

# 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-Co4wUPCwOvYEEPvCKOOdol8LjcOi4

**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:** chatcmpl-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-Co4wpheKtNSDCyilrro0pCLMNiYZJ

**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)