



JÖNKÖPING UNIVERSITY

*School of Engineering*

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# INTRODUCTION TO COMPUTERS AND PROGRAMMING

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# WHAT IS A COMPUTER?

Something that computes something.

E.g. an orrery:

<https://www.youtube.com/watch?v=yKS7CodC-bU>

<https://en.wikipedia.org/wiki/Orrery>



# WHAT IS A COMPUTER?

Something that computes something.

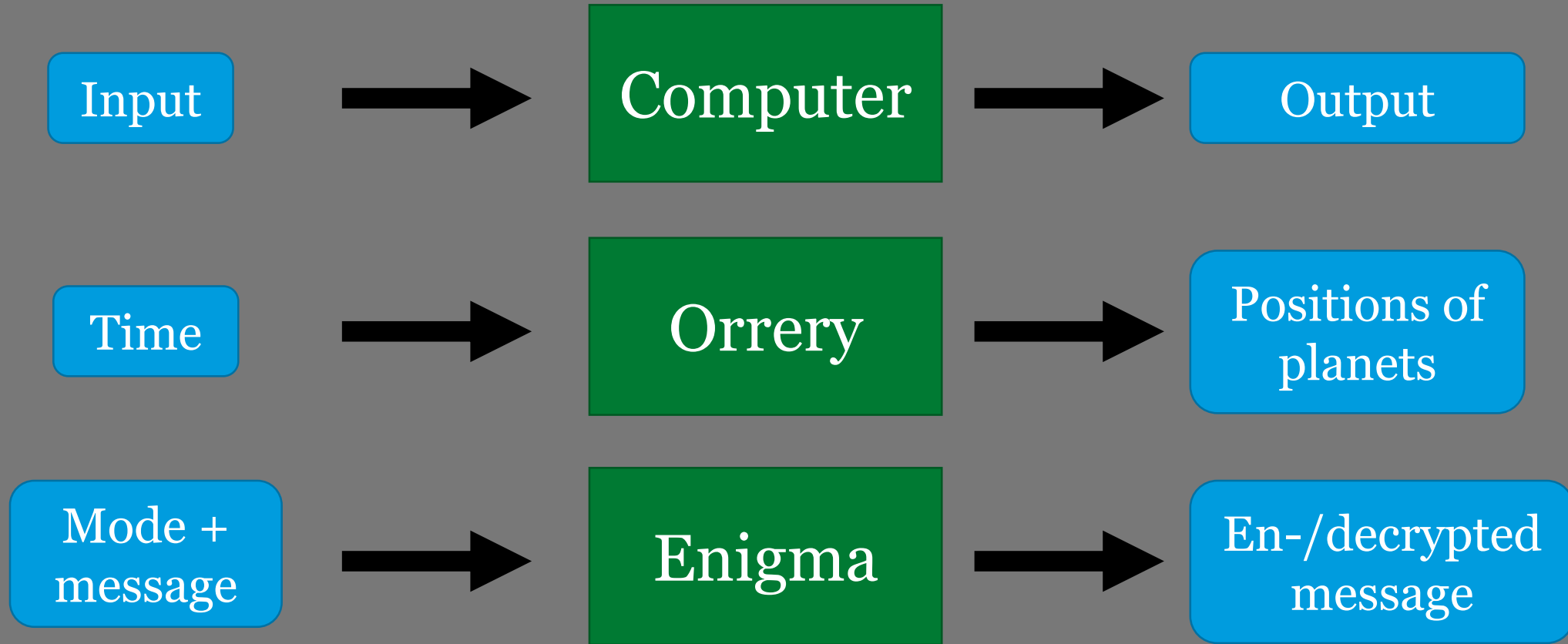
E.g. the enigma machine:

[https://www.youtube.com/watch?v=ASfAPOiq\\_eQ&feature=youtu.be&t=129](https://www.youtube.com/watch?v=ASfAPOiq_eQ&feature=youtu.be&t=129)

[https://en.wikipedia.org/wiki/Enigma\\_machine](https://en.wikipedia.org/wiki/Enigma_machine)



# AN ABSTRACT VIEW OF A COMPUTER



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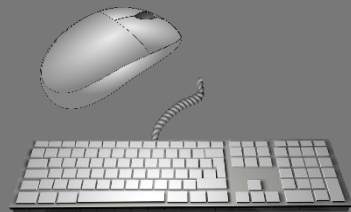
Does this view fit modern computers?



# MODERN COMPUTERS

Modern computers are *general-purpose computers*.

- The hardware in the computer can be used to compute things.



The program



- The software (the program) tells the hardware what to compute.

# HARDWARE ♥ SOFTWARE

- A program (the software) consists of a sequence of instructions.
- The hardware executes these instructions, one after another.

Many modern computers support a set of instructions called X86.

- See all of the instructions at [https://en.wikipedia.org/wiki/X86\\_instruction\\_listings](https://en.wikipedia.org/wiki/X86_instruction_listings).



# SAMPLE PROGRAM

Checking if the sum of the integers between 0 and 2 is 3.

## Instructions

```
➔ 0: SET    0, #9
➔ 1: ADD    1, #9
➔ 2: ADD    2, #9
➔ 3: SUB    3, #9
➔ 4: JINZ   #9, #7
➔ 5: SET    4, #10
➔ 6: JUMP   #8
    7: SET    5, #10
➔ 8: FINISH
    9: 0 1 3 0
   10: 4
```

Hard to read &  
hard to write.

↓  
Programming  
languages  
invented.

## Python

```
sum = 0
sum += 1
sum += 2
if sum == 3:
    answer = "Yes"
else:
    answer = "No"
```

# PROGRAMMING IN THE FUTURE?

Visual programming?



# PROGRAMMING IN THE FUTURE?

Just tell it what to do?



# PROGRAMMING PARADIGMS

A programming paradigm is a special way to express how a program should work.

- With C we primarily do *imperative programming*.
  - The program consists of statements to be executed.
  - Maps very well to how computers works internally.

```
int sum = 0;  
sum += 1;  
sum += 2;  
sum += 3;
```

# PROGRAMMING PARADIGMS

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- With C we primarily do *imperative programming*.
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- With Java we primarily do *object-oriented programming*.
  - The program consists of objects that communicates with each other.
  - Maps very well to how the real world works.

```
Car petersCar = new Car("ABC123");  
petersCar.increaseSpeed(10);  
petersCar.break();
```

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  - Maps very well to how the real world works.
- With Haskell, we primarily do *declarative programming*.
  - The program consists of definitions.
  - Maps very well to recursively defined functions (math...).

```
factorial 3
```



```
3 * factorial 2
```



```
3 * 2 * factorial 1
```



```
3 * 2 * 1
```



```
6
```

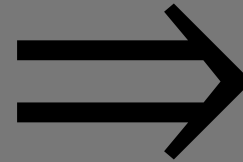
```
factorial 1 = 1
```

```
factorial n = n * factorial (n - 1)
```

# OPERATING SYSTEMS

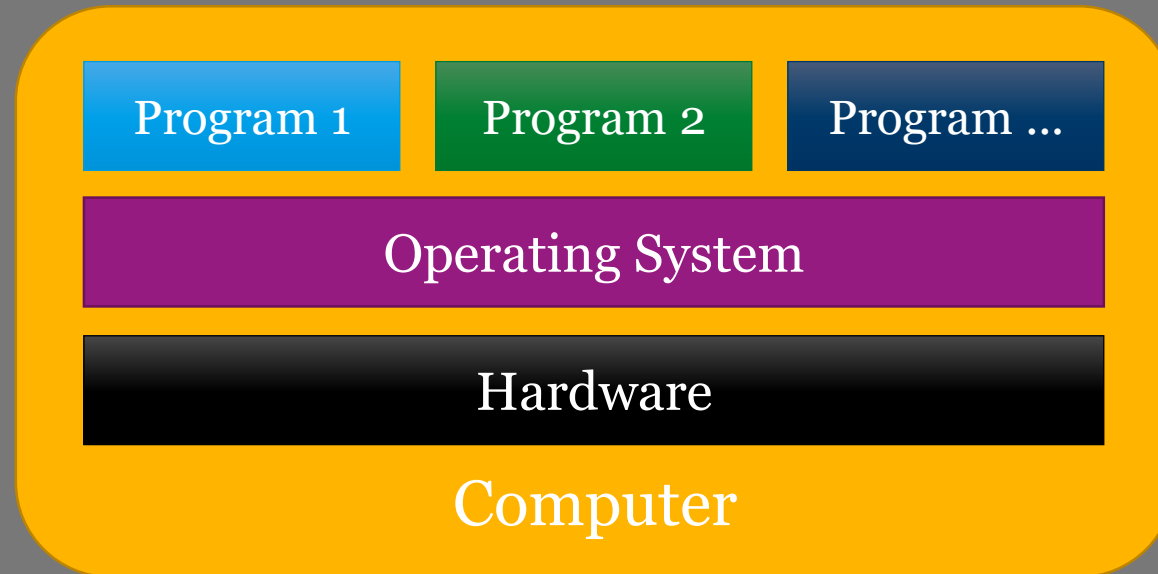
A computer can  
only run one  
program at a time.

Users want to run  
multiple programs  
at the same time.



Operating Systems  
invented

# OPERATING SYSTEMS



- The OS switches between the programs so fast that users don't notice.



# PROGRAMMING IS HARD!

Edsger W. Dijkstra:

*Programming is one of the most difficult branches of applied mathematics; the poorer mathematicians had better remain pure mathematicians.*