Pensieve header: The main program and demo.

```
In[∘]:= SetDirectory["C:\\drorbn\\AcademicPensieve\\Talks\\ICERM-2305"];
```

tex

{\bf\red Implementation} (sources: \url{http://drorbn.net/icerm23/ap}). I like it most when the implementation matches the math perfectly. We failed here.

pdf

```
In[∘]:= Once[<< KnotTheory`];
```

pdf

```
Loading KnotTheory` version of February 2, 2020, 10:53:45.2097.
Read more at http://katlas.org/wiki/KnotTheory.
```

tex

\par{\bf\red Utilities.} The step function, algebraic numbers, canonical forms.

pdf

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

pdf

```
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]]];
```

pdf

```
In[∘]:= sign[ℰ_] := Module[{n, d, v, p, rs, e, k},
          {n, d} = NumeratorDenominator[ℰ]; {n, d} /= ω^(Exponent[n,ω]/2);
          p = Factor[ω2[v]@n * ω2[v]@d /. v → 4 u^2 - 2];
          rs = Solve[p == 0, u, Reals];
          If[rs === {}, Return[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}] ]
```

pdf

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

pdf

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

pdf

In[∘]:=
```
CF[{}] = {};
CF[𝒞_List] := Module[{ηs = Union@Cases[𝒞, η_, ∞], η},
  CF /@ DeleteCases[0][
    RowReduce[Table[∂_η r, {r, 𝒞}, {η, ηs}]].ηs ] ]
```

pdf

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

pdf

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

pdf

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

tex

\needspace{32mm}
\par{\bf\red Pretty-Printing.}

pdf

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

tex

\par{\bf\red The Face-Centric Core.}

pdf

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]];
```

tex

\par FM for Face Merge:

pdf

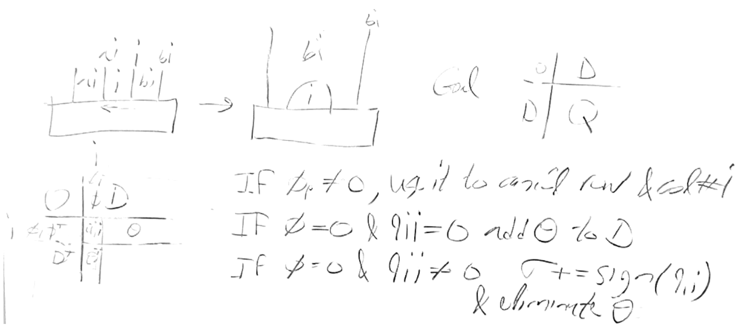
```
In[∘]:= FM_{i_,j_}@Σ_B[{li___,i_,ri___},{lj___,j_,rj___},bs___][σ_, PQ[C_, q_]] :=
  CF@Σ_B[{ri,li,j,rj,lj,i},bs][σ, PQ[C ∪ {η_i - η_j}, q]]
```

cor·don (kôr′dn)

n.

1. A line of people, military posts, or ships stationed around an area to enclose or guard it: *a police cordon.*

2. A rope, line, tape, or similar border stretched around an area, usually by the police, indicating that access is restricted.



tex

\par\Cordon

pdf

```
In[∘]:= Cordon_{i_}@Σ_B[{li___,i_,ri___},bs___][σ_, PQ[C_, q_]] :=
  Module[{ϕ = ∂_{η_i} C, λ = ∂_{η̄_i,η_i} q, nσ = σ, nC, nq, p},
   {p} = FirstPosition[(# =!= 0) & /@ ϕ, True, {0}];
   {nC, nq} = Which[
     p > 0, {C, q} /. (η_i → -C⟦p⟧ / ϕ⟦p⟧)^+ /. (η_i → 0)^+,
     λ =!= 0, (nσ += sign[λ]; {C, q /. (η_i → -(∂_{η̄_i} q) / λ)^+ /. (η_i → 0)^+}),
     λ === 0, {C ∪ {∂_{η̄_i} q}, q /. (η_i → 0)^+}];
   CF@Σ_B[Most@{ri,li},bs][nσ, PQ[nC, nq] /. (η_{Last@{ri,li}} → η_{First@{ri,li}})^+] ]
```

tex

\par\needspace{20mm}

{\bf\red Strand Operations.} c for contract, mc for magnetic contract:

pdf

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

pdf

```
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
```

pdf

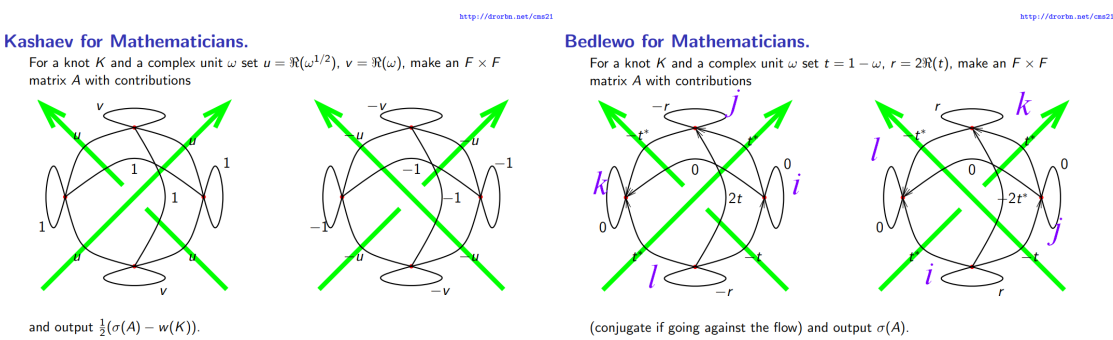
```
In[∘]:=
mc[ℰ_] := ℰ //.
  t : Σ_{B[{___,i_,___},{___,j_,___},___]}[__] | Σ_{B[{___,i_,j_,___},___]}[__] | Σ_{B[{j_,___,i_},___]}[__] /;
    i + j == 0 :→ c_{i,j}@t
```

tex

\par{\bf\red The Crossings} (and empty strands).

pdf

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



pdf

```
In[∘]:=
Kas[x : X[i_, j_, k_, l_]] := Kas@If[PositiveQ[x], X_{-i,j,k,-l}, X̄_{-j,k,l,-i}];
Kas[(x : X | X̄)_{fs__}] := Module[{v = 2 u^2 - 1, p, ηs, m},
  ηs = η_# & /@ {fs}; p = (x === X);
  m = If[p, ( v u 1 u
              u 1 u 1
              1 u v u
              u 1 u 1 ), - ( v u 1 u
                             u 1 u 1
                             1 u v u
                             u 1 u 1 )];
  CF@Σ_{B[{fs}]}[If[p, -1, 1], PQ[{}, ηs*.m.ηs]]]
```

pdf

In[∘]:=
```
TL[x : X[i_, j_, k_, l_]] := TL@If[PositiveQ[x], X_{-i,j,k,-l}, X̄_{-j,k,l,-i}];
TL[(x : X | X̄)_{fs__}] := Module[{t = 1 - ω, r, ηs, m},
  r = t + t*; ηs = η_# & /@ {fs};
  m = If[x === X,
     ( -r   -t   2 t   t*  )    (  r    -t  -2 t*  t*  )
     ( -t*   0   t*    0   ) ,  ( -t*    0   t*    0   )   ];
     ( 2 t*  t   -r   -t*  )    ( -2 t   t    r   -t*  )
     (  t    0   -t    0   )    (  t     0   -t    0   )
  CF@Σ_{B[{fs}]}[0, PQ[{}, ηs*.m.ηs]]]
```

tex

\par{\bf\red Evaluation on Tangles and Knots.}

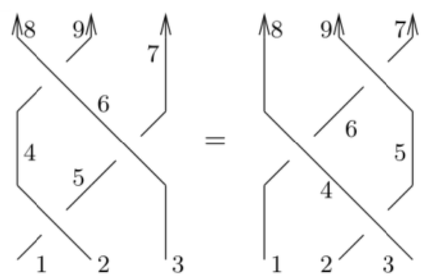
pdf

In[∘]:=
```
Kas[K_] := Fold[mc[#1 ⊕ #2] &, Σ_{B[]}[0, PQ[{}, 0]], List @@ (Kas /@ PD@K)];
KasSig[K_] := Expand[Kas[K][[1]] / 2]
```

pdf

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

Reidemeister 3



tex

\par\needspace{20mm}
\parpic[r]{\input{figs/R3.pdf_t}}
{\bf\red Reidemeister 3.}

pdf

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}];
{TL@R3L == TL@R3R, Kas@R3L == Kas@R3R}
```

Out[∘]=
pdf

```
{True, True}
```

tex

\needspace{15mm}

pdf

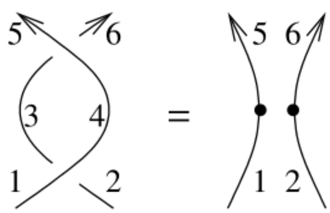
In[ ]:= **Kas@R3L**

Out[ ]=
pdf

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

	$(\eta_{-3}$	η_7	η_9	η_8	η_{-1}	η_{-2}
$\overline{\eta}_{-3}$	$\frac{2u^2(4u^2-3)}{(2u-1)(2u+1)}$	$\frac{u(4u^2-3)}{(2u-1)(2u+1)}$	$-\frac{1}{(2u-1)(2u+1)}$	$-\frac{2u}{(2u-1)(2u+1)}$	$-\frac{1}{(2u-1)(2u+1)}$	$\frac{u\,(4u\ldots}{(2u-1)\ldots}$
$\overline{\eta}_7$	$\frac{u(4u^2-3)}{(2u-1)(2u+1)}$	$\frac{2(2u^2-1)}{(2u-1)(2u+1)}$	$\frac{u(4u^2-3)}{(2u-1)(2u+1)}$	$-\frac{1}{(2u-1)(2u+1)}$	$-\frac{2u}{(2u-1)(2u+1)}$	$-\frac{\ldots}{(2u-1)\ldots}$
$\overline{\eta}_9$	$-\frac{1}{(2u-1)(2u+1)}$	$\frac{u(4u^2-3)}{(2u-1)(2u+1)}$	$\frac{2u^2(4u^2-3)}{(2u-1)(2u+1)}$	$\frac{u(4u^2-3)}{(2u-1)(2u+1)}$	$-\frac{1}{(2u-1)(2u+1)}$	$-\frac{2\ldots}{(2u-1)\ldots}$
$\overline{\eta}_8$	$-\frac{2u}{(2u-1)(2u+1)}$	$-\frac{1}{(2u-1)(2u+1)}$	$\frac{u(4u^2-3)}{(2u-1)(2u+1)}$	$\frac{2u^2(4u^2-3)}{(2u-1)(2u+1)}$	$\frac{u(4u^2-3)}{(2u-1)(2u+1)}$	$-\frac{\ldots}{(2u-1)\ldots}$
$\overline{\eta}_{-1}$	$-\frac{1}{(2u-1)(2u+1)}$	$-\frac{2u}{(2u-1)(2u+1)}$	$-\frac{1}{(2u-1)(2u+1)}$	$\frac{u(4u^2-3)}{(2u-1)(2u+1)}$	$\frac{2(2u^2-1)}{(2u-1)(2u+1)}$	$\frac{u\,(4u\ldots}{(2u-1)\ldots}$
$\overline{\eta}_{-2}$	$\frac{u(4u^2-3)}{(2u-1)(2u+1)}$	$-\frac{1}{(2u-1)(2u+1)}$	$-\frac{2u}{(2u-1)(2u+1)}$	$-\frac{1}{(2u-1)(2u+1)}$	$\frac{u(4u^2-3)}{(2u-1)(2u+1)}$	$\frac{2u^2\,(4\ldots}{(2u-1)\ldots}$

Reidemeister 2



tex

\par
\parpic[r]{\input{figs/R2.pdf_t}}
{\bf\red Reidemeister 2.}

pdf

In[ ]:= **TL@PD[$X_{-2,4,3,-1}$, $\overline{X}_{-4,6,5,-3}$]**

Out[ ]=
pdf

		0		
	1	0	−1	0
	$(\eta_{-2}$	η_6	η_5	$\eta_{-1})$
$\overline{\eta}_{-2}$	0	0	0	0
$\overline{\eta}_6$	0	0	0	0
$\overline{\eta}_5$	0	0	0	0
$\overline{\eta}_{-1}$	0	0	0	0

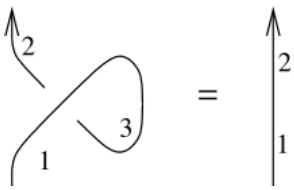
pdf

In[∘]:=
```
{TL@PD[X_{-2,4,3,-1}, X̄_{-4,6,5,-3}] == FM_{5,-2}@TL@PD[P_{-1,5}, P_{-2,6}],
 Kas@PD[X_{-2,4,3,-1}, X̄_{-4,6,5,-3}] == FM_{5,-2}@Kas@PD[P_{-1,5}, P_{-2,6}]}
```

Out[∘]=
pdf

{True, True}

Reidemeister 1



tex

\par
\parpic[r]{\input{figs/R1.pdf_t}}
{\bf\red Reidemeister 1.}

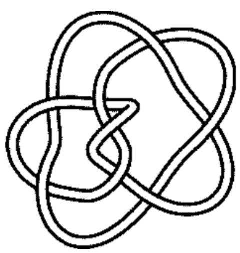
pdf

In[∘]:=
```
{TL@PD[X_{-3,3,2,-1}] == TL@P_{-1,2},
 Kas@PD[X_{-3,3,2,-1}] == Kas@P_{-1,2}}
```

Out[∘]=
pdf

{True, True}

A Knot



tex

\par
\parpic[r]{\includegraphics[width=1in]{8_5.png}}
{\bf\red A Knot.}

pdf

In[∘]:=
```
f = TLSig[Knot[8, 5]]
```

pdf

KnotTheory: Loading precomputed data in PD4Knots`.

Out[∘]=
pdf

$$2\,\theta\left[-\frac{\sqrt{3}}{2}+u\right]-2\,\theta\left[\frac{\sqrt{3}}{2}+u\right]-2\,\theta\left[u-\boxed{-0.630\ldots}\right]+2\,\theta\left[u-\boxed{0.630\ldots}\right]$$

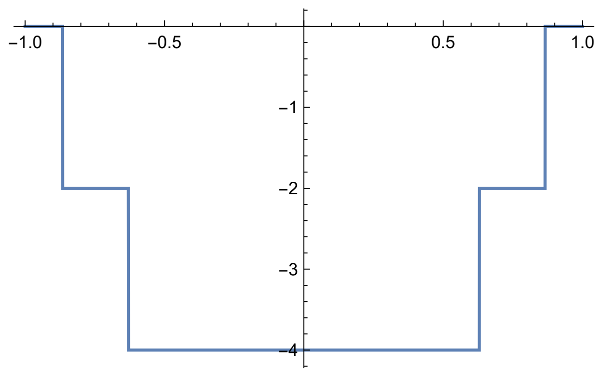
tex

\par\picskip{0}{
 \def\nbpdfInput#1{\vskip 1mm\par\noindent\includegraphics{#1}}
 \def\nbpdfOutput#1{\hfill\includegraphics[width=0.4\linewidth,valign=t]{#1}}

pdf

In[∘]:=
```
Plot[f, {u, -1, 1}]
```

Out[∘]=
pdf



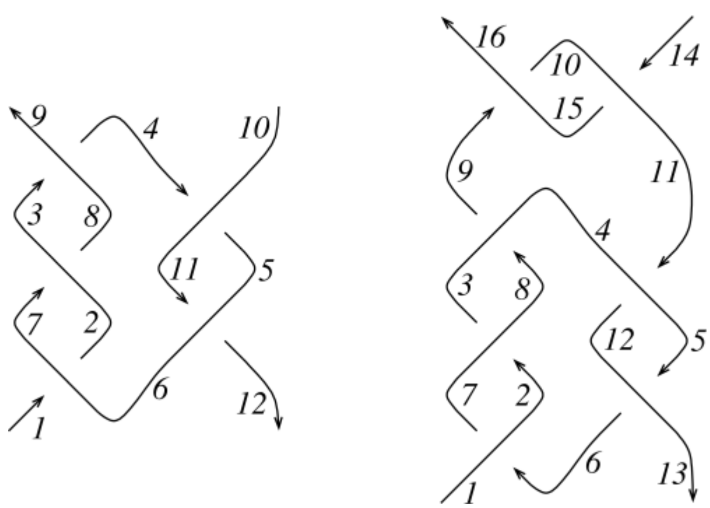
tex

}

Some Tangles

tex

\needspace{30mm}
\par\parpic[r]{\includegraphics[width=1.88in]{figs/CKT.pdf}}
{\bf\red The Conway-Kinoshita-Terasaka Tangles.}



pdf

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}];
```

tex

\par\needspace{10mm}

pdf

In[∘]:=
```
Column@{TL[T1], Kas[T1]}
```

Out[∘]=
pdf

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

	$(\eta_{-10}$	η_9	η_{-1}	$\eta_{12})$
$\bar\eta_{-10}$	0	$1-\omega$	0	$\omega-1$
$\bar\eta_9$	$\frac{\omega-1}{\omega}$	$\frac{2\omega}{\omega^2-\omega+1}$	$-\frac{\omega-1}{\omega}$	$-\frac{2\omega}{\omega^2-\omega+1}$
$\bar\eta_{-1}$	0	$\omega-1$	0	$1-\omega$
$\bar\eta_{12}$	$-\frac{\omega-1}{\omega}$	$-\frac{2\omega}{\omega^2-\omega+1}$	$\frac{\omega-1}{\omega}$	$\frac{2\omega}{\omega^2-\omega+1}$

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

	$(\eta_{-10}$	η_9	η_{-1}	$\eta_{12})$
$\bar\eta_{-10}$	$2\,(u-1)\,(u+1)\,(4u^2-3)$	0	$-2\,(u-1)\,(u+1)\,(4u^2-3)$	0
$\bar\eta_9$	0	$\frac{1}{2\,(4u^2-3)}$	0	$-\frac{1}{2\,(4u^2-3)}$
$\bar\eta_{-1}$	$-2\,(u-1)\,(u+1)\,(4u^2-3)$	0	$2\,(u-1)\,(u+1)\,(4u^2-3)$	0
$\bar\eta_{12}$	0	$-\frac{1}{2\,(4u^2-3)}$	0	$\frac{1}{2\,(4u^2-3)}$

pdf

In[∘]:=
```
Column@{TL[T2], Kas[T2]}
```

Out[∘]=
pdf

$$0$$

	$(\eta_{-14}$	η_{16}	η_{-1}	$\eta_{13})$
$\bar\eta_{-14}$	0	$1-\omega$	0	$\omega-1$
$\bar\eta_{16}$	$\frac{\omega-1}{\omega}$	$-\frac{2\,(\omega-1)^2\,\omega}{\omega^4-3\omega^3+5\omega^2-3\omega+1}$	$-\frac{\omega-1}{\omega}$	$\frac{2\,(\omega-1)^2\,\omega}{\omega^4-3\omega^3+5\omega^2-3\omega+1}$
$\bar\eta_{-1}$	0	$\omega-1$	0	$1-\omega$
$\bar\eta_{13}$	$-\frac{\omega-1}{\omega}$	$\frac{2\,(\omega-1)^2\,\omega}{\omega^4-3\omega^3+5\omega^2-3\omega+1}$	$\frac{\omega-1}{\omega}$	$-\frac{2\,(\omega-1)^2\,\omega}{\omega^4-3\omega^3+5\omega^2-3\omega+1}$

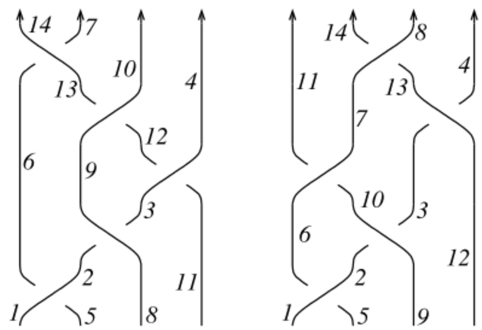
$$1$$

	$(\eta_{-14}$	η_{16}	η_{-1}	$\eta_{13})$
$\bar\eta_{-14}$	$\frac{1}{2}\left(-16u^4+28u^2-13\right)$	0	$\frac{1}{2}\left(16u^4-28u^2+13\right)$	0
$\bar\eta_{16}$	0	$-\frac{2\,(u-1)\,(u+1)}{16u^4-28u^2+13}$	0	$\frac{2\,(u-1)\,(u+1)}{16u^4-28u^2+13}$
$\bar\eta_{-1}$	$\frac{1}{2}\left(16u^4-28u^2+13\right)$	0	$\frac{1}{2}\left(-16u^4+28u^2-13\right)$	0
$\bar\eta_{13}$	0	$\frac{2\,(u-1)\,(u+1)}{16u^4-28u^2+13}$	0	$-\frac{2\,(u-1)\,(u+1)}{16u^4-28u^2+13}$

Some Braids

tex

\parpic[r]{\includegraphics[width=1.88in]{figs/B1B2.pdf}}
{\bf\red 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[∘]=

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

pdf

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}];
```

pdf

In[∘]:= **Column@{TL[B1], Kas[B1]}**

Out[∘]=
pdf

0

	1	0	−1	0	$\frac{1}{\omega}$	0	$-\frac{1}{\omega}$	0
	0	0	0	−1	$\frac{1}{\omega}$	0	$-\frac{1}{\omega}$	1
	$(\eta_{-11}$	η_4	η_{10}	η_7	η_{14}	η_{-1}	η_{-5}	$\eta_{-8})$
$\overline{\eta}_{-11}$	0	0	0	0	0	0	0	0
$\overline{\eta}_4$	0	0	0	0	$\frac{\omega-1}{\omega^2}$	0	$-\frac{\omega-1}{\omega^2}$	0
$\overline{\eta}_{10}$	0	0	0	0	$-\frac{\omega-1}{\omega}$	0	$\frac{\omega-1}{\omega}$	0
$\overline{\eta}_7$	0	0	0	0	$\frac{(\omega-1)^2}{\omega^2}$	0	$-\frac{(\omega-1)^2}{\omega^2}$	0
$\overline{\eta}_{14}$	0	$-((\omega-1)\,\omega)$	$\omega-1$	$(\omega-1)^2$	0	$-\frac{\omega-1}{\omega}$	$\frac{\omega-1}{\omega}$	0
$\overline{\eta}_{-1}$	0	0	0	0	$\omega-1$	0	$1-\omega$	0
$\overline{\eta}_{-5}$	0	$(\omega-1)\,\omega$	$1-\omega$	$-(\omega-1)^2$	$1-\omega$	$\frac{\omega-1}{\omega}$	$\frac{(\omega-1)^2}{\omega}$	0
$\overline{\eta}_{-8}$	0	0	0	0	0	0	0	0

0

	1	0	−1	0	1	0	−1	0
	$(\eta_{-11}$	η_4	η_{10}	η_7	η_{14}	η_{-1}	η_{-5}	$\eta_{-8})$
$\overline{\eta}_{-11}$	0	0	0	0	0	0	0	0
$\overline{\eta}_4$	0	0	0	−1	$-u$	0	u	1
$\overline{\eta}_{10}$	0	0	0	$-u$	$1-2u^2$	0	$2u^2-1$	u
$\overline{\eta}_7$	0	−1	$-u$	$2u^2-3$	$-u$	−1	0	1
$\overline{\eta}_{14}$	0	$-u$	$1-2u^2$	$-u$	−1	$-u$	$-2(u-1)(u+1)$	u
$\overline{\eta}_{-1}$	0	0	0	−1	$-u$	0	u	1
$\overline{\eta}_{-5}$	0	u	$2u^2-1$	0	$-2(u-1)(u+1)$	u	$4u^2-3$	0
$\overline{\eta}_{-8}$	0	1	u	1	u	1	0	$1-2$ ι

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	$(\eta_{-12}$	η_4	η_8	η_{14}	η_{11}	η_{-1}	
$\overline{\eta}_{-12}$	$\frac{(\omega-1)^2}{\omega}$	$\omega-1$	$-2(\omega-1)$	$\frac{2(\omega-1)^2}{\omega}$	$\frac{2(\omega-1)}{\omega^2}$	0	$-$ [cut off]
$\overline{\eta}_4$	$-\frac{\omega-1}{\omega}$	0	$\frac{\omega-1}{\omega}$	0	0	0	
$\overline{\eta}_8$	$\frac{2(\omega-1)}{\omega}$	$1-\omega$	$\frac{(\omega-1)^2}{\omega}$	$-\frac{(\omega-1)(2\omega-3)}{\omega}$	$-\frac{2(\omega-1)}{\omega^2}$	0	2 [cut off]
$\overline{\eta}_{14}$	$\frac{2(\omega-1)^2}{\omega}$	0	$-\frac{(\omega-1)(3\omega-2)}{\omega}$	$\frac{3(\omega-1)^2}{\omega}$	$-\frac{(\omega-2)(\omega-1)}{\omega^2}$	0	$-$ [cut off]
$\overline{\eta}_{11}$	$-2(\omega-1)\omega$	0	$2(\omega-1)\omega$	$-((\omega-1)(2\omega-1))$	$\frac{(\omega-1)^2}{\omega}$	$-\frac{\omega-1}{\omega}$	2 [cut off]
$\overline{\eta}_{-1}$	0	0	0	0	$\omega-1$	0	[cut off]
$\overline{\eta}_{-5}$	$2(\omega-1)\omega$	0	$-2(\omega-1)\omega$	$2(\omega-1)\omega$	$-2(\omega-1)$	$\frac{\omega-1}{\omega}$	[cut off]
$\overline{\eta}_{-9}$	$-\frac{(\omega-1)(3\omega-2)}{\omega}$	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	$-(\omega$ [cut off]

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

	1	$\frac{1}{2u}$	0	$-\frac{1}{2u}$	-1	$-\frac{1}{2u}$
	$(\eta_{-12}$	η_4	η_8	η_{14}	η_{11}	η_{-1}
$\overline{\eta}_{-12}$	0	0	0	0	0	0
$\overline{\eta}_4$	0	$-\frac{(2u-1)(2u+1)(2u^2-1)}{4u^2(4u^2-3)}$	$-\frac{2u^2-1}{2u}$	$\frac{1}{4u^2(4u^2-3)}$	0	$-\frac{(2u-1)(2}{4u^2(4u^2-}$ [cut off]
$\overline{\eta}_8$	0	$-\frac{2u^2-1}{2u}$	$-2(u-1)(u+1)$	$\frac{2u^2-1}{2u}$	0	$-\frac{1}{2u}$
$\overline{\eta}_{14}$	0	$\frac{1}{4u^2(4u^2-3)}$	$\frac{2u^2-1}{2u}$	$\frac{(2u^2-1)(16u^4-16u^2+1)}{4u^2(4u^2-3)}$	0	$-\frac{8u^4-10u^2}{4u^2(4u^2-}$ [cut off]
$\overline{\eta}_{11}$	0	0	0	0	0	0
$\overline{\eta}_{-1}$	0	$-\frac{(2u-1)(2u+1)}{4u^2(4u^2-3)}$	$-\frac{1}{2u}$	$-\frac{8u^4-10u^2+1}{4u^2(4u^2-3)}$	0	$\frac{8u^4-10u^2-}{4u^2(4u^2-3}$ [cut off]
$\overline{\eta}_{-5}$	0	$-\frac{1}{2u(4u^2-3)}$	0	$\frac{1}{2u(4u^2-3)}$	0	$\frac{8u^4-10u^2+}{2u(4u^2-3}$ [cut off]
$\overline{\eta}_{-9}$	0	$\frac{8u^4-6u^2-1}{4u^2(4u^2-3)}$	$\frac{1}{2u}$	$\frac{1}{4u^2(4u^2-3)}$	0	$\frac{16u^4-16u^2}{4u^2(4u^2-3}$ [cut off]