

Arden Syntax overview

Educational material, part 2

Medexter Healthcare
Borschkegasse 7/5
A-1090 Vienna

www.medexter.com

www.meduniwien.ac.at/kpa (academic)

```
logic:  
  let hmi be weight / (size ** 2); // BMI  
  age := currenttime - birth; // AGE  
  if the age is less than 19 years then  
    classification := null;  
  elseif the hmi is less than 18.5 then  
    classification := localized 'under';  
  elseif the hmi is less than 25 then  
    classification := null; // BMI normal range  
  else  
    let the classification be localized 'over';  
  endif;
```

Better care, patient safety, and quality assurance by Medexter, Vienna, Austria

Medical logic modules (MLMs)

Arden Syntax – Structure

- In Arden Syntax, medical knowledge is hierarchically arranged within medical logic modules (MLMs)
- Each MLM represents sufficient knowledge to make at least one single medical decision
- An MLM is stored in a file that has the file extension “.mlm”
- Each MLM is well organized and structured into **categories** and **slots**
- Categories must appear in a predefined order
- Each category contains a category-specific set of **slots**, also in a predefined order

```

maintenance
library
knowledge
resources

```

```

maintenance:
  title: ;;
  mlmname: [required];;
  arden: [required];;
  version: [required];;
  institution: [required];;
  author: ;;
  specialist: ;;
  date: [required];;
  validation: [required];;

library:
  purpose: ;;
  explanation: ;;
  keywords: ;;
  citations: ;;
  links: ;;

knowledge:
  type: data_driven;;
  data: ;;
  priority: ;;
  evoke: ;;
  logic: ;;
  action: ;;
  urgency: ;;

resources: [optional]
  default: ;;
  language: ;;

end:

```

Arden Syntax MLM – Maintenance Category

- Purpose
 - To provide general information on the MLM, unrelated to the MLM's medical knowledge.
 - Used for MLM knowledge base maintenance and version control.
- Slots (**bold** means required)
 - **title**: Title of the MLM
 - **mlmname**: Name as referred to by the host system; must have the extension .mlm
 - **arden**: Arden Syntax version
 - **version**: MLM version
 - **institution**: Institution which created / adopted the MLM
 - **author**: Author / implementer of the MLM
 - **specialist**: Medical specialist supervising the MLM's medical content
 - **date**: Date of creation / last update
 - **validation**: The MLM's current status: *production*, *research*, *testing*, or *expired*
- **MLMname**, **institution**, and **MLM version** are used to identify the MLM.



Arden Syntax MLM – Maintenance Category – Example

```
1 maintenance:
2   title:      SIRS alert notification;;
3   mlmname:    SIRSNotification;;
4   arden:      version 2.9;;
5   version:    1.0;;
6   institution: Medexter Healthcare, Vienna, Austria;;
7   author:     Knowledge engineering group;;
8   specialist: Clinical specialists group;;
9   date:       2016-08-19;;
10  validation: production;;
```

Arden Syntax MLM – Library Category

- Purpose
 - Meant to provide medical background information about the MLM.
 - Contains slots pertinent to maintenance activities related to the MLM’s medical knowledge.
- Slots
 - **purpose:** This slot describes the clinical aim of the MLM.
 - **explanation:** Description on how the MLM works.
 - **keywords:** Keywords are descriptive words used for searching through modules. Keywords are delimited by semicolons.
 - **citations:** Citations allow for the documentation of references to relevant used literature.
 - **links:** This slot allows for providing links to sources of information relevant for this MLM (e.g., electronic textbook, teaching cases, web resources).

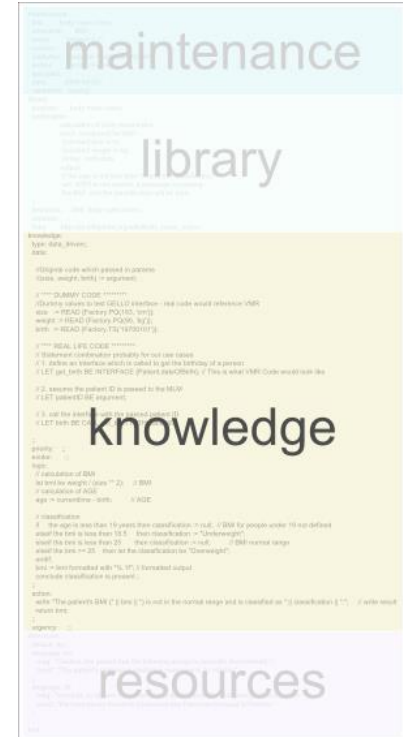


Arden Syntax MLM – Library Category – Example

```
11 library:
12     purpose:      To generate an alert once SIRS indications are sufficiently
13                   present.
14                   ;;
15     explanation:  The MLM captures input data, then interprets this data
16                   using implemented SIRS rules. For each matched rule, a
17                   positive rule counter is increased by one. If, at the end,
18                   two or more rules matched, an alert is generated.
19                   ;;
20     keywords:     Systemic Inflammatory Response Syndrome
21                   ;;
22     citations:    Definitions For Sepsis And Organ Failure And Guidelines For
23                   The Use Of Innovative Therapies In Sepsis. The Accp/Sccm
24                   Consensus Conference Committee. American College Of Chest
25                   Physicians/Society Of Critical Care Medicine.
26                   Bone R, Balk R, Cerra F, et al.
27                   Chest. 1992;101(6):1644-1655.;;
28     links:        ;;
```

Arden Syntax MLM – Knowledge Category

- Purpose
 - Contains the slots that actually specify what the MLM does.
 - Used for data acquisition and for programming the CDS logic / algorithm.
- Slots (**bold** means required)
 - **type**: Only *data_driven* is available!
 - **data**: Here, variables locally used in the MLM are mapped to variables at the healthcare institution.
 - **priority**: Indicates the relative order in which MLMs should be evoked.
 - **evoke**: The conditions at which the MLM is activated.
 - **logic**: The actual programmed CDS logic / algorithm.
 - **action**: Specifies the action taken when the logic slot concludes *true*.
 - **urgency**: The importance of the action when the MLM concludes *true*.



Arden Syntax MLM – Knowledge Category – Example

SIRS Notification

ALERT if ≥ 2 criteria

Temperature > 38°C (100.4°F) or < 36°C (96.8°F)

and/or

Heart rate > 90 beats per minute

and/or

Respiratory rate > 20 breaths per minute or arterial carbon dioxide tension (PaCO₂) < 32 mm Hg

and/or

White blood cell count (>12,000/μL or < 4,000/μL or >10% immature [band] forms)

SIRS: systemic inflammatory response syndrome, unsharpness of boundaries not considered

```
17 knowledge:
18     type: data_driven;;
19     data:
20         (Temperature,HeartRate,RespRate,
21          PaCO2,WBcellCount,ImmatureBand):= ARGUMENT;
22     ;;
23     priority: ;;
24     evoke: ;;
25     logic:
26
27         //Start - Checking SIRS criteria
28         counter := 0;
29
30         IF Temperature IS GREATER THAN 38 OR Temperature IS LESS THAN 36 THEN
31             counter:= counter + 1;
32         ENDF;
33
34         IF HeartRate IS GREATER THAN 90 THEN
35             counter:= counter + 1;
36         ENDF;
37
38         IF RespRate IS GREATER THAN 20 OR PaCO2 IS LESS THAN 32 THEN
39             counter:= counter + 1;
40         ENDF;
41
42         IF WBcellCount IS GREATER THAN 12000 OR WBcellCount IS LESS THAN 4000
43         OR ImmatureBand IS GREATER THAN 10 THEN
44             counter:= counter + 1;
45         ENDF;
46
47         IF counter IS GREATER THAN OR EQUAL 2 THEN
48             notification:= LOCALIZED 'SIRS';
49             CONCLUDE TRUE;
50         ENDF;
51         //End - Checking SIRS criteria
52
53     ;;
54     action:
55         RETURN notification;
56     ;;
57     urgency: ;;
```

Use Case: Hypoglycemia at intensive care units

- Hypoglycemia may seriously harm.
- If patient is unconscious, it is difficult to notice.
- The PDMS (patient data management system) should actively notify the physician:

If glucose is less than 50mg/dl, then send an SMS message to the physician.



```
DATA:  
LET glucose BE READ {...glucose...};  
LET physician_DECT BE DESTINATION {sms:26789};  
  
LOGIC:  
IF LATEST glucose IS LESS THAN 50 THEN  
    CONCLUDE TRUE;  
ENDIF;  
  
ACTION:  
WRITE „Warning...” AT physician_DECT;
```



CONCLUDE TRUE
→ Do something

from Stefan Kraus, Erlangen, Germany

Arden Syntax MLM – Resources Category

- Purpose
 - Allows for defining localized, different language messages.
 - Specify the textual resources from which the localized messages are taken.
 - The Resources Category is optional.
- Slots (**bold** means required)
 - **default**: Defines the default language to be used.
 - **language**: One language slot for each language to be used. Language codes are defined either as 2-character ISO 639-1 codes or as combination of this language code and a 2-character ISO 3166-1 geographical code.

```

category:
  name: maintenance
  title: maintenance
  description:
  keywords:
  author:
  version:
  default:
  language:
  resources:
  ...

category:
  name: library
  title: library
  description:
  keywords:
  author:
  version:
  default:
  language:
  resources:
  ...

category:
  name: knowledge
  title: knowledge
  description:
  keywords:
  author:
  version:
  default:
  language:
  resources:
  ...

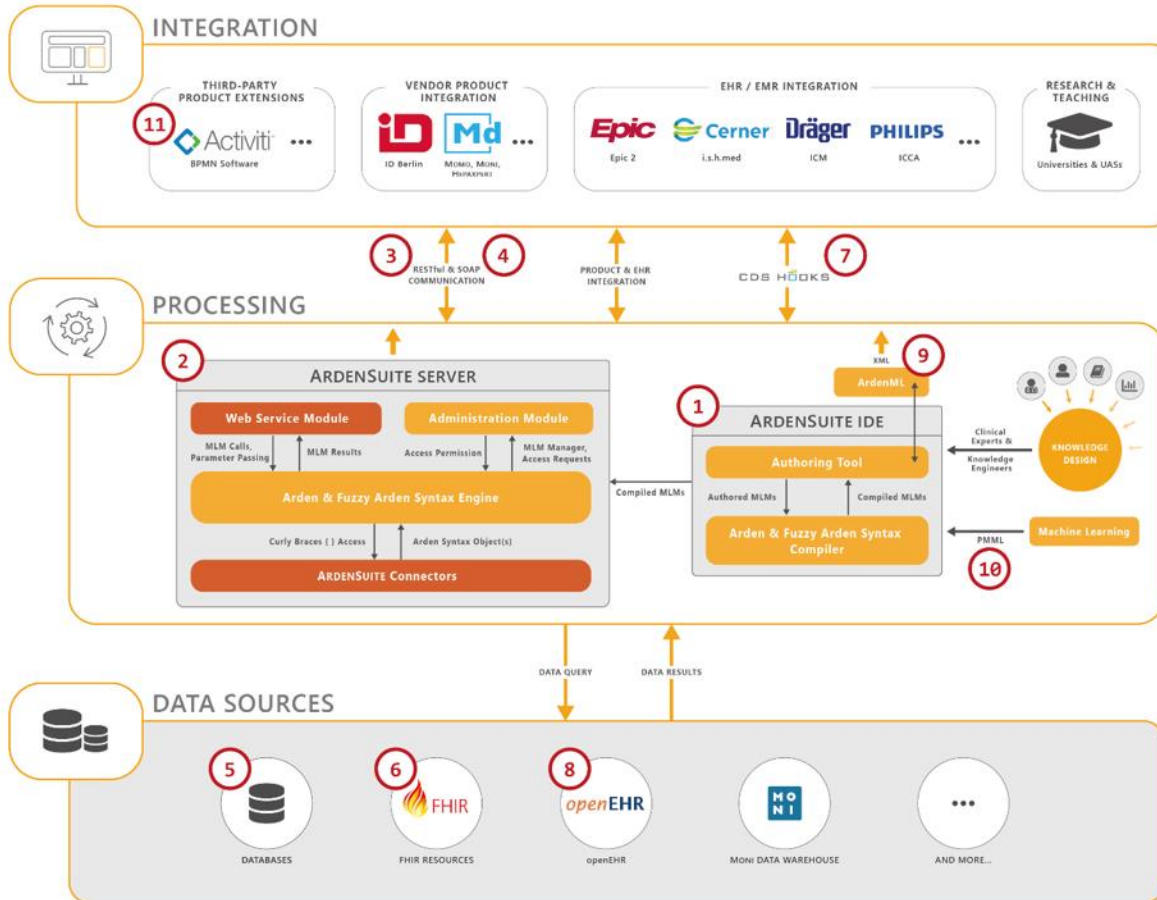
category:
  name: resources
  title: resources
  description:
  keywords:
  author:
  version:
  default:
  language:
  resources:
  ...
end

```

Arden Syntax MLM – Resources Category – Example

```
59 resources:  
60     default: en;;  
61     language: en  
62         'SIRS': "Alert for SIRS";  
63     ;;  
64     language: de  
65         'SIRS': "Alert für SIRS";  
66     ;;
```

The ArdenSuite



AVAILABLE FOR:

