JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

САНКТ-ПЕТЕРБУРГСКИЙ ГОСУДАРСТВЕННЫЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

Science 2.0 & Clouds for Better Research Collaboration: A Case of MIR

Evgeny Pyshkin *speaker*

Ph.D., Senior Associate Professor, Dept. of Computer Systems and Software Engineering

St. Petersburg State Polytechnic University

Andrey Kuznetsov

Senior Software Engineer, Motorola Solutions Inc.,

Assistant Professor, St. Petersburg State Polytechnic University

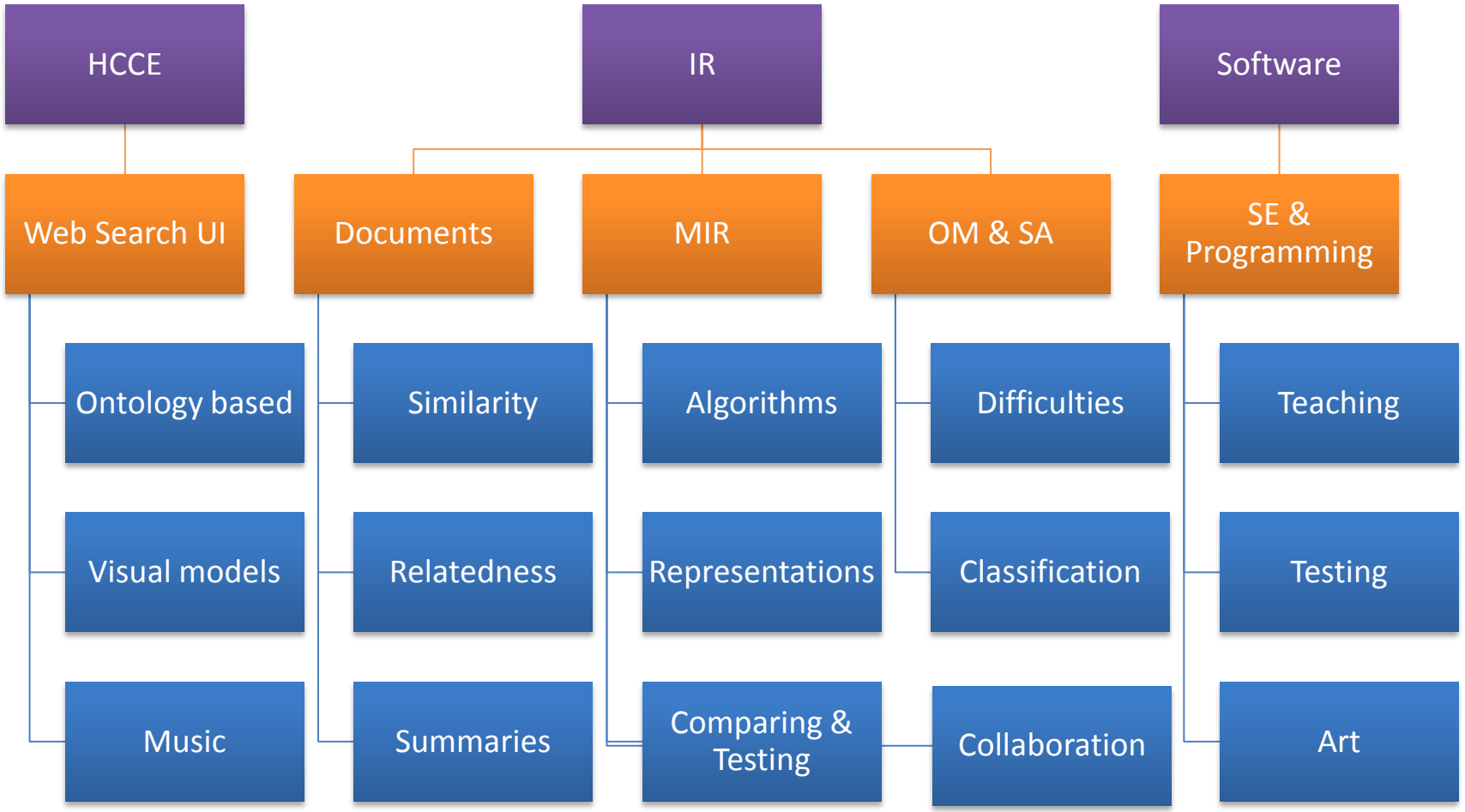
Outline

- Clouds for Better Collaboration: A Case of MIR
  - Personal Experience
  - People and Communities
  - Ideas and Evaluations
  - Communication and Collaboration
  - Some Technical Details

Science 2.0 & Clouds
for Better Research Collaboration:
A Case of MIR

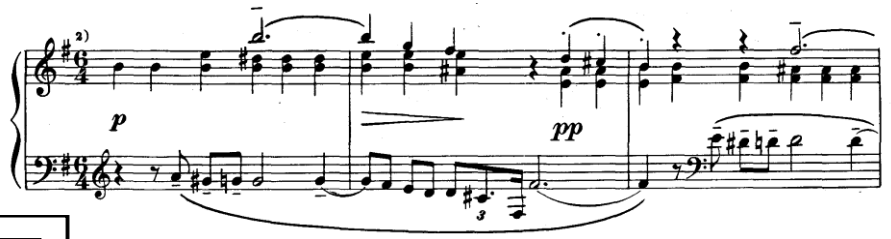
INTRODUCTION TO OUR RESEARCH PROJECTS IN THE DOMAIN OF IR (& RELATED)

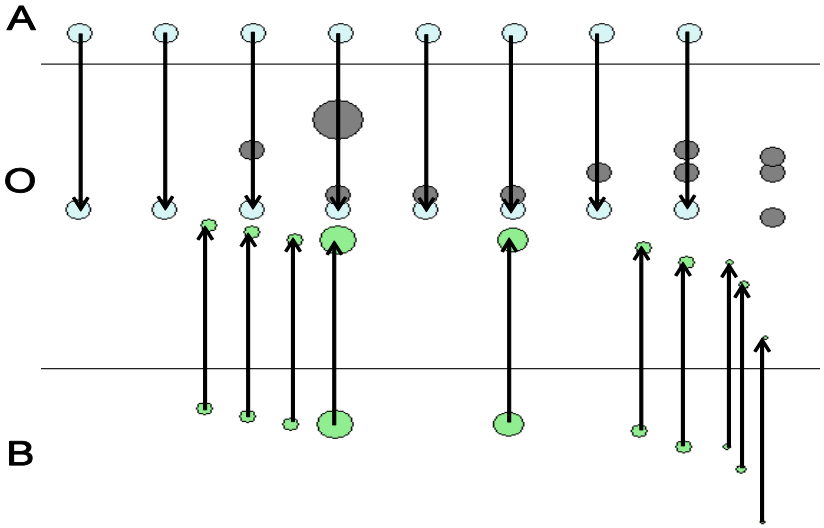
Research Topics



Searching for music: from melody in mind to the resources on the web

- Improving an EMD algorithm to compare user's melody to polyphonic fragment
- Minimizing false positive results





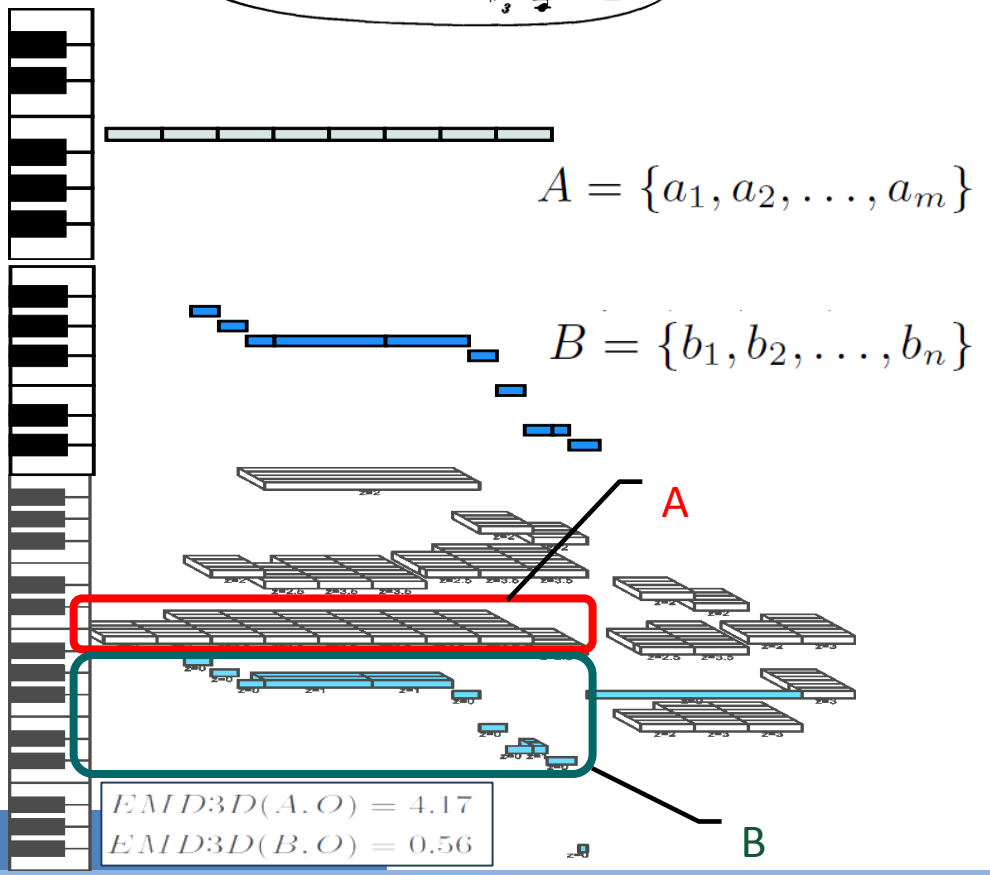
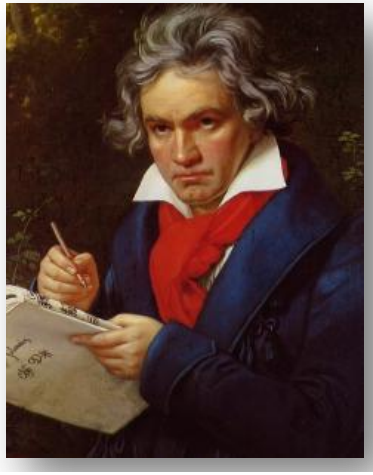
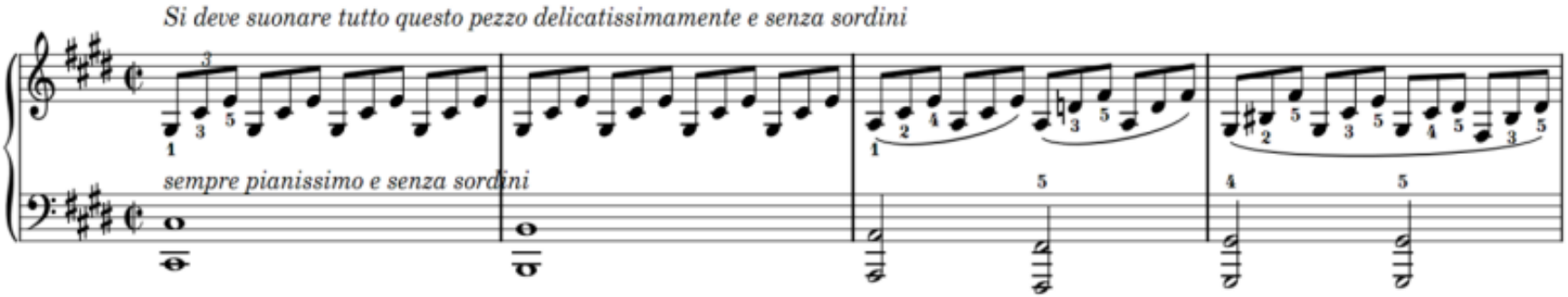
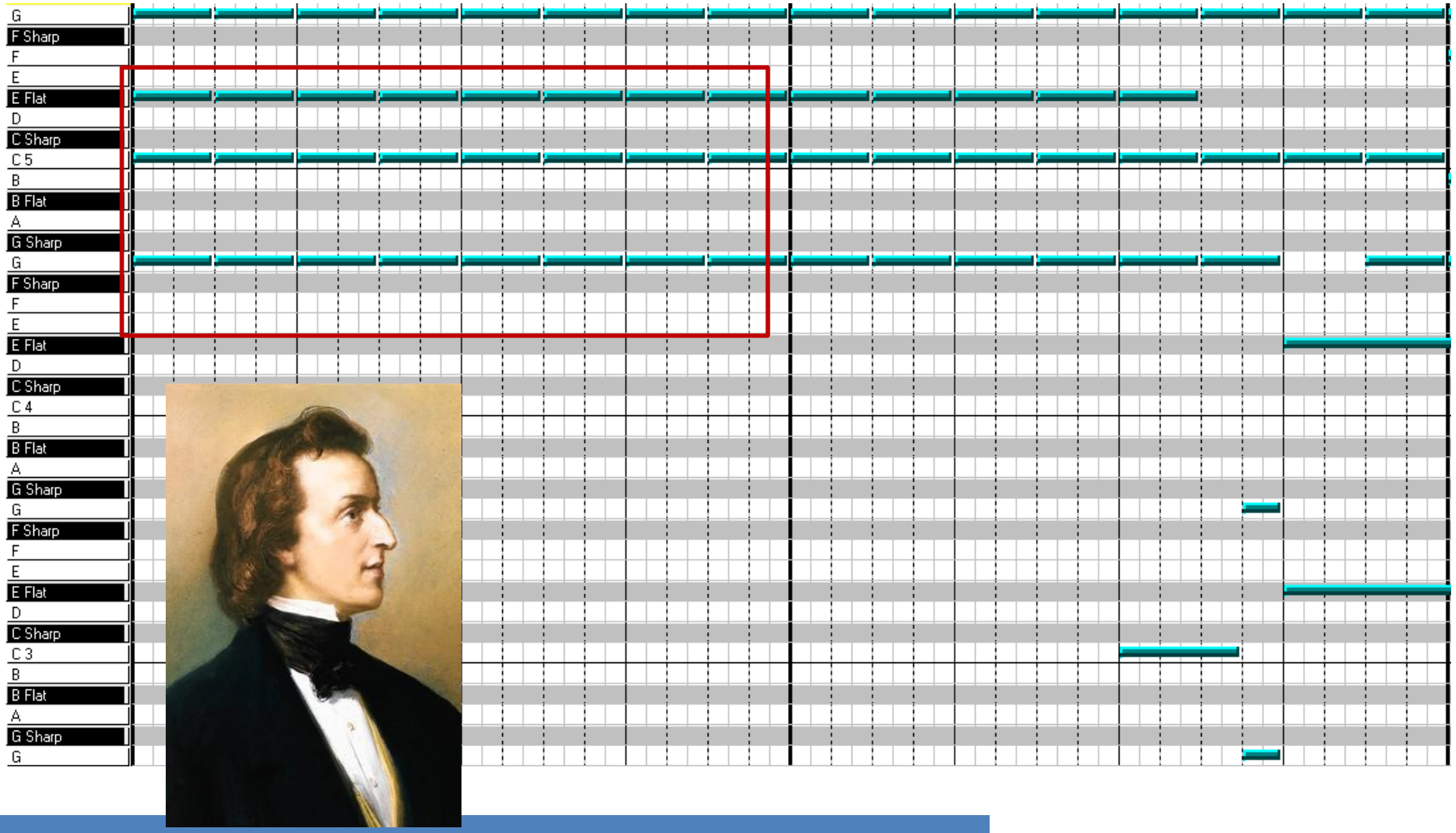


Illustration:
Beethoven's Moonlight sonata

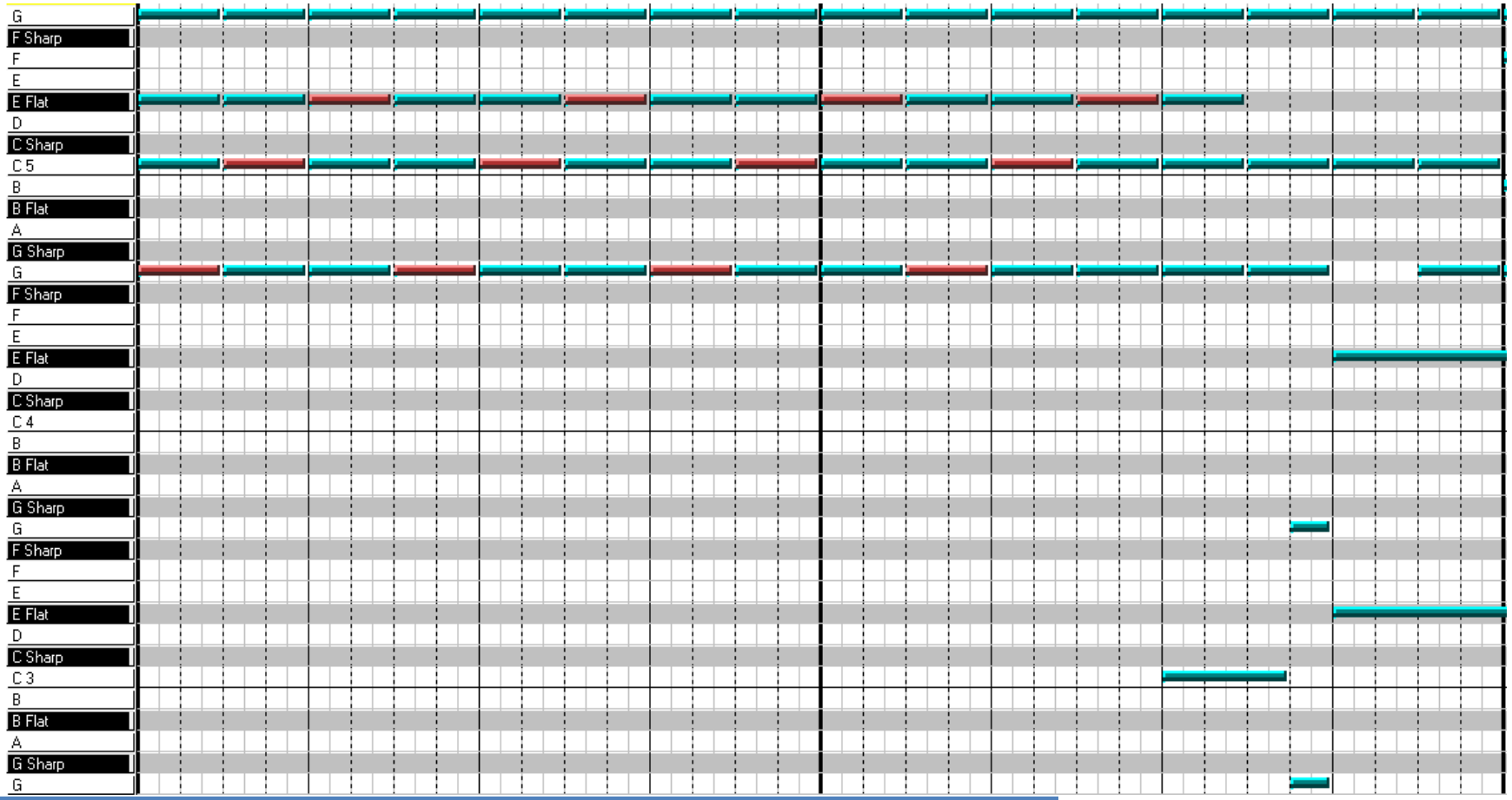




Chopin's Polonaise c-moll Op. 40 No.2

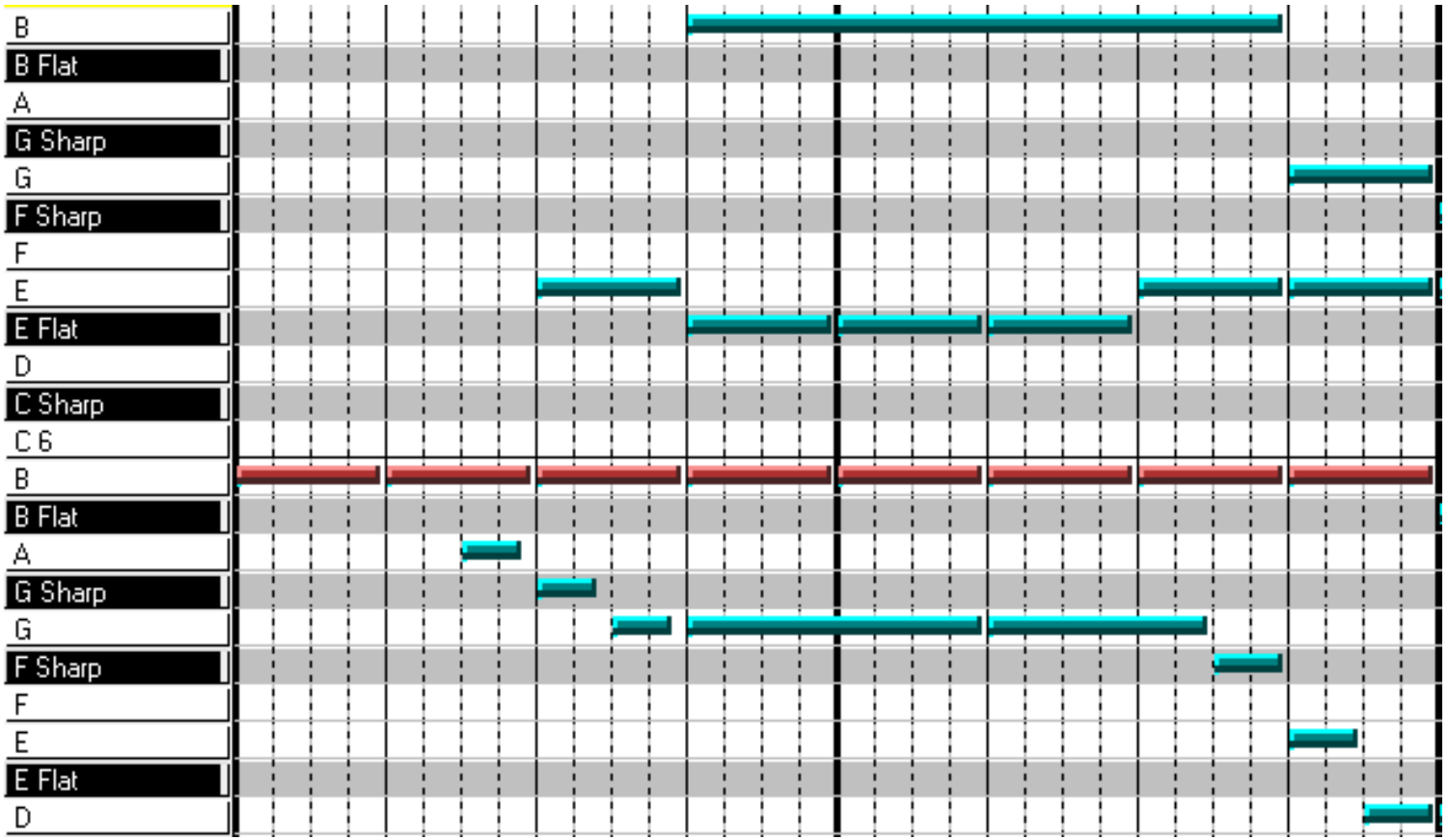


Moonlight =>
Chopin's Polonaise Op. 40 No.2



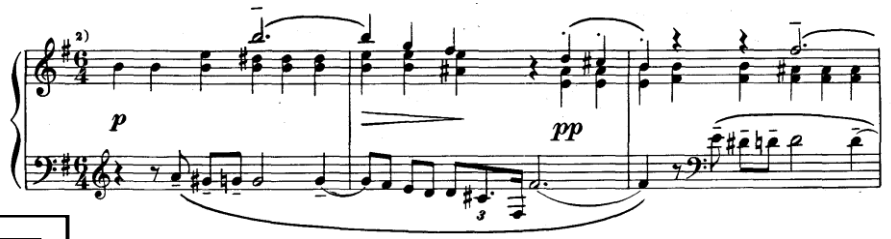
Chopin's Polonaise c-moll Op. 40 No.2

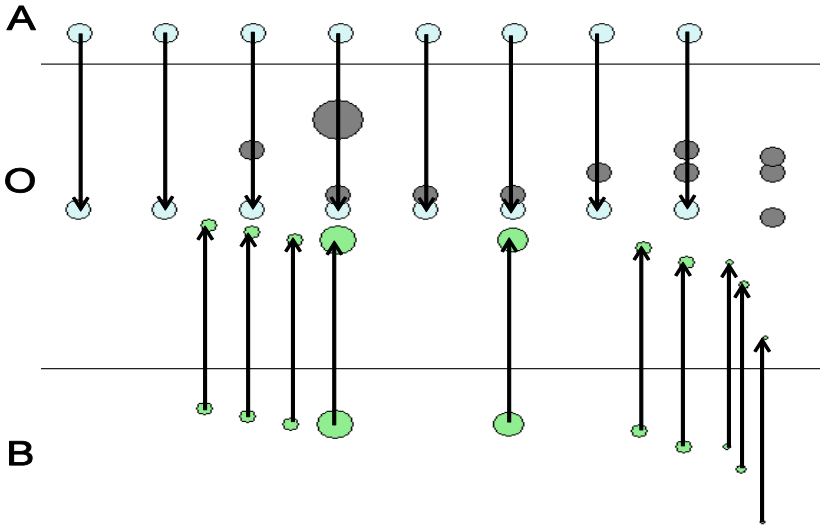
Chopin's Polonaise Op. 40 No.2 => Scriabin's Prelude No. 4, op.11

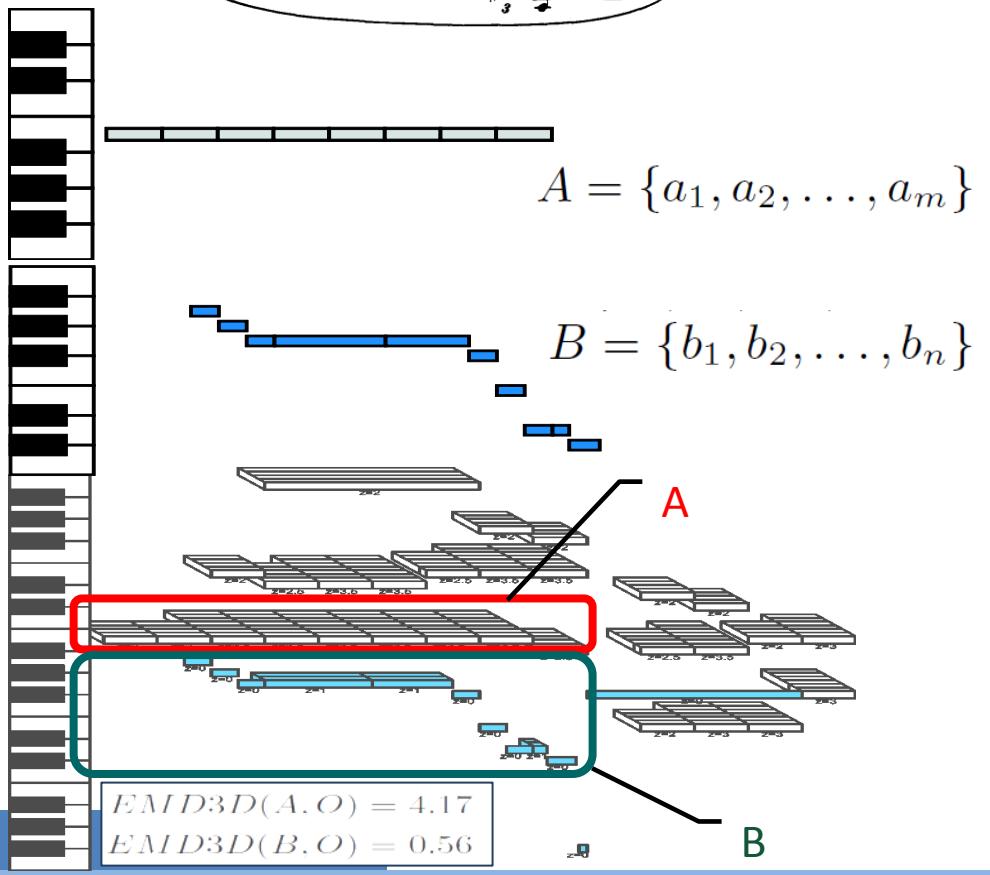


Searching for music: from melody in mind to the resources on the web

- Improving an EMD algorithm to compare user's melody to polyphonic fragment
- Minimizing false positive results



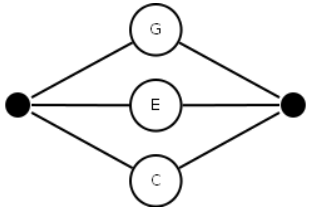




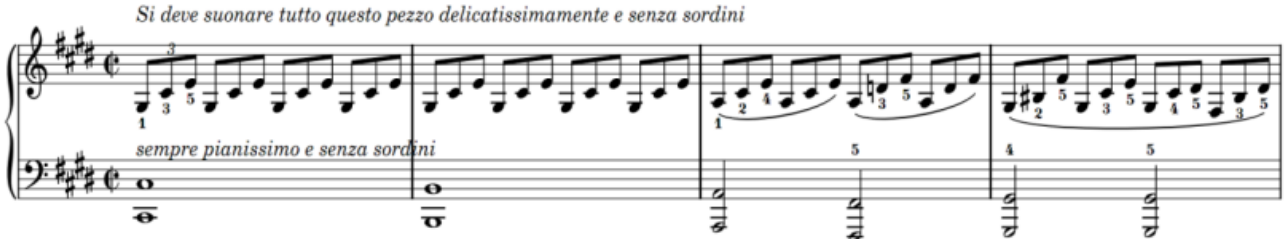
Function-based and circuit-based symbolic music representation, or Back to Beethoven

- Models of Symbolic Music Representations

  {{C4,1/4},
  {E4,1/4},
  {G4,1/4}}



- Function-based music representation



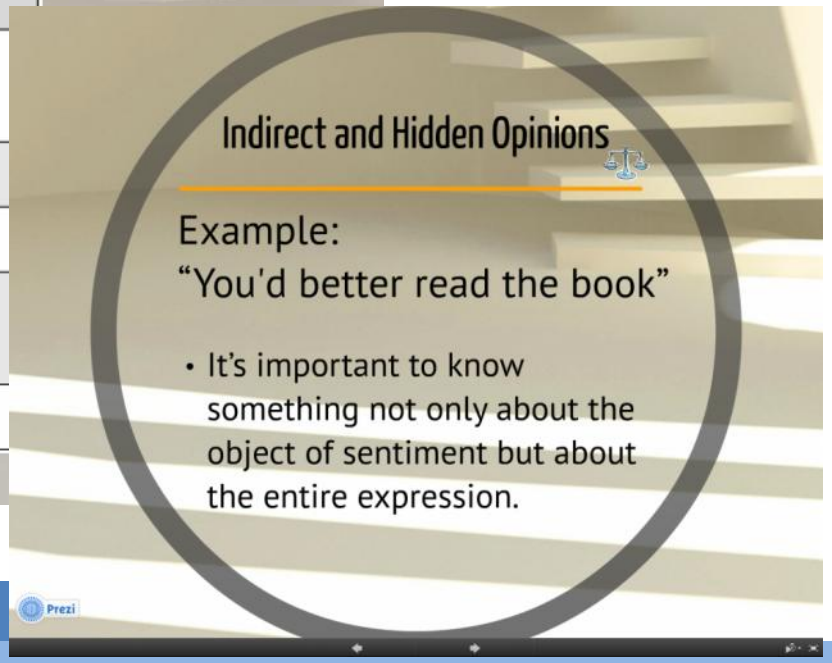
$$
\begin{aligned}
F(t) = {} & (O(C\#2) \cdot CON(t,0,1,1,2)+ \\
& + A(t, CR(C\#4, moll, ton) \cdot Inv(0,0,-1)) \cdot m(0,1) \cdot v_3)+ \\
& + (O(H1) \cdot CON(t,1,1,1,2)+ \\
& + A(t, CR(C\#4, moll, ton) \cdot Inv(0,0,-1)) \cdot m(1,1) \cdot v_3)+ \\
& + (O(A1) \cdot CON(t,2,\tfrac{1}{2},1,2)+ \\
& + A(t, CR(A3, dur, ton) \cdot Inv(0,0,0)) \cdot m(2,\tfrac{1}{2}) \cdot v_3)+ \\
& + (O(F\#1) \cdot CON(t,2\tfrac{1}{2},\tfrac{1}{2},1,2)+ \\
& + A(t, CR(D4, dur, ton) \cdot Inv(0,0,-1)) \cdot m(2\tfrac{1}{2},\tfrac{1}{2}) \cdot v_3)+ \\
& + (O(G\#1) \cdot CON(t,3,\tfrac{1}{2},1,2)+ \\
& + A(t, CR(G\#3, dur, ton) \cdot Inv(0,0,0)) \cdot m(3,\tfrac{1}{4}) \cdot v_3+ \\
& + A(t, CR(C\#4, moll, ton) \cdot Inv(0,0,-1)) \cdot m(3\tfrac{1}{4},\tfrac{1}{4}) \cdot v_3)+ \\
& + (O(G\#1) \cdot CON(t,3\tfrac{1}{2},\tfrac{1}{2},1,2)+ \\
& + A(t, CR(G\#3, moll, sus4)) \cdot Inv(0,0,0)) \cdot m(3\tfrac{1}{2},\tfrac{1}{4}) \cdot v_3+ \\
& + A(t, CR(H\#3, moll, dim) \cdot Inv(0,0,-1)) \cdot m(3\tfrac{3}{4},\tfrac{1}{4}) \cdot v_3)
\end{aligned}
$$

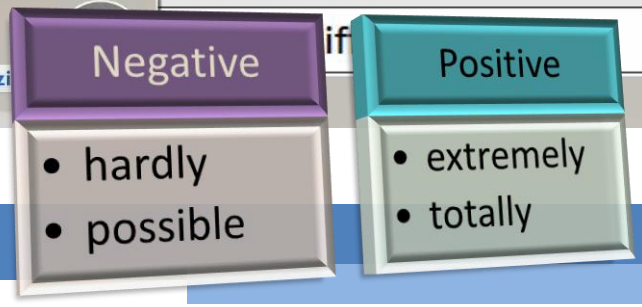
Spelling Out Opinions: Difficult Cases of Sentiment Analysis

Difficult cases:

	What groups can be identified?
A.	Indirect and Hidden Opinions
B.	Difficulties of Opinion or Sentiment Word Detection
C.	Errors Conditioned by Spelling and Grammar Factors
D.	Feature Interinfluence in Feature-based Opinion Mining
E.	Opinions Temporal Dependency
F.	Case of Multilingualism
G.	Subjective Opinions and Their Semantic Orientation

- Opinions and sentiments which are multi-faceted
- When sentiment classifiers are wrong?





Related published works

- A. Kuznetsov, and E. Pyshkin, ***"Searching for music: from melody in mind to the resources on the Web,"*** In Proceedings of the 13th International Conference on Humans and Computers (HC2010), Dec. 8-10, Aizu-Wakamatsu, Japan, 2010, 152–158.
- A. Kuznetsov, and E. Pyshkin, ***"Function-based and circuit-based symbolic music representation, or Back to Beethoven,"*** In Proceedings of the 14th International Conference on Humans and Computers, The Joint Conference on Human-Centered Computer Environment (HCCE-2012), Aizu-Wakamatsu, Japan, March, 8 – 13, 2012, 171–177. – University of Aizu Press. – 2012.
- I. Khozyainov, E. Pyshkin, and V. Klyuev. ***"Spelling out opinions: Difficult cases of sentiment analysis,"*** In Proceedings of 2013 International Joint Conference on Awareness Science and Technology & Ubi-Media Computing (iCAST-UMEDIA), Nov 2-4, Aizu-Wakamatsu, Japan, pp. 231–237.

Scientific community demands

- Computational and data resources distribution
- Ability to reproduce results reported by other researchers
- Getting access to algorithms and test collections
- Inspired* by Music Information Retrieval (MIR) domain

See ISMIR 2012: "Reusable software and reproducibility in music informatics research"

Science 2.0 & Clouds
for Better Research Collaboration:
A Case of MIR

SCIENCE 2.0: GETTING INVOLVED

Science 2.0 Initiative (1)

Current Model

- Research done **privately**; then submitted to journals; then peer-reviewed by gatekeepers in major journals; published
- Scientific literature **behind paywalls** online
- Credit established by **journal** name or journal impact factor.

Emerging Model

- Research **data shared** during discovery stages; ideas shared; scientists collaborate; then findings are disseminated online
- Scientific discoveries **free** online
- Credit established by citation count, number of **views** or downloads.

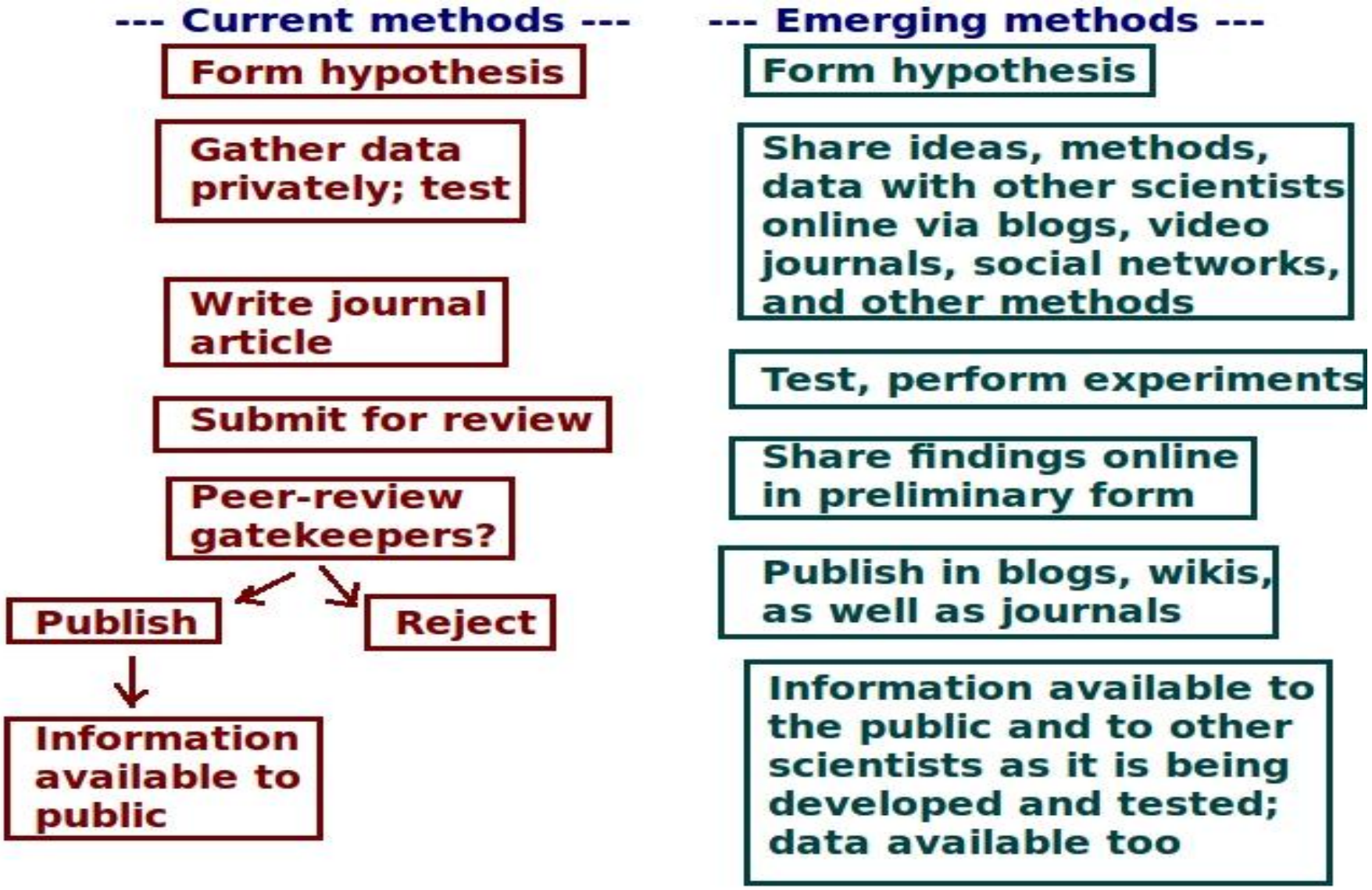
Science 2.0 Initiative (2)

Current Model

- Data is **private until** publication
- Papers generally protected by **copyright**
- Publishers raise funds by **charging** for access to content
- Journal article summaries available online **after publication**

Emerging Model

- Data is **shared before** publication
- Many **different licenses** possible
- Publishers seek **alternative funding**
- **Share** methods, data, findings via blogs, social networking sites, wikis, computer networking,, video journals, etc.



wikipedia.org

Science 2.0: Benefits & Drawbacks

Benefits

- more collaborative
- freer, less expensive
- faster development
- wider access & diverse applications
- lets other scientists see results instantly and comment

Drawbacks

- difficulty getting paid
- risk others will copy preliminary work to get credit, patents, money
- how will reviewers and editors get paid?
- need infrastructure
- discouraging

Science 2.0 & Clouds
for Better Research Collaboration:
A Case of MIR

AN ATTEMPT TO CONTRIBUTE: PROVISIONING RESEARCH APPLICATIONS IN CLOUDS

Major Problems in (M)IR

- Access to the implementation
  - Unpublished / Legal issues
- Reproducibility
  - Implementation doesn’t work properly
  - Test data aren’t accessible (copyright restrictions, big size)
- Expertise
  - Third party execution within the local environment

Known Solutions (out of scope of our approach)

- Publishing a source code as files
- Publishing a dataset as files
- Publishing completely configured VM as files
- Publishing completely configured VM as a service
  - E.g. remote workplace
- Outsourcing to third party organization
  - E.g. MIREX

Known Solutions (in scope of our work)

- Publishing algorithms as services
  - E.g. in a cloud
- Publishing data as a services
  - E.g. in a cloud

- Reason:
  - No need to publish application nor dataset collection => no copyright issues violation

MIR Research Software in Practice

- 82 % of researchers developed software
  - Only 39% of those took steps toward reproducibility
    - Only 35% of those published any code
- Only 11% made efforts toward the reproducibility of result
- 51% said their code never left their own computer

We believe in the results reported in papers without being sure that the reported results came from a certain method, and not from bugs in the software

What are difficulties? **

- There are some for IT experts
- There are many for non IT experts
  - Example: MIR community
  - Research software is developed as desktop applications not intended to be executed in networked or distributed environments
  - Researchers aren't experienced enough to resolve deployment problems and to configure cloud runtime environment properly

***** to deploy applications in clouds***

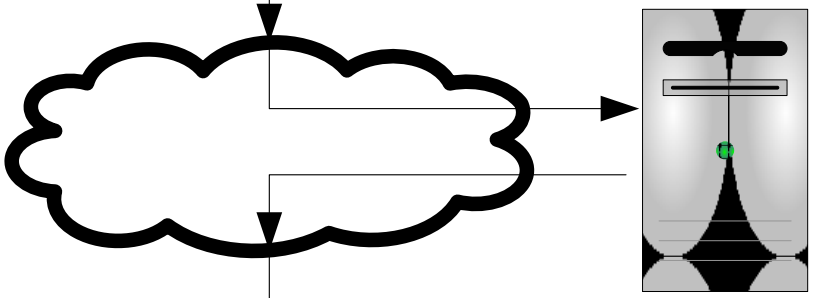
Cloud in Theory (Algorithm as a Service)

www.algorithm.org

This service executes our private ‘algorithm’ against your dataset

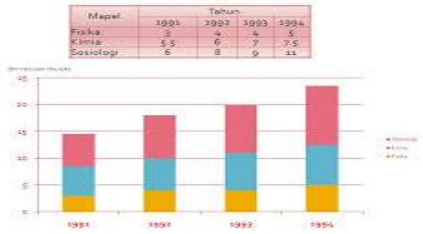
select dataset

Algorithm ‘algorithm’ is deployed here



www.algorithm.org

Results for your dataset in comparison with other state-of-the-art datasets



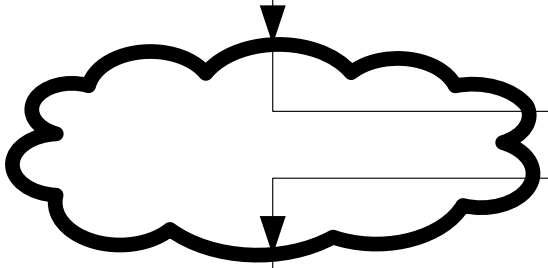
Cloud in Theory (Dataset as a Service)

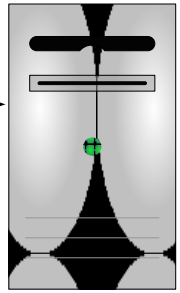
www.dataset.org

This service executes your application against our private ‘dataset’

select application

Dataset ‘dataset’ is deployed here

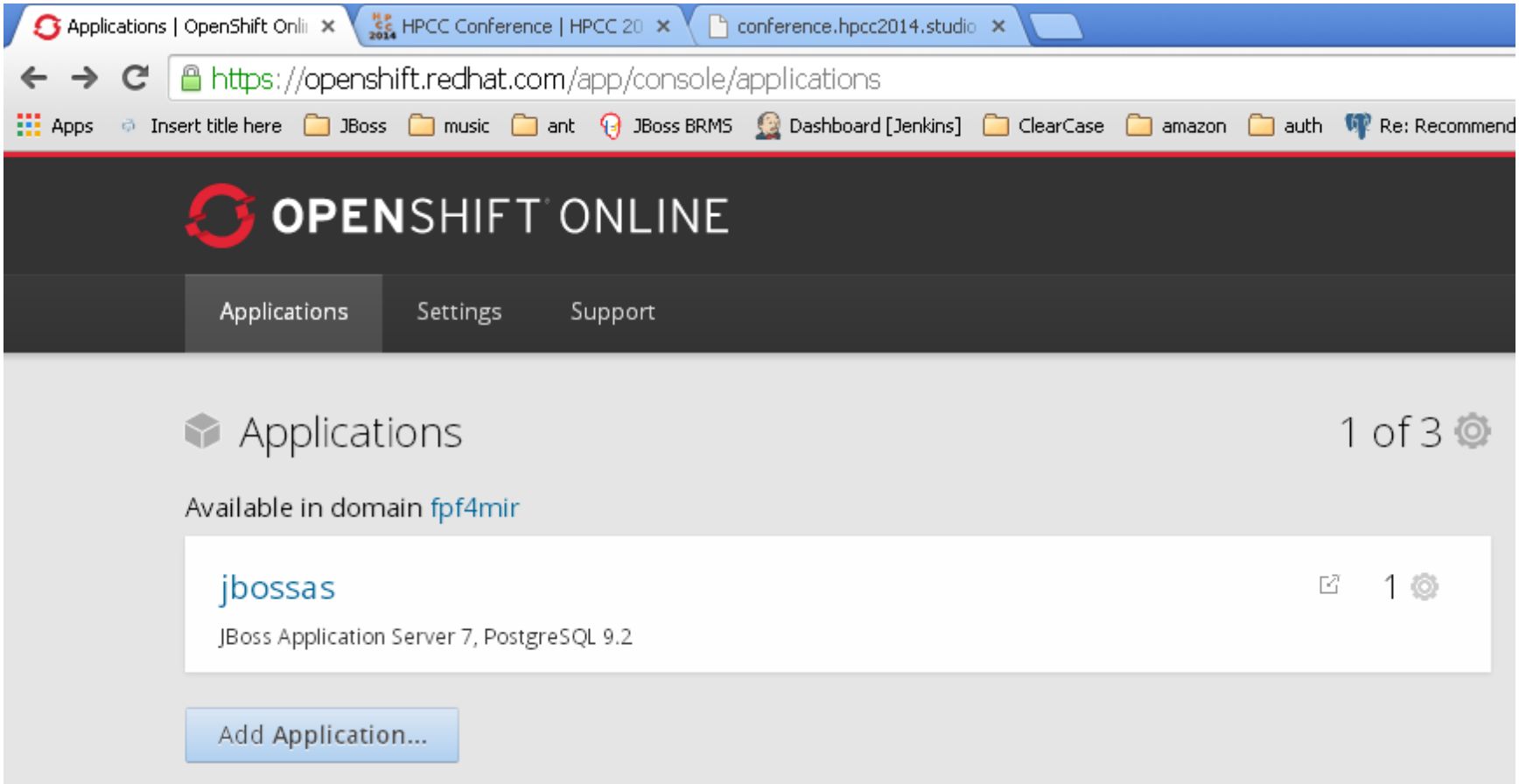




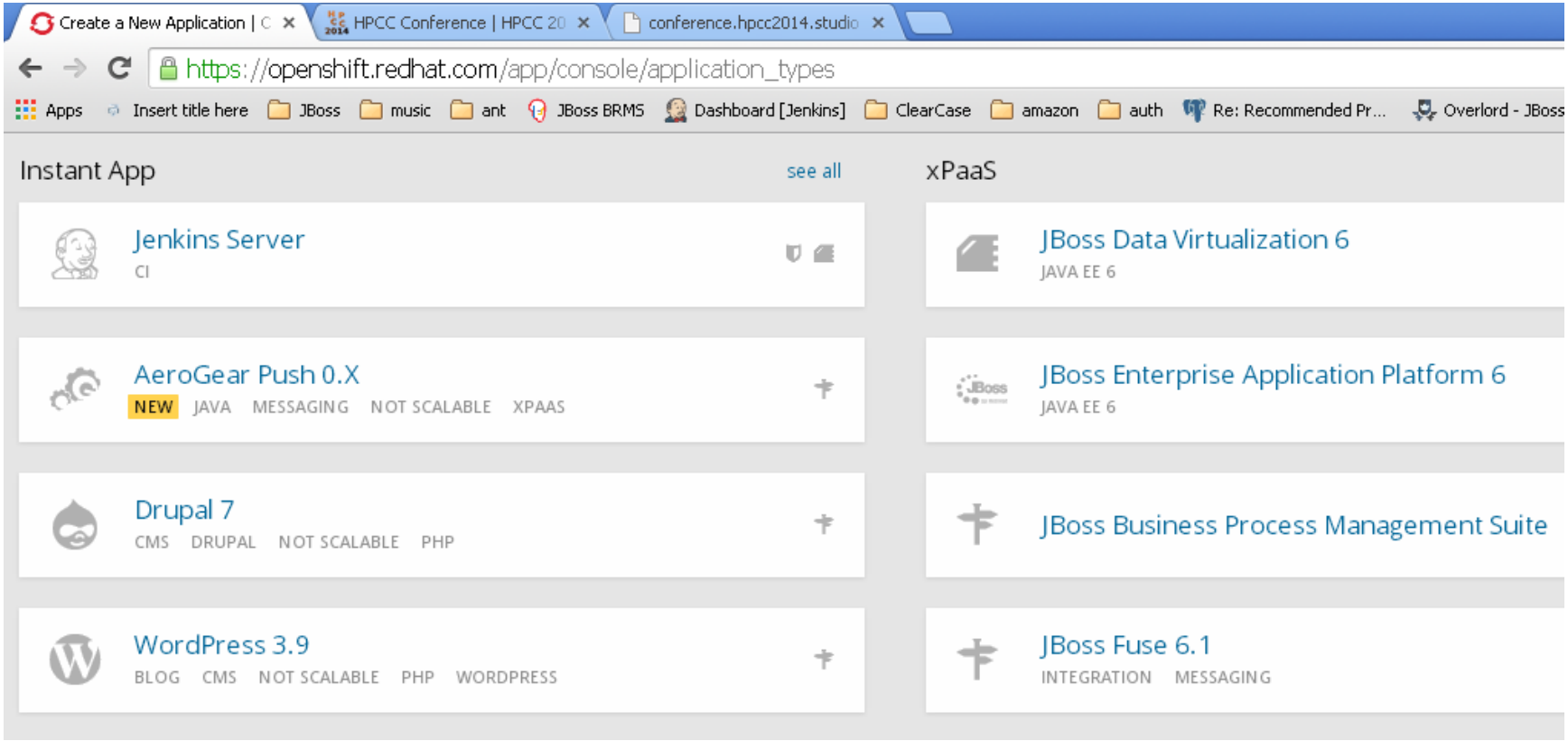
www.dataset.org

Results for your algorithm in comparison with other state-of-the-art algorithms

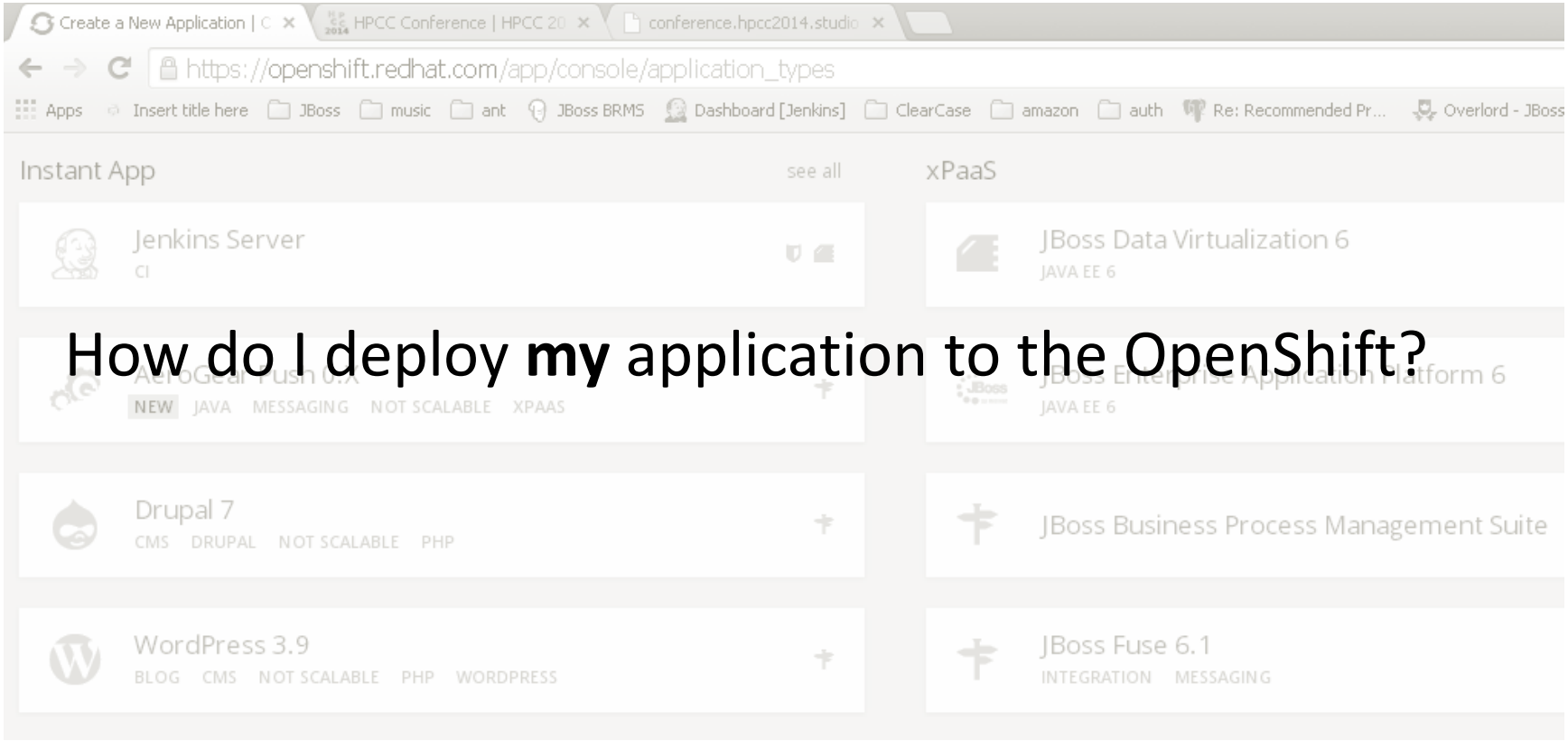
Cloud in Practice (OpenShift example)



Cloud in Practice (OpenShift example)



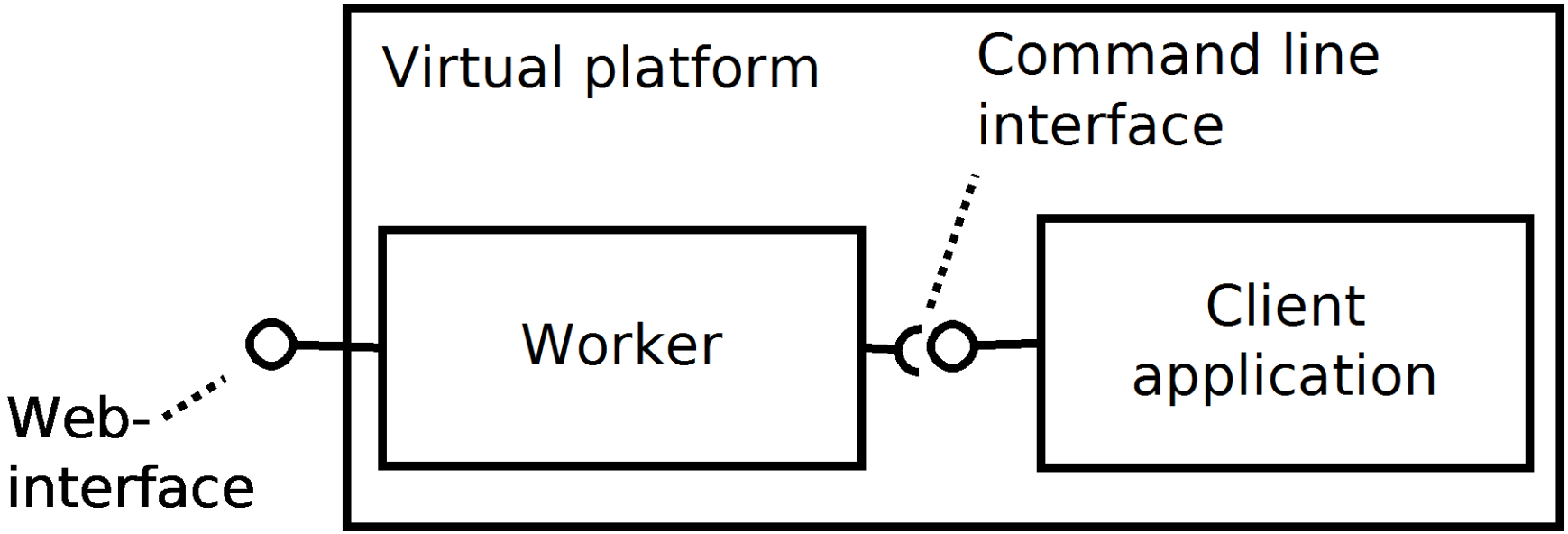
Cloud in Practice (OpenShift example)



How do I deploy **my** application to the OpenShift?

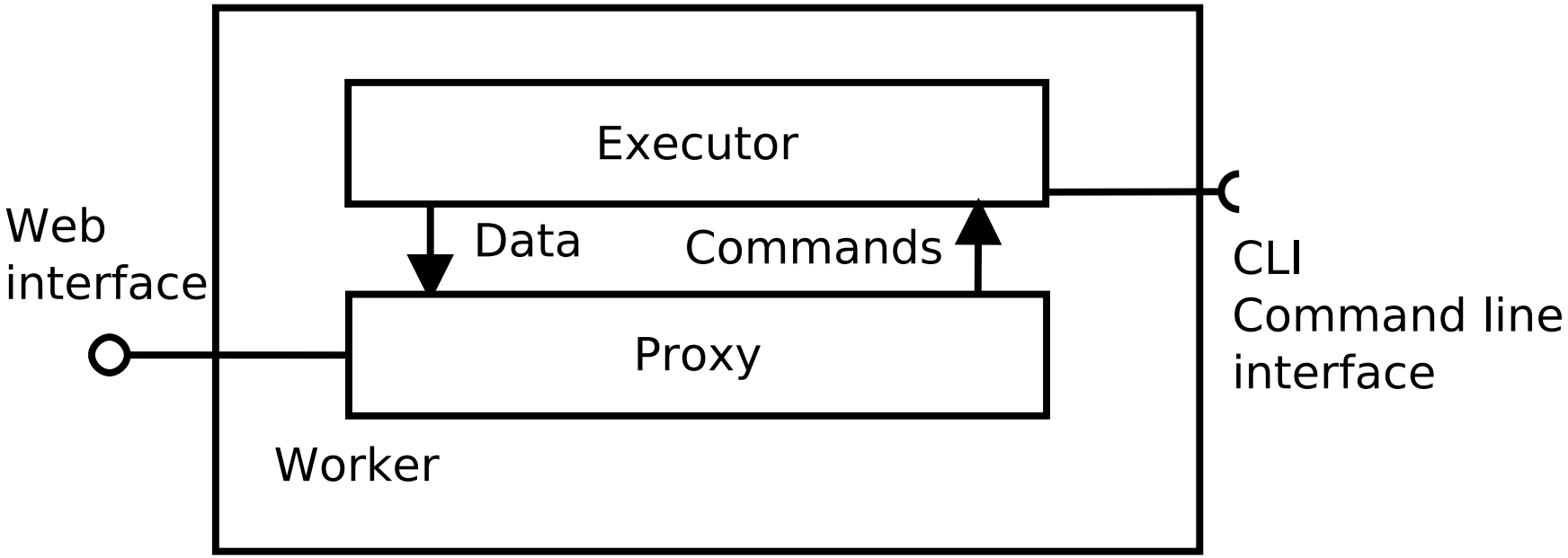
Mediation: Traditional Approach

- In order to support networking features without modifying an existing application a proxy component is required.



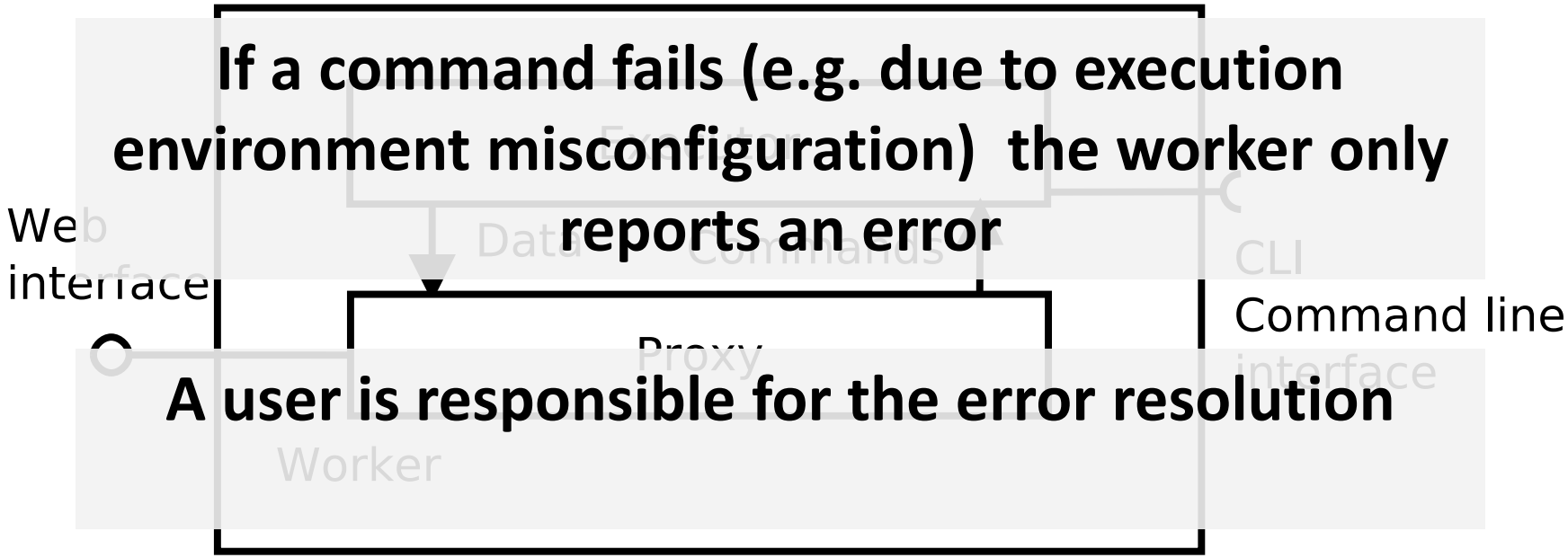
Mediation: Traditional Approach

- In order to support networking features without modifying an existing application a proxy component is required.

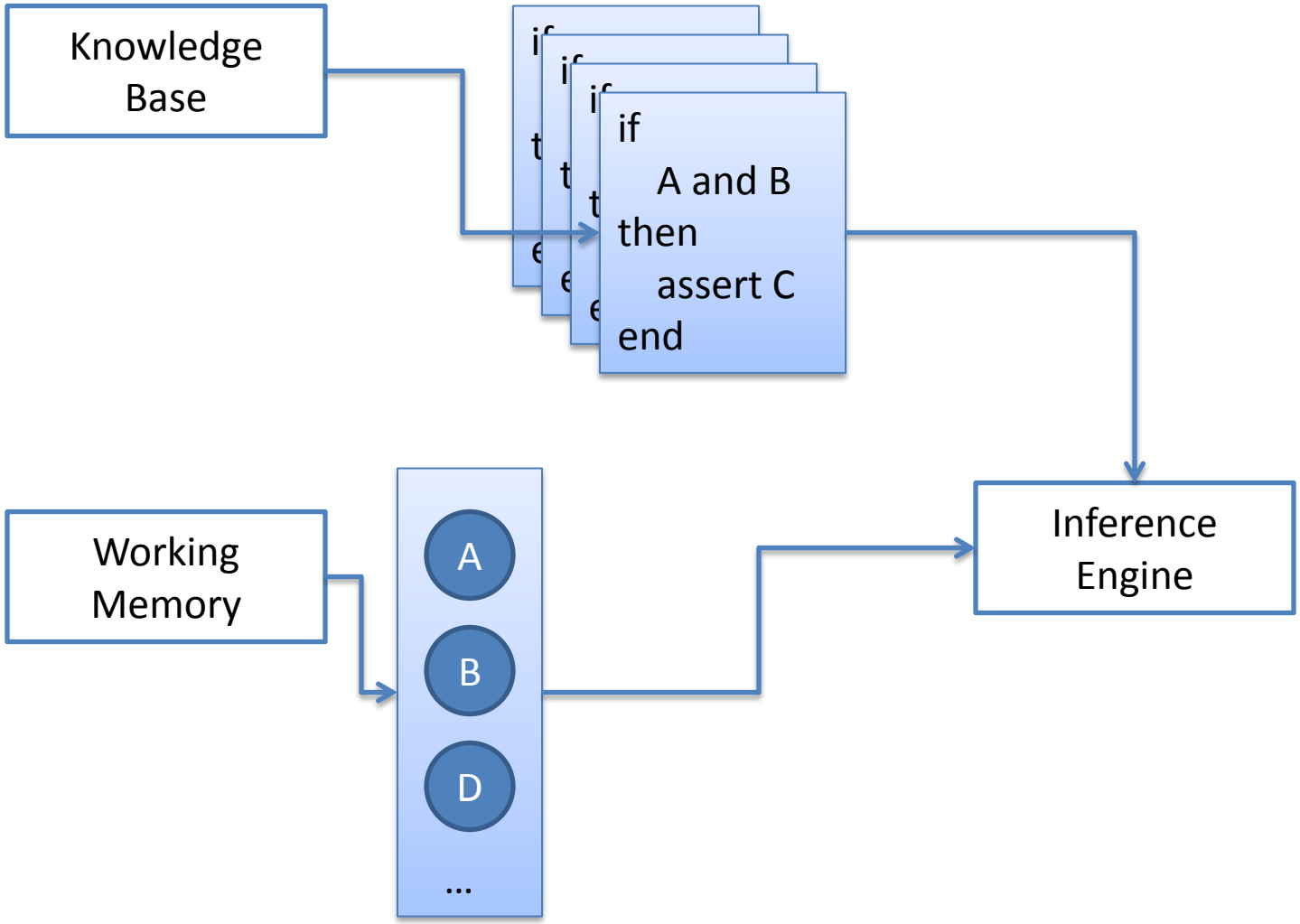


Mediation: Traditional Approach

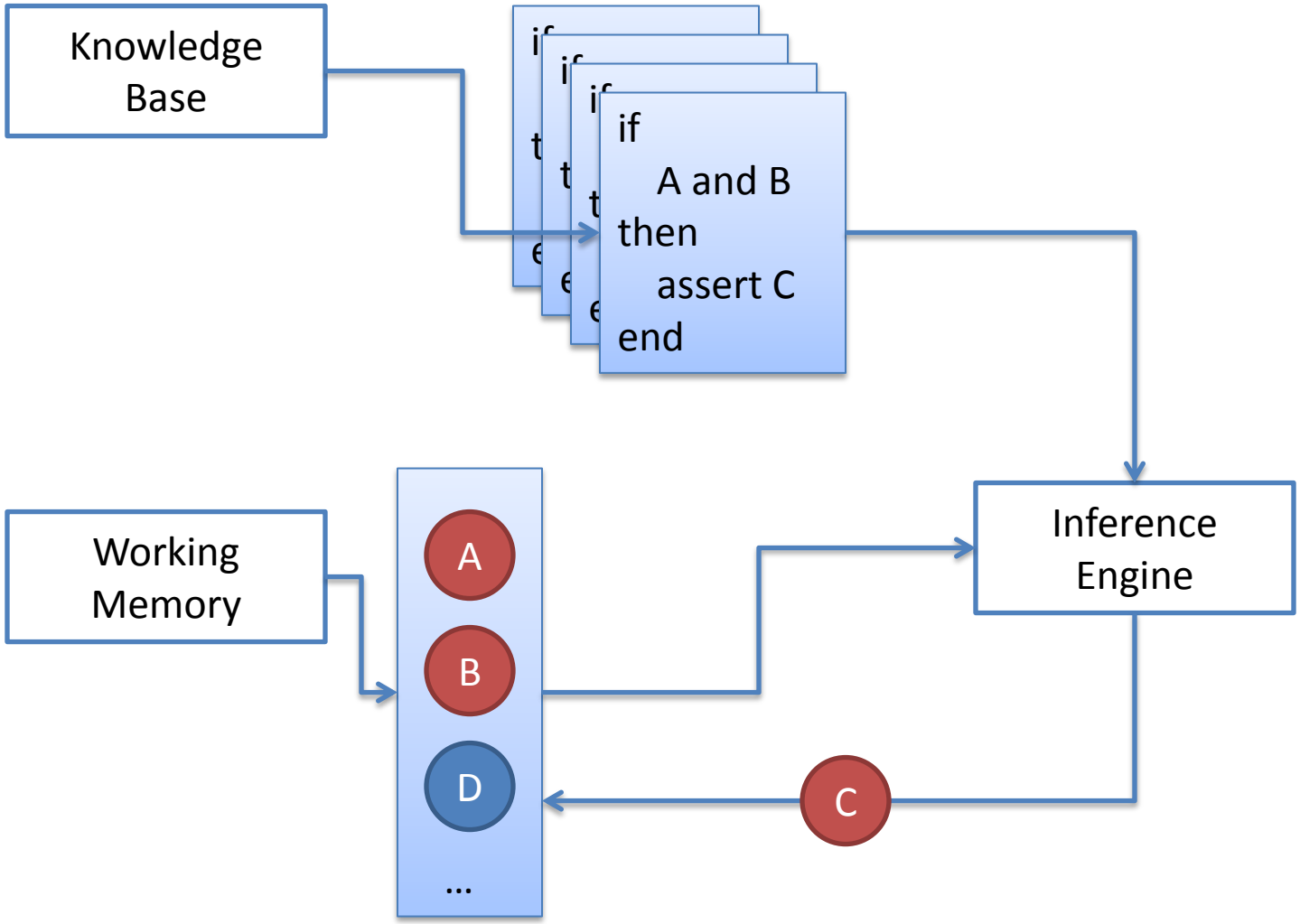
- In order to support networking features without modifying an existing application a proxy component is required.



Reminder: Expert Systems



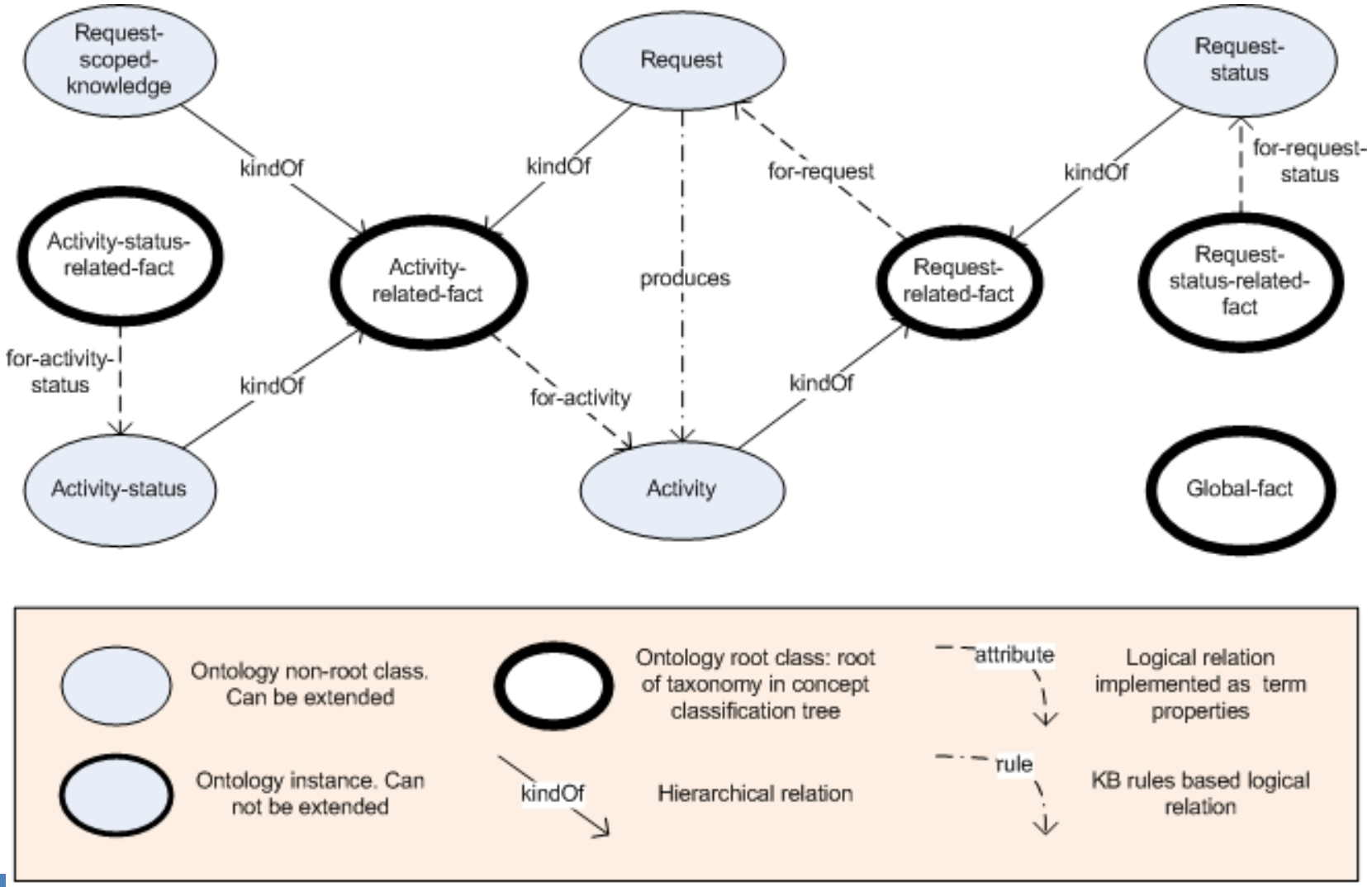
Reminder: Expert Systems



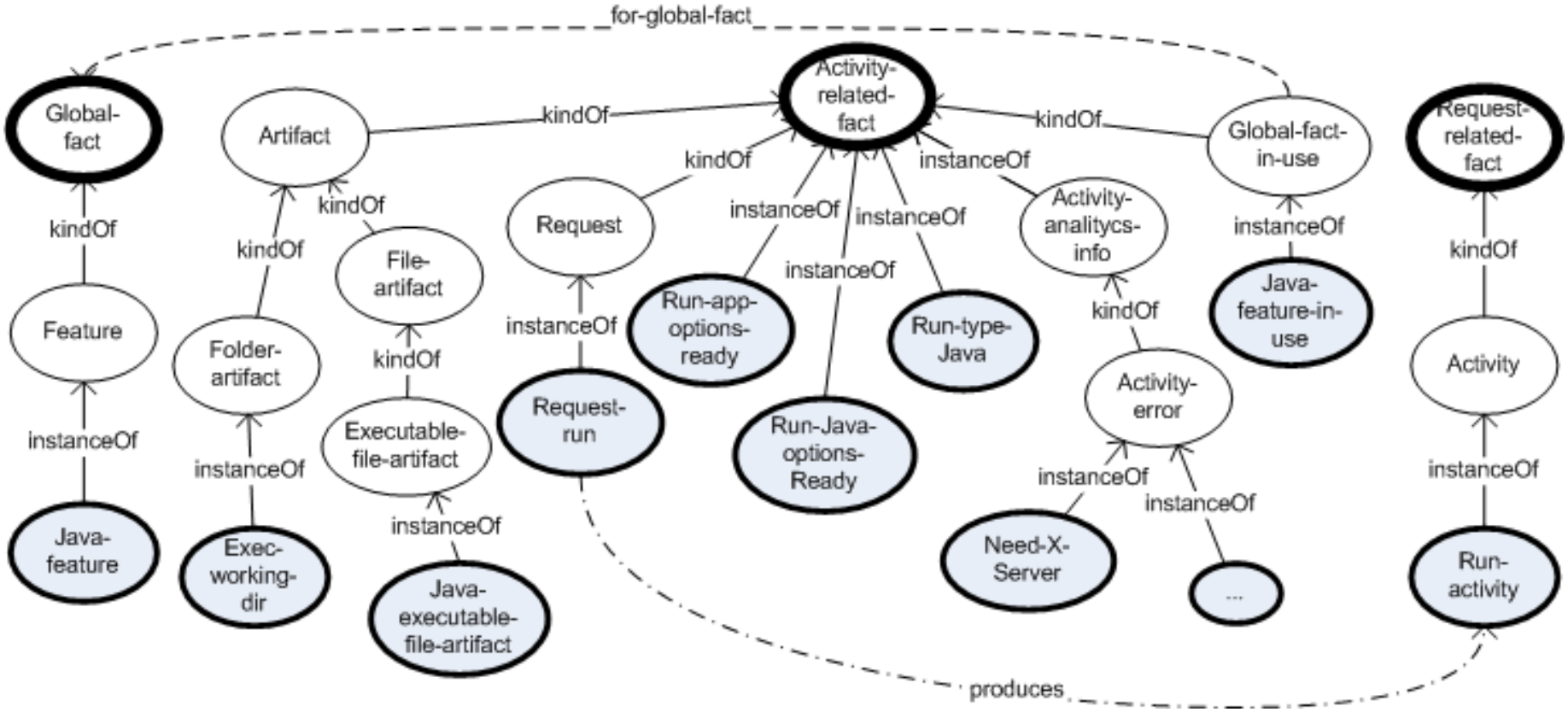
Software provisioning ontology as a core knowledge formalism …

- … to describe processes of software code building and execution
- … to represent build and execution errors as well as actions required for fixing recognized errors
- … to demonstrate how ontologies of specific tasks can be defined by extending the core ontology

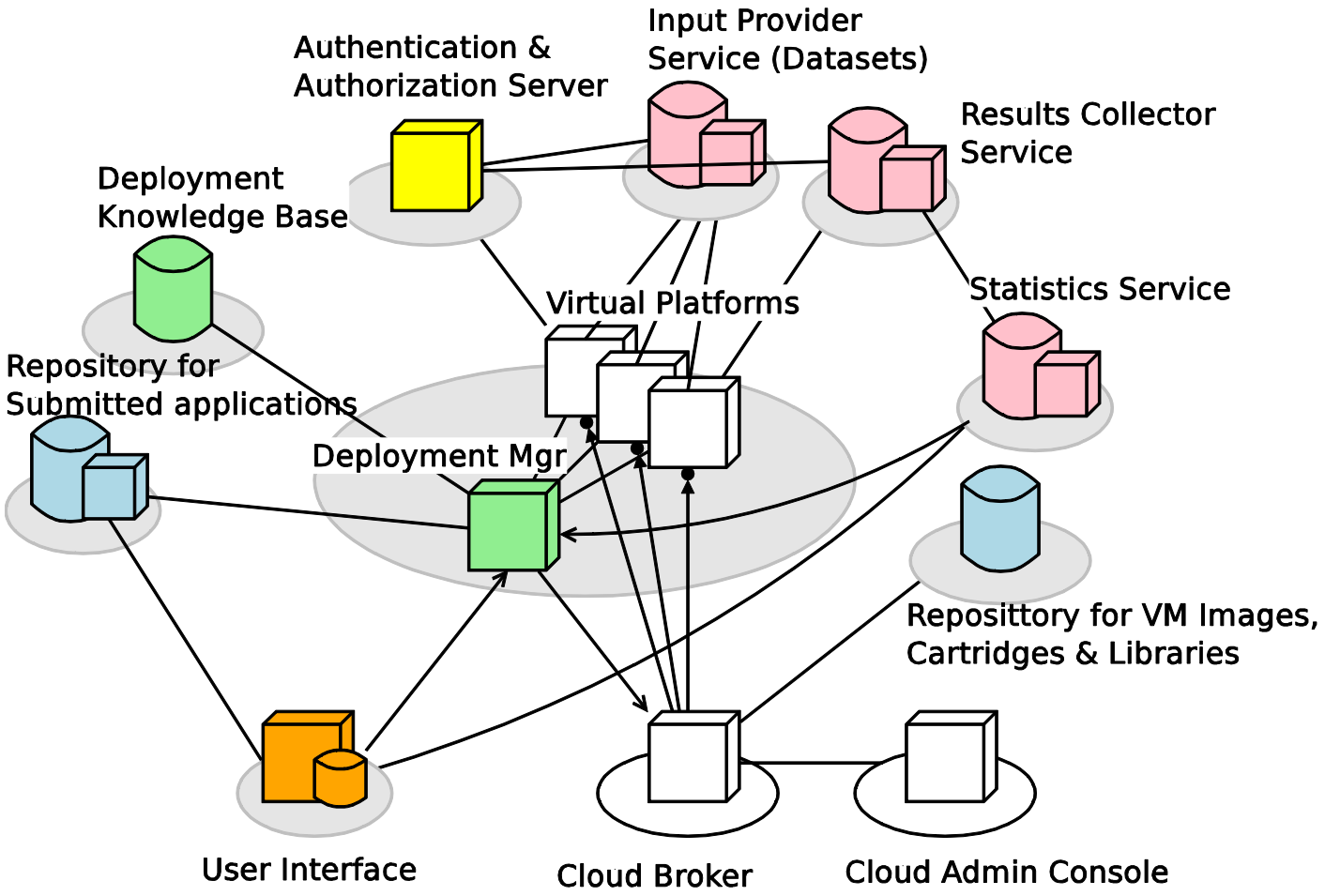
Activities and requests



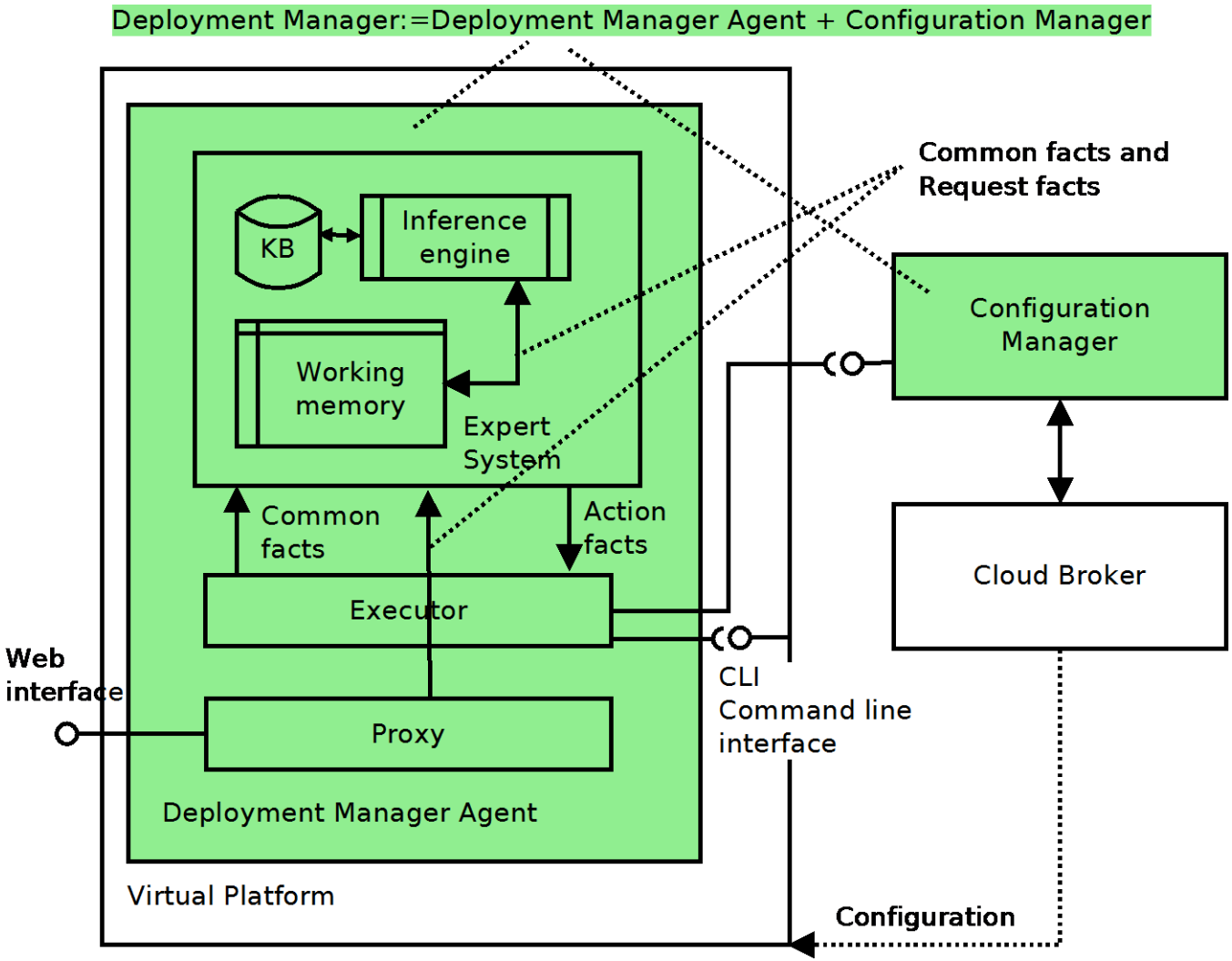
Example of an ontology of specific tasks (Java)



Software Provisioning Self-Service Networked Infrastructure



Deployment Manager Architecture



Evaluation

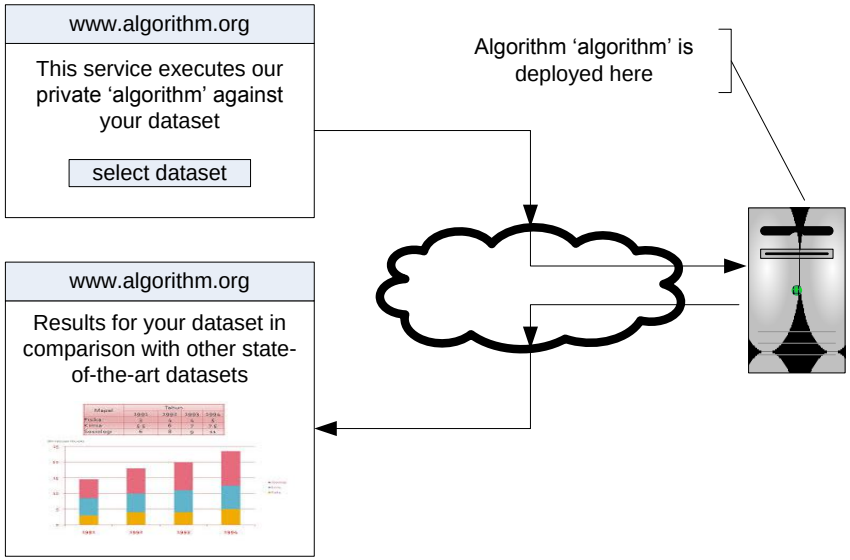
- We developed a system implementing proposed architecture as an **OpenShift cartridge**
  - Private cloud so far. Going public soon
- We successfully deployed (so far) 3 CLI applications in automatic mode
  - The most challenging part is knowledge representation

Summary (architecture capabilities)

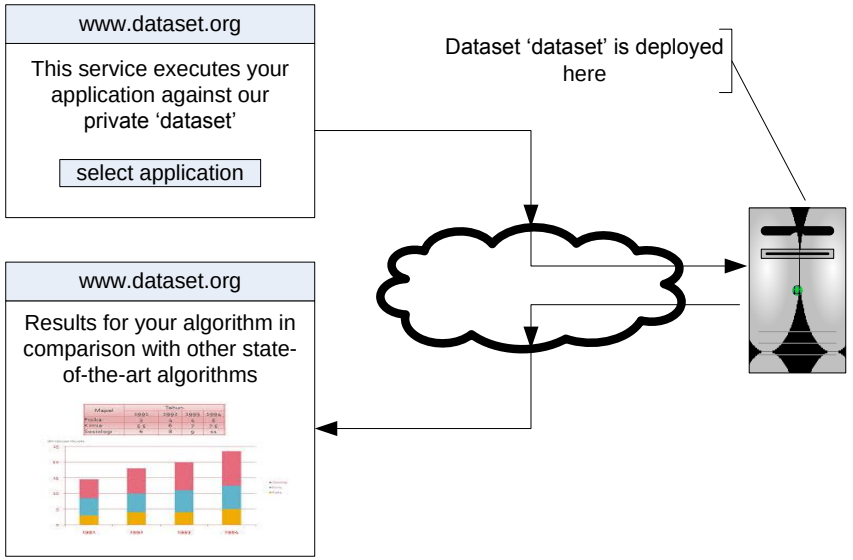
- **Able to learn**: Any technical issue needs to be resolved only once by an expert
  - Solution added to the knowledge base
- **Extensible:** New domain-specific tasks can be solved by only modifying the knowledge base
- **Platform independent:** Can be implemented to work in a cloud or in a local environment on any operation system. “CLI” can be changed to “Unified Interface”

Cloud in Theory

Algorithm as a Service



Dataset as a Service



Provisioning Service in Practice

Algorithm as a Service

Dataset as a Service

JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

САНКТ-ПЕТЕРБУРГСКИЙ
ГОСУДАРСТВЕННЫЙ
ПОЛИТЕХНИЧЕСКИЙ
УНИВЕРСИТЕТ

Science 2.0 & Clouds for Better Research Collaboration: A Case of MIR

Q & (may be) A