Arbitrage


Bitcoin Charts
Linear Scale
Log Scale
Zoom
1d
7d
1m
3m
1y
YTD
ALL
From
Apr 27, 2017
To
Sep 18, 2019
Market Cap
$320B
$240B
$160B
$80B
$0
24h Vol
24B
0
May '17
Jul '17
Sep '17
Nov '17
Jan '18
Mar '18
May '18
Jul '18
Sep '18
Nov '18
Jan '19
Mar '19
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Arbitrage

Input: array of n numbers

12	15	12	24	6	9	23	32	33	13	44	15	46	12	33	1	5	17	18	2

Goal: to find index i,j, s.t., i<j which Mazimize A[j]-A[i]

θ(nlogn)

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12	15	12	24	6	9	23	32	33	13	44	15	46	12	33	1	5	17	18	2

12	15	12	24	6	9	23	32	33	13

44	15	46	12	33	1	5	17	18	2

Arbit(A[1……n])

Base case if |A|<=2: return

LG=arbit(left(A))

RG=arbit(right(A))

Minlg=min(left(A))

Maxrg=max(right(A))

Return max{Maxrg-Minlg, LG,RG)}

Example base case:

12	15

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Goal: to find index i,j, s.t., i<j which Mazimize A[j]-A[i]

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Return max{Maxrg-Minlg, LG,RG)}

$T(n)=2T(n/2)+\theta(n)= \theta(n\log n)$

Better approach?

Arbitrage

Input: array of n numbers

Goal: to find index i,j, s.t., i<j which Mazimize A[j]-A[i]

12	15	12	24	6	9	23	32	33	13	44	15	46	12	33	1	5	17	18	2

12	15	12	24	6	9	23	32	33	13

44	15	46	12	33	1	5	17	18	2

Arbit(A[1……n])

Base case if |A|<=2: return

LG=arbit(left(A)) $T(n/2)$

RG=arbit(right(A)) $T(n/2)$

Minlg=min(left(A)) $\Theta(n)$

Maxrg=max(right(A)) $\Theta(n)$

Return max{Maxrg-Minlg, LG,RG)}

$T(n)=2T(n/2)+\theta(n)=\theta(n\log n)$

Big idea?

We can pass information about min/max trough the return values!

Arbitrage

Input: array of n numbers

Goal: to find index i,j, s.t., i<j which Mazimize A[j]-A[i]

Arbit(A[1……n])

Base case if |A|<=2: return

LG, MinL, MaxL=arbit(left(A))

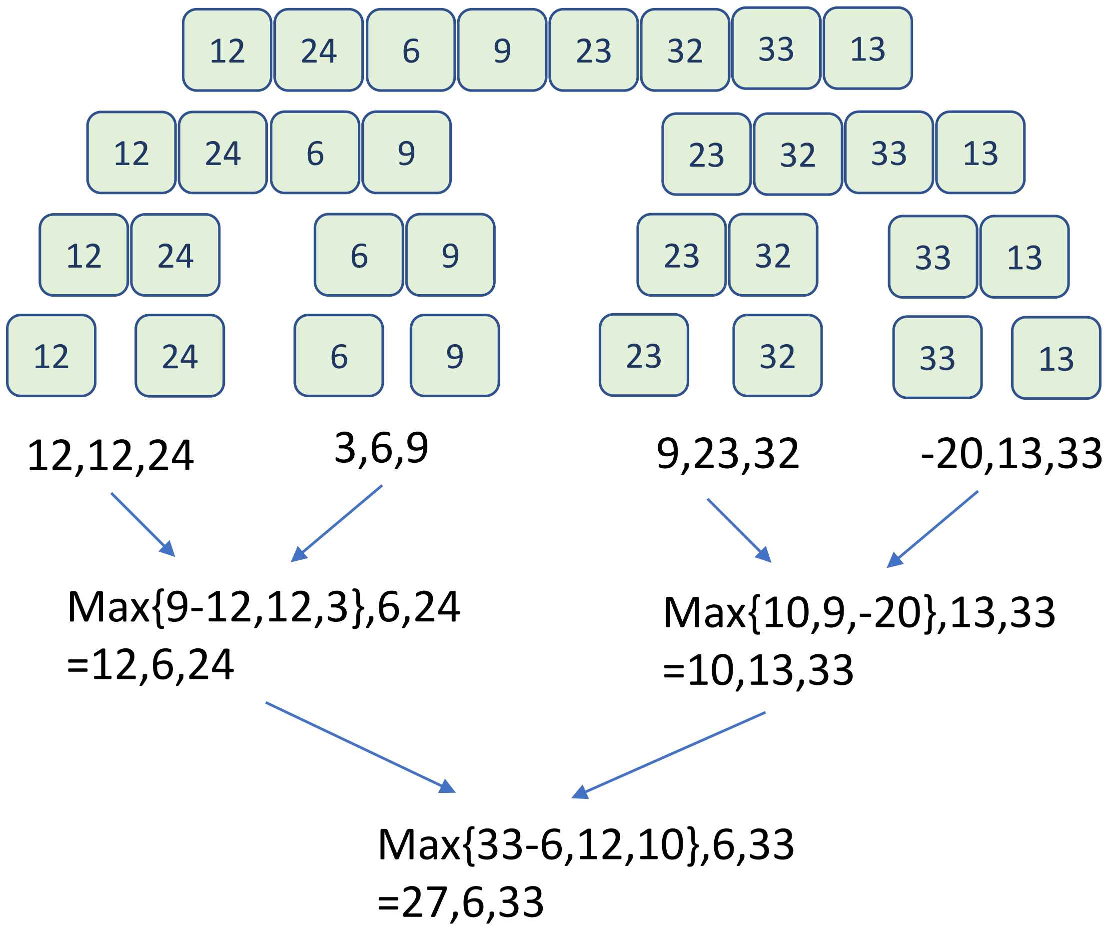
RG, MinR, MaxR=arbit(right(A))

Return max{MaxR-MinL, LG,RG),

min{MinL,MinR},

max{MaxL,MaxR}}

T(n)=2T(n/2)+θ(1)= θ(n)



$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \times \begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$$

$$\begin{bmatrix} 5 + 14 & 6 + 16 \\ 15 + 28 & 18 + 32 \end{bmatrix} = \begin{bmatrix} 19 & 22 \\ 43 & 50 \end{bmatrix}$$

$$\begin{bmatrix} a_{1,1} & a_{1,2} & a_{1,3} & \cdots & a_{1,n} \\ & \vdots & & \ddots & \vdots \\ a_{\frac{n}{2},1} & a_{\frac{n}{2},2} & a_{\frac{n}{2},3} & \cdots & a_{\frac{n}{2},n} \\ & & \vdots & & \\ a_{n,1} & a_{n,2} & a_{n,3} & \cdots\cdots\cdots \quad \cdots\cdots & a_{n,n} \end{bmatrix} \times \begin{bmatrix} b_{1,1} & b_{1,2} & b_{1,3} & \cdots & b_{1,n} \\ & \vdots & & \ddots & \vdots \\ b_{\frac{n}{2},1} & b_{\frac{n}{2},2} & b_{\frac{n}{2},3} & \cdots & b_{\frac{n}{2},n} \\ & & \vdots & & \\ b_{n,1} & b_{n,2} & b_{n,3} & \cdots\cdots\cdots \quad \cdots\cdots & b_{n,n} \end{bmatrix} = \begin{bmatrix} c_{1,1} & c_{1,2} & c_{1,3} & \cdots & c_{1,n} \\ & \vdots & & \ddots & \vdots \\ c_{\frac{n}{2},1} & c_{\frac{n}{2},2} & c_{\frac{n}{2},3} & \cdots & c_{\frac{n}{2},n} \\ & & \vdots & & \\ c_{n,1} & c_{n,2} & c_{n,3} & \cdots\cdots\cdots \quad \cdots\cdots & c_{n,n} \end{bmatrix}$$

Matrix has n×m terms, or n^2 terms

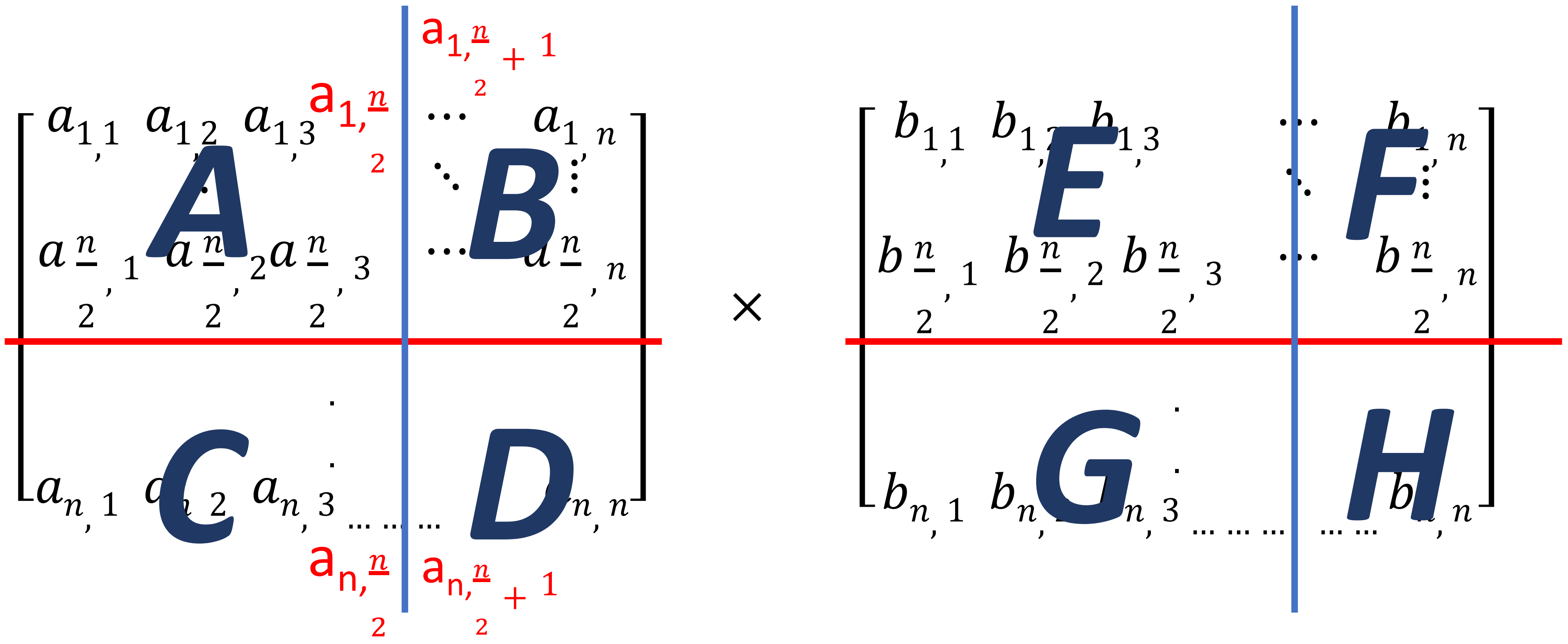
$\Theta(n^2)$

$$C_{i,j} = \sum_{k=1}^{n} a_{i,k} \times b_{k,j}$$

$\Theta(n)$

$$\begin{bmatrix} a_{1,1} & a_{1,2} & a_{1,3} & \cdots & a_{1,n} \\ & \vdots & & \ddots & \vdots \\ a_{\frac{n}{2},1} & a_{\frac{n}{2},2} & a_{\frac{n}{2},3} & \cdots & a_{\frac{n}{2},n} \\ & & \vdots & & \\ a_{n,1} & a_{n,2} & a_{n,3} & \dots\dots\dots \quad \dots\dots & a_{n,n} \end{bmatrix} \times \begin{bmatrix} b_{1,1} & b_{1,2} & b_{1,3} & \cdots & b_{1,n} \\ & \vdots & & \ddots & \vdots \\ b_{\frac{n}{2},1} & b_{\frac{n}{2},2} & b_{\frac{n}{2},3} & \cdots & b_{\frac{n}{2},n} \\ & & \vdots & & \\ b_{n,1} & b_{n,2} & b_{n,3} & \dots\dots\dots \quad \dots\dots & b_{n,n} \end{bmatrix} = \begin{bmatrix} c_{1,1} & c_{1,2} & c_{1,3} & \cdots & c_{1,n} \\ & \vdots & & \ddots & \vdots \\ c_{\frac{n}{2},1} & c_{\frac{n}{2},2} & c_{\frac{n}{2},3} & \cdots & c_{\frac{n}{2},n} \\ & & \vdots & & \\ c_{n,1} & c_{n,2} & c_{n,3} & \dots\dots\dots \quad \dots\dots & c_{n,n} \end{bmatrix}$$

Divide each matrix into 4 matrices that are $\frac{n}{2} \times \frac{n}{2}\ in\ size$



Divide each matrix into 4 matrices that are $\frac{n}{2} \times \frac{n}{2}$ *in size*

Where each of these us an $\frac{n}{2} \times \frac{n}{2}$ matrix

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix} \times \begin{bmatrix} E & F \\ G & H \end{bmatrix} \qquad \begin{bmatrix} A.E + B.G & A.F + B.H \\ C.E + D.G & C.F + D.H \end{bmatrix}$$

$$T(n)=8T(\frac{n}{2}) + 4(\frac{n}{2})^2$$