Fast Lagrange interpolation implementation, coefficient generation, Klaus Reuter, MPCDF, 2015

```
> with(codegen,fortran)
```

[*fortran*] **(1)**

For convenience, the following formula is taken from Abramowitz and Stegun, Section 25.2.7:

```
> item := proc(n, k, p)
  description "Lagrange n point coefficient, n odd";
  ((-1)^(1/2 * (n-1)+ k))/(((((n-1)/2)+k)!*(((n-1)/2)-k)!)*(p-k))*
  product(p+(n-1)/2-t, t=0..(n-1))
  end proc;
```

item := **proc**(*n*, *k*, *p*) **(2)**

description "Lagrange n point coefficient, n odd";

(−1)^(1/2 * *n* − 1/2 + *k*) * *product*(*p* + 1/2 * *n* − 1/2 − *t*, *t* = 0..*n* − 1) / (factorial(1/2 * *n* − 1/2 + *k*) * factorial(1/2 * *n* − 1/2 − *k*) * (*p* − *k*))

end proc

```
> gen := proc(n_pt)
  description "print fortran notation";
  o:=(n_pt-1)/2;
  for i from -o to o do
  fortran(simplify(item(n_pt, i, p)))
  end do;
  end proc;
```

Warning, `o` is implicitly declared local to procedure `gen`
Warning, `i` is implicitly declared local to procedure `gen`

gen := **proc**(*n_pt*) **(3)**

local *o*, *i*;

description "print fortran notation";

o := 1/2 * *n_pt* − 1/2;

for *i* **from** −*o* **to** *o* **do**

codegen:-fortran(*simplify*(*item*(*n_pt*, *i*, *p*)))

end do

end proc

```
> gen(3)
      t0 = p*(p-1)/2
      t0 = -p**2+1
      t0 = (p+1)*p/2
> gen(5)
      t0 = p*(p-2)*(p**2-1)/24
      t0 = -p*(p-1)*(p**2-4)/6
      t0 = (p**2-4)*(p**2-1)/4
      t0 = -(p+1)*p*(p**2-4)/6
      t0 = (p+2)*p*(p**2-1)/24
> gen(7)
      t0 = p*(p-3)*(p**2-4)*(p**2-1)/720
      t0 = -p*(p-2)*(p**2-9)*(p**2-1)/120
      t0 = p*(p-1)*(p**2-9)*(p**2-4)/48
      t0 = -(p**2-9)*(p**2-4)*(p**2-1)/36
      t0 = (p+1)*p*(p**2-9)*(p**2-4)/48
      t0 = -(p+2)*p*(p**2-9)*(p**2-1)/120
```

```
    t0 = (p+3)*p*(p**2-4)*(p**2-1)/720
> gen(9)
    t0 = p*(p-4)*(p**2-9)*(p**2-4)*(p**2-1)/40320
    t0 = -p*(p-3)*(p**2-16)*(p**2-4)*(p**2-1)/5040
    t0 = p*(p-2)*(p**2-16)*(p**2-9)*(p**2-1)/1440
    t0 = -p*(p-1)*(p**2-16)*(p**2-9)*(p**2-4)/720
    t0 = (p**2-16)*(p**2-9)*(p**2-4)*(p**2-1)/576
    t0 = -(p+1)*p*(p**2-16)*(p**2-9)*(p**2-4)/720
    t0 = (p+2)*p*(p**2-16)*(p**2-9)*(p**2-1)/1440
    t0 = -(p+3)*p*(p**2-16)*(p**2-4)*(p**2-1)/5040
    t0 = (p+4)*p*(p**2-9)*(p**2-4)*(p**2-1)/40320
> gen(11)
    t0 = p*(p-5)*(p**2-16)*(p**2-9)*(p**2-4)*(p**2-1)/3628800
    t0 = -p*(p-4)*(p**2-25)*(p**2-9)*(p**2-4)*(p**2-1)/362880
    t0 = p*(p-3)*(p**2-25)*(p**2-16)*(p**2-4)*(p**2-1)/80640
    t0 = -p*(p-2)*(p**2-25)*(p**2-16)*(p**2-9)*(p**2-1)/30240
    t0 = p*(p-1)*(p**2-25)*(p**2-16)*(p**2-9)*(p**2-4)/17280
    t0 = -(p**2-25)*(p**2-16)*(p**2-9)*(p**2-4)*(p**2-1)/14400
    t0 = (p+1)*p*(p**2-25)*(p**2-16)*(p**2-9)*(p**2-4)/17280
    t0 = -(p+2)*p*(p**2-25)*(p**2-16)*(p**2-9)*(p**2-1)/30240
    t0 = (p+3)*p*(p**2-25)*(p**2-16)*(p**2-4)*(p**2-1)/80640
    t0 = -(p+4)*p*(p**2-25)*(p**2-9)*(p**2-4)*(p**2-1)/362880
    t0 = (p+5)*p*(p**2-16)*(p**2-9)*(p**2-4)*(p**2-1)/3628800
> gen(13)
    t0 = p*(p-6)*(p**2-25)*(p**2-16)*(p**2-9)*(p**2-4)*(p**2
-1)/479001
   #600
    t0 = -p*(p-5)*(p**2-36)*(p**2-16)*(p**2-9)*(p**2-4)*(p**2
-1)/39916
   #800
    t0 = p*(p-4)*(p**2-36)*(p**2-25)*(p**2-9)*(p**2-4)*(p**2
-1)/725760
    #0
    t0 = -p*(p-3)*(p**2-36)*(p**2-25)*(p**2-16)*(p**2-4)*(p**2
-1)/2177
   #280
    t0 = p*(p-2)*(p**2-36)*(p**2-25)*(p**2-16)*(p**2-9)*(p**2
-1)/96768
    #0
    t0 = -p*(p-1)*(p**2-36)*(p**2-25)*(p**2-16)*(p**2-9)*(p**2
-4)/6048
    #00
    t0 = (p**2-36)*(p**2-25)*(p**2-16)*(p**2-9)*(p**2-4)*(p**2
-1)/5184
    #00
    t0 = -(p+1)*p*(p**2-36)*(p**2-25)*(p**2-16)*(p**2-9)*(p**2
-4)/6048
    #00
    t0 = (p+2)*p*(p**2-36)*(p**2-25)*(p**2-16)*(p**2-9)*(p**2
-1)/96768
    #0
    t0 = -(p+3)*p*(p**2-36)*(p**2-25)*(p**2-16)*(p**2-4)*(p**2
-1)/2177
   #280
    t0 = (p+4)*p*(p**2-36)*(p**2-25)*(p**2-9)*(p**2-4)*(p**2
-1)/725760
```

```
    #0
    t0 = -(p+5)*p*(p**2-36)*(p**2-16)*(p**2-9)*(p**2-4)*(p**2
-1)/39916
    #800
    t0 = (p+6)*p*(p**2-25)*(p**2-16)*(p**2-9)*(p**2-4)*(p**2
-1)/479001
    #600
```