Test cases and Outputs

Case 1 : The bird falls on the pigs position but the pig escapes (bird time > network delay)

```
Some pigs might fail in the network at random
the pigs that failed in the current iteration are :
[]
Iteration : 1
Displaying the 1d grid
0-unoccupied
1-Pig
2-stone
positions denoted from 0 to 13 with 0 being on the left
[2, 0, 1, 0, 1, 0, 0, 2, 1, 2, 1, 1, 1, 1]
Leader election using the bully algorithm
Pig which starts the election = pig with id 2
LEADER ELECTED :6
PIG POSITION received. Total number of pigs alive  - 6
Bird landing position :2
Time taken by the bird :10
The Leader gets the bird time and bird landing positions and find the
affected pig
Pigs to be warned : [0]
Received BIRD APPROACHING message - ID : 0 Leaders Clock value : 51 received
pigs clock time : 16 synchronized to : 52.0
 pig with id 0 with position : 2 takes evasive action
Waiting till the leader has received all the statuses
received BIRD LANDING  message : 0 Leaders Clock: 54 recipients Clock
synchronized from 58.0 to : 59.0
Score : 0
A visualization representing the result
Displaying the 1d grid
'0'-unoccupied
'1'-Pig
'2'-stone
'D'-Deadpig
'11'- Two pigs
['2', '0', '0', '1', '1', '0', '0', '2', '1', '2', '1', '1', '1', '1']
y to continue / n to exit
```

Explanation :

Since the bird approaching message comes before the bird landing message the pig takes evasive action

Case 2 : One pig , bird falls on the pigs position . Pig dies due to network delay

```
Some pigs might fail in the network at random
the pigs that failed in the current iteration are :
[]
Iteration : 1
Displaying the 1d grid
0-unoccupied
1-Pig
2-stone
positions denoted from 0 to 13 with 0 being on the left
[2, 0, 1, 0, 1, 0, 0, 2, 1, 2, 1, 1, 1, 1]
Leader election using the bully algorithm
Pig which starts the election = pig with id 4
LEADER ELECTED :6
PIG POSITION received. Total number of pigs alive  - 6
Bird landing position :2
Time taken by the bird :1
The Leader gets the bird time and bird landing positions and find the
affected pig
Pigs to be warned : [0]
Waiting till the leader has received all the statuses
received BIRD LANDING  message : 0 Leaders Clock: 39.0 recipients Clock
synchronized from 13 to : 40.0
Received BIRD HIT at (leader):  synchronized time at 6 : 41.0
Received BIRD APPROACHING message - ID : 0 Leaders Clock value : 38.0
received pigs clock time : 43.0 synchronized to : 44.0
Pig 0 Killed !
The Pigs that were hit : [0]
Score : 1
A visualization representing the result
Displaying the 1d grid
'0'-unoccupied
'1'-Pig
'2'-stone
'D'-Deadpig
'11'- Two pigs
['2', '0', 'D', '0', '1', '0', '0', '2', '1', '2', '1', '1', '1', '1']
y to continue / n to exit
```

Explanation : Bird approaching packet comes late due to the network delay and hence the pig gets killed

Case 3 : Pig with the highest Id fails in an iteration

```
Some pigs might fail in the network at random
the pigs that failed in the current iteration are :
[2, 6]
Iteration : 1
Displaying the 1d grid
0-unoccupied
1-Pig
2-stone
positions denoted from 0 to 13 with 0 being on the left
[2, 0, 1, 0, 0, 0, 0, 2, 1, 2, 0, 1, 1, 1]
Leader election using the bully algorithm
Pig which starts the election = pig with id 5
PIG POSITION received. Total number of pigs alive  - 4
Bird landing position :8
Time taken by the bird :3
The Leader gets the bird time and bird landing positions and find the
affected pig
Pigs to be warned : [3, 1]
Received BIRD APPROACHING message - ID : 1 Leaders Clock value : 22.0
received pigs clock time : 15 synchronized to : 23.0
 pig with id 1 with position : 10 takes evasive action
Waiting till the leader has received all the statuses
received BIRD LANDING  message : 3 Leaders Clock: 24.0 recipients Clock
synchronized from 15 to : 25.0
received BIRD LANDING  message : 1 Leaders Clock: 24.0 recipients Clock
synchronized from 26.0 to : 27.0
Received BIRD HIT at (leader):  synchronized time at 5 : 26.0
Pig 3 Killed !
Received BIRD APPROACHING message - ID : 3 Leaders Clock value : 22.0
received pigs clock time : 27.0 synchronized to : 28.0
The Pigs that were hit : [3]
Score : 1
A visualization representing the result
Displaying the 1d grid
'0'-unoccupied
'1'-Pig
'2'-stone
'D'-Deadpig
'11'- Two pigs
['2', '0', '1', '0', '0', '0', '0', '2', 'D', '0', '0', '1', '1', '1']
y to continue / n to exit
```

Explanation :

In this iteration the two pigs that fail are pigs with ids 2 , 6 . Since according to bully algorithm the leader is the pig with the highest id and since that pig is down , pig with id 5 is elected as the leader . This pig coordinates the actions . The failed pigs are not depicted in the visualization since they are down.

Case 4 : Three random pigs fail in that particular iteration

```
Some pigs might fail in the network at random
the pigs that failed in the current iteration are :
[2, 3, 5]
Iteration : 1
Displaying the 1d grid
0-unoccupied
1-Pig
2-stone
positions denoted from 0 to 13 with 0 being on the left
[2, 0, 1, 0, 1, 0, 0, 2, 0, 2, 0, 0, 1, 1]
Leader election using the bully algorithm
Pig which starts the election = pig with id 4
LEADER ELECTED :6
PIG POSITION received. Total number of pigs alive  - 3
Bird landing position :2
Time taken by the bird :10
The Leader gets the bird time and bird landing positions and find the
affected pig
Pigs to be warned : [0]
Received BIRD APPROACHING message - ID : 0 Leaders Clock value : 20 received
pigs clock time : 18 synchronized to : 21.0
 pig with id 0 with position : 2 takes evasive action moves to : 3
Waiting till the leader has received all the statuses
received BIRD LANDING  message : 0 Leaders Clock: 23 recipients Clock
synchronized from 27.0 to : 28.0
Score : 0
A visualization representing the result
Displaying the 1d grid
'0'-unoccupied
'1'-Pig
'2'-stone
'D'-Deadpig
'11'- Two pigs
['2', '0', '0', '1', '1', '0', '0', '2', '0', '2', '1', '0', '0', '1']
y to continue / n to exit
```

Explanation :

The pigs with id 2 ,3,5 fail in this iteration . Hence the grid shows only 4 pigs . The execution happens like before and the bird escapes since the bird approaching comes before bird landing message

Case 5: When the bird falls in the leaders position

```
Some pigs might fail in the network at random
the pigs that failed in the current iteration are :
[]
Iteration : 1
Displaying the 1d grid
0-unoccupied
1-Pig
2-stone
positions denoted from 0 to 13 with 0 being on the left
[2, 0, 1, 0, 1, 0, 0, 2, 1, 2, 1, 1, 1, 1]
Leader election using the bully algorithm
Pig which starts the election = pig with id 0
LEADER ELECTED :6
PIG POSITION received. Total number of pigs alive  - 6
Bird landing position :4
Time taken by the bird :10
The Leader gets the bird time and bird landing positions and find the
affected pig
 the bird is falling at the leaders position
 leader takes evasive action and escapes
Pigs to be warned : []
Waiting till the leader has received all the statuses
Score : 0
A visualization representing the result
Displaying the 1d grid
'0'-unoccupied
'1'-Pig
'2'-stone
'D'-Deadpig
'11'- Two pigs
['2', '0', '1', '0', '0', '1', '0', '2', '1', '2', '1', '1', '1', '1']
y to continue / n to exit
```

Explanation :

If the bird is falling in the leaders position . The leader will definitely escape since there is no need for the message transfer and it moves to a safe position . If the pig in the neighborhood of the leader are affected the leader takes evasive action as well .

Case 6: Two pigs next to each other . The bird falls on one of the pigs . This pig falls on the next pig , both the pigs die

```
Some pigs might fail in the network at random
the pigs that failed in the current iteration are :
[]
Iteration : 1
Displaying the 1d grid
0-unoccupied
1-Pig
2-stone
positions denoted from 0 to 13 with 0 being on the left
[2, 0, 1, 0, 1, 0, 0, 2, 1, 2, 1, 1, 1, 1]
Leader election using the bully algorithm
Pig which starts the election = pig with id 3
LEADER ELECTED :6
PIG POSITION received. Total number of pigs alive  - 6
Bird landing position :10
Time taken by the bird :2
The Leader gets the bird time and bird landing positions and find the
affected pig
Pigs to be warned : [1, 2]
Waiting till the leader has received all the statuses
received BIRD LANDING  message : 1 Leaders Clock: 38 recipients Clock
synchronized from 11 to : 39.0
received BIRD LANDING  message : 2 Leaders Clock: 38 recipients Clock
synchronized from 6 to : 39.0
Received BIRD APPROACHING message - ID : 1 Leaders Clock value : 35 received
pigs clock time : 44.0 synchronized to : 45.0
Received BIRD APPROACHING message - ID : 2 Leaders Clock value : 35 received
pigs clock time : 47.0 synchronized to : 48.0
Received BIRD HIT at (leader):  synchronized time at 6 : 40.0
Pig 1 Killed !
Received BIRD HIT at (leader):  synchronized time at 6 : 40.0
Pig 2 Killed !
The Pigs that were hit : [1, 2]
Score : 2
A visualization representing the result
Displaying the 1d grid
'0'-unoccupied
'1'-Pig
'2'-stone
'D'-Deadpig
'11'- Two pigs
['2', '0', '1', '0', '1', '0', '0', '2', '1', '2', 'D', 'D', '1', '1']
y to continue / n to exit
```

Explanation :

Both the bird landing messages reach before the bird approaching messages and hence both the pigs are not able to take evasive action and are killed

Case 7: Two pigs next to each other . The bird falls on one of the pigs . One of the pigs escape

```
the pigs that failed in the current iteration are :
[]
Iteration : 1
Displaying the 1d grid
0-unoccupied
1-Pig
2-stone
positions denoted from 0 to 13 with 0 being on the left
[2, 0, 1, 0, 1, 0, 0, 2, 1, 2, 1, 1, 1, 1]
Leader election using the bully algorithm
Pig which starts the election = pig with id 1
LEADER ELECTED :6
PIG POSITION RECIEVED . Total number of pigs alive  - 6
Bird landing position :10
Time taken by the bird :2
The Leader gets the bird time and bird landing positions and find the
affected pig
Pigs to be warned : [1, 2]
Received BIRD APPROACHING message - ID : 2 Leaders Clock value : 79 received
pigs clock time : 27 Synchronized to : 80.0
 pig with id 2 with position : 11 takes evasive action
Waiting till the leader has received all the statuses
Received BIRD LANDING  message : 1 Leaders Clock: 83 Recipients Clock
synchronized from 23 to : 84.0
Received BIRD LANDING  message : 2 Leaders Clock: 83 Recipients Clock
synchronized from 87.0 to : 88.0
Received BIRD APPROACHING message - ID : 1 Leaders Clock value : 79 received
pigs clock time : 88.0 Synchronized to : 89.0
Received BIRD HIT at (leader):  Synchronized time at 6 : 85.0
Pig 1 Killed !
The Pigs that were hit : [1]
Score : 1
A visualization representing the result
Displaying the 1d grid
'0'-unoccupied
'1'-Pig
'2'-stone
'D'-Deadpig
'11'- Two pigs
['2', '0', '1', '0', '1', '0', '0', '2', '1', '2', 'D', '0', '11', '1']
y to continue / n to exit
```

Explanation :

Due to varying network delays the bird approaching packet reaches one pig and does not reach the other pig in time . Hence one of the pigs dies and the other pig takes an evasive action . From the messages it is clear the bird approaching event happens before bird landing in one case whereas it is the other way round in the second case

Case 8 : Two pigs next to each other . The bird falls on one of the pigs .The both pigs escapes because of the high bird time

```
Some pigs might fail in the network at random
the pigs that failed in the current iteration are :
[]
Iteration : 1
Displaying the 1d grid
0-unoccupied
1-Pig
2-stone
positions denoted from 0 to 13 with 0 being on the left
[2, 0, 1, 0, 1, 0, 0, 2, 1, 2, 1, 1, 1, 1]
Leader election using the bully algorithm
Pig which starts the election = pig with id 0
LEADER ELECTED :6
PIG POSITION received. Total number of pigs alive  - 6
Bird landing position :10
Time taken by the bird :10
The Leader gets the bird time and bird landing positions and find the
affected pig
Pigs to be warned : [1, 2]
Received BIRD APPROACHING message - ID : 1 Leaders Clock value : 143 received
pigs clock time : 37 synchronized to : 144.0
 pig with id 1 with position : 10 takes evasive action
Received BIRD APPROACHING message - ID : 2 Leaders Clock value : 143 received
pigs clock time : 49 synchronized to : 144.0
 pig with id 2 with position : 11 takes evasive action
Waiting till the leader has received all the statuses
received BIRD LANDING  message : 1 Leaders Clock: 148 recipients Clock
synchronized from 147.0 to : 149.0
received BIRD LANDING  message : 2 Leaders Clock: 148 recipients Clock
synchronized from 149.0 to : 150.0
Score : 0
A visualization representing the result
Displaying the 1d grid
'0'-unoccupied
'1'-Pig
'2'-stone
'D'-Deadpig
'11'- Two pigs
['2', '0', '1', '0', '1', '0', '0', '2', '1', '2', '0', '1', '11', '1']
y to continue / n to exit
```

Explanation :

Since the bird landing time is higher than the network delay the bird approaching packet reaches before the bird landing packet in this case and hence both the pigs take evasive action

Case 9: bird falls on pig , pig falls on stone column , stone column falls on the next pig

```
Displaying the 1d grid
0-unoccupied
1-Pig
2-stone
positions denoted from 0 to 13 with 0 being on the left
[2, 0, 1, 0, 1, 0, 0, 2, 1, 2, 1, 1, 1, 1]
Leader election using the bully algorithm
Pig which starts the election = pig with id 5
LEADER ELECTED :6
PIG POSITION received. Total number of pigs alive  - 6
Bird landing position :8
Time taken by the bird :3
The Leader gets the bird time and bird landing positions and find the
affected pig
Pigs to be warned : [3, 1]
Waiting till the leader has received all the statuses
received BIRD LANDING  message : 3 Leaders Clock: 32 recipients Clock
synchronized from 16 to : 33.0
received BIRD LANDING  message : 1 Leaders Clock: 32 recipients Clock
synchronized from 2 to : 33.0
Received BIRD APPROACHING message - ID : 1 Leaders Clock value : 31 received
pigs clock time : 37.0 synchronized to : 38.0
Received BIRD HIT at (leader):  synchronized time at 6 : 34.0
Pig 3 Killed !
Received BIRD APPROACHING message - ID : 3 Leaders Clock value : 31 received
pigs clock time : 41.0 synchronized to : 42.0
Received BIRD HIT at (leader):  synchronized time at 6 : 34.0
Pig 1 Killed !
The Pigs that were hit : [3, 1]
Score : 2
A visualization representing the result
Displaying the 1d grid
'0'-unoccupied
'1'-Pig
'2'-stone
'D'-Deadpig
'11'- Two pigs
['2', '0', '1', '0', '1', '0', '0', '2', 'D', '0', 'D', '1', '1', '1']
y to continue / n to exit
```

Explanation : here since both the bird landing messages come before the bird approaching messages both the pigs die . The pig dies and falls on the adjacent stone column and that falls on the next pig . The warning message is sent to both the pigs but due to the network delay the messages do not reach in time

Case 10 : Bird falls on no man's land

```
Some pigs might fail in the network at random
the pigs that failed in the current iteration are :
[]
Iteration : 1
Displaying the 1d grid
0-unoccupied
1-Pig
2-stone
positions denoted from 0 to 13 with 0 being on the left
[2, 0, 1, 0, 1, 0, 0, 2, 1, 2, 1, 1, 1, 1]
Leader election using the bully algorithm
Pig which starts the election = pig with id 1
LEADER ELECTED :6
PIG POSITION received. Total number of pigs alive  - 6
Bird landing position :1
Time taken by the bird :1
The Leader gets the bird time and bird landing positions and find the
affected pig
Pigs to be warned : []
Waiting till the leader has received all the statuses
Score : 0
A visualization representing the result
Displaying the 1d grid
'0'-unoccupied
'1'-Pig
'2'-stone
'D'-Deadpig
'11'- Two pigs
['2', '0', '1', '0', '1', '0', '0', '2', '1', '2', '1', '1', '1', '1']
y to continue / n to exit
```

Explanation :

Bird falls in no man's land no pig is notified

Case 11: Bird falls on a stone column which is not near any pig

```
Some pigs might fail in the network at random
the pigs that failed in the current iteration are :
[]
Iteration : 1
Displaying the 1d grid
0-unoccupied
1-Pig
2-stone
positions denoted from 0 to 13 with 0 being on the left
[2, 0, 1, 0, 1, 0, 0, 2, 1, 2, 1, 1, 1, 1]
Leader election using the bully algorithm
Pig which starts the election = pig with id 1
LEADER ELECTED :6
PIG POSITION received. Total number of pigs alive  - 6
Bird landing position :0
Time taken by the bird :1
The Leader gets the bird time and bird landing positions and find the
affected pig
Pigs to be warned : []
Waiting till the leader has received all the statuses
Score : 0
A visualization representing the result
Displaying the 1d grid
'0'-unoccupied
'1'-Pig
'2'-stone
'D'-Deadpig
'11'- Two pigs
['0', '0', '1', '0', '1', '0', '0', '2', '1', '2', '1', '1', '1', '1']
y to continue / n to exit
```

Note :

A number of other combinations were tried out as well . The code seemed to work for almost all of them