Starting d

LTZ: less than zero
GTZ: Greater than zero
i: initial
n: next

$d_i = f(x+1, y-\frac{1}{2}) = (x+1)^2 + (y-\frac{1}{2})^2 - r^2$

$= x^2+2x+1 + y^2 - y + \frac{1}{4} - r^2$

as $x=0, y=r$ for the d_i calc,

$= \cancel{0^2} + \cancel{2 0} + 1 + \cancel{r^2} - r + \frac{1}{4} - \cancel{r^2}$

$= \frac{5}{4} - r$

Case: $d < 0$

$\underset{LTZ}{d_n} = f(ME) = f(x+2, y-\frac{1}{2})$

$= (x+2)^2 + (y-\frac{1}{2})^2 - r^2$

$= x^2 + 4x + 4 + y^2 - y + \frac{1}{4} - r^2$

$\Delta d_{LTZ} = d_{n_{LTZ}} - d_i$

$= (\cancel{x^2} + \overset{2x+3}{\cancel{4x+4}} + \cancel{y^2} - \cancel{y} + \cancel{\frac{1}{4}} - \cancel{r^2}) - (\cancel{x^2} + \cancel{2x} + \cancel{1} + \cancel{y^2} - \cancel{y} + \cancel{\frac{1}{4}} - \cancel{r^2})$

$= 2x + 3$

Case: $d > 0$

$\underset{GTZ}{d_n} = f(MSE) = f(x+2, y-\frac{3}{2})$

$= (x+2)^2 + (y-\frac{3}{2})^2 - r^2$

$= x^2 + 4x + 4 + y^2 - 3y + \frac{9}{4} - r^2$

$\Delta d_{GTZ} = d_{n_{GTZ}} - d_i$

$= (\cancel{x^2} + \overset{2x}{\cancel{4x}} + \overset{3}{\cancel{4}} + \cancel{y^2} - \overset{2y}{\cancel{3y}} + \overset{8}{\cancel{\frac{9}{4}}} - \cancel{r^2}) - (\cancel{x^2} + \cancel{2x} + \cancel{1} + \cancel{y^2} - \cancel{y} + \cancel{\frac{1}{4}} - \cancel{r^2})$

$= 2x + 3 - 2y + \frac{9}{4} + \frac{1}{4}$

$= 2x - 2y + 3 + \frac{8}{4} = 2(x-y) + 5$

Get rid of floating point operations · multiply everything by 4

$4d_i = 5 - 4r$

$4 \cdot \Delta d_{GTZ} = 4d_i - 4d_{n_{GTZ}} = 8x + 12$

$4 \cdot \Delta d_{LTZ} = 4d_i - 4d_{n_{LTZ}} = 8(x-y) + 20$