

Maly Projekt nr 4 – Permutacje

Jan Czechowski

zad 1.

```
In[ ]:= s5 := Permutations[Range[5]]
          lista permutacji zakres
commutativePairs = Select[Subsets[s5, {2}],
                          wybierz... podzbiory
                          PermutationProduct[#[[1]], #[[2]]] === PermutationProduct[#[[2]], #[[1]]] &]
                          iloczyn permutacyjny iloczyn permutacyjny
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Out[]:=

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 $\{\{4, 1, 3, 5, 2\}, \{5, 4, 3, 2, 1\}\}, \{\{4, 1, 5, 3, 2\}, \{5, 3, 1, 2, 4\}\},$
 $\{\{4, 2, 1, 3, 5\}, \{4, 5, 1, 3, 2\}\}, \{\{4, 2, 1, 5, 3\}, \{5, 2, 4, 3, 1\}\},$
 $\{\{4, 2, 3, 1, 5\}, \{4, 2, 5, 1, 3\}\}, \{\{4, 2, 3, 1, 5\}, \{4, 3, 2, 1, 5\}\},$
 $\{\{4, 2, 3, 1, 5\}, \{4, 3, 5, 1, 2\}\}, \{\{4, 2, 3, 1, 5\}, \{4, 5, 2, 1, 3\}\},$
 $\{\{4, 2, 3, 1, 5\}, \{4, 5, 3, 1, 2\}\}, \{\{4, 2, 3, 5, 1\}, \{4, 3, 2, 5, 1\}\},$
 $\{\{4, 2, 3, 5, 1\}, \{5, 2, 3, 1, 4\}\}, \{\{4, 2, 3, 5, 1\}, \{5, 3, 2, 1, 4\}\},$
 $\{\{4, 2, 5, 1, 3\}, \{5, 2, 1, 3, 4\}\}, \{\{4, 2, 5, 1, 3\}, \{5, 2, 4, 3, 1\}\},$
 $\{\{4, 2, 5, 3, 1\}, \{5, 2, 4, 1, 3\}\}, \{\{4, 3, 1, 5, 2\}, \{5, 1, 4, 2, 3\}\},$
 $\{\{4, 3, 2, 5, 1\}, \{5, 2, 3, 1, 4\}\}, \{\{4, 3, 2, 5, 1\}, \{5, 3, 2, 1, 4\}\},$
 $\{\{4, 3, 5, 1, 2\}, \{4, 5, 2, 1, 3\}\}, \{\{4, 3, 5, 2, 1\}, \{5, 4, 2, 1, 3\}\},$
 $\{\{4, 5, 1, 2, 3\}, \{5, 1, 2, 3, 4\}\}, \{\{4, 5, 2, 3, 1\}, \{5, 3, 4, 1, 2\}\},$
 $\{\{4, 5, 3, 1, 2\}, \{5, 1, 3, 2, 4\}\}, \{\{4, 5, 3, 1, 2\}, \{5, 4, 3, 2, 1\}\},$
 $\{\{4, 5, 3, 2, 1\}, \{5, 4, 3, 1, 2\}\}, \{\{5, 1, 3, 4, 2\}, \{5, 1, 4, 3, 2\}\},$
 $\{\{5, 2, 1, 4, 3\}, \{5, 4, 1, 2, 3\}\}, \{\{5, 2, 3, 1, 4\}, \{5, 3, 2, 1, 4\}\},$
 $\{\{5, 2, 3, 4, 1\}, \{5, 2, 4, 3, 1\}\}, \{\{5, 2, 3, 4, 1\}, \{5, 3, 2, 4, 1\}\},$
 $\{\{5, 2, 3, 4, 1\}, \{5, 3, 4, 2, 1\}\}, \{\{5, 2, 3, 4, 1\}, \{5, 4, 2, 3, 1\}\},$
 $\{\{5, 2, 3, 4, 1\}, \{5, 4, 3, 2, 1\}\}, \{\{5, 3, 4, 2, 1\}, \{5, 4, 2, 3, 1\}\}$

zad 2.

```

In[*]:= s4 := Permutations[Range[4]]
           lista permutacji zakres
NieparzystePermutacje := Select[s4, Signature[#] === -1 &]
           wybierz wed... podpis
NieTranspozycja := Select[NieparzystePermutacje, Length[Cycles[#][[1]]] > 1 &]
           wybierz według kryterium długość cykle
PermutacjaOdwrotna = {#, InversePermutation[#]} & /@ NieTranspozycja
           permutacja odwrotna

```

```

Out[*]:=
{{ {1, 2, 4, 3}, {1, 2, 4, 3} }, { {1, 3, 2, 4}, {1, 3, 2, 4} }, { {1, 4, 3, 2}, {1, 4, 3, 2} },
  { {2, 1, 3, 4}, {2, 1, 3, 4} }, { {2, 3, 4, 1}, {4, 1, 2, 3} }, { {2, 4, 1, 3}, {3, 1, 4, 2} },
  { {3, 1, 4, 2}, {2, 4, 1, 3} }, { {3, 2, 1, 4}, {3, 2, 1, 4} }, { {3, 4, 2, 1}, {4, 3, 1, 2} },
  { {4, 1, 2, 3}, {2, 3, 4, 1} }, { {4, 2, 3, 1}, {4, 2, 3, 1} }, { {4, 3, 1, 2}, {3, 4, 2, 1} } }

```

zad 3.

```

In[15]:= n = 52;
perm = Table[If[i ≤ 26, 2 i, 2 (i - 26) - 1], {i, 0, n - 1}];
           tabela operator warunkowy
In[26]:= cycles = FindPermutationCycles[perm];
In[42]:= znak = Signature[perm];
           podpis
In[19]:= order = LCM@@(Length /@ cycles);
           najmni... długość
In[20]:= inversions = Select[Subsets[Range[0, n - 1], {2}], perm[[#][1] + 1] > perm[[#][2] + 1] &];
           wybierz... podzbiory zakres
In[24]:= modulo52 = Mod[#, 52] &;
           modulo

```

```
In[43]:= {cycles, znak, order, inversions}
```

```
Out[43]=
```

```
{{{1}, {2, 3, 5, 9, 17, 33, 12, 23, 45, 36, 18, 35, 16, 31, 8, 15, 29, 4, 7, 13, 25, 49, 44,
  34, 14, 27}, {6, 11, 21, 41, 28}, {10, 19, 37, 20, 39, 24, 47, 40, 26, 51, 48, 42, 30},
  {22, 43, 32}, {38}, {46}, {50}, {52}}, 1, 390,
{{1, 27}, {2, 27}, {2, 28}, {3, 27}, {3, 28}, {3, 29}, {4, 27}, {4, 28}, {4, 29},
  {4, 30}, {5, 27}, {5, 28}, {5, 29}, {5, 30}, {5, 31}, {6, 27}, {6, 28}, {6, 29}, {6, 30},
  {6, 31}, {6, 32}, {7, 27}, {7, 28}, {7, 29}, {7, 30}, {7, 31}, {7, 32}, {7, 33},
  {8, 27}, {8, 28}, {8, 29}, {8, 30}, {8, 31}, {8, 32}, {8, 33}, {8, 34}, {9, 27},
  {9, 28}, {9, 29}, {9, 30}, {9, 31}, {9, 32}, {9, 33}, {9, 34}, {9, 35}, {10, 27},
  {10, 28}, {10, 29}, {10, 30}, {10, 31}, {10, 32}, {10, 33}, {10, 34}, {10, 35},
  {10, 36}, {11, 27}, {11, 28}, {11, 29}, {11, 30}, {11, 31}, {11, 32}, {11, 33},
  {11, 34}, {11, 35}, {11, 36}, {11, 37}, {12, 27}, {12, 28}, {12, 29}, {12, 30},
  {12, 31}, {12, 32}, {12, 33}, {12, 34}, {12, 35}, {12, 36}, {12, 37}, {12, 38},
  {13, 27}, {13, 28}, {13, 29}, {13, 30}, {13, 31}, {13, 32}, {13, 33}, {13, 34},
  {13, 35}, {13, 36}, {13, 37}, {13, 38}, {13, 39}, {14, 27}, {14, 28}, {14, 29},
  {14, 30}, {14, 31}, {14, 32}, {14, 33}, {14, 34}, {14, 35}, {14, 36}, {14, 37},
  {14, 38}, {14, 39}, {14, 40}, {15, 27}, {15, 28}, {15, 29}, {15, 30}, {15, 31},
  {15, 32}, {15, 33}, {15, 34}, {15, 35}, {15, 36}, {15, 37}, {15, 38}, {15, 39},
  {15, 40}, {15, 41}, {16, 27}, {16, 28}, {16, 29}, {16, 30}, {16, 31}, {16, 32},
  {16, 33}, {16, 34}, {16, 35}, {16, 36}, {16, 37}, {16, 38}, {16, 39}, {16, 40},
  {16, 41}, {16, 42}, {17, 27}, {17, 28}, {17, 29}, {17, 30}, {17, 31}, {17, 32},
  {17, 33}, {17, 34}, {17, 35}, {17, 36}, {17, 37}, {17, 38}, {17, 39}, {17, 40},
  {17, 41}, {17, 42}, {17, 43}, {18, 27}, {18, 28}, {18, 29}, {18, 30}, {18, 31},
  {18, 32}, {18, 33}, {18, 34}, {18, 35}, {18, 36}, {18, 37}, {18, 38}, {18, 39},
  {18, 40}, {18, 41}, {18, 42}, {18, 43}, {18, 44}, {19, 27}, {19, 28}, {19, 29},
  {19, 30}, {19, 31}, {19, 32}, {19, 33}, {19, 34}, {19, 35}, {19, 36}, {19, 37},
  {19, 38}, {19, 39}, {19, 40}, {19, 41}, {19, 42}, {19, 43}, {19, 44}, {19, 45},
  {20, 27}, {20, 28}, {20, 29}, {20, 30}, {20, 31}, {20, 32}, {20, 33}, {20, 34},
  {20, 35}, {20, 36}, {20, 37}, {20, 38}, {20, 39}, {20, 40}, {20, 41}, {20, 42},
  {20, 43}, {20, 44}, {20, 45}, {20, 46}, {21, 27}, {21, 28}, {21, 29}, {21, 30},
  {21, 31}, {21, 32}, {21, 33}, {21, 34}, {21, 35}, {21, 36}, {21, 37}, {21, 38},
  {21, 39}, {21, 40}, {21, 41}, {21, 42}, {21, 43}, {21, 44}, {21, 45}, {21, 46},
  {21, 47}, {22, 27}, {22, 28}, {22, 29}, {22, 30}, {22, 31}, {22, 32}, {22, 33},
  {22, 34}, {22, 35}, {22, 36}, {22, 37}, {22, 38}, {22, 39}, {22, 40}, {22, 41},
  {22, 42}, {22, 43}, {22, 44}, {22, 45}, {22, 46}, {22, 47}, {22, 48}, {23, 27},
  {23, 28}, {23, 29}, {23, 30}, {23, 31}, {23, 32}, {23, 33}, {23, 34}, {23, 35},
  {23, 36}, {23, 37}, {23, 38}, {23, 39}, {23, 40}, {23, 41}, {23, 42}, {23, 43},
  {23, 44}, {23, 45}, {23, 46}, {23, 47}, {23, 48}, {23, 49}, {24, 27}, {24, 28},
  {24, 29}, {24, 30}, {24, 31}, {24, 32}, {24, 33}, {24, 34}, {24, 35}, {24, 36},
  {24, 37}, {24, 38}, {24, 39}, {24, 40}, {24, 41}, {24, 42}, {24, 43}, {24, 44},
  {24, 45}, {24, 46}, {24, 47}, {24, 48}, {24, 49}, {24, 50}, {25, 27}, {25, 28},
  {25, 29}, {25, 30}, {25, 31}, {25, 32}, {25, 33}, {25, 34}, {25, 35}, {25, 36},
  {25, 37}, {25, 38}, {25, 39}, {25, 40}, {25, 41}, {25, 42}, {25, 43}, {25, 44},
  {25, 45}, {25, 46}, {25, 47}, {25, 48}, {25, 49}, {25, 50}, {25, 51}, {26, 27},
  {26, 28}, {26, 29}, {26, 30}, {26, 31}, {26, 32}, {26, 33}, {26, 34}, {26, 35},
  {26, 36}, {26, 37}, {26, 38}, {26, 39}, {26, 40}, {26, 41}, {26, 42}, {26, 43},
  {26, 44}, {26, 45}, {26, 46}, {26, 47}, {26, 48}, {26, 49}, {26, 50}, {26, 51}}}
```

zad 4.

```
In[*]:= permGroup := Permutations[{1, 2, 3, 4}]
           lista permutacji

bezPunktowStalychQ[perm_] := AllTrue[Range[4], # != perm[[#]] &]
           wszystkie... zakres

derangements = Select[permGroup, bezPunktowStalychQ]
           wybierz według kryterium

Out[*]=
{{2, 1, 4, 3}, {2, 3, 4, 1}, {2, 4, 1, 3}, {3, 1, 4, 2},
 {3, 4, 1, 2}, {3, 4, 2, 1}, {4, 1, 2, 3}, {4, 3, 1, 2}, {4, 3, 2, 1}}
```

zad 5.

```
In[*]:= permGroup := Permutations[{1, 2, 3, 4}]
           lista permutacji

czyParzysta[perm_] := EvenQ[Length[PermutationCycles[perm]] - 1]
           liczba... długość permutacje cykliczne

permParzyste = Select[permGroup, czyParzysta]
           wybierz według kryterium

Out[*]=
{{1, 2, 3, 4}, {1, 2, 4, 3}, {1, 3, 2, 4}, {1, 3, 4, 2}, {1, 4, 2, 3}, {1, 4, 3, 2},
 {2, 1, 3, 4}, {2, 1, 4, 3}, {2, 3, 1, 4}, {2, 3, 4, 1}, {2, 4, 1, 3}, {2, 4, 3, 1},
 {3, 1, 2, 4}, {3, 1, 4, 2}, {3, 2, 1, 4}, {3, 2, 4, 1}, {3, 4, 1, 2}, {3, 4, 2, 1},
 {4, 1, 2, 3}, {4, 1, 3, 2}, {4, 2, 1, 3}, {4, 2, 3, 1}, {4, 3, 1, 2}, {4, 3, 2, 1}}
```

zad 6.

```
In[*]:= swap[perm_, i_] := Module[{newPerm}, newPerm = perm;
           moduł

           newPerm[[i]] = perm[[i + 1]];
           newPerm[[i + 1]] = perm[[i]];
           newPerm]

pi := {1, 2, 3, 4, 5}
transpozycje = Table[swap[pi, i], {i, 1, Length[pi] - 1}]
           tabela           długość

Out[*]=
{{2, 1, 3, 4, 5}, {1, 3, 2, 4, 5}, {1, 2, 4, 3, 5}, {1, 2, 3, 5, 4}}
```

zad 7.

```

In[*]:= obrot[k_, n_] := RotateLeft[Range[n], k]
                                     |cykliczne prz... |zakres

odbicie[n_] := Table[If[i ≤ Floor[n/2], n + 1 - i, i], {i, 1, n}]
                                     |tabela |opera... |podłoga

n1 = 3;
symetrieTrojkata = Join[{obrot[0, n1], obrot[1, n1], obrot[2, n1]}, {odbicie[n1]}]
                                     |połącz

n2 = 4;
symetrieKwadratu = Join[{obrot[0, n2], obrot[1, n2], obrot[2, n2], obrot[3, n2]},
                                     |połącz
                        {odbicie[n2], odbicie[n2]}]

n3 = 6;
symetrieSzescianu = Join[
                                     |połącz
                        {obrot[0, n3], obrot[1, n3], obrot[2, n3], obrot[3, n3], obrot[4, n3], obrot[5, n3]},
                        {odbicie[n3], odbicie[n3], odbicie[n3], odbicie[n3], odbicie[n3], odbicie[n3]}]

Out[*]=
{{1, 2, 3}, {2, 3, 1}, {3, 1, 2}, {3, 2, 3}}

Out[*]=
{{1, 2, 3, 4}, {2, 3, 4, 1}, {3, 4, 1, 2}, {4, 1, 2, 3}, {4, 3, 3, 4}, {4, 3, 3, 4}}

Out[*]=
{{1, 2, 3, 4, 5, 6}, {2, 3, 4, 5, 6, 1}, {3, 4, 5, 6, 1, 2}, {4, 5, 6, 1, 2, 3},
 {5, 6, 1, 2, 3, 4}, {6, 1, 2, 3, 4, 5}, {6, 5, 4, 4, 5, 6}, {6, 5, 4, 4, 5, 6},
 {6, 5, 4, 4, 5, 6}, {6, 5, 4, 4, 5, 6}, {6, 5, 4, 4, 5, 6}, {6, 5, 4, 4, 5, 6}}

```