**Domain Specific Language (DSL)**

**Hiding Complexity: A Language Tailored to CEA Studies**

- **Purpose**: Provide a summary description of the study
- **Attributes**: References, Main objective, Perspective, Place, Time horizon, Discount rate

**Condition**

- **Purpose**: Define the health issue object of the study, the health states of individuals and possible evolutions
- **Attributes**: Name, Health states, Transition, Revision Period

**Individuals**

- **Purpose**: Define the characteristics of individuals in the study
- **Attributes**: Number, Genders, Ages...

**Groups**

- **Purpose**: Define sub-groups to provide shorthand notation
- **Attributes**: Group name, Composition

**Initial Conditions**

- **Purpose**: Assign individuals to health states at time t = 0
- **Attributes**: Group names, number, percentages

**Intervention**

- **Purpose**: Define actions aimed at improving the condition of patients
- **Attributes**: Name, Treatment, Subjects, Period, Cost, Value

**Cost**

- **Purpose**: Name cost elements defined by users, assign monetary values and specify the frequency of cost accrual
- **Attributes**: Name, Amount, Accrued

**Utilities & Benefits**

- **Purpose**: Assign value of intervention effects to each state
- **Attributes**: Name, Treatment, Subjects, Period, Cost, Value

**Metrics**

- **Purpose**: Define quantities to be evaluated
- **Attributes**: Name, Evaluation Rules, such as:
  - accumulate <quantity> on <health states> for <treatment>
  - count <health states> for <treatment>

**Analysis**

- **Purpose**: Specify the parameter for sensitivity analysis
- **Attributes**: Name, Parameters, Metric, Algorithm

**Report**

- **Purpose**: Specify the output to be generated
- **Attributes**: Metrics, Analysis, Formats = table/line/histogram/bars

**Definition of Key Concepts**

- **Cost-Effectiveness Analysis (CEA)**: A formalized process to comparatively evaluate both the costs and outcomes of candidate health interventions
- **Stochastic Reward Nets (SRN)**: A probabilistic modeling formalism supporting definition of structural and timing behavior of the system, as well as the specification of the measures to be computed
- **Stochastic Petri Net Package (SPNP)**: Tool developed by Prof. Trivedi to define and analyze SRN models
- **Domain Specific Language (DSL)**: Computer language specialized to a particular application domain

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**Predictive Modeling for Decision-making in Public Health**

Ivan Murá1, Meifang Chen1, Truls Ostbye2, Kishor Trivedi2, Shruti Pandey4, Shuyi Qiu1, Xueting Li1, Haowen Ji1, Zhexu (Alex) Jin1

Affiliation: 1 Duke Kunshan University, 2 Duke Global Health Institute, 3 Pratt School of Engineering, 4 Duke University Graduate School, 5 Sanford School of Public Policy

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**Research Background**

- **Aims of Our BASS Team**
  - **Main Objective**: Provide public health practitioners and policy makers with a user-friendly tool supporting Cost-Effectiveness Analysis (CEA) through Interdisciplinary research: Join efforts from computer engineering, global health and public policy, from Duke and from DKU
  - **A Domain Specific Language**: Specify and execute CEA, using a solid modeling formalism called Stochastic Reward Nets (SRNs)

**Project Activities**

- **Background Knowledge**
  - Group study on CEA and SRNs
  - Conducted case study on papers using CEA
  - Translated the model from DTMC into SRN

- **Case Studies**
  - Conducted literature review on CEA papers
  - Compared the results with the original one

- **Applications in SPNP**
  - Practice using SPNP
  - Fixed the existing research with our DSL

- **Concept Transfer**
  - Mapping CEA into SPNP
  - Breaked CEA into separate steps

- **DSL Concept Construction**
  - Design on DSL
  - Listed attributes for each concept from CEA

- **Real Case Application**
  - Conducted literature review on CEA papers
  - Fitted the existing research with our DSL

- **DSL Tool Coding Work**
  - Program the DSL on SPNP tool
  - Test and improve using more cases

**Stochastic Reward Nets (SRNs)**

**Our Choice for Predictive Modeling**

- **Basic Components of SRN models**
- **Input Place**
- **Transition (event)**
- **Output Place**
- **Input Arc**
- **Output Arc**

**Advantages of SRNs**

- Better abstraction, closer to the domain than Markov chains
- Easier to define models for large and complex systems
- Easier to solve analytically
- Natively incorporate the concepts of costs and benefits
- Able to study the dynamic behavior of the system
- SPNP tool available from Duke

**STOCHASTIC REWARD NETS (SRNS)**

**Our choice for predictive modeling**

A simplified example to compare $T_1$, $T_2$, $T_3$:

**Purpose**

- Specify the output to be generated

**References**

- Name, Evaluation Rules, such as:
  - accumulate <quantity> on <health states> for <treatment>
  - count <health states> for <treatment>

**Analysis**

- Specify the parameter for sensitivity analysis

**Attributes**: Name, Parameters, Metric, Algorithm

**Cost**

- Name cost elements defined by users, assign monetary values and specify the frequency of cost accrual

**Utilities & Benefits**

- Assign value of intervention effects to each state

**Attributes**: Name, Treatment, Subjects, Period, Cost, Value

**Metrics**

- Define quantities to be evaluated

**Attributes**: Name, Evaluation Rules, such as:
  - accumulate <quantity> on <health states> for <treatment>
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**Groups**

- Define sub-groups to provide shorthand notation

**Attributes**: Group name, Composition

**Initial Conditions**

- Assign individuals to health states at time $t = 0$

**Attributes**: Group names, number, percentages

**Intervention**

- Define actions aimed at improving the condition of patients

**Attributes**: Name, Treatment, Subjects, Period, Cost, Value