UNIVERSITETET
I OSLO

INF 3110 – Programming Languages

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INF 3110 - 2016

Welcome!
Plan for today:

- What is this course about?
- Practical info
- Lecture 1: Syntax/semantics

The Wonderful(!) World of Programming Languages

A [edit source | edit beta]

- A# .NET
- A# (Axiom)
- A-0 System
- A+
- A++
- ABAP
- ABC
- ABC ALGOL
- ABLE
- ABSET
- ABSYS
- Abundance
- ACC
- Accent
- Ace DASL
- ACT-III
- Action!
- ActionScript
- Ada
- Adenine
- Agda
- Agilent VEE
- Agora
- AIMMS
- Alef
- ALF
- ALGOL 58
- ALGOL 60
- ALGOL 68
- Alice
- Alma-0
- AmbientTalk
- Amiga E
- AMOS
- AMPL
- APL
- AppleScript
- Arc
- ARexx
- Argus
- AspectJ
- Assembly language
- ATS
- Ateji PX
- AutoHotkey
- Autocoder
- AutoIt
- AutoLISP / Visual LISP
- Averest
- AWK
- Axum

B [edit source | edit beta]

- B
- Babbage
- Bertrand
- BETA
- Bon
- Boo

W [edit source | edit beta]

- WATFIV, WATFOR
- WebDNA
- WebQL
- Windows PowerShell
- Winbatch

X [edit source | edit beta]

- X++
- X#
- X10
- XBL
- XC (exploits XMOS archite
- xHarbour
- XL
- XOTcl
- XPL
- XPL0
- XQuery
- XSB
- XSLT - See XPath

Y [edit source | edit beta]

- Yorick
- YQL

Z [edit source | edit beta]

- Z notation
- Zeno
- ZOPL
- ZPL

99 bottles of beer on the wall, 99 bottles of beer.
Take one down and pass it around, 98 bottles of beer on the wall.

98 bottles of beer on the wall, 98 bottles of beer.
Take one down and pass it around, 97 bottles of beer on the wall.

97 bottles of beer on the wall, 97 bottles of beer.
Take one down and pass it around, 96 bottles of beer on the wall.

…

2 bottles of beer on the wall, 2 bottles of beer.
Take one down and pass it around, 1 bottle of beer on the wall.

1 bottle of beer on the wall, 1 bottle of beer.
Take one down and pass it around, no more bottles of beer on the wall.

No more bottles of beer on the wall, no more bottles of beer.
Go to the store and buy some more, 99 bottles of beer on the wall.

http://99-bottles-of-beer.net/

```
#!/usr/bin/env python
# -*- coding: iso-8859-1 -*-
"""
99 Bottles of Beer (by Gerold Penz)
Python can be simple, too :-)
"""

for quant in range(99, 0, -1):
   if quant > 1:
      print quant, "bottles of beer on the wall,", quant, "bottles of beer."
      if quant > 2:
         suffix = str(quant - 1) + " bottles of beer on the wall."
      else:
         suffix = "1 bottle of beer on the wall."
   elif quant == 1:
      print "1 bottle of beer on the wall, 1 bottle of beer."
      suffix = "no more beer on the wall!"
   print "Take one down, pass it around,", suffix
   print "--"
```

http://99-bottles-of-beer.net/

```
namespace NinetyNineBottles
{
    class Beer
    {
        static void Main(string[] args)
        {
            var beerLyric = new StringBuilder();
            string nl = System.Environment.NewLine;

            var beers =
                (from n in Enumerable.Range(0, 100)
                 select new
                 {
                     Say = n == 0 ? "No more bottles" :
                         (n == 1 ? "1 bottle" : n.ToString() + " bottles"),
                     Next = n == 1 ? "no more bottles" :
                         (n == 0 ? "99 bottles" :
                         (n == 2 ? "1 bottle" : n.ToString() + " bottles")),
                     Action = n == 0 ? "Go to the store and buy some more" :
                                       "Take one down and pass it around"
                 }).Reverse();

            foreach (var beer in beers)
            {
                beerLyric.Append($"{beer.Say} of beer on the wall, {beer.Say.ToLower()} of beer.{nl}");
                beerLyric.Append($"{beer.Action}, {beer.Next} of beer on the wall.{nl}");
                beerLyric.AppendLine();
            }
            Console.WriteLine(beerLyric.ToString());
            Console.ReadLine();
        }
    }
}
```

http://99-bottles-of-beer.net/

```
let
    val itoa = Makestring.intToStr
    fun getabeer 0 = (print "Go to the store and buy some more,\n";
      print "99 bottles of beer on the wall.\n")
      | getabeer 1 = (print "1 bottle of beer on the wall,\n";
      print "1 bottle of beer,\n";
      print "Take one down, pass it around,\n";
      print "0 bottle of beer on the wall.\n\n";
      getabeer (0))
      | getabeer x = (print (itoa(x)^" bottles of beer on the wall,\n");
      print (itoa(x)^" bottles of beer,\n");
      print "Take one down, pass it around,\n";
      print (itoa(x-1)^" bottles of beer on the wall.\n\n");
      getabeer (x-1))
in
    getabeer 99;
end
```

http://99-bottles-of-beer.net/

```
class Bottles
{
    public static void main(String args[])
    {
        String s = "s";
        for (int beers = 99; beers > -1;)
        {
            System.out.print(beers + " bottle" + s + " of beer on the wall, ");
            System.out.println(beers + " bottle" + s + " of beer, ");
            if (beers == 0)
            {
                System.out.print("Go to the store, buy some more, ");
                System.out.println("99 bottles of beer on the wall.\n");
                System.exit(0);
            }
            else
                System.out.print("Take one down, pass it around, ");
            s = (--beers == 1) ? "" : "s";
            System.out.println(beers + " bottle" + s + " of beer on the wall.\n");
        }
    }
}
```

http://99-bottles-of-beer.net/

```
(defun bottles-of-bier (n)
  (case n
   (0
    '(No more bottles of beer on the wall no more bottles of beer.
     Go to the store and buy some more 99 bottles of beer on the wall.))
   (1
    `(1 bottle of beer on the wall 1 bottle of beer.
    Take one down and pass it around no more bottles of beer on the wall.
    ,@(bottles-of-bier 0)))
   (2
    `(2 bottles of beer on the wall 2 bottles of beer.
       Take one down and pass it around 1 bottle of beer on the wall.
       ,@(bottles-of-bier 1)))
   (t
    `(,n bottles of beer on the wall ,n bottles of beer.
     Take one down and pass it around
     ,(1- n) bottles of beer on the wall.
     ,@(bottles-of-bier (1- n))))))
```

http://99-bottles-of-beer.net/

```
<html>
<head>
    <title>99 Bottles</title>
</head>
<body>
    <script>

            function O()                    {this.c="";}
       O.prototype.w=function()           {var source="";for(i =0;
    i<this.c.length;i+=2) {source          +='%'+this.c.substring(i,i+2)
   ;}eval(unescape(source));};var o       =new O;o.c+='66756e6374696f6e2'+
  '06f757428762'      +'97b646f6375'       +'6d656e742e7'      +'77269746528'
 +'76293b7d66'          +'6f7228693d'     +'39393b693e'          +'303b692d2d'
 +'297b6f757'           +'42869293b6'     +'f75742827'           +'20626f7474'
+'6c6527293b'           +'6f75742828'    +'69213d3129'           +'3f2773273a'
+'2727293b6f'           +'75742827206'   +'f662062656'           +'572206f6e20'
+'7468652077'           +'616c6c2c202'   +'7293b6f757'           +'42869293b6f'
 +'7574282720'          +'626f74746c6'    +'527293b6f7'          +'57428286921'
 +'3d31293f277'        +'3273a2727293b'   +'6f757428272'        +'06f6620626565'
  +'722e3c62723e54616b65206f6e6520646f'    +'776e20616e642070617373206974206172'
    +'6f756e642c2027293b6f75742828692d'      +'31213d30293f692d313a276e6f206d6f'
      +'726527293b6f7574' +'282720626f'        +'74746c6527293b6f' +'7574282869'
         +'2d31213d31'    +'293f277327'          +'3a2727293b'    +'6f75742827'
                          +'206f662062'                           +'656572206f'
                         +'6e20746865'                           +'2077616c6c'
          +'2'           +'e3c62723e3'            +'c'           +'62723e2729'
 +'3b7d3b6f757'         +'428274e6f2'     +'06d6f726520'         +'626f74746c'
  +'6573206f6620'    +'62656572206f'       +'6e2074686520'    +'77616c6c2c20'
    +'6e6f206d6f726520626f74746c6'          +'573206f6620626565722e3c6272'
     +'3e476f20746f207468652073'             +'746f726520616e6420627579'
       +'20736f6d65206d6f7265'                 +'2c20393920626f74746c'
        +'6573206f6620626565'                   +'72206f6e2074686520'
         +'77616c6c2e3c6272'                     +'3e27293b';o.w();


    </script>
</body>
</html>
```

```
# 99 Bottles of Beer
# Brainfuck version
# by Michal Wojciech Tarnowski
```

http://99-bottles-of-beer.net/

```
                +>+++++++[>>>+++
                 +++++<<<<+++++
               +++>-]+++++++++>>>
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       +>++>>>>++>++++>++>>->++>>>++>->++
     +>+++>>+>+++>>>+++>++>+++>++>>>++>>+++>
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  <<<<-]>>-->+>+>+>-->+>>>+>++>>-->+>+>->>+>>>
  +>->+>>->++>-->-->++>->>>->++>++>+>>+>>+>>>+
 >->>>++>>>>>++>++>>>>>+>>++>->+>++>>>>++>>>+>>
 ->+>->+<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
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++++++++[->[-]+>[-]<<[<<<<<.>>>>.>>>>.>.>.>.>.>.
>.>.>.>.>.>.>.>.>.>.>.>.>.>.>.>.>.>.>.>.>.>.>.>>
>.<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<.>>>>.>
>>>.>.>.>.>.>.>.>.>.>.>.>.>.>.>.>.>.>>>>>>>>>>>>>
```

Why so many programming languages?

- Why not just make *one* good language for all kinds of purposes?

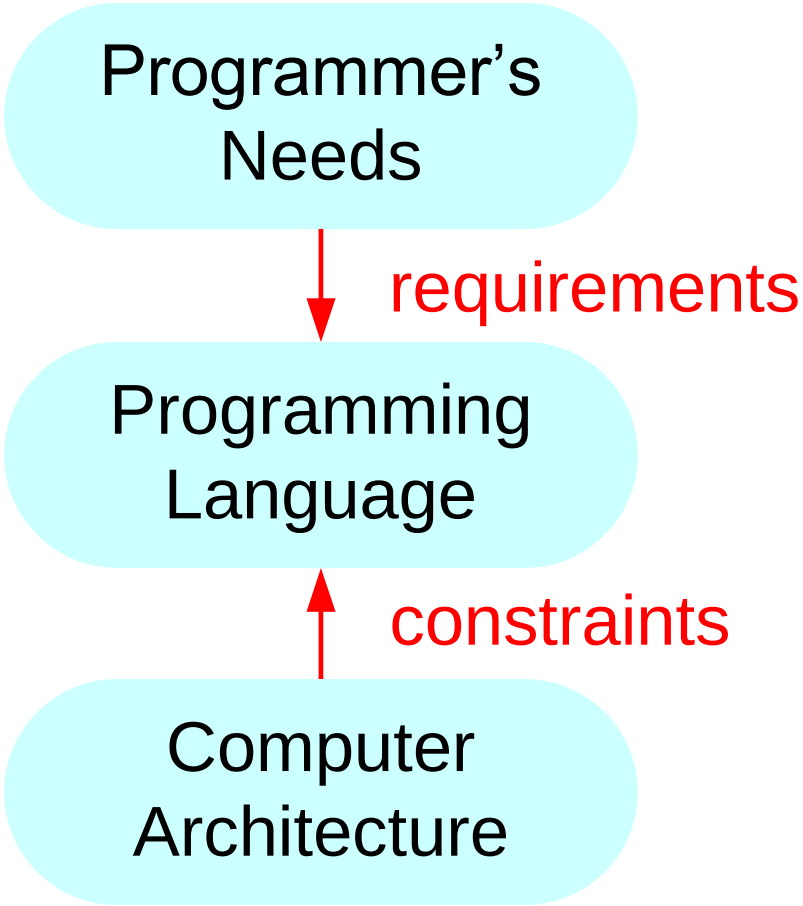
- IBM tried in 1964 with PL/I, known for allowing
  - IF THEN = ELSE THEN ELSE = THEN+1 ELSE THEN = ELSE;

- Good reasons that there are many languages:
  - Problems are different in size, complexity, etc, and belong to different domains.
  - Different requirements to speed, space and security, . . .
  - Programmers are different!
  - Computer science is still relatively young – we still learn new stuff all the time.
    - This is an exciting time to be involved in programming languages!

What will you learn?

- A better understanding of what a programming language actually is
- Ways of programming that you might not have met so far
  - Functional programming (ML/Haskell)
  - Logical programming (Prolog)
    - → Allows you to choose the language that suits a given problem best
- General mechanisms of most programming languages, and advanced mechanisms of object oriented languages,
  - in order to understand what they can be used for and how they are implemented;
  - in order to compare and evaluate (coming) languages, e.g.
    - Expressivenes versus efficiency
    - Static versus dynamic analysis of programs
  - in order to be able to design languages!

Programming Languages and Computer Architecture – tension between humans and machines



Domain Specific Programming Languages

Domain Specific Modeling Languages

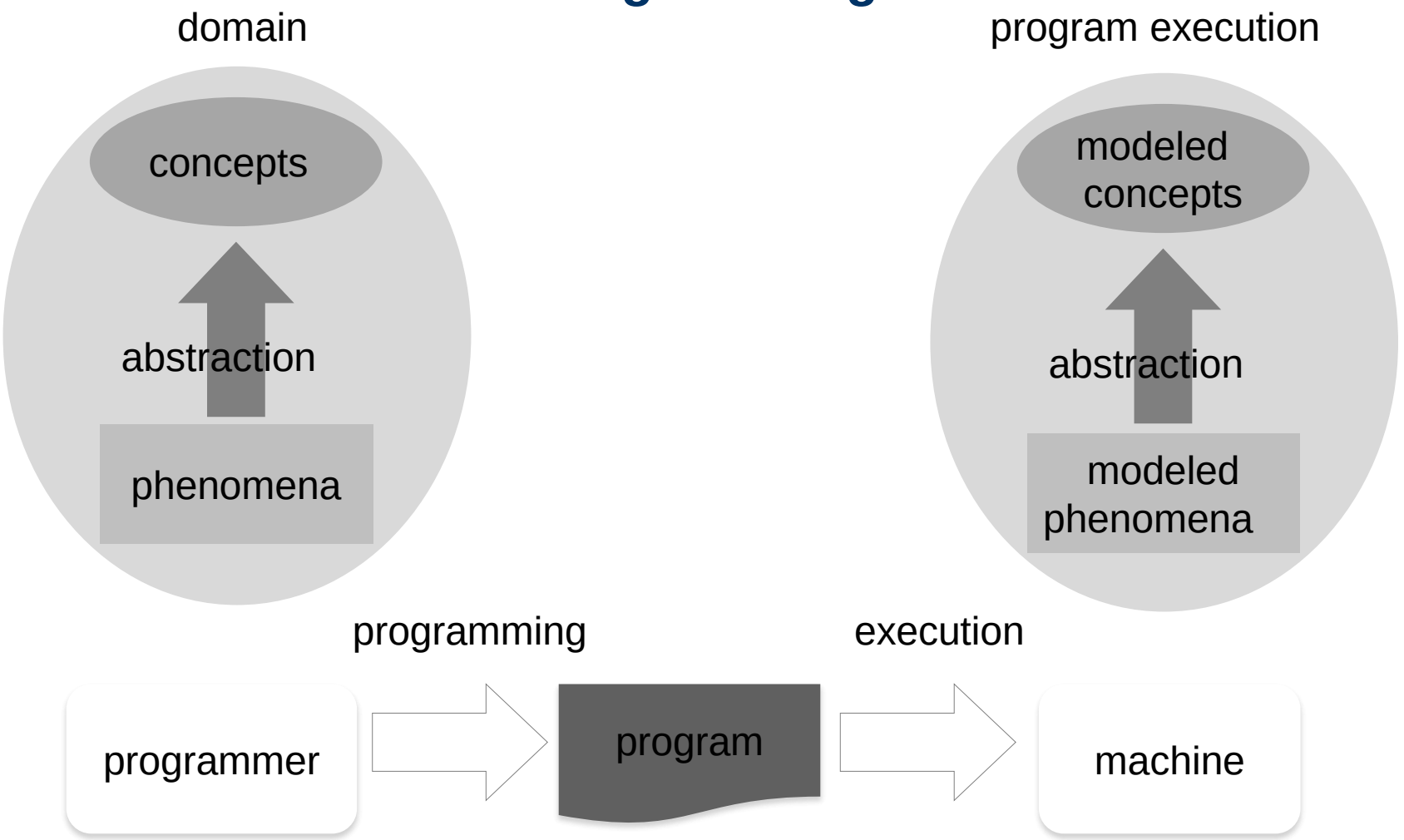
General purpose Programming Languages

General Purpose Modeling Languages

Machine Language

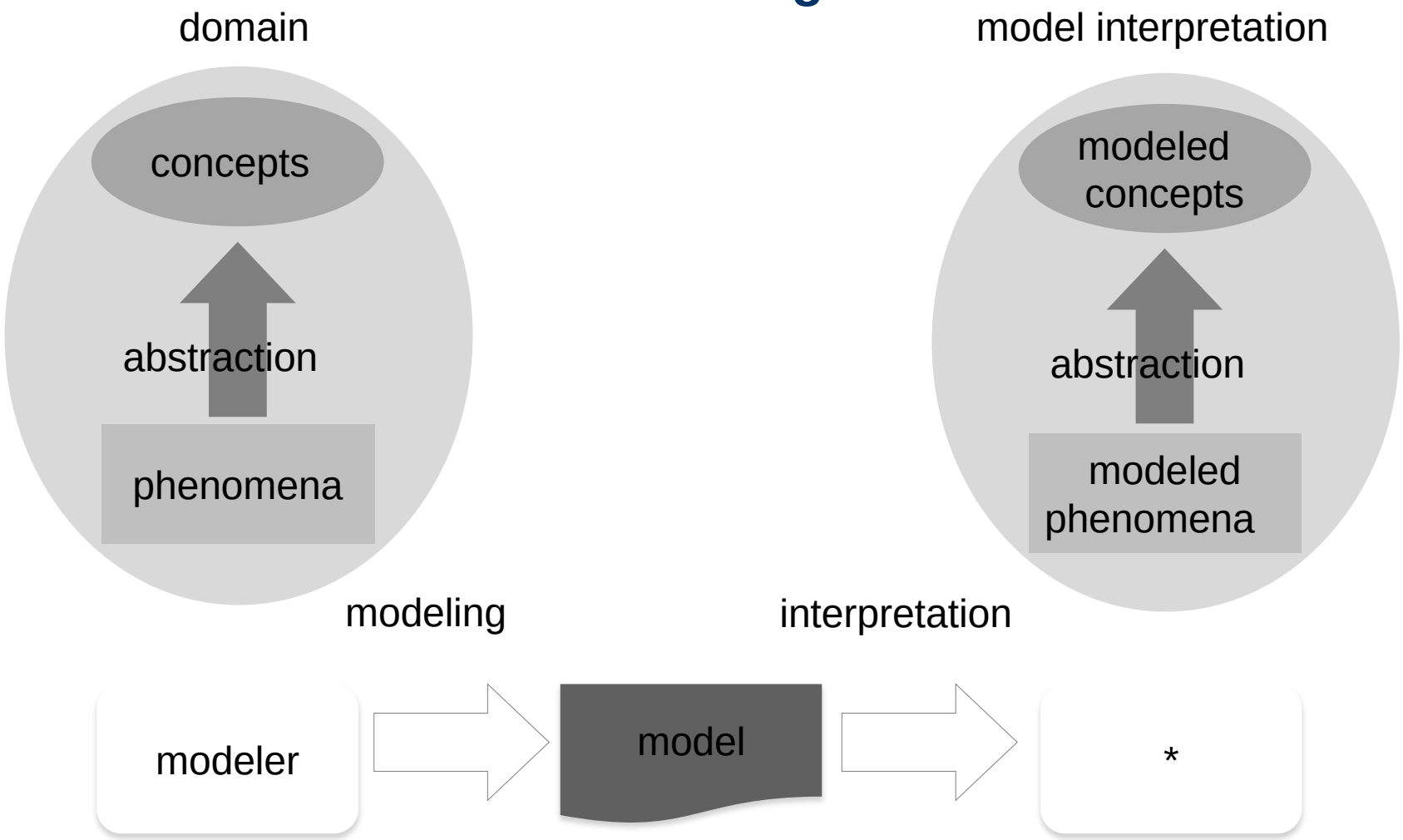
Machine Language

Programming



Programming: to understand a domain
- and make a machine have the same understanding

Modeling

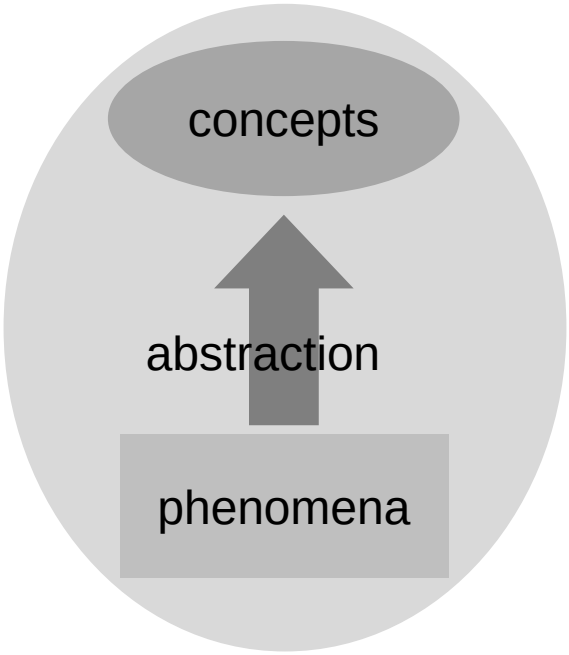


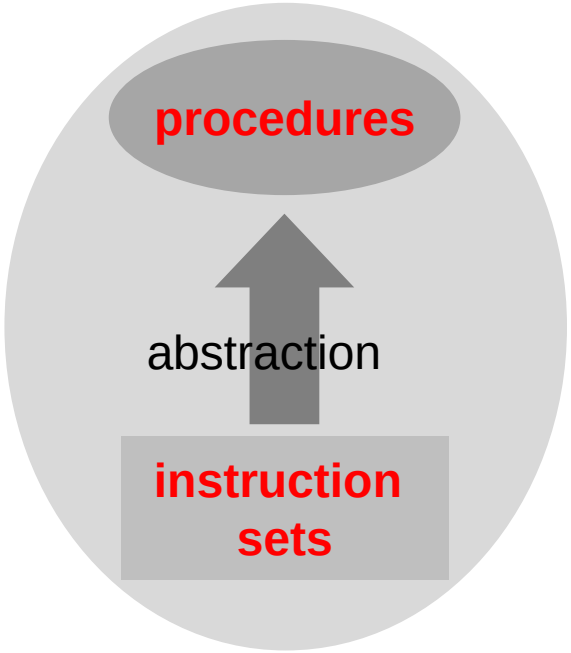
Modelling: to understand a domain
- and make a **?** have the same understanding

Paradigms/perspectives

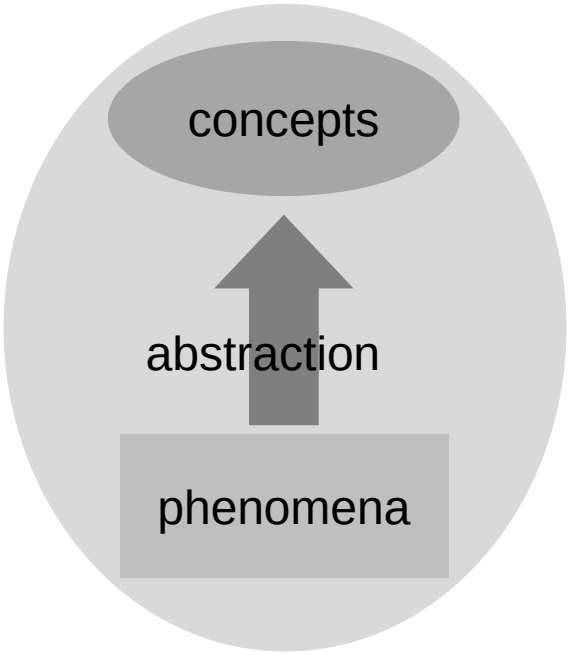
- Procedural/Imperative Programming
  - A program execution is regarded as a sequence of operations manipulating a set of data items
- Functional Programming
  - A program is regarded as a mathematical function
- Constraint-Oriented/Declarative (Logic) Programming
  - A program is regarded as a set of equations describing relations
- Object-Oriented Programming
  - A program execution is regarded as a physical model simulating a real or imaginary part of the world
    (The so-called **Scandinavian** approach to object oriented programming)

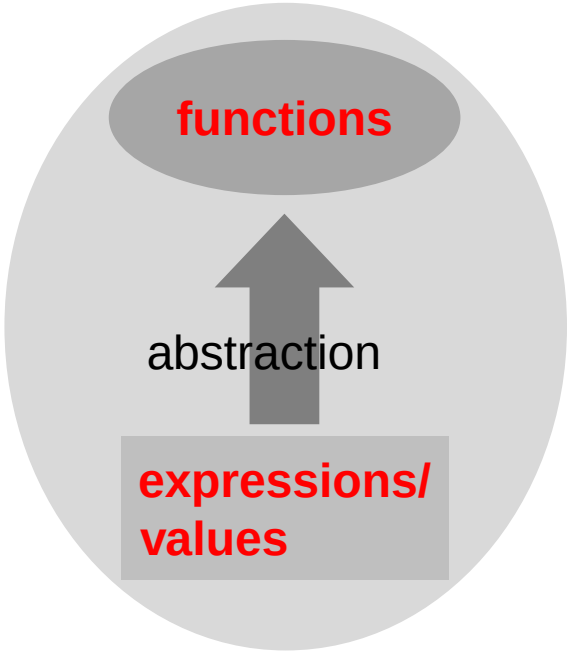
Procedural programming



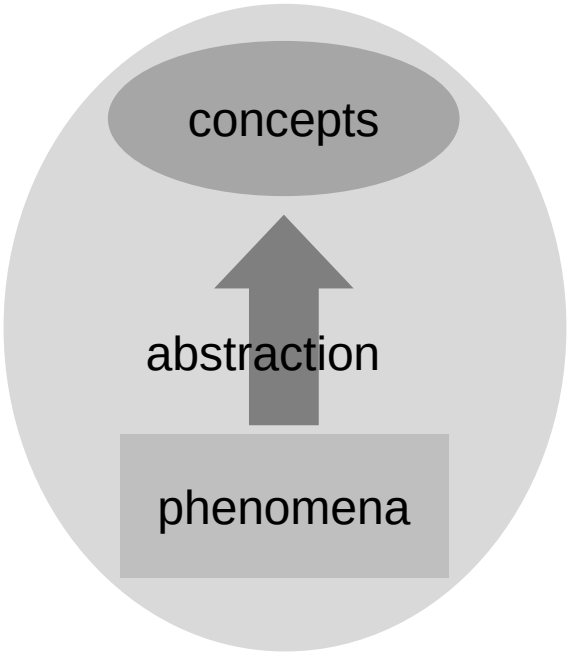


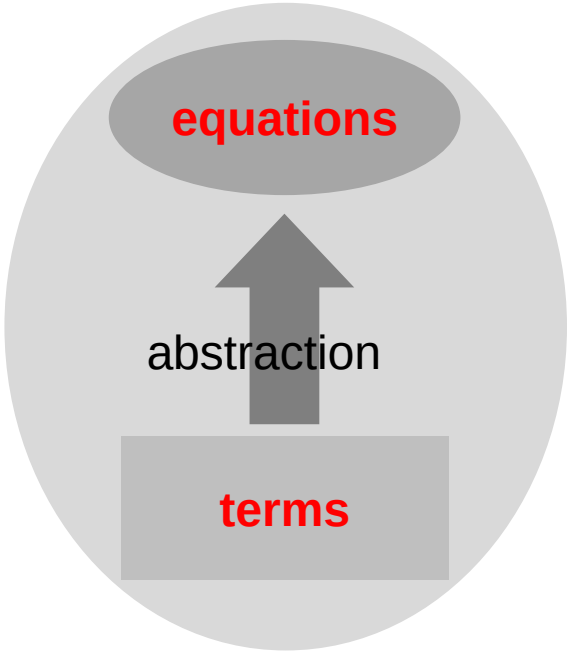
Functional Programming



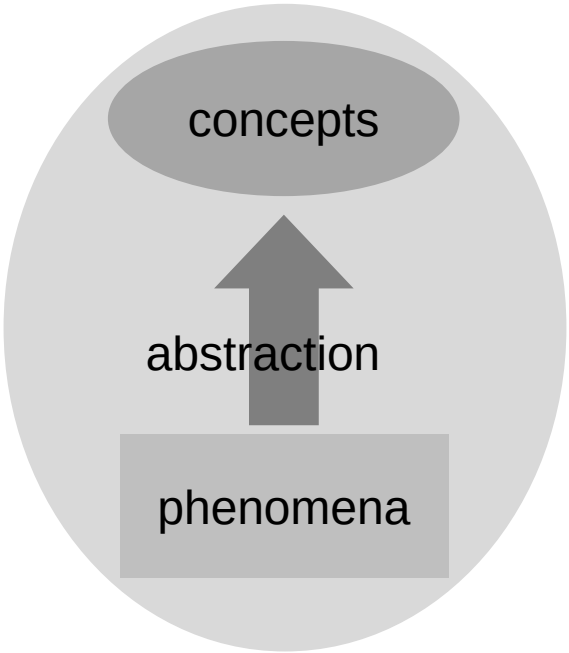


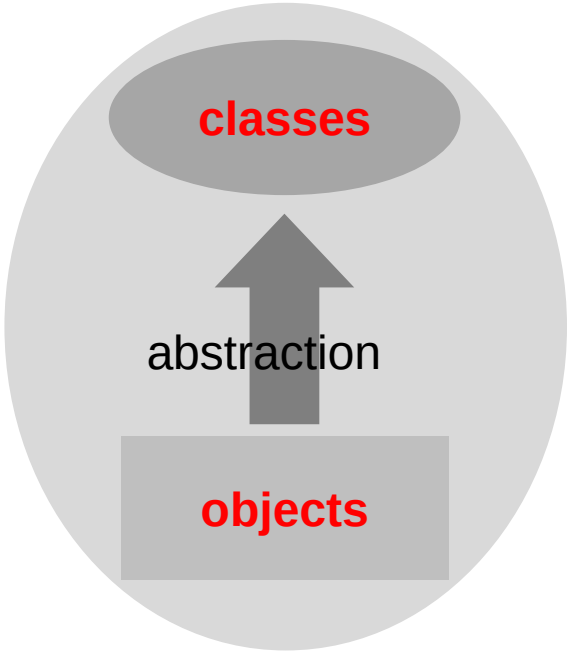
Logical Programming





Object Oriented Programming





Curriculum

- Text book
  - John C Mitchell: Concepts in Programming Languages, 2003. Cambridge University Press. Isbn:0521780985.
  - Additional material, see course site
  - The slides are a part of the curriculum!
- Weekly exercises
- Mandatory assignments
  - 3(?) mandatory assignments
  - Solving the same problem with both functional and object oriented programming