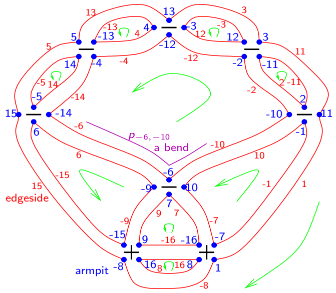
```
XingsByArmpits =
 List @@ PD[K] /.
  x : X[i_, j_, k_, l_] :→
   If[PositiveQ[x], X₊[-i, j, k, -l],
    X₋[-j, k, l, -i]]
```

$\{X_-[-1, 11, 2, -10], X_-[-11, 3, 12, -2], X_-[-3, 13, 4, -12], X_-[-13, 5, 14, -4], X_-[-5, 15, 6, -14], X_+[-8, 16, 9, -15], X_+[-16, 8, 1, -7], X_-[-9, 7, 10, -6]\}$

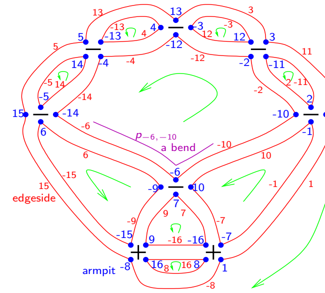



```
bends = Times @@ XingsByArmpits /.
  _[X][a_, b_, c_, d_] :→
   p[a,-d] p[b,-a] p[c,-b] p[d,-c]
```

$p_{-16,7}\, p_{-15,-9}\, p_{-14,-6}\, p_{-13,4}\, p_{-12,-4}\, p_{-11,2}\, p_{-10,-2}\, p_{-9,6}\, p_{-8,15}\, p_{-7,-1}\, p_{-6,-10}\, p_{-5,14}\, p_{-4,-14}\, p_{-3,12}\, p_{-2,-12}\, p_{-1,10}\, p_{1,-8}\, p_{2,-11}\, p_{3,11}\, p_{4,-13}\, p_{5,13}\, p_{6,-15}\, p_{7,9}\, p_{8,16}\, p_{9,-16}\, p_{10,-7}\, p_{11,1}\, p_{12,-3}\, p_{13,3}\, p_{14,-5}\, p_{15,5}\, p_{16,8}$

```
faces = bends //. p[x__,y_] p[y_,z__] :→ p[x,y,z]
```

$p_{-13,4,-13}\, p_{-11,2,-11}\, p_{-5,14,-5}\, p_{-3,12,-3}\, p_{8,16,8}\, p_{6,-15,-9,6}\, p_{9,-16,7,9}\, p_{10,-7,-1,10}\, p_{-10,-2,-12,-4,-14,-6,-10}\, p_{1,-8,15,5,13,3,11,1}$




```
A = Table[0, Length@faces, Length@faces];
A // MatrixForm
```

$$\begin{pmatrix} 0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0 \end{pmatrix}$$

$$\text{Do}\Big[\text{is} = \text{Position[faces, \#][[1, 1]] \& /@ List @@ x;}\\ \text{A[[is, is]] += If}\Big[\text{Head[x] === X}_+,\ \begin{pmatrix} v&u&1&u\\ u&1&u&1\\ 1&u&v&u\\ u&1&u&1 \end{pmatrix},\ -\begin{pmatrix} v&u&1&u\\ u&1&u&1\\ 1&u&v&u\\ u&1&u&1 \end{pmatrix}\Big],\\ \{\text{x, XingsByArmpits}\}\Big];$$


```
x = XingsByArmpits[[1]]
```

$X_-[-1, 11, 2, -10]$

```
faces
```

$p_{-13,4,-13}\, p_{-11,2,-11}\, p_{-5,14,-5}\, p_{-3,12,-3}\, p_{8,16,8}\, p_{6,-15,-9,6}\, p_{9,-16,7,9}\, p_{10,-7,-1,10}\, p_{-10,-2,-12,-4,-14,-6,-10}\, p_{1,-8,15,5,13,3,11,1}$

```
is = Position[faces, #][[1, 1]] & /@ List @@ x
```

$\{8, 10, 2, 9\}$

$$\text{A[[is, is]] += If}\Big[\text{Head[x] === X}_+,\ \begin{pmatrix} v&u&1&u\\ u&1&u&1\\ 1&u&v&u\\ u&1&u&1 \end{pmatrix},\ -\begin{pmatrix} v&u&1&u\\ u&1&u&1\\ 1&u&v&u\\ u&1&u&1 \end{pmatrix}\Big];$$

```
A // MatrixForm
```

$$\begin{pmatrix} 0&0&0&0&0&0&0&0&0&0\\ 0&-v&0&0&0&0&0&-1&-u&-u\\ 0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0\\ 0&0&0&0&0&0&0&0&0&0\\ 0&-1&0&0&0&0&0&-v&-u&-u\\ 0&-u&0&0&0&0&0&-u&-1&-1\\ 0&-u&0&0&0&0&0&-u&-1&-1 \end{pmatrix}$$

Recall, $is = \{8, 10, 2, 9\}$

$$\text{Do}\Big[\text{is} = \text{Position[faces, \#][[1, 1]] \& /@ List @@ x;}\\ \text{A[[is, is]] += If}\Big[\text{Head[x] === X}_+,\ \begin{pmatrix} v&u&1&u\\ u&1&u&1\\ 1&u&v&u\\ u&1&u&1 \end{pmatrix},\ -\begin{pmatrix} v&u&1&u\\ u&1&u&1\\ 1&u&v&u\\ u&1&u&1 \end{pmatrix}\Big],\\ \{\text{x, Rest@XingsByArmpits}\}\Big]$$


```
A // MatrixForm
```

$$\begin{pmatrix} -2v&0&-1&-1&0&0&0&0&-2u&-2u\\ 0&-2v&0&-1&0&0&0&-1&-2u&-2u\\ -1&0&-2v&0&0&-1&0&0&-2u&-2u\\ -1&-1&0&-2v&0&0&0&0&-2u&-2u\\ 0&0&0&0&2&1&2u&1&0&2u\\ 0&0&-1&0&1&1-2v&0&-1&-2u&0\\ 0&0&0&0&2u&0&-1+2v&0&-1&2\\ 0&-1&0&0&1&-1&0&1-2v&-2u&0\\ -2u&-2u&-2u&-2u&0&-2u&-1&-2u&-6&-5\\ -2u&-2u&-2u&-2u&2u&0&2&0&-5&-5+2v \end{pmatrix}$$

Video and more at http://www.math.toronto.edu/~drorbn/Talks/CMS-2112/