Questions：

A. Raspberry Pi:

a. What are the differences between a Raspberry Pi and an Arduino ?

Raspberry Pi 属于微型电脑，支持通用性操作系统运行；Arduino 属于单片机，不运行通用操作系统。

b. What can you do with a RPi?

文本编辑、程序运行、图像预览等。

c. What are the components of a modern electronic system, such as RPi ？ A robot?

输入/输出；控制、存储、运算；

d. What is computer architecture ？ What are the necessary components of a computer?

Von neumann；input device、output device、CPU（ALU、CU）、memory

B. This course:

a. What is analog circuit? And digital circuit?

模拟电路: 使用模拟信号进行工作 (关于时间的函数, 连续变化)

数字电路: 以二值数字逻辑为基础, 工作信号是数字信号 (离散)

b. What are the connections between analog and digital?

1、在一个周期内模拟电路的电流和电压是持续不变的，而数字电路中它的电流和电压是脉动变化的。

2、模拟电路在电路中对信号的放大和削减是通过元器件的放大特性来实现操作的, 而数字电路是对信号的传输是通过开关特性来实现操作的。

*三极管的状态：截止、饱和 – 开关特性

放大 --- 放大特性

3、在模拟电路中，电压，电流频率，周期的变化是互相制约的，而数字电路中电路中电压电流频率周期的变化是离散的。

4、模拟电路可以在大电流高电压下工作, 而数字电路只能在小电压, 小电流下工作。

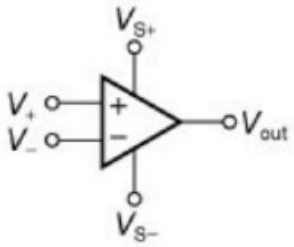
c. What are the subjects beyond analog and digital signal in an electric system?

d. What are the connections of electronic systems to other subjects such as materials, mechanical systems and prototyping? Use Robomaster Ai robot as an example?

Electronic system is the core of robot control and processing. The mechanical part needs to cooperate with the electronic system to achieve the desired function; The modular electronic system needs to be supported or accommodated with appropriate materials, and the feasibility of the scheme and the maintainability of the equipment need to be verified through the prototype mechanism.

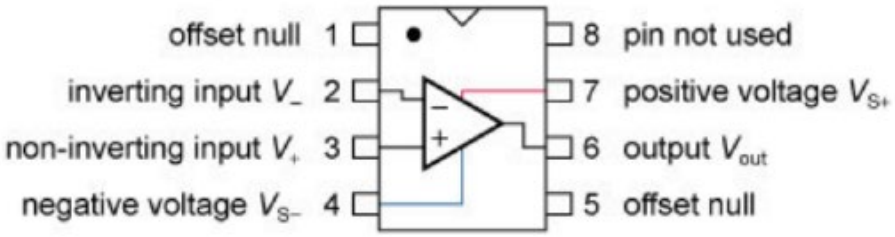
Notes:

- Safety first! Use the equipment after reading the instructions to prevent unnecessary losses.
- It is recommended NOT to forcibly unplug the raspberry PI, as it will not lose files, but will shorten the life of electronic devices.
- About OP-AMP: (Operational Amplifier)



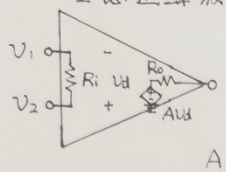
(a)

(b)



电路基础 Lec.05. 运算放大器.

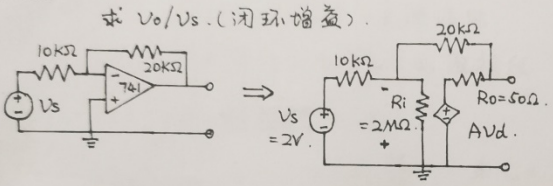
Part-1. 理想运算放大器 (Op-AMP).



$V_o = AV_d = A(V_2 - V_1)$

A: Open Loop Voltage Gain (开环增益).
Ri: Input resistance.
Ro: Output resistance.

ex.1. $A = 2\times10^5$. $R_i = 2M\Omega$. $R_o = 50\Omega$. $V_s = 2V$.
求 V_o/V_s. (闭环增益).



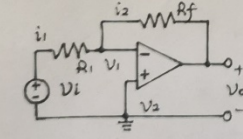
※ Ri上的电流/电压很小.
一般可以忽略...

※ 理想情况下:

$R_i \to \infty \Rightarrow i \approx 0$ (虚断, Virtual Opening)
$R_o \approx 0$
$A \to \infty \Rightarrow V_d = (V_2 - V_1) \to 0$ (虚短, Virtual shorting)

Part-2. 应用与操作.

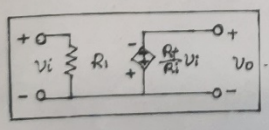
1. 反相放大器. (Invereing Amplifier).



$i_1 = i_2 \Rightarrow \frac{V_i - V_1}{R_1} = \frac{V_1 - V_o}{R_f}$

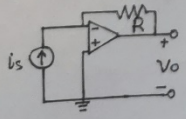
$V_1 = V_2 = 0 \Rightarrow \frac{V_i}{R_1} = \frac{-V_o}{R_f}$

$\Rightarrow V_o = -\frac{R_f}{R_1} V_i = V_{Th}$.



$\longrightarrow$ ※ $R_{Th} = 0$! (与外界电路元关).

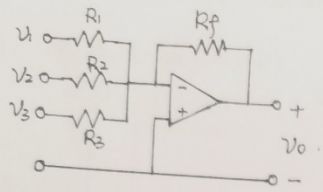
2. 跨阻放大器.



$\frac{V_o}{i_s} = -R$. ($-R i_s$)

Part-2 应用与操作.

3. 求和放大/加法器. (负组反相…?)

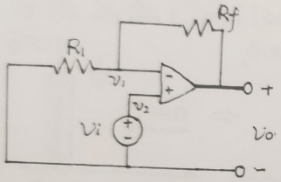


$i = i_1 + i_2 + i_3$

$\Rightarrow V_o = -\left(\frac{R_f}{R_1}V_1 + \frac{R_f}{R_2}V_2 + \frac{R_f}{R_3}V_3\right) = V_{Th}$.

$R_{Th} = 0$.

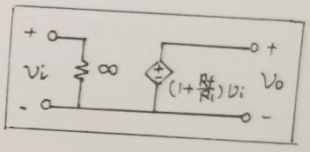
4. 同相放大器.



$i_1 = i_2 \Rightarrow \frac{0-V_1}{R_1} = \frac{V_1-V_o}{R_f}$

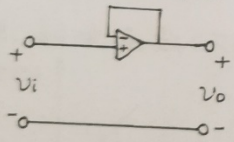
$V_1 = V_2 = V_i \Rightarrow \frac{-V_i}{R_1} = \frac{V_i-V_o}{R_f}$

$\Rightarrow V_o = \left(1+\frac{R_f}{R_1}\right)V_i$



5. 电压跟随器.

first stage.



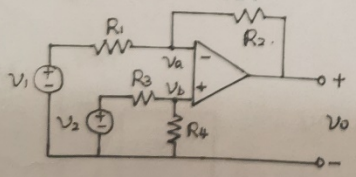
Sec. Stage.

$V_o = V_i$ 传递电压信号.

消耗(传输能量)少.

隔离; Sec. stage. 能量来自 E.

6. 差分放大器.



$\frac{V_1-V_a}{R_1} = \frac{V_a-V_o}{R_2}$

$V_b = \frac{R_4}{R_3+R_4}V_2$.

$V_a \approx V_b$.

$\Rightarrow V_o = \frac{R_2}{R_1}\frac{(1+R_1/R_2)}{(1+R_3/R_4)}V_2 - \frac{R_2}{R_1}V_1$.

① $R_1/R_2 = R_3/R_4 \Rightarrow V_o = \frac{R_2}{R_1}(V_2-V_1)$

② $R_1 = R_2$, $R_3 = R_4 \Rightarrow V_o = V_2 - V_1$.

Part-3 扩展内容.