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> # This week, we start with the convert command
> # It is used to convert expressions to another form
> # We are going to use it to convert a rational expression using partial fractions
> # First, we need a rational expression; for example:
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$$> \; f := \frac{3}{(x+1)\cdot(x+2)\cdot x}$$

$$f := \frac{3}{(x+1)\,(x+2)\,x} \tag{1}$$

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> # Which we can use with the convert command
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> *convert*(*f*, *parfrac*)

$$\frac{3}{2\,x} - \frac{3}{x+1} + \frac{3}{2\,(x+2)} \tag{2}$$

> # The *parfrac* should be same everytime - just *f* should change
>
> # It tells the convert command what method to use
>
> # There are loads of other options (which you can look at on the documentation page for the convert command), but we only need to worry about *parfrac*

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> # For the next command, we need the Calculus 1 package
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> *with*(*Student*[*Calculus1*]) :

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> # The command is called ApproimateInt and it works almost exactly like the RiemannSum command from lab 1
> # We need to give it:
> # - A function
> # - An independent variable with a range of integration
> # - A method
> # - The number of partitions
> # - And the type of output
> # The only parameter that will change is the method:
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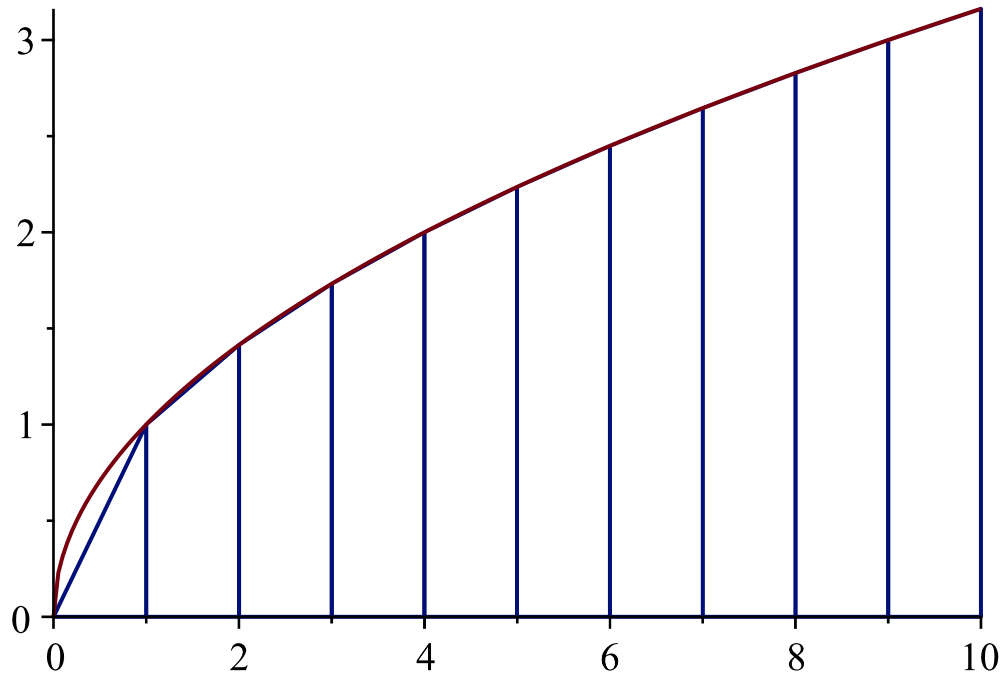
$$> \; g := \mathrm{sqrt}(x)$$

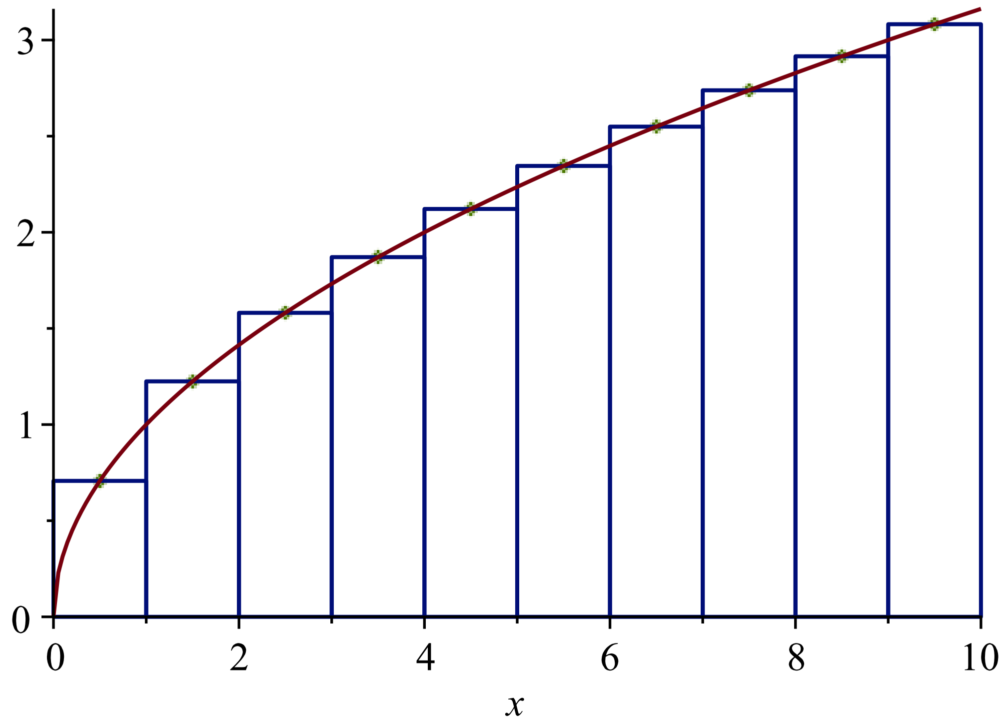
$$g := \sqrt{x} \tag{3}$$

$$> \; ApproximateInt(g, x = 0\,..10, method = trapezoid, partition = 10, output = plot)$$



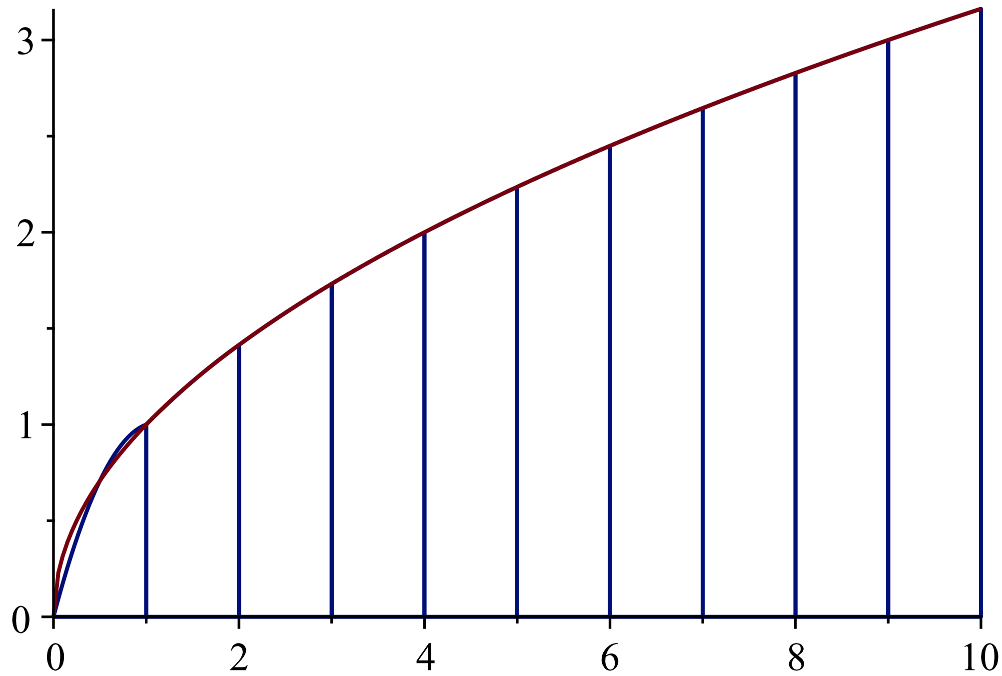
An approximation of $\int_0^{10} f(x)\, dx$ using trapezoid rule, where $f(x) = \sqrt{x}$ and the partition is uniform. The approximate value of the integral is 20.88713936. Number of subintervals used: 10.

> $ApproximateInt(g, x = 0..10, method = midpoint, partition = 10, output = plot)$



A midpoint Riemann sum approximation of $\int_0^{10} f(x)\, dx$, where $f(x) = \sqrt{x}$ and the partition is uniform. The approximate value of the integral is 21.13615290. Number of subintervals used: 10.

> $ApproximateInt(g, x = 0..10, method = simpson, partition = 10, output = plot)$



An approximation of $\int_{0}^{10} f(x)\,dx$ using Simpson's rule, where $f(x) = \sqrt{x}$ and the partition is uniform. The approximate value of the integral is 21.05314838. Number of subintervals used: 10.

> # Q2 also requires you to compare these approximations to the actual value of the integral

> # In this case, the evalf command becomes useful. It converts an exact value (like the value of the integral below) into its decimal form.

> $int(g, x = 0..10)$

$$\frac{20\sqrt{10}}{3} \quad \textbf{(4)}$$

> $evalf(int(g, x = 0..10))$

$$21.08185107 \quad \textbf{(5)}$$

> # Which makes it a lot easier to compare the approximations to the exact value of the integral

>

>

> # Q3 asks you to compute the value of an improper integral with the range being the entire real line

> # Maple makes this situation very easy to deal with - we just need to use the keyword *infinity* in the second parameter of the int command

> $int(\exp(-x^2)\cdot\sin(x), x = -\text{infinity}..\text{infinity})$

$$0 \quad \textbf{(6)}$$

>

>

> # Finally, the last command we'll look at is the laplace command which applies the Laplace transform

> # To use this command, we need to load the inttrans package

> $with(inttrans)$:

> # laplace then takes 3 parameters:

> # - The function we want to apply the transform to

> # - The independent variable of the function (usually t)

> # - The parameter of the transform (usually s)

> $laplace(t^2 + t + 1, t, s)$

$$\frac{s^2 + s + 2}{s^3} \tag{7}$$

>