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MAI4CAREU Master programmes in Artificial
Intelligence 4 Careers in Europe

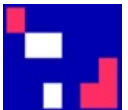
 POLITECNICO DI MILANO



DRIVING AUTOMATION: AN ETHICAL PERSPECTIVE

 Co-financed by the European Union
Connecting Europe Facility

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POLITECNICO DI MILANO

Aims

1. Introduce driving automation and its ethical significance
2. Analyse three ethical issues:
 - Safety
 - Sustainability
 - Responsibility
3. Discuss unavoidable collision moral dilemmas with you



Driving Automation



Driving Automation



SAE J3016™ LEVELS OF DRIVING AUTOMATION

	SAE LEVEL 0	SAE LEVEL 1	SAE LEVEL 2	SAE LEVEL 3	SAE LEVEL 4	SAE LEVEL 5
What does the human in the driver's seat have to do?	You <u>are</u> driving whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			You <u>are not</u> driving when these automated driving features are engaged – even if you are seated in “the driver’s seat”		
	You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	
What do these features do?	These are driver support features			These are automated driving features		
	These features are limited to providing warnings and momentary assistance	These features provide steering OR brake/acceleration support to the driver	These features provide steering AND brake/acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met	This feature can drive the vehicle under all conditions	
	<u>Operational Design Domain</u>					
Example Features	<ul style="list-style-type: none"> • automatic emergency braking • blind spot warning • lane departure warning 	<ul style="list-style-type: none"> • lane centering OR • adaptive cruise control 	<ul style="list-style-type: none"> • lane centering AND • adaptive cruise control at the same time 	<ul style="list-style-type: none"> • traffic jam chauffeur 	<ul style="list-style-type: none"> • local driverless taxi • pedals/steering wheel may or may not be installed 	<ul style="list-style-type: none"> • same as level 4, but feature can drive everywhere in all conditions

Ethics of Driving Automation

What?

Technical issues:
Level 5 Autonomy

Ethics of Driving Automation

Safety



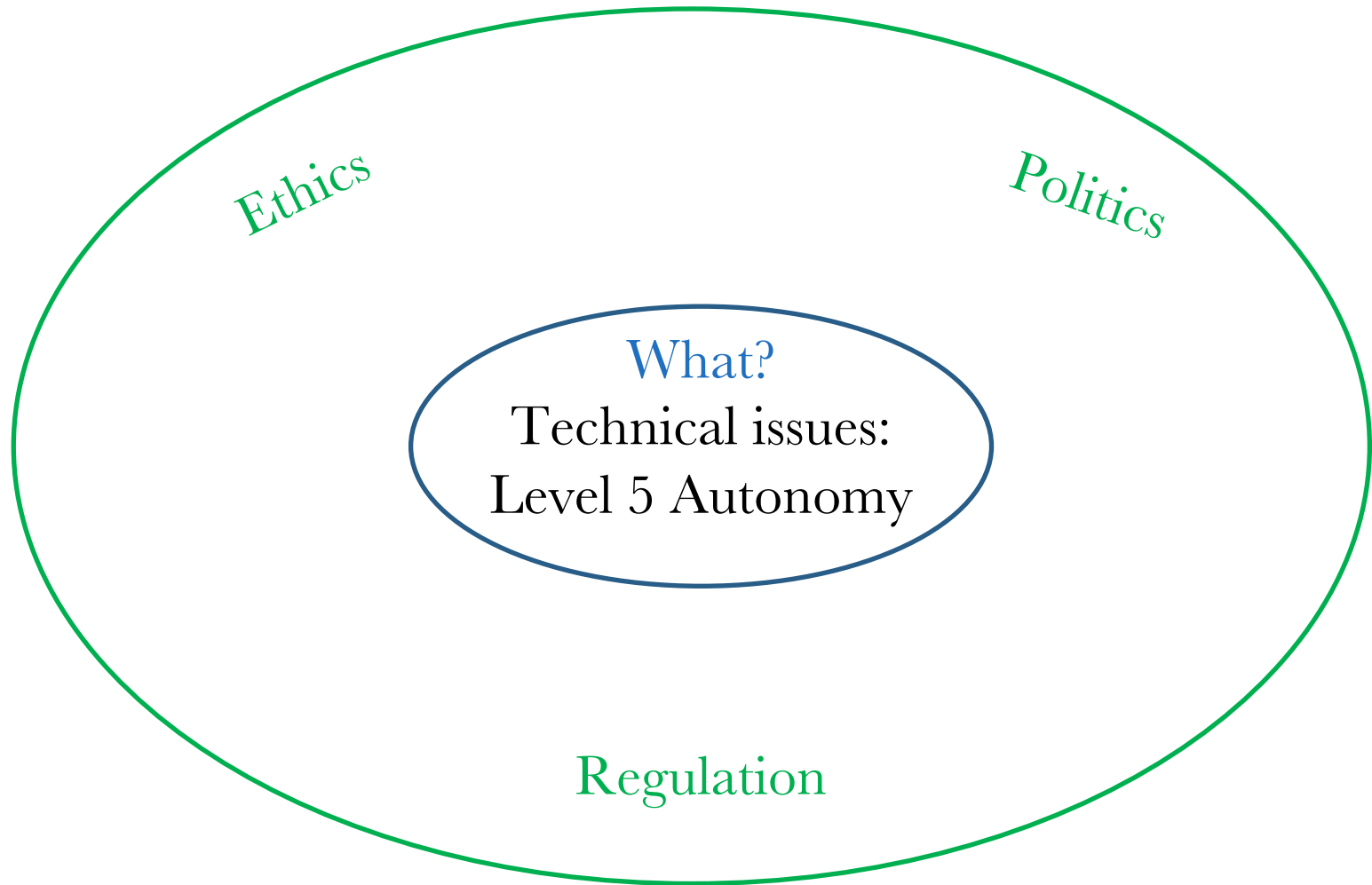
Responsibility Allocation



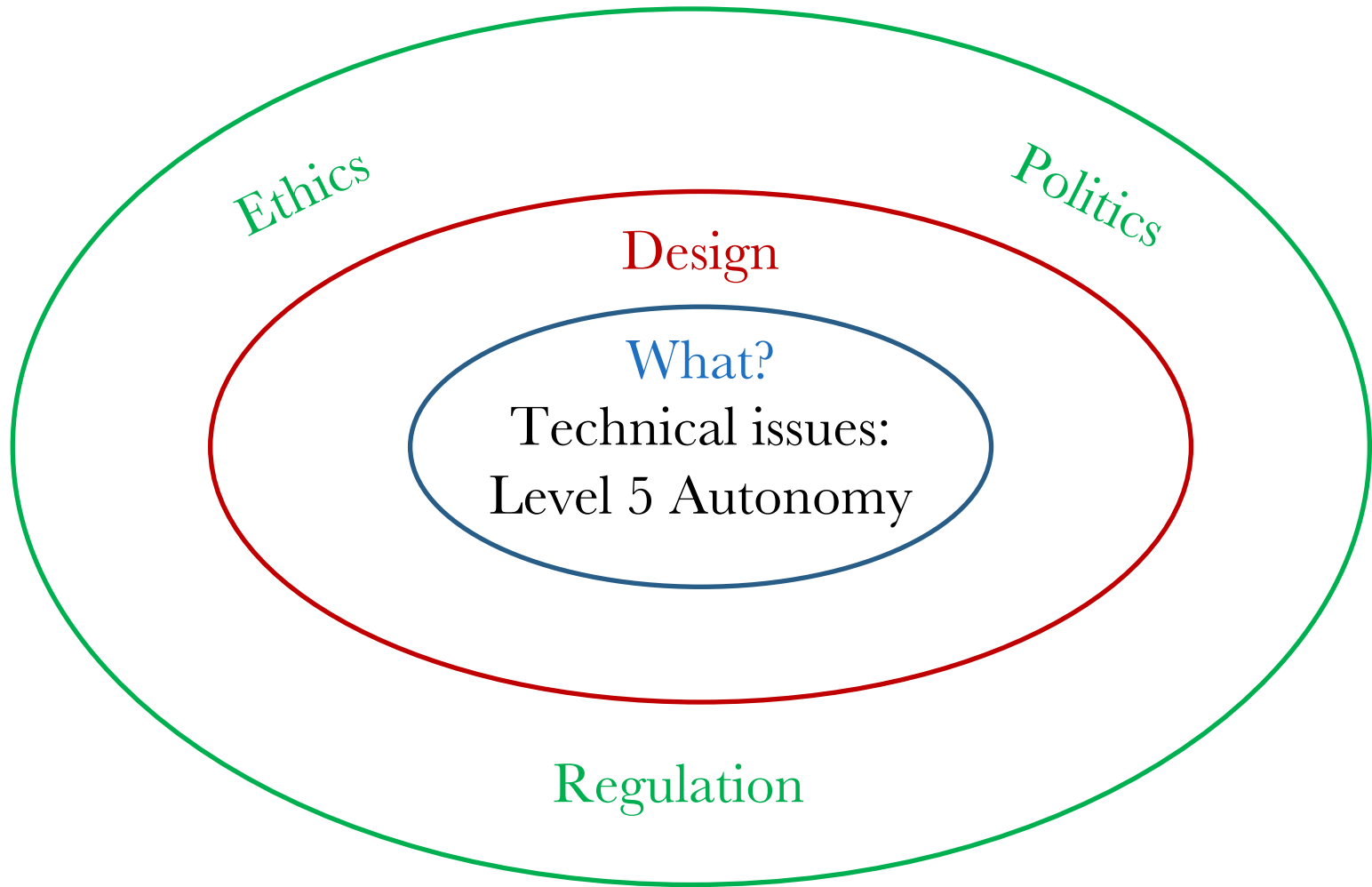
Sustainability



Ethics of Driving Automation



Ethics of Driving Automation



↑ **Social Trust** ↑

Safety



The Safety Argument



- Traditional problems: ‘usual’ mobility risks
- Artificial Intelligence: new **opportunities!**
- HUGE opportunities – theoretically, at least:
 - ☞ Up to 90% of traffic accidents are caused by human error (text and drive, drunk driving, falling asleep at the wheel, fatigue, road rage, stress...)
 - ☞ 1.3 million deaths per year worldwide



Many collisions will be **avoidable!**

By taking control out of human hands and delivering it to reliable systems, driving automation could dramatically reduce accidents and traffic deaths

The Safety Argument



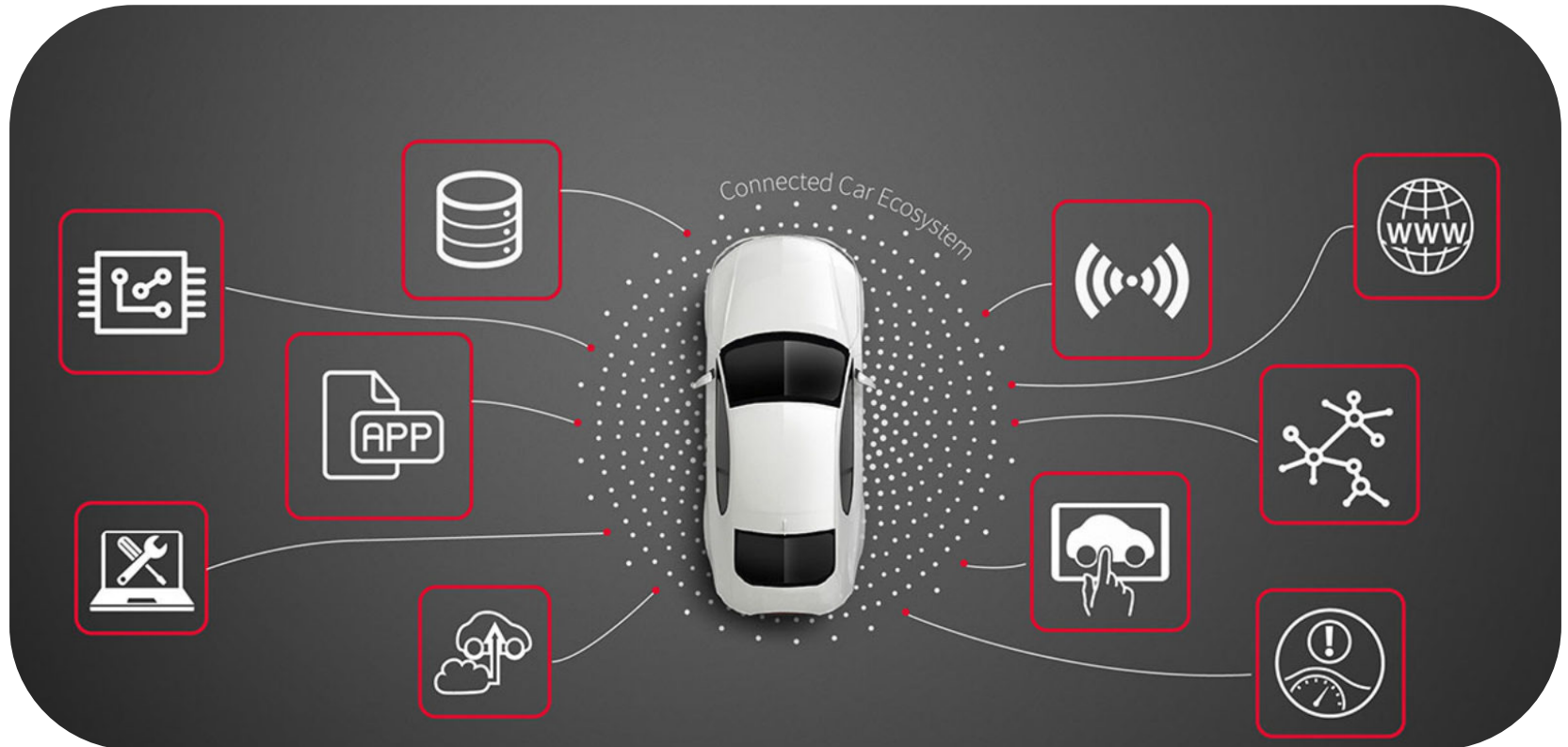
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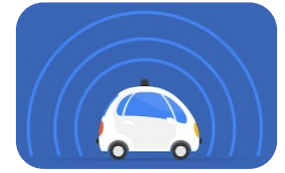
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Security & Privacy



Security



Bogus Satellite Nav Signals Send Autonomous Cars Off the Road

At the Black Hat security conference, a researcher demonstrated how making tweaks to navigation signals could send a self-driving car careening off the road.



Hacking street signs with stickers could confuse self-driving cars

Subtle or camouflaged optical hacks can change a stop sign into something else.

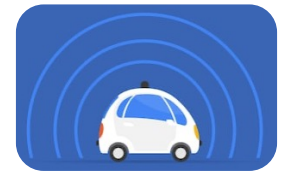
Researcher Hacks Self-driving Car Sensors

\$60 lidar spoofing device generates fake cars, pedestrians and walls



Researchers Fool Autonomous Vehicle Systems with Phantom Images

Privacy



How Self-Driving Cars Will Threaten Privacy

Automated vehicles will learn everything about you—and influence your behavior in ways you might not even realize.

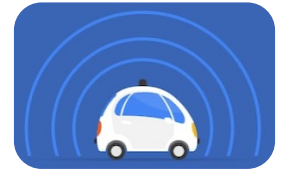


Self-driving cars: bigger road safety, less privacy

They are supposed to reduce road casualties, but what else do they entail?

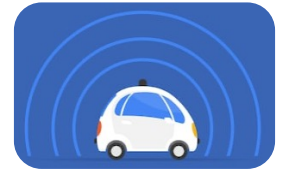
Self-Driving Cars: Balancing Safety and Data Privacy Considerations

Security & Privacy



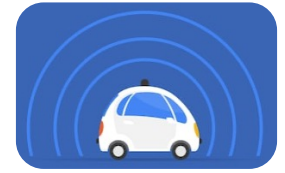
- Autonomous vehicles pose risks proper of both usual vehicles *and* information systems

Security & Privacy



- Autonomous vehicles pose risks proper of both usual vehicles *and* information systems
 - ☞ double safety challenge:
 - Make vehicles *safe*: usual stuff (crashworthiness, reliability) but also bugs, software issues, sensor failures, communication problems...
 - Make vehicles *secure*: digital infrastructure liabilities, hijacking, external attacks, data thefts, data leaks...

Security & Privacy



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 - Make vehicles *safe*: usual stuff (crashworthiness, reliability) but also bugs, software issues, sensor failures, communication problems...
 - Make vehicles *secure*: digital infrastructure liabilities, hijacking, external attacks, data thefts, data leaks...
 - ☞ privacy issues:
 - For autonomous vehicles to function properly, a huge quantity of data must be collected, shared, and stored: **personal data** as well!
 - Definitions of privacy and sensible data as involved in AD
 - Privacy protection throughout the entire infrastructure
 - Informed consent (...)

Safety



Plus:

- ☞ **Reflect critically** on ethically relevant opportunities and risks
- ☞ Integrate ethical considerations to **design** processes
- ☞ Provide effective **regulation, policy measures,** and **institutional support** to safe mobility

Sustainability



Sustainability Narratives



Sustainability Narratives



Traffic optimization and new mobility paradigms

- Reduced fuel consumption (air pollution)
- Reduced CO₂ emissions (global warming)
- Reduced land use



Sustainability Narratives



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More wealth

- New business opportunities
- New job opportunities

Sustainability Narratives



Traffic optimization and new mobility paradigms

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Increased well-being

- Less time wasted in traffic
- No time wasted in driving
- Improved mobility options
- Inclusivity



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Sustainability Narratives



Rebound effects

Traffic optimization and new mobility paradigms

Beyond private property?

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Empty trips

Data Centres

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Inequality

Technological Unemployment

Sustainability Narratives



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Empty trips

Data Centres

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More time to do what?



For whom?

Inequality

Sure?

More wealth

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Technological Unemployment

Beware of Ethical Innovation Narratives!



?



Ethical accomplishments depend on how society
shapes driving automation

Moral **commitment** and **responsibility** are crucial

Responsibility Allocation



Responsibility Allocation



- Who is to be held responsible for harm caused by accidents where autonomous vehicles are involved?

Responsibility Allocation



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 - The systems themselves?



Responsibility Allocation



- Who is to be held responsible for harm caused by accidents where autonomous vehicles are involved?
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Responsibility Allocation



- Who is to be held responsible for harm caused by accidents where autonomous vehicles are involved?
 - The systems themselves? **NO**
 - passengers?
 - owners?
 - designers/developers?
 - producers?
 - regulators
 - nobody, just insurance system?



Responsibility Allocation



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 - The systems themselves? **NO**
 - passengers?
 - owners?
 - designers/developers?
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 - regulators
 - nobody, just insurance system?



Responsibility Allocation



Tech

Uber's self-driving operator charged over fatal crash

16 Sept. 2020

Why Wasn't Uber Charged in a Fatal Self-Driving Car Crash?

17 Sept. 2020

Authorities charged the vehicle's "safety driver" with criminal negligence, but not the company that developed the technology.

Self-Driving Car Users Shouldn't Be Held Responsible For Crashes, U.K. Report Says

25 Jan. 2022

28 Mar. 2022

Mercedes will accept responsibility for autonomous technology crashes

Unavoidable Collisions



Unavoidable Collisions



- Unavoidable collisions have been a primary worry in the ethical debate on autonomous driving
- Q: how should the system handle morally laden situations – i.e., situations where harm is unavoidable *but* can be distributed in different ways? ➔ [Accident-algorithms](#)

rights

duties

non-discrimination

consequences

protect children



sacrifice passengers

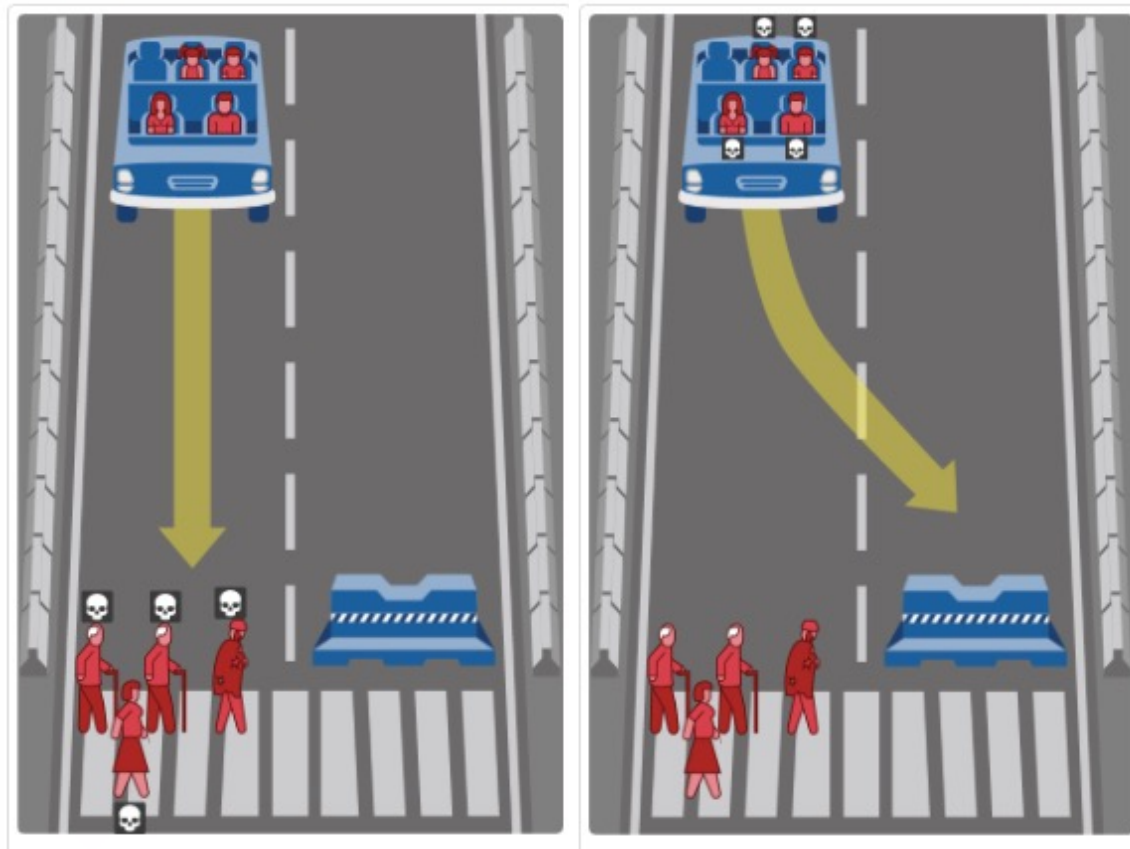
sacrifice bystanders

save more lives possible

Unavoidable Collision



A self-driving car with sudden brake failure is approaching a crosswalk.
What should it do?



Unavoidable Collision



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Choice A

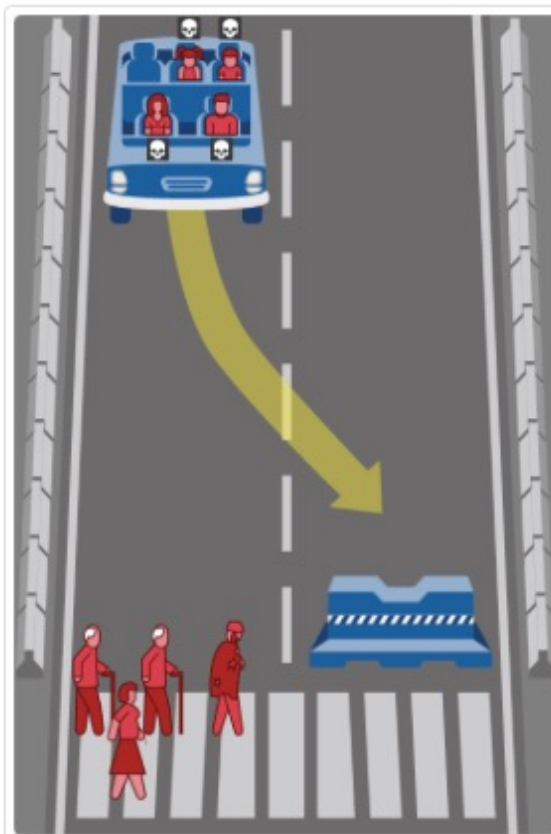
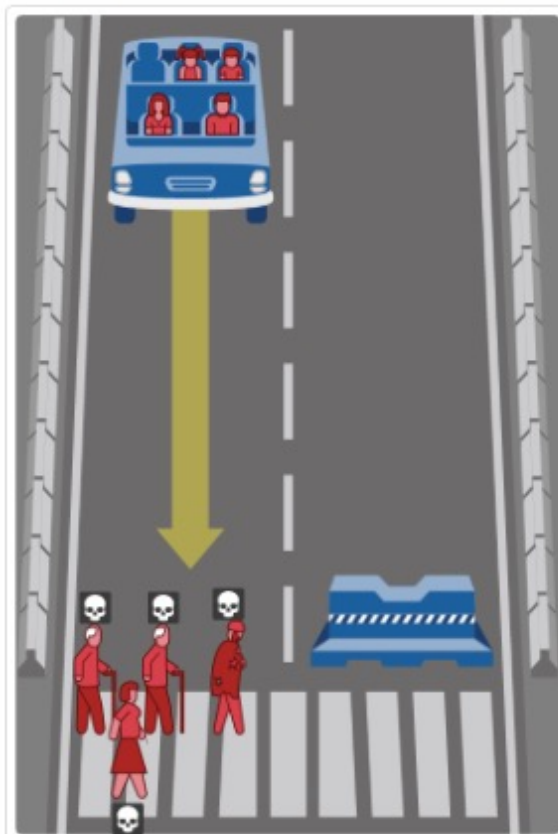
Action:
don't swerve

Consequences:
Pedestrians die

2 elderly men
1 homeless person
1 fat woman

Passengers safe:

1 man
1 woman
1 little girl
1 little boy



Unavoidable Collision



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What should it do?

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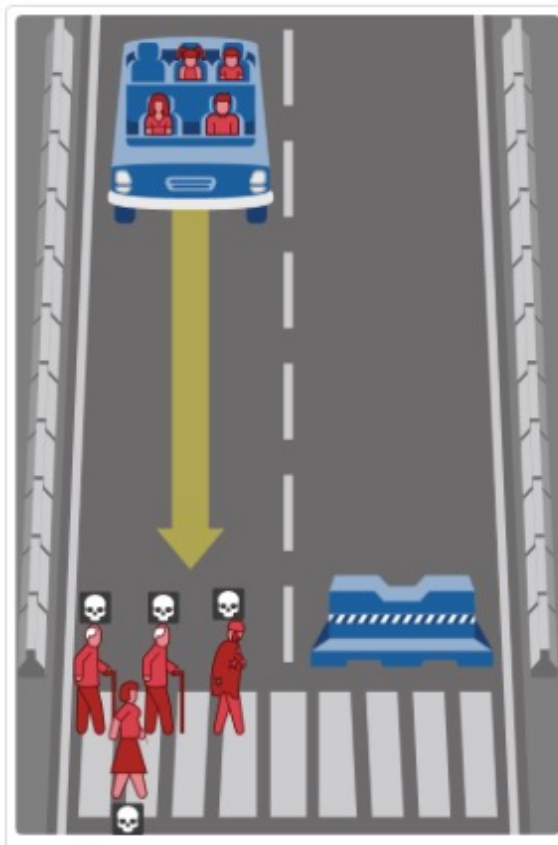
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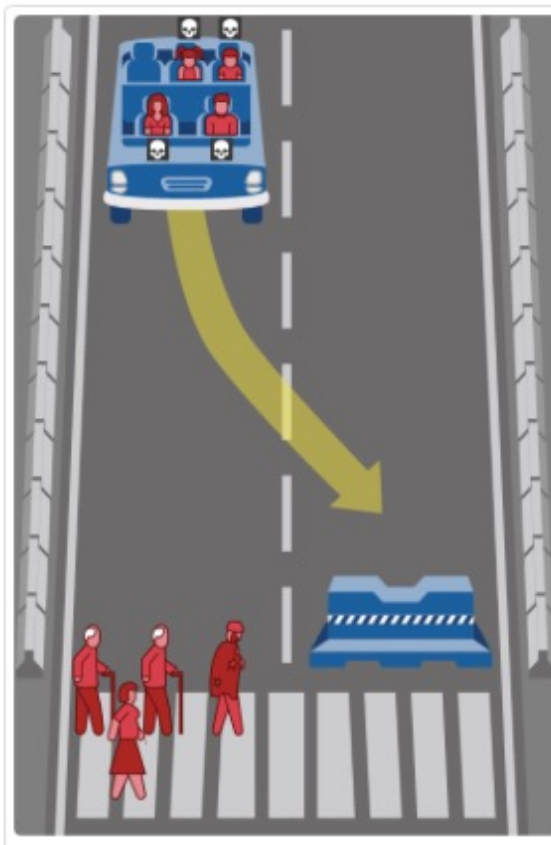
Choice B

Action:
swerve

Consequences:
Passengers die

1 man
1 woman
1 little girl
1 little boy

Pedestrians safe:
2 elderly men
1 homeless person
1 fat woman



Thank you for
your attention!

Questions?

