Pensieve header: Twisting the LT crossings.

```
In[∘]:= SetDirectory["C:\\drorbn\\AcademicPensieve\\Talks\\USC-240205"];
```

```
In[∘]:= Once[<< KnotTheory`];
```

Loading KnotTheory` version of October 29, 2024, 10:29:52.1301.
Read more at http://katlas.org/wiki/KnotTheory.

```
In[∘]:= θ[x_] /; NumericQ[x] := UnitStep[x]
```

```
In[∘]:= ω2[v_][p_] := Module[{q = Expand[p], n, c},
    If[q === 0, 0, c = Coefficient[q, ω, n = Exponent[q, ω]];
     c v^n + ω2[v][q - c (ω + ω^-1)^n]]];
```

```
In[∘]:= sign[ℰ_] := Module[{n, d, v, p, rs, e, k},
   {n, d} = NumeratorDenominator[ℰ];
   {n, d} /= ω^(Exponent[n,ω]/2+Exponent[n,ω,Min]/2);
   p = Factor[ω2[v]@n * ω2[v]@d /. v → 4 u^2 - 2];
   rs = Solve[p == 0, u, Reals];
   If[rs === {}, Sign[p /. u → 0],
    rs = Union@(u /. rs);
    Sign[(-1)^(e=Exponent[p,u]) Coefficient[p, u, e]] + Sum[
      k = 0; While[(d = RootReduce[∂_{u,++k} p /. u → r]) == 0];
      If[EvenQ[k], 0, 2 Sign[d]] * θ[u - r],
      {r, rs}]
   ]
  ]
```

```
In[∘]:= SetAttributes[B, Orderless];
CF[b_B] := RotateLeft[#, First@Ordering[#] - 1] & /@ DeleteCases[b, {}]
```

```
In[∘]:= CF[ℰ_] := Module[{γs = Union@Cases[ℰ, γ_ | γ̄_, ∞]},
   Total[CoefficientRules[ℰ, γs] /. (ps_ → c_) :→ Factor[c] Times @@ γs^ps]]
```

```
In[∘]:= CF[{}] = {};
CF[𝒞_List] := Module[{γs = Union@Cases[𝒞, γ_, ∞], γ},
   CF /@ DeleteCases[0][
     RowReduce[Table[∂_γ r, {r, 𝒞}, {γ, γs}]].γs] ]
```

```
In[∘]:= (ℰ_)^* := ℰ /. {γ̄ → γ, γ → γ̄, ω → ω^-1, c_Complex :→ c^*};
r_Rule^+ := {r, r^*}
```

```
In[∘]:= RulesOf[γ_i_ + rest_.] := (γ_i → -rest)^+;
CF[PQ[C_, q_]] := Module[{nC = CF[C]},
   PQ[nC, CF[q /. Union @@ RulesOf /@ nC]] ]
```

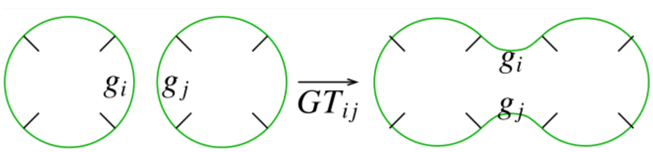
```
In[∘]:= CF[Σ_b_[σ_, pq_]] := Σ_CF[b][σ, CF[pq]]
```

Pretty-Printing.

```
In[∘]:= Format[Σ_b_B[σ_, PQ[C_, q_]]] := Module[{γs},
    γs = γ_# & /@ Join @@ b;
    Column[{TraditionalForm@σ,
      TableForm[Join[
        Prepend[""] /@ Table[TraditionalForm[∂_c r], {r, C}, {c, γs}],
        {Prepend[""][
          Join @@ (b /. {l_, m___, r_} :→ {DisplayForm@RowBox[{"(", l}],
                m, DisplayForm@RowBox[{r, ")"}]}) /. i_Integer :→ γ_i ]},
        MapThread[Prepend, {Table[TraditionalForm[∂_r,c q], {r, γs*}, {c, γs}], γs*}]
       ], TableAlignments → Center]
     }, Center] ];
```

The Face-Centric Core.

```
In[∘]:= Σ_b1_[σ1_, PQ[C1_, q1_]] ⊕ Σ_b2_[σ2_, PQ[C2_, q2_]] ^:=
   CF@Σ_Join[b1,b2][σ1 + σ2, PQ[C1 ⋃ C2, q1 + q2]];
```



GT for Gap Touch:

```
In[∘]:= GT_i_,j_@Σ_B[{li___,i_,ri___},{lj___,j_,rj___},bs___][σ_, PQ[C_, q_]] :=
  CF@Σ_B[{ri,li,j,rj,lj,i},bs][σ, PQ[C ⋃ {γ_i - γ_j}, q]]
```

Cordon:

```
In[∘]:= Cordon_i_@Σ_B[{li___,i_,ri___},bs___][σ_, PQ[C_, q_]] :=
  Module[{ϕ = ∂_γ_i C, λ = ∂_γ̄_i,γ_i q, nσ = σ, nC, nq, p},
   {p} = FirstPosition[(# =!= 0) & /@ ϕ, True, {0}];
   {nC, nq} = Which[
     p > 0, {C, q} /. (γ_i → -C⟦p⟧ / ϕ⟦p⟧)^+ /. (γ_i → 0)^+,
     λ =!= 0, (nσ += sign[λ]; {C, q /. (γ_i → -(∂_γ̄_i q) / λ)^+ /. (γ_i → 0)^+}),
     λ === 0, {C ⋃ {∂_γ̄_i q}, q /. (γ_i → 0)^+}];
   CF@Σ_B[Most@{ri,li},bs][nσ, PQ[nC, nq] /. (γ_Last@{ri,li} → γ_First@{ri,li})^+] ]
```

Strand Operations. c for contract, mc for magnetic contract:

```
In[∘]:= c_{i_,j_}@t : Σ_{B[{li___,i_,ri___},{___,j_,___},___]}[__] := t // GT_{j,First@{ri,li}} // Cordon_j
```

```
In[∘]:= c_{i_,j_}@t : Σ_{B[{___,i_,j_,___},___]}[__] := Cordon_j@t
        c_{i_,j_}@t : Σ_{B[{j_,___,i_},___]}[__] := Cordon_j@t
        c_{i_,j_}@t : Σ_{B[{___,j_,i_,___},___]}[__] := Cordon_i@t
        c_{i_,j_}@t : Σ_{B[{i_,___,j_},___]}[__] := Cordon_i@t
```

```
In[∘]:= mc[ℰ_] := ℰ //.
          t : Σ_{B[{___,i_,___},{___,j_,___},___]}[__] | Σ_{B[{___,i_,j_,___},___]}[__] | Σ_{B[{j_,___,i_},___]}[__] /;
            i + j == 0 :→ c_{i,j}@t
```

The twist.

```
In[∘]:= tw_-[γ1_, γ2_] := {γ1, γ2}*.( a1 , 1 - ω ; (1 - ω)* , a3 ).{γ1, γ2}
        tw_-[γ1_, γ2_] := {γ1, γ2}*.( a1 , a2 ; a2‾ , a3 ).{γ1, γ2}
        tw_-[γ1_, γ2_] := {γ1, γ2}*.( a1 , ω - 1 ; (ω - 1)* , a3 ).{γ1, γ2}
        tw_-[γ1_, γ2_] := {γ1, γ2}*.( a1 , 0 ; 0 , a3 ).{γ1, γ2}
        tw_+[γ1_, γ2_] := -tw_-[γ2, γ1]
```

```
In[∘]:= Expand@{tw_-[γ_1, γ_2], tw_+[γ_1, γ_2], tw_-[γ_1, γ_2] + tw_+[γ_2, γ_1]}
```

Out[∘]=

$$\{a1\,\gamma_1\,\overline{\gamma}_1 + a2\,\gamma_2\,\overline{\gamma}_1 + \overline{a2}\,\gamma_1\,\overline{\gamma}_2 + a3\,\gamma_2\,\overline{\gamma}_2,\ -a3\,\gamma_1\,\overline{\gamma}_1 - \overline{a2}\,\gamma_2\,\overline{\gamma}_1 - a2\,\gamma_1\,\overline{\gamma}_2 - a1\,\gamma_2\,\overline{\gamma}_2,\ 0\}$$

The Crossings (and empty strands).

```
In[∘]:= LT@P_{i_,j_} := CF@Σ_{B[{i,j}]}[0, PQ[{}, 0]]
```

```
In[∘]:= LT[x : X[i_, j_, k_, l_]] := LT@If[PositiveQ[x], X_{-i,j,k,-l}, X‾_{-j,k,l,-i}];
        LT[(x : X | X‾)_{fs__}] := Module[{t = 1 - ω, r, γs, m},
          r = t + t*; γs = γ_# & /@ {fs};
          m = If[x === X, ( -r   -t  2 t   t* ;
                            -t*   0   t*   0  ;
                            2 t*  t  -r   -t* ;
                            t     0  -t    0  ),
                          ( r    -t  -2 t*  t* ;
                            -t*   0   t*    0  ;
                            -2 t  t   r    -t* ;
                            t     0  -t     0  )];
          CF@Σ_{B[{fs}]}[0, PQ[{},
              γs*.m.γs + tw_- @@ γs⟦{1, 2}⟧ + tw_+ @@ γs⟦{2, 3}⟧ + tw_+ @@ γs⟦{3, 4}⟧ + tw_- @@ γs⟦{4, 1}⟧]]]
```

In[∘]:= LT@$X_{-1,2,3,-4}$

Out[∘]=

$$\begin{array}{c} 0 \\ \begin{array}{c|cccc} & \gamma_{-4} & \gamma_{-1} & \gamma_2 & \gamma_3 \\ \overline{\gamma}_{-4} & 0 & 1-\omega & 0 & \omega-1 \\ \overline{\gamma}_{-1} & \frac{\omega-1}{\omega} & \frac{a1\,\omega+a3\,\omega+\omega^2-2\,\omega+1}{\omega} & \omega-1 & -2\,(\omega-1) \\ \overline{\gamma}_2 & 0 & -\frac{\omega-1}{\omega} & 0 & \frac{\omega-1}{\omega} \\ \overline{\gamma}_3 & -\frac{\omega-1}{\omega} & \frac{2\,(\omega-1)}{\omega} & 1-\omega & -\frac{a1\,\omega+a3\,\omega-\omega^2+2\,\omega-1}{\omega} \end{array} \end{array}$$

Solve$\left[\frac{\omega\,\overline{a2}+\omega-1}{\omega}==0,\ \overline{a2}\right]$

Out[∘]=

$\left\{\left\{\overline{a2}\to\frac{1-\omega}{\omega}\right\}\right\}$

In[∘]:= Simplify$\left[\left(\frac{1-\omega}{\omega}\right)^*\right]$

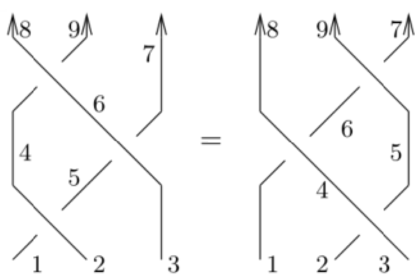
Out[∘]=

$-1+\omega$

Evaluation on Tangles and Knots.

In[∘]:=
```
LT[K_] := Fold[mc[#1 ⊕ #2] &, Σ_B[][0, PQ[{}, 0]], List @@ (LT /@ PD@K)] /.
   θ[c_ + u] /; Abs[c] ≥ 1 :> θ[c];
LTSig[K_] := LT[K][[1]]
```

Reidemeister 3



In[∘]:=
```
R3L = PD[X_{-2,5,4,-1}, X_{-3,7,6,-5}, X_{-6,9,8,-4}];
R3R = PD[X_{-3,5,4,-2}, X_{-4,6,8,-1}, X_{-5,7,9,-6}];
LT@R3L == LT@R3R
```

Out[∘]=

True

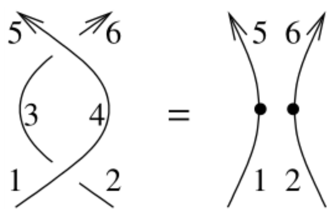
In[∘]:= **LT@R3L**

Out[∘]=

-1

	$(\gamma_{-3}$	γ_7	γ_9	γ_8	γ_{-1}	$\gamma_{-2})$
$\bar\gamma_{-3}$	$\frac{a1\,\omega+a3\,\omega+\omega^2+1}{\omega}$	$2\,(\omega-1)$	$-2\,\omega$	2	0	-2
$\bar\gamma_7$	$-\frac{2\,(\omega-1)}{\omega}$	0	$\frac{2\,(\omega-1)}{\omega}$	0	0	0
$\bar\gamma_9$	$-\frac{2}{\omega}$	$-2\,(\omega-1)$	$-\frac{a1\,\omega+a3\,\omega-\omega^2-1}{\omega}$	$-\frac{2}{\omega}$	0	$\frac{2}{\omega}$
$\bar\gamma_8$	2	0	$-2\,\omega$	$-\frac{a1\,\omega+a3\,\omega-\omega^2-1}{\omega}$	0	$-\frac{2}{\omega}$
$\bar\gamma_{-1}$	0	0	0	0	0	0
$\bar\gamma_{-2}$	-2	0	$2\,\omega$	$-2\,\omega$	0	$\frac{a1\,\omega+a3\,\omega+\omega^2+1}{\omega}$

Reidemeister 2b



In[∘]:= **LT@PD**$[X_{-2,4,3,-1},\ \bar X_{-4,6,5,-3}]$

Out[∘]=

0

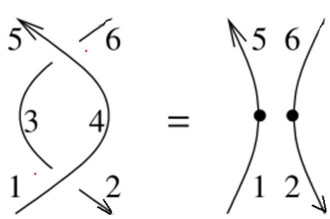
	1	0	-1	0
	$(\gamma_{-2}$	γ_6	γ_5	$\gamma_{-1})$
$\bar\gamma_{-2}$	0	0	0	0
$\bar\gamma_6$	0	0	0	0
$\bar\gamma_5$	0	0	0	0
$\bar\gamma_{-1}$	0	0	0	0

In[∘]:= **LT@PD**$[X_{-2,4,3,-1},\ \bar X_{-4,6,5,-3}]$ **==** **GT**$_{5,-2}$**@LT@PD**$[P_{-1,5},\ P_{-2,6}]$

Out[∘]=

True

Reidemeister 2c



In[∘]:= $\{\mathbf{LT@PD}[\bar{X}_{-1,2,4,-3}, X_{-6,5,3,-4}], \mathbf{LT@PD}[X_{-1,2,4,-3}, \bar{X}_{-6,5,3,-4}]\}$

Out[∘]=

$$\left\{ \begin{array}{c|cccc} & & 0 & & \\ & (\gamma_{-6} & \gamma_5 & \gamma_{-1} & \gamma_2) \\ \bar\gamma_{-6} & 0 & \omega-1 & 0 & 1-\omega \\ \bar\gamma_5 & -\frac{\omega-1}{\omega} & 0 & \frac{\omega-1}{\omega} & 0 \\ \bar\gamma_{-1} & 0 & 1-\omega & 0 & \omega-1 \\ \bar\gamma_2 & \frac{\omega-1}{\omega} & 0 & -\frac{\omega-1}{\omega} & 0 \end{array} , \begin{array}{c|cccc} & & 0 & & \\ & (\gamma_{-6} & \gamma_5 & \gamma_{-1} & \gamma_2) \\ \bar\gamma_{-6} & 0 & \omega-1 & 0 & 1-\omega \\ \bar\gamma_5 & -\frac{\omega-1}{\omega} & 0 & \frac{\omega-1}{\omega} & 0 \\ \bar\gamma_{-1} & 0 & 1-\omega & 0 & \omega-1 \\ \bar\gamma_2 & \frac{\omega-1}{\omega} & 0 & -\frac{\omega-1}{\omega} & 0 \end{array} \right\}$$

In[∘]:= $\mathbf{LT@PD}[\bar{X}_{-1,2,4,-3}, X_{-6,5,3,-4}] == \mathbf{GT}_{5,2}\mathbf{@LT@PD}[P_{-1,5}, P_{-6,2}]$

Out[∘]=

$$\begin{array}{c|cccc} & & 0 & & \\ & (\gamma_{-6} & \gamma_5 & \gamma_{-1} & \gamma_2) \\ \bar\gamma_{-6} & 0 & \omega-1 & 0 & 1-\omega \\ \bar\gamma_5 & -\frac{\omega-1}{\omega} & 0 & \frac{\omega-1}{\omega} & 0 \\ \bar\gamma_{-1} & 0 & 1-\omega & 0 & \omega-1 \\ \bar\gamma_2 & \frac{\omega-1}{\omega} & 0 & -\frac{\omega-1}{\omega} & 0 \end{array} == \begin{array}{c|cccc} & & 0 & & \\ & 0 & -1 & 0 & 1 \\ & (\gamma_{-6} & \gamma_5 & \gamma_{-1} & \gamma_2) \\ \bar\gamma_{-6} & 0 & 0 & 0 & 0 \\ \bar\gamma_5 & 0 & 0 & 0 & 0 \\ \bar\gamma_{-1} & 0 & 0 & 0 & 0 \\ \bar\gamma_2 & 0 & 0 & 0 & 0 \end{array}$$

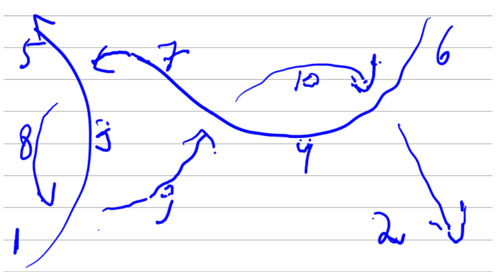
That’s a fail for LT!

The clockwise R2c:

In[∘]:= $\mathbf{LT@PD}[\bar{X}_{4,-3,-1,2}, X_{3,-4,-6,5}]$

Out[∘]=

$$\begin{array}{c|cccc} & & 0 & & \\ & (\gamma_{-6} & \gamma_5 & \gamma_{-1} & \gamma_2) \\ \bar\gamma_{-6} & 0 & -\frac{\omega-1}{\omega} & 0 & \frac{\omega-1}{\omega} \\ \bar\gamma_5 & \omega-1 & 0 & 1-\omega & 0 \\ \bar\gamma_{-1} & 0 & \frac{\omega-1}{\omega} & 0 & -\frac{\omega-1}{\omega} \\ \bar\gamma_2 & 1-\omega & 0 & \omega-1 & 0 \end{array}$$

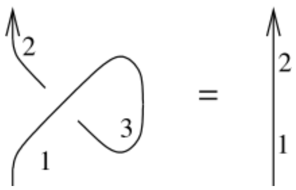


In[∘]:= $\mathbf{LT@PD}[\bar{X}_{-1,9,3,-8}, X_{-7,5,8,-3}, \bar{X}_{-4,10,7,-9}, X_{-10,4,2,-6}]$

Out[∘]=

$$\begin{array}{c|cccc} & & 0 & & \\ & 0 & -1 & 0 & 1 \\ & (\gamma_{-6} & \gamma_5 & \gamma_{-1} & \gamma_2) \\ \bar\gamma_{-6} & 0 & 0 & 0 & 0 \\ \bar\gamma_5 & 0 & 0 & 0 & 0 \\ \bar\gamma_{-1} & 0 & 0 & 0 & 0 \\ \bar\gamma_2 & 0 & 0 & 0 & 0 \end{array}$$

Reidemeister 1

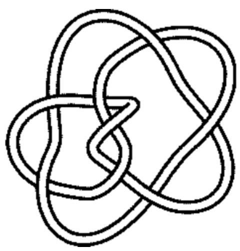


In[∘]:= LT@PD[$X_{-3,3,2,-1}$] == LT@$P_{-1,2}$

Out[∘]=

True

A Knot



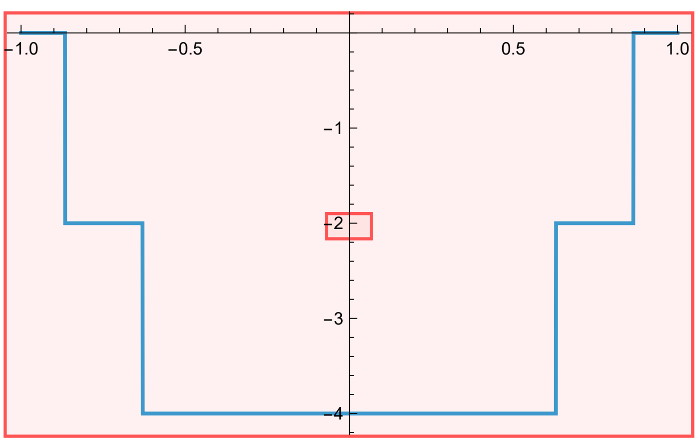
In[∘]:= `f = LTSig[Knot[8, 5]]`

Out[∘]=

$$2\,\theta\left[-\frac{\sqrt{3}}{2}+u\right]-2\,\theta\left[\frac{\sqrt{3}}{2}+u\right]-2\,\theta\left[u-\text{Root}(4,\ -0.630\ldots)\right]+2\,\theta\left[u-\text{Root}(4,\ 0.630\ldots)\right]$$

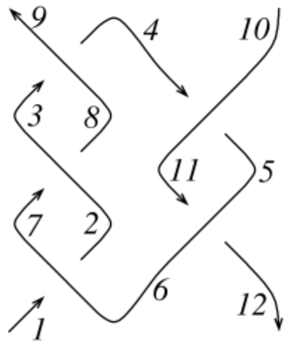
In[∘]:= `Plot[f, {u, -1, 1}]`

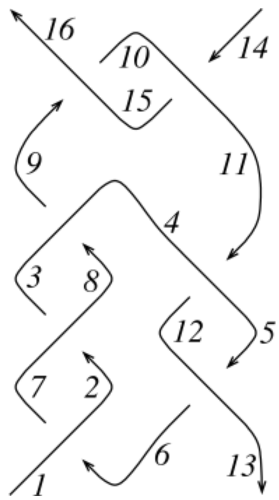
Out[∘]=



Some Tangles

The Conway-Kinoshita-Terasaka Tangles.





In[∘]:=
```
T1 = PD[X̄_{-6,2,7,-1}, X̄_{-2,8,3,-7}, X̄_{-8,4,9,-3}, X_{-11,6,12,-5}, X_{-4,11,5,-10}];
T2 = PD[X_{-6,2,7,-1}, X_{-2,8,3,-7}, X_{-8,4,9,-3}, X̄_{-12,6,13,-5}, X̄_{-4,12,5,-11}, X̄_{-10,15,11,-14}, X̄_{-15,10,16,-9}];
```

In[∘]:=
```
LT[T1]
```

Out[∘]=

$$-2\,\Theta\left(u-\frac{\sqrt{3}}{2}\right)+2\,\Theta\left(u+\frac{\sqrt{3}}{2}\right)-1$$

$$\begin{array}{c|cccc} & \Upsilon_{-10} & \Upsilon_{9} & \Upsilon_{-1} & \Upsilon_{12} \\ \bar\Upsilon_{-10} & 0 & -2\,(\omega-1) & 0 & 2\,(\omega-1) \\ \bar\Upsilon_{9} & \frac{2\,(\omega-1)}{\omega} & \frac{2\,\omega}{\omega^2-\omega+1} & -\frac{2\,(\omega-1)}{\omega} & -\frac{2\,\omega}{\omega^2-\omega+1} \\ \bar\Upsilon_{-1} & 0 & 2\,(\omega-1) & 0 & -2\,(\omega-1) \\ \bar\Upsilon_{12} & -\frac{2\,(\omega-1)}{\omega} & -\frac{2\,\omega}{\omega^2-\omega+1} & \frac{2\,(\omega-1)}{\omega} & \frac{2\,\omega}{\omega^2-\omega+1} \end{array}$$

In[∘]:=
```
LT[T2]
```

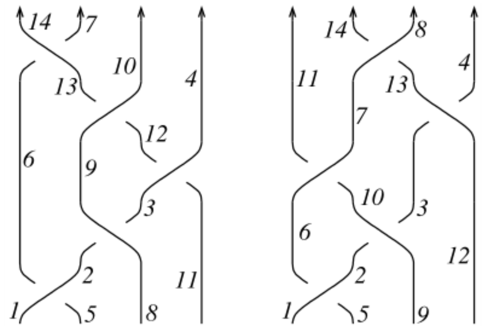
Out[∘]=

$$0$$

$$\begin{array}{c|cccc} & \Upsilon_{-14} & \Upsilon_{16} & \Upsilon_{-1} & \Upsilon_{13} \\ \bar\Upsilon_{-14} & 0 & -2\,(\omega-1) & 0 & 2\,(\omega-1) \\ \bar\Upsilon_{16} & \frac{2\,(\omega-1)}{\omega} & -\frac{2\,(\omega-1)^2\,\omega}{\omega^4-3\,\omega^3+5\,\omega^2-3\,\omega+1} & -\frac{2\,(\omega-1)}{\omega} & \frac{2\,(\omega-1)^2\,\omega}{\omega^4-3\,\omega^3+5\,\omega^2-3\,\omega+1} \\ \bar\Upsilon_{-1} & 0 & 2\,(\omega-1) & 0 & -2\,(\omega-1) \\ \bar\Upsilon_{13} & -\frac{2\,(\omega-1)}{\omega} & \frac{2\,(\omega-1)^2\,\omega}{\omega^4-3\,\omega^3+5\,\omega^2-3\,\omega+1} & \frac{2\,(\omega-1)}{\omega} & -\frac{2\,(\omega-1)^2\,\omega}{\omega^4-3\,\omega^3+5\,\omega^2-3\,\omega+1} \end{array}$$

Some Braids

Examples with non-trivial codimension.



In[•]:=
```
PD[X[5, 2, 6, 1], X[2, 9, 3, 10], X[10, 7, 11, 6], X[3, 12, 4, 13], X[13, 8, 14, 7]] /.
  x : X[i_, j_, k_, l_] :> If[PositiveQ@x, X_{-i,j,k,-l}, X̄_{-j,k,l,-i}]
```

Out[•]=

$PD\left[X_{-5,2,6,-1},\ \overline{X}_{-9,3,10,-2},\ X_{-10,7,11,-6},\ \overline{X}_{-12,4,13,-3},\ X_{-13,8,14,-7}\right]$

In[•]:=
```
B1 = PD[X_{-5,2,6,-1}, X̄_{-8,3,9,-2}, X_{-11,4,12,-3}, X_{-12,10,13,-9}, X̄_{-13,7,14,-6}];
B2 = PD[X_{-5,2,6,-1}, X̄_{-9,3,10,-2}, X_{-10,7,11,-6}, X̄_{-12,4,13,-3}, X_{-13,8,14,-7}];
```

In[•]:=
```
LT[B1]
```

Out[•]=

0

	1	0	−1	0	$\frac{1}{\omega}$	0
	0	0	0	−1	$\frac{1}{\omega}$	0
	(Υ_{-11}	Υ_{4}	Υ_{10}	Υ_{7}	Υ_{14}	Υ_{-1}
$\overline{\Upsilon}_{-11}$	0	0	0	0	0	0
$\overline{\Upsilon}_{4}$	0	0	0	0	0	0
$\overline{\Upsilon}_{10}$	0	0	0	0	$-\frac{a1\,\omega+a3\,\omega+\omega^2-1}{\omega^2}$	0
$\overline{\Upsilon}_{7}$	0	0	0	0	$\frac{-a1\,\omega-a3\,\omega+\omega^2-2\,\omega+1}{\omega^2}$	0
$\overline{\Upsilon}_{14}$	0	0	$-a1\,\omega-a3\,\omega+\omega^2-1$	$-a1\,\omega-a3\,\omega+\omega^2-2\,\omega+1$	$\frac{a1\,\omega+a3\,\omega-\omega^2+2\,\omega-1}{\omega}$	$-\frac{2\,(\omega-1)}{\omega}$
$\overline{\Upsilon}_{-1}$	0	0	0	0	$2\,(\omega-1)$	0
$\overline{\Upsilon}_{-5}$	0	0	$a1\,\omega+a3\,\omega-\omega^2+1$	$a1\,\omega+a3\,\omega-\omega^2+2\,\omega-1$	$-2\,(a1+a3)$	$\frac{2\,(\omega-1)}{\omega}$
$\overline{\Upsilon}_{-8}$	0	0	0	0	0	0

In[•]:=
```
LT[B2]
```

Out[•]=

0

	(Υ_{-12}	Υ_{4}	Υ_{8}	Υ_{14}	Υ_{11}	Υ_{-1}
$\overline{\Upsilon}_{-12}$	$\frac{a1\,\omega+a3\,\omega+\omega^2-2\,\omega+1}{\omega}$	0	$-2\,(\omega-1)$	$\frac{2\,(\omega-1)^2}{\omega}$	$\frac{2\,(\omega-1)}{\omega^2}$	0
$\overline{\Upsilon}_{4}$	0	0	0	0	0	0
$\overline{\Upsilon}_{8}$	$\frac{2\,(\omega-1)}{\omega}$	0	$-\frac{a1\,\omega+a3\,\omega-\omega^2+2\,\omega-1}{\omega}$	$-\frac{2\,(\omega-1)^2}{\omega}$	$-\frac{2\,(\omega-1)}{\omega^2}$	0
$\overline{\Upsilon}_{14}$	$\frac{2\,(\omega-1)^2}{\omega}$	0	$-\frac{2\,(\omega-1)^2}{\omega}$	$-\frac{a1\,\omega+a3\,\omega-3\,\omega^2+6\,\omega-3}{\omega}$	$-\frac{2\,(\omega-1)^2}{\omega^2}$	0
$\overline{\Upsilon}_{11}$	$-2\,(\omega-1)\,\omega$	0	$2\,(\omega-1)\,\omega$	$-2\,(\omega-1)^2$	$-\frac{a1\,\omega+a3\,\omega-\omega^2+2\,\omega-1}{\omega}$	$-\frac{2\,(\omega-1)}{\omega}$
$\overline{\Upsilon}_{-1}$	0	0	0	0	$2\,(\omega-1)$	0
$\overline{\Upsilon}_{-5}$	$2\,(\omega-1)\,\omega$	0	$-2\,(\omega-1)\,\omega$	$2\,(\omega-1)\,\omega$	$-2\,(\omega-1)$	$\frac{2\,(\omega-1)}{\omega}$
$\overline{\Upsilon}_{-9}$	$-\frac{2\,(\omega-1)\,(2\,\omega-1)}{\omega}$	0	$\frac{2\,(\omega-1)\,(2\,\omega-1)}{\omega}$	$-\frac{2\,(\omega-1)\,(2\,\omega-1)}{\omega}$	$\frac{2\,(\omega-1)^2}{\omega^2}$	0