The Book of Magne

INF222 Crashcourse - v2022

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Agenda

Script and Presentation

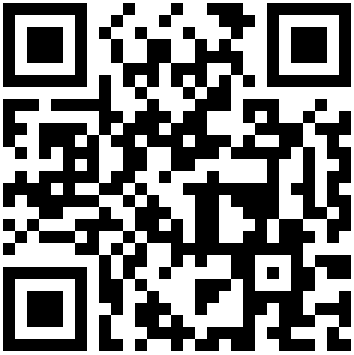

Figure: https://tinyurl.com/book-of-magne

What is a programming language?

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- is an artificial language(i.e made by us humans on purpose)
- is used to tell machines what to do

Grouping Languages

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- Ex. purpose, typing, paradigm, generality vs. specificity
- Look at; generality vs. specificity, and paradigm

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Languages are usually grouped into two categories when based on their specificity

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- DSLs, small, targeted at specific problems. Internal/embedded vs external
- GPLs, large, many uses.

Generality vs. Specificity

Characteristic	DSL	GPL
Domain	Small, Well-defined	Large, Not specialized
Size	Small	Large
Lifespan	Weeks, Months	Years, Decades

Paradigms

- Imperative Languages

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- Imperative Languages
- Functional Languages
- OOP languages
- Logic languages

Syntax and Semantics

All languages consist of two parts

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The Interpreter Process

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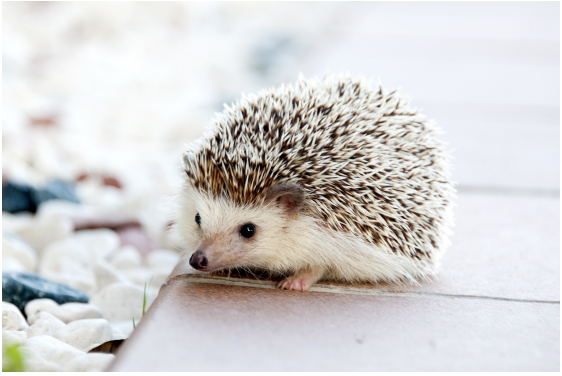
- Lexical Analyzer
- Syntax Analyzer
- Semantic Analyzer
- Evaluator

Meta Programming

A metaprogram is a program that works on *other* programs.
When you see a data structure like BSL or BIPL in Haskell it represents those programs.

Questions?



Abstract Syntax Trees

ASTs represent the abstract syntax of a program. Abstract means that unnecessary tokens are removed, ex. parenthesis, curly braces.
It's produced by the Syntax Analyzer.
Often used as an intermediary representation by the interpreter.

Sum of Products

```
1       data SomeType = A Bool Bool Bool
2                     | B Bool
3                     | C
```

Sum of Products

$$\underbrace{(\text{Bool} \times \text{Bool} \times \text{Bool})}_{A} + \underbrace{\text{Bool}}_{B} + \underbrace{1}_{C}$$

The Bool type can take on 2 different values (True or False), so the A constructor can construct $2 * 2 * 2 = 8$ different values.
the total numbers of values of type SomeType is $8 + 2 + 1 = 11$, as the data type is the sum of the three products we've just described.

Type Checking

Typing falls into two categories

- Static

Type Checking

Typing falls into two categories

- Static
- Dynamic

Type Checking

Example!

Wellformedness

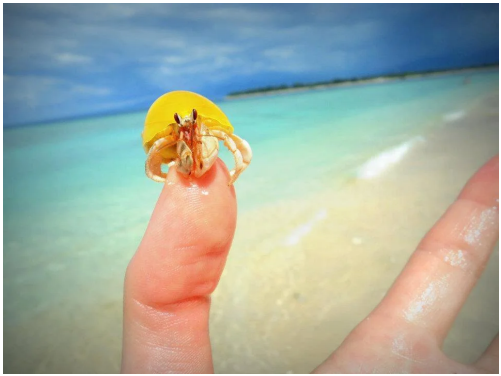
For a program to be Wellformedit needs to satisfy all the constraints(kinda like rules) on it. This means that the program follows all the rules for it like;

- The program conforms to the AST
- Typed correctly
- all procs/declarations are wellformed
- other things

Type Inference

Some languages don't specify the type of expressions and therefore need to be inferred. Example!

Questions?



Store

A store lets us "store"[1] things.
Usually array of bytes or values(depends on abstraction level)
Items are stored at specific index.
Usually grows upwards.

[1] duh

Variables and Enviroment

Variables associate names with storage locations.
Environments are the map of variables.
Kinda like a phonebook.

Scoping

A scope is an overview of what exists when
Usually talk about the scope of something like a var.
Describes when it exists.
Two types

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- Dynamic - Determined at runtime

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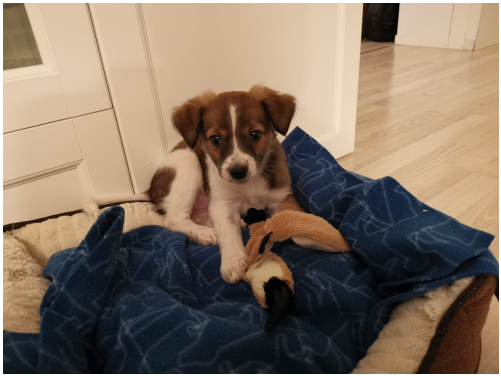

Procedures

Procedures, Subroutines, Functions, Methods, etc. let us abstract away the algo implementation.
Only need to implement code once.

Procedure Declarations

Our procedures have been inspired by PASCAL.
Our procedure declerations have;

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- code

Procedure Declarations

See script 5.1

Parameters & Local Variables

- Local variables are vars that are declared and used only within the procedure.
- Parameters are local vars that are instantiated with the value/reference of arg.

Parameters also specify *how* the procedure communicats with the outside world.

Performing a Procedure

Performing a procedure is done in the following steps

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2. We then add all the local variables.
3. We then execute the procedure statements.
4. We then reset the environment back to how it looked before using the saved stack frame from (1). This ensures that all local variables that shouldn't exist outside the procedure are removed.

Executing a Procedure Call

We have now established how to perform a procedure.
We need to set up the environment for it first.

Argument Passing

- Copy Semantics

Argument Passing

- Copy Semantics
- Reference Semantics

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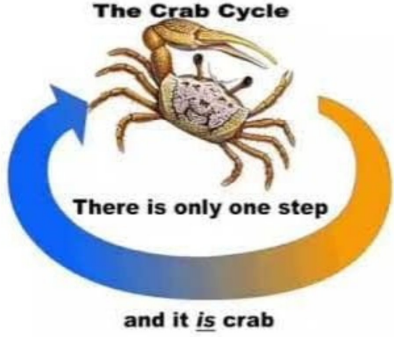
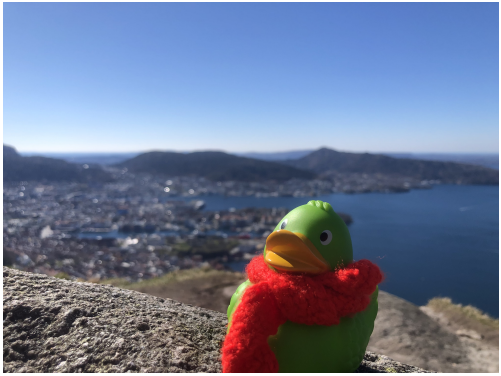


Generics

Generics lets us create "universal" algos.
Example!

Questions?



Implications of Language

Backus-Naur Form

- BNF describes context-free grammars.
- Used to describe concrete syntax of a language.
- Most commonly we use E(xtended)-BNF

<Example from script>

Lykke til på eksamen!

Takk for oss :)