

# Experiment ‘p5\_6\_countVowels’ Results

December 18, 2025

**Experiment outcome:** FAILURE\_VERIFY

**Bad responses:** 0

**Responses containing assume :** 0

**Resolution attempts:** 8

**Hard fails (resolution):** 6

**Soft fails (resolution):** 0

**Verification attempts:** 2

## Problem Specification

**Problem name:** p5\_6\_countVowels

**Natural language statement:** Write a method that returns the count of all vowels in a string. Vowels are the letters a, e, i, o, and u, and their uppercase variants.

**Method signature:** p5\_6\_countVowels(str: seq<char>) returns (vowelCount: int)

### Ensures

- `vowelCount >= 0`
- `vowelCount <= |str|`
- `(forall c :: c in str ==> (c == 'a' || c == 'e' || c == 'i' || c == 'o' || c == 'u' || c == 'A' || c == 'E' || c == 'I' || c == 'O' || c == 'U')) ==> vowelCount == |str|`
- `(forall c :: c in str ==> !(c == 'a' || c == 'e' || c == 'i' || c == 'o' || c == 'u' || c == 'A' || c == 'E' || c == 'I' || c == 'O' || c == 'U')) ==> vowelCount == 0`

## 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 that returns the count of all vowels in a string. Vowels are the letters a ↪ , e, i, o, and u, and their uppercase variants.

The signature should be:

```
method p5_6_countVowels(str: seq<char>) returns (vowelCount: int)
```

The method should respect the following contract:

```
ensures vowelCount >= 0, ensures vowelCount <= |str|, ensures (forall c :: c in str ==> (c == 'a' || c == 'e' || c == 'i' || c == 'o' || c == 'u' || c == 'A' || c == 'E' || c == 'I' || c == 'O' || c == 'U')) ==> vowelCount == |str|, ensures (forall c :: c in str ==> !(c == 'a' || c == 'e' || c == 'i' || c == 'o' || c == 'u' || c == 'A' || c == 'E' || c == 'I' || c == 'O' || c == 'U')) ==> vowelCount == 0
```

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-Co4wH07wVDD77id34cPignYubvwUL

Model: gpt-5.1-chat-latest

Created at: 1766051421

Finish reason: stop

Usage: 618 tokens in, and 477 tokens out

```
{  
    vowelCount := 0;  
    var i := 0;  
    while i < |str|  
        invariant 0 <= i <= |str|;  
        invariant 0 <= vowelCount <= i;  
        invariant vowelCount == |{ j:int | 0 <= j < i && (str[j] == 'a' || str[j] == 'e' || str[j] == 'i' || str[j] == 'o' || str[j] == 'u' || str[j] == 'A' || str[j] == 'E' || str[j] == 'I' || str[j] == 'O' || str[j] == 'U') }|;  
    {  
        if str[i] == 'a' || str[i] == 'e' || str[i] == 'i' || str[i] == 'o' || str[i] == 'u'  
            || str[i] == 'A' || str[i] == 'E' || str[i] == 'I' || str[i] == 'O' || str[i] == 'U'  
        {  
            vowelCount := vowelCount + 1;  
        }  
    }
```

```

        i := i + 1;
    }
}
```

## Program → GenAI

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

```

problem_data/p5_6_countVowels/program.dfy(10,29): Warning: deprecated style: a semi-colon
    ↪ is not needed here
|
10 | invariant 0 <= i <= |str|;
| ^

problem_data/p5_6_countVowels/program.dfy(11,34): Warning: deprecated style: a semi-colon
    ↪ is not needed here
|
11 | invariant 0 <= vowelCount <= i;
| ^

problem_data/p5_6_countVowels/program.dfy(12,32): Error: rbrace expected
|
12 | invariant vowelCount == |{ j:int | 0 <= j < i && (str[j] == 'a' || str[j] == 'e' ||
    ↪ str[j] == 'i' || str[j] == 'o' || str[j] == 'u' || str[j] == 'A' || str[j] == 'E' ||
    ↪ || str[j] == 'I' || str[j] == 'O' || str[j] == 'U') }|;
| ^

1 parse errors detected in program.dfy
```

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-Co4wNyixqZWUICplf3uBni0mSosHh

**Model:** gpt-5.1-chat-latest

**Created at:** 1766051427

**Finish reason:** stop

**Usage:** 1219 tokens in, and 544 tokens out

```
{
    vowelCount := 0;
    var i := 0;
    while i < |str|
        invariant 0 <= i <= |str|
        invariant 0 <= vowelCount <= i
        invariant vowelCount == |{ j:int | 0 <= j < i &&
            (str[j] == 'a' || str[j] == 'e' || str[j] == 'i' || str[j] ==
            ↪ 'o' || str[j] == 'u' ||
```

```

        str[j] == 'A' || str[j] == 'E' || str[j] == 'I' || str[j] ==
        ↪ 'O' || str[j] == 'U') })|
{
    if str[i] == 'a' || str[i] == 'e' || str[i] == 'i' || str[i] == 'o' || str[i] == 'u'
    ↪ ||
        str[i] == 'A' || str[i] == 'E' || str[i] == 'I' || str[i] == 'O' || str[i] == 'U'
    {
        vowelCount := vowelCount + 1;
    }
    i := i + 1;
}
}

```

## Program → GenAI

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

```

problem_data/p5_6_countVowels/program.dfy(12,33): Error: rbrace expected
|
12 | invariant vowelCount == |({ j:int | 0 <= j < i &&
| ^
|
1 parse errors detected in program.dfy

```

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-Co4wUPCwOvYEEPvCKOOdol8LjcOj4

**Model:** gpt-5.1-chat-latest

**Created at:** 1766051434

**Finish reason:** stop

**Usage:** 1447 tokens in, and 352 tokens out

```

{
    vowelCount := 0;
    var i := 0;
    while i < |str|
        invariant 0 <= i <= |str|
        invariant 0 <= vowelCount <= i
        invariant vowelCount == |{ j:int | 0 <= j < i &&
            (str[j] == 'a' || str[j] == 'e' || str[j] == 'i' || str[j] ==
            ↪ 'o' || str[j] == 'u' ||
            str[j] == 'A' || str[j] == 'E' || str[j] == 'I' || str[j] == 'O' ||
            ↪ str[j] == 'U') }|
    {
        if str[i] == 'a' || str[i] == 'e' || str[i] == 'i' || str[i] == 'o' || str[i] == 'u'
        ↪ ||

```

```

        str[i] == 'A' || str[i] == 'E' || str[i] == 'I' || str[i] == 'O' || str[i] == 'U'
    {
        vowelCount := vowelCount + 1;
    }
    i := i + 1;
}
}

```

## Program → GenAI

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

```

problem_data/p5_6_countVowels/program.dfy(12,32): Error: rbrace expected
|
12 | invariant vowelCount == |{ j:int | 0 <= j < i &&
| ^
|
1 parse errors detected in program.dfy

```

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:** chatmpl-Co4wY5mpGoQpmdQX67nEJBXm2v3lV

**Model:** gpt-5.1-chat-latest

**Created at:** 1766051438

**Finish reason:** stop

**Usage:** 1857 tokens in, and 246 tokens out

```

{
    vowelCount := 0;
    var i := 0;
    while i < |str|
        invariant 0 <= i <= |str|
        invariant 0 <= vowelCount <= i
    {
        if str[i] == 'a' || str[i] == 'e' || str[i] == 'i' || str[i] == 'o' || str[i] == 'u'
            ↳ ||
        str[i] == 'A' || str[i] == 'E' || str[i] == 'I' || str[i] == 'O' || str[i] == 'U'
        {
            vowelCount := vowelCount + 1;
        }
        i := i + 1;
    }
}

```

## Program → GenAI

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

```
problem_data/p5_6_countVowels/program.dfy(6,0): Error: a postcondition could not be
  ↪ proved on this return path
|
6 | {
| ^
|
problem_data/p5_6_countVowels/program.dfy(4,170): Related location: this is the
  ↪ postcondition that could not be proved
|
4 | ensures (forall c :: c in str ==> (c == 'a' || c == 'e' || c == 'i' || c == 'o' || c
  ↪ == 'u' || c == 'A' || c == 'E' || c == 'I' || c == 'O' || c == 'U')) ==>
  ↪ vowelCount == |str|
| ^^
|
problem_data/p5_6_countVowels/program.dfy(6,0): Error: a postcondition could not be
  ↪ proved on this return path
|
6 | {
| ^
|
problem_data/p5_6_countVowels/program.dfy(5,171): Related location: this is the
  ↪ postcondition that could not be proved
|
5 | ensures (forall c :: c in str ==> !(c == 'a' || c == 'e' || c == 'i' || c == 'o' ||
  ↪ c == 'u' || c == 'A' || c == 'E' || c == 'I' || c == 'O' || c == 'U')) ==>
  ↪ vowelCount == 0
| ^^
```

Dafny program verifier finished with 0 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-Co4wdZpf278cUlDEPJGwsWHKNiiEa

Model: gpt-5.1-chat-latest

Created at: 1766051443

Finish reason: stop

Usage: 2713 tokens in, and 282 tokens out

```
{
  vowelCount := 0;
  var i := 0;
  while i < |str|
```

```

invariant 0 <= i <= |str|
invariant 0 <= vowelCount <= i
invariant vowelCount == |{ j:int | 0 <= j < i && (str[j] == 'a' || str[j] == 'e' ||
    ↪ str[j] == 'i' || str[j] == 'o' || str[j] == 'u' || str[j] == 'A' || str[j] == 'E' ||
    ↪ str[j] == 'I' || str[j] == 'O' || str[j] == 'U') }|
{
    if str[i] == 'a' || str[i] == 'e' || str[i] == 'i' || str[i] == 'o' || str[i] == 'u' ||
        ↪ ||
        str[i] == 'A' || str[i] == 'E' || str[i] == 'I' || str[i] == 'O' || str[i] == 'U'
    {
        vowelCount := vowelCount + 1;
    }
    i := i + 1;
}
}

```

## Program → GenAI

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

```

problem_data/p5_6_countVowels/program.dfy(12,32): Error: rbrace expected
|
12 | invariant vowelCount == |{ j:int | 0 <= j < i && (str[j] == 'a' || str[j] == 'e' ||
    ↪ str[j] == 'i' || str[j] == 'o' || str[j] == 'u' || str[j] == 'A' || str[j] == 'E' ||
    ↪ || str[j] == 'I' || str[j] == 'O' || str[j] == 'U') }|
| ^
1 parse errors detected in program.dfy

```

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-Co4wiCz2Cw9KGbDTpSC6cmeURaWSu

**Model:** gpt-5.1-chat-latest

**Created at:** 1766051448

**Finish reason:** stop

**Usage:** 3005 tokens in, and 546 tokens out

```
{
    vowelCount := 0;
    var i := 0;
    while i < |str|
        invariant 0 <= i <= |str|
        invariant 0 <= vowelCount <= i
        invariant vowelCount == (| { j:int | 0 <= j < i &&
            (str[j] == 'a' || str[j] == 'e' || str[j] == 'i' || str[j] ==
            ↪ 'o' || str[j] == 'u' ||
```

```

        str[j] == 'A' || str[j] == 'E' || str[j] == 'I' || str[j] ==
        ↪ 'O' || str[j] == 'U') } |)
{
  if str[i] == 'a' || str[i] == 'e' || str[i] == 'i' || str[i] == 'o' || str[i] == 'u'
    ↪ ||
    str[i] == 'A' || str[i] == 'E' || str[i] == 'I' || str[i] == 'O' || str[i] == 'U'
  {
    vowelCount := vowelCount + 1;
  }
  i := i + 1;
}
}

```

## Program → GenAI

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

```

problem_data/p5_6_countVowels/program.dfy(12,34): Error: rbrace expected
|
12 | invariant vowelCount == (| { j:int | 0 <= j < i &&
| ^
|
1 parse errors detected in program.dfy

```

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-Co4wpheKtNSDCyi1rro0pCLMNIYZJ

**Model:** gpt-5.1-chat-latest

**Created at:** 1766051455

**Finish reason:** stop

**Usage:** 3337 tokens in, and 182 tokens out

```

{
  vowelCount := 0;
  var i := 0;
  while i < |str|
    invariant 0 <= i <= |str|
    invariant 0 <= vowelCount <= i
  {
    if str[i] == 'a' || str[i] == 'e' || str[i] == 'i' || str[i] == 'o' || str[i] == 'u'
      ↪ ||
      str[i] == 'A' || str[i] == 'E' || str[i] == 'I' || str[i] == 'O' || str[i] == 'U'
    {
      vowelCount := vowelCount + 1;
    }
    i := i + 1;
}

```

```
}
```

## Program → GenAI

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

```
problem_data/p5_6_countVowels/program.dfy(6,0): Error: a postcondition could not be
  ↪ proved on this return path
|
6 | {
| ^
|



problem_data/p5_6_countVowels/program.dfy(4,170): Related location: this is the
  ↪ postcondition that could not be proved
|
4 | ensures (forall c :: c in str ==> (c == 'a' || c == 'e' || c == 'i' || c == 'o' || c
  ↪ == 'u' || c == 'A' || c == 'E' || c == 'I' || c == 'O' || c == 'U')) ==>
  ↪ vowelCount == |str|
| ^~



problem_data/p5_6_countVowels/program.dfy(6,0): Error: a postcondition could not be
  ↪ proved on this return path
|
6 | {
| ^



problem_data/p5_6_countVowels/program.dfy(5,171): Related location: this is the
  ↪ postcondition that could not be proved
|
5 | ensures (forall c :: c in str ==> !(c == 'a' || c == 'e' || c == 'i' || c == 'o' ||
  ↪ c == 'u' || c == 'A' || c == 'E' || c == 'I' || c == 'O' || c == 'U')) ==>
  ↪ vowelCount == 0
| ^~



Dafny program verifier finished with 0 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-Co4wtqGduhREERH6MB0zfz6TisqzD

**Model:** gpt-5.1-chat-latest

**Created at:** 1766051459

**Finish reason:** stop

**Usage:** 4192 tokens in, and 540 tokens out

```

{
    vowelCount := 0;
    var i := 0;
    while i < |str|
        invariant 0 <= i <= |str|
        invariant 0 <= vowelCount <= i
        invariant vowelCount == (|{ j:int | 0 <= j < i && (str[j] == 'a' || str[j] == 'e' ||
            ↪ str[j] == 'i' || str[j] == 'o' || str[j] == 'u' || str[j] == 'A' || str[j] == 'E' ||
            ↪ str[j] == 'I' || str[j] == 'O' || str[j] == 'U') }|)
    {
        if str[i] == 'a' || str[i] == 'e' || str[i] == 'i' || str[i] == 'o' || str[i] == 'u' ||
            ↪ ||
            str[i] == 'A' || str[i] == 'E' || str[i] == 'I' || str[i] == 'O' || str[i] == 'U'
        {
            vowelCount := vowelCount + 1;
        }
        i := i + 1;
    }
}

```

## Final Program

```

method p5_6_countVowels(str: seq<char>) returns (vowelCount: int)
    ensures vowelCount >= 0
    ensures vowelCount <= |str|
    ensures (forall c :: c in str ==> (c == 'a' || c == 'e' || c == 'i' || c == 'o' ||
        ↪ c == 'u' || c == 'A' || c == 'E' || c == 'I' || c == 'O' || c == 'U')) ==>
        ↪ vowelCount == |str|
    ensures (forall c :: c in str ==> !(c == 'a' || c == 'e' || c == 'i' || c == 'o' ||
        ↪ || c == 'u' || c == 'A' || c == 'E' || c == 'I' || c == 'O' || c == 'U'))
        ↪ ==> vowelCount == 0
{
    vowelCount := 0;
    var i := 0;
    while i < |str|
        invariant 0 <= i <= |str|
        invariant 0 <= vowelCount <= i
        invariant vowelCount == (|{ j:int | 0 <= j < i && (str[j] == 'a' || str[j] == 'e' ||
            ↪ str[j] == 'i' || str[j] == 'o' || str[j] == 'u' || str[j] == 'A' || str[j] == 'E' ||
            ↪ str[j] == 'I' || str[j] == 'O' || str[j] == 'U') }|)
    {
        if str[i] == 'a' || str[i] == 'e' || str[i] == 'i' || str[i] == 'o' || str[i] == 'u' ||
            ↪ ||
            str[i] == 'A' || str[i] == 'E' || str[i] == 'I' || str[i] == 'O' || str[i] == 'U'
        {
            vowelCount := vowelCount + 1;
        }
        i := i + 1;
    }
}

```

---

## Total Token Usage

**Input tokens:** 18388

**Output tokens:** 3169

**Reasoning tokens:** 1088

**Sum of ‘total tokens’:** 21557

## Experiment Timings

**Iteration #8** started at 1766051461212, ended at 1766051467731, lasting 6519ms (6.52 seconds)

**Overall Experiment** started at 1766051423027, ended at 1766051467731, lasting 44704ms (44.70 seconds)

**Iteration #4** started at 1766051440767, ended at 1766051445689, lasting 4922ms (4.92 seconds)

**Iteration #5** started at 1766051445689, ended at 1766051450561, lasting 4872ms (4.87 seconds)

**Iteration #6** started at 1766051450561, ended at 1766051457094, lasting 6533ms (6.53 seconds)

**Iteration #7** started at 1766051457094, ended at 1766051461212, lasting 4118ms (4.12 seconds)

**Iteration #1** started at 1766051423027, ended at 1766051429320, lasting 6293ms (6.29 seconds)

**Iteration #2** started at 1766051429320, ended at 1766051436027, lasting 6707ms (6.71 seconds)

**Iteration #3** started at 1766051436027, ended at 1766051440767, lasting 4740ms (4.74 seconds)