

special functions

gamma and beta functions

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```
(%i1) kill(all);
```

```
(%o0) done
```

```
(%i1) gamma(-7/2);
```

```
(%o1)  $\frac{16\sqrt{\pi}}{105}$ 
```

```
(%i2) gamma(n);
```

```
(%o2)  $\Gamma(n)$ 
```

```
→ map(·gamma,[1,2,3,4,5,6,7,8,9]);
```

```
→ map(·gamma,[1/2,3/2,-5/2,7/2]);
```

```
→ map(·gamma,[2/3,5/3,7/3]);
```

```
→ gamma_expand:true;
```

```
→ [gamma(n+1),gamma(n-1),gamma(n+2)/gamma(n+1)];
```

```
(%i4) plot2d(gamma(n),[n,-4.5,2.0]);
```

```
(%o4) [ C:/Users/aiswa/AppData/Local/Temp/maxout13784.gnuplot ]
```

```
(%i5) beta(m,n);
```

```
(%o5) beta(m,n)
```

```
(%i6) [beta(2,3),beta(2,1/3),beta(2,a)];
```

```
(%o6)  $\left[\frac{1}{12}, \frac{9}{4}, \frac{1}{a(a+1)}\right]$ 
```

```
(%i7) [beta(1/2,5/2),beta(1/3,2/3),beta(1/4,3/4)];
```

```
(%o7) [ $\frac{3\pi}{8}, \frac{2\pi}{\sqrt{3}}, \sqrt{2}\pi$ ]
```

calculate beta using defination

```
(%i8) [beta(3,-1),beta(-2,3),beta(-4,5)];
```

```
(%o8) [beta(-1,3),beta(-2,3),beta(-4,5)]
```

```
(%i9) beta_expand:true;
```

```
(beta_expand) true
```

```
(%i10) [beta(m+1,n),beta(m-1,n),beta(m+1,n)/beta(m,n+1)];
```

```
(%o10) [ $\frac{m \beta(m,n)}{n+m}, \frac{\beta(m,n)(n+m-1)}{m-1}, \frac{m}{n}$ ]
```

```
(%i11) makegamma(%);
```

```
(%o11) [ $\frac{m \Gamma(m) \Gamma(n)}{(n+m) \Gamma(n+m)}, \frac{\Gamma(m)(n+m-1) \Gamma(n)}{(m-1) \Gamma(n+m)}, \frac{m}{n}$ ]
```

```
(%i12) bea(1/8,6/8);
```

```
(%o12) bea( $\frac{1}{8}, \frac{3}{4}$ )
```

```
(%i13) plot3d(beta(m,n),[m,-3,3],[n,-3,3]);
```

```
(%o13) [C:/Users/aiswa/AppData/Local/Temp/maxout13784.gnuplot]
```

```
(%i14) integrate(x^(m-1)*(1-x^2)^(n),x,0,1);
```

Is m positive, negative or zero? positive;

Is n+1 positive, negative or zero? positive;

```
(%o14) 
$$\frac{\beta\left(\frac{m}{2}, n\right) n}{2 \left(n + \frac{m}{2}\right)}$$

```

```
(%i15) makegamma(%);
```

```
(%o15) 
$$\frac{\Gamma\left(\frac{m}{2}\right) n \Gamma(n)}{2 \left(n + \frac{m}{2}\right) \Gamma\left(n + \frac{m}{2}\right)}$$

```

(%i16) ratsimp(%);

(%o16)
$$\frac{\Gamma\left(\frac{m}{2}\right) n \Gamma(n)}{(2n+m) \Gamma\left(\frac{2n+m}{2}\right)}$$

bessel functions

(%i17) kill(all);

(%o0) done

(%i1) besselexpand:true;

(besselexpand) true

(%i2) a:bessel_j(1/2,x);

(a)
$$\frac{\sqrt{2} \sin(x)}{\sqrt{\pi} \sqrt{x}}$$

(%i3) bessel_j(3/2,x);

(%o3)
$$\frac{\sqrt{2} \sqrt{x} \left(\frac{\sin(x)}{x^2} - \frac{\cos(x)}{x} \right)}{\sqrt{\pi}}$$

(%i4) b:bessel_j(-1/2,x);

(b)
$$\frac{\sqrt{2} \cos(x)}{\sqrt{\pi} \sqrt{x}}$$

(%i5) a^2+b^2;

(%o5)
$$\frac{2 \sin(x)^2}{\pi x} + \frac{2 \cos(x)^2}{\pi x}$$

(%i6) trigsimp(%);

(%o6)
$$\frac{2}{\pi x}$$