Métodos Formais de Programação

Modelação formal de um Grafo Computacional

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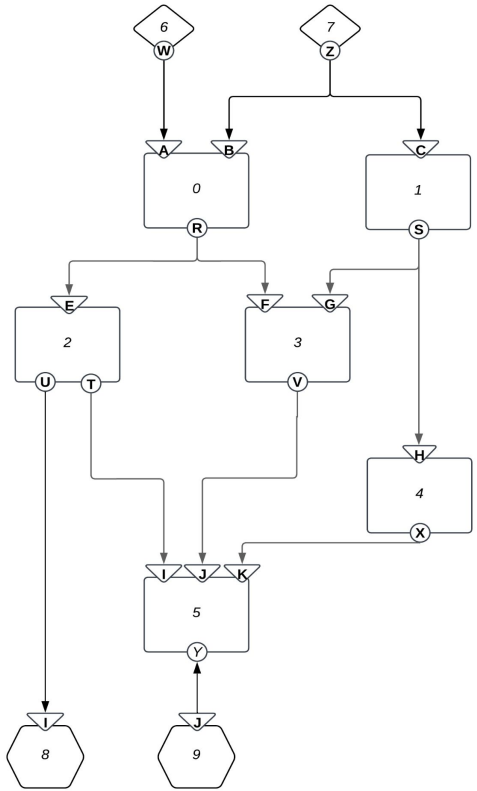
Introdução

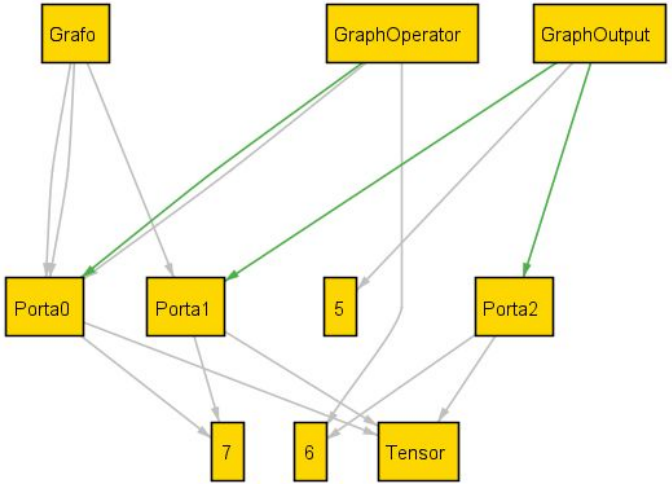


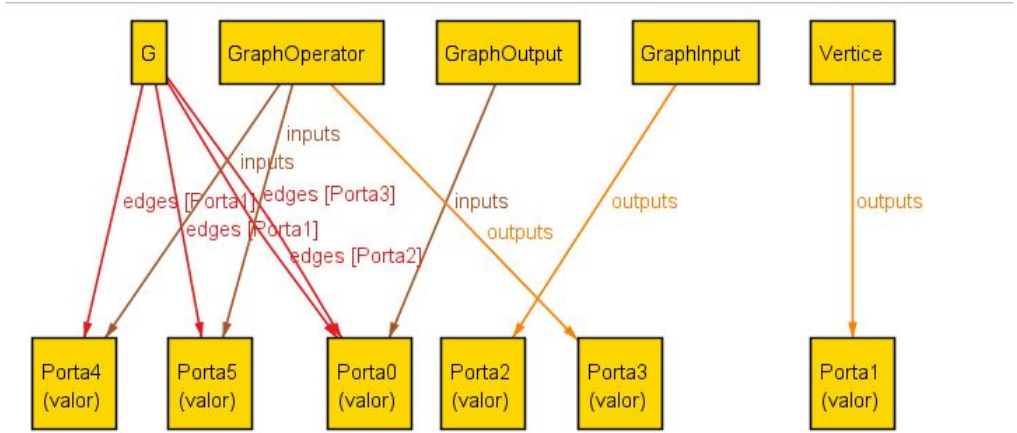
Objetivos

Modelação de grafo ONNX em alloy, onde temos de garantir:

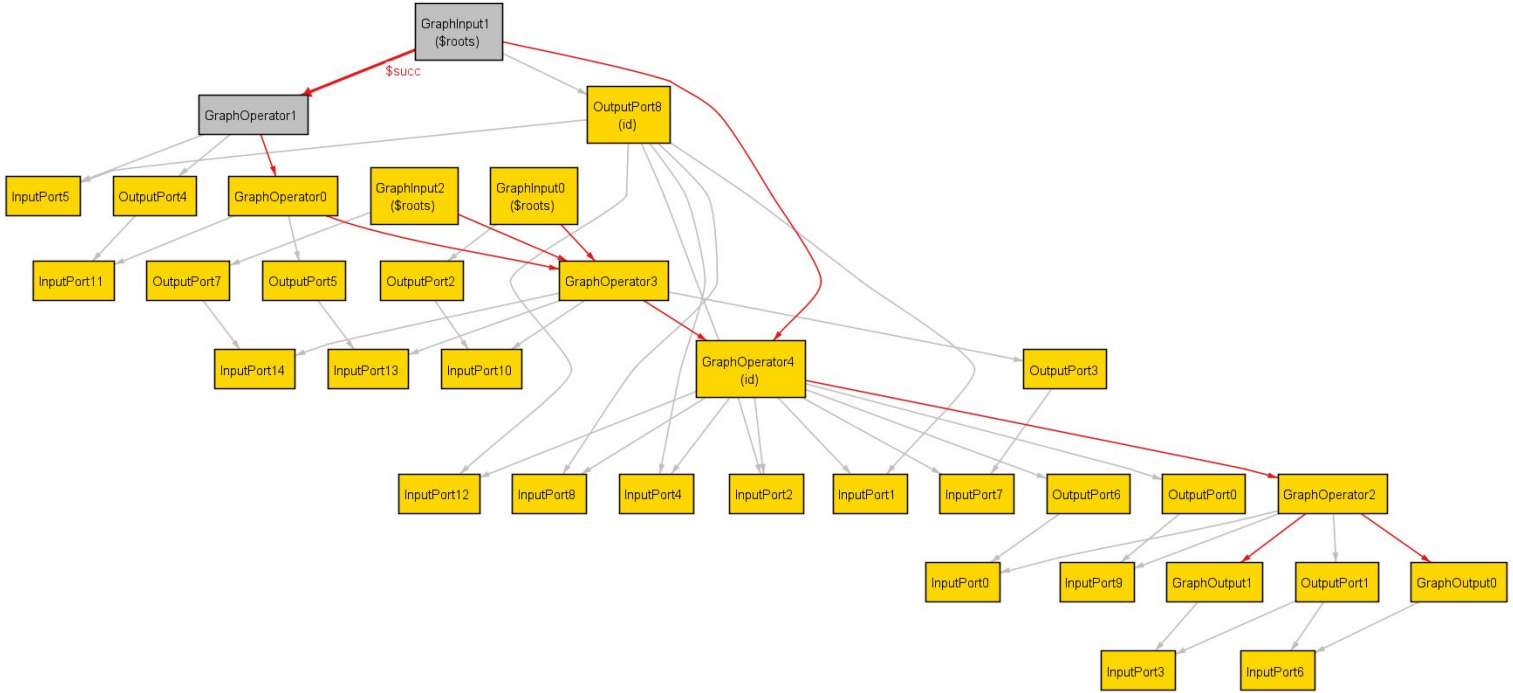
- Estrutura correta
- Fluxo válido
- Garantir invariantes
- Ausência de erros

Evolução do Modelo





Modelo Atual



Estrutura atual

```
abstract sig IdPorta {}

abstract sig IdVertice {}

abstract sig Porta {
    id: one IdPorta,
    edges: set Porta
}

sig InputPort extends Porta {}
sig OutputPort extends Porta {}

abstract sig Vertice {
    id: one IdVertice,
    portas: set Porta
}
```

```
sig GraphInput extends Vertice {} {
    no portas & InputPort
    one portas & OutputPort
}

sig GraphOutput extends Vertice {} {
    no portas & OutputPort
    one portas & InputPort
}

sig GraphOperator extends Vertice {} {
    some portas & InputPort
    some portas & OutputPort
}
```

Regras (fact)

```
fact PortaPertenceAUmVertice {
    all p: Porta |
        one v: Vertice | p in v.portas
}
```

```
fact InputsVemDeOutputs {
    all p: InputPort |
       one q: OutputPort | p in q.edges
}
```

```
fact OutputsLigamAInputs {
    all p: OutputPort |
        some p.edges
}
```

```
fact EdgesOutputParaInput {
    all p1, p2: Porta |
        p2 in p1.edges implies
            p1 in OutputPort and p2 in InputPort
}
```

```
fact Acyclic {
    no v: Vertice | v in v.^succ
}
```

Regras (fact)

```
fact UniqueIds {
    all disj p1, p2: Porta |
        p1.id != p2.id

    all disj v1, v2: Vertice |
        v1.id != v2.id
}
```

```
fact ReachableFromRoots {
    all v: Vertice |
        some r: roots |
            v in r.*succ
}
```

```
fact NoDirectInputToOutputConnections {
    all gi: GraphInput, go: GraphOutput |
        no outputs[gi].edges & inputs[go]
}
```

```
fact NoDeadNodes {
    all v: Vertice - GraphOutput |
        some g: GraphOutput | g in v.^succ
}
```

Trabalho futuro

- Funções e subgrafos
- Operadores de Controlo de Fluxo

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