

Week6

February 27, 2022

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[1]: from week6 import *
```

1 Kauffman Bracket and Jones polynomial

```
[2]: K = Torus(2,3)
     Writhe(K)
```

```
[2]: 3
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[3]: K2 = Mirror(K)
     Writhe(K2)
```

```
[3]: -3
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[4]: KauffmanBracket(Torus(2,3))
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```
[4]: ((-7, 1), (-3, -1), (5, -1))
```

```
[5]: KauffmanBracket(Torus(2,-3))
```

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[5]: ((-5, -1), (3, -1), (7, 1))
```

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[6]: Jones(Torus(2,3))
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[6]: ((1, 1), (3, 1), (4, -1))
```

```
[7]: Jones(Torus(2,-3))
```

```
[7]: ((-4, -1), (-3, 1), (-1, 1))
```

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[8]: Jones(Torus(5,7))
```

```
[8]: ((12, 1), (14, 1), (16, 1), (20, -1), (22, -1))
```

```
[9]: print(Jones(Conway()))
```

$((-6, 1), (-5, -2), (-4, 2), (-3, -2), (-2, 1), (1, 2), (2, -2), (3, 2), (4, -1))$

```
[10]: print(Jones(KT()))
```

$((-6, 1), (-5, -2), (-4, 2), (-3, -2), (-2, 1), (1, 2), (2, -2), (3, 2), (4, -1))$

```
[11]: PrintJones((Conway()))
```

```
[11]: 'T^{-6}-2T^{-5}+2T^{-4}-2T^{-3}+T^{-2}+2T^{-1}-2T^2+2T^3-T^4'
```

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[12]: PrintJones(Torus(8,9))
```

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[12]: 'T^{28}+T^{30}+T^{32}+T^{34}+T^{36}-T^{37}-T^{39}-T^{41}-T^{43}'
```

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[13]: PrintJones(Torus(3,4))
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[13]: 'T^3+T^5-T^8'
```

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[14]: PrintJones(Torus(4,5))
```

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[14]: 'T^6+T^8+T^{10}-T^{11}-T^{13}'
```

```
[15]: PrintJones(Pretzel(2,3,3))
```

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[15]: '1-T^1+3T^2-3T^3+3T^4-4T^5+3T^6-2T^7+T^8'
```

```
[16]: PrintJones(Pretzel(-3,5,7))
```

```
[16]: 'T^{-12}-T^{-11}+T^{-10}-2T^{-9}+T^{-8}-T^{-7}+T^{-5}-T^{-4}+2T^{-3}-T^{-2}+T^{-1}'
```

2 Khovanov homology

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[17]: KhovanovHomology(Torus(2,3), Prime = 2)
```

Number of generators 30

Number of arrows 45

Total Rank 6

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[17]: ((0, 1, 1), (0, 3, 1), (2, 5, 1), (2, 7, 1), (3, 7, 1), (3, 9, 1))
```

```
[18]: KhovanovHomology(Torus(2,3), Prime = 3)
```

Number of generators 30
Number of arrows 45
Total Rank 4

[18]: ((0, 1, 1), (0, 3, 1), (2, 5, 1), (3, 9, 1))

[19]: KhovanovHomology(Pretzel(-2,3,5), Prime = 3)

Number of generators 29946
Number of arrows 149730
Remaining Generators to Check : 20000
Remaining Generators to Check : 10000
Total Rank 10

[19]: ((0, 7, 1),
(0, 9, 1),
(2, 11, 1),
(3, 15, 1),
(4, 13, 1),
(4, 15, 1),
(5, 17, 1),
(5, 19, 1),
(6, 17, 1),
(7, 21, 1))

[20]: KhovanovHomology(Torus(3,5), Prime =2)

Number of generators 8418
Number of arrows 42090
Total Rank 14

[20]: ((0, 7, 1),
(0, 9, 1),
(2, 11, 1),
(2, 13, 1),
(3, 13, 1),
(3, 15, 1),
(4, 13, 1),
(4, 15, 1),
(5, 17, 1),
(5, 19, 1),
(6, 17, 1),
(6, 19, 1),
(7, 19, 1),
(7, 21, 1))

[21]: KhovanovLeeHomology(Torus(3,5), Prime = 3)

Number of generators 8418
Number of arrows 56120
Remaining Generators to Check : 0
Total Rank 2

[21]: ((0, 7, 1), (0, 9, 1))

[22]: KhovanovHomology(Conway(), Prime = 3)

Number of generators 95106
Number of arrows 570636
Remaining Generators to Check : 90000
Remaining Generators to Check : 80000
Remaining Generators to Check : 70000
Remaining Generators to Check : 60000
Remaining Generators to Check : 50000
Remaining Generators to Check : 40000
Remaining Generators to Check : 30000
Remaining Generators to Check : 20000
Remaining Generators to Check : 10000
Total Rank 34

[22]: ((-6, -13, 1),
(-5, -11, 1),
(-5, -9, 1),
(-4, -9, 1),
(-4, -7, 1),
(-3, -7, 2),
(-3, -5, 1),
(-2, -7, 1),
(-2, -5, 1),
(-2, -3, 2),
(-1, -5, 1),
(-1, -3, 2),
(-1, -1, 1),
(0, -3, 1),
(0, -1, 3),
(0, 1, 2),
(1, -1, 2),
(1, 1, 1),
(1, 3, 1),
(2, 1, 1),
(2, 3, 2),
(3, 3, 1),
(3, 5, 1),
(4, 5, 1),
(4, 7, 1),
(5, 9, 1))

[23]: KhovanovLeeHomology(Conway(), Prime = 3)

Number of generators 95106
Number of arrows 760848
Remaining Generators to Check : 0
Total Rank 2

[23]: ((0, -1, 1), (0, 1, 1))

[24]: KhovanovHomology(Conway(), Prime = 2)

Number of generators 95106
Number of arrows 570636
Remaining Generators to Check : 90000
Remaining Generators to Check : 80000
Remaining Generators to Check : 70000
Remaining Generators to Check : 60000
Remaining Generators to Check : 50000
Remaining Generators to Check : 40000
Remaining Generators to Check : 30000
Remaining Generators to Check : 20000
Remaining Generators to Check : 10000
Total Rank 66

[24]: ((-6, -13, 1),
(-6, -11, 1),
(-5, -11, 2),
(-5, -9, 2),
(-4, -9, 2),
(-4, -7, 2),
(-3, -7, 3),
(-3, -5, 3),
(-2, -7, 1),
(-2, -5, 4),
(-2, -3, 3),
(-1, -5, 2),
(-1, -3, 4),
(-1, -1, 2),
(0, -3, 2),
(0, -1, 5),
(0, 1, 3),
(1, -1, 3),
(1, 1, 4),
(1, 3, 1),
(2, 1, 3),
(2, 3, 3),
(3, 3, 2),

(3, 5, 2),
(4, 5, 2),
(4, 7, 2),
(5, 7, 1),
(5, 9, 1))

[25]: KhovanovLeeHomology(Conway(), Prime = 2)

Number of generators 95106
Number of arrows 760848
Remaining Generators to Check : 0
Total Rank 66

[25]: ((-6, -13, 1),
(-6, -11, 1),
(-5, -11, 2),
(-5, -9, 2),
(-4, -9, 2),
(-4, -7, 2),
(-3, -7, 3),
(-3, -5, 3),
(-2, -7, 1),
(-2, -5, 4),
(-2, -3, 3),
(-1, -5, 2),
(-1, -3, 4),
(-1, -1, 2),
(0, -3, 2),
(0, -1, 5),
(0, 1, 3),
(1, -1, 3),
(1, 1, 4),
(1, 3, 1),
(2, 1, 3),
(2, 3, 3),
(3, 3, 2),
(3, 5, 2),
(4, 5, 2),
(4, 7, 2),
(5, 7, 1),
(5, 9, 1))

[]: