Hashing

In[2]:=
```
<< Graphics`Graphics`
<< Statistics`DataManipulation`
```

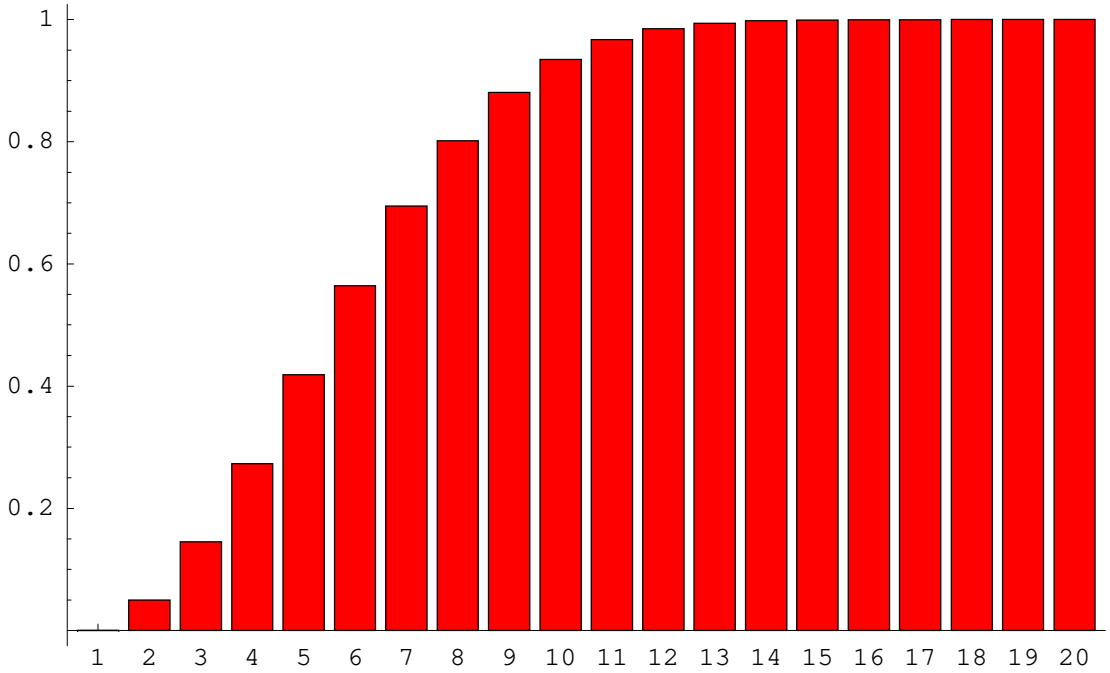
Kollisionen beim Hashing

- Warum kommt es zu Kollisionen?

Beispiel: In ein Array der Länge 20 wurden *m* Elemente eingefügt. Mit welcher Wahrscheinlichkeit ist zu einer Kollision gekommen?

$$p[m_] := 1 - \frac{\prod_{i=1}^{m} (20 - i + 1)}{20^m}$$

```
BarChart[Table[p[m], {m, 1, 20}]]
```



- Graphics -

Hashfunktionen

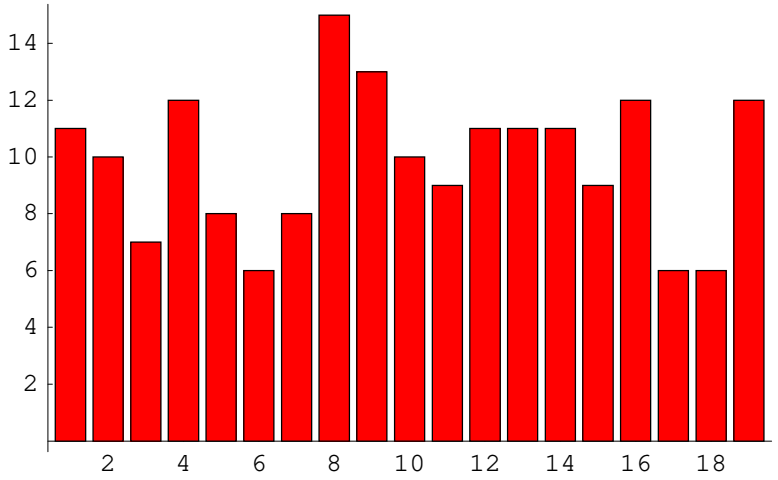
In[3]:=
```
Clear[GenDist]
GenDist[h_, n_: 20] :=
 Block[{
   l = Table[h[Random[Integer, {0, 99999}], n],
         {i, 1, 10 n}]
        },
    BarChart[BinCounts[l, {0, n - 1, 1}],
     Ticks -> {Table[i, {i, 0, n, 2}],
       Table[i, {i, 0, 20, 2}]},
     DisplayFunction -> Identity]]
```

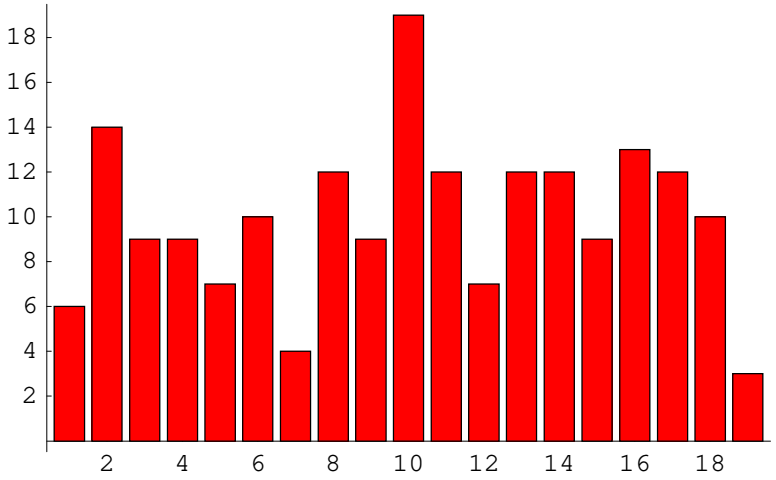
In[11]:=
```
ShowDist[h_] :=
 Show[GraphicsArray[Partition[Table[GenDist[h, 20], {4}], {2}]],
    DisplayFunction -> $DisplayFunction]
```

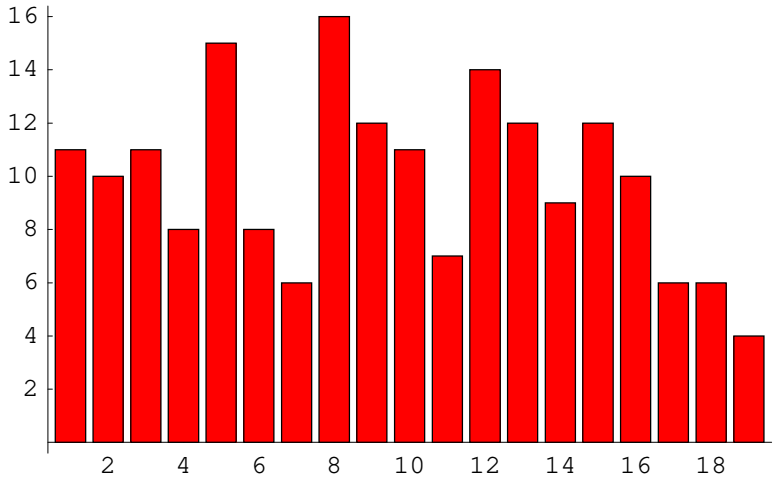
1. $h(k) = k \bmod n$

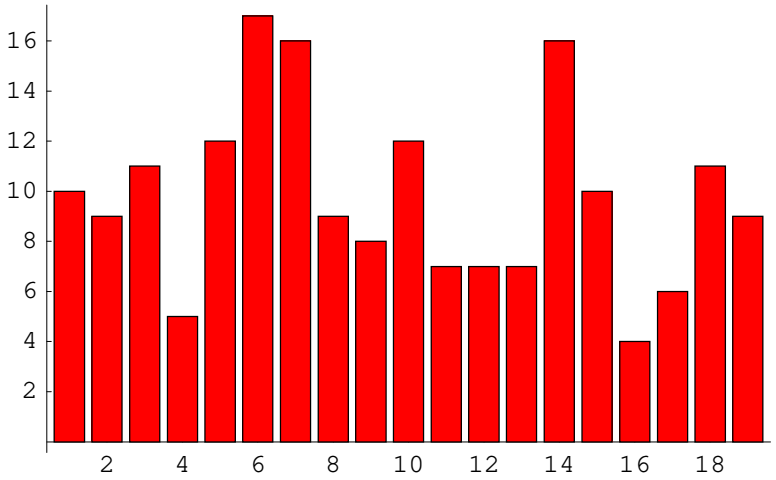
In[10]:=
```
h[k_, n_] := Mod[k, n]
```

In[12]:=
```
ShowDist[h]
```





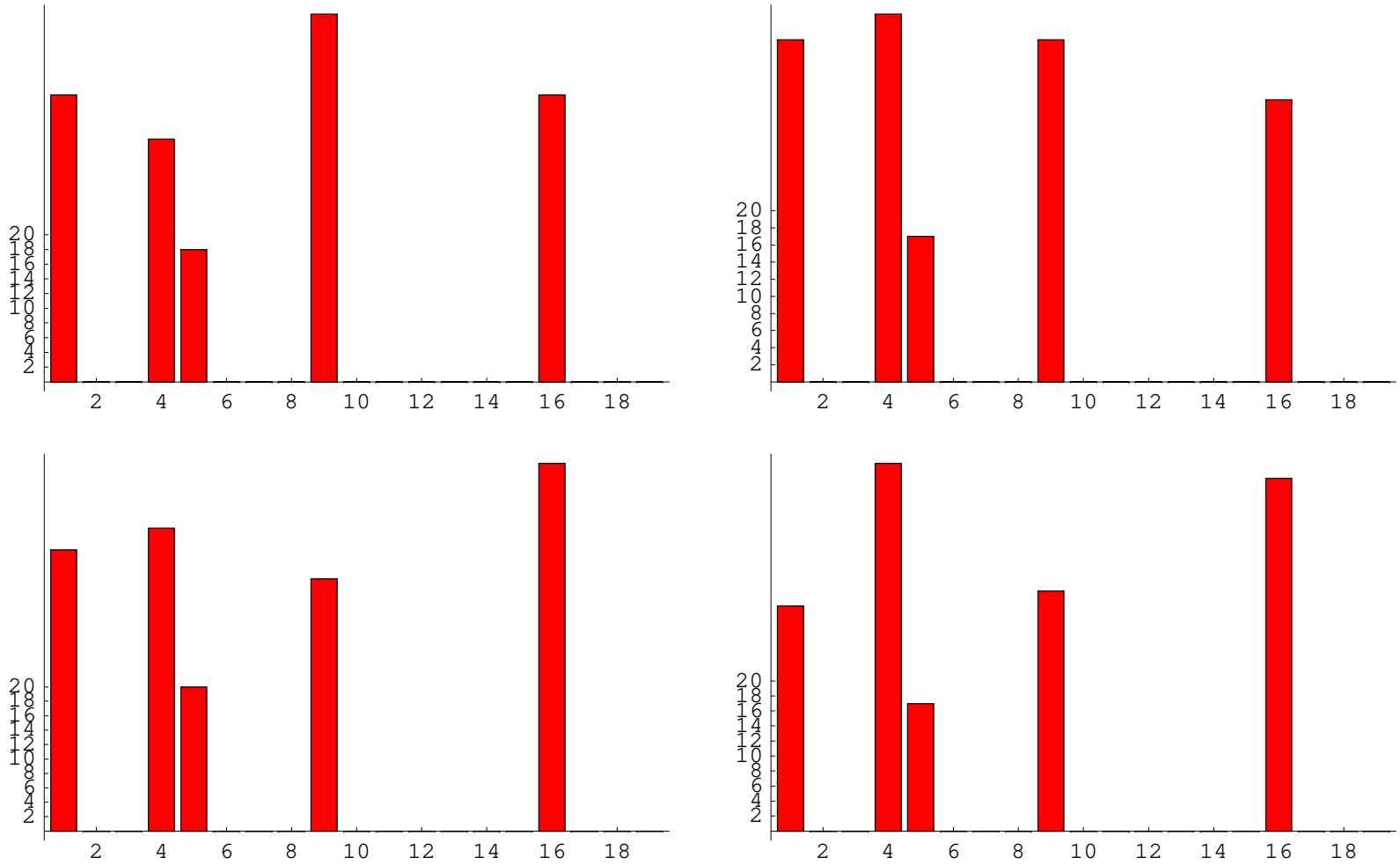




2. $h(k) = k^2 \bmod n$

In[13]:=
```
h[k_, n_] := Mod[k^2, n]
```

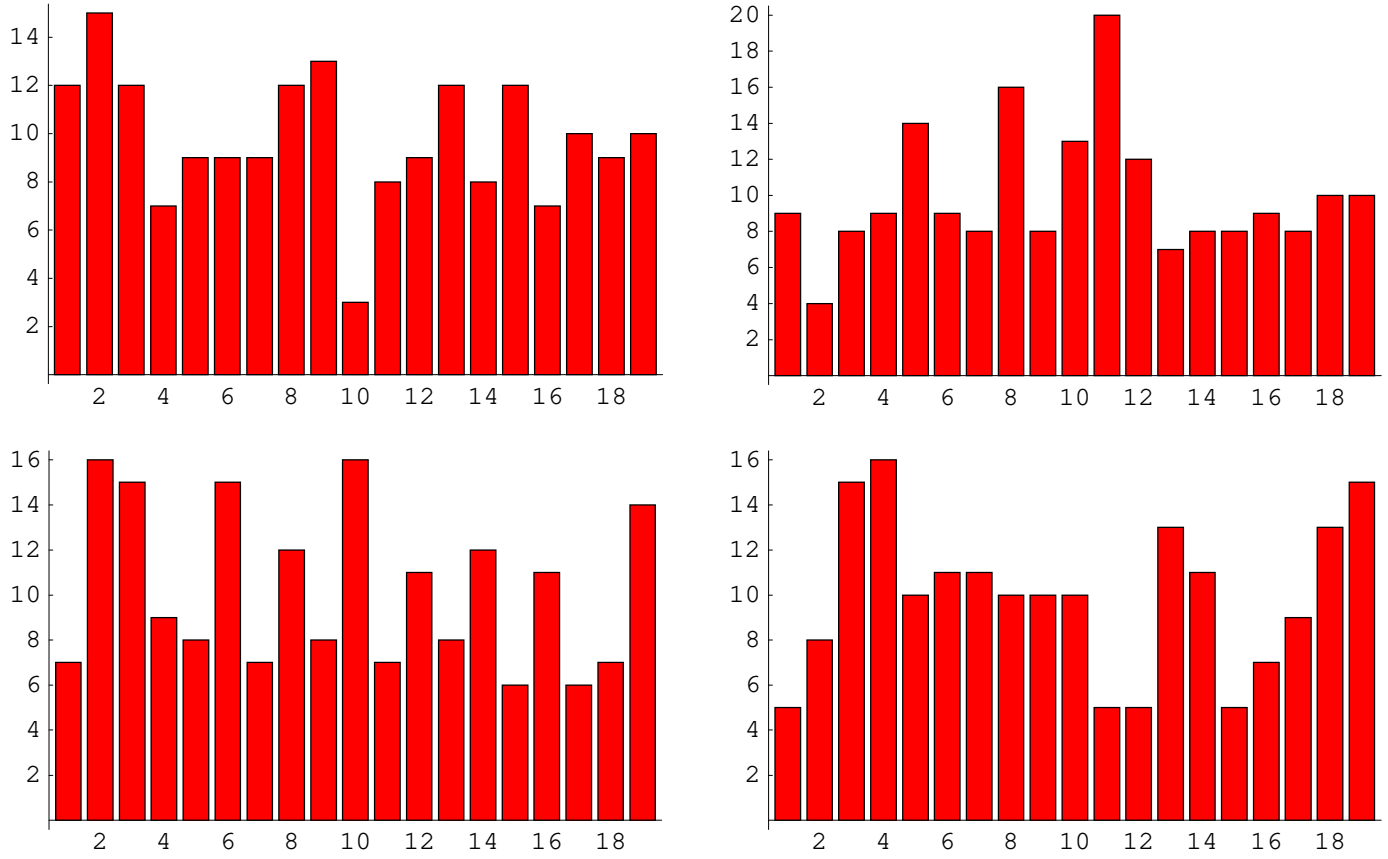
In[14]:=
```
ShowDist[h]
```



3. $h(k) = \lfloor n(k\,a \bmod 1)\rfloor$

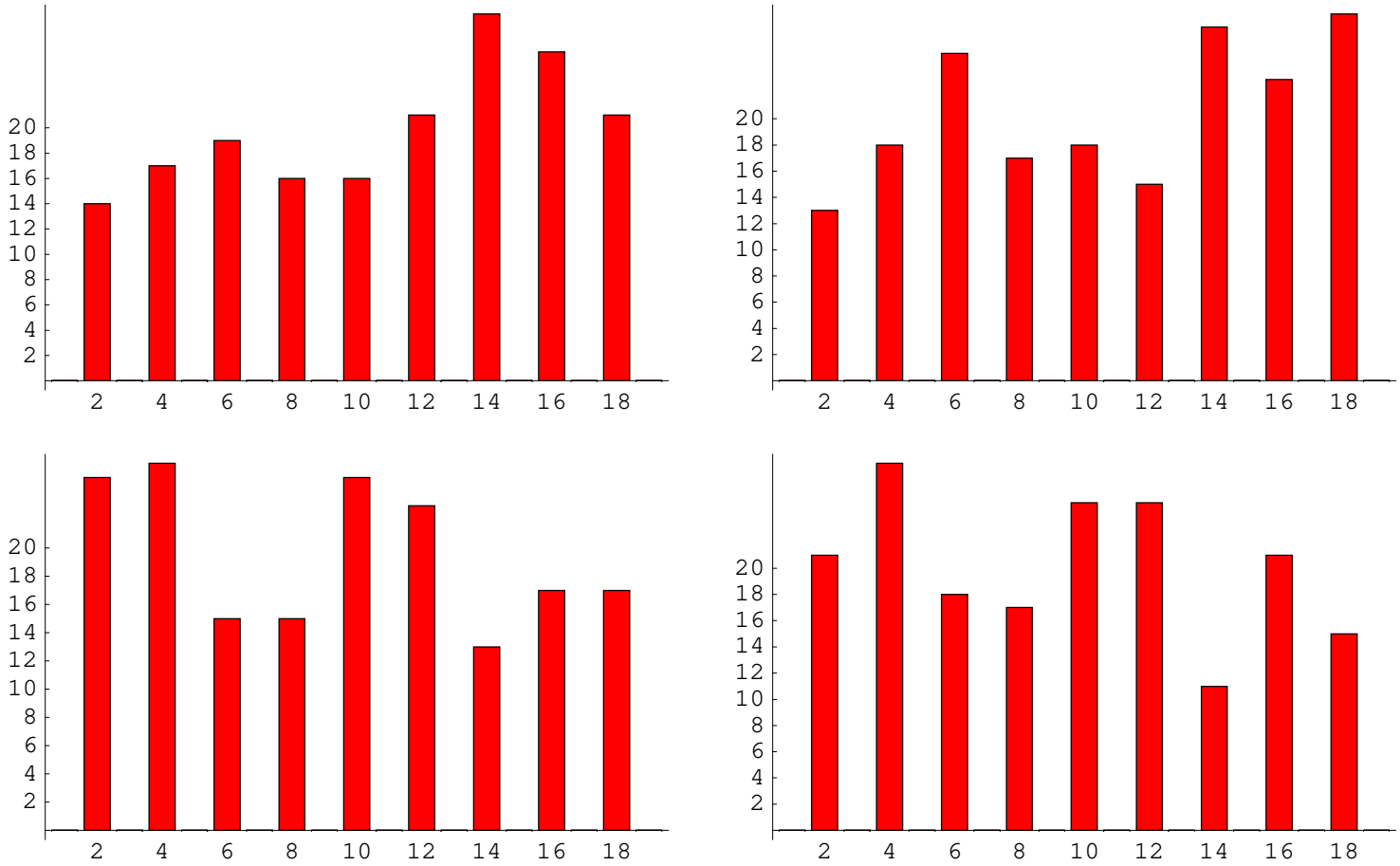
■ $a = \frac{\sqrt{5}-1}{2}$

In[35]:=
```
h[k_, n_] := Block[{a = (Sqrt[5] - 1) / 2},
        Floor[n (k a - IntegerPart[k a])]]
ShowDist[h]
```



■ $a = \frac{3}{10}$

In[37]:=
```
h[k_, n_] := Block[{a = 3 / 10},
        Floor[n (k a - IntegerPart[k a])]]
ShowDist[h]
```



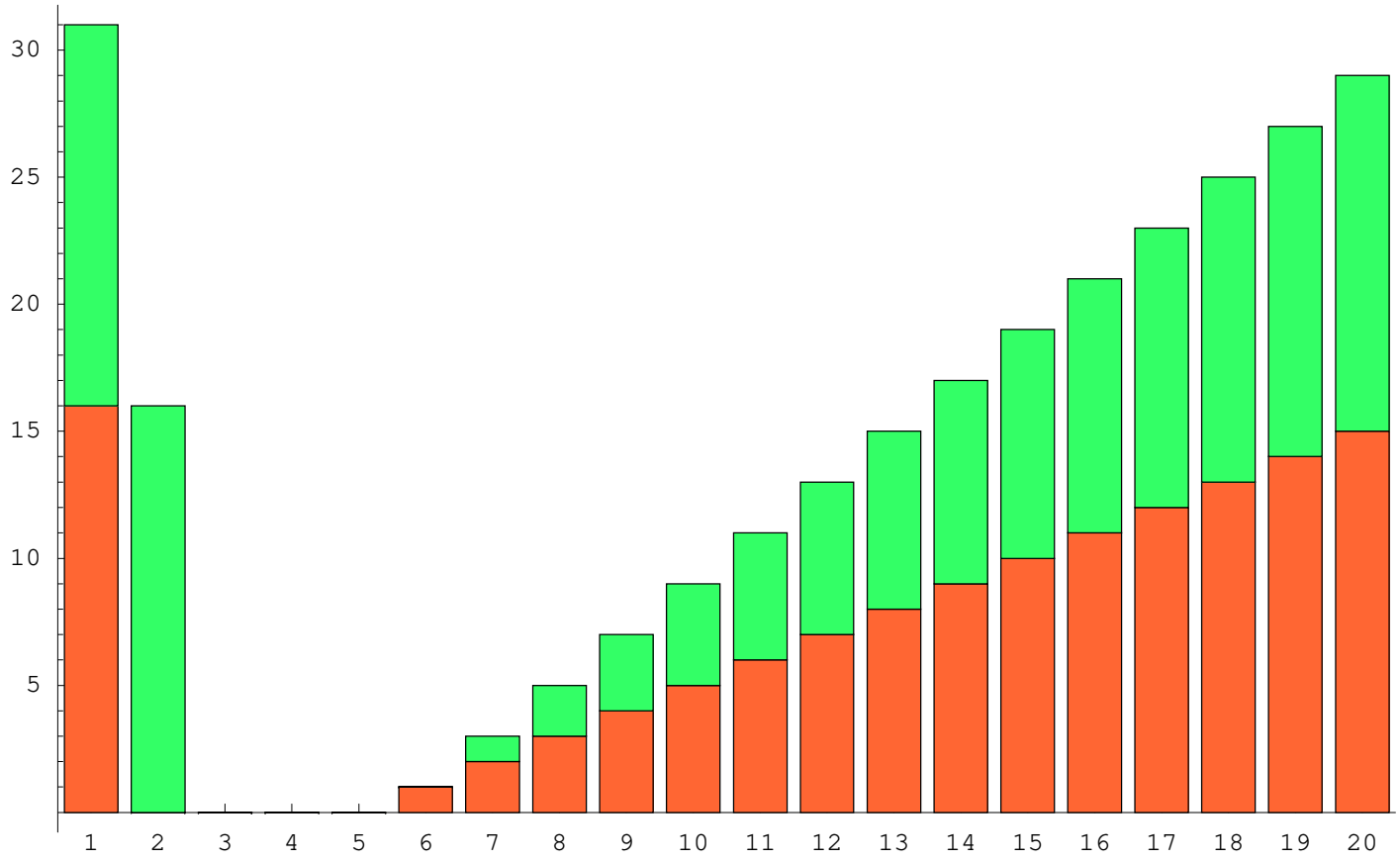
Offenes Hashing

$$h(k) = k \bmod n$$
$$h(k, i) = h(k) + i \bmod n$$

In[19]:=
```
Clear[h]
h[k_] := Mod[k, 20]
h[k_, i_] := Mod[h[k] + i, 20]
```

In[30]:=

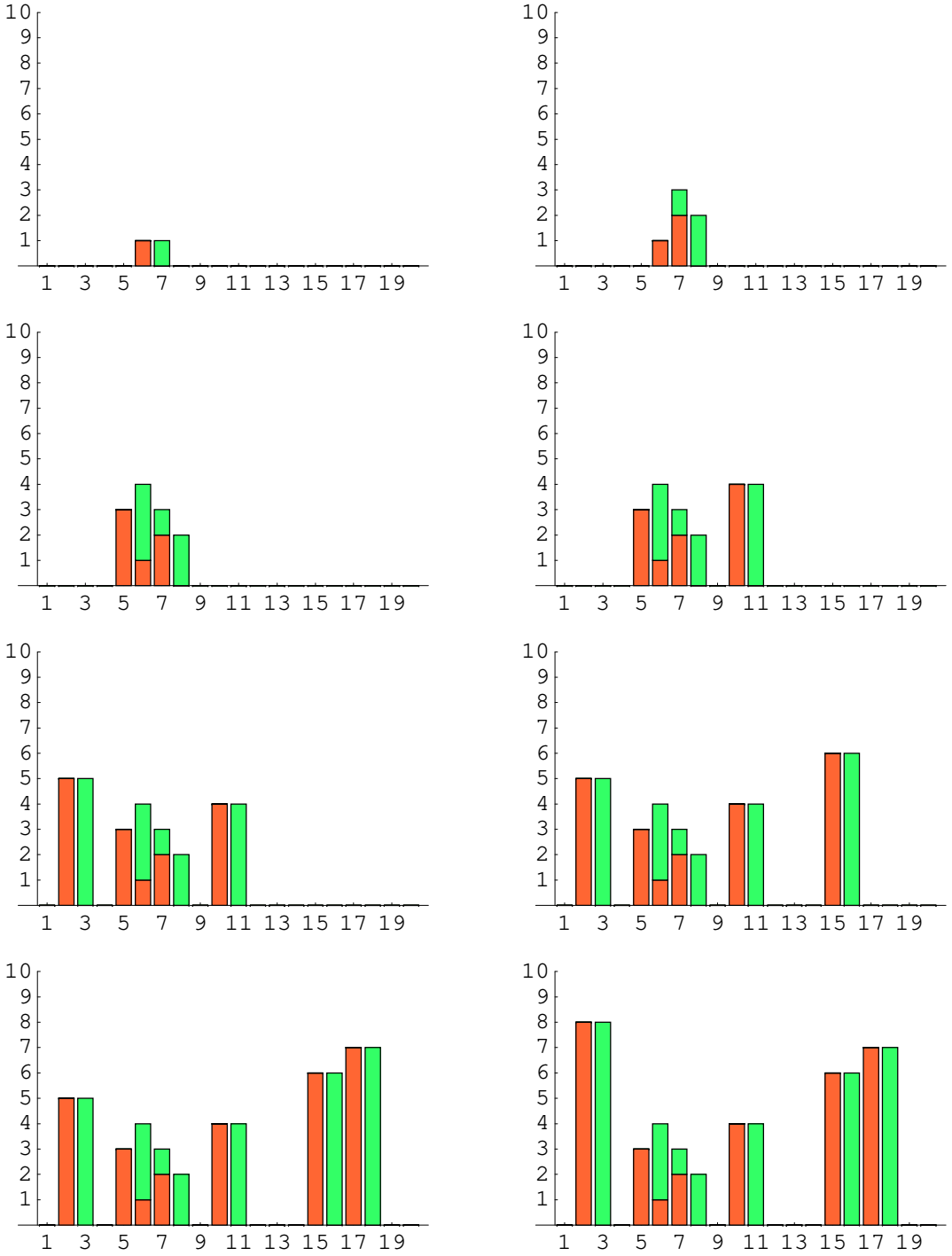
```
Block[{l = Table[0, {20}], m = Table[0, {20}]},
    For[i = 0, i <= 15, i++, l = ReplacePart[l, i + 1, Mod[h[5, i], 20] + 1]];
    For[i = 0, i <= 15, i++, m = ReplacePart[m, i + 1, Mod[h[6, i], 20] + 1]];
    StackedBarChart[l, m,
  BarStyle -> {RGBColor[1, 0.4, 0.2], RGBColor[0.2, 1, 0.4]}]]
```



$$h(k,\ i) = h(k) - (-1)^i \left(\left\lceil \frac{i}{2} \right\rceil\right)^2 \bmod n$$

In[31]:=
```
h[k_, i_] := Mod[h[k] - (-1)^i Ceiling[i / 2]^2, 20]
```

In[34]:=
```
Show[GraphicsArray[Partition[Table[
    Block[{l = Table[0, {20}], m = Table[0, {20}]},
    For[i = 0, i <= j, i++,
      l = ReplacePart[l, i + 1, Mod[h[5, i], 20] + 1]];
    For[i = 0, i <= j, i++, m = ReplacePart[m, i + 1, Mod[h[6, i], 20] + 1]];
    StackedBarChart[l, m, DisplayFunction -> Identity, PlotRange -> {0, 10},
                          BarStyle ->
       {RGBColor[1, 0.4, 0.2], RGBColor[0.2, 1, 0.4]},
                          Ticks -> {Table[k, {k, 1, 20, 2}],
        Table[k, {k, 1, 10}]}]], {j, 0, 7}], 2]],
    DisplayFunction -> $DisplayFunction]
```


10
9
8
7
6
5
4
3
2
1
1 3 5 7 9 11 13 15 17 19