# Task 2: White-box Testing: Structural Testing

1. **Test cases for 100% statement coverage**

public BigInteger gcd(BigInteger y)

**Test cases**  
**t1 =** <*words* = null, *xval* = 0, *yval* = 0, *y.words* = null>**t2 =** <*words* = null, *xval* = -1, *yval* = -1, *y.words* = null>**t3 =** <*words* = 1, *xval* = -1, *yval* = 0, *y.words* = null>**t4 =** <*words* = 1, *xval* = 1, *yval* = 0, *y.words* = null>**t5 =** <*words* = 1, *xval* = 1, *yval* = 1, *y.words* = 1>

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Test case* | *words == null* | *xval == 0* | *y.words == null && xval != Integer.MIN\_VALUE && yval != Integer.MIN\_VALUE* | *xval < 0* | *yval < 0* | *y.words == null* | *yval == 0* | *xval > yval* |
| **t1** | true | true | -- | true | true | -- | -- | -- |
| **t2** | true | false | true | true | true | -- | -- | -- |
| **t3** | true | false | false | -- | -- | true | true | -- |
| **t4** | false | -- | -- | -- | -- | true | false | true |
| **t5** | false | -- | -- | -- | -- | false | -- | false |

public BigInteger modInverse(BigInteger y)

**Test cases**  
**t1 =** <*yval* = -1, *xval* = 0, *isOne()* = false, *y.words* = null, *words* = null>**t2 =** <*yval* = 1, *xval* = 0, *isOne()* = false, *y.words* = null, *words* = null>**t3 =** <*yval* = 10, *xval* = 1, *isOne()* = true, *y.words* = null, *words* = null>**t4 =** <*yval* = *10*, *xval* = 0, *isOne()* = false, *y.words* = null, *words*= null>**t5 =** <*yval* = *10*, *xval* = -1, *isOne()* = false, *y.words* = null, *words* = null>**t6 =** <*yval* = 1, *xval* = 1, *isOne()* = false, *y.words* = 1, *words* = 2>**t7 =** <*yval* = 1, *xval* = -1, *isOne()* = false, *y.words* = 1, *words* = 0>

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *Test case* | *y.isNegative()* | *y.IsZero()* | *y.IsOne()* | *IsOne()* | *y.words == null* | *words != null || isNegative()* | *yval > xval* |
| **t1** | true | false | -- | -- | -- | -- | -- |
| **t2** | false | false | true | -- | -- | -- | -- |
| **t3** | false | false | false | true | -- | -- | -- |
| **t4** | false | false | false | false | true | false | true |
| **t5** | false | false | false | false | true | true | false |
| **t6** | false | false | false | false | false | -- | -- |
| **t7** | false | false | false | false | false | -- | -- |
|  |  |  |  |  |  |  |  |
| *Test case* | *swapped()* | *result.ival < 0* | *isNegative()* | *x.compareTo(y) < 0* | *swapped()* | *result.IsNegative()* | *swapped()* |
| **t1** | -- | -- | -- | -- | -- | -- | -- |
| **t2** | -- | -- | -- | -- | -- | -- | -- |
| **t3** | -- | -- | -- | -- | -- | -- | -- |
| **t4** | true | true | -- | -- | -- | -- | -- |
| **t5** | false | true | -- | -- | -- | -- | -- |
| **t6** | -- | -- | false | false | false | true | false |
| **t7** | -- | -- | true | true | true | true | false |

private static int compareTo(BigInteger x, BigInteger y)

**Test cases**

**t1** = <*x.words* = null, *y.words* = null, *xval* = 0, *yval* = 0>  
**t2** = <*x.words* = 1, *y.words* = 1, *xval* = 1, *yval* = -1>  
**t3** = <*x.words* = 1, *y.words* = 1 *xval* = 1, *yval* = 2>  
**t4** = <*x.words* = 1, *y.words* = 1, *xval* = 2, *yval* = 2>

|  |  |  |  |
| --- | --- | --- | --- |
| *Test case* | *x.words == null && y.words == null* | *x\_negative != y\_negative* | *x\_len != y\_len* |
| **t1** | true | -- | -- |
| **t2** | false | true | -- |
| **t3** | false | false | true |
| **t4** | false | false | false |

1. **Test cases for 100% decision coverage**

public BigInteger gcd(BigInteger y)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *Test case* | *words == null* | *xval == 0* | *y.words == null && xval != Integer.MIN\_VALUE && yval != Integer.MIN\_VALUE* | *xval < 0* | *yval < 0* | *y.words == null* | *yval == 0* |
| **t1** | true | true | -- | true | true | -- |  |
| **t2** | true | false | true | true | true | -- |  |
| **t3** | true | false | true | false | false |  |  |
| **t4** | true | false | false | -- | -- | true | true |
| **t5** | true | false | false | -- | -- | false | -- |

**Test cases**  
**t1 =** <*words* = null, *xval* = 0, *yval* = 0, *y.words* = null>**t2 =** <*words* = null, *xval* = -1, *yval* = -1, *y.words* = null>**t3 =** <*words* = null, *xval* = 1, *yval* = 1, *y.words* = null>**t4 =** <*words* = null, *xval* = min, *yval* = 0, *y.words* = null>**t5 =** <*words* = null, *xval* = 1, *yval* = 1, *y.words* = 1>

public BigInteger modInverse(BigInteger y)

**Test cases**  
**t1 =** <*yval* = -1, *xval* = 0, *isOne()* = false, *words* = null, *y.words* = null>**t2 =** <*yval* = 1, *xval* = 0, *isOne()* = false, *words* = null, *y.words* = null>**t3 =** <*yval* = 2, *xval* = 0, *isOne()* = true, *words* = null, *y.words* = null>**t4 =** <*yval* = 2, *xval* = 0, *isOne()* = false, *words* = null, *y.words* = null>**t5 =** <*yval* = 2, *xval* = 0, *isOne()* = false, *words* = null, *y.words* = null>**t6 =** <*yval* = 2, *xval* = 0, *isOne()* = false, *words* = null, *y.words* = null>**t7 =** <*yval* = 2, *xval* = 0, *isOne()* = false, *words* = null, *y.words* = null>

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Test case* | *y.isNegative()* | *y.IsZero()* | *y.IsOne()* | *IsOne()* | *y.words == null* |
| **t1** | true | false | -- | -- | -- |
| **t2** | false | false | true | -- | -- |
| **t3** | false | false | false | true | -- |
| **t4** | false | false | false | false | true |
| **t5** | false | false | false | false | false |
| **t5** | false | false | false | false | false |
|  |  |  |  |  |  |
| *Test case* | *yval > xval* | *result.ival < 0* | *x.compareTo(y) < 0* | *result.IsNegative()* |  |
| **t1** | -- | -- | -- | -- |  |
| **t2** | -- | -- | -- | -- |  |
| **t3** | -- | -- | -- | -- |  |
| **t4** | true | true | -- | -- |  |
| **t5** | false | false | -- | -- |  |
| **t6** | -- | -- | true | true |  |
| **t7** | -- | -- | false | false |  |

private static int compareTo(BigInteger x, BigInteger y)

**Test cases**

**t1** = <*x.words* = null, *y.words* = null, *xval* = 0, *yval* = 1>

**t2** = <*x.words* = null, *y.words* = null, *xval* = 0, *yval* = -1>

**t3** = <*x.words* = null, *y.words* = null, *xval* = 0, *yval* = 0>  
**t4** = <*x.words* = 1, *y.words* = null, *xval* = -1, *yval* = 1>  
**t5** = <*x.words* = null, *y.words* = 1 *xval* = 1, *yval* = -1>  
**t6** = <*x.words* = 1, *y.words* = null, *xval* = 1, *yval* = -1>   
**t7** = <*x.words* = null, *y.words* = 1, *xval* = -1, *yval* = 1>   
**t8** = <*x.words* = 1, *y.words* = 1, *xval* = 1, *yval* = 1>

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Test case* | *x.words == null && y.words == null* | *x.ival < y.ival* | *x.ival > y.ival* | *x\_negative != y\_negative* | *x\_negative* | *x.words == null* | *y.words == null* | *x\_len != y\_len* | *(x\_len > y\_len) != x\_negative* |
| **t1** | true | true | -- | -- |  | -- | -- | -- | -- |
| **t2** | true | false | true | -- |  | -- | -- | -- | -- |
| **t3** | true | false | false | -- |  | -- | -- | -- | -- |
| **t4** | false | -- | -- | true | true | -- | -- | -- | -- |
| **t5** | false | -- | -- | true | false | -- | -- | -- | -- |
| **t6** | false | -- | -- | false | -- | false | true | true | true |
| **t7** | false | -- | -- | false | -- | true | false | true | false |
| **t8** | false | -- | -- | false | -- | true | true | false | -- |

1. **Test cases for 100% condition coverage**

public BigInteger gcd(BigInteger y)

**Test cases**  
**t1 =** <*words* = null, *xval* = 0, *yval* = 0, *y.words* = null>**t2 =** <*words* = null, *xval* = -1, *yval* = -1, *y.words* = null>**t3 =** <*words* = null, *xval* = 1, *yval* = 1, *y.words* = null>**t4 =** <*words* = null, *xval* = -1, *yval* = 0, *y.words* = 1>**t5 =** <*words* = null, *xval* = min, *yval* = -1, *y.words* = null>**t6 =** <*words* = 1, *xval* = -1, *yval* = -1, *y.words* = 1>**t7 =** <*words* = 1, *xval* = min, *yval* = min, *y.words* = null>

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Test case* | *words == null* | *xval == 0* | *y.words == null* | *xval != Integer.MIN\_VALUE* | *yval != Integer.MIN\_VALUE* | *xval < 0* | *yval < 0* | *y.words == null* | *yval == 0* |
| **t1** | true | true | -- | -- | -- | true | true | -- | -- |
| **t2** | true | false | true | true | true | true | true | -- | -- |
| **t3** | true | false | true | true | true | false | false | -- | -- |
| **t4** | true | false | false | true | true | -- | -- | true | true |
| **t5** | true | false | false | true | true | -- | -- | true | false |
| **t6** | false | false | false | true | true | -- | -- | false | false |
| **t7** | false | false | false | false | false | -- | -- | false | false |

public BigInteger modInverse(BigInteger y)

**Test cases**  
**t1 =** <*yval* = -1, *xval* = 0, *isOne()* = false, *words* = null, *y.words* = null>   
**t2 =** <*yval* = 0, *xval* = 0, *isOne()* = false, *words* = null, *y.words* = null>**t3 =** <*yval* = 1, *xval* = 0, *isOne()* = false, *words* = null, *y.words* = null>**t4 =** <*yval* = 10, *xval* = 1, *isOne()* = true, *words* = null, *y.words* = null>**t5 =** <*yval* = 10, *xval* = -1, *isOne()* = false, *words* = 1, *y.words* = null>**t6 =** <*yval* = 10, *xval* = 0, *isOne()* = false, *words* = null, *y.words* = null>**t7 =** <*yval* = 10, *xval* = 1, *isOne()* = false, *words* = null, *y.words* = null>**t8 =** <*yval* = 10, *xval* = 0, *isOne()* = false, *words* = null, *y.words* = null>

**t9 =** <*yval* = 1, *xval* = -1, *isOne()* = false, *words* = 1, *y.words* = 1>**t10 =** <*yval* = 1, *xval* = 1, *isOne()* = false, *words* = null, *y.words* = 1>**t11 =** <*yval* = 1, *xval* = 0, *isOne()* = false, *words* = null, *y.words* = 1>

**t12 =** <*yval* = 1, *xval* = -1, *isOne()* = false, *words* = 1, *y.words* = 1>

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *Test case* | *y.isNegative()* | *y.IsZero()* | *y.IsOne()* | *IsOne()* | *y.words == null* | *words != null* |
| **t1** | true | false | -- | -- | -- | -- |
| **t2** | false | true | -- | -- | -- | -- |
| **t3** | false | false | true | -- | -- | -- |
| **t4** | false | false | false | true | -- | -- |
| **t5** | false | false | false | false | true | false |
| **t6** | false | false | false | false | true | false |
| **t7** | false | false | false | false | true | false |
| **t8** | false | false | false | false | true | false |
| **t9** | false | false | false | false | false | -- |
| **t10** | false | false | false | false | false | -- |
| **t11** | false | false | false | false | false | -- |
| **t12** | false | false | false | false | false | -- |
|  |  |  |  |  |  |  |
| *Test case* | *isNegative()* | *yval > xval* | *result.ival < 0* | *x.compareTo(y) < 0* | *result.IsNegative()* |  |
| **t1** | -- | -- | -- | -- | -- |  |
| **t2** | -- | -- | -- | -- | -- |  |
| **t3** | -- | -- | -- | -- | -- |  |
| **t4** | -- | -- | -- | -- | -- |  |
| **t5** | true | true | true | -- | -- |  |
| **t6** | false | true | -- | -- | -- |  |
| **t7** | false | true | false | -- | -- |  |
| **t8** | -- | -- | -- | false | false |  |
| **t9** | -- | -- | -- | -- | -- |  |
| **t10** |  |  |  |  |  |  |
| **t11** |  |  |  |  |  |  |
| **t12** |  |  |  |  |  |  |

private static int compareTo(BigInteger x, BigInteger y)

**Test cases**

**t1** = <*x.words* = null, *y.words* = null, *xval* = 0, *yval* = 1>

**t2** = <*x.words* = null, *y.words* = null, *xval* = 0, *yval* = -1>

**t3** = <*x.words* = null, *y.words* = null, *xval* = 0, *yval* = 0>  
**t4** = <*x.words* = 1, *y.words* = null, *xval* = -1, *yval* = 1>  
**t5** = <*x.words* = null, *y.words* = 1, *xval* = 1, *yval* = -1>  
**t6** = <*x.words* = 2, *y.words* = 1, *xval* = 1, *yval* = 1>   
**t7** = <*x.words* = 1, *y.words* = 2, *xval* = 1, *yval* = 1>   
**t8** = <*x.words* = 1, *y.words* = 1, *xval* = 1, *yval* = 1>

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Test case* | *x.words == null* | *y.words == null* | *x.ival < y.ival* | *x.ival > y.ival* | *x\_negative != y\_negative* |
| **t1** | true | true | true | -- | -- |
| **t2** | true | true | false | true | -- |
| **t3** | true | true | false | false | -- |
| **t4** | false | false | -- | -- | true |
| **t5** | true | false | -- | -- | true |
| **t6** | false | -- | -- | -- | false |
| **t7** | false | -- | -- | -- | false |
| **t8** | false | -- | -- | -- | false |
|  |  |  |  |  |  |
| *Test case* | *x\_negative* | *x.words == null* | *y.words == null* | *x\_len != y\_len* | *(x\_len > y\_len) != x\_negative* |
| **t1** | -- | -- | -- | -- | -- |
| **t2** | -- | -- | -- | -- | -- |
| **t3** | -- | -- | -- | -- | -- |
| **t4** | true | -- | -- | -- | -- |
| **t5** | false | -- | -- | -- | -- |
| **t6** | -- | false | true | false | true |
| **t7** | -- | true | false | false | false |
| **t8** | -- | false | false | true | -- |