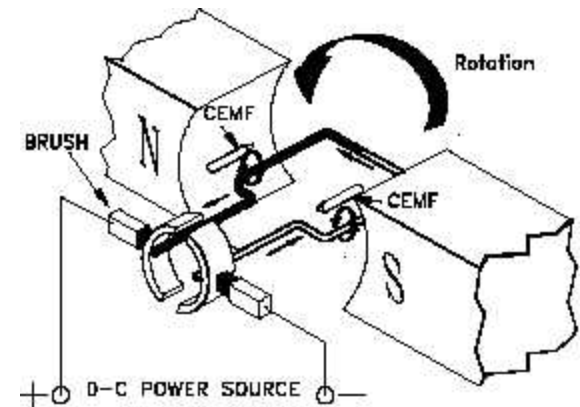


DC Motors

- Current (ideally) is proportional to the torque produced by the motor
- Direction of current flow determines torque direction

How can a digital input control torque magnitude?



www.tpub.com



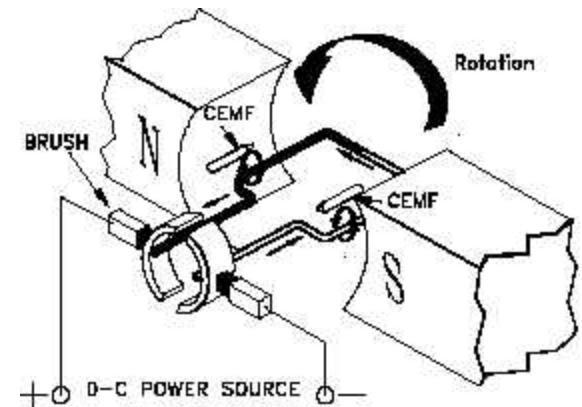
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DC Motors

How can a digital input control torque magnitude?

- Use PWM!

How do we handle torque direction?



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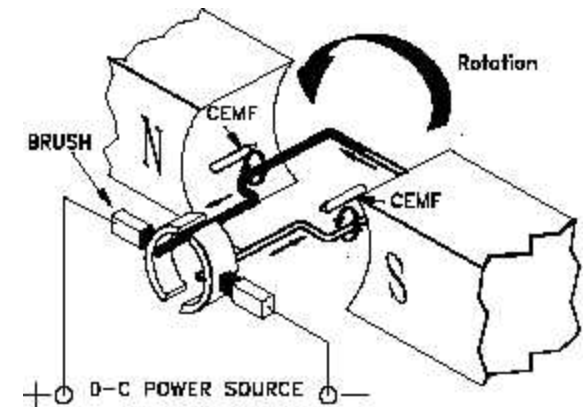


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DC Motors

How do we handle torque direction?

- +5V to north 0V to south
- 0V to north +5V to south



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How would we implement this?



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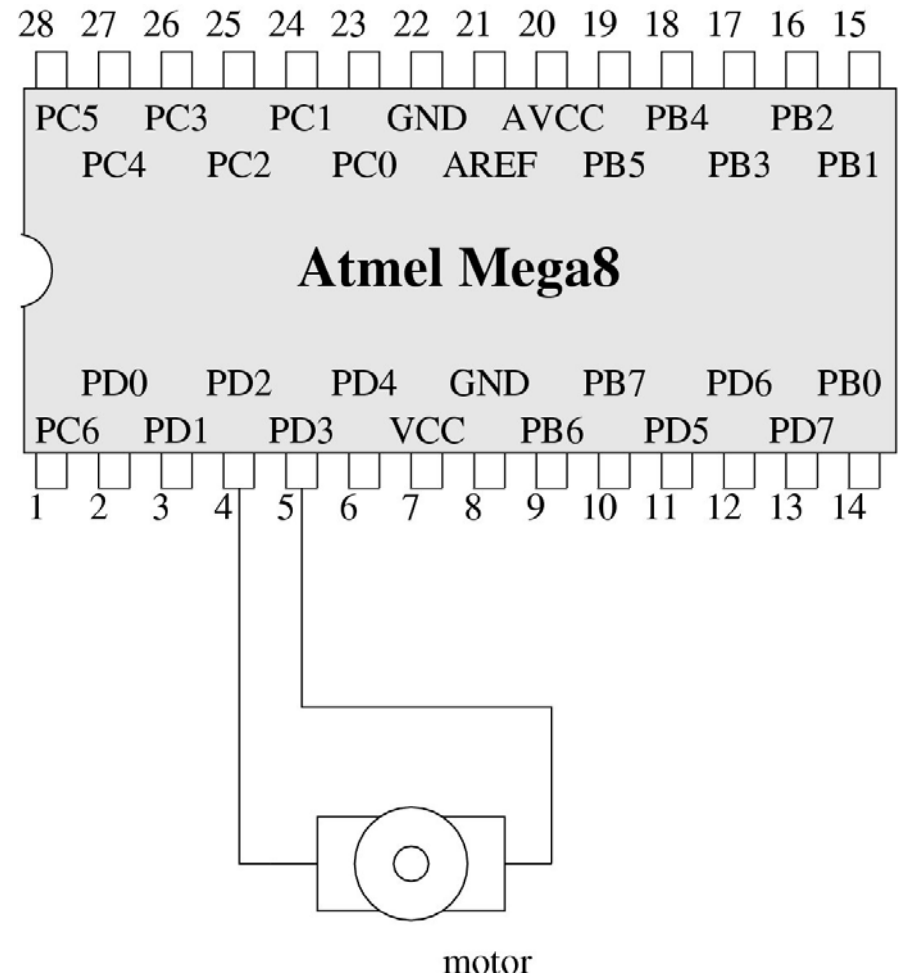
DC Motor Control

One possibility...

- Connect motor directly to the I/O pins

Two directions:

- PD2: 1; PD3: 0
- PD2: 0; PD3: 1

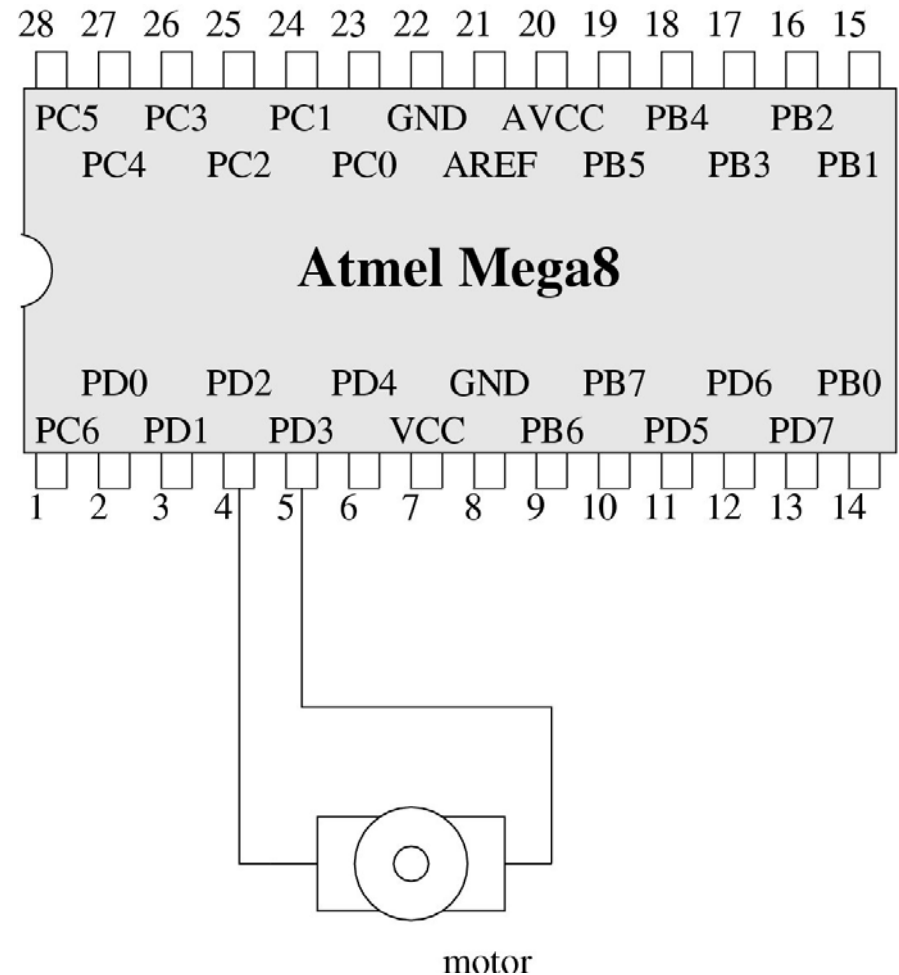


DC Motor Control

One possibility...

- Connect motor directly to the I/O pins

What is wrong with this implementation?

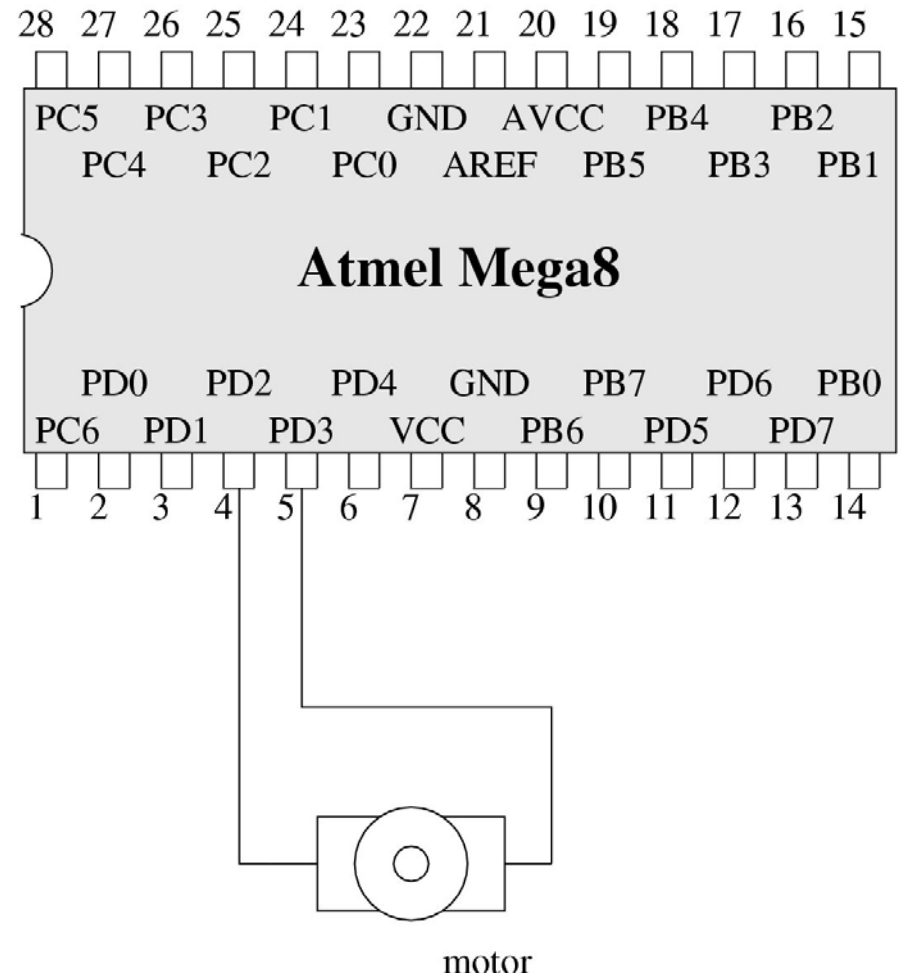


DC Motor Control

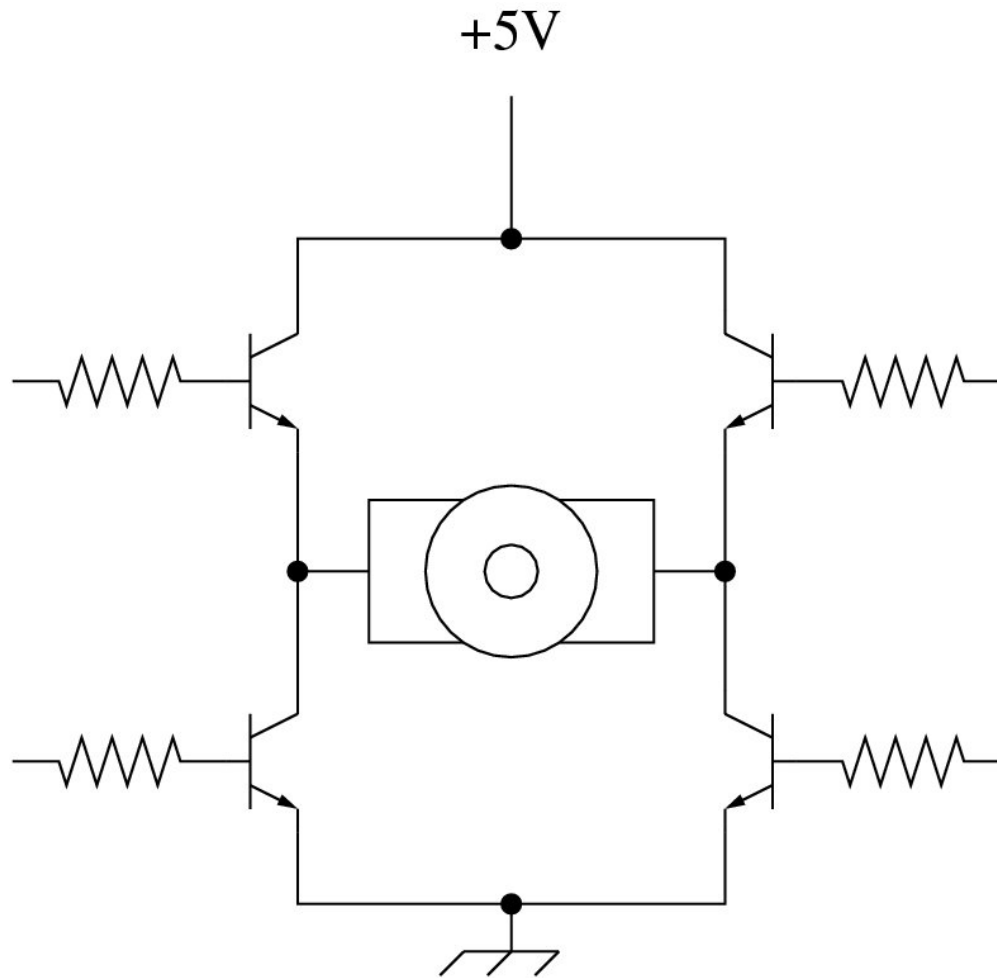
What is wrong with this implementation?

- Our I/O pins can source/sink at most 20 mA of current
- This is not very much when it comes to motors...

How do we fix this?

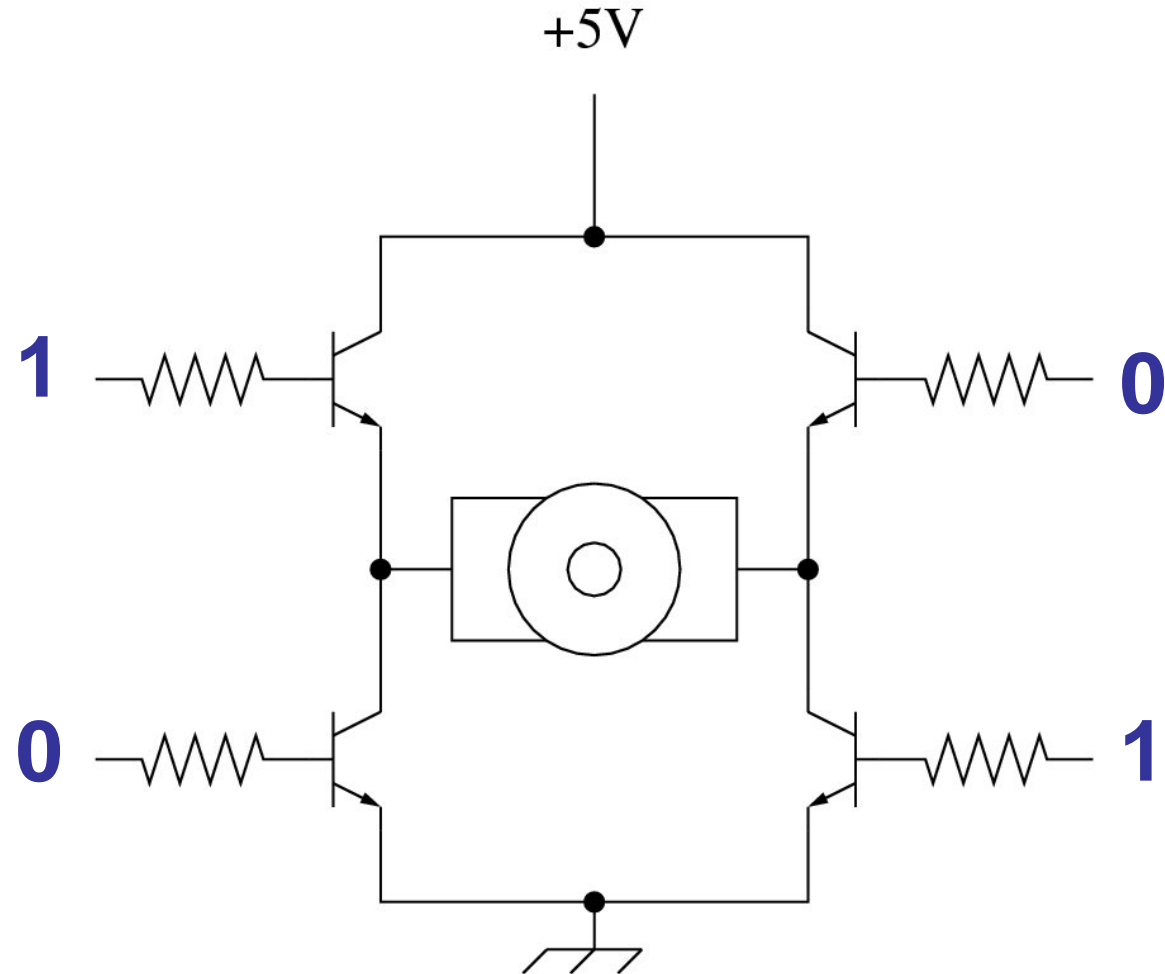


Simple H-Bridge



Simple H-Bridge

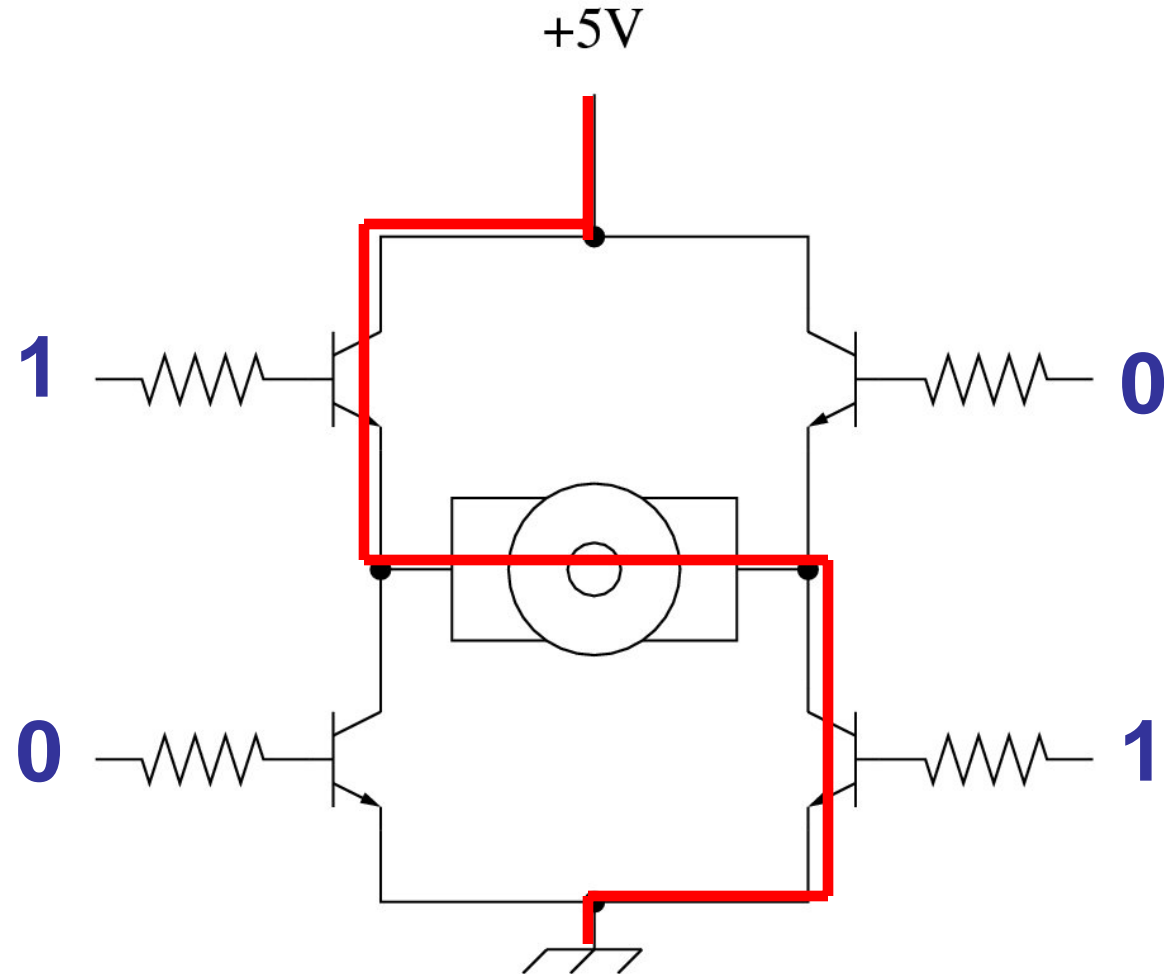
What happens with these inputs?



Simple H-Bridge

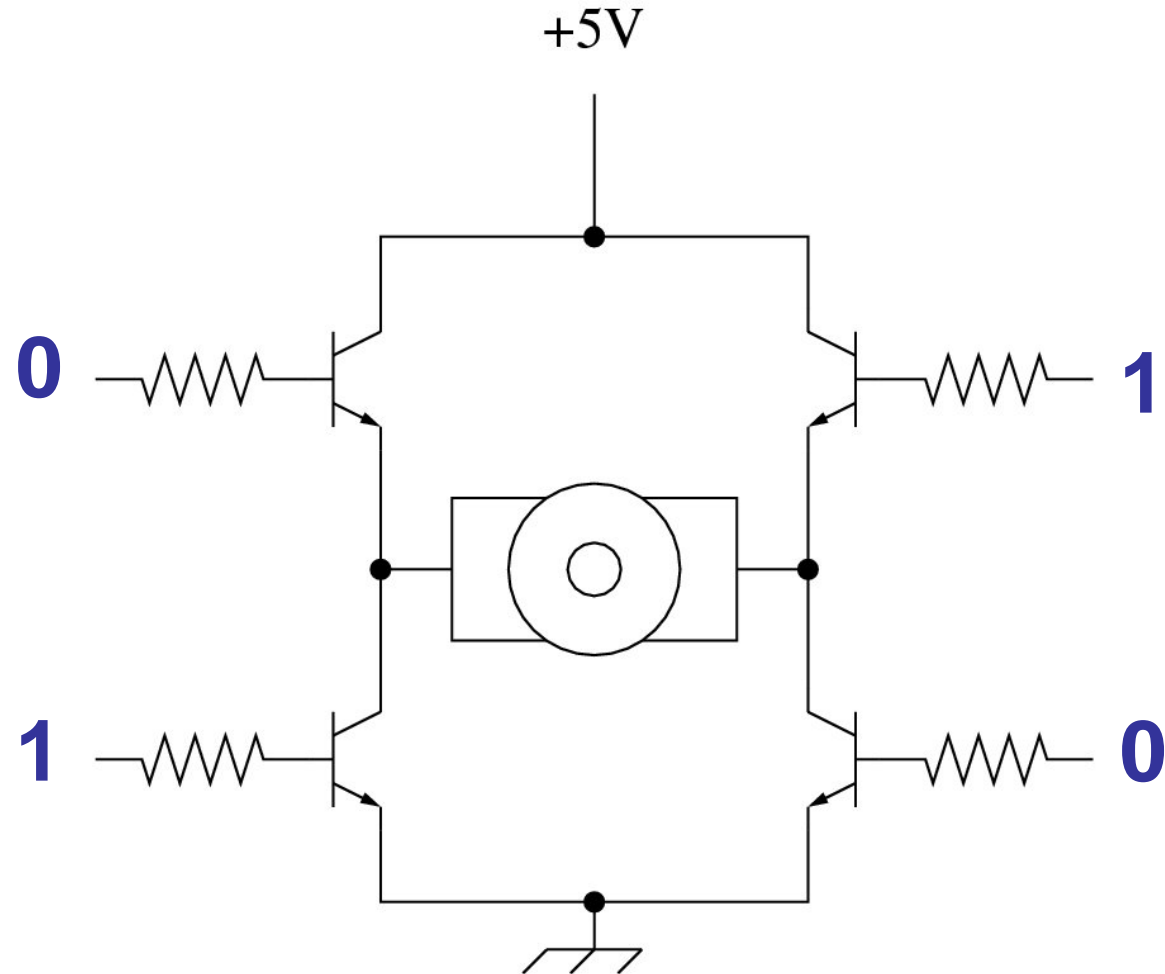
What happens with these inputs?

- Motor turns in one direction



Simple H-Bridge

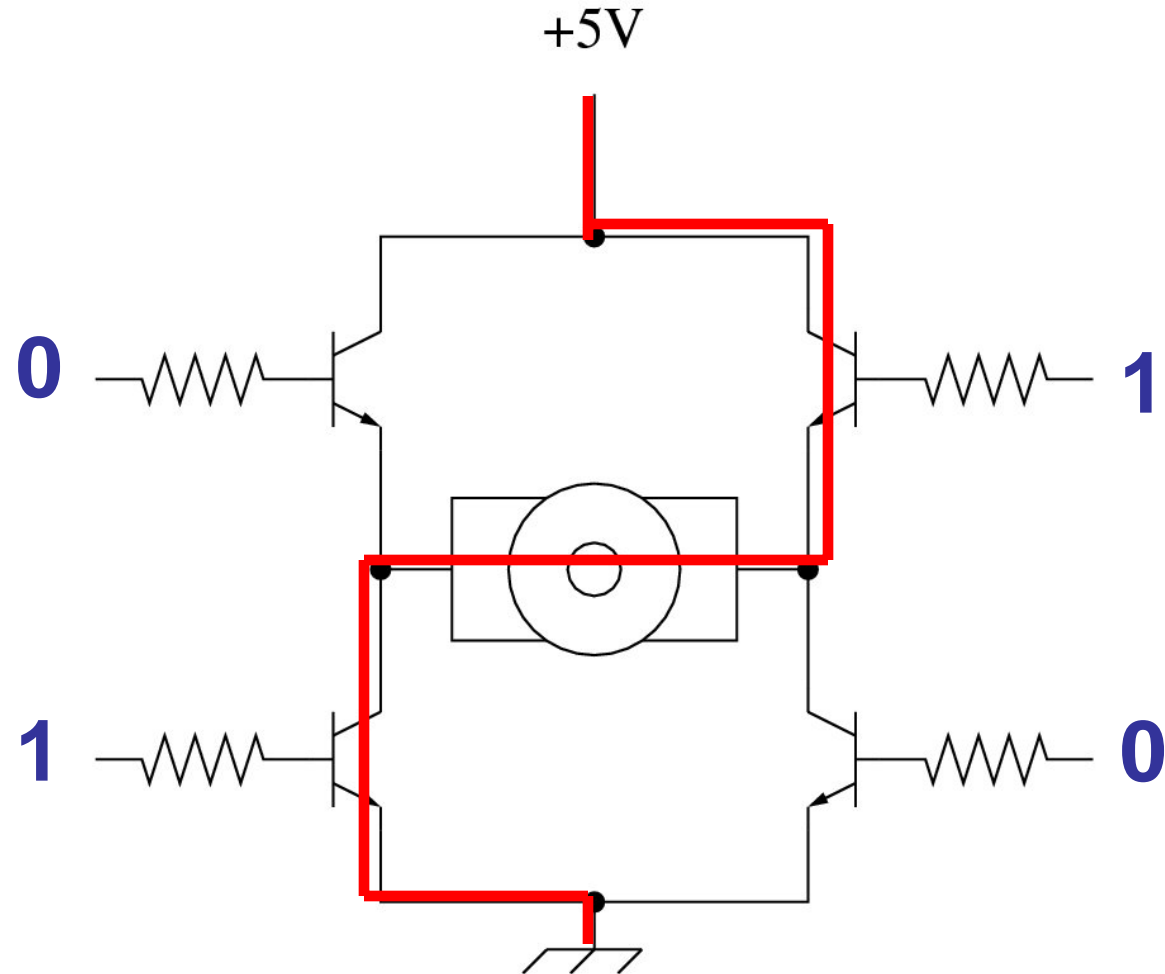
How about
these
inputs?



Simple H-Bridge

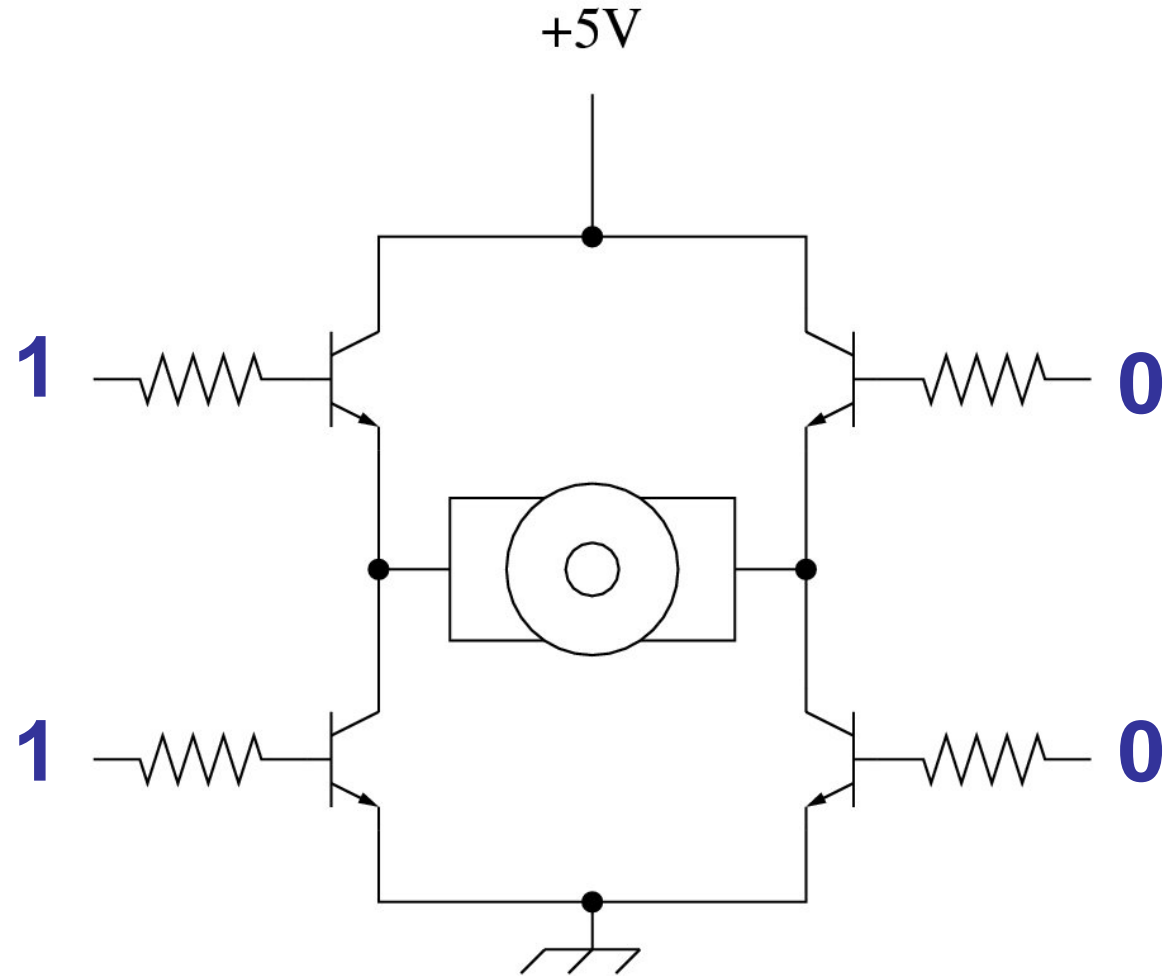
What happens with these inputs?

- Motor turns in the other direction!



Simple H-Bridge

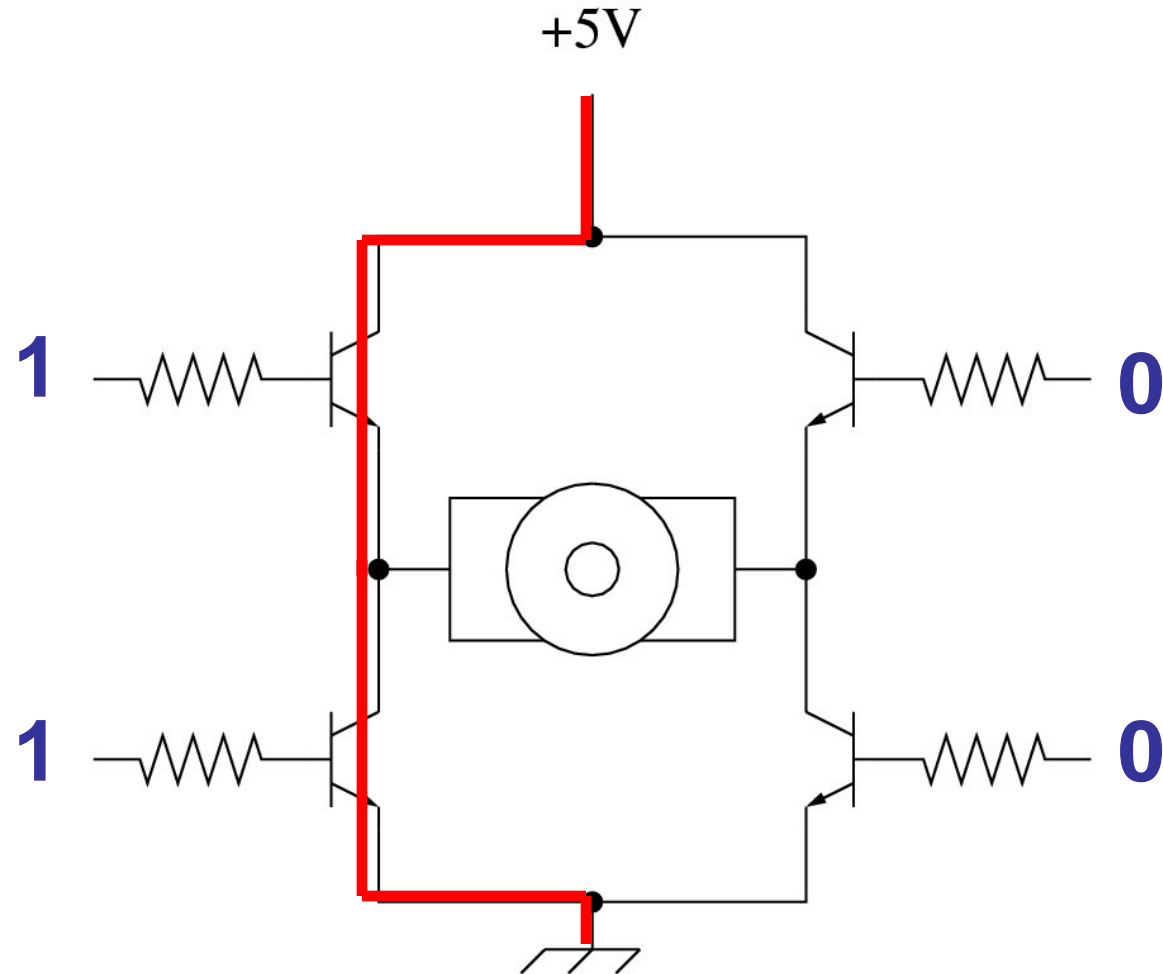
How about
these
inputs?



Simple H-Bridge

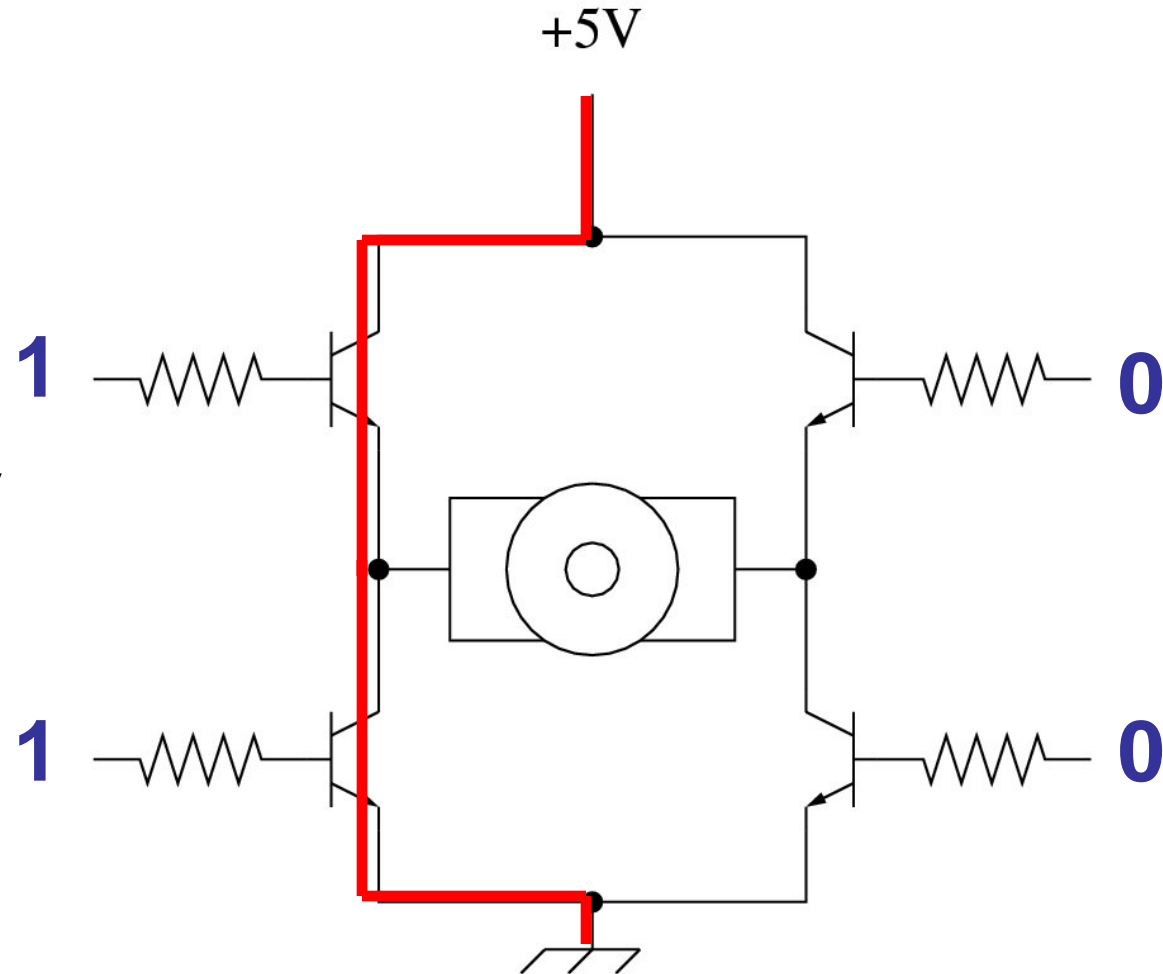
What happens with these inputs?

- We short power to ground
- ... very bad



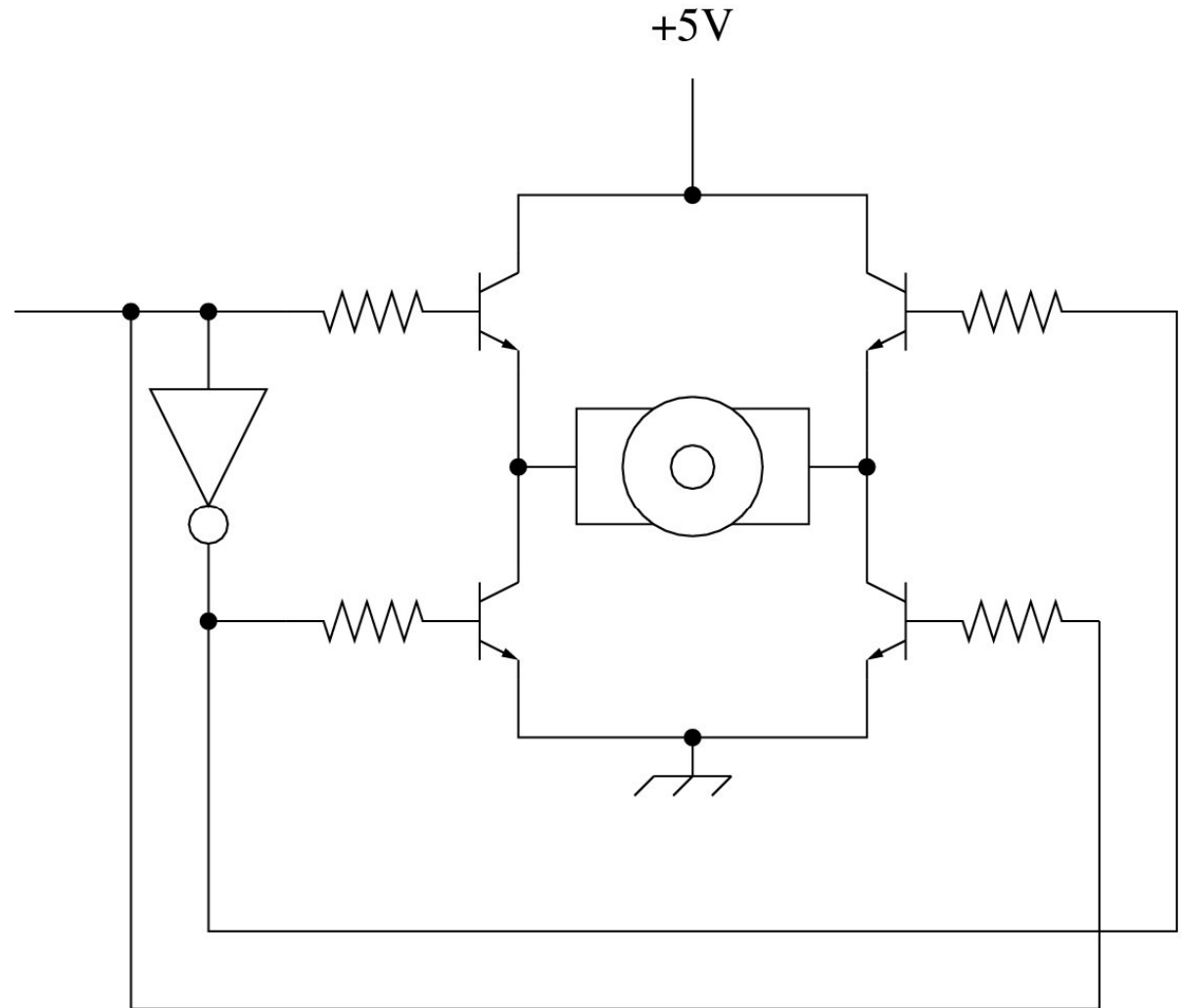
Simple H-Bridge

How can we prevent a processor from accidentally producing this case?



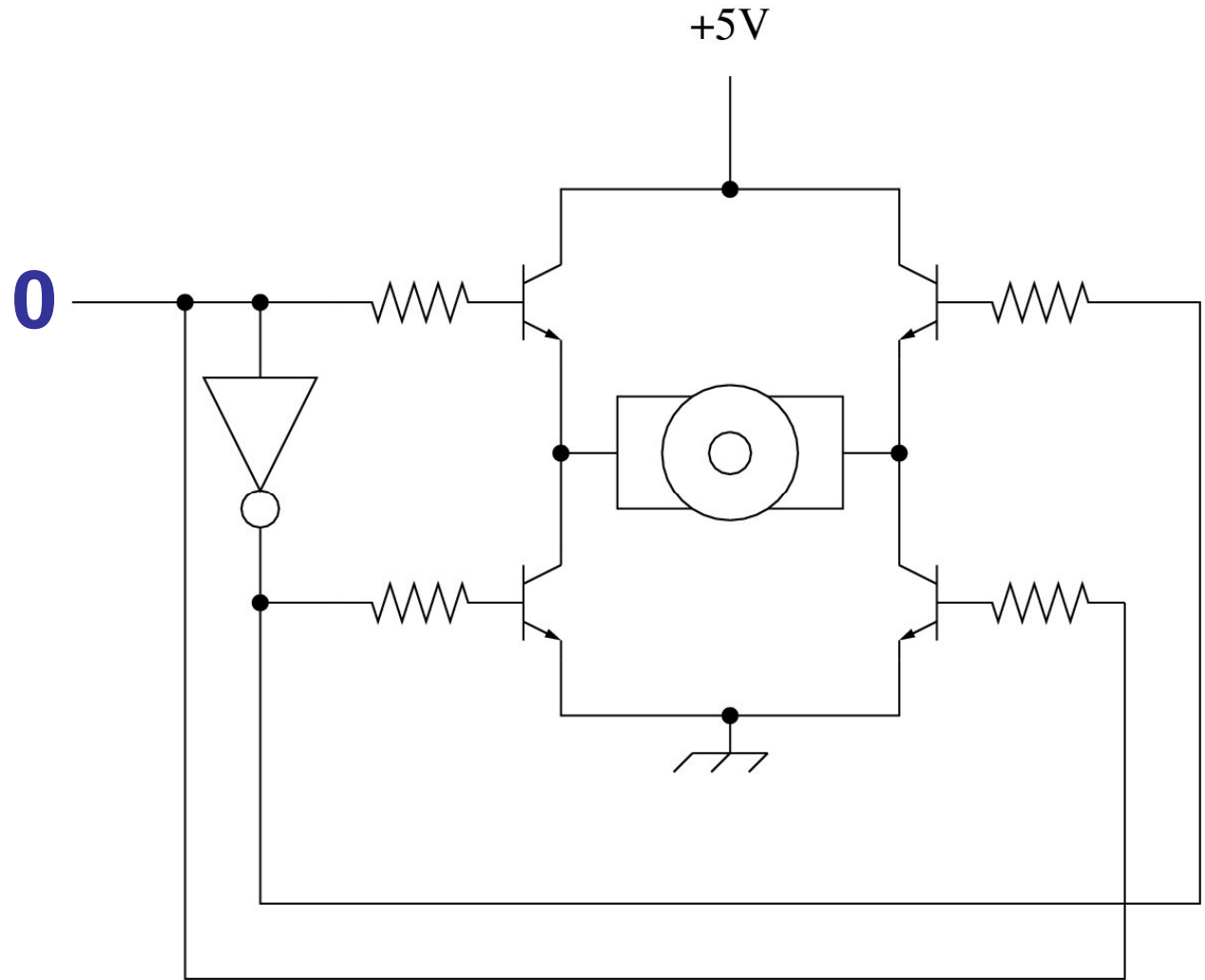
Modified H-Bridge

We introduce a little logic to ensure the short never occurs



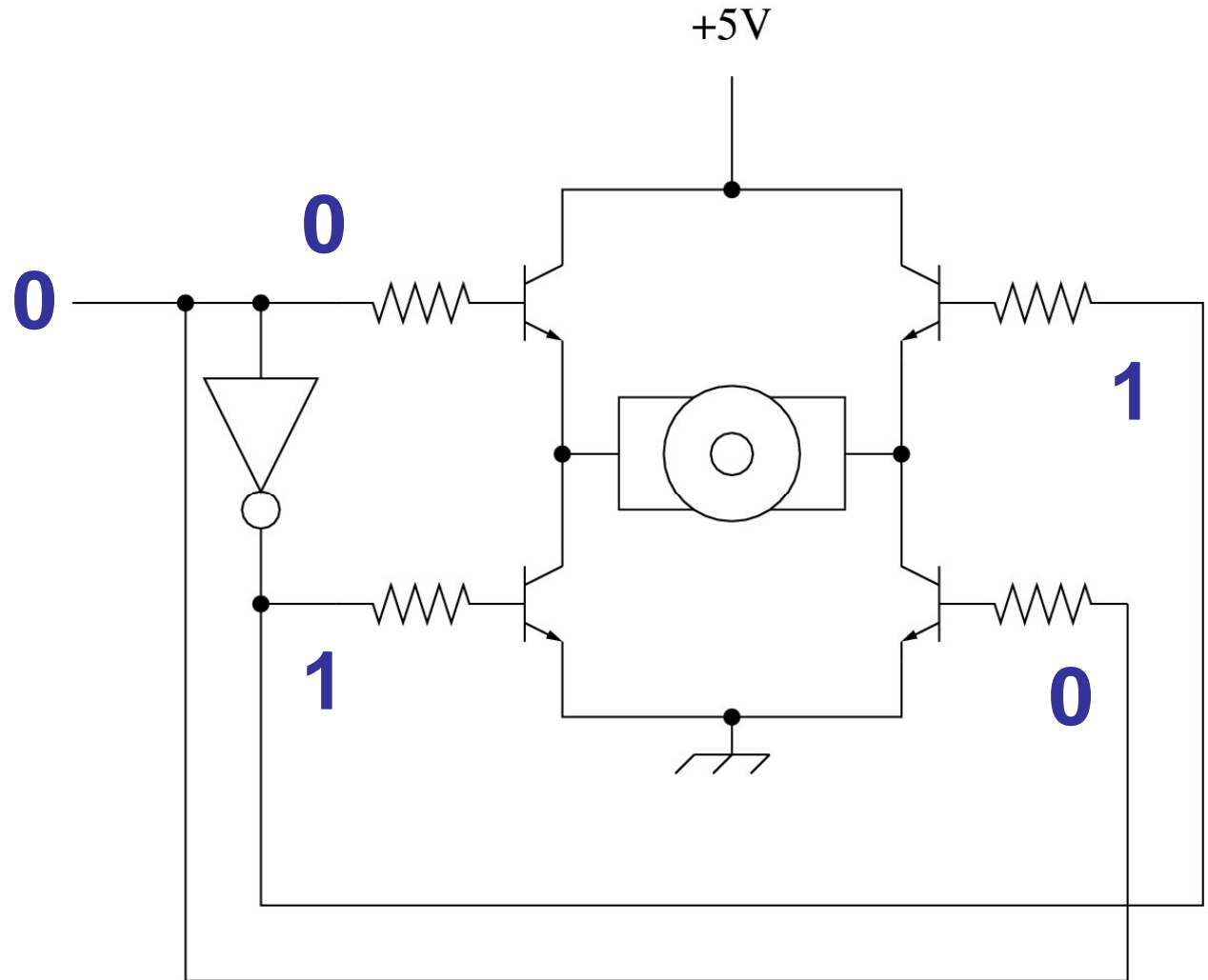
Modified H-Bridge

What happens
with this
input?



Modified H-Bridge

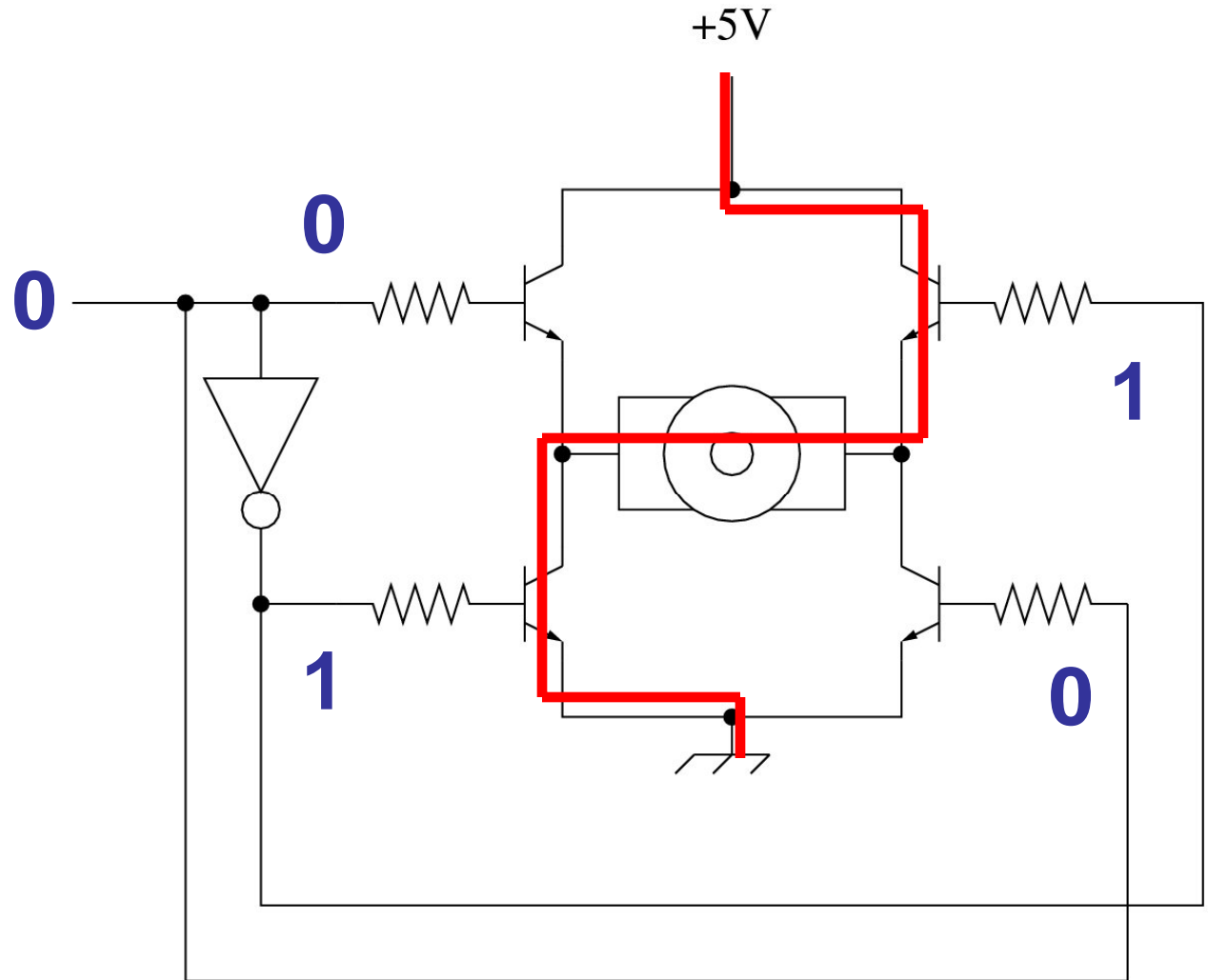
What happens with this input?



Modified H-Bridge

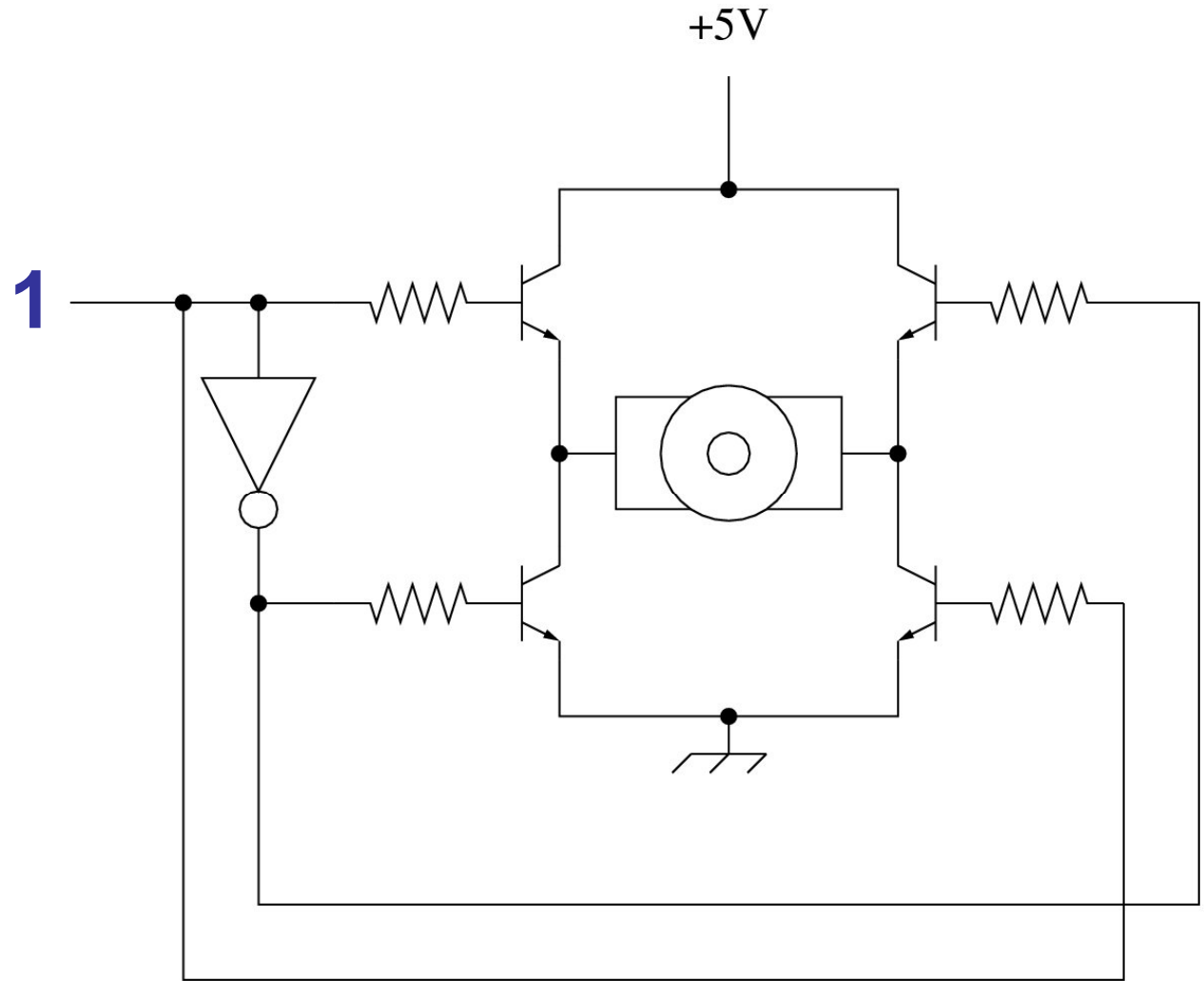
What happens with this input?

- Motor turns in one direction



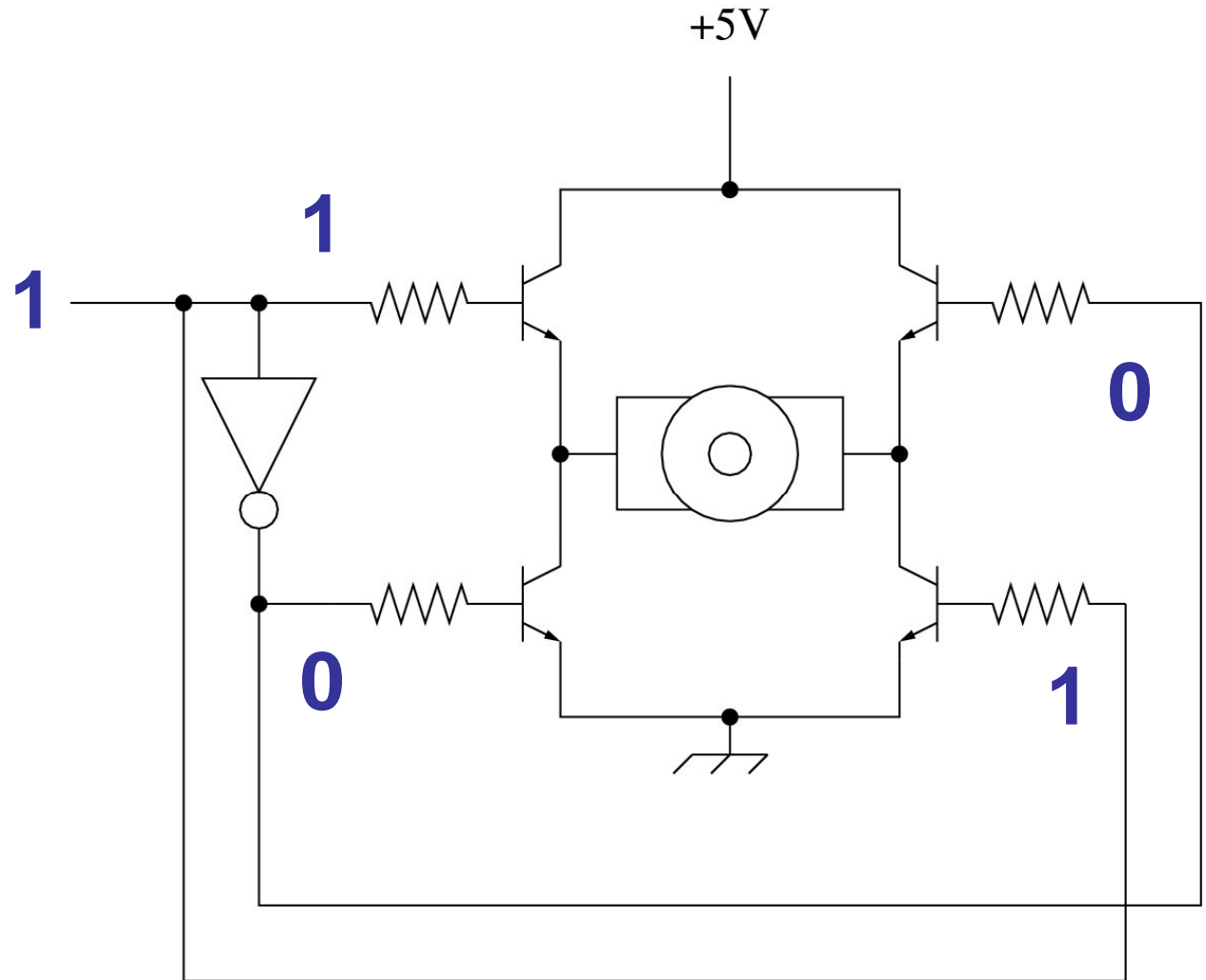
Modified H-Bridge

How about this
input?



Modified H-Bridge

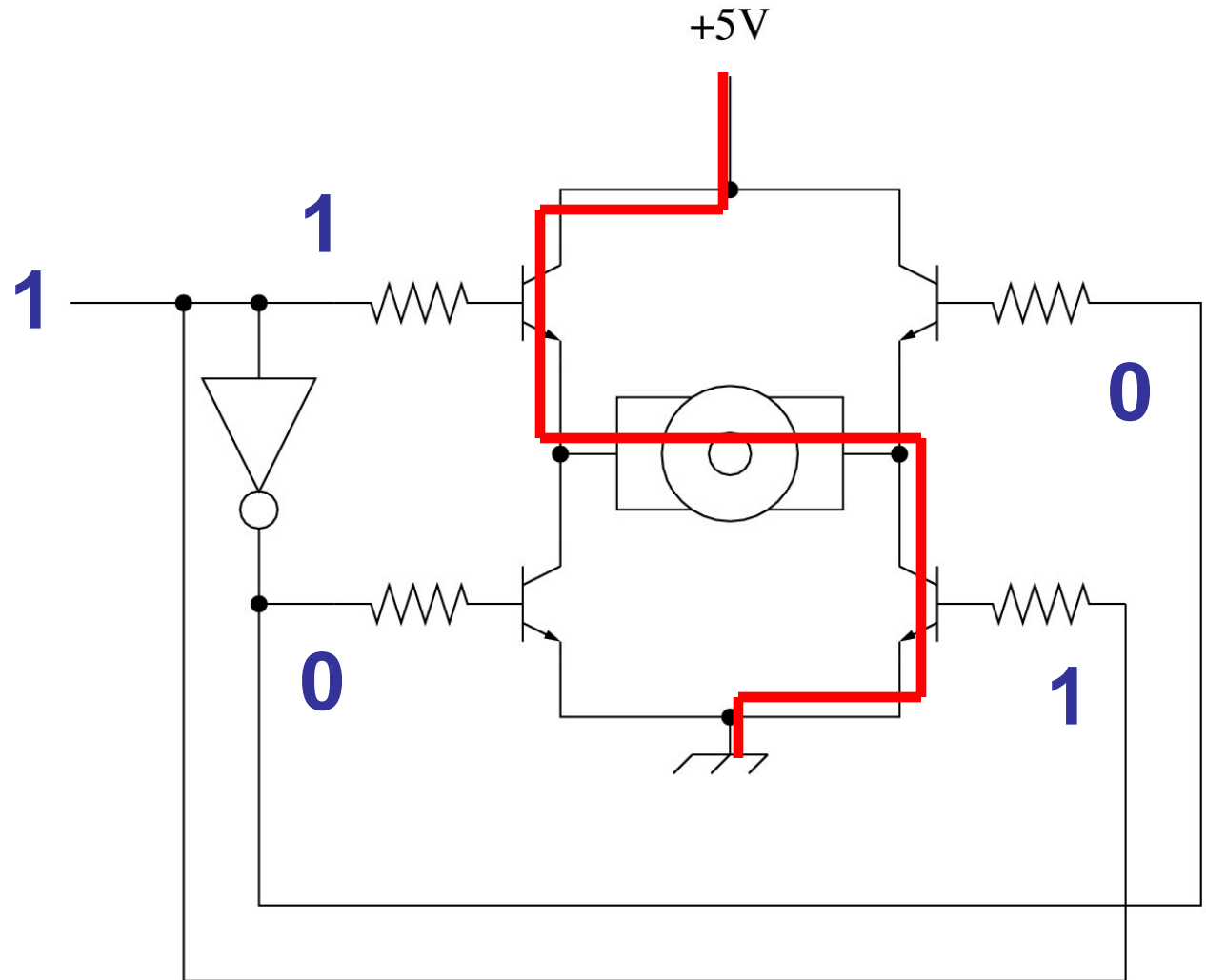
What happens
with this
input?



Modified H-Bridge

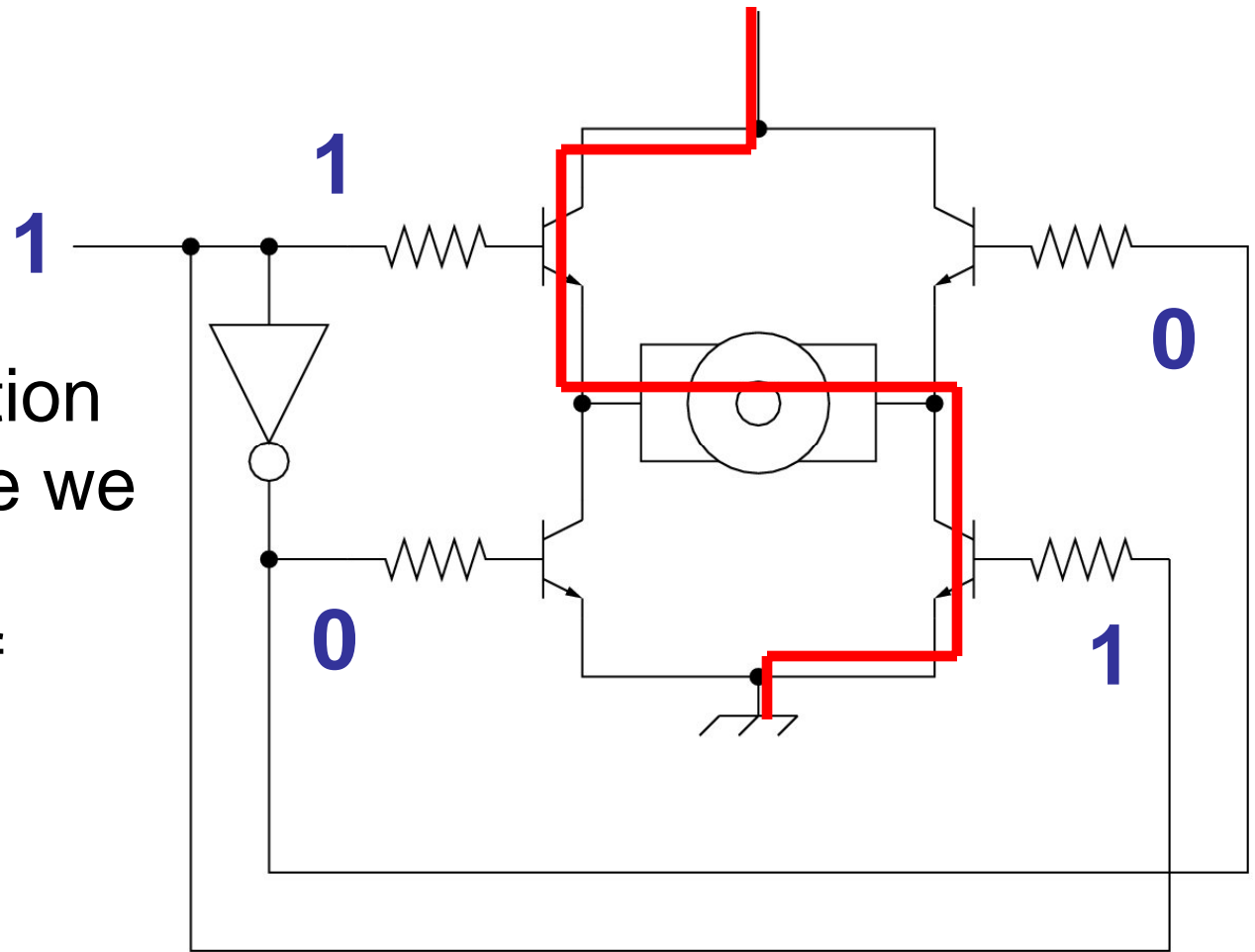
How about this input?

- Motor turns in the other direction



Modified H-Bridge

+5V



This implementation is nice because we only need one **direction** bit of control

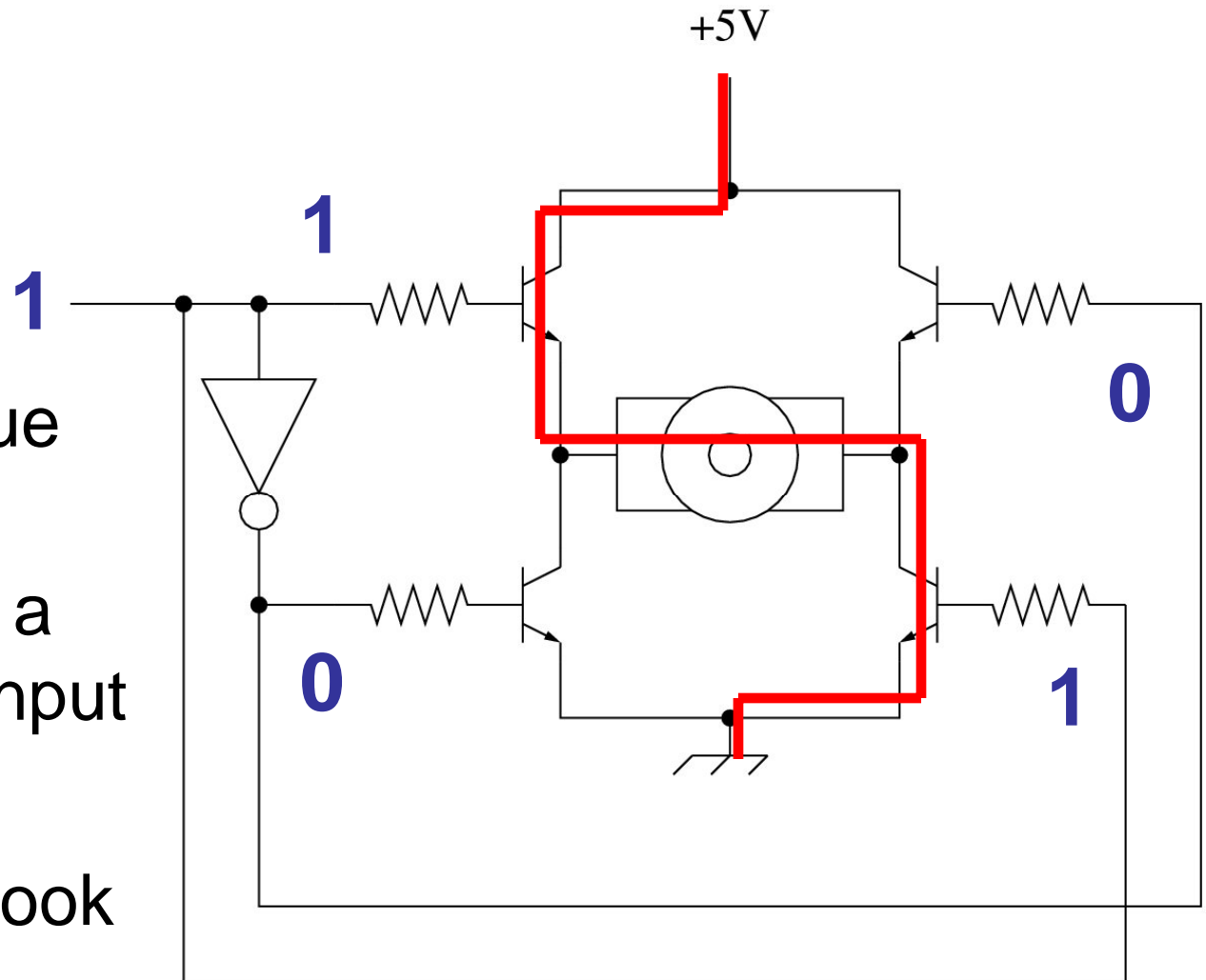
- What are we missing?

Modified H-Bridge

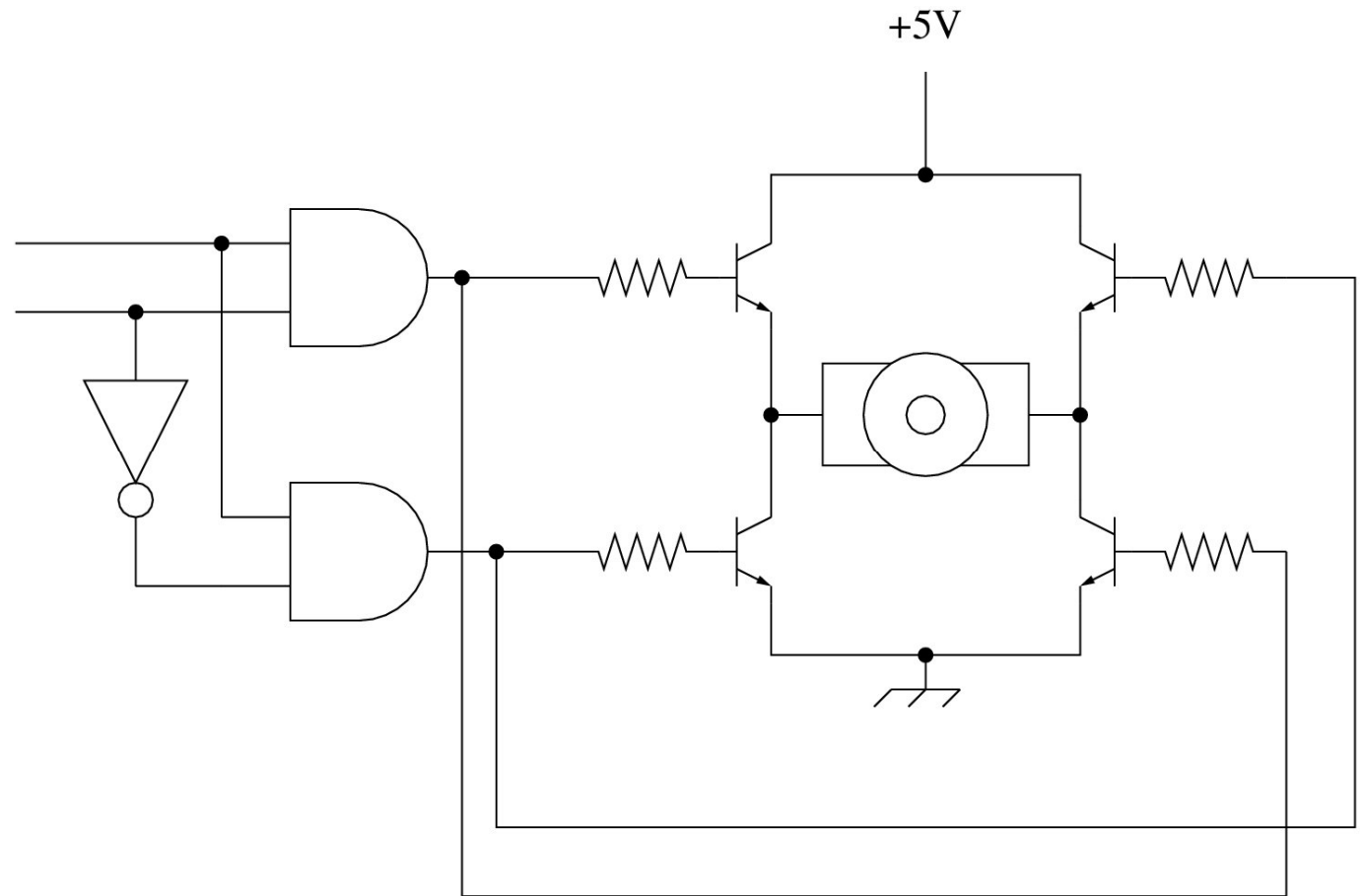
What are we missing?

- Control of torque magnitude
- Let's introduce a second PWM input

What would this look like?

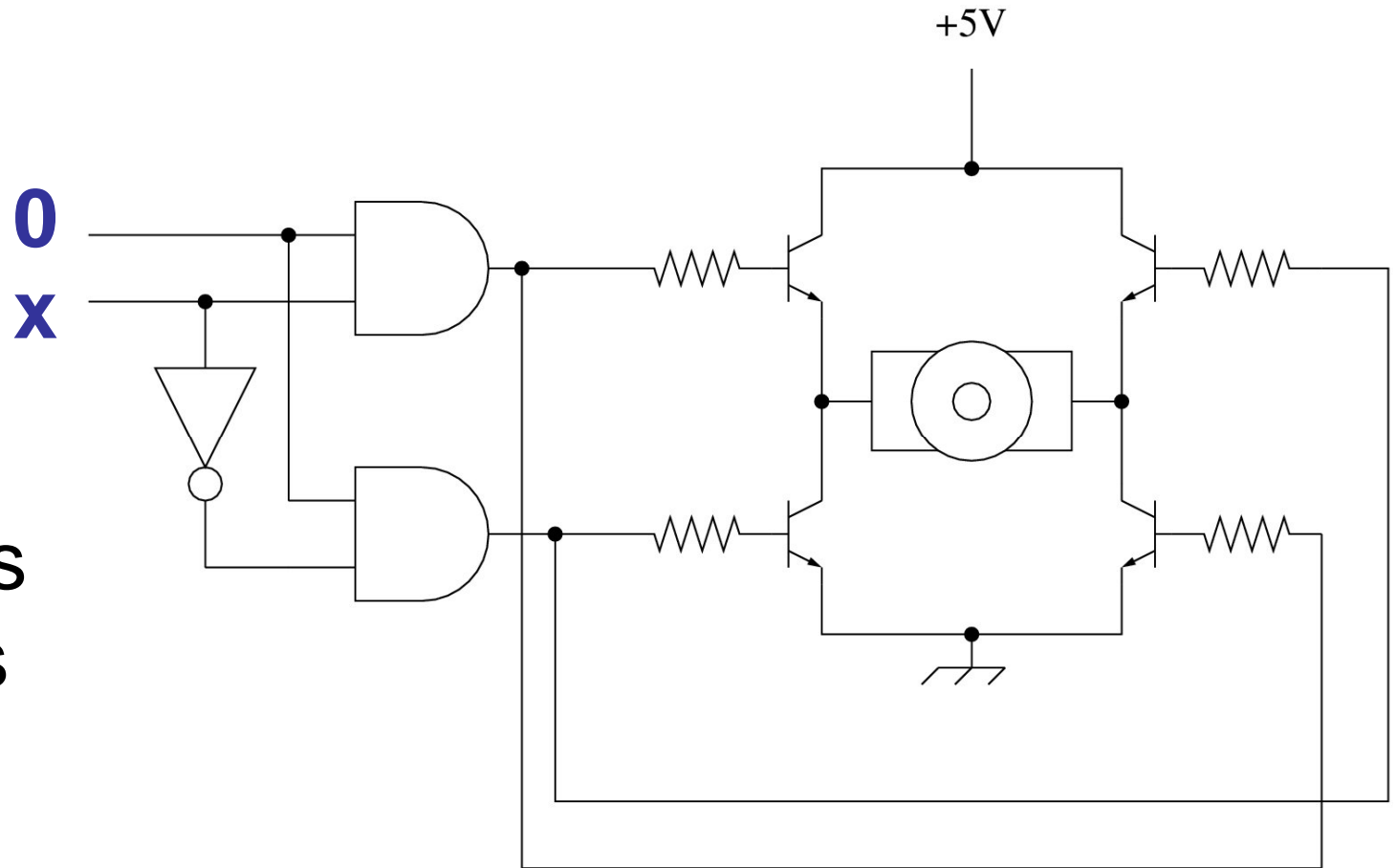


PWM and Direction Control



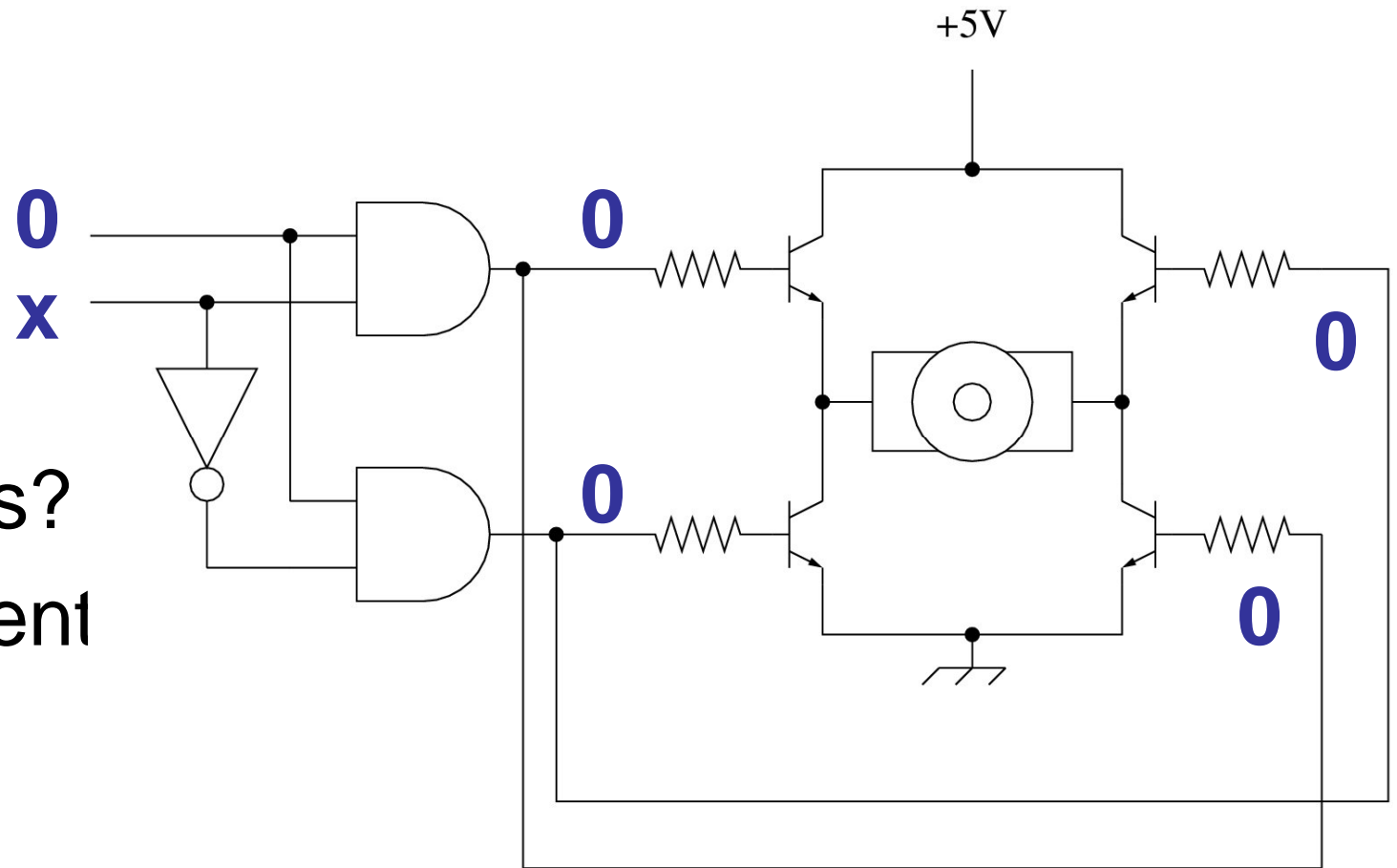
PWM and Direction Control

What happens with this input?



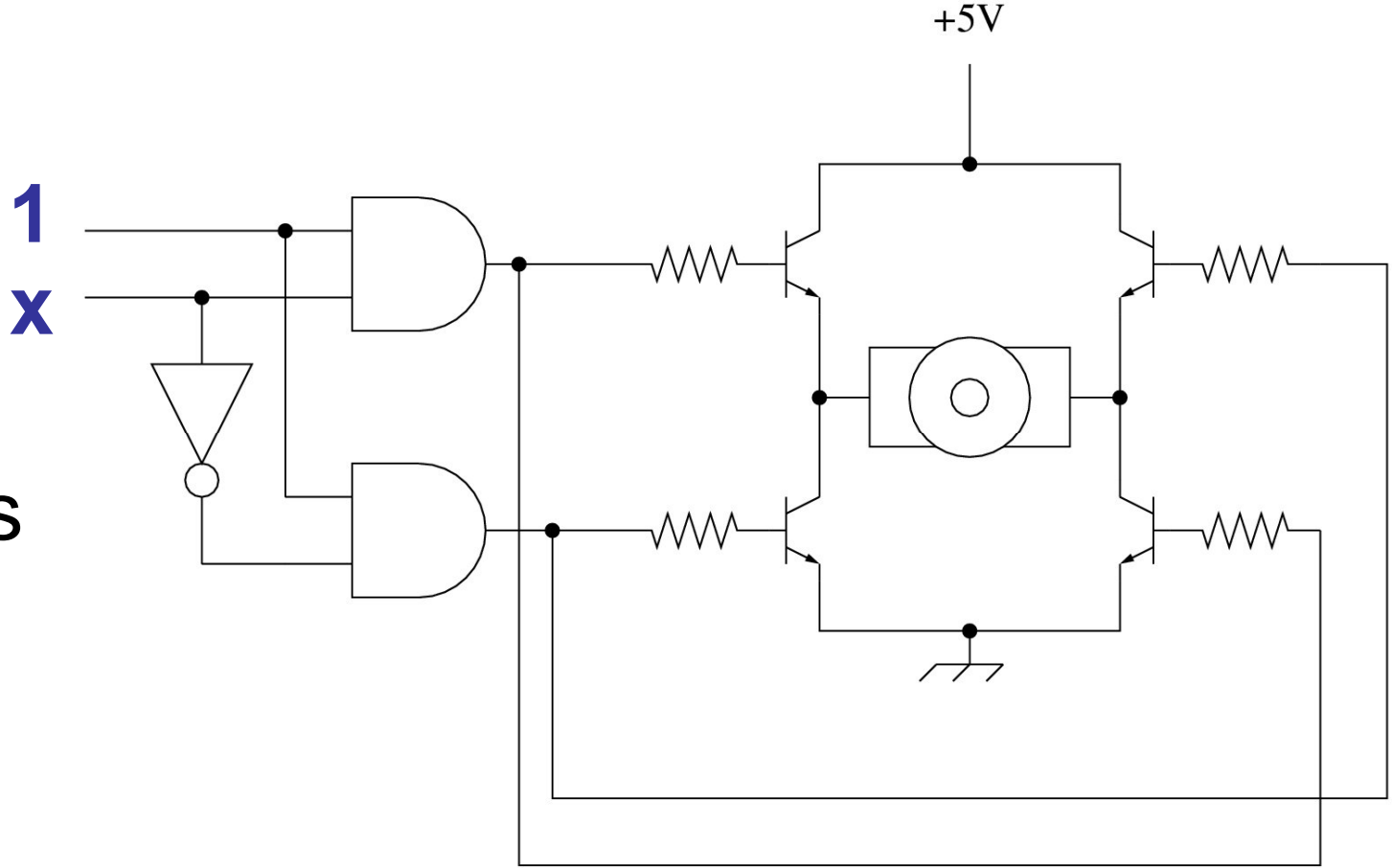
PWM and Direction Control

- What happens?
- No current flow



PWM and Direction Control

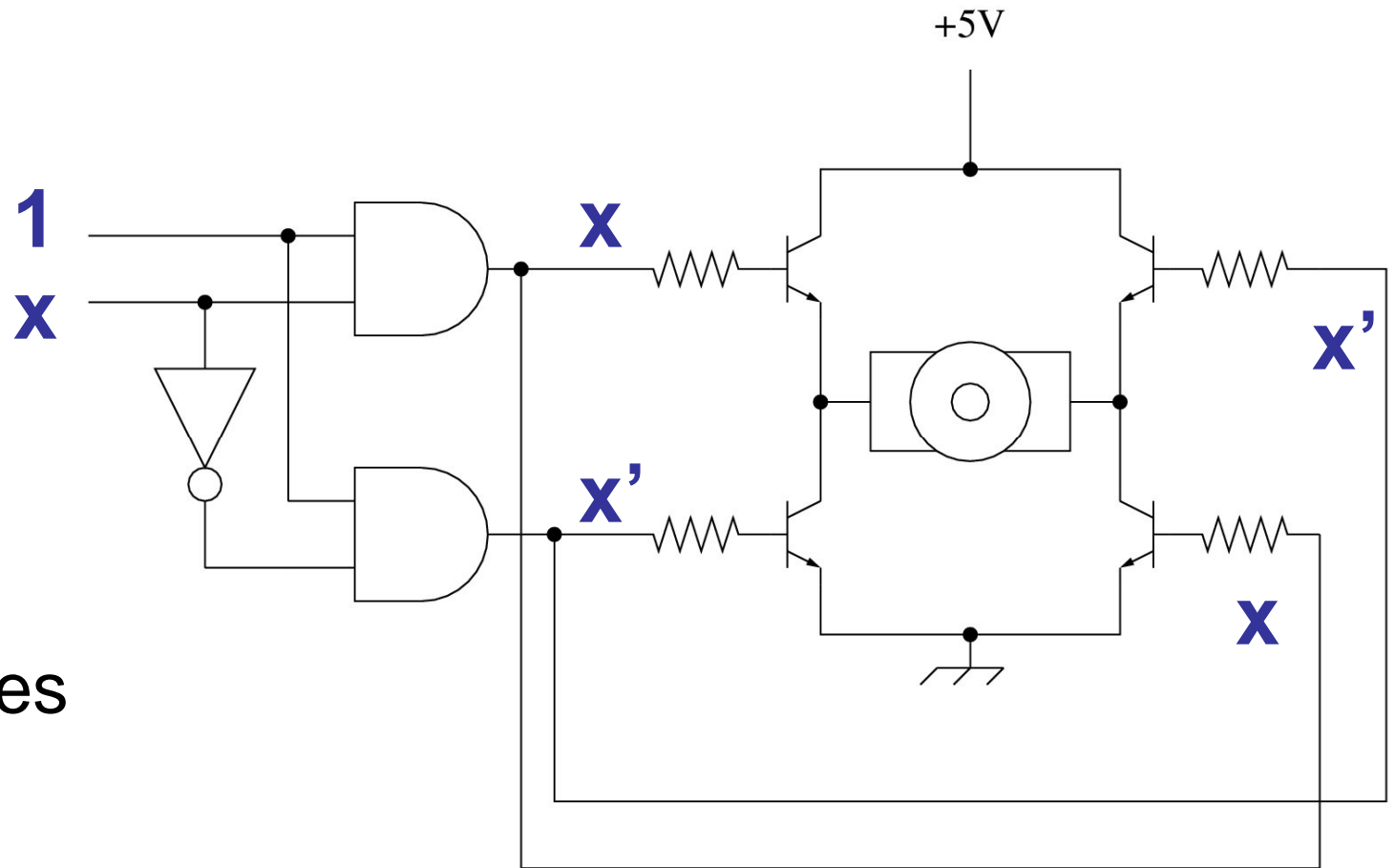
What happens now?



PWM and Direction Control

What happens now?

- 'x' determines motor direction



PWM and Direction Control



Direction

With the
PWM input,
we can
control the
magnitude
of torque

