

```
> restart;
```

```
> # IRK method by collocation
```

```
> with(LinearAlgebra):
```

```
> c:=Vector([1/4,1/2,3/4]);
```

$$c := \begin{bmatrix} \frac{1}{4} \\ \frac{1}{2} \\ \frac{3}{4} \end{bmatrix}$$

```
> nu:=Dimension(c);
```

$$v := 3$$

```
> q:=1:
```

```
  for i from 1 to nu do
```

```
    q:=q*(t-c[i]);
```

```
  od:
```

```
> qi:=(n,tau)->unapply(q/(t-c[n]),t)(tau);
```

$$qi := (n, \tau) \rightarrow \text{unapply} \left( \frac{q}{t - c_n}, t \right) (\tau)$$

```
> A:=Matrix(3,3):
```

```
> for i from 1 to nu do
```

```
  for j from 1 to nu do
```

```
    A[j,i]:=int(qi(i,tau)/qi(i,c[i]),tau=0..c[j]);
```

```
  od:
```

```
od:
```

```
> b:=Vector(3):
```

```
> for j from 1 to nu do
```

```
  b[j]:=int(qi(j,tau)/qi(j,c[j]),tau=0..1);
```

```
od:
```

```
> simplify(A);
```

$$\begin{bmatrix} \frac{23}{48} & -\frac{1}{3} & \frac{5}{48} \\ \frac{7}{12} & -\frac{1}{6} & \frac{1}{12} \\ \frac{9}{16} & 0 & \frac{3}{16} \end{bmatrix}$$

> simplify(b);

$$\begin{bmatrix} \frac{2}{3} \\ -\frac{1}{3} \\ \frac{2}{3} \end{bmatrix}$$

```
> for j from 0 to nu do
  ri:=int(q*t^j,t=0..1);
  if ri <> 0 then
    break;
  fi
od;
m:=j;
```

$$\begin{aligned} ri &:= 0 \\ ri &:= \frac{7}{960} \\ m &:= 1 \end{aligned}$$

```
> #The order of this method is
m+nu;
```

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