

CSCI 1540 Fundamental Computing with C++ Tutorial 2

Xinyi Hu

SHB 1005

xyhu@cse.cuhk.edu.hk

Outline

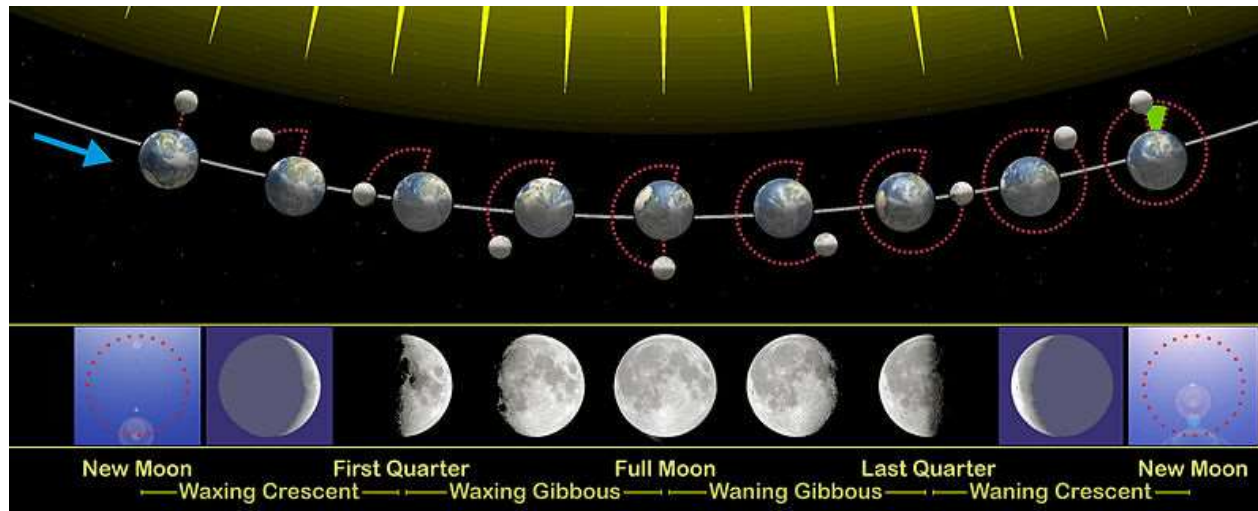
- **Assignment 2**
- **Exercise**

Assignment 2: Lunar New Year

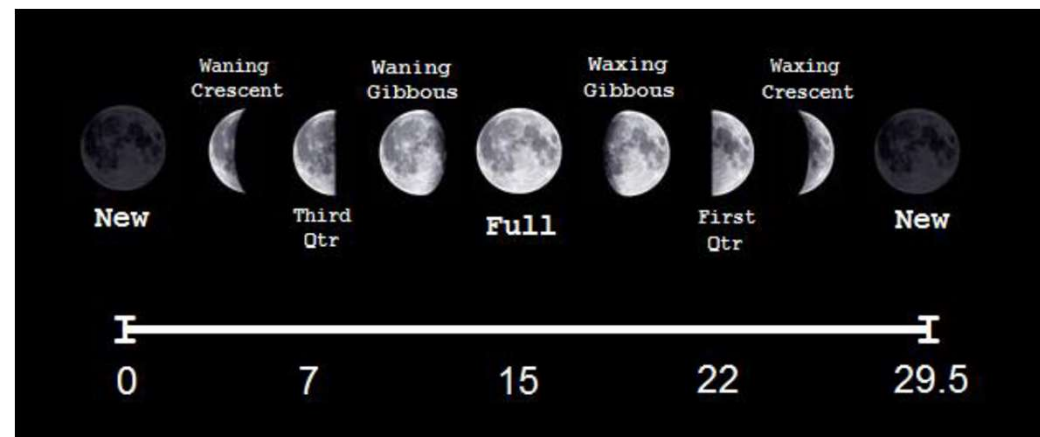
- Due : 20:00, Tue 2 Oct 2019.
- estimate the date of Lunar New Year (LNY / Chinese New Year / Spring Festival)

```
Enter a year: 2019↵  
LNY of 2019 is around: Tue, 5 Feb 2019
```

The date should be printed in the format “**ddd, d mmm y**”, where ddd is the three-letter abbreviation for day of the week (e.g., Tue), d is the day of the month, mmm is the three-letter abbreviation for month (e.g., Feb), and y is the year.



The New Moon (when the sun does not illuminate any of the moon's surface we see on Earth) repeats every 29.53 days.



The easiest way to calculate the current phase of the moon is to compare it to a known time when it was new (e.g., HKT 02:13, 6 Jan 2000), and determine how many cycles it has passed through.

Julian day numbers

Julian day numbers are a system of counting days since a specific day (January 1, 4713 BC).

$$a = \left\lfloor \frac{14 - m}{12} \right\rfloor$$

$$b = m + 12a - 3$$

$$c = y + 4800 - a$$

$$j = d + \left\lfloor \frac{153b + 2}{5} \right\rfloor + 365c + \left\lfloor \frac{c}{4} \right\rfloor - \left\lfloor \frac{c}{100} \right\rfloor + \left\lfloor \frac{c}{400} \right\rfloor - 32045$$

Given a year number y , $m=1$, and $d=21$ (meaning 21 Jan) :

Julian day numbers

$$\begin{aligned}
 a &= \left\lfloor \frac{14 - m}{12} \right\rfloor \\
 b &= m + 12a - 3 \\
 c &= y + 4800 - a \\
 j &= d + \left\lfloor \frac{153b + 2}{5} \right\rfloor + 365c + \left\lfloor \frac{c}{4} \right\rfloor - \left\lfloor \frac{c}{100} \right\rfloor + \left\lfloor \frac{c}{400} \right\rfloor - 32045 \\
 k &= \frac{j - 2451551.0923611}{29.530587981} \\
 n &= [29.530587981 \times ([k] - k)]
 \end{aligned}$$

$\lfloor x \rfloor$ Floor Function: the greatest integer that is less than or equal to x .

$\lceil x \rceil$ Ceiling Function: the least integer that is greater than or equal to x .



- Given a year number y , $m=1$, and $d=21$:

$$\begin{aligned}
 a &= \left\lfloor \frac{14 - m}{12} \right\rfloor \\
 b &= m + 12a - 3 \\
 c &= y + 4800 - a \\
 j &= d + \left\lfloor \frac{153b + 2}{5} \right\rfloor + 365c + \left\lfloor \frac{c}{4} \right\rfloor - \left\lfloor \frac{c}{100} \right\rfloor + \left\lfloor \frac{c}{400} \right\rfloor - 32045 \\
 k &= \frac{j - 2451551.0923611}{29.530587981} \\
 n &= \lfloor 29.530587981 \times ([k] - k) \rfloor
 \end{aligned}$$

- Example: $y=2061$:

$$\begin{aligned}
 a &= \left\lfloor \frac{14 - 1}{12} \right\rfloor = 1 \\
 b &= 1 + 12 \times 1 - 3 = 10 \\
 c &= 2061 + 4800 - 1 = 6860 \\
 j &= 21 + \left\lfloor \frac{153 \times 10 + 2}{5} \right\rfloor + 365 \times 6860 + \left\lfloor \frac{6860}{4} \right\rfloor - \left\lfloor \frac{6860}{100} \right\rfloor + \left\lfloor \frac{6860}{400} \right\rfloor - 32045 \\
 &= 21 + 306 + 2503900 + 1715 - 68 + 17 - 32045 = 2473846 \\
 k &= \frac{2473846 - 2451551.0923611}{29.530587981} = \frac{22294.9076389}{29.530587981} = 754.976760139167 \\
 n &= \lfloor 29.530587981 \times (755 - 754.976760139167) \rfloor = \lfloor 0.68628675501781 \rfloor = 0
 \end{aligned}$$

Therefore, LNY of year 2061 is around 0 day after 21 Jan. That is, 21 Jan. Also, $((j + n) \bmod 7) + 1 = ((2473846 + 0) \bmod 7) + 1 = 4 + 1 = 5$. So, 21 Jan 2061 is Friday.

Program Specification

- The output should be the **100% same** with sample output (i.e., same text, same symbols, same letter case, same number of spaces, etc.)
- Otherwise, it will be considered as ***wrong***, even if you have computed the correct result.

Sample Output

The diagram illustrates sample output with annotations. It consists of three terminal-like screenshots. The first screenshot shows 'Enter a year: 2019' and 'LNY of 2019 is around: Tue, 5 Feb 2019'. Red boxes highlight '2019' and 'Tue, 5 Feb 2019', with arrows pointing to 'User Input' and 'Output' labels respectively. The second screenshot shows 'Enter a year:2019' and 'LNY of 2019 is around: Tue, 5 Feb 2019'. A red box highlights 'Enter a year:2019', with an arrow pointing to a 'No space!' label. A thought bubble above it says 'What's wrong?'. The third screenshot shows 'Enter a year: 2061' and 'LNY of 2061 is around: Fri, 21 Jan 2061'. Red boxes highlight the spaces in the input and output. A red arrow points from the 'No space!' label to the space in the second line of the third screenshot. A red text label 'Be aware of spaces!' is positioned to the right of the third screenshot.

User Input

Output

What's wrong?

No space!

Be aware of spaces!

The date should be printed in the format “ddd, d mmm y”, where ddd is the three-letter abbreviation for day of the week (e.g., Tue), d is the day of the month, mmm is the three-letter abbreviation for month (e.g., Feb), and y is the year.

Real-time Demonstration

You can also run the sample program on blackboard

Compare your program outputs and sample program outputs!

Hints

- Variables needed in program:
 - Storing Input:
`int y`
 - Storing intermediate values:
`int a, b, c, j, n,`
`double k`
 - Use if-else statement to output the “ddd” and “mmm”

```
if (m == 1)
    cout << " Jan ";
if (m == 2)
    cout << " Feb ";
```

Program hints

- How to implement $\lfloor x \rfloor$, $\lceil x \rceil$ and mod in the C++?
 - For $\lfloor x \rfloor$, just let `n=(int)(x)` and if x, y are all integers, to calculate $z = \left\lfloor \frac{x}{y} \right\rfloor$, `z=x/y` can work. E.g. `19/10=1`.
 - For mod, use operator `%`. E.g. `19%10=9`.
 - For $\lceil x \rceil$, you can write `z = ceil(x)`. Be careful that you need to add `#include <cmath>` at the beginning of your program.

Program Hints

- Test your program!
 - use some self-thought numbers (including some extreme cases)
 - work out the a, b, c, j, k, n by hand
 - verify with program output.

Others

- Program file: Iny.cpp
- Please insert your personal information (SID, email, name)
- Please insert some suitable comments. (tell me what your codes are now doing)
- Free of errors and warnings.
- **No Plagiarism !**

Outline

- **Assignment 2**
- **Exercise**

Exercise: Introduction

Computus:

- **Computus** : the calculation of the Easter Day in the Christian calendar.

An algorithm to
calculate the Easter Day
for a particular *year*

$$a = \text{year} \bmod 19$$

$$b = \left\lfloor \frac{\text{year}}{100} \right\rfloor$$

$$c = \text{year} \bmod 100$$

$$d = \left\lfloor \frac{b}{4} \right\rfloor$$

$$e = b \bmod 4$$

$$f = \left\lfloor \frac{b + 8}{25} \right\rfloor$$

$$g = \left\lfloor \frac{b - f + 1}{3} \right\rfloor$$

$$h = (19a + b - d - g + 15) \bmod 30$$

$$i = \left\lfloor \frac{c}{4} \right\rfloor$$

$$k = c \bmod 4$$

$$L = (32 + 2e + 2i - h - k) \bmod 7$$

$$m = \left\lfloor \frac{a + 11h + 22L}{451} \right\rfloor$$

$$\text{month} = \left\lfloor \frac{h + L - 7m + 114}{31} \right\rfloor$$

$$\text{day} = ((h + L - 7m + 114) \bmod 31) + 1$$

Exercise: Introduction

Computus:

- **Computus** : the calculation of the Easter Day in the Christian calendar.
- **Goal**: write a program to calculate the Easter Day for some given years
- Examples:

```
Enter year: 2015
Easter Day in 2015 is 5/4/2015.
Press any key to continue . . . _
```

```
Enter year: 2016
Easter Day in 2016 is 27/3/2016.
Press any key to continue . . . _
```

Step 1: Input

Inputs: the year you want to calculate the Easter Day

cin use “cin” to read in the input

- *The region of the input year*

The program will obtain a year as user input. You can assume that the input year is always integers greater than 1582 (when the Gregorian calendar was first adopted).

Step 2: Computation

-- Define each variable first and then assign them.

$$a = \text{year} \bmod 19$$

$$b = \left\lfloor \frac{\text{year}}{100} \right\rfloor$$

$$c = \text{year} \bmod 100$$

$$d = \left\lfloor \frac{b}{4} \right\rfloor$$

$$e = b \bmod 4$$

$$f = \left\lfloor \frac{b + 8}{25} \right\rfloor$$

$$g = \left\lfloor \frac{b - f + 1}{3} \right\rfloor$$

$$h = (19a + b - d - g + 15) \bmod 30$$

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$$L = (32 + 2e + 2i - h - k) \bmod 7$$

$$m = \left\lfloor \frac{a + 11h + 22L}{451} \right\rfloor$$

$$\text{month} = \left\lfloor \frac{h + L - 7m + 114}{31} \right\rfloor$$

$$\text{day} = ((h + L - 7m + 114) \bmod 31) + 1$$

Step 2: Computation

The operators used in C++ (an example using year 2023)

- modulo operation : %

$$\text{year mod } 19 \rightarrow \text{year \% } 19 = 2023 \% 19 = 9;$$

- floor operation : /

$$b = \left\lfloor \frac{\text{year}}{100} \right\rfloor \rightarrow \text{b} = \text{year} / 100 = 2023 / 100 = 20;$$

- With the same way.

$$\text{c} = \text{year mod } 100 \rightarrow \text{c} = \text{year \% } 100 = 2023 \% 100 = 23;$$

$$d = \left\lfloor \frac{b}{4} \right\rfloor \rightarrow \text{d} = b / 4 = 20 / 4 = 5;$$

Step 2: Computation

- modulo operation : % floor operation : /

- $a = 9; b = 20; c = 23; d = 5;$

$e = b \bmod 4 \rightarrow e = b \% 4 = 20 \% 4 = 0;$

$f = \left\lfloor \frac{b+8}{25} \right\rfloor \rightarrow f = (b+8) / 25 = 28 / 25 = 1;$

$g = \left\lfloor \frac{b-f+1}{3} \right\rfloor \rightarrow g = (b-f+1) / 4 = 20 / 4 = 5;$

$h = (19a + b - d - g + 15) \bmod 30$

$\rightarrow h = (19a + b - d - g + 15) \% 30 = 196 \% 30 = 16;$

$i = \left\lfloor \frac{c}{4} \right\rfloor \rightarrow i = c / 4 = 23 / 4 = 5;$

$k = c \bmod 4 \rightarrow k = c \% 4 = 23 \% 4 = 3;$

Step 2: Computation

• modulo operation : % floor operation : /

$a = 9; b = 20; c = 23; d = 5; e = 0; f = 1; g = 5; h = 16; i = 5; k = 3;$

$$L = (32 + 2e + 2i - h - k) \bmod 7$$

$$\rightarrow L = (32 + 2e + 2i - h - k) \% 7 = 23 \% 7 = 2;$$

$$m = \left\lfloor \frac{a + 11h + 22L}{451} \right\rfloor$$

$$\rightarrow m = (a + 11h + 22L) / 451 = 229 / 451 = 0;$$

$$month = \left\lfloor \frac{h + L - 7m + 114}{31} \right\rfloor$$

$$\rightarrow month = (h + L - 7m + 114) / 31 = 132 / 31 = 4;$$

$$day = ((h + L - 7m + 114) \bmod 31) + 1$$

$$\rightarrow day = ((h + L - 7m + 114) \% 31) + 1 = (132 \% 31) + 1 = 9;$$

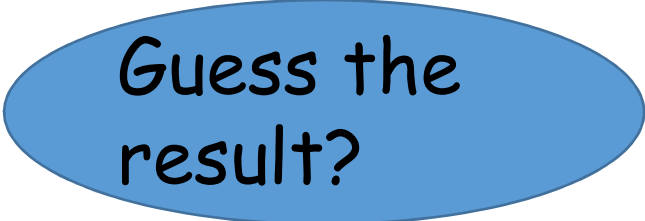
Step 2: Computation

Integer division

/ could only get the integer part of the result and omit the decimals.

For example,

$$7/2 + 5$$



Guess the result?

Step 3: Output

Outputs: cout use “cout” to print out

- *The output date format*

The program output is the date of the Easter Day of the input year, in the format d/m/y.

Sample Codes

```
#include <iostream>
using namespace std;

int main()
{
// Declare variables
    int year, month, day;
    int a, b, c, d, e, f, g, h, i, k, L, m;

// Prompt the user to enter a 'year' and store
the value in variable 'year'
    cout<<"Enter year: ";
    cin>>year;

// Follow the assigned algorithm
    a = year % 19;
    b = year / 100;
    c = year % 100;
    d = b / 4;
    e = b % 4;
```

```
    f = (b + 8) / 25;
    g = (b - f + 1) / 3;
    h = (19 * a + b - d - g + 15) % 30;
    i = c / 4;
    k = c % 4;
    L = (32 + 2 * e + 2 * i - h - k) % 7;
    m = (a + 11 * h + 22 * L) / 451;

    month = (h + L - 7 * m + 114) / 31;
    day = ((h + L - 7 * m + 114) % 31) + 1;

// Print out the result
    cout<<"Easter Day in " << year << " is "
<< day << "/" << month << "/" << year << ".";

    return 0;
}
```

Output Samples

```
C:\Windows\system32\cmd.exe
Enter year: 2013
Easter Day in 2013 is 31/3/2013.
Press any key to continue . . .
```

```
C:\Windows\system32\cmd.exe
Enter year: 2015
Easter Day in 2015 is 5/4/2015.
Press any key to continue . . .
```

```
C:\Windows\system32\cmd.exe
Enter year: 2017
Easter Day in 2017 is 16/4/2017.
Press any key to continue . . . _
```

Thanks!

A simple line drawing of a smiling face with a hand raised in a gesture of thanks or applause. The face is circular with a wide, curved smile and two small dots for eyes. A hand is raised next to the face, with fingers spread. The entire drawing is positioned below the word "Thanks!" and is partially enclosed by a horizontal line that starts under the 'T' and ends under the 's'.