

Usage Example

Defining a rule in DGGML.

(1) Stochastic Growth:

(2) $(\bigcirc_1 \text{ --- } \bullet_2) \ll (x_1, u_1), (x_2, u_2) \gg$

(3) $\rightarrow (\bigcirc_1 \text{ --- } \bigcirc_3 \text{ --- } \bullet_2) \ll (x_1, u_1), (x_2, u_2), (x_3, u_3) \gg$

(4) with $H(\|x_2 - x_1\|; L_{div})$

(5) where $\begin{cases} x_3 = x_2 - (x_2 - x_1)/100.0 \\ u_3 = u_1 \end{cases}$

Example of how a stochastic rule written in the DGG form is transformed into C++ code.

```
GraphType lhs_graph;
lhs_graph.addNode({1, {Intermediate{}}});
lhs_graph.addNode({2, {Positive{}}});
lhs_graph.addEdge(1, 2);
```



2

```
GraphType rhs_graph;
rhs_graph.addNode({1, {Intermediate{}}});
rhs_graph.addNode({3, {Intermediate{}}});
rhs_graph.addNode({2, {Positive{}}});
rhs_graph.addEdge(1, 3);
rhs_graph.addEdge(3, 2);
```



3

4



```
auto propensity = [&](auto& lhs, auto& m)
{
    auto& node1 = lhs.findNode(m[1])>second.getData();
    auto& node2 = lhs.findNode(m[2])>second.getData();
    auto len = calculate_distance(node1.position, node2.position);
    double propensity = heaviside(len, settings.DIV_LENGTH);
    return propensity;
};
```

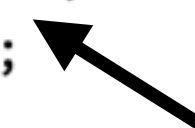
5



```
auto update = [](auto& lhs, auto& rhs, auto& m1, auto& m2) {
    for(int i = 0; i < 3; i++) // set position
        rhs[m2[3]].position[i] = lhs[m1[2]].position[i]
            - (lhs[m1[2]].position[i] - lhs[m1[1]].position[i])/100.0;
    for(int i = 0; i < 3; i++) // next set the unit vector
        std::get<Intermediate>(rhs[m2[3]].data).unit_vec[i]
            = std::get<Intermediate>(lhs[m1[1]].data).unit_vec[i];
};

using RT = WithRule<GraphType>; // rule type
RT stochastic_growth("with_growth", lhs_graph, rhs_graph, propensity, update);
gamma.addRule(stochastic_growth);
```

1



Grammar Analysis

Abstract Syntax Tree

- Represents everything we need for DGG grammar rules.
- In DGGML we this is a data structure to represent the grammar.
- Analysis is ran on this grammar data structure.

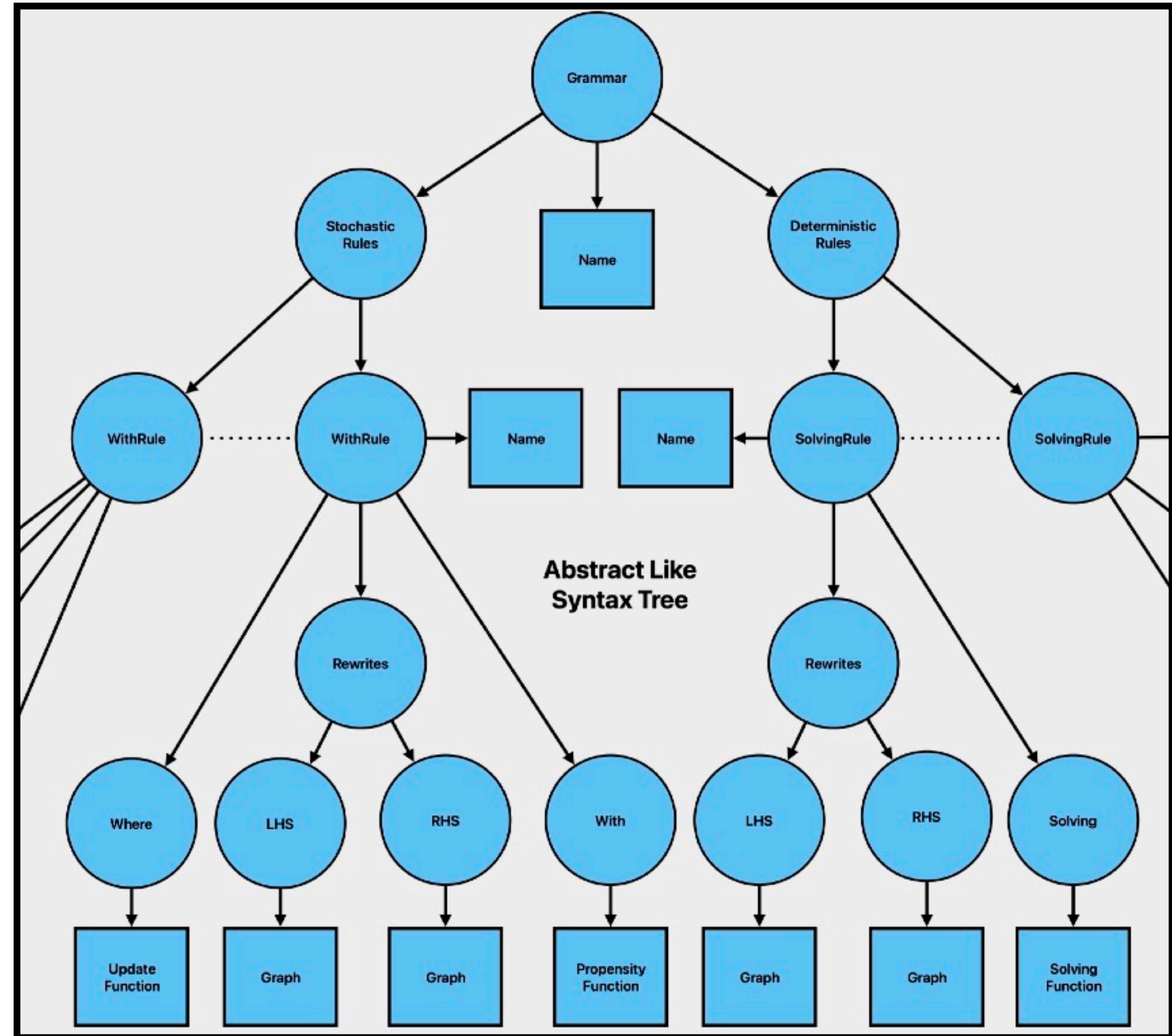


Figure 20: A section of an abstract syntax tree (AST) for a DGG.