Initialize extension field and polynomial ring over it. Syntax is initF(p,m) for field GF(p^m).

```
> initF(2,3);
```

$$\alpha^3 + \alpha + 1 \tag{2}$$

Initialize Reed-Solomon code. Syntax is initRS(n, r), where n=code length and r=code redundancy. The roots of the code are α^i for i=1,2,...,r.

```
> g := initRS(7,4);
```

Returns code generator polynomial

$$g := \alpha + 1 + \alpha x + x^2 + (\alpha + 1) x^3 + x^4 \tag{3}$$

Generate random message

```
> u := rmsg();
```

$$u := \alpha^2 + \left(\alpha^2 + 1\right) x + \left(\alpha^2 + 1\right) x^2 \tag{4}$$

Encode message

```
> c := encodeRS(u);
```

$$c := \alpha^2 + \alpha + \left(\alpha^2 + \alpha + 1\right) x + \alpha^2 x^2 + \left(\alpha^2 + \alpha\right) x^3 + \alpha^2 x^4 + \left(\alpha^2 + 1\right) x^5 + \left(\alpha^2 + 1\right) x^6 \tag{5}$$

Verify syndrome is zero

```
> syndrome(c);
```

$$0 \tag{6}$$

Generate random error vector

```
> e:=rerr(2);
```

$$e := \alpha^2 + \left(\alpha^2 + 1\right) x^6 \tag{7}$$

Compute received word

```
> y:=P[`+`](c,e);
```

$$y := \alpha + \left(\alpha^2 + \alpha + 1\right) x + \alpha^2 x^2 + \left(\alpha^2 + \alpha\right) x^3 + \alpha^2 x^4 + \left(\alpha^2 + 1\right) x^5 \tag{8}$$

Decode received word

```
> decodeRS(y);
```

```
syndrome S(x): :
```

$$\alpha + 1 + \alpha x + \left(\alpha^2 + \alpha + 1\right) x^2$$

```
Running Euclidean algorithm:
iteration: -1
 q : 0
 r :
```

$$x^4$$

```
 s :
```

$$1$$

```
 t :
```

$$0$$

```
iteration: 0
 q : 0
 r :
```

$$\alpha + 1 + \alpha x + \left(\alpha^2 + \alpha + 1\right) x^2$$

```
 s :
```

$$0$$

```
 t :
```

$$1$$

```
iteration: 1
 q :
```

$$\alpha + 1 + \left(\alpha^2 + \alpha + 1\right) x + \alpha^2 x^2$$

```
 r :
```

$$\alpha^2 + 1 + \alpha^2 x$$

```
 s :
```

$$1$$

```
 t :
```

$$\alpha + 1 + \left(\alpha^2 + \alpha + 1\right) x + \alpha^2 x^2$$

```
Lambda:
```

$$\alpha + 1 + \left(\alpha^2 + \alpha + 1\right) x + \alpha^2 x^2$$

```
Gamma:
```

$$\alpha^2 + 1 + \alpha^2 x$$

error word:

$$\alpha^2 + \left(\alpha^2 + 1\right) x^6$$

codeword :

$$\alpha^2 + \alpha + \left(\alpha^2 + \alpha + 1\right) x + \alpha^2 x^2 + \left(\alpha^2 + \alpha\right) x^3 + \alpha^2 x^4 + \left(\alpha^2 + 1\right) x^5 + \left(\alpha^2 + 1\right) x^6$$

syndrome :

$$0 \qquad (9$$

>

>