마이크로프로세서
– Processors –

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Outline

- 마이크로프로세서가 하는 일
- 상용 프로세서
- 프로세서가 알아듣는 언어 - 기계코드

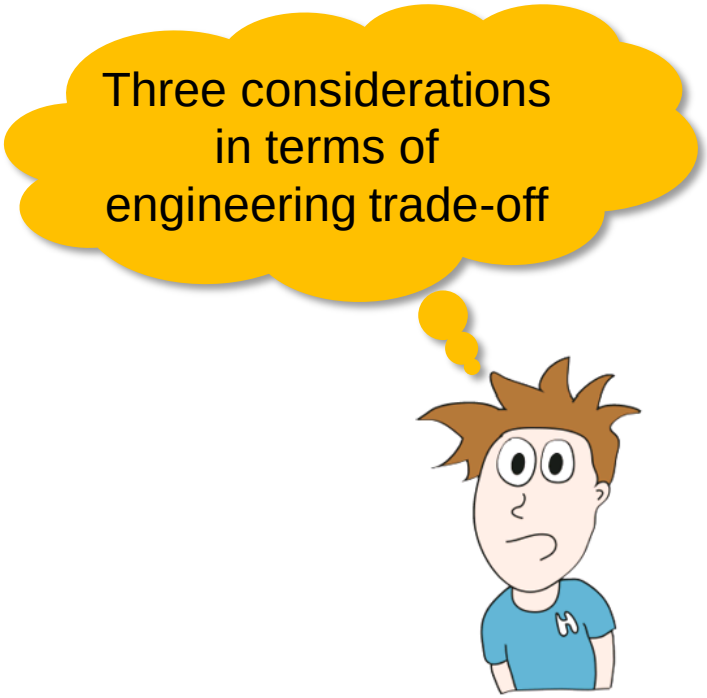
마이크로프로세서가 하는 일

Task Allocations on Resource (Human, Machine)

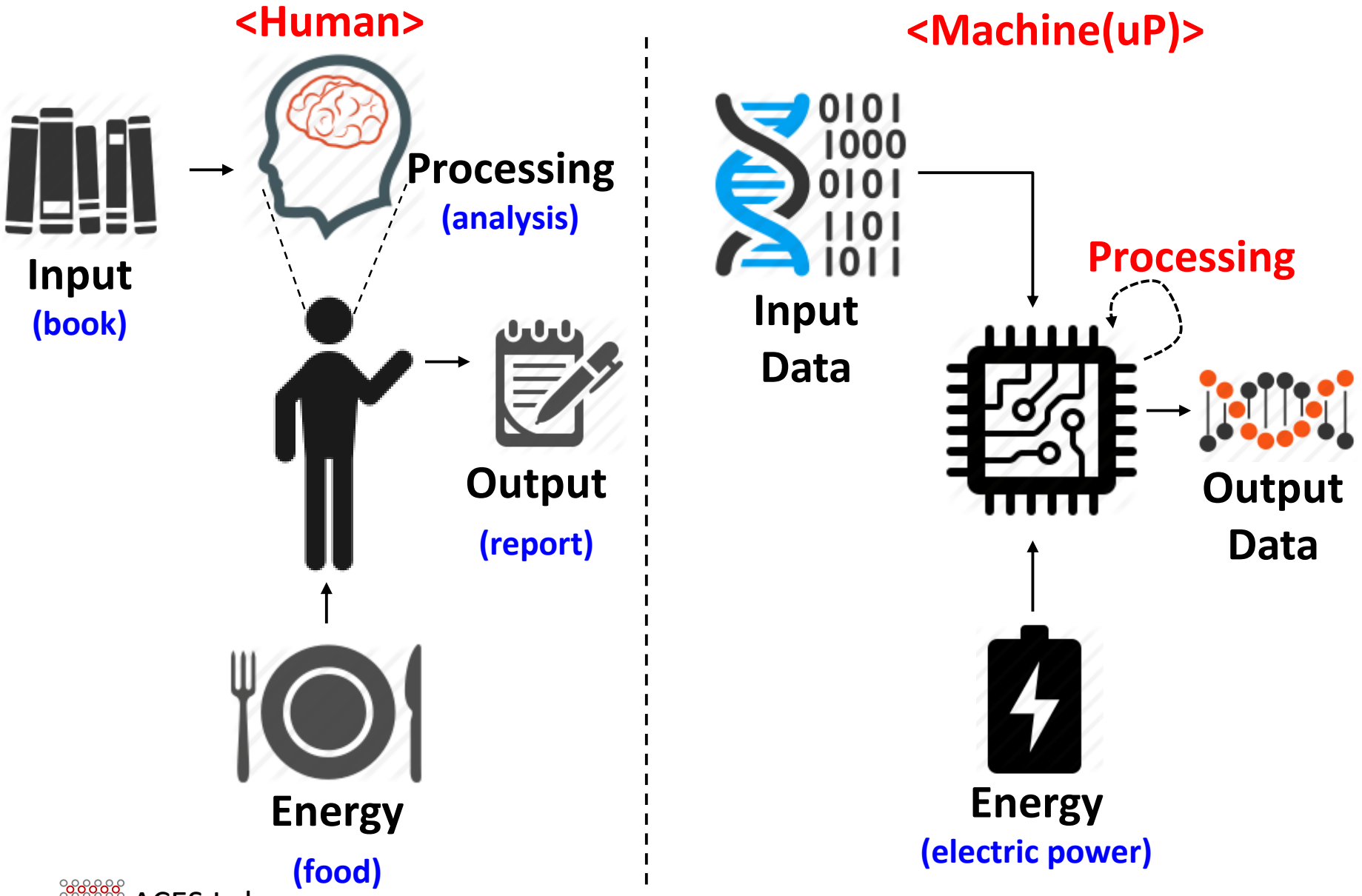
Input: XXXX

- Processing **Method**
- Required **Time** (Delay)
- Consumed **Cost**

Output: YYYY



Microprocessor: Task Processing Unit in Machine

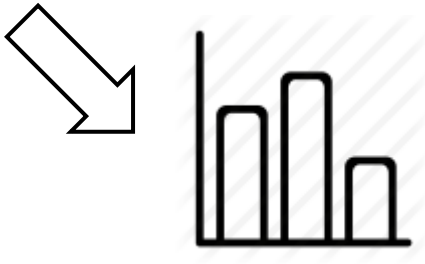


Task-Processing Example

Task: Counting ‘XYZ’ in books

Input: All books during 100 years

- Method: Sequential Read
- Allocated Time: 1 month
- Cost: $3000

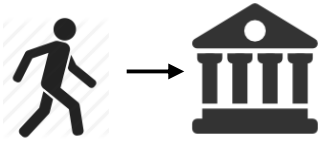


Output:

The number of ‘XYZ’ words in books)

Task-Processing Procedures

1. Eat food
2. Go to the library (slow)
3. Search books, & borrow
4. Place them on table (limited)
5. Read/analyze books
6. Write down results



Energy	AC Power
Storage Access	SATA/PCI HDD/SSD
Data Access	DRAM
Cache	SRAM
Processing	CPU
Output	HDD/SSD

Power Consumption: How efficient ?

Energy **AC Power**

Storage Access

Data Access

Cache

Processing

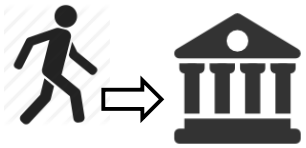
Output

CPU	Intel Core i7-4960X	Intel Core i7-5960X
설계구조	Ivy Bridge-E	Haswell-E
리소그라피	22nm	22nm
코어/스레드	6/12	8/16
캐시 용량	15 MB L3	20 MB L3
작동속도	3.6/4.0 GHz	3.0/3.3 GHz
소켓방식	LGA 2011	LGA 2011-3
설계전력	130W	140W
메모리	DDR3-1600 MHz	DDR4-2133 MHz
대응칩셋	X79	X99

Battery size

Heat Passivation

Access to External Storage: Path to Library



Bus ? Taxi ?
Walk ?

Energy

Storage Access
SATA/IDE/PCI

Data Access

Cache

Processing

Output

	IDE	SATA
Advantages	Maximum compatibility	Inexpensive, large storage capacity.
Disadvantages	Lacks support for new technology such as native command queuing and hot-plugging hard drives	Lower MTBF than SAS (700,000 hours to 1.2 million hours of use at 25 °C), less suited for servers.
Hot plugging (add/remove component while the computer is running)	IDE interface does not support hot plugging	SATA interface supports hot plugging
Speed	data transfers at the rate of up to 133MB/s	Data transfers at the rate of up to 6 Gb/s

Search Speed to Storage: How fast search-computer ?

Access Capability (Sequential ?, Indexed ?

- Energy
- **Storage Access** HDD/SSD
- Data Access
- Cache
- Processing
- Output

SSD	Vs	HDD
0.1MS	ACCESS TIMES SSD virtually has no access time	5.5 ~ 8 MS
at least 6000 IO/S	I / O PERFORMANCE SSDs are at least 15 times faster than HDD	up to 400 IO/S

HDD vs SSD

<Storage Type: Data Access Method>

Buffer Size: How many books can I borrow ?

Energy

Storage Access

Data Access

Cache

Processing

Output

DRAM

Cache: Size of Table

Energy

Storage Access

Data Access

Cache

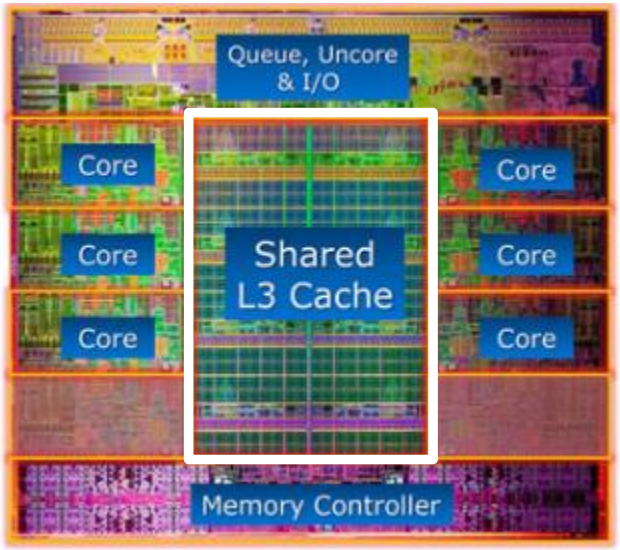
Processing

Output

On-CPU SRAM

You cannot borrow many books, due to the limited size of table.

➔ You have to go to the library frequently

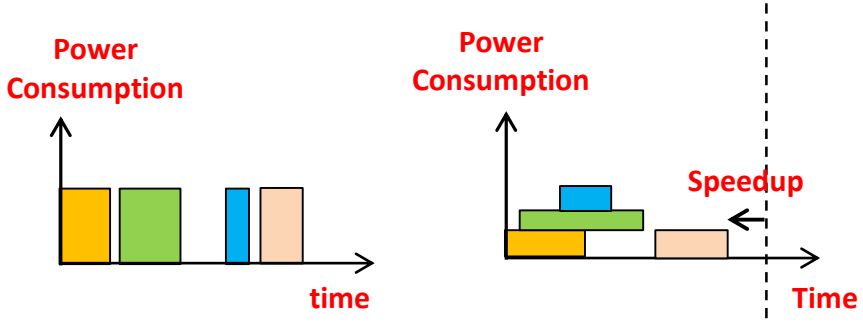


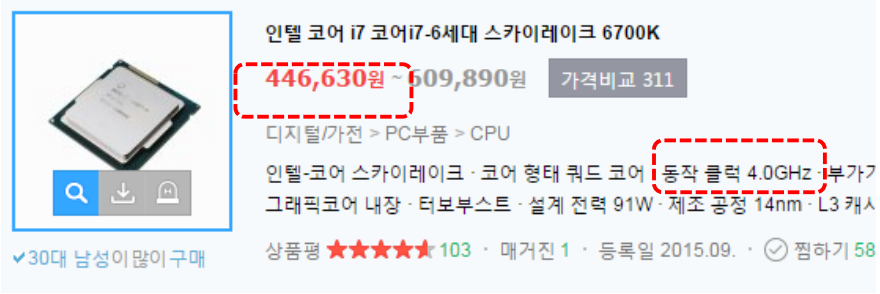
Cache: Most expensive area

Processing: How Fast ? How Many ?

- Energy
- Storage Access
- Data Access
- Cache
- **Processing** **CPU**
- Output

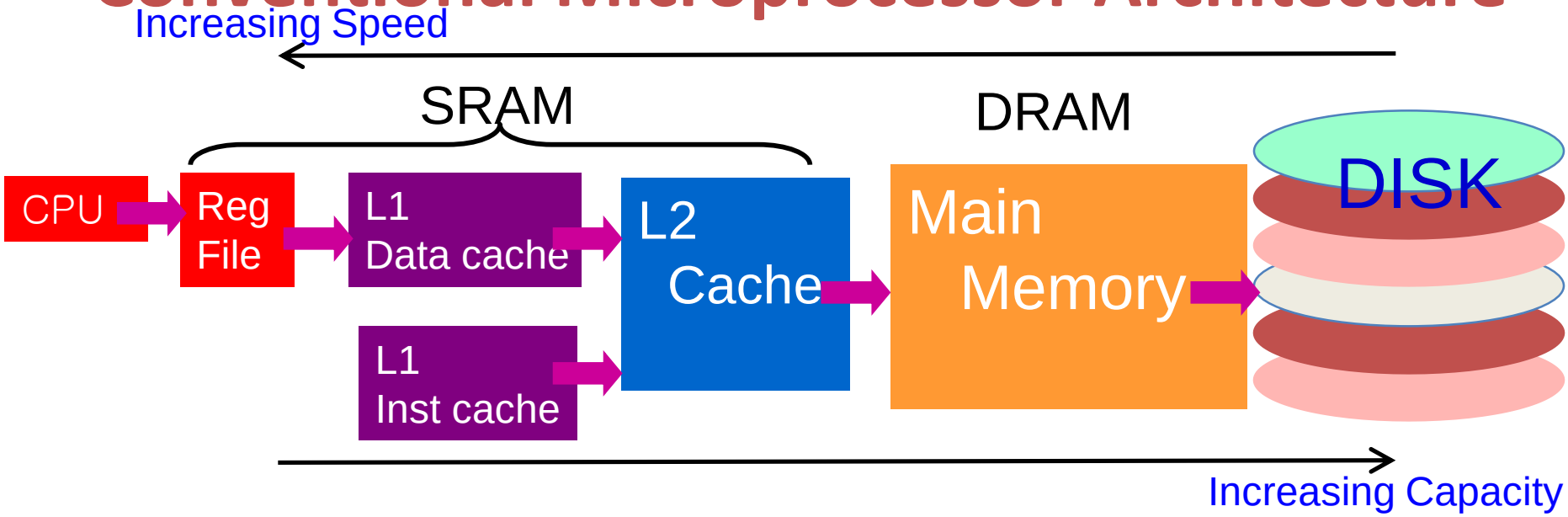
<Processing Speed and Bandwidth>





상용 프로세서 구조

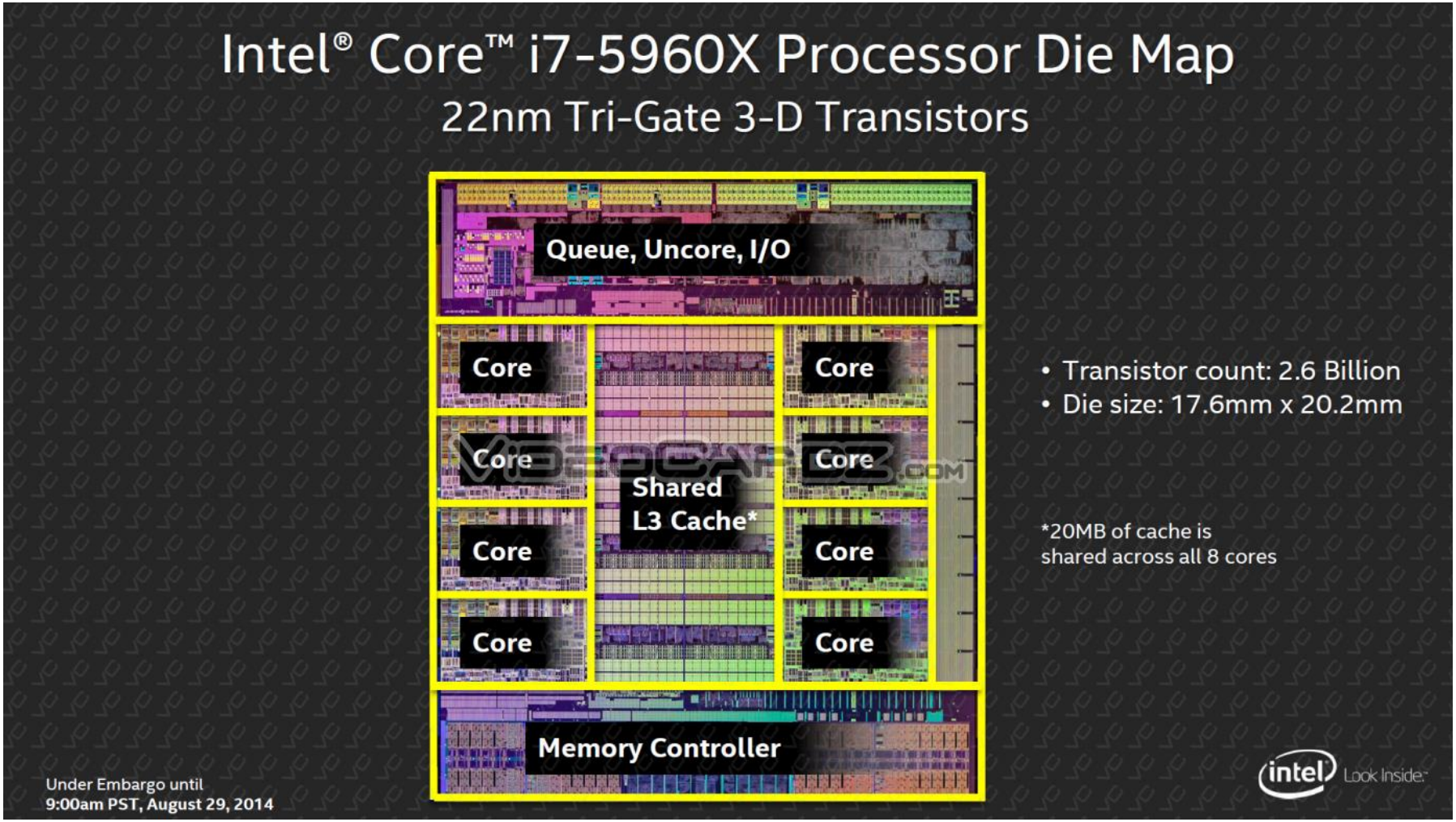
Conventional Microprocessor Architecture



Intel Core i7-5960X	
Haswell-E	•
22nm	•
8/16	•
20 MB L3	•
3.0/3.3 GHz	•
LGA 2011-3	•
140W	•
DDR4-2133 MHz	•

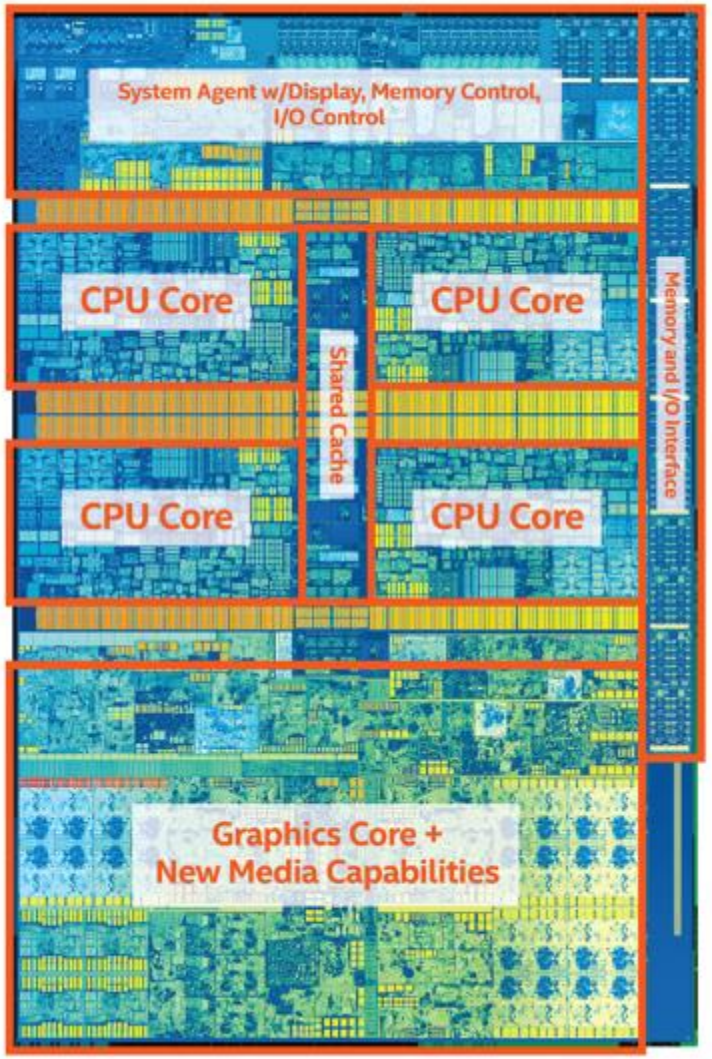
Architecture: Genetic Identity
Process: Who is my father ?
Number of Cores: How many tasks simultaneously ?
Cache Size: Table Size
Operating Speed: How fast can I read a book?
Socket: Compatible interface
Power Consumption: How efficiently processes ?
Memory Interface: Do I have a car ?

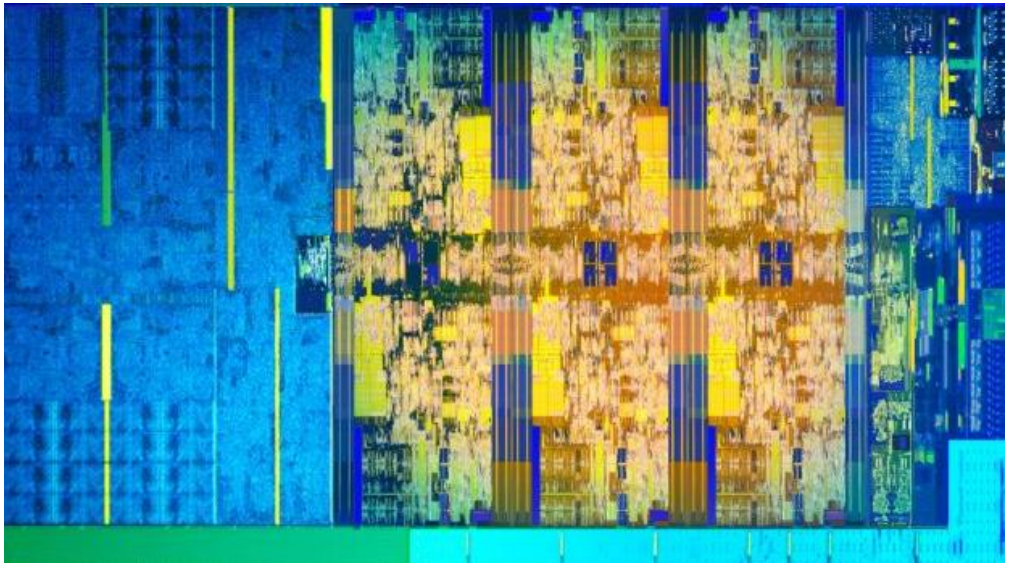
CPU = Cache + Cache Controller



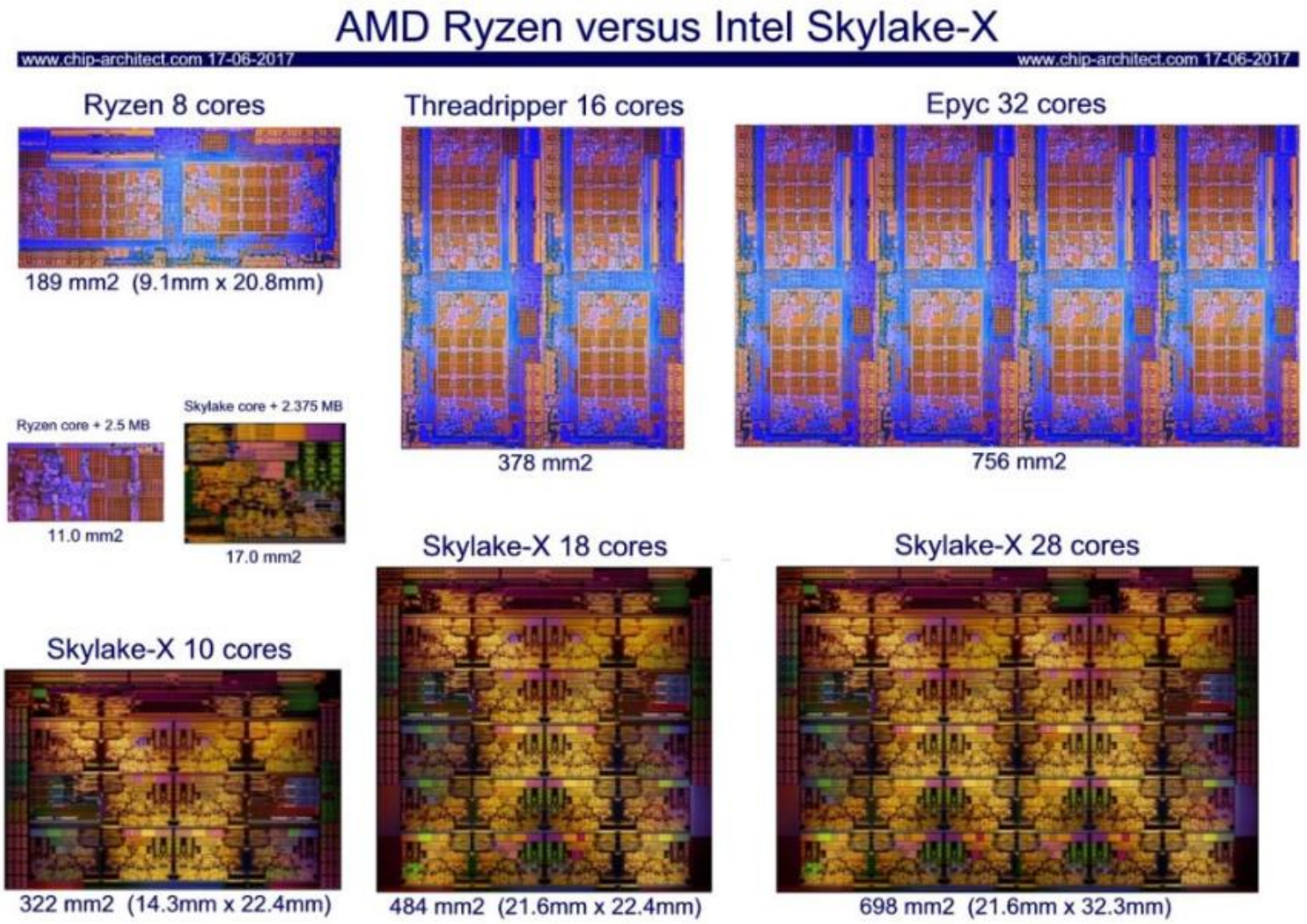
8 Core and 20MB Cache

Intel Processor + GPU 온칩화

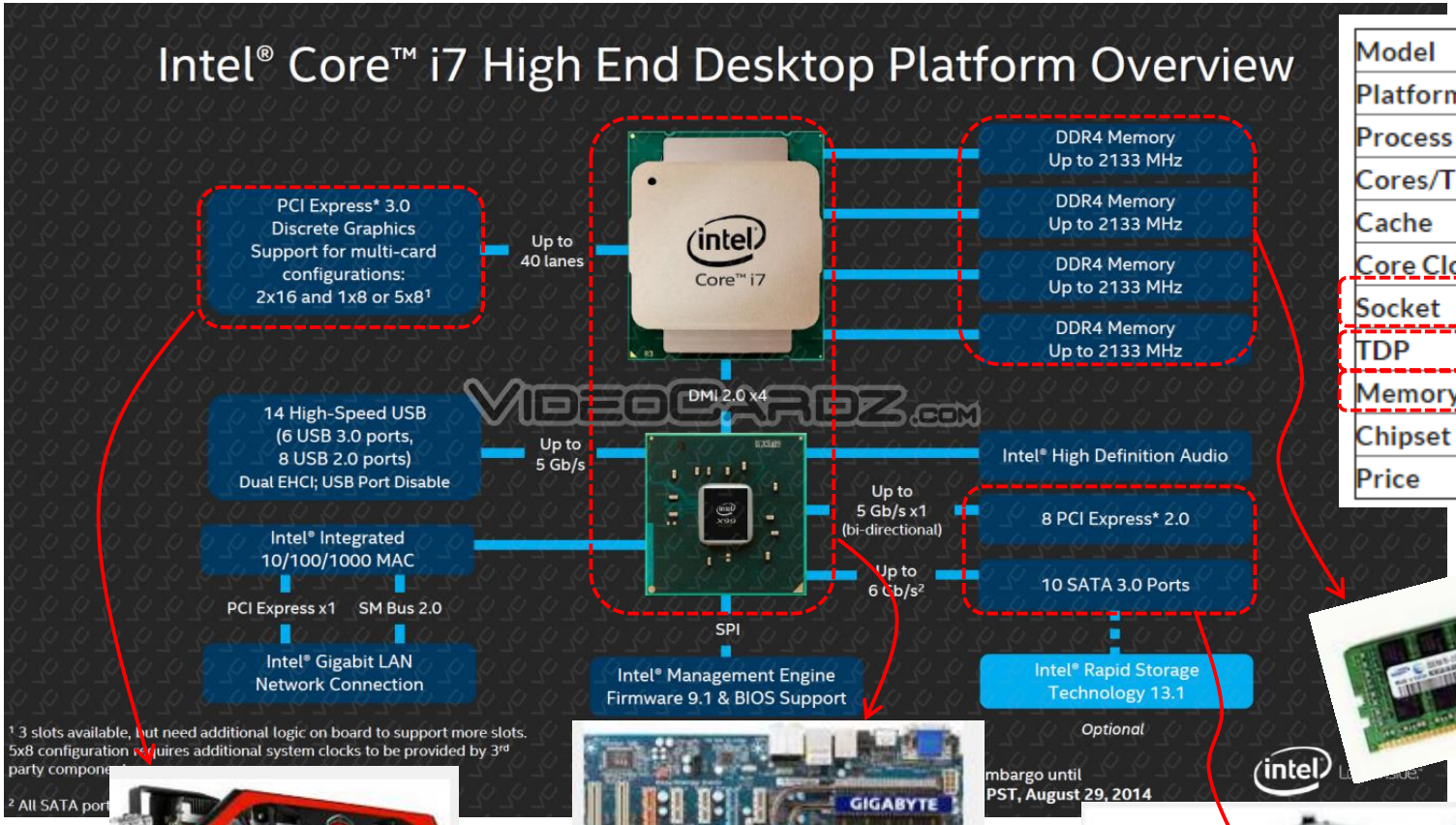




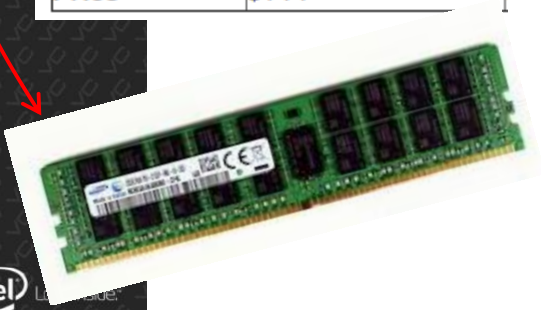
AMD vs Intel – 면적대비 성능, 발열이슈



uP가 시스템 전체 스펙을 결정함



Model	Intel Core i7-5960X
Platform	Haswell-E
Process	22nm
Cores/Threads	8/16
Cache	20 MB L3
Core Clock	3.0/3.5 GHz
Socket	LGA 2011-3
TDP	140W
Memory	DDR4-2133 MHz
Chipset	X99
Price	$999



What are major factors to determine Microprocessor Cost

- https://search.naver.com/search.naver?where=nexearch&query=i7-5960X&sm=top_hty&fbm=0&ie=utf8
- i7-5960X

인텔 코어 i7 하스웰-E 5960X

1,326,340 ~ 1,609,700원 가격비교 107개 쇼핑등록

구입조건 상세구입조건 선택

제품정보 인텔-코어 하스웰, 코어 형태 옥타(8) 코어, 동작 클
계 전력 140W, 제조 공정 22nm , 더보기

카테고리 디지털/가전 > PC부품 > CPU

관련정보 같은 브랜드 인기상품

제품리뷰 4.8 | 매거진 3건 | 사용자 리뷰 5건

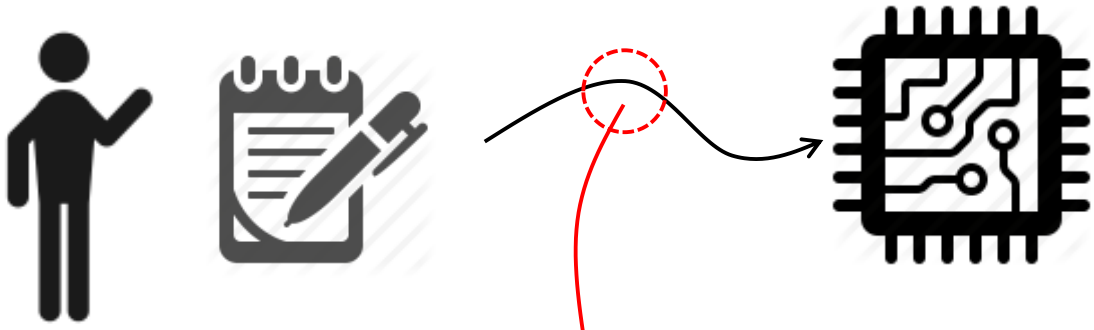
- 하스웰-E '인텔 코어 i7-5960X' 2014.09.19. | 테크핫이슈 매거진
- 인텔 코어 i7 5960X 2014.09.17. | 테크핫이슈 매거진

- Cores
- Cache
- Speed

Machine Language

High Level Language → Machine Level Language

You have to speak native language to instruct tasks



A + B — High level language

add A,B — Assembly language

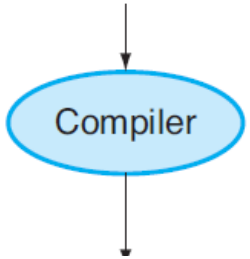
1000110010100000 — Machine language

Language Translation

Coding → Compilation

High-level language program (in C)

```
swap(int v[], int k)
{int temp;
   temp = v[k];
   v[k] = v[k+1];
   v[k+1] = temp;
}
```



Assembly language program (for MIPS)

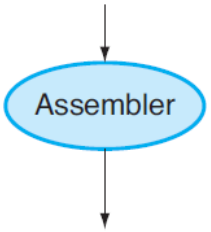
```
swap:
        multi  $2, $5,4
        add    $2, $4,$2
        lw     $15, 0($2)
        lw     $16, 4($2)
        sw     $16, 0($2)
        sw     $15, 4($2)
        jr     $31
```

Language Translation

- Coding → Compilation → Assembling

Assembly language program (for MIPS)

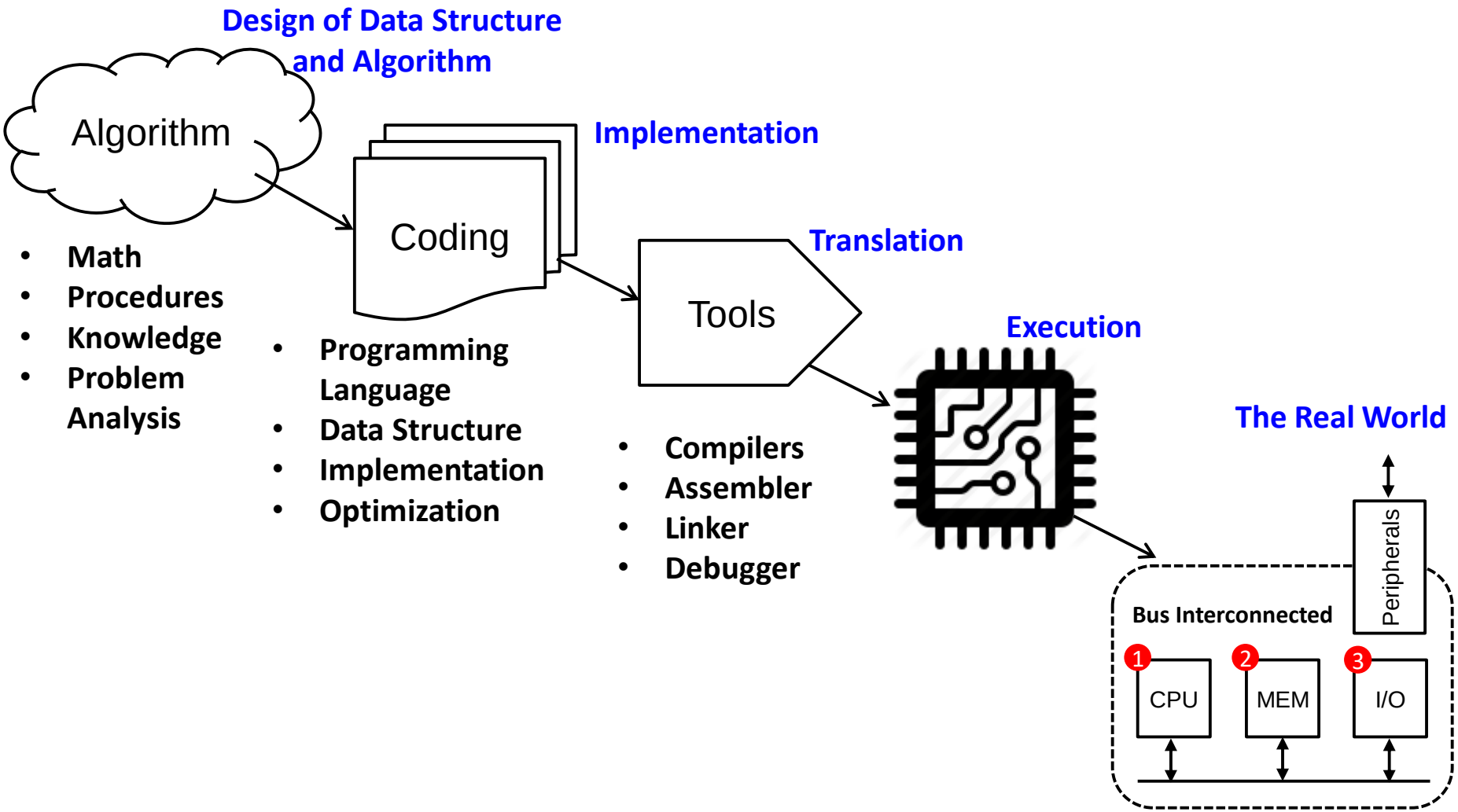
```
swap:
        multi  $2, $5,4
        add    $2, $4,$2
        lw     $15, 0($2)
        lw     $16, 4($2)
        sw     $16, 0($2)
        sw     $15, 4($2)
        jr     $31
```



Binary machine language program (for MIPS)

```
00000000101000100000000100011000
00000000100000100001000000100001
10001101111000100000000000000000
10001111000010010000000000000100
10101111000010010000000000000000
10101101111000100000000000000100
00000011111000000000000000001000
```

Embedding Software into Microprocessors (Hardware)



- Math
- Procedures
- Knowledge
- Problem Analysis

- Programming Language
- Data Structure
- Implementation
- Optimization

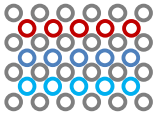
- Compilers
- Assembler
- Linker
- Debugger

다음주 준비

- VirtualBox 설치
  - https://www.virtualbox.org/wiki/Downloads
- Linux Image 로딩 및 부팅해보기
  - https://www.dropbox.com/s/77ysfm0tde0psci/uP_VM.ova?dl=0
  - Id/password: student/password
- ABEEK 사이트에 공지사항 올라오니 확인바람
  - 첫날 강의자료
  - 오늘 강의자료.. 곧 올릴 예정..

Q & A

Thank you for your attention



Application-aware Computing
for Embedded Systems Lab.

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