- start by showing https://www.youtube.com/watch?v=-7xvqQeoA8c from second 0 to second 17

- (turning around from a chair)
- did you ever wonder how “handle” works? looks like magic, right? looks impossible, right? like they are cheating or using photoshop or so?
- Well, as you will discover in this project, this is neither magic magic nor impossible.
- This is automatic control and in fact - it is all around us!
- hello, I am Steffi, and today we are starting our learning how to make a robot balance on its wheels and learn lot’s of cool stuff about control, automatic control and how things around us work.

Making robots balance
Part 1

What are we doing here?

- before jumping in the details, let's discuss what is the purpose of this project, what is going to happen, what you are going to do, and what you are going to learn

Our purposes

Our purposes

- have fun

Our purposes

- have fun
- understand the world a bit better

Our purposes

- have fun
- understand the world a bit better
- see that math is useful

What is going to happen in the whole series

What is going to happen in the whole series

- build a robot

What is going to happen in the whole series

- build a robot
- fiddle with it

What is going to happen in the whole series

- build a robot
- fiddle with it
- fiddle with our intuitions

What is going to happen in the whole series

- build a robot
- fiddle with it
- fiddle with our intuitions
- see what we can achieve using math and control

What we are going to learn in the whole series

What we are going to learn in the whole series

- understand what control and automatic control mean

What we are going to learn in the whole series

- understand what control and automatic control mean
- create and tune a controller

What we are going to learn in the whole series

- understand what control and automatic control mean
- create and tune a controller
- get intuitions of the pervasiveness of control

What is going to happen in today's part

What is going to happen in today's part

- look into some examples of control

What is going to happen in today's part

- look into some examples of control
- play with some pens

A controller? What is it, mom?

- let's make an example
- you enter a shower, and turn on the water
- is it too cold? then you turn the knob to make it warmer
- is it too warm? then you do the viceversa
- is there too little water? you increase the flux
- are you happy now? well done, you controlled the shower!

More seriously. . . what is control?

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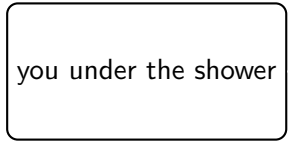

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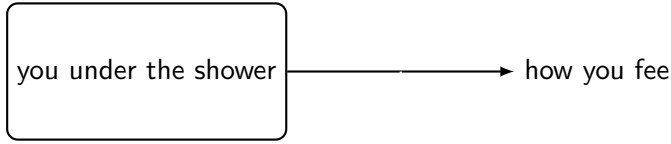

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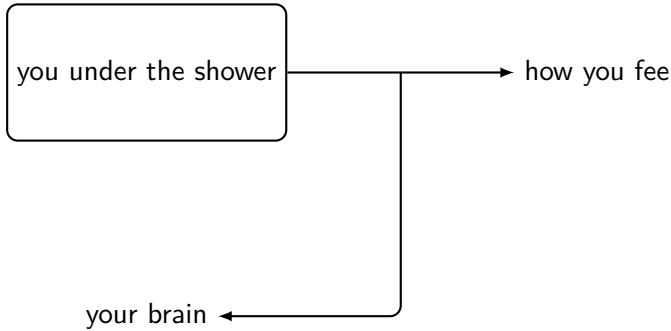

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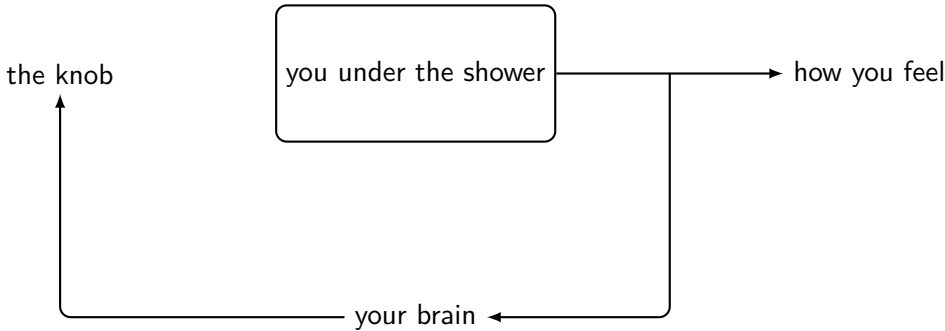

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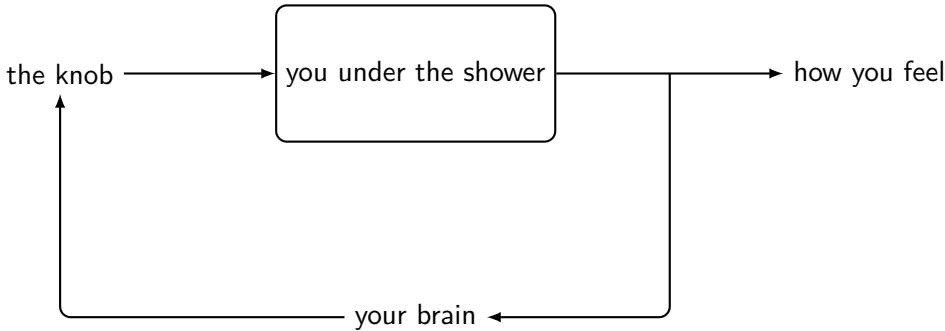

Control and Automation

https://www.youtube.com/watch?v=XJLMW6l303g

Automation, by Alessandro Falsone - IEEE CSS Video Clip Contest 2014

- which examples can you come up with?
- look around you and try to find examples of control!
- which other control tasks can you accomplish?
- pause this video and discuss with your friend!
- Let's see, who can find the most examples!

- how did it go?
- did you find many examples?
- here is one I found:
- another example from everyday life, that we can connect to the concept of control is to balance a pen in your hand
- try at desk with the pen
- ok, let's go outside and do some practise!

videos outside balancing sticks etc

ok, now it's your turn! Take a pen or a stick or a ruler and try to balance it with your hand.

- see and feel how the pen is tipping, and counteract with your hands
- try to use different pens or sticks or brooms with different heights and weights, and get an intuitive understanding of the following things:
  - do you feel it is more difficult to balance a longer pen or a shorter one? a heavier pen or a lighter one? and why?
  - try and discuss!

no worries if it takes a bit of practise. believe me, we produced a lot of outtakes here as well!

Tryout pause!

- what do you do with your hand to balance the pen?
- more difficult to balance a longer or a shorter pen? A heavier or a lighter pen? And why?
- is it easier to start with the pen vertical? And why?
- how do you adapt your strategy?

- you are actually applying feedback and control when you are balancing your pen!
- what you have to do is to counteract the tipping by observing how the pen tips and reacting with your hand
- your eyes = your sensors seeing the pen tip
- your hand = actuator moving around to balance the pen
- your brain = the computer deciding how to move

- amazing, I am proud of your trying!
- and I am proud that you also learned
  - what control and feedback mean
  - how to connect this concept with real life examples
- now we are ready to move to the next part of the experience! See you in 'part 2'