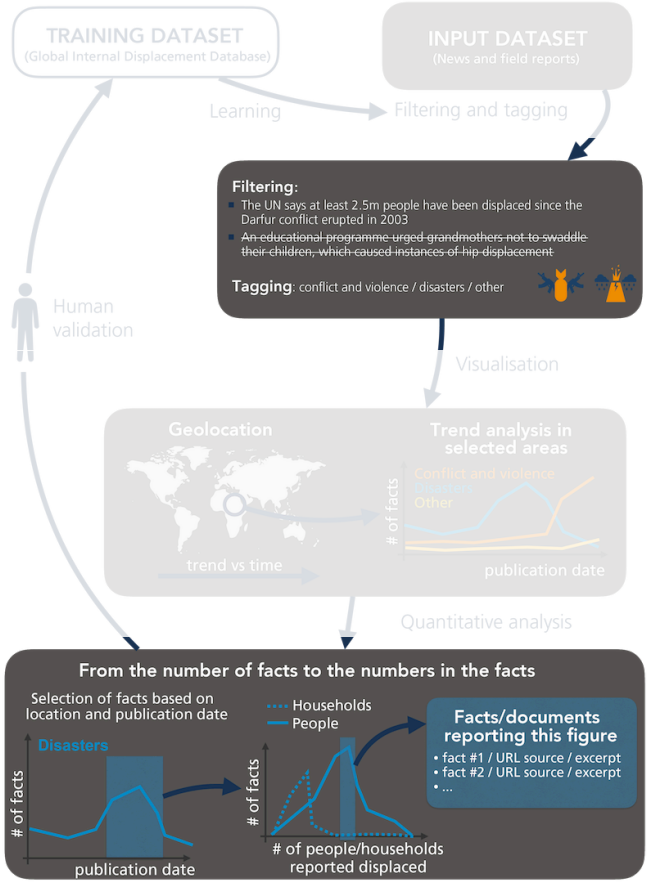
In [3]:
```
a.title
```

Out[3]:
```
'Episode 1 - Utopia or Dispatch'
```

In [4]:
```
a.text
```

Out[4]:
```
'In the first episode of Utopia Dispatch we take a lighthearted tour of T
homas More's "Utopia", the book that coined the term 500 years ago. We se
e how the ideas hold up today, and how they might set the direction for o
ur search for the perfect world.\n\nWe also bring you some good news, wit
h The Good, The Best, and The Bestest.'
```

# Part II – Article Processing

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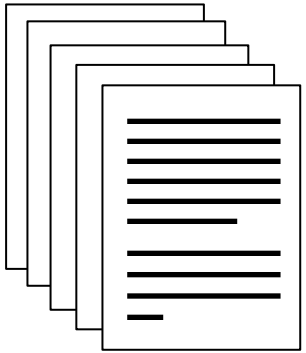
# NLP Overview

"NLP is a way for computers to analyze, understand, and derive meaning from human language in a smart and useful way."

Matt Kiser, Algorithmia

# NLP Overview



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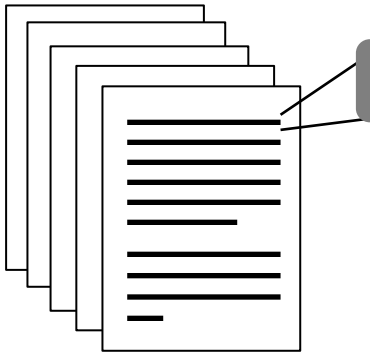
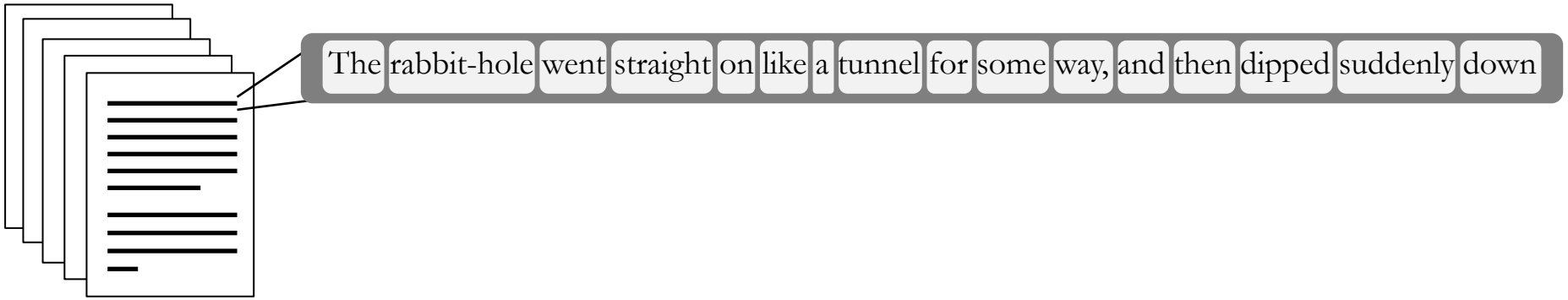
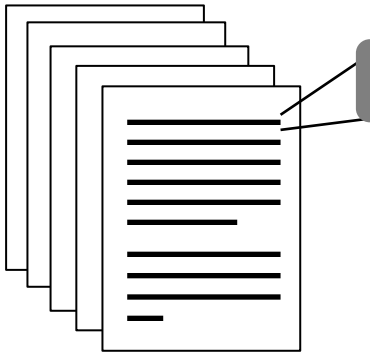


The rabbit-hole went straight on like a tunnel for some way, and then dipped suddenly down

# NLP Overview



# NLP Overview



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## Linguistic

NLTK

spaCy

- Preprocessing
- Parsing
- Part of speech
- Lexical databases

## Numerical

scikit learn

gensim
topic modelling for humans

- Vectorisation
- Machine learning
- Deep learning

# Content Confusion

The storm killed more than 500 people in Haiti and at least 23 in the U.S. — nearly half of them in North Carolina. At least three people were missing.  The full extent of the disaster in North Carolina was still unclear, but it appeared that thousands of homes were damaged, and more were in danger of flooding.

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A levee in Lumberton appeared to fail overnight, but officials later concluded that floodwaters had flowed around it.  About 1,500 people had to be rescued early Monday. Most of them were in knee-deep water, but some fled to rooftops as the brown waters swirled around them.

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# Continuous Content Confusion

…NDRF Director General O P Singh told PTI that while five teams are being airlifted for immediate deployment from its base in Odisha to Uttar Pradesh, the rest five are being picked by choppers from Bathinda in Punjab and will be sent to Bihar.

…

Singh said the teams will be in addition to the 56 such contingents which are undertaking flood combat operations in these two states, besides Rajasthan, Madhya Pradesh and Uttarakhand.

…

"So far, the NDRF teams have evacuated more than 26,400 people from various flood-prone areas in the country this monsoon season.

…

In Bihar on Monday, NDRF teams evacuated 3,400 people from Didarganj, 580 from Bakhtiyarpur, 545 from Danapur, 380 from Chhapra, 355 from Vaishali and 15 from Maner in Patna. The NDRF said 11 flood rescue teams rescued 275 people from Ballia, 275 from Varanasi and 325 from Chitrakoot in UP on yesterday.  Nearly 150 marooned people were shifted to safer places from Rewa district in Madhya Pradesh on Sunday.

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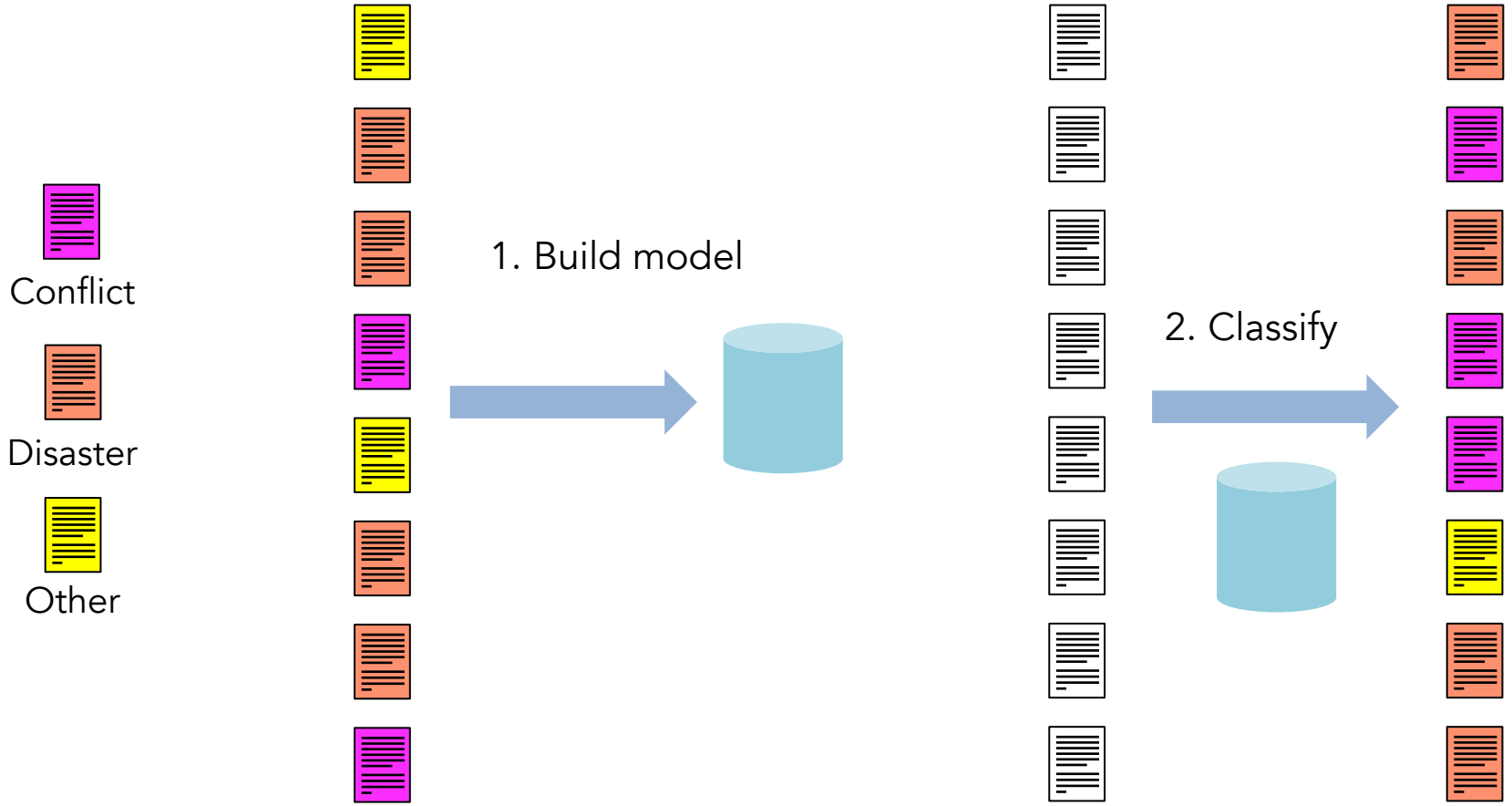
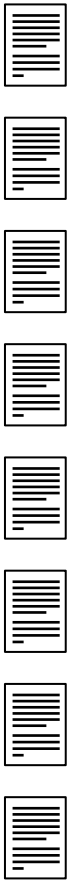


# Article Classification



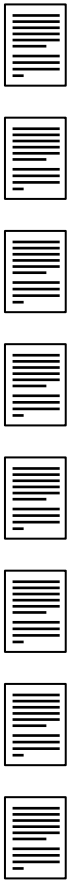
## Term Frequency Matrix

| | country | evacuated | fighting | flood | … | houses | storm |
|---|---|---|---|---|---|---|---|
| Document 1 | 2 | 1 | 2 | | | 1 | |
| Document 2 | 1 | 2 | | 2 | | | |
| Document 3 | 2 | | | | | | 3 |

## Term Frequency-Inverse Document Frequency Matrix (tf-idf)

| | country | evacuated | fighting | flood | … | houses | storm |
|---|---|---|---|---|---|---|---|
| Document 1 | 0.12 | 0.21 | 0.51 | | | 0.02 | |
| Document 2 | 0.10 | 0.25 | | 0.38 | | | |
| Document 3 | 0.12 | | | | | | 0.47 |

# Article Classification



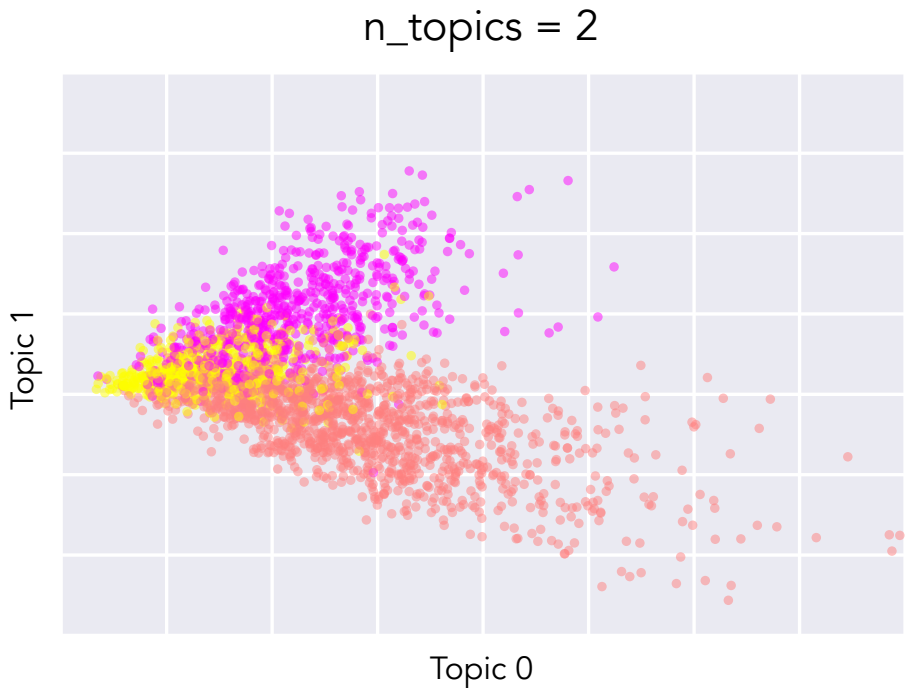
Dimensionality Reduction

Topic Matrix (Latent Semantic Indexing) (n_topics ~300)

| | topic 0 | topic 1 | topic 2 | topic 3 | … | topic k |
|---|---|---|---|---|---|---|
| Document 1 | 0.12 | 0.93 | 0.38 | 0.07 | | |
| Document 2 | 0.34 | 0.25 | 0.30 | 0.46 | | |
| Document 3 | 0.01 | 0.14 | 0.87 | 0.22 | | |

```
topic 0: 0.7 * flooding + 0.2 * flee + 0.14 * water + …
topic 1: 0.6 * vehicles + 0.3 * combat + 0.14 * nation + …
topic 2: 0.4 * evacuated + 0.2 * people + 0.2 * houses + …
…
```

# Article Classification - Category


F1 ≈ 0.92

# Article Classification - Relevance

Not Displacement

Displacement

F1 ≈ 0.80

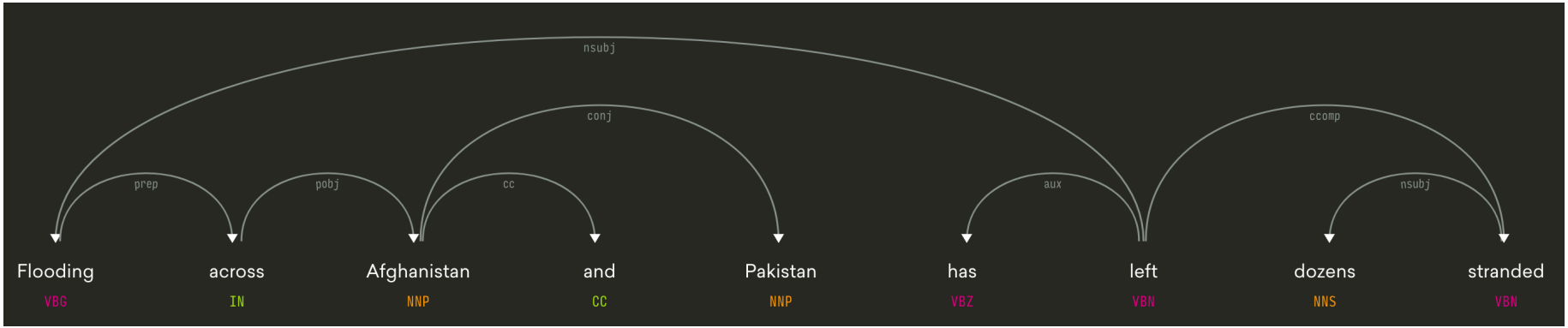
# Feature Engineering for Edge Cases

Flooding across Afghanistan and Pakistan has left dozens stranded

A disaster management official said the careful clearing of the landslide across the border

# Feature Engineering for Edge Cases

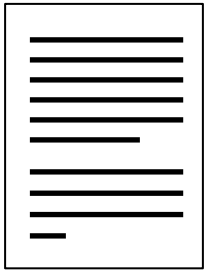
Flooding across Afghanistan and Pakistan has left dozens stranded




A disaster management official said the careful clearing of the landslide across the border

✅ `landslide_across_border` ❌ `fled_across_border` ❌ `safety_across_border`

# Information Extraction



- Date
- Location
- Displacement Figure
- Reporting Term
- Reporting Unit

**Reporting Terms**

- ❑ displaced
- ❑ evacuated
- ❑ forced to flee
- ❑ homeless
- ❑ in relief camp
- ❑ sheltered
- ❑ relocated
- ❑ destroyed housing
- ❑ partially destroyed housing
- ❑ uninhabitable housing

**Reporting Units**

- ❑ people
- ❑ persons
- ❑ individuals
- ❑ children
- ❑ inhabitants
- ❑ residents
- ❑ migrants
- ❑ families
- ❑ households
- ❑ houses
- ❑ homes

# Articles to Reports

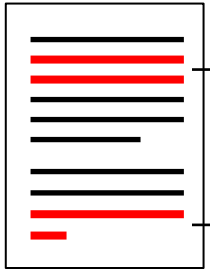
on Monday, NDRF teams evacuated 3,400 people from Didarganj

NDRF teams have evacuated more than 26,400 people from various flood-prone areas

Report = Key word co-occurences:

e.g. “people” + “evacuated”

# Information Extraction



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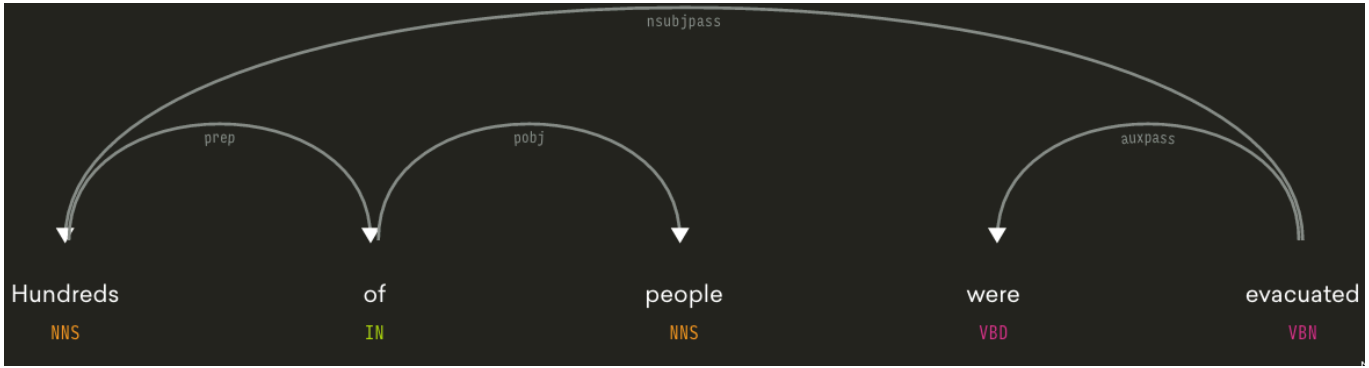


**Reporting Term** (displaced, evacuated, …) -> **verb**
**Reporting Unit** (people, houses, …) -> **object** or **subject** of the verb

# Entity Recognition

spaCy + displaCy

# Information Extraction

2,000 citizens were moved to safety

**Reporting Terms**

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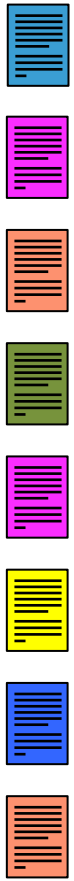
# Information Extraction

- Word2Vec Models
- Word Vectorisation
- Bigrams

| | a1 | a2 | a3 | a4 | a5 | ... | an |
|---|---|---|---|---|---|---|---|
| r0 | | | | | | | |
| r1 | | | | | | | |
| r3 | | | | | | | |
| r4 | | | | | | | |
| r5 | | | | | | | |
| ... | | | | | | | |
| rm | | | | | | | |

Rules + ML



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- Word2Vec Models
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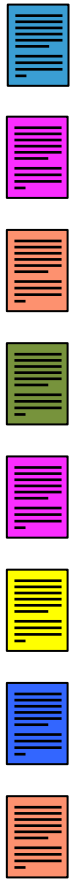
| | a1 | a2 | a3 | a4 | a5 | ... | an |
|---|---|---|---|---|---|---|---|
| r0 | | | | | | | |
| r1 | | | | | | | |
| r3 | | | | | | | |
| r4 | | | | | | | |
| r5 | | | | | | | |
| ... | | | | | | | |
| rm | | | | | | | |

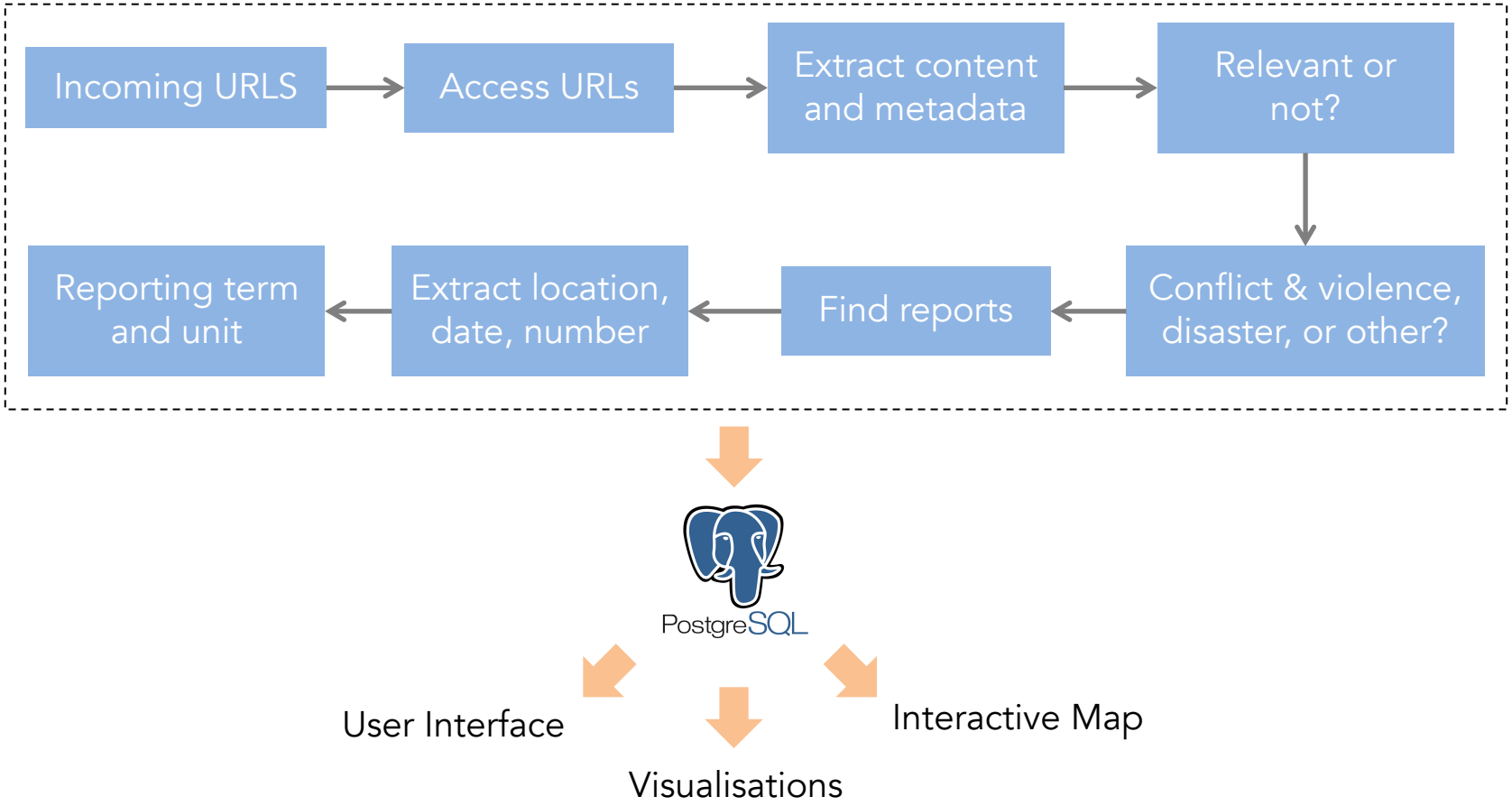
Rules + ML



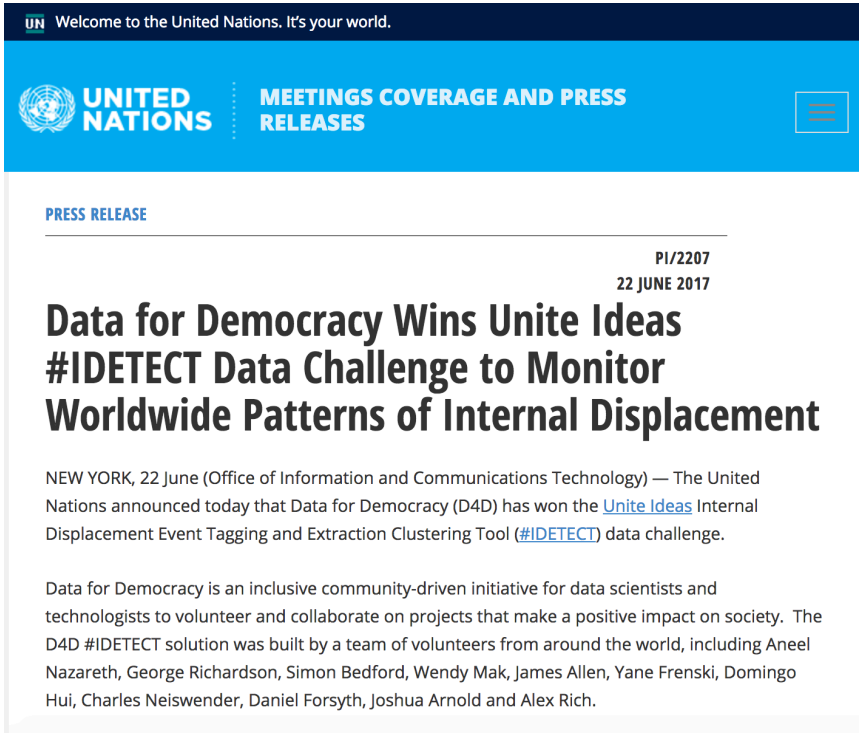
F1-score Reporting Unit: 0.73 → 0.93

F1-score Reporting Term: 0.68 → 0.71

# The Whole Picture



# The Result



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PRESS RELEASE

PI/2207
22 JUNE 2017

## Data for Democracy Wins Unite Ideas #IDETECT Data Challenge to Monitor Worldwide Patterns of Internal Displacement

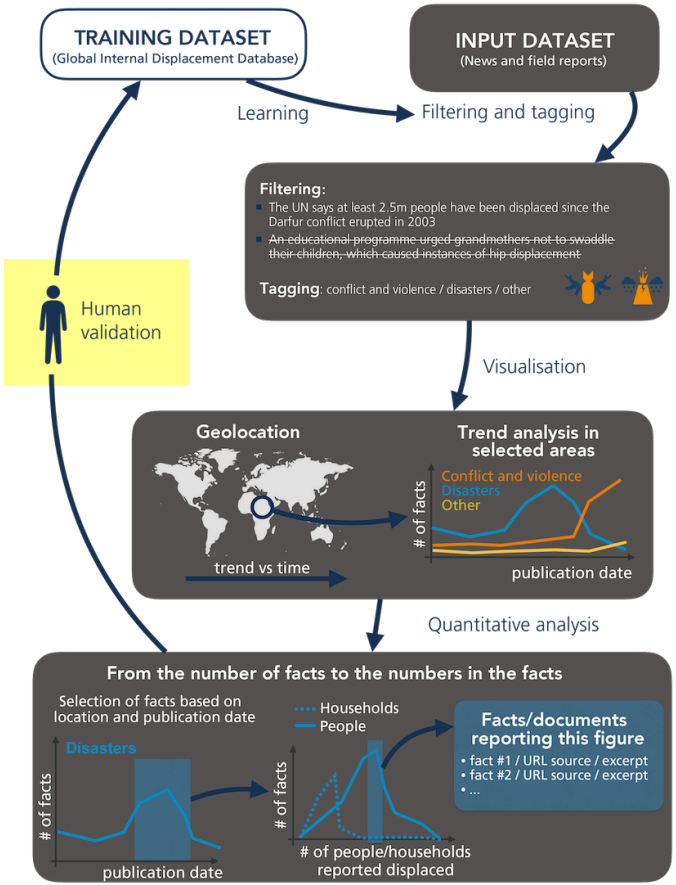
NEW YORK, 22 June (Office of Information and Communications Technology) — The United Nations announced today that Data for Democracy (D4D) has won the Unite Ideas Internal Displacement Event Tagging and Extraction Clustering Tool (#IDETECT) data challenge.

Data for Democracy is an inclusive community-driven initiative for data scientists and technologists to volunteer and collaborate on projects that make a positive impact on society. The D4D #IDETECT solution was built by a team of volunteers from around the world, including Aneel Nazareth, George Richardson, Simon Bedford, Wendy Mak, James Allen, Yane Frenski, Domingo Hui, Charles Neiswender, Daniel Forsyth, Joshua Arnold and Alex Rich.

"Open-source developers are proving to be an invaluable resource to the United Nations and our partners"

"a machine learning approach is better suited for a non-static context like internal displacement as the themes and topics can be updated (online learning)"

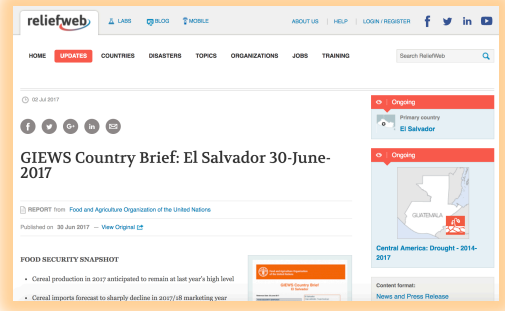
# 21st Century Displacement Monitoring



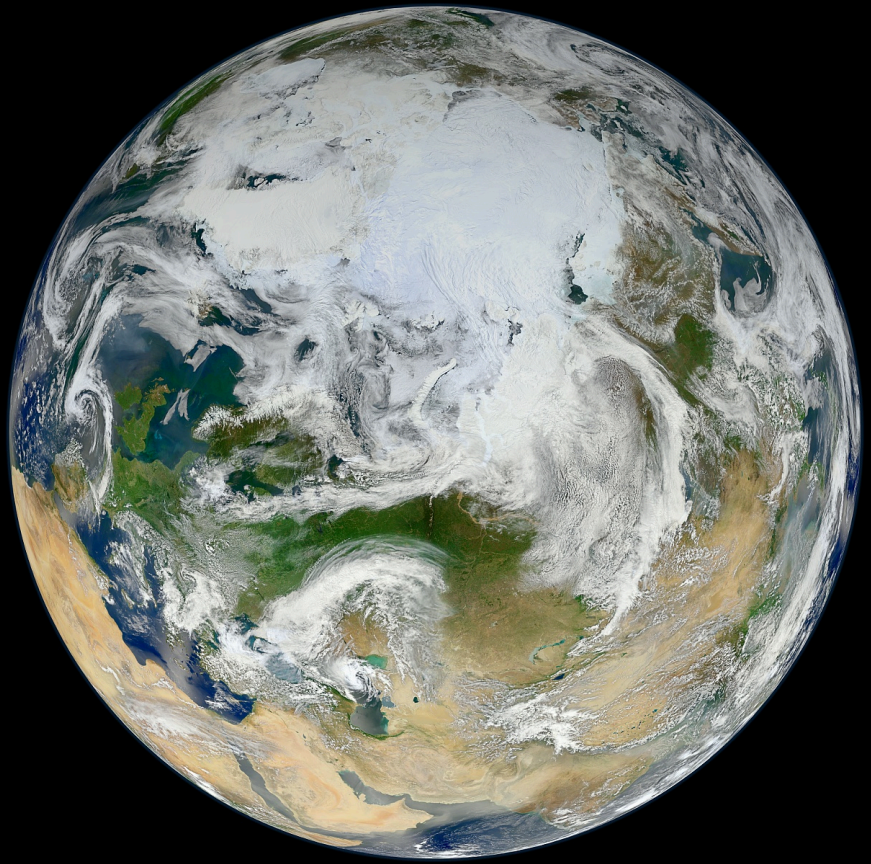

internal displacement monitoring centre

~~Human NLP~~

Human/Computer NLP



# Reflections



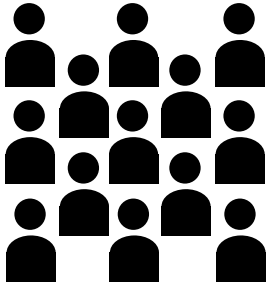
https://eoimages.gsfc.nasa.gov/images/imagerecords/78000/78349/arctic_vir_2012147_lrg.jpg

# Building a New Project

SINCE 1979

DESC

*opening doors to end homelessness*

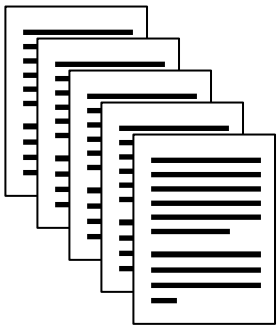


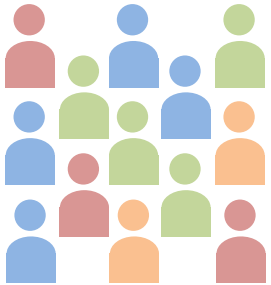
# Building a New Project

SINCE 1979

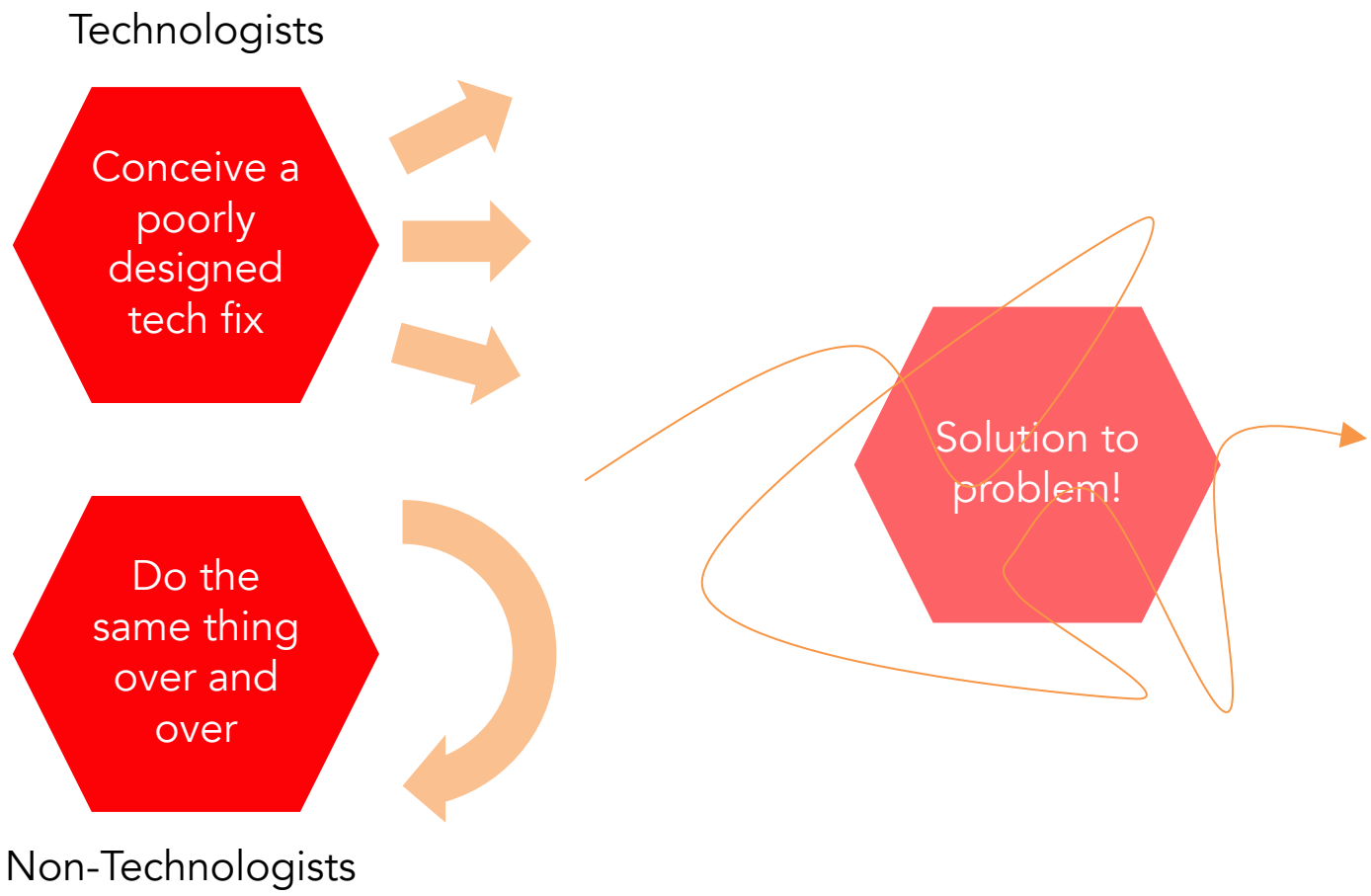
DESC

*opening doors to end homelessness*

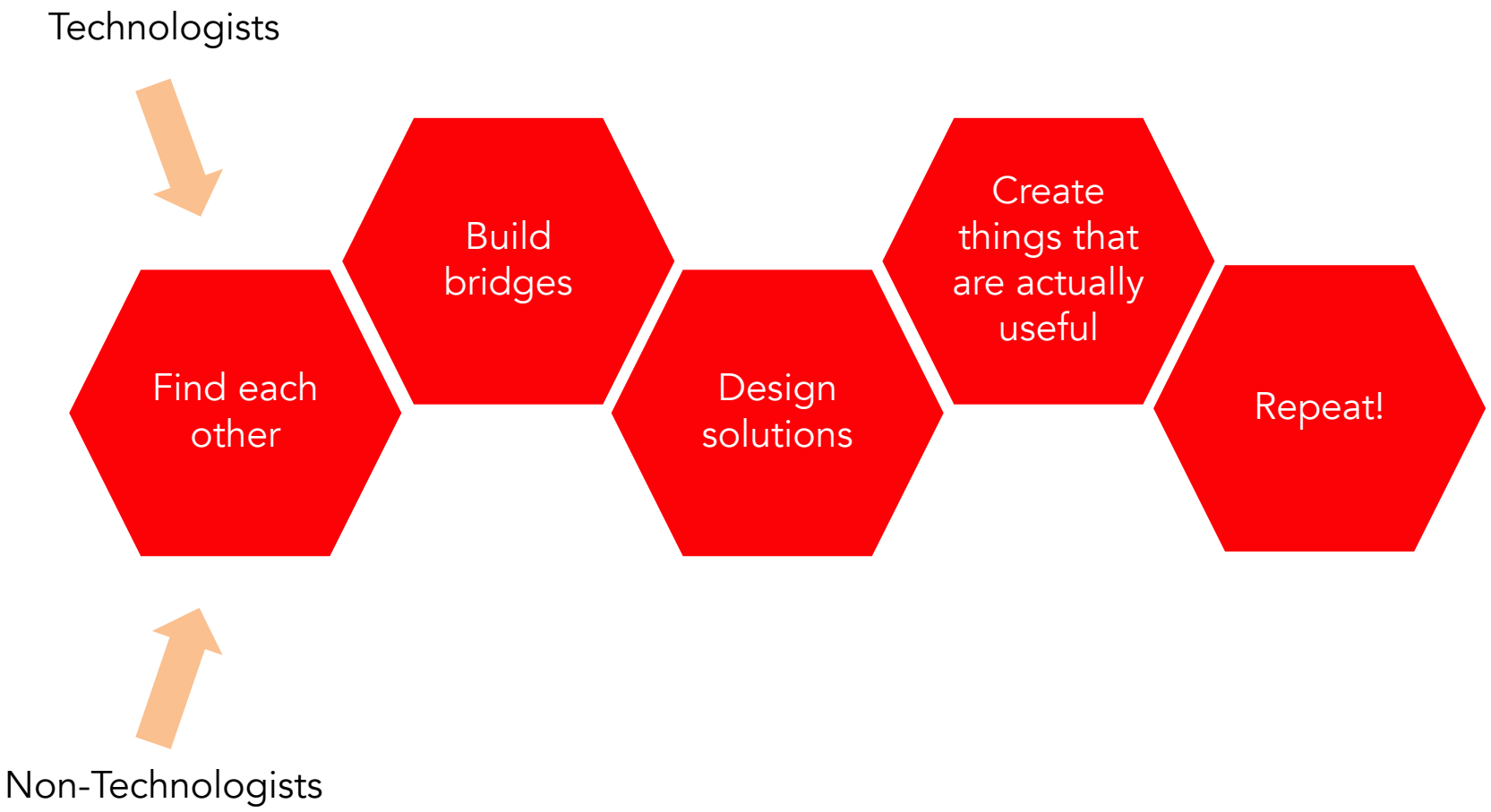




# Occasionally Successful Pathways Base On Unfair Generalizations



# Collaborative Pathway for Increased Progress!



# Doing Good Doing in D4D

**Form an Alliance**
- Domain expertise
- External partnerships

**Launch Something**
- Doing something is better than nothing

**Have Fun!**
- Interest area
- Awesome people

- Loose collective
- No rules, just guidelines
- “Open source model applied to civic good”

# Acknowledgements



★ Simon Bedford
★ Aneel Nazareth

★ Wendy Mak
★ James Allen
★ Yane Frenski
★ Domingo Hui
★ Charles Neiswender
★ Daniel Forsyth
★ Joshua Arnold
★ Alex Rich
★ Everyone else!

# Get Involved

Data for Democracy Meetup
Mondays 6:30pm @ Galvanize


Open Seattle Project Nights

Last Wednesday of Every Month 6:30pm @ Socrata