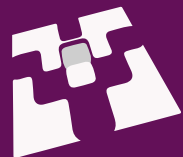


# HUMAN-IN-THE-LOOP OR HUMAN-IN-THE-WAY

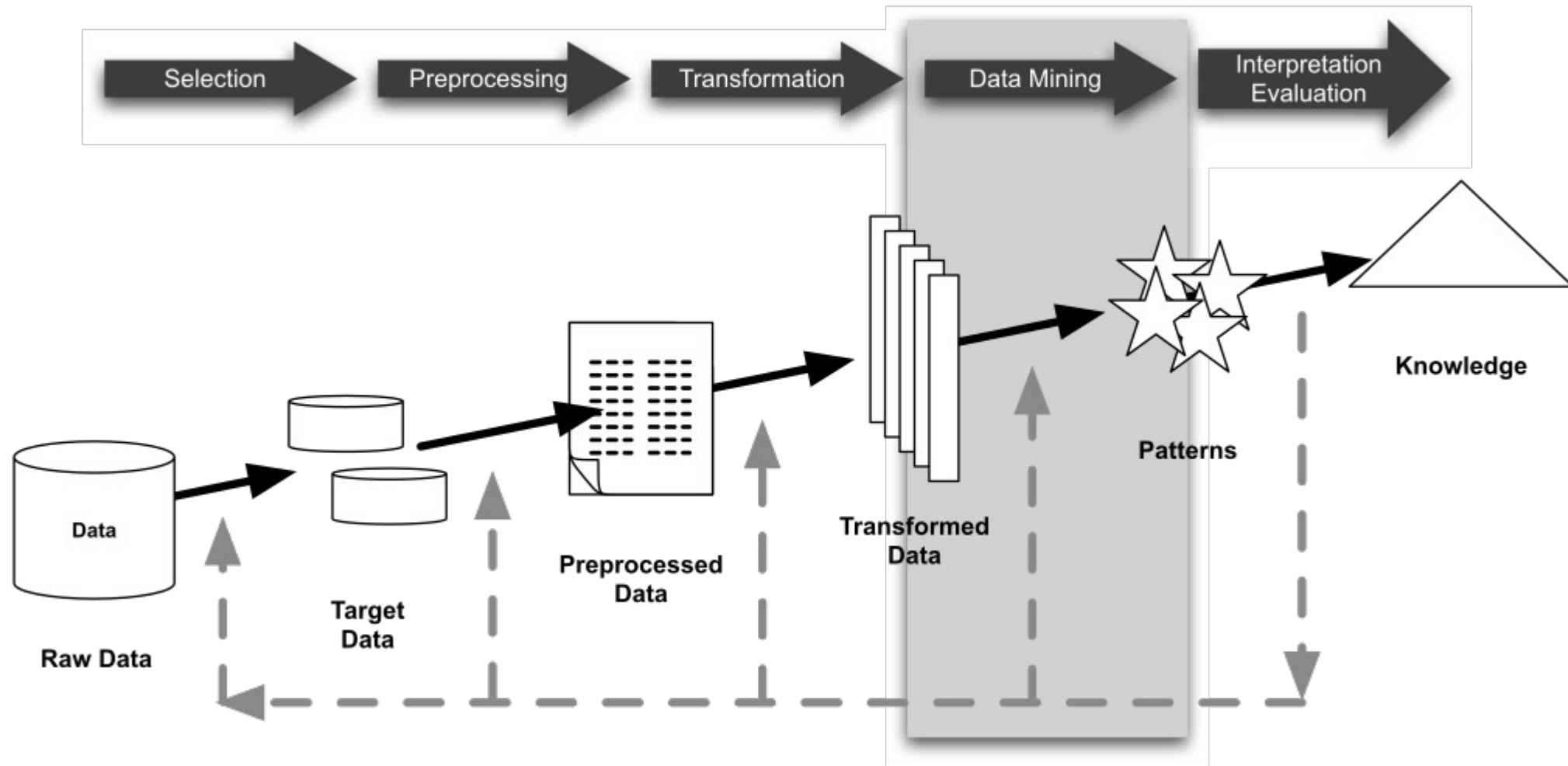
Pitfalls of interactive data mining or : how to help the user

**Albrecht Zimmermann**

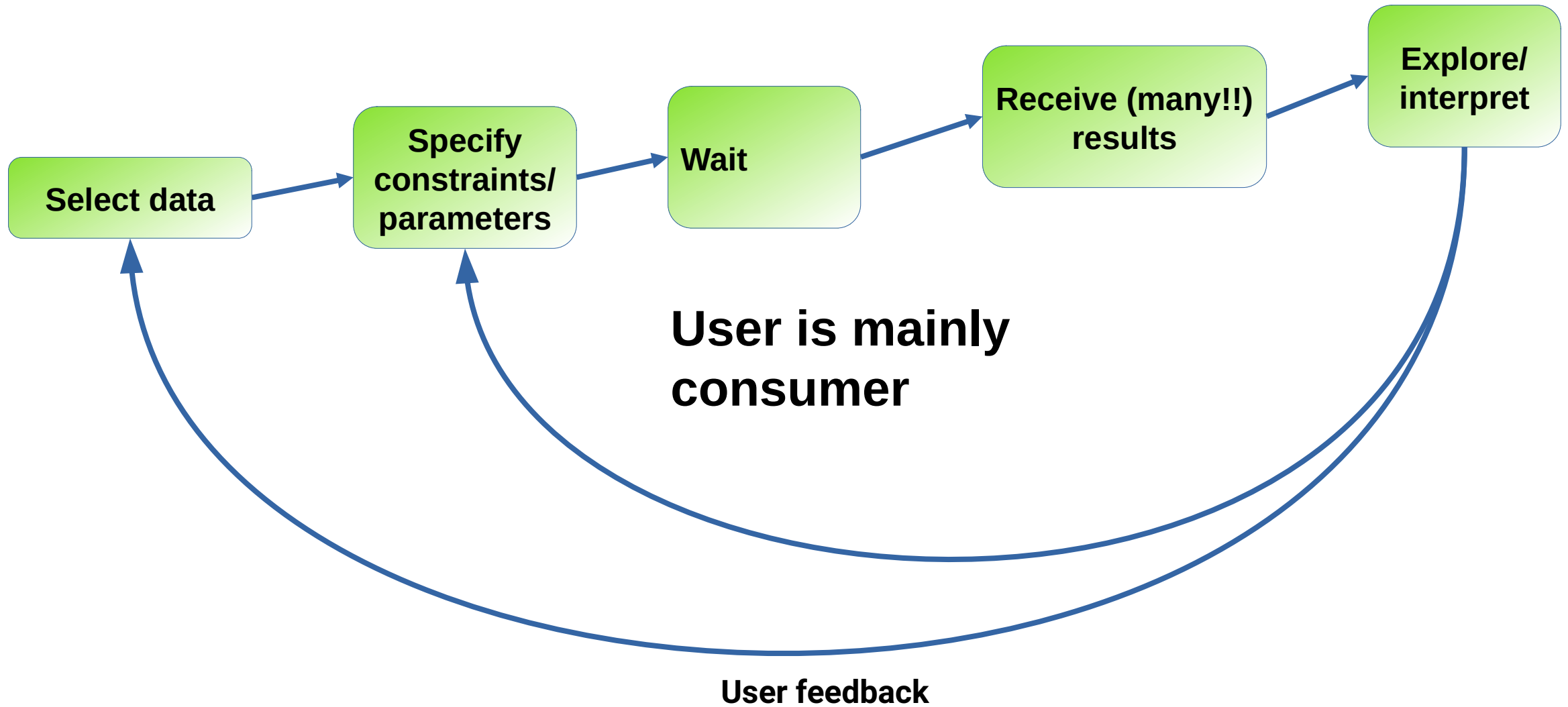
CODAG, GREYC, University of Caen



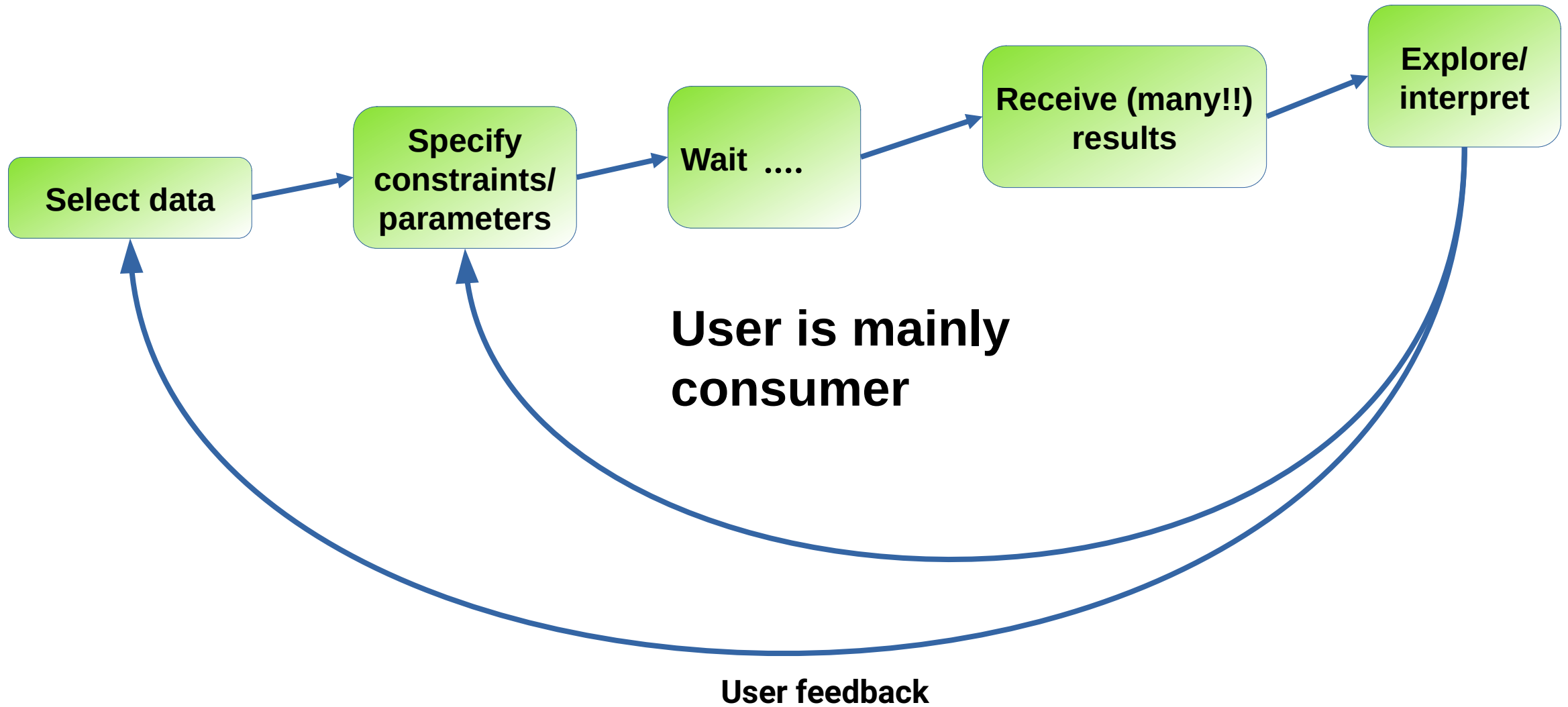
# The classical knowledge discovery process



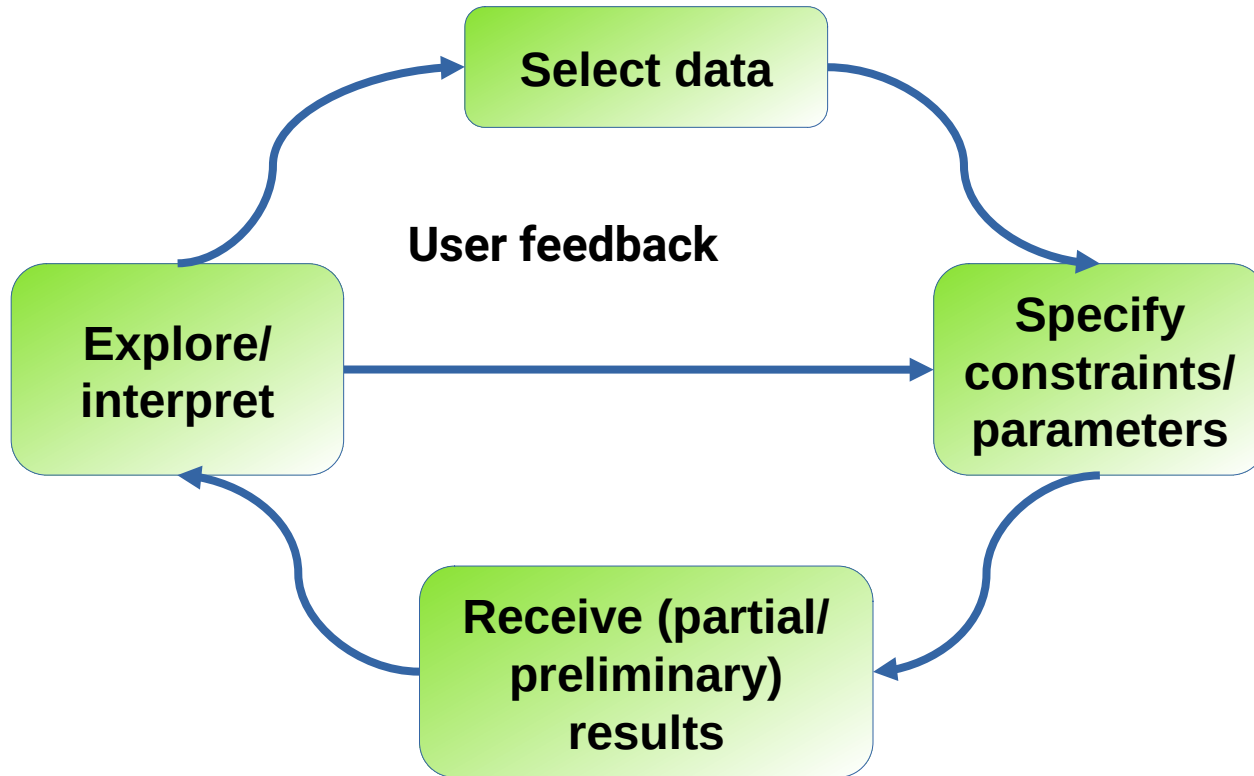
# The classical « loop » (2)



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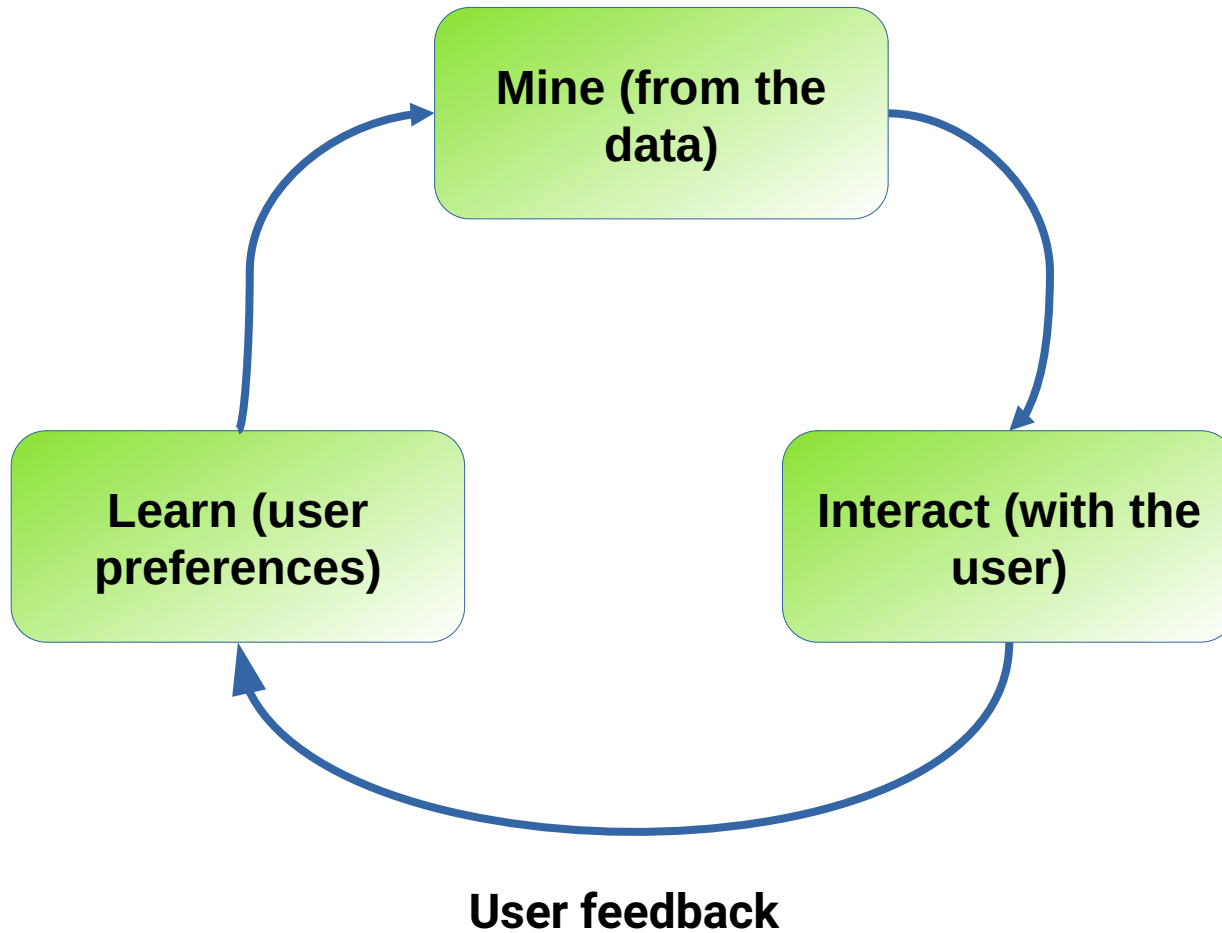


# The iterative mining loop



**User becomes a much more important part of the machinery**

# The implicit iterative mining loop



**User becomes an integral part of the machinery**

- somewhat replaces constraints/parameters
- potentially replaces data selection

# Requirements to put the human in the loop usefully

1. Result representation
2. Feedback option
3. Translation of feedback into internal model
4. Appropriate approximation of preference function
5. Correct internal model of the user

# Result representation

- (Ordered) lists of patterns
  - Ordered by what ?
  - Requires user to relate them to each other
- Augmented with (some) statistics
  - Requires to keep background stats in mind
  - Not too many as to not overwhelm – not too few/which ones ?



# Result representation

- (Ordered) lists of patterns
  - Ordered by what ? **Order risks biasing user**
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# Result representation

- (Ordered) lists of patterns
  - Ordered by what ? **Order risks biasing user**
  - Requires user to relate them to each other
- Augmented with (some) statistics **Larger values risk introducing bias**
  - Requires to keep background stats in mind
  - Not too many as to not overwhelm – not too few/which ones ?

# Result representation

- + Data
  - Whole data set ?
  - Linked to pattern ?
    - Rest of data hidden ?
  - Dimensionality problem
    - Original presentation ?
    - PCA or similar ?
- Lots of literature on interactive visual clustering analysis...not for now

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- + Data
  - Whole data set ?
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# Have the user learn the representation ?

- Enforces certain thought patterns (like a language)
- Out of sight, out of mind
- Clashes w/promise of democratic DM

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Think of pattern list vs  
pattern graph

# Feedback options

- Like/dislike – what's the meaning ?
  - Right vs wrong ?
  - Known vs unknown ?
  - Doesn't look interesting ?
  - Don't understand ?
- (Pairwise) ranking
  - But the list's already sorted
  - Meaning of low-ranked patterns ?



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- But the list's already sorted

Harder to move things down

- Meaning of low-ranked patterns ?

# Feedback options

- Delete/filter patterns
  - Stronger than dislike but semantic problem stays
  - Affects data ?
- Tag for keeping
  - Should be taken into account in the future ?
- Tag for extending
- Create new descriptors
  - For the data ?
  - For patterns ?

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Interaction with  
presentation ?

# Feedback options

- Select data
  - Give more weight to these data ?
  - Work only on this data ?
  - Effect on prior patterns ?
- Explicit constraint adjustment
  - Kind of what we wanted to avoid

# Feedback options

- Select clusters
  - → Like ? Equal to selecting data ?
- Customizing/splitting/merging clusters (Geono-Cluster, Das et al. '20)
  - Do they make algorithmic sense ?
- Change feature weights ?
  - Effects on data ?
  - On patterns ?
  - On presentation ?

Revisit old patterns ?

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- Select clusters
  - → Like ? Equal to selecting data ?
- Customizing/splitting/merging clusters (Geono-Cluster, Das et al. '20)
  - Do they make algorithmic sense ? **How to deal w/it if not ?**
- Change feature weights ?
  - Effects on data ?
  - On patterns ? **Revisit old patterns ?**
  - On presentation ?

# Feedback options

- Undo ?
  - How far back ?
  - What's it mean ?



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**Do we roll back the learned preference function ?**

# Have the user learn the feedback options ?

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  - Learn work-arounds ?
2. Limits ways of thinking about pattern interestingness
3. How about « demonstration-based interaction » ?

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Learned feedback  
options from user ?

# Translation

1. Cannot-/must-link constraints
  - Explicit : fine but limiting feedback
  - Implicit : truly what the user meant ?
2. Weights for elements/features/descriptive statistics
  - Equal weight = equal importance ?
3. Classification examples
  - Depends on meaning of feedback labels
4. Ranking examples

# Preference/quality approximation ?

1. Regression/classification function
  - Linear ?
  - Multiplicative ?
  - Cannot model complex relationships
2. A single decider enough ?
3. « Don't know » needed ?
4. Set of instance level constraints ?
  - Encodes all the possible information ?

# Correct internal model ?

1. Does user know what he/she's looking for ?
  - Something frequent ?
  - Something unexpected ?
  - Something counter-intuitive ?
2. Are they too locked into what they look for ?
  - → exploration/exploitation dilemma
3. Can they tell random noise from structure ?
  - Calibrate to user ?

# Which leads me to....

## Can we put the human in the loop ?

**Which leads me to....**

**Can we put the human in the loop ?**

**In my opinion, right now : NO !**



**Which leads me to....**

**Can we put the human in the loop ?**

**In my opinion, right now : NO !**

**Solving it's gonna be hard because the problems are not DM-expertise...**