

Introduction – Introduction to Computer (計算機概論)



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<http://winstonhsu.info>

- ❖ 學歷：
 - 紐約哥倫比亞大學 電機工程博士
 - 國立臺灣大學 資訊工程碩士
- ❖ 研究專長：
 - 機器學習
 - 電腦視覺
 - 大規模影像視訊搜尋與辨識
- ❖ 經歷：
 - 國立臺灣大學 資訊工程學系教授 (現任)
 - 富智捷 (Foxconn + Stellantis) 技術長/副總經理 (現任)
 - thingnario (慧景科技) 共同創辦人 (現任)
 - 協助多家大型企業成立「深度學習團隊」
 - 國立臺灣大學 NVIDIA AI Lab計劃主持人
 - Visiting Scientist, IBM TJ Watson Research Center (2016-2017)
 - Visiting Researcher, Microsoft Research Redmond (2014)
 - CyberLink Corp.(訊連科技) 創始工程師, R&D Manager
 - Editor Board, IEEE Multimedia Mag., AE for IEEE TMM, TCSV



Introduction to Computer

- Before going for the lecture details for the semester, let's see what computers can do now
- We are trained to enable such exciting applications!

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Demo Video for Cruise Origin to Navigate in Cities (for Robotaxi) – Perception, Prediction, and Planning

Origin 是 Cruise 第一款專門無人駕駛車輛，沒有油門或方向盤等手動控制器。Cruise 目前已將數百輛安裝無人駕駛技術的雪佛蘭 Bolt 電動車編入測試車隊，後續車隊將持續擴大直到 Origin 投入生產為止。



But cost is critical issue for scalable business!

*from Cruise

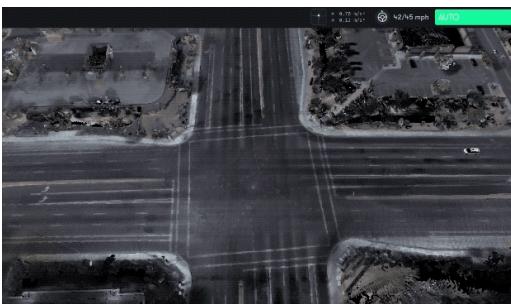
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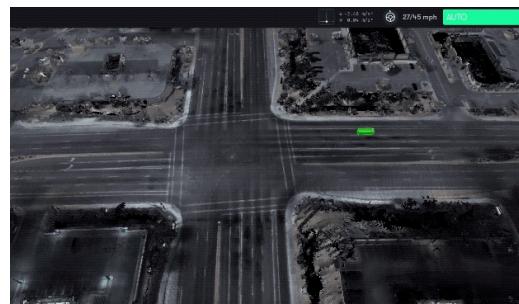
Technologies Helpful for Transportation Safety?

– Waymo's Simulation

- More than 1.3 million people per year die on the roads in the world (by WHO). That's equivalent to a passenger plane's worth of people crashing every single hour—or one death every 30 sec.
- Simulating 91 fatal crashes happened in Chandler, Arizona (2008 through 2017); (**52 initiators and 39 responders**)
 - **Initiator role: 100% avoided**
 - **Responder role: 82% avoided, 10% mitigated; 8% unchanged** as stopped or traveling at a constant speed



Waymo Driver replacing the responder. The Waymo Driver perceives and accurately predicts the initiator (running red light)



Waymo Driver replacing the initiator. The Waymo Driver is driving the speed limit and stops at a traffic light.

<https://blog.waymo.com/2021/03/replaying-real-life.html>

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How Software Is Eating the Car

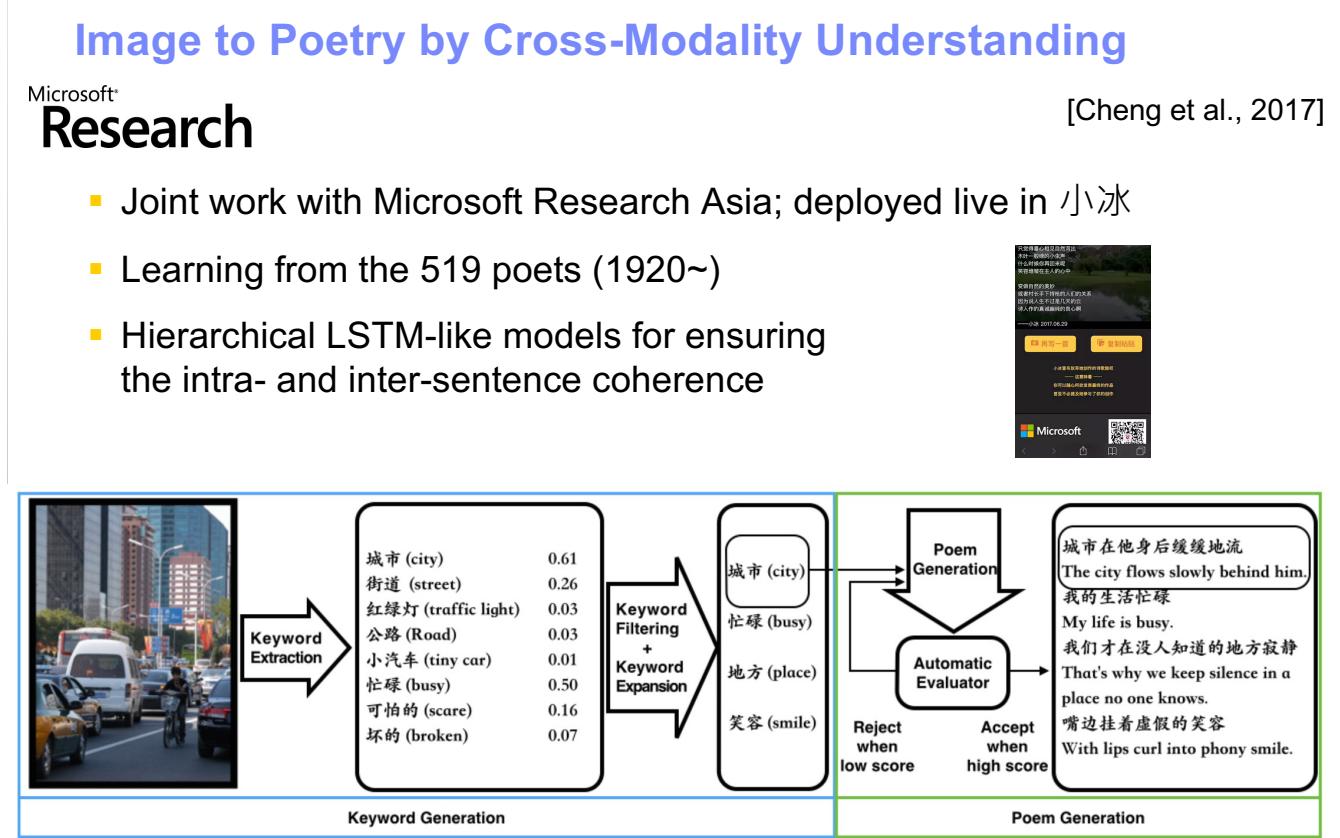
Intelligence!
Intelligence!
Intelligence!

- “Once, software was a part of the car. Now, software determines the value of a car” —Manfred Broy
- ECU (electronic control units), microprocessor-based
 - Ten years ago, only premium cars contained 100 (ECUs) networked throughout the body of a car, executing 100 million lines of code or more.
 - Today, high-end cars like the BMW 7-series may contain **150 ECUs** or more
 - Even low-end vehicles are quickly approaching **100 ECUs** and 100 million of lines of code as more features that were once considered luxury options, such as adaptive cruise control and automatic emergency braking, are becoming standard.





Expressing Sentiments



【AI寫詩不得獎還能出書】臺灣學生如何讓Chatbot小冰學會圖文創作

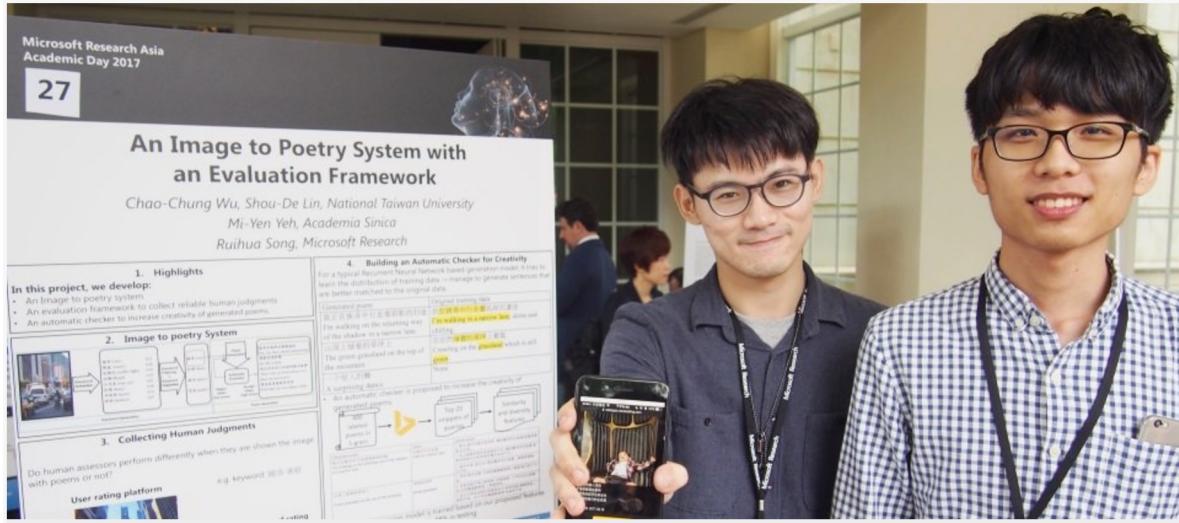
臺大資工所研究生吳肇中及網多所畢業生鄭文峰去年在微軟亞洲研究院實習時，靠519人詩作訓練語意模型，搭配電腦視覺技術解讀圖片，讓小冰機器人具備了看圖寫詩的能力

文/ 何維涓 | 2017-09-09 發表

讚 4.4 萬 按讚加入iThome粉絲團

讚 166 分享

G+



臺大資工所研究生吳肇中及網多所畢業生鄭文峰去年在微軟亞洲研究院實習時，讓小冰機器人具備了看圖寫詩的能力，後來還集結作品出版了一本詩集《陽光失去了玻璃窗》。（攝影／王宏仁）

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Top 3 in 2018 IEEE Signal Processing Society Video and Image Processing (VIP) Cup by EECS Unders → Traveling to Athens, Greece



國立臺灣大學 National Taiwan University

2018年11月6日 ·

IEEE訊號處理學會世界競賽【肺癌腫瘤切割，臺大電機資訊團隊榮獲全球第三】

醫學影像智能分析目前是醫學以及電資領域中非常重要的研究主題。肇因於近幾年機器學習技術的精進，特別是在深度學習技術上的進展，帶來影像、語音、以及文字的分析與生成，都有突破性的發展。臺大電資學院身為全球EECS領域的頂尖學院，也持續在醫學及電資跨領域研究上，持續有著耀眼的成績。

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FIRST PLACE in Disguised Face Recognition for CVPR 2018

iThome

新聞

【臺灣人臉辨識實例：臺大CMLab實驗室】識破萬臉偽裝靠女神卡卡濃妝照，臺大打敗美中俄奪全球第一

專門研發先進情報技術的美國IARPA，去年贊助頂尖電腦視覺會議，舉辦第一屆偽裝人臉辨識競賽，邀集全球AI專家，來挑戰1萬多張畫上各種偽裝的人臉。臺大一舉奪下冠軍，打敗美、中、俄團隊

文/ 余至浩 | 2019-07-05 發表



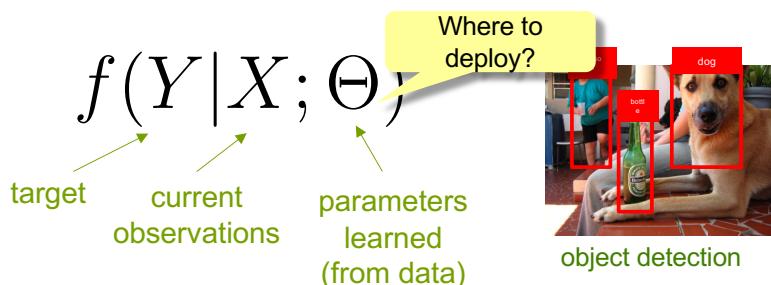
臺大資工系教授徐宏民去年率領臺大CMLab團隊，靠著自創的偽裝人臉辨識演算法，贏得了CVPR 2018偽臉辨識比賽優勝，不僅是唯一辨識率達9成的隊伍，更是第一家進榜的臺灣隊伍。（攝影 / 洪政偉）

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Core for AI (Machine Learning)

- A prediction function f for
 - Classification (分類)
 - Recommendation (or ranking) (e.g., shopping, ad, etc.)
 - Decisions for action (go, transaction, driving, etc.)
 - Translation (voice vs. text, English vs. Chinese, image vs. caption, etc.)



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The Big Picture in Computing, Cloud, and Human

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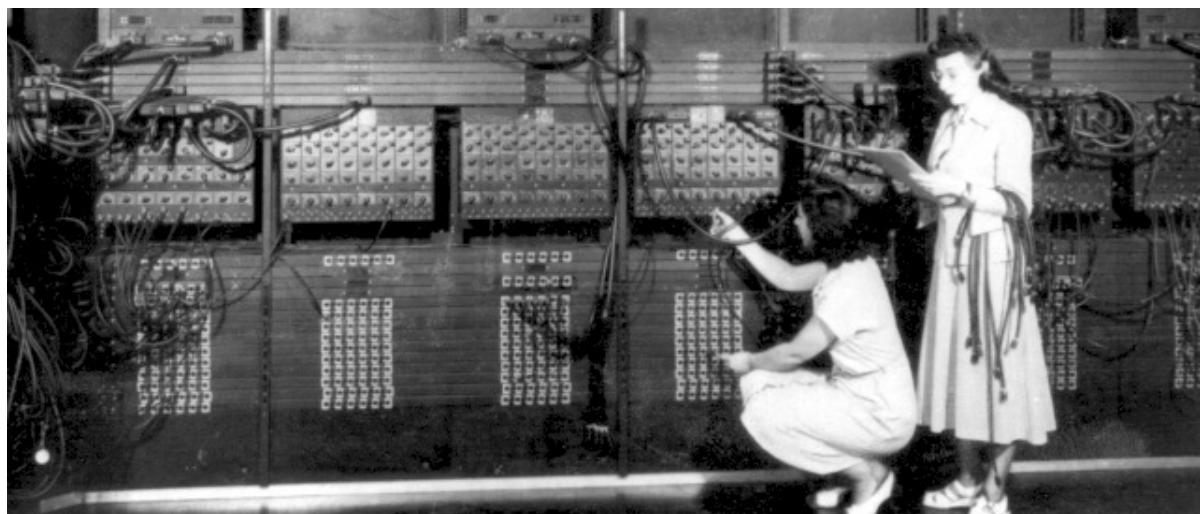
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Amazing Technologies are Enabled
by Tiny Bits!

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Early Computers



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Early Programming Tools



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First Popular PCs



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Early PCs



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GUI/IDE

A screenshot of a Delphi IDE interface. The menu bar includes File, Edit, Search, Run, Compile, Debug, Options, Window, and Help. A context menu is open over some code, with the 'Watches' option highlighted. Other options in the menu include Evaluate/modify..., Ctrl-F4; Add watch... Ctrl-F7; Delete watch; Edit watch...; and Remove all watches. The code in the editor window is:

```
type pstiva^=tstива;
  tstива = record
    next : pstива;
    val : longint;
  end;

var
  a : array[1..100,1..100] of longint;
  d,pi : array[1..100] of longint;
  n : longint;
  prim,ultim : pstива;

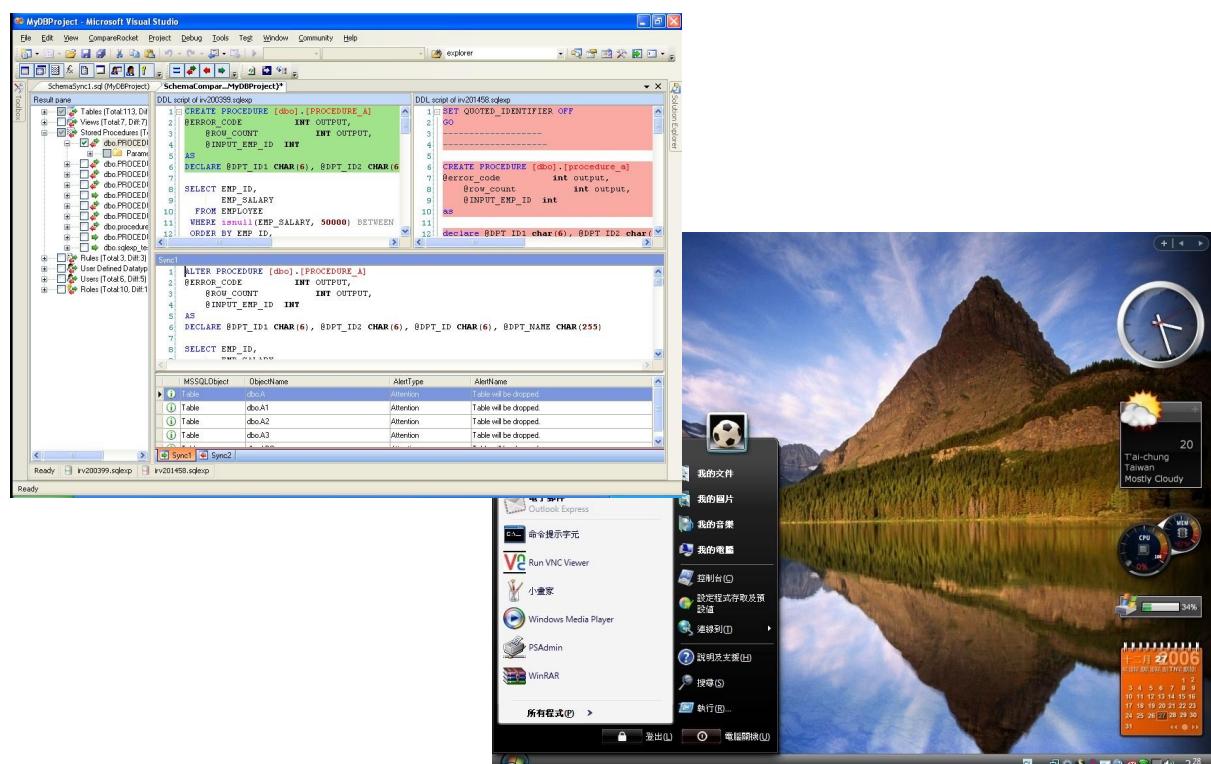
procedure AddToStива(i:longint);
begin
  if (prim = nil) then
    begin
      new(prim);
      ultim := prim;
      prim^.next := nil;
    end
  else
    begin
      ultim^.next := i;
      ultim := i;
    end;
end;
```

The status bar at the bottom shows F1 Help | Insert a watch expression into the Watch window.

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More Advanced Software



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More “Computers” around Us



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The Downside

- *“Once upon a time, every computer specialist had a gestalt understanding of how computers worked. ... As modern computer technologies have become increasingly more complex, this clarity is all but lost.” Quoted from the reference*

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How Does a Program Work?

```
Python 2.7.10 (default, Feb 7 2017, 00:08:15)
[GCC 4.2.1 Compatible Apple LLVM 8.0.0 (clang-800.0.34)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>>
>>>
>>>
>>>
>>> print "hello world!"
hello world!
>>>
>>>
>>> for i in range(10):
...     print "hellow world!"
...
hellow world!
>>> █
```

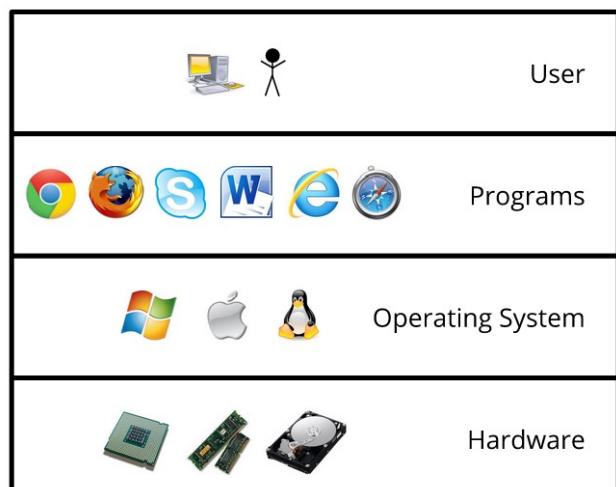
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Layers of Applications and (Software/Hardware) Systems



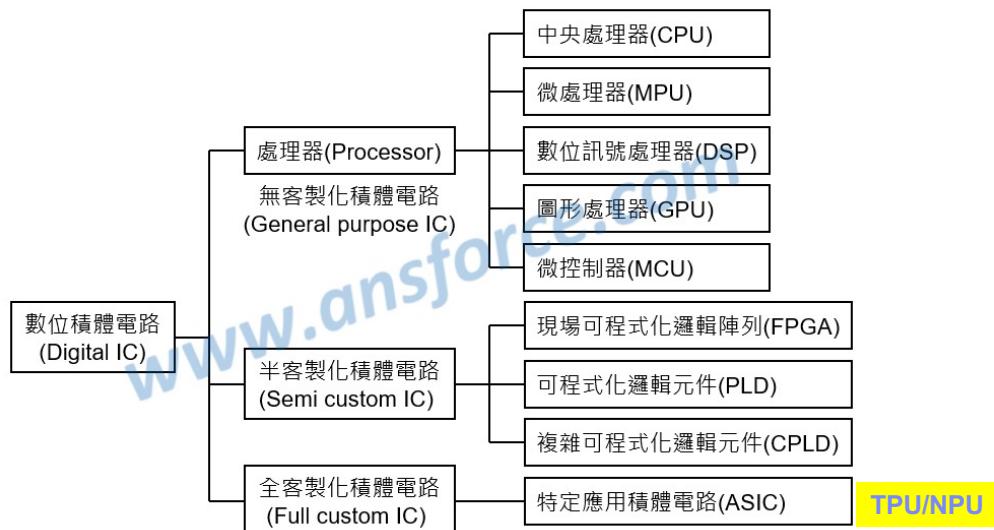
Facebook as a three-tier system



Your computer as a layered system

Many others are missing here; for example, compilers, architecture, programming languages, data structure, database, etc.

Variants of Computing Units

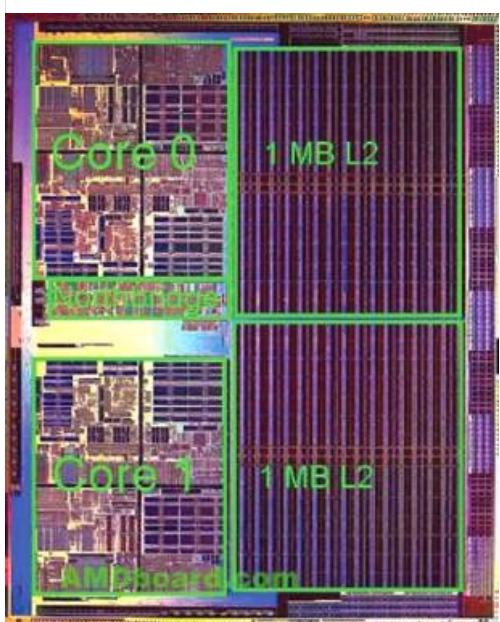


<https://www.stockfeel.com.tw/處理器-cpu-gpu-mcu-dsp-mpu/>

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More Advanced Architectures – Multi-Cores, GPUs

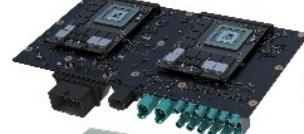


DRIVE PX2

- Dual Next Generation Tegra
- Dual Discrete GPUs
- 12 CPU Cores
- Pascal GPU
- 8TFLOPS (FP32)
- 24DL TOPS
- 12 simultaneous LVDS camera inputs



Dual Tegras on Top



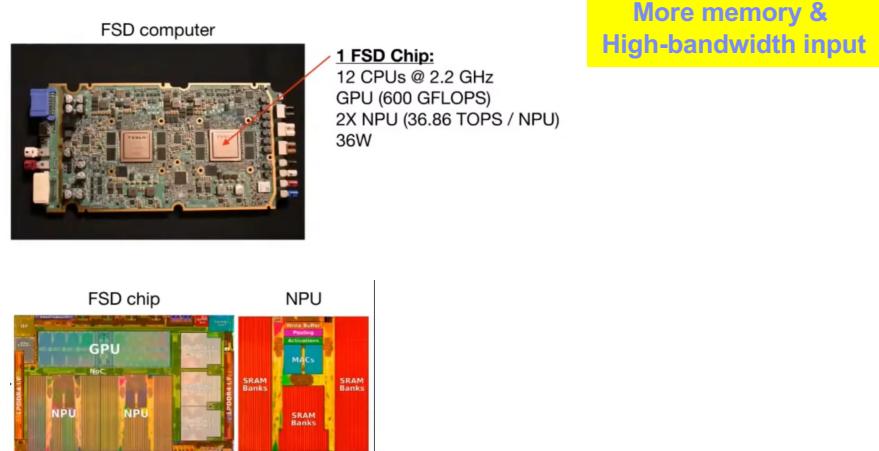
Dual Discrete GPUs on the Bottom



Liquid Cooled if All Devices used

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FSD Computer for Tesla – Growing Computing Power Required



Andrej Karpathy, Tesla
<https://www.youtube.com/watch?v=g6bOwQdCJrc>

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DGX-1, AI Supercomputer, with 8 V100 GPUs (upgraded from P100 in 2019; the first one in Taiwan, Nov. 2016)



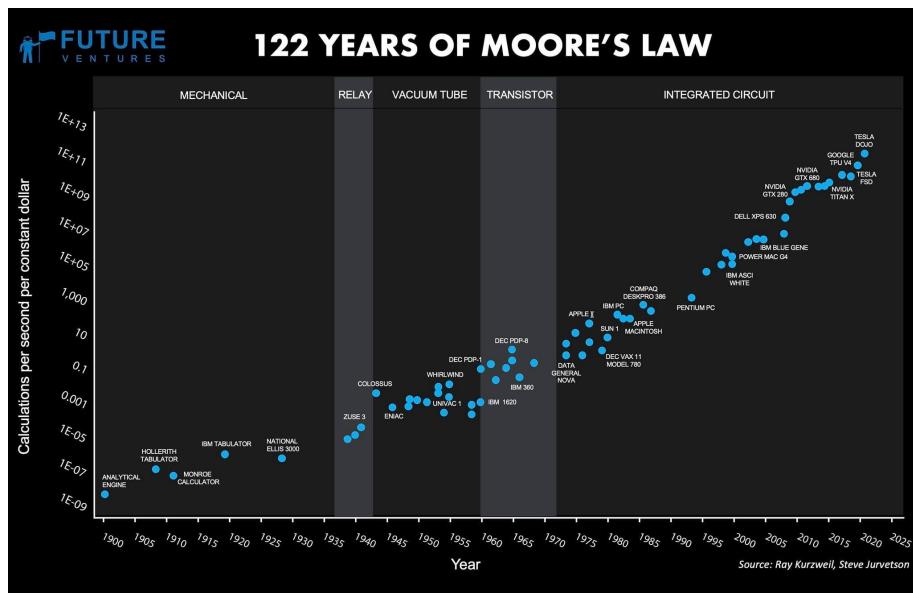
- 960 TFLOPS (GPU FP16)
- 40,960 CUDA Cores
- 5,120 Tensor Cores



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Autonomous Computer – A New Computing Battlefield

- Tesla AI Day 上發表了 D1 晶片，7 奈米製程技術，運算效能為 362 teraflops
- Not GPU but ASIC optimized for vehicle computations
→ 高性價比
- Intel → NVIDIA → Tesla?
- 軟硬整合高度整合
- If it matters, how other OEMs will join the competition?
- Other local IC design house for that? Like mobile chipsets?



Tesla為何自己設計晶片？
<https://www.digitimes.com.tw/col/article.asp?id=1418>

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Layers of Computer Cores To Be Covered

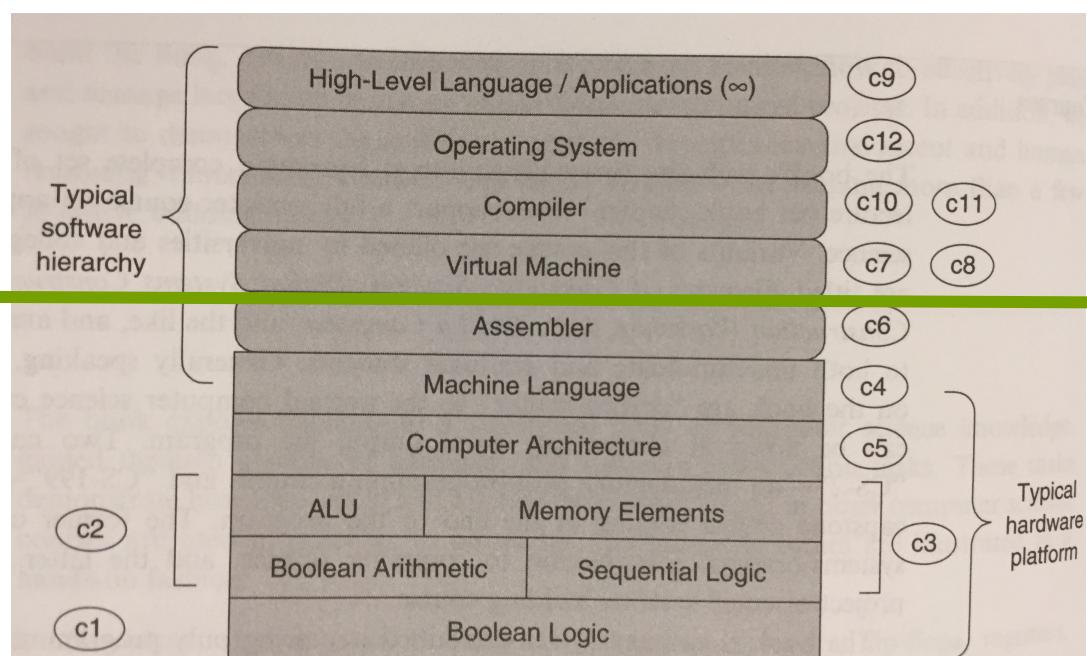
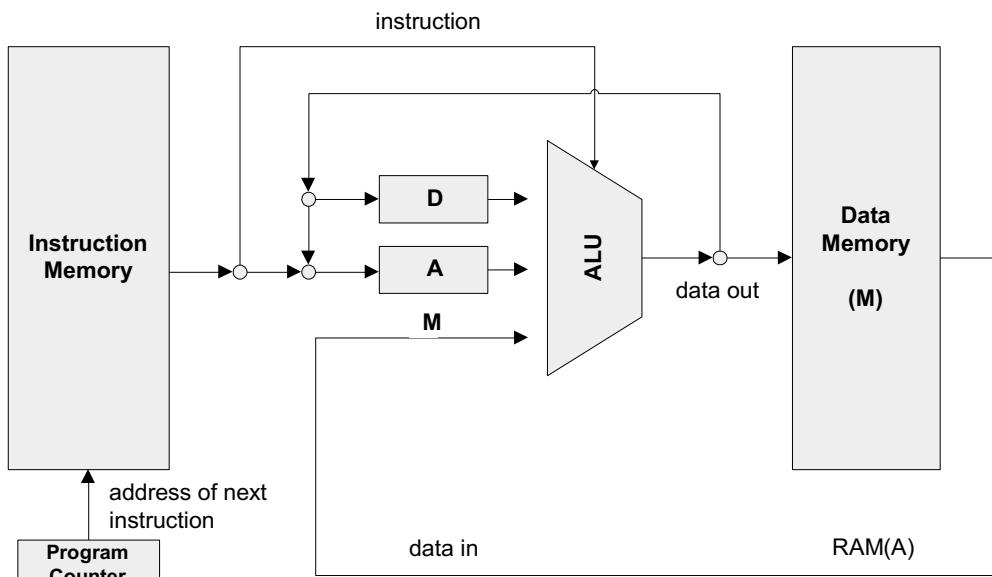


Figure P.1 Book and proposed course map, with chapter numbers in circles.

Computer Architecture (Simplified)



- **A typical Von Neumann machine**
- An ALU is a fundamental building block of many types of computing circuits, including the central processing unit (CPU) of computers, FPGAs, and graphics processing units (GPUs).

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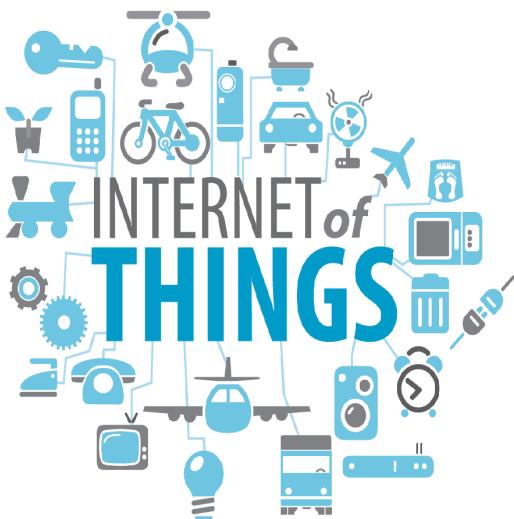
Why Learning So Many Details?

- Q: Computers are getting easier. Why I need to learn such complex details?
- Answers:
 - You are in **the best computer science department**
 - You need to know how to design (both hardware/software) from the scratch
 - Or Have the ability to invent the new computation paradigm
 - e.g., NOSQL, GPU-enabled data computing, quantum computer, intelligent X, etc.

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Especially, Designing (Future) AI-Savvy Products – Combining both Hardware/Software



V.S.



Operation	Energy [pJ]	Relative Cost
32 bit int ADD	0.1	1
32 bit float ADD	0.9	9
32 bit Register File	1	10
32 bit int MULT	3.1	31
32 bit float MULT	3.7	37
32 bit SRAM Cache	5	50
32 bit DRAM Memory	640	6400

Energy table for 45nm CMOS process

| Learning both Weights and Connections for Efficient Neural Networks, Han et al., NIPS 2015

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Course Goal

- Introductory course for the (new) undergraduates in the computer science department – with strong CS-level requirements
- We will cover basic knowledge about computer, data manipulation & abstraction, computer architecture, organization, software, operating system, database, network, GitHub, machine learning, etc. (if time permitted)
- Mix with technical details and fun!
- **Discovering future career path**
- **Expecting the students to be able to work as an (basic) intern in Summer 2023**

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Topics To Be Covered (Tentative)

- Data and number systems
- Boolean logic
- Boolean arithmetic (ALU)
- Sequential logic
- Machine language
- Computer architecture
- Assembler
- Operation systems
- Git & python programming
- networks and the Internet
- database systems
- machine learning and deep neural networks

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Lecture and Homework Schedule (Tentative)

date	planning	hw assigned	hw due
9/5/22	introduction	HW #1	
9/12/22	data and number	HW #2	
9/19/22	boolean logic -1	HW #3	HW #1
9/26/22	boolean logic -2		HW #2
10/3/22	sequential logic -1	HW #4	HW #3
10/10/22	<i>holiday</i>		
10/17/22	sequential logic -2		
10/24/22	midterm exam		HW #4
10/31/22	python + git	HW #5 python	
11/7/22	Arithmetic Logic Unit (ALU)	HW #6	
	computer architecture + machine		
11/14/22	language	HW #7	HW #5 python
11/21/22	operation systems + networks		HW #6
11/28/22	database (1)	HW #8	HW #7
12/5/22	database (2)		
12/12/22	machine learning + dnn		HW #8
12/19/22	final exam		

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:: Administrative Issues ::

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Administrative Issues

- ~8 assignments in the lecture (every two weeks)
 - Homework (#1) available now (creating your own CV)
 - **DUE: at 12pm, September 19, 2021; NTU Cool submission**
- TAs
 - 趙雋同 <r11922109@ntu.edu.tw>, R506
 - 許雅晴 <r10922192@ntu.edu.tw>, R506
 - Office hours (mail inquiry first): 2-3pm, Tuesday & Wednesday
- Course information
 - **Course outline**
<https://winstonhsu.info/2022f-comp-intro/>
 - **Readings, homework, slides, etc.**
<https://cool.ntu.edu.tw/courses/19517>



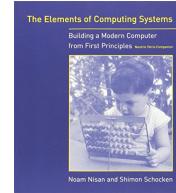
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Textbook and References

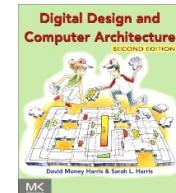
■ Textbook:

- The Elements of Computing Systems,
Noam Nisan and Shimon Schocken
 - The first 6 chapters (to be used) are available online;
you probably need not buy the hard copy
 - Or upload in NTU Cool
- Digital Design and Computer Architecture,
2nd Edition, David Harris and Sarah Harris.
- **Digital copy can be easily found online**



■ References (NOT required)

- Computer Science: An Overview,
12th Edition, by J. Glenn Brookshear
 - To be used in the second half
 - 前幾屆的單班用書



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Grading (Tentative)

- Assignments : 30-35%
 - Midterm Exam.: 30-35%
 - Final Exam.: 30-35%
 - Class Participation: 5-10%
-
- **Cheating in homeworks or exams will cause the grade as “F” automatically**

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Create Your Own CV (Curriculum Vitae)

- What's CV?
- Why needing CV?
- How to fill in the perfect CV for your future career? study, job market?
- Draft one (HW #1) and keep updating for the coming years
 - Create your own webpage or GitHub
 - Be careful for your ID style – being professional
- Consult others and Google what kind of CV highlights you need?
- Tutorial (many others)
 - <https://www.naaree.com/resume-writing-help/>
 - <https://medium.com/duomly-blockchain-online-courses/how-to-write-a-resume-for-it-professional-tutorial-with-resume-example-template-cbdc0275a16d>

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How to Prepare for a Good CV?

Format (Suggested)

Left column (30%-40%)

Personal data

Languages (optional)

Natural languages

Right column (60%-70%)

About me (or Objective)

Write 2-3 sentences about who you are, your main career path, and what you would like to do.

Main skills

Programming languages

IT projects experience

Non-IT projects experience

- Remember to proofread and edit your typos
- Choose a font size of at least 10 and avoid using too many different font to ensure the readability
- Focus more on the messages than designs
- Always keep your CV up to date

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