Mr. C can Float!

ESC101: Foundations of Computing

Purushottam Kar

Announcements - Holiday

- No lecture, no lab this Wednesday (institute holiday)
- Extra lecture this Saturday 18 August 2018
  - 12 noon, L20 (same as usual)
- Extra lab for B10, B11, B12, B14 this Saturday 18 August
  - 2PM – 5PM, New Core Labs CC-01 and CC-02 (same as usual)

Announcements – Marks

- Lab marks and minor quiz marks for a particular week will be released after all labs for next week are over
  - Marks for last week will be released after Saturday lab this week
  - Lab problems already released as practice problems – practice!
  - Hidden test cases for these lab-practice problems will also be released
- Your questions were auto-graded – no grace marks!
- If you discover, autograder made a mistake (hidden test case), you may request for regrading
- Useless regrading requests **will be given negative marks** – be very careful before making request!

A handy Tip for Prutor

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How to check if you have extra spaces or not ☺

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10:05:40 AM

Evaluation Results

Your program passed 0 out of 1 visible test case(s).

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1	5	/---\ |%%%| |%5%| |%%%| \---/	/---\ |%%%| |%5%| |%%%| \---/	✖

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1  #include<stdio.h>
2
3  int main(){
4      int val;
5      scanf("%d", &val);
6
7      printf("/---\ \n");
8      printf("|%%%%%%| \n");
9      printf("|%%%d%%| \n",val);
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Select both the expected output and your output. Any extra spaces will get revealed.

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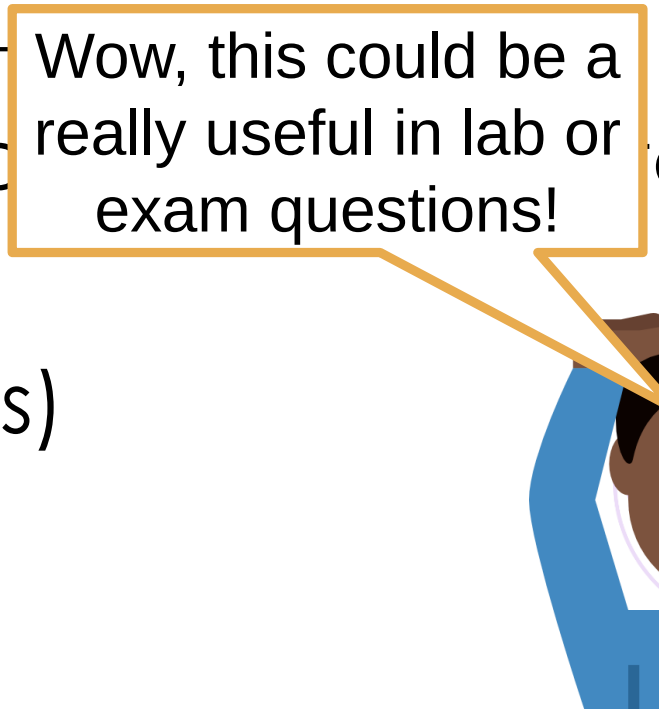

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Yup, my solution for the bonus problem used this exact same trick ☺

Wow, this could be a really useful in lab or exam questions!

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Integer division and % can be used to extract digits from an integer

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Oh, Hi Puru. Nice of you to drop by

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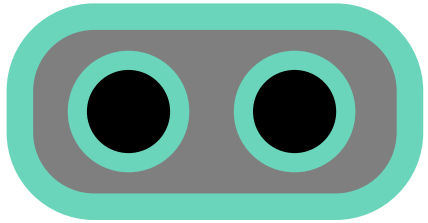

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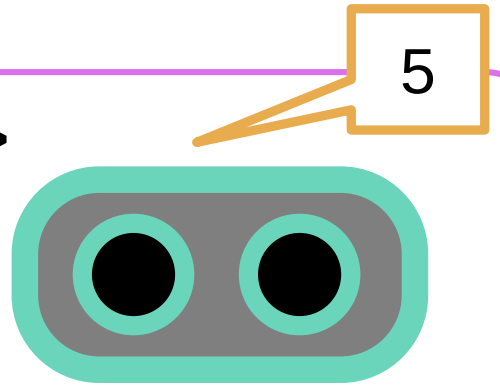

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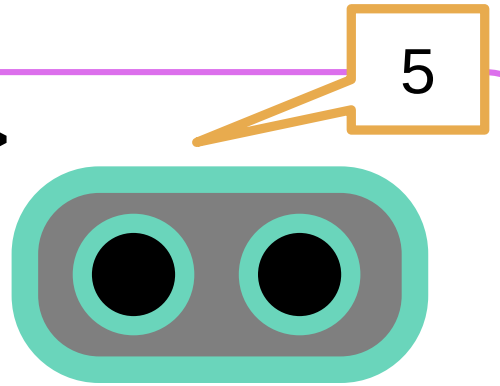


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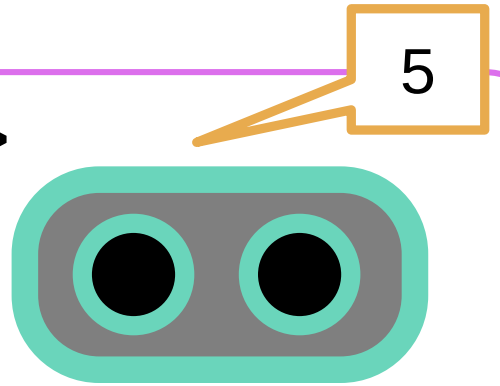


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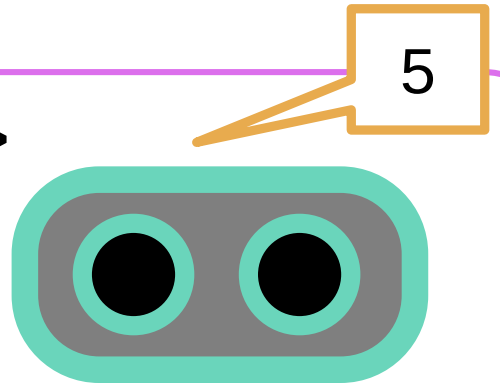


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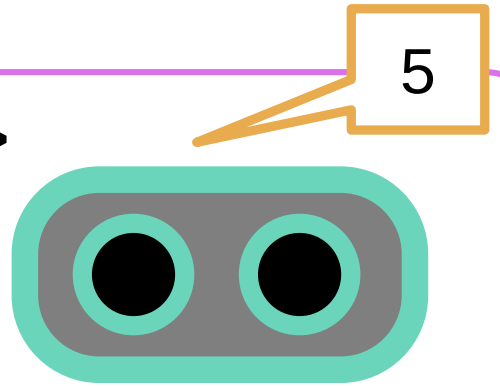


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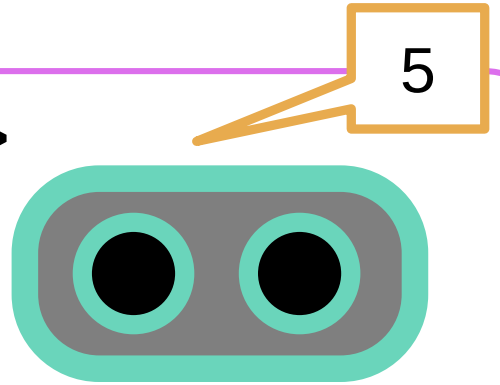


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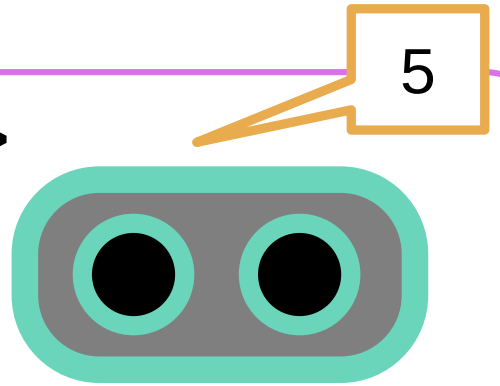


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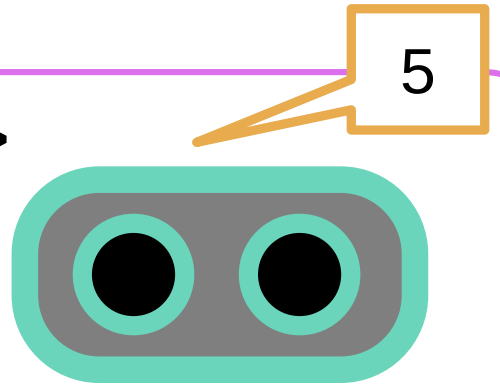


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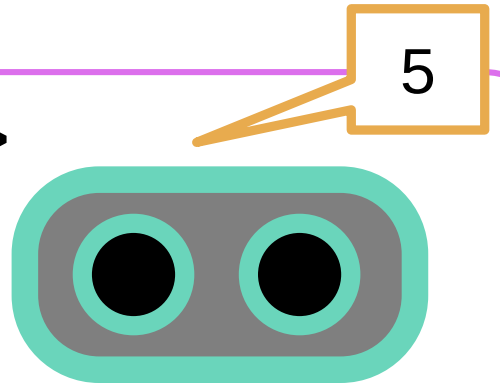


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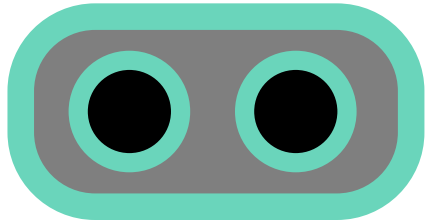

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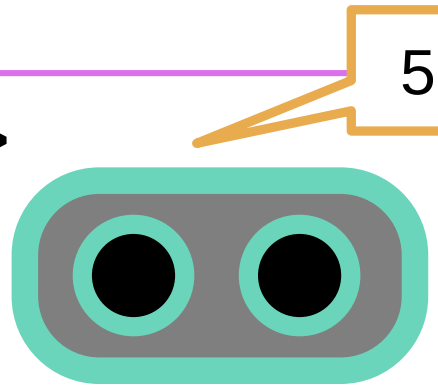


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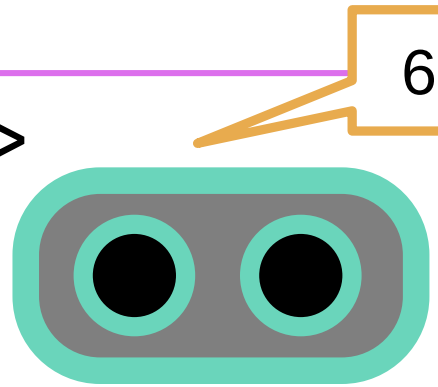

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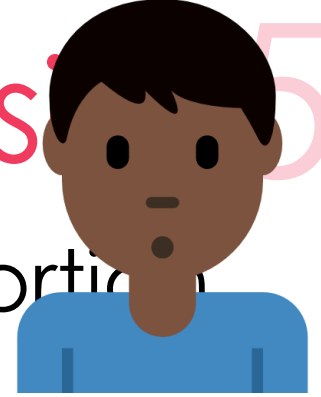

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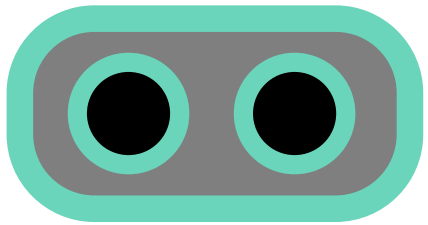

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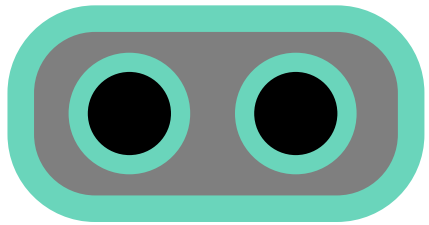

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In the first program 5/2 = 2 (loss of 0.5) and 7/2 = 3 (loss of 0.5). Total loss of 1.0

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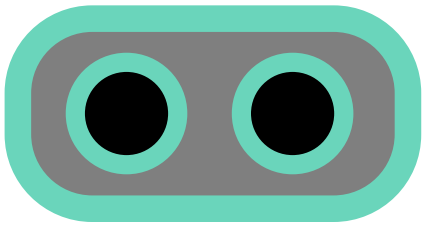

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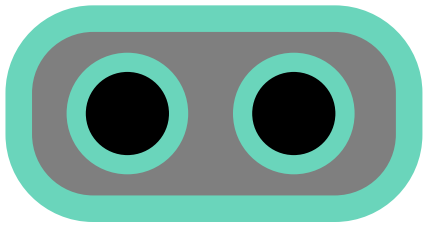

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```

Int type

Can store integers b/w -2,147,483,648 and 2,147,483,647

```
#include <stdio.h>
int main(){
int a;
scanf("%d", &a);
printf("My first int %d", a);
return 0;
}
```


Integer arithmetic applies to long int as well +, -, /, *, %, ()

Have worked with them a lot so far

Long int type

Really long – can store integers between -9,223,372,036,854,775,808 and 9,223,372,036,854,775,807

```
#include <stdio.h>
int main(){
long a; //long int also
scanf("%ld", &a);
printf("My first long int %ld", a);
return 0;
}
```


Integer arithmetic applies to long int as well +, -, /, *, %, ()

Try them out on Prutor

How does long work with int int + long, int * long?

Will see today

Float type

int, long allow us to store, do math formulae with integers

float allows us to store, do math formulae with reals

```
#include <stdio.h>
int main(){
float a;
scanf("%f", &a);
printf("My first real %f", a);
return 0;
}
```

Very large range ± 3.4e+38

Arithmetic operations apply to float as well +, -, /, *, ()

Try them out on Prutor

Double type

भारतीय प्रौद्योगिकी संस्थान कानपुर
INDIAN INSTITUTE OF TECHNOLOGY KANPUR

Double type

Double can also handle real numbers but very large ones

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Similar relation to float as long has to int

Double type

Double can also handle real numbers but very large ones

Similar relation to float as long has to int

```
#include <stdio.h>
int main(){
double a;
scanf("%f", &a);
printf("My first real %f", a);
return 0;
}
```

Double type

Double can also handle real numbers but very large ones

Similar relation to float as long has to int

```
#include <stdio.h>
int main(){
double a;
scanf("%f", &a);
printf("My first real %f", a);
return 0;
}
```

Double type

Double can also handle real numbers but very large ones

Similar relation to float as long has to int

```
#include <stdio.h>
int main(){
double a;
scanf("%f", &a);
printf("My first real %f", a);
return 0;
}
```


a

%lf works too!

Double type

Double can also handle real numbers but very large ones

Similar relation to float as long has to int

```
#include <stdio.h>
int main(){
double a;
scanf("%f", &a);
printf("My first real %f", a);
return 0;
}
```


%lf works too!

Very large range ± 1.79e+308

Double type

Double can also handle real numbers but very large ones

Similar relation to float as long has to int

```
#include <stdio.h>
int main(){
double a;
scanf("%f", &a);
printf("My first real %f", a);
return 0;
}
```


a

%lf works too!

Very large range ± 1.79e+308

Arithmetic operations apply to double as well +, -, /, *, ()

Double type

Double can also handle real numbers but very large ones

Similar relation to float as long has to int

```
#include <stdio.h>
int main(){
double a;
scanf("%f", &a);
printf("My first real %f", a);
return 0;
}
```


a

%lf works too!

Very large range ± 1.79e+308

Arithmetic operations apply to double as well +, -, /, *, ()

There is something called long double as well ☺

Double type

Double can also handle real numbers but very large ones

Similar relation to float as long has to int

```
#include <stdio.h>
int main(){
double a;
scanf("%f", &a);
printf("My first real %f", a);
return 0;
}
```


a

%lf works too!

Very large range ± 1.79e+308

Arithmetic operations apply to double as well +, -, /, *, ()

There is something called long double as well ☺

Use %Lf to work with long doubles

Double type

Double can also handle real numbers but very large ones

Similar relation to float as long has to int

```
#include <stdio.h>
int main(){
double a;
scanf("%f", &a);
printf("My first real %f", a);
return 0;
}
```


a

%lf works too!

- Very large range ± 1.79e+308
- Arithmetic operations apply to double as well +, -, /, *, ()
- There is something called long double as well ☺
- Use %Lf to work with long doubles
- Try these out on Prutor

Fun with Printing floats and doubles

Fun with Printing floats and doubles

Both %f and %lf work for float and double

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For long double, %Lf needed

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Can use %e if want answer in exponential notation

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Fun with Printing floats and doubles

Both %f and %lf work for float and double

For long double, %Lf needed

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```
#include <stdio.h>
```

Fun with Printing floats and doubles

Both %f and %lf work for float and double

For long double, %Lf needed

Can use %e if want answer in exponential notation

```
#include <stdio.h>
int main(){
```

Fun with Printing floats and doubles

Both %f and %lf work for float and double

For long double, %Lf needed

Can use %e if want answer in exponential notation

```
#include <stdio.h>
int main(){
    double a = 123.4567;
```

Fun with Printing floats and doubles

Both %f and %lf work for float and double

For long double, %Lf needed

Can use %e if want answer in exponential notation

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
```

Fun with Printing floats and doubles

Both %f and %lf work for float and double

For long double, %Lf needed

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    double a = 123.4567;
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    return 0;
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Fun with Printing floats and doubles

Both %f and %lf work for float and double

For long double, %Lf needed

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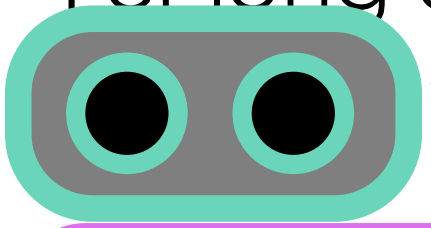
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

Fun with Printing floats and doubles

Both %f and %lf work for float and double

For long double, %Lf needed



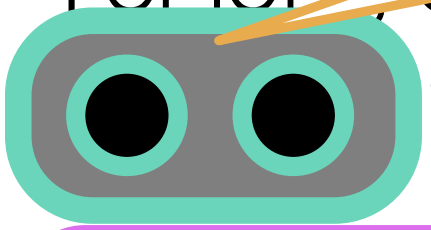
%e if want answer in exponential notation

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

Fun with Printing floats and doubles

Both %f and %lf can be used for float and double

For long double, %Lf needed



%e if want answer in exponential notation

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

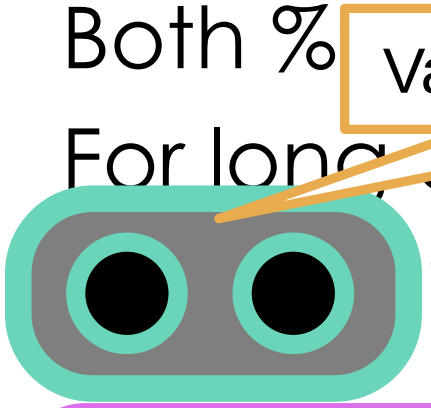
Value of a = 123.456700

Fun with Printing floats and doubles

Both %f and %lf for float and double

For long double, %Lf needed

%e if want answer in exponential notation



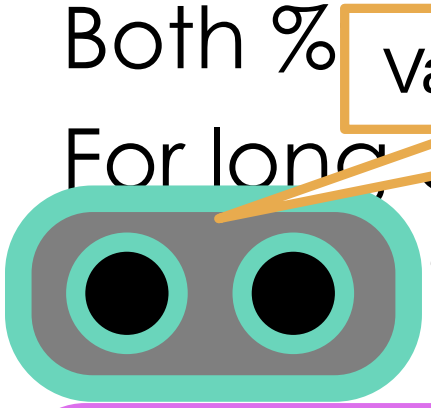

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

Fun with Printing floats and doubles

Both %f and %lf for float and double

For long double, %Lf needed

%e if want answer in exponential notation




```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

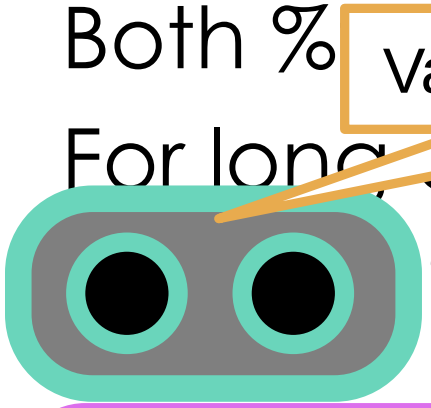
```
#include <stdio.h>
```

Fun with Printing floats and doubles

Both %f and %lf for float and double

For long double, %Lf needed

%e if want answer in exponential notation




```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

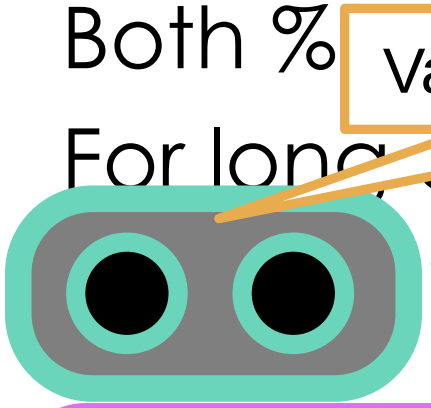
```
#include <stdio.h>
int main(){
```

Fun with Printing floats and doubles

Both %f and %lf for float and double

For long double, %Lf needed

%e if want answer in exponential notation




```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

```
#include <stdio.h>
int main(){
    double a = 123.4567;
```

Fun with Printing floats and doubles

Both %f and %lf for float and double

For long double, %Lf needed

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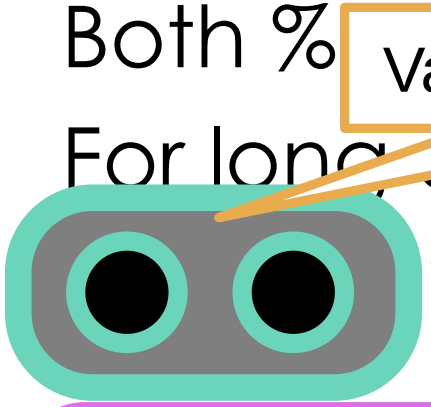



```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

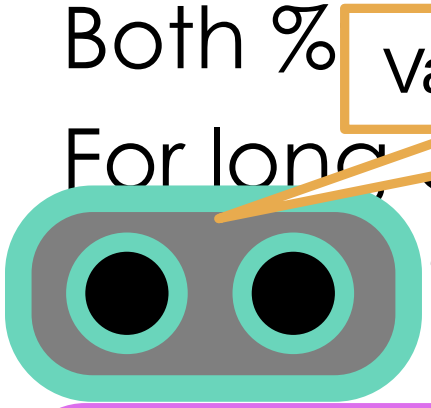
```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %e", a);
```

Fun with Printing floats and doubles

Both %f and %lf for float and double

For long double, %Lf needed

%e if want answer in exponential notation




```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %e", a);
    return 0;
}
```

Fun with Printing floats and doubles

Both %f and %lf for float and double

For long double, %Lf needed

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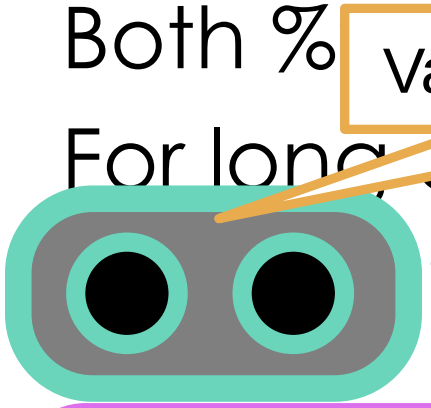


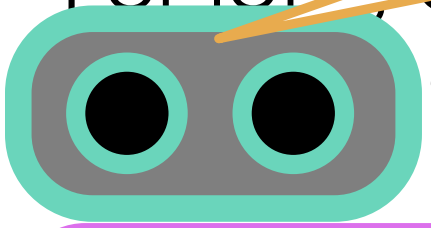

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %e", a);
    return 0;
}
```

Fun with Printing floats and doubles

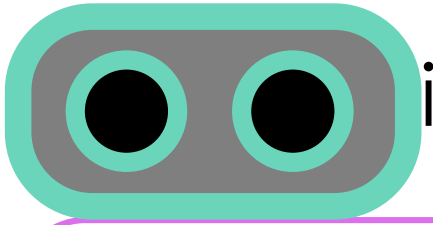
Both %f and %lf for float and double

For long double, %Lf needed



Value of a = 123.456700

%e if want answer in



exponential notation

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

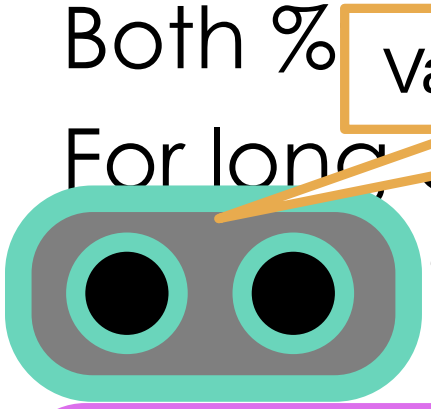
```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %e", a);
    return 0;
}
```

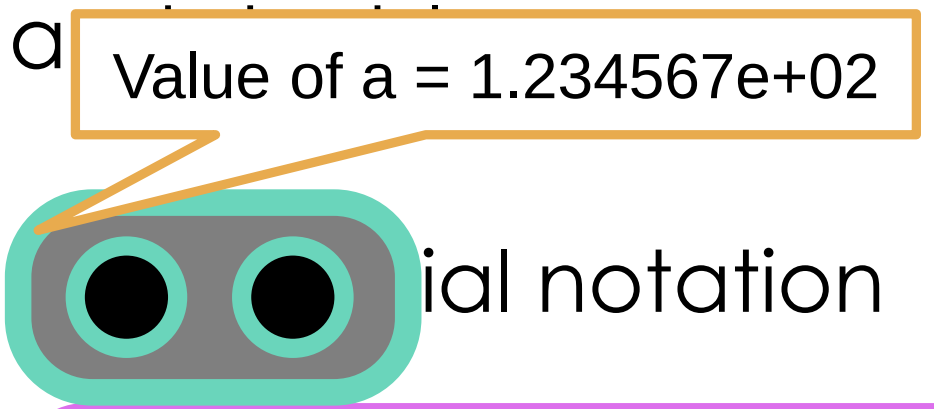
Fun with Printing floats and doubles

Both %f and %e for float and double

For long double, %Lf needed

%e if want answer in exponential notation

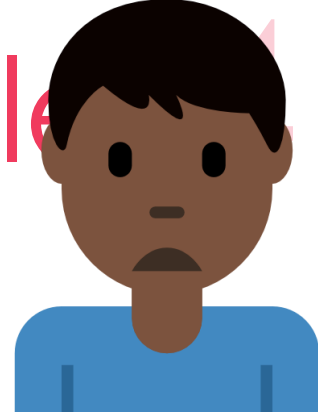





```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %e", a);
    return 0;
}
```

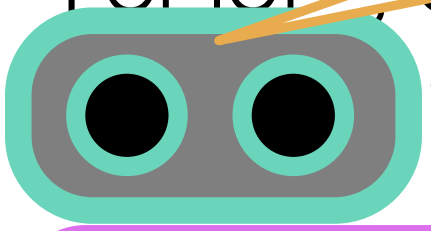
Fun with Printing floats and double



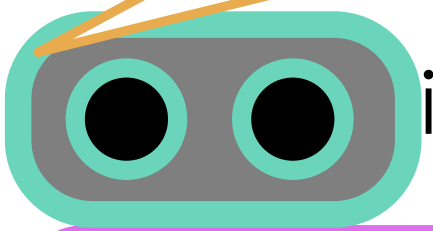
Both %f and %lf for a float a

For long double, %Lf needed

%e if want answer in exponential notation



Value of a = 123.456700



Value of a = 1.234567e+02

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %e", a);
    return 0;
}
```

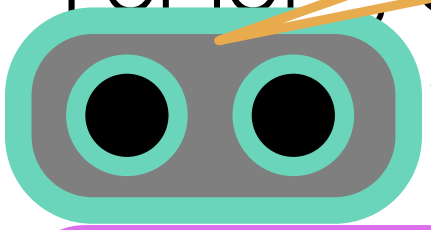
Fun with Printing floating point numbers

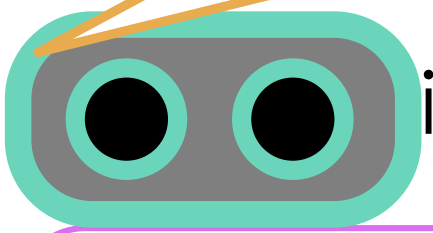
Both %f and %e are for float and double

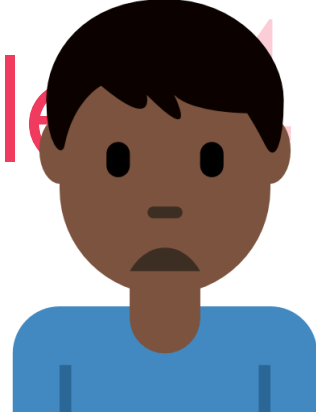
For long double, %Lf needed

%f if want answer in decimal notation

%e if want answer in exponential notation







Too many decimal digits being printed. Can I just print one or two?

Value of a = 123.456700

Value of a = 1.234567e+02

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

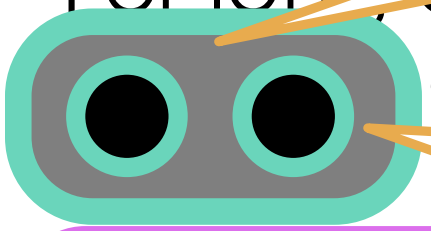
```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %e", a);
    return 0;
}
```

Fun with Printing floating point numbers

Both %f and %e are for float and double

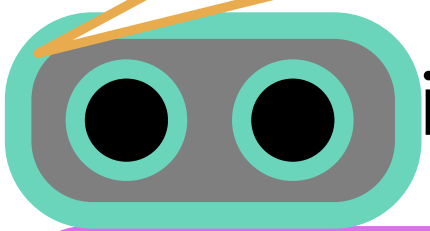
For long double, %Lf needed

%e prints in exponential notation

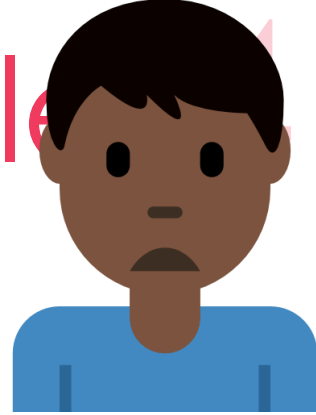


Value of a = 123.456700

Of course. Use %0.2f to print 2 decimal places



Value of a = 1.234567e+02



Too many decimal digits being printed. Can I just print one or two?

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#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %f", a);
    return 0;
}
```

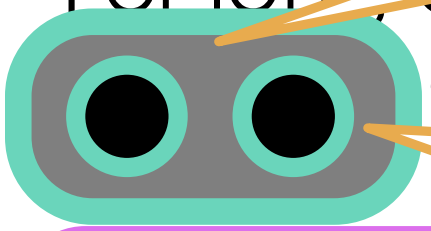
```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %e", a);
    return 0;
}
```

Fun with Printing floating point numbers

Both %f and %e are used for float and double

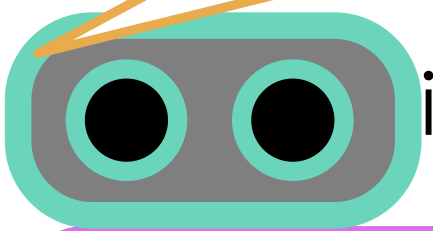
For long double, %Lf needed

%e prints in exponential notation

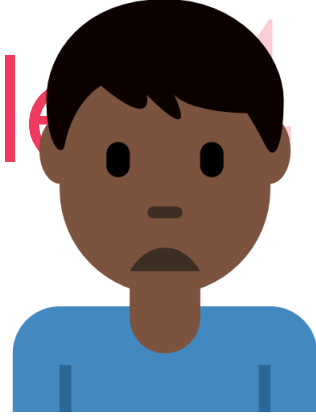


Value of a = 123.456700

Of course. Use %0.2f to print 2 decimal places



Value of a = 1.234567e+02



Too many decimal digits being printed. Can I just print one or two?

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %0.2f", a);
    return 0;
}
```

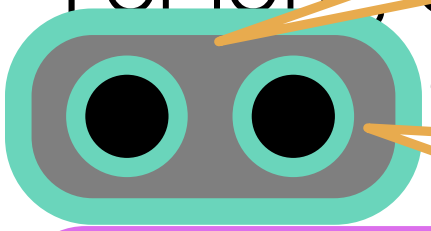
```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %e", a);
    return 0;
}
```

Fun with Printing floating point numbers

Both %f and %e are used for float and double

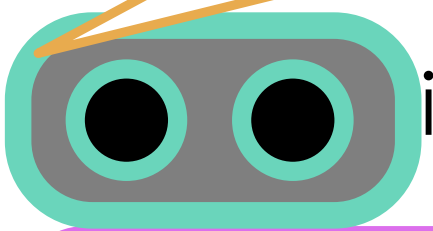
For long double, %Lf needed

%e prints in exponential notation

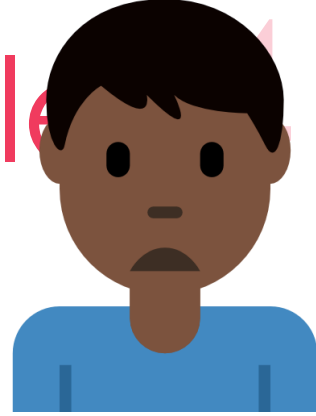


Value of a = 123.46

Of course. Use %0.2f to print 2 decimal places



Value of a = 1.234567e+02



Too many decimal digits being printed. Can I just print one or two?

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %0.2f", a);
    return 0;
}
```

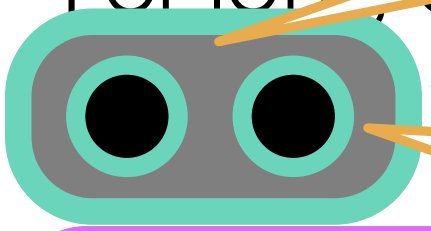
```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %e", a);
    return 0;
}
```

Fun with Printing floating point numbers

Both %f and %e print a floating point number

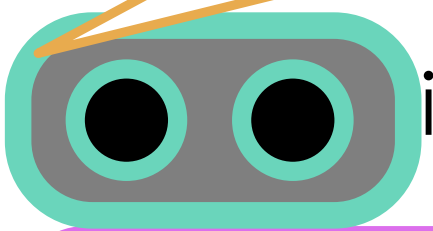
For long double, %Lf needed

%e prints in exponential notation

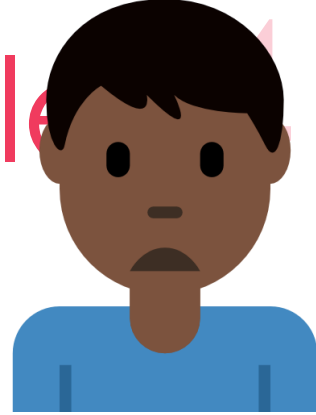


Value of a = 123.46

Of course. Use %0.2f to print 2 decimal places



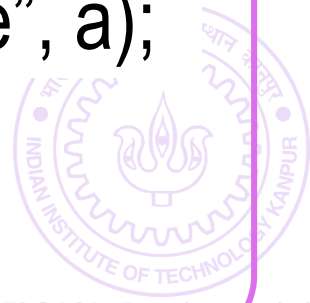
Value of a = 1.234567e+02



Too many decimal digits being printed. Can I just print one or two?

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %0.2f", a);
    return 0;
}
```

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %0.2e", a);
    return 0;
}
```

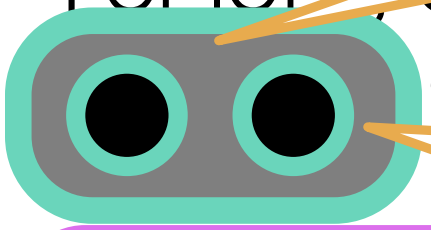


Fun with Printing flo ble

Both % oat a

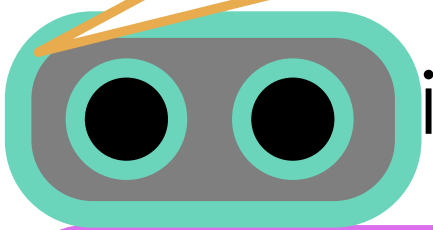
For long double, %Lf needed

%e ial notation

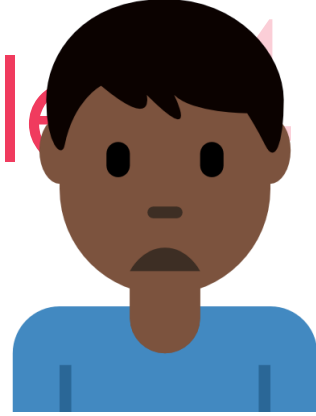


Value of a = 123.46

Of course. Use %0.2f to print 2 decimal places



Value of a = 1.23e+02



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int main(){
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    printf("Value of a = %0.2f", a);
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}
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int main(){
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    printf("Value of a = %0.2e", a);
    return 0;
}
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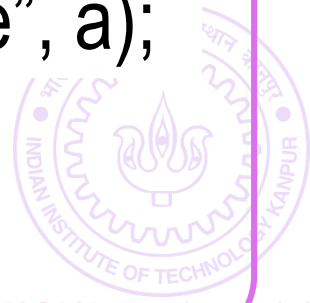
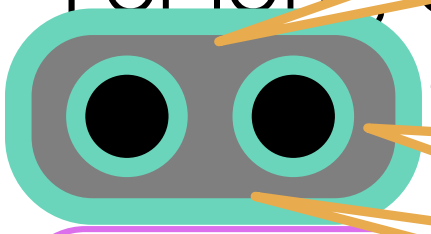


Fun with Printing floating point numbers

Both %f and %e are used for float and double

For long double, %Lf needed

%e prints in exponential notation



Value of a = 123.46

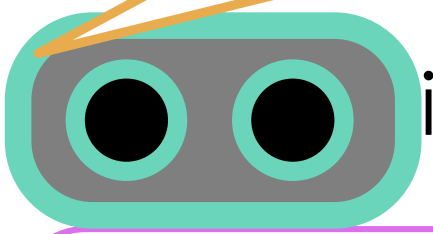
Of course. Use %0.2f to print 2 decimal places

Be careful, I am rounding while giving answer correct to 2 decimal places

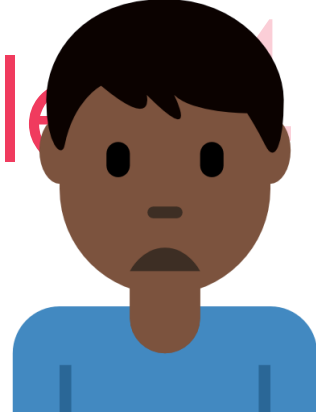
123.4567 → 123.46

1.234567 → 1.23

```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %0.2f", a);
    return 0;
}
```



Too many decimal digits being printed. Can I just print one or two?



Value of a = 1.23e+02

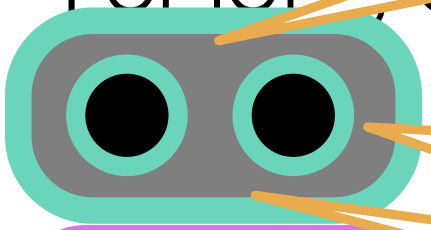
```
#include <stdio.h>
int main(){
    double a = 123.4567;
    printf("Value of a = %0.2e", a);
    return 0;
}
```

Fun with Printing flo ble

Both % oat a

For long double, %Lf needed

%e



Value of a = 123.46

Of course. Use %0.2f to print 2 decimal places

Be careful, I am rounding while giving answer correct to 2 decimal places
123.4567 → 123.46
1.234567 → 1.23

```
#include <
int main()
    double
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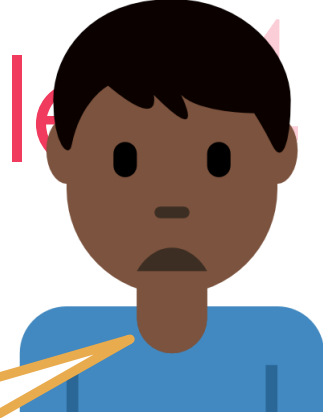
    return 0;
}
```

Too many decimal digits being printed. Can I just print one or two?



Value of a = 1.23e+02

Oh right. The usual rules of rounding apply here too. 1.5644 will become 1.56 if rounded to 2 places but 1.5654 will become 1.57

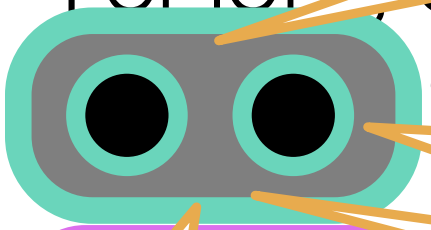
```
#
a
uble a = 123.4567;
    printf("Value of a = %0.2e", a);
    return 0;
}
```

Fun with Printing floating point numbers

Both %f and %lf are used for float and double

For long double, %Lf needed

%e



Value of a = 123.46

Of course. Use %0.2f to print 2 decimal places

Correct!

Be careful, I am rounding while giving answer correct to 2 decimal places

123.4567 → 123.46

1.234567 → 1.23

```
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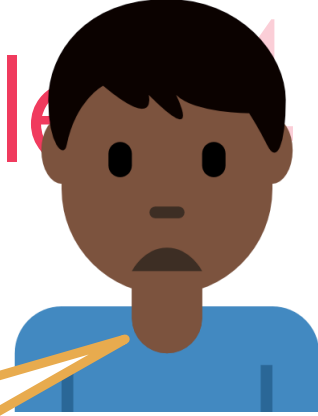
int main()
{
    double a = 123.4567;
    printf("Value of a = %0.2f", a);
    return 0;
}
```

Too many decimal digits being printed. Can I just print one or two?



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Mixed-type formulae

Mixed-type formulae

int a; long b; float c; double d;

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Recall the care we took when working with long and int

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int a; long b; float c; double d;

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Recall the care we took when working with long and int

- We saw that b = a + a; could cause errors
- Mr C will first try to store a + a into a temporary integer variable

Mixed-type formulae

int a; long b; float c; double d;

Recall the care we took when working with long and int

- We saw that b = a + a; could cause errors
- Mr C will first try to store a + a into a temporary integer variable
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Mixed-type formulae

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- b = (long) a + (long) a;

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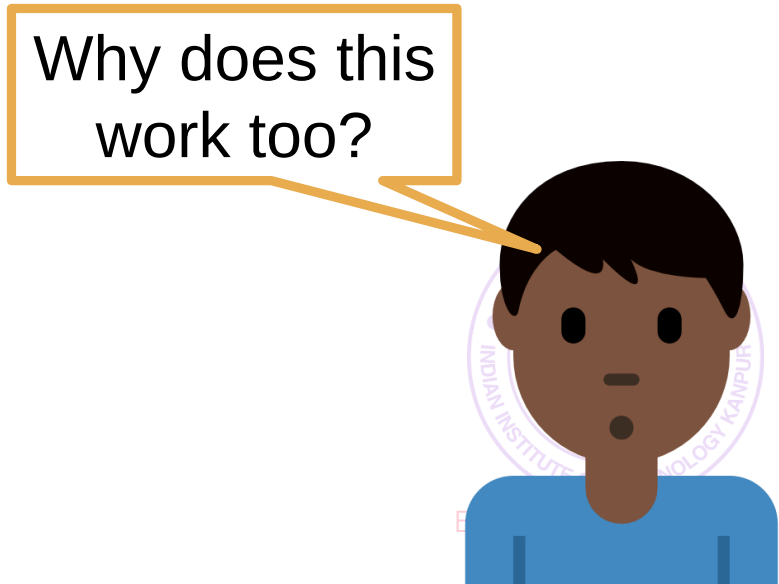
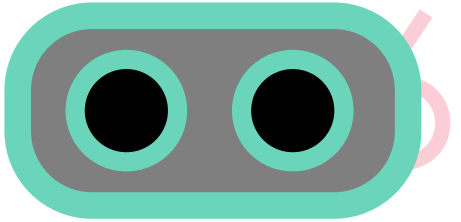


Mixed-type formulae



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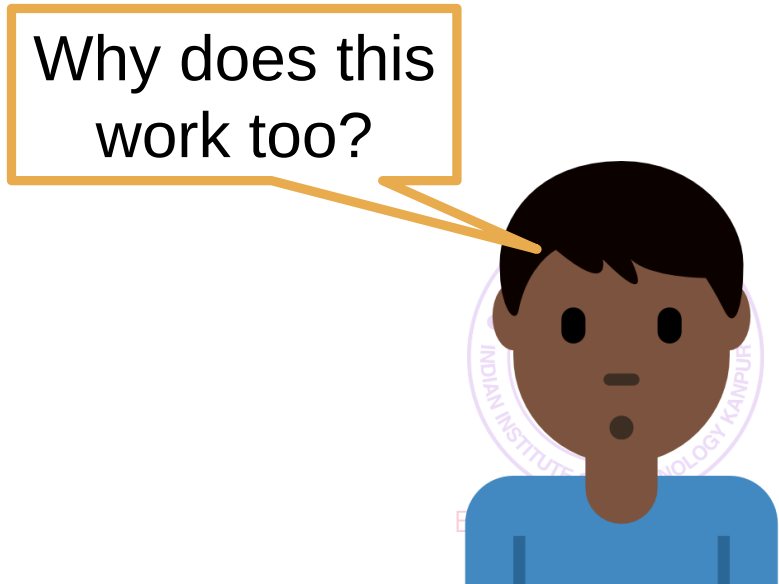
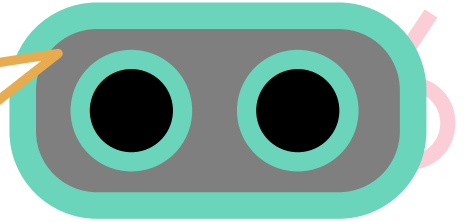


Mixed-type formul

int a; long b; float c; double

Because I see this as a mixed type formula and convert everything to long to avoid mistakes



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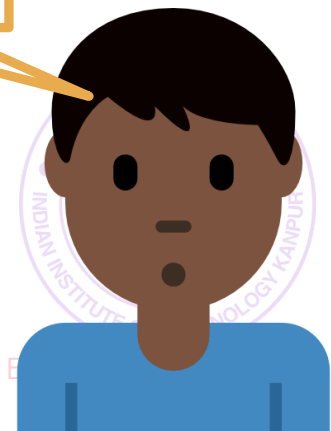
Why does this work too?



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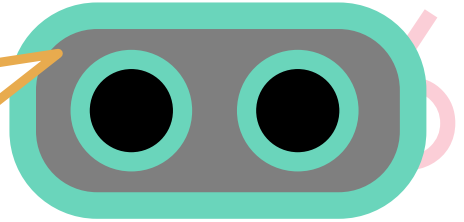

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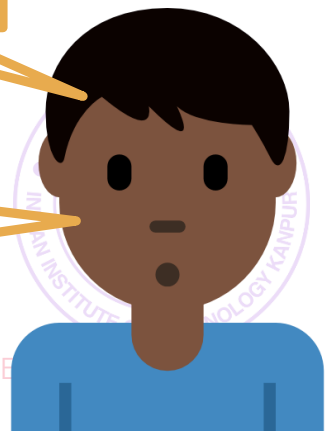
Hmm.. So just because I typecasted one of the variables in the formula, you typecasted the rest for free



Mixed-type formul

int a; long b; float c; double

Recall the care we took when working with lon

We saw that b = a + a; could cause errors

Mr C will first try to store a + a into a temporary integer variable

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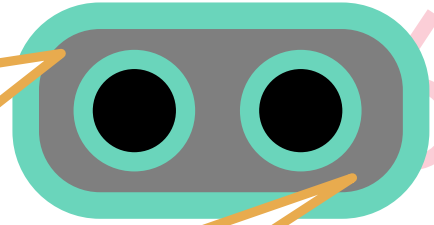
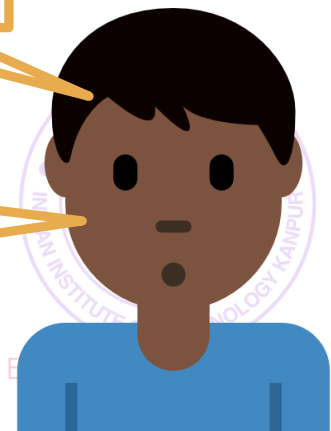


See, I am so helpful!

Why does this work too?

Hmm.. So just because I typecasted one of the variables in the formula, you typecasted the rest for free



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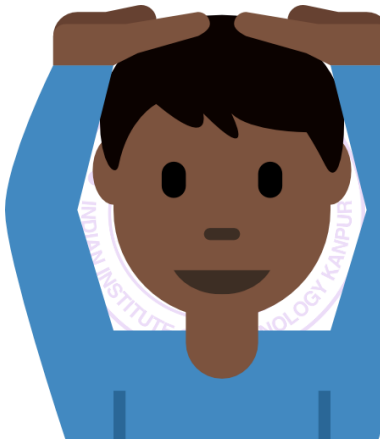

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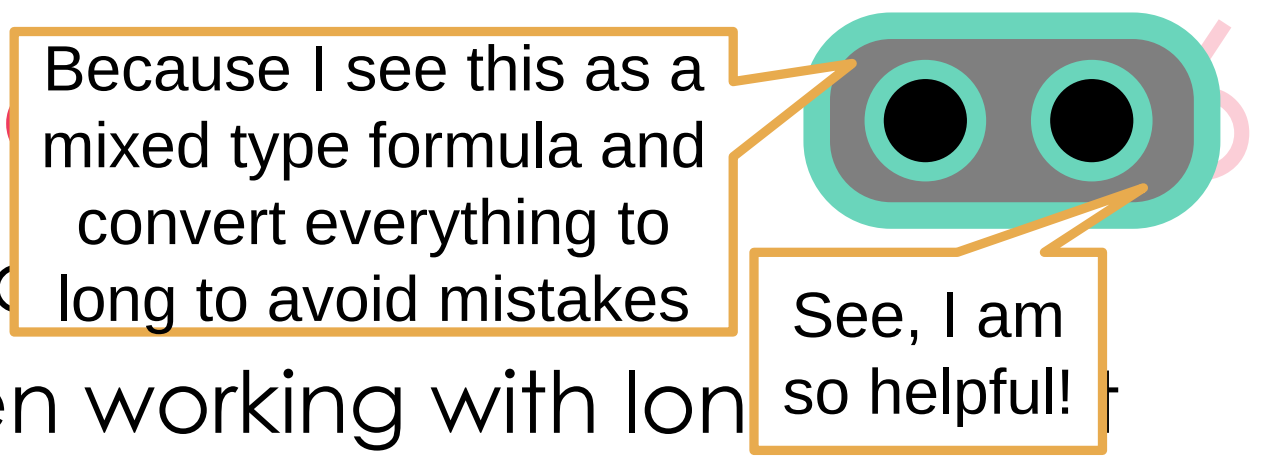

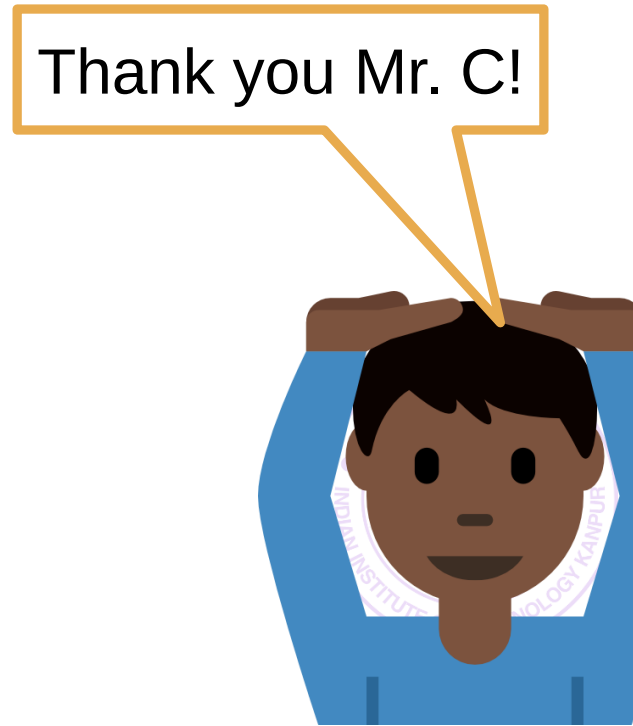

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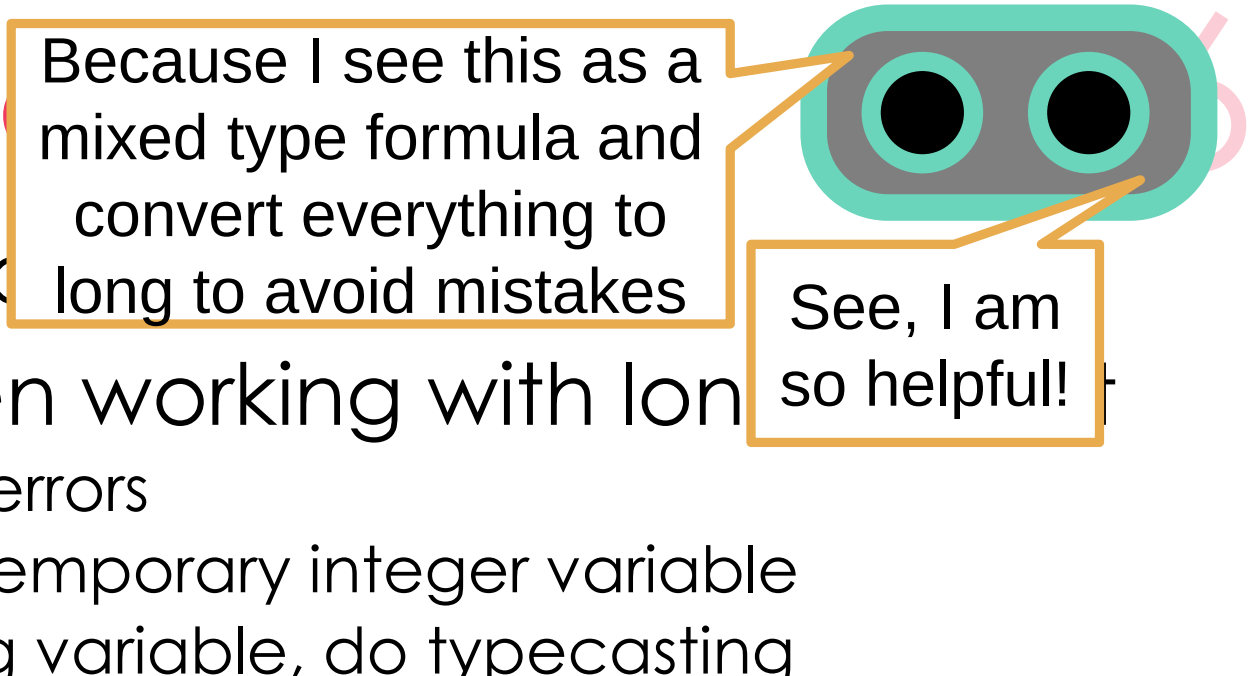
Similar care must be taken with int + float, int + double



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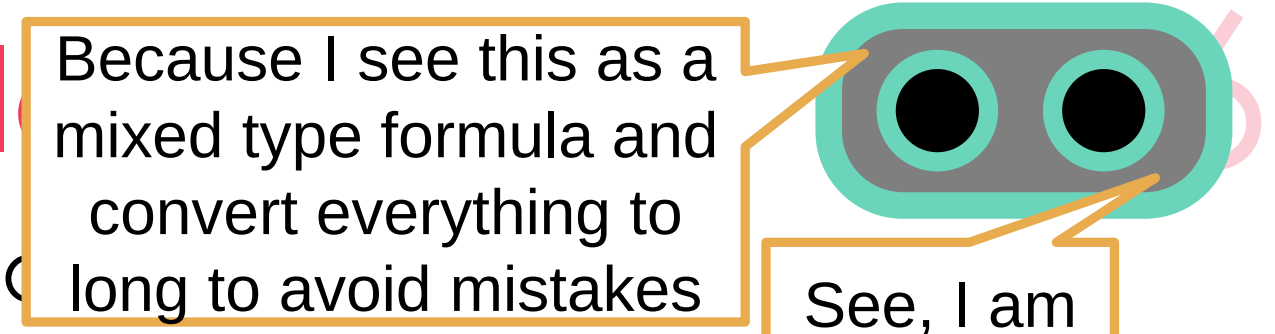
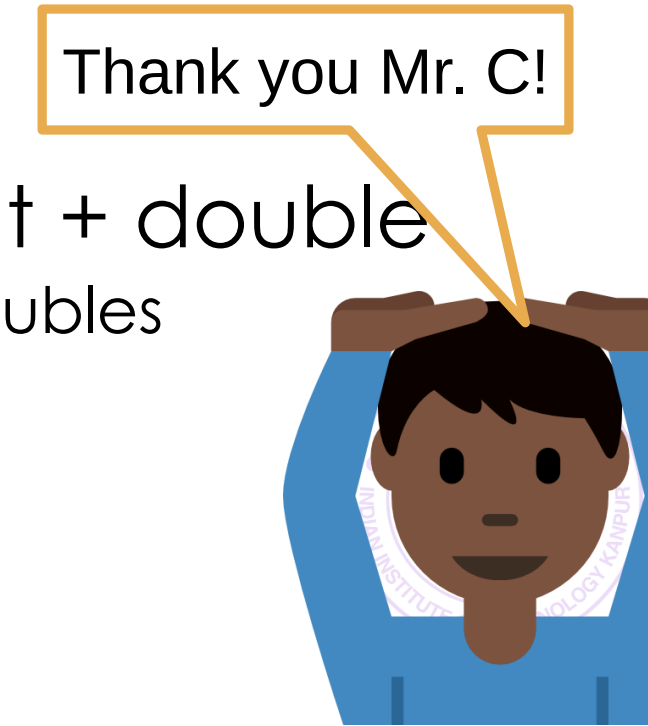
Similar care must be taken with int + float, int + double

- To avoid integer division, typecast integers to floats or doubles





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- Mr C will first try to store a + a into a temporary integer variable
- To force him to store a + a into a long variable, do typecasting
- b = (long) a + (long) a;
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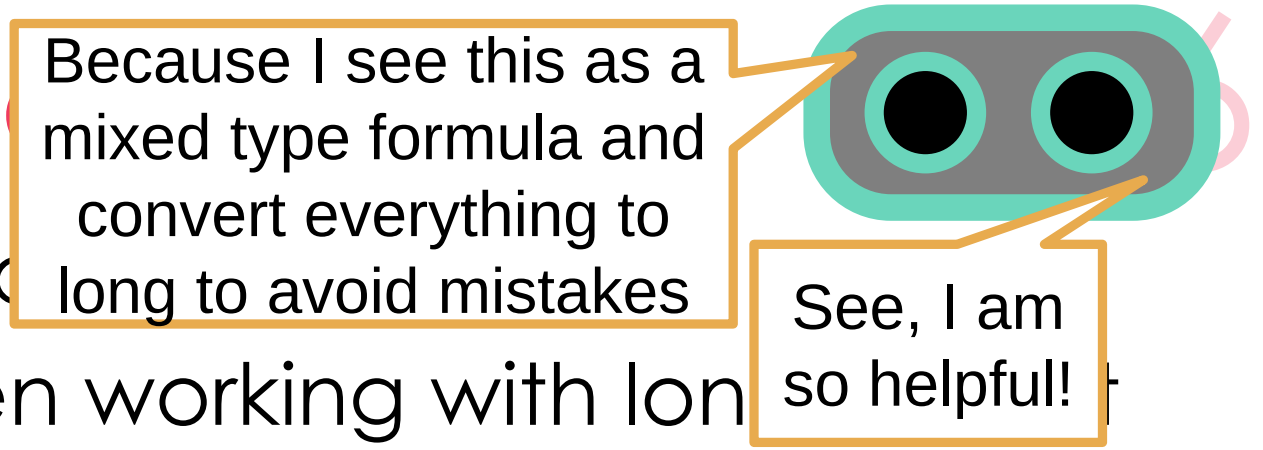
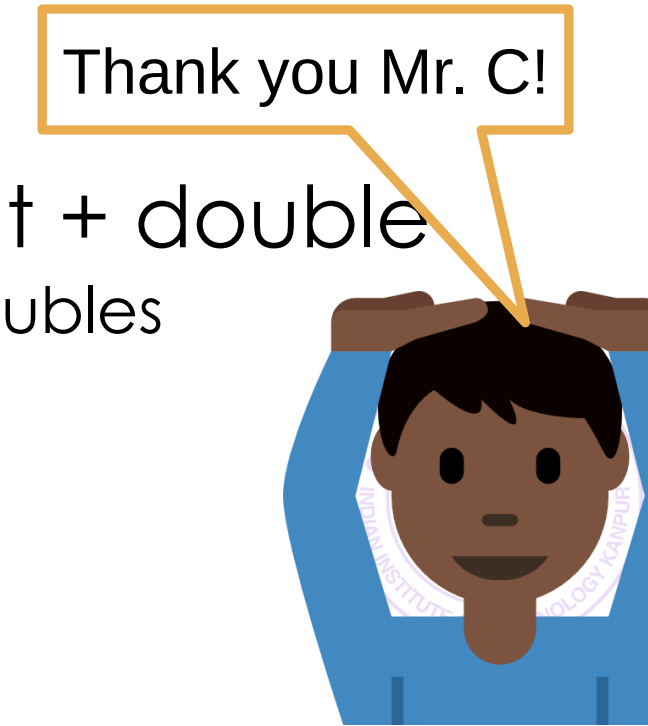
Similar care must be taken with int + float, int + double

- To avoid integer division, typecast integers to floats or doubles
- int a = 2;





Mixed-type formul

int a; long b; float c; double

Recall the care we took when working with lon

We saw that b = a + a; could cause errors

Mr C will first try to store a + a into a temporary integer variable

To force him to store a + a into a long variable, do typecasting

b = (long) a + (long) a;

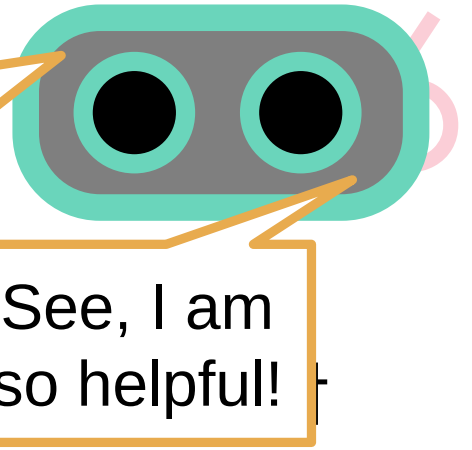
b = a + (long) a;

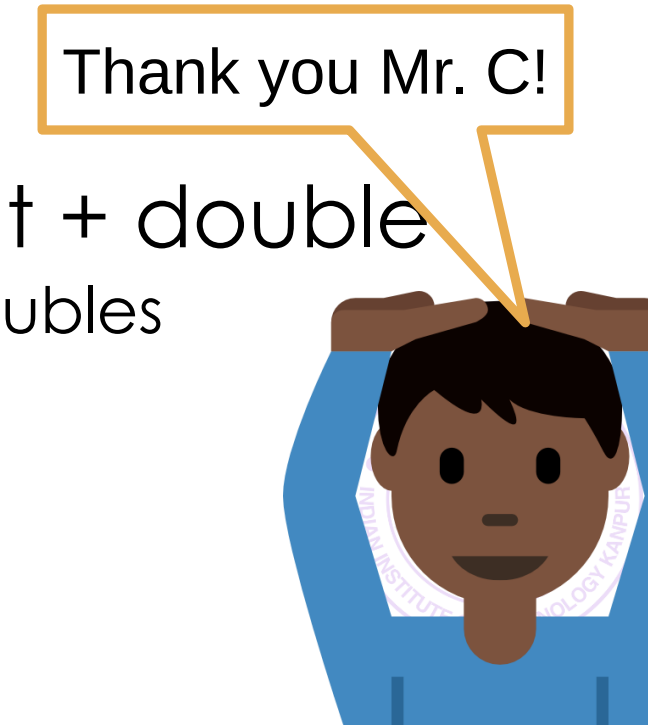
Similar care must be taken with int + float, int + double

To avoid integer division, typecast integers to floats or doubles

int a = 2;

c = a / (a+1); → 0





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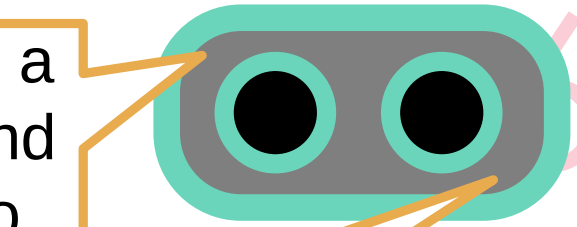
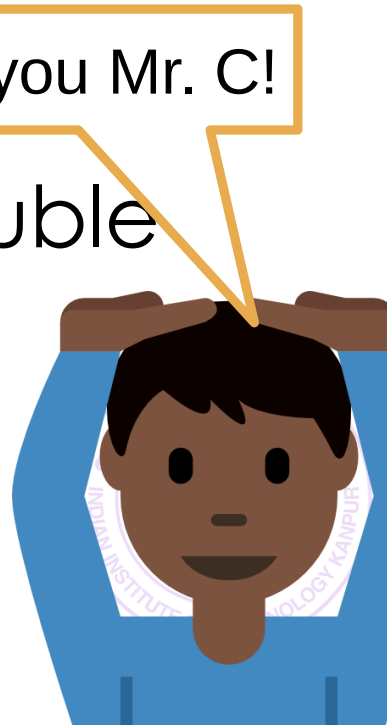
Similar care must be taken with int + float, int + double

- To avoid integer division, typecast integers to floats or doubles
- int a = 2;
- c = a / (a+1); → 0
- c = (float) a / (a + 1); → 0.666666666





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To avoid integer division, typecast integers to floats or doubles

int a = 2;

c = a / (a+1); → 0

c = (float) a / (a + 1); → 0.666666666

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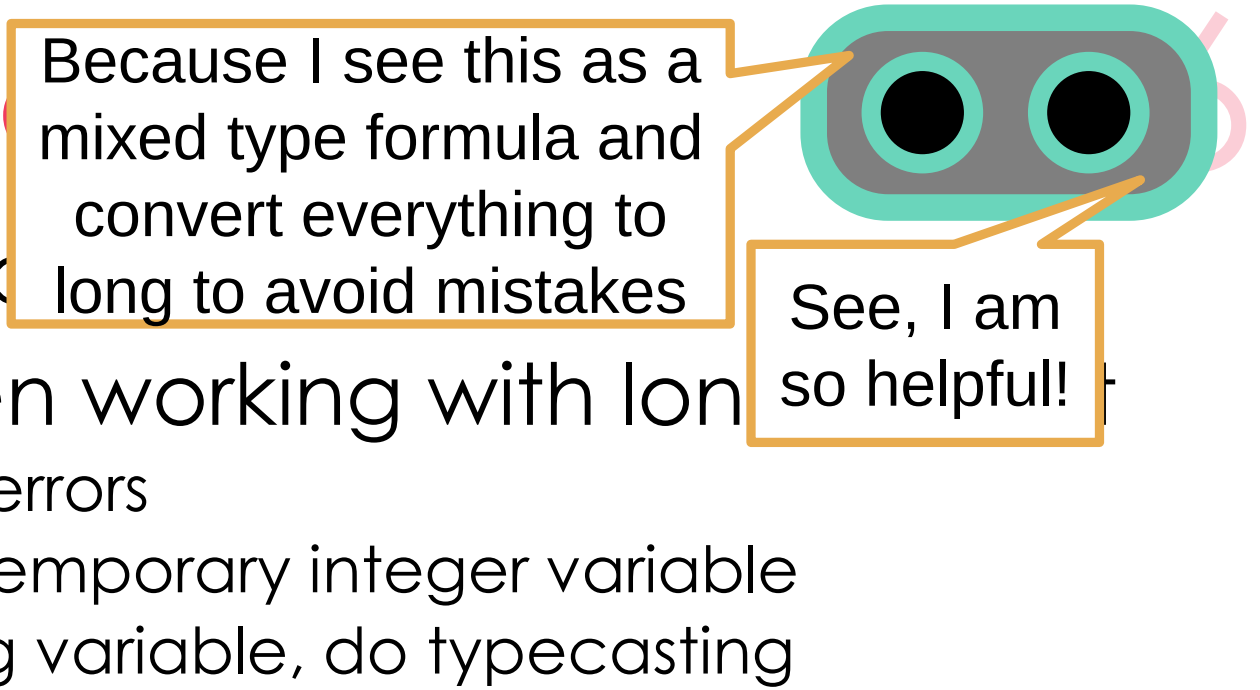

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int a; long b; float c; double

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We saw that b = a + a; could cause errors

Mr C will first try to store a + a into a temporary integer variable

To force him to store a + a into a long variable, do typecasting

b = (long) a + (long) a;

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Similar care must be taken with int + float, int + double

To avoid integer division, typecast integers to floats or doubles

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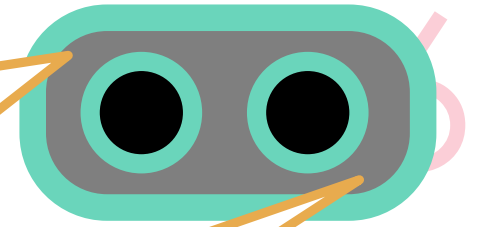

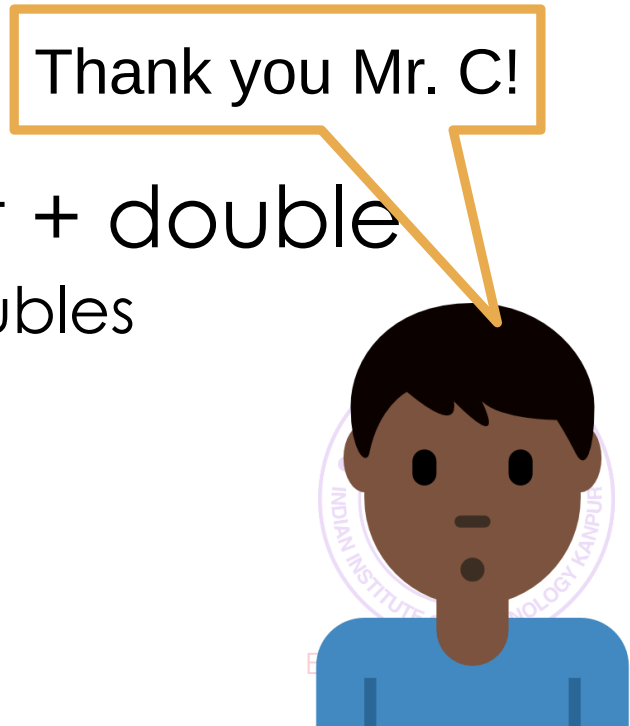

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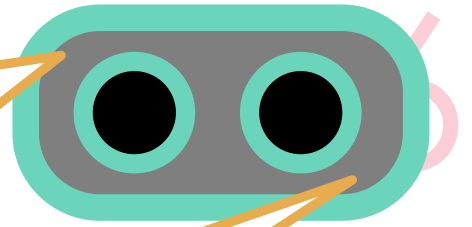

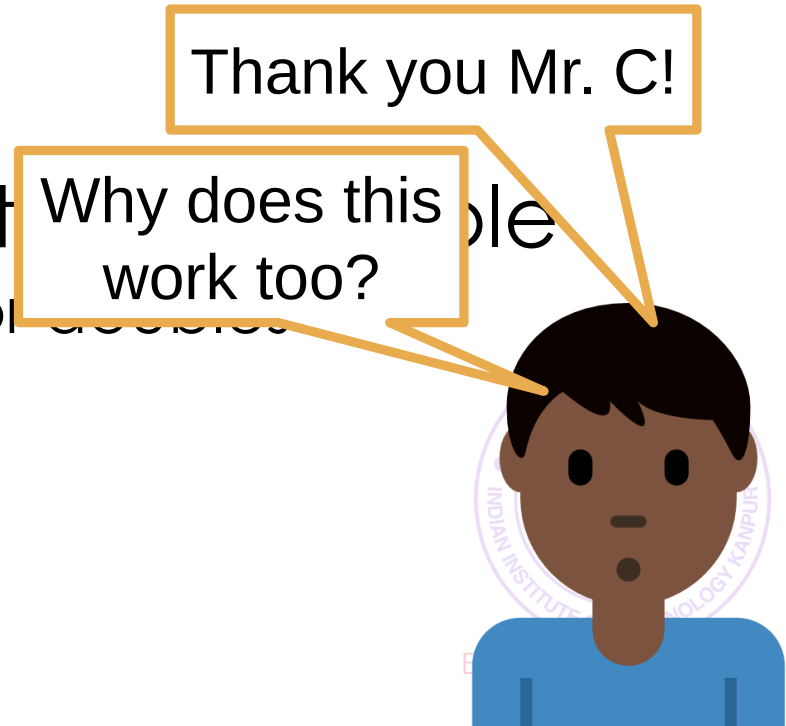

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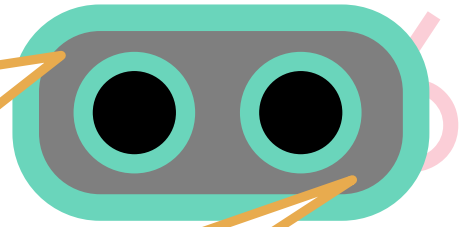

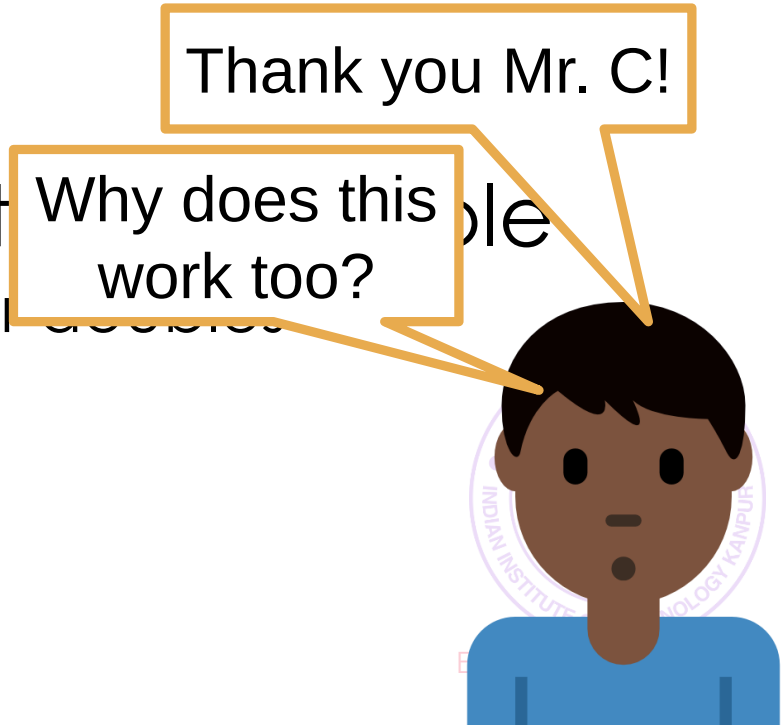

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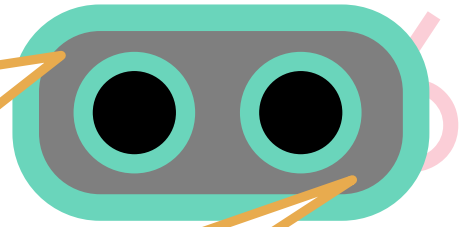

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If your integer is too long, Mr C will approximate it when storing it as a float even though the value of the number is well within Mr C's range of numbers

math.h

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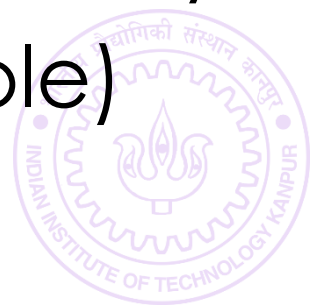

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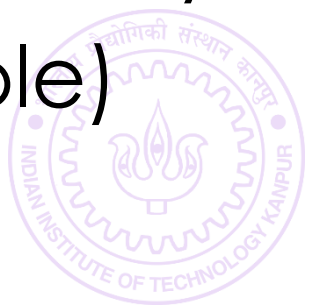
cos(x), sin(x), tan(x) etc are also present – explore!



Operators

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