Representing Combinatorial Genetic Designs with SBOL

Raytheon
BBN Technologies

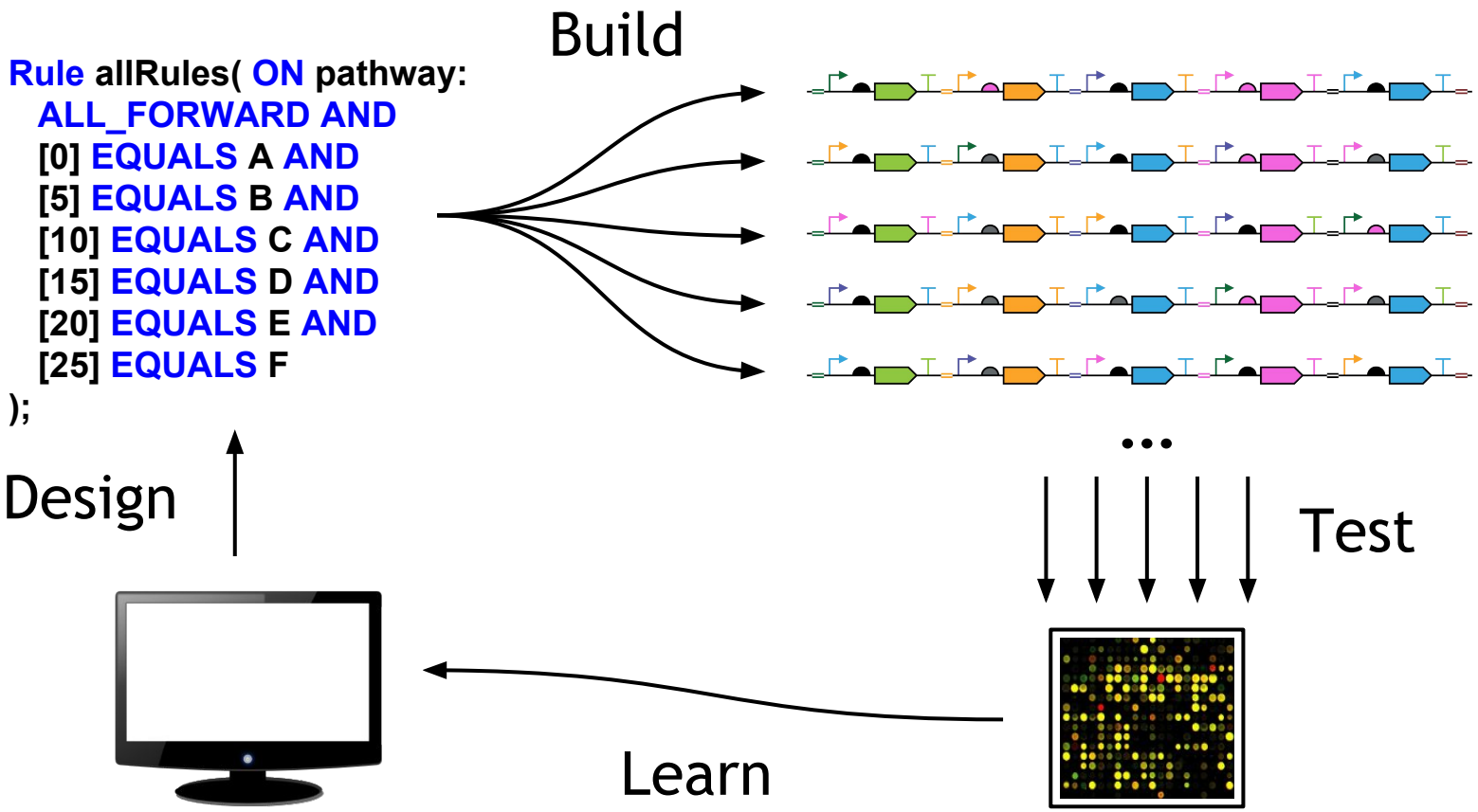
Nicholas Roehner, Jacob Beal
Raytheon BBN Technologies

COMBINE 2017 | Oct 13th, 2017 | Milan, Italy

Automation & Multiplexing Encourage Combinatorial Assembly & Screening

Raytheon
BBN Technologies

```
Rule allRules( ON pathway:
   ALL_FORWARD AND
   [0] EQUALS A AND
   [5] EQUALS B AND
   [10] EQUALS C AND
   [15] EQUALS D AND
   [20] EQUALS E AND
   [25] EQUALS F
);
```



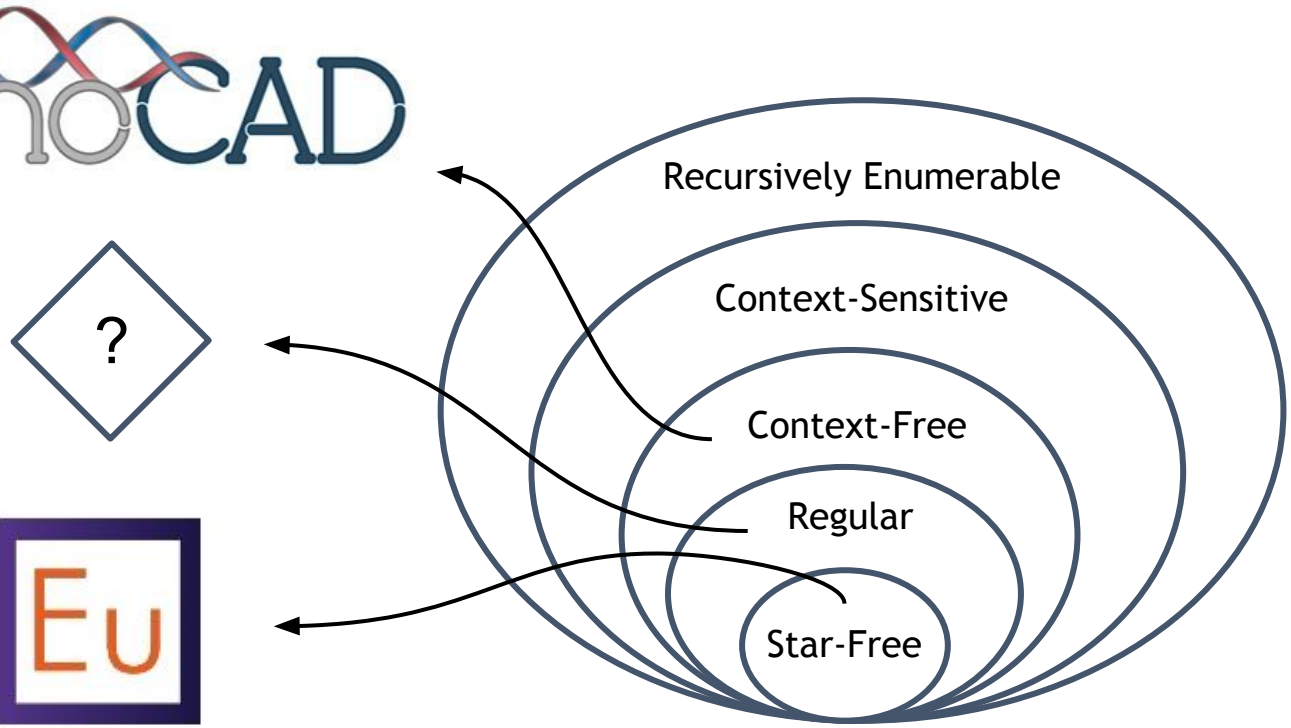
Existing Tools and Languages for Combinatorial Genetic Design

Raytheon
BBN Technologies

GenoCAD

Knox

Eugene



A CombinatorialDerivation Links a Structural Template to Choices

Raytheon
BBN Technologies

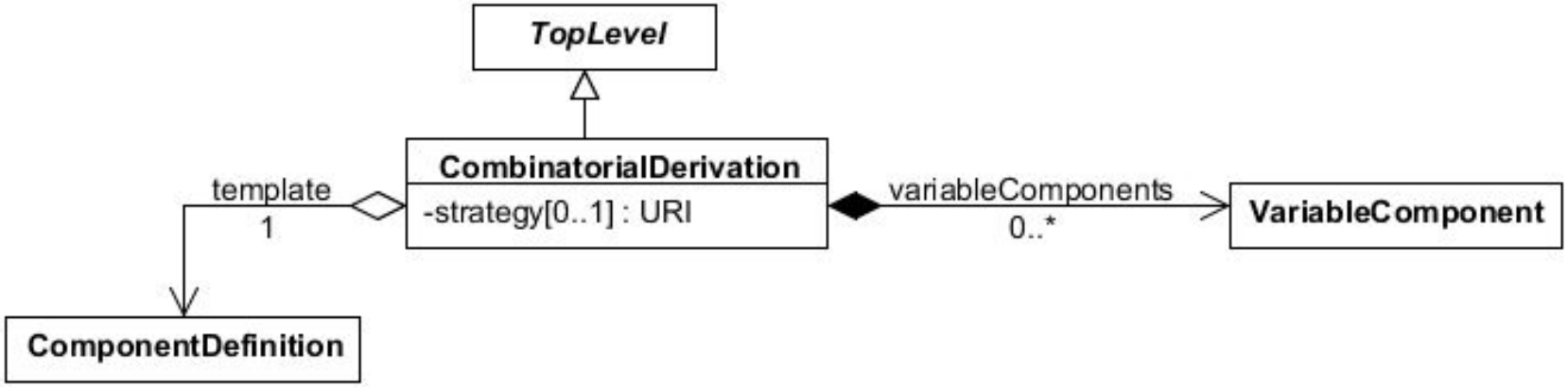


Table 1. URIs for the strategy property

http://sbols.org/v2#enumerate	A user SHOULD derive all possible ComponentDefinition objects...
http://sbols.org/v2#sample	A user SHOULD derive a subset of all possible ComponentDefinition objects...

A VariableComponent Links a Choice to Available Options for Substructure

Raytheon
BBN Technologies

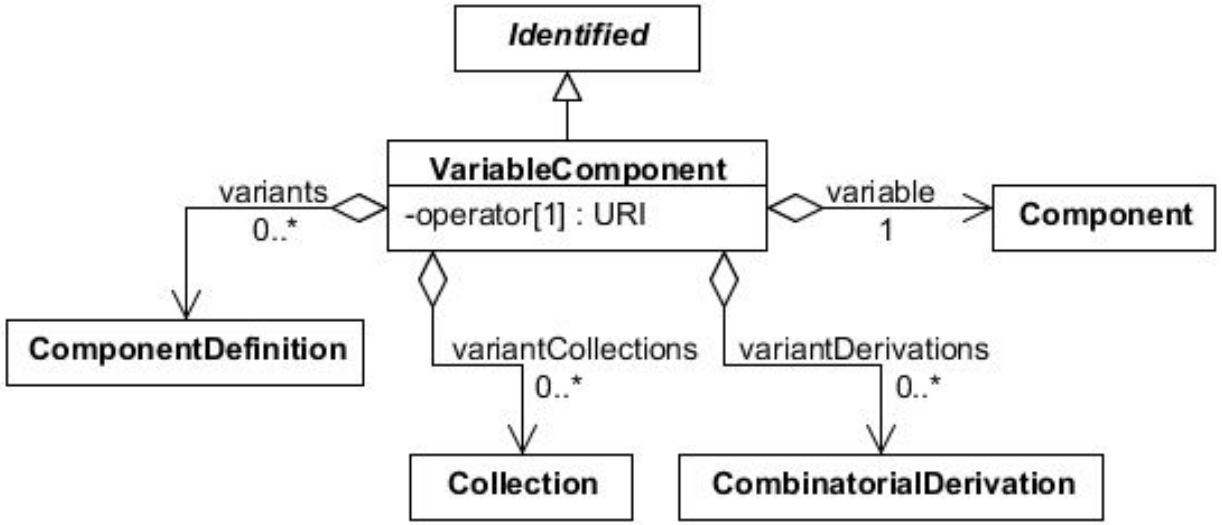
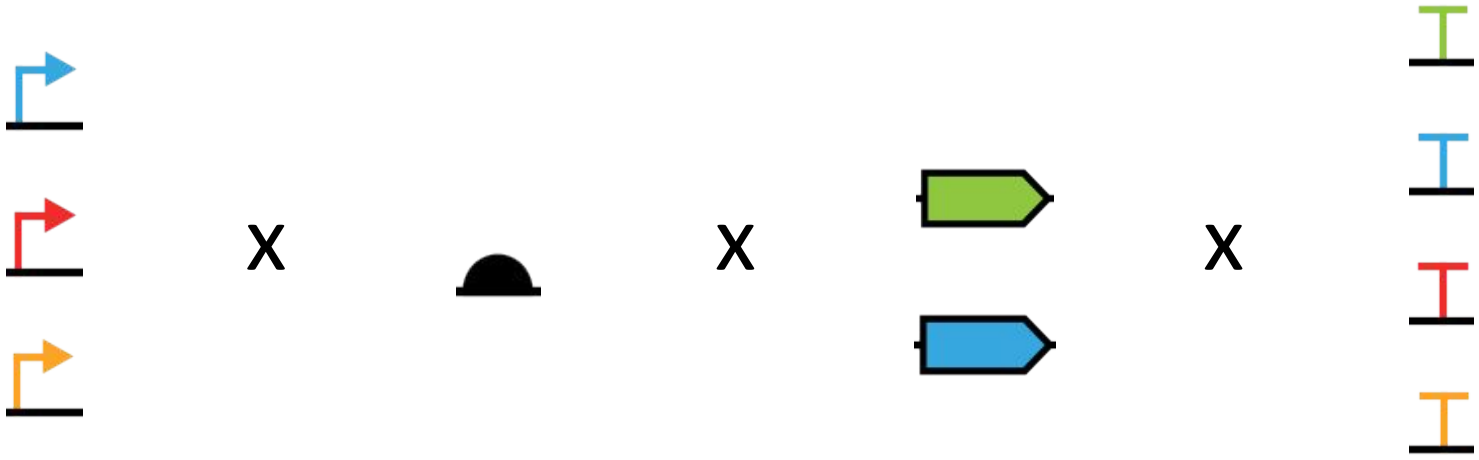


Table 2. URIs for the operator property

http://sbols.org/v2#zeroOrOne	No more than one Component...
http://sbols.org/v2#one	Exactly one Component...
http://sbols.org/v2#zeroOrMore	Any number of Component objects...
http://sbols.org/v2#oneOrMore	At least one Component...

Use Case 1: NxN Designs

Raytheon
BBN Technologies

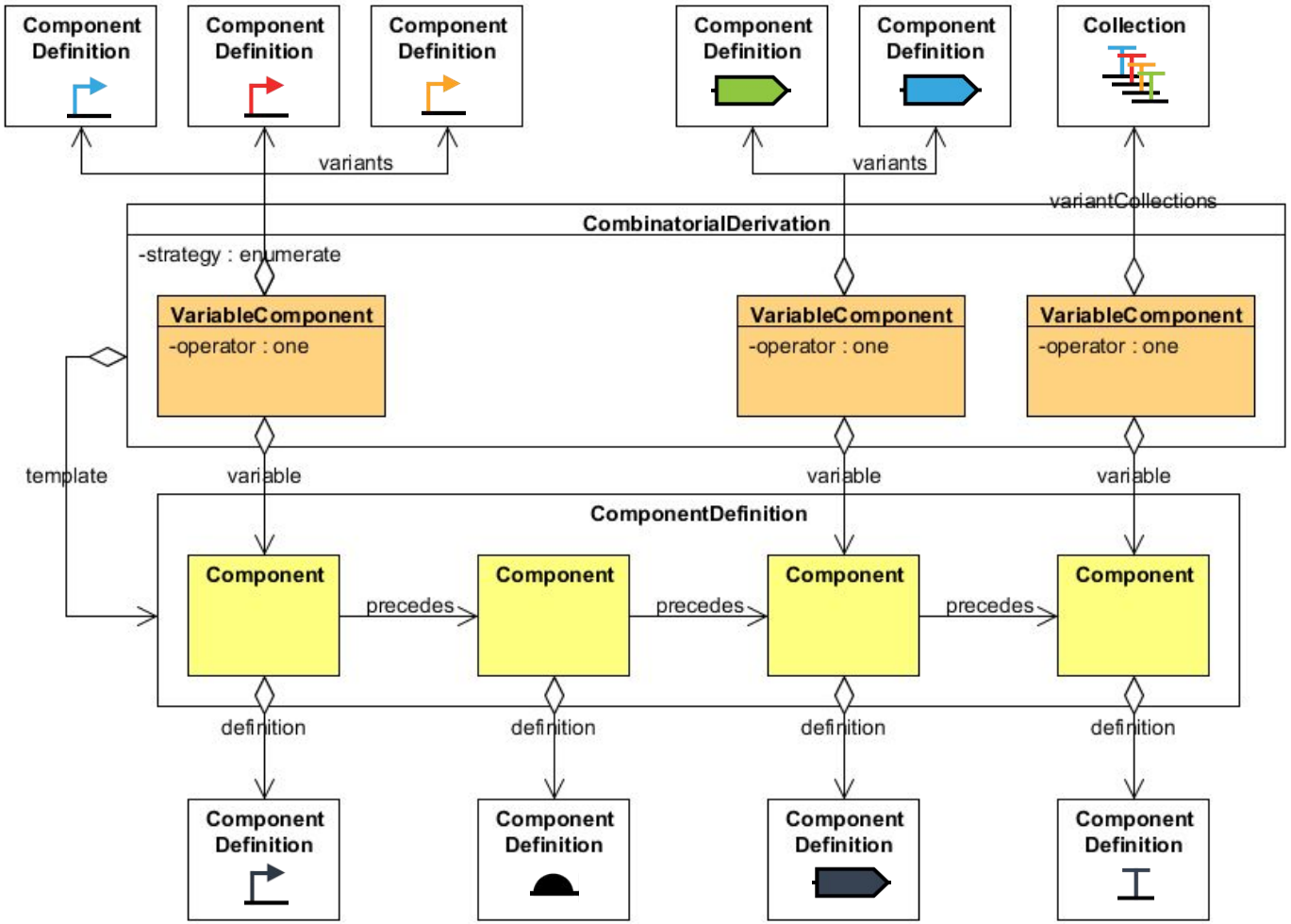


Supporting Tools: Eugene, Knox, GenoCAD

Formal Language Class: Subclass of Star-Free

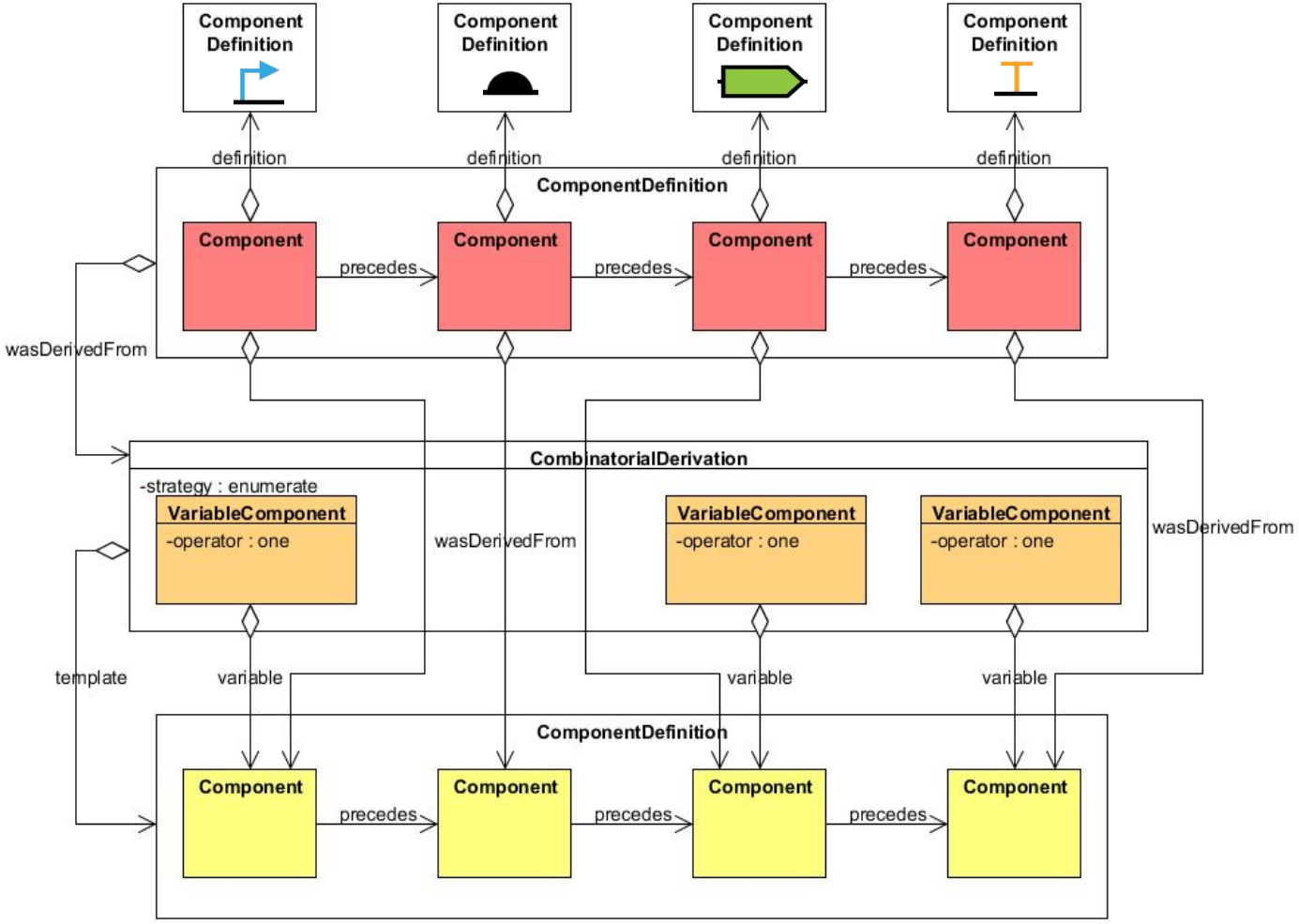
Derivation of a NxN Design

Raytheon
BBN Technologies



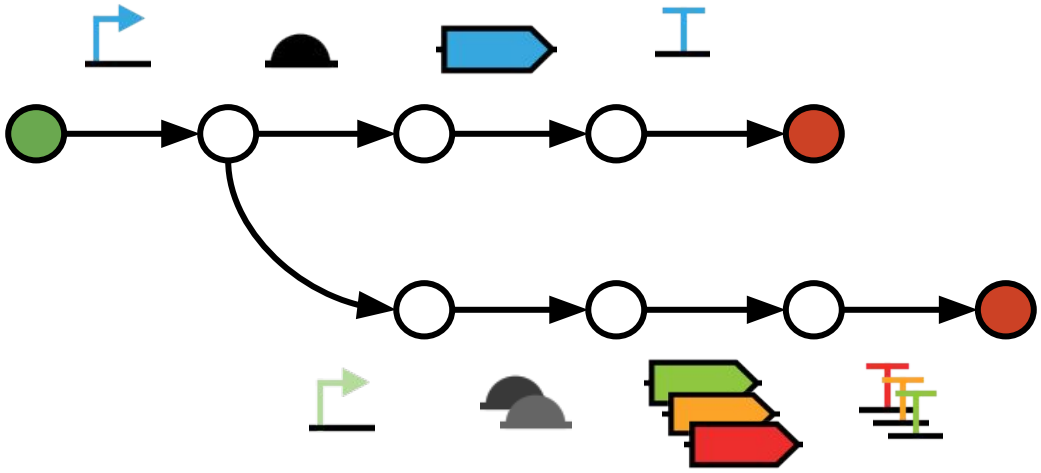
Derived NxN Design

Raytheon
BBN Technologies



Use Case 2: Branching Designs

Raytheon
BBN Technologies

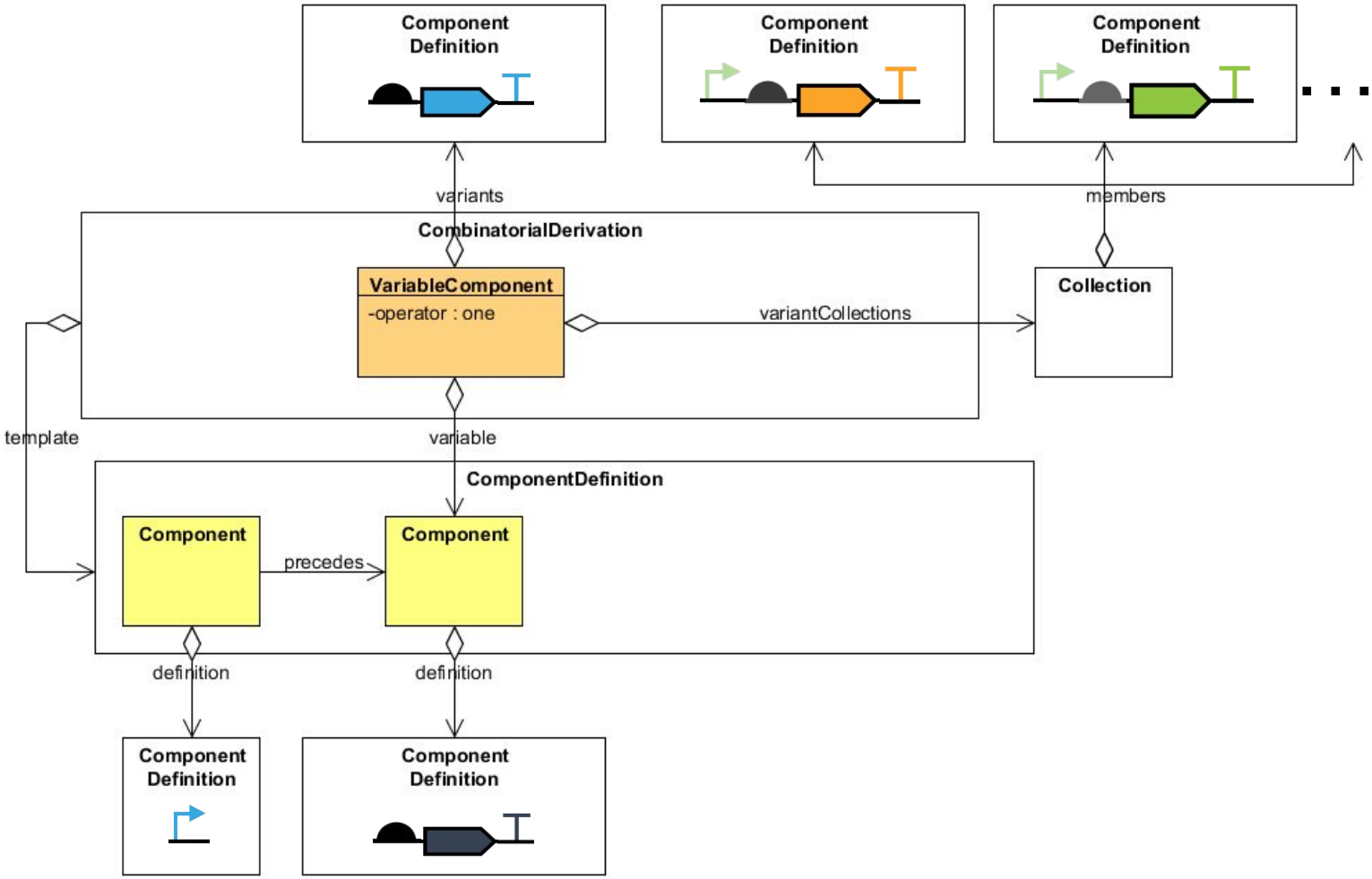


Supporting Tools: Knox, GenoCAD

Formal Language Class: Star-Free

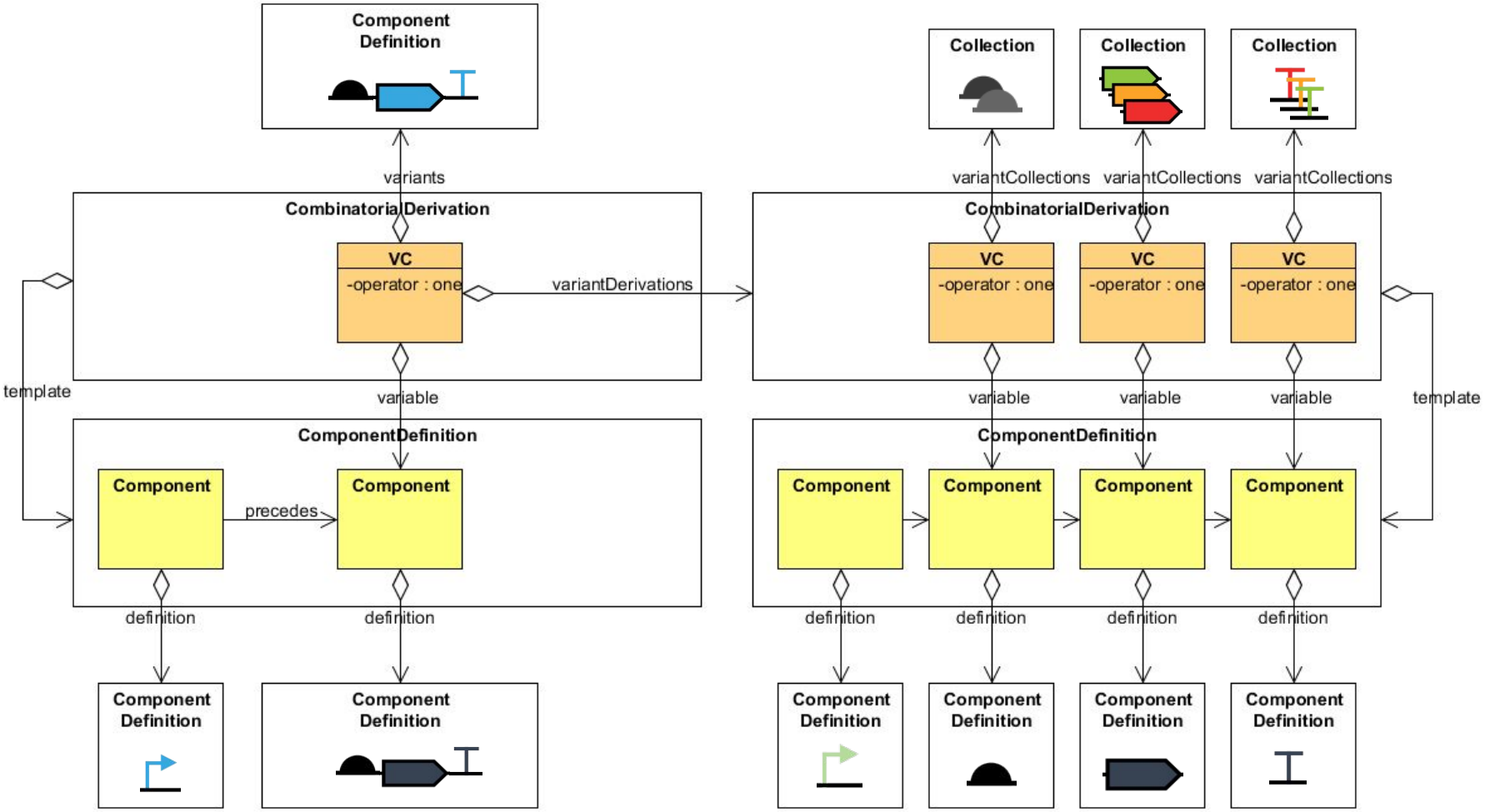
Naive Derivation of Branching Design

Raytheon
BBN Technologies



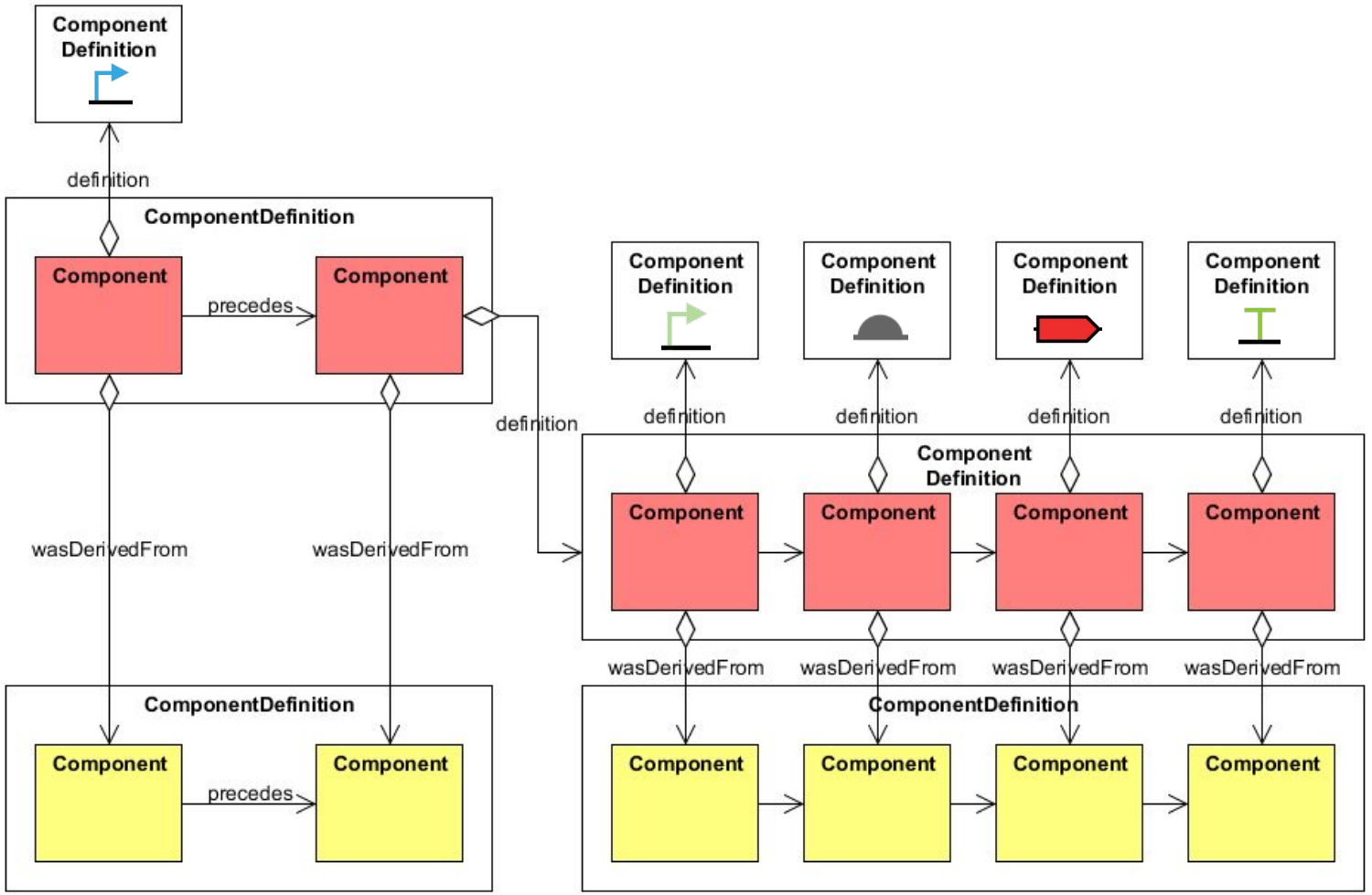
Derivation of Branching Design

Raytheon
BBN Technologies



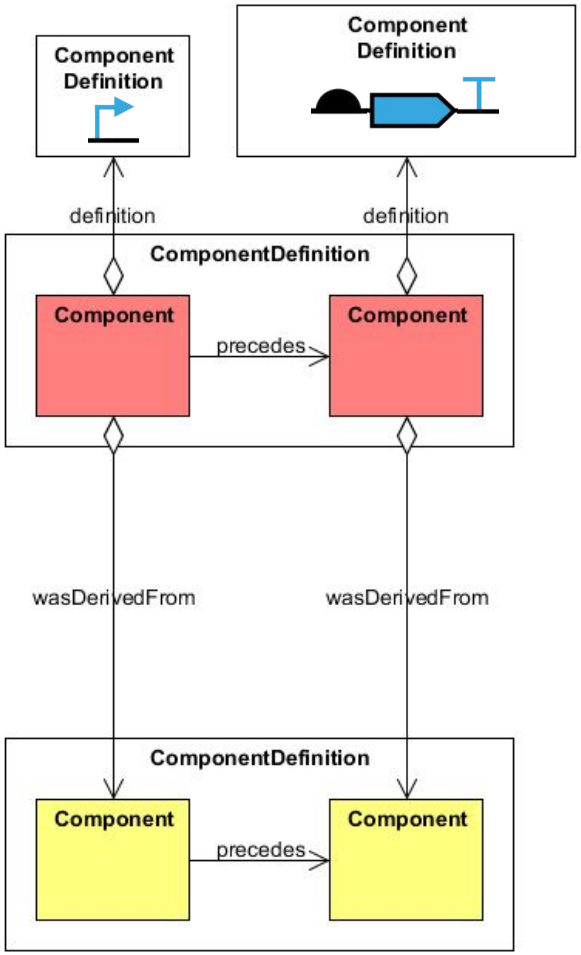
Derived Branching Design

Raytheon
BBN Technologies



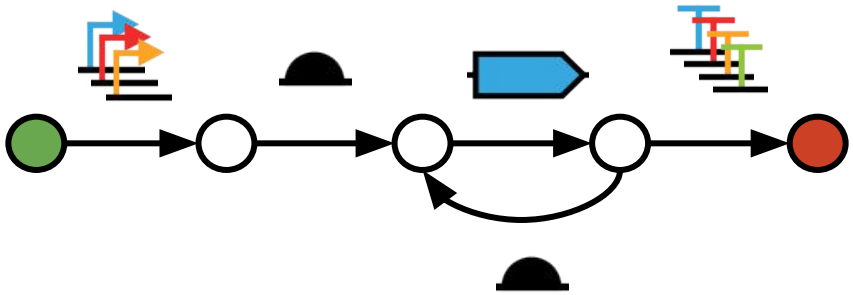
Alternate Derived Branching Design

Raytheon
BBN Technologies



Use Case: Repetitive Designs

Raytheon
BBN Technologies

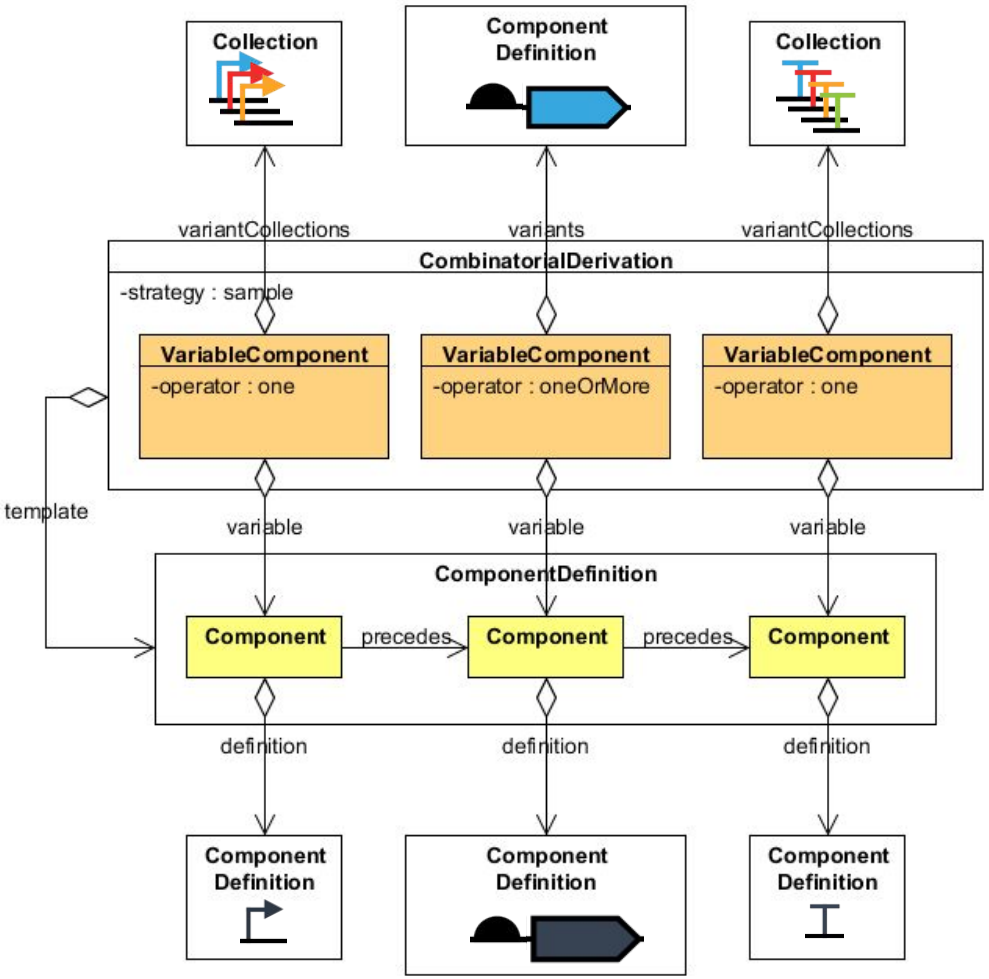


Supporting Tools: Knox, GenoCAD

Formal Language Class: Regular

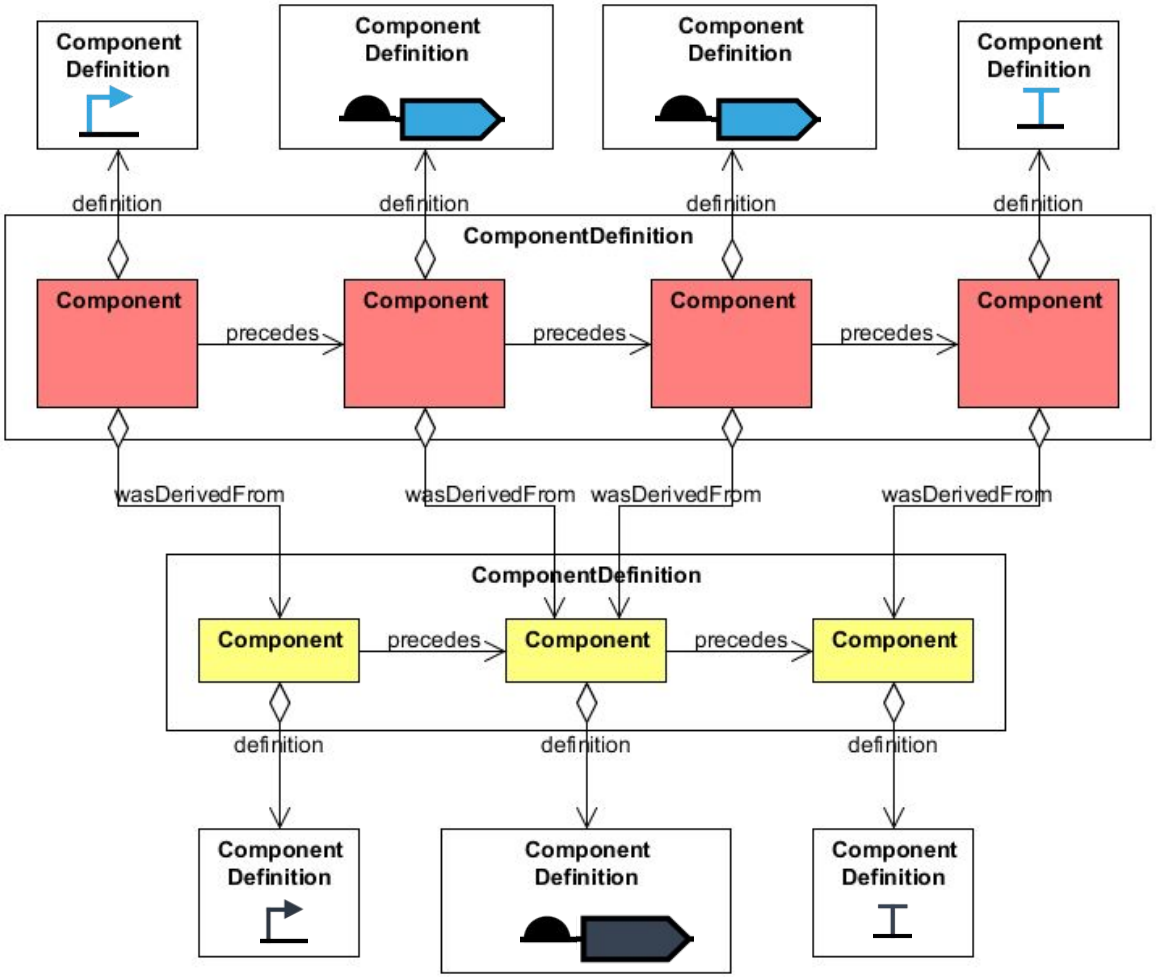
Derivation of Repetitive Design

Raytheon
BBN Technologies



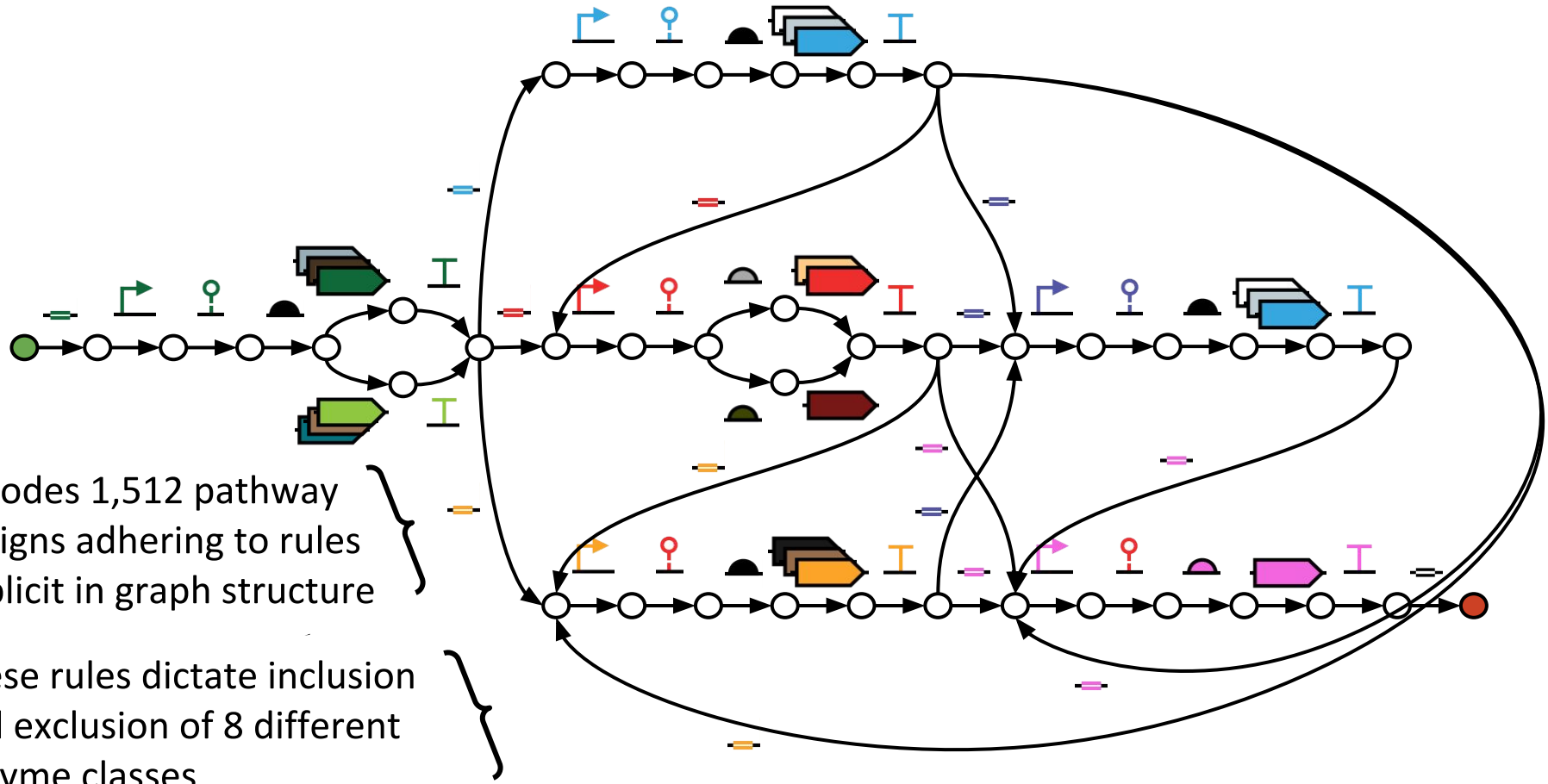
Derived Repetitive Design

Raytheon
BBN Technologies



Real Use Case: Combinatorial Design Space for Biosynthetic Pathways

Raytheon
BBN Technologies

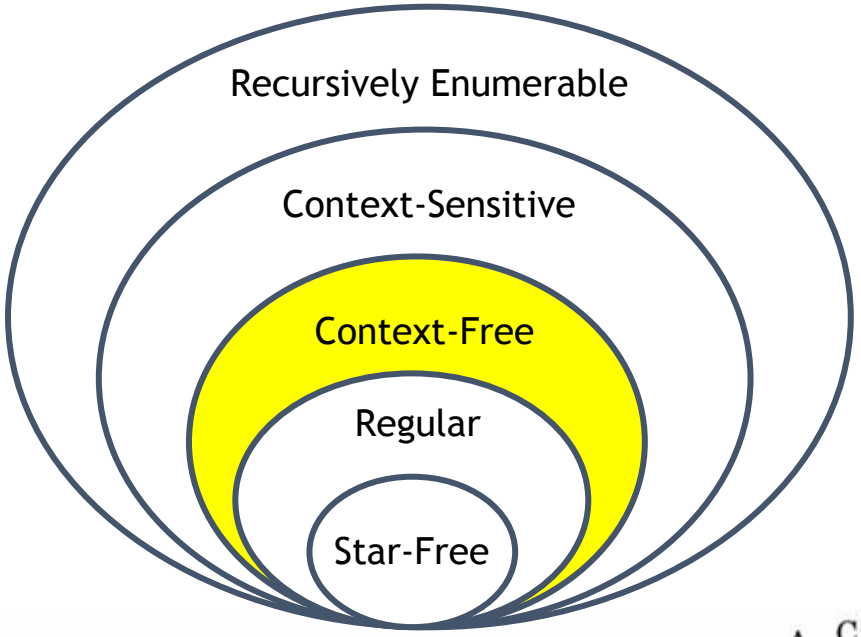


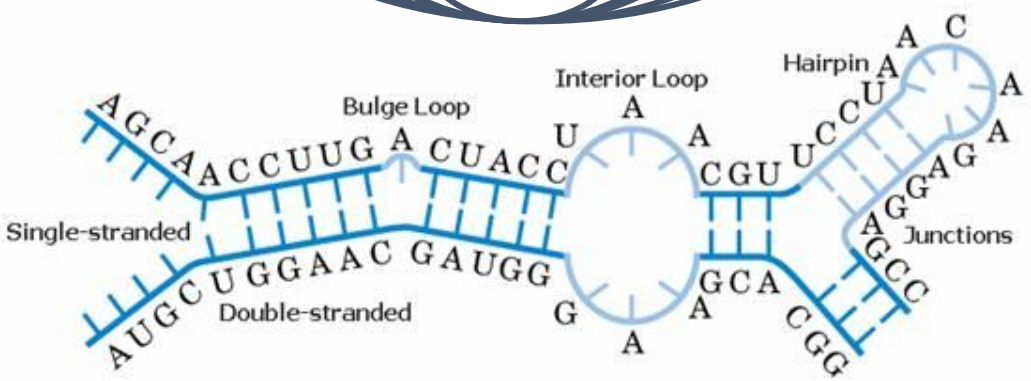
Encodes 1,512 pathway designs adhering to rules implicit in graph structure

These rules dictate inclusion and exclusion of 8 different enzyme classes

Next Up: Context-Free Languages

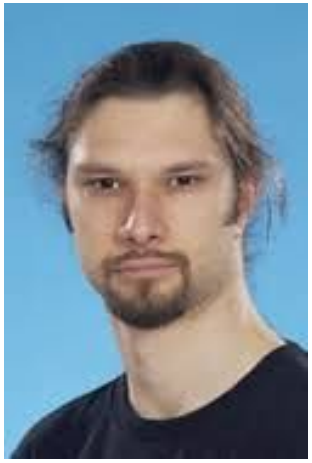
Raytheon
BBN Technologies





Acknowledgements

Raytheon
BBN Technologies



Matthew Pocock

Jacob Beal