Artificial intelligence for emergency response and civil protection

Opportunities and Application areas for Colombia

Dr. Kakia Chatsiou
Senior Research Officer
University of Essex

The webinar will be starting at 10.00AM (Colombia time)

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Welcome to the workshop!

Nice to meet you!

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Senior Research Officer

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Areas of interest:

Information Extraction • Natural Language Processing • Deep Learning • Cloud Computing • AI methods for Text mining

Administrative data • Digital Transformation • Algorithmic Ethics & Bias

Workshop aims (1)

recent advancements in AI technologies that could be used to address different civil protection challenges

ideas/examples/case studies of the use of AI in an emergency response setting that could find an application in the Colombian context

how different types of data (numbers, images, text) are being used to help societies meet prevention, mitigation and emergency response needs

Workshop aims (2)

- Discuss important considerations for using AI to meet prevention, mitigation and emergency response needs such as:
  - data quality,
  - fairness,
  - ethics,
  - privacy,
  - explainability, transparency, accountability,
  - compliance with data protection laws

Time(Colombia)	Time (UK)	Topic
10.00 - 10.10	15.00 – 15.10	Welcome to the workshop & Aims Introductions
10.10 - 11.00	15.10 – 16.00	Using AI in Civil protection & Emergency response: definitions and common ground - What is AI? What is not AI? - Disaster management cycle - Civil protection challenges & opportunities - Activity 1: Civil protection challenges in Colombia
11.00 - 11.15	16.00 – 16.15	Break
11.15 - 12.00	16.15 – 17.00	Using AI in Civil protection & Emergency response: from response to prevention - AI helping on the ground responders (response) - AI helping restoring and reconstructing (recovery) - AI helping understand risks & raising awareness (mitigation) - AI helps understand and reduce risk (prevention/ preparedness)
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12.15 - 13.00	17.15 – 18.00	Activity 2: Can any of these examples apply to the challenges identified in Activity 1? Discussion & Summary of ideas

Useful links

- LinkedIn Group: http://bit.ly/AI4Dis_group
- Link to workshop material: https://github.com/kakiac/AI4Disasters_ColGov/
- Link to virtual whiteboard: http://bit.ly/AI4dis_whiteboard

Introductions

Using AI in Civil protection & Emergency response

Definitions and common ground

The impact of disasters worldwide (2019, EMDAT)

- 11 755 deaths
- 95 million people affected
- 103 billion US$ in economic losses
- Floods were the deadliest type of disaster accounting for 43.5% of deaths, followed by extreme temperatures at 25% and storms at 21.5%.

In Colombia…

Exposure to volcano

Number of volcanoes	15
Total population living within 30km from a volcano	3,236,251
% of population living with 30km distance from a volcano	7

Source:
https://www.preventionweb.net/countries/col/data/

In a disaster…

… smart, timely decisions are needed to avert, mitigate and manage risks

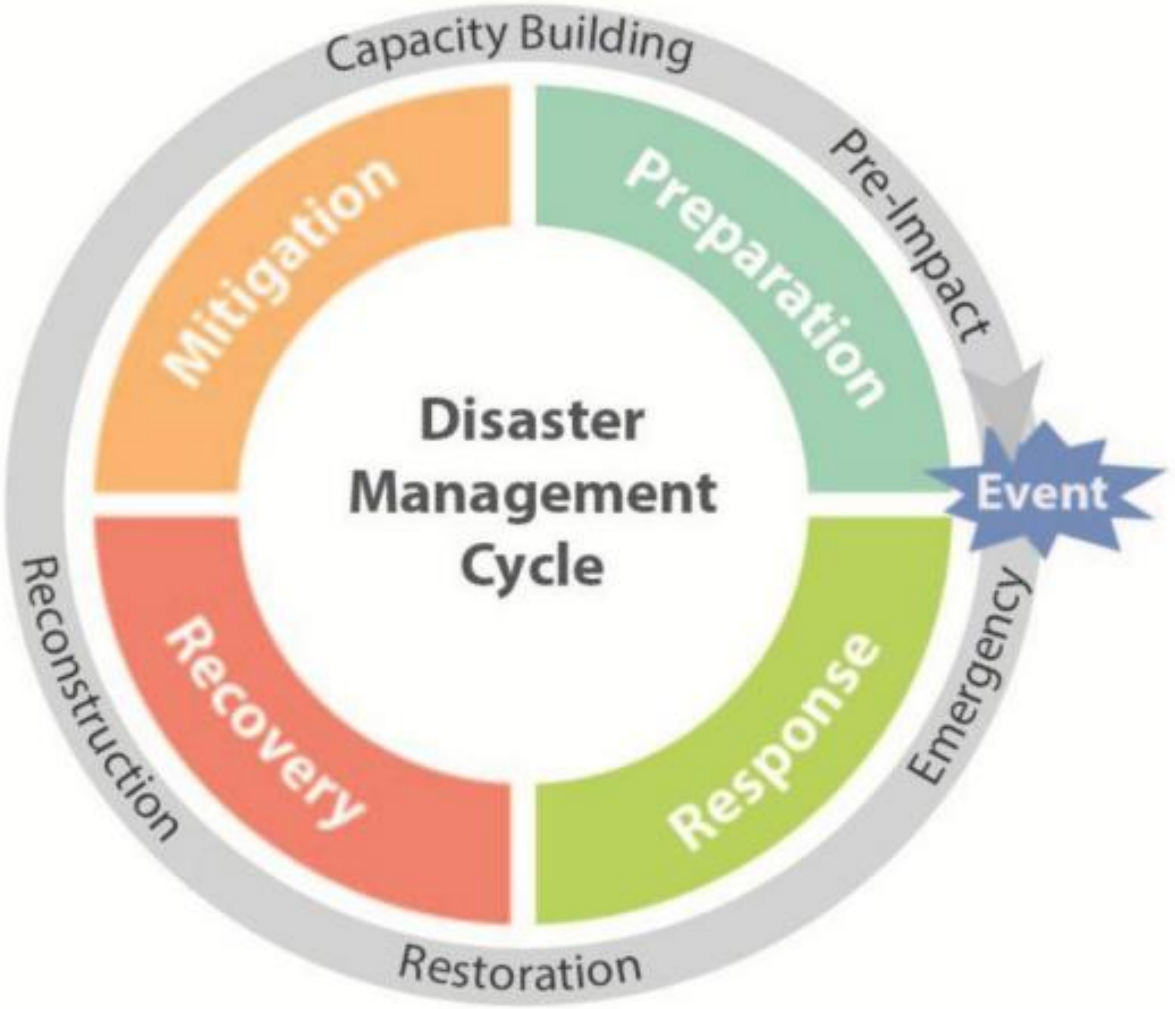
…and can save lives!

In a disaster…

- Tight resources with an exhausted workforce
- Large volumes of data generated daily (real and simulation data) e.g. social media, telecommunications data, remote sensing
- Quick decision making is needed, but not enough time for evaluation of all resources and data available.

Could AI help?

Disaster Management Cycle



What is Artificial Intelligence?

- “any task performed by a machine that would have previously been considered to require human intelligence” (Minsky & MacCarthy, 1950s)
- “the efficiency with which a machine acquires new skills at tasks they didn’t previously prepare for” (Chollet) : **narrow AI**
  - at least some elements of human intelligence are possible e.g. planning, learning, reasoning, problem solving, knowledge representation, motion

AI methods

- Supervised models
  - Trained on pre-existing data that humans have labelled
- Unsupervised models
  - No human input required, statistical methods that automatically extract information in data and groups/labels
- Deep Learning
  - Use multiple layers to extract information from the data. Learning over and over again using the same data and new knowledge

AI Methods

- Reinforcement Learning
  - Like deep learning (learning in layers, with multiple runs) ; decisions are made in a sequence. Needs to be trained with data very close to tasks to be performed
- Optimisation
  - Finding the best model possible for each task
  - (not an AI method per se, but a core part of any disaster management process)

AI in our daily lives

- Recommend what you should buy next online
- Understanding what you say to Siri/Alexa
- Recognise who or what is in a photo
- Spot spam emails
- Detect credit card fraud
- Automatically suggest the next words when you are writing an email

Civil Protection Challenges: can AI help?

- Can improve disaster response
- Can reduce time to assess damage
- Can help monitor social media to flag a disaster happening
- Can help deliver aid more effectively
- Can help with quicker decision making

But: be careful of limitations of AI and data used to train it!

Activity 1: Civil Protection Challenges in Colombia

What is PESTEL Analysis?

A tool that helps you analyse the context which might have impact on an issue or concept. Elements include:

- Political: challenges dependant on government policy, political stability or instability, trade restrictions, tax policy etc
- Economic: challenges relevant to economic growth, income & spending of consumers, interest rates
- Societal: challenges relevant to people and society
- Technological: challenges related to technology or digital skills
- Environmental & Ethical: challenges related to environmental and ethical factors
- Legal: challenges related to the legislation and the regulatory framework in place

http://bit.ly/AI4dis_whiteboard

PESTEL analysis

Political	Economic	Societal	Technological	Environmental	Legal

Break

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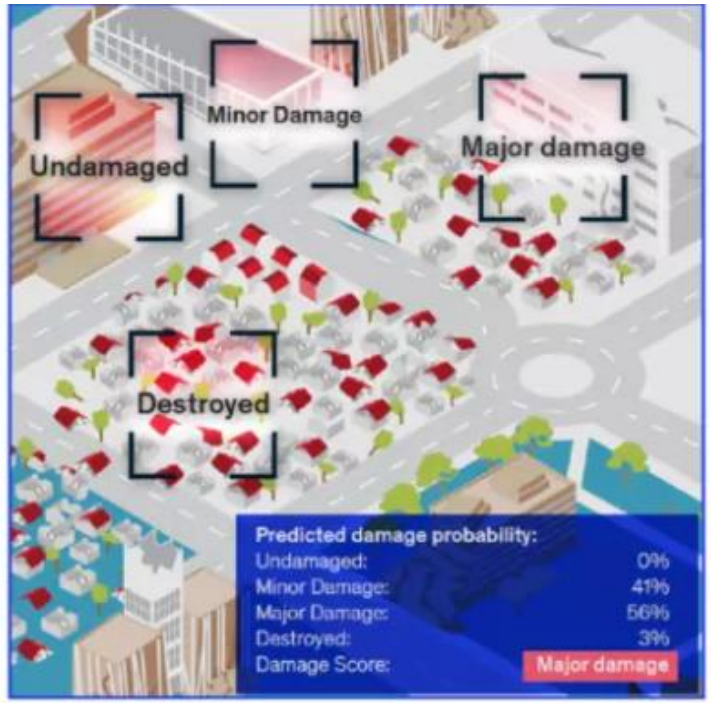
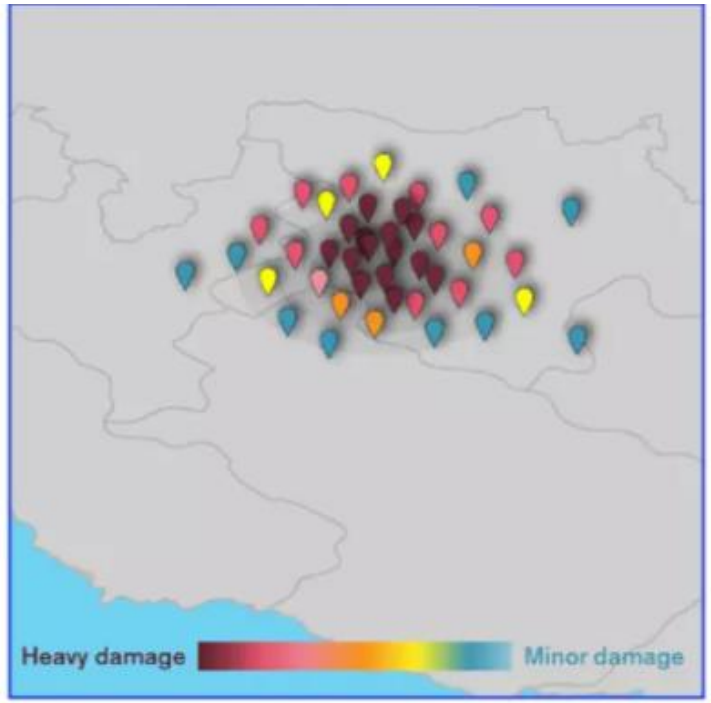
Using AI in Civil protection & Emergency response

Use cases: from response to prevention

1. Predicting and classifying damage

- AI models can use satellite and other data to predict areas at risk
- Damaged buildings and routes can be geo-tagged to help relief workers identify areas and allocate resources in an optimal way





Drones for disaster damage assessment in Vanuatu – World Bank

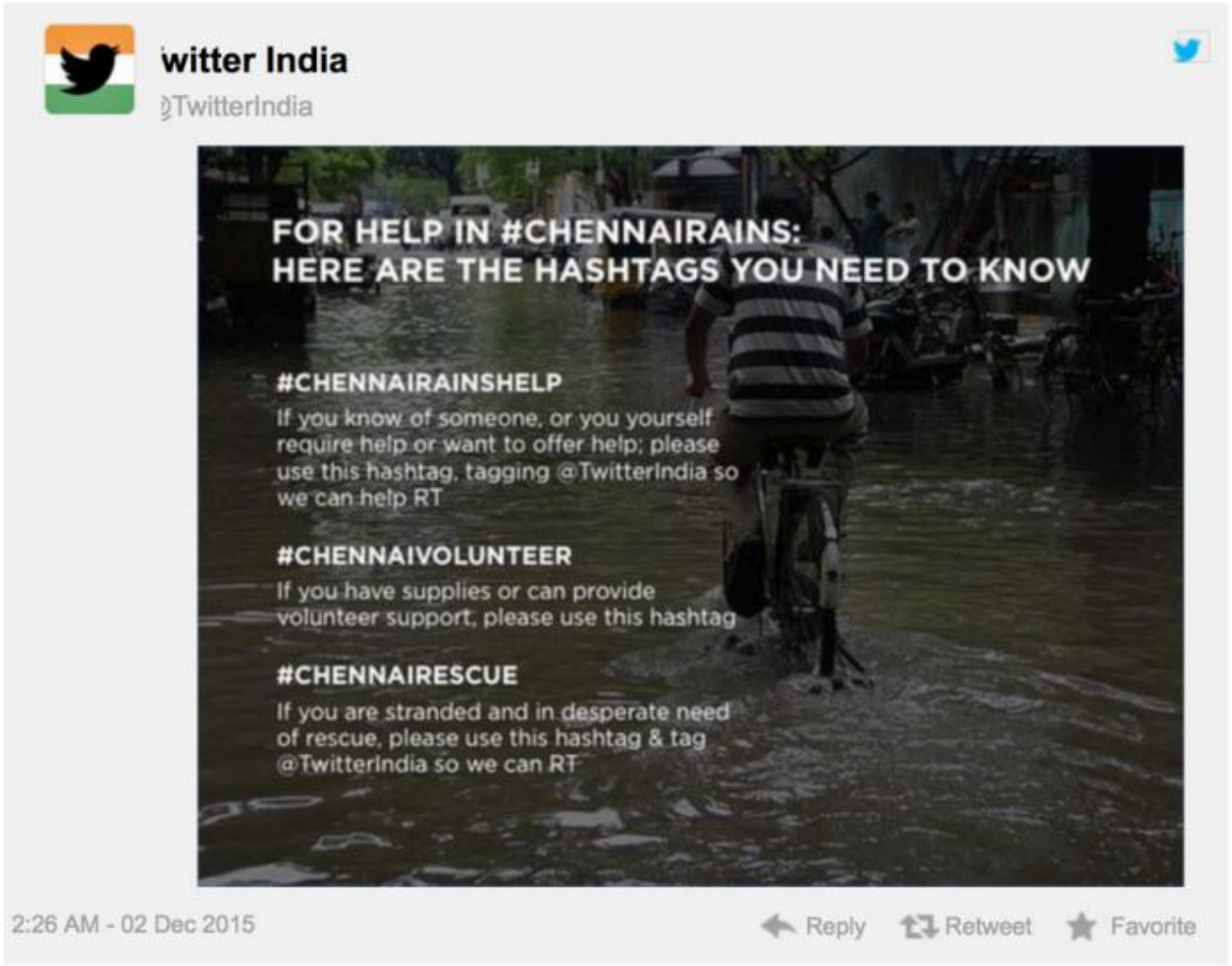
- Cyclone Pam struck the South Pacific archipelago nation of Vanuatu on 13–14 March 2015
- Need for quick assessment of damages emerged
- Solution : using drones to capture images, then open source maps (Mapbox) to visualize existing state of buildings
  - Twitter image geotagged overlayed
  - Quickly determined which houses were unrepairable, aid was directed quickly

2. Drones used for rescuing swimmers in Australia

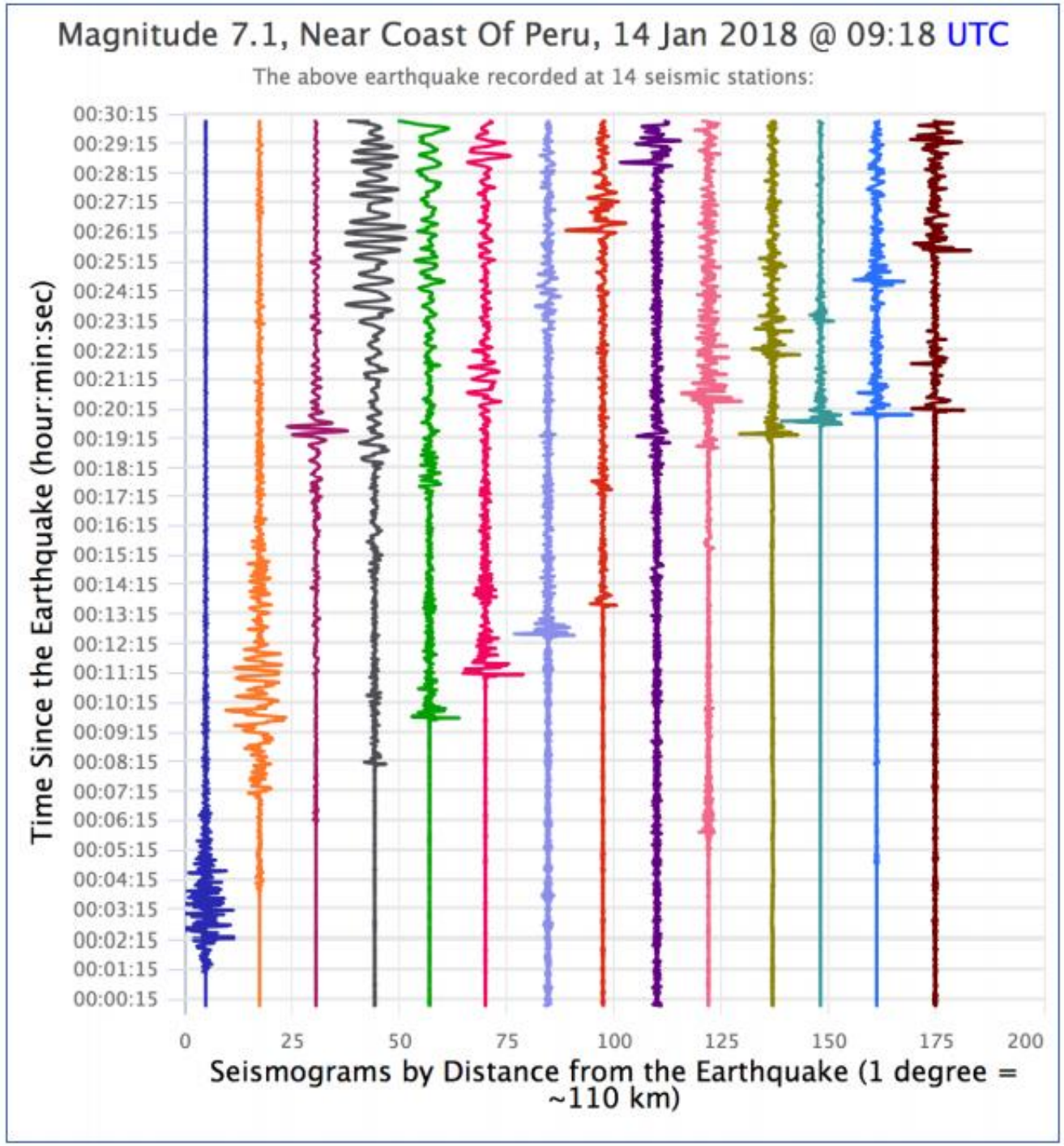
3. Twitter used during the Chennai Flood, India

- Monsoons in 2015, 90% above normal rainfall for over 100 years
- Est 500 people died, 1.8 million people were displaced
- No telephones, but internet access!
- Twitter India publicized three hashtags to be used during the flood, depending on the nature of the tweet: #ChennaiRainsHelp, #ChennaiRescue and #ChennaiVolunteer

Twitter used during the Chennai Flood, India

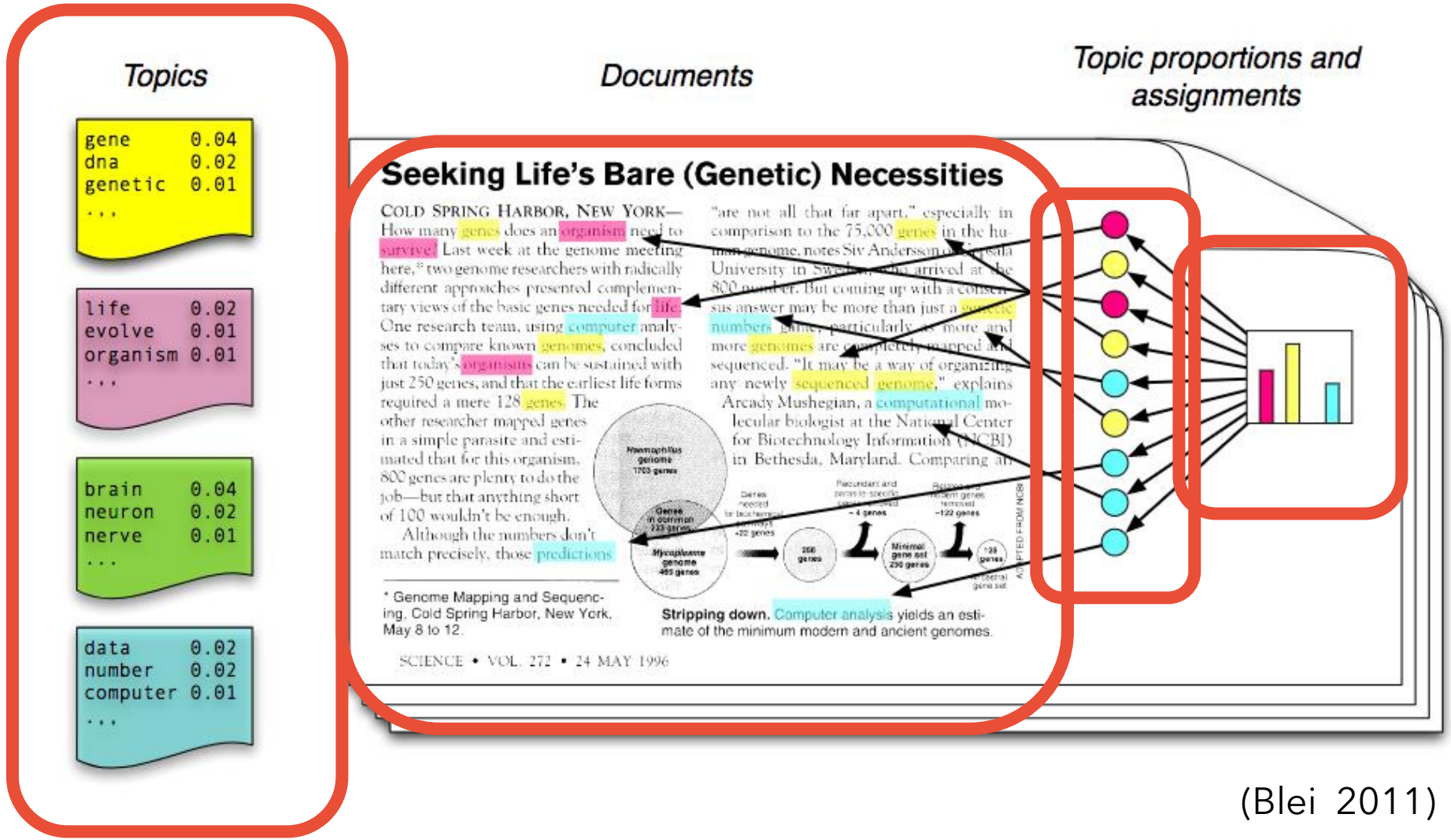


4. Artificial intelligence for earthquake detection and prediction



5. Topic Modelling of Local Government Resilience Action Plans

- high-level strategic documents, describing ways a nation or a municipality should react in case of emergency and how it plans to build up capacity to improve its resilience
- Latent Dirichlet Allocation Topic Modelling (Blei et al, 2003; Blei 2011)
- Corpus available: https://github.com/kakiac/ResiliencePolicyDatabase


Topics
gene 0.04
dna 0.02
genetic 0.01
...
life 0.02
evolve 0.01
organism 0.01
...
brain 0.04
neuron 0.02
nerve 0.01
...
data 0.02
number 0.02
computer 0.01
...
Documents
Topic proportions and assignments
Seeking Life's Bare (Genetic) Necessities
COLD SPRING HARBOR, NEW YORK—How many genes does an organism need to survive? Last week at the genome meeting here,* two genome researchers with radically different approaches presented complementary views of the basic genes needed for life. One research team, using computer analyses to compare known genomes, concluded that today's organisms can be sustained with just 250 genes, and that the earliest life forms required a mere 128 genes. The other researcher mapped genes in a simple parasite and estimated that for this organism, 800 genes are plenty to do the job—but that anything short of 100 wouldn't be enough.
Although the numbers don't match precisely, those predictions
"are not all that far apart," especially in comparison to the 75,000 genes in the human genome, notes Siv Andersson of Uppsala University in Sweden, who arrived at the 800 number. But coming up with a consensus answer may be more than just a genetic numbers game, particularly as more and more genomes are completely mapped and sequenced. "It may be a way of organizing any newly sequenced genome," explains Arcady Mushegian, a computational molecular biologist at the National Center for Biotechnology Information (NCBI) in Bethesda, Maryland. Comparing an
* Genome Mapping and Sequencing, Cold Spring Harbor, New York, May 8 to 12.
Stripping down. Computer analysis yields an estimate of the minimum modern and ancient genomes.
SCIENCE • VOL. 272 • 24 MAY 1996

(Blei 2011)

Topics: Europe

Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6	Topic 7
Terrorism	Heatwave	Community	Health	Preparation	Nuclear	Health
Vigilance	Measures	Trigger	County	Cyberwar	Biological	Risk
Plan	Fire	Mobilisation	Interregional	Hacking	Hazards	Ebola
Prefecture	Map	Forecast	System	Intensification	Threat-to-life	Pandemic
Warning	Weather	Prevention	Alerts	Computers	Accident	Sanitary
Information	Seasonal	Resilience	Limits	Smartphones	Environment	Animals
System	Risk	Strengthening	Hospitals	Espionage	Substances	Contagious

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IRELAND

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Flood	Local group	Public	Recovery	Authorities	Weather	Agencies
Local	Emergency	Rescue	Affected	Framework	Met	Communications
Response	Co-ordination	Defence	Damage	Services	Infrastructure	Coast
Water authority	Information	Resources	Appropriate	Rescue	Community	Protocol
Equipment	Management	Services	Support	Event	Incident	Critical
Management	Areas	Risk	Significant	Assistance	Property	Met
Assessment	Service	Persons	Evacuation	Warnings	Assessment	Housing agencies

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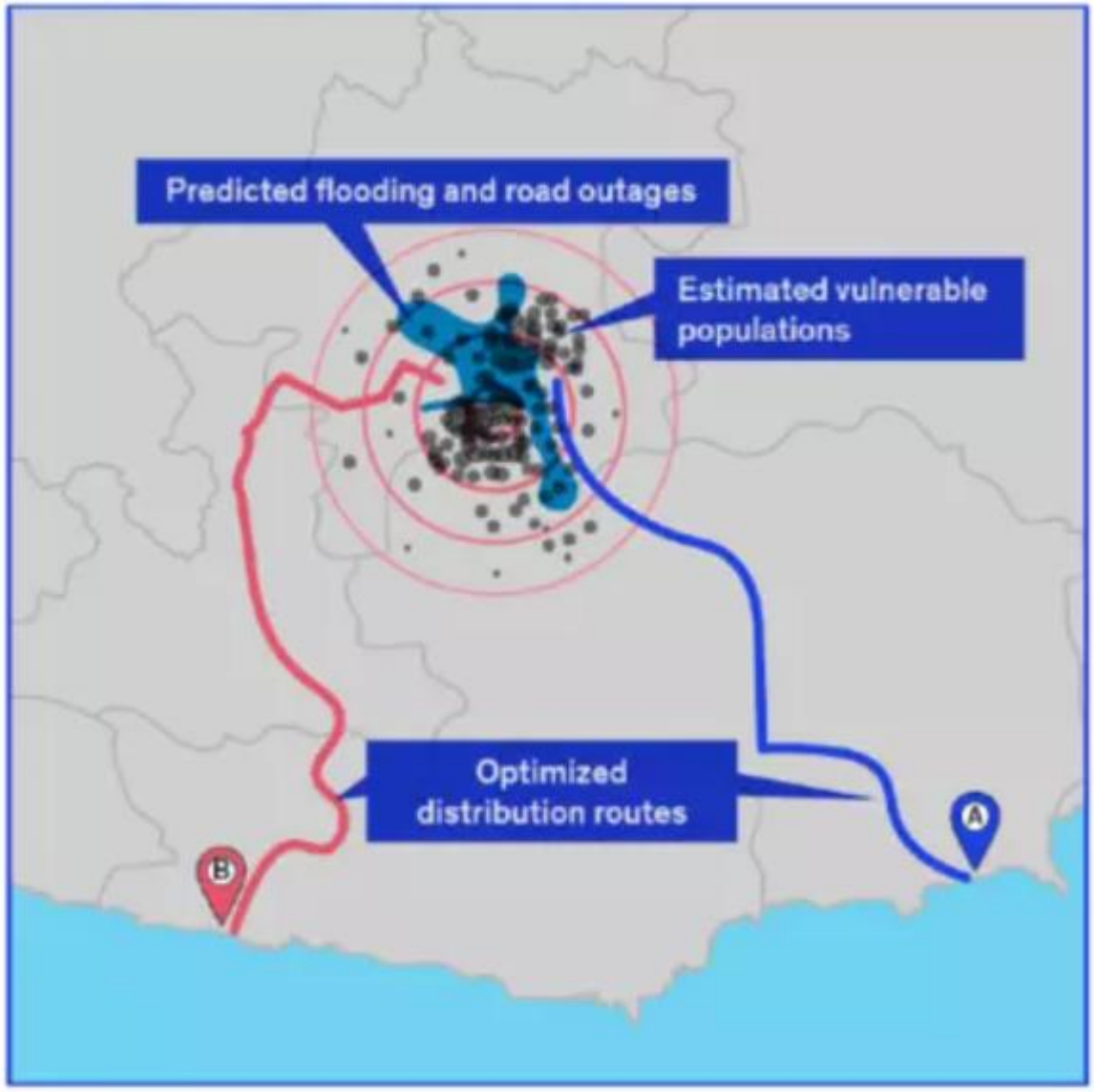
6. Planning optimal delivery routes

- AI can provide optimal route planning based on the damage assessment maps for faster aid delivery in post-disaster areas



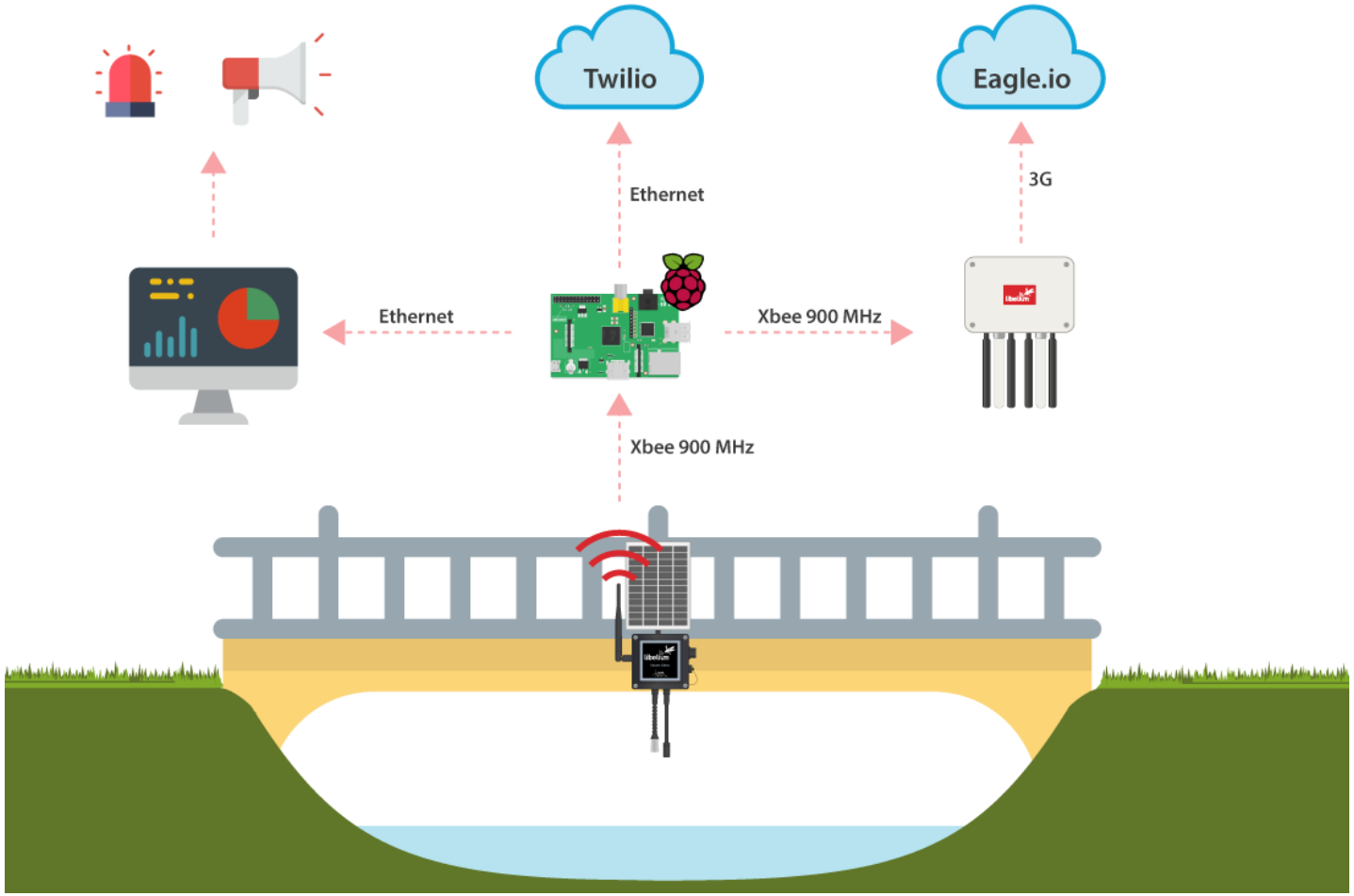
7. Estimate funding requirements

- Faster damage assessments can help governments and funders understand and provide necessary resources faster

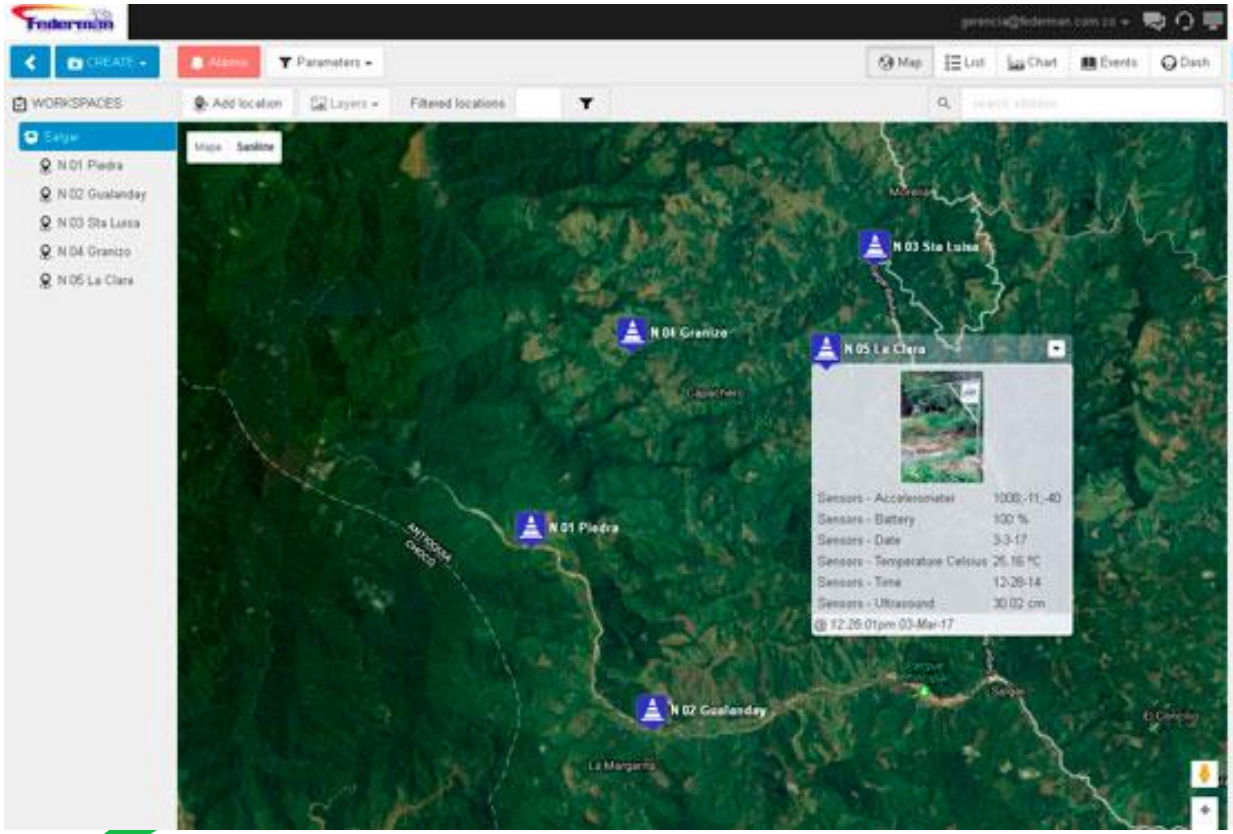
8. Early warning system to prevent floods and allow disaster management in Colombian rivers

- On May 18th 2015, the Colombian village of Salgar was devastated by a landslide. The **La Liboriana river flood caused 83 deaths** and left devastation and destruction on the communities all over the area.
- National Unit for Disaster Risk Management – Unidad Nacional para la Gestión de Riesgos de Desastres (UNGRD)
- plan to monitor and compile information on the La Liboriana, La Clara and Barroso rivers to prevent tragedies like the Salgar landslide

6. Early warning system to prevent floods and allow disaster management in Colombian rivers



Early warning system to prevent floods and allow disaster management in Colombian rivers



AI for Disaster Response: Things to consider

- Skills shortage
- Big Data
- Misinformation
- Legal implications
- Scaling up
- (upfront) set up costs
- Regulation and ownership
- Readiness & infrastructure resilience
- Data quality
- Algorithmic bias

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Activity 2: Civil Protection Challenges in Colombia: can AI help?

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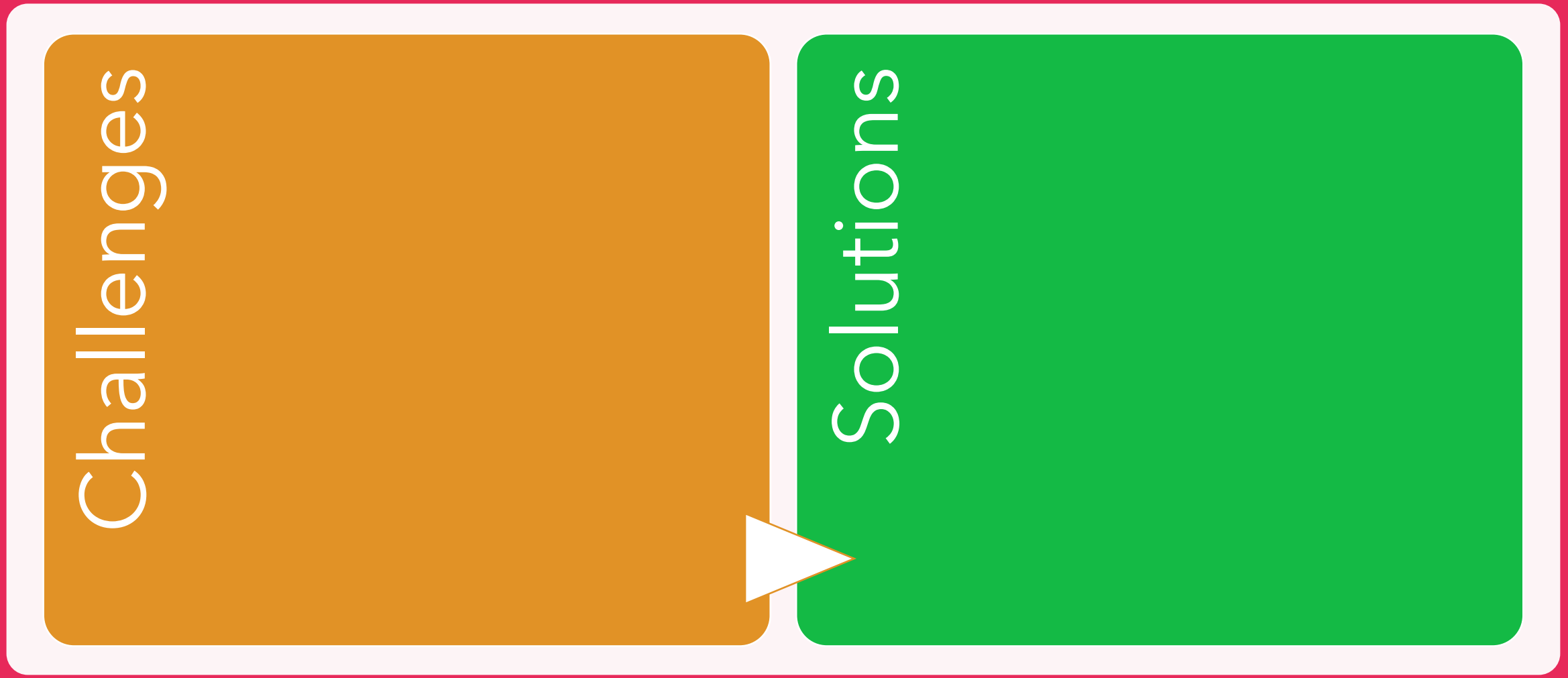
Mapping challenges to solutions



Discussion

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