A Landscapes of Artificial Intelligence

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Global Forum on Artificial Intelligence for Humanity (Paris, October 2019)

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Research protocol

1. Query

Define a query to retrieve from ISI Web of Science a dataset representing literature on

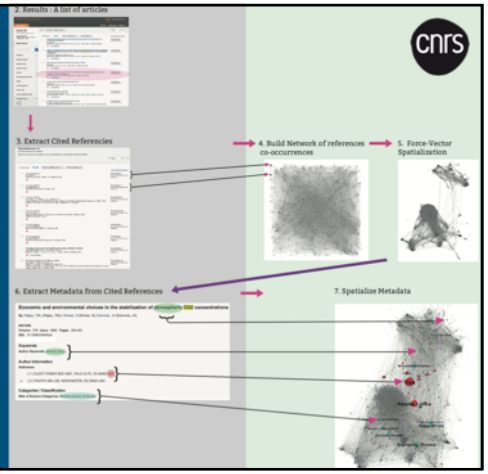
- the social and human impacts of AI as well as
- the uses of AI in social science & humanities

2. Basemap

- Extract the references cited by <3 dataset records
- Build a network connecting the references if co-appearing in <2 records
- Remove the isolated references
- Spatialize with a force-directed layout

3. Metadata projection

- Extract the article keywords appearing in >18 records and co-appearing to >3 extracted references
- the subject areas appearing in >18 records and co-appearing to >3 extracted references
- the institutions appearing in >20 records and co-appearing to >3 extracted references
- Project the metadata on the basemap according to references to which they are connected



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1. Query (16.757 results)

AI synonyms & techniques	OR	AI synonyms & techniques
AND		AND
social & human issues		social & human disciplines
AND		
doc. type = article OR proceedings		published between 2015 and 2019

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1. Query - AI synonyms & techniques

("abstraction and micro-operator*" OR "action recognition" OR "activit* recognition" OR "adversarial learning" OR "adversarial network*" OR "agent-based simulation*" OR "agent* communication" OR "agent* model" OR "agent* societ*" OR "ai-chipset*" OR "algorithmic game theory" OR "algorithms" OR "answer set programming" OR "ant colony optimisation" OR "ant colony optimization" OR "artificial evolution" OR "artificial intelligence" OR "association rule learning" OR "automated planning" OR "automated reasoning" OR "automated scheduling" OR "automation" OR "autonomous car*" OR "autonomous system*" OR "autonomous vehicle*" OR "bayesian method*" OR "bayesian network*" OR "big data" OR "biometric" OR "BOT" OR "BOTs" OR "case-based reasoning" OR "character recognition" OR "cognitive computing" OR "cognitive robotic" OR "combinatorial search" OR "computational complexity of reasoning" OR "computational control theory" OR "computational models of argument*" OR "computational photography" OR "computational social choice*" OR "computer vision" OR "constraint* programming" OR "constraint* satisfaction problem*" OR "continuous space search" OR "cooperative game*" OR "coordination and cooperation" OR "cost-sensitive learning" OR "data mining" OR "data stream" OR "deep learning" OR "dependable robot*" OR "description logic" OR "developmental robotic" OR "dimensionality reduction" OR "discrete space search" OR "distributed ai" OR "distributed constraint*" OR "distributed search" OR "driverless car" OR "driverless vehicle" OR "dynamic programming" OR "ensemble method*" OR "ensemble model*" OR "evolutionary algorithm*" OR "evolutionary programming" OR "evolutionary robotic" OR "expert system*" OR "face recognition" OR "feature* selection" OR "fuzzy logic" OR "fuzzy system*" OR "game tree search" OR "genetic algorithm*" OR "genetic programming" OR "gesture* recognition" OR "handwriting detection" OR "hardware for ai" OR "heuristic function construction" OR "heuristic search" OR "hierarchical planning" OR "image segmentation" OR "inference engine*" OR "instance segmentation" OR "instance-based learning" OR "intelligent agent*" OR "intelligent system*" OR "kernel method*" OR "knowledge based system*" OR "knowledge discovery" OR "knowledge engineering" OR "knowledge extraction" OR "knowledge representation" OR "knowledge-based learning" OR "latent representation*" OR "learning generative model*" OR "learning graphical model*" OR "learning in robotic" OR "learning sparse model*" OR "lexical semantic" OR "logic programming" OR "logics for knowledge representation" OR "machine learning" OR "machine translation" OR "machine vision" OR "manifold learning" OR "markov decision process*" OR "markov model*" OR "massive data analysis" OR "maxsat" OR "minsat" OR "mobile agent*" OR "model-based reasoning" OR "motion estimation" OR "motion path planning" OR "motion tracking" OR "multi-agent* learning" OR "multi-agent* planning" OR "multi-agent* system*" OR "multi-robot system*" OR "multi-task learning" OR "naive bayes" OR "natural language generation" OR "natural language processing" OR "natural language semantic" OR "natural language summarisation" OR "natural language summarization" OR "neural network*" OR "neuromorphic architecture" OR "neuromorphic computing" OR "neuromorphic engineering" OR "nlp" OR "non-classical logics for knowledge representation" OR "non-monotonic reasoning" OR "noncooperative game*" OR "nonprobabilistic model*" OR "ontology engineering" OR "optical character recognition" OR "optimisation for learning" OR "optimization for learning" OR "pattern search" OR "planning algorithm" OR "planning under uncertainty" OR "planning with incomplete information" OR "pomdp" OR "predictive analytics" OR "preference* modeling" OR "preference* modelling" OR "probabilistic graphical model*" OR "probabilistic inference*" OR "probabilistic reasoning" OR "random forest*" OR "randomized search" OR "recommendation system*" OR "recommender system*" OR "regression tree*" OR "reinforcement learning" OR "robot fleet*" OR "robot interaction*" OR "robot learning" OR "robot planning" OR "rule* learning" OR "sat analysis" OR "sat application*" OR "sat evaluation*" OR "sat solver*" OR "sat tool*" OR "satisfiability" OR "search engine*" OR "search in image bank*" OR "search in planning and scheduling" OR "search in video bank*" OR "self-driving car*" OR "semantic network*" OR "semantic ontolog*" OR "semantic web" OR "semi-supervised learning" OR "sensor network*" OR "sentiment analysis" OR "sequential decision making" OR "sequential learning" OR "sequential processing" OR "serial learning" OR "social robot*" OR "soft computing" OR "spatiotemporal reconstruction" OR "speaker recognition" OR "speech identification" OR "speech processing" OR "speech recognition" OR "speech synthesis" OR "speech verification" OR "speech-to-speech" OR "supervised learning" OR "support vector* machine*" OR "support vector*" OR "swarm intelligence" OR "swarm optimisation" OR "swarm optimization" OR "temporal and hybrid planning" OR "tensor processing" OR "text classification" OR "text mining" OR "text recognition" OR "unsupervised learning" OR "video segmentation" OR "visual servoing" OR "artificial neural network*" OR "autoencoder*" OR "backprop*" OR "boltzmann machine*" OR "convolutional neural network*" OR "deductive database*" OR "deep belief network*" OR "deep learning" OR "deep neural network*" OR "expert system*" OR "hopfield network*" OR "inference engine*" OR "knowledge based system*" OR "knowledge representation*" OR "lisp" OR "logic programming" OR "minimax" OR "nonmonotonic reasoning*" OR "perceptron*" OR "prolog" OR "recurrent neural network*" OR "search tree*" OR "theorem prover*" OR "tree search" OR "automated trading system" OR "algorithmic trading" OR "smart cit*" OR "differential privacy")

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1. Query - social & human issues

Title =

("explainability" OR "interpretability" OR "societal" OR "disinformation" OR "data privacy" OR "gender" OR "labour" OR "labor" OR "transparency" OR "fairness" OR "oversight" OR "bias" OR "legal" OR "education" OR "educational" OR "business" OR "intelligibl*" OR "journalis*" OR "suicid*" OR "commons" OR "sustainability" OR "misinformation" OR "information disorder*" OR "propagand*" OR "well-being" OR "wellbeing" OR "fake")

OR

Title, Abstract or Keywords =

("accountab*" OR "ethic*" OR "moral*" OR "prosperity" OR "human control" OR "*justice" OR injustice OR "benevol*" OR "wellfare" OR "censorship" OR "hate speech" OR "fake news" OR "filter bubbles" OR "civil libert*" OR "human right*" OR "surveillance capitalism" OR "algorithmic justice" OR "critical AI studies" OR "critical algorithm studies" OR "platform studies" OR "app studies" OR "media studies" OR "gender studies" OR "private life" OR "humanity" OR "legislative" OR "political" OR "stakeholder*" OR "debias*" OR "GDPR" OR "racial discrimin*" OR "gender discrimin*" OR "predictive policing" OR "deepfake" OR "future of work" OR "gig economy" OR "uberisation" OR "uberization" OR "precari*" OR "public polic*" OR "attention economy" OR "quantified self" OR "whistleblow*" OR "whistle-blow*" OR "snowden" OR "internet surveillance" OR "mass surveillance" OR "gender equality" OR "decent work" OR "peace" OR "conspira*" OR "microwork*" OR "micro-work*" OR "free will" OR "biopolitics" OR "human autonomy" OR "psychology")

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1. Query - social & human disciplines

Research Area =

("Architecture" OR "Art" OR "Arts & Humanities Other Topics" OR "History" OR "History & Philosophy of Science" OR "Literature" OR "Music" OR "Philosophy" OR "Biomedical Social Sciences" OR "Communication" OR "Geography" OR "Government & Law" OR "International Relations" OR "Public Administration" OR "Social Issues" OR "Sociology" OR "Urban Studies" OR "Women's Studies")

AND

NOT Research Area =

("Physical Geography" OR "Neurology")

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≈ 23.000 ISI WoS bibliographic records
(≈ 15.000 journal articles & ≈ 9.000 papers in conference proceedings)

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2. Basemap

- We constructed a network in which
  - nodes are the ≈ 28.000 references appear in the bibliography of <3 dataset records
  - edges connects the references that co-appear in the bibliography of <2 dataset records (cf. Small 1973 co-citation method)
- We spatialized the reference network in Gephi (gephi.org) with a force-vector layout (ForceAtlas2, Jacomy et al. 2014) to reveal disciplinary and sub-disciplinary clustering
- To simplify the image, we replaced nodes and edges by a heatmap of the density of nodes distribution
- We identified and named the
  - 3 larger scientific regions
  - and 18 thematic smaller clusters that characterize the basemap

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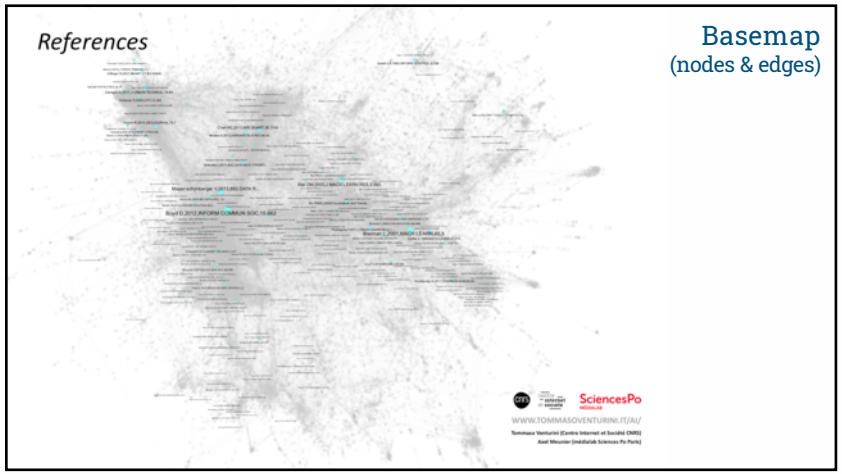

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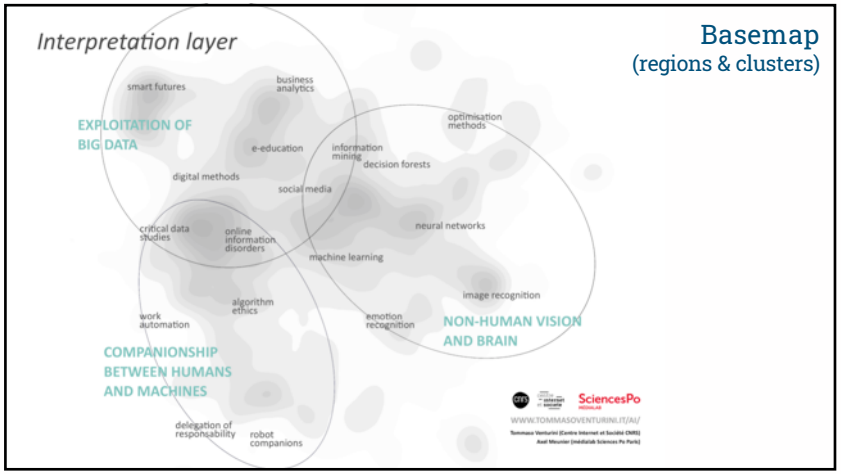

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3. Metadata projection

- From the WOS dataset, we extracted
  - the most frequent article keywords most frequent
  - the most frequent subject areas
  - the most frequent institutions

  (and removed the generic institutions, e.g. Dept. Comp. Sci., Sch. Law)
- We added the metadata to the network, connecting them to the references that co-appear with them in <3 records of the WOS datased
- We spatialize the metadata with the same force-vector layout while keeping the references blocked (so that that the metadata positions themselves relatively to the references basemap)

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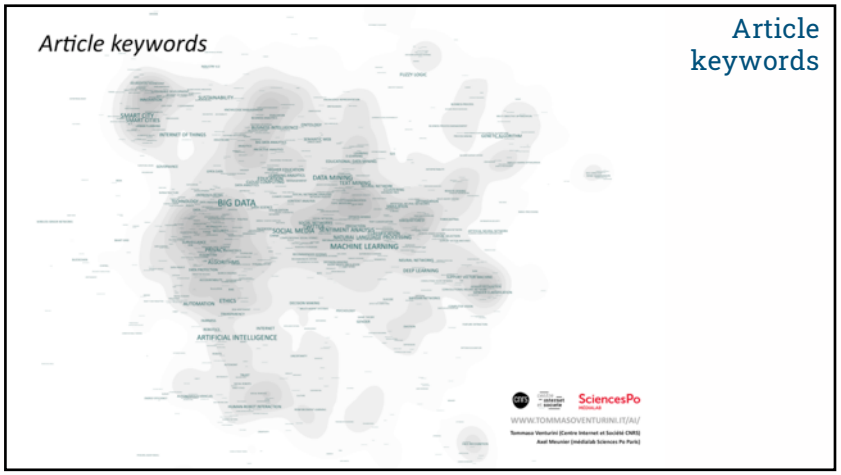

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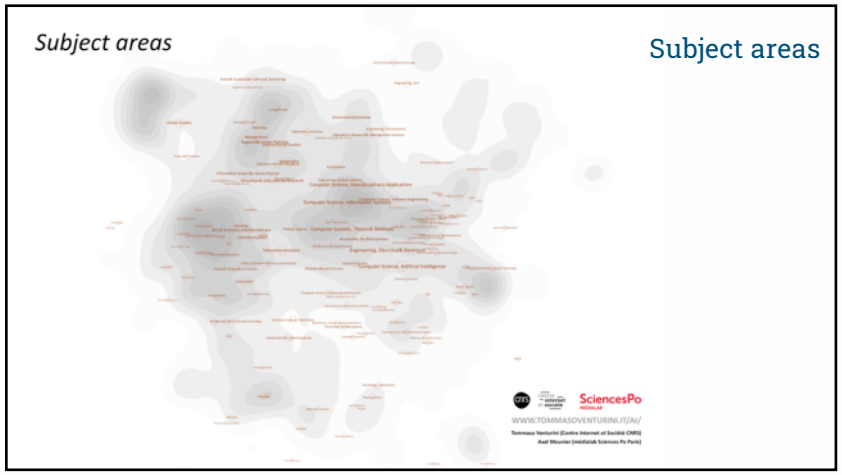

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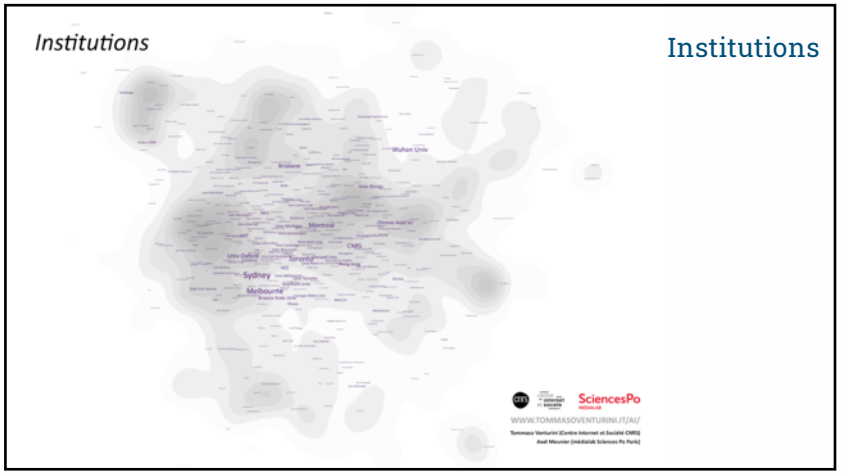

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3 design twists

1. Represent nodes and edges other then by points and lines
2. Encourage engagement with the maps
3. Abandon a god-like viewpoint

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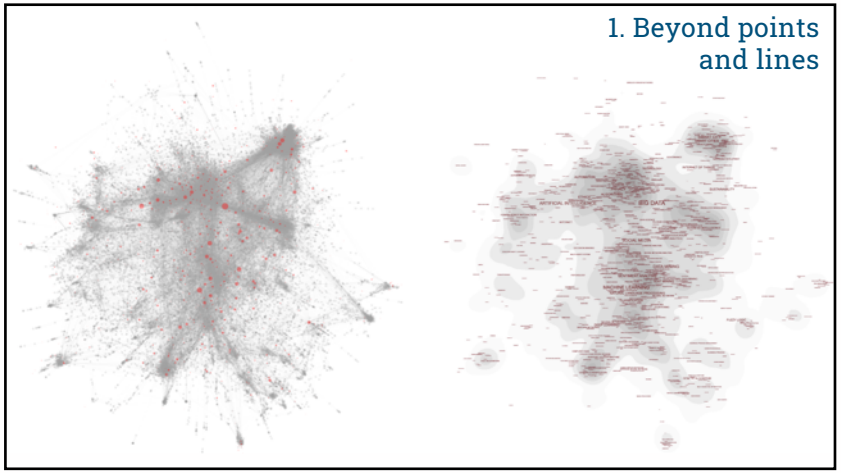
1. Beyond points and lines



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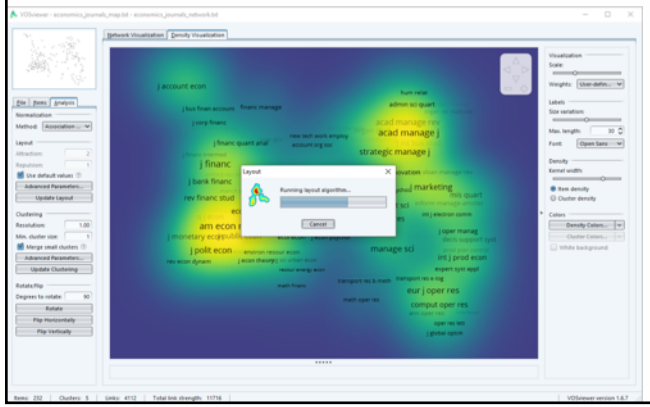
VOSviewer

https://www.vosviewer.com



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Graph Recipes

https://medialab.github.io/graph-recipes

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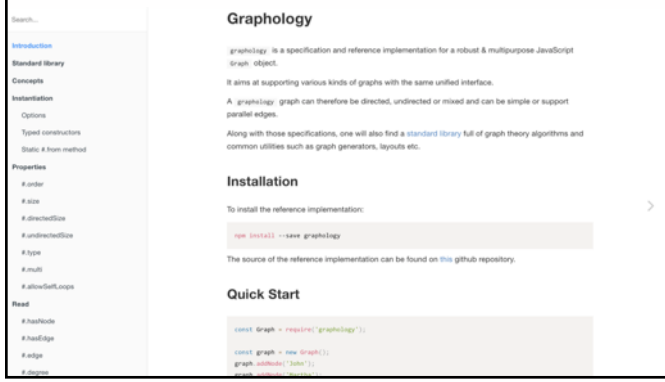
Graphology

https://graphology.github.io



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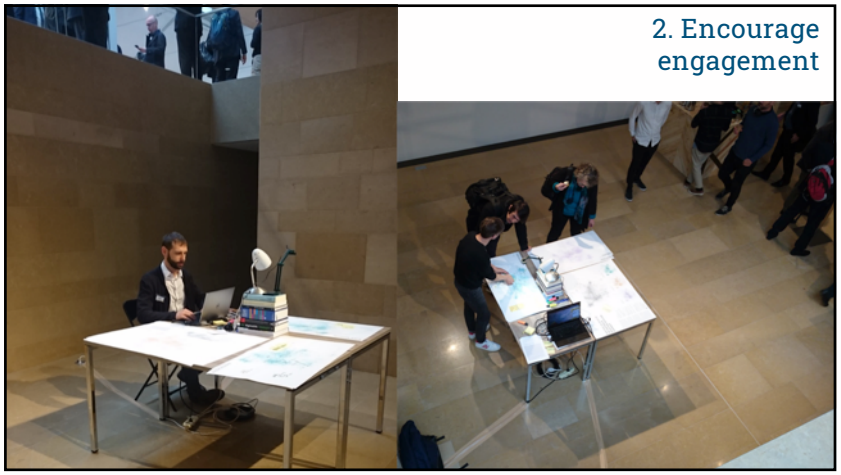
2. Encourage engagement



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2. Encourage engagement

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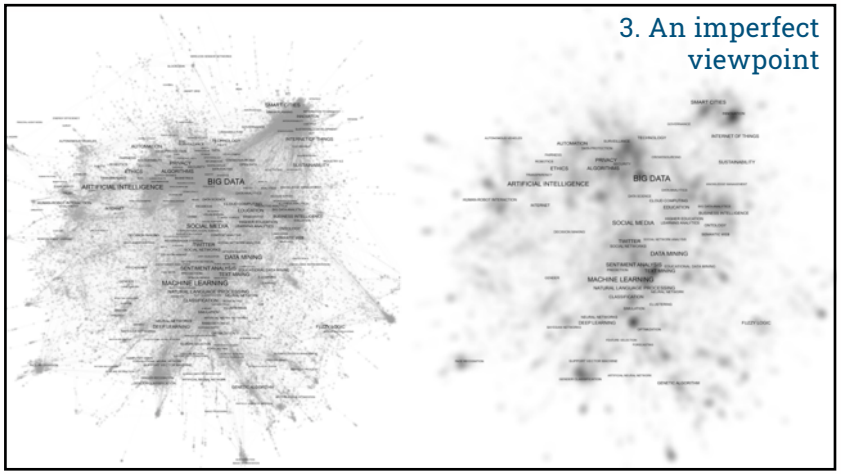
3. An imperfect viewpoint



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3. A situated viewpoint

danah boyd & Kate Crawford (2012)
Critical Questions for Big Data
Information, Communication & Society

Leo Breiman (2001)
Random Forests,
Machine Learning

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Thank you!

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