

Functional Testing

Zelin Cai, Patrick Silvestre

1 Input Domain

The input domain of the unit `nextDate` consists of dates formatted as follows: $MM/DD/YYYY$. For months, MM , the input condition specifies the range $[1, 12]$. If $MM = 2$ and the year is not a leap year, then the input condition range for dates, DD is $[1, 28]$ (a year is a leap year if divisible by 4 and not divisible by 100 (unless divisible by 400)). If $MM = 2$ and the year is a leap year, then the input condition range for DD is $[1, 29]$. If $MM = 4, 6, 9$, or 11 , then the input condition range for DD is $[1, 30]$. If $MM = 1, 3, 5, 7, 8, 10$, or 12 , then the input condition range for DD is $[1, 31]$.

2 Equivalence Classes

In order to identify equivalence classes (ECs), the following strategy was used: input conditions typically specified a range $[a, b]$, thus one EC valid input was identified for $a \leq X \leq b$, and two others with invalid input were identified for $X < a$ and $b < X$.

2.1 Months

- EC-01: $01 \leq MM \leq 12$
- EC-02: $MM < 01$
- EC-03: $12 < MM$

2.2 Dates

2.2.1 $MM = 2$, YY is not a leap year

- EC-04: $01 \leq DD \leq 28$
- EC-05: $DD < 01$
- EC-06: $28 < DD$

2.2.2 MM = 2, YY is a leap year

- EC-07: $01 \leq DD \leq 29$
- EC-08: $DD < 01$
- EC-09: $29 < DD$

2.2.3 MM = 4, 6, 9, or 11

- EC-10: $01 \leq DD \leq 30$
- EC-11: $DD < 01$
- EC-12: $30 < DD$

2.2.4 MM = 1, 3, 5, 7, 8, 10, or 12

- EC-13: $01 \leq DD \leq 31$
- EC-14: $DD < 01$
- EC-15: $31 < DD$

2.3 Years

- EC-16: $1900 \leq YYYY \leq 2099$
- EC-17: $YYYY < 1900$
- EC-18: $2099 < YYYY$

3 Test Cases

3.1 Test Cases from Equivalence Classes

In order to identify test cases (TCs) from ECs, the following strategy is used: For each EC with valid input that has not been covered by a TC, write a TC covering as many uncovered ECs as possible. Then, for each EC with invalid input that has been covered, write a new TC that covers only that EC.

3.1.1 Test Cases for ECs with Valid Input

Valid Input ECs: EC-01, EC-04, EC-07, EC-10, EC-13, EC-16

TC	Test Value	Expected Result	EC-01	EC-04	EC-07	EC-10	EC-13	EC-16
01	02/01/1999	02/02/1999	✓	✓				✓
02	02/01/2000	02/02/2000	✓		✓			✓
03	04/01/2000	04/02/2000	✓			✓		✓
04	01/01/2000	01/02/2000	✓				✓	✓

3.1.2 Test Cases for ECs with Invalid Input

Invalid Input ECs: EC-02, EC-03, EC-05, EC-06, EC-08, EC-09, EC-11, EC-12, EC-14
EC-15, EC-17, EC-18

TC	Test Value	Expected Result	EC-02	EC-03	EC-05
05	00/01/2000	ERROR: The month needs to be between 1 to 12	✓		
06	13/01/2000	ERROR: The month needs to be between 1 to 12		✓	
07	02/00/1999	ERROR: The day needs to be between 1 to 28			✓

TC	Test Value	Expected Result	EC-06	EC-08	EC-09
08	02/29/1999	ERROR: This year isn't a leap year	✓		
09	02/00/2000	ERROR: The day needs to be between 1 to 29		✓	
10	02/30/2000	ERROR: The day needs to be between 1 to 29			✓

TC	Test Value	Expected Result	EC-11	EC-12	EC-14
11	04/00/2000	ERROR: The day needs to be between 1 to 30	✓		
12	04/31/2000	ERROR: This month only has 30 days		✓	
13	01/00/2000	ERROR: The day needs to be between 1 to 30			✓

TC	Test Value	Expected Result	EC-15	EC-17	EC-18
14	01/32/2000	ERROR: The day needs to be between 1 to 31	✓		
15	01/01/1899	ERROR: The year needs to be between 1900 to 2099		✓	
16	01/01/2100	ERROR: The year needs to be between 1900 to 2099			✓

3.2 Test Cases for Boundary Value Analysis

In order to identify test cases for boundary value analysis (BVA), the following strategy is used: Since ECs specify ranges, test cases are constructed by considering the boundary points of the range and points just beyond the boundaries of the range.

3.2.1 EC-01: $01 \leq MM \leq 12$

TC	Test Value	Expected Result
01	00/01/2000	ERROR: The month needs to be between 1 to 12
02	01/01/2000	01/02/2000
03	02/01/2000	02/02/2000
04	11/01/2000	11/02/2000
05	12/01/2000	12/02/2000
06	13/01/2000	ERROR: The month needs to be between 1 to 12

3.2.2 EC-02: $MM < 01$

TC	Test Value	Expected Result
01	00/01/2000	ERROR: The month needs to be between 1 to 12
02	01/01/2000	01/02/2000
03	02/01/2000	02/02/2000

3.2.3 EC-03: $12 < MM$

TC	Test Value	Expected Result
01	11/01/2000	11/02/2000
02	12/01/2000	12/02/2000
03	13/01/2000	ERROR: The month needs to be between 1 to 12

3.2.4 EC-04: $01 \leq DD \leq 28$ ($MM = 2$, YY is not a leap year)

TC	Test Value	Expected Result
01	02/00/1999	ERROR: The day needs to be between 1 to 28
02	02/01/1999	02/02/1999
03	02/02/1999	02/03/1999
04	02/27/1999	02/28/1999
05	02/28/1999	03/01/1999
06	02/29/1999	ERROR: This year isn't a leap year

3.2.5 EC-05: $DD < 01$ (MM = 2, YY is not a leap year)

TC	Test Value	Expected Result
01	02/00/1999	ERROR: The day needs to be between 1 to 28
02	02/01/1999	02/02/1999
03	02/02/1999	02/03/1999

3.2.6 EC-06: $28 < DD$ (MM = 2, YY is not a leap year)

04	02/27/1999	02/28/1999
05	02/28/1999	03/01/1999
06	02/29/1999	ERROR: This year isn't a leap year

3.2.7 EC-07: $01 \leq DD \leq 29$ (MM = 2, YY is a leap year)

TC	Test Value	Expected Result
01	02/00/2000	ERROR: The day needs to be between 1 to 29
02	02/01/2000	02/02/2000
03	02/02/2000	02/03/2000
04	02/28/2000	02/29/2000
05	02/29/2000	03/01/2000
06	02/30/2000	ERROR: The day needs to be between 1 to 29

3.2.8 EC-08: $DD < 01$ (MM = 2, YY is a leap year)

TC	Test Value	Expected Result
01	02/00/2000	ERROR: The day needs to be between 1 to 29
02	02/01/2000	02/02/2000
03	02/02/2000	02/03/2000

3.2.9 EC-09: $29 < DD$ (MM = 2, YY is a leap year)

TC	Test Value	Expected Result
01	02/28/2000	02/29/2000
02	02/29/2000	03/01/2000
03	02/30/2000	ERROR: The day needs to be between 1 to 29

3.2.10 EC-10: $01 \leq DD \leq 30$ (MM = 4, 6, 9, or 11)

TC	Test Value	Expected Result
01	04/00/2000	ERROR: The day needs to be between 1 to 30
02	04/01/2000	04/02/2000
03	04/02/2000	04/03/2000
04	04/29/2000	04/30/2000
05	04/30/2000	05/01/2000
06	04/31/2000	ERROR: The day needs to be between 1 to 30

3.2.11 EC-11: $DD < 01$ (MM = 4, 6, 9, or 11)

TC	Test Value	Expected Result
01	04/00/2000	ERROR: The day needs to be between 1 to 30
02	04/01/2000	04/02/2000
03	04/02/2000	04/03/2000

3.2.12 EC-12: $30 < DD$ (MM = 4, 6, 9, or 11)

TC	Test Value	Expected Result
01	04/29/2000	04/30/2000
02	04/30/2000	05/01/2000
03	04/31/2000	ERROR: The day needs to be between 1 to 30

3.2.13 EC-13: $01 \leq DD \leq 31$ (MM = 1, 3, 5, 7, 8, 10, or 12)

TC	Test Value	Expected Result
01	01/00/2000	ERROR: The day needs to be between 1 to 31
02	01/01/2000	01/02/2000
03	01/02/2000	01/03/2000
04	01/30/2000	01/31/2000
05	01/31/2000	02/01/2000
06	01/32/2000	ERROR: The day needs to be between 1 to 31

3.2.14 EC-14: $DD < 01$ (MM = 1, 3, 5, 7, 8, 10, or 12)

TC	Test Value	Expected Result
01	01/00/2000	ERROR: The day needs to be between 1 to 31
02	01/01/2000	01/02/2000
03	01/02/2000	01/03/2000

3.2.15 EC-15: $31 < DD$ (MM = 1, 3, 5, 7, 8, 10, or 12)

TC	Test Value	Expected Result
01	01/30/2000	01/31/2000
02	01/31/2000	02/01/2000
03	01/32/2000	ERROR: The day needs to be between 1 to 31

3.2.16 EC-16: $1900 \leq YYYY \leq 2099$

TC	Test Value	Expected Result
01	01/01/1899	ERROR: The year needs to be between 1900 to 2099
02	01/01/1900	01/02/1900
03	01/01/1901	01/02/1901
04	01/01/2098	01/02/2098
05	01/01/2099	01/02/2099
06	01/01/2100	ERROR: The year needs to be between 1900 to 2099

3.2.17 EC-17: $YYYY < 1900$

TC	Test Value	Expected Result
01	01/01/1899	ERROR: The year needs to be between 1900 to 2099
02	01/01/1900	01/02/1900
03	01/01/1901	01/02/1901

3.2.18 EC-18: $2099 < YYYY$

TC	Test Value	Expected Result
01	01/01/2098	01/02/2098
02	01/01/2099	01/02/2099
03	01/01/2100	ERROR: The year needs to be between 1900 to 2099

3.3 Test Cases for Random Testing

Typically, in random testing, test inputs are randomly generated according to some operational profile. In this case, we generate 16 test cases using a random number generator via `random.org`. MM is limited to the range [00, 13], DD [00, 32], and YYYY [1899, 2100].

TC	Test Value	Expected Result
01	13/15/2040	ERROR: The month needs to be between 1 to 12
02	00/31/1909	ERROR: The month needs to be between 1 to 12
03	06/08/2053	06/09/2053
04	01/05/1986	01/06/1986
05	04/23/1977	04/24/1977
06	13/10/2024	ERROR: The month needs to be between 1 to 12
07	11/27/1955	11/28/1955
08	13/03/2084	ERROR: The month needs to be between 1 to 12
09	11/08/2059	11/09/2059
10	12/04/1912	12/05/1912
11	11/14/1902	11/15/1902
12	10/15/1972	10/16/1972
13	13/21/1985	ERROR: The month needs to be between 1 to 12
14	11/27/2039	11/28/2039
15	08/29/2035	08/30/2035
16	00/02/2031	ERROR: The month needs to be between 1 to 12