CODE GENERATION IN DRASIL

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OVERVIEW

1. Current code generation design
2. Results of current generator
3. Next steps

CURRENT DESIGN

CODE SPECIFICATION

- Specification:
  - Database of symbols used in the code
  - Inputs to the program
  - Outputs of the program
  - Relations between symbols
- Built from captured knowledge
- Using the code specification, Drasil finds a path from inputs to outputs through the set of relations
- Generates code using these relations to transform inputs to outputs

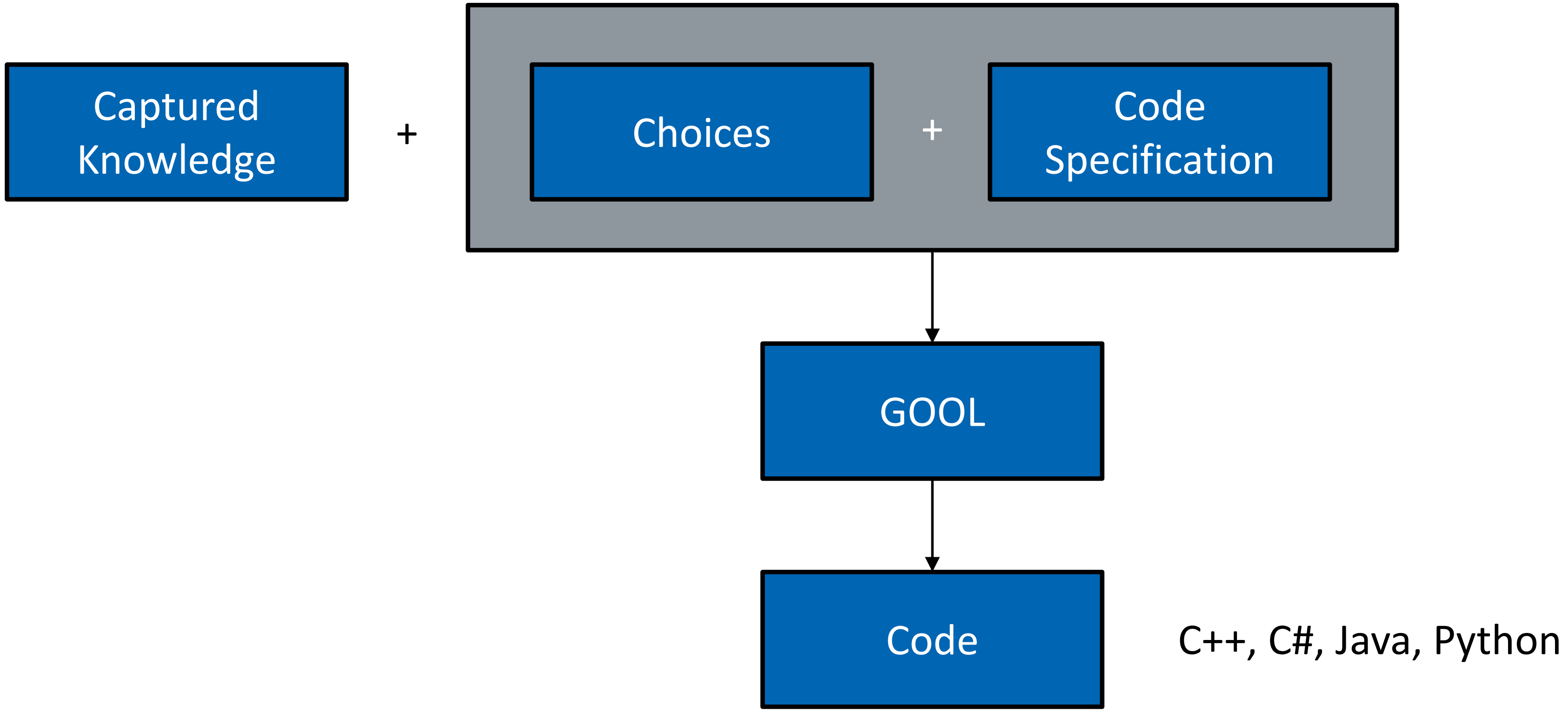
CHOICES

- Allow user to make decisions about features of the generated code
- Examples of choices:
  - Programming language?
  - Library vs program?
  - Logging?
  - Documentation in code?
  - Input/output structure?
  - Which algorithm to use?

GOOL

- Generic Object-Oriented Language
  - Developed by Jason Costabile as MEng project, 2012
  - Abstract syntax tree (AST) for OO languages
  - Integrated into Drasil and extended
- Allows rendering code in multiple OO languages
  - C++, C#, Java, Python

CURRENT DESIGN



RESULTS

GLASSBR CASE STUDY

- GlassBR:
  - Computes whether a given plate of glass will resist a blast force
  - Small: ~200 lines
  - Simple: Input -> Calculations -> Output
  - Good starting point for developing code generation in Drasil
- Currently able to generate complete working code for GlassBR
  - C++, C#, Java, and Python!

RISK OF FAILURE FROM GLASSBR THEORY

Number	DD1
Label	**Risk of Failure (B)**
Equation	$B = \frac{k}{(a \times b)^{m-1}}((E \times 1000)(h)^2)^m \times \text{LDF} \times e^J$
Description	B is the risk of failure m, k are the surface flaw parameters a, b are dimensions of the plate, where $(a > b)$ E is the modulus of elasticity h is the true thickness, which is based on the nominal thickness as shown in DD2 LDF is the Load Duration Factor, as defined in DD3 J is the stress distribution factor, as defined in DD4

RISK OF FAILURE: DRASIL CODE

$$B = \frac{k}{(a \times b)^{m-1}}((E \times 1000)(h)^2)^m \times \mathrm{LDF} \times e^J$$

```
risk_eq :: Expr
risk_eq = ((C sflawParamK) / (Grouping ((C plate_len) *
  (C plate_width))) :^ ((C sflawParamM) - 1) *
  (Grouping (C mod_elas * 1000) * (square (Grouping (C act_thick))))
  :^ (C sflawParamM) * (C lDurFac) * (exp (C stressDistFac)))
```

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RISK OF FAILURE: DRASIL CODE

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```

RISK OF FAILURE: GENERATED CODE

C++:

```
double func_B(InputParameters &inParams, double J) {
    return ((((2.86 * (pow(10, -(53)))) / (pow(inParams.a * inParams.b, 7 - 1))) *
        (pow(((7.17 * (pow(10, 7))) * 1000) * (pow(inParams.h, 2)), 7))) *
        (pow(3 / 60, 7 / 16))) * (exp(J));
}
```

C#:

```
public static double func_B(InputParameters inParams, double J) {
    return ((((2.86 * (Math.Pow(10, -(53)))) /
        (Math.Pow(inParams.a * inParams.b, 7 - 1))) *
        (Math.Pow(((7.17 * (Math.Pow(10, 7))) * 1000) *
        (Math.Pow(inParams.h, 2)), 7))) * (Math.Pow(3 / 60, 7 / 16))) * (Math.Exp(J));
}
```

RISK OF FAILURE: GENERATED CODE

Python:

```
def func_B(inParams, J):
    return ((((2.86 * (10 ** (-(53)))) / ((inParams.a * inParams.b) **
        (7 - 1))) * ((((7.17 * (10 ** 7)) * 1000) *
        (inParams.h ** 2)) ** 7)) * ((3 / 60) ** (7 / 16))) *
        (math.exp(J))
```

Java:

```
public static double func_B(InputParameters inParams, double J) throws Exception {
    return ((((2.86 * (Math.pow(10, -(53)))) /
        (Math.pow(inParams.a * inParams.b, 7 - 1))) *
        (Math.pow(((7.17 * (Math.pow(10, 7))) * 1000) *
        (Math.pow(inParams.h, 2)), 7))) * (Math.pow(3 / 60, 7 / 16))) * (Math.exp(J));
}
```

CHOICE: FUNCTION COMMENTING

```
def func_B(inParams, J):
    # function 'func_B': risk of failure
    # parameter 'inParams':
    # parameter 'J': stress distribution factor (Function)

    return ((((2.86 * (10 ** (-(53)))) / ((inParams.a * inParams.b) **
      (7 - 1))) * ((((7.17 * (10 ** 7)) * 1000) *
      (inParams.h ** 2)) ** 7)) * ((3 / 60) ** (7 / 16))) *
      (math.exp(J))
```

CHOICE: FUNCTION LOGGING

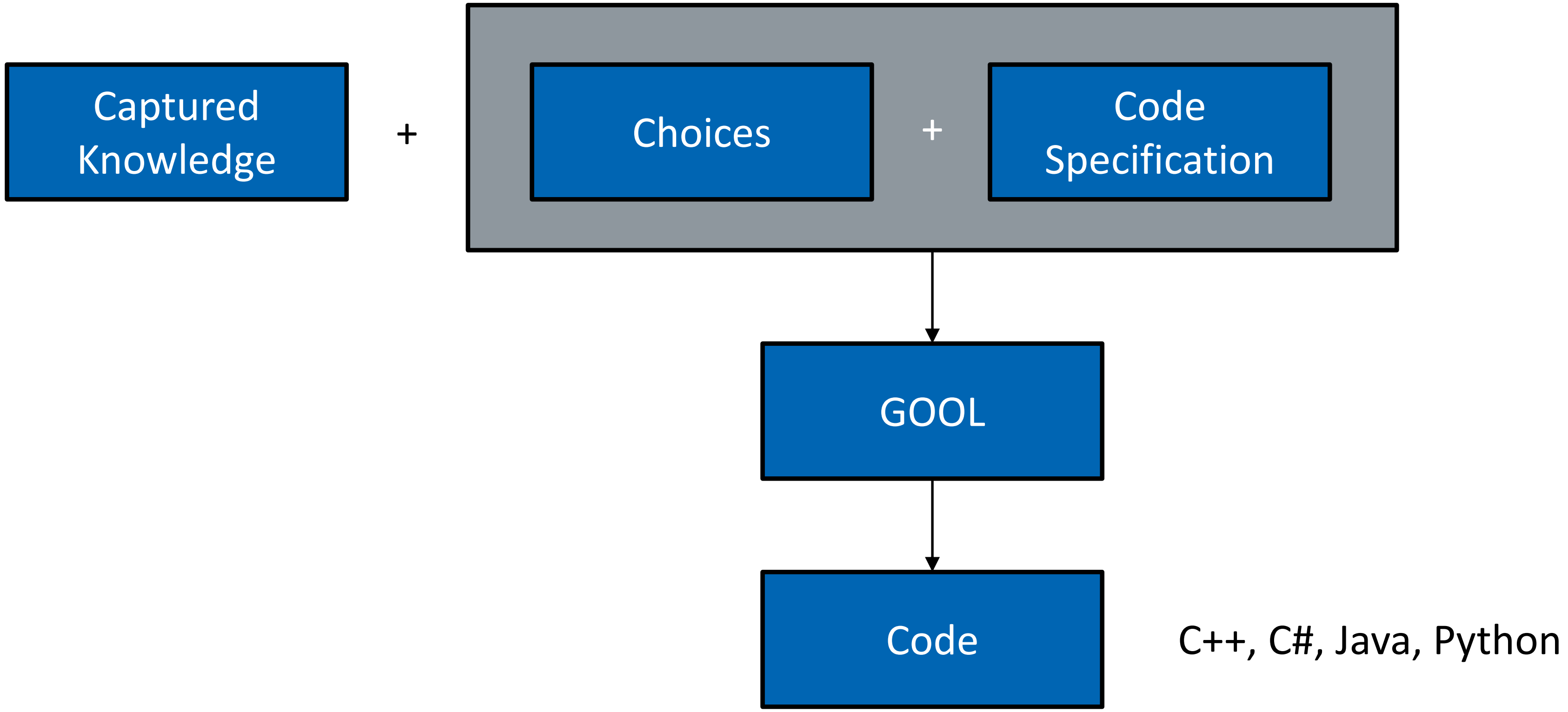
```
def func_B(inParams, J):
    # function 'func_B': risk of failure
    # parameter 'inParams':
    # parameter 'J': stress distribution factor (Function)

    outfile = open("log.txt", "w")
    print("function func_B(", end='', file=outfile)
    print(inParams, end='', file=outfile)
    print(", ", end='', file=outfile)
    print(J, end='', file=outfile)
    print(") called", file=outfile)
    outfile.close()

    return ((((2.86 * (10 ** (-(53)))) / ((inParams.a * inParams.b) **
      (7 - 1))) * ((((7.17 * (10 ** 7)) * 1000) *
      (inParams.h ** 2)) ** 7)) * ((3 / 60) ** (7 / 16))) *
      (math.exp(J))
```

NEXT STEPS

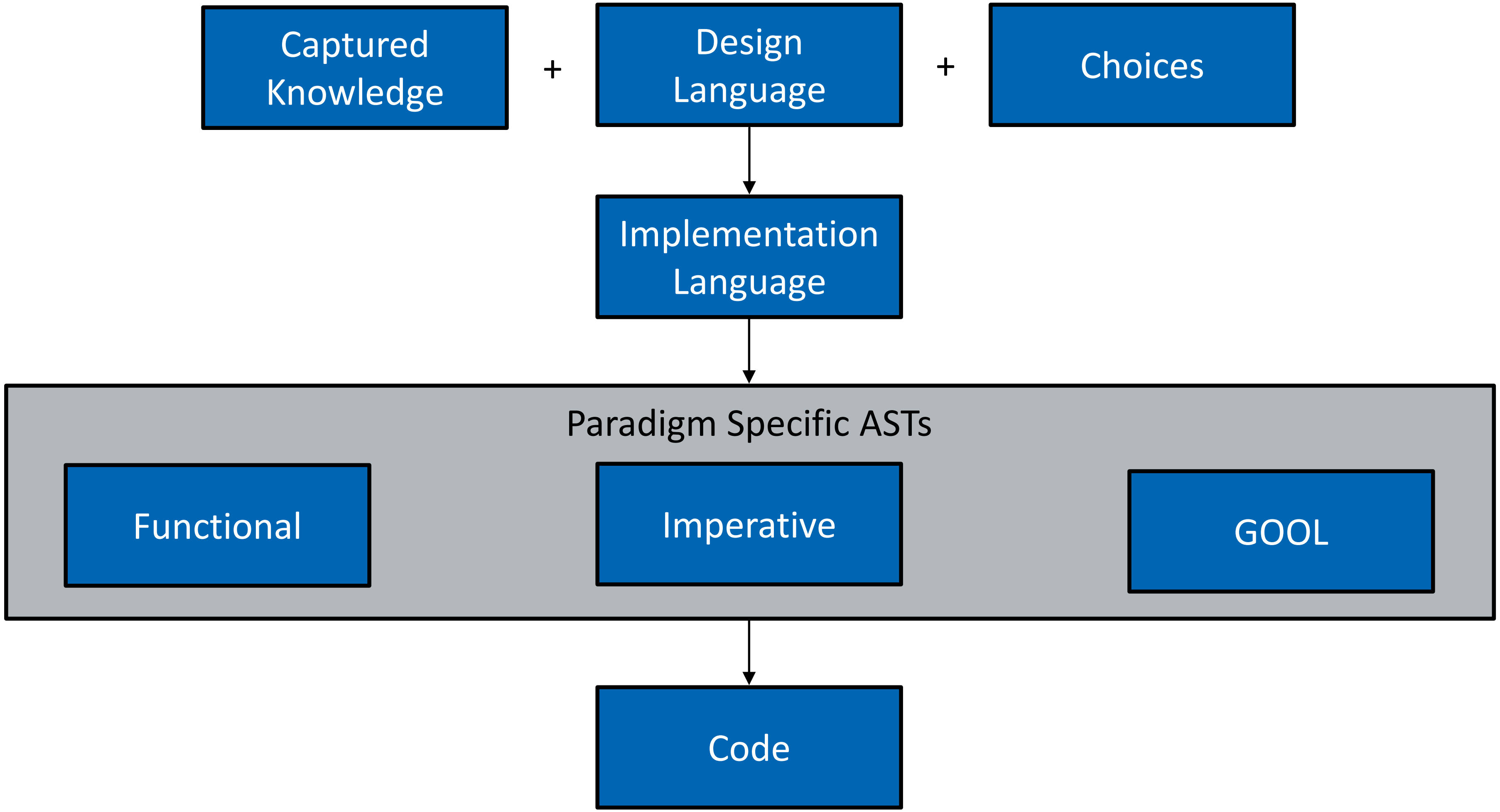
RECALL: CURRENT DESIGN



LIMITATIONS OF CURRENT DESIGN

- Works only for simple program structures:
  - Read inputs, do some (serial) computations, write outputs
- Lacks expressiveness for the user:
  - The current design is rigid
  - Tries to do too much in an automated way
  - Need a way for the user of Drasil to specify the design of the code
  - Design language

FUTURE DESIGN



THANK YOU