

# 3 Laws & 5 Levels

## The Three Laws of Human-Centered Robotics

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- 1** A human-centered robot will not replace humans, only forms of human labor that are dangerous, repetitive, and exhausting.
- 2** A human-centered robot assists human beings, extends their capabilities, and promotes their quality of life.
- 3** To protect its own existence, a human-centered robot protects the existence of its human operator.

## 5 Levels of *Autonomy for Humans*™

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Autonomy for Humans describes the movement of intelligent vehicles in pedestrian environments (as well as roadways suitable for human-powered vehicles like skateboards, push scooters, and bicycles) including sidewalks, promenades, plazas, parks, malls, and building interiors.

This class of machines senses, understands, and anticipates the movements and behaviors of people, rather than treating them as obstacles (as would a self-driving automobile or warehouse robot). It interacts with them intimately: on a human scale, in close proximity, attending to the complexity of human behaviors and needs.

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### Level 0

#### No Autonomy

The human operator is responsible for the control and guidance of the vehicle at all times.

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### Level 1

#### Following

The vehicle can precisely match the movements, pace, and behavior of a person within its line of sight by making use of its own wayfinding. This includes avoiding collisions with fixed or slow-moving obstacles along its path.

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### Level 2

#### Paired Autonomy

The vehicle can match the movements, pace, and behavior of a person even when out of the line of sight by inferring human behaviors and movements, such as moving through a crowd and traveling around corners.

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### Level 3

#### Smart Behaviors

In addition to following paths and routes by matching the motion of the human operator, the vehicle is capable of behaviors such as passing through doorways while a door is held open, entering and exiting elevators, parking and waiting, returning to base over limited distances, and otherwise navigating without guidance from its human operator.

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### Level 4

#### Autonomy on Learned Routes

The vehicle can navigate pedestrian environments along known paths and routes it or other vehicles have previously traveled following a human operator. While traveling it is capable of interacting with people on those routes not only using obstacle avoidance but also performing selective following (drafting), passing, moving aside to let others pass, dodging diagonally into gaps between people, pausing to allow others to cross, and other behaviors associated with proper pedestrian etiquette.

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### Level 5

#### Autonomy of Unknown Routes

The vehicle can travel from a source position to a destination along a continuous route without familiarity or a-priori knowledge of the route while observing the basic rules of pedestrian etiquette.