

```

In[2]:= LatticeGraph[k_] := GridGraph[{k, k}]

In[3]:= PC[k_, x_] := ChromaticPolynomial[LatticeGraph[k], x];
x = Symbol["x"];

(*Chromatic Polynomial of a 5x5 lattice*)

In[6]:= pc5 = PC[5, x]
Out[6]= 32 126 211 x - 290 435 775 x2 + 1 292 190 143 x3 - 3 767 970 906 x4 + 8 082 227 271 x5 -
13 560 791 041 x6 + 18 473 119 556 x7 - 20 932 275 014 x8 + 20 054 961 996 x9 -
16 429 209 737 x10 + 11 594 826 096 x11 - 7 082 871 652 x12 + 3 754 018 486 x13 -
1 726 958 903 x14 + 688 444 232 x15 - 236 955 938 x16 + 69 997 383 x17 - 17 590 911 x18 +
3 714 180 x19 - 647 352 x20 + 90 798 x21 - 9864 x22 + 780 x23 - 40 x24 + x25

In[8]:= (*10 colorings of a 5x5 lattice*)

pc5 /. x -> 10
Out[15]= 151 086 899 096 935 604 867 610

(*k=2*)

In[9]:= results2 = Table[{q, PC[2, q]}, {q, 2, 15}]
Out[9]= {{2, 2}, {3, 18}, {4, 84}, {5, 260}, {6, 630}, {7, 1302}, {8, 2408}, {9, 4104},
{10, 6570}, {11, 10 010}, {12, 14 652}, {13, 20 748}, {14, 28 574}, {15, 38 430}}

In[2]:= (*k=3*)

In[16]:= results3 = Table[{q, PC[3, q]}, {q, 2, 15}]
Out[16]= {{2, 2}, {3, 246}, {4, 9612}, {5, 142 820}, {6, 1 166 910}, {7, 6 464 682},
{8, 27 350 456}, {9, 95 004 072}, {10, 283 982 490}, {11, 754 324 670},
{12, 1 821 684 612}, {13, 4 067 709 516}, {14, 8 506 024 982}, {15, 16 822 697 010}}

In[1]:= (*k=4*)

In[7]:= results4 = Table[{q, PC[4, q]}, {q, 2, 15}]
Out[7]= {{2, 2}, {3, 7812}, {4, 6 000 732}, {5, 828 850 160}, {6, 38 128 724 910},
{7, 856 858 754 052}, {8, 11 722 360 851 992}, {9, 111 647 093 496 192},
{10, 807 567 269 568 570}, {11, 4 707 230 299 664 420}, {12, 23 062 698 161 984 052},
{13, 97 963 534 144 477 872}, {14, 369 313 246 327 400 102}, {15, 1 258 250 118 125 770 980}}

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(*k=5*)

results5 = Table[{q, PC[5, q]}, {q, 2, 15}]

Out[10]=

```
{{2, 2}, {3, 580 986}, {4, 20 442 892 764}, {5, 50 820 390 410 180}, {6, 21 977 869 327 169 310},
 {7, 3 031 776 844 080 257 742}, {8, 189 586 772 101 347 563 096}, {9, 6 660 747 304 179 593 671 944},
 {10, 151 086 899 096 935 604 867 610}, {11, 2 432 514 752 747 773 742 479 970},
 {12, 29 730 874 656 484 222 810 604 532}, {13, 289 814 278 376 886 365 788 686 156},
 {14, 2 338 706 558 881 006 527 354 278 774}, {15, 16 079 941 149 554 432 258 574 500 790}}
```

In[12]:= (*k=6*)

In[11]:= results6 = Table[{q, PC[6, q]}, {q, 2, 15}]

Out[11]=

```
{{2, 2}, {3, 101 596 896}, {4, 380 053 267 505 964},
 {5, 32 921 147 633 979 091 400}, {6, 223 479 277 713 132 418 833 390},
 {7, 286 359 202 456 130 400 260 611 752}, {8, 115 702 677 512 781 649 307 005 417 016},
 {9, 20 172 922 880 766 721 483 554 814 468 464}, {10, 1 859 669 891 770 248 856 476 997 904 547 450},
 {11, 104 094 652 664 259 277 009 814 001 042 264 080},
 {12, 3 902 706 595 258 725 042 220 943 436 744 767 652},
 {13, 105 321 232 530 952 648 899 117 870 043 962 825 336},
 {14, 2 160 076 836 868 464 110 960 157 773 766 060 869 414},
 {15, 35 111 392 067 312 546 609 182 417 173 618 968 309 400}}
```

In[13]:= (*k=7*)

results7 = Table[{q, PC[7, q]}, {q, 2, 15}]

Out[13]=

```
{{2, 2}, {3, 41 869 995 708}, {4, 38 557 892 676 685 306 572},
 {5, 225 313 329 780 157 255 086 187 280}, {6, 40 087 345 104 573 458 097 599 768 622 030},
 {7, 722 022 905 627 873 731 429 602 000 554 432 412},
 {8, 2 664 533 696 267 986 042 969 615 868 160 108 207 608},
 {9, 3 101 594 610 276 176 352 440 997 042 418 550 841 885 312},
 {10, 1 505 933 744 255 415 534 793 832 118 356 329 294 462 055 610},
 {11, 368 879 277 984 660 057 018 944 113 007 596 468 930 552 762 460},
 {12, 52 165 666 940 966 795 634 555 971 171 590 612 361 421 172 621 572},
 {13, 4 701 678 278 015 774 960 172 015 306 840 176 414 525 523 362 269 008},
 {14, 290 988 136 771 156 891 920 507 578 262 485 806 342 801 661 960 991 302},
 {15, 13 099 591 719 762 965 565 281 394 772 689 392 638 859 825 972 900 575 740}}
```

In[5]:= (*k=8*)

results8 = Table[{q, PC[8, q]}, {q, 2, 15}]