Introduction to the Art of Programming
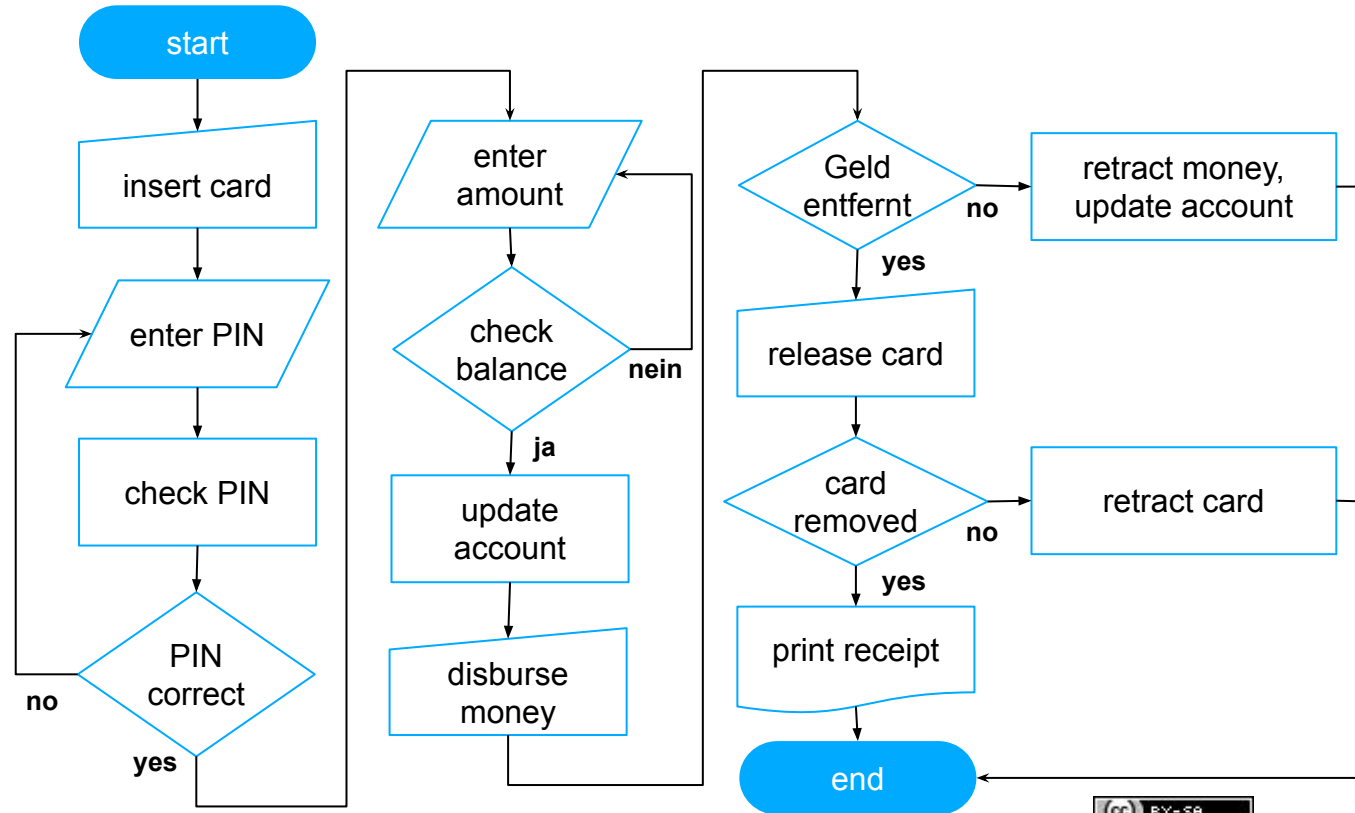
Module 3: Programming Languages

What's a Program?

Input(s) → **Output(s)**

Example of a Flowchart


```
start
  ↓
insert card
  ↓
enter PIN ←─────┐
  ↓             │
check PIN       │
  ↓             │ no
PIN correct ────┘
  │ yes
  ↓
enter amount ←──────┐
  ↓                 │
check balance ──────┘ nein
  │ ja
  ↓
update account
  ↓
disburse money
  ↓
Geld entfernt ──── no ──→ retract money, update account
  │ yes
  ↓
release card
  ↓
card removed ──── no ──→ retract card
  │ yes
  ↓
print receipt
  ↓
end
```

Draw sequential search in phone book as a flowchart.

Task

Sequential Search in Phone Book

start

take phone book in hand

open phone book at first entry

store search term "Stuker, Jürg"

compare search term with current entry

go to next entry

entry = search term?

last entry reached?

no

no

yes

yes

"found"

"not found"

end

Solution
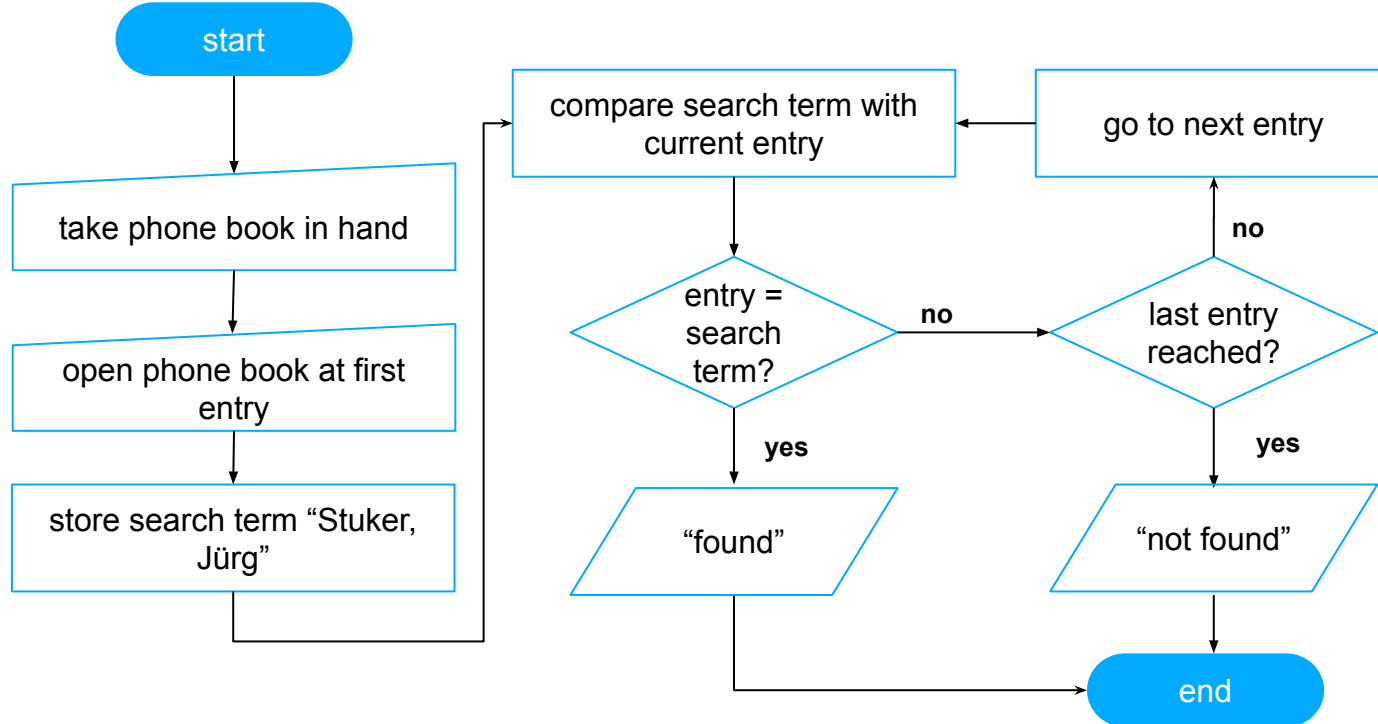
Example of Pseudocode

(Sequential Search)

```
I take phone book in my hand
I memorize entry number is 1
I memorize search term is Stuker, Jürg

as long as I haven't reached the end, I repeat
        {
        if book[entry number] is search term
                say book[entry number] "found"
        else increase entry number by 1
        }
say "not found"
```
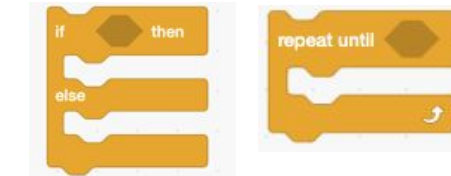
Structural Elements of a Programming Language

Syntax
(form)

Semantic
(meaning)

variables (memory)

looping

input / output

decisions

math

Basiselemente in Pseudocode.
(Sequenzielle Suche)

```
I take phone book in my hand
I memorize entry number is 1                                    variables (memory)
I memorize search term is Stuker, Jürg


as long as I haven't reached the end, I repeat                       looping
        {
        if book[entry number] is search term                        decisions
            say book[entry number] "found"                      input / output
        else increase entry number by 1                     decisions | math
        }
say "not found"                                             input / output
```

Example of a Visual Programing Language
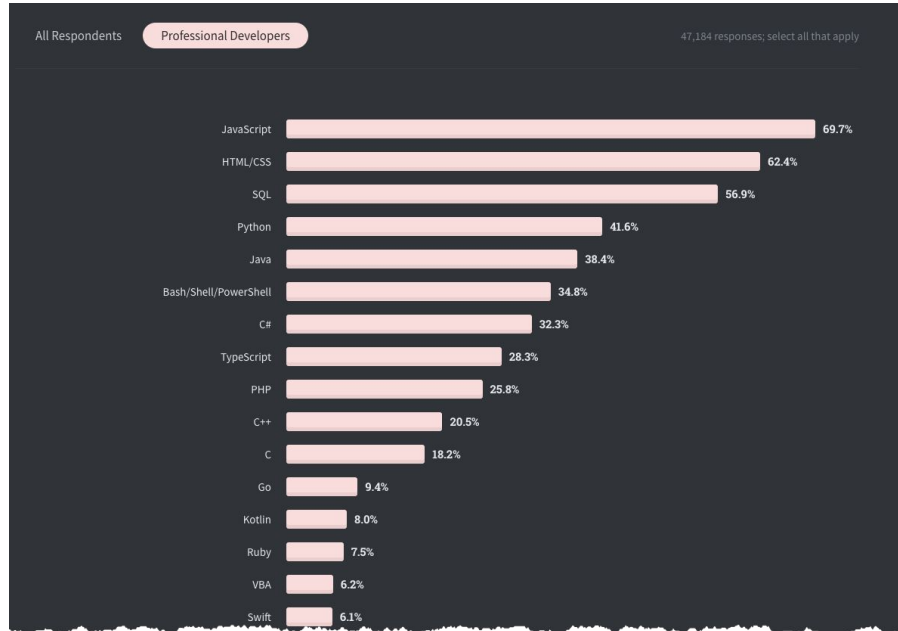**(Scratch)**

variables (memory)

decisions
looping
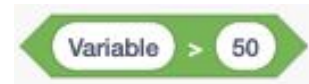
math

input / output

Which and how many?

Source: https://insights.stackoverflow.com/survey/2020

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

"Hello, World"
(in Java)

```java
public class HelloWorld {

    public static void main(String[] args){

        System.out.println("Hello, World");

    }

}
```

"Hello, World"
(in C)

```c
#include<stdio.h>

int main() {

    printf("Hello, World\n");

    return 0;

  }
```

"Hello, World"
(in Python)

```
print("Hello, World")
```

"Hello, World"
(in Assembler, Intel 8086/8088)

```asm
mov ax,cs
mov ds,ax
mov ah,9
mov dx, offset Hello
int 21h
xor ax,ax
int 21h

Hello:
  db "Hello World!",13,10,"$"
```

Sequential Search

Binary Search

Binary Search
(Pseudocode)

```
I take phone book in my hand
I memorize left is 0
I memorize right is number of entries
I memorize search term is Stuker, Jürg

as long as left is smaller or equal right, I repeat
        {
        middle equals the center of the book in my hand

        if book[middle] equals search term
                say book[middle] "found"

        else, if book[middle] smaller search term:
                left = middle plus one

        else:
                right = middle minus one
        }
say "not found"
```

Binary Search

(left Pseudocode, right Python)

```
I take phone book in my hand
I memorize left is 0
I memorize right is number of entries
I memorize search term is Stuker, Jürg

as long as left is smaller or equal right, I repeat
    {
    middle equals the center of the book in my hand

    if book[middle] equals search term
        say book[middle] "found"


    else, if book[middle] smaller search term:
        left = middle plus one

    else:
        right = middle minus one
    }
say "not found"
```

```python
left = 0
right = len(book)-1
search_term = 'Stuker, Jürg'


while left <= right:

    middle = left + (right - left)/2

    if book[middle] == search_term:
        print (book[mitte])
        quit()

    elif buch[mitte] < search_term:
        left = left + 1

    else:
        right = left - 1

print ('not found')
```
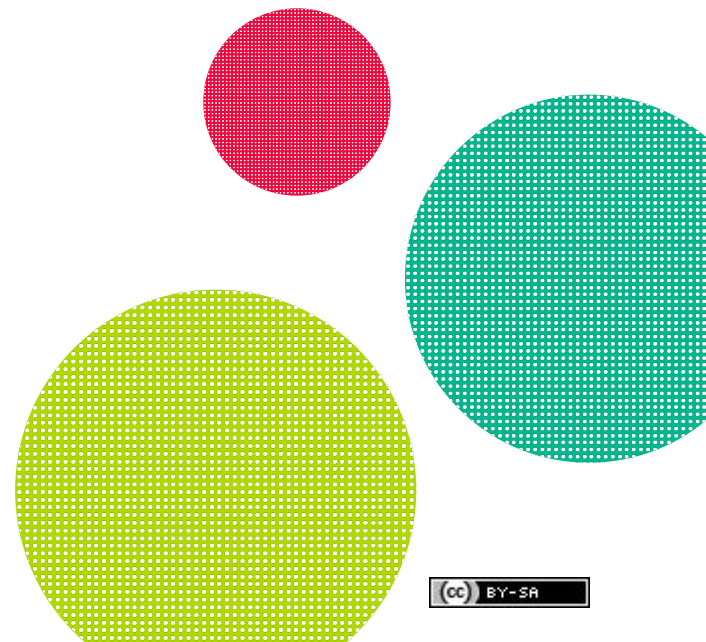
Wrap up Module 3

Representation of programming logic

- Flowchart
- Pseudocode

Structural elements of a programming language

Examples of common programming languages

- JavaScript, Python, Java...

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Module 3: Programming Languages

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