



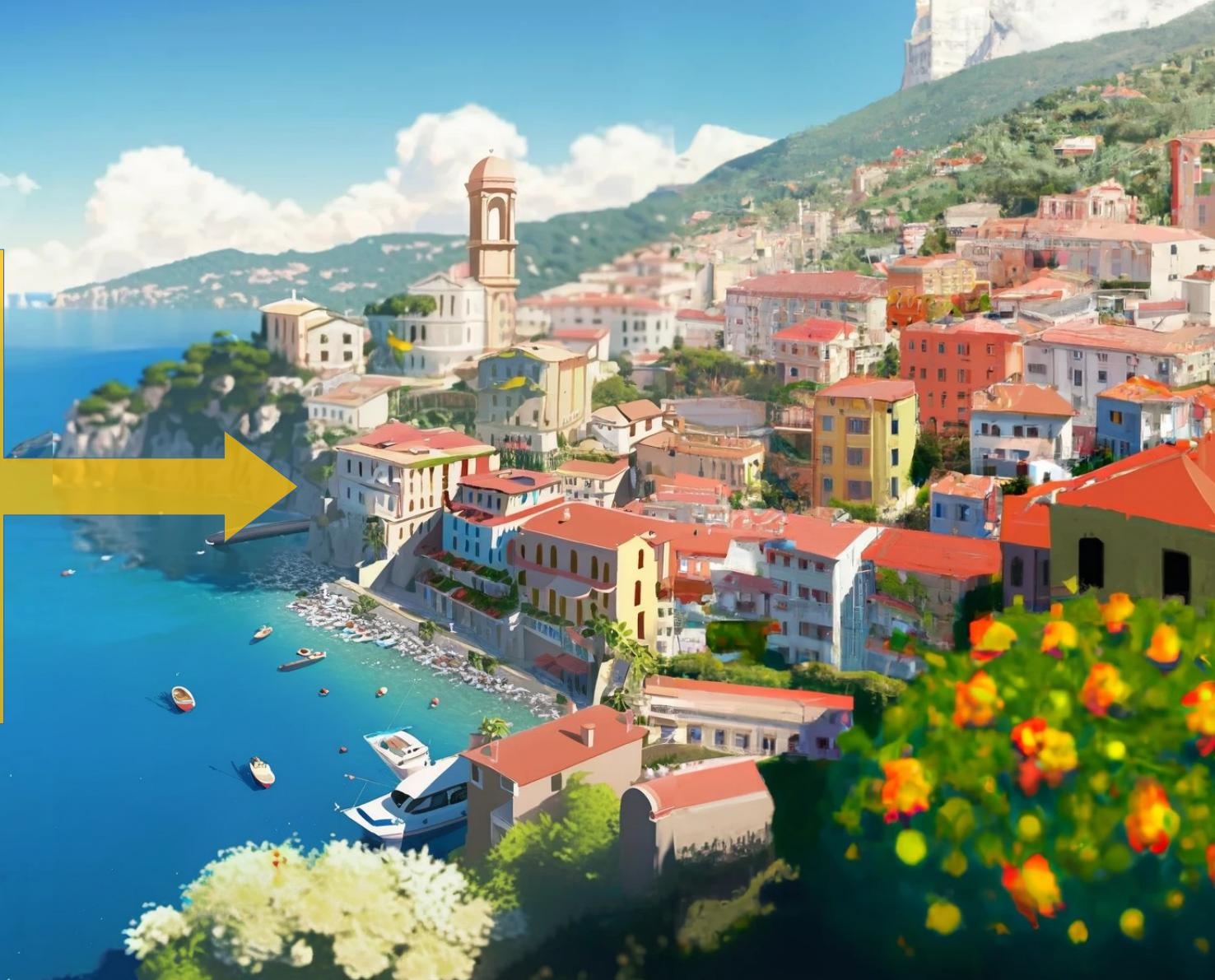




# Sorrento Bay; Freshman city; Ultimate Programming University (UPU)



Freshmen city  
Main campus  
building





At the end of the first week of term,  
Ricky and Dany are chatting

Hey Dany, are you ok?



Hey Dany, are you ok?

Do I look ok to you?



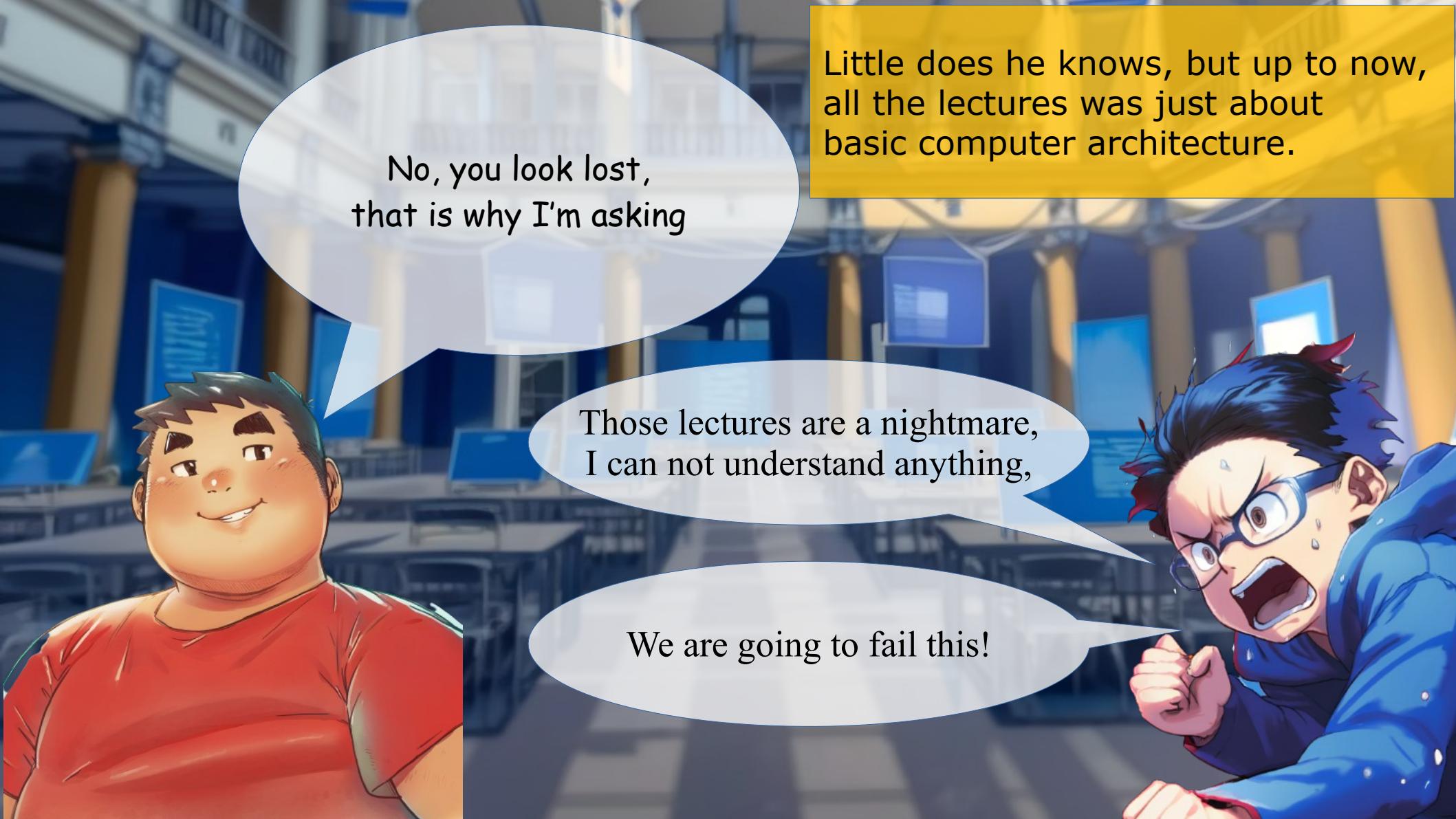
No, you look lost,  
that is why I'm asking





No, you look lost,  
that is why I'm asking

Those lectures are a nightmare,  
I can not understand anything,



No, you look lost,  
that is why I'm asking

Those lectures are a nightmare,  
I can not understand anything,

We are going to fail this!

Little does he know, but up to now,  
all the lectures were just about  
basic computer architecture.



This university is absurd!

What's up with that giant  
ivory tower?



This university is absurd!

What's up with that giant  
ivory tower?



I'm not sure, but it is very cool!





That is where the second  
year students live



That is where the second year students live

But do no worry about it.





Only few manage to get there,  
and that is a good thing.





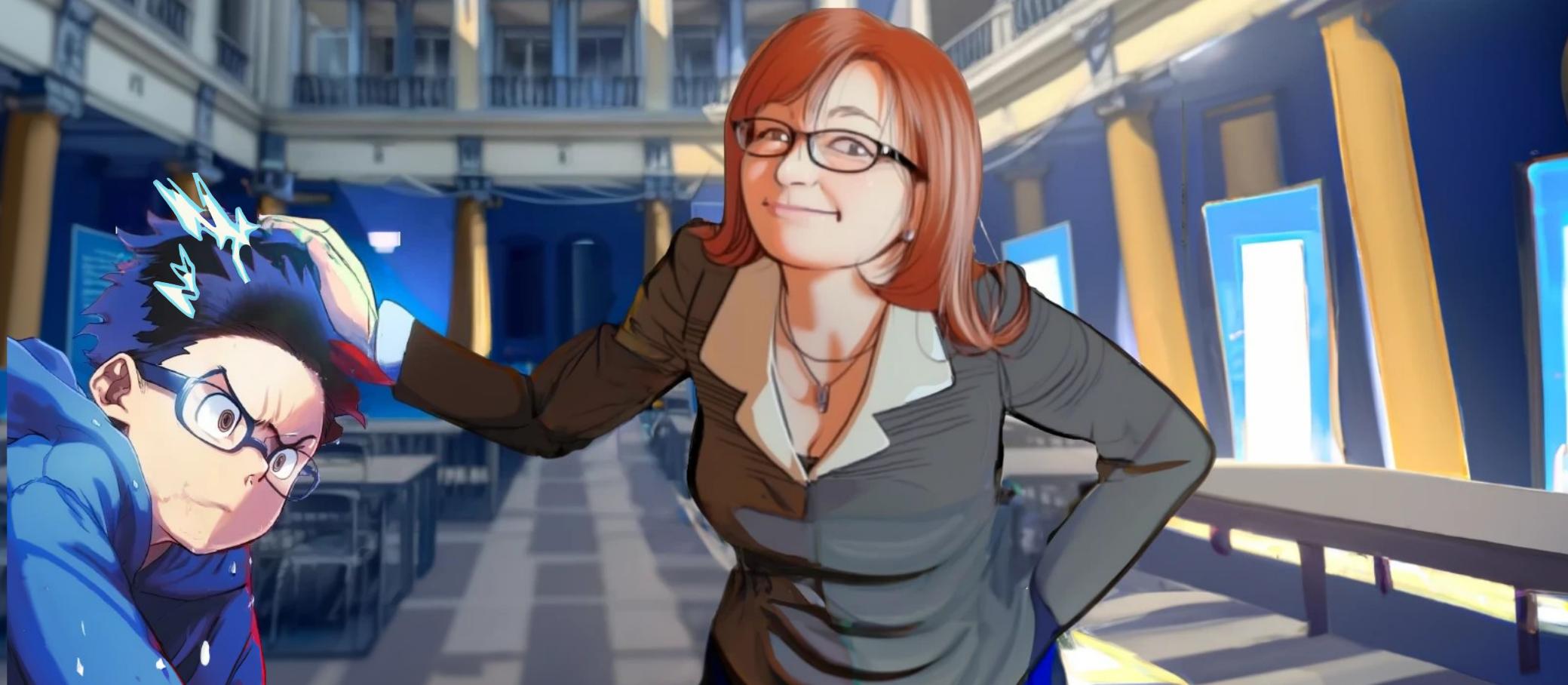
Only few manage to get there,  
and that is a good thing.



This place is not good for you,  
leave while you can!

An anime-style illustration of a woman with short brown hair and glasses, wearing a grey blazer over a white shirt, standing in a city street. She is looking towards the right. A man with dark blue hair and glasses, wearing a blue jacket, is leaning against a railing behind her, looking up at her. In the background, there are buildings with arched windows and a bridge. A speech bubble originates from the woman's head.

Poor guys,  
they never listen  
in time





Aaah!





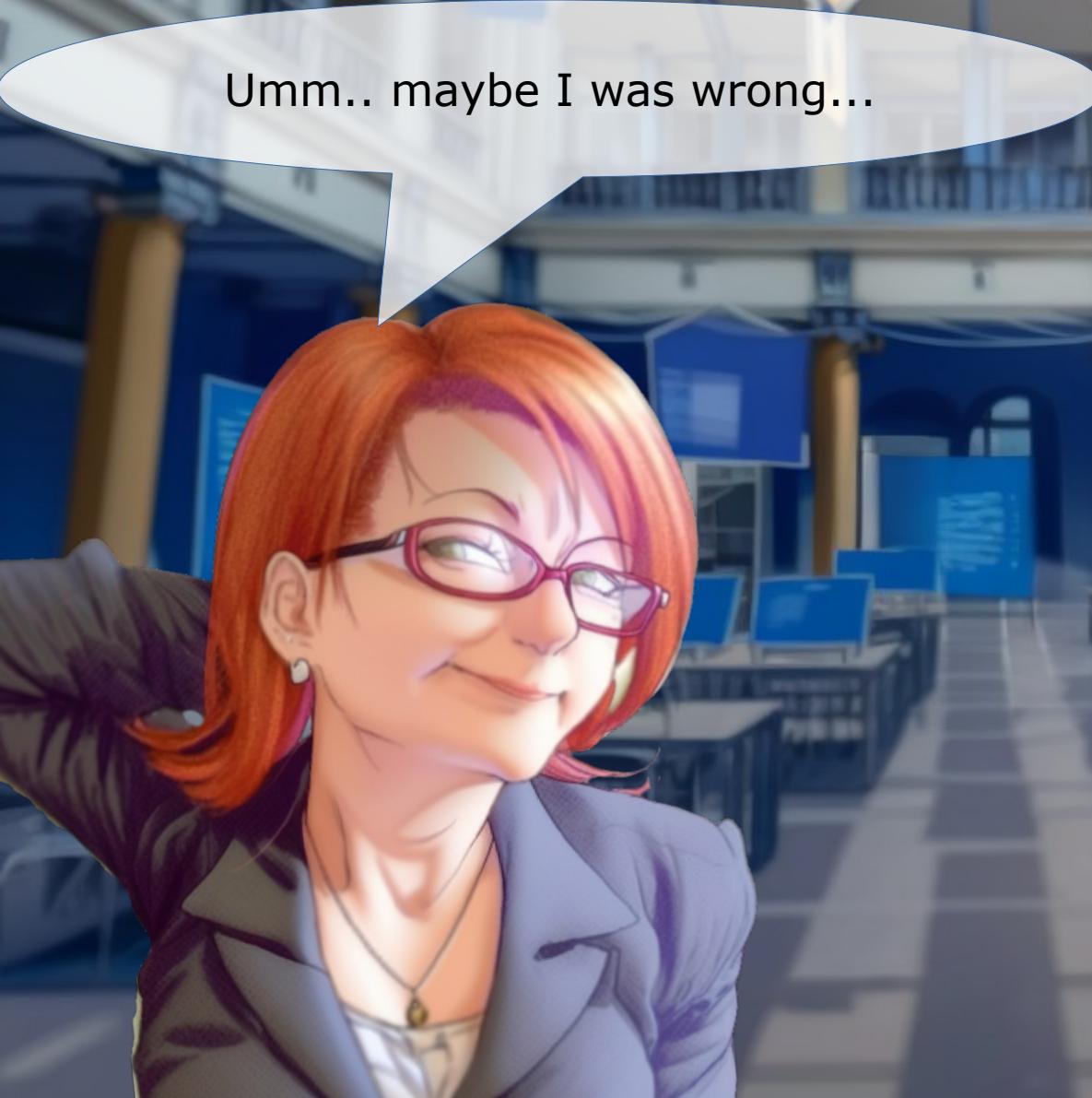
Aaah!

Whooops,  
what was that...



What is going on?  
I hate this place!





Umm.. maybe I was wrong...



What is going on?  
I hate this place!



Umm.. maybe I was wrong...

What is going on?  
I hate this place!

Maybe you do have what it takes  
to survive here



The next lecture is starting.  
Maybe this is going to be easier!





The next lecture is starting.  
Maybe this is going to be easier!

Where is the lecturer?



A classroom setting with rows of desks and students. In the foreground, two male students are visible: one with brown hair and a red shirt, and another with blue hair and glasses. A large white speech bubble originates from the brown-haired student. In the background, three bald men wearing black sunglasses and dark suits are standing near the chalkboard. The room has a modern design with recessed ceiling lights.

Three lecturers?





All three are bald?





All three with sun glasses?





Welcome to the first  
programming lecture





**I'm Elricho Pupon  
Your Programming Professor**



**I'm Elricho Pupon  
Your Programming Professor**

**Please, do not mind the  
security guards**



I'm Elricho Pupon  
Your Programming Professor

We had some petulant  
troublemakers last year,

Please, do not mind the  
security guards



I'm Elricho Pupon  
Your Programming Professor

We had some petulant  
troublemakers last year,

Please, do not mind the  
security guards

We have to be ready, this time



**Variables:**

**Places where the computer store information.**



## **Variables:**

**Places where the computer store information.**

**They have names, called identifiers.**



## Variables:

Places where the computer store information.

They have names, called identifiers.

We can access them by their names,  
and we can update the data stored in them  
by using the 'equal' sign.



## **Variables:**

**Places where the computer store information.**

**They have names, called identifiers.**

**We can access them by their names, and we can update the data stored in them by using the 'equal' sign.**

**For example, variables can contains numbers, and we can use conventional operations on those numbers, like addition, multiplication or subtraction**



We can start  
with some  
example code

A cartoon illustration of a bald man wearing dark sunglasses and a dark suit jacket over a white shirt. He is smiling and has his right hand near his face, with fingers touching his cheek.

**We can start  
with some  
example code**

**We are going to use Java, but  
this would work the same in many  
other languages**

```
int a = 24;  
int b = 50;
```



I'm declaring two variables, "a" and "b".

```
int a = 24;  
int b = 50;
```

A cartoon illustration of a man with a bald head, wearing blue sunglasses and a light-colored jacket over a striped shirt. He is positioned on the left side of the frame, looking towards the right where the speech bubbles are located.

I'm declaring two variables, "a" and "b".

They are both of type "int".

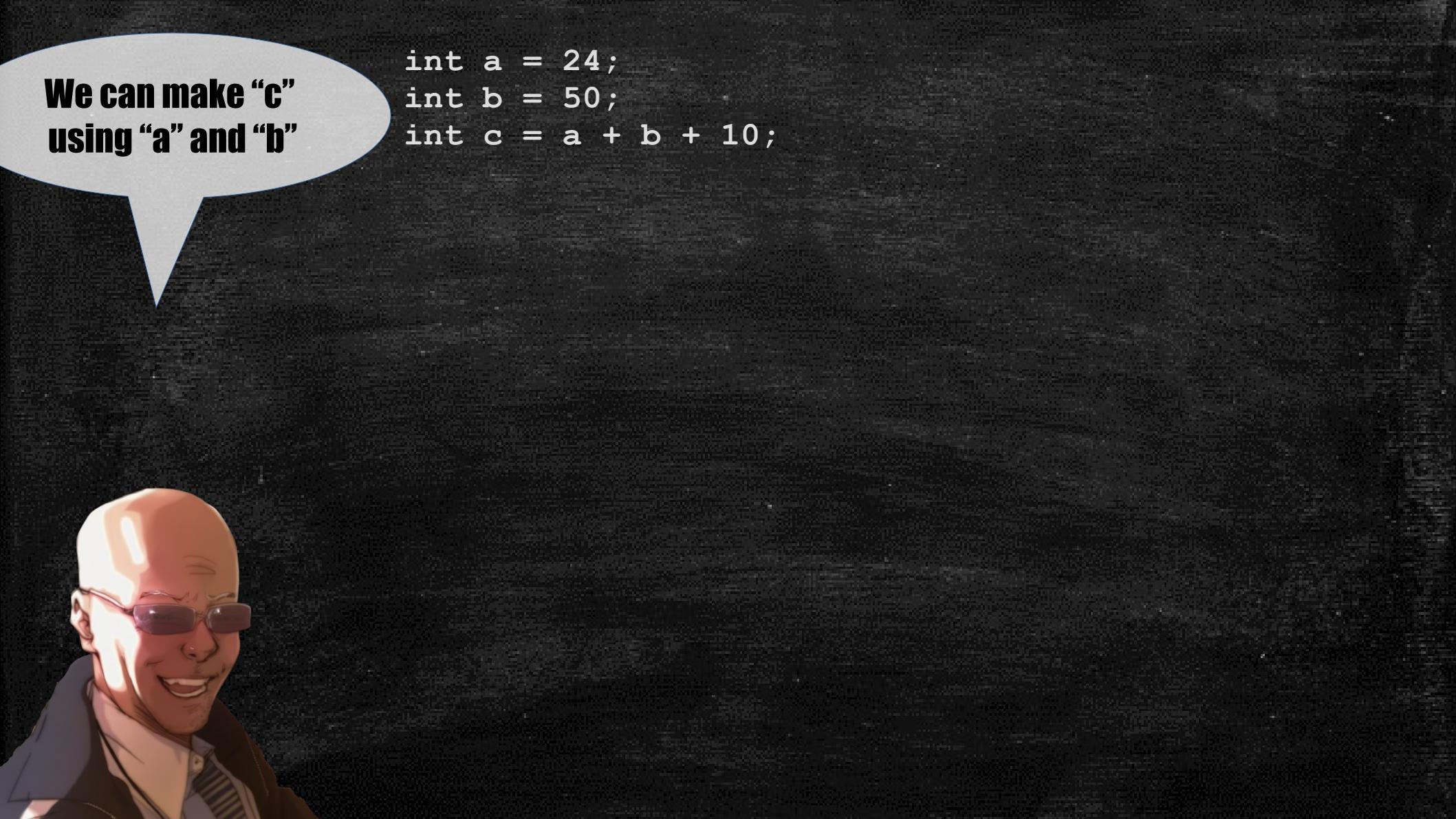
```
int a = 24;  
int b = 50;
```



I'm declaring two variables, "a" and "b".

They are both of type "int".

They are initialized with values  
"24" and "50".

A cartoon illustration of a bald man wearing dark sunglasses and a light-colored jacket over a striped shirt. He is smiling and looking towards the right. A large, semi-transparent white speech bubble originates from his mouth, containing the text.

**We can make “c”  
using “a” and “b”**

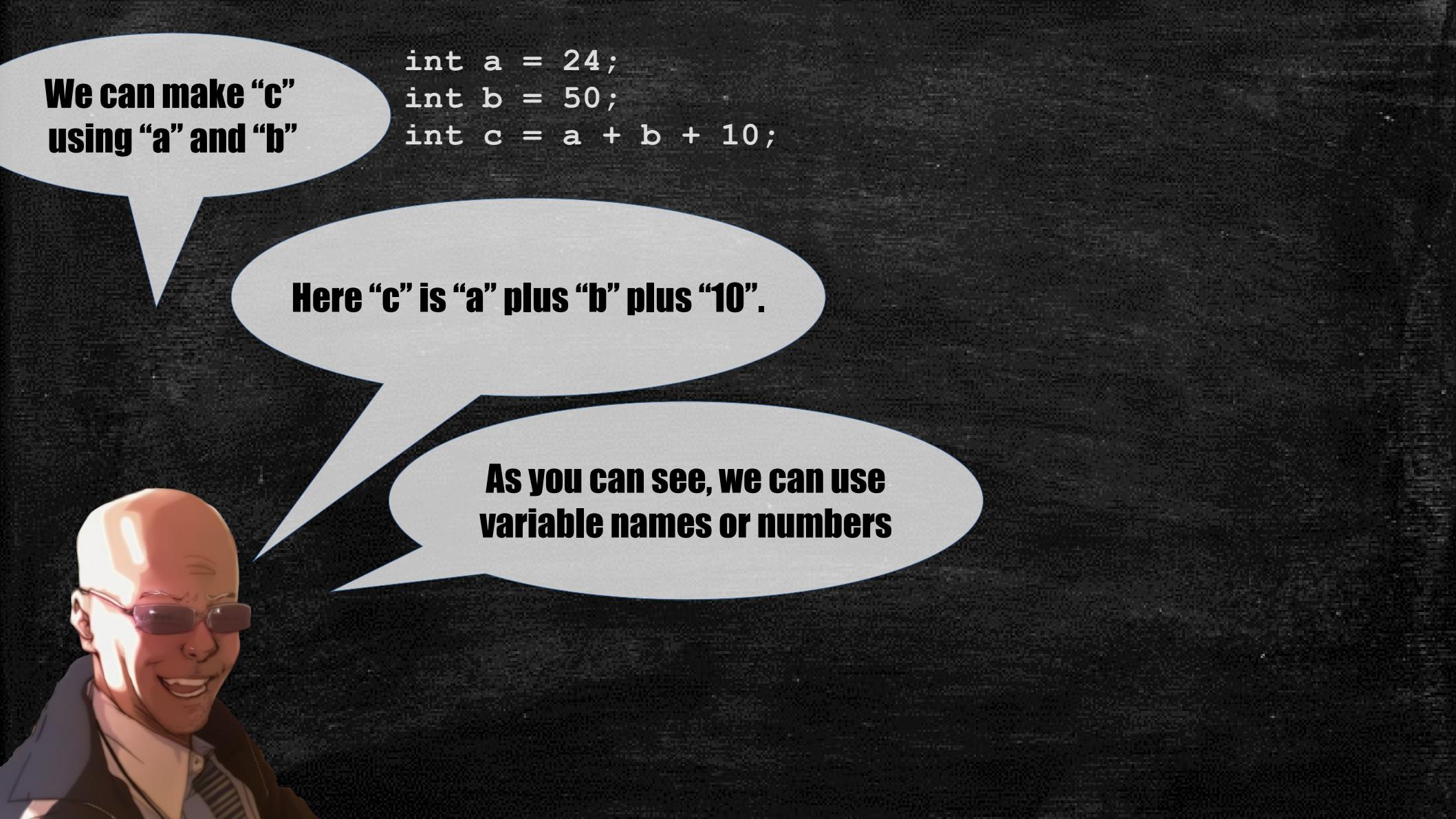
```
int a = 24;  
int b = 50;  
int c = a + b + 10;
```



We can make “c”  
using “a” and “b”

```
int a = 24;  
int b = 50;  
int c = a + b + 10;
```

Here “c” is “a” plus “b” plus “10”.

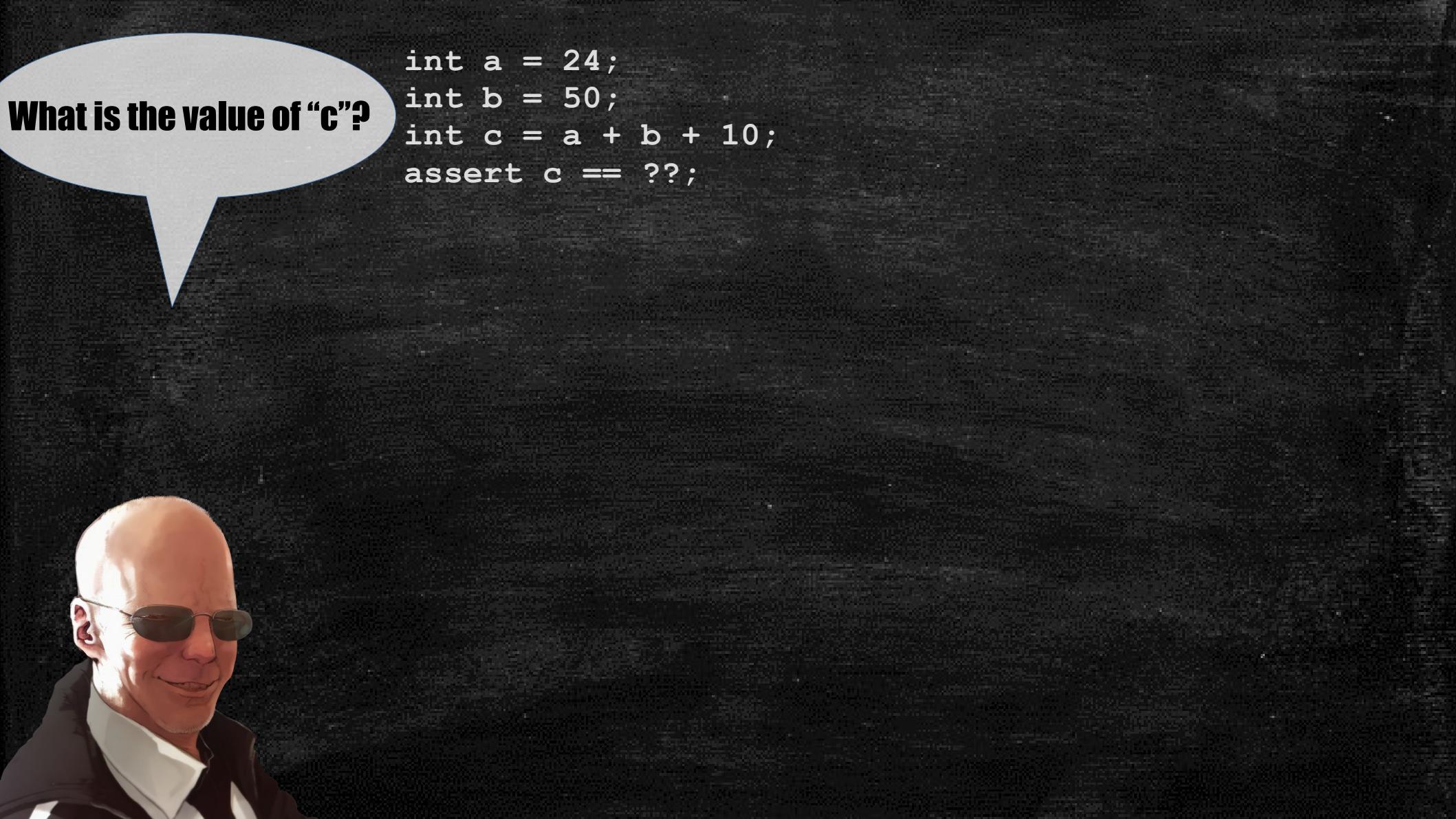
A cartoon illustration of a bald man wearing dark sunglasses and a grey hoodie. He has a slight smile and is looking towards the right. The background behind him is a warm orange and red gradient.

**We can make “c”  
using “a” and “b”**

```
int a = 24;  
int b = 50;  
int c = a + b + 10;
```

**Here “c” is “a” plus “b” plus “10”.**

**As you can see, we can use  
variable names or numbers**



What is the value of “c”?

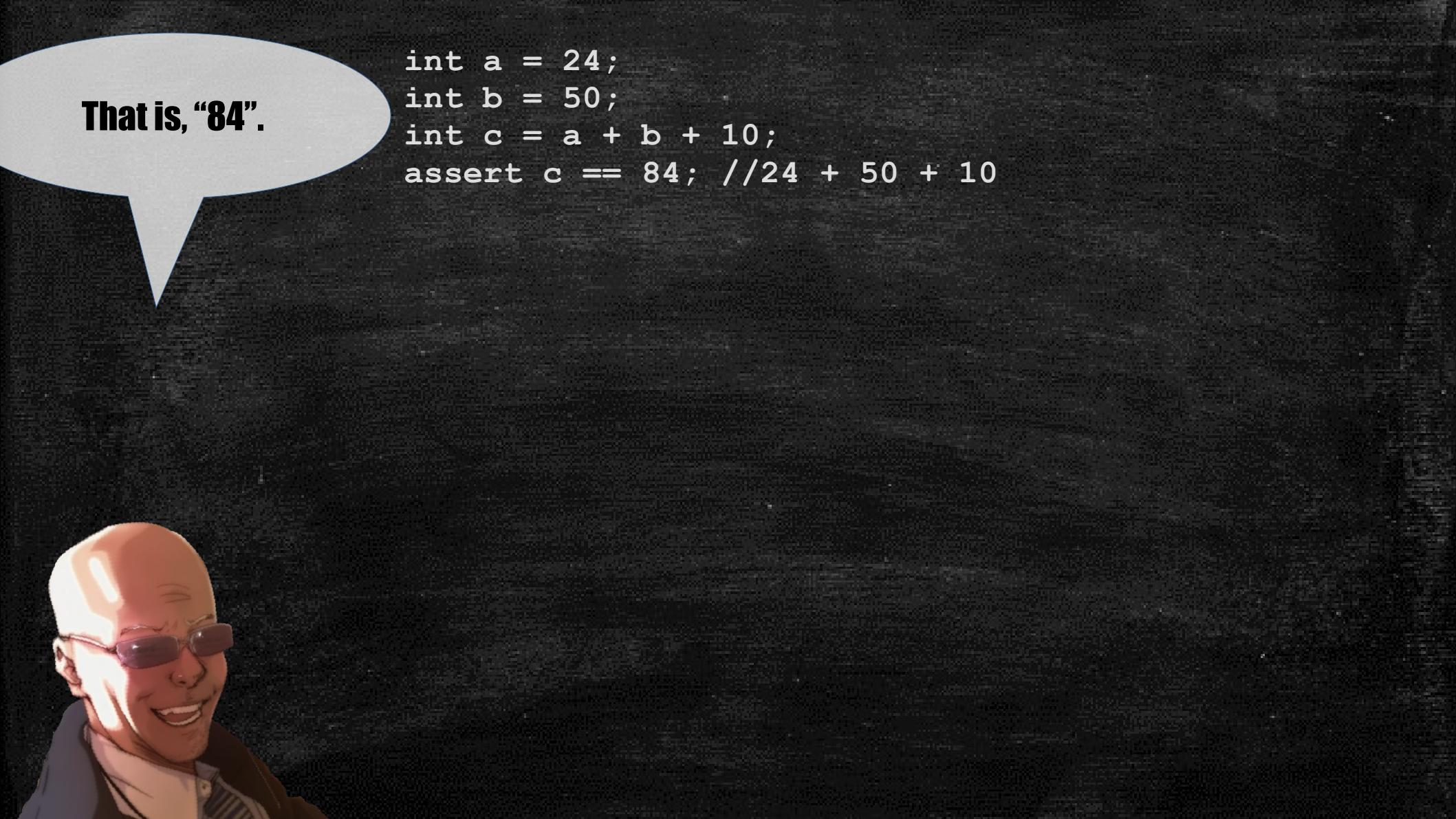
```
int a = 24;  
int b = 50;  
int c = a + b + 10;  
assert c == ??;
```



**What is the value of “c”?**

```
int a = 24;  
int b = 50;  
int c = a + b + 10;  
assert c == ??;
```

**It is the value of “a” plus  
the value of “b” plus “10”**



That is, “84”.

```
int a = 24;  
int b = 50;  
int c = a + b + 10;  
assert c == 84; //24 + 50 + 10
```



**That is, “84”.**

```
int a = 24;  
int b = 50;  
int c = a + b + 10;  
assert c == 84; //24 + 50 + 10
```

**We write “assert” to mark expressions  
that should hold.**



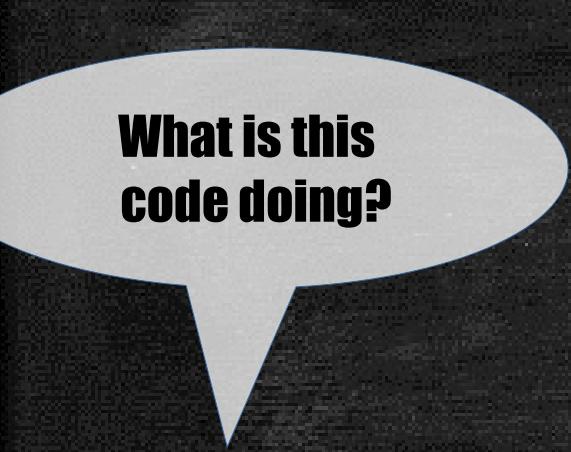
**That is, “84”.**

```
int a = 24;  
int b = 50;  
int c = a + b + 10;  
assert c == 84; //24 + 50 + 10
```

**We write “assert” to mark expressions  
that should hold true.**

**Equals equals evaluates to “true” if the  
left and the right value are the same, and “false”  
otherwise.**

**We can reuse a variable  
instead of making a new one.**



**What is this  
code doing?**

```
int a = 24;  
int b = 50;  
b = a + b + 10;
```



**What is this  
code doing?**

```
int a = 24;  
int b = 50;  
b = a + b + 10;
```

**It is updating the value of “b”  
using the result of the expression  
on the right.**

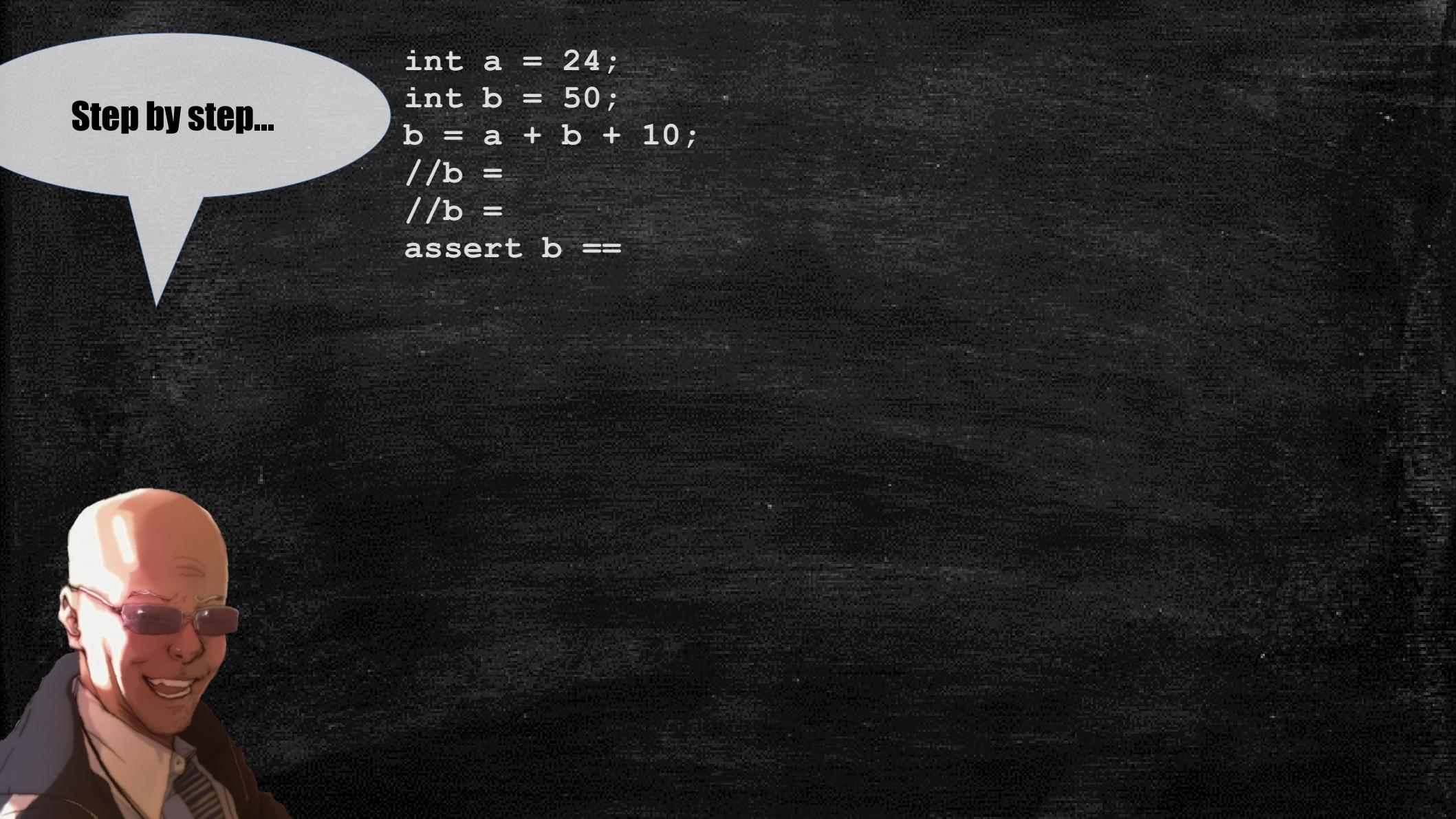


What is this  
code doing?

```
int a = 24;  
int b = 50;  
b = a + b + 10;
```

It is updating the value of “b”  
using the result of the expression  
on the right.

That is, the equals is not like the  
math equals, where we state that two terms  
have the same value

A cartoon illustration of a bald man wearing dark sunglasses and a black hoodie. He is smiling and looking towards the right. A large white speech bubble originates from his mouth, containing the text "Step by step...".

**Step by step...**

```
int a = 24;  
int b = 50;  
b = a + b + 10;  
//b =  
//b =  
assert b ==
```



**Step by step...**

```
int a = 24;  
int b = 50;  
b = a + b + 10;  
//b = 24 + b + 10;  
//b =  
//b =  
//b =  
assert b ==
```

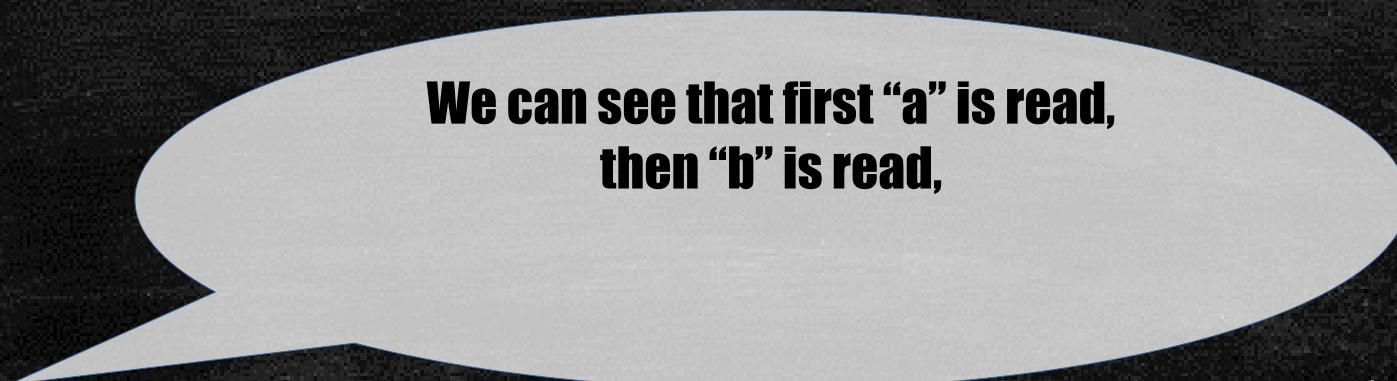


**We can see that first “a” is read,**



**Step by step...**

```
int a = 24;  
int b = 50;  
b = a + b + 10;  
//b = 24 + b + 10;  
//b = 24 + 50 + 10;  
//b =  
//b =  
assert b ==
```



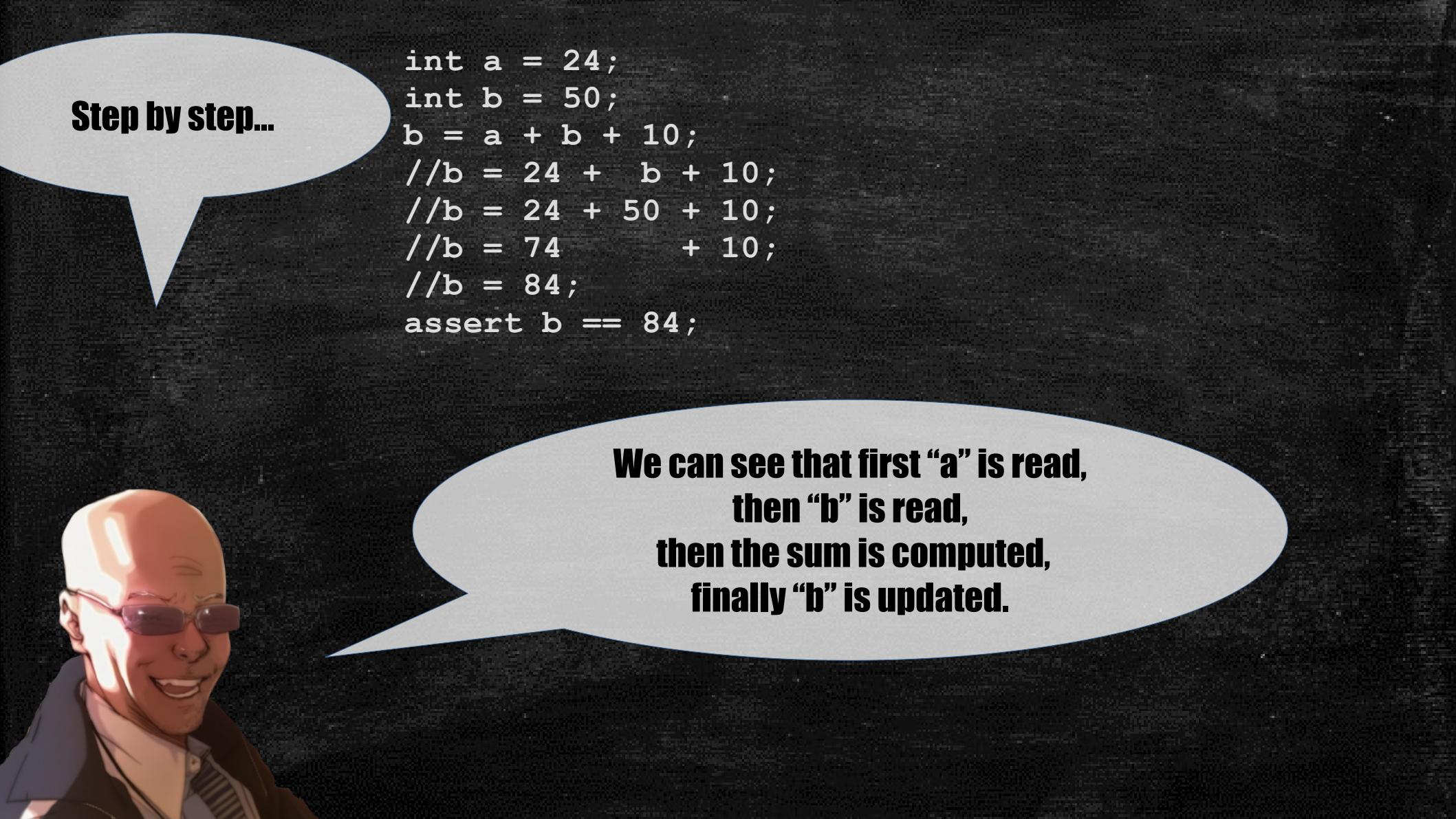
**We can see that first “a” is read,  
then “b” is read,**



**Step by step...**

```
int a = 24;  
int b = 50;  
b = a + b + 10;  
//b = 24 + b + 10;  
//b = 24 + 50 + 10;  
//b = 74 + 10;  
//b =  
assert b ==
```

**We can see that first “a” is read,  
then “b” is read,  
then the sum is computed,**

A cartoon illustration of a bald man wearing dark sunglasses and a black jacket over a striped shirt. He is positioned on the left side of the frame, looking towards the right. A large, light gray speech bubble originates from his mouth and extends towards the center of the slide.

**Step by step...**

```
int a = 24;  
int b = 50;  
b = a + b + 10;  
//b = 24 + b + 10;  
//b = 24 + 50 + 10;  
//b = 74 + 10;  
//b = 84;  
assert b == 84;
```

**We can see that first “a” is read,  
then “b” is read,  
then the sum is computed,  
finally “b” is updated.**



**What if we wanted to swap the  
content of two variables?**



**We can see our two variables  
as our two hands,  
holding one ball each.**



**We can see our two variables  
as our two hands,  
holding one ball each.**

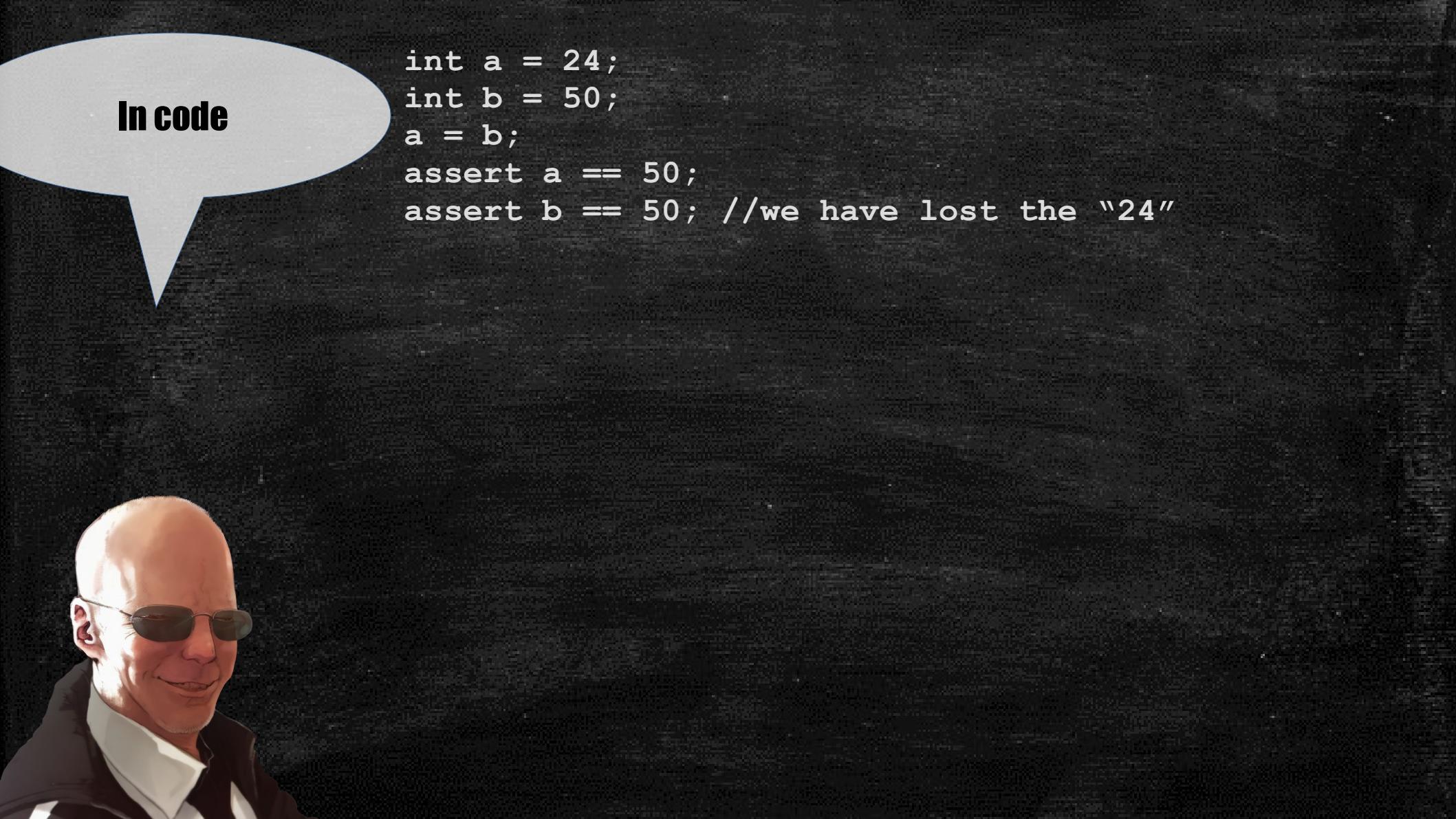
**A hand only holds one ball;**



**We can see our two variables  
as our two hands,  
holding one ball each.**

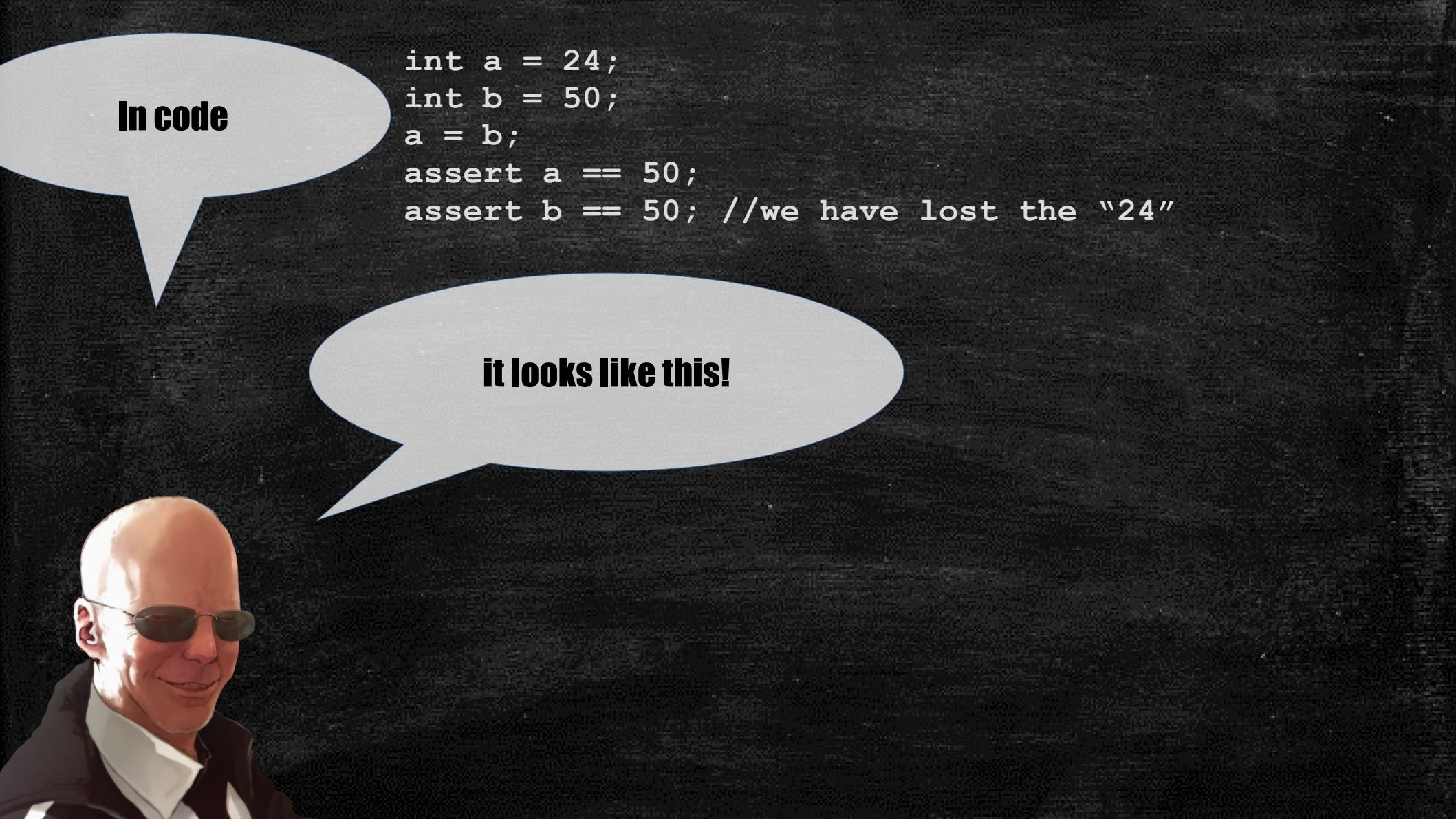
**A hand only holds one ball;**

**taking the other ball, we have to  
abandon the current ball, which  
would fall down, out of reach.**



In code

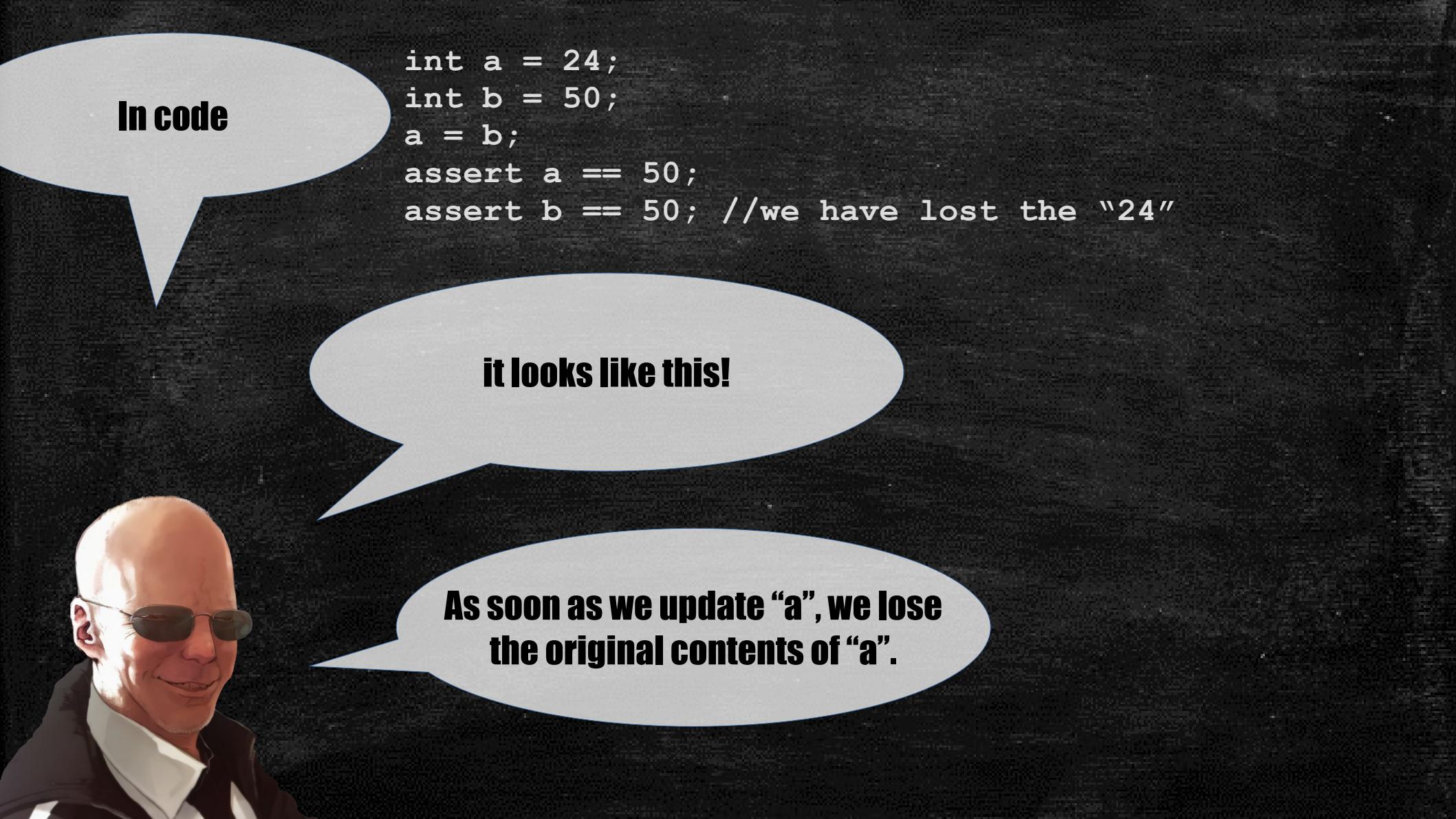
```
int a = 24;  
int b = 50;  
a = b;  
assert a == 50;  
assert b == 50; //we have lost the "24"
```

A cartoon illustration of Bruce Banner, the Hulk. He is shown from the chest up, wearing dark sunglasses and a black suit jacket over a white shirt. He has a slight smile and is looking towards the right. A large, light gray speech bubble originates from his head, pointing towards the text on the right.

**In code**

```
int a = 24;  
int b = 50;  
a = b;  
assert a == 50;  
assert b == 50; //we have lost the "24"
```

**it looks like this!**



In code

```
int a = 24;  
int b = 50;  
a = b;  
assert a == 50;  
assert b == 50; //we have lost the "24"
```

it looks like this!

As soon as we update “a”, we lose  
the original contents of “a”.



**As you can see, we can't do it!**



**As you can see, we can't do it!**

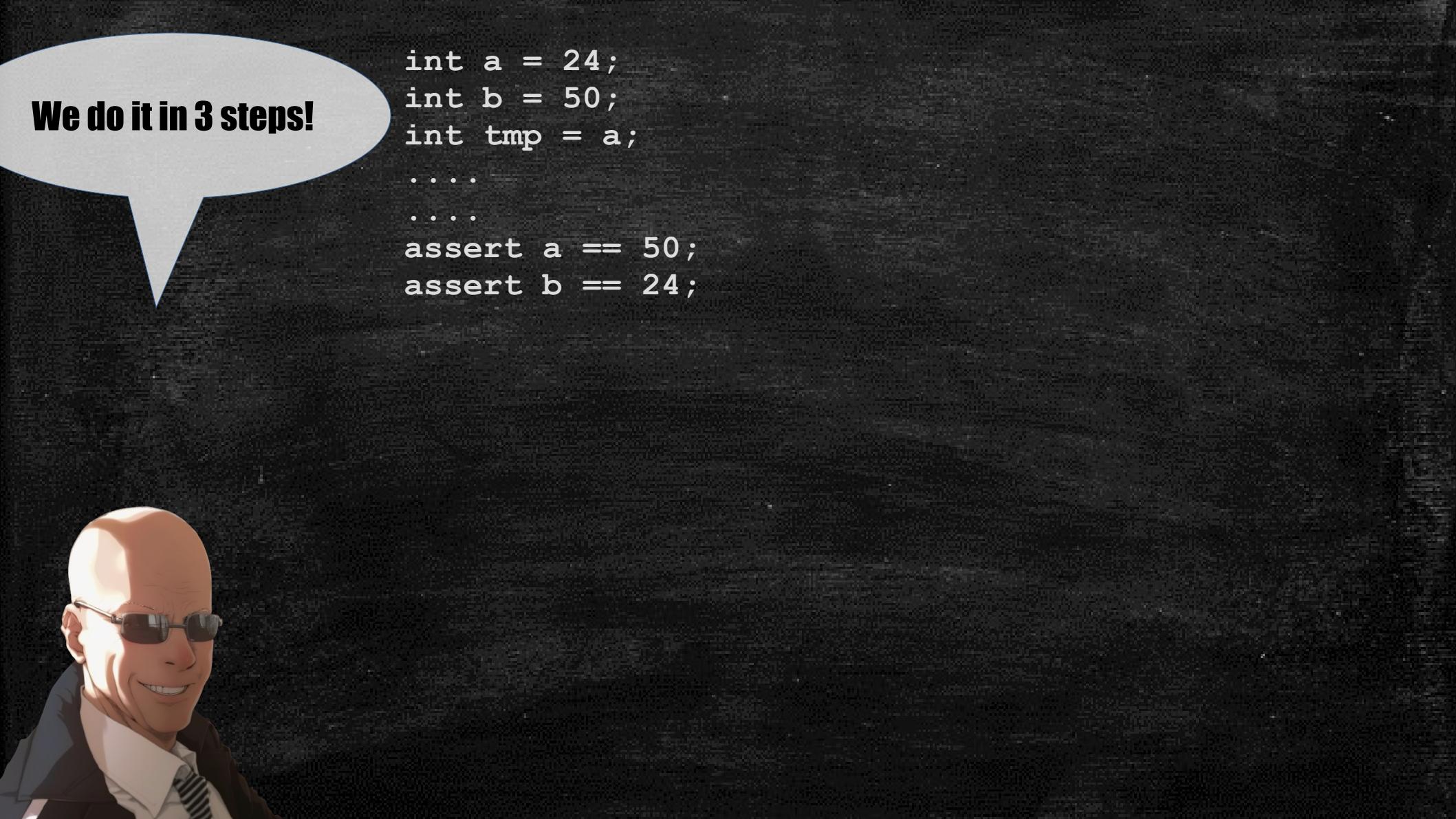
**Not with only two variables!**



**As you can see, we can't do it!**

**Not with only two variables!**

**We need a third variable to help us!**

A cartoon illustration of a bald man wearing dark sunglasses and a suit. He is smiling and has his hand near his face. A large white speech bubble originates from his mouth, containing the text "We do it in 3 steps!".

We do it in 3 steps!

```
int a = 24;  
int b = 50;  
int tmp = a;  
....  
....  
assert a == 50;  
assert b == 24;
```



We do it in 3 steps!

```
int a = 24;  
int b = 50;  
int tmp = a; //step 1  
....  
....  
assert a == 50;  
assert b == 24;
```

First we save the original value of “a”  
in a new temporary local variable

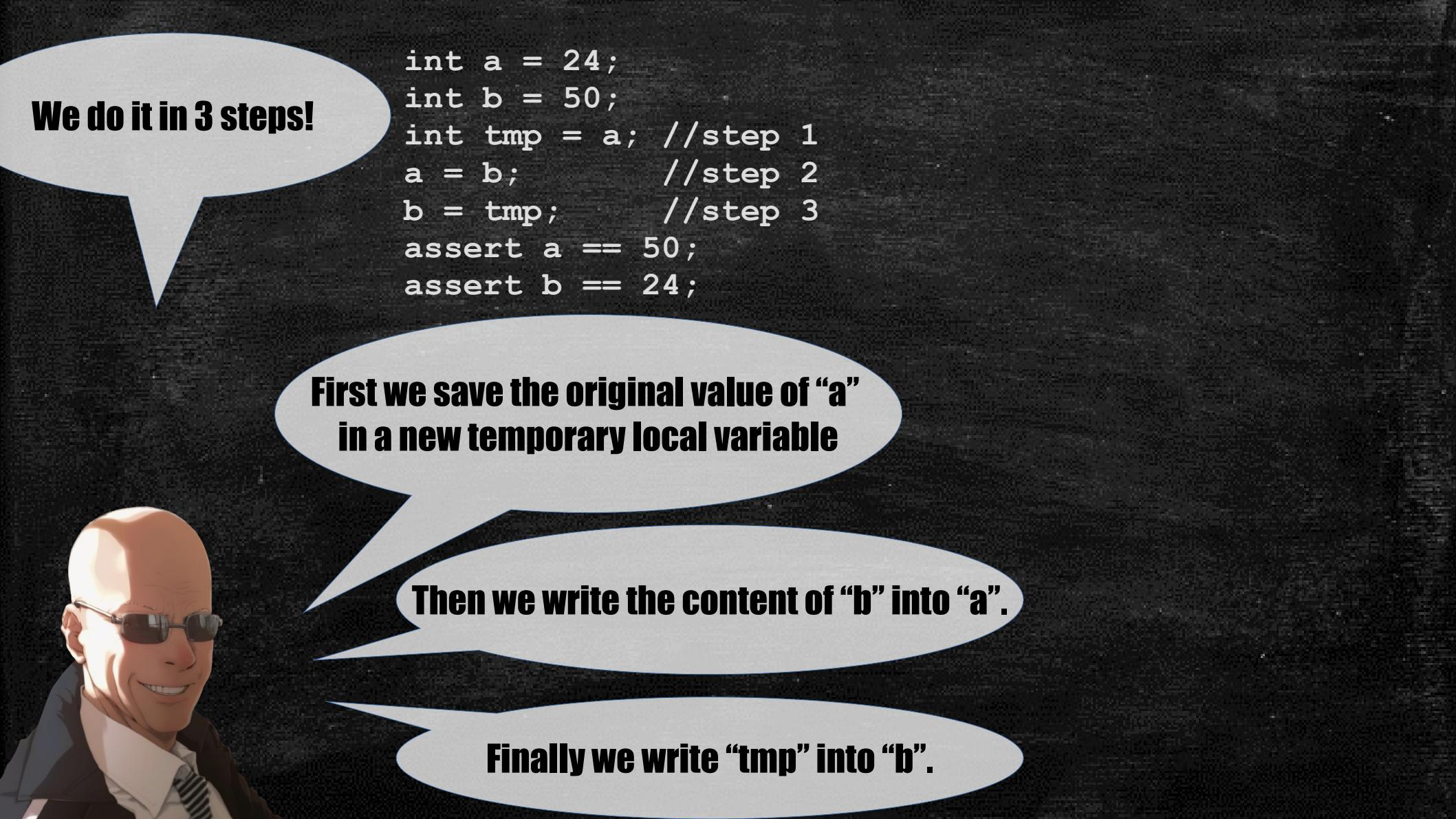


**We do it in 3 steps!**

```
int a = 24;  
int b = 50;  
int tmp = a; //step 1  
a = b; //step 2  
....  
assert a == 50;  
assert b == 24;
```

**First we save the original value of “a”  
in a new temporary local variable**

**Then we write the content of “b” into “a”.**

A cartoon illustration of a bald man wearing dark sunglasses and a dark suit jacket over a white shirt. He is smiling and looking towards the text.

We do it in 3 steps!

```
int a = 24;  
int b = 50;  
int tmp = a; //step 1  
a = b; //step 2  
b = tmp; //step 3  
assert a == 50;  
assert b == 24;
```

First we save the original value of “a”  
in a new temporary local variable

Then we write the content of “b” into “a”.

Finally we write “tmp” into “b”.



We do it in 3 steps!

```
int a = 24;  
int b = 50;  
int tmp = a; //step 1  
a = b; //step 2  
b = tmp; //step 3  
assert a == 50;  
assert b == 24;
```

As you can see, it can not be done  
with only two variables,  
it is mathematically proven

You need a third variable!

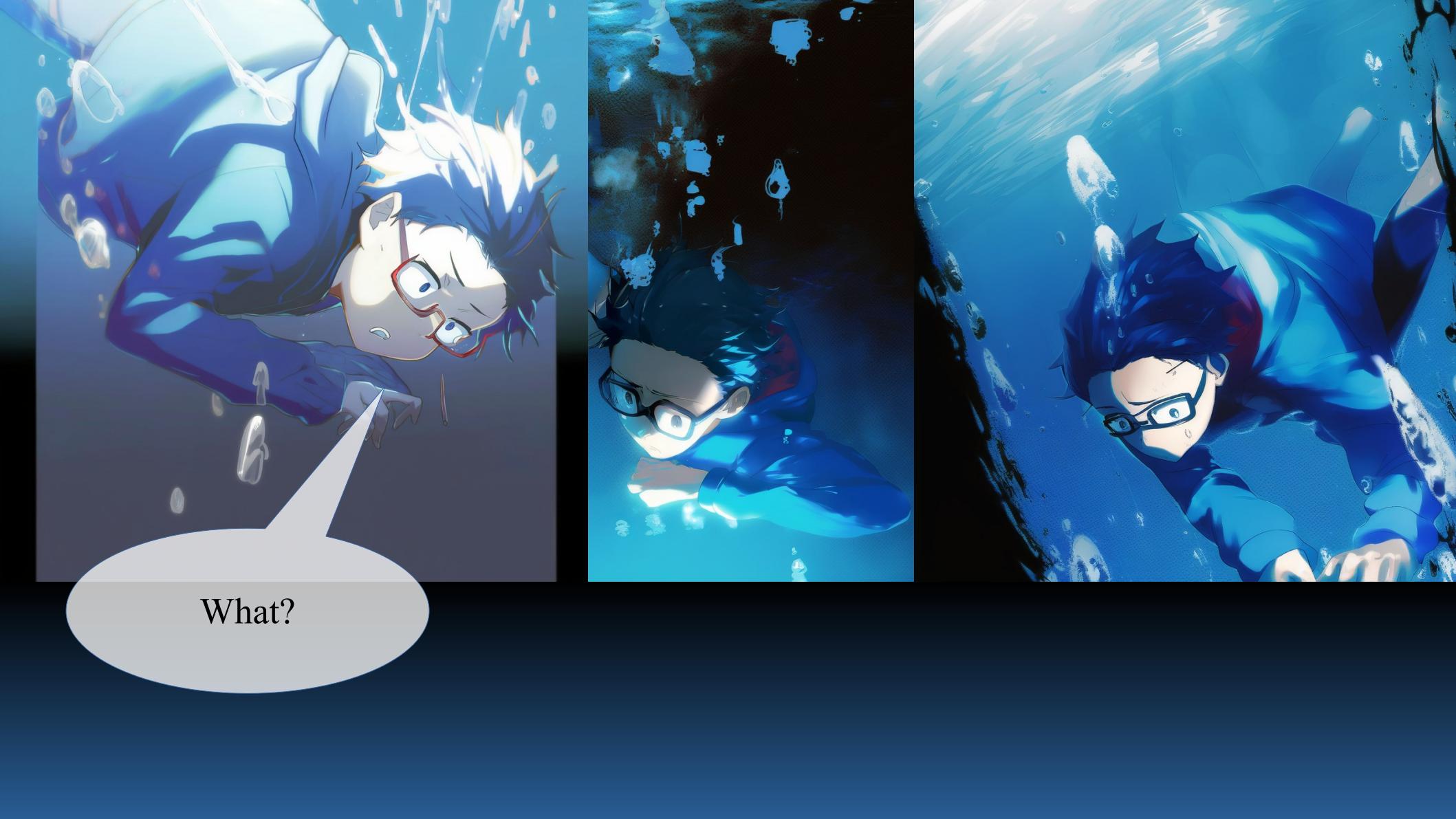


Something is wrong here



Something is wrong here

I'm seeing stuff



What?





What?



I'm under water?





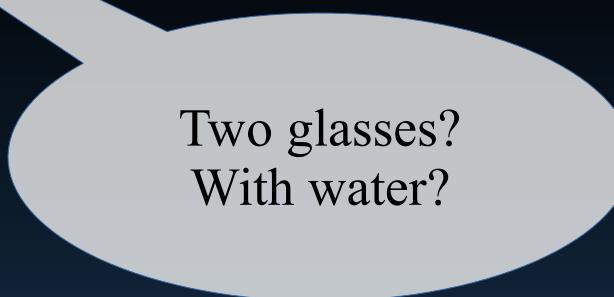
What?



I'm under water?



What is this?



Two glasses?  
With water?





Two glasses?  
With water?

But I'm already  
underwater...



Two glasses?  
With water?

But I'm already  
underwater...

I must be dreaming

Anyway, can I swap  
the content



Anyway, can I swap  
the content

without  
a third glass?





```
int a = 24;  
int b = 50;  
a = a + b;
```



If I add the two glasses in  
the first one,

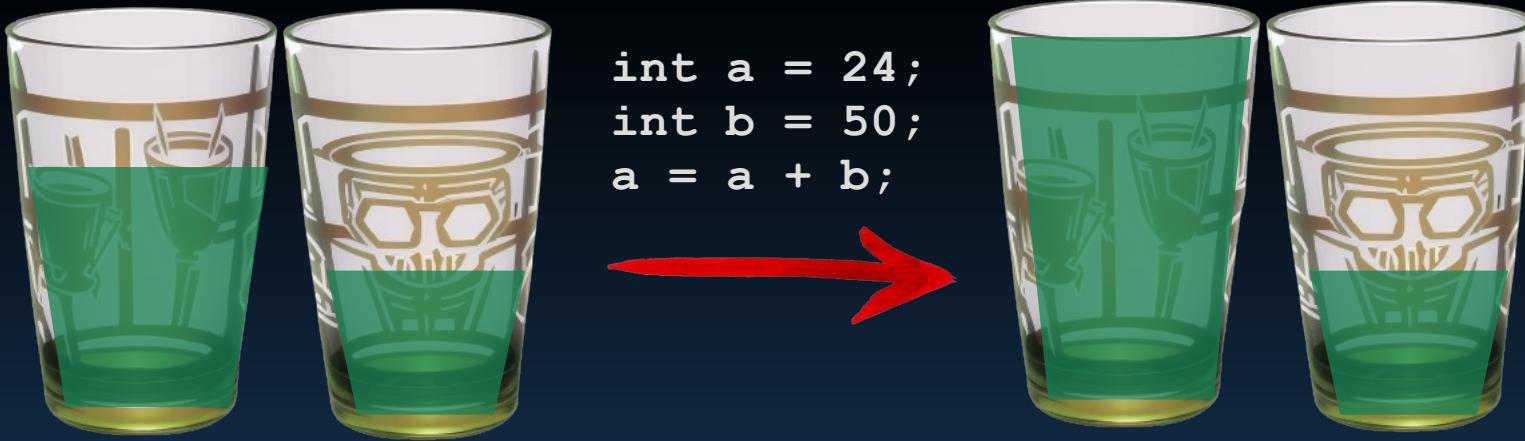


```
int a = 24;  
int b = 50;  
a = a + b;
```



If I add the two glasses in  
the first one,

would the second  
glass get empty?



```
int a = 24;  
int b = 50;  
a = a + b;
```



No! This does not  
update b.





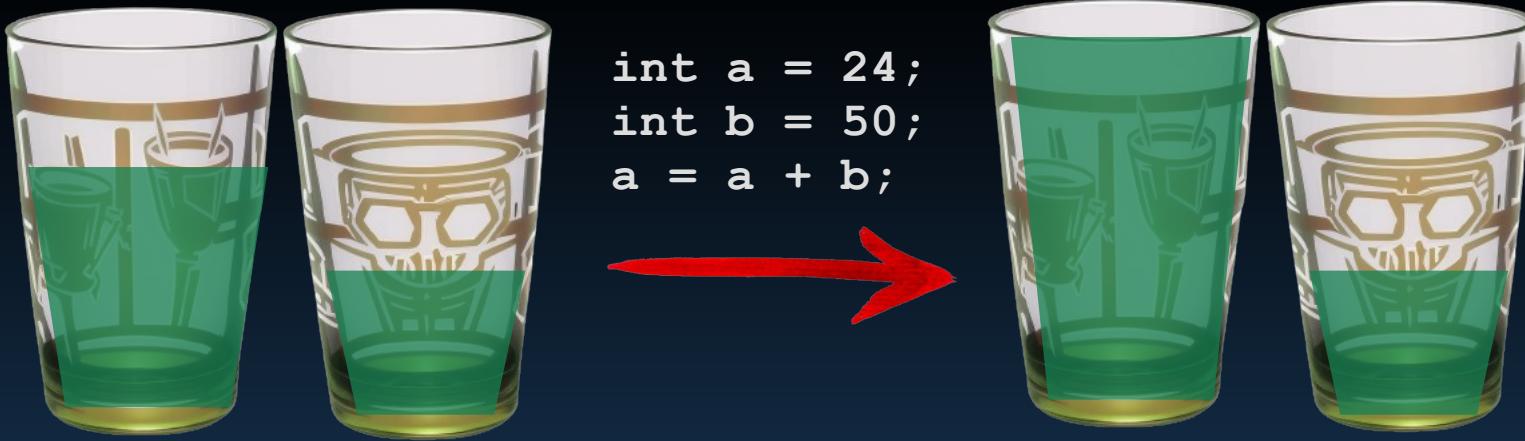
```
int a = 24;  
int b = 50;  
a = a + b;
```



No! This does not  
update b.

Values are not shuffled  
around, but duplicated





```
int a = 24;  
int b = 50;  
a = a + b;
```



That is, even after  
adding a and b



```
int a = 24;  
int b = 50;  
a = a + b;
```



That is, even after  
adding a and b

All the information  
is still in the system.



```
int a = 24;  
int b = 50;  
a = a + b;
```



That is, even after  
adding a and b

All the information  
is still in the system.

b is still in b, and  
the original a is just  
the current a minus b



```
int a = 24;  
int b = 50;
```



a = a + b;



b = a - b;



a = a - b;



So, in 3 steps,  
I can swap them







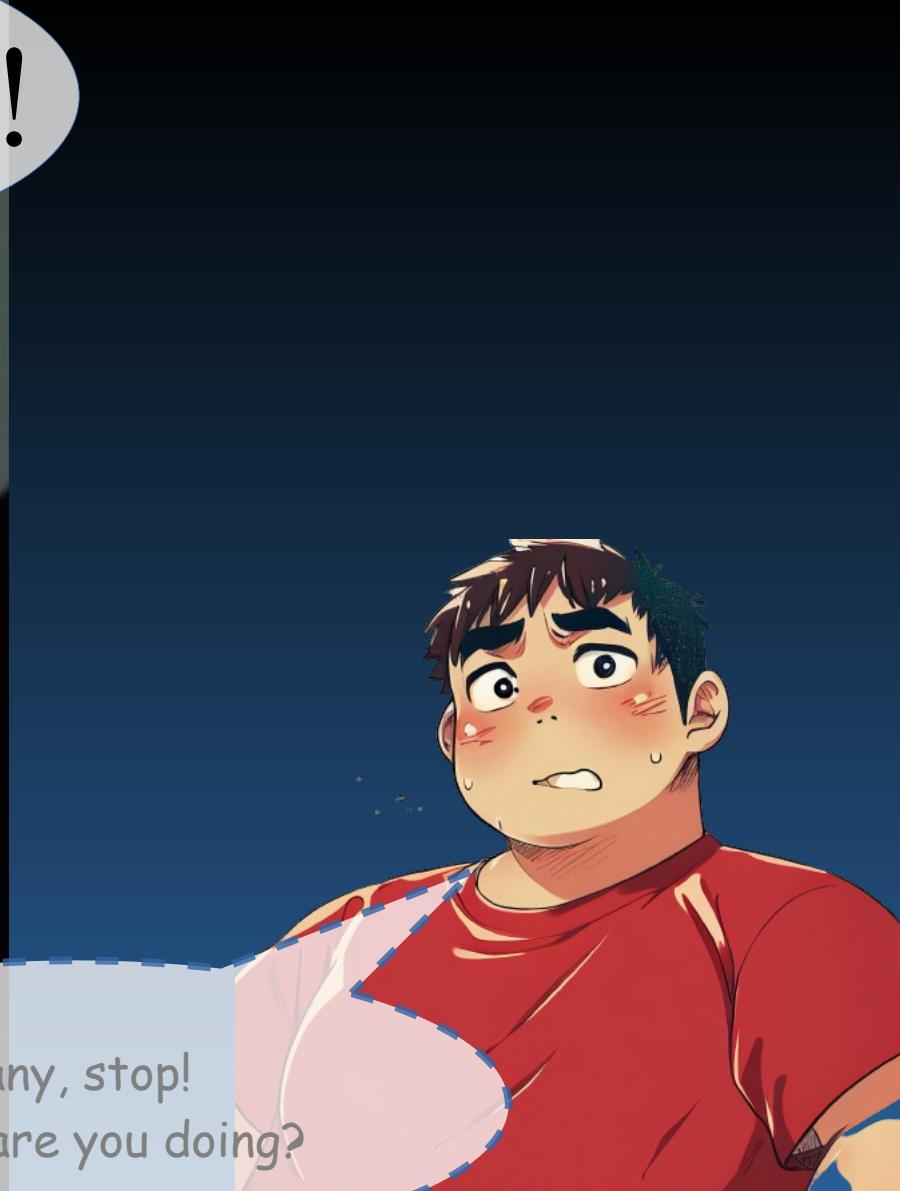
! Sorry !







! Hey, ... !



Dany, stop!  
What are you doing?



Yes?

**Do you have a question on  
this basic material?**





I CAN do it!

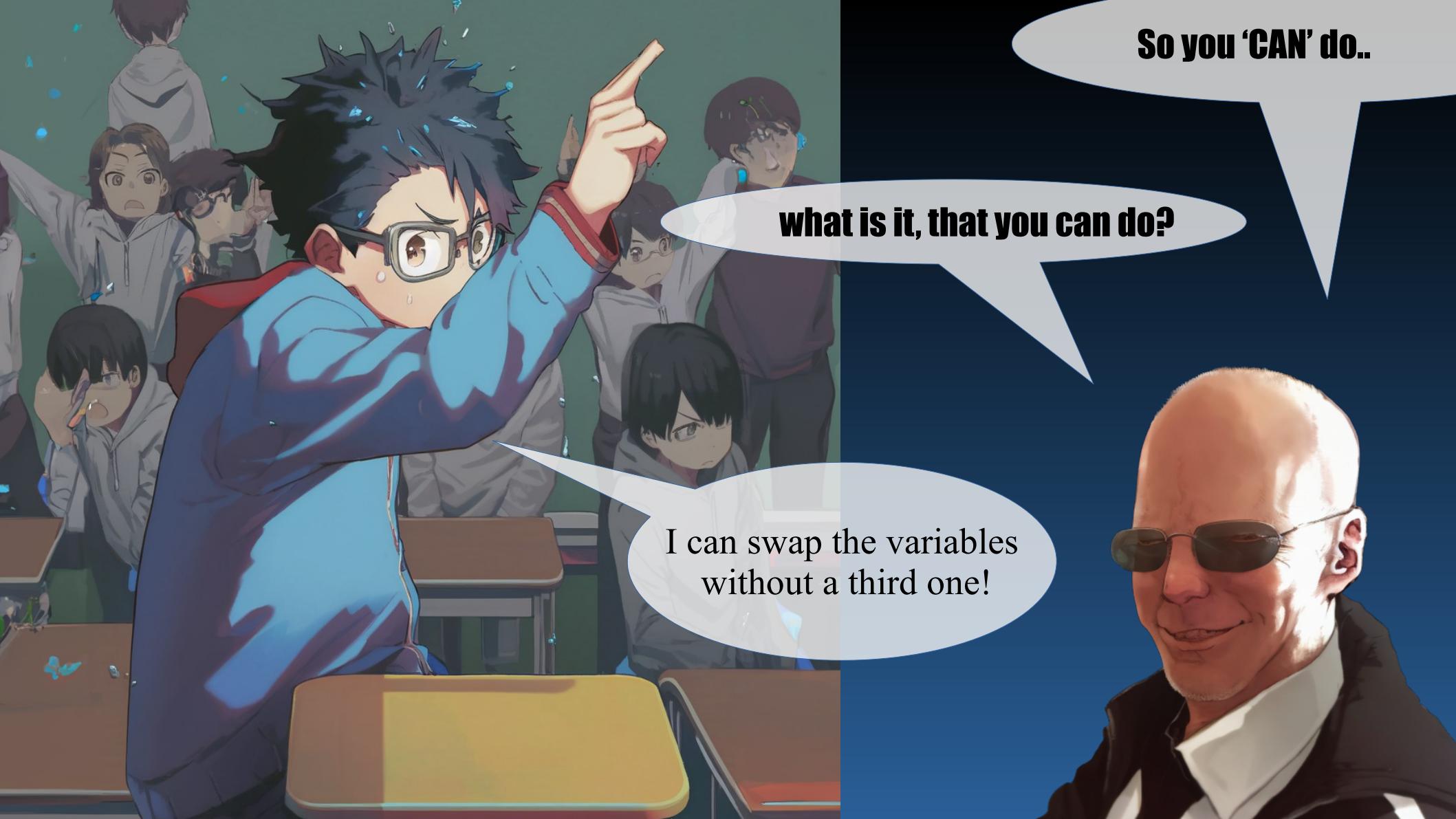




So you 'CAN' do..

what is it, that you can do?





So you 'CAN' do..

what is it, that you can do?

I can swap the variables  
without a third one!

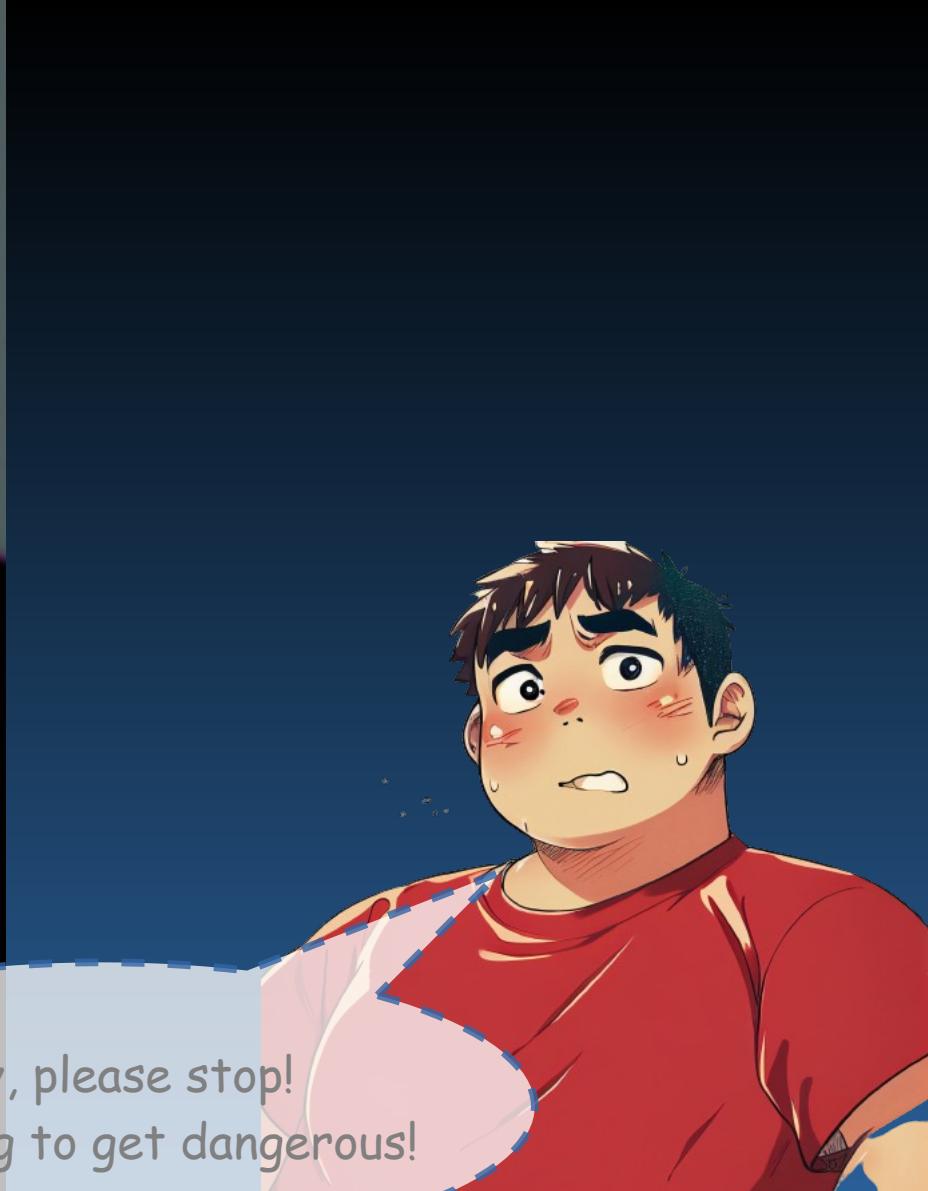


**Really?  
Do not make us laugh.  
It is mathematically proved.  
It can not be done!**

A cartoon illustration of a balding man with glasses, wearing a white shirt and a dark blazer, standing in front of a chalkboard. He is smiling and holding a piece of chalk. A large speech bubble originates from his mouth.

**Really?  
Do not make us laugh.  
It is mathematically proved.  
It can not be done!**

**Now, let's move one  
with the lecture..**



Dany, please stop!  
It is going to get dangerous!



WRITE IT DOWN!





WRITE IT DOWN!

$$a = a + b;$$



WRITE IT DOWN!

$a = a + b;$



$b = a - b;$

$a = a - b;$



A 3D animated scene featuring Mr. Incredible from the Pixar movie "The Incredibles". He is standing in a classroom, leaning against a chalkboard with his right hand. He is wearing his signature superhero suit, which is white with a grey vest over a striped shirt and yellow pants. He has a wide, mischievous smile and is wearing sunglasses. To his right, there is a wooden desk with a single sheet of paper on it. A large, white, speech bubble originates from Mr. Incredible's mouth, containing the text "P.. are you...". The background shows a dark wall and a chalkboard.

?.. are you...



A 3D animated scene featuring Mr. Incredible from the Pixar movie "The Incredibles". He is standing in a classroom, leaning against a chalkboard with his right hand. He is wearing his signature superhero suit, which is white with a grey waistband and orange pants. He has a wide, mischievous smile and is wearing sunglasses. A speech bubble originates from him, containing the text "?. are you... for real.. ?" in a bold, black font. To his right, there is a wooden desk with a single sheet of paper on it. The floor is dark blue, and the walls are dark grey.

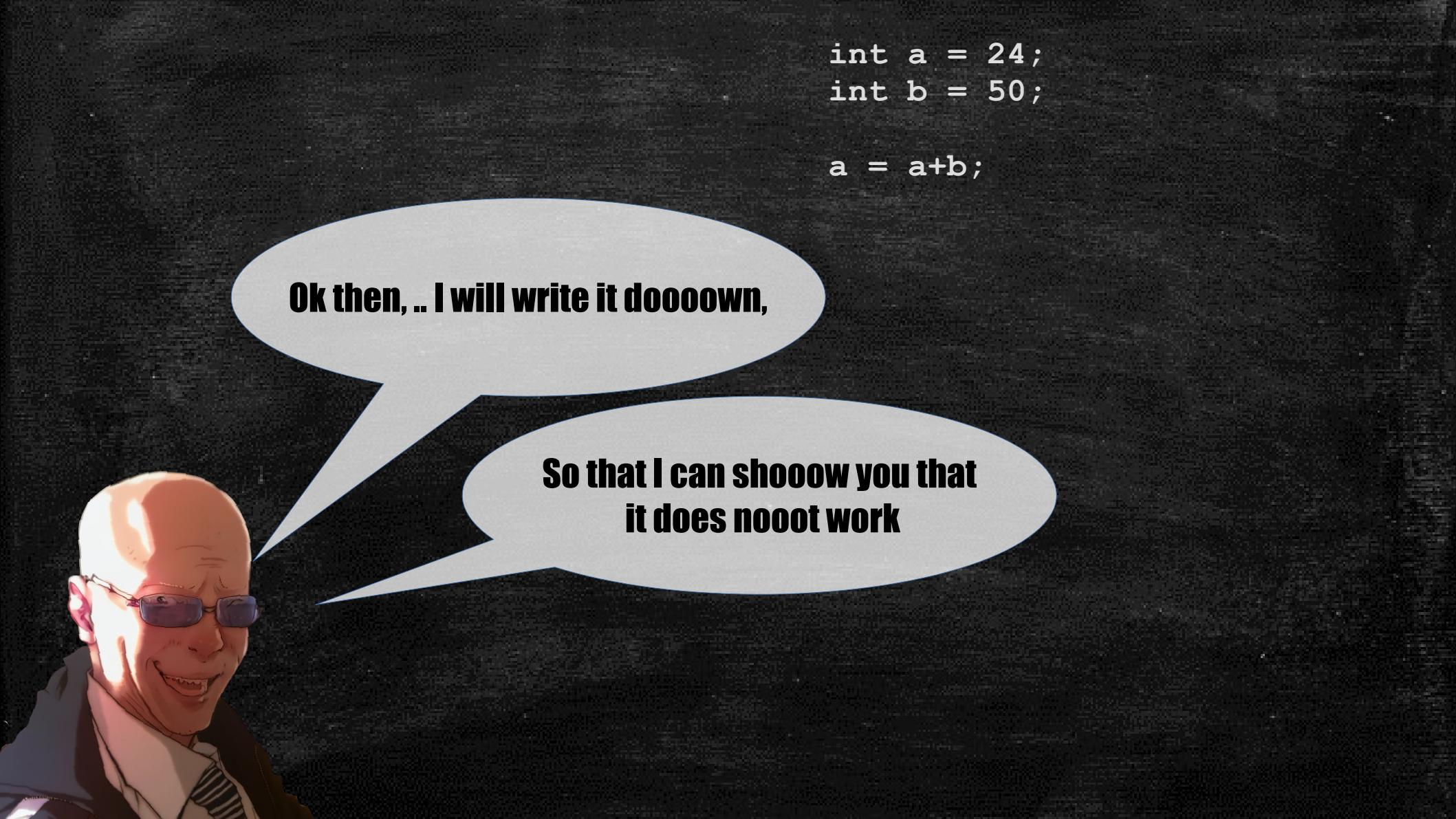
?.. are you... for real.. ?

```
int a = 24;  
int b = 50;
```



Ok then, .. I will write it doooown,

```
int a = 24;  
int b = 50;  
  
a = a+b;
```

A cartoon illustration of a bald man with glasses, smiling and pointing his finger towards the text. He is positioned on the left side of the frame.

Ok then, .. I will write it doooown,

So that I can shooow you that  
it does nooot work



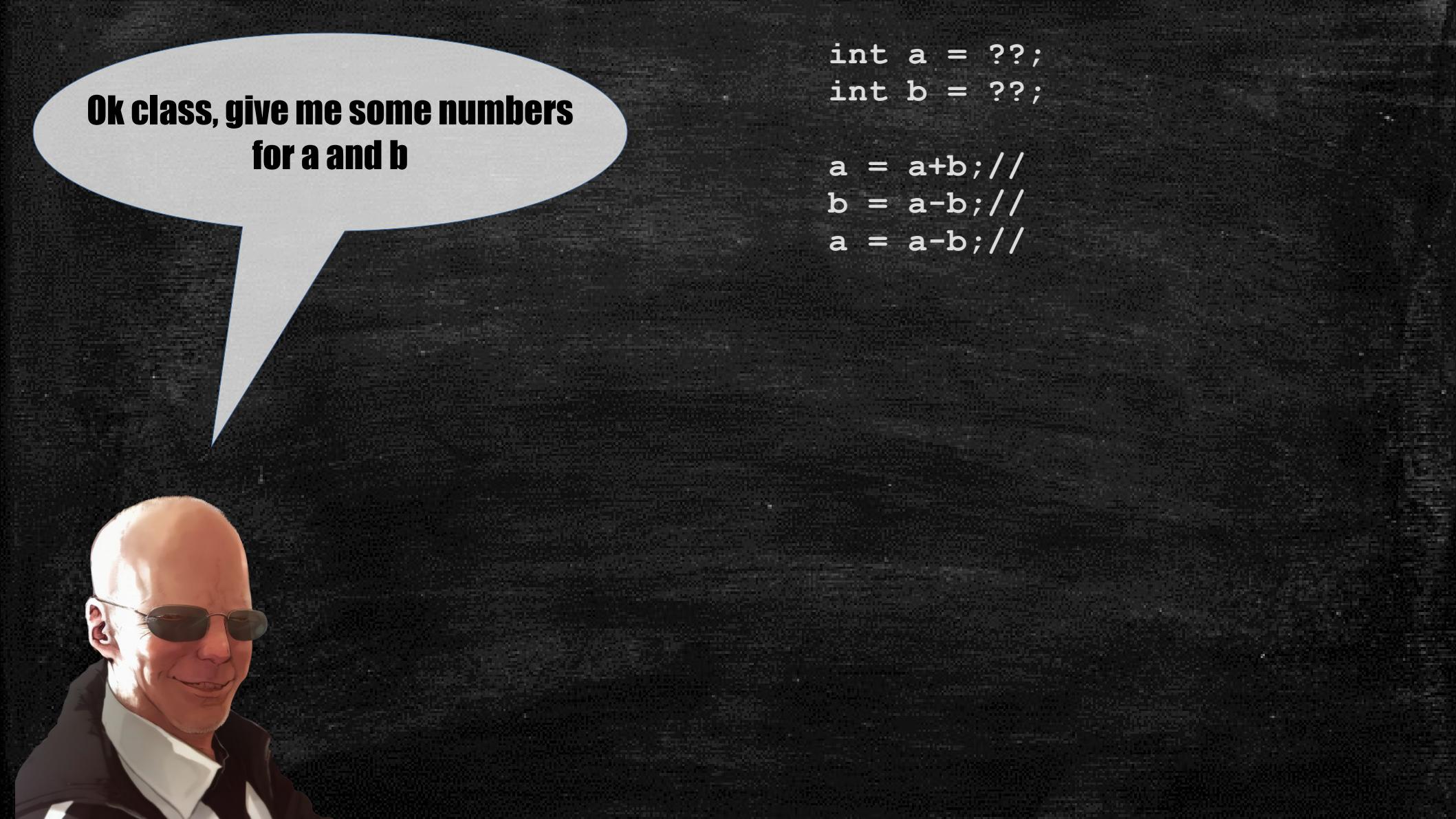
```
int a = 24;  
int b = 50;
```

```
a = a+b;  
b = a-b;  
a = a-b;
```

**Ok then, .. I will write it doooown,**

**So that I can shooow you that  
it does nooot work**

**And then we will all laughs at you  
and your dumb arrogance!**



**Ok class, give me some numbers  
for a and b**

```
int a = ??;  
int b = ??;  
  
a = a+b;//  
b = a-b;//  
a = a-b;//
```



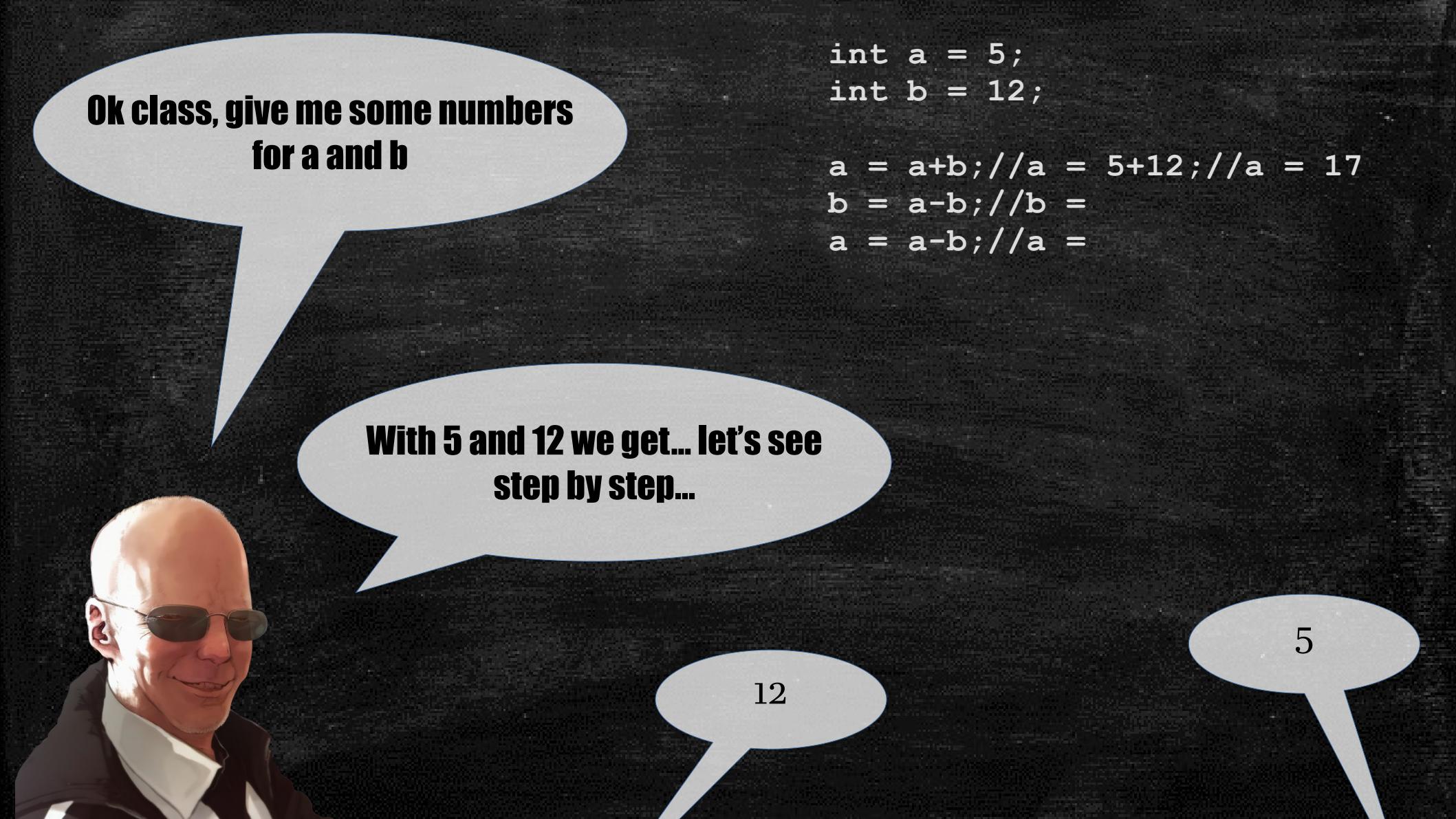
**Ok class, give me some numbers  
for a and b**

```
int a = 5;  
int b = 12;
```

```
a = a+b;//  
b = a-b;//  
a = a-b;//
```

12

5



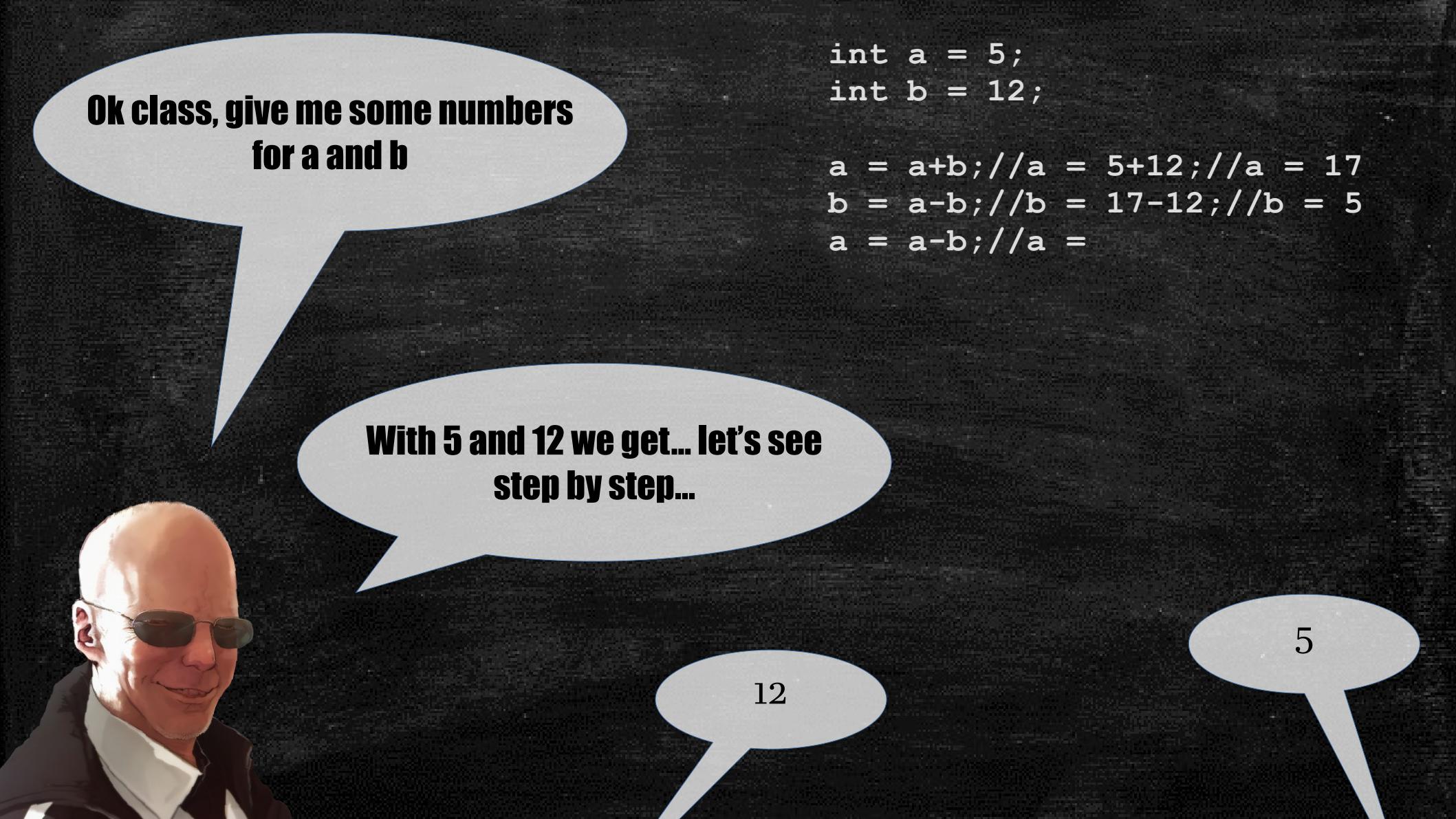
**Ok class, give me some numbers  
for a and b**

```
int a = 5;  
int b = 12;  
  
a = a+b;//a = 5+12;//a = 17  
b = a-b;//b =  
a = a-b;//a =
```

**With 5 and 12 we get... let's see  
step by step...**

12

5



**Ok class, give me some numbers  
for a and b**

```
int a = 5;  
int b = 12;  
  
a = a+b;//a = 5+12;//a = 17  
b = a-b;//b = 17-12;//b = 5  
a = a-b;//a =
```

**With 5 and 12 we get... let's see  
step by step...**

12

5



....

```
int a = 5;  
int b = 12;  
  
a = a+b;//a = 5+12;//a = 17  
b = a-b;//b = 17-12;//b = 5  
a = a-b;//a = 17-5;// a = 12
```

hahah



....

```
int a = 5;  
int b = 12;
```

```
a = a+b;//a = 5+12;//a = 17  
b = a-b;//b = 17-12;//b = 5  
a = a-b;//a = 17-5;// a = 12
```

What, it worked?

hahah

A cartoon illustration of Steve Jobs, showing his head and shoulders. He has a shaved head, wears dark sunglasses, and has a warm, smiling expression. He is wearing a light-colored collared shirt.

**Relax, it must be that those  
two numbers are somehow special**

```
int a = 5;  
int b = 12;  
  
a = a+b;//a = 5+12;//a = 17  
b = a-b;//b = 17-12;//b = 5  
a = a-b;//a = 17-5;// a = 12
```



**Relax, it must be that those  
two numbers are somehow special**

```
int a = 5;  
int b = 12;
```

```
a = a+b;//a = 5+12;//a = 17  
b = a-b;//b = 17-12;//b = 5  
a = a-b;//a = 17-5;// a = 12
```

**Give me two other numbers,  
this time one positive  
and one negative**



Please, stop this  
and just solve  
it symbolically

A 3D animated scene featuring Mr. Incredible from the Pixar movie "The Incredibles". He is standing in a classroom, leaning against a chalkboard with his right hand. He is wearing his signature superhero suit, which is white with a grey vest and yellow pants. He has a wide, smiling expression and is wearing sunglasses. To his right, there is a wooden desk with a single sheet of paper on it. A large, light blue speech bubble originates from Mr. Incredible's mouth, containing the text.

**Such a good idea,  
you must be very smart.**



We can use use x and y for the  
Original values of a and b.

```
int a = x;  
int b = y;  
  
a = a+b;//a = x+y;  
b = a-b;//b =  
a = a-b;//a =
```

A cartoon illustration of Steve Jobs, recognizable by his bald head, glasses, and intense expression. He is positioned on the left side of the frame, looking towards the right where the speech bubbles are located.

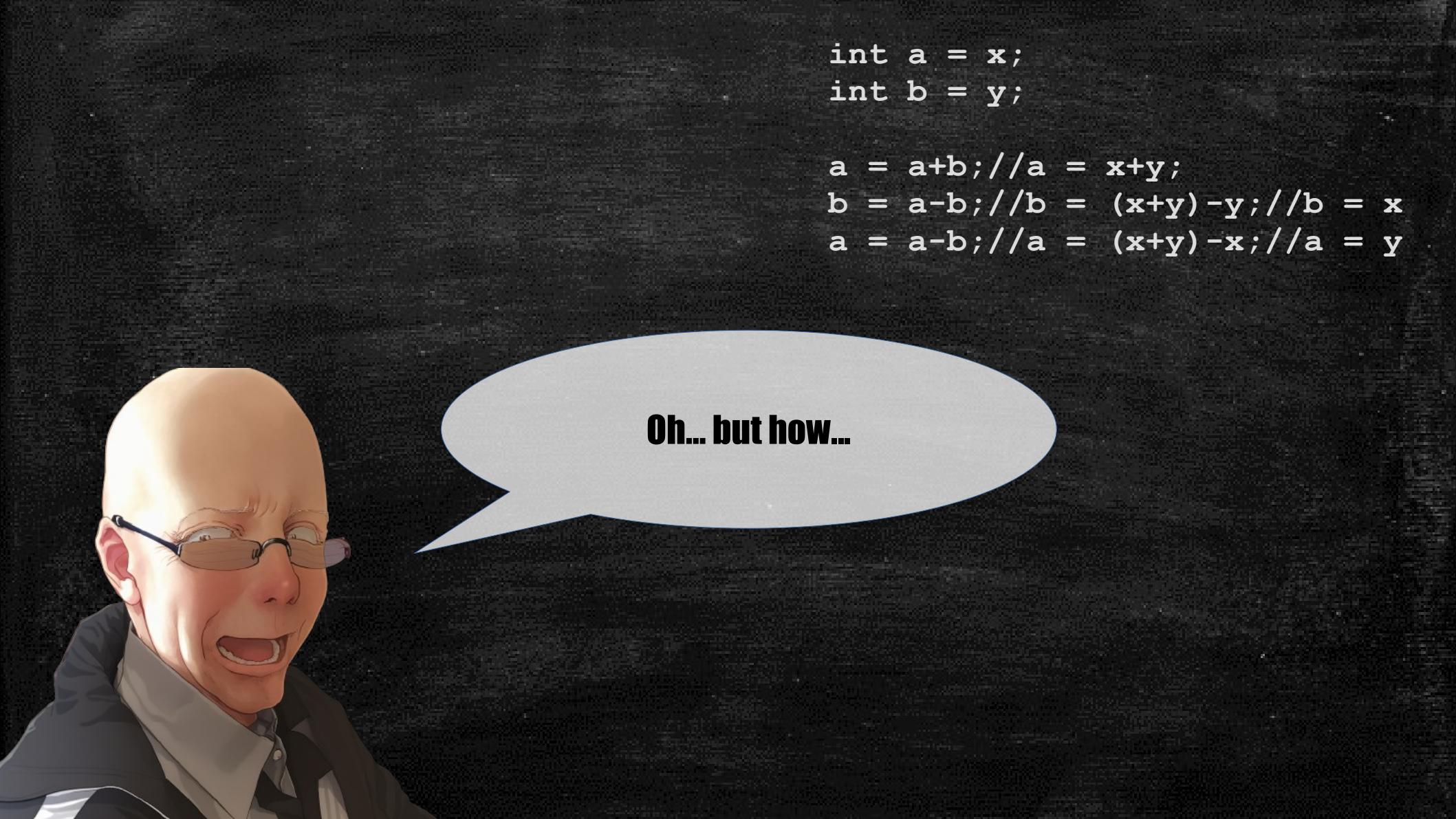
**We can use x and y for the  
Original values of a and b.**

**int a = x;  
int b = y;**

**a = a+b; // a = x+y;  
b = a-b; // b = (x+y) - y; // b = x  
a = a-b; // a =**

**It can't be!**

```
int a = x;  
int b = y;  
  
a = a+b;//a = x+y;  
b = a-b;//b = (x+y)-y;//b = x  
a = a-b;//a = (x+y)-x;//a = y
```



Oh... but how...

```
int a = x;  
int b = y;  
  
a = a+b;//a = x+y;  
b = a-b;//b = (x+y)-y;//b = x  
a = a-b;//a = (x+y)-x;//a = y
```



**It does not make sense,  
there is even a repeated  
“a” minus “b”...**

```
int a = x;  
int b = y;  
  
a = a+b;//a = x+y;  
b = a-b;//b = (x+y)-y;//b = x  
a = a-b;//a = (x+y)-x;//a = y
```



**It does not make sense,  
there is even a repeated  
“a” minus “b”...**

Ah?  
so it is  
working!

```
int a = x;  
int b = y;  
  
a = a+b;//a = x+y;  
b = a-b;//b = (x+y)-y;//b = x  
a = a-b;//a = (x+y)-x;//a = y
```



**It does not make sense,  
there is even a repeated  
“a” minus “b”...**

LOL, I'm  
never forgetting  
this

Ah?  
so it is  
working!

```
int a = x;  
int b = y;  
  
a = a+b;//a = x+y;  
b = a-b;//b = (x+y)-y;//b = x  
a = a-b;//a = (x+y)-x;//a = y
```

A cartoon illustration of Steve Jobs, showing his head and shoulders. He has a bald head, wears glasses, and has a surprised or confused expression with his mouth open. He is positioned on the left side of the frame.

**It does not make sense,  
there is even a repeated  
“a” minus “b”...**

**How can the same expression  
make two different results...**

```
int a = x;  
int b = y;  
  
a = a+b;//a = x+y;  
b = a-b;//b = (x+y)-y;//b = x  
a = a-b;//a = (x+y)-x;//a = y
```

A cartoon caricature of Steve Jobs, showing him from the chest up. He has a bald head, wears glasses, and has a wide, open-mouthed smile. He is wearing a dark jacket over a light-colored shirt.

**No, wait, there must be some other...**

The bell rings in this crucial moment.  
It is the end of the lecture





No, NO!





What have I done!



It is over!





It is over!

All the class was  
laughing at him,  
he is going to hate me!





It is over!

All the class was  
laughing at him,  
he is going to hate me!



He is going to make  
my life a nightmare!



# 01: Invalid Metaphors



This is the end of  
the first chapter.

What waits in the future  
for our cowardly hero?

# Credits

- Story: Marco
- Art: MidJourney, NijiJourney, Dall-E
- Composition: Marco
- Thanks to all my friends for providing great feedback!