

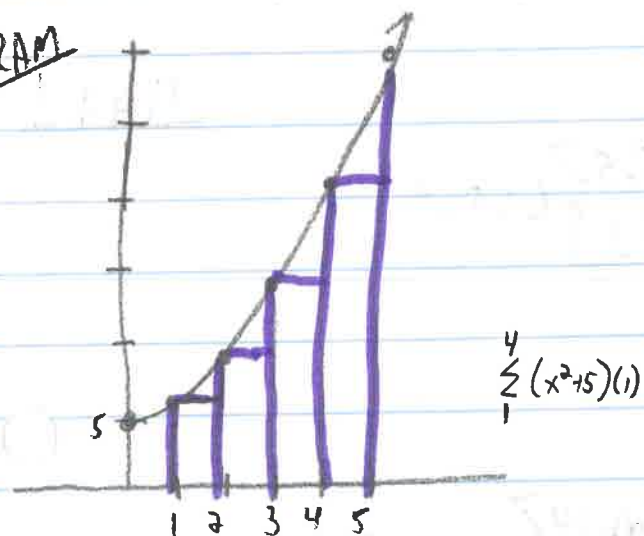
6.6) Area Under the Curve - Example 1

Given: $y = x^2 + 5$ $[1, 5]$ using 4 rectangles. Find LRAM/RRAM/MRAM

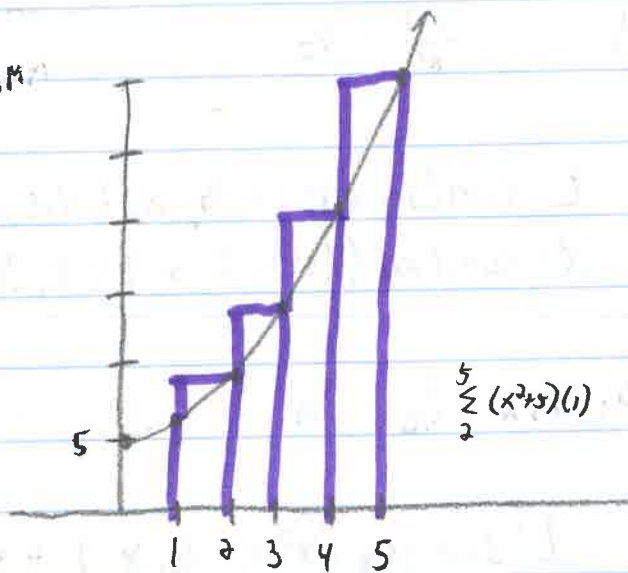
x	1	2	3	4	5
f(x)	6	9	14	21	30

$$\Delta x = \frac{5-1}{4} = 1 \rightarrow \sum_1^5 (x^2+5) \Delta x_i$$

LRAM



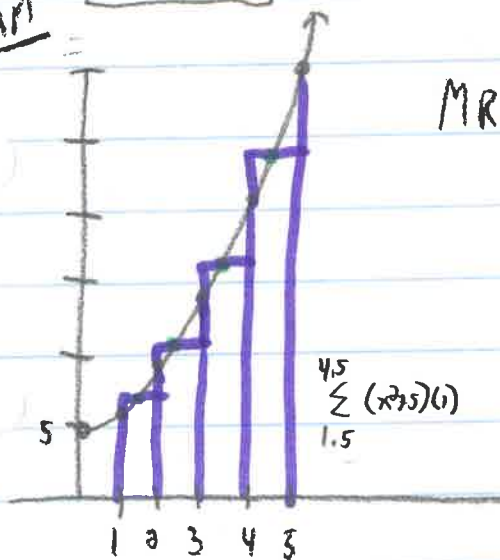
RRAM



$$\begin{aligned} \text{LRAM} &= (1) \cdot f(1) + (1) \cdot f(2) + (1) \cdot f(3) + (1) \cdot f(4) \\ &= (1) \cdot 6 + (1) \cdot 9 + (1) \cdot 14 + (1) \cdot 21 \\ &= 6 + 9 + 14 + 21 \\ &= 50 \text{ u}^2 \end{aligned}$$

$$\begin{aligned} \text{RRAM} &= (1) \cdot f(2) + (1) \cdot f(3) + (1) \cdot f(4) + (1) \cdot f(5) \\ &= (1) \cdot 9 + (1) \cdot 14 + (1) \cdot 21 + (1) \cdot 30 \\ &= 9 + 14 + 21 + 30 \\ &= 74 \text{ u}^2 \end{aligned}$$

MRAM



$$\begin{aligned} \text{MRAM} &= (1) \cdot f(1.5) + (1) \cdot f(2.5) + (1) \cdot f(3.5) + (1) \cdot f(4.5) \\ &= (1) \cdot (7.25) + (1) \cdot (11.25) + (1) \cdot (17.25) + (1) \cdot (25.25) \\ &= 7.25 + 11.25 + 17.25 + 25.25 \\ &= 61 \text{ u}^2 \end{aligned}$$

* Avg of LRAM & RRAM is TRAM

$$\frac{50 + 74}{2} = 62 \text{ u}^2$$

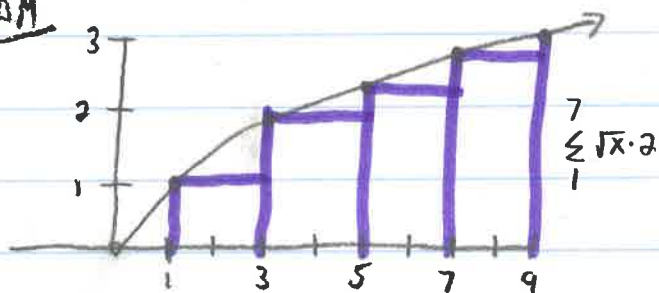
6.6) Area Under the Curve - Example 2

Given: $y = \sqrt{x}$ $[1, 9]$ $n=4$. Find LRAM/RRAM/MRAM

X	1	3	5	7	9
f(x)	1	$\sqrt{3}$	$\sqrt{5}$	$\sqrt{7}$	3

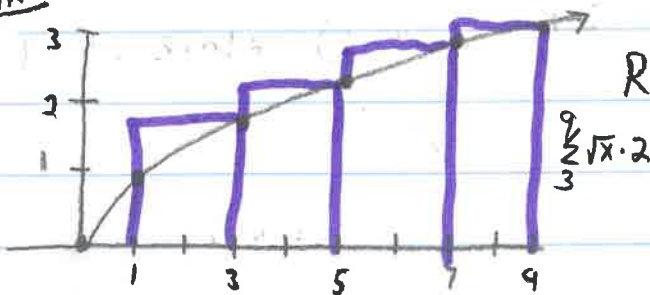
$$\Delta x = \frac{9-1}{4} = 2 \Rightarrow \sum_{i=1}^4 \sqrt{x} \cdot \Delta x$$

LRAM



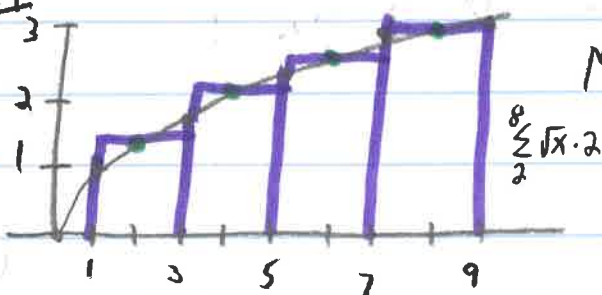
$$\begin{aligned} \text{LRAM} &= 2 \cdot f(1) + 2 \cdot f(3) + 2 \cdot f(5) + 2 \cdot f(7) \\ &= 2 (f(1) + f(3) + f(5) + f(7)) \\ &= 2 (1 + \sqrt{3} + \sqrt{5} + \sqrt{7}) \\ &= 15.228 \text{ u}^2 \end{aligned}$$

RRAM



$$\begin{aligned} \text{RRAM} &= 2 \cdot f(3) + 2 \cdot f(5) + 2 \cdot f(7) + 2 \cdot f(9) \\ &= 2 (f(3) + f(5) + f(7) + f(9)) \\ &= 2 (\sqrt{3} + \sqrt{5} + \sqrt{7} + 3) \\ &= 19.228 \text{ u}^2 \end{aligned}$$

MRAM



$$\begin{aligned} \text{MRAM} &= 2 \cdot f(2) + 2 \cdot f(4) + 2 \cdot f(6) + 2 \cdot f(8) \\ &= 2 (f(2) + f(4) + f(6) + f(8)) \\ &= 2 (\sqrt{2} + 2 + \sqrt{6} + \sqrt{8}) \\ &= 17.384 \text{ u}^2 \end{aligned}$$

$$\text{TRAM} = \frac{\text{LRAM} + \text{RRAM}}{2}$$

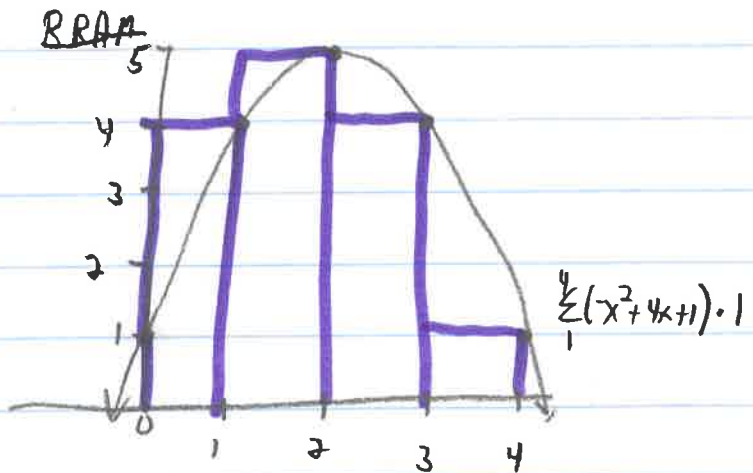
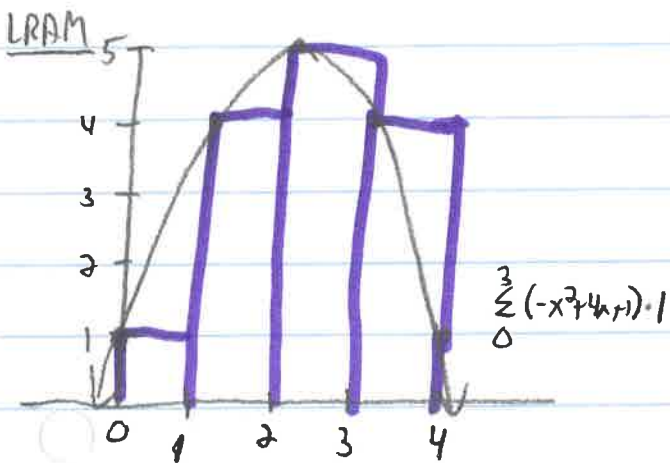
$$= \frac{15.228 + 19.228}{2} = 17.228 \text{ u}^2$$

6.6) Area Under the Curve - Example 3

Given: $y = -x^2 + 4x + 1$ $[0, 4]$ $n=4$ Find LRAM/RRAM/MRAM

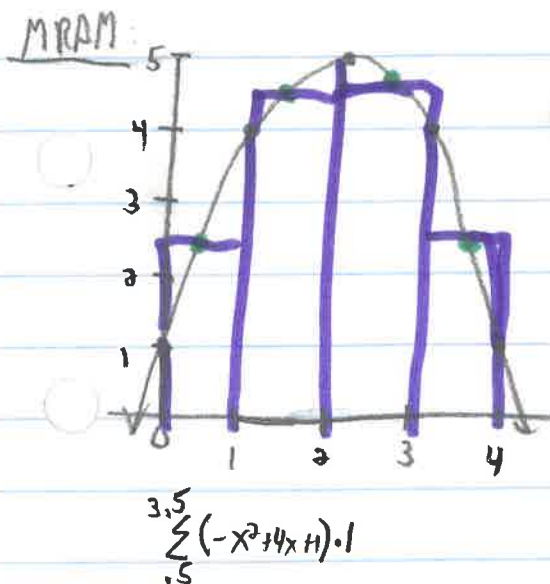
x	0	1	2	3	4
f(x)	1	4	5	4	1

$$\Delta x = \frac{4-0}{4} = 1 \Rightarrow \int_0^4 (-x^2 + 4x + 1) dx \quad (1)$$



$$\begin{aligned} \text{LRAM} &= (1) \cdot f(0) + (1) \cdot f(1) + (1) \cdot f(2) + (1) \cdot f(3) \\ &= (1) \cdot (f(0) + f(1) + f(2) + f(3)) \\ &= (1) \cdot (1 + 4 + 5 + 4) \\ &= \boxed{14 \text{ u}^2} \end{aligned}$$

$$\begin{aligned} \text{RRAM} &= (1) \cdot f(1) + (1) \cdot f(2) + (1) \cdot f(3) + (1) \cdot f(4) \\ &= (1) (f(1) + f(2) + f(3) + f(4)) \\ &= (1) (4 + 5 + 4 + 1) \\ &= \boxed{14 \text{ u}^2} \end{aligned}$$



$$\begin{aligned} \text{MRAM} &= (1) \cdot f(0.5) + (1) \cdot f(1.5) + (1) \cdot f(2.5) + (1) \cdot f(3.5) \\ &= (1) (f(0.5) + f(1.5) + f(2.5) + f(3.5)) \\ &= (1) (2.75 + 4.75 + 4.75 + 2.75) \\ &= \boxed{15 \text{ u}^2} \end{aligned}$$

TRAP = 14 u²

$n=4$ $\sum (seg(FN \cdot \Delta x, x, start, end, \Delta x))$
 $y = x^2 + 5$ $[1, 5]$ $\Delta x = \frac{5-1}{4} = 1$

L: $\sum (seg((x^2+5) \cdot 1, x, 1, 4, 1)) = 50$
 R: $\sum (seg((x^2+5) \cdot 1, x, 2, 5, 1)) = 74$ } 62.5

$n=8$ $\Delta x = \frac{5-1}{8} = 1/2$

L: $\sum (seg((x^2+5) \cdot 1/2, x, 1, 4.5, 1/2)) = 55.5$
 R: $\sum (seg((x^2+5) \cdot 1/2, x, 1.5, 5, 1/2)) = 67.5$ } 61.5

$n=40$ $\Delta x = \frac{5-1}{40} = 1/10$

L: $\sum (seg((x^2+5) \cdot 1/10, x, 1, 4.9, 1/10)) = 60.14$
 R: $\sum (seg((x^2+5) \cdot 1/10, x, 1.1, 5, 1/10)) = 62.54$ } 61.34