The **recursive dense** polynomial data structure
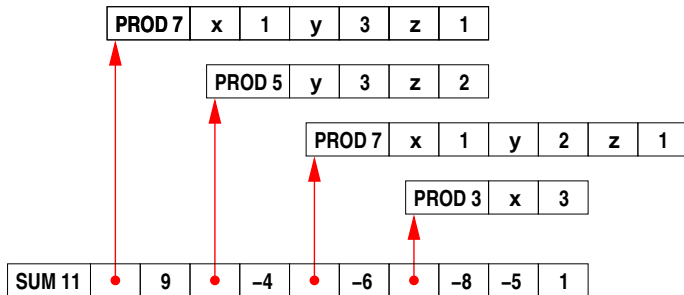
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Talk Outline

1. Sparse distributed polynomial data structures
2. Recursive polynomial data structures
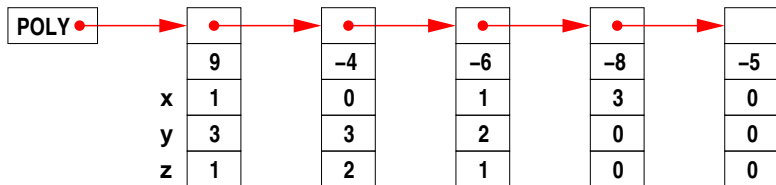3. Maple's RECDEN data structure
4. Demo of RECDEN

Maple's sum of products representation

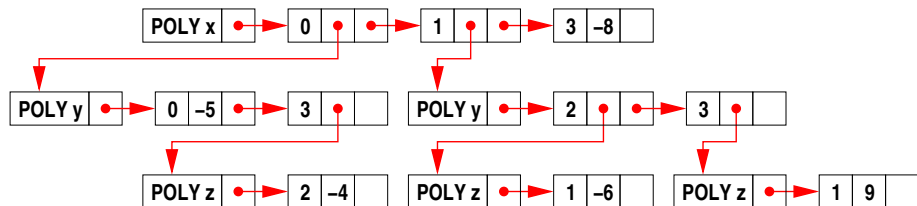$$9xy^3z - 4y^3z^2 - 6xy^2z - 8x^3 - 5$$

$$9xy^3z - 4y^3z^2 - 6xy^2z - 8x^3 - 5$$

$$(-5 - 4z^2y^3) + (-6zy^2 + 9zy^3)x - 8x^3$$
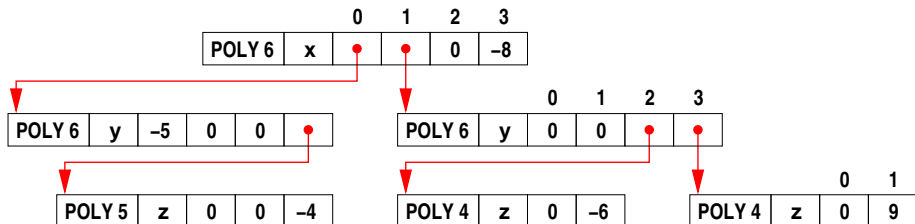
Pari's recursive dense representation

$$(-5 - 4z^2y^3) + (-6zy^2 + 9zy^3)x - 8x^3$$

Maple's RECDEN data structure

```
> read "/home/mmonagan/sydney/recden/recden";
> f := 9*x*y^3*z-4*y^3*z^2-6*x*y^2*z-8*x^3-5:
> F := rpoly(f,[x,y,z]);
```

$$F := -8x^3 - 5 + \left(9z\,y^3 - 6z\,y^2\right)x - 4y^3z^2$$

```
> getring(F); # op(1,F)
```

$$[0, [x, y, z], []]$$

```
> getpoly(F); # op(2,F)
```

$$[[[-5], 0, 0, [0, 0, -4]], [0, 0, [0, -6], [0, 9]], 0, [[-8]]]$$

```
> seq(coeffrpoly(F,i),i=0..degrpoly(F));
```

$$-4y^3z^2 - 5,\ 9z\,y^3 - 6z\,y^2,\ 0,\ -8$$

Maple's RECDEN data structure cont.

```
> F := rpoly(f,[x,y,z],z^2-2);  # Q(sqrt(2))
```

$$F := -8x^3 - 5 + \left(9z\,y^3 - 6z\,y^2\right)x - 8y^3 \quad \text{mod } \langle z^2 - 2\rangle$$

```
> getring(F); # op(1,F)
```

$$[0, [x, y, z], [[-2, 0, 0, 1]]]$$

```
> F := rpoly(f,[x,y,z],[z^2-2,y^2-3]); # Q(sqrt(2),sqrt(3))
```

$$-8x^3 - 5 + (27zy - 18z)x - 24y \quad \text{mod } \langle y^2 - 3, z^2 - 2\rangle$$

```
> getring(F); # op(1,F)
```

$$[0, [x, y, z], [[[-3], 0, [1]], [-2, 0, 1]]]$$