Overview

- Motivation
- The Asgaard/Asbru Project
- Asbru Language
  - Terminology, Knowledge Roles
- Tools
  - Pontifex
  - Authoring Protocols with Asbru
  - Plan Verification
  - Data Abstraction and Monitoring Units
- Conclusions

Motivation

- Discourse Model vs. Process Model
- Diagnosis vs. Treatment
  - Both are Indispensable
- Guideline vs. Protocols
  - Cite-specific
  - Communication & Quality Assessment
Which Plan Management is Needed?

Plan Management

at Design Time
- Plan Generation
- Advanced Plan Editing
- Plan Visualization
- Plan Verification
- Plan Validation
- Plan-Scenario Testing

at Execution Time
- Plan Selection
- Plan Instantiation
- Data Abstraction
- Monitoring
- Plan Execution
- Critiquing
- Plan Evaluation
- Execution Visualization
- Plan Rationale / History

Tasks

- Medical Roles
- Resources

Fully Integrated and Intertwined Tasks

Asbru’s Key Features

- Hierarchical Decomposition of Plans
- Temporal Annotations & Uncertainty
- Knowledge Roles
  - Preferences
  - Intentions
  - Conditions
  - Effects
  - Plan Layouts

Hierarchical Decomposition of Plans
Parameter Proposition

- Parameter or its Abstraction
- Value
- Context
- Time Annotation

Example:
"Temperature in the context of controlled ventilation is high for more than 3 hours starting from 24 to 26 hours after I-RDS was diagnosed."

(\text{Temperature High Controlled-Ventilation} \{[24 \text{ HOURS}, 26 \text{ HOURS}], [\_, \_], [3 \text{ HOURS}, \_], \text{I-RDS-diagnosed}\})

Asbru's Time Annotation

**Definition:** \[[\text{ESS}, \text{LSS}], [\text{EFS}, \text{LFS}], [\text{MinDu}, \text{MaxDu}], \text{Reference}\]

- **ESS:** Earliest Starting Shift
- **LSS:** Latest Starting Shift
- **EFS:** Earliest Finishing Shift
- **LFS:** Latest Finishing Shift
- **MinDu:** Minimum Duration
- **MaxDu:** Maximum Duration
- **Reference Point**

Example: \[[\_, \_], [\_, \_], [180 \text{ MIN}, \_], \text{*self*}\]

Asbru's Knowledge Roles (1/2)

- Preferences
- Intentions
- Conditions
- Effects
- Plan body

Asbru's Knowledge Roles (2/2)

- Conditions
- Preferences
- Intentions
- Effects
- Plan body
- Conditions
- Preferences
- Intentions
- Effects
- Plan body

- Filter
- Setup
- Suspend
- Abort
- Complete
- Reactivate

- Activate
- Unorder
- Any Order
- Concurrent
- Parallel
- Sequential
- Cyclic
I-RDS Example in Asbru 6.5

(PLAN controlled-ventilation)
(INTERMEDIATE-STATE (MAINTAIN STATE(BG) NORMAL controlled-ventilation*))
(INTERMEDIATE-ACTION (MAINTAIN STATE(RESPIRATOR-SETTING) LOW controlled-ventilation*))

(SAMPLING-FREQUENCY 10 SEC)

I-RDS Example in Asbru 7.1d

<?xml version="1.0" encoding="UTF-8" ?>

<plan-library>
  <domain-defs>
    <domain name="controlled-ventilation" type="automatic">...
  </domain-defs>

Tools

- Pontifex
- Design Time
  - Authoring Protocols with Asbru
  - AsbruView - SopoView
  - From XML-Editors to PIXEE
  - Guideline Markup Tool
- Execution Time
  - Data Abstraction, Monitoring, and Execution
  - AsbrUI: Execution Unit User Interface
Pontifex

Based on "Harmless Specification Language" (HSL)

- Write Document Type Description (DTD)
- Create Parser
  - Supports Scopes and Namespaces
- Create Classes and Listeners
- Various Documentation
  - Write HTML Documentation
  - Write LaTeX Files

HSL

- "Harmless Specification Language"
- XML Application
- Defines
  - Elements
  - Attributes
  - Children
- Comments in XHTML
- used in Pontifex

Pontifex: HTML Documentation

AsbruView

Interface to the Plan-Representation Language Asbru
AsbruView’s Dimensions

1. Flow of Time
2. Parallel Plans
3. Plan A
4. Color

Anatomy of a Plan

- Filter Precondition
- Complete Condition
- Abort Condition
- Suspend Condition
- Reactivate Condition

Sequential Plans

- Topological View
- Temporal View

AsbruView
After GDM was detected in third trimester pregnancy, tested by glucose tolerance test (GTT) being between 140 and 300 mg/dl, do the following:

Patients will check glucose values four times/day (fasting and one hour postprandial). Preprandial, bedtime and 2 AM blood glucose will be added at the discretion of the physician. One hour postprandial glucose is the time of the glucose peak for most patients. Treatment goals should be no higher than 130 mg/dl for one hour post meals.
Multi-level Plan Verification

- Check for Anomalies Within Several Layers
  - Level 1: Within a Single Component
  - Level 2: Within a Single Plan
  - Level 3: Within a Plan Hierarchy

<table>
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<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
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<td>✓</td>
<td>✓</td>
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<tr>
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<tr>
<td>Cond. X2</td>
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Goal: to arrive at legal or meaningful plans

Tools

- Pontifex
- Design Time
  - Authoring Protocols with Asbru
  - From XML-Editors to PIXEE
  - Guideline Markup Tool
  - Plan Verification
- Execution Time
  - Data Abstraction, Monitoring, and Execution
  - AsbrUI: Execution Unit User Interface

Overview: Run-Time Modules

AsbrUI

- A User Interface for Execution Unit
- Supports
  - Data Acquisition
  - Plan Control
  - Administrative Tasks
- Real-time
- Adapts to Plans
Patient Record

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Time</th>
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<tr>
<td>Surname</td>
<td>Miller</td>
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</tr>
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<td>First Name</td>
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<tr>
<td>Sex</td>
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<td></td>
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<tr>
<td>Term Child</td>
<td>Yes</td>
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</tr>
<tr>
<td>Mother Diabetes</td>
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</tr>
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</table>

Multi-Parameter Input

Conclusions

- Asbru
  - Hierarchical Decomposition of Plans
  - Temporal Annotations & Uncertainty
  - Knowledge Roles
  - Rich Set of Operators

- Workbench - Tools
  - Design and Execution Time
  - Task-Specific Problem-Solving Methods for Plan Management

Future ...

- Plan Management
  - Design Time
  - Execution Time
- Knowledge Crystallization
  - Data, Information, and Knowledge
- Information Visualization (InfoVis)
  - Task-Specific Visualization
  - Plans & Data together
  - Integrating Manifold Views Seamlessly
- Usability Study
Questions?

http://www.asgaard.tuwien.ac.at/