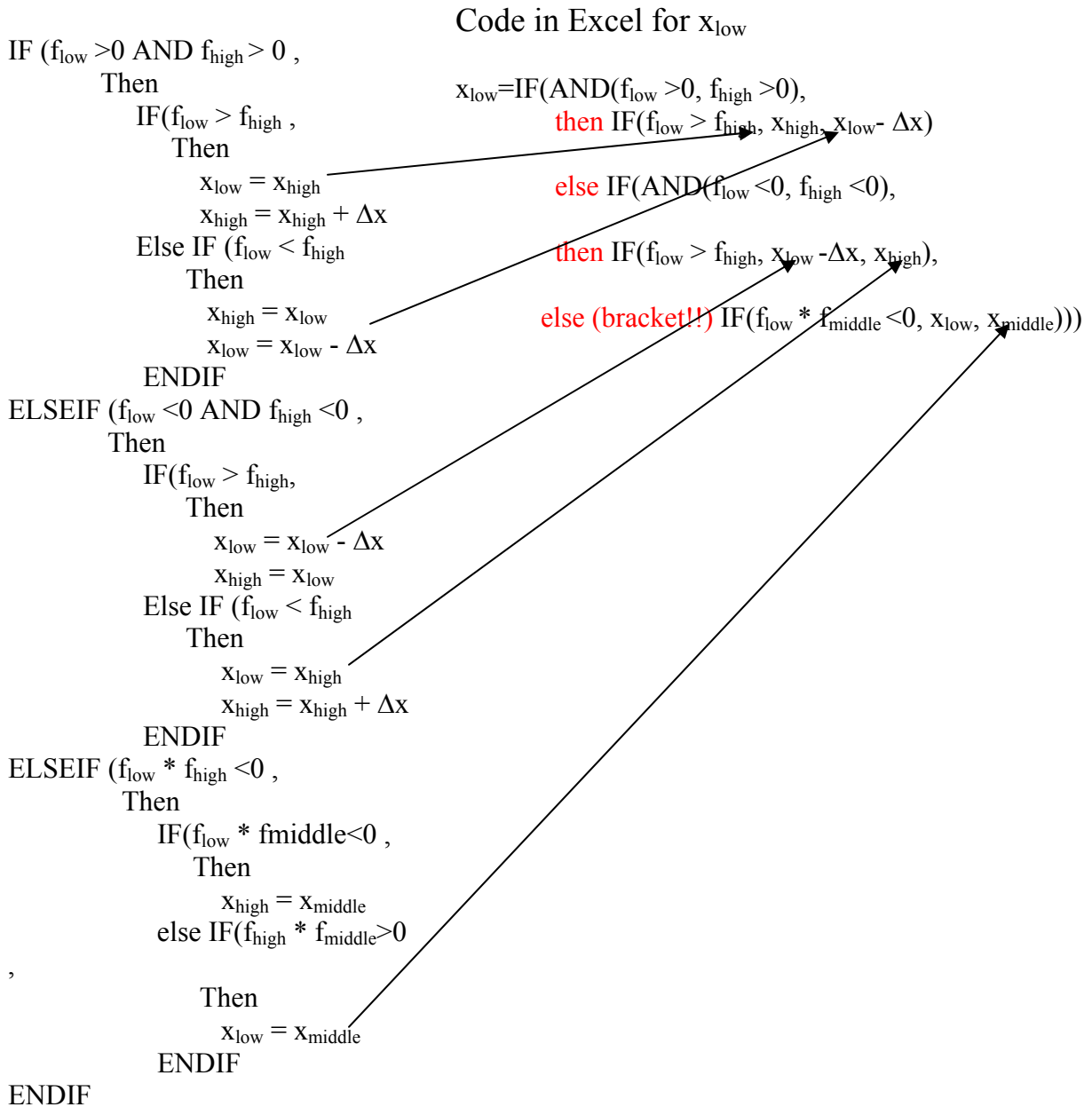


# Algorithm for obtaining first bracket



## Code in Excel for $x_{high}$

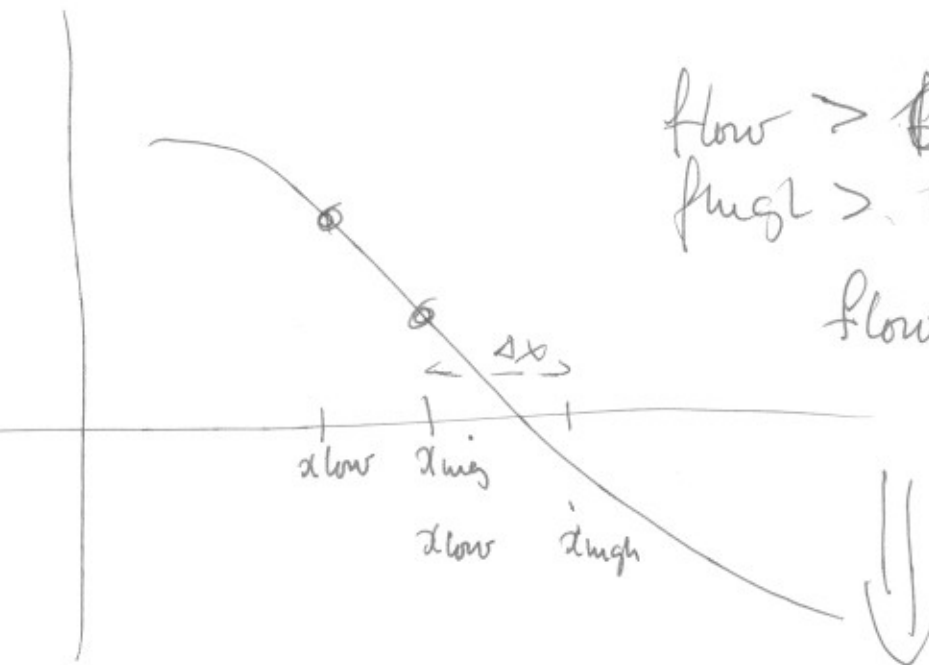
```

IF (flow > 0 AND fhigh > 0 ,
  Then
    IF(flow > fhigh ,
      Then
        xlow = xhigh
        xhigh = xhigh + Δx
      Else IF (flow < fhigh
        Then
          xhigh = xlow
          xlow = xlow - Δx
        ENDIF
      ELSEIF (flow < 0 AND fhigh < 0 ,
        Then
          IF(flow > fhigh,
            Then
              xlow = xlow - Δx
              xhigh = xlow
            Else IF (flow < fhigh
              Then
                xlow = xhigh
                xhigh = xhigh + Δx
              ENDIF
            ELSEIF (flow * fhigh < 0 ,
              Then
                IF(flow * fmiddle < 0 ,
                  Then
                    xhigh = xmiddle
                  else IF(fhigh * fmiddle > 0 ,
                    Then
                      xlow = xmiddle
                    ENDIF
                ENDIF
              ENDIF
            ENDIF
          )
        ENDIF
      )
    )
  )

```

$x_{high} = \text{IF}(\text{AND}(f_{low} > 0, f_{high} > 0),$   
then  $\text{IF}(f_{low} > f_{high}, x_{high} + \Delta x, x_{low}),$   
else  $\text{IF}(\text{AND}(f_{low} < 0, f_{high} < 0),$   
then  $\text{IF}(f_{low} > f_{high}, x_{low}, x_{high} + \Delta x),$   
else (bracket!!)  $\text{IF}(f_{low} * f_{middle} < 0, x_{middle}, x_{high}))$

1



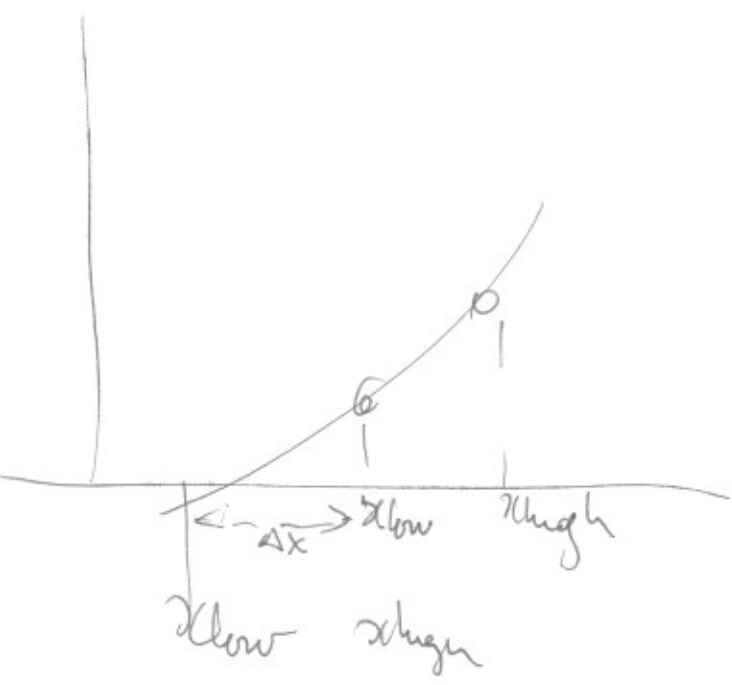
flow > 0  
flux > 0

flow > flux

$$x_{low} = x_{high}$$

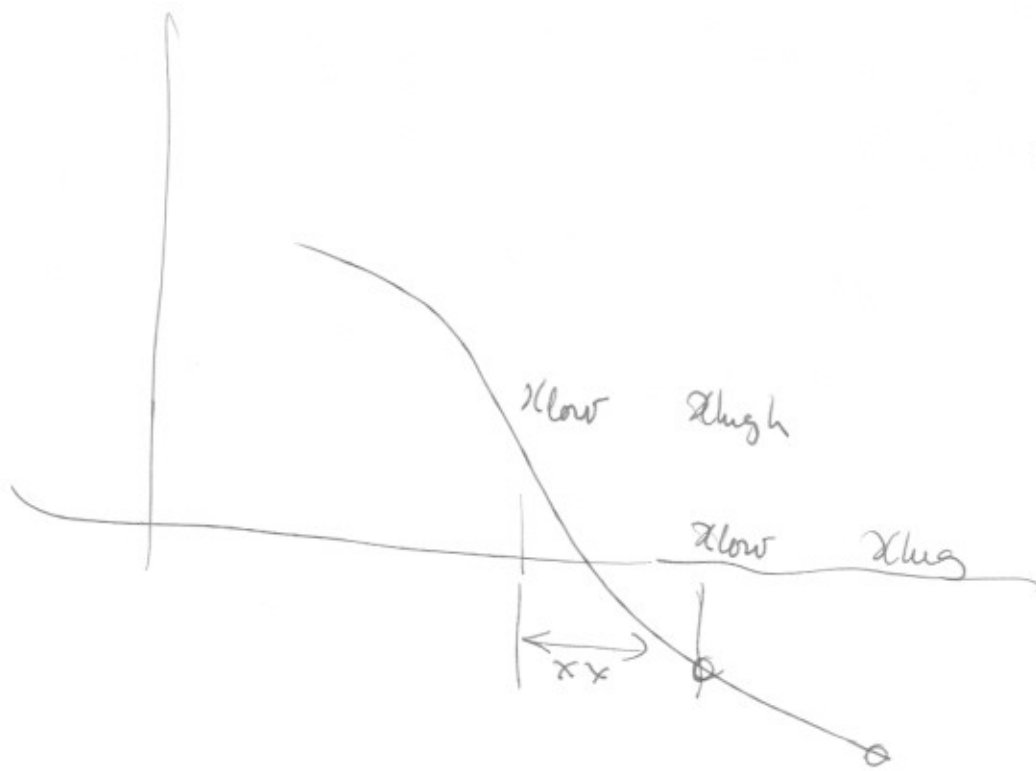
$$x_{high} = x_{high} + \Delta x$$

flow < flux



$$x_{low} = x_{low} - \Delta x$$

$$x_{high} = x_{low}$$



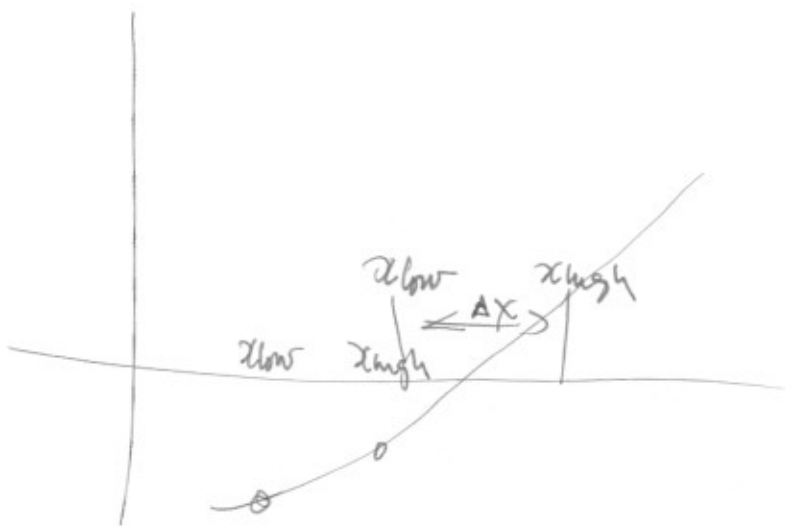
flow < 0  
 $f_{high} < 0$   
 $f_{low} > f_{high}$



$$x_{low} = x_{low} - \Delta x$$

$$x_{high} = x_{low}$$

flow <  $f_{high}$



$$x_{low} = x_{high}$$

$$x_{high} = x_{high} + \Delta x$$