AI
on Nvidia Jetson Edge System

Jeong-Gun Lee

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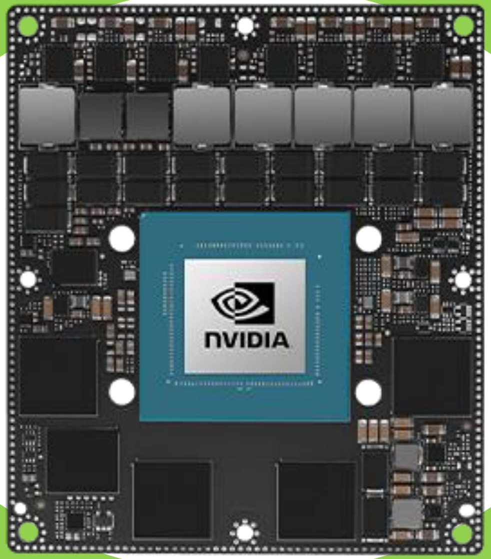
차례

한림대학교
HALLYM UNIVERSITY

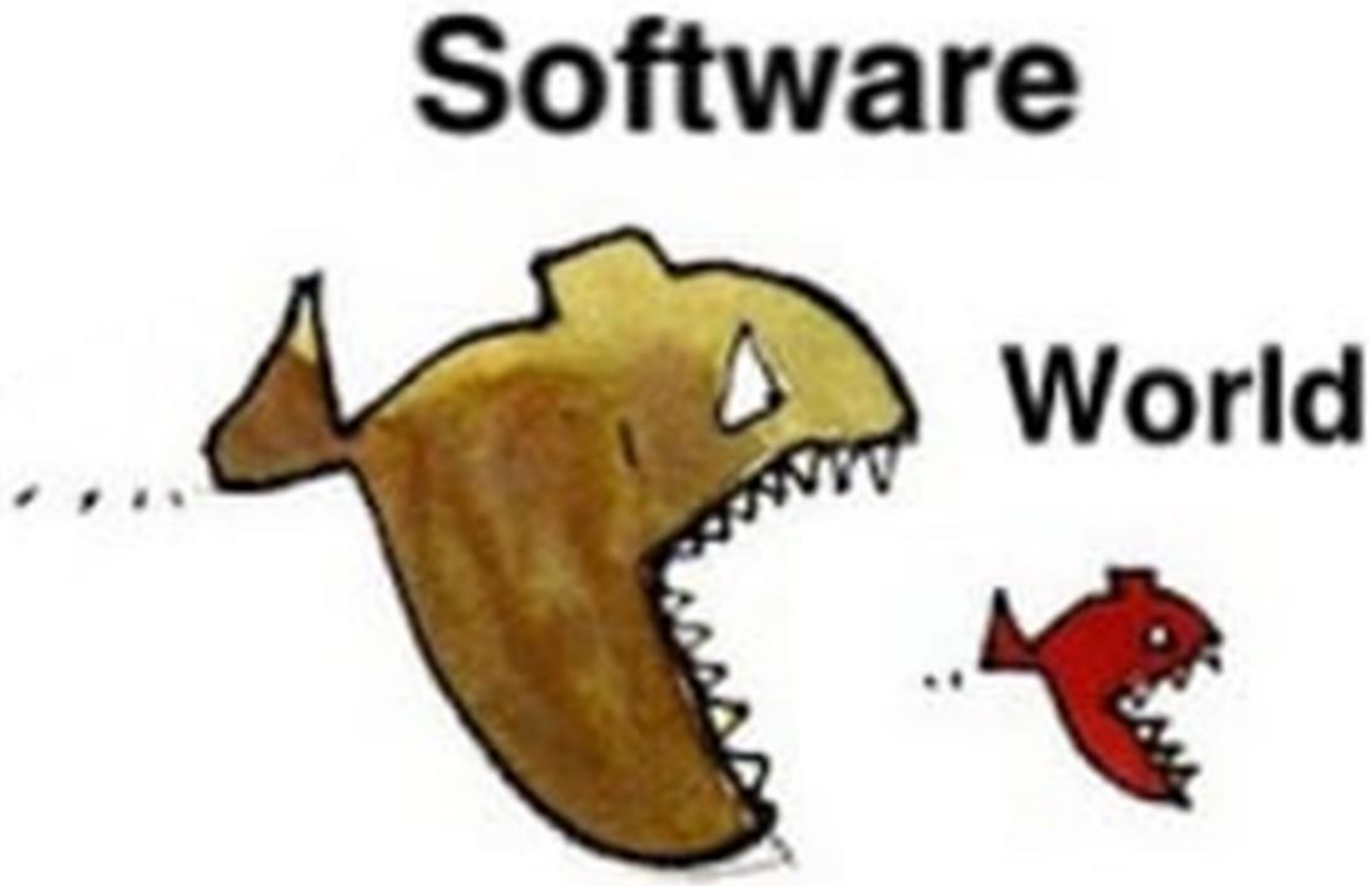
- Nvidia Jetson System 소개
- Jetson Nano System 설정
- Jetson Nano에서 즐기는 Parallel Computing (CUDA)
- Jetson Nano에서 즐기는 Deep Learning

AIAC lab

Nvidia Jetson System 소개

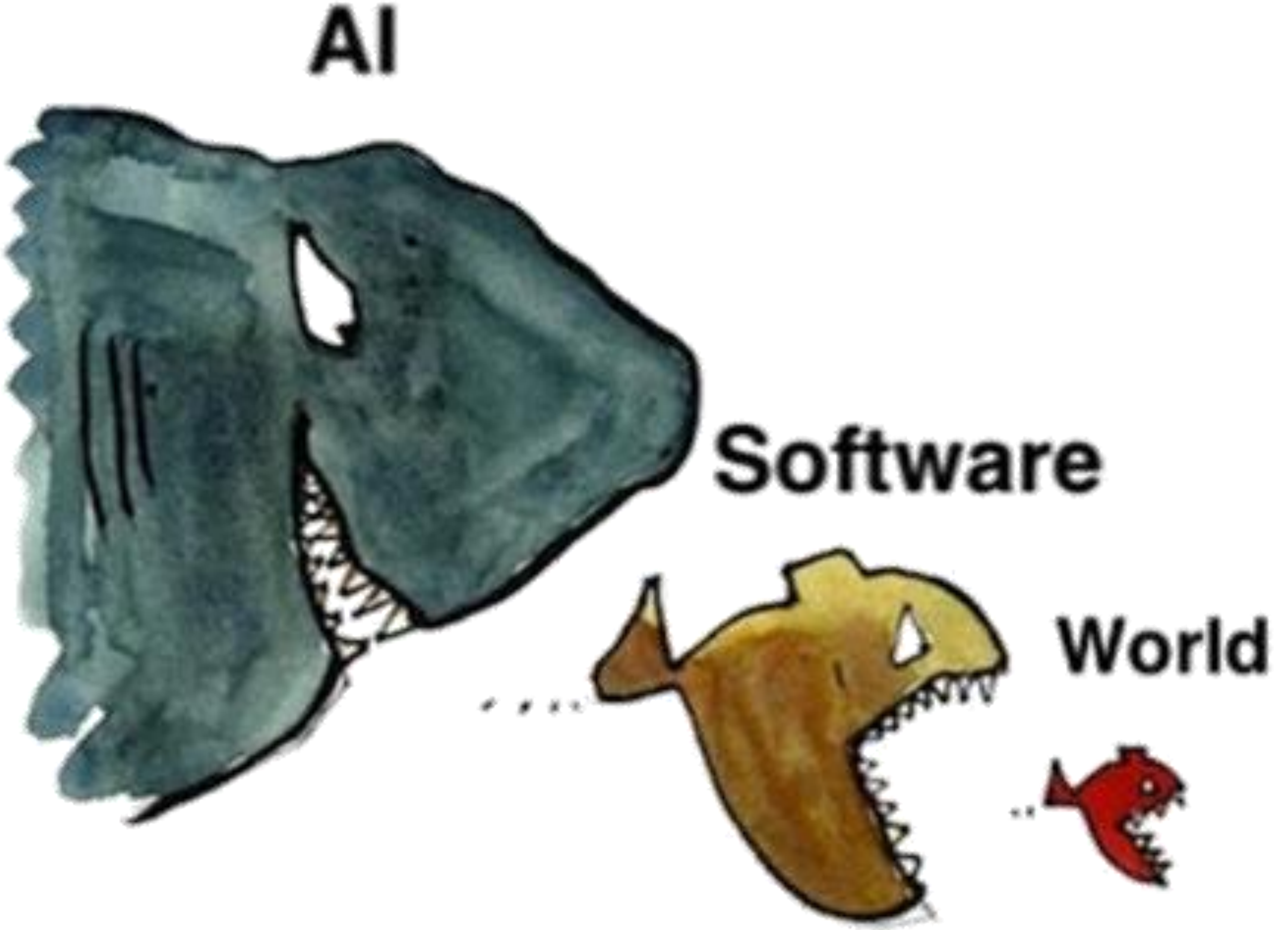


지금 세상을 생각하면...



지금 세상을 생각하면…

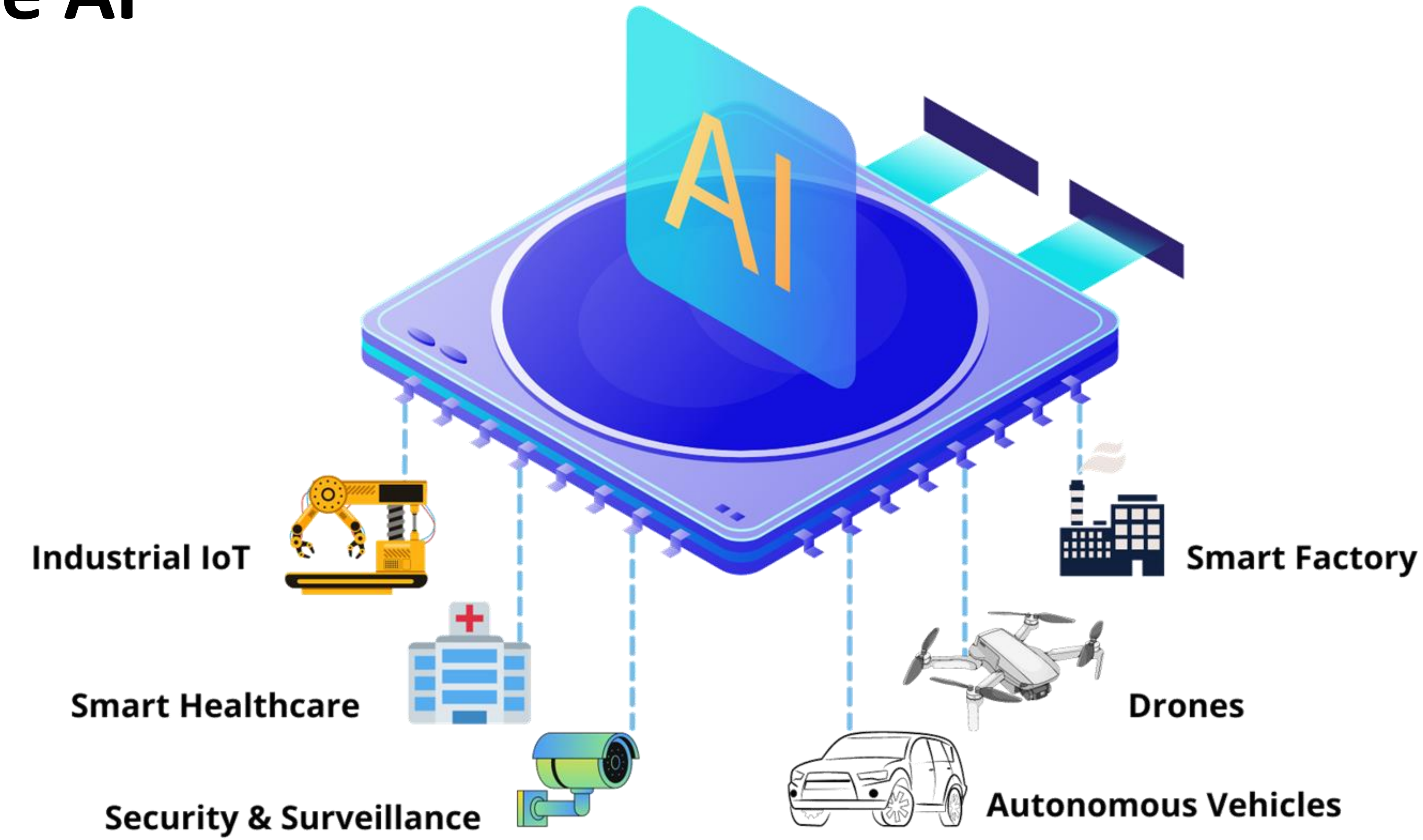
AI Revolution & What is the NEXT?



지금 세상을 생각하면...

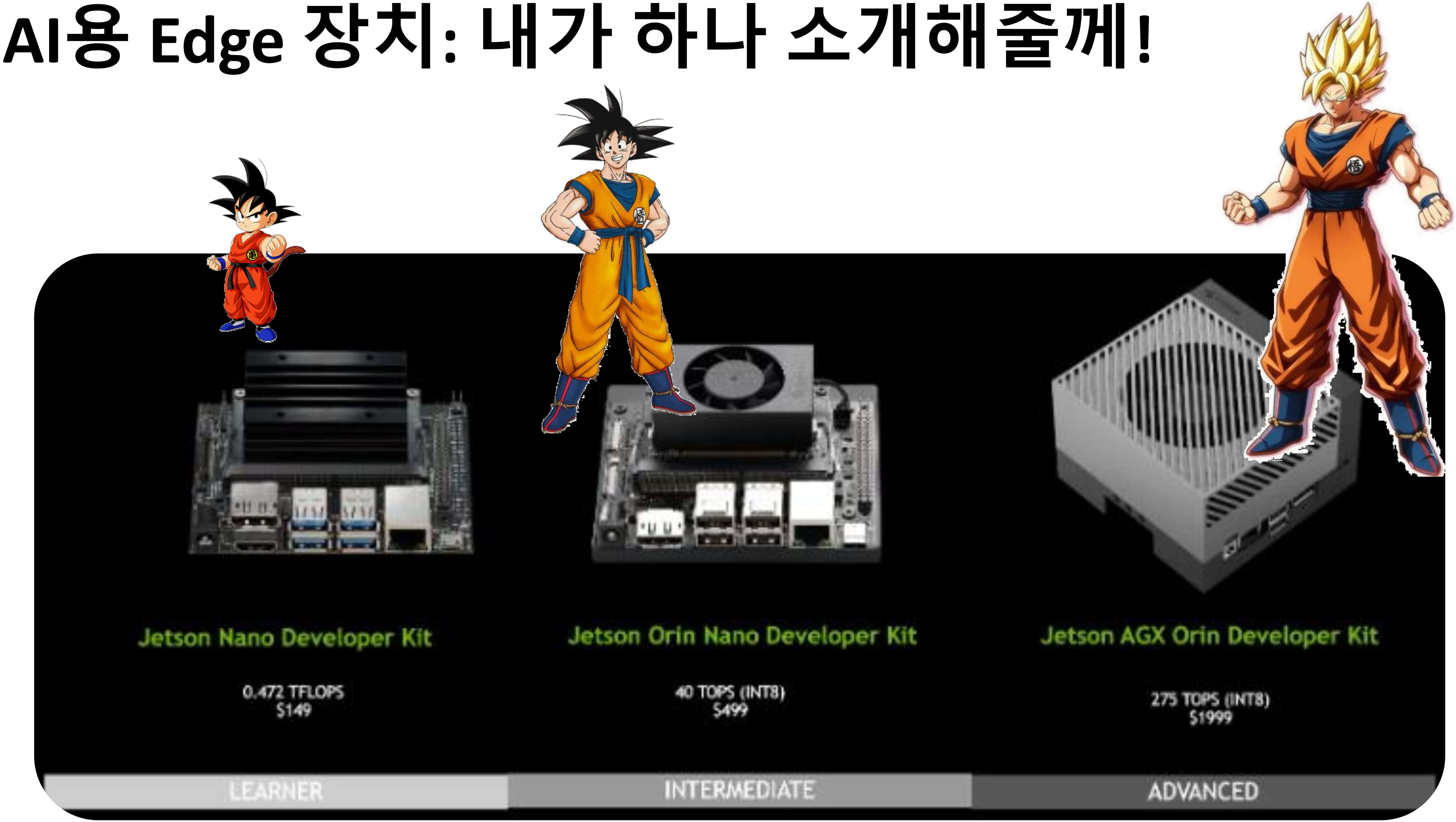
Edge AI
AI
Software
World

Edge AI



AI
Industrial IoT
Smart Healthcare
Security & Surveillance
Smart Factory
Drones
Autonomous Vehicles

AI용 Edge 장치: 내가 하나 소개해줄께!



Jetson Nano Developer Kit

0.472 TFLOPS
$149

Jetson Orin Nano Developer Kit

40 TOPS (INT8)
$499

Jetson AGX Orin Developer Kit

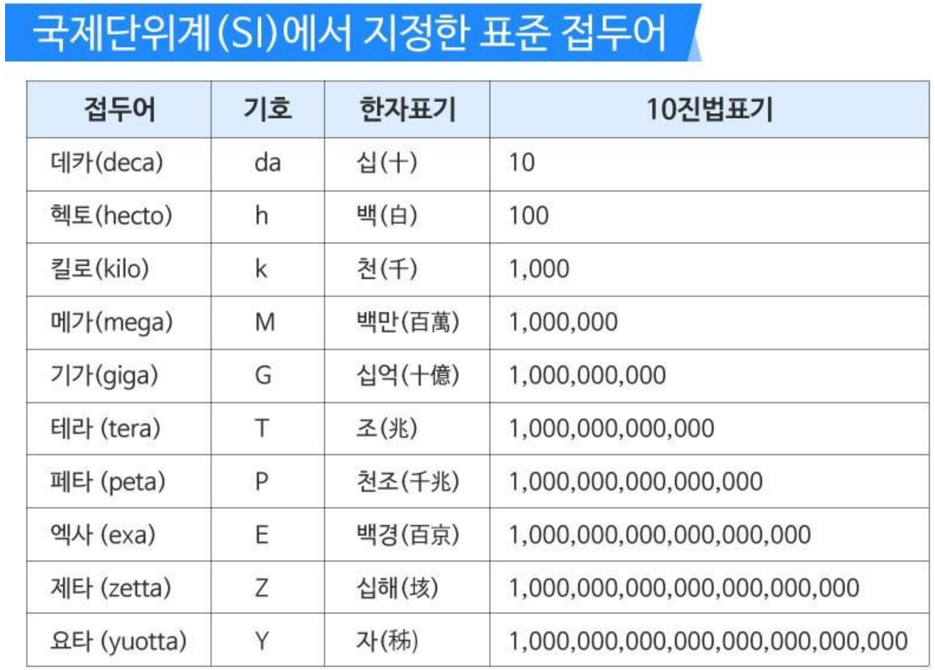
275 TOPS (INT8)
$1999

AI용 Edge 장치: 기본 용어 정리~

TOPS: Tera Operations Per Second

GFLOPS: Giga Floating-Point Operations Per Second

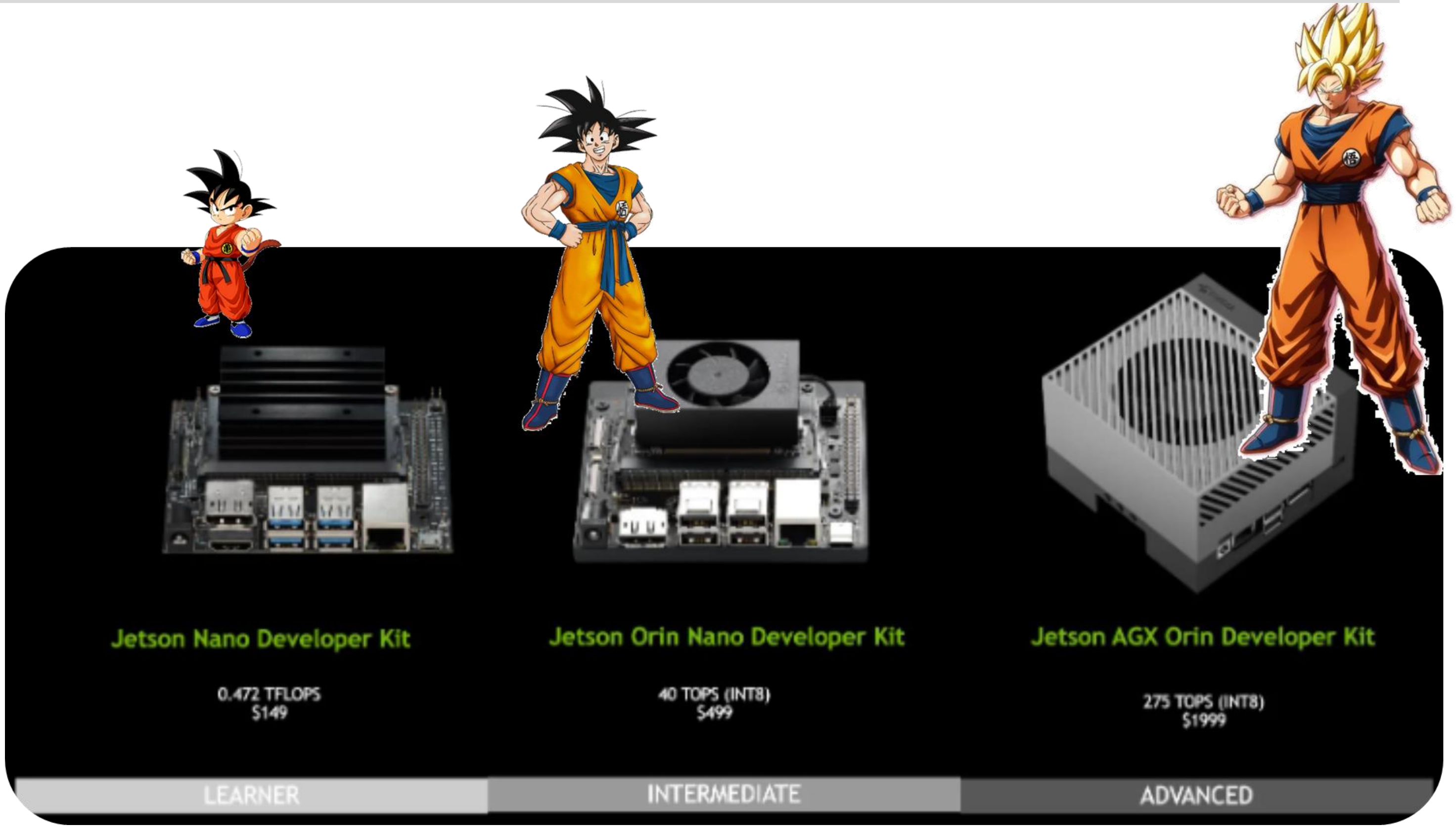
TFLOPS: Tera Floating-Point Operations Per Second



국제단위계(SI)에서 지정한 표준 접두어

접두어	기호	한자표기	10진법표기
데카(deca)	da	십(十)	10
헥토(hecto)	h	백(百)	100
킬로(kilo)	k	천(千)	1,000
메가(mega)	M	백만(百萬)	1,000,000
기가(giga)	G	십억(十億)	1,000,000,000
테라 (tera)	T	조(兆)	1,000,000,000,000
페타 (peta)	P	천조(千兆)	1,000,000,000,000,000
엑사 (exa)	E	백경(百京)	1,000,000,000,000,000,000
제타 (zetta)	Z	십해(垓)	1,000,000,000,000,000,000,000
요타 (yuotta)	Y	자(秭)	1,000,000,000,000,000,000,000,000

https://it.donga.com/7949/



Jetson Nano Developer Kit
0.472 TFLOPS
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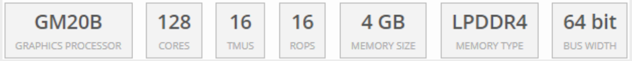
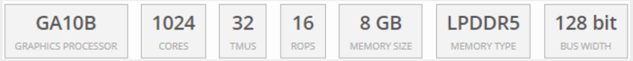
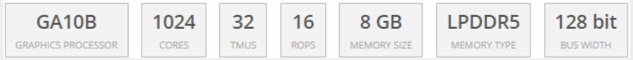
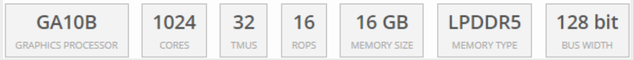
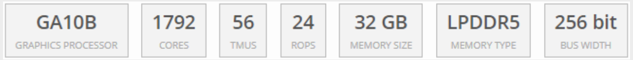
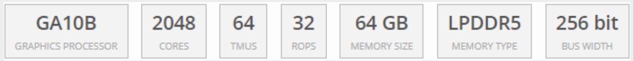
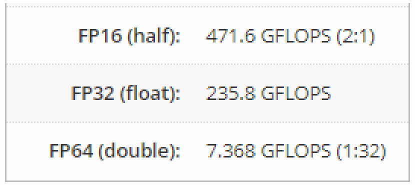
$1999
LEARNER
INTERMEDIATE
ADVANCED

Nvidia Jetsons

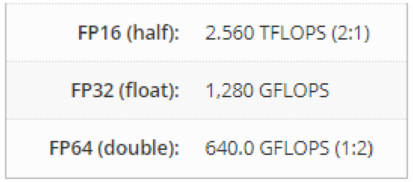
REF: https://www.techpowerup.com/gpu-specs/?mfgr=NVIDIA&generation=Tegra&sort=name

- Nvidia Jetson Family

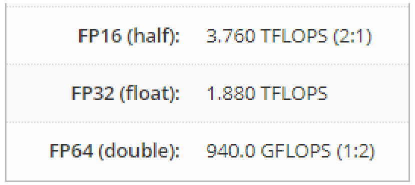
Year	Version	Performance	GPU	CPU	Memory	Power
2019	Jetson Nano	**235.8 GFLOPS**	**128-core** Nvidia Maxwell architecture GPU  GM20B GRAPHICS PROCESSOR 128 CORES 16 TMUS 16 ROPS 4 GB MEMORY SIZE LPDDR4 MEMORY TYPE 64 bit BUS WIDTH	**Quad-core** ARM Cortex-A57 MPCore processor	4 GiB	5–10 W
2023	Jetson Orin Nano	**20–40 TOPS** **-** **1,280 GFLOPS**	from **512-core** Nvidia Ampere architecture GPU with 16 Tensor cores  GA10B GRAPHICS PROCESSOR 1024 CORES 32 TMUS 16 ROPS 8 GB MEMORY SIZE LPDDR5 MEMORY TYPE 128 bit BUS WIDTH	**6-core** ARM Cortex-A78AE v8.2 64-bit CPU 1.5MB L2 + 4MB L3	4-8 GiB	7–10 W
2023	Jetson Orin NX	**70–100 TOPS** **-** **1.880 TFLOPS**	**1024-core** Nvidia Ampere architecture GPU with 32 Tensor cores  GA10B GRAPHICS PROCESSOR 1024 CORES 32 TMUS 16 ROPS 8 GB MEMORY SIZE LPDDR5 MEMORY TYPE 128 bit BUS WIDTH  GA10B GRAPHICS PROCESSOR 1024 CORES 32 TMUS 16 ROPS 16 GB MEMORY SIZE LPDDR5 MEMORY TYPE 128 bit BUS WIDTH	up to **8-core** ARM Cortex-A78AE v8.2 64-bit CPU 2MB L2 + 4MB L3	8–16 GiB	10–25 W
2023	Jetson Orin AGX	**200-275 TOPS** **-** **5.325 TFLOPS**	up to **2048(1792)-core** Nvidia Ampere architecture GPU with 64 Tensor cores  GA10B GRAPHICS PROCESSOR 1792 CORES 56 TMUS 24 ROPS 32 GB MEMORY SIZE LPDDR5 MEMORY TYPE 256 bit BUS WIDTH  GA10B GRAPHICS PROCESSOR 2048 CORES 64 TMUS 32 ROPS 64 GB MEMORY SIZE LPDDR5 MEMORY TYPE 256 bit BUS WIDTH	up to **12-core** ARM Cortex-A78AE v8.2 64-bit CPU 3MB L2 + 6MB L3	32–64 GiB	15–60 W



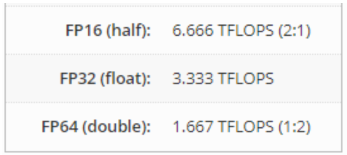
FP16 (half):	471.6 GFLOPS (2:1)
FP32 (float):	235.8 GFLOPS
FP64 (double):	7.368 GFLOPS (1:32)



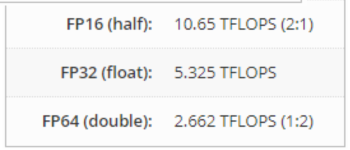
FP16 (half):	2.560 TFLOPS (2:1)
FP32 (float):	1,280 GFLOPS
FP64 (double):	640.0 GFLOPS (1:2)



FP16 (half):	3.760 TFLOPS (2:1)
FP32 (float):	1.880 TFLOPS
FP64 (double):	940.0 GFLOPS (1:2)



FP16 (half):	6.666 TFLOPS (2:1)
FP32 (float):	3.333 TFLOPS
FP64 (double):	1.667 TFLOPS (1:2)

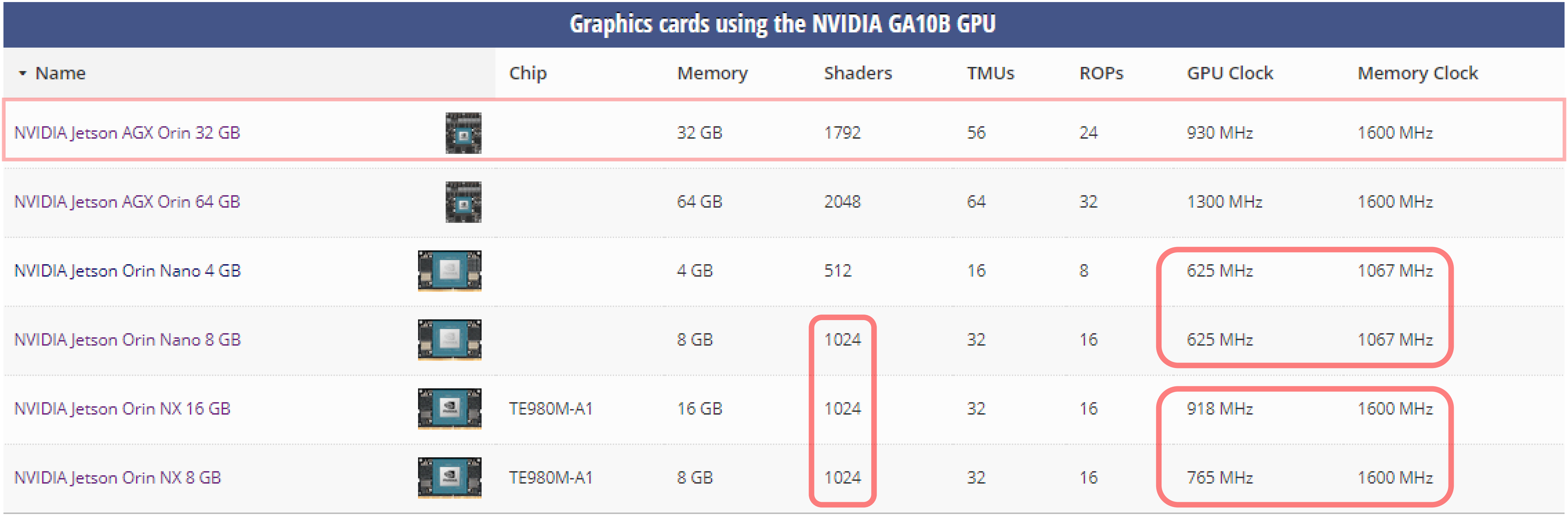


FP16 (half):	10.65 TFLOPS (2:1)
FP32 (float):	5.325 TFLOPS
FP64 (double):	2.662 TFLOPS (1:2)

Nvidia Jetsons

REF: https://www.techpowerup.com/gpu-specs/?mfgr=NVIDIA&generation=Tegra&sort=name

- Nvidia Jetson Family



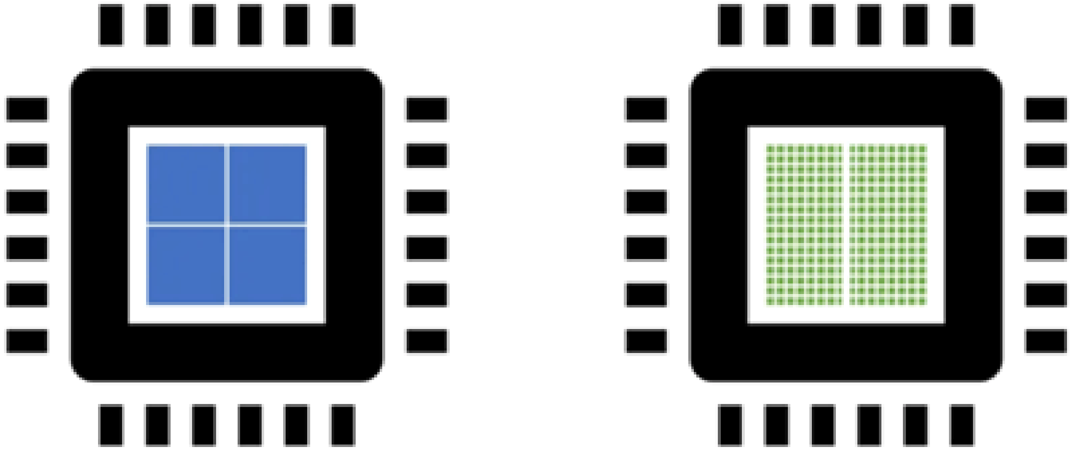
Graphics cards using the NVIDIA GA10B GPU

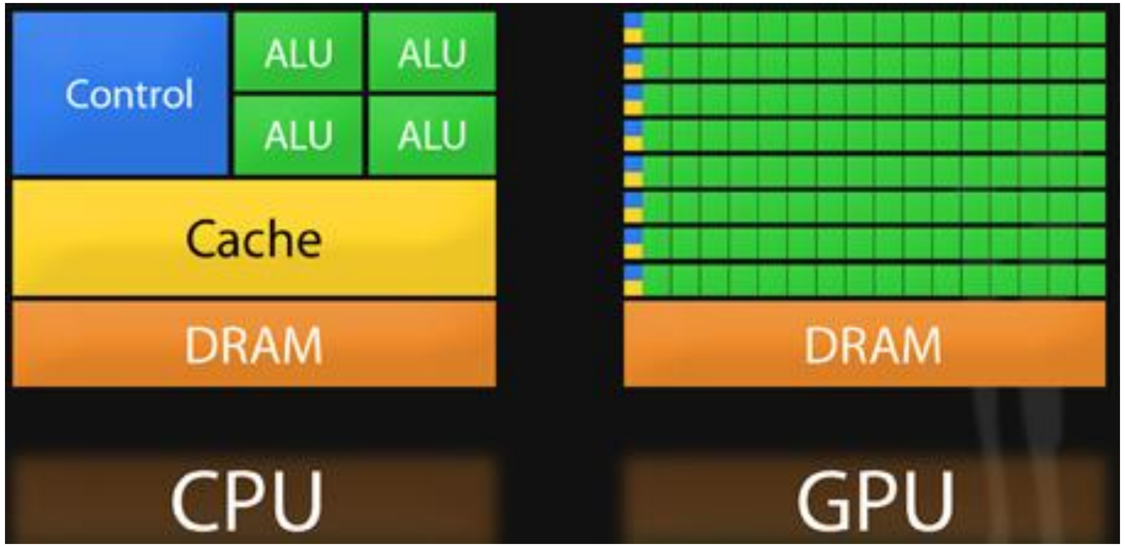
▾ Name	Chip	Memory	Shaders	TMUs	ROPs	GPU Clock	Memory Clock
NVIDIA Jetson AGX Orin 32 GB		32 GB	1792	56	24	930 MHz	1600 MHz
NVIDIA Jetson AGX Orin 64 GB		64 GB	2048	64	32	1300 MHz	1600 MHz
NVIDIA Jetson Orin Nano 4 GB		4 GB	512	16	8	625 MHz	1067 MHz
NVIDIA Jetson Orin Nano 8 GB		8 GB	1024	32	16	625 MHz	1067 MHz
NVIDIA Jetson Orin NX 16 GB	TE980M-A1	16 GB	1024	32	16	918 MHz	1600 MHz
NVIDIA Jetson Orin NX 8 GB	TE980M-A1	8 GB	1024	32	16	765 MHz	1600 MHz

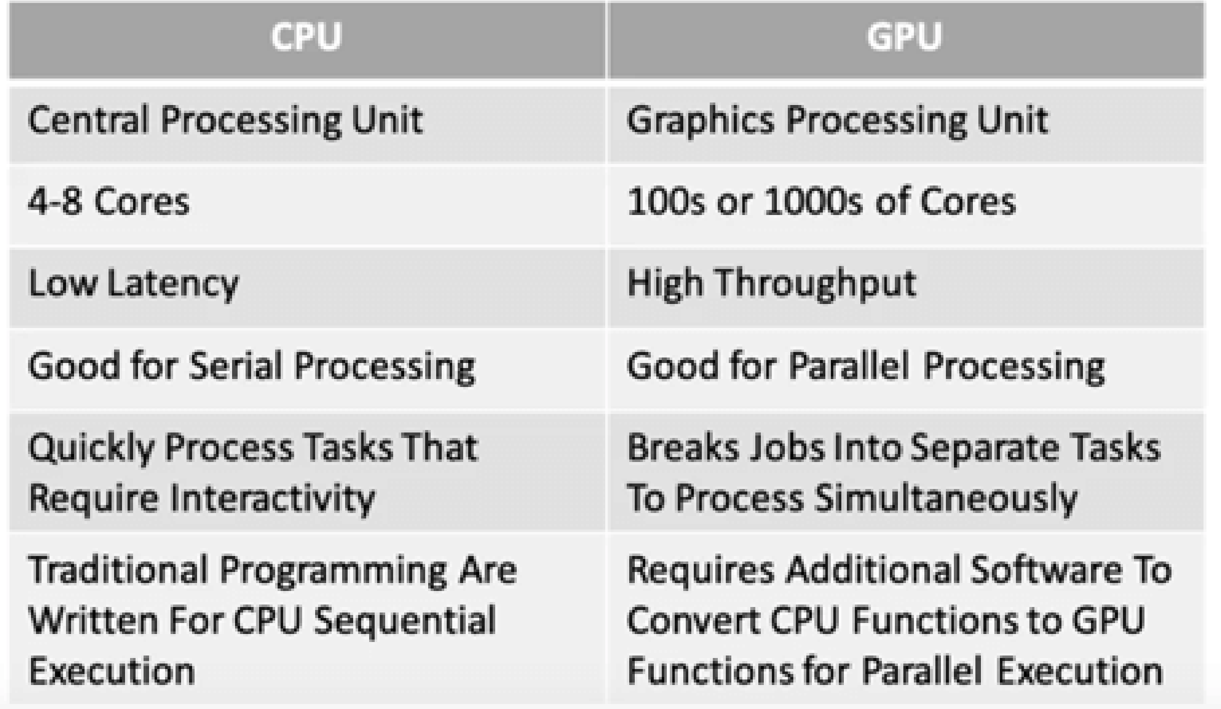
- **Shaders ~ CUDA cores**
- **TMUs ~ Texture mapping units**
- **ROPs ~ Render output units**

Nvidia GPUs

- GPU ???
- CPU ???
- Cores ???





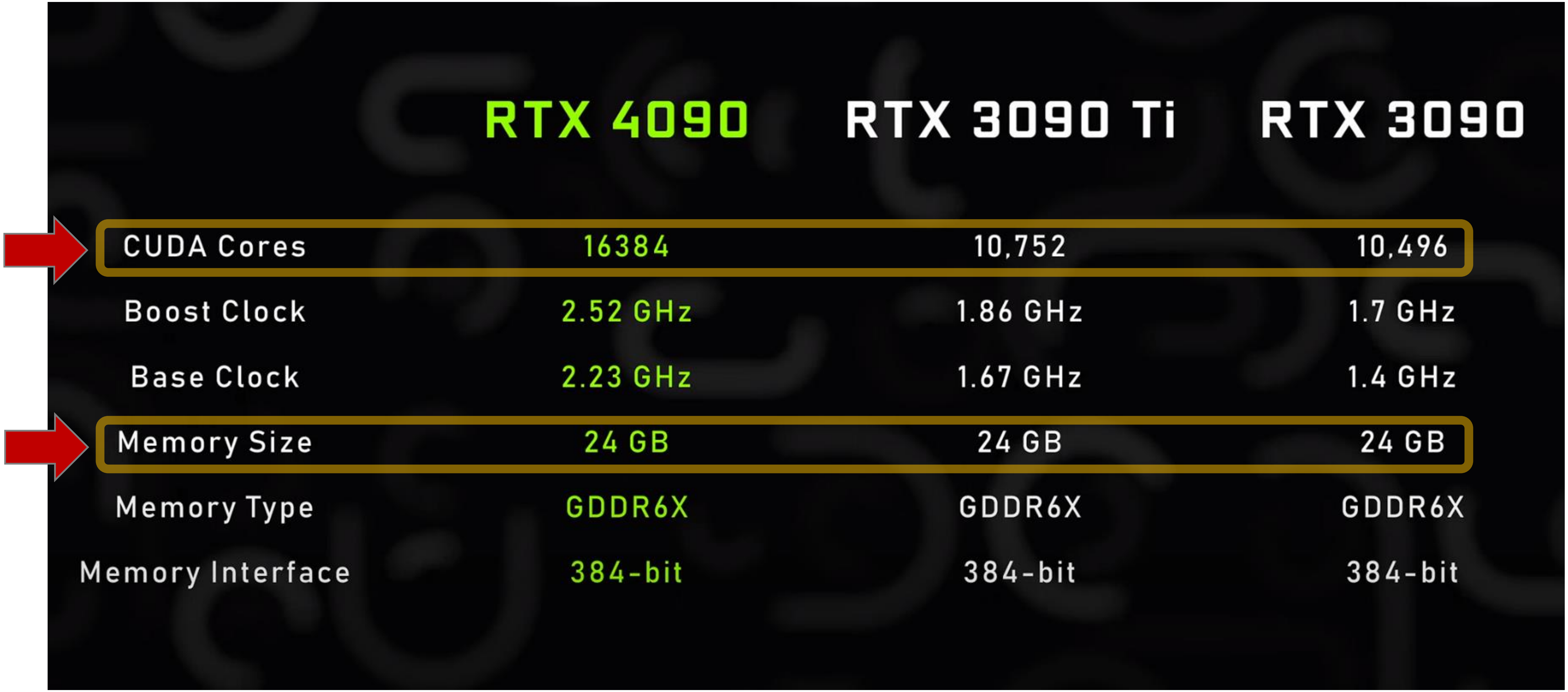


CPU	GPU
Central Processing Unit	Graphics Processing Unit
4-8 Cores	100s or 1000s of Cores
Low Latency	High Throughput
Good for Serial Processing	Good for Parallel Processing
Quickly Process Tasks That Require Interactivity	Breaks Jobs Into Separate Tasks To Process Simultaneously
Traditional Programming Are Written For CPU Sequential Execution	Requires Additional Software To Convert CPU Functions to GPU Functions for Parallel Execution

Nvidia Jetsons

REF: https://www.techpowerup.com/gpu-specs/?mfgr=NVIDIA&generation=Tegra&sort=name

- Nvidia **RTX 3090, 4090**, A100, H100

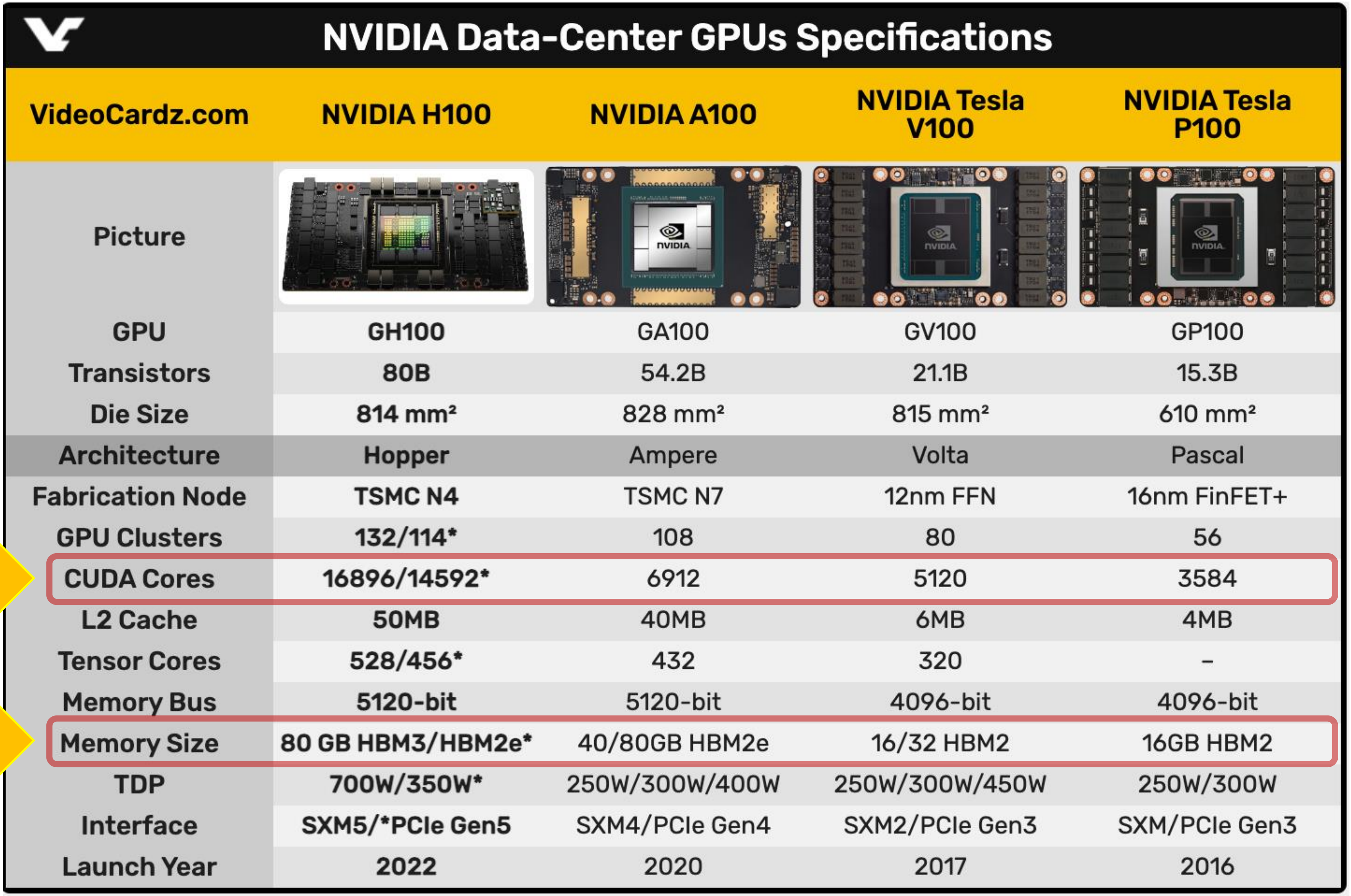


	RTX 4090	RTX 3090 Ti	RTX 3090
CUDA Cores	16384	10,752	10,496
Boost Clock	2.52 GHz	1.86 GHz	1.7 GHz
Base Clock	2.23 GHz	1.67 GHz	1.4 GHz
Memory Size	24 GB	24 GB	24 GB
Memory Type	GDDR6X	GDDR6X	GDDR6X
Memory Interface	384-bit	384-bit	384-bit

Nvidia Jetsons

REF: https://videocardz.com/newz/nvidia-h100-hopper-gpu-with-80gb-memory-listed-in-japan-for-over-33000-usd

- Nvidia RTX 3090, 4090, **A100, H100**



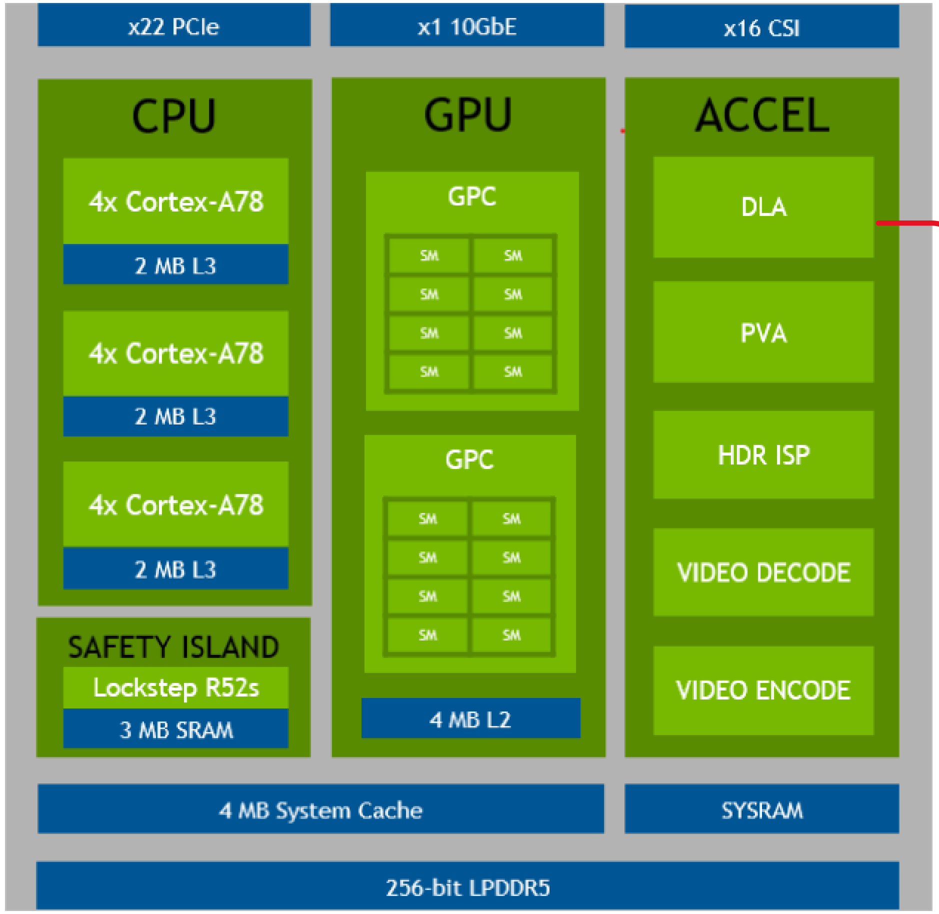
NVIDIA Data-Center GPUs Specifications

VideoCardz.com	NVIDIA H100	NVIDIA A100	NVIDIA Tesla V100	NVIDIA Tesla P100
Picture				
GPU	GH100	GA100	GV100	GP100
Transistors	80B	54.2B	21.1B	15.3B
Die Size	814 mm²	828 mm²	815 mm²	610 mm²
Architecture	Hopper	Ampere	Volta	Pascal
Fabrication Node	TSMC N4	TSMC N7	12nm FFN	16nm FinFET+
GPU Clusters	132/114*	108	80	56
CUDA Cores	16896/14592*	6912	5120	3584
L2 Cache	50MB	40MB	6MB	4MB
Tensor Cores	528/456*	432	320	–
Memory Bus	5120-bit	5120-bit	4096-bit	4096-bit
Memory Size	80 GB HBM3/HBM2e*	40/80GB HBM2e	16/32 HBM2	16GB HBM2
TDP	700W/350W*	250W/300W/400W	250W/300W/450W	250W/300W
Interface	SXM5/*PCIe Gen5	SXM4/PCIe Gen4	SXM2/PCIe Gen3	SXM/PCIe Gen3
Launch Year	2022	2020	2017	2016

Nvidia Jetsons

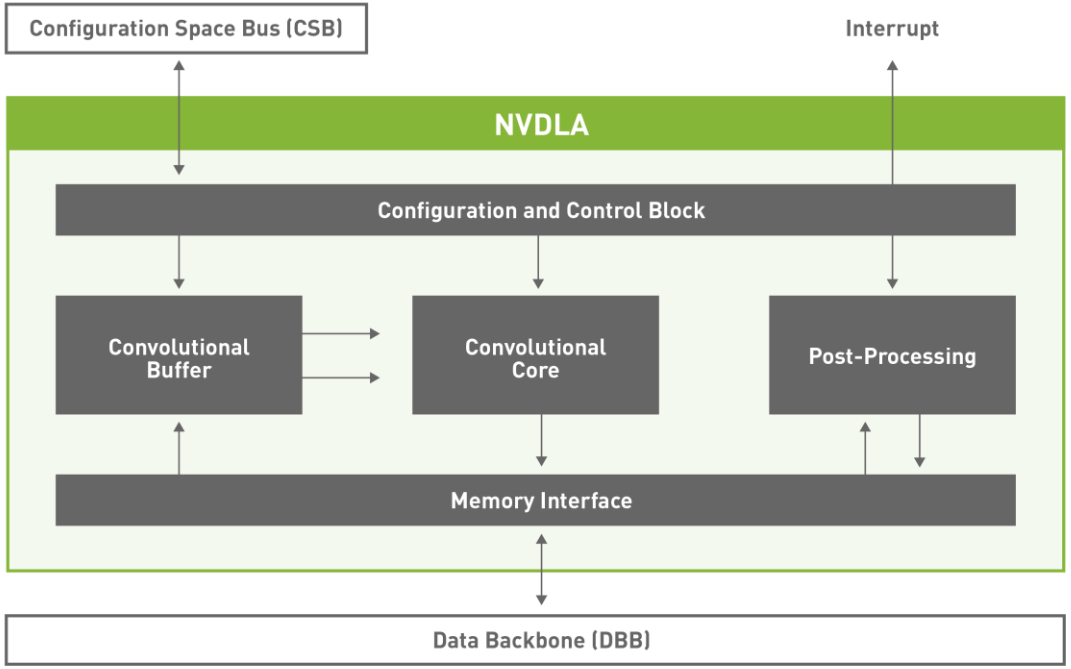
- Nvidia Jetson Family

Figure 2: Orin System-on-Chip (SoC) Block Diagram



NOTE: Jetson AGX Orin 32GB will have 2x 4 Core Clusters, and 7 TPCs with 14 SMs

- **GPC**: Graphics Processing Cluster
- **DLA**: Deep Learning Accelerator
- **PVA**: Programmable Vision Accelerator is a processor in NVIDIA® Jetson AGX Xavier™ and NVIDIA® Jetson Xavier™ NX devices that is specialized for image processing and computer vision algorithms



https://www.nvidia.com/content/dam/en-zz/Solutions/gtcf21/jetson-orin/nvidia-jetson-agx-orin-technical-brief.pdf

AI Model Performance on a Jetson (FPS)

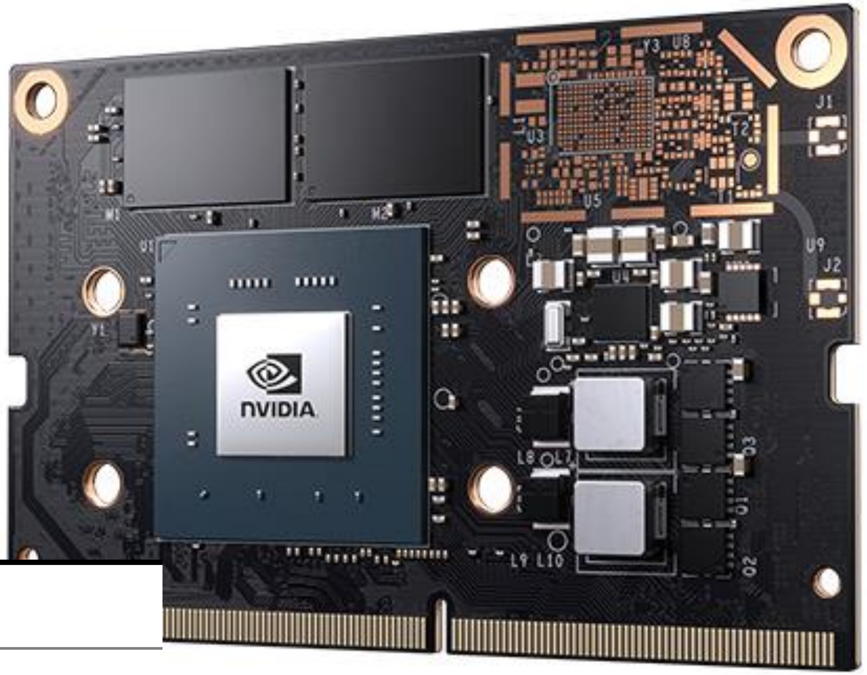
	사용 모델	고성능		중간 성능				저성능			
Model	Jetson AGX Orin 32GB	Jetson AGX Orin 64GB	성능 비율	Jetson Orin NX 8GB	성능 비율	Jetson Orin NX 16GB	성능 비율	Jetson Orin Nano 4GB	성능 비율	Jetson Orin Nano 8GB	성능 비율
Inveption_V4	1337.8	1702.6	1.27	593	0.44	769	0.57	182	0.14	361	0.27
VGG19	937	1471	1.57	442	0.47	532	0.57	174	0.19	361	0.39
Super_resolution	610	882	1.45	280	0.46	386	0.63	102	0.17	203	0.33
UNET-sgmentation	387	584	1.51	183	0.47	217	0.56	76	0.20	148	0.38
Pose Estimation	1424	2048	1.44	665	0.47	800	0.56	280	0.20	546	0.38
Yolov3-tiny	2611	3179	1.22	1156	0.44	1440	0.55	371	0.14	731	0.28
Resnet50	3717	4834	1.30	1725	0.46	2183	0.59	621	0.17	1158	0.31
SSD-Mobilnet	6415	7671	1.20	2893	0.45	3457	0.54	1094	0.17	2156	0.34
SSD_Resnet34_1200 x1200	120	163	1.36	52	0.43	72	0.60	18	0.15	34	0.28
Yolov5m	342	519	1.52	162	0.47	193	0.56	69	0.20	131	0.38
Yolov5s	785	1135	1.45	379	0.48	449	0.57	158	0.20	301	0.38
평균 성능 비율	1		1.39		0.46		0.57		0.17		0.34

- These Benchmarks were run using Jetpack 5.1.1
- Each Jetson module was run with maximum performance (Max Frequencies in MAXN for JAO64, JAO32, ONX16, ONX8; and 15W mode for JON8, and 10W mode for JON4)
- Steps to reproduce these results can be found here (https://github.com/NVIDIA-AI-IOT/jetson_benchmarks/)

Jetson Nano System 설정

Jetson Nano에 대해...

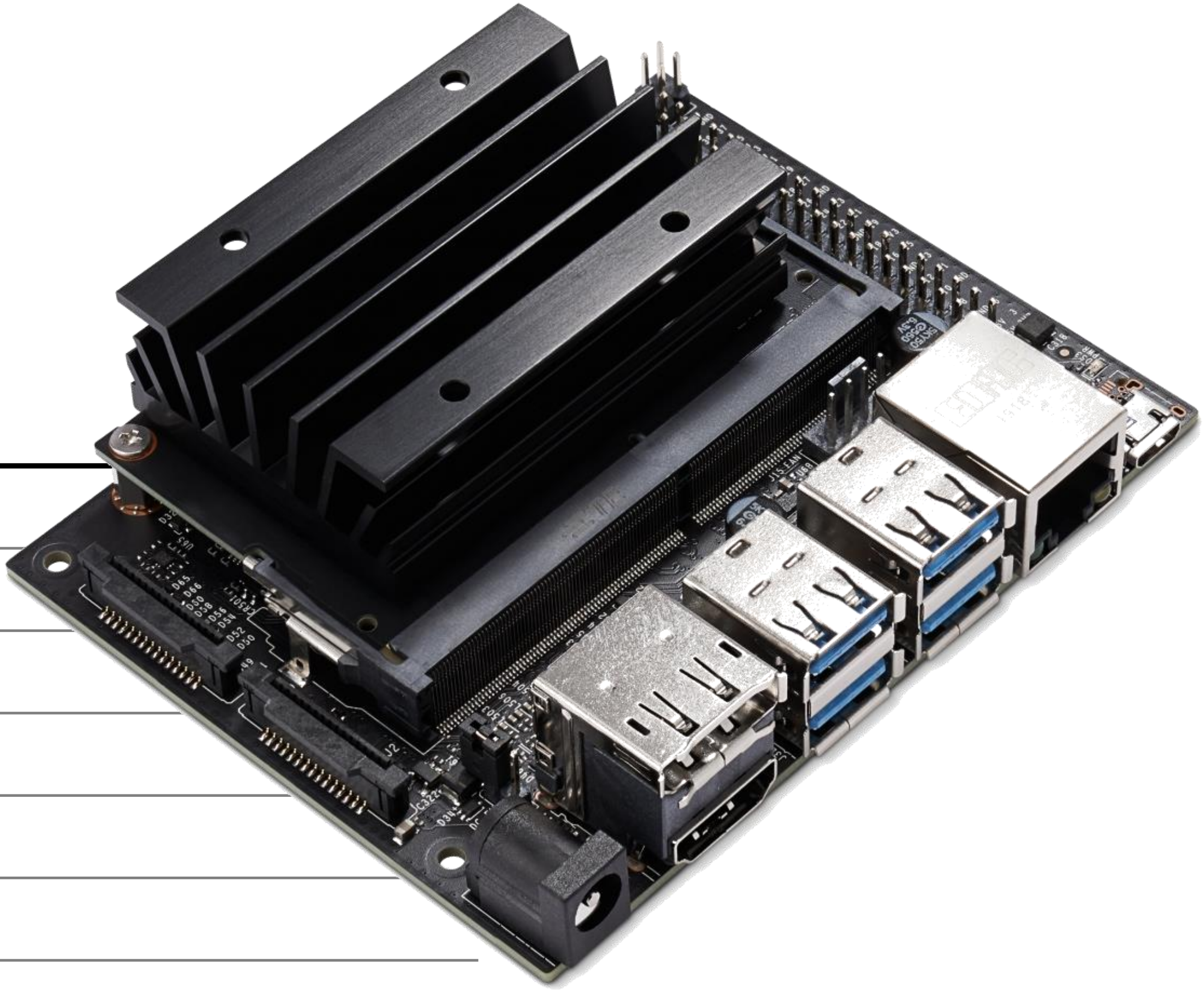
- Nvidia Jetson Nano



GPU	**NVIDIA Maxwell architecture with 128 NVIDIA CUDA® cores**
CPU	**Quad-core ARM Cortex-A57 MPCore processor**
Memory	**4 GB 64-bit LPDDR4, 1600MHz 25.6 GB/s**
Storage	**16 GB eMMC 5.1**
Camera	**12 lanes (3x4 or 4x2) MIPI CSI-2 D-PHY 1.1 (1.5 Gb/s per pair)**
Connectivity	**Gigabit Ethernet, M.2 Key E**
Display	**HDMI 2.0 and eDP 1.4**
USB	**4x USB 3.0, USB 2.0 Micro-B**
Others	**GPIO, I^{2}C, I^{2}S, SPI, UART**
Mechanical	**69.6 mm x 45 mm 260-pin edge connector**

Jetson Nano에 대해...

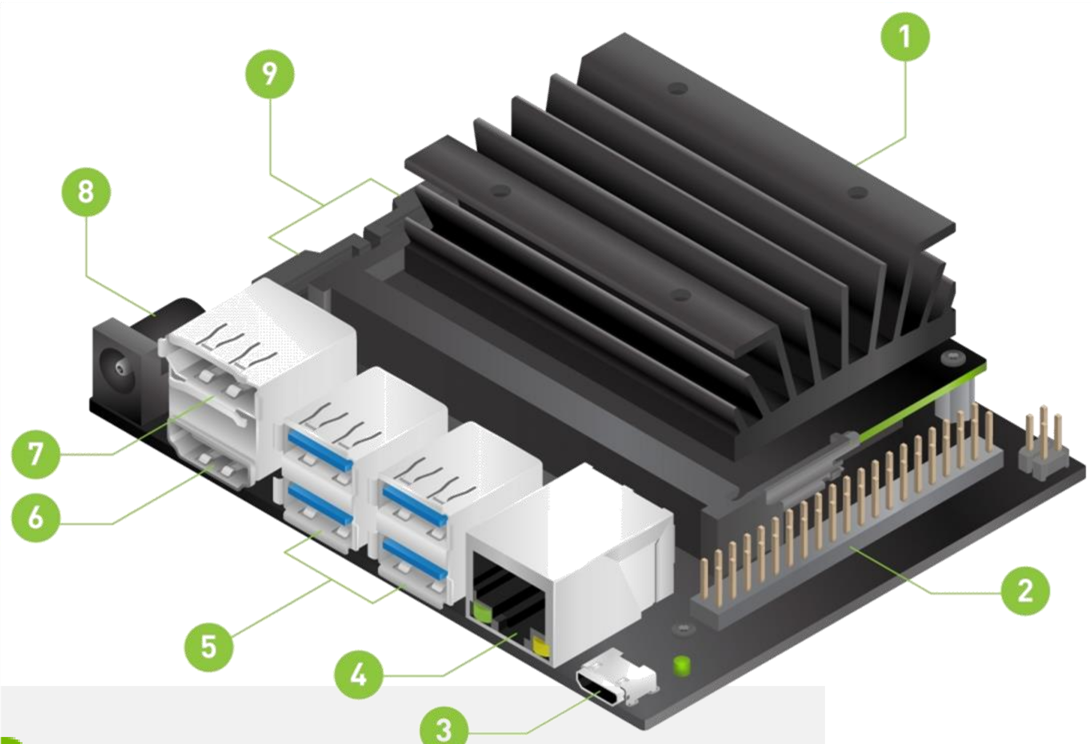
- Nvidia Jetson Nano

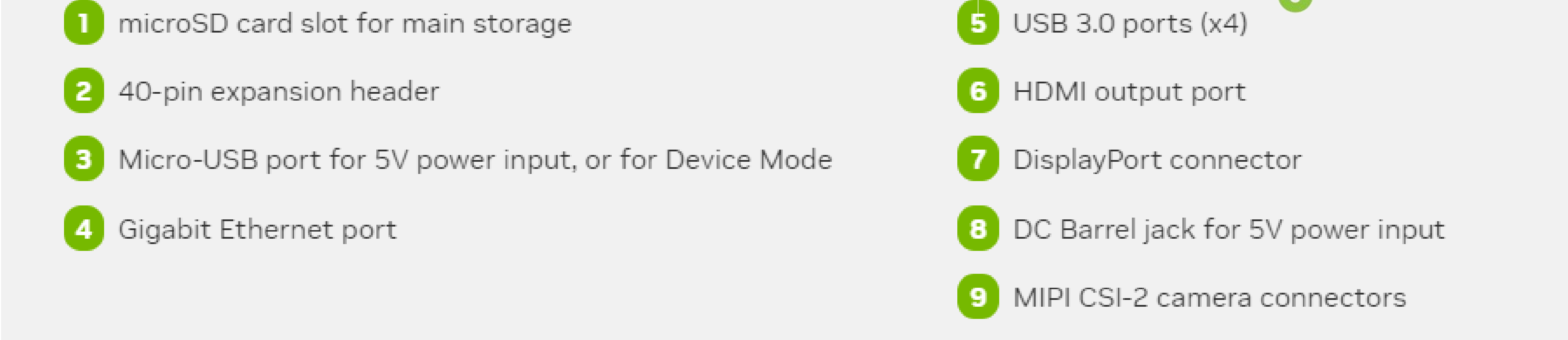


GPU	128-core Maxwell
CPU	Quad-core ARM A57 @ 1.43 GHz
Memory	4 GB 64-bit LPDDR4 25.6 GB/s
Storage	microSD (not included)
Camera	2x MIPI CSI-2 DPHY lanes
Connectivity	Gigabit Ethernet, M.2 Key E
Display	HDMI and display port
USB	4x USB 3.0, USB 2.0 Micro-B
Others	GPIO, I^{2}C, I^{2}S, SPI, UART
Mechanical	69 mm x 45 mm, 260-pin edge connector

Jetson Nano에 대해...

- Nvidia Jetson Nano





1 microSD card slot for main storage

2 40-pin expansion header

3 Micro-USB port for 5V power input, or for Device Mode

4 Gigabit Ethernet port

5 USB 3.0 ports (x4)

6 HDMI output port

7 DisplayPort connector

8 DC Barrel jack for 5V power input

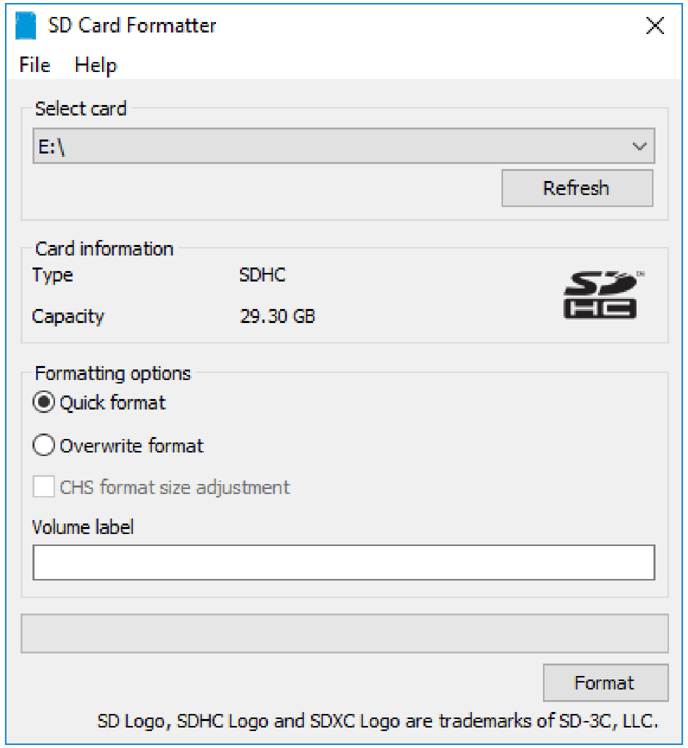
9 MIPI CSI-2 camera connectors

https://developer.nvidia.com/embedded/learn/get-started-jetson-nano-devkit

Jetson Nano에 대해...

- Nvidia Jetson Nano에 OS 설치하자!

  https://developer.nvidia.com/embedded/learn/get-started-jetson-nano-devkit
- Download the [Jetson Nano Developer Kit SD Card Image]()
- Write the image to your microSD card



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File Help

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Refresh

Card information

Type SDHC

Capacity 29.30 GB

Formatting options

● Quick format

○ Overwrite format

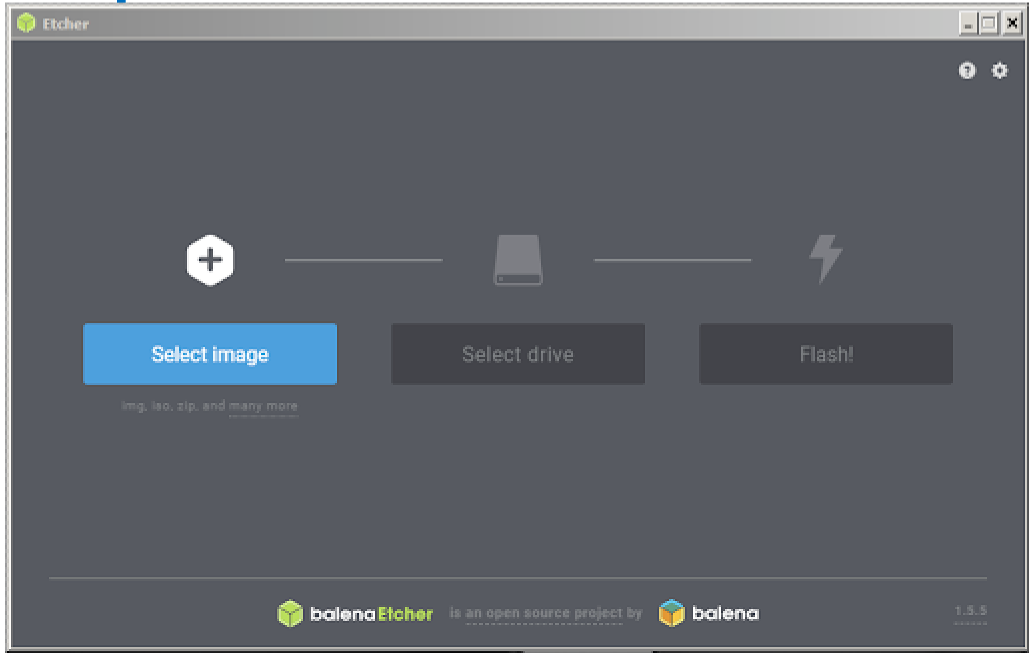
□ CHS format size adjustment

Volume label

Format

SD Logo, SDHC Logo and SDXC Logo are trademarks of SD-3C, LLC.

https://etcher.balena.io/



Etcher
Select image
img, iso, zip, and many more
Select drive
Flash!
balenaEtcher is an open source project by balena
1.5.5

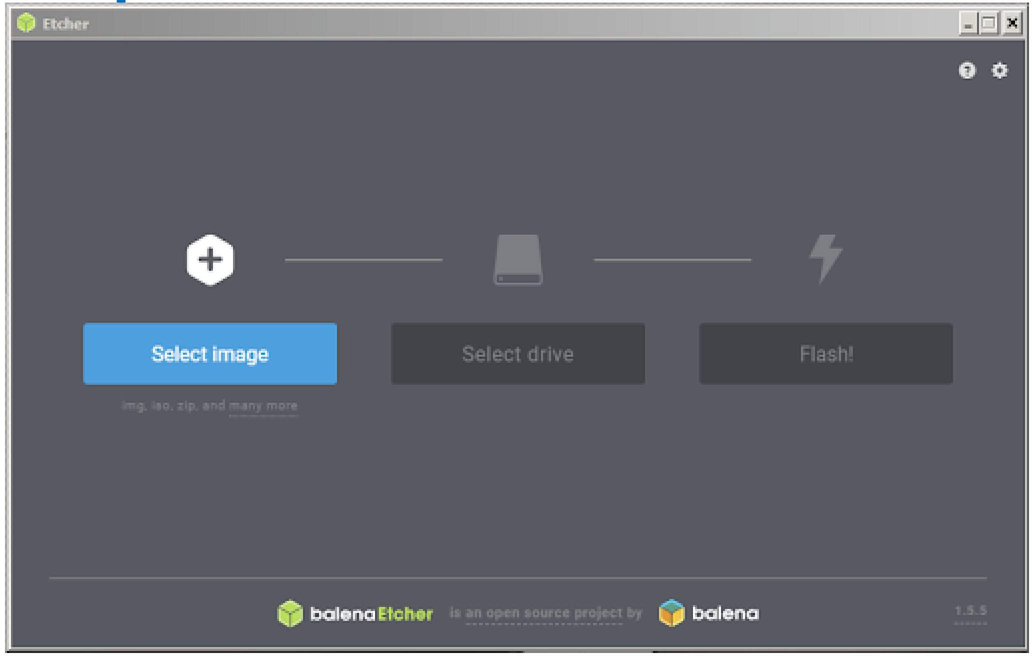
Jetson Nano에 대해...

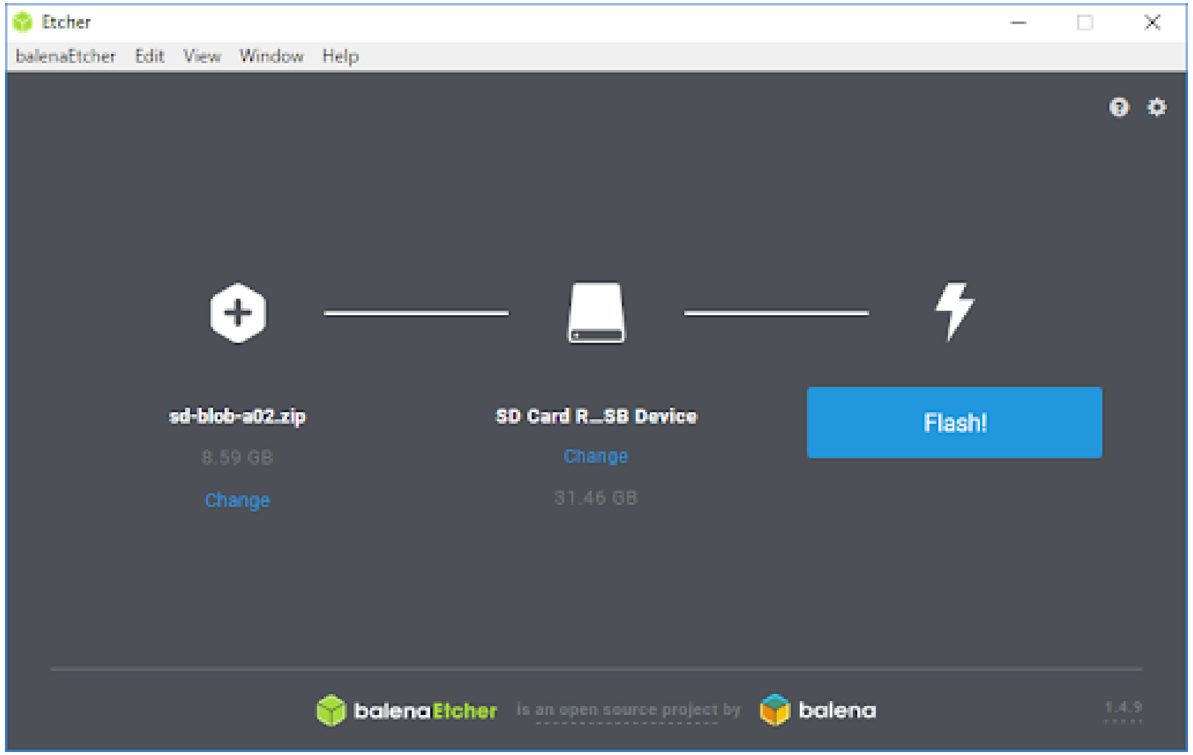
- Nvidia Jetson Nano에 OS 설치하자!

  https://developer.nvidia.com/embedded/learn/get-started-jetson-nano-devkit

- Download the Jetson Nano Developer Kit SD Card Image (**Jetpack 4.6.1**)
- Write the image to your microSD card

  https://etcher.balena.io/


Etcher
Select image
img, iso, zip, and many more
Select drive
Flash!
balenaEtcher is an open source project by balena
1.5.5

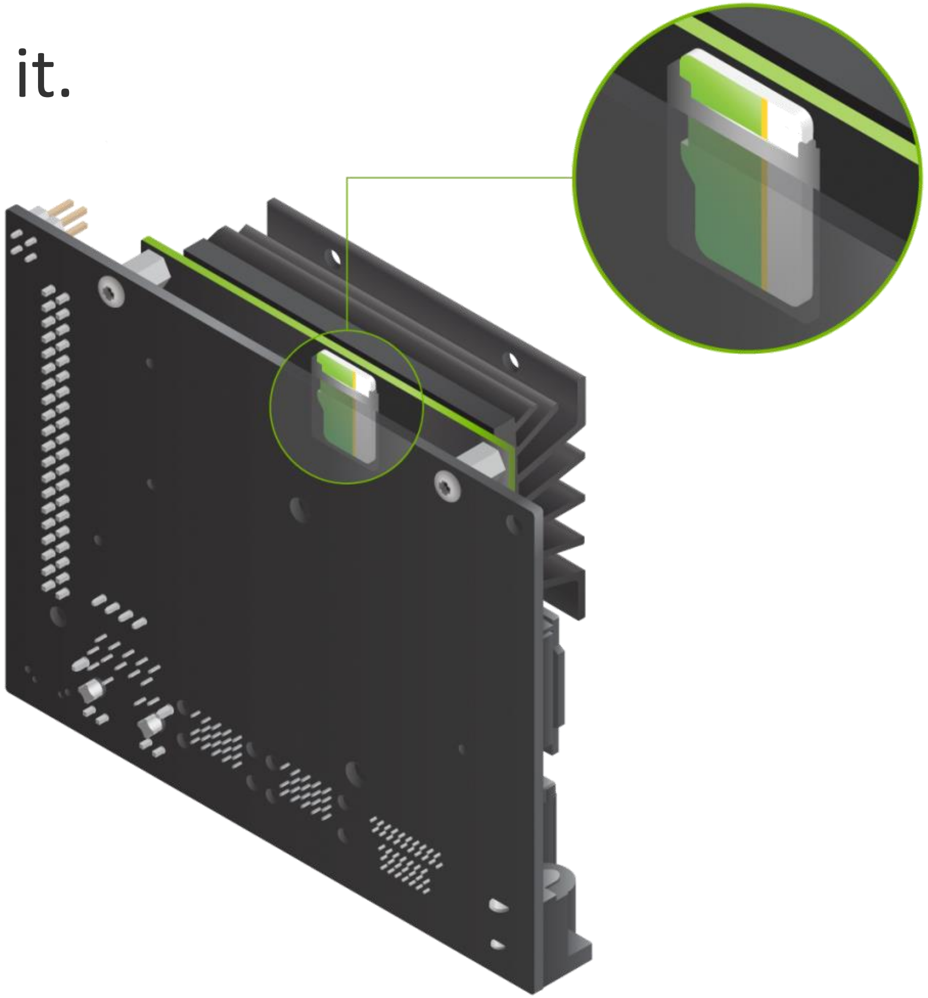

Etcher
balenaEtcher Edit View Window Help
sd-blob-a02.zip
8.59 GB
Change
SD Card R...SB Device
Change
31.46 GB
Flash!
balenaEtcher is an open source project by balena
1.4.9

Jetson Nano의 전원을 올려볼까요 ?

https://developer.nvidia.com/embedded/learn/get-started-jetson-nano-devkit#setup

Jetson Nano의 전원을 올려볼까요 ?

- Insert the microSD card.
- Power on your computer display and connect it.
- Connect the USB keyboard and mouse.
- Connect your Micro-USB power supply



https://developer.nvidia.com/embedded/learn/get-started-jetson-nano-devkit#setup

Jetson Nano 부팅부팅~

- A green LED next to the Micro-USB connector will light as soon as the developer kit powers on.
- When you boot the first time, the developer kit will take you through some initial setup, including:
  - Review and accept NVIDIA Jetson software EULA (사용자 라이선스 동의)
  - Select system language, keyboard layout, and time zone
  - Create username, password, and computer name
  - Select APP partition size—it is recommended to use the max size suggested

Keyboard Shortcuts

Launcher

Super (Hold)	Opens the Launcher, displays shortcuts.
Alt + F1	Opens Launcher keyboard navigation mode.
Super + Tab	Switches applications via the Launcher.
Super + 1 to 9	Same as clicking on a Launcher icon.
Super + Shift + 1 to 9	Opens a new window in the app.
Super + T	Opens the Trash.

HUD & Menu Bar

Alt (Tap)	Opens the HUD.
Alt (Hold)	Reveals the application menu.
Alt + F10	Opens the indicator menu.
Cursor Left or Right	Moves focus between indicators.
Print	Take a screenshot.
Alt + Print	Take a screenshot of the current window.

Switching

Alt + Tab	Switches between applications.
Alt + `	Switches windows of current applications.
Cursor Left or Right	Moves the focus.
Cursor Up or Down	Enter / Exit from spread mode or Select windows.
Alt + Q	Closes the selected application / window.

Dash

Super (Tap)	Opens the Dash Home.
Super + A	Opens the Dash App Lens.
Super + F	Opens the Dash Files Lens.
Super + M	Opens the Dash Music Lens.
Super + C	Opens the Dash Photo Lens.
Super + V	Opens the Dash Video Lens.
Ctrl + Tab	Switches between Lenses.
Arrow Keys	Moves the focus.
Enter	Opens the currently focused item.

Windows

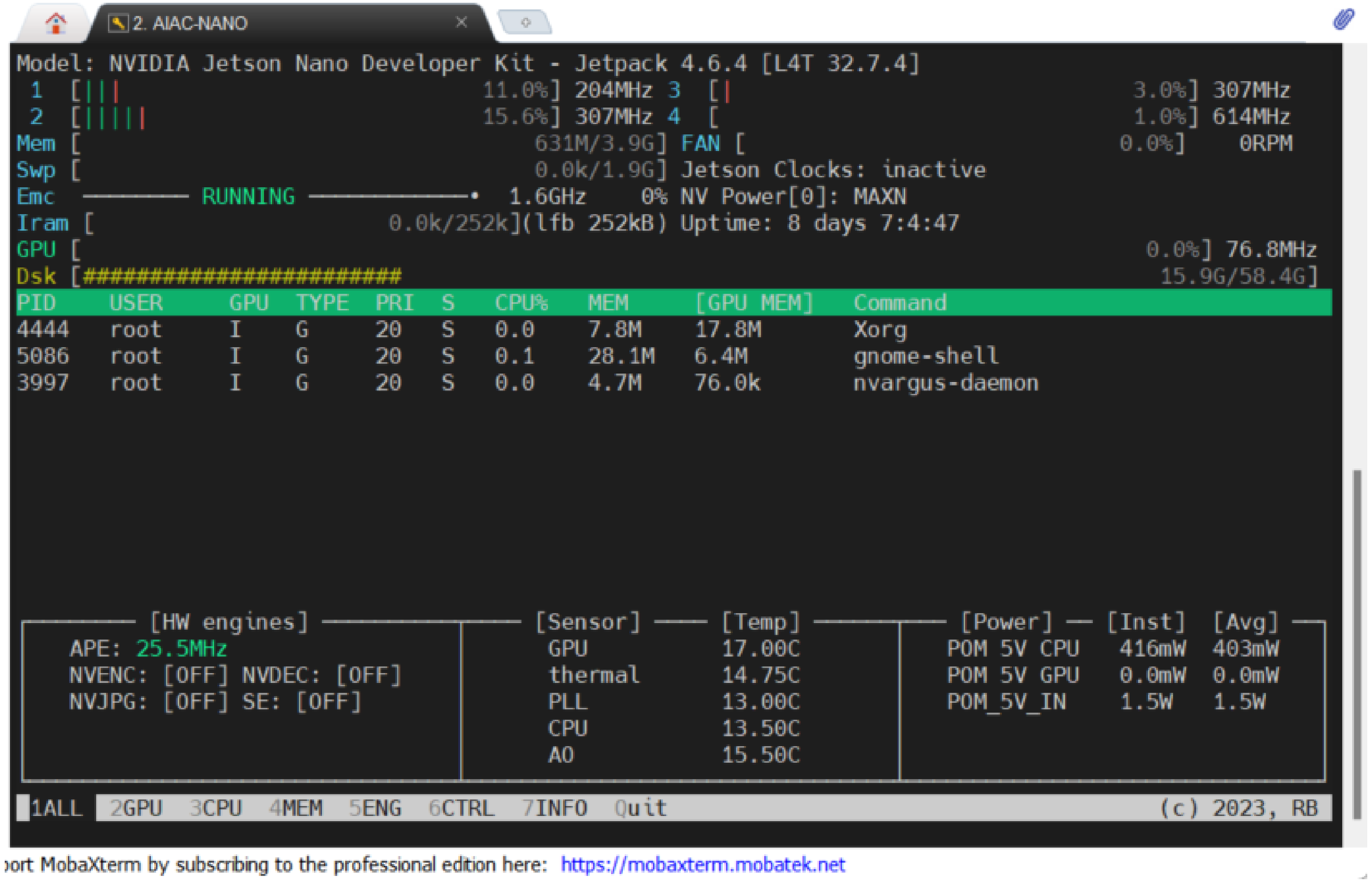
Super + W	Spreads all windows.
Ctrl + Super + W	Spreads all windows of the focused application.
Ctrl + Super + D	Minimises all windows.
Ctrl + Super + Up	Maximises the current window.
Ctrl + Super + Down	Restores or minimises the current window.
Ctrl + Super + Left or Right	Semi-maximise the current window.
Alt + F4	Closes the current window.
Alt + Space	Opens the window accessibility menu.
Ctrl + Alt + Num (keypad)	Places the window in corresponding position.
Alt + Left Mouse Drag	Moves the window.
Alt + Middle Mouse Drag	Resizes the window.

https://developer.nvidia.com/embedded/learn/get-started-jetson-nano-devkit#setup

Jetson Nano 부팅부팅~

- jtop 설치

```
sudo apt-get update
sudo apt-get upgrade
sudo apt-get install python-pip
# jetson-stats 설치
sudo -H pip install -U jetson-stats
# 재부팅
sudo reboot now
# jetpack 버전 확인 및 cpu, 메모리 cuda,
# opencv 정보까지 확인 가능
```



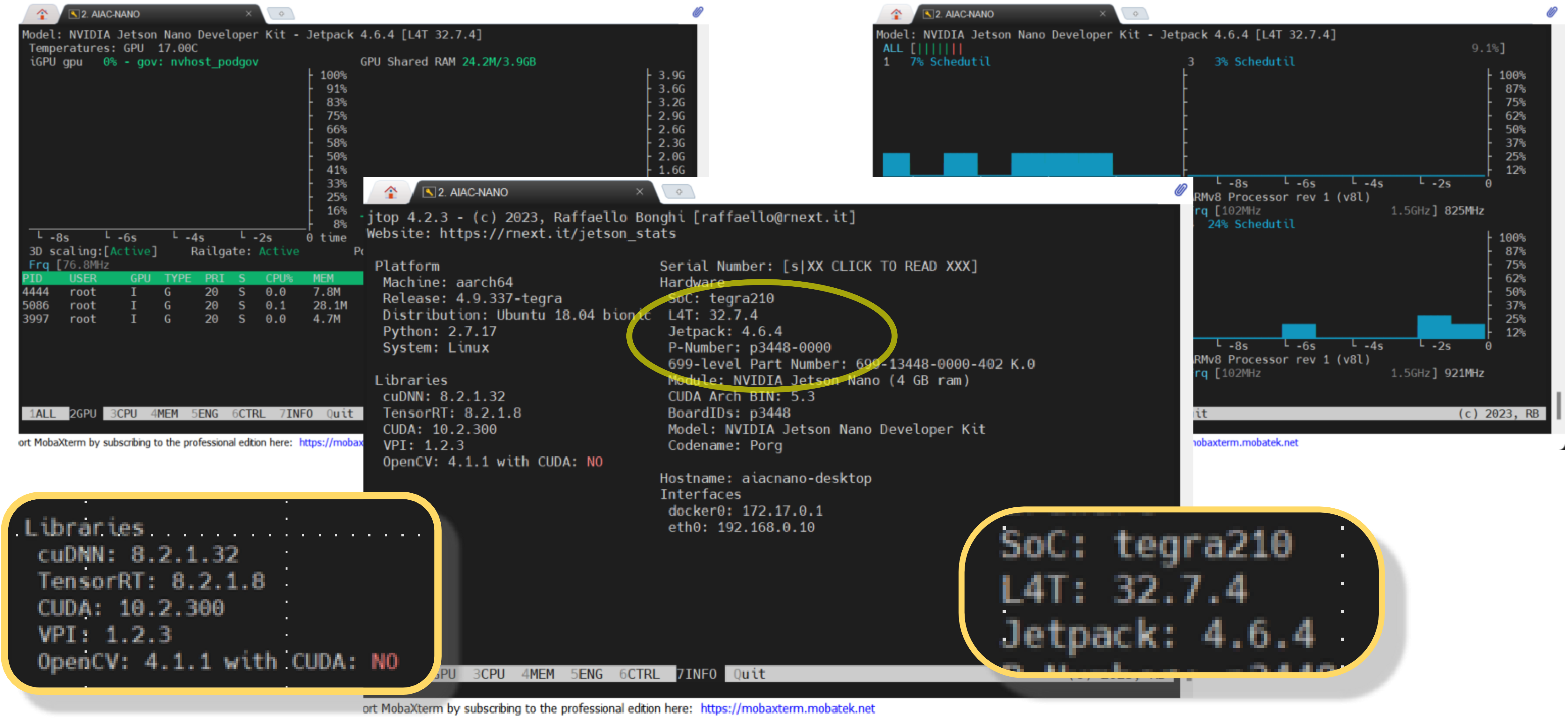
```
Model: NVIDIA Jetson Nano Developer Kit - Jetpack 4.6.4 [L4T 32.7.4]
 1  [|||                           11.0%] 204MHz 3  [|                           3.0%] 307MHz
 2  [|||||                         15.6%] 307MHz 4  [                            1.0%] 614MHz
Mem [                            631M/3.9G] FAN [                          0.0%]    0RPM
Swp [                            0.0k/1.9G] Jetson Clocks: inactive
Emc  ──────── RUNNING ─────────────• 1.6GHz    0% NV Power[0]: MAXN
Iram [                   0.0k/252k](lfb 252kB) Uptime: 8 days 7:4:47
GPU [                                                                           0.0%] 76.8MHz
Dsk [########################                                                15.9G/58.4G]
PID     USER     GPU  TYPE  PRI   S   CPU%    MEM     [GPU MEM]    Command
4444    root     I    G     20    S   0.0     7.8M    17.8M        Xorg
5086    root     I    G     20    S   0.1     28.1M   6.4M         gnome-shell
3997    root     I    G     20    S   0.0     4.7M    76.0k        nvargus-daemon

┌──────── [HW engines] ───────────┬── [Sensor] ──── [Temp] ────────┬── [Power] ─ [Inst] [Avg] ─┐
   APE: 25.5MHz                       GPU           17.00C            POM 5V CPU   416mW  403mW
   NVENC: [OFF] NVDEC: [OFF]          thermal       14.75C            POM 5V GPU   0.0mW  0.0mW
   NVJPG: [OFF] SE: [OFF]             PLL           13.00C            POM_5V_IN    1.5W   1.5W
                                      CPU           13.50C
                                      AO            15.50C
└─────────────────────────────────┴───────────────────────────────┴──────────────────────────┘
 1ALL  2GPU  3CPU  4MEM  5ENG  6CTRL  7INFO  Quit                                  (c) 2023, RB
```

ort MobaXterm by subscribing to the professional edition here: https://mobaxterm.mobatek.net

Jetson Nano 부팅부팅~

- Jtop을 통해 시스템의 정보를 살펴보기



```
Model: NVIDIA Jetson Nano Developer Kit - Jetpack 4.6.4 [L4T 32.7.4]
 Temperatures: GPU  17.00C
 iGPU gpu    0% - gov: nvhost_podgov                  GPU Shared RAM 24.2M/3.9GB
                                         100%                                3.9G
                                          91%                                3.6G
                                          83%                                3.2G
                                          75%                                2.9G
                                          66%                                2.6G
                                          58%                                2.3G
                                          50%                                2.0G
                                          41%                                1.6G
                                          33%
                                          25%
                                          16%
                                           8%
  └ -8s      └ -6s      └ -4s      └ -2s   0 time
 3D scaling:[Active]      Railgate: Active              Po
 Frq [76.8MHz
PID     USER      GPU  TYPE  PRI  S    CPU%    MEM
4444    root      I    G     20   S    0.0     7.8M
5086    root      I    G     20   S    0.1     28.1M
3997    root      I    G     20   S    0.0     4.7M

 1ALL  2GPU  3CPU  4MEM  5ENG  6CTRL  7INFO  Quit
```

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```
Model: NVIDIA Jetson Nano Developer Kit - Jetpack 4.6.4 [L4T 32.7.4]
 ALL [|||||||                                                     9.1%]
 1   7% Schedutil                            3   3% Schedutil
                                                                        100%
                                                                         87%
                                                                         75%
                                                                         62%
                                                                         50%
                                                                         37%
                                                                         25%
                                                                         12%
                                         └ -8s   └ -6s   └ -4s   └ -2s   0
                                        RMv8 Processor rev 1 (v8l)
                                        rq [102MHz               1.5GHz] 825MHz
                                             24% Schedutil
                                                                        100%
                                                                         87%
                                                                         75%
                                                                         62%
                                                                         50%
                                                                         37%
                                                                         25%
                                                                         12%
                                         └ -8s   └ -6s   └ -4s   └ -2s   0
                                        RMv8 Processor rev 1 (v8l)
                                        rq [102MHz               1.5GHz] 921MHz

                                        it                          (c) 2023, RB
```

obaxterm.mobatek.net

```
jtop 4.2.3 - (c) 2023, Raffaello Bonghi [raffaello@rnext.it]
Website: https://rnext.it/jetson_stats

 Platform                                  Serial Number: [s|XX CLICK TO READ XXX]
  Machine: aarch64                         Hardware
  Release: 4.9.337-tegra                    SoC: tegra210
  Distribution: Ubuntu 18.04 bionic         L4T: 32.7.4
  Python: 2.7.17                            Jetpack: 4.6.4
  System: Linux                             P-Number: p3448-0000
                                            699-level Part Number: 699-13448-0000-402 K.0
 Libraries                                  Module: NVIDIA Jetson Nano (4 GB ram)
  cuDNN: 8.2.1.32                           CUDA Arch BIN: 5.3
  TensorRT: 8.2.1.8                         BoardIDs: p3448
  CUDA: 10.2.300                            Model: NVIDIA Jetson Nano Developer Kit
  VPI: 1.2.3                                Codename: Porg
  OpenCV: 4.1.1 with CUDA: NO
                                           Hostname: aiacnano-desktop
                                           Interfaces
                                            docker0: 172.17.0.1
                                            eth0: 192.168.0.10

   PU  3CPU  4MEM  5ENG  6CTRL  7INFO  Quit
```

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```
Libraries
 cuDNN: 8.2.1.32
 TensorRT: 8.2.1.8
 CUDA: 10.2.300
 VPI: 1.2.3
 OpenCV: 4.1.1 with CUDA: NO
```

```
SoC: tegra210
L4T: 32.7.4
Jetpack: 4.6.4
```