A Glossary for IWGS (Auto-Generated)

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Preface

This document contains an English glossary for the course *Informatische Werkzeuge in den Geistes- und Sozialwissenschaften* at FAU Erlangen-Nürnberg (IWGS). It is automatically generated from the sources of the IWGS course notes and should be up-to-date with the course progress.

The glossary contains definitions for all technical terms used in the course, both the ones defined in the course, as well as the ones presupposed. The latter should be relatively few, since IWGS is intended as a beginner's course.

1 Glossary for IWGS

AI Artificial Intelligence (AI) studies how we can make the computer do things that humans can still do better at the moment.

ALU Defined along with main processor

Boolean Defined along with integer

CLI A command-line interface (CLI) is a means of interacting with a computer program where the user (or client) issues instructions (called commands in a CLI) to the program in the form of successive lines of text (command line). The program which handles this user interface is called a command-line interpreter or command-line processor.

CS Computer science (or short CS) is the study of algorithms and information processing system in theory and practice. A CS professional is called a computer scientist.

OS An operating system (OS) is a system program that manages computer hardware, software resources, and provides common services for computer programs.

RTFM RTFM ($\widehat{=}$ "read those fine manuals")

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algorithm An algorithm is a formal or informal specification for solving a problem by executing a finite sequence of instructions (concrete or imaginary/abstract) information processing systems.

argument A subroutine (also called routine or subprogram) is a program fragment in a program P that performs a specific task, packaged as a unit in so that it can be executed (called, or invoked) by P.

A subroutine p consists of an identifier (its name), a sequence $xx_1, \ldots, x_n$ of local identifiers called parameters, and a program fragment (called the body of p). The length n of x is called the arity of p.

When P (the invoker) calls p, then it supplies a list of values (called arguments) to p: the parameters are replaced by the arguments, and the body is executed in the context where it is called. p may or may not return values v to P, the return values. If it does, it is called a function otherwise a procedure.

arity A python function is defined by a code snippet of the form

```
def f (p_1,...,p_n):
    """docstring, what does this function do on parameters
        :param p_i: document arguments}
    """
    ⟨body⟩ # it can contain p_1,...,p_n, and even f
    return ⟨value⟩ # value of the function call (e.g text or number)
⟨more code⟩
```

- the indented part is called the body of f, (⚠: whitespace matters in python)
- the p_i are called parameters, and n the arity of f.

A function f can be called on arguments $a_1, \ldots, a_n$ by writing the expression $f(a_1, ..., a_n)$. This executes the body of f where the (formal) parameters p_i are replaced by the arguments a_i.

assign Defined along with variable assignment

binary Defined along with source

body Defined along with loop

body Defined along with argument

branch Defined along with conditional execution

cell Jupyter notebooks consist of cells which come in three forms

- a raw cell shows text as is
- a markdown cell interprets the contents as markdown text (later more)
- a code cell interprets the contents as (e.g. python) code

class In object-oriented programming, a class is a program construct for creating objects as well as providing the fields with initial values and the methods with implementations.

close Defined along with open

cloud IDE A web IDE or cloud IDE, is a browser-based integrated development environment.

code cell Defined along with cell

compiler A compiler is a program that translates (compiles)code written in one programming language (the source language) into another language (the target language).

complexes Defined along with integer

compose Defined along with composition principle

composition principle All programming languages provide composition principles that allow to compose smaller program fragments into larger ones in such a way, that the semantics of the larger is determined by the semantics of the smaller ones and that of the composition principle employed.

putationally universal An information processing system is said to be Turing complete or computationally universal if it can be used to simulate any Turing machine.

computer A computing device or simply a computer is an physical (usually electrical or electronic) information processing system that can automatically execute a sequence of machine instructions i.e. arithmetic or logical operations that change state of the system.

A computer consists of physical parts (its hardware) and a set of programs and data, its software.

condition A condition is a Boolean expression in a control structure.

conditional execution Conditional execution allows to execute (or not to execute) certain parts of a program (the branches) depending on a condition. We call a code block that enables conditional execution a conditional statement.

conditional statement Defined along with conditional execution

control flow The control flow of a program is the sequence of execution of the program instructions. It is specified via special program instructions called control structures.

control structure Defined along with control flow

control unit Defined along with main processor

dashboard A dashboard is a user interface that organizes and presents system information give an overview over the state of a complex system and its services.

data Data is information that is used to represent objects by giving values to their relevant attributes and stating their relationships.

data language A data language is a formal language for specifying data in an information processing system. data languages are not Turing complete.

dot notation Defined along with object

element Defined along with list

embedded system An embedded system is a computing device with a dedicated function within a larger mechanical or electrical system.

expression An expression in a programming language is a combination of one or more constants, variables, operators, and functions that the programming language computes to produce a value. This process is called evaluation.

file A file is a resource for recording data in a storage device.

finite We say that a set A is finite and has cardinality (or size) $\#(A) \in \mathbb{N}$, iff there is a bijective function $f\colon A \to \{n \in \mathbb{N} \,|\, n<\#(A)\}$.

The cardinality of a set A is also written as $|A|$, $\mathrm{card}(A)$, $n(A)$, or $\overline{\overline{A}}$.

float Defined along with integer

float A floating point number (or short a float) is a quintuple $n := \langle \sigma, s_1, s_2, b, e \rangle$, where

1. the sign σ is unit sequence $-$ or the empty sequence, and the s_i are sequence of digits of base b. Together, (i.e. concatenated with a decimal point between s_1 and s_2) σ, s_1, and s_2 make up the significand s (also called the mantissa or coefficient.
2. an exponent $e \in \mathbb{Z}$ (also referred to as the characteristic, or scale), which modifies the magnitude of the number n.

The number $\langle \sigma, s_1, s_2, b, e \rangle$ represents the rational number $\frac{s}{b^{p-1}} \cdot b^e$.

The length $p := \mathrm{len}(s_1) + \mathrm{len}(s_2)$ of the significand determines the precision to which numbers can be represented.

for loop A for loop iterates a program fragment over a sequence; we call the process iteration. python uses the following general syntax

```
for ⟪var⟫ in ⟪range⟫:
    ⟪body⟫
⟪other code⟫
```

function Defined along with argument

eral-purpose computer A general-purpose computer is one that, given the appropriate Software and the required time, should be able to perform arbitrary computing tasks.

hardware Defined along with computer

input subsystem An information processing system (or information processor) is a stateful system (be it electrical, mechanical or biological) which takes information in one form and transforms it into another form.

An information processing system S is made up of four subsystems:

1. the input subsystem channels information into S,
2. the processor executes the transformation in a sequence of operations called instructions on the processor state,
3. the storage subsystem stores information, and
4. the output subsystem channels the transformed information out of S.

instruction Defined along with input subsystem

integer python has the following five basic data types

Data type	Keyword	contains	Examples
integers	int	bounded integers	1, −5, 0, ...
floats	float	floating point numbers	1.2, .125, −1.0, ...
strings	str	strings	"Hello", 'Hello', "123", 'a', ...
Booleans	bool	truth values	True, False
complexess	complex	complex numbers	2+3j,...

integer The set $\mathbb{Z}$ of integer numbers (or integers) is defined as $\mathbb{Z} := \mathbb{N} \cup \{-n \mid n \in \mathbb{N}^+\}$.

interpreter An interpreter is a program that directly executes instructions written in a programming language, without requiring them previously to have been compiled into a machine language program.

invoke Defined along with argument

iterate Defined along with for loop

iteration Defined along with for loop

library A python library is a python file with a collection of functions, classes, and methods. It can be loaded via the import command.

license A license is an authorization (by the licensor) to use the licensed material (by the licensee).

line In practice, text files are often processed as a sequence of text lines (or just lines), i.e. substrings separated by the line feed character U+000A; LINE FEED (LF). The line number is just the position in the sequence.

list A list is a finite sequence of objects, its elements.

list constructor We call [⟪seq⟫] the list constructor.

loop A loop is a control structure that allows to execute certain parts of a program (the body) multiple times depending on conditions.

main processor A central processing unit (CPU), also called a central processor or main processor, is the electronic circuitry within a computer that carries out the instructions of a program by performing the basic arithmetic, logic, controlling, and input/output (I/O) operations specified by the instructions.

A CPU that consists of a

- control unit that interprets the program and controls the flow of machine instructions and
- a arithmetic/logic unit (ALU) that does the actual computations internally.

markdown cell Defined along with cell

method Object-oriented programming (OOP) is a programming paradigm based on the concept of an objects. Objects can contain data, in the form of fields (often known as attribute or properties) to represent object properties. Object behavior is specified via procedures (called methods in OOP).

object In python all values belong to a class, which provide special functions we call methods. Values are also called objects, to emphasise class aspects. Method application is written with dot notation: ⟪obj⟫.⟪meth⟫(⟪args⟫) corresponds to ⟪meth⟫(⟪obj⟫,⟪args⟫).

open Once a file has been opened, the CPU can write to it and read from it. After use a file should be closed to protect it from accidental reads and writes.

open source Free/Libre/Open-Source Software (FLOSS or just open source) is software that is and licensed via licenses that ensure that its source code is available.

operator An operator is a function that differs syntactically (e.g. by using infix notation) or semantically (in evaluation strategy or argument passing mode) from usual functions.

output subsystem Defined along with input subsystem

pair Let A and B be sets, then the set of pairs $A \times B$ of A and B is defined as $\{(a, b) \mid a \in A, b \in B\}$, we call $(a, b) \in A \times B$ a pair. $(a, b) = (c, d)$, iff $a = c$ and $b = d$.

parameter Defined along with argument

primary storage The memory (also primary storage) is a storage subsystem in a computer that stores information for immediate use by its CPU.

primitive In a programming language, a primitive is a "basic unit of processing", i.e. the simplest element that can be given a procedural meaning (its semantics) of its own.

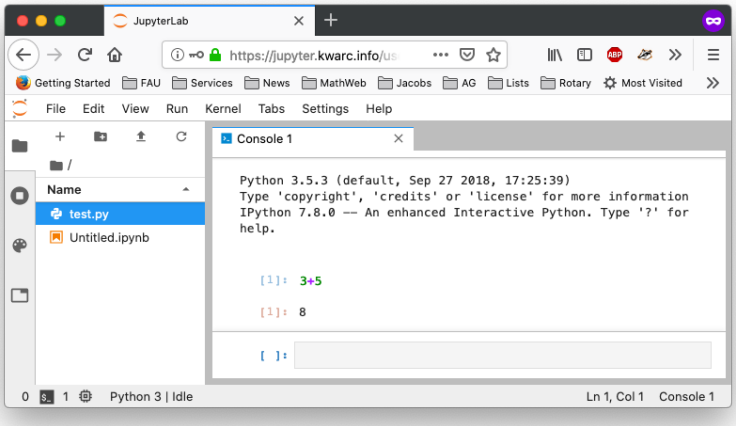
program A programming language L is a formal language for specifying sequences information processing system instructions. A word in L is called a program of L.

programming Computer programming (or just programming) is the process of designing and building a program for accomplishing a specific computing task.

It involves sub-processes, such as: analysis, generating algorithms, profiling algorithms' resource consumption, proving algorithm properties, coding, and program verification.

programming language Defined along with program

python console The JupyterLab python console, i.e. a python interpreter in your browser. (use this for python interaction and testing)



range A range is a finite sequence of numbers it can conveniently be constructed by the range function: range(⟨start⟩,⟨stop⟩,⟨step⟩) construts a range from ⟨start⟩ to ⟨stop⟩ with step size ⟨step⟩.

raw cell Defined along with cell

read Defined along with open

regexp A regular expression (also called regexp) is a formal expression that specifies a set of strings.

semantics Defined along with primitive

sequence python has more types that behave just like lists, they are called sequence types.

sequence A sequence, $(a_n)_{n\in S}$, is a function whose domain is a countable, totally ordered set S (e.g. $\mathbb{N}$, then we often write (a_i)). If S is infinite, we call any sequence $(a_i)_{i\in S}$ on S an infinite sequence, and finite sequence otherwise. Then the cardinality of S is called the length of $(a_i)_{i\in S}$.

Sequences are writen as

- $1,2,3,4$ for a concrete finite sequence,
- $1,2,3,4,\ldots,10$ for a finite sequence with ellipsis,
- $x^1,\ldots,x^n$ and $x_1,\ldots,x_n$ for a sequence of upper/lower-indexed variables of length n,
- $1,2,3,4,\ldots$ for an infinite sequence,
- $x^1,x^2,\ldots$ and $x_1,x_2,\ldots$ for a sequence of upper/lower-indexed variables of length n,

Given a sequence $a\colon S\to T$, and $a\in S$ we write the i^{th} element of a as S_i.

service A server is a program or a computer that provides functionality – called a service– for other programs or computers, called clients.

shell A shell is a command-line interface for accessing the services of a computer's operating system.

software Defined along with computer

source Compiler: translates a program (the source) into another program (the binary) in a much simpler programming language for optimized execution on hardware directly.

storage device A storage device is any type of hardware that stores (i.e. records with the purpose of later returning) data in a (fixed or removable) storage medium.

stream Many operating systems use files as a primary computational metaphor, also treating other resources like files. This leads to an abstraction of files called streams, which encompass files as well as e.g. keyboards, printers, and the screen, which are seen as objects that can be read from (keyboards) and written to (e.g. screens). This practice allows flexible use of programs, e.g. re-directing a the (screen) output of a program to a file by simply changing the output stream.

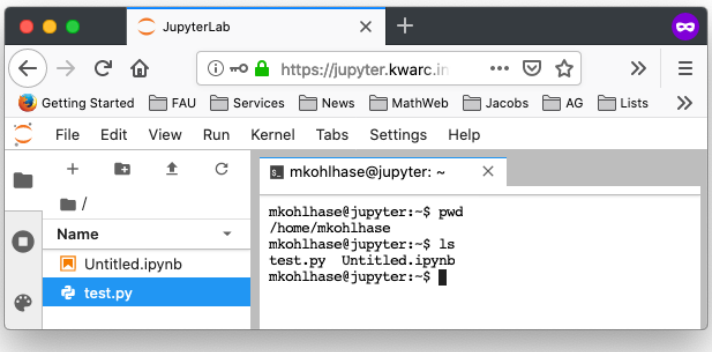
string Defined along with integer

string An alphabet A is a finite set; we call each element $a \in A$ a character, and an n-tuple of $s \in A^n$ a word (or string) of over A. We will often write a string $\langle c_1, \ldots, c_n \rangle$ as "$c_1 \ldots c_n$" or even as $c_1 \ldots c_n$. We write the empty word (empty string) in A^0 with ϵ.

symbol table A dictionary (also called associative array, map, symbol table) is an abstract data type composed of a set of key/value pairs, such that each possible key appears at most once in the collection.

syntax Programming language syntax describes the surface form of the program: the admissible character sequences. It is also a composition of the syntax for the primitives.

terminal The JupyterLab terminal, i.e. a `UNIX` shell in your browser. (use this for managing files)



truth value There are two truth values: true (also called verum, denoted by T, 1, or $\top$) and false (or untrue, also falsum); written as F, 0, or $\bot$).

type A data type or simply type is an programming language attribute of data which tells the compiler or interpreter how the programmer intends to use the data.

A type constrains the values a variable or function can might take and defines the operators that can be applied to it.

value A value is the representation of some entity that can be manipulated by a program.

variable A variable is a memory location which contains a value. It is referenced by an identifier – the variable name.

variable assignment A variable assignment $\langle\!\langle \mathsf{var} \rangle\!\rangle = \langle\!\langle \mathsf{val} \rangle\!\rangle$ assigns a value.

variable name Defined along with variable

web browser A web browser is a software application for retrieving (via HTTP), presenting, and traversing information resources on the WWWeb, enabling users to view web pages and to jump from one page to another.

write Defined along with open