ROBOT DRIVE SYSTEMS

Drive Essentials

"The best drive train…

- is more important than anything else on the robot
- meets your strategy goals
- can be built with your resources
- rarely needs maintenance
- can be fixed within 4 minutes
- is more important than anything else on the robot"

-Andy Baker

Set a Schedule!

- Get something driving early
  - End of week 2
  - Practice for operators
  - Strategy lessons
- Continuously improve
  - Good enough is not good enough
- Finish final drive train by week 4

Note that…

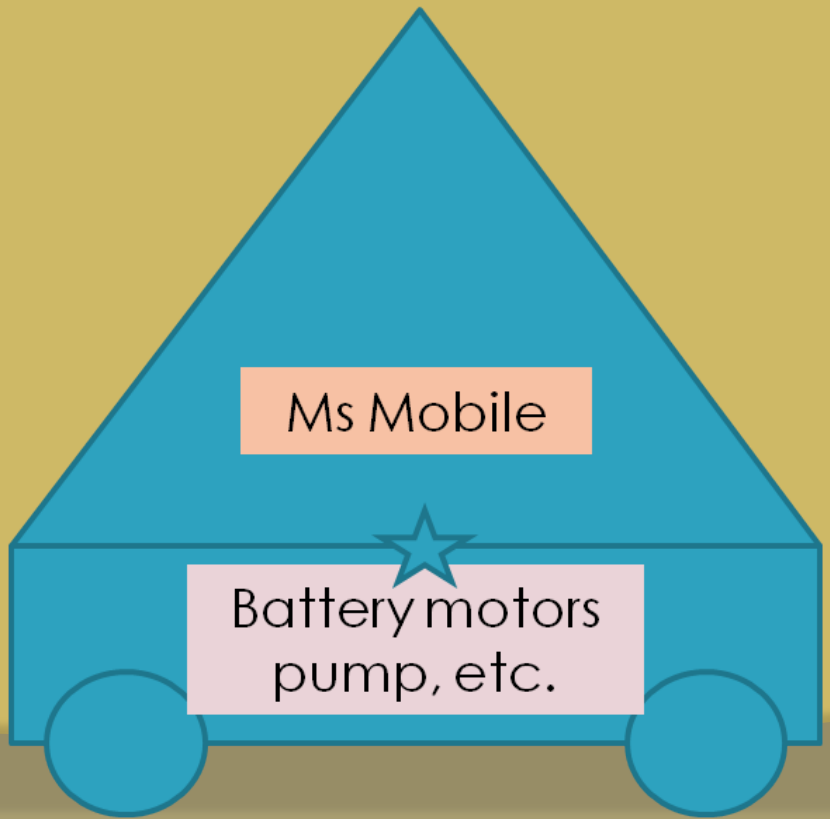
- Good drive bases win consistently
- Reliable drive bases win awards
- Well-controlled, robust drive bases win Championships
- Boat anchor = any heavy mass that does not move
- A non-reliable or non-repairable drive base will turn your robot into a boat anchor

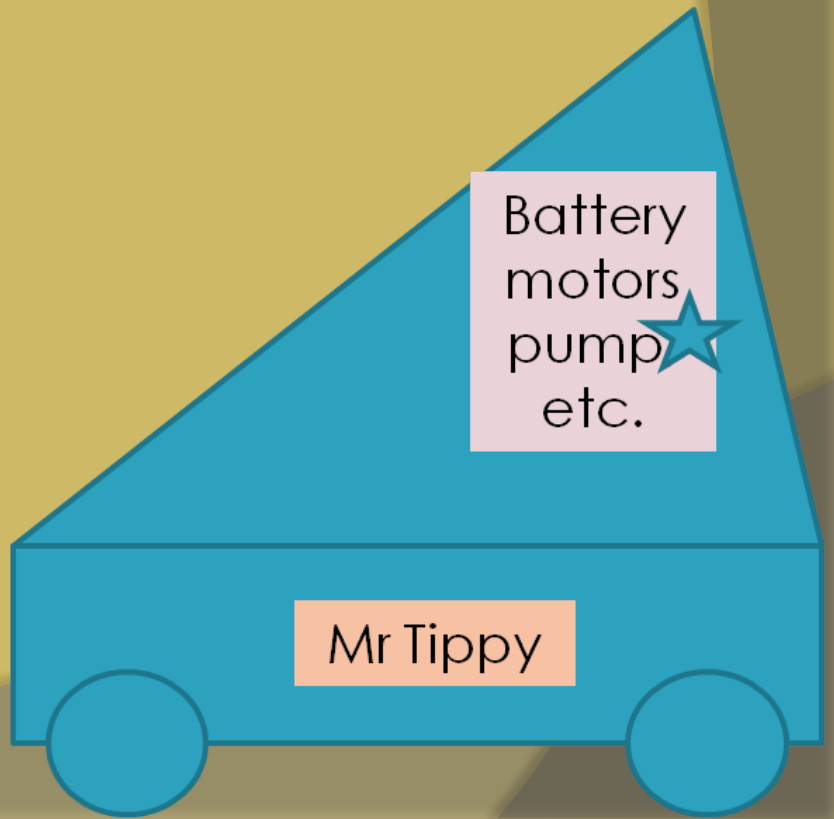
Note that…

- Speed is game dependent, however, it increases every year.
  - Controllable top speed: 15 ft/sec
  - Average 1-speed rate: 9 ft/sec
  - Good pushing speed: 5 ft/sec

Center of gravity (Cg)

- Robot mass is represented at one point
- Mobility increases when Cg is low and centered
- High parts = light weight
- Low parts = heavy (within reason)





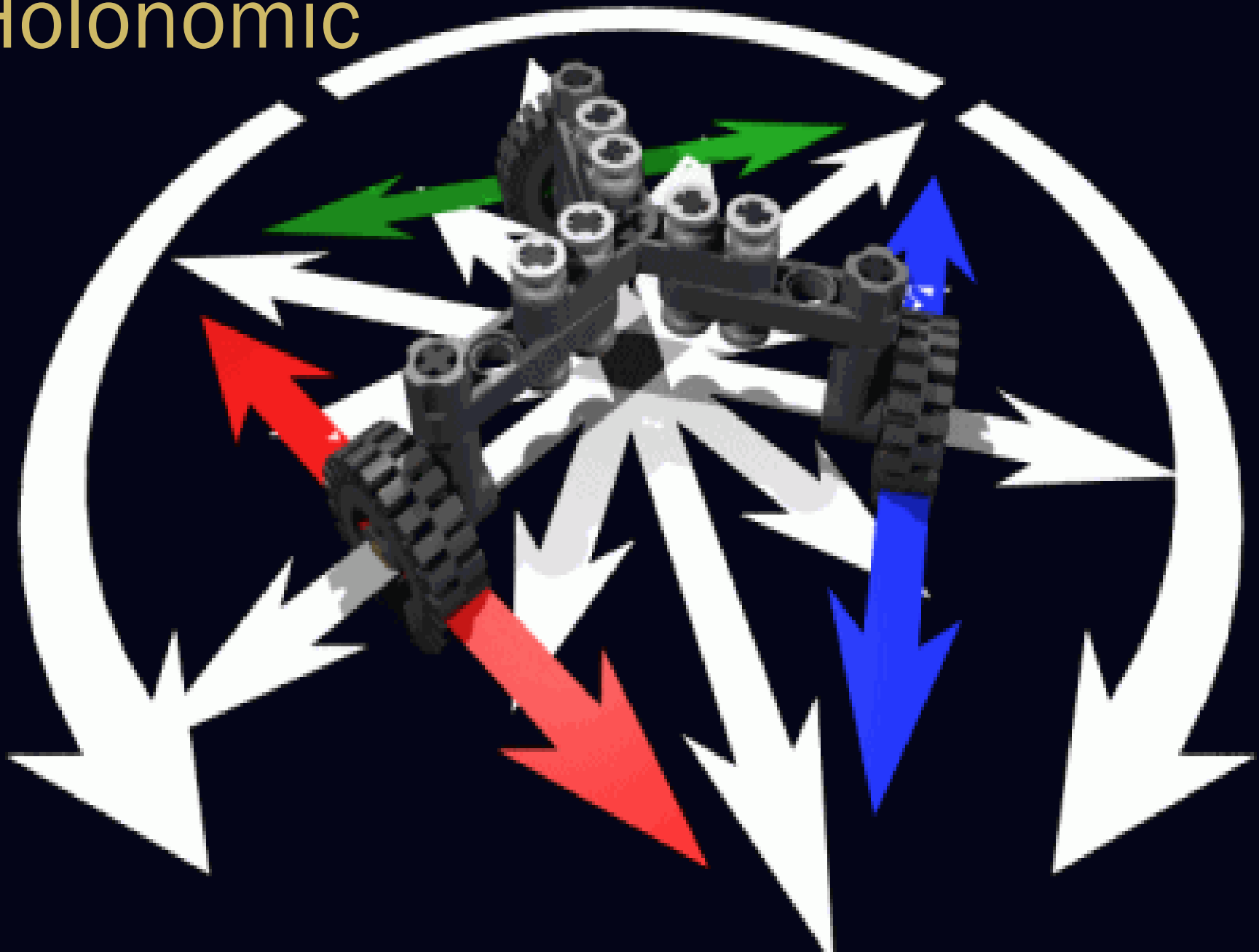
Drive Essentials

- Decide together after kickoff:
  - Speed, power, shifting, mobility
- Use most powerful motors on drive train
- Give software team TIME to work
- Give drivers TIME to drive
- Know your resources

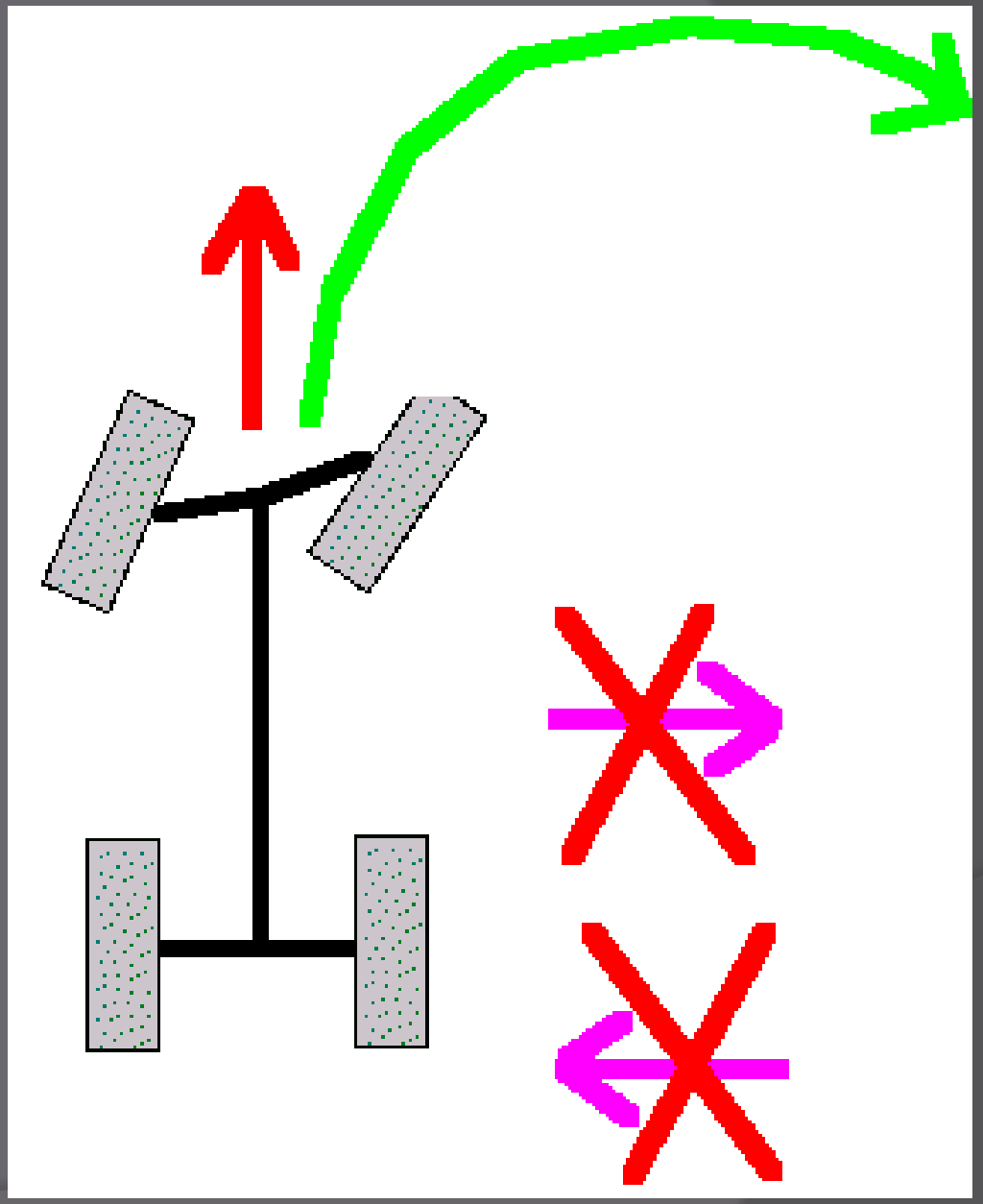
Drive systems Infomation

- Systems differ in advantages and disadvantages.
- Motion Control
  - Holonomic : Controllable DOF equal Positional DOF
  - Non-holonomic: Controllable DOF is less than Positional DOF

Holonomic



Non-holonomic



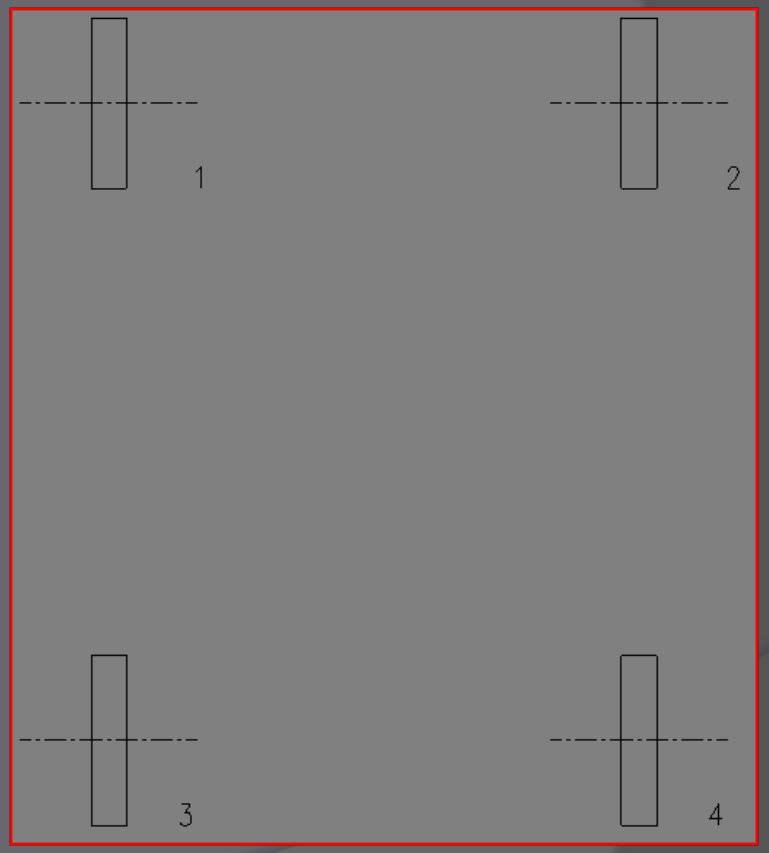
Basic Drive Types

- Non- holonomic
  - Tank
- Holonomic
  - Crab
  - Omni –including Mecanum

Tank

- Moves in one direction
- Cannot drive left or right without turning
- Navigate on difficult ground
- Simple to construct
- Pushes well in direction of travel

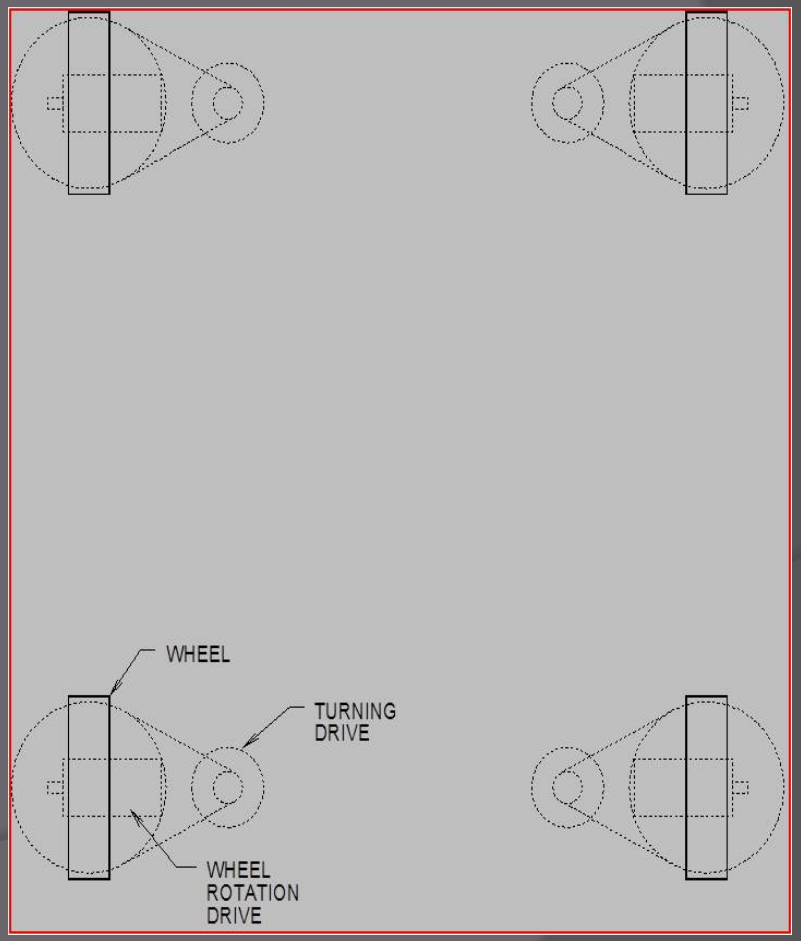
- Classic tank drive
- Wheels can be added at a lower contact point



Crab

- Typically has four wheels
- Diverse
  - Tank
  - Car
  - Swerve drive
- Involves eight motors
  - drive motors and turning motors
- Turning drives require encoders
- Complex software

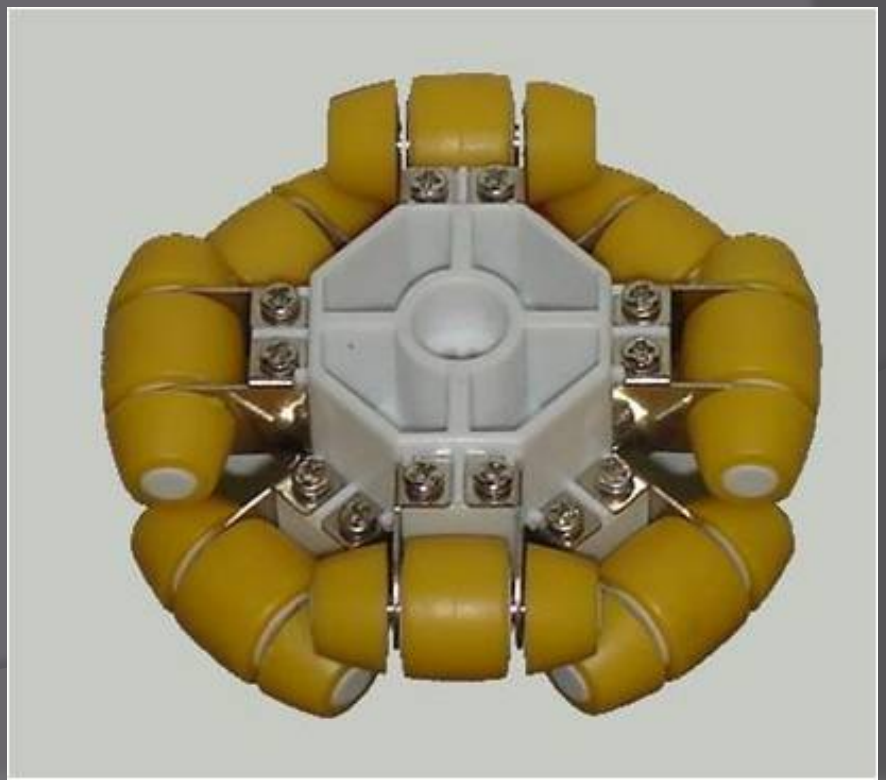
- High traction wheels
- Pushes and holds position
- Difficult to drive
- Wheel turning delay



Omni

- Moves in one direction
- Typically has three wheels
- Can drive forward, reverse, left, right, turn right and turn left

- Maneuverable on flat surface
- Difficult to drive on terrain
- Difficult to push an object
- Immediate turning
- Incline difficulty

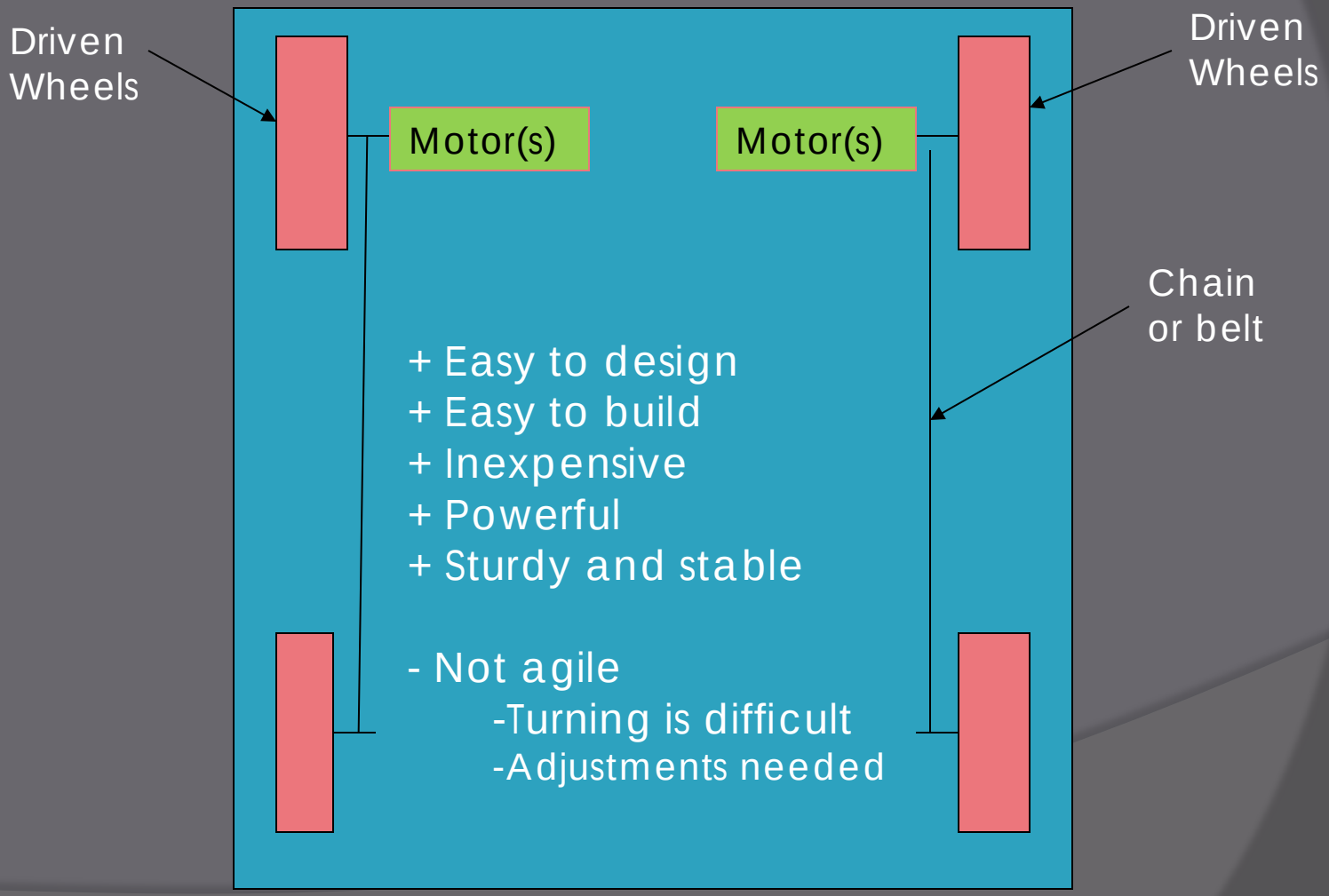


Mecanum

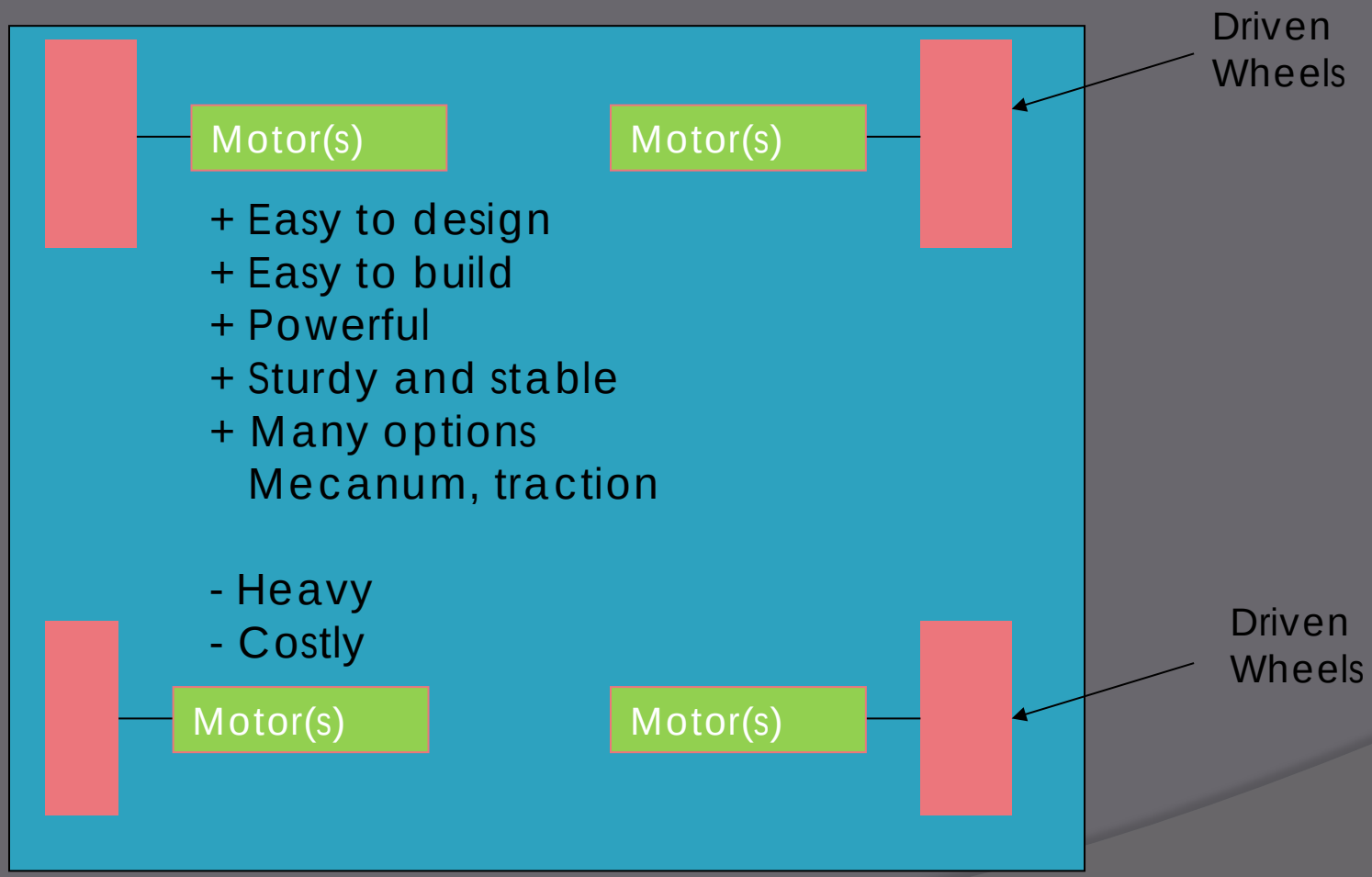
- Typically has 4 wheels
- 4 independent wheels
- Weight should be balanced on all four wheels

- Maneuverable on a flat surface
- Can incline in forward position only
- Pushes fairly reasonably

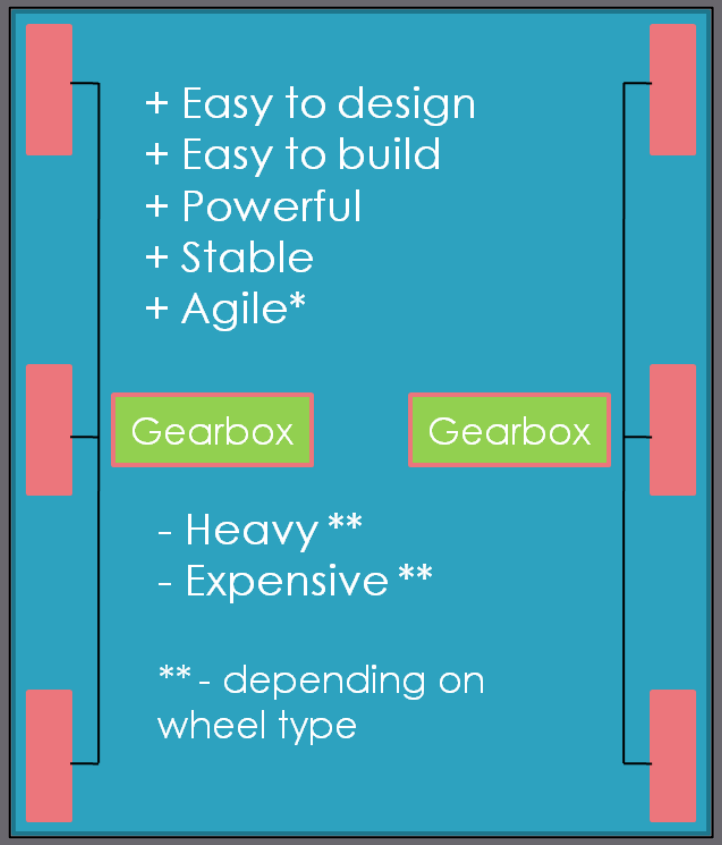
4 wheel drive, 2 gearboxes



4 wheel drive, 4 gearboxes



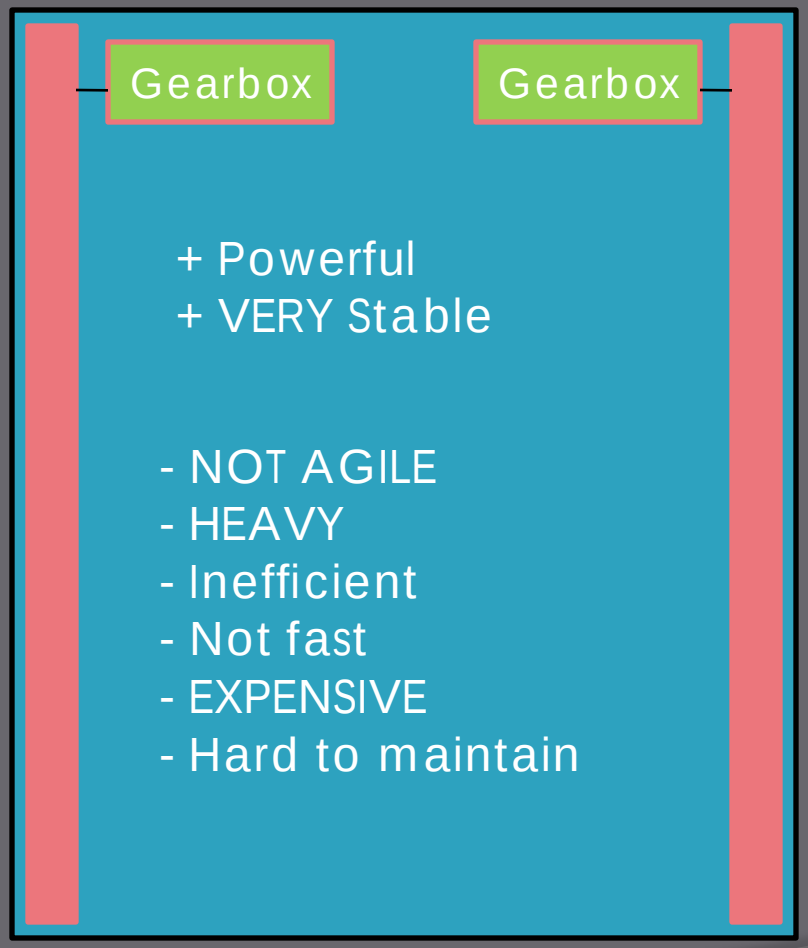
6 wheel drive, 2 gearboxes



*Being Agile

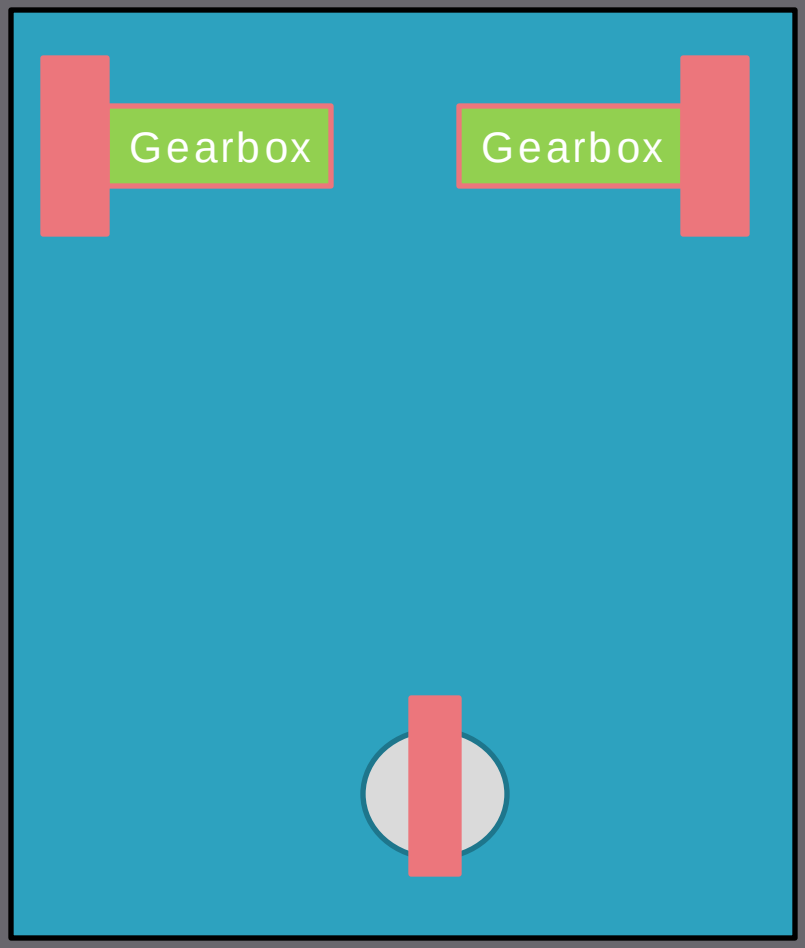
1. Middle wheel at lower point of contact
2. Omni wheels on front, back, or both

Tank tread drive, 2 gearboxes



Sole ability: to go over objects

3 wheel drive, 2 gearboxes



- Light weight
- Fast
- Various types
- Not standard

Drive Effectiveness

Excellent, Good, Mediocre, Poor

	pushing power	quickness of maneuverability	effect of weight distribution	effectivness in terrain	intuitiveness of drive
tank drive with two wheels	M	G	M	M	E
tank drive with four wheels	E	G	G	G	E
tank drive with six wheels	E	G	E	E	E
tank drive with eight wheels	E	G	E	E	E
omni drive with 3 wheels	P	E	P	P	E
omni drive with 4 wheels	M	E	P	P	E
mecanum drive with 4 wheels	G	E	M	G*	E
crab drive with 4 wheel steering	E	G	E	E	M*
crab drive with pair wheel steering	E	G	G	G	M*
swerve drive with 4 wheel steering	E	G	E	E	M*
car drive with 2 wheel steering	G	M	G	G	E
car drive with 4 wheel steering	E	G	E	E	E

* in forward direction only
* can improve with software
* can improve with software
* can improve with software

Quiz time

#1

- A tank tread drive with two gearboxes can easily

A. Push
B. Go over objects
C. Be designed

#2

- According to Andy Baker, “the best drive train …

A. Is the most important thing on your robot”
B. Can be fixed within 15 minutes
C. Needs maintenance through out the season

#3

- When adding wheels between any two driven wheels what should you do? Why?

A. Position them at a higher level of contact
B. Position them at the same level
C. Position them at a lower level

#4

- What type of wheel is this?

A. Omni
B. Mecanum
C. Tank

#5

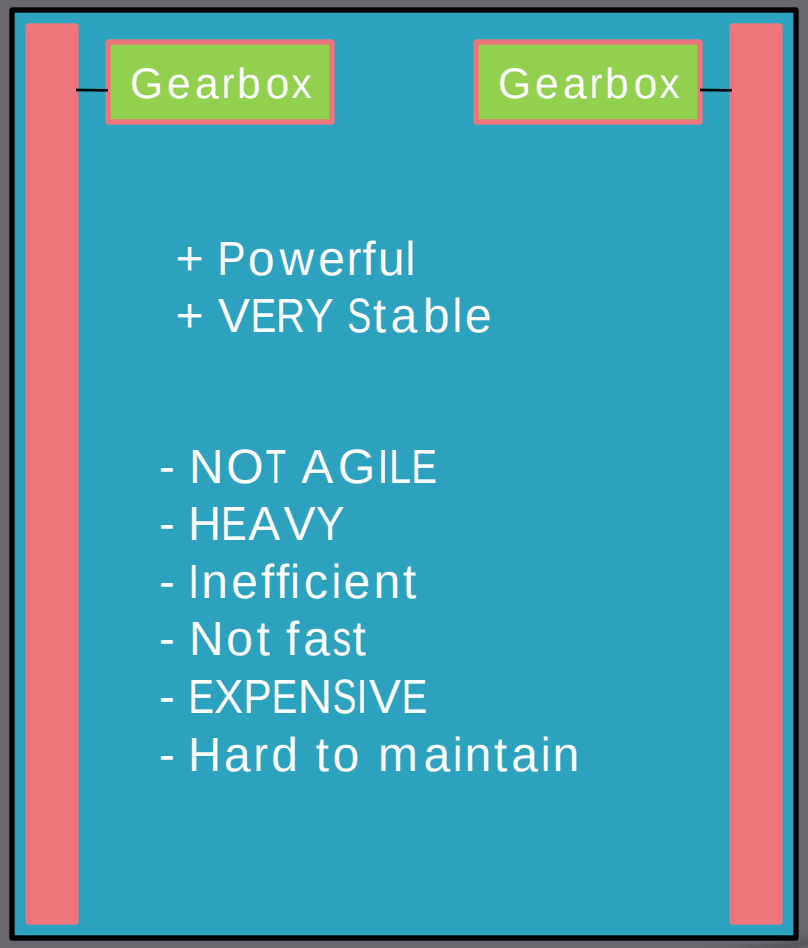
- How many motors should a crab drive have?

A. Eight
B. Four
C. Two

#6

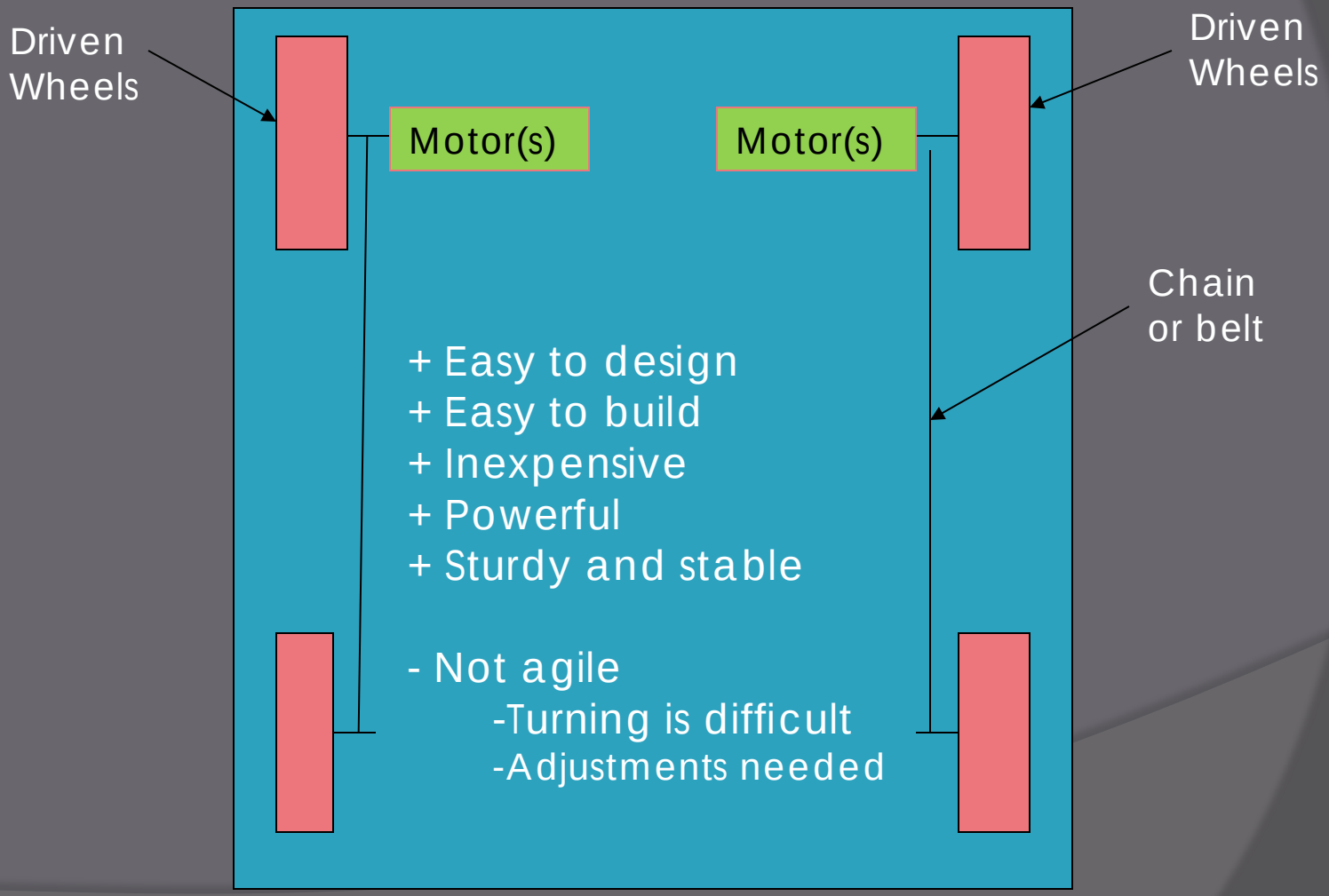
- Name some characteristics of the following drive types.

Tank tread drive, 2 gearboxes

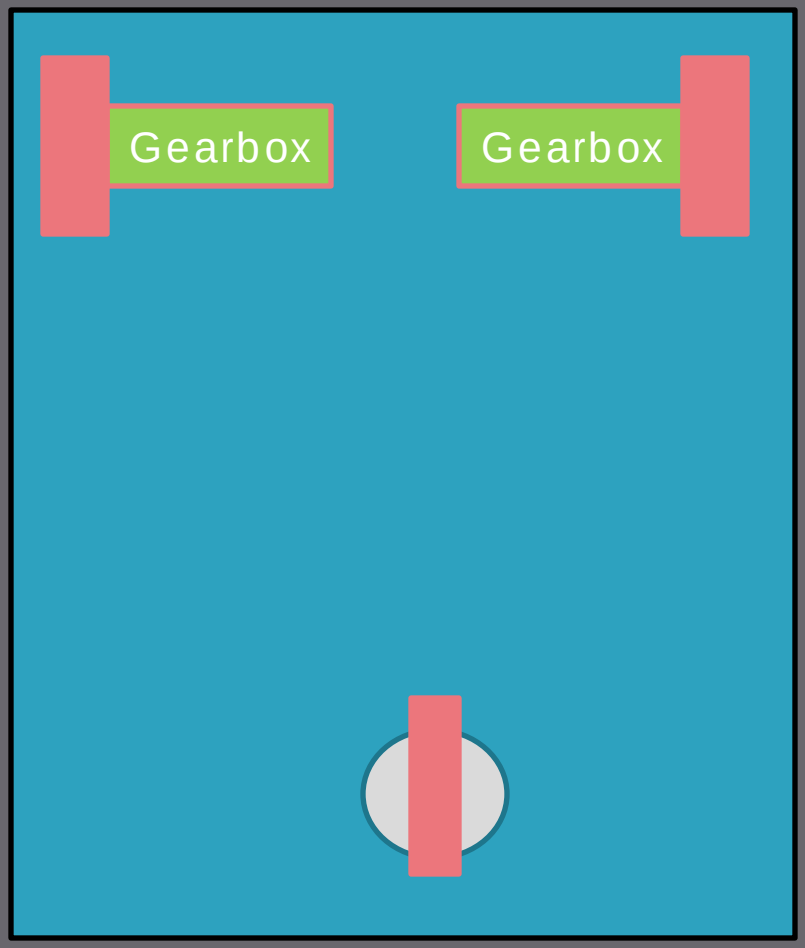


Sole ability: to go over objects

4 wheel drive, 2 gearboxes

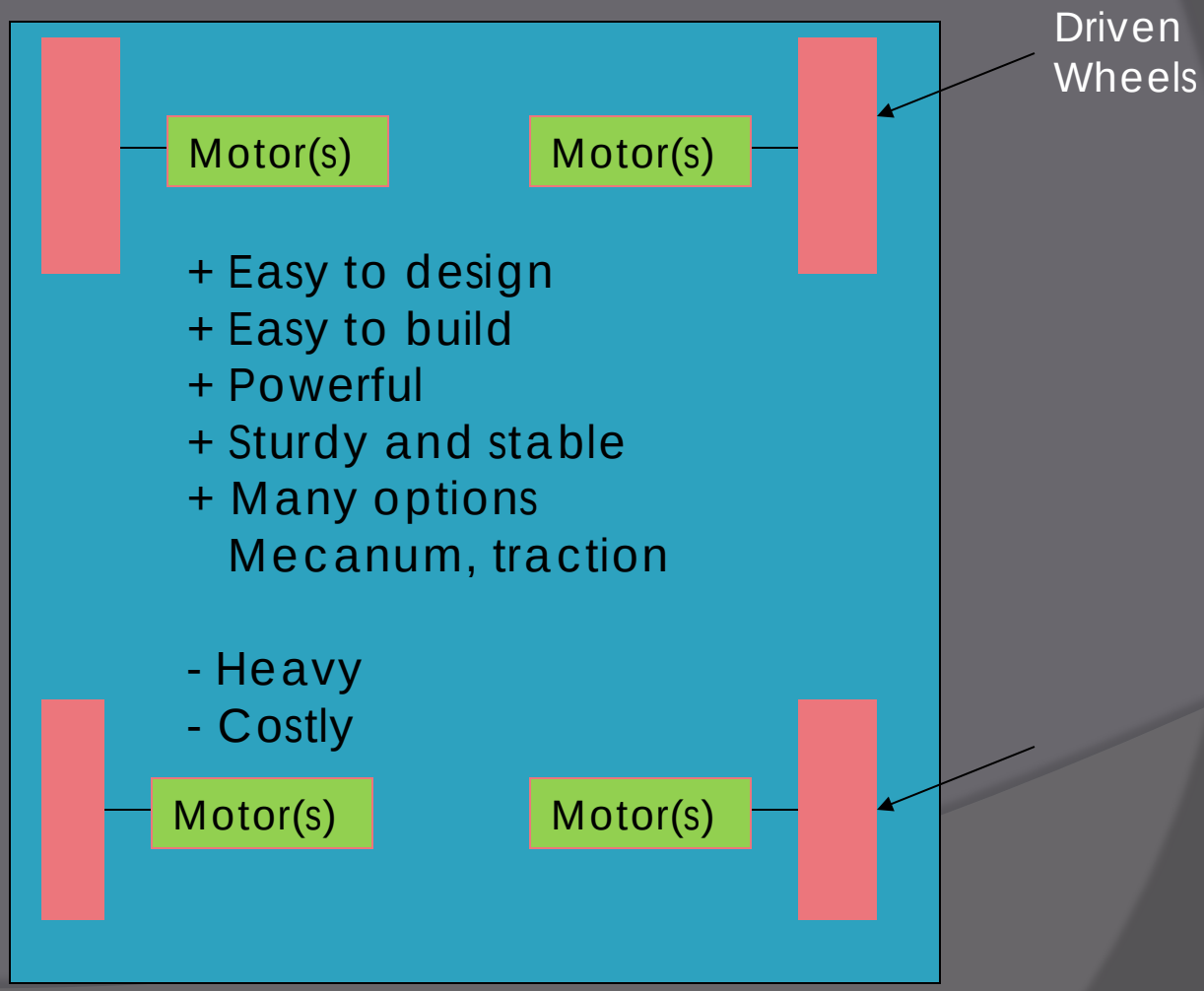


3 wheel drive, 2 gearboxes



- Light weight
- Fast
- Various types
- Not standard

4 wheel drive, 4 gearboxes



6 wheel drive, 2 gearboxes