



ICT 4203

**Computer Graphics and
Animation**

Lecture 03

Bresenham Line Drawing Algorithm

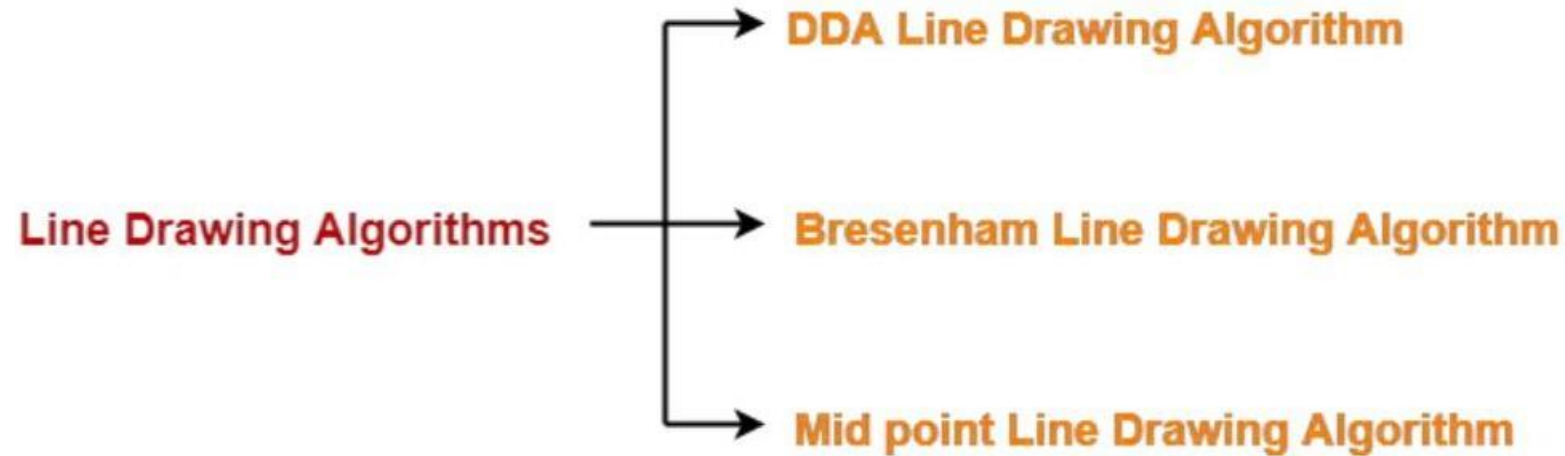
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Line Drawing Algorithms

- In computer graphics, popular algorithms used to generate lines are-

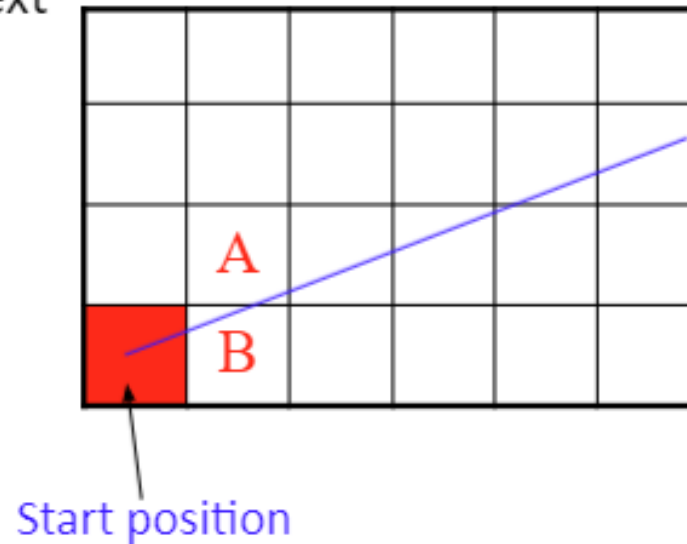


Bresenham's Line Algorithm

- **DDA algorithm**, DDA has the following problems:
 - Accumulation of round-off errors can make the pixelated line drift away from the intended.
 - The rounding operations and floating-point arithmetic involved are time consuming.
- **The Bresenham line algorithm** has the following advantages:
 - A fast incremental algorithm.
 - Uses only integer calculations.

Bresenham's Line Algorithm

- Basis of the algorithm:
- From start position decide **A** or **B** next



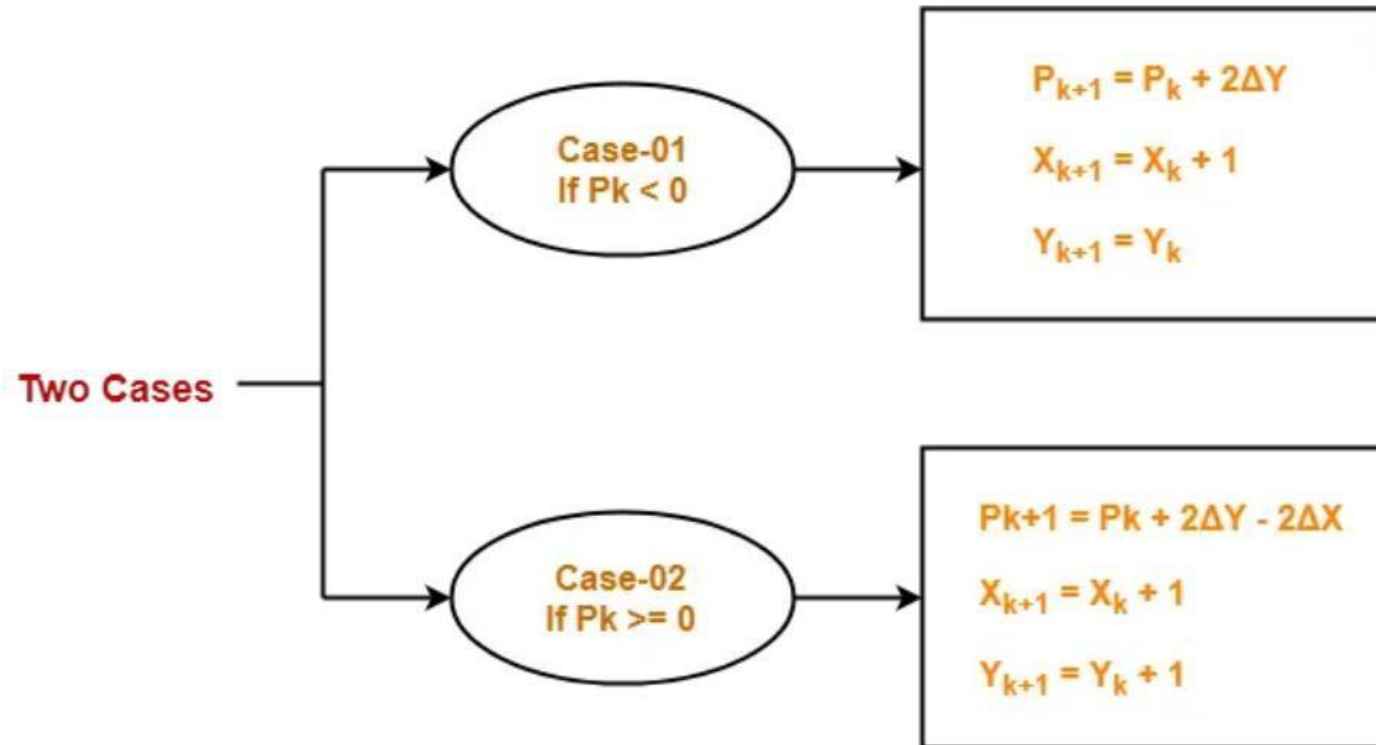
Bresenham's Line Algorithm

- Procedure
- Given-
 - Starting coordinates = (X_0, Y_0)
 - Ending coordinates = (X_n, Y_n)
- The points generation using Bresenham Line Drawing Algorithm involves the following steps-
- Step-01:
 - Calculate ΔX and ΔY from the given input.
 - These parameters are calculated as-
 - $\Delta X = X_n - X_0$
 - $\Delta Y = Y_n - Y_0$
- Step-02:
 - Calculate the decision parameter P_k .
 - $P_k = 2\Delta Y - \Delta X$

Bresenham's Line Algorithm

- **Step-03:**

- Suppose the current point is (X_k, Y_k) and the next point is (X_{k+1}, Y_{k+1}) .
- Find the next point depending on the value of decision parameter P_k .



- **Step-04:**

- Keep repeating Step-03 until the end point is reached or number of iterations equals to $(\Delta X - 1)$ times.

Bresenham's Line Algorithm – Practice Problems

Problem-01: Calculate the points between the starting coordinates (9, 18) and ending coordinates (14, 22).

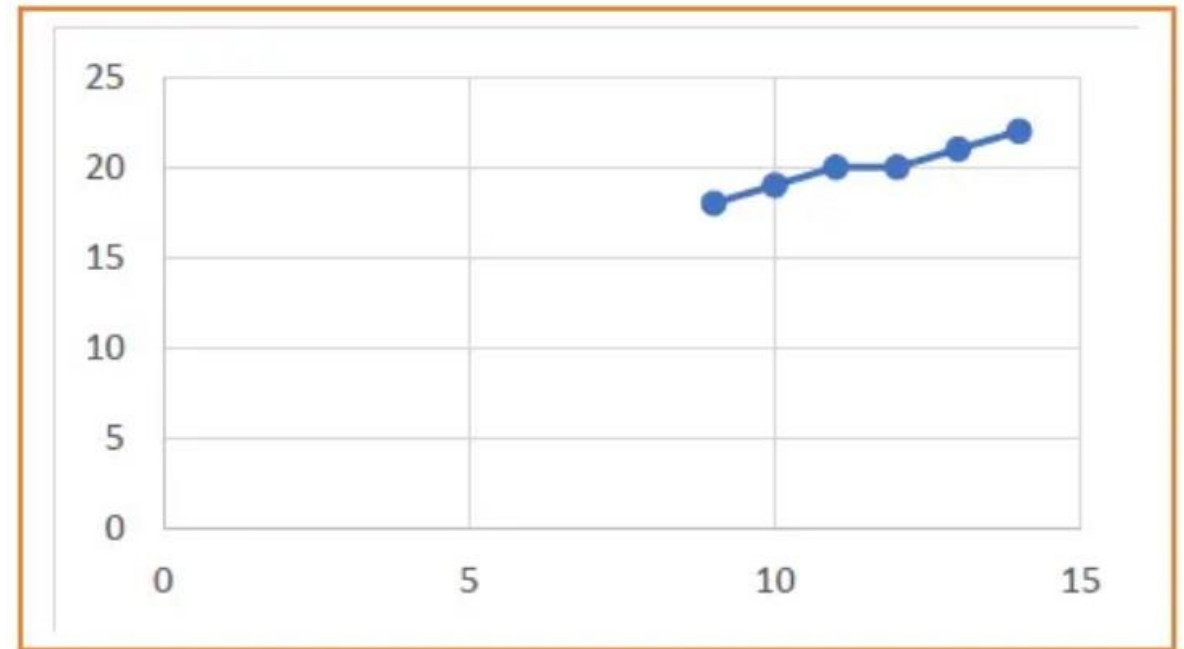
Solution:

- Step-01: Calculate ΔX and ΔY from the given input.
 - $\Delta X = X_n - X_0 = 14 - 9 = 5$
 - $\Delta Y = Y_n - Y_0 = 22 - 18 = 4$
- Step-02: Calculate the decision parameter.
 - $P_k = 2\Delta Y - \Delta X = 2 \times 4 - 5 = 3$
 - So, decision parameter $P_k = 3$
- Step-03: As $P_k \geq 0$, so case-02 is satisfied.
 - $P_{k+1} = P_k + 2\Delta Y - 2\Delta X = 3 + (2 \times 4) - (2 \times 5) = 1$
 - $X_{k+1} = X_k + 1 = 9 + 1 = 10$
 - $Y_{k+1} = Y_k = 18 + 1 = 19$
- Step-03 is executed until the end point is reached or number of iterations equals to 4 times.
- (Number of iterations = $\Delta X - 1 = 5 - 1 = 4$)

Bresenham's Line Algorithm – Practice Problems

- Step-03 is executed until the end point is reached or number of iterations equals to 4 times.
 - (Number of iterations = $\Delta X - 1 = 5 - 1 = 4$)

| P_k | P_{k+1} | X_{k+1} | Y_{k+1} |
|-------|-----------|-----------|-----------|
| | | 9 | 18 |
| 3 | 1 | 10 | 19 |
| 1 | -1 | 11 | 20 |
| -1 | 7 | 12 | 20 |
| 7 | 5 | 13 | 21 |
| 5 | 3 | 14 | 22 |



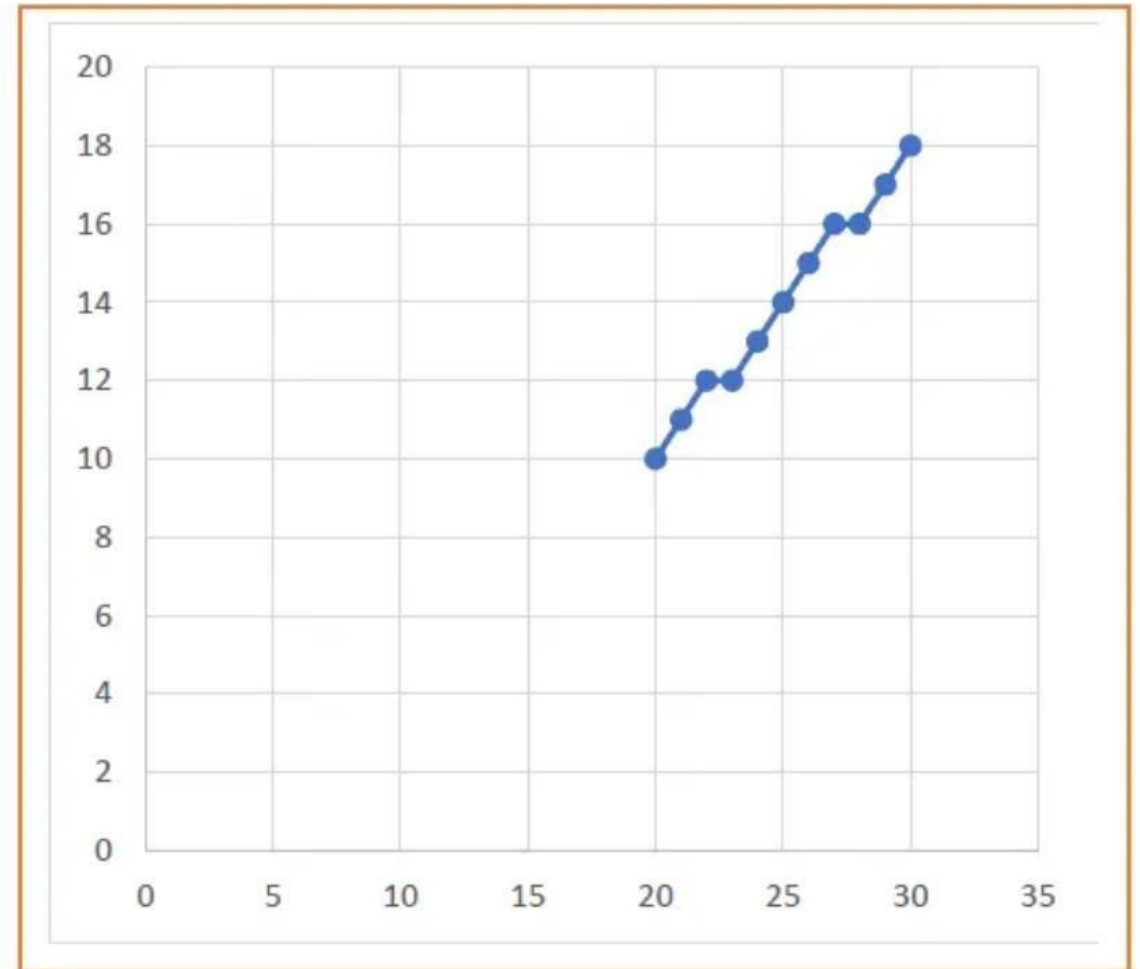
Bresenham's Line Algorithm – Practice Problems

Problem-02: Calculate the points between the (20, 10) and (30, 18).

Bresenham's Line Algorithm – Practice Problems

Problem-02: Calculate the points between the (20, 10) and (30, 18).

| P_k | P_{k+1} | X_{k+1} | Y_{k+1} |
|-------|-----------|-----------|-----------|
| | | 20 | 10 |
| 6 | 2 | 21 | 11 |
| 2 | -2 | 22 | 12 |
| -2 | 14 | 23 | 12 |
| 14 | 10 | 24 | 13 |
| 10 | 6 | 25 | 14 |
| 6 | 2 | 26 | 15 |
| 2 | -2 | 27 | 16 |
| -2 | 14 | 28 | 16 |
| 14 | 10 | 29 | 17 |
| 10 | 6 | 30 | 18 |



Bresenham's Line Algorithm – Self Study

Task: Find the equations for different slopes and practice at least one problem from each types.

THANK YOU