

$$\begin{matrix} x & y & u & v \\ x & \begin{pmatrix} a & b & c & d \\ \vdots & \vdots & \vdots & \vdots \end{pmatrix} \\ y & \begin{pmatrix} e & f & g & h \\ \vdots & \vdots & \vdots & \vdots \end{pmatrix} \\ u & \begin{pmatrix} i & j & k & l \\ \vdots & \vdots & \vdots & \vdots \end{pmatrix} \\ v & \begin{pmatrix} m & n & o & p \\ \vdots & \vdots & \vdots & \vdots \end{pmatrix} \end{matrix}$$

$$\downarrow M_z^{x,y}$$

$$\begin{matrix} z & \dots \\ z & \begin{pmatrix} a+b & \dots \\ c+d & \dots \\ \vdots & \vdots \end{pmatrix} \\ \vdots & \vdots \end{matrix}$$

$$\begin{pmatrix} x_1 & \dots & x_n \\ \vdots & & \vdots \end{pmatrix} \cup \begin{pmatrix} y_1 & \dots & y_m \\ \vdots & & \vdots \end{pmatrix} = \begin{pmatrix} \square & \dots & \square \\ \vdots & & \vdots \end{pmatrix}$$

$$\pi_T(X) \cong \pi_1(X) \rtimes \pi_2(X)$$

Sorry - Yesterday I got the answer to the computational complexity question wrong. Complexity is exponential in the length and super-exponential in the width. The actual constants are such that in practice you can compute the homology of knots with up to about 70 crossings, and if they are long yet narrow, even a lot more. [Knot tables continue up to 17 crossings, and there are millions of knots that big].

(Thanks, Semen Artamonov)

*New handout on desk at front!*

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- [252504, [1,2], "Handout view 3: Riddle"],
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- [424217, [1,3], "Handout view 4: Ugliest part"],
- [484327, [1,4], "Handout view 5: Abstract, again"],
- [507790, [1,5], "Handout view 6: KBH"],
- [532165, [1,6], "Handout view 7: Knots and tangles"],
- [613629, [1,7], "Handout view 8: Standard Alexander"],
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