

Maple Learn Content Tools

Maple 2021 provides new tools for creating documents and interactive applications programmatically. These tools can be used to develop [Maple Learn](#) content or to create applications to be used in Maple. Maple Learn is a new online environment designed specifically for teaching and learning mathematics.

[Canvas Scripting](#)

[Help with Math Problems](#)

[Canvas-based Practice Sheets](#)

[Animated Step-by-Step Solutions](#)

Canvas Scripting

Maple 2021 provides new tools for creating documents and interactive applications programmatically. The new concept of a canvas has two main uses.

First, the canvas allows you to create Maple Learn content in Maple and then share it through Maple Learn. This allows instructors to take advantage of Maple's more advanced document and analysis tools to create sophisticated content that students can then use in Maple Learn.

Second, the canvas provides a framework for Maple users to easily build applications where the number of required input fields is not known in advance. The user can create as many input fields as they need as they use the application, and Maple looks after the details of creating and extracting the information from those fields for you. All canvas applications be used in Maple or shared through Maple Learn.

Canvas Package

The [DocumentTools\[Canvas\]](#) package builds on [DocumentTools](#) component primitives to provide a simple way to generate a grid layout of text and math.

A *canvas* is both:

1. a document template where math can be inserted and acted upon by button clicks within Maple, and
2. the document environment used by [Maple Learn](#).

The [NewCanvas](#) and [ShowCanvas](#) commands can be used to construct and display math and text content organized in a grid layout. When a [ScriptButton](#) is present, additional

controls and blank entry boxes are available for user input. Using [Script](#) actions the math and text can be modified and/or annotated.

In scenario 1., the canvas is viewed and interacted with directly inside a Maple document.

In scenario 2., the [ShareCanvas](#) command is used to send the canvas to [Maple Learn](#), where it can be viewed and interacted with inside a web browser.

Simple Example

In this example we use the [NewCanvas](#) command with lists of content in order to arrange the output into two columns.

```
> with(DocumentTools:-Canvas) :
```

```
> eq1 := ∫-∞∞ √(√xn +  $\frac{1}{\alpha + \beta^\gamma}$ ) dx :
```

```
> inerteq := %+(1, 1) :
```

```
> cv := NewCanvas([ "Canvas Layout Example",  
                  [ "Column 1", "Column 2" ],  
                  [ Math( $\pi$ ), Text("Mixed text and %1", √(b2 - 4 a c) ) ],  
                  [ inerteq, eq1 ]  
                ]):
```

The [ShowCanvas](#) command displays the created canvas.

```
> ShowCanvas(cv)
```

Canvas Layout Example

Column 1

π

$1 + 1$

Column 2

Mixed text and

$$\sqrt{-4ac + b^2}$$

$$\int_{-\infty}^{\infty} \sqrt{\sqrt{x^n} + \frac{1}{\alpha + \beta^\gamma}} dx$$

The [ShareCanvas](#) command sends the canvas to Maple Learn and gives you a link to your document.

> *ShareCanvas*(cv)

<https://learn.maplesoft.com/#/?d=JSKFAPGRLOEMOILRAHFTGFBHFKCOHUHPKULNFPBTELLSOGHNDUMSOIPNBPLLMLKPHPHKCTKPEKLNNFPOPHOGOJPNPNLOAJPJPAK>

Interactive Example

In this example, we will define an application that allows user input and provides feedback. The FindPrimes procedure will run when a button is pressed. It will use the [GetMath](#) command to extract all of the math in the canvas area, then use [Script](#) commands, including [Annotate](#) to add annotations to the inputs.

```
> FindPrimes := proc( canvas )
    uses DC=DocumentTools:-Canvas;
    local script := DC:-Script();
    for local m in DC:-GetMath(canvas) do # get all the math in
the canvas
        SetActive(script,m); # set the location of the
annotation
        if m:-math::integer and isprime(m:-math) then
```

```

        Annotate(script,"Good job, this is prime");    #
    annotate based on the given math
    else
        Annotate(script,"This is not prime");
    end if;
end do;
ToString(script);
end proc:

```

Generate the canvas

```

> with(DocumentTools:-Canvas) :
> cv := NewCanvas(["Write Some Prime Numbers Anywhere", ScriptButton("Check Your Page",
    FindPrimes, position = [500, 50])]) :

```

To test this within Maple, run:

```

> ShowCanvas(cv)

```

Write Some Prime Numbers
Anywhere

Check Your Page

3

Good job, this is prime

10

This is not prime

> New Math Entry Box

To try this on the web using [Maple Learn](https://learn.maplesoft.com/#/?d=PKHUBIIINLGTCLNKLJPERNOMOFJDQDFETEKNOIFHOGOMMKIAGJQFHFSOODNCPPGNKEMAMPGRHTGIESNLLKNGBRFPKDKDQOQFBPEHOT), execute:

```

> ShareCanvas(cv);

```

<https://learn.maplesoft.com/#/?d=PKHUBIIINLGTCLNKLJPERNOMOFJDQDFETEKNOIFHOGOMMKIAGJQFHFSOODNCPPGNKEMAMPGRHTGIESNLLKNGBRFPKDKDQOQFBPEHOT>

Help with Math Problems

The new [SolvePractice](#) command generates a canvas with [SolveFeedback](#) as the

command behind the button.

> *with(Grading)* :

> *SolvePractice*($2x + 3 = 4x - 5, x$)

Solve this equation

Check Page

$$2x + 3 = 4x - 5$$

ok

Check this step...

consistent with previous step

no correct and fully simplified
solution found; please try again

> New Math Entry Box

This interactive example can also be shared via Maple Learn:

cv := SolvePractice($2x + 3 = 4x - 5, x, 'output'='link'$) :

<https://learn.maplesoft.com/#/?d=JPJUCLECOHQBSLFIKCRCRORKMFLALBFGLOLEGHROT KPFIJKAJMTLKKNJGIKNLGHCHLKMMOQIHKKPPQFMQDIMGLPENLHFLNRFHJMJR>

Canvas-based Practice Sheets

The [PracticeSheet](#) command now has an option to return a canvas, which can be deployed to Maple Learn.

> *with(Student-Basics)* :

> *cv := Student-Basics:-PracticeSheet*("integer/integer(range=2..5) + integer/integer(range=2..5)",
title = "Addition of Fractions",
message = "Add and reduce each expression"
, *inline, output = canvas*) :

> *with(DocumentTools:-Canvas)* :

> *ShowCanvas(cv)*;

Addition of Fractions

Add and reduce each expression

$$\frac{-2}{5} + \frac{8}{2} = \frac{36}{10} \quad \checkmark$$

$$\frac{-7}{3} - \frac{7}{5} = -\frac{14}{35} \quad \times$$

$$\frac{-3}{3} + \frac{5}{3} = \frac{2}{3} \quad \checkmark$$

$$\frac{10}{2} + \frac{4}{5} =$$

$$\frac{-8}{2} + \frac{3}{4} =$$

$$\frac{-6}{5} - \frac{7}{4} =$$

$$\frac{-3}{3} - \frac{9}{4} =$$

$$\frac{-5}{5} - \frac{3}{5} =$$

$$\frac{5}{5} - \frac{2}{5} =$$

$$\frac{-8}{3} + \frac{6}{2} =$$

Check My Work

New Sheet

> New Math Entry Box

> *ShareCanvas(cv)*;

<https://learn.maplesoft.com/#/?d=HTCFHQEGJMNQLSMOHTGIMBPBJNIFLEMIMLJNJMOGQMOQBHHIFHFQJKHFMGCRHUIMLGKPOLPOGPLHBPDSFNAOPPPSEGLRJOETCILT>

Animated Step-by-Step Solutions

The [ShowSolution](#) commands and many other commands that generate step-by-step solutions to problems can generate a canvas that is scripted in such a way that it will reveal solution steps in an animated fashion.

> `with(Student-Calculus1) :`

> `expr := Int(sin(2·x), x)`

$$expr := \int \sin(2x) dx \quad (4.1)$$

> `ShowSolution(expr , 'displaystyle' = 'columns');`

Integration Steps

$$\int \sin(2x) \, dx$$

1. Apply a change of variables to rewrite the integral in terms of u

$$\int \frac{\sin(u)}{2} \, du$$

2. Apply the **constant multiple** rule to the term $\int \frac{\sin(u)}{2} \, du$

$$\frac{\left(\int \sin(u) \, du \right)}{2}$$

3. Evaluate the integral of $\sin(u)$

$$-\frac{\cos(u)}{2}$$

4. Revert change of variable

$$-\frac{\cos(2x)}{2}$$

1. Apply a change of variables to rewrite the integral in terms of u

Let u be

$$u = 2x$$

Isolate equation for x

$$x = \frac{u}{2}$$

Differentiate both sides

$$dx = \frac{du}{2}$$

Substitute the values for x and dx back into the original

$$\int \sin(2x) \, dx = \int \frac{\sin(u)}{2} \, du$$

2. Apply the **constant multiple** rule to the term $\int \frac{\sin(u)}{2} \, du$

- > *cv* := *ShowSolution*(*expr*, 'displaystyle' = 'columns', 'output' = 'canvas') :
- > *with*(*DocumentTools*:-*Canvas*) :
- > *ShareCanvas*(*cv*);

<https://learn.maplesoft.com/#/?d=KHLMGRHHJRJTETOSOHEJFFDJANMHHUMODJPGKPKFJUFTMRFMOFHFOMPJHHCGOMELLSLMNLPiEOKTDHMIAKLPKSPRESPLHRCJDMLE>