Evaluation

- 10 programming exercises (5% each)
- 2 tests (10% each)
- project (30%)

Write an app that prints the age of Java as a real number.

Data types: example

- **name**: double
- **values**: 3.14, -7.3, . . .
- **operations**:

$$\cdot + \cdot : (\text{double} \times \text{double}) \rightarrow \text{double}$$
$$\cdot - \cdot : (\text{double} \times \text{double}) \rightarrow \text{double}$$
$$\cdot * \cdot : (\text{double} \times \text{double}) \rightarrow \text{double}$$
$$\cdot / \cdot : (\text{double} \times \text{double}) \rightarrow \text{double}$$
$$\cdots$$

To convert an int to a double we use the operation

$$(\text{double})\cdot : \text{int} \rightarrow \text{double}$$

This operation, known as casting, takes a value of type int and returns a corresponding value of type double.

A value of type double is represented by 8 bytes.

Question: How many bits is that?
Answer:

Double

A value of type double is represented by 8 bytes.

Question: How many bits is that?
Answer: $8 \times 8 = 64$

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Question: How many values of type double are there?
Answer:

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Question: How many values of type double are there?
Answer: 2^{64}

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Question: How many real number are there?
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Question: How many values of type double are there?
Answer: 2^{64}

Question: How many real number are there?
Answer: infinitely many

A value of type double is represented by 8 bytes.

Question: How many bits is that?
Answer: $8 \times 8 = 64$

Question: How many values of type $double$ are there?
Answer: 2^{64}

Question: How many real number are there?
Answer: infinitely many

Conclusion: most real numbers cannot be represented exactly

We distinguish between these two cases:

- $$(\text{double})\cdot : \text{int} \rightarrow \text{double}$$

  is an example of promotion. In general, promotions only lead to small round off errors or are precise.

- $$(\text{int})\cdot : \text{double} \rightarrow \text{int}$$

  is an example of demotion. In general, demotions loose information.

Casting

The compiler performs promotions automatically when needed.

Question

From the expression

(double) year +
(double) (currentDay − birthDay) / (double) daysPerYear

which casts can be removed?

Write an app that prints the age of Java as a real number with two
digits precision.

Write an app that prints the age of Java as a real number preceded by

```
The age of Java is
```

- name: String
- values: "zero or more characters"
- operations:

$$\cdot + \cdot : (\text{String} \times \text{String}) \rightarrow \text{String}$$
$$\cdots$$

Write an app that prints the age of Java as a real number preceded
by

```
The "age" of Java is
```

Write an app that prints the age of Java as a real number preceded
by

```
The age of Java is
```

in Chinese.

Unicode

A Unicode is represented as

$$\backslash u????$$

where is each ? is one of the following:

$$0, 1, \ldots, 9, A, B, \ldots, F$$

For example, the Unicode for $\nless$ is $\backslash u226E$.

Question: How many Unicodes are there?
Answer:

Unicode

A Unicode is represented as

$$\backslash u????$$

where is each ? is one of the following:

$$0, 1, \ldots, 9, A, B, \ldots, F$$

For example, the Unicode for $\not<$ is $\backslash u226E$.

Question: How many Unicodes are there?
Answer: $16^4 = (2^4)^4 = 2^{16}$

Another problem

Write an app that prints the age of Java as a real number preceded by

```
The age of Java is
```

which not only gives the correct result today, but also tomorrow, the day after tomorrow, etc.

import franck.cse5910.Today;

- franck is a package
- cse5910 is a subpackage
- Today is a class

Write an app that prints the age of Java as a real number preceded by

```
The age of Java is
```

which not only gives the correct result today, but also tomorrow, the day after tomorrow, etc, even if it is a leap year.

The operator

$$\cdot \% \cdot : (\text{int} \times \text{int}) \to \text{int}$$

yields the remainder of the division.

For example, the expression $2014 \% 4$ evaluates to 2.

Property

For all values a and b of type int,

$(a \mathbin{/} b) * b + (a \% b) = a$

- name: boolean
- values: true, false
- operations:

    $\cdot \&\& \cdot : (\text{boolean} \times \text{boolean}) \rightarrow \text{boolean}$
    $\cdot || \cdot : (\text{boolean} \times \text{boolean}) \rightarrow \text{boolean}$
    $! \cdot : \text{boolean} \rightarrow \text{boolean}$
    $\cdots$

Some binary operations

$$\cdot == \cdot : (\text{int} \times \text{int}) \to \text{boolean}$$
$$\cdot < \cdot : (\text{int} \times \text{int}) \to \text{boolean}$$
$$\cdot <= \cdot : (\text{int} \times \text{int}) \to \text{boolean}$$
$$\dots$$
$$\cdot == \cdot : (\text{double} \times \text{double}) \to \text{boolean}$$
$$\cdot < \cdot : (\text{double} \times \text{double}) \to \text{boolean}$$
$$\cdot <= \cdot : (\text{double} \times \text{double}) \to \text{boolean}$$
$$\dots$$

The expression $5 == 6$ evaluates to false and the expression
$5 <= 6$ evaluates to true.

The operation

$$\cdot ? \cdot : \cdot$$

of type

$$(\text{boolean} \times \text{int} \times \text{int}) \rightarrow \text{int}$$

is ternary, since it takes three arguments.

The expression $(5 == 6) ? 0 : 1$ evaluates to 1 and the expression $(5 <= 6) ? 0 : 1$ evaluates to 0.

Write an app that prints the age of Java as a fraction preceded by

```
The age of Java is
```

which not only gives the correct result today, but also tomorrow, the day after tomorrow, etc, even if it is a leap year.

- Study Chapter 1 of the textbook.
- Activate your EECS account: `www.eecs.yorku.ca/activ8`.
- Do the first programming exercise (details will be provided on the course webpage)