

AIR - A General Policy Language for the Web

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N3 -> N3Logic -> AIR

- ◆ AIR is a rule language that extends N3Logic and is represented in N3
- ◆ N3
 - a human-readable serialization of Resource Description Framework (RDF) models

```
@prefix bob: <http://dig.csail.mit.edu/2008/02/rmp/bob-foaf#>
```

```
bob:myself a <http://xmlns.com/foaf/0.1/Person>;  
  <http://xmlns.com/foaf/0.1/name> "Bob Biggins";  
  <http://xmlns.com/foaf/0.1/family_name> "Biggins";  
  <http://xmlns.com/foaf/0.1/givenname> "Bob";  
  <http://xmlns.com/foaf/0.1/img> <http://dig.csail.mit.edu/2008/02/rmp/images/  
bob.jpg>;  
  a <http://example.org/ont#Vegetarian>.
```

N3 -> N3Logic -> AIR

- ♦ N3Logic is a logic that allows rules to be expressed in a Web environment
 - N3 syntax with shorthand notations + rules
 - Extends RDF
 - rules
 - ability to access Web resources
 - functions for cryptographic, string, math, etc.
 - quoting (handling graphs)

```
@forAll X, FOAF, F.  
{ FOAF foaf:maker X.  
  FOAF log:semantics F.  
  F log:includes { X a ex:Vegetarian }  
} => { X a ex:Vegetarian}.
```

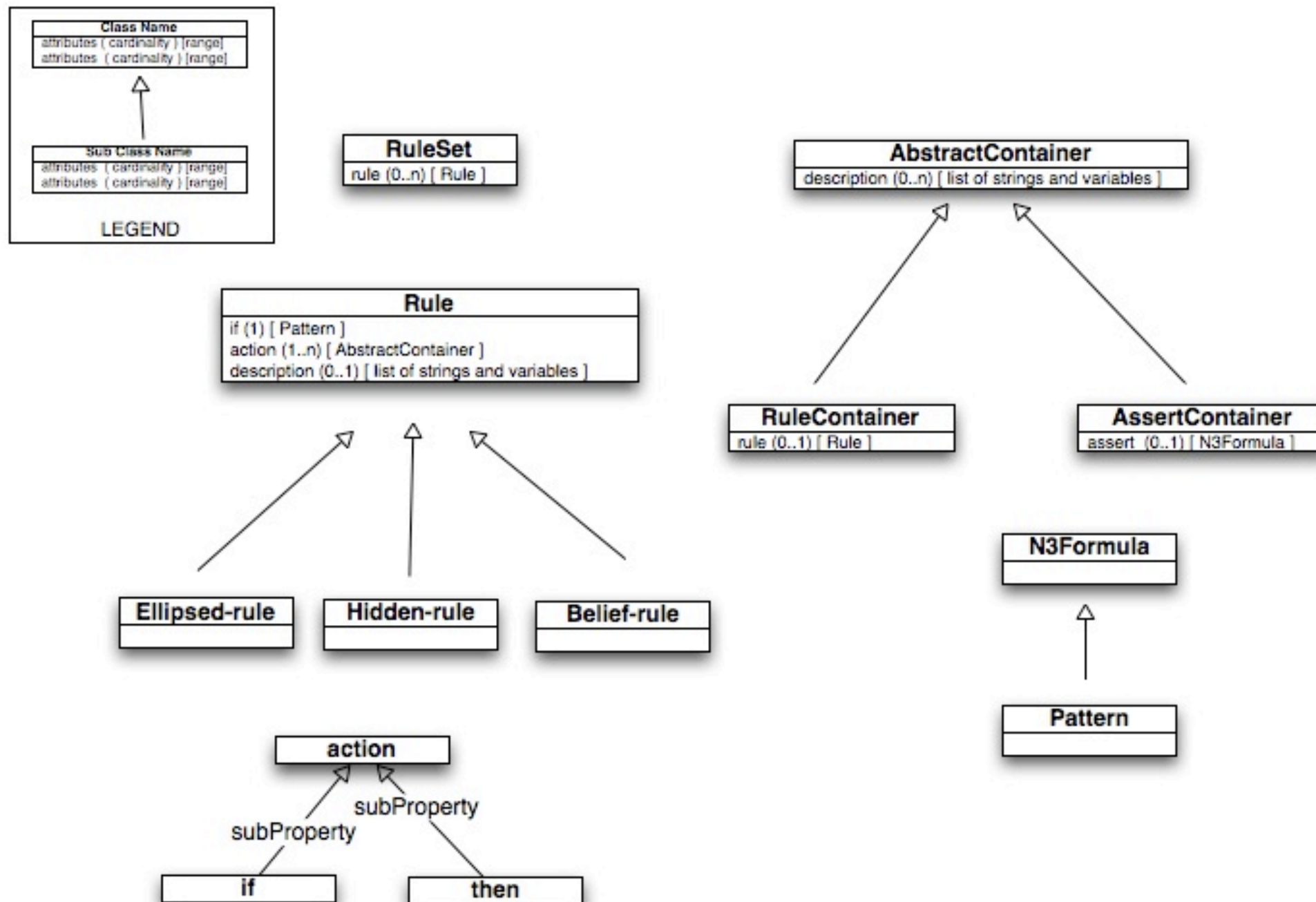
```
{ Superman can fly }  
LoisLane believes { ClarkKent is Superman}  
Does not imply { ClarkKent can fly }
```

N3 -> N3Logic -> AIR

◆ AIR

- extends N3Logic with
 - focus on providing & manipulating justification
 - focus on providing reusability and extensibility
- Features
 - named rules
 - **if - then - else** syntax (closed world negation)
 - nested rules (then and else can fire other rules)
 - incorporates querying of SPARQL endpoints

AIR Language



AIR Language

- ◆ Each AIR **ruleset** consists of one or more **rules**
 - `ruleset = { rule }`
- ◆ A **rule** is made up of a **pattern** that when matched causes an **then action** to be fired. otherwise **else action**
 - `rule = { if , then action, else action }`
- ◆ An action can either be an **assertion**, which is a set of facts that are added to the knowledge base or a **nested rule**
 - `action = { description [assert | rule] }`

```
:MyFirstPolicy a air:RuleSet;  
  air:rule :FirstRule.
```

```
:FirstRule a air:BeliefRule;  
  air:if { :EVENT a :Disseminate; receiver :R; sender :S };  
  air:then [  
    air:description {"Pattern matches"};  
    air:assert{:EVENT air:complaint :MyFirstPolicy }  
  ];  
  air:else [  
    air:description {"Pattern does not match (CW)"};  
    air:rule :SecondRule;  
  ].
```

Manipulating Justifications

- ◆ **description** attached to each action
 - List of natural language and variables
 - When action fires, the description is instantiated and attached to the justification

air:description (X can view pic, “ IMG “, because she/he knows Alice and the image is of Personal category”);
- ◆ To prevent sensitive information from being revealed or to reduce the size of explanations, you can use **Hidden** and **Ellipsed** rules
 - Declaring a rule to be **Hidden** prevents all deductions from that rule including nested rules from appearing in the justification
 - Declaring a rule to be **Ellipsed** prevents the description and assertion of that particular rule from appearing in the justification but all nested rules continue to appear

Hidden Rule Example

```
@forAll:Violation, :Work, :Creator, :ViolationDate, :DeathDate, :Value .
```

```
:CopyrightCriminalPolicy a air:Policy;  
  air:rule:FindInfringement; air:rule:SomeOtherRule.
```

```
:FindInfringement a air:Belief-rule ;  
  air:if{ :Violation a copyright:PotentialCopyrightInfringement;  
    copyright:infringesCopyrightOn:Work . } ;  
  air:then[ air:rule:FindValue] .
```

```
:FindValue a air:BeliefRule;  
  air:if{ :Work gr:hasCurrencyValue:Value ; gr:hasCurrency "USD" . } ;  
  air:then[ air:rule:CheckValue] .
```

```
:CheckValue a air:Hidden-rule;  
  air:if{ :Value math:greaterThan"1000" . } ;  
  air:else[ air:assert{ :Violation air:non-compliant- with :CopyrightCriminalPolicy. } ;  
  air:description( :Violation " is not a criminal copyright infringement as it is  
    under $1,000 in value" ) ] ;
```


AIR Tools

◆ AIR reasoner

- reason over rules, data and infer new facts with associated justifications
- Rete engine for pattern matching
- Truth Maintenance System for dependency tracking

◆ Justification User Interface

- browser based tool to explore justifications graphically
- Firefox extension

Real world policy in AIR

- ◆ Massachusetts General Law Chapter 6 Section 172
http://dig.csail.mit.edu/2010/DHS-fusion/MA/rules/MGL_6-172.n3

Massachusetts General Law, Part I, Title II, Chapter 6, Section 172	rule	init																														
	type	Policy																														
	comment	Dissemination of record information; certification; eligibility for access; scope of inquiry; listing; access limited; ; use of information																														
	label	Massachusetts General Law, Part I, Title II, Chapter 6, Section 172																														
init	if	<table border="1"> <tr> <td>EVENT</td> <td>by</td> <td>S</td> </tr> <tr> <td></td> <td>data</td> <td>INFO</td> </tr> <tr> <td></td> <td>doc data</td> <td>DATA</td> </tr> <tr> <td></td> <td>to</td> <td>R</td> </tr> <tr> <td></td> <td>type</td> <td>Disseminate Request</td> </tr> <tr> <td>S</td> <td>semantics</td> <td>SENDER</td> </tr> <tr> <td>R</td> <td>semantics</td> <td>RECEIVER</td> </tr> <tr> <td>SENDER</td> <td>includes</td> <td>S name SNAME</td> </tr> <tr> <td>RECEIVER</td> <td>includes</td> <td>R family name RNAME</td> </tr> <tr> <td>DATA</td> <td>semantics</td> <td>DOC DATA</td> </tr> </table>	EVENT	by	S		data	INFO		doc data	DATA		to	R		type	Disseminate Request	S	semantics	SENDER	R	semantics	RECEIVER	SENDER	includes	S name SNAME	RECEIVER	includes	R family name RNAME	DATA	semantics	DOC DATA
EVENT	by	S																														
	data	INFO																														
	doc data	DATA																														
	to	R																														
	type	Disseminate Request																														
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R	semantics	RECEIVER																														
SENDER	includes	S name SNAME																														
RECEIVER	includes	R family name RNAME																														
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	then	<table border="1"> <tr> <td>description</td> <td>EVENT is a dissemination request from S to R</td> </tr> <tr> <td>rule</td> <td>Rule1</td> </tr> </table>	description	EVENT is a dissemination request from S to R	rule	Rule1																										
description	EVENT is a dissemination request from S to R																															
rule	Rule1																															
	type	Belief rule																														
	comment	Section 172. Except as otherwise provided in this section and ***sections one hundred and seventy-three to one hundred and seventy-five***, in ***evaluative information***, shall be disseminated, whether directly or through any intermediary, only to (a) criminal justice agencies																														
Rule1	if	<table border="1"> <tr> <td>DOC DATA</td> <td>includes</td> <td>INFO type Criminal Offender Record Information</td> </tr> <tr> <td>SENDER</td> <td>includes</td> <td>S government type MA Executive Branch</td> </tr> <tr> <td>RECEIVER</td> <td>includes</td> <td>R organization type Agency</td> </tr> </table>	DOC DATA	includes	INFO type Criminal Offender Record Information	SENDER	includes	S government type MA Executive Branch	RECEIVER	includes	R organization type Agency																					
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	then	<table border="1"> <tr> <td>description</td> <td>INFO is criminal offender info.</td> </tr> </table>	description	INFO is criminal offender info.																												
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Example of AIR Justification/Explanation

```

MGL:init      tms:justification tms:premise .

test:MiaToFeddyRequest  air:compliant-with MGL:MGL_6_172_Para_2 .
{
  test:MiaToFeddyRequest  air:compliant-with MGL:MGL_6_172_Para_2 .

  }    tms:description (
    " so long as "
    mia:me
    "'s "
    <http://dig.csail.mit.edu/2009/DHS-fusion/documents/SDMaRFI.pdf>
    " is "
    mgl:necessary_for
    " "
    mgl:Criminal_Justice_Duties
    ", and "
    feddy:me
    " is "
    mgl:performing
    " "
    mgl:Criminal_Justice_Duties
    ", as required by MGL 6-172, Para. 2." );
  tms:justification [
    tms:antecedent-expr [
      a tms:And-justification;
      tms:sub-expr [
        air:instanceOf MGL:MGL_6_172_Para_2;
        tms:description (
          "The principal function of "
          feddy:me
          " is "
          mgl:prosecution
          "." );
        tms:justification [
          tms:antecedent-expr [
            a tms:And-justification;
            tms:sub-expr [
              air:instanceOf MGL:MGL_6_172_01b;
              tms:description (
                "Cannot prove the principal function of "
                feddy:me

```

Tabulator: Justification Pane

▼ http://mr-burns.w3.org/cgi-bin/air_2_0.py?logFile=http://dig.csail.mit.edu/2009/DHS-fusion/Mass/MGL_6-172/testing/test.n3&rulesFile=http://dig.csail.mit.edu/2009/DHS-fusion/Mass/MGL_6-172/testing/MGL_6-172.n3

/Mass/MGL_6-172/testing/MGL_6-172.n3

Mia To Feddy Request is compliant with Massachusetts General Law, Part I, Title II, Chapter 6, Section 172, Paragraph 2

Mia To Feddy Request is compliant with Massachusetts General Law, Part I, Title II, Chapter 6, Section 172, Paragraph 2

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so long as Mia Analyza's Document is necessary for actual performance of Criminal Justice Duties, and Feddy Agenti is actually performing Criminal Justice Duties, as required by MGL 6-172, Para. 2.

Premises:

http://dig.csail.mit.edu/2009/DHS-fusion/actors/feddy	Title	Feddy Agenti's User Profile	includes	Feddy Agenti	certified by	The Board
	type	http://xmlns.com/foaf/0.1/PersonalProfileDocument				
	maker	Feddy Agenti				
	primary Topic	Feddy Agenti				
Feddy Agenti	certified by	The Board				
	actually performing	Criminal Justice Duties				
	whose principle function is	prosecution of criminal offenders				
	type	Male				
		http://xmlns.com/foaf/0.1/Person				
	label	Feddy Agenti				
	office	g3				
	lat	40.7532				
	long	-74.0007				
	authorized purpose	law enforcement				
	family name	Agenti				
	given name	Fred				

AIR Summary

◆ Advantages

- General policy language
- Domain independent
- Linked data principles
- Localized reasoning
- Focus on justification

◆ Need to do

- policy conflicts
- policy defaults
- rule properties to have URIs as well

References

- ◆ AIR specifications, <http://dig.csail.mit.edu/2009/AIR/>
- ◆ AIR Tutorial, http://tw.rpi.edu/proj/tami/AIR_Policy_Tutorial
- ◆ AIR Semantics, Under review at RR 2010, http://dig.csail.mit.edu/2010/Papers/RR2010/Analyzing_the_AIR_Language.pdf
- ◆ Lalana Kagal, Chris Hanson, and Daniel Weitzner, Integrated Policy Explanations via Dependency Tracking, IEEE Policy 2008, <http://dig.csail.mit.edu/2008/Papers/IEEE%20Policy/air-overview.pdf>
- ◆ Some projects that use AIR
 - <http://dig.csail.mit.edu/2009/DHS-fusion/>
 - <http://dig.csail.mit.edu/2009/IARPA-PIR/>
 - <http://dig.csail.mit.edu/2009/NSF-TPAS/index.html>