Kreslení čar

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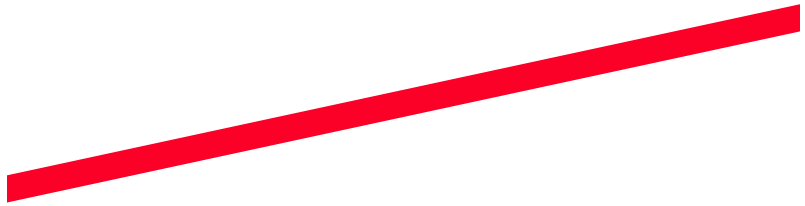
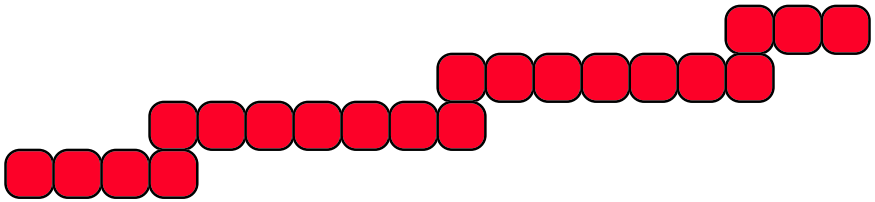
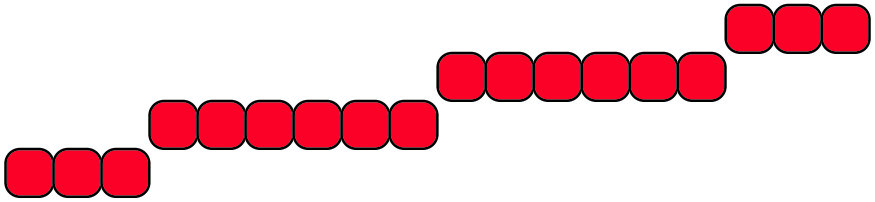
Kreslení úseček



vektorové zařízení

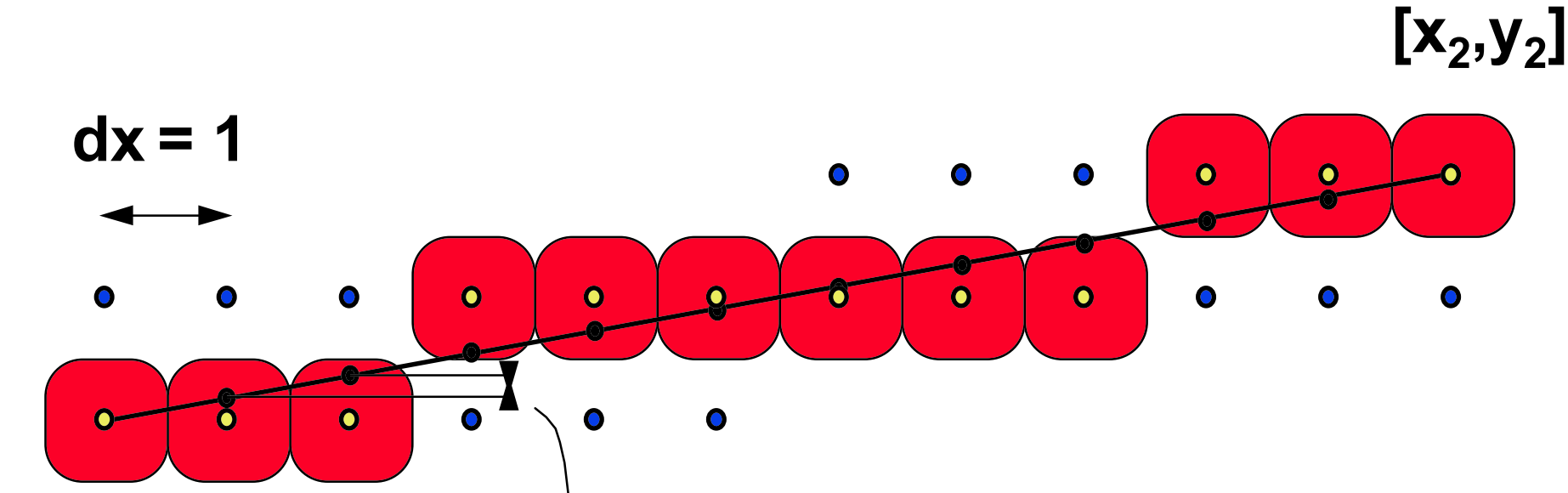


rastrové zařízení



OK

DDA algoritmus



$$dy = \frac{y_2 - y_1}{x_2 - x_1}$$

DDA algoritmus

```
procedure LineDDA ( x1, y1, x2, y2, color : integer );
              { předpoklady: x1 < x2, |y2-y1| < |x2-x1| }
var y, dy : real;
begin
  y := y1;
  dy := (y2-y1)/(x2-x1);
  PutPixel(x1,y1,color);
  while x1 < x2 do
    begin
      x1 := x1 + 1;
      y := y + dy;
      PutPixel(x1,round(y),color);
    end;
end;
```

DDA algoritmus

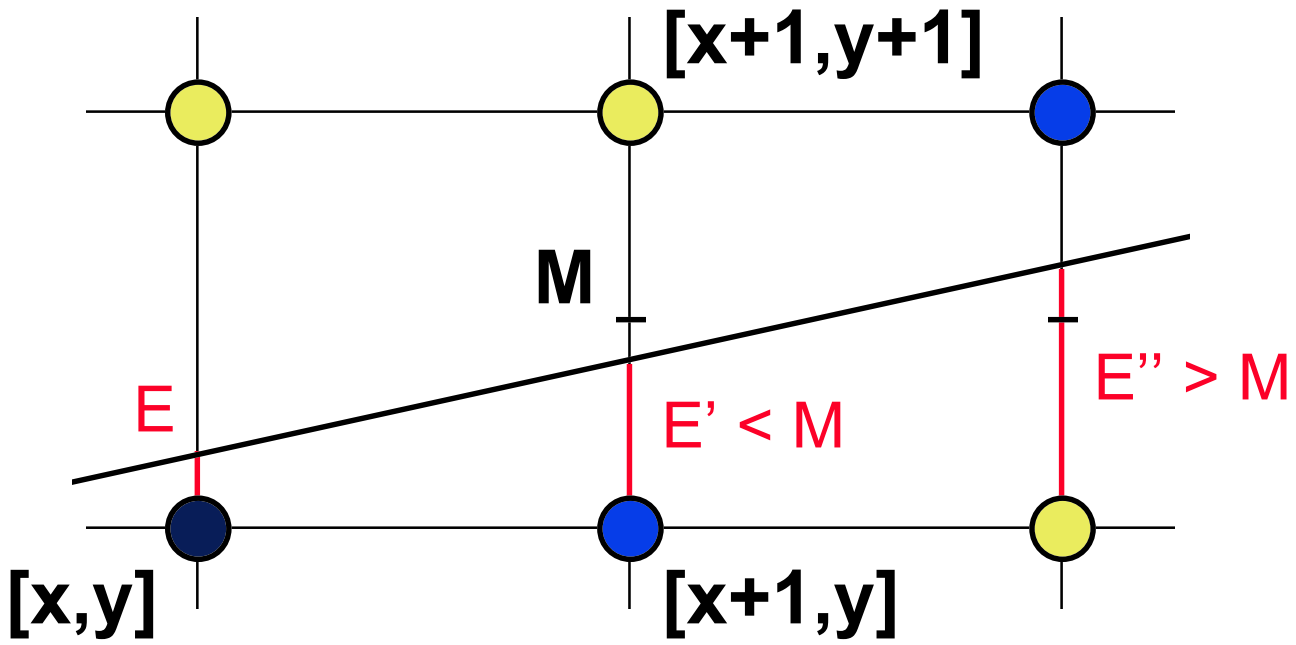
✚ **výhody:**

- snadná implementace (HW)

➔ **nevýhody:**

- nutno počítat s velkou **přesností** (real, fixed point)
- jedno **dělení** a v cyklu **zaokrouhlování**

Bresenhamův algoritmus



$$dx = x_2 - x_1$$

$$dy = y_2 - y_1$$

$$E' = E + \frac{dy}{dx} \leq M = \frac{1}{2}$$

Celočíselné odvození

$$E' = E + \frac{dy}{dx} \leq \frac{1}{2} \quad / \cdot 2dx$$

$$2dx \cdot E' = 2dx \cdot E + 2dy \leq dx \quad / - dx$$

$$dx(2E' - 1) = dx(2E - 1) + 2dy \leq 0$$

$$D' = D + 2dy \leq 0$$

$$D_0 = 2dy - dx$$

$$D \leq 0 \Rightarrow D' = D + 2dy, \qquad y' = y$$

$$D > 0 \Rightarrow D' = D + 2dy - 2dx, \qquad y' = y + 1$$

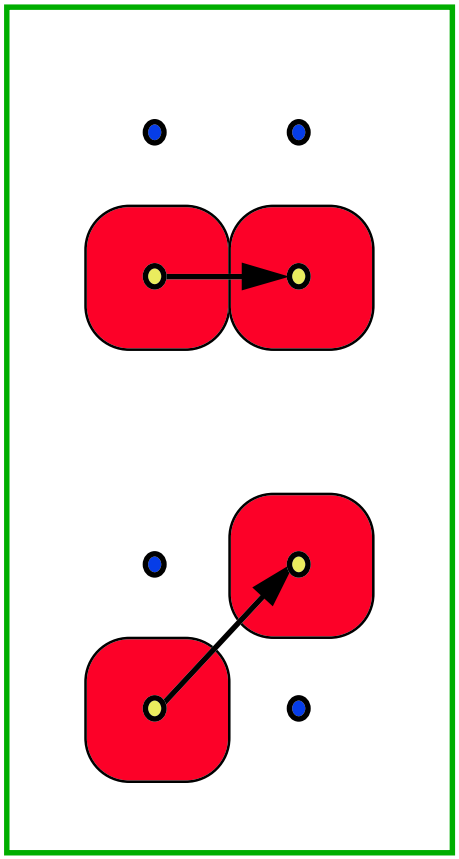
Bresenhamův algoritmus

```
procedure LineBres ( x1, y1, x2, y2, color : integer );
            { předpoklady: x1 < x2, |y2-y1| < |x2-x1| }
var dx, dy, D, inc0, inc1 : integer;
begin
  dx := x2 - x1;
  dy := y2 - y1;
  D  := 2*dy - dx;
  inc0 := 2*dy;
  inc1 := 2*(dy - dx);
  PutPixel(x1,y1,color);
  ...
```

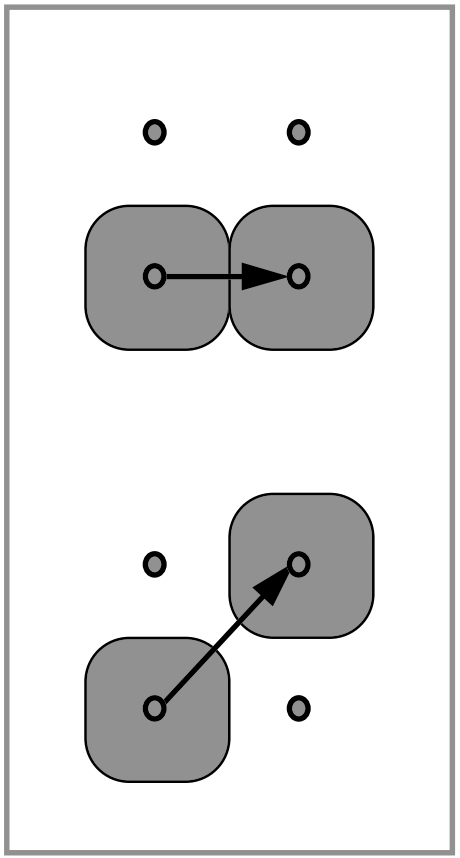
Bresenhamův algoritmus

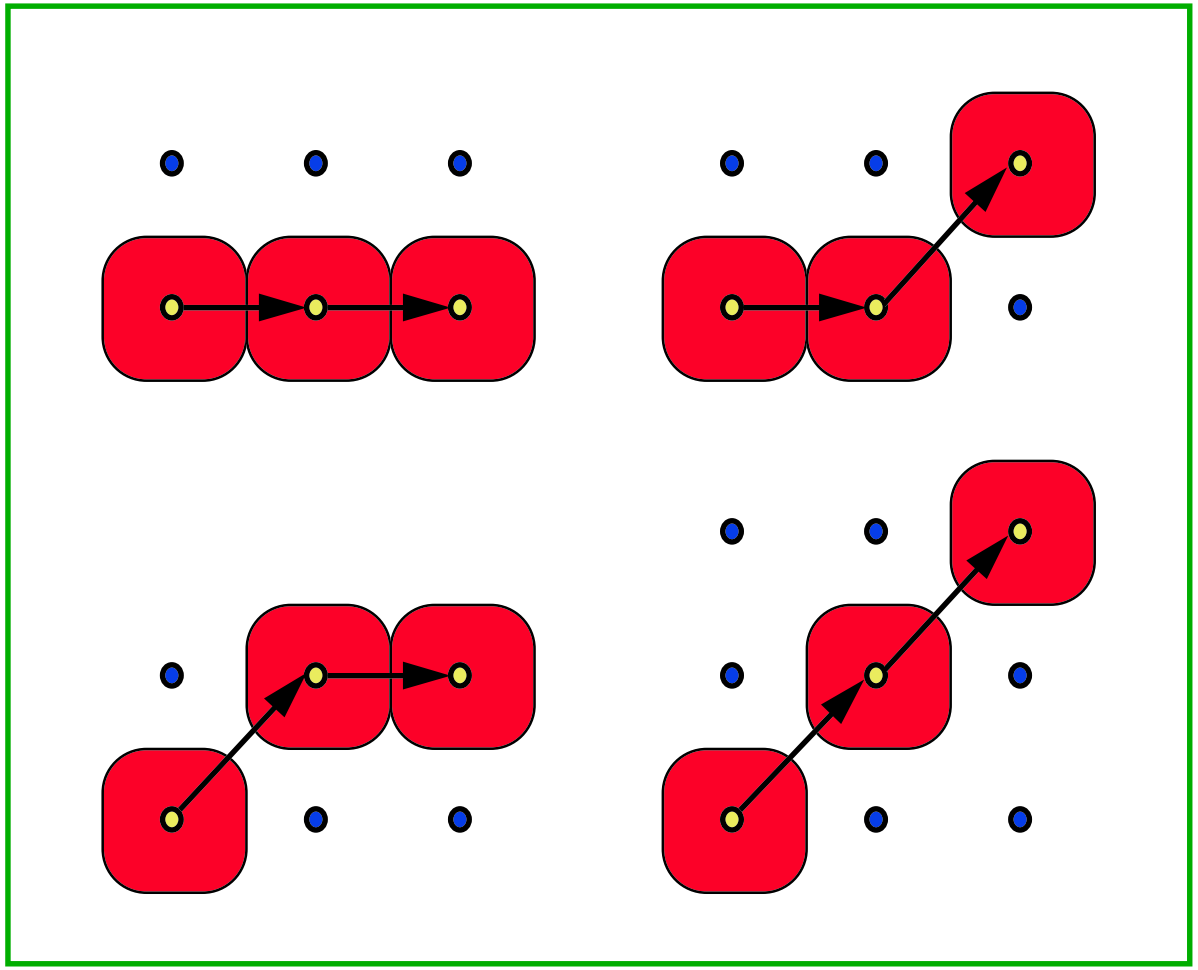
```
  ...
  while x1 < x2 do
    begin
      if D <= 0 then D := D + inc0
                else
        begin
          D := D + inc1;
          y1 := y1 + 1;
        end;
      x1 := x1 + 1;
      PutPixel(x1,y1,color);
    end;
end;
```

Jednokrokový algoritmus

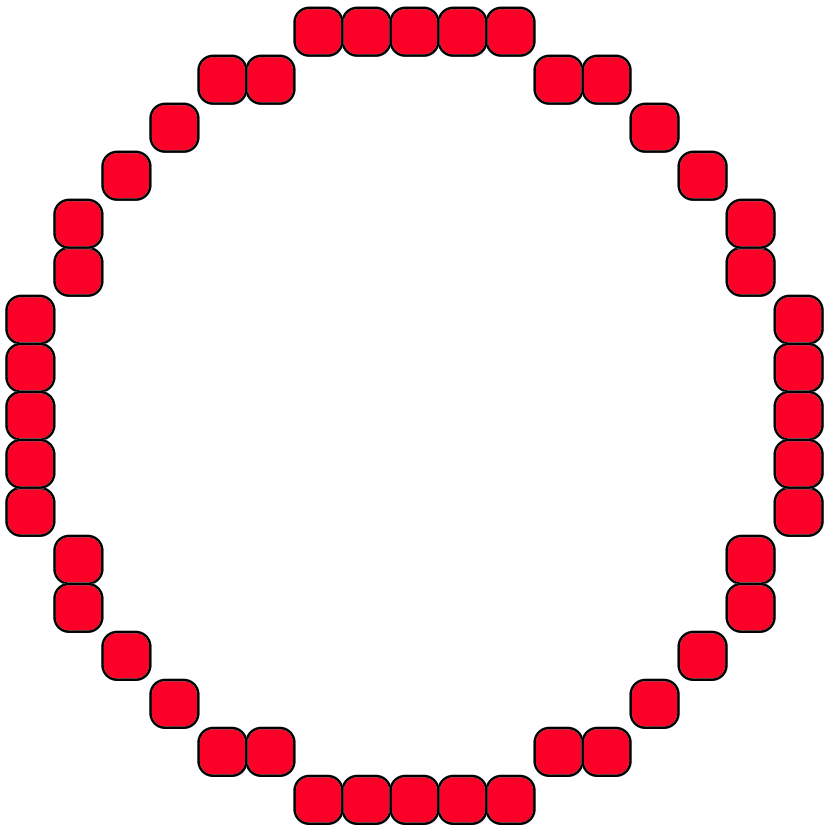


Vícekrokové algoritmy

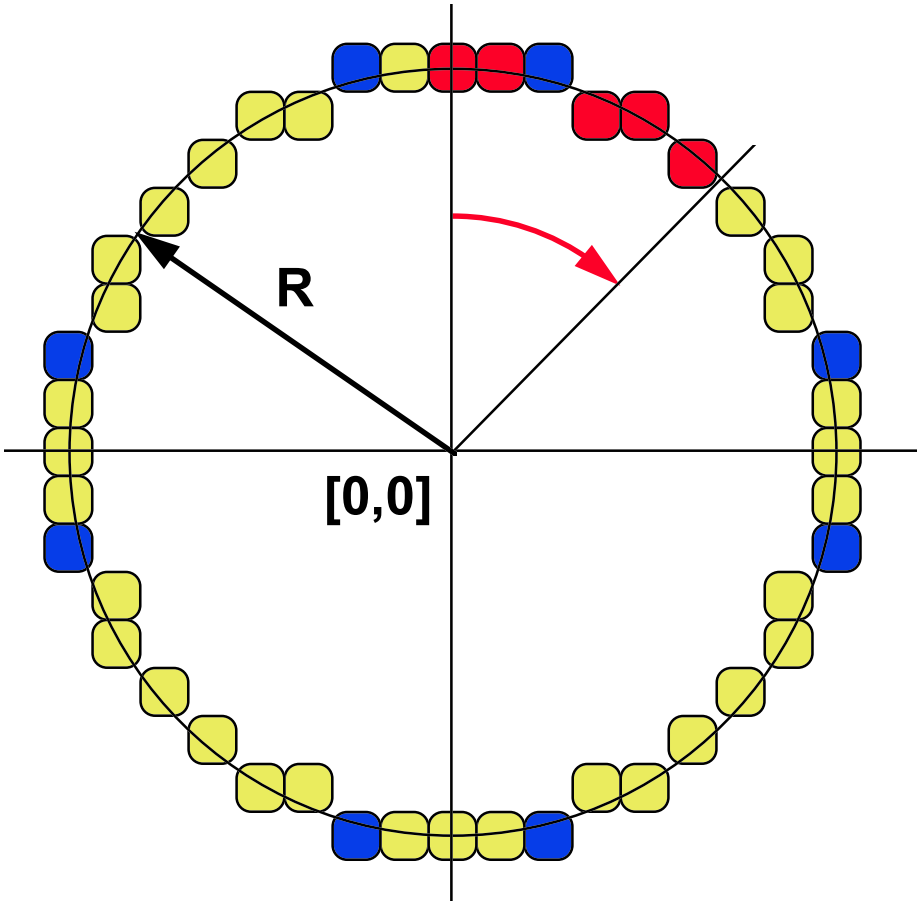




Kreslení kružnice

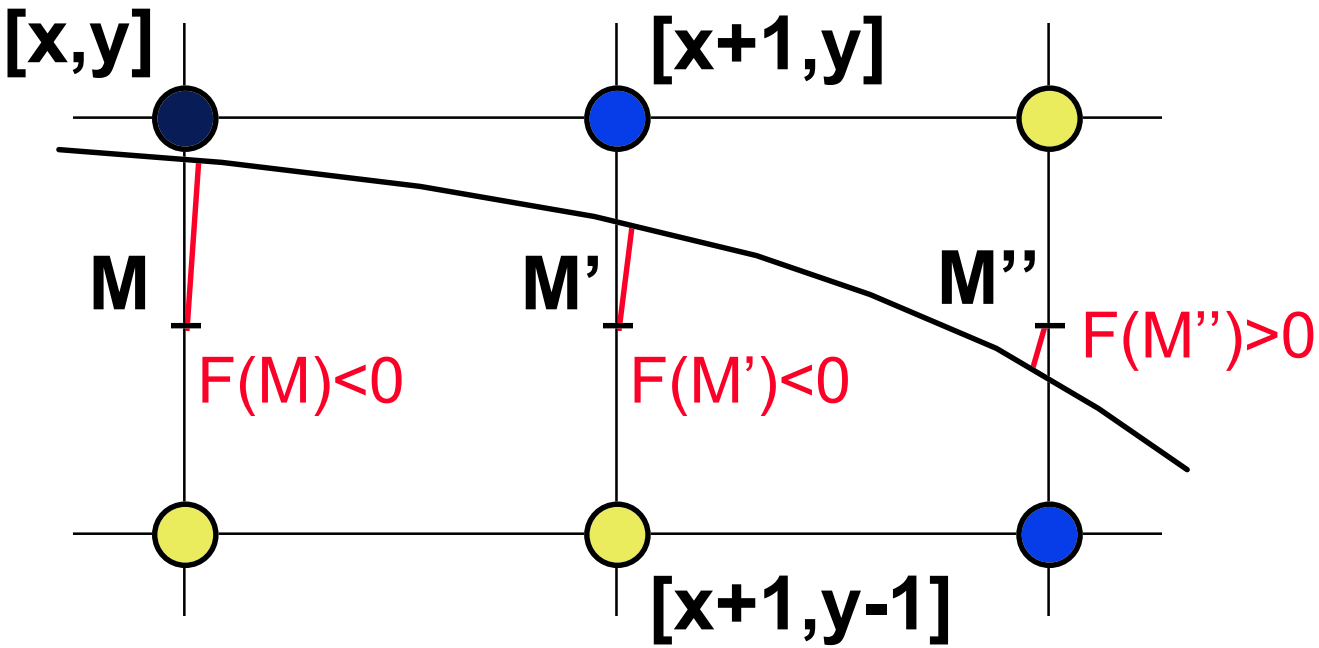


Kreslení kružnice



Kreslí se jen jedna osmina oblouku
- zbytek se přenese pomocí symetrií

Bresenhamův algoritmus



$$F(M) = M_x^{\,2} + M_y^{\,2} - R^2$$

Inkrementální odvození

1) $F(M') = (x+1)^2 + (y - \frac{1}{2})^2 - R^2 \quad < \quad 0$

$F(M'') = (x+2)^2 + (y - \frac{1}{2})^2 - R^2 = F(M') + 2x + 3$

2) $F(M') \geq \quad 0$

$F(M'') = (x+2)^2 + (y - \frac{3}{2})^2 - R^2 = F(M') + 2x - 2y + 5$

$D_0 = 1.25 - R \quad \{1 - R\}$

$D < 0 \Rightarrow D' = D + 2x + 3, \qquad y' = y$

$D \geq 0 \Rightarrow D' = D + 2x - 2y + 5, \qquad y' = y - 1$

Kreslení kružnice

```
procedure CirclePoints ( x, y, color : integer );
            { předpoklad: střed kružnice je v počátku }
begin
  PutPixel( x, y,color);
  PutPixel( y, x,color);
  PutPixel( x,-y,color);
  PutPixel( y,-x,color);
  PutPixel(-x, y,color);
  PutPixel(-y, x,color);
  PutPixel(-x,-y,color);
  PutPixel(-y,-x,color);
end;

...
```

Kreslení kružnice

```
procedure CircleBres ( R, color : integer );
var x, y, D : integer;
begin
  x := 0; y := R; D := 1 - R;
  CirclePoints(0,R,color);
  while y > x do
    begin
      if D < 0 then D := D + 2*x + 3
               else
        begin
          D := D + 2*(x - y) + 5;
          y := y - 1;
        end;
      x := x + 1;
      CirclePoints(x,y,color);
    end;
end;
```

Konec

Další informace:

- **J. Foley, A. van Dam, S. Feiner, J. Hughes**: ***Computer Graphics, Principles and Practice***, 72-87
- **Jiří Žára a kol.**: ***Počítačová grafika***, principy a algoritmy, 91-100, 106-112
- **LAN** na Malé Straně:
  - **barbora\usr:\vyuka\pelikan\2**