Critical Algorithm Studies

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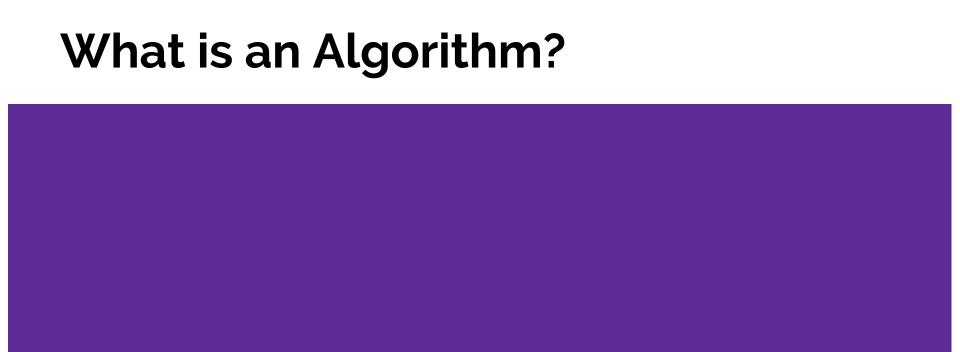# What is an Algorithm?

Characterizations of Algorithm [1]

- No generally accepted formal definition
- Church-Turing Thesis
- Knuth's requirements for an algorithm [2]
  - Finiteness, Definiteness, Input, Output, Effectiveness
- Berlinski [3]
  - "an algorithm is a finite procedure, written in a fixed symbolic vocabulary,
  - governed by precise instructions, moving in discrete steps, 1, 2, 3, . . .,
  - whose execution requires no insight, cleverness, intuition, intelligence, or perspicuity,
  - and that sooner or later comes to an end."
- Sipser [4]
  - Informally speaking, an algorithm is a collection of simple instructions for carrying out some task.
  - Commonplace in everyday life, algorithms sometimes are called procedures or recipes.

Algorithm = Logic + Control by Robert Kowalski

- Logic Component L
  - What is to be done? (meaning)
  - Logic Program
  - e.g.:
    - Component(Logic). Component(Control).
    - Algorithm(l, c) ← Component(l), Component(c), c ≠ l.
- Control Component C
  - How is it to be done? (efficiency)
  - e.g. bottom-up (iterative) vs. top-down (recursive)
- Wirth: Program = algorithm + data structure
  - Def. of data structures in logical component

Algorithm by Tarleton Gillespie

Algorithm as technical solution to technical problem

- **Algorithm:** logical series of steps for organizing and acting on data to quickly achieve an outcome
- "Algorithm" comes after "model" (or "logic")
- Embedded values mostly in modeling, goal & operationalization of goal
  → not certifiable correct
- Algorithms are trained on data and tuned via parameters
  → selection and preparation of data is of concern
- Algorithms instantiated in Applications

Algorithm by Tarleton Gillespie

Algorithm as synecdoche

- ○ **Algorithm:** sociotechnical assemblage including algorithm, model, target goal, data, training data, application, hardware and connect it all to achieve social endeavor
    - ▪ People are involved everywhere → study underlying logics
- ○ **Algorithm:** name for socio-technical ensemble, part of family of authoritative systems for knowledge production or decision making
    - ▪ humans are data, put into systematic relationships with each other and information, and then given information resources based on calculated assessments of them and their inputs
- ○ Advantage
    - ▪ easy to understand and acknowledges role as a seamless tool
- ○ Risk
    - ▪ Obscuring political values (creators initially surprised by "values in algorithms")
    - ▪ Erase people involved, downplay role (Accountability)

Algorithm by Tarleton Gillespie

Algorithm as talisman

- **Algorithm:** mathematical, logical, impartial, consistent with disposition towards objectivity
- Generated by algorithm implies powerful legitimacy (Cultural Authority)
  - Quantification or interpretation, mechanical distance or human closeness
- Used as "talisman" to ward off criticism (Justification)
  - Algorithm responsible for results and thereby creates distance from providers
  - E.g. Critique on "Facebook's algorithm" often means "Facebook and the choices it makes"

Algorithm by Tarleton Gillespie

Algorithmic as committed to procedure

- **Concern:** Insertion of procedure into human knowledge & social experience
- **Algorithmic:** Produced by or related to IS generating knowledge or decisions
- Process automated → instantly, repetitively, across many contexts
- **Algorithm:** Part of mechanisms that introduce and privilege quantification, proceduralization, and automation in human endeavours
- Critique: Latest extension of Taylorism (quantification of everything, bureaucracy, …)
- Positive: Intervention against discrimination, nepotism, errors through procedure
  - e.g. traffic (users must accept procedure to participate)
- Struggle between operationalized aims and humans undermining, altering, exceeding those aims

Field Survey

Governing Algorithms by Malte Ziewitz

- In contrast to HCI new focus also on "inner workings"
- Algorithms: powerful entities that rule, sort, govern, shape, or otherwise control our lives in obscure and inscrutable ways
  - Shape social and cultural formations and impact individual lives
  - Pathways through which capitalistic power works
  - Rules of rationality replace self-critical judgement of reason
  - Interpretative key of modernity
- Concerns
  - Agency, Inscrutability, Normativity
  - Loss of Autonomy, Accountability, Fairness, Bais, Opacity, Visibility, Surveillance
  - Algorithms (similar to language of politics) privilege decision maker at expense of complex reality

Governing Algorithms by Malte Ziewitz

- "Black box society" → Transparency:
  - Disclosure, reverse engineering, value-centered design, educational initiatives, audit, code review, interviews …
- Questions:
  - What is an algorithm? How to study algorithms? What are their consequences?
  - How to make complex and rich accounts? Role in different contexts? …
- Some topics
  - Algorithms as performative, Fetishising of algorithms, Publics produced by Algorithms
  - Algorithms as Networks, Ethics, New empirical setting (Case studies)
  - Algorithms as devices to enact the problems they account for, as "sensitizing concepts" that attune us to concerns and contradictions without explaining them away
  - Algorithmic Culture vs. Algorithmic Theocracy (invisible hand)

The Relevance of Algorithms by Tarleton Gillespie

- Public relevance algorithms: producing and certifying knowledge
- Patterns of inclusion
  - What data is included, excluded and how is it made algorithm ready
  - e.g. digital traces, politics of databases (atomized)
- Cycles of Anticipation
  - Implications of providers attempt to predict users and how their conclusions matter
- The evaluation of relevance
  - Criteria for relevance of algorithms, how they are obscured and how they enact political choices about appropriate and legitimate knowledge

The Relevance of Algorithms by Tarleton Gillespie

- The promise of algorithmic objectivity
  - Technical character used to assure impartiality and how it is maintained in the face of controversy
- Entanglement with practice
  - Users reshaping practices due to algorithms they depend on, how they turn algorithms into political contests, and how they interrogate the politics of algorithms themselves
- The production of calculated publics
  - How the algorithmic presentations of publics shapes their sense of themselves, and who is in the best positions to benefit from that knowledge

Discussion Points

Points

1. What constitutes an algorithm? Are there other definitions of algorithm? Do we need a definition?
2. What gives algorithms authority? How is this authority performed?
3. Differences and similarities between an assembly line in a factory and an algorithm?
4. What algorithms do you encounter in your daily life? How do they shape it? How do you notice then?
5. How and where have you encountered "publics" produced by algorithms in your life?
6. In what ways are algorithms relevant?

References

[1]   https://en.wikipedia.org/wiki/Algorithm_characterizations. Accessed 6. April 2016, 13:00 (CET)

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[4]   Michael Sipser, (2006), Introduction to the Theory of Computation: Second Edition, Thompson Course Technology div. of Thompson Learning, Inc. Boston, MA. ISBN 978-0-534-95097-2.

[5]   Kowalski, R. (1979). Algorithm= logic+ control. *Communications of the ACM*,*22*(7), 424-436.

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[8]   Barocas, S., Hood, S., & Ziewitz, M. (2013). Governing algorithms: A provocation piece. *Available at SSRN 2245322*.