# Compositional Model Translation for IR-Based Code Generation: From SysMLv2 to IR through Gumbo

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## Abstract

This document presents a compositional translation pipeline for IR-based code generation that bridges high-level system models in SysMLv2 with a KS Gumbo-based backend. A reverse transformation from SysMLv2 to Gumbo enables reuse of the existing Serum toolchain, which maps Gumbo specifications to an Intermediate Representation (IR) for code synthesis. The transformation chain is visualized to show how IR can be generated from SysMLv2 via composition of functions.

## Mapping Overview

Let $X$ be a specification written in Gumbo. The KS tool-chain defines a transformation $T_{KS}$ such that:
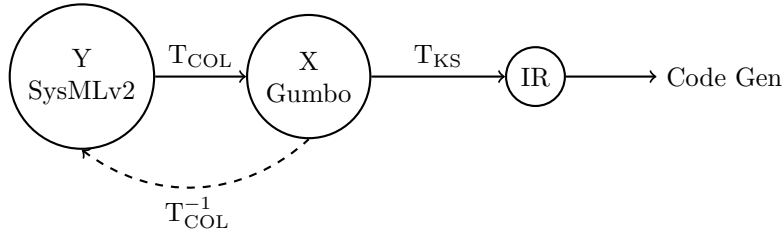
$$T_{KS}(X) \in IR$$

We define a reverse transformation $T_{COL}^{-1}$ from Gumbo to SysMLv2, created by the Collins team:

$$T_{COL}^{-1}(X) = Y \in SysMLv2$$

To reuse the KS tool-chain backend, we define a composition of functions:

$$T_C(Y) = (T_{KS} \circ T_{COL})(Y) \in IR$$

## Pipeline Diagram



## Conclusion

This approach enables seamless reuse of the KS backend by mapping SysMLv2 specifications into the Gumbo domain, and then proceeding with the original IR generation pipeline.