```
showtime: true$
```
Evaluation took 0.0000 seconds (0.0000 elapsed) using 0 bytes.
```
file_search_maxima : cons(sconcat("C:\maxima-5.47.0\share\###.{lisp,mac,mc}"), f
```
Evaluation took 0.0000 seconds (0.0000 elapsed) using 0 bytes.
```
load("retode");
```
Evaluation took 0.0469 seconds (0.0477 elapsed) using 6.434 MB.

C:retode.mac

1 Example 1

We consider the three term recurrence relation satisfied by the polynomials (7) in Daniel D. Tcheutia and Wolfram Koepf. Properties of some finite families of classical orthogonal polynomials.

```
Mnpq: ((−p+2·n+2)·(−p+n+2))·P[n+2] + ((2·n−p+3)·(4·n^2·x − 4·n·p·x + p^2·x + 2·n
+ ((q + n+1)·(n+1)·(2·n−p+4)·(n−p−q+1))·P[n] = 0;
```
Evaluation took 0.0000 seconds (0.0004 elapsed) using 95.484 KB.

$$P_{n+1}\,(-p+2\,n+3)\,(p^2\,x-4\,n\,p\,x-6\,p\,x+4\,n^2\,x+12\,n\,x+8\,x-p\,q-2\,n\,p-3\,p+2\,n^2+6\,n+4)+(n+1)\,P_n\,(-p+2\,n+4)\,(-q-p+n+1)\,(q+n+1)+P_{n+2}\,(-p+n+2)\,(-p+2\,n+2)=0$$

```
REtoDE(Mnpq, P[n], x);
```
Warning, parameters have the values [
$[f=-2, g=-1, alphaJacobi=-q-p, betaJacobi=q]$,
$[f=2, g=1, alphaJacobi=q, betaJacobi=-q-p]$]
Warning, several solutions found

This recurrence equation has no classical orthogonal polynomial solution
This recurrence equation has no classical orthogonal polynomial solution
This recurrence equation has no classical orthogonal polynomial solution
Evaluation took 0.5469 seconds (0.5806 elapsed) using 151.182 MB.

$$[\textit{Has a solution as Jacobi}, [[[\sigma(x)=x^2+x, \tau(x)=-(p\,x)+2\,x+q+1, \lambda_n=n\,p-n^2-n, \mathrm{p}(n,x)=J_n(-(2\,x)-1,-q-p,q), \mathrm{w}(x)=\%e^{-(q\log(x+1))-p\log(x+1)+q\log(x)}, \frac{k_{n+1}}{k_n}=-\left(\frac{(p-2\,n-2)\,(p-2\,n-1)}{2\,(p-n-1)}\right), I=[-1,0]], [\sigma(x)=x^2+x, \tau(x)=-(p\,x)+2\,x+q+1, \lambda_n=n\,p-n^2-n, \mathrm{p}(n,x)=J_n(2\,x+1,q,-q-p), \mathrm{w}(x)=\%e^{-(q\log(x+1))-p\log(x+1)+q\log(x)}, \frac{k_{n+1}}{k_n}=\frac{(p-2\,n-2)\,(p-2\,n-1)}{2\,(p-n-1)}, I=[-1,0]]]]]$$

Example 4 from article: Wolfram Koepf and Dieter Schmersau. Recurrence equations and their classical orthogonal polynomial solutions.

```
RE: ((n+2+alpha)·(2+n)·(2·n+2)·(n−N+1))·p[n+2] + ((3+2·n)·(−6·n·alpha − 2·n^2·alp
− ((1+n)·(n + 1−alpha)·(2·n+4)·(n+N+2))·p[n] = 0;
```

Evaluation took 0.0000 seconds (0.0002 elapsed) using 31.750 KB.

$$(2n+3)\,p_{n+1}\left(-(4n^2x)-12nx-8x-2\,alpha\,n^2+2Nn^2-6\,alpha\,n+6Nn-4\,alpha+4N\right)+(n+2)(n-N+1)(n+alpha+2)(2n+2)\,p_{n+2}-(n+1)(n+N+2)(n-alpha+1)(2n+4)\,p_n=0$$

```
REtoDiscrete(RE, p[n], x);
```

Warning, parameters have the values $[[N=-\left(\frac{1}{2}\right), f=2, alpha=0, g=0, muMeixner=-1, gammaMeixner=1], [N=-\left(\frac{3}{2}\right), f=2, alpha=0, g=1, muMeixner=-1, gammaMeixner=1], [N=-\left(\frac{1}{2}\right), f=-2, alpha=0, g=-1, muMeixner=-1, gammaMeixner=1], [N=-\left(\frac{3}{2}\right), f=-2, alpha=0, g=-2, muMeixner=-1, gammaMeixner=1], [N=-1, f=2, alpha=\frac{1}{2}, g=1, muMeixner=-1, gammaMeixner=1], [N=-1, f=2, alpha=-\left(\frac{1}{2}\right), g=0, muMeixner=-1, gammaMeixner=1], [N=-1, f=-2, alpha=\frac{1}{2}, g=-2, muMeixner=-1, gammaMeixner=1], [N=-1, f=-2, alpha=-\left(\frac{1}{2}\right), g=-1, muMeixner=-1, gammaMeixner=1]]$

Warning, several solutions found

This recurrence equation has no classical orthogonal polynomial solution

Warning, parameters have the values [

$$\left[N=-\left(\frac{1}{2}\right), f=2, alpha=0, g=0, NKraw=-1, pKraw=\frac{1}{2}\right],$$
$$\left[N=-\left(\frac{3}{2}\right), f=2, alpha=0, g=1, NKraw=-1, pKraw=\frac{1}{2}\right],$$
$$\left[N=-\left(\frac{1}{2}\right), f=-2, alpha=0, g=-1, NKraw=-1, pKraw=\frac{1}{2}\right],$$
$$\left[N=-\left(\frac{3}{2}\right), f=-2, alpha=0, g=-2, NKraw=-1, pKraw=\frac{1}{2}\right],$$

$\left[N=-1, f=2, alpha=\frac{1}{2}, g=1, NKraw=-1, pKraw=\frac{1}{2}\right]$,

$\left[N=-1, f=2, alpha=-\left(\frac{1}{2}\right), g=0, NKraw=-1, pKraw=\frac{1}{2}\right]$,

$\left[N=-1, f=-2, alpha=\frac{1}{2}, g=-2, NKraw=-1, pKraw=\frac{1}{2}\right], [N=-1, f=-2, alpha=-\left(\frac{1}{2}\right), g=-1, NKraw=-1, pKraw=\frac{1}{2}]]$

Warning, several solutions found

Warning, parameters have the values $[[f=1, g=0, alphaHahn=-N-1, betaHahn=N+1, NHahn=-alpha-1], [f=1, g=0, alphaHahn=alpha, betaHahn=-alpha, NHahn=N], [f=1, g=alpha-N-1, alphaHahn=N+1, betaHahn=-N-1, NHahn=alpha-1], [f=1, g=alpha-N-1, alphaHahn=-alpha, betaHahn=alpha, NHahn=-N-2], [f=1, g=-N-1, alphaHahn=N+1, betaHahn=-N-1, NHahn=-alpha-1], [f=1, g=-N-1, alphaHahn=alpha, betaHahn=-alpha, NHahn=-N-2], [f=1, g=alpha, alphaHahn=-N-1, betaHahn=N+1, NHahn=alpha-1], [f=1, g=alpha, alphaHahn=-alpha, betaHahn=alpha, NHahn=N], [f=-1, g=-1, alphaHahn=N+1, betaHahn=-N-1, NHahn=alpha-1], [f=-1, g=-1, alphaHahn=-alpha, betaHahn=alpha, NHahn=-N-2], [f=-1, g=N-alpha, alphaHahn=-N-1, betaHahn=N+1, NHahn=-alpha-1], [f=-1, g=N-alpha, alphaHahn=alpha, betaHahn=-alpha, NHahn=N], [f=-1, g=N, alphaHahn=-N-1, betaHahn=N+1, NHahn=alpha-1], [f=-1, g=N, alphaHahn=-alpha, betaHahn=alpha, NHahn=N], [f=-1, g=-alpha-1, alphaHahn=N+1, betaHahn=-N-1, NHahn=-alpha-1], [f=-1, g=-alpha-1, alphaHahn=alpha, betaHahn=-alpha, NHahn=-N-2]]$

Warning, several solutions found

```
Evaluation took 0.9375 seconds (0.9463 elapsed) using 298.584 MB.
```

[*Has a solution as Meixner*, $[[[\sigma(x)=2x, \tau(x)=-(4x)-1, \lambda_n=2n, \mathrm{p}(n,x)=M_n(2x,1,-1), \frac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=-\left(\frac{2x+1}{2(x+1)}\right), \frac{k_{n+1}}{k_n}=\frac{2}{n+1}, I=\left[0, \frac{1}{2}, 1, \ldots, \infty\right]], [\sigma(x)=2x+1, \tau(x)=-(4x)-3, \lambda_n=2n, \mathrm{p}(n,x)=M_n(2x+1,1,-1), \frac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=-\left(\frac{2(x+1)}{2x+3}\right), \frac{k_{n+1}}{k_n}=\frac{2(2n+1)}{(n+1)(2n+3)}, I=\left[-\left(\frac{1}{2}\right), 0, \frac{1}{2}, \ldots, \infty\right]], [\sigma(x)=-(2x)-1, \tau(x)=4x+1, \lambda_n=2n, \mathrm{p}(n,x)=M_n(-(2x)-1,1,-1), \frac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=-\left(\frac{2x}{2x+3}\right), \frac{k_{n+1}}{k_n}=-\left(\frac{2}{n+1}\right), I=\left[-\infty, \ldots, -\left(\frac{3}{2}\right), -1, -\left(\frac{1}{2}\right)\right]], [\sigma(x)=-(2x)-2,$

$\tau(x)=4\,x+3, \lambda_n=2\,n, \mathrm{p}(n,x)=M_n(-(2\,x)-2,1,-1), \frac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=-\left(\frac{2\,x+1}{2\,(x+2)}\right), \frac{k_{n+1}}{k_n}=-\left(\frac{2\,(2\,n+1)}{(n+1)\,(2\,n+3)}\right), I=\left[-\infty,\ldots,-2,-\left(\frac{3}{2}\right),-1\right]]$
$,[\sigma(x)=2\,x+1, \tau(x)=-(4\,x)-3, \lambda_n=2\,n, \mathrm{p}(n,x)=M_n(2\,x+1,1,-1), \frac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=-\left(\frac{2\,(x+1)}{2\,x+3}\right), \frac{k_{n+1}}{k_n}=\frac{2\,(2\,n+1)}{(n+1)\,(2\,n+3)}, I=\left[-\left(\frac{1}{2}\right),0,\frac{1}{2},\ldots,\infty\right]], [\sigma(x)=2\,x, \tau(x)=-(4\,x)-1, \lambda_n=2\,n, \mathrm{p}(n,x)=M_n(2\,x,1,-1), \frac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=-\left(\frac{2\,x+1}{2\,(x+1)}\right), \frac{k_{n+1}}{k_n}=\frac{2}{n+1}, I=\left[0,\frac{1}{2},1,\ldots,\infty\right]], [\sigma(x)=-(2\,x)-2, \tau(x)=4\,x+3, \lambda_n=2\,n, \mathrm{p}(n,x)=M_n(-(2\,x)-2,1,-1), \frac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=-\left(\frac{2\,x+1}{2\,(x+2)}\right), \frac{k_{n+1}}{k_n}=-\left(\frac{2\,(2\,n+1)}{(n+1)\,(2\,n+3)}\right), I=\left[-\infty,\ldots,-2,-\left(\frac{3}{2}\right),-1\right]], [\sigma(x)=-(2\,x)-1, \tau(x)=4\,x+1, \lambda_n=2\,n, \mathrm{p}(n,x)=M_n(-(2\,x)-1,1,-1), \frac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=-\left(\frac{2\,x}{2\,x+3}\right), \frac{k_{n+1}}{k_n}=-\left(\frac{2}{n+1}\right), I=\left[-\infty,\ldots,-\left(\frac{3}{2}\right),-1,-\left(\frac{1}{2}\right)\right]]]],$

Has a solution as Krawtchouk, $[[[\sigma(x)=2\,x, \tau(x)=-(4\,x)-1, \lambda_n=2\,n, \mathrm{p}(n,x)=K_n\left(2\,x,\frac{1}{2},-1\right), \frac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=-\left(\frac{2\,x+1}{2\,(x+1)}\right), \frac{k_{n+1}}{k_n}=\frac{2}{n+1}, I=\left[0,\frac{1}{2},1,\ldots,-\left(\frac{1}{2}\right)\right]], [\sigma(x)=2\,x+1, \tau(x)=-(4\,x)-3, \lambda_n=2\,n, \mathrm{p}(n,x)=K_n\left(2\,x+1,\frac{1}{2},-1\right), \frac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=-\left(\frac{2\,(x+1)}{2\,x+3}\right), \frac{k_{n+1}}{k_n}=\frac{2\,(2\,n+1)}{(n+1)\,(2\,n+3)}, I=\left[-\left(\frac{1}{2}\right),0,\frac{1}{2},\ldots,-1\right]], [\sigma(x)=-(2\,x)-1, \tau(x)=4\,x+1, \lambda_n=2\,n, \mathrm{p}(n,x)=K_n\left(-(2\,x)-1,\frac{1}{2},-1\right), \frac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=-\left(\frac{2\,x}{2\,x+3}\right), \frac{k_{n+1}}{k_n}=-\left(\frac{2}{n+1}\right), I=\left[0,\ldots,-\left(\frac{3}{2}\right),-1,-\left(\frac{1}{2}\right)\right]], [\sigma(x)=-(2\,x)-2, \tau(x)=4\,x+3, \lambda_n=2\,n, \mathrm{p}(n,x)=K_n\left(-(2\,x)-2,\frac{1}{2},-1\right), \frac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=-\left(\frac{2\,x+1}{2\,(x+2)}\right), \frac{k_{n+1}}{k_n}=-\left(\frac{2\,(2\,n+1)}{(n+1)\,(2\,n+3)}\right), I=$

$\left[-\left(\frac{1}{2}\right),\ldots,-2,-\left(\frac{3}{2}\right),-1\right]],[\sigma(x)=2\,x+1,\tau(x)=-(4\,x)-3,\lambda_n=2\,n$

$,p(n,x)=K_n\left(2\,x+1,\frac{1}{2},-1\right),\frac{w(x+1)}{w(x)}=-\left(\frac{2\,(x+1)}{2\,x+3}\right),\frac{k_{n+1}}{k_n}=$

$\frac{2\,(2\,n+1)}{(n+1)\,(2\,n+3)},I=\left[-\left(\frac{1}{2}\right),0,\frac{1}{2},\ldots,-1\right]],[\sigma(x)=2\,x,\tau(x)=-(4\,x)$

$-1,\lambda_n=2\,n,p(n,x)=K_n\left(2\,x,\frac{1}{2},-1\right),\frac{w(x+1)}{w(x)}=-\left(\frac{2\,x+1}{2\,(x+1)}\right),$

$\frac{k_{n+1}}{k_n}=\frac{2}{n+1},I=\left[0,\frac{1}{2},1,\ldots,-\left(\frac{1}{2}\right)\right]],[\sigma(x)=-(2\,x)-2,\tau(x)=4\,x$

$+3,\lambda_n=2\,n,p(n,x)=K_n\left(-(2\,x)-2,\frac{1}{2},-1\right),\frac{w(x+1)}{w(x)}=-$

$\left(\frac{2\,x+1}{2\,(x+2)}\right),\frac{k_{n+1}}{k_n}=-\left(\frac{2\,(2\,n+1)}{(n+1)\,(2\,n+3)}\right),I=$

$\left[-\left(\frac{1}{2}\right),\ldots,-2,-\left(\frac{3}{2}\right),-1\right]],[\sigma(x)=-(2\,x)-1,\tau(x)=4\,x+1,\lambda_n=2\,n$

$,p(n,x)=K_n\left(-(2\,x)-1,\frac{1}{2},-1\right),\frac{w(x+1)}{w(x)}=-\left(\frac{2\,x}{2\,x+3}\right),\frac{k_{n+1}}{k_n}=-$

$\left(\frac{2}{n+1}\right),I=\left[0,\ldots,-\left(\frac{3}{2}\right),-1,-\left(\frac{1}{2}\right)\right]]]],$ *Has a solution as Hahn*, [[[

$\sigma(x)=-x^2-alpha\,x+N\,x+x,\tau(x)=-(2\,x)+N\,alpha+N,\lambda_n=n^2+n,$

$p(n,x)=Q_n(x,-N-1,N+1,-alpha-1),\frac{w(x+1)}{w(x)}=$

$\frac{(x-N)\,(x+alpha+1)}{(x+1)\,(x+alpha-N)},\frac{k_{n+1}}{k_n}=\frac{2\,(2\,n+1)}{(n-N)\,(n+alpha+1)},I=$

$[0,1,2,\ldots,-alpha-1]],[\sigma(x)=-x^2-alpha\,x+N\,x+x,\tau(x)=-(2\,x)$

$+N\,alpha+N,\lambda_n=n^2+n,p(n,x)=Q_n(x,alpha,-alpha,N),\frac{w(x+1)}{w(x)}$

$=\frac{(x-N)\,(x+alpha+1)}{(x+1)\,(x+alpha-N)},\frac{k_{n+1}}{k_n}=\frac{2\,(2\,n+1)}{(n-N)\,(n+alpha+1)},I=$

$[0,1,2,\ldots,N]],[\sigma(x)=-x^2-alpha\,x+N\,x+x,\tau(x)=-(2\,x)+N\,alpha$

$+N,\lambda_n=n^2+n,p(n,x)=Q_n(x+alpha-N-1,N+1,-N-1,alpha-1),$

$\frac{w(x+1)}{w(x)}=\frac{(x-N)\,(x+alpha+1)}{(x+1)\,(x+alpha-N)},\frac{k_{n+1}}{k_n}=\frac{2\,(2\,n+1)}{(n-N)\,(n+alpha+1)},I=$

$[-alpha+N+1,-alpha+N+2,-alpha+N+3,\ldots,N]],[\sigma(x)=-x^2-$

$alpha\,x+N\,x+x,\tau(x)=-(2\,x)+N\,alpha+N,\lambda_n=n^2+n,p(n,x)=$

$Q_n(x+alpha-N-1,-alpha,alpha,-N-2),\frac{w(x+1)}{w(x)}=$

$\frac{(x-N)(x+alpha+1)}{(x+1)(x+alpha-N)},\frac{k_{n+1}}{k_n}=\frac{2(2n+1)}{(n-N)(n+alpha+1)},I=$

$[-alpha+N+1,-alpha+N+2,-alpha+N+3,\ldots,-alpha-1]],[\sigma(x)=$

$-x^2-alpha\ x+N\ x+x+N\ alpha+alpha,\tau(x)=-(2\ x)-N\ alpha-2$

$alpha+N,\lambda_n=n^2+n,\mathrm{p}(n,x)=Q_n(x-N-1,N+1,-N-1,-alpha-1),$

$\frac{w(x+1)}{w(x)}=\frac{(x+1)(x+alpha-N)}{(x-N)(x+alpha+1)},\frac{k_{n+1}}{k_n}=\frac{2(2n+1)}{(n-N)(n+alpha+1)},I=$

$[N+1,N+2,N+3,\ldots,N-alpha]],[\sigma(x)=-x^2-alpha\ x+N\ x+x+N$

$alpha+alpha,\tau(x)=-(2\ x)-N\ alpha-2\ alpha+N,\lambda_n=n^2+n,\mathrm{p}(n,x)$

$=Q_n(x-N-1,alpha,-alpha,-N-2),\frac{w(x+1)}{w(x)}=$

$\frac{(x+1)(x+alpha-N)}{(x-N)(x+alpha+1)},\frac{k_{n+1}}{k_n}=\frac{2(2n+1)}{(n-N)(n+alpha+1)},I=$

$[N+1,N+2,N+3,\ldots,-1]],[\sigma(x)=-x^2-alpha\ x+N\ x+x+N\ alpha+$

$alpha,\tau(x)=-(2\ x)-N\ alpha-2\ alpha+N,\lambda_n=n^2+n,\mathrm{p}(n,x)=$

$Q_n(x+alpha,-N-1,N+1,alpha-1),\frac{w(x+1)}{w(x)}=$

$\frac{(x+1)(x+alpha-N)}{(x-N)(x+alpha+1)},\frac{k_{n+1}}{k_n}=\frac{2(2n+1)}{(n-N)(n+alpha+1)},I=$

$[-alpha,1-alpha,2-alpha,\ldots,-1]],[\sigma(x)=-x^2-alpha\ x+N\ x+x+$

$N\ alpha+alpha,\tau(x)=-(2\ x)-N\ alpha-2\ alpha+N,\lambda_n=n^2+n,$

$\mathrm{p}(n,x)=Q_n(x+alpha,-alpha,alpha,N),\frac{w(x+1)}{w(x)}=$

$\frac{(x+1)(x+alpha-N)}{(x-N)(x+alpha+1)},\frac{k_{n+1}}{k_n}=\frac{2(2n+1)}{(n-N)(n+alpha+1)},I=$

$[-alpha,1-alpha,2-alpha,\ldots,N-alpha]],[\sigma(x)=-x^2-alpha\ x+N$

$x-x-alpha+N,\tau(x)=2\ x+N\ alpha+2\ alpha-N,\lambda_n=n^2+n,\mathrm{p}(n,x)=$

$Q_n(-x-1,N+1,-N-1,alpha-1),\frac{w(x+1)}{w(x)}=$

$\frac{(x-N-1)(x+alpha)}{(x+2)(x+alpha-N+1)},\frac{k_{n+1}}{k_n}=-\left(\frac{2(2n+1)}{(n-N)(n+alpha+1)}\right),I=$

$[-alpha,\ldots,-3,-2,-1]],[\sigma(x)=-x^2-alpha\ x+N\ x-x-alpha+N,$

$\tau(x)=2\ x+N\ alpha+2\ alpha-N,\lambda_n=n^2+n,\mathrm{p}(n,x)=$

$Q_n(-x-1,-alpha,alpha,-N-2),\dfrac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=$

$\dfrac{(x-N-1)\ (x+alpha)}{(x+2)\ (x+alpha-N+1)},\dfrac{k_{n+1}}{k_n}=-\left(\dfrac{2\ (2\ n+1)}{(n-N)\ (n+alpha+1)}\right),I=$

$[N+1,\ldots,-3,-2,-1]],[\sigma(x)=-x^2-alpha\ x+N\ x-x-alpha+N,$

$\tau(x)=2\ x+N\ alpha+2\ alpha-N,\lambda_n=n^2+n,\mathrm{p}(n,x)=$

$Q_n(-x-alpha+N,-N-1,N+1,-alpha-1),\dfrac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=$

$\dfrac{(x-N-1)\ (x+alpha)}{(x+2)\ (x+alpha-N+1)},\dfrac{k_{n+1}}{k_n}=-\left(\dfrac{2\ (2\ n+1)}{(n-N)\ (n+alpha+1)}\right),I=$

$[N+1,\ldots,-alpha+N-2,-alpha+N-1,N-alpha]],[\sigma(x)=-x^2-$

$alpha\ x+N\ x-x-alpha+N,\tau(x)=2\ x+N\ alpha+2\ alpha-N,\lambda_n=n^2+$

$n,\mathrm{p}(n,x)=Q_n(-x-alpha+N,alpha,-alpha,N),\dfrac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=$

$\dfrac{(x-N-1)\ (x+alpha)}{(x+2)\ (x+alpha-N+1)},\dfrac{k_{n+1}}{k_n}=-\left(\dfrac{2\ (2\ n+1)}{(n-N)\ (n+alpha+1)}\right),I=$

$[-alpha,\ldots,-alpha+N-2,-alpha+N-1,N-alpha]],[\sigma(x)=-x^2-$

$alpha\ x+N\ x-x+N\ alpha+N,\tau(x)=2\ x-N\ alpha-N,\lambda_n=n^2+n,$

$\mathrm{p}(n,x)=Q_n(N-x,-N-1,N+1,alpha-1),\dfrac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=$

$\dfrac{x\ (x+alpha-N-1)}{(x-N+1)\ (x+alpha+2)},\dfrac{k_{n+1}}{k_n}=-\left(\dfrac{2\ (2\ n+1)}{(n-N)\ (n+alpha+1)}\right),I=$

$[-alpha+N+1,\ldots,N-2,N-1,N]],[\sigma(x)=-x^2-alpha\ x+N\ x-x+N$

$alpha+N,\tau(x)=2\ x-N\ alpha-N,\lambda_n=n^2+n,\mathrm{p}(n,x)=$

$Q_n(N-x,-alpha,alpha,N),\dfrac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=\dfrac{x\ (x+alpha-N-1)}{(x-N+1)\ (x+alpha+2)},$

$\dfrac{k_{n+1}}{k_n}=-\left(\dfrac{2\ (2\ n+1)}{(n-N)\ (n+alpha+1)}\right),I=[0,\ldots,N-2,N-1,N]],[\sigma(x)=-$

$x^2-alpha\ x+N\ x-x+N\ alpha+N,\tau(x)=2\ x-N\ alpha-N,\lambda_n=n^2+n,$

$\mathrm{p}(n,x)=Q_n(-x-alpha-1,N+1,-N-1,-alpha-1),\dfrac{\mathrm{w}(x+1)}{\mathrm{w}(x)}=$

$\dfrac{x\ (x+alpha-N-1)}{(x-N+1)\ (x+alpha+2)},\dfrac{k_{n+1}}{k_n}=-\left(\dfrac{2\ (2\ n+1)}{(n-N)\ (n+alpha+1)}\right),I=$

$$[0, \ldots, -alpha-3, -alpha-2, -alpha-1]], [\sigma(x) = -x^2 - alpha\ x + N\ x - x + N\ alpha + N, \tau(x) = 2\ x - N\ alpha - N, \lambda_n = n^2 + n, \mathrm{p}(n, x) = Q_n(-x-alpha-1, alpha, -alpha, -N-2), \frac{\mathrm{w}(x+1)}{\mathrm{w}(x)} = \frac{x\ (x+alpha-N-1)}{(x-N+1)\ (x+alpha+2)}, \frac{k_{n+1}}{k_n} = -\left(\frac{2\ (2\ n+1)}{(n-N)\ (n+alpha+1)}\right), I = [-alpha+N+1, \ldots, -alpha-3, -alpha-2, -alpha-1]]]]]$$