solving problems with computers

prof. dr. nicolas meseth

1. what happens in the middle?
2. the boxes in the light link
3. boxes all the way down
4. two questions inside every box

part 1

what happens in the middle?

you order and
a tray appears,
but what happened
in between?

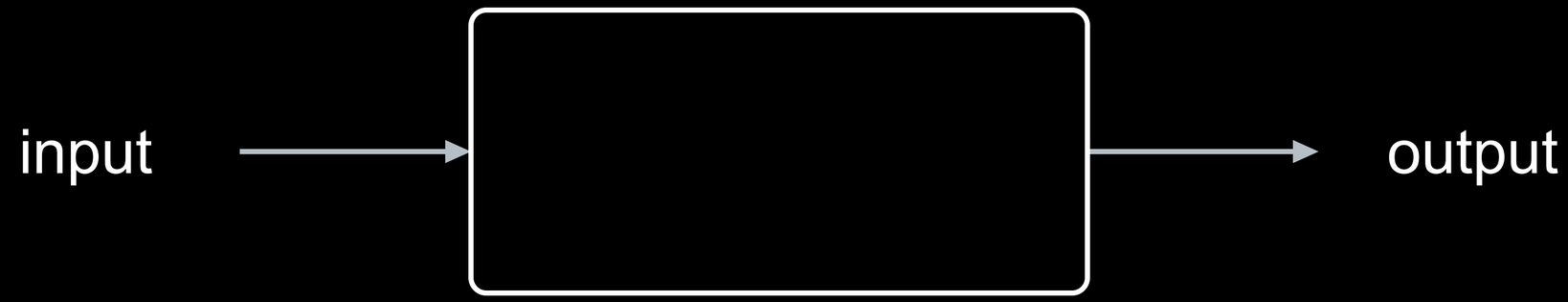


image: ai-generated (gpt-image-2)

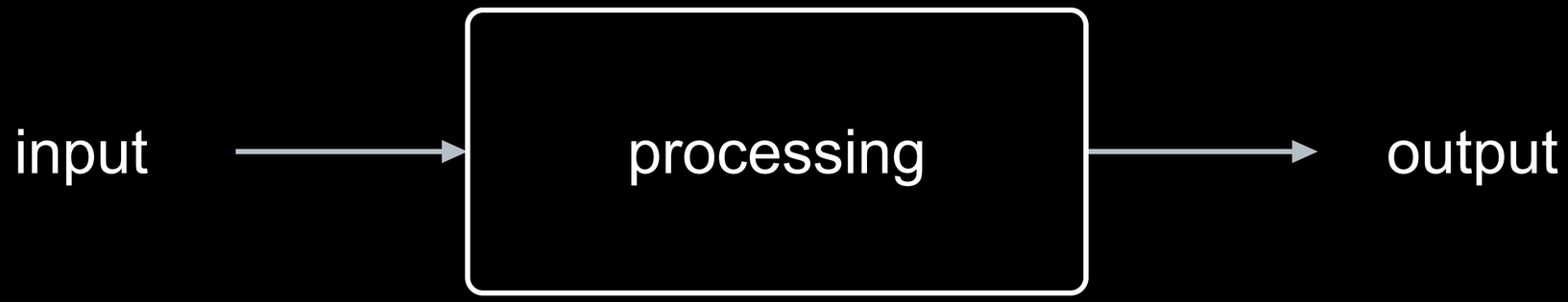
every computable piece has this shape



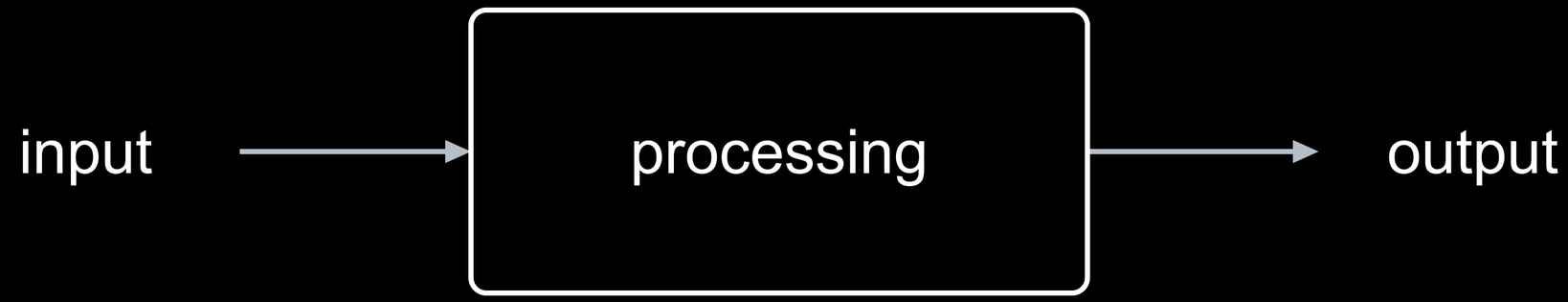
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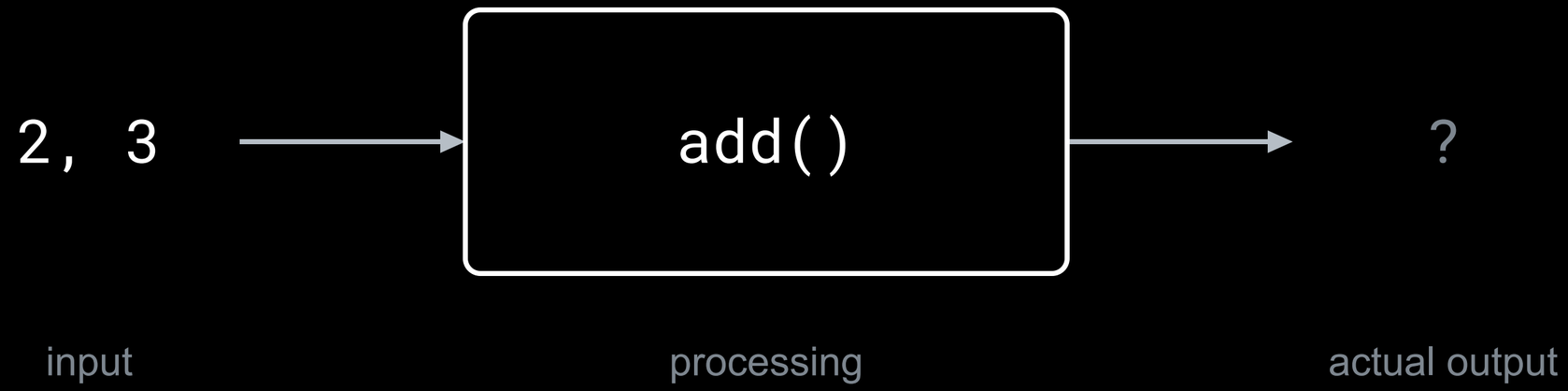
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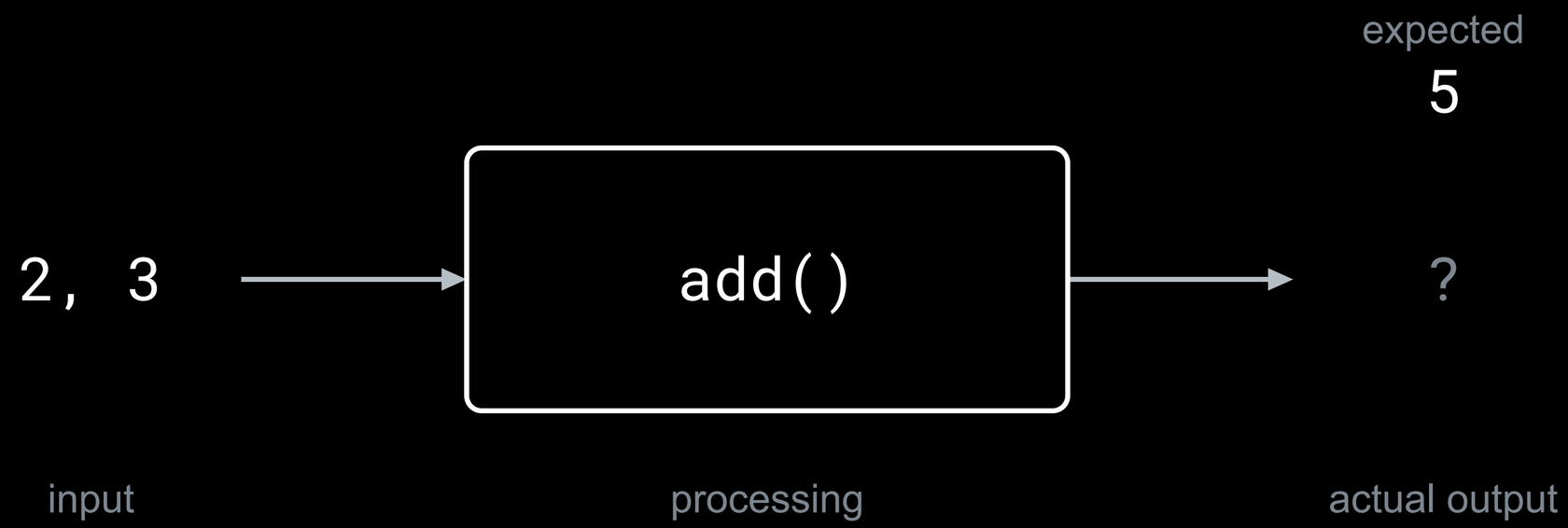
IPO

input, processing, output

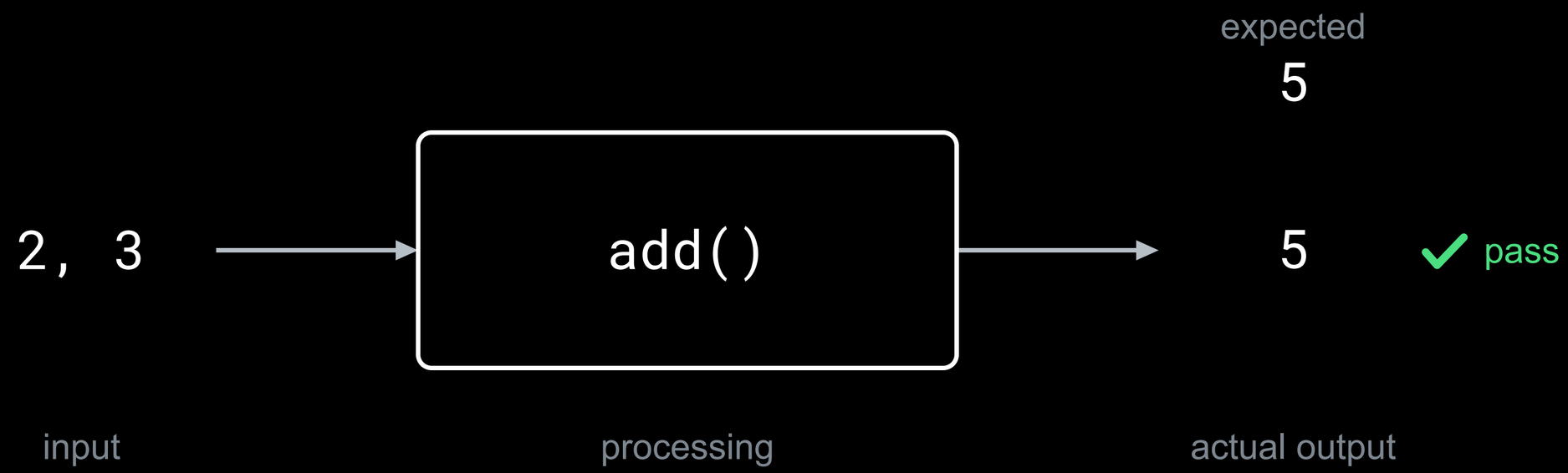
a box with clear edges brings its own test



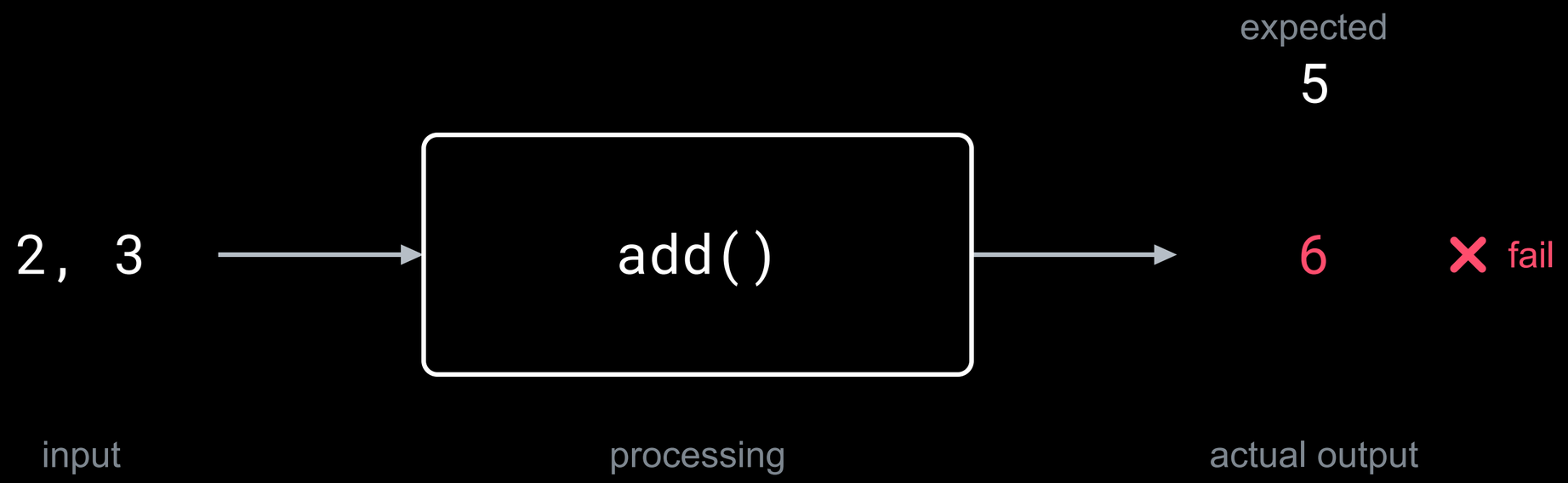
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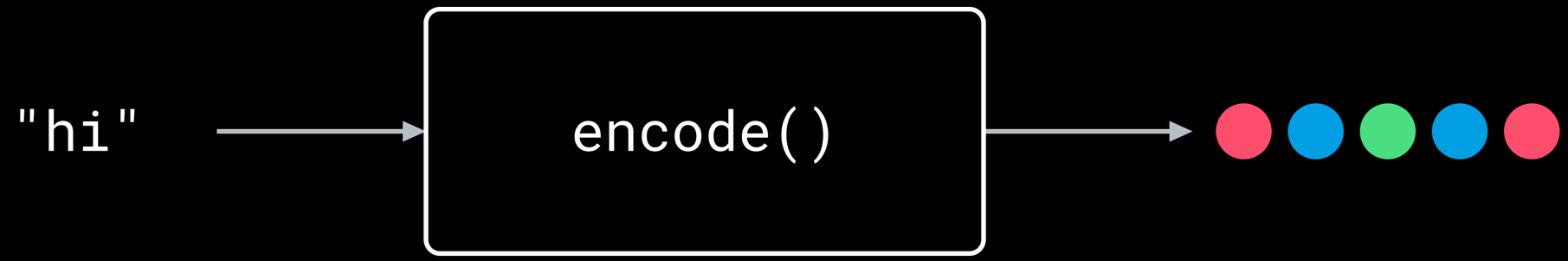
a box with clear edges brings its own test



if you know the input and the expected output, you already have a test.

part 2

the boxes in the light link



which colour stands for which character is an agreement within the team.

what enters the receiver?



red light

a decision rule

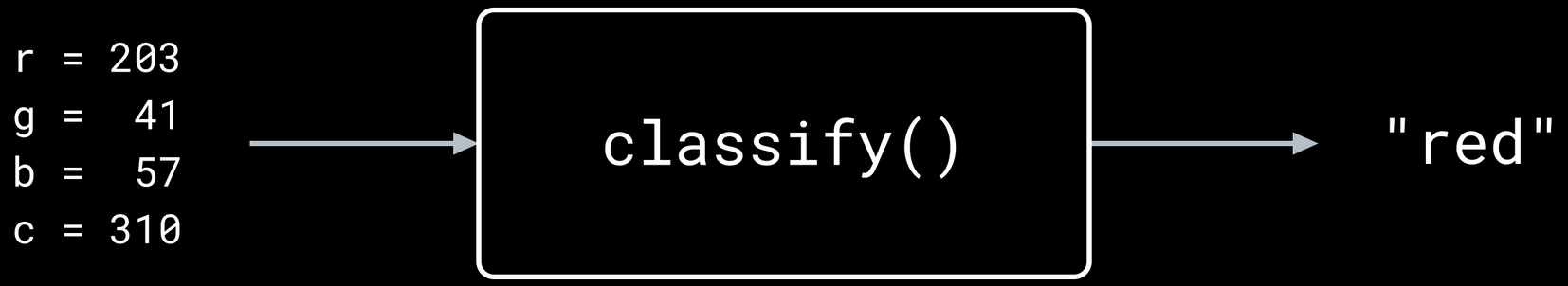
what enters the receiver?



four readings

a decision rule

your eyes see red, but the box only sees four numbers.



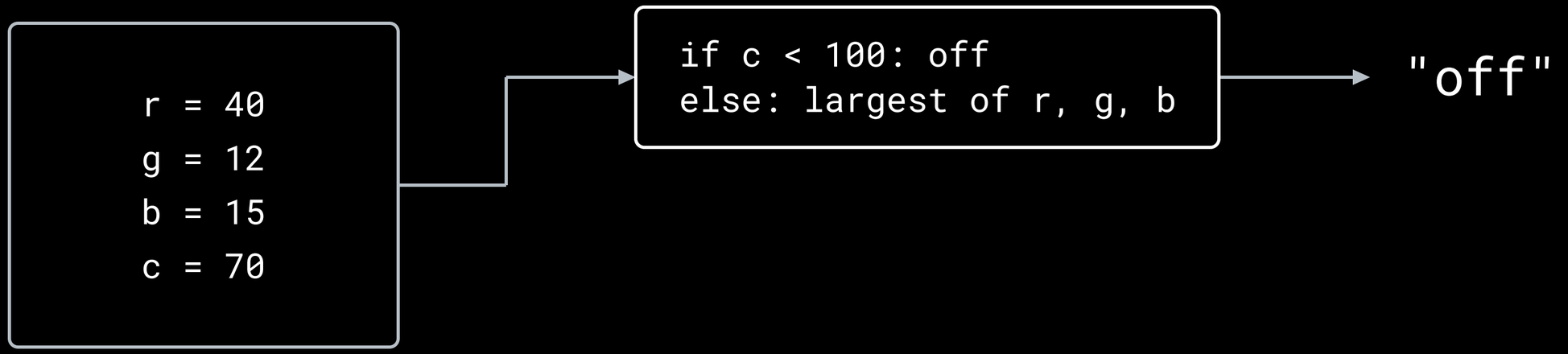
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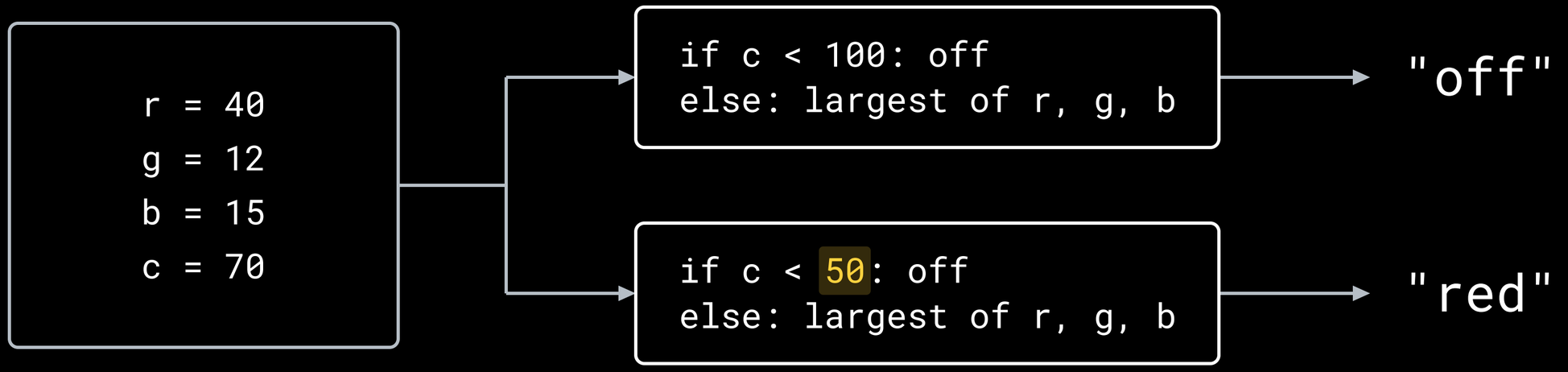
same reading, two rules

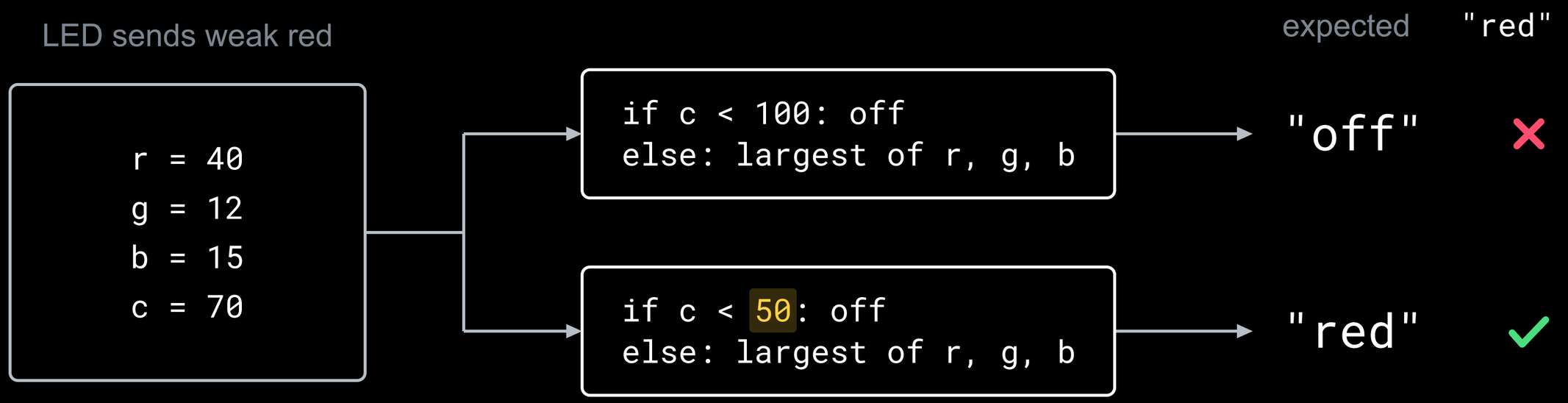
LED sends weak red



same reading, two rules

LED sends weak red



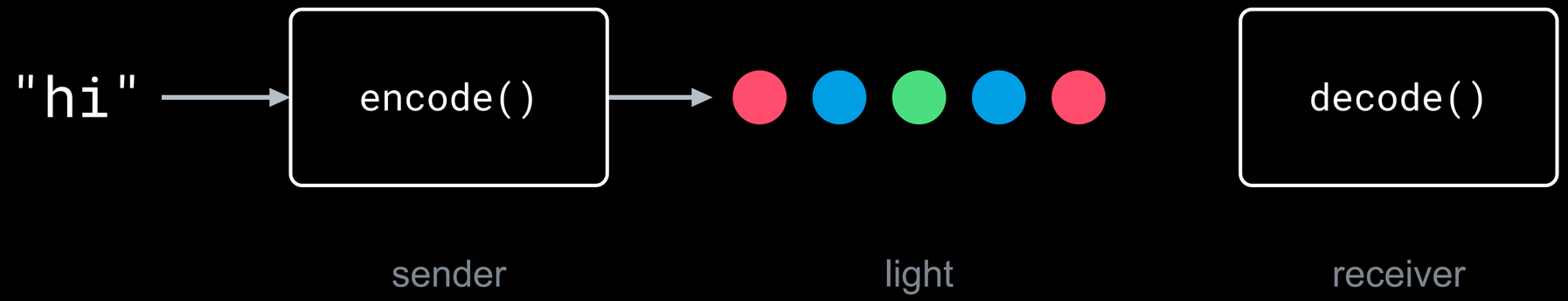


the rule decides what the numbers mean, and a test decides which rule is right.

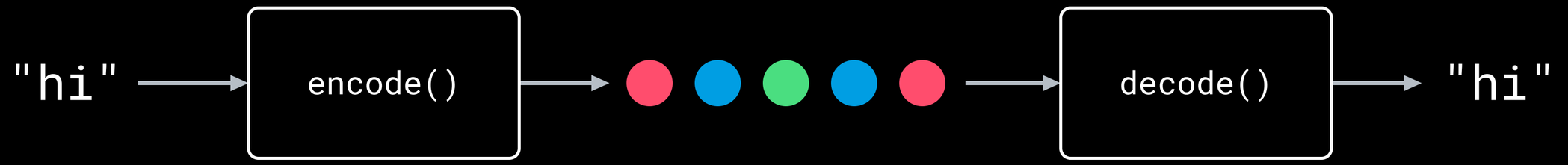
boxes connect when their edges agree



boxes connect when their edges agree



boxes connect when their edges agree



sender light receiver

boxes connect when their edges agree



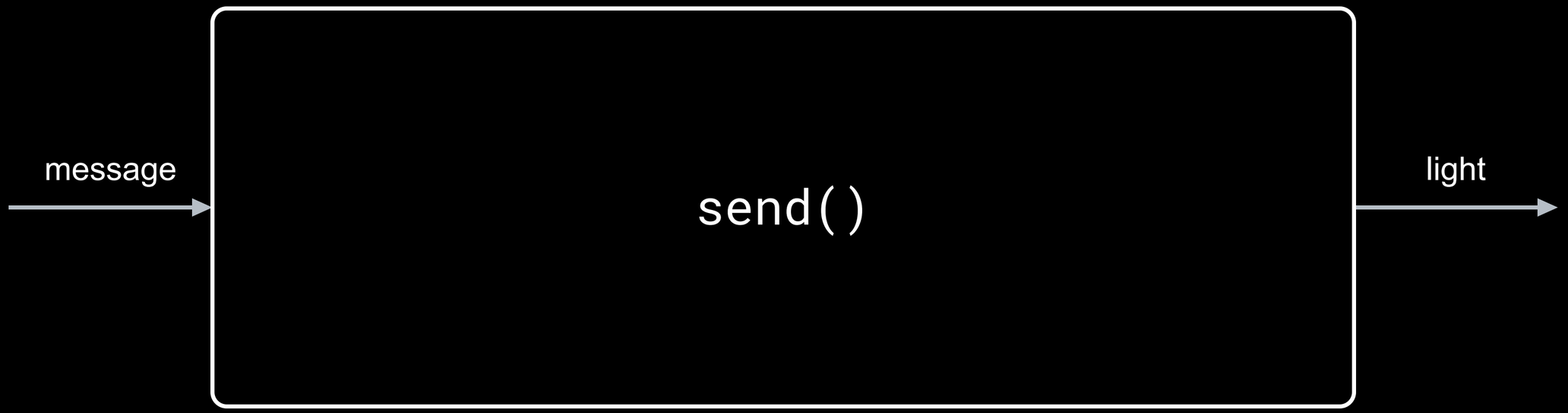
every boundary needs an agreement about the form and meaning of the data.

to find the fault, follow the data from one boundary to the next.

the question is up to which boundary the data are still correct.

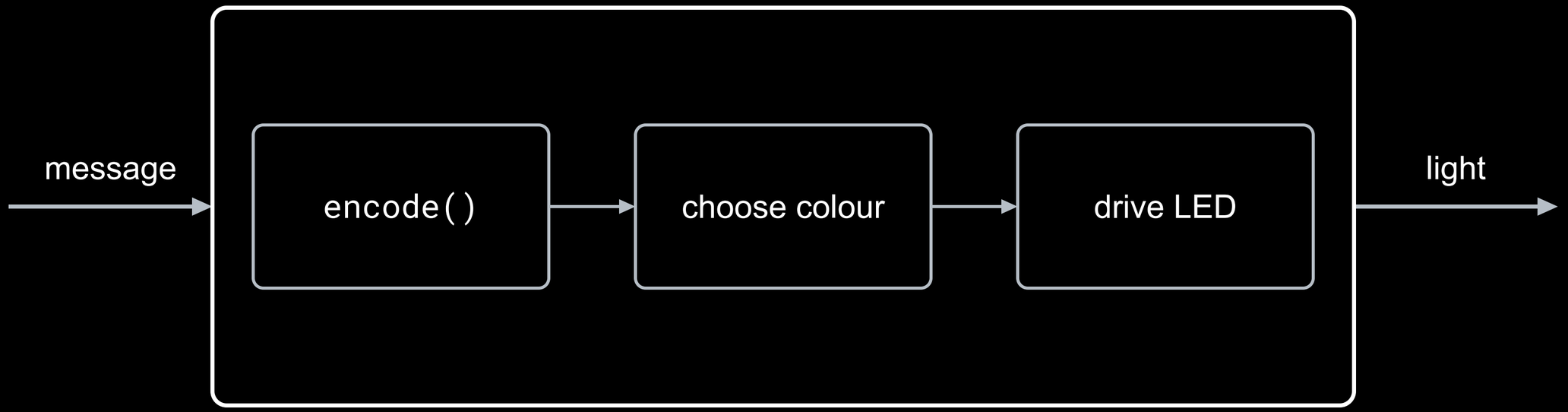
part 3

boxes all the way down



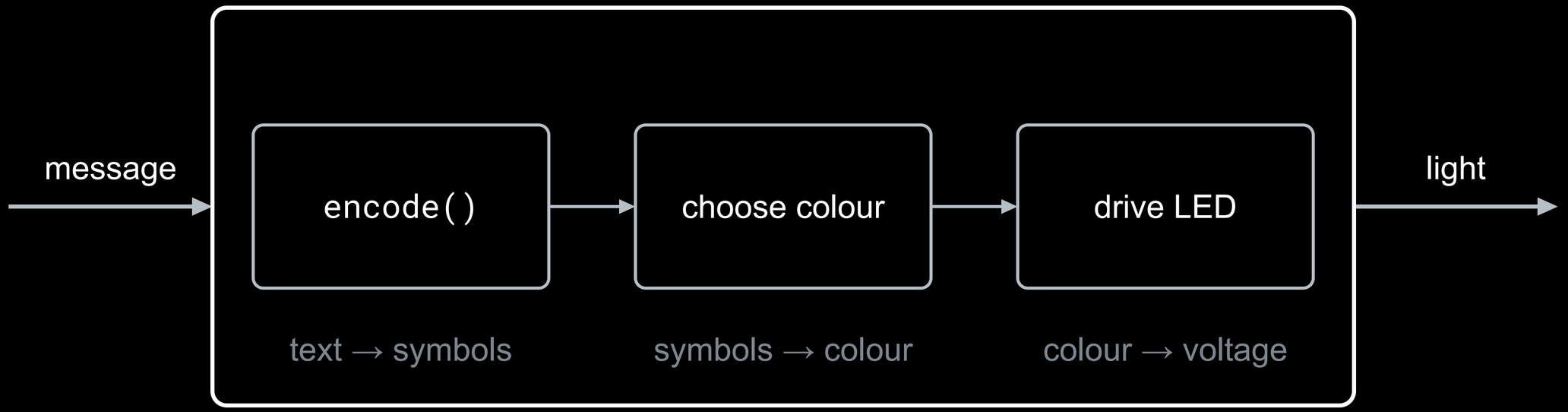
open a box only as far as your question requires.

one box from the outside



open a box only as far as your question requires.

one box from the outside

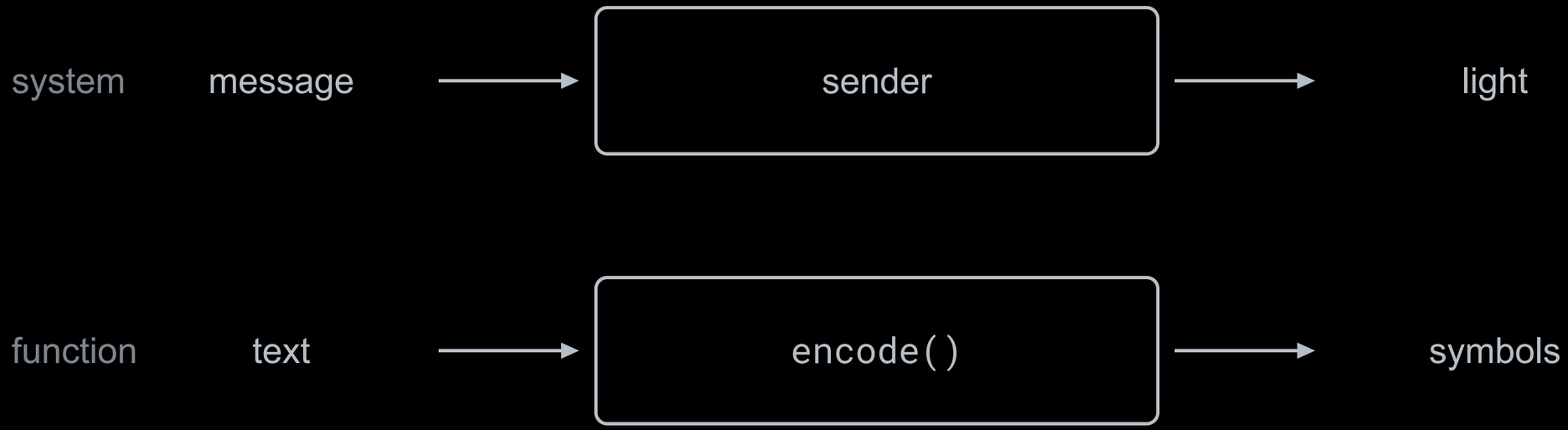


open a box only as far as your question requires.

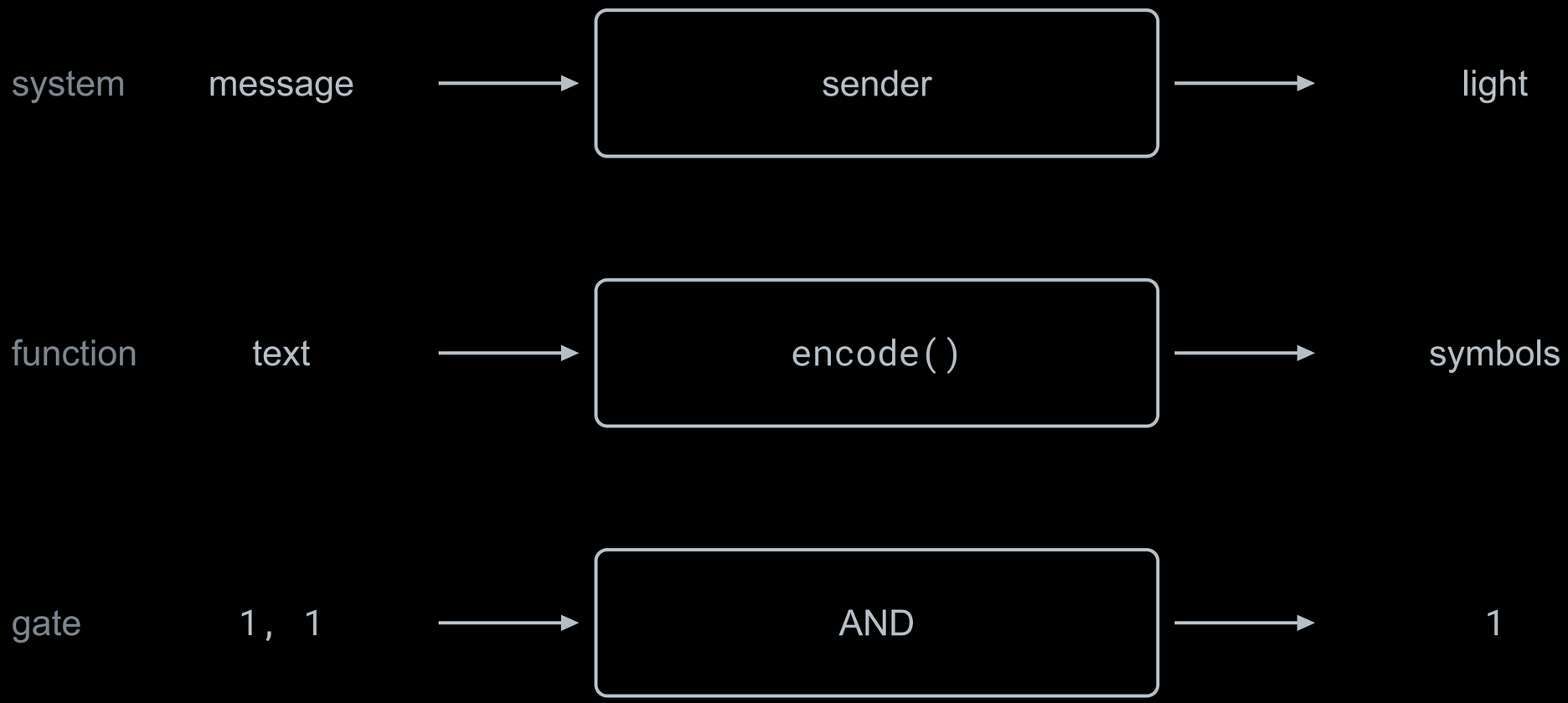
the shape survives every level



the shape survives every level

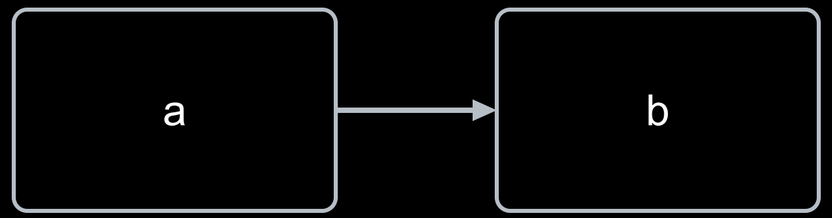


the shape survives every level



boxes in a row

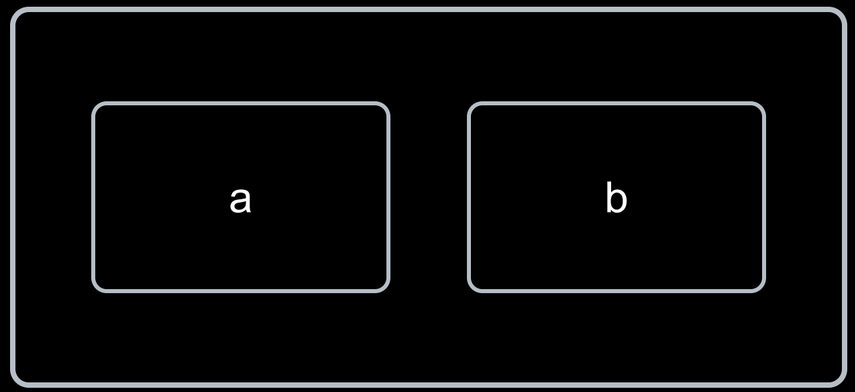
where do the data go next?



data flow

boxes inside boxes

what smaller work happens inside?



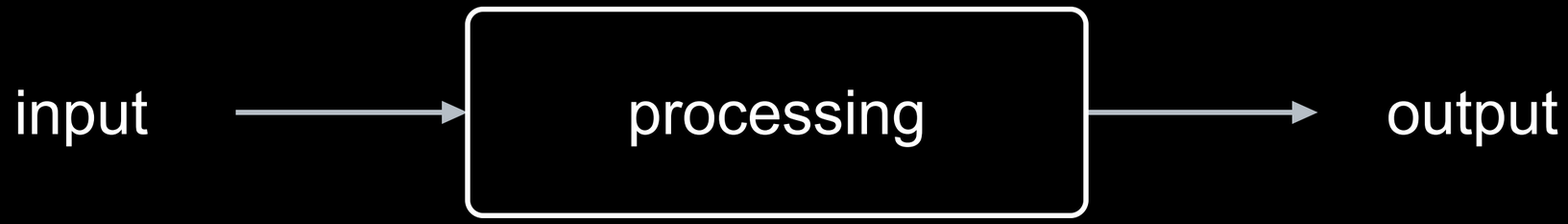
hierarchy

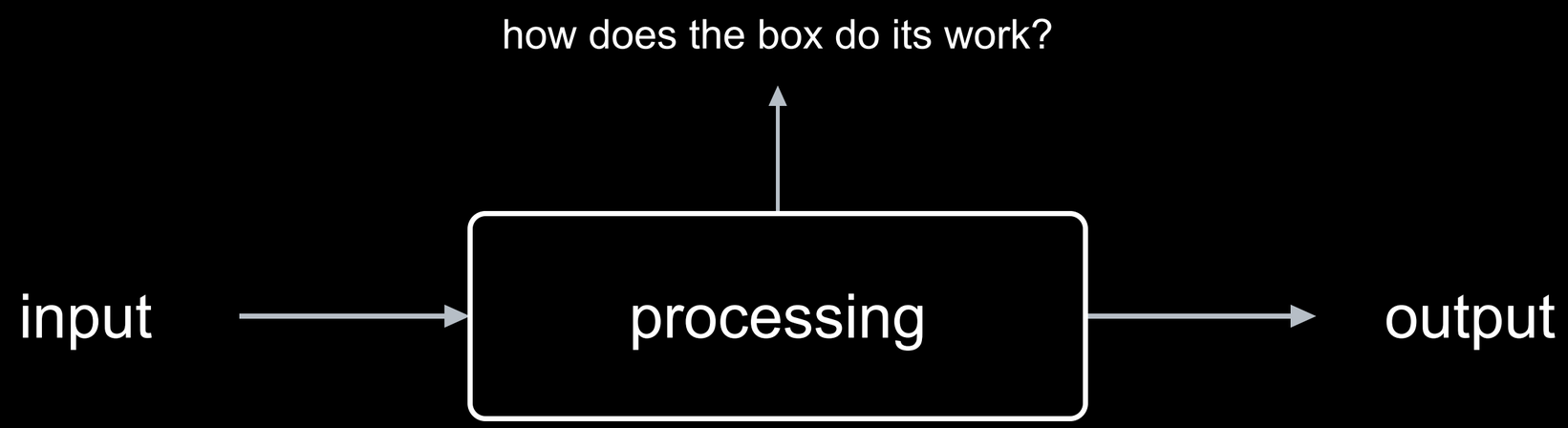
both cut a problem, once into steps in a row and once into smaller work inside.

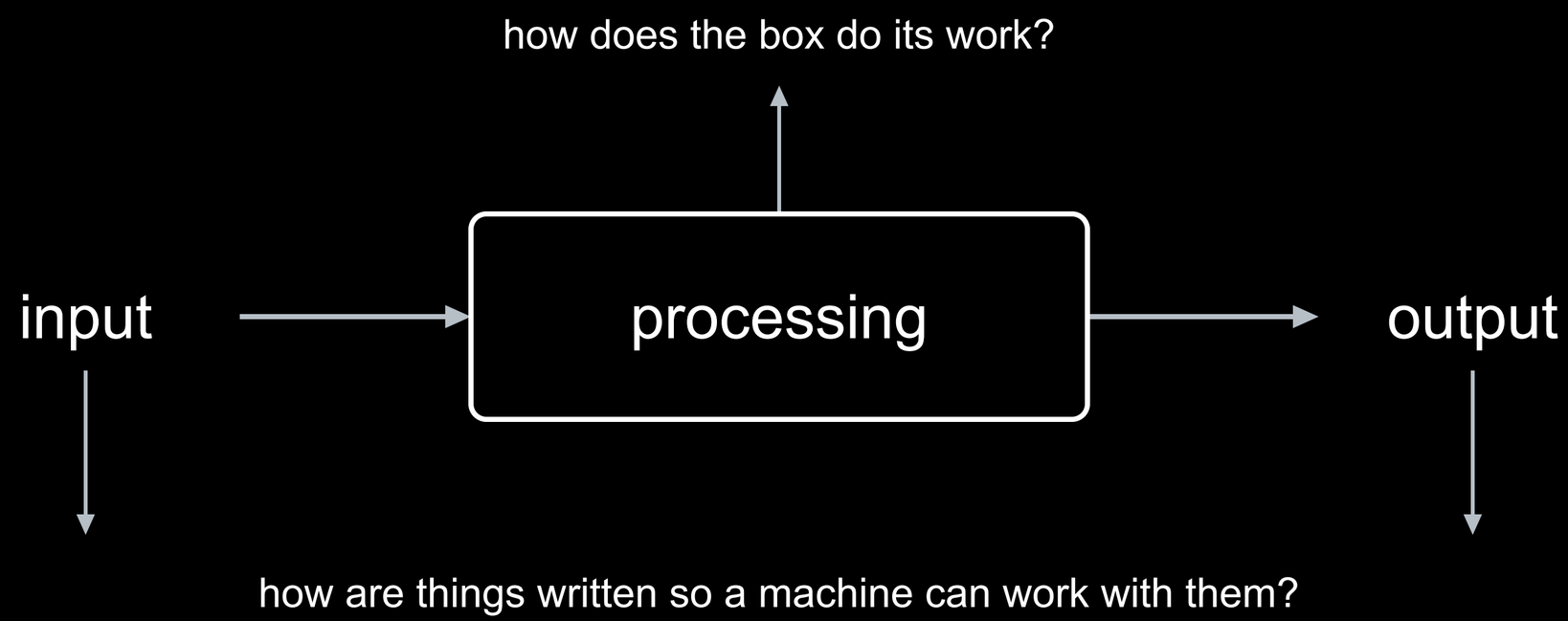
the right level is the one
you can test.

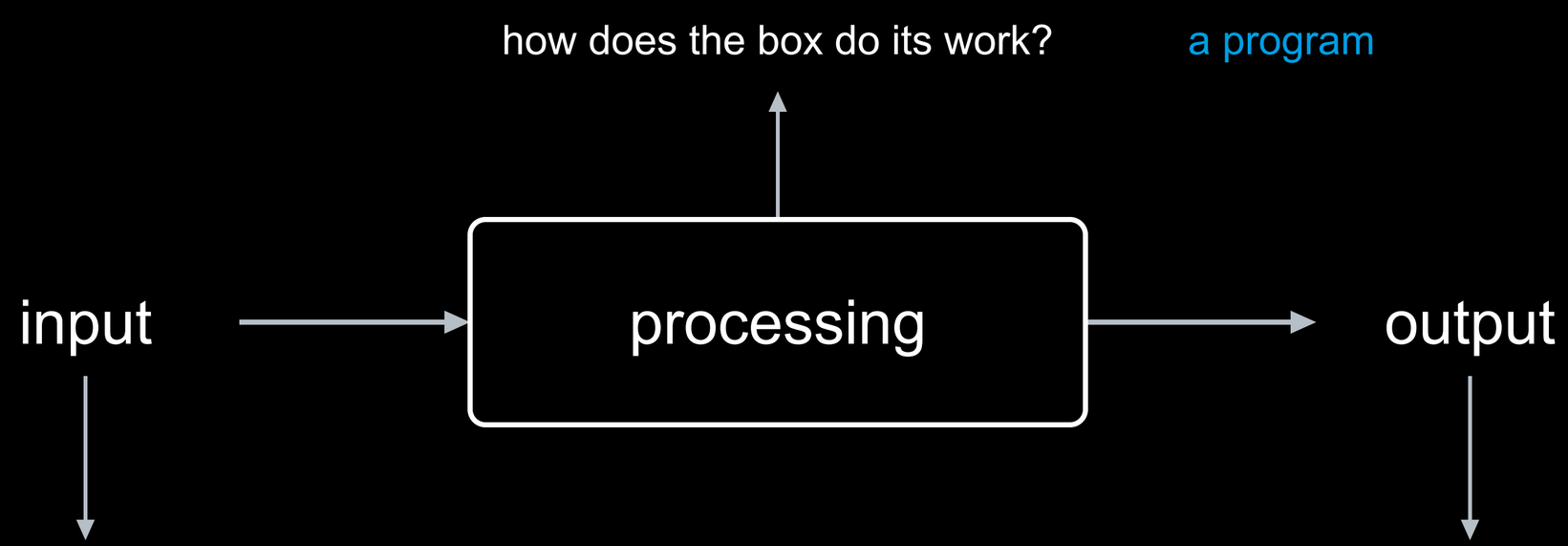
part 4

two questions inside every box


input
processing
output


how does the box do its work?
input
processing
output


how does the box do its work?
input
processing
output
how are things written so a machine can work with them?


how does the box do its work?
a program
input
processing
output
how are things written so a machine can work with them?
representation

an AI agent is a box, too



you do not have to trust a box when you have a test for it.

an AI agent is a box, too



a clear example

you do not have to trust a box when you have a test for it.

an AI agent is a box, too



a clear example

an expected result

you do not have to trust a box when you have a test for it.

an AI agent is a box, too



a clear example

✓ run it and compare

an expected result

you do not have to trust a box when you have a test for it.

inside the box,
a program works
through the order
step by step.



image: ai-generated (gpt-image-2.5-flare)