–LEETOP TECH CO., LTD.–

User Guide

Leetop_ALP_680_

User_Guide_V2.0

NVIDIA ELITE PARTNER

Leetop Technology (Shenzhen) Co., Ltd..
http://www.leetop.top

Notice

- Please read manual carefully before install, operate, or transport Leetop device.
- Ensure that the correct power range is being used before powering the device.
- Avoid hot plugging.
- To properly turn off the power, please shut down the Ubuntu system first, and then cut off the power. Due to the particularity of the Ubuntu system, on the Nvidia developer kit, if the power is turned off when the startup is not completed, there will be a 0.03% probability of abnormality, which will cause the device to fail to start. Due to the use of the Ubuntu system, the same problem also exists on the Leetop device.
- Do not use cables or connectors other than described in this manual.
- Do not use Leetop device near strong magnetic fields.
- Backup your data before transportation or Leetop device is idle.
- Recommend to transport Leetop device in its original packaging.
- Warn! This is a Class A product, in a living environment this product may cause radio interference. In this case, the user may be required to take practicable measures against the interference.
- Working in a high temperature environment for a long time, it is not recommended to touch the shell to avoid burns.
- Dismantling the machine without consent is regarded as a waiver of the warranty.

Careful scald at high temperature

Service and Support

Technical Support

Leetop is glad to help you with any questions you may have about our product, or about the use of the technology for your application. The fastest way is sending us an email: service@leetop.top

Warranties

Warranty period: One year from the date of delivery.

Warranty content:

Leetop warrants the product manufactured by us to be free from defects in material and workmanship during warranty period. Please contact service@leetop.top for return material authorization (RMA) prior to returning any items for repair or exchange. The product must be returned in its original packaging to prevent damage during shipping. Before returning any product for repair, it is recommended to back up your data and delete any confidential or personal data.

Packing List

- Leetop_ALP_680

  Non-standard equipment:
- Power adapter x 1
- Power cord x 2

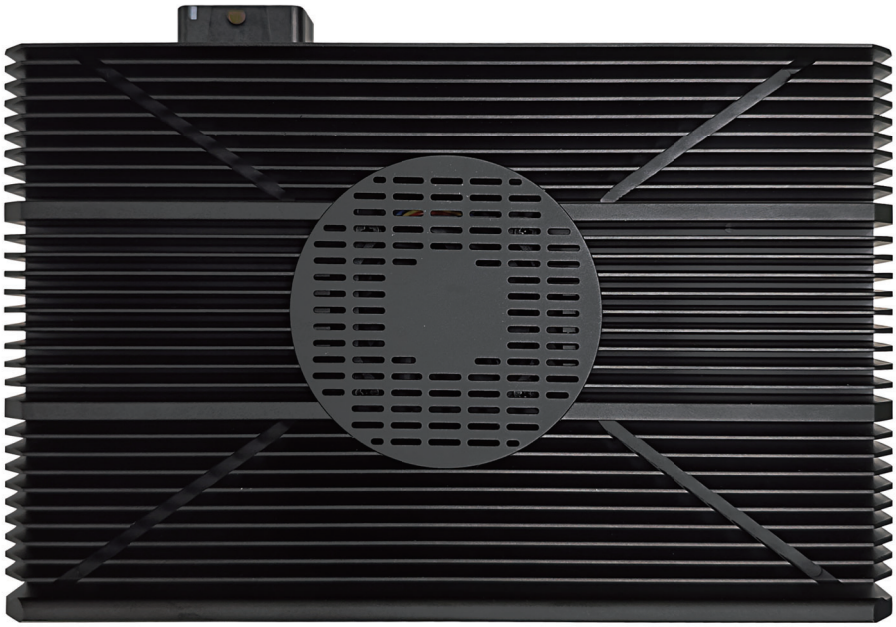
DOCUMENT CHANGE HISTORY

Document	Version	date	Description of Change
Leetop_ALP_680	V1.0	20231213	Initial release
	V2.0	20240109	Replace carrier board

Leetop_ALP_680 Product description

Brief

Leetop_ ALP_ 680 is an embedded artificial intelligence computer that can provide up to 200/275 TOPS of computing power to numerous terminal devices. Leetop_ ALP_ 680 provides a fast active heat dissipation design that can meet industrial standards such as earthquake resistance and anti-static. Meanwhile, Leetop_ ALP_ 680 has rich interfaces and high cost-effectiveness.



Product specifications

Processor module

Processor	Jetson AGX Orin 32GB	Jetson AGX Orin 64GB
AI Performance	200 TOPS	275 TOPS
GPU	1792-core NVIDIA Ampere architecture GPU with 56 Tensor Cores	2048-core NVIDIA Ampere architecture GPU with 64 Tensor Cores
CPU	8-core NVIDIA Arm® Cortex A78AE v8.2 64-bit CPU 2MB L2 + 4MB L3	12-core NVIDIA Arm® Cortex A78AE v8.2 64-bit CPU 3MB L2 + 6MB L3
Memory	32GB 256-bit LPDDR5 204.8GB/s"	64GB 256-bit LPDDR5 204.8GB/s
Storage	64GB eMMC 5.1	64GB eMMC 5.1
Power	15W - 40W	15W - 60W
PCIe	Up to 2 x8 + 2 x4 + 2 x1 (PCIe Gen4, Root Port & Endpoint)	Up to 2 x8 + 2 x4 + 2 x1 (PCIe Gen4, Root Port & Endpoint)
CSI Camera	Up to 6 cameras (16 via virtual channels**) 16 lanes MIPI CSI-2 D-PHY 2.1 (up to 40Gbps) C-PHY 2.0 (up to 164Gbps)	Up to 6 cameras (16 via virtual channels**) 16 lanes MIPI CSI-2 D-PHY 2.1 (up to 40Gbps) C-PHY 2.0 (up to 164Gbps)
Video Encode	1x 4K60 (H.265) 3x 4K30 (H.265) 6x 1080p60 (H.265) 12x 1080p30 (H.265)	2x 4K60 (H.265) 4x 4K30 (H.265) 8x 1080p60 (H.265) 16x 1080p30 (H.265)
Video Decode	1x 8K30 (H.265) 2x 4K60 (H.265) 4x 4K30 (H.265) 9x 1080p60 (H.265) 18x 1080p30 (H.265)	1x 8K30 (H.265) 3x 4K60 (H.265) 7x 4K30 (H.265) 11x 1080p60 (H.265) 22x 1080p30 (H.265)
Display	1x 8K60 multi-mode DP 1.4a (+MST)/eDP 1.4a/HDMI 2.1	1x 8K60 multi-mode DP 1.4a (+MST)/eDP 1.4a/HDMI 2.1
Networking	1x GbE 1x 10GbE	1x GbE 1x 10GbE
Mechanical	100mm x 87mm 699-pin Molex Mirror Mezz Connector Integrated Thermal Transfer Plate	100mm x 87mm 699-pin Molex Mirror Mezz Connector Integrated Thermal Transfer Plate

I/O

Interface	Specification
Overall Size	313.9x197.2x86.1 mm
Display	1x HDMI
Ethernet	5x Gigabit Ethernet(10/100/1000)
	1x 10G
USB	6x USB 3.0 Type A (Integrated USB 2.0) 1x USB3.0 (Type C)
Multifunctional port	1×RS232 2×CAN 1×I2C(+3.3V) 1xI2S(+3.3V) 6×GPIO(+3.3V) 2×GPIO(+12V) 1×GPIO(+5V) 1×RS485 1×UART(+3.3V) 1×SPI(+3.3V)
1xAudio	1xAudio
TF_Card	1xTF_Card
SIM_Card	1x SIM_Card
GMSL	2x GMSL
Function key	1xPower key; 1xRecovery key; 1xReset key
Power Requirements	+12-36V(150W) DC Input

Power Supply

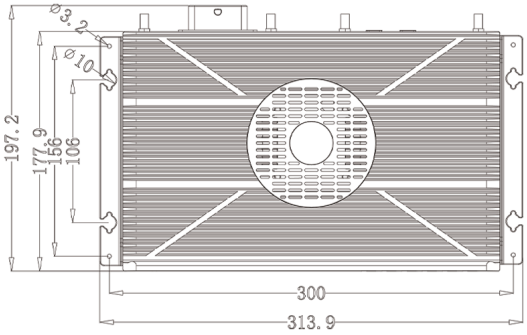
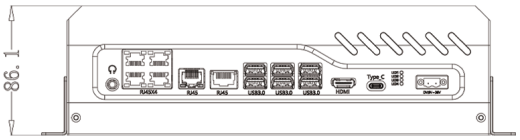
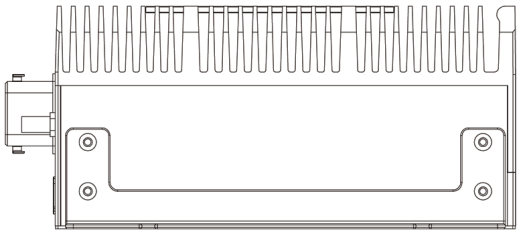
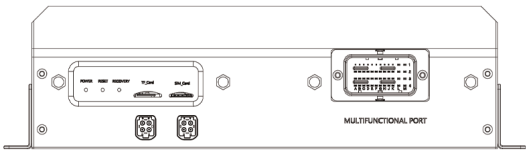
Power Supply	Specification
Input Type	DC
Input Voltage	+12-36V(150W) DC Input

Environmental

Environmental	Specification
Operating Temperature	-25 ℃ --+70℃
Storage temperature humidity	-25℃ -- +65℃ 10%-90% Non condensation environment

Install Dimension

Leetop_ALP_680 Dimensions as below:

Up view (Unit:mm)	*Front view (Unit:mm)*
	
Left view (Unit:mm)	***Rear view(Unit:mm)***
	

Leetop_ALP_680 Interfaces

Front interface

Leetop_ALP_680 Front interface diagram

Interface	Interface name	Interface description
HDMI	HDMI	1-channel HDMI interface
USB 3.0	USB 3.0 interface	6x USB 3.0 Type A (Integrated USB 2.0) 1x USB 2.0+3.2 Type C
RJ45	Ethernet Gigabit port	5x Gigabit Ethernet (10/100/1000) (W2 2x2PSE optional)
Lan10GbE	10 Gigabit ports	1x 10G
Audio	Audio port	Accessible audio
DC	DC power interface	+12--+36V(150W) DC Input

> Note: This product starts automatically when plugged in

Back interface

Leetop_ALP_680 Back interface diagram

Interface	Interface name	Interface description
Misc.	Multi function port	1×RS232 2×CAN 1×I2C(+3.3V) 1xI2S(+3.3V) 6×GPIO(+3.3V) 2×GPIO(+12V) 1×GPIO(+5V) 1×RS485 1×UART(+3.3V) 1×SPI(+3.3V)
TF_Card	TF card slot	Access TF_Card
SIM_Card	SIM slot	Access SIM_ Card
Recovery	Recovery key	System recovery button
RESET	Reset key	System reset button
POWER	Power key	System power button
GMSL	GMSL interface	Accessible to GMSL camera

Multifunctional port

PIN	Signal Name	PIN#	Ball Name	PIN	Signal Name	PIN#	Ball Name
A1	VDD_3V3_CP1			A2	GPIO33_12V	C54	GPIO33
B1	VDD_3V3_CP1			B2	GPIO19_12V	K56	GPIO19
C1	VDD_3V3_CP1			C2	GPIO35_PWM3_3V3	L50	GPIO35
D1	RS232_TX5			D2	GPS_PPS_GPIO17_3V3	A54	GPIO17
E1	RS232_RX5			E2	GPIO9_5V	C61	GPIO9
F1	GND			F2	RS485_A	C58	UART2_TX
G1	CAN0_L	F58	CAN0_DOUT	G2	RS485_B	C56	UART2_RX
H1	CAN0_H	D59	CAN0_DIN	H2	GND		
J1	GND			J2	UART1_RTS_3V3	L51	UART1_RTS
K1	I2C_GP8_DAT_3V3	E60	I2C_DAT	K2	UART1_CTS_3V3	H54	UART1_CTS
L1	I2C_GP8_CLK_3V3	D61	I2C_CLK	L2	UART1_RX_3V3	K54	UART1_RX
M1	GND			M2	UART1_TX_3V3	K53	UART1_TX
A3	MCLK05_3V3	L67	MCLK05	A4	GND		
B3	PWM01_3V3	K57	PWM01	B4	I2S2_DIN_3V3	F6	I2S2_DIN
C3	GPIO27_PWM2_3V3	H52	GPIO27	C4	I2S2_DOUT_3V3	F5	I2S2_DOUT
D3	I2C_GP2_DAT_3V3	K61	I2C_DAT	D4	I2S2_CLK_3V3	G4	I2S2_CLK
E3	I2C_GP2_CLK_3V3	J61	I2C_CLK	E4	I2S2_FS_3V3	E4	I2S2_FS
F3	GND			F4	GPIO8_3V3	B62	GPIO8
G3	SPI1_CS1_3V3	B56	SPI1_CS1_N	G4	GND		
H3	SPI1_CS0_3V3	E55	SPI1_CS0_N	H4	CAN1_L	B61	CAN1_DIN
J3	SPI1_MOSI_3V3	D55	SPI1_MOSI	J4	CAN1_H	H61	CAN1_DOUT
K3	SPI1_MISO_3V3	A56	SPI1_MISO	K4	VDD_5V_CP		
L3	SPI1_SCK_3V3	J57	SPI1_SCK	L4	VDD_5V_CP		
M3	GND			M4	VDD_5V_CP		
H1	NC			H2	NC		

Board Interface Description

Carrier plate specifications

Feature	A680 Carrier for NVIDIA Jetson AGX Orin
Module Compatibility	Jetson AGX Orin
PCB Size / Overall Size	240x160mm
Display	1x HDMI
Ethernet	5x Gigabit Ethernet (10/100/1000)
	1x10G
USB	6x USB 3.0 Type A (Integrated USB 2.0) 1x USB3.0 (Type C)
FAN	1 x FAN(12V PWM)
Misc.	1×RS232 2×CAN 1×I2C(+3.3V) 1xI2S(+3.3V) 6×GPIO(+3.3V) 2×GPIO(+12V) 1×GPIO(+5V) 1×RS485 1×UART(+3.3V) 1×SPI(+3.3V)
Power Requirements	+12-36V(150W) DC Input
Operating Temperature	-25℃--- +70 ℃
Warranty and Support	1 Year Warranty and Free Support

Function Introduction

Operating system setup

1.Hardware preparation

- Ubuntu 18.04/20.04 PC x1
- Type c data cable x1

2.Environment requirements

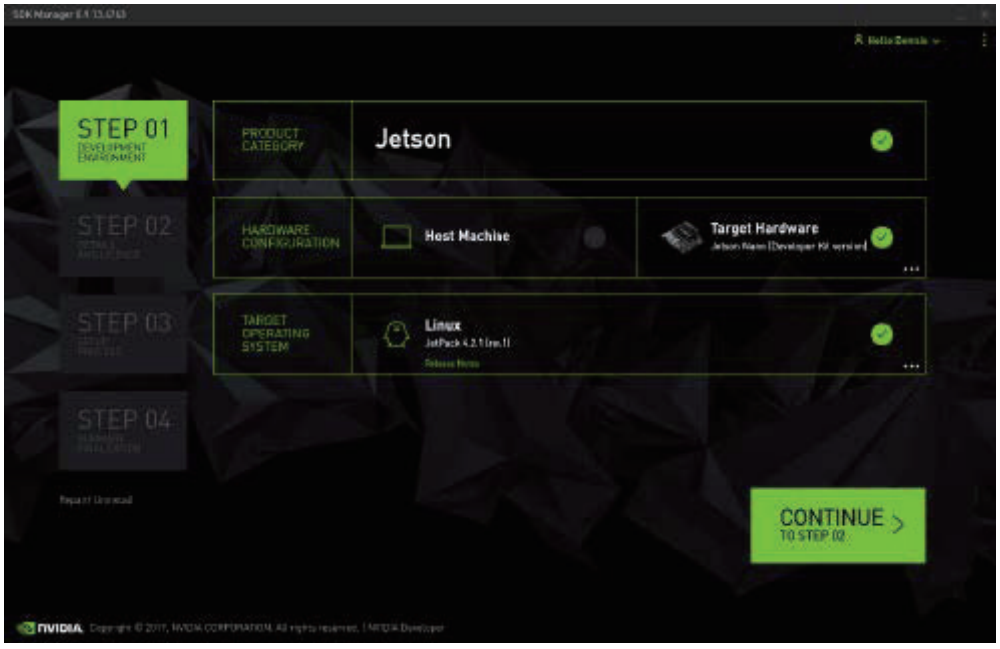
1. 1. Download the system image package to the PC host of Ubuntu18.04/20.04 system:

   Programming steps:

   1. Use a USB cable to connect the USB Type-A of the Ubuntu18.04/20.04 system PC to the Type c of the Leetop_ALP_680 Development System;
   2. Power on Leetop_ALP_680 and enter Recovery mode;
   3. Open Nvidia-SDK-Manager on the PC, as shown in the figure below, select Jetson AGX Orin in the interface to download the Jetpack5.xx system image package and development tools, or download it from https://developer.nvidia.com/embedded/jetpack- archive to download the latest Jetson Linux release package and the sample file system of the Jetson Development Kit. (Jetson Linux Driver Package (L4T)).
   4. Download supporting driver:

      Link: https://pan.baidu.com/s/1CPMrPLSTP3dXJhcXt9rbYw Extraction code: nfyw

	Jetson Orin modules and developer kit	Jetson Xavier modules and developer kits
DRIVERS	Driver Package (BSP)	
	Sample Root Filesystem	



```
#If you can't find the version using the latest sdk, you can use this command to get it
sdkmanager --archivedeversions
```

> Please contact us for the rest of the information：service@leetop.top

2. Unzip the downloaded image package and enter the Linux for Tegra(L4T) directory

```
sudo mkdir [$path] #Create a folder and freely name the path
cd [$path] #Enter folde
tar xf Jetson_Linux_R35.4.1_aarch64.tbz2
cd Linux_for_tegra/rootfs
sudo tar xfp Tegra_Linux_Sample-Root-Filesystem_R35.4.1_aarch64.tbz2
cd ..
sudo ./ apply_binaries.sh
sudo ./tools/l4t_flash_prerequisites.sh
#Replace Driver
sudo cp -r 680_jpxx/Linux_for_Tegra/* Linux_for_tegra/
```

3. Enter the Linux_for_tegra directory and use the flash command

```
#Use this command for the first time to generate system.img
sudo ./flash.sh jetson-agx-orin-devkit mmcblk0p1
#-r flashing will not generate a new system.img
sudo ./flash.sh -r jetson-agx-orin-devkit mmcblk0p1
```

3.Recovery mode

Leetop_ALP_680 can update the system through USB, and the update needs to enter the USB Recovery mode. In USB Recovery mode, you can perform file system update, kernel update, boot loader update, BCT update and other operations.

Steps to enter Recovery Mode:

1. Power off the system, make sure to power off and not go into standby;
2. Connect the carrier and host using the USB Type C to USB Type A cable;
3. Power on the equipment;
4. After pressing the recovery button and the reset button for two seconds at the same time, first release the reset button and then release the recovery button to make it enter the rec mode.
5. Open a terminal window on your host computer and enter command `lsusb`. The Jetson module is in Force Recovery Mode if you see the message:

   ```
   Bus <bbb> Device <ddd>: ID 0955: <nnnn> Nvidia Corp.
   ```

   Where:

   = `<bbb>` is any three-digit number

   = `<ddd>` is any three-digit number

   - `<nnnn>` is a four-digit number that represents the type of your Jetson module:
     - `7023` for Jetson AGX Orin (P3701-0000 with 32GB)
     - `7023` for Jetson AGX Orin (P3701-0005 with 64GB)
     - `7223` for Jetson AGX Orin (P3701-0004 with 32GB)
     - `7323` for Jetson Orin NX (P3767-0000 with 16GB)
     - `7423` for Jetson Orin NX (P3767-0001 with 8GB)
     - `7523` for Jetson Orin Nano (P3767-0003 and P3767-0005 with 8GB)
     - `7623` for Jetson Orin Nano (P3767-0004 with 4GB)
     - `7019` for Jetson AGX Xavier (P2888-0001 with 16GB)
     - `7019` for Jetson AGX Xavier (P2888-0004 with 32GB)
     - `7019` for Jetson AGX Xavier (P2888-0005 with 64GB)
     - `7019` for Jetson AGX Xavier Industrial (P2888-0008)
     - `7e19` for Jetson Xavier NX (P3668)

> Note: In the USB Recovery mode, the system will not start, and the serial port will not have debugging information output

4.Install system image

a) Connect USB type-A of Ubuntu 18.04 Host to Type-c of Leetop_ALP_680 ;

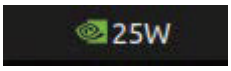
b) Power up Leetop_ALP_680 and enter Recovery mode(RCM);

c) The PC Host enters the L4T directory and executes the flashing instruction：

```
cd Linux_for_tegra
#Use this command for the first time to generate system.img
sudo ./flash.sh jetson-agx-orin-devkit mmcblk0p1
#-r flashing will not generate a new system.img
sudo ./flash.sh -r jetson-agx-orin-devkit mmcblk0p1
```

d) After flashing, power on Leetop_ALP_680 again and log in to the system.

5.Switching working modes

After logging in to the system, you can click on the operation modification in the upper right corner of the system interface, as shown in the figure: 

After logging in to the system, you can click on the operation modification in the upper right corner of the system interface, as shown in the figure:

Or, enter the command in the terminal to switch:

```
#witch to mode 0, use the -q parameter to view the current mode
sudo nvpmodel -m 0
```

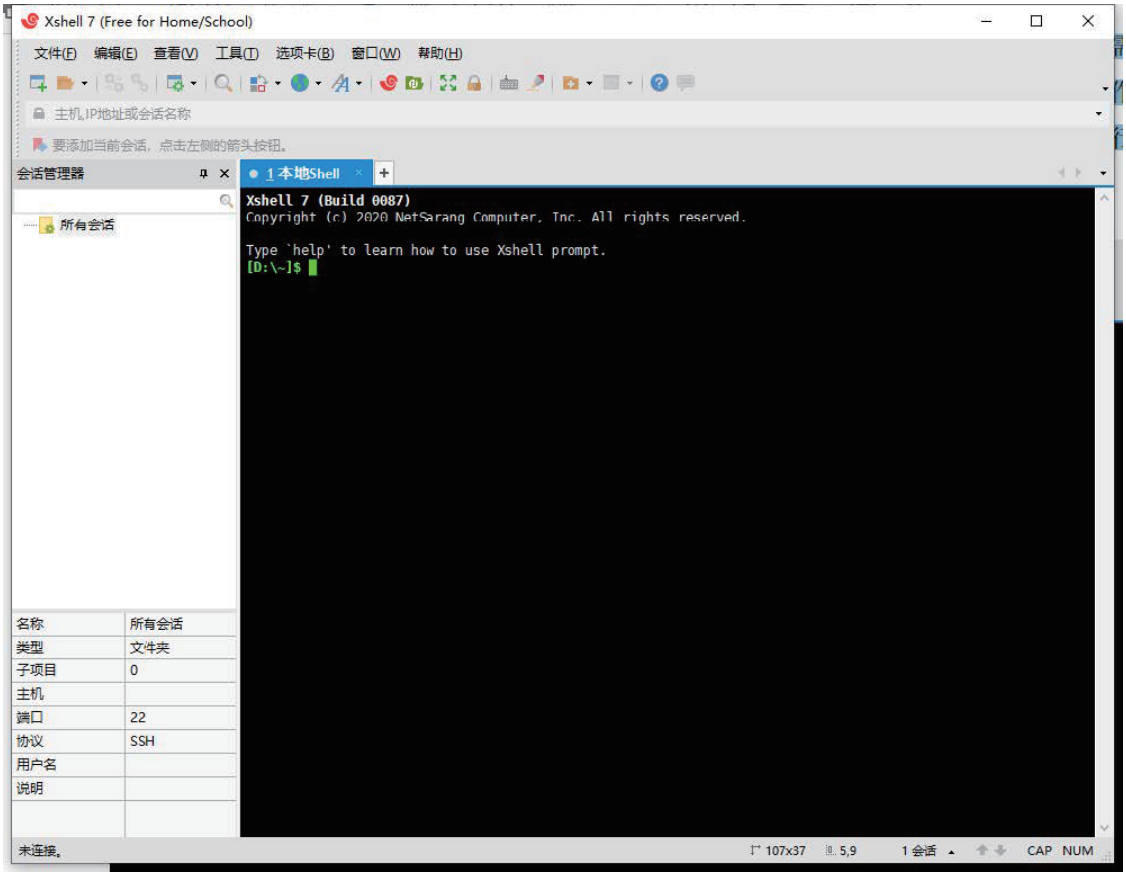
6. Install Jetpack components

```
sudo apt update
sudo reboot
sudo install nvidia-jetpack
```

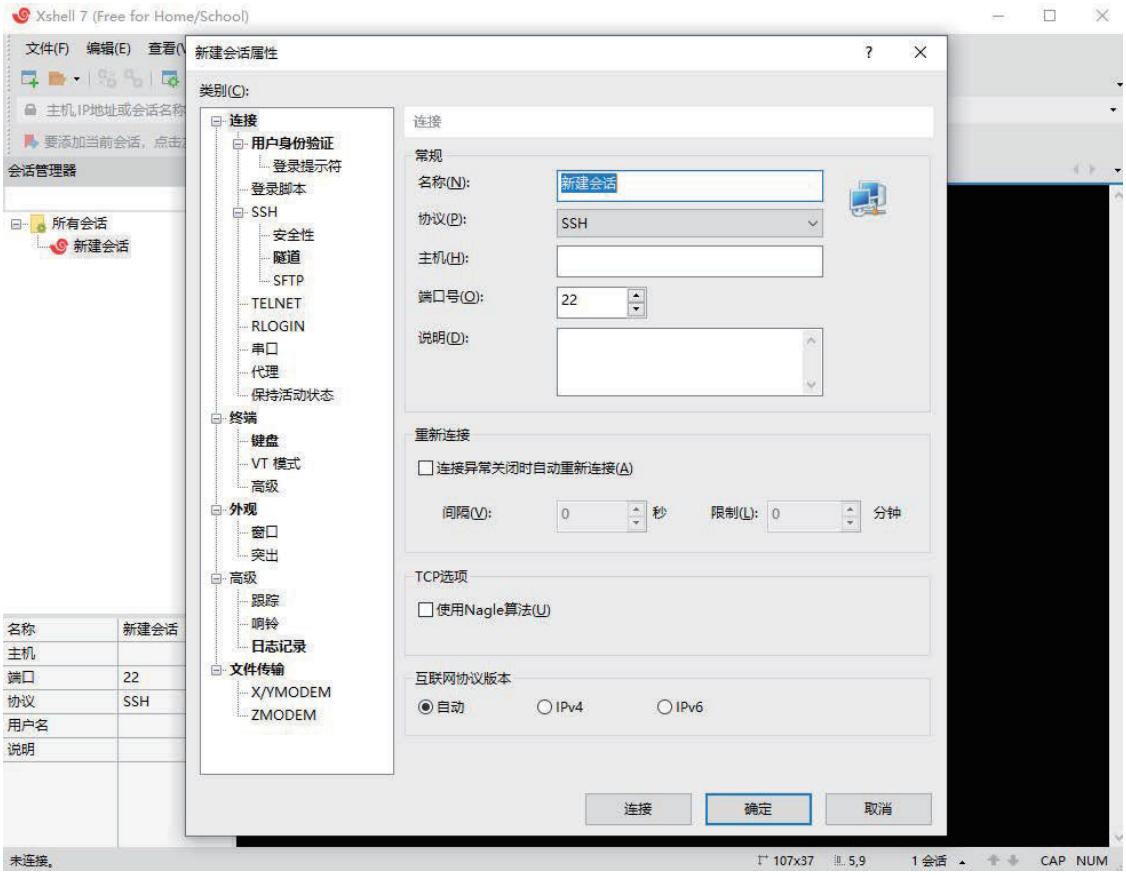
Use of xshell

Xshell is a powerful security terminal emulation software, it supports SSH1, SSH2, and TELNET protocol of Microsoft Windows platform. Xshell's secure connection to remote hosts through the Internet and its innovative design and features help users enjoy their work in complex network environments. Xshell can be used to access servers under different remote systems under the Windows interface, so as to better achieve the purpose of remote control of the terminal. xshell is not necessary, but it can better assist us in using equipment. It can link your Windows system with your Ubuntu system, allowing you to operate your Linux system under Windows system. To install xshell, you can download and install it by searching Baidu on the Internet. (When the product cannot enter the desktop system, you can also use xshell to perform remote control and modify configuration errors).

- Open Xshell

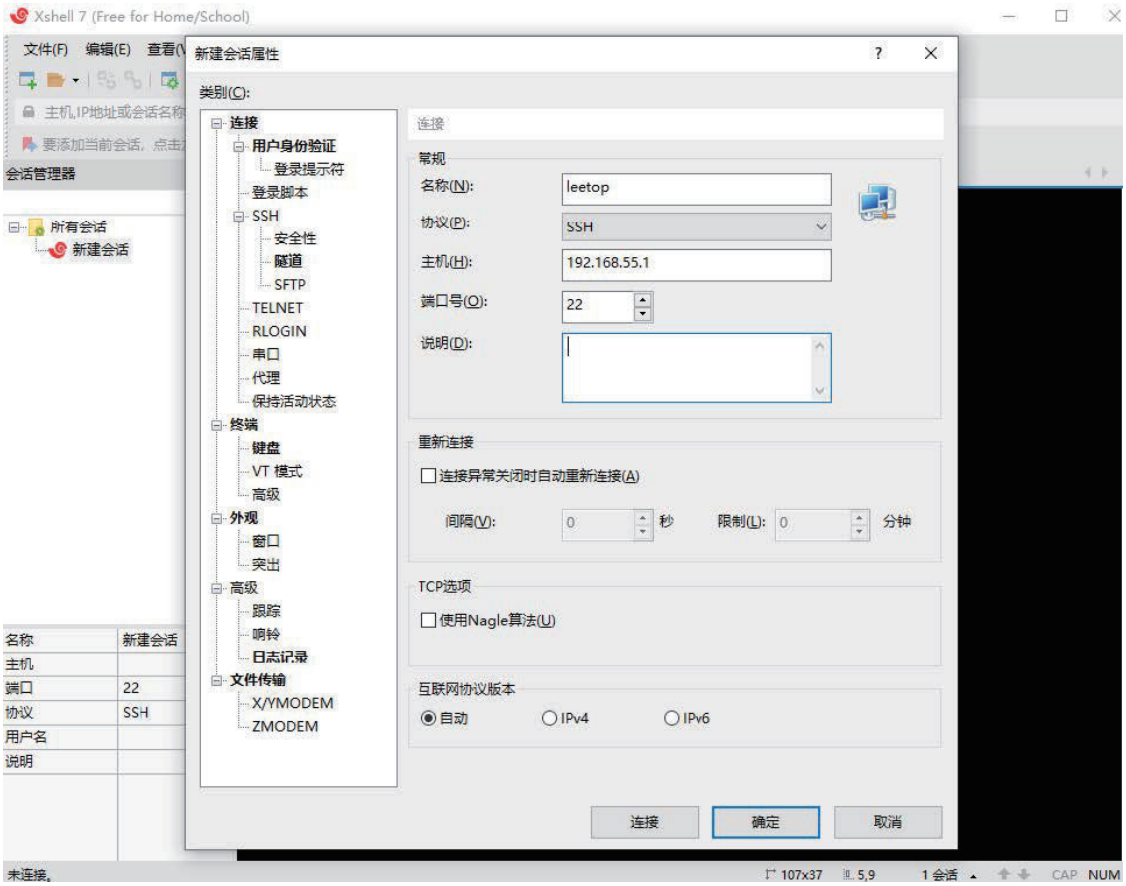


- Newly bulit

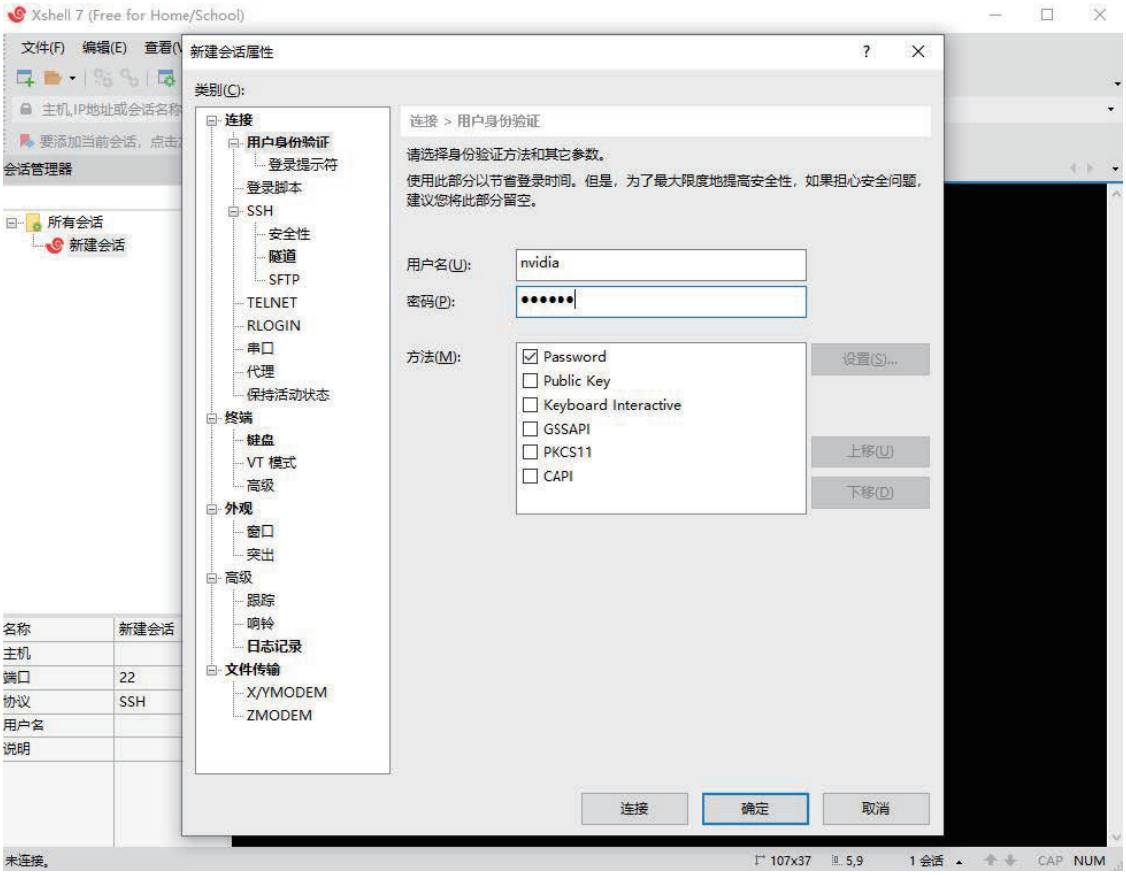


- Fill in the name and host IP (normally you can connect through the network IP. If you don't know the IP, you can connect the computer and the device OTG port through the USB data cable and fill in the fixed IP to connect).

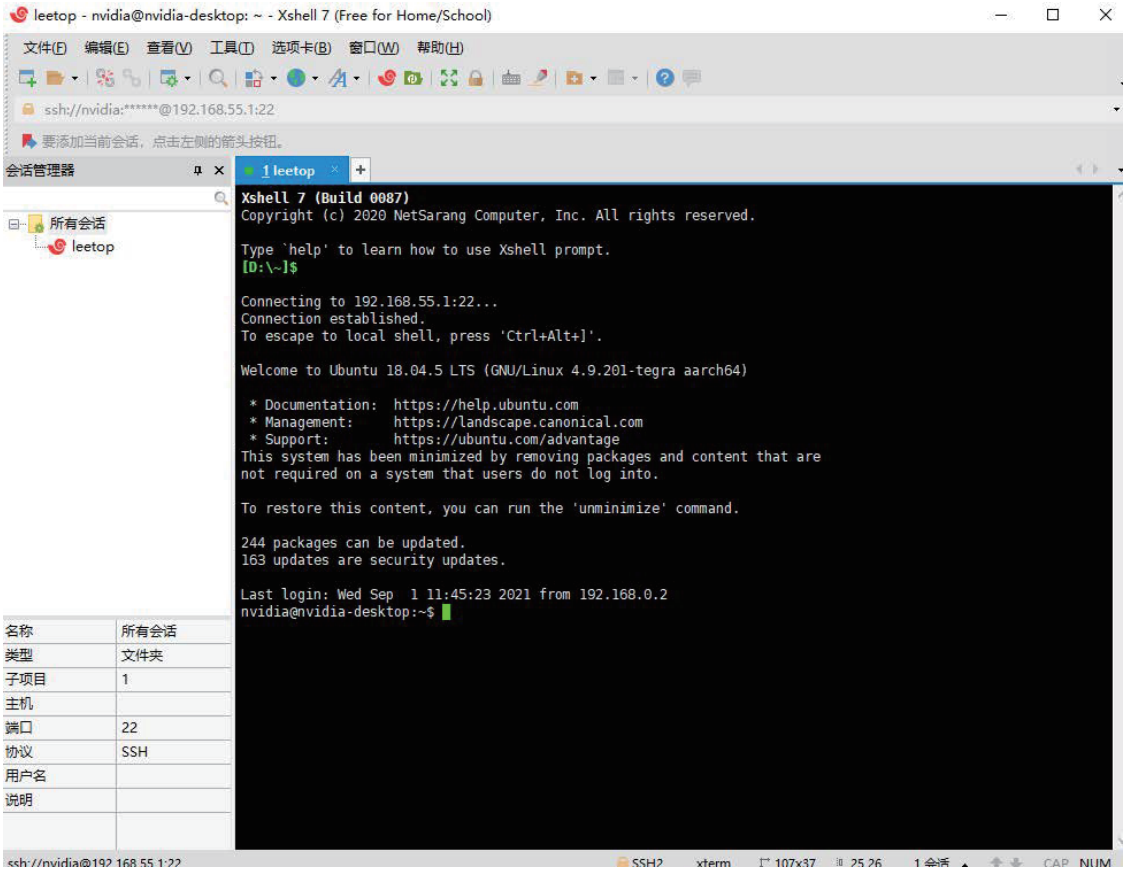
```
192.168.55.1
```



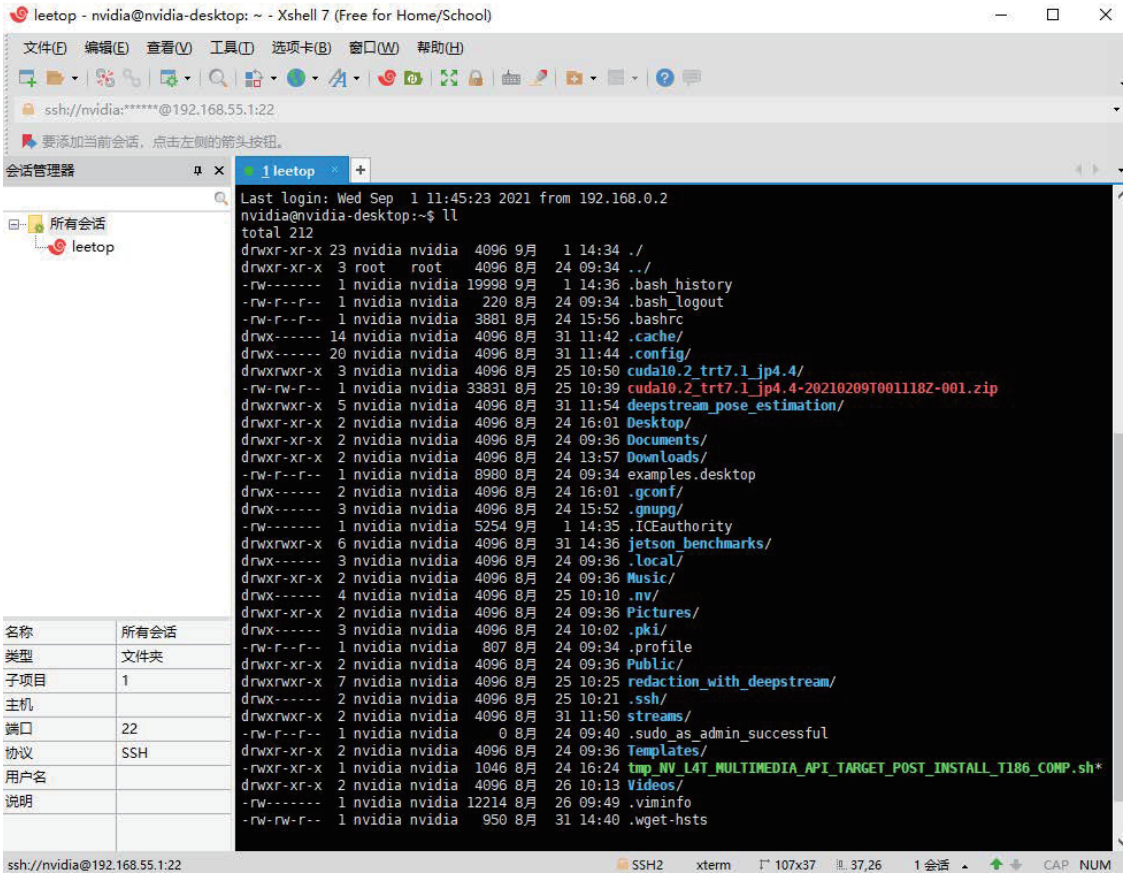
- Enter user and password



- Click Connect to enter the command line interface



- Remotely operate the jetson device through xshell


leetop - nvidia@nvidia-desktop: ~ - Xshell 7 (Free for Home/School)
文件(F) 编辑(E) 查看(V) 工具(T) 选项卡(B) 窗口(W) 帮助(H)
ssh://nvidia:******@192.168.55.1:22
要添加当前会话，点击左侧的箭头按钮。
会话管理器
所有会话
leetop
1 leetop
Last login: Wed Sep 1 11:45:23 2021 from 192.168.0.2
nvidia@nvidia-desktop:~$ ll
total 212
drwxr-xr-x 23 nvidia nvidia 4096 9月 1 14:34 ./
drwxr-xr-x 3 root root 4096 8月 24 09:34 ../
-rw------- 1 nvidia nvidia 19998 9月 1 14:36 .bash_history
-rw-r--r-- 1 nvidia nvidia 220 8月 24 09:34 .bash_logout
-rw-r--r-- 1 nvidia nvidia 3881 8月 24 15:56 .bashrc
drwx------ 14 nvidia nvidia 4096 8月 31 11:42 .cache/
drwx------ 20 nvidia nvidia 4096 8月 31 11:44 .config/
drwxrwxr-x 3 nvidia nvidia 4096 8月 25 10:50 cuda10.2_trt7.1_jp4.4/
-rw-rw-r-- 1 nvidia nvidia 33831 8月 25 10:39 cuda10.2_trt7.1_jp4.4-20210209T001118Z-001.zip
drwxrwxr-x 5 nvidia nvidia 4096 8月 31 11:54 deepstream_pose_estimation/
drwxr-xr-x 2 nvidia nvidia 4096 8月 24 16:01 Desktop/
drwxr-xr-x 2 nvidia nvidia 4096 8月 24 09:36 Documents/
drwxr-xr-x 2 nvidia nvidia 4096 8月 24 13:57 Downloads/
-rw-r--r-- 1 nvidia nvidia 8980 8月 24 09:34 examples.desktop
drwx------ 2 nvidia nvidia 4096 8月 24 16:01 .gconf/
drwx------ 3 nvidia nvidia 4096 8月 24 15:52 .gnupg/
-rw------- 1 nvidia nvidia 5254 9月 1 14:35 .ICEauthority
drwxrwxr-x 6 nvidia nvidia 4096 8月 31 14:36 jetson_benchmarks/
drwx------ 3 nvidia nvidia 4096 8月 24 09:36 .local/
drwxr-xr-x 2 nvidia nvidia 4096 8月 24 09:36 Music/
drwx------ 4 nvidia nvidia 4096 8月 25 10:10 .nv/
drwxr-xr-x 2 nvidia nvidia 4096 8月 24 09:36 Pictures/
drwx------ 3 nvidia nvidia 4096 8月 24 10:02 .pki/
-rw-r--r-- 1 nvidia nvidia 807 8月 24 09:34 .profile
drwxr-xr-x 2 nvidia nvidia 4096 8月 24 09:36 Public/
drwxrwxr-x 7 nvidia nvidia 4096 8月 25 10:25 redaction_with_deepstream/
drwx------ 2 nvidia nvidia 4096 8月 25 10:21 .ssh/
drwxrwxr-x 2 nvidia nvidia 4096 8月 31 11:50 streams/
-rw-r--r-- 1 nvidia nvidia 0 8月 24 09:40 .sudo_as_admin_successful
drwxr-xr-x 2 nvidia nvidia 4096 8月 24 09:36 Templates/
-rwxr-xr-x 1 nvidia nvidia 1046 8月 24 16:24 tmp_NV_L4T_MULTIMEDIA_API_TARGET_POST_INSTALL_T186_COMP.sh*
drwxr-xr-x 2 nvidia nvidia 4096 8月 26 10:13 Videos/
-rw------- 1 nvidia nvidia 12214 8月 26 09:49 .viminfo
-rw-rw-r-- 1 nvidia nvidia 950 8月 31 14:40 .wget-hsts
名称 所有会话
类型 文件夹
子项目 1
主机
端口 22
协议 SSH
用户名
说明
ssh://nvidia@192.168.55.1:22
SSH2 xterm 107x37 37,26 1 会话 CAP NUM

System configuration

Default username: nvidia Password: nvidia

- ***NVIDIA Linux For Tegra (L4T)***

  The carrier board supports native NVIDIA Linux For Tegra (L4T) Builds. DP, 10 Gigabit Ethernet, USB3.0, USB OTG, serial port, GPIO, and I2C bus are all supported and can run directly on the A680 without modification.

  Detailed instructions and tools download links: https://developer.nvidia.com/embedded/jetson-linux

  > Note: The native system does not support PWM fan control. If the native system is used, IPCall-BSP must be deployed

- ***NVIDIA Jetpack for L4T***

  Jetpack is a software package released by NVIDIA, which contains various software tools required for AGX Orin development using Leetop_ALP_680, including various tools on the host side and target side, including OS image files, middleware, sample programs, documents, etc. . The latest release of JetPack runs on Ubuntu20.04 Linux 64-bit host.

  It can be downloaded from the following link:

  https://developer.nvidia.com/embedded/jetpack

- ***Default configuration system***

  Leetop_ALP_680 uses Ubuntu 20.04 system, default username: nvidia password: nvidia

- ***Development MATERIALS and forums***

  L4T development data: https://developer.nvidia.com/embedded/linux-tegra

  Developer forum: https://forums.developer.nvidia.com/

View System Version

View the installed system package version

```
cat /etc/nv_tegra_release
```

View information about the installed JetPack

```
sudo apt show nvidia-jetpack
```

Make a backup image

Making a backup image needs to be done in the environment of command line flashing, only the system.img file is backed up

1. Use A USB cable to connect USB Type-A of the Ubuntu18.04 PC to Type c of the Leetop_ALP_680 .
2. Power on the Leetop_ALP_680 and enter the Recovery mode;
3. Enter the Linux_for_tegra directory, and refer to the official document description Flashing Support for backup.

```
sudo ./flash.sh -r -k APP -G <clone.img> <board> <rootdev>
#The image you backed up from your device. The name is based on your personal needs
#board:Refer to the board mentioned in the brush
#rootdev:Generally take mmcblk0p1 (jetson internal storage) / internal Usually take mmcblk0p1 (jetson internal storage)
```

4. Backup Jetson AGX Orin core module command:

```
sudo ./flash.sh -r -k APP -G clone.img jetson-agx-orin-devkit mmcblk0p1
```

5.Using backup image to flash.

```
#Copy <clone>.img to the <BSP>/bootloader/system.img directory, where <BSP> is the directory in which the Jetson Linux BSP is installed. Enter the command:
sudo clone>.img bootloader/system.img
#If the target board has already been flashed, reflash the clone image to the APP partition. The time it takes to back up a partition depends on the size of the partition. To back up the partition, run the following command:
sudo ./flash.sh -r -k APP <board> mmcblk0p1
#If the target board has never been flashed, flash all of the board's partitions. Enter the command:
sudo ./flash.sh -r <board> mmcblk0p1
```

If the backup image can be used normally, it indicates that the backup image is available.

Installation of Jtop tools

Jtop is a system monitoring utility for Jetson that can be run on a terminal to view and control the status of NVIDIA Jetson in real time.

Installation steps:

1. Installing the pip3 tool

```
sudo apt-get install python3-pip
```

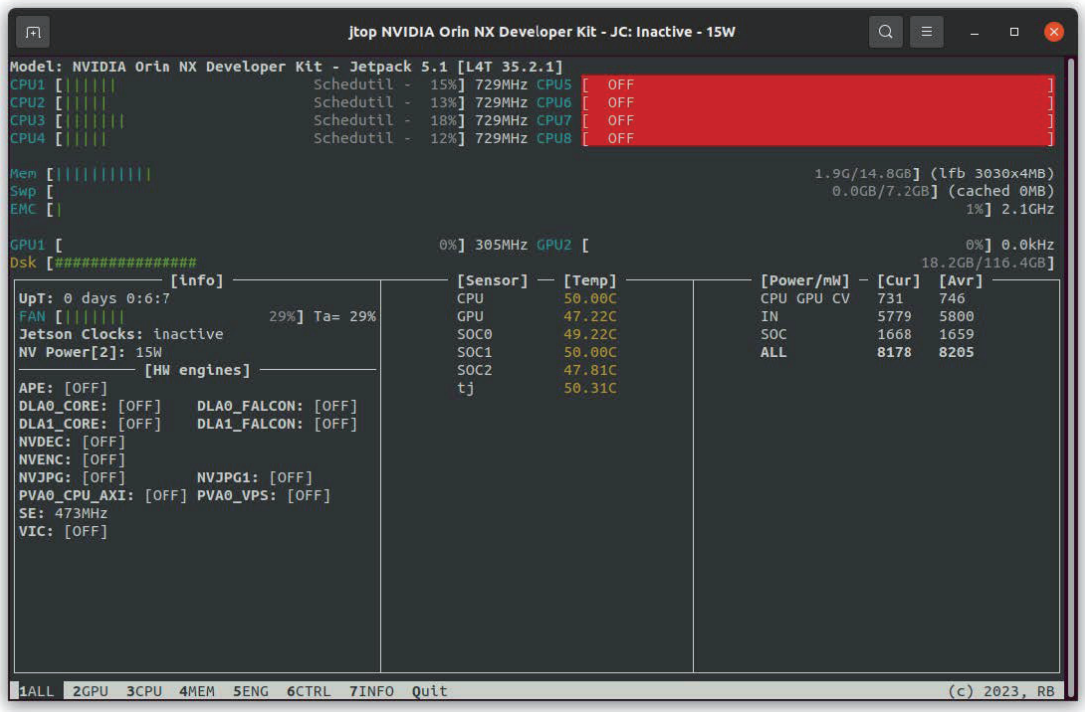
2. Installing jtop packages with pip3

```
sudo -H pip3 install -U jetson-stats
```

3. Restart to run jtop

```
jtop
```

After running, as shown in the figure below:



Developer Tools

JetPack

NVIDIA JetPack SDK is the most comprehensive solution for building AI applications. It bundles Jetson platform software including TensorRT, cuDNN, CUDA Toolkit, VisionWorks, GStreamer, and OpenCV, all built on top of L4T with LTS Linux kernel.

JetPack includes NVIDIA container runtime, enabling cloud-native technologies and workflows at the edge.

JetPack SDK Cloud-Native on Jetson

L4T

NVIDIA L4T provides the Linux kernel, bootloader, NVIDIA drivers, flashing utilities, sample filesystem, and more for the Jetson platform.

You can customize L4T software to fit the needs of your project. By following the platform adaptation and bring-up guide, you can optimize your use of the complete Jetson product feature set. Follow the links below for details about the latest software libraries, frameworks, and source packages.

DeepStream SDK on Jetson

NVIDIA's DeepStream SDK delivers a complete streaming analytics toolkit for AI-based multi-sensor processing, video and image understanding. DeepStream is an integral part of NVIDIA Metropolis, the platform for building end-to-end services and solutions that transform pixel and sensor data to actionable insights. Learn about the latest 6.0DP developer preview features in our developer news article.

Isaac SDK

The NVIDIA Isaac SDK makes it easy for developers to create and deploy AI-powered robotics. The SDK includes the Isaac Engine (application framework), Isaac GEMs (packages with high-performance robotics algorithms), Isaac Apps (reference applications) and Isaac Sim for Navigation (a powerful simulation platform). These tools and APIs accelerate robot development by making it easier to add artificial intelligence (AI) for perception and navigation into robots.

Key Features of Jetpack

OS	NVIDIA Jetson Linux 35.4.1 provides the Linux Kernel 5.10, UEFI based bootloader, Ubuntu 20.04 based root file system, NVIDIA drivers, necessary firmwares, toolchain and more.**JetPack 5.1.2 includes Jetson Linux 35.4.1 which adds following highlights: (Please refer to release notes for additional details)** Adds support for Jetson AGX Orin Industrial module; Bootloader: Support for Grub as OS Loader in UEFI; Support for PXE boot; Camera: Enhanced error resiliency for improved stability in Argus; Support for multiple camera synchronization (sample argus_syncstereo added) Deskew calibration support for high data rate sensors (> 1.5 Gbps) Support for alternating exposures in Argus (sample argus_userAlternatingAutoexposure added) Multimedia: Deprecated Nvbuf_utils is removed. Refer to migration guide to migrate from Nvbuf_utils to NvUtils. Security: Support for up to 3 signing keys to sign bootloader in secure boot and ability to revoke the keys Ability to add and revoke UEFI signing keys Enhanced secure boot for encrypting kernel, kernel-dtb and initrd Support for delegated authentication with ability to sign UEFI with platform vendor owned keys Support in disk encryption for encrypting only User Data Partition (UDA) and runtime enabling encryption of UDA partitions Over The Air Updates: Support for Jetson Orin NX and Jetson Orin Nano in Image based OTA tools
TensorRT	TensorRT is a high performance deep learning inference runtime for image classification, segmentation, and object detection neural networks. TensorRT is built on CUDA, NVIDIA's parallel programming model, and enables you to optimize inference for all deep learning frameworks. It includes a deep learning inference optimizer and runtime that delivers low latency and high-throughput for deep learning inference applications. **JetPack 5.1.2 includes TensorRT 8.5.2**
DLA	NVIDIA DLA hardware is a fixed-function accelerator engine targeted for deep learning operations. It's designed to do full hardware acceleration of convolutional neural networks, supporting various layers such as convolution, deconvolution, fully connected, activation, pooling, batch normalization, and others DLA software consists of the DLA compiler and the DLA runtime stack. The offline compiler translates the neural network graph into a DLA loadable binary and can be invoked using NVIDIA TensorRT™. The runtime stack consists of the DLA firmware, kernel mode driver, and user mode driver. **JetPack 5.1.2 includes DLA 3.12.1**
cuDNN	CUDA Deep Neural Network library provides high-performance primitives for deep learning frameworks. It provides highly tuned implementations for standard routines such as forward and backward convolution, pooling, normalization, and activation layers. **JetPack 5.1.2 includes cuDNN 8.6.0**

CUDA	CUDA Toolkit provides a comprehensive development environment for C and C++ developers building GPU-accelerated applications. The toolkit includes a compiler for NVIDIA GPUs, math libraries, and tools for debugging and optimizing the performance of your applications. **JetPack 5.1.2 includes CUDA 11.4.19** Starting with JetPack 5.0.2, upgrade to latest and greatest CUDA releases from CUDA 11.8 onwards without the need to update Jetson Linux other JetPack components. Refer to instructions in the CUDA documentation on how to get the latest CUDA on JetPack.
Multimedia API	The Jetson Multimedia API package provides low level APIs for flexible application development. Camera application API: libargus offers a low-level frame-synchronous API for camera applications, with per frame camera parameter control, multiple (including synchronized) camera support, and EGL stream outputs. RAW output CSI cameras needing ISP can be used with either libargus or GStreamer plugin. In either case, the V4L2 media-controller sensor driver API is used. Sensor driver API: V4L2 API enables video decode, encode, format conversion and scaling functionality. V4L2 for encode opens up many features like bit rate control, quality presets, low latency encode, temporal tradeoff, motion vector maps, and more. **JetPack 5.1.2 Camera highlights include:** Enhanced error resiliency for improved stability in Argus; Support for multiple camera synchronization (sample argus_syncstereo added). Deskew calibration support for high data rate sensors (> 1.5 Gbps) .Support for alternating exposures in Argus (sample argus_userAlternatingAutoexposure added)
Computer Vision	VPI (Vision Programing Interface) is a software library that provides Computer Vision / Image Processing algorithms implemented on multiple hardware accelerators found on Jetson such as PVA (Programmable Vision Accelerator), GPU, NVDEC(NVIDIA Decoder), NVENC (NVIDIA Encoder), VIC (Video Image Compositor) and so on. OpenCV is an open source library for computer vision, image processing and machine learning. **JetPack 5.1.2 includes VPI 2.3 with following highlights:** New Brute Force Matcher algorithm supported on CPU and GPU backends ; New Transform Estimator algorithm supported on CPU backend. JetPack 5.1.2 includes OpenCV 4.5.4

Graphics	JetPack 5.1.2 includes the following graphics libraries: Vulkan® 1.3 (including the Roadmap 2022 Profile). Vulkan 1.3 Announcement Vulkan® SC 1.0: Vulkan SC is a low-level, deterministic, robust API that is based on Vulkan 1.2. This API enables state-of-the-art GPU-accelerated graphics and computation that can be deployed in safety-critical systems and that are certified to meet industry functional safety standards. Refer to https://www.khronos.org/vulkansc/ for more information;Vulkan SC can also be invaluable for real-time non safety critical embedded applications. Vulkan SC increases determinism and reduces application size by shifting preparation of the run-time application environment either offline, or into application setup, as much as possible. This includes offline compilation of graphics pipelines that define how the GPU processes data, together with static memory allocation, that together enable detailed GPU control that can be rigorously specified and tested.Vulkan SC 1.0 is evolved from Vulkan 1.2 and includes: the removal of runtime functionality that is not needed in safety-critical markets, an updated design to provide predictable execution times and results, and clarifications to remove potential ambiguity in its operation. For more details see https://www.khronos.org/blog/vulkan-sc-overview **Note**: Jetson support for Vulkan SC is **not** safety certified. OpenWF™ Display 1.0: OpenWF Display is a Khronos API for low overhead interaction with the native display driver on Jetson and allows interaction with Vulkan SC to display images. **Note**: Jetson support for OpenWF Display is **not** safety certified.
Developer Tools	CUDA Toolkit provides a comprehensive development environment for C and C++ developers building high-performance GPU-accelerated applications with CUDA libraries. The toolkit includes Nsight Visual Studio Code Edition, Nsight Eclipse Plugins, debugging and profiling tools including Nsight Compute, and a toolchain for cross-compiling applications NVIDIA Nsight Systems is a low overhead system-wide profiling tool, providing the insights developers need to analyze and optimize software performance. NVIDIA Nsight Graphics is a standalone application for debugging and profiling graphics applications. NVIDIA Nsight Deep Learning Designer is an integrated development environment that helps developers efficiently design and develop deep neural networks for in-app inference. Nsight System, Nsight Graphics, and Nsight Compute are all supported on Jetson Orin modules to assist development for autonomous machines. **JetPack 5.1.2 includes NVIDIA Nsight Systems v2022.5** ;**JetPack 5.1.2 includes NVIDIA Nsight Graphics 2022.6** ;**JetPack 5.1.2 includes NVIDIA Nsight Deep Learning Designer 2022.2**

Supported SDKs and Tools	NVIDIA DeepStream SDK is a complete analytics toolkit for AI-based multi-sensor processing and video and audio understanding. **DeepStream 6.2 release supports JetPack 5.1.2** NVIDIA Triton™ Inference Server simplifies deployment of AI models at scale. Triton Inference Server is open source and supports deployment of trained AI models from NVIDIA TensorRT, TensorFlow and ONNX Runtime on Jetson. On Jetson, Triton Inference Server is provided as a shared library for direct integration with C API. PowerEstimator is a webapp that simplifies creation of custom power mode profiles and estimates Jetson module power consumption. **JetPack 5.1.2 adds supports for Jetson Orin NX and Jetson Orin Nano in PowerEstimator.** NVIDIA Isaac™ ROS is a collection of hardware-accelerated packages that make it easier for ROS developers to build high-performance solutions on NVIDIA hardware including NVIDIA Jetson. **Isaac ROS DP 3.1 supports JetPack 5.1.2**
Cloud Native	Jetson brings Cloud-Native to the edge and enables technologies like containers and container orchestration. NVIDIA JetPack includes NVIDIA Container Runtime with Docker integration, enabling GPU accelerated containerized applications on Jetson platform. NVIDIA hosts several container images for Jetson on NVIDIA NGC. Some are suitable for software development with samples and documentation and others are suitable for production software deployment, containing only runtime components. Find more information and a list of all container images at the Cloud-Native on Jetson page.
Security	NVIDIA Jetson modules include various security features including Hardware Root of Trust, Secure Boot, Hardware Cryptographic Acceleration, Trusted Execution Environment, Disk and Memory Encryption, Physical Attack Protection and more. Learn about the security features by jumping to the security section of the Jetson Linux Developer guide. **JetPack 5.1.2 Security highlights include:** Support for up to 3 signing keys to sign bootloader in secure boot and ability to revoke the keys;Ability to add and revoke UEFI signing keys;Enhanced secure boot for encrypting kernel, kernel-dtb and initrd;Support for signing kernel modules ;Support for delegated authentication with ability to sign UEFI with platform vendor owned keys ;Support in disk encryption for encrypting only User Data Partition (UDA) and runtime enabling encryption of UDA partitions

Sample Applications

JetPack includes several samples which demonstrate the use of JetPack components. These are stored in the reference filesystem and can be compiled on the developer kit.

JetPack component	Sample locations on reference filesystem
TensorRT	/usr/src/tensorrt/samples/
cuDNN	/usr/src/cudnn_samples_/
CUDA	/usr/local/cuda-/samples/
Multimedia API	/usr/src/tegra_multimedia_api/
VisionWorks	/usr/share/visionworks/sources/samples/ /usr/share/visionworks-tracking/sources/samples/ /usr/share/visionworks-sfm/sources/samples/
OpenCV	/usr/share/OpenCV/samples/
VPI	/opt/nvidia/vpi/vpi-/samples

Developer Tools

JetPack includes the following developer tools. Some are used directly on a Jetson system, and others run on a Linux host computer connected to a Jetson system.

- Tools for application development and debugging:
    - NSight Eclipse Edition for development of GPU accelerated applications: Runs on Linux host computer. Supports all Jetson products.
    - CUDA-GDB for application debugging: Runs on the Jetson system or the Linux host computer. Supports all Jetson products.
    - CUDA-MEMCHECK for debugging application memory errors: Runs on the Jetson system. Supports all Jetson products.
- Tools for application profiling and optimization:
    - NSight Systems for application multi-core CPU profiling: Runs on the Linux host computer. Helps you improve application performance by identifying slow parts of code. Supports all Jetson products.
    - NVIDIA® Nsight™ Compute kernel profiler: An interactive profiling tool for CUDA applications. It provides detailed performance metrics and API debugging via a user interface and command line tool.
    - NSight Graphics for graphics application debugging and profiling: A console-grade tool for debugging and optimizing OpenGL and OpenGL ES programs. Runs on the Linux host computer. Supports all Jetson products.

FCC Warnning:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection againstharmful interference in a residential installation. This equipment generates, uses and can radiateradio frequency energy and, if not installed and used in accordance with the instructions, maycause harmful interference to radio communications. However, there is no guarantee thatinterference will not occur in a particular installation. If this equipment does cause harmfulinterference to radio or television reception, which can be determined by turning the equipmentoff and on, the user is encouraged to try to correct the interference by one or more of thefollowing measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Caution: Any changes or modifications to this device not explicitly approved by manufacturer could void your authority to operate this equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1)This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.