

# Binomni koeficijent MAXELER projekat

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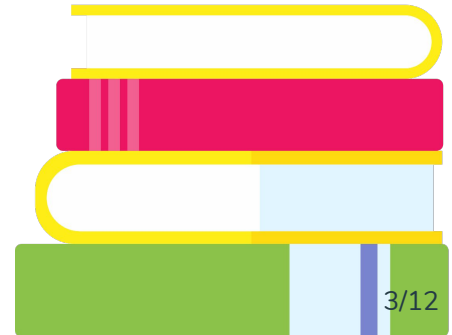
# Definicija

$$\binom{n}{k} = \frac{n!}{k!(n-k)!}$$

# Binomna formula

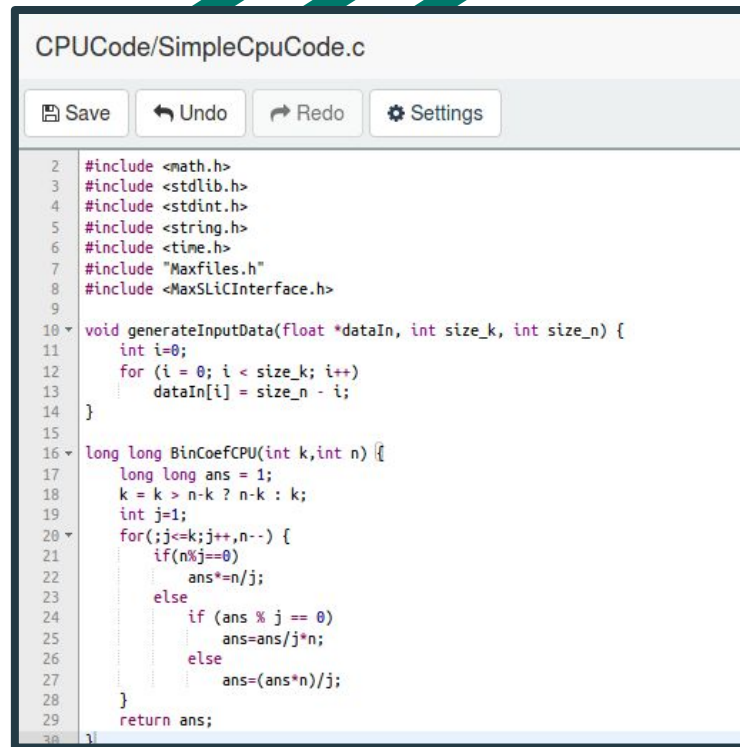
$$(a \pm x)^n = a^n \pm na^{n-1}x + \frac{n(n-1)}{2!}a^{n-2}x^2 \pm \frac{n(n-1)(n-2)}{3!}a^{n-3}x^3 + \dots$$

$$= a^n \pm \binom{n}{1}a^{n-1}x + \binom{n}{2}a^{n-2}x^2 \pm \binom{n}{3}a^{n-3}x^3 + \dots$$



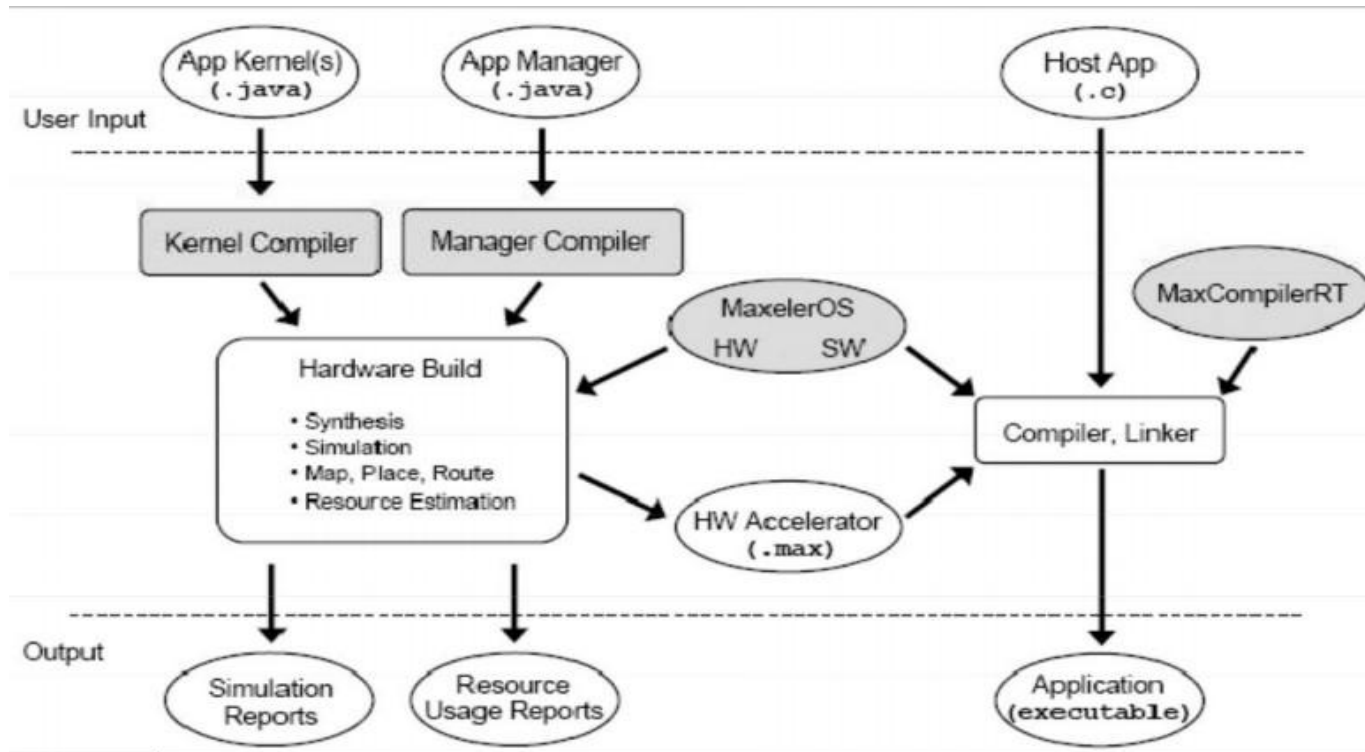
# Implementacija u programskom jeziku C

```
long long BK(int k,int n) {  
    long long ans = 1;  
    k = k > n-k ? n-k : k;  
    int j = 1;  
    for(; j <= k; j++, n--)  
        if (n % j == 0)  
            ans *= n / j;  
        else  
            if (ans % j == 0)  
                ans = ans / j*n;  
            else  
                ans = (ans*n) / j;  
    return ans;  
}
```



```
CPUCode/SimpleCpuCode.c  
  
2  #include <math.h>  
3  #include <stdlib.h>  
4  #include <stdint.h>  
5  #include <string.h>  
6  #include <time.h>  
7  #include "Maxfiles.h"  
8  #include <MaxSLiCInterface.h>  
9  
10 void generateInputData(float *dataIn, int size_k, int size_n) {  
11     int i=0;  
12     for (i = 0; i < size_k; i++)  
13         dataIn[i] = size_n - i;  
14 }  
15  
16 long long BinCoefCPU(int k,int n) {  
17     long long ans = 1;  
18     k = k > n-k ? n-k : k;  
19     int j=1;  
20     for(;j<=k;j++,n--) {  
21         if(n%j==0)  
22             ans*=n/j;  
23         else  
24             if (ans % j == 0)  
25                 ans=ans/j*n;  
26             else  
27                 ans=(ans*n)/j;  
28     }  
29     return ans;  
30 }
```

# Maxeler

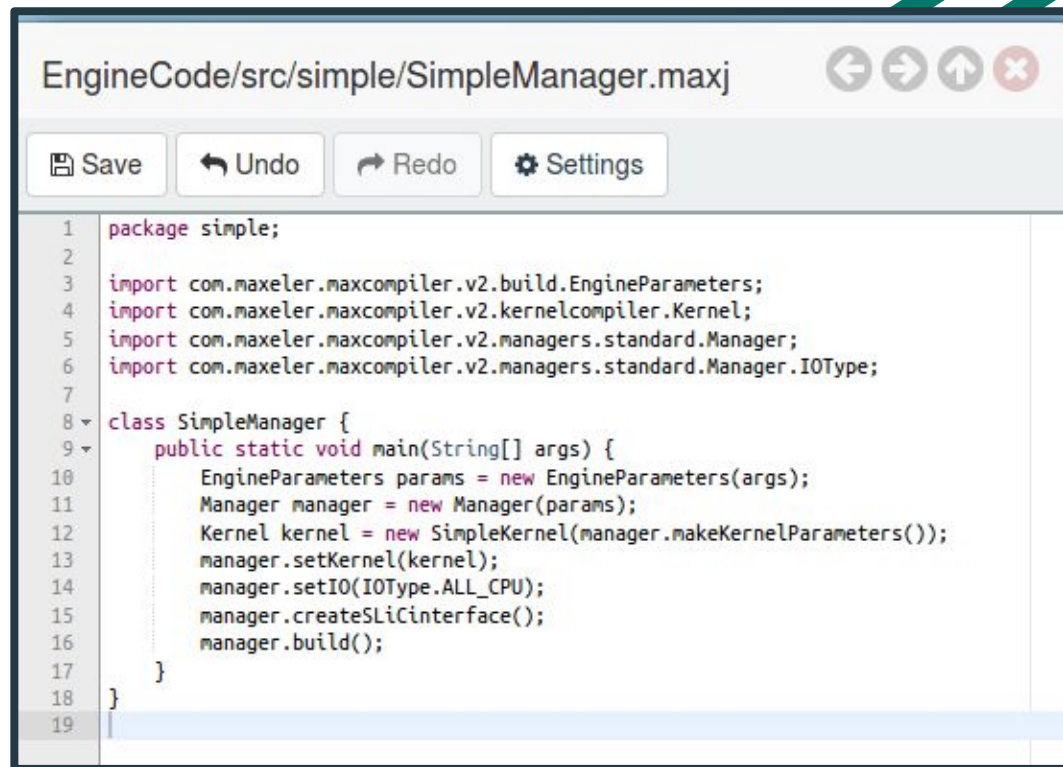


# BinCoefKernel

```
EngineCode/src/simple/SimpleKernel.maxj

2
3 import com.maxeler.maxcompiler.v2.kernelcompiler.Kernel;
4 import com.maxeler.maxcompiler.v2.kernelcompiler.KernelParameters;
5 import com.maxeler.maxcompiler.v2.kernelcompiler.types.base.DFEVar;
6
7 class BinCoefKernel extends Kernel {
8     BinCoefKernel(KernelParameters parameters) {
9         super(parameters);
10
11         // Input
12         DFEVar x = io.input("x", dfeFloat(8, 24));
13         DFEVar count = control.count.simpleCounter(32);
14         DFEVar jedan = constant.var(dfeFloat(8,24), 1);
15
16         DFEVar result = x / (count.cast(dfeFloat(8,24)) + jedan) ;
17
18         // Output
19         io.output("y", result, dfeFloat(8, 24));
20     }
21 }
22
23
```

# BinCoefManager



```
1 package simple;
2
3 import com.maxeler.maxcompiler.v2.build.EngineParameters;
4 import com.maxeler.maxcompiler.v2.kernelcompiler.Kernel;
5 import com.maxeler.maxcompiler.v2.managers.standard.Manager;
6 import com.maxeler.maxcompiler.v2.managers.standard.Manager.IOType;
7
8 class SimpleManager {
9     public static void main(String[] args) {
10         EngineParameters params = new EngineParameters(args);
11         Manager manager = new Manager(params);
12         Kernel kernel = new SimpleKernel(manager.makeKernelParameters());
13         manager.setKernel(kernel);
14         manager.setIO(IOType.ALL_CPU);
15         manager.createSLiInterface();
16         manager.build();
17     }
18 }
19
```

# Main program

```
43
44 int main()
45 {
46     struct timespec start, stop;
47     clock_t begin;
48     clock_t end;
49     double result;
50     float timeInMillis;
51     const int size_k = 64;
52     const int size_n = 100;
53     float res = 1;
54     long long rezultat;
55     float *dataIn = malloc(size_k * sizeof(float));
56     float *dataOut = malloc(size_k * sizeof(float));
57
58     generateInputData(dataIn, size_k, size_n);
59
60     clock_gettime(CLOCK_PROCESS_CPUTIME_ID, &start);
61     begin = clock();
62     rezultat = BinCofCPU(size_k, size_n);
63     end = clock();
64     clock_gettime(CLOCK_PROCESS_CPUTIME_ID, &stop);
65
```

CPUCode/SimpleCpuCode.c

Save

Undo

Redo

Settings

```
57
58     generateInputData(dataIn, size_k, size_n);
59
60     clock_gettime(CLOCK_PROCESS_CPUTIME_ID, &start);
61     begin = clock();
62     rezultat = BinCofCPU(size_k, size_n);
63     end = clock();
64     clock_gettime(CLOCK_PROCESS_CPUTIME_ID, &stop);
65
66     timeInMillis = (float)(end-begin)/(CLOCKS_PER_SEC/1000000);
67     result = (stop.tv_sec - start.tv_sec) * 1e6 + (stop.tv_nsec - start.tv_nsec);
68     printf("CPU REZULTAT: %lli\n", rezultat);
69     printf("time(nanosec): %lf\n", result);
70     printf("CPU time: %f\n", timeInMillis);
71
72     clock_gettime(CLOCK_PROCESS_CPUTIME_ID, &start);
73     begin = clock();
74     BinCof(size_k, dataIn, dataOut);
75     end = clock();
76     clock_gettime(CLOCK_PROCESS_CPUTIME_ID, &stop);
77
78     for(int i = 0; i < size_k; i++)
79         res = res*dataOut[i];
80     timeInMillis = (float)(end-begin)/(CLOCKS_PER_SEC/1000000);
81     result = (stop.tv_sec - start.tv_sec) * 1e6 + (stop.tv_nsec - start.tv_nsec);
82     printf("MAX REZULTAT: %d\n", (int)round(res));
83     printf("time(nanosec): %lf\n", result);
84     printf("MAX time: %f\n", timeInMillis);
85
86     return 0;
```



Output

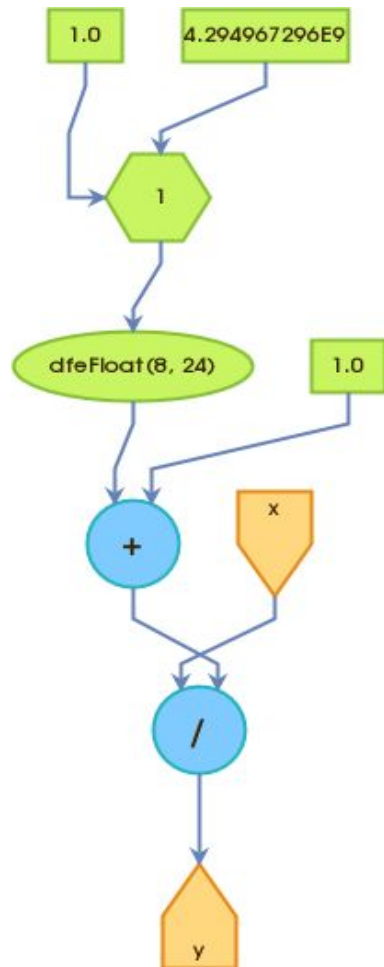
```
87 make[2]: Leaving directory '/home/damnjanovic.tanja96/WebIDE-Projects/SimpleKernel'
88 make -f Makefile.rules run
89 make[2]: Entering directory '/home/damnjanovic.tanja96/WebIDE-Projects/SimpleKernel'
90 env MAXELEROSDIR="/opt/maxcompiler/lib/maxeleros" make -f Makefile.rules run
91 CPU REZULTAT: 4845
92 time(nanosec): 13754.000000
93 CPU time: 0.000000
94
95 MAX REZULTAT: 4845
96 time(nanosec): 10338767.000000
97 MAX time: 0.000000
98
99 make[2]: Leaving directory '/home/damnjanovic.tanja96/WebIDE-Projects/SimpleKernel'
100 make[1]: Leaving directory '/home/damnjanovic.tanja96/WebIDE-Projects/SimpleKernel'
101 make stopsim
102 make[1]: Entering directory '/home/damnjanovic.tanja96/WebIDE-Projects/SimpleKernel'
103 make -f Makefile.rules stopsim
104 make[2]: Entering directory '/home/damnjanovic.tanja96/WebIDE-Projects/SimpleKernel'
105 make -C ../RunRules/Simulation stopsim
106 make[3]: Entering directory '/home/damnjanovic.tanja96/WebIDE-Projects/SimpleKernel'
107 make -f Makefile.rules stopsim
108 make[4]: Entering directory '/home/damnjanovic.tanja96/WebIDE-Projects/SimpleKernel'
109 '/opt/maxcompiler/bin/maxcompilersim' -n maxcsimple -c MAIA -d 1 stop
110 Terminating MaxelerOS daemon (PID 51)...
111 MaxelerOS daemon killed
112 Terminating simulated system (PID 47)...
113 Simulated system killed
114 make[4]: Leaving directory '/home/damnjanovic.tanja96/WebIDE-Projects/SimpleKernel'
115 make[3]: Leaving directory '/home/damnjanovic.tanja96/WebIDE-Projects/SimpleKernel'
116 make[2]: Leaving directory '/home/damnjanovic.tanja96/WebIDE-Projects/SimpleKernel'
117 make[1]: Leaving directory '/home/damnjanovic.tanja96/WebIDE-Projects/SimpleKernel'
118 make: Leaving directory '/home/damnjanovic.tanja96/WebIDE-Projects/SimpleKernel/'
119 Starting generating graphs...
120 Graphs generated
```

Rezultat simulacije  
za ulaze  
manje od 100

Output

```
80 make[2]: Nothing to be done for 'build'.
81 make[2]: Leaving directory `/home/damnjanovic.tanja96/WebIDE-Projects/Si
82 make -f Makefile.rules run
83 make[2]: Entering directory `/home/damnjanovic.tanja96/WebIDE-Projects/Si
84 env MAXELEROSDIR="/opt/maxcompiler//lib/maxeleros-sim" LD_LIBRARY_PATH="
85 CPU RESULTAT: 8297547632113
86 time(nanosec): 29921817.000000
87 CPU time: 30000.000000
88
89 MAX RESULTAT: -2147483648
90 time(nanosec): 806554035.000000
91 MAX time: 4800000.000000
92
93 make[2]: Leaving directory `/home/damnjanovic.tanja96/WebIDE-Projects/Si
94 make[1]: Leaving directory `/home/damnjanovic.tanja96/WebIDE-Projects/Si
95 make stopsim
96 make[1]: Entering directory `/home/damnjanovic.tanja96/WebIDE-Projects/Si
97 make -f Makefile.rules stopsim
98 make[2]: Entering directory `/home/damnjanovic.tanja96/WebIDE-Projects/Si
99 make -C ../RunRules/Simulation stopsim
100 make[3]: Entering directory `/home/damnjanovic.tanja96/WebIDE-Projects/Si
101 make -f Makefile.rules stopsim
102 make[4]: Entering directory `/home/damnjanovic.tanja96/WebIDE-Projects/Si
103 '/opt/maxcompiler//bin/maxcompilersim' -n maxcsimple -c MAIA -d 1 stop
104 Terminating MaxelerOS daemon (PID 51)...
105 MaxelerOS daemon killed
106 Terminating simulated system (PID 47)...
107 Simulated system killed
108 make[4]: Leaving directory `/home/damnjanovic.tanja96/WebIDE-Projects/Si
109 make[3]: Leaving directory `/home/damnjanovic.tanja96/WebIDE-Projects/Si
110 make[2]: Leaving directory `/home/damnjanovic.tanja96/WebIDE-Projects/Si
111 make[1]: Leaving directory `/home/damnjanovic.tanja96/WebIDE-Projects/Si
112 make: Leaving directory `/home/damnjanovic.tanja96/WebIDE-Projects/Simpl
113 Starting generating graphs...
114 Graphs generated
```

Rezultat simulacije  
za ulaze  
veće od 1,000,000



## ZAKLJUČAK

- Za ulaze ~100  
Maxeler je sporiji 750 puta
- Za ulaze ~10,000  
Maxeler je sporiji 68 puta
- Za ulaze ~1,000,000  
Maxeler je sporiji 27 puta

*Failure is not the opposite of success;  
It's part of it!*

- Arianna Huffington



## Kontakt

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