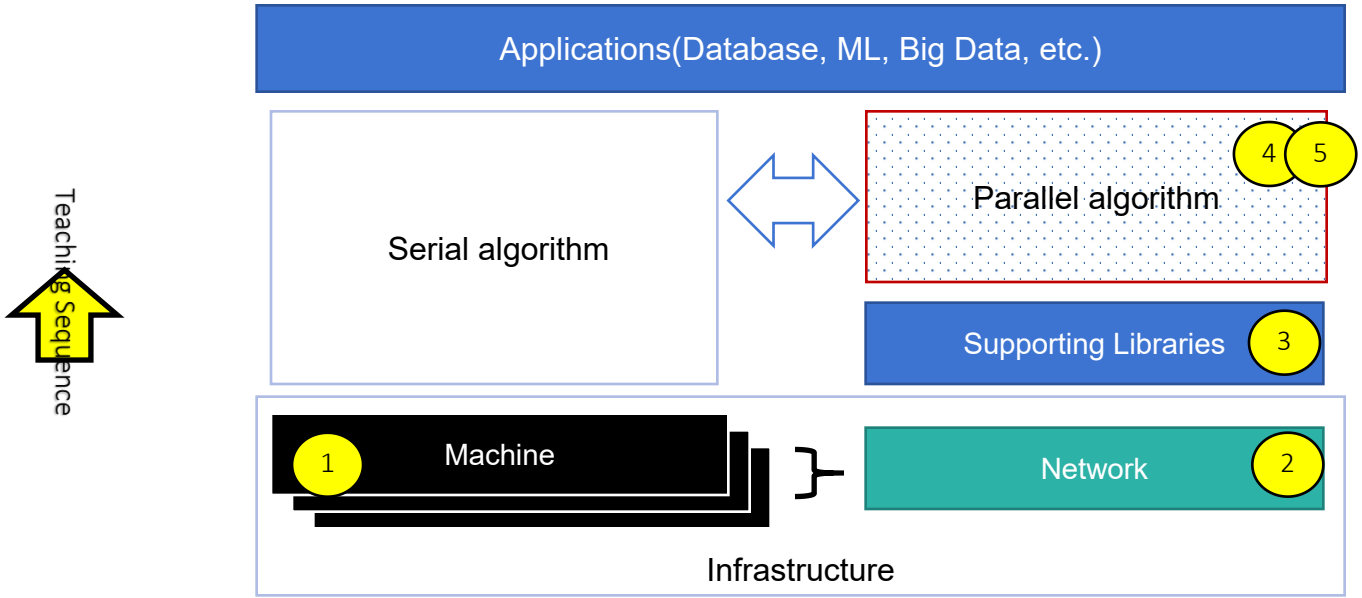
DTS205TC High Performance Computing

Lecture 1 Infrastructure 1

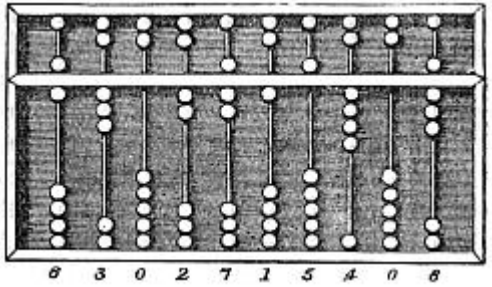
Di Zhang, Spring 2024

Technology stack



- For hardware, parallel algorithms should try to make full use of it to improve performance
- For applications, regardless of whether the algorithm is serial or parallel, it should ensure that their calculation steps are equivalent, or output consistent or approximate result
- Supporting Libraries: Abstract the hardware and communication process to facilitate the development process

What is a Computer?

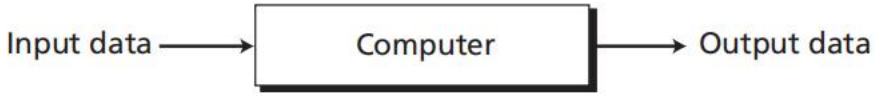


Suanpan

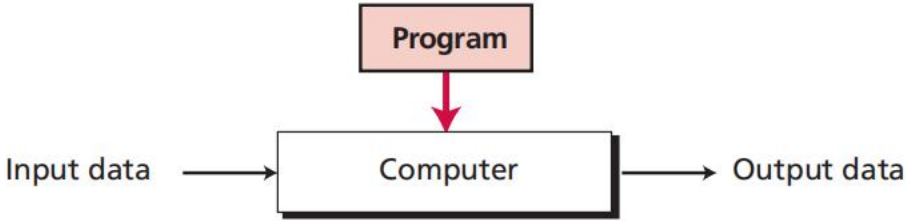
Slidable Ruler

- Three-Body
- Minecraft

What is a Computer?



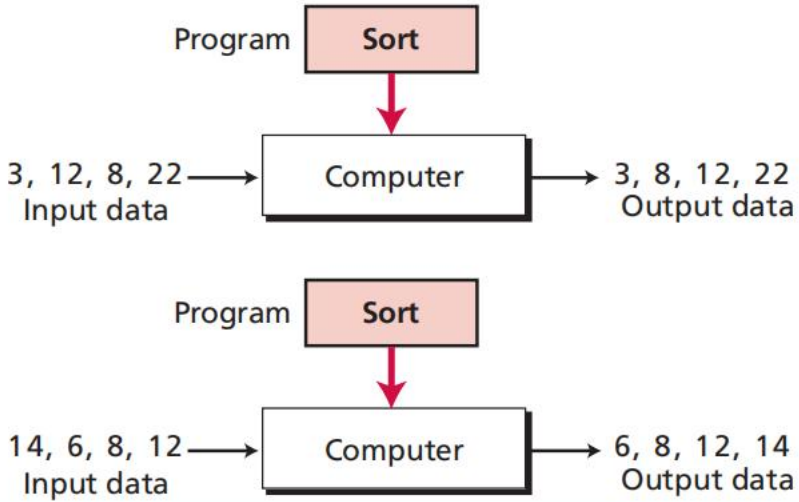
A single-purpose computing machine



programmable data processor

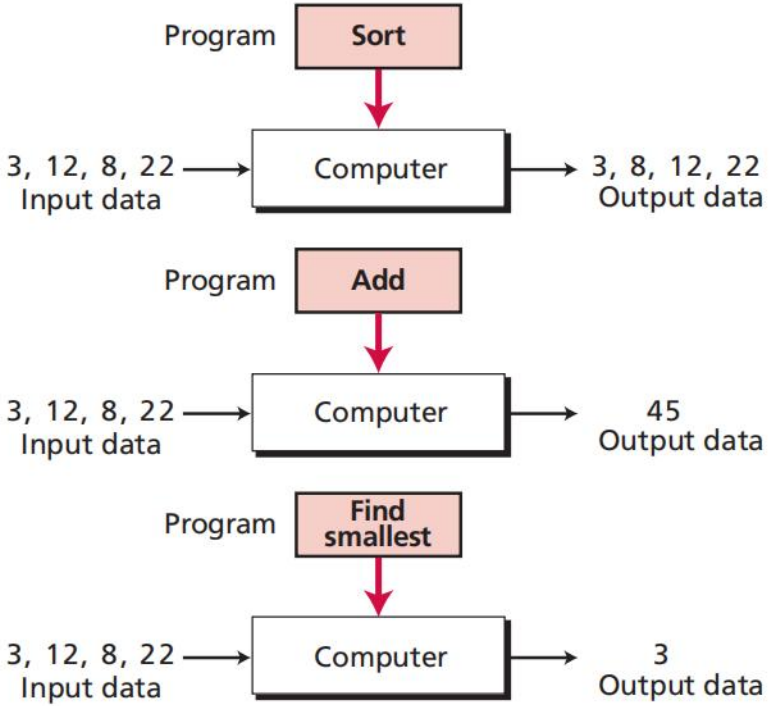
Cases

Figure 1.3 *The same program, different data*



Cases

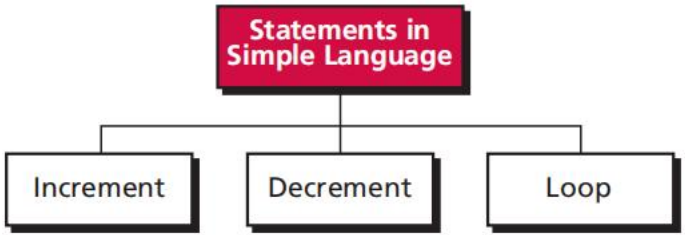
Figure 1.4 *The same data, different programs*



How to build a conceptual computer?

- Simple Language + Machine on Paper

Figure 17.1 *Statements in Simple Language*



Simple Language


```
incr (X)
```

```
decr (X)
```

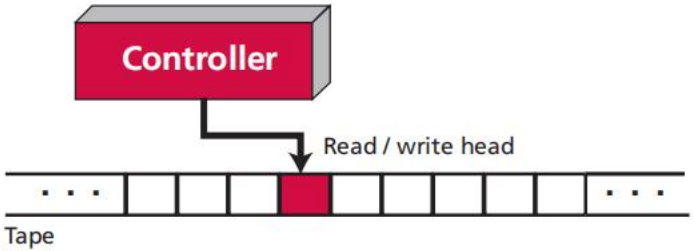
```
while (X)
{
   decr (X)
   Body of the loop
}
```

Examples

- As powerful as any sophisticated language, e.g. C, Python, etc.
  - $X \leftarrow 0$
  - $X \leftarrow n$
  - $Y \leftarrow X$
  - $Y \leftarrow Y + X$
  - $Y \leftarrow Y \times X$
  - if X then A

Turing Machine

Figure 17.2 *The Turing machine*



- Tape

- Read/write head
- Controller

Demo

- https://doodles.google/doodle/alan-turings-100th-birthday/

Figure 17.6 *The Turing machine for the incr (X) statement*

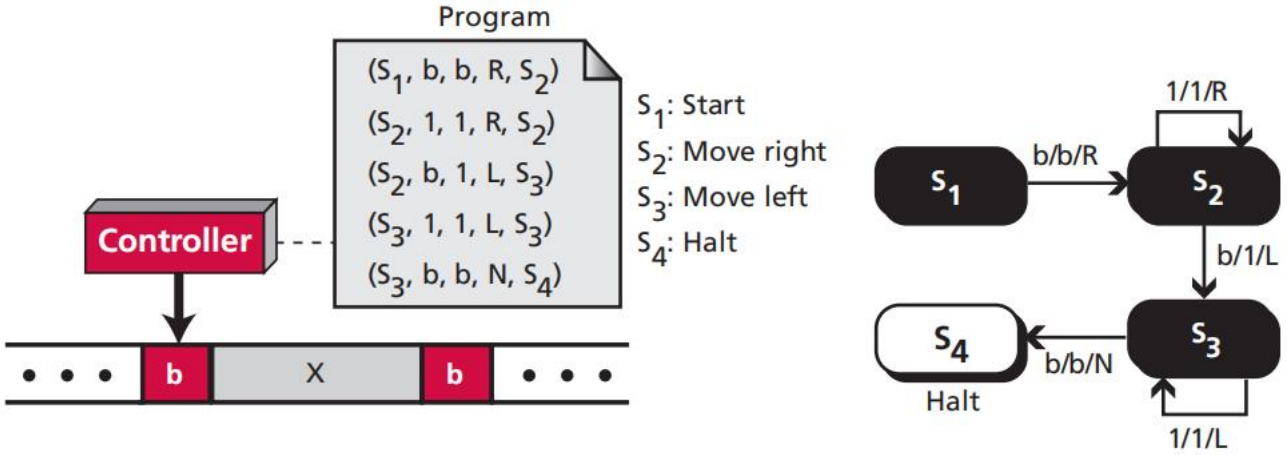


Figure 17.8 *The Turing machine for the decr (X) statement*

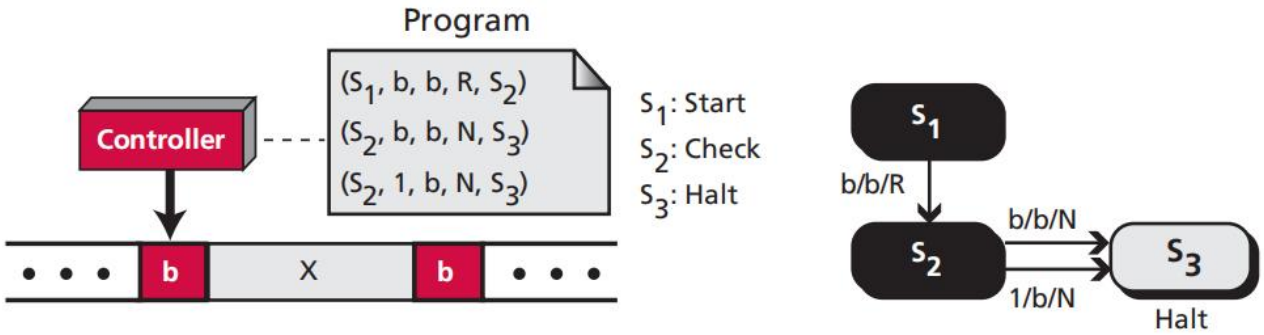
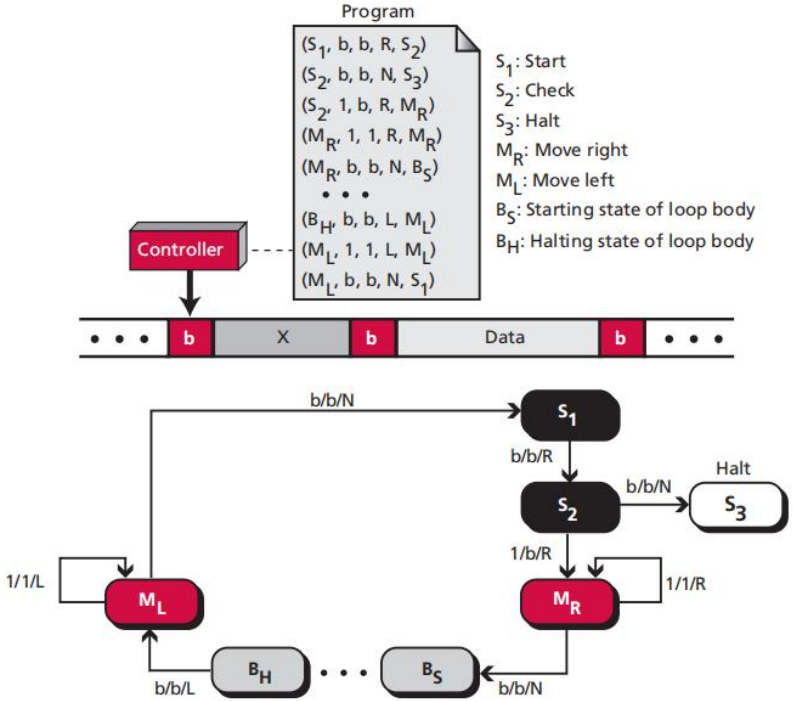
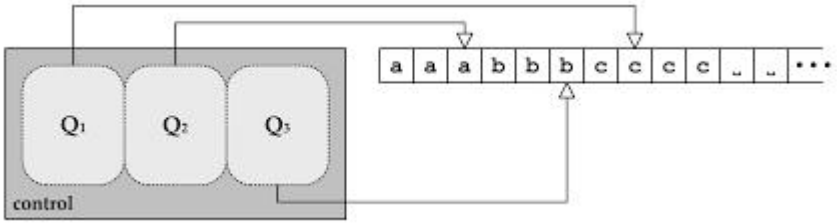
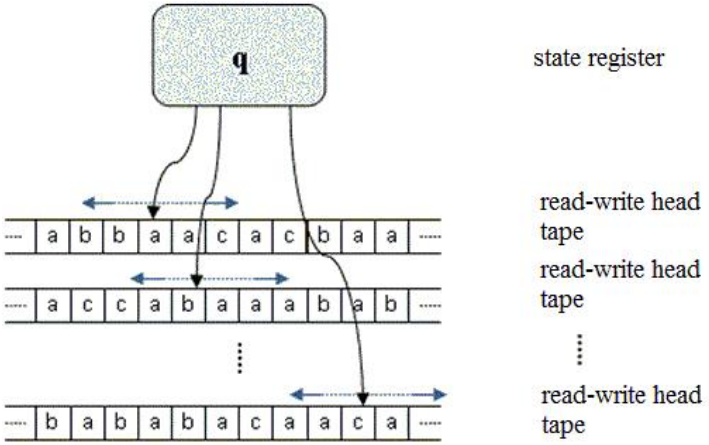


Figure 17.10 *The Turing machine for the while loop statement*



*Turing Machine and Parallel Computing





- Computationally equivalent to serial version