ENGR 3421: Robotics I

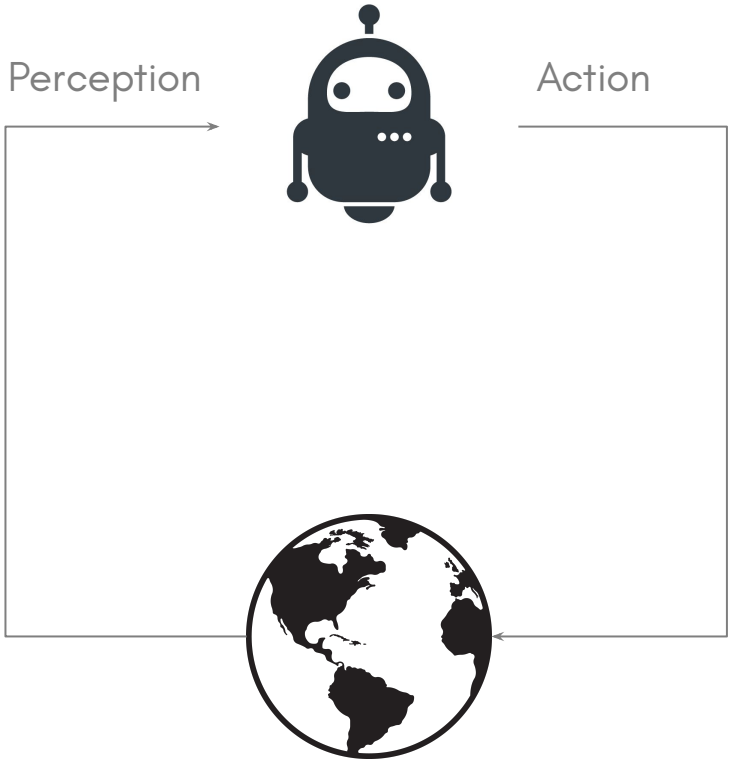
Power Management

09/23/2025

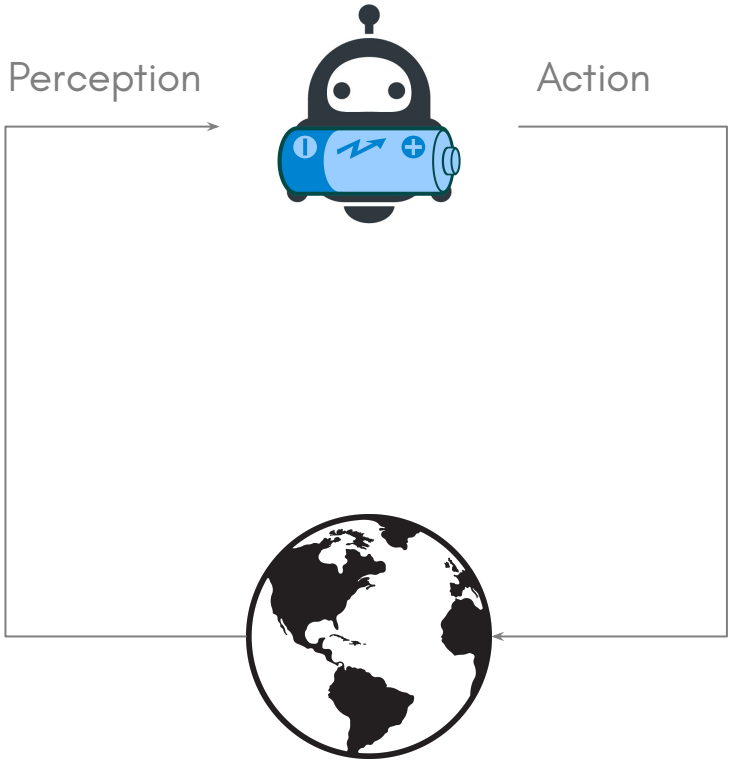
Outline

- Power Requirements
- Power Management

A Robot Needs a Heart



A Robot Needs a Heart



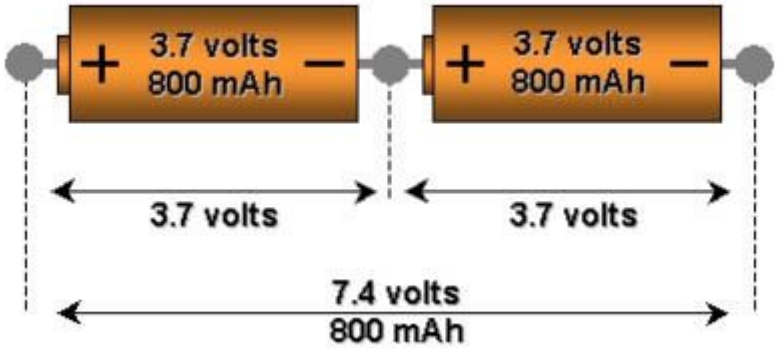
Batteries

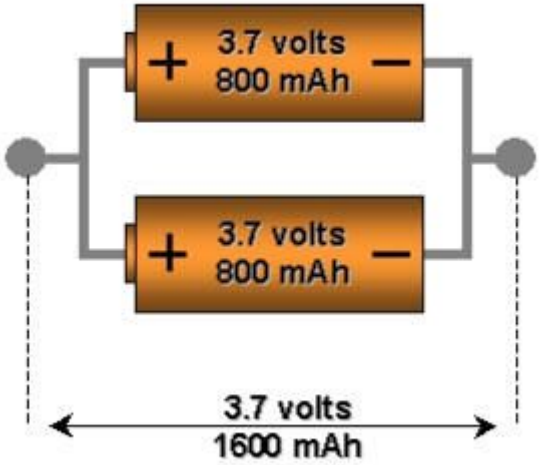
Type	Nominal Voltage	Max Current	Notes
AA / AAA 	1.5 V	2 A	easy to buy, good for small robots, rechargeable versions has nominal voltage of 1.2 V per cell
9V Alkaline 	9 V	3 A	easy to buy, classical source for Arduino Uno
Lithium-ion 	3.7 V	5 A to 30 A	rechargeable, relatively safe, good for mid-scale robots
Lithium Polymer 	3.7 V	5A to LARGE	rechargeable, fire/explosion hazard, powerful, good for speedy robots
Others  			

18650 Lithium-Ion Battery

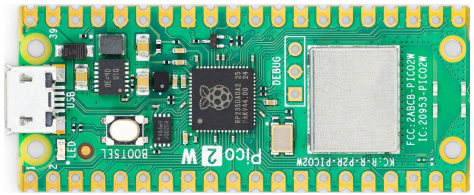
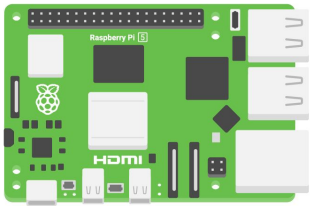
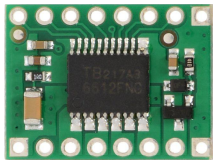
Capacity	2500mAh
Nominal Voltage	3.7V
Full Charge Voltage	4.2V
Discharge Cutoff Voltage	2.5V
Continuous Discharge Rate (CDR)	20A
Rechargeable	Yes
Cycle Life	~250-300 charge cycles

Serialize vs. Parallelize

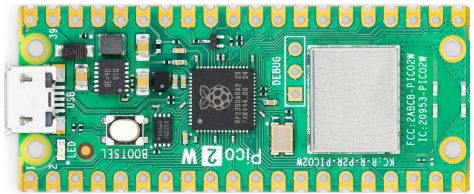
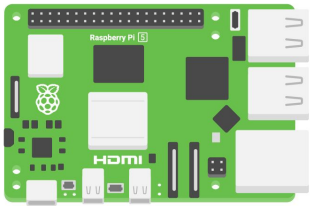
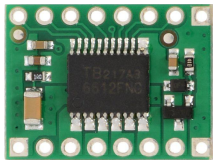




Voltage Requirements

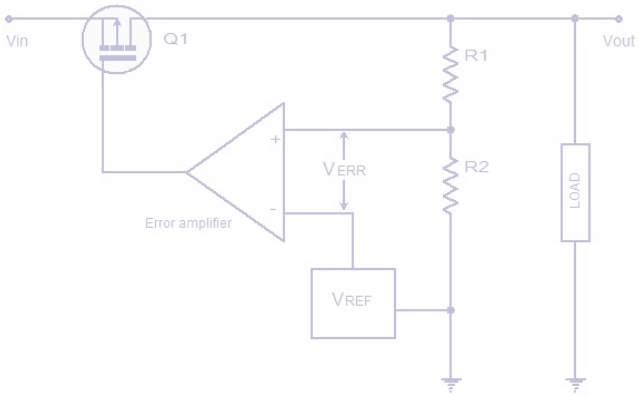
1.8 - 5.5 V	
5 V	
4.5 - 12 V	 

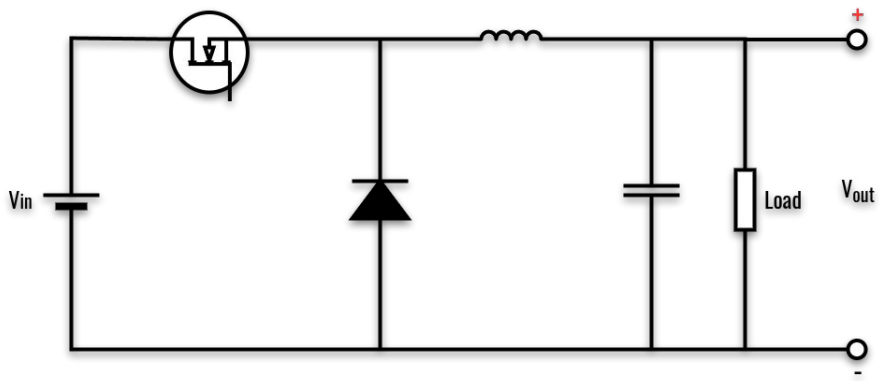
Current Requirements

< 0.3 A	
< 5 A	
< 1 A	 

Voltage Regulator

A circuit converts input voltage to a stabilized output voltage.





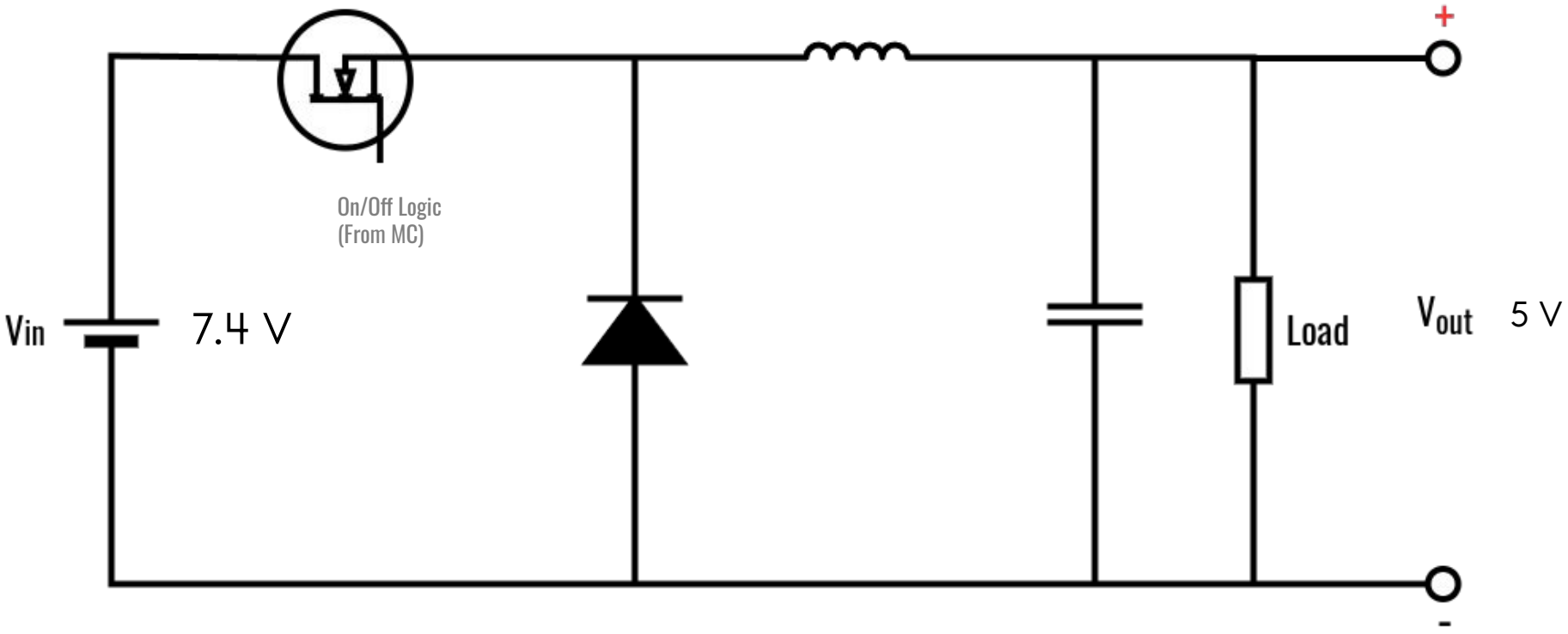
Low-Dropout Regulator (LDO):

- Pros: fast response, good stability, small output ripple.
- Cons: Low efficiency, small load (< 5A).

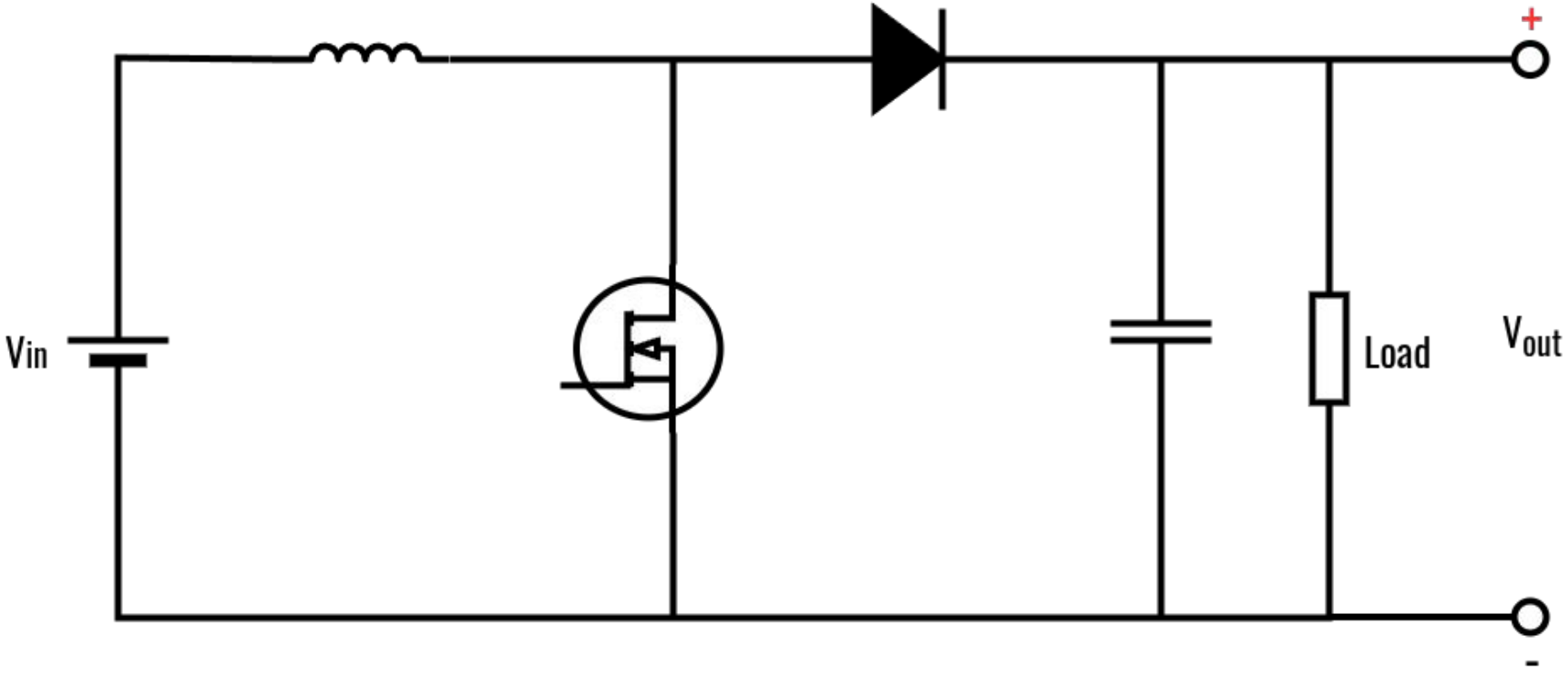
Switching Regulator:

- Pros: High efficiency, wide input voltage range.
- Cons: More complex design, larger output ripple.

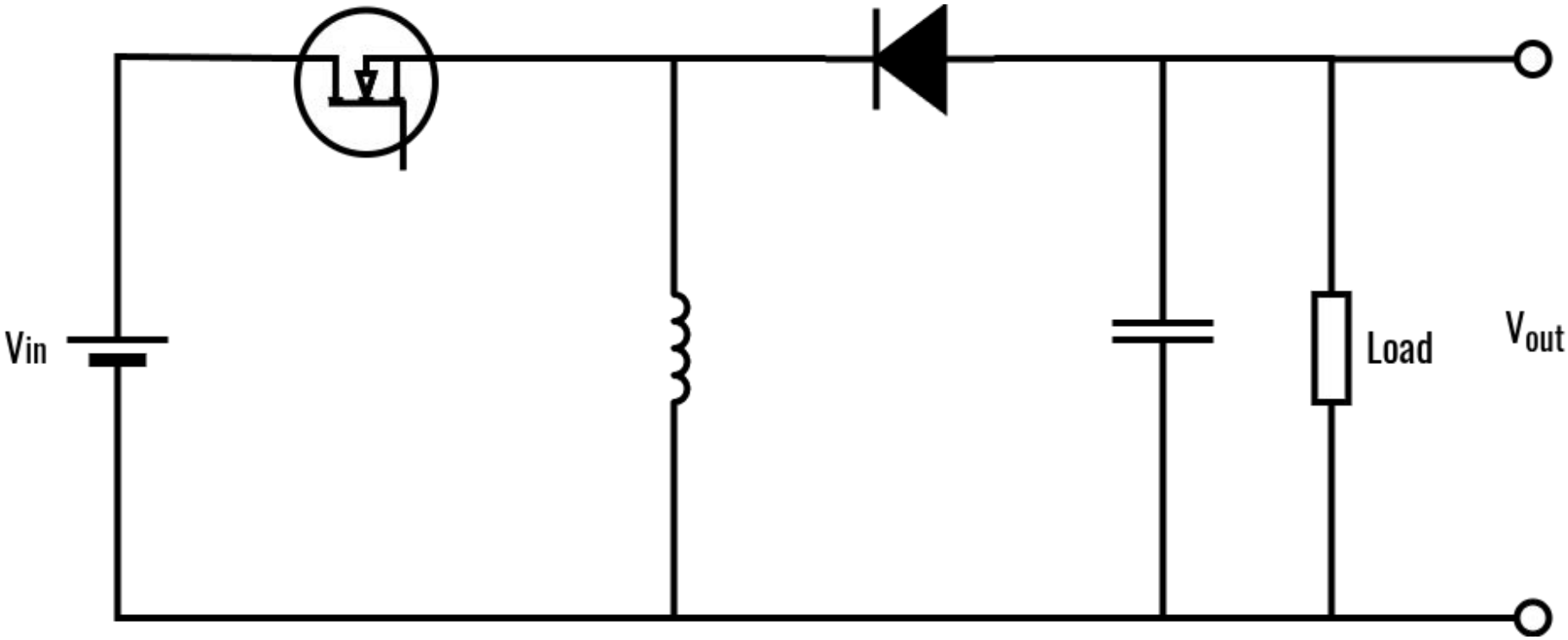
Buck Converter



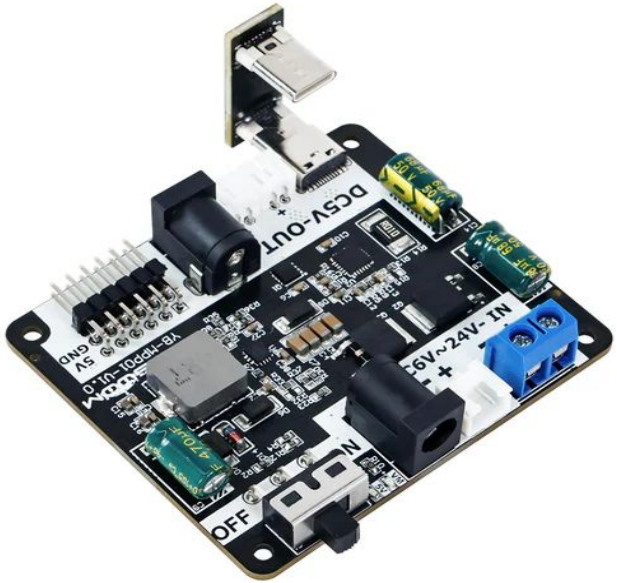
Boost Converter



Buck-Boost Converter



Power Expansion Board



Input	6 - 24 V (limited current if < 7 V)
Output	5 V

Power Wiring