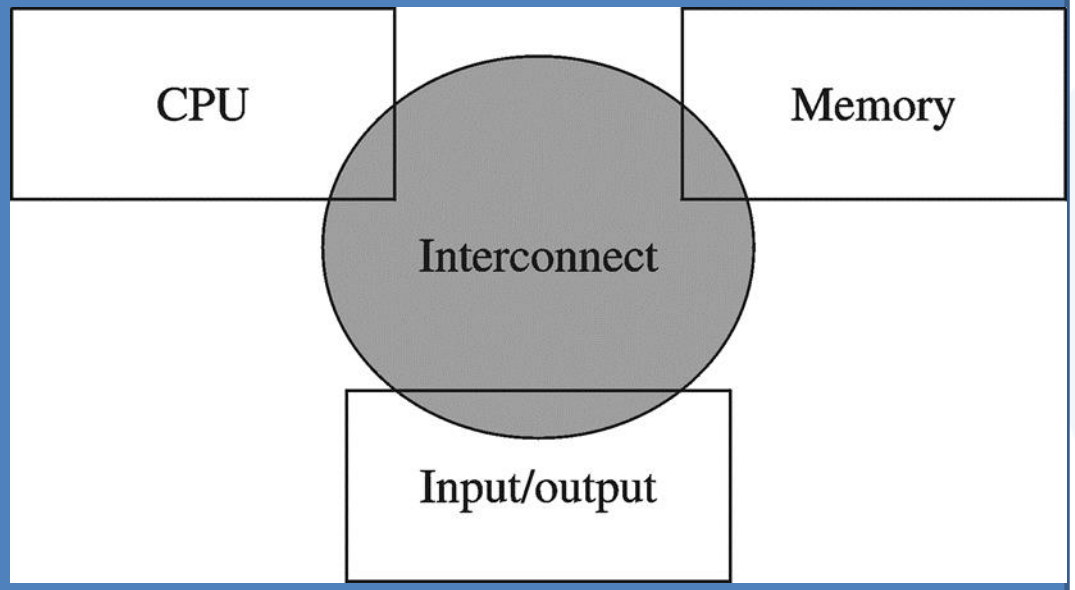
Basic Computer Organization
المكونات الأساسية للحاسب

- Basic components
- The processor
  - Execution cycle
  - System clock
- Number of addresses
  - 3-address machines
  - 2-address machines
  - 1-address machines
  - 0-address machines
  - Load/store architecture

- Memory
  - Basic operations
  - Types of memory
  - Storing multibyte data
- Input/Output

Basic Computer Organization
المكونات الأساسية للحاسب

- Basic components of a computer system
  - * Processor
  - * Memory
  - * I/O
  - * System bus
    - » Address bus
    - » Data bus
    - » Control bus



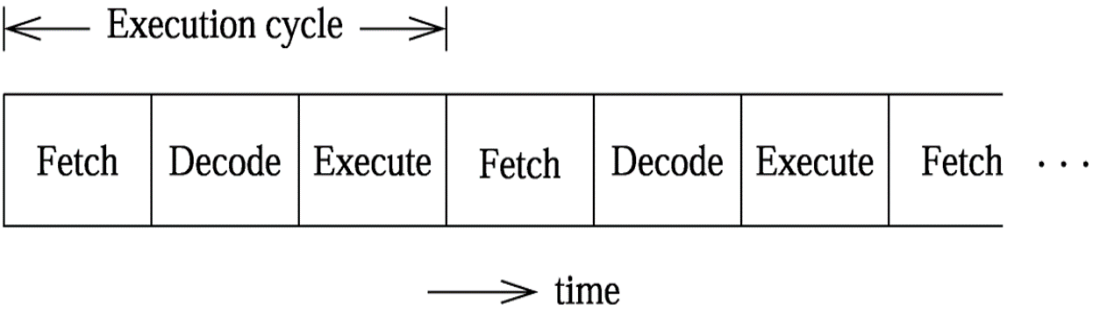
* المعالج
* الذواكر
* وحدات الدخل /خرج
* خطوط النقل
.. خطوط العنونة
.. خطوط المعطيات
.. خطوط التحكم

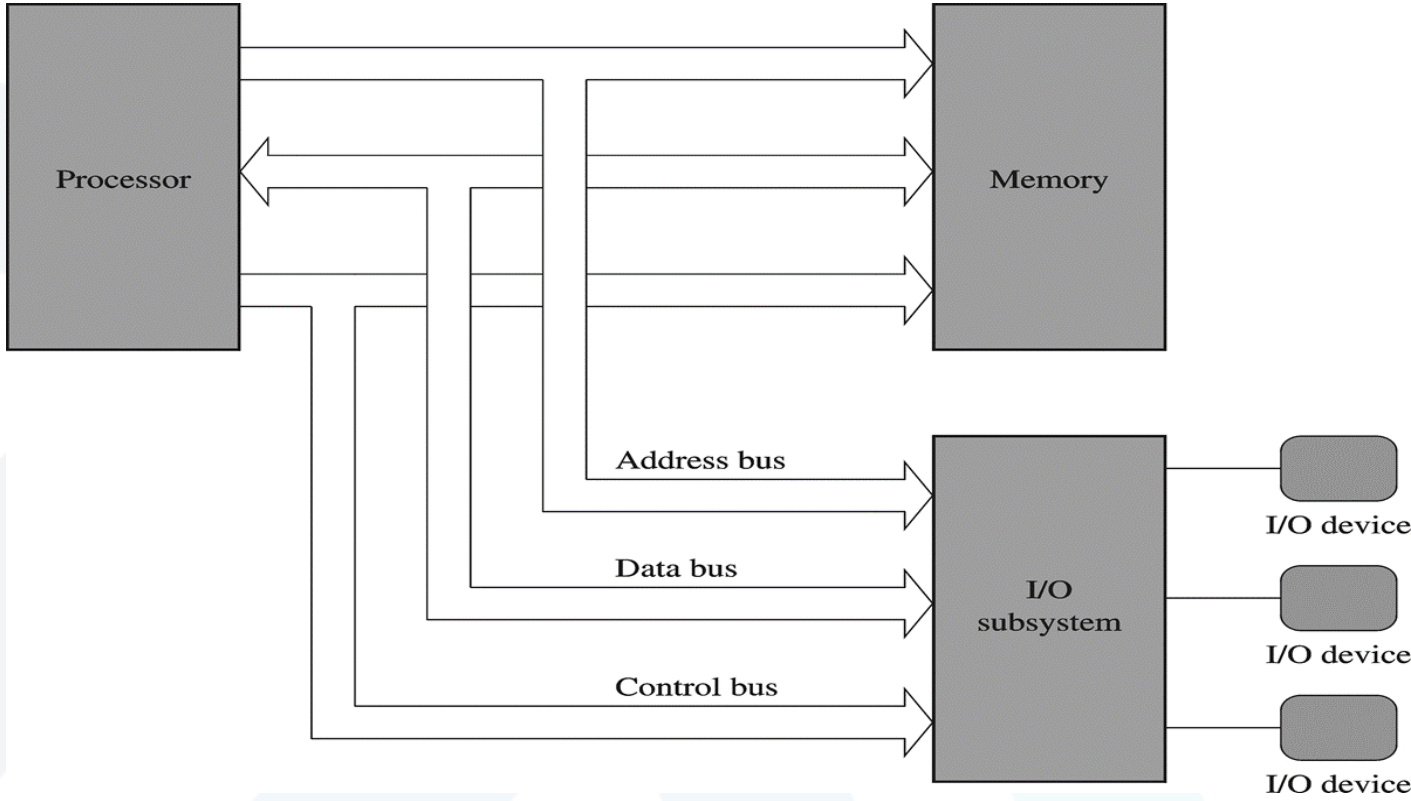
عمل المعالج processor

المكونات الأساسية

يقوم المعالج خلال دورة تنفيذ التعليمة بما يلي:

- مرحلة البحث عن التعليمة Fetch cycle
- مرحلة فك ترميز Decode
- مرحلة تنفيذ Execution



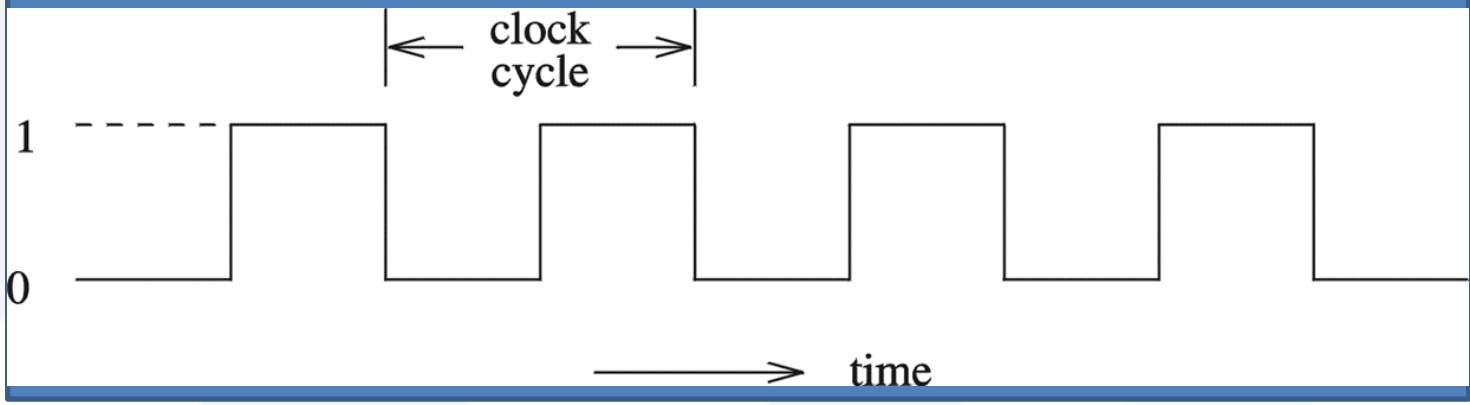


Number of Addresses

- Four categories
  - 3-address machines
    - » 2 for the source operands and one for the result
  - 2-address machines
    - » One address doubles as source and result
  - 1-address machine
    - » Accumulator machines
    - » Accumulator is used for one source and result
  - 0-address machines
    - » Stack machines
    - » Operands are taken from the stack
    - » Result goes onto the stack

The Processor

- System clock
  - Provides timing signal
  - Clock period = $\frac{1}{\text{Clock frequency}}$



Number of Addresses

- Two-address machines
  - One address doubles (for source operand & result)
  - Last example makes a case for it
    - Address T is used twice
  - Sample instructions

```
load    dest,src  ; M(dest)=[src]
add     dest,src  ; M(dest)=[dest]+[src]
sub     dest,src  ; M(dest)=[dest]-[src]
mult    dest,src  ; M(dest)=[dest]*[src]
```

- Three-address machines
  - Two for the source operands, one for the result
  - RISC processors use three addresses
  - Sample instructions

```
add     dest,src1,src2
        ; M(dest)=[src1]+[src2]
sub     dest,src1,src2
        ; M(dest)=[src1]-[src2]
mult    dest,src1,src2
        ; M(dest)=[src1]*[src2]
```

Number of Addresses

- Zero-address machines
  - Stack supplies operands and receives the result
    - Special instructions to load and store use an address
  - Called stack machines (Ex: HP3000, Burroughs B5500)
  - Sample instructions

```
push    addr ; push([addr])
pop     addr ; pop([addr])
add          ; push(pop + pop)
sub          ; push(pop - pop)
mult         ; push(pop * pop)
```

- One-address machines
  - Uses special set of registers called accumulators
    - Specify one source operand & receive the result
  - Called accumulator machines
  - Sample instructions

```
load    addr ; accum = [addr]
store   addr ; M[addr] = accum
add     addr ; accum = accum + [addr]
sub     addr ; accum = accum - [addr]
mult    addr ; accum = accum * [addr]
```

Memory الذواكر

الذوا كر

تبدو الذاكرة كنسق من البايت المتتالية

لكل بايت عنوان

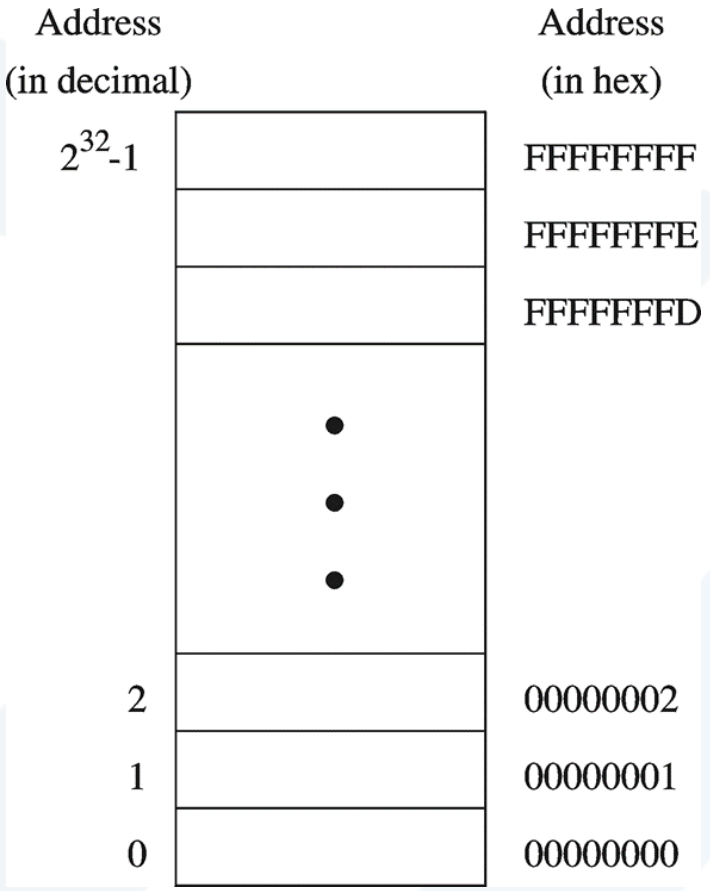
مثال تعنون الذاكرة من

$$0 \longrightarrow 2^N - 1$$

اذا كان عدد خطوط العنونة 32 bit

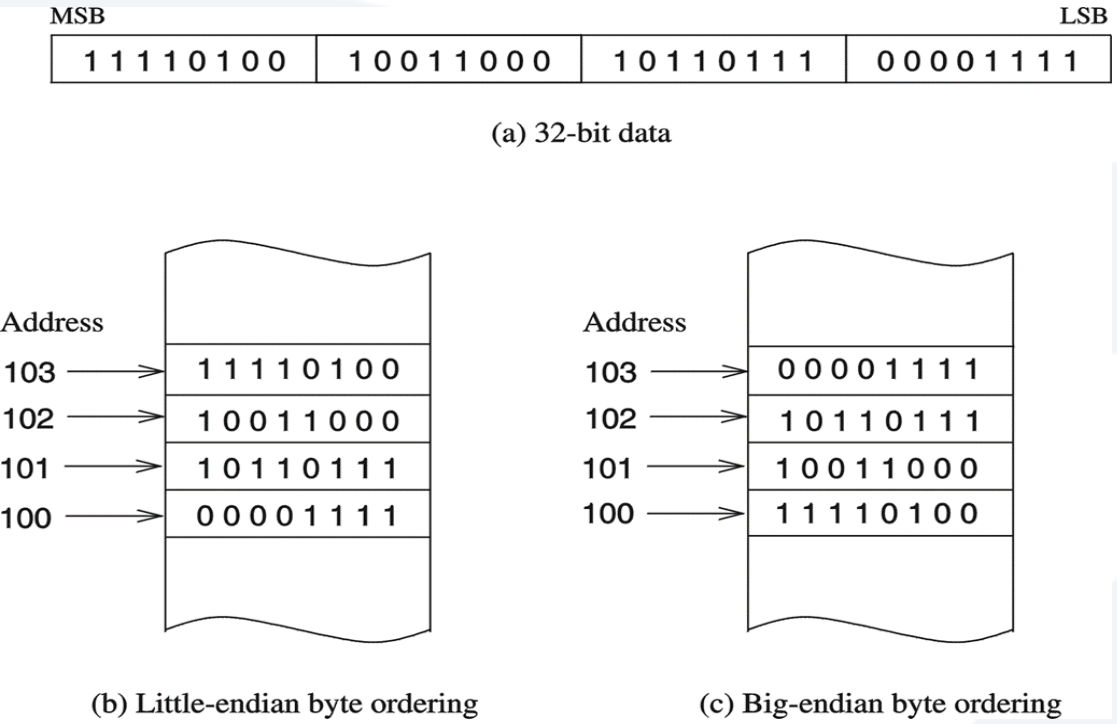
فيكون عدد مواقع الذاكرة

$$2^N - 1 = 4\ G\ byte$$



- Memory can be viewed as an ordered sequence of bytes
- Each byte of memory has an address
  - Memory address is essentially the sequence number of the byte
  - Such memories are called *byte addressable*
  - Number of address lines determine the memory address space of a processor

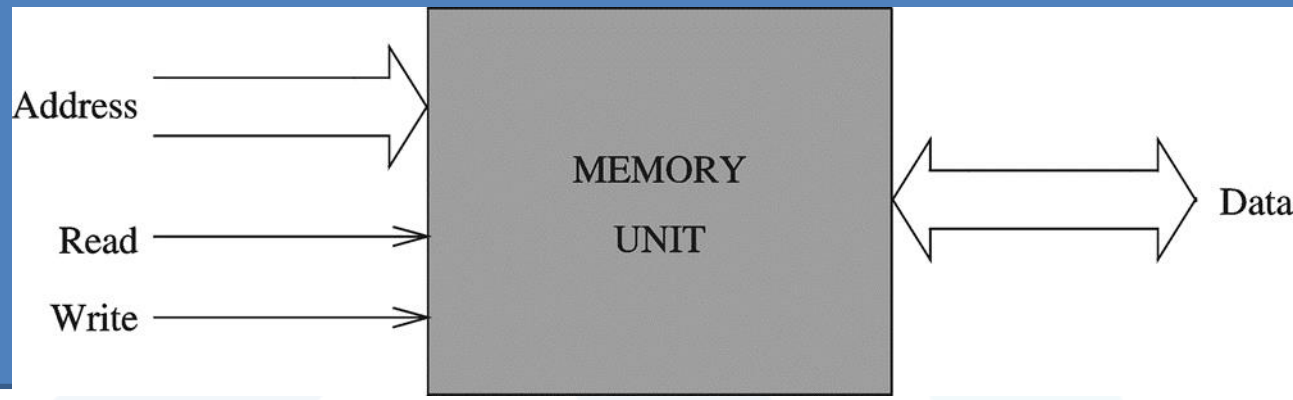
multibyte تخزين



- Little endian
  - » Used by Intel IA-32 processors
- Big endian
  - » Used most processors by default

Memory الذواكر

- Two basic memory operations
  - * Read operation (read from memory)
  - * Write operation (write into memory)
- Access time
  - » Time needed to retrieve data at addressed location
- Cycle time
  - » Minimum time between successive operations



وحدات الدخل والخرج

وحدات الادخال والإخراج I/O

تستخدم بوابات الاخال والإخراج لتبادل المعطيات بين المعالج وبوابات الدخل / خرج

يمكن تخطيط بوابات **I/O** كوحدة من الذاكرة

* تحجز بوابات الدخل / خرج عناوين من الذاكرة الرئيسية كما تقوم بعملية القراءة والكتابة كما في الذواكر

*بوابات دخل/خرج معزولة

- تستخدم فضاء عناوين منفصلة

- تحتاج الى تعليمات خاصة للدخل والخرج في معالجات بنتيوم مثل in , out

- تدعم معالجات انتل 80x68 وحدات دخل/خرج منفصلة

- Processor and I/O interface points for exchanging data are called *I/O ports*
- Two ways of mapping I/O ports
  - * Memory-mapped I/O
    - » I/O ports are mapped to the memory address space
      - – Reading/writing I/O is similar to reading/writing memory
        - ✈ Can use memory read/write instructions
  - * Isolated I/O
    - » Separate I/O address space
    - » Requires special I/O instructions (like `in` and `out` in Pentium)
    - » Intel 80x86 processors support isolated I/O
-

Input/Output الدخل والخرج

عنونة I/O في معالجات بنتيوم
تستخدم معالجات بنتيوم فضاء العناوين
- تزود بفضاء عنوان 64 k byte
- يمكن ان تستخدم بوابات من 8 أو16 أو 32
- تعليمات I/O لاتمر عبر المقاطع أو الصفحات

- Pentium I/O address space
  - Provides 64 KB I/O address space
  - Can be used for 8-, 16-, and 32-bit I/O ports
  - Combination cannot exceed the total I/O address space
    - can have 64 K 8-bit ports
    - can have 32 K 16-bit ports
    - can have 16 K 32-bit ports
    - A combination of these for a total of 64 KB
  - I/O instructions do not go through segmentation or paging
    - I/O address refers to the physical I/O address

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