Differential Equations

Dennis Silverman
Mathematical Physics 212 A
Department of Physics and Astronomy
U.C. Irvine

```
DSolve[y'[x] + a y[x] == 0, y[x], x]
```

```
{{y[x] → E^(-a x) C[1]}}
```

$$\int E^{a x}\, dx$$

$$\frac{E^{a x}}{a}$$

```
NIntegrate[x^3, {x, 0, 4}]
```

```
64.
```

```
?? BesselJ
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```
BesselJ[n, z] gives the Bessel function of the first kind J(n, z).

Attributes[BesselJ] = {Listable, NumericFunction, Protected}
```

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?? Series
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```
Series[f, {x, x0, n}] generates a power series expansion for f about the point x = x0
  to order (x - x0)^n. Series[f, {x, x0, nx}, {y, y0, ny}] successively finds series
  expansions with respect to y, then x.

Attributes[Series] = {Protected, ReadProtected}

Options[Series] = Analytic -> True
```

```
Series[BesselJ[0, x], {x, 0, 10}]
```

$$1 - \frac{x^2}{4} + \frac{x^4}{64} - \frac{x^6}{2304} + \frac{x^8}{147456} - \frac{x^{10}}{14745600} + O[x]^{12}$$

```
Series[BesselK[0, x], {x, 0, 4}]
```

$$(-\text{EulerGamma} + \text{Log}[2] - \text{Log}[x]) + \left(\frac{1}{8}(2 - 2\,\text{EulerGamma}) + \frac{1}{4}(\text{Log}[2] - \text{Log}[x])\right) x^2 + O[x]^4$$

```
Series[BesselJ[3/2, x], {x, 0, 6}]
```

$$\frac{1}{3}\sqrt{\frac{2}{\pi}}\,x^{3/2} - \frac{x^{7/2}}{15\sqrt{2\pi}} + \frac{x^{11/2}}{420\sqrt{2\pi}} + O[x]^{13/2}$$

```
DSolve[y''[x] + 6 y'[x] + 9 y[x] == 0, y[x], x]
```

```
{{y[x] → E^(-3 x) C[1] + E^(-3 x) x C[2]}}
```