Experiment ‘p6_2_j_has_duplicates’ Results

December 18, 2025

Experiment outcome: SUCCESS
Bad responses: 0
Responses containing `assume` : 0
Resolution attempts: 7
Hard fails (resolution): 0
Soft fails (resolution): 0
Verification attempts: 7

Problem Specification

Problem name: p6_2_j_has_duplicates
Natural language statement: Write a method to return true if the given array contains duplicate elements (which need not be adjacent).
Method signature: p6_2_j_has_duplicates(arr: seq<int>) returns (hasDuplicates: bool)

Ensures

- `hasDuplicates == (exists i, j :: 0 <= i < j < |arr| && arr[i] == arr[j])`

Requires

- `|arr| >= 2`

GenAI interactions

Below you will find all interactions between the ‘user’ (program) and the ‘assistant’ (OpenAI).

Program → GenAI

```
You are given the following task to perform in Dafny:

Write a method to return true if the given array contains duplicate elements (which need not be adjacent).

The signature should be:

method p6_2_j_has_duplicates(arr: seq<int>) returns (hasDuplicates: bool)

The method should respect the following contract:

requires |arr| >= 2, ensures hasDuplicates == (exists i, j :: 0 <= i < j < |arr| && arr[i] == arr[j])

Produce and show only the Dafny body of this method, including the curly braces that surround it. Do not show the signature nor contract. You must not use 'assume' anywhere in your code.
```

GenAI → Program

System fingerprint:
ID: chatcmpl-Co59Wz52cxDRwG42CcjENOM7WcJD4
Model: gpt-5.1-chat-latest
Created at: 1766052242
Finish reason: stop
Usage: 320 tokens in, and 388 tokens out

```
{
  var i := 0;
  while i < |arr|
    invariant 0 <= i <= |arr|
  {
    var j := i + 1;
    while j < |arr|
      invariant i + 1 <= j <= |arr|
    {
      if arr[i] == arr[j] {
        return true;
      }
      j := j + 1;
    }
    i := i + 1;
  }
  return false;
}
```

Program → GenAI

```
When using dafny verify, the below error is emitted and verify fails:

problem_data/p6_2_j_has_duplicates/program.dfy(20,2): Error: a postcondition could not be
    ↪  proved on this return path
   |
20 | return false;
   | ^^^^^^^^^^^^^

problem_data/p6_2_j_has_duplicates/program.dfy(3,23): Related location: this is the
    ↪ postcondition that could not be proved
  |
3 |  ensures hasDuplicates == (exists i, j :: 0 <= i < j < |arr| && arr[i] == arr[j])
  | ^^


Dafny program verifier finished with 1 verified, 1 error

Correct the error by altering only the method body. Produce and show only the Dafny body,
    ↪  including the curly braces that surround it. Do not show the signature nor
    ↪ contract. You must not use 'assume' anywhere in your code.
```

GenAI → Program

System fingerprint:
ID: chatcmpl-Co59cH2nOXEMRDIpLJhjFT2cpTcaT
Model: gpt-5.1-chat-latest
Created at: 1766052248
Finish reason: stop
Usage: 701 tokens in, and 265 tokens out

```
{
  var hasDup := false;
  var i := 0;
  while i < |arr|
    invariant 0 <= i <= |arr|
    invariant hasDup ==> (exists a, b :: 0 <= a < b < |arr| && arr[a] == arr[b])
    invariant !hasDup ==> (forall a, b :: 0 <= a < b < i ==> arr[a] != arr[b])
  {
    var j := i + 1;
    while j < |arr|
      invariant i + 1 <= j <= |arr|
      invariant hasDup ==> (exists a, b :: 0 <= a < b < |arr| && arr[a] == arr[b])
      invariant !hasDup ==> (forall a, b :: 0 <= a < b < j ==> arr[a] != arr[b])
    {
      if arr[i] == arr[j] {
        hasDup := true;
      }
      j := j + 1;
    }
    i := i + 1;
  }
  return hasDup;
}
```

Program → GenAI

```
When using dafny verify, the below error is emitted and verify fails:

problem_data/p6_2_j_has_duplicates/program.dfy(16,29): Error: this loop invariant could
    ↪ not be proved on entry
 Related message: loop invariant violation
   |
16 | invariant !hasDup ==> (forall a, b :: 0 <= a < b < j ==> arr[a] != arr[b])
   | ^^^^^^

problem_data/p6_2_j_has_duplicates/program.dfy(16,29): Error: this invariant could not be
    ↪  proved to be maintained by the loop
 Related message: loop invariant violation
   |
16 | invariant !hasDup ==> (forall a, b :: 0 <= a < b < j ==> arr[a] != arr[b])
   | ^^^^^^



Dafny program verifier finished with 1 verified, 2 errors

Correct the error by altering only the method body. Produce and show only the Dafny body,
    ↪  including the curly braces that surround it. Do not show the signature nor
    ↪ contract. You must not use 'assume' anywhere in your code.
```

GenAI → Program

System fingerprint:
ID: chatcmpl-Co59hIea2ekqrh0VuFwwPqD5NPLXd
Model: gpt-5.1-chat-latest
Created at: 1766052253
Finish reason: stop
Usage: 1232 tokens in, and 394 tokens out

```
{
  var i := 0;
  while i < |arr|
    invariant 0 <= i <= |arr|
    invariant forall a, b :: 0 <= a < b < i ==> arr[a] != arr[b]
  {
    var j := i + 1;
    while j < |arr|
      invariant i + 1 <= j <= |arr|
      invariant forall a, b :: 0 <= a < b < i ==> arr[a] != arr[b]
      invariant forall k :: i + 1 <= k < j ==> arr[i] != arr[k]
    {
      if arr[i] == arr[j] {
```

```
    return true;
   }
   j := j + 1;
  }
  i := i + 1;
 }
 return false;
}
```

Program → GenAI

```
When using dafny verify, the below error is emitted and verify fails:

problem_data/p6_2_j_has_duplicates/program.dfy(8,14): Error: this invariant could not be
    ↪ proved to be maintained by the loop
 Related message: loop invariant violation
  |
8 | invariant forall a, b :: 0 <= a < b < i ==> arr[a] != arr[b]
  | ^^^^^^



Dafny program verifier finished with 1 verified, 1 error

Correct the error by altering only the method body. Produce and show only the Dafny body,
    ↪  including the curly braces that surround it. Do not show the signature nor
    ↪ contract. You must not use 'assume' anywhere in your code.
```

GenAI → Program

System fingerprint:
ID: chatcmpl-Co59pwWQ1hDpxxDOTvAJUlMpeHn3Z
Model: gpt-5.1-chat-latest
Created at: 1766052261
Finish reason: stop
Usage: 1507 tokens in, and 317 tokens out

```
{
 var seen: set<int> := {};
 var i := 0;
 while i < |arr|
  invariant 0 <= i <= |arr|
  invariant seen == set x | 0 <= x < i :: arr[x]
 {
  if arr[i] in seen {
   return true;
  }
  seen := seen + {arr[i]};
  i := i + 1;
 }
 return false;
}
```

Program → GenAI

```
When using dafny verify, the below error is emitted and verify fails:

problem_data/p6_2_j_has_duplicates/program.dfy(17,2): Error: a postcondition could not be
    ↪  proved on this return path
   |
17 | return false;
   | ^^^^^^^^^^^^^

problem_data/p6_2_j_has_duplicates/program.dfy(3,23): Related location: this is the
    ↪ postcondition that could not be proved
  |
3 |  ensures hasDuplicates == (exists i, j :: 0 <= i < j < |arr| && arr[i] == arr[j])
  | ^^


Dafny program verifier finished with 1 verified, 1 error

Correct the error by altering only the method body. Produce and show only the Dafny body,
    ↪  including the curly braces that surround it. Do not show the signature nor
    ↪ contract. You must not use 'assume' anywhere in your code.
```

GenAI → Program

System fingerprint:
ID: chatcmpl-Co59uZDv3T8Mu163jODusLcfl3UvQ
Model: gpt-5.1-chat-latest
Created at: 1766052266
Finish reason: stop
Usage: 1872 tokens in, and 261 tokens out

```
{
  var seen: set<int> := {};
  var i := 0;
  while i < |arr|
    invariant 0 <= i <= |arr|
    invariant seen == set x | 0 <= x < i :: arr[x]
    invariant |seen| == i
  {
    if arr[i] in seen {
      return true;
    }
    seen := seen + {arr[i]};
    i := i + 1;
  }
  return false;
}
```

Program → GenAI

```
When using dafny verify, the below error is emitted and verify fails:

problem_data/p6_2_j_has_duplicates/program.dfy(18,2): Error: a postcondition could not be
    ↪  proved on this return path
   |
18 | return false;
   | ^^^^^^^^^^^^^

problem_data/p6_2_j_has_duplicates/program.dfy(3,23): Related location: this is the
    ↪ postcondition that could not be proved
  |
3 |  ensures hasDuplicates == (exists i, j :: 0 <= i < j < |arr| && arr[i] == arr[j])
  | ^^


Dafny program verifier finished with 1 verified, 1 error

Correct the error by altering only the method body. Produce and show only the Dafny body,
    ↪  including the curly braces that surround it. Do not show the signature nor
    ↪ contract. You must not use 'assume' anywhere in your code.
```

GenAI → Program

System fingerprint:
ID: chatcmpl-Co59yLfluBAMyHjRNmquTW3CIacL3
Model: gpt-5.1-chat-latest
Created at: 1766052270
Finish reason: stop
Usage: 2201 tokens in, and 513 tokens out

```
{
  var i := 0;
  while i < |arr|
    invariant 0 <= i <= |arr|
    invariant forall a, b :: 0 <= a < b < i ==> arr[a] != arr[b]
  {
    var j := i + 1;
    while j < |arr|
      invariant i + 1 <= j <= |arr|
      invariant forall a, b :: (0 <= a < b < i) || (a == i && i < b < j) ==> arr[a] != arr
          ↪ [b]
    {
      if arr[i] == arr[j] {
        return true;
      }
      j := j + 1;
    }
    i := i + 1;
  }
  return false;
}
```

Program → GenAI

```
When using dafny verify, the below error is emitted and verify fails:

problem_data/p6_2_j_has_duplicates/program.dfy(8,14): Error: this invariant could not be
    ↪ proved to be maintained by the loop
 Related message: loop invariant violation
  |
8 | invariant forall a, b :: 0 <= a < b < i ==> arr[a] != arr[b]
  | ^^^^^^



Dafny program verifier finished with 1 verified, 1 error

Correct the error by altering only the method body. Produce and show only the Dafny body,
    ↪  including the curly braces that surround it. Do not show the signature nor
    ↪ contract. You must not use 'assume' anywhere in your code.
```

GenAI → Program

System fingerprint:
ID: chatcmpl-Co5A5Sg69HcMSjAycj3PI8GZBcX3P
Model: gpt-5.1-chat-latest
Created at: 1766052277
Finish reason: stop
Usage: 2502 tokens in, and 797 tokens out

```
{
  var seen: set<int> := {};
  var i := 0;
  while i < |arr|
    invariant 0 <= i <= |arr|
    invariant seen == set x | 0 <= x < i :: arr[x]
    invariant |seen| == i
    invariant forall a, b :: 0 <= a < b < i ==> arr[a] != arr[b]
  {
    if arr[i] in seen {
      return true;
    }
    seen := seen + {arr[i]};
    i := i + 1;
  }
  return false;
}
```

Final Program

```
method p6_2_j_has_duplicates(arr: seq<int>) returns (hasDuplicates: bool)
       requires |arr| >= 2
       ensures hasDuplicates == (exists i, j :: 0 <= i < j < |arr| && arr[i] == arr[j])
{
  var seen: set<int> := {};
  var i := 0;
  while i < |arr|
    invariant 0 <= i <= |arr|
    invariant seen == set x | 0 <= x < i :: arr[x]
    invariant |seen| == i
    invariant forall a, b :: 0 <= a < b < i ==> arr[a] != arr[b]
  {
    if arr[i] in seen {
      return true;
    }
    seen := seen + {arr[i]};
    i := i + 1;
  }
  return false;
}
```

Total Token Usage

Input tokens: 10335
Output tokens: 2935
Reasoning tokens: 1728
Sum of 'total tokens': 13270

Experiment Timings

Overall Experiment started at 1766052244462, ended at 1766052289296, lasting 44834ms (44.83 seconds)
Iteration #4 started at 1766052263167, ended at 1766052268212, lasting 5045ms (5.05 seconds)
Iteration #5 started at 1766052268212, ended at 1766052272455, lasting 4243ms (4.24 seconds)
Iteration #6 started at 1766052272455, ended at 1766052279723, lasting 7268ms (7.27 seconds)
Iteration #7 started at 1766052279723, ended at 1766052289296, lasting 9573ms (9.57 seconds)
Iteration #1 started at 1766052244462, ended at 1766052250680, lasting 6218ms (6.22 seconds)
Iteration #2 started at 1766052250680, ended at 1766052255720, lasting 5040ms (5.04 seconds)
Iteration #3 started at 1766052255720, ended at 1766052263167, lasting 7447ms (7.45 seconds)