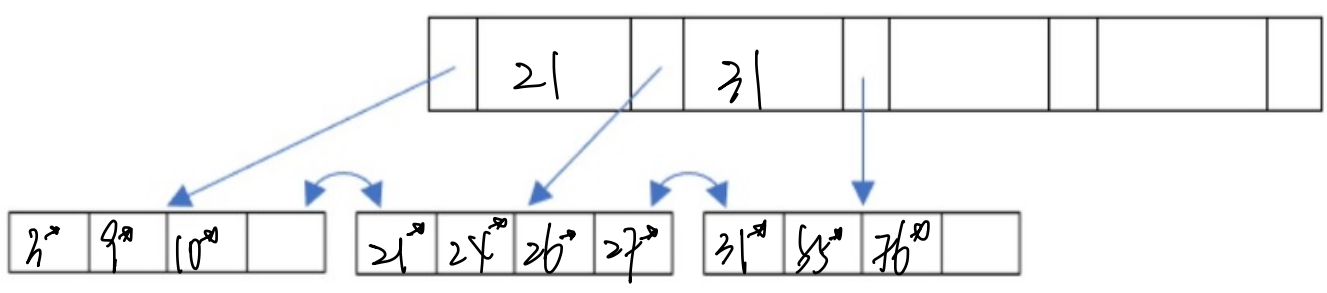
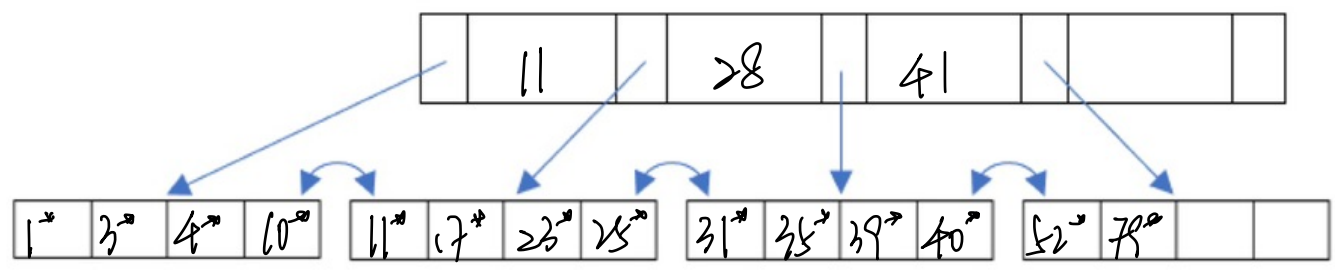


Question 1.

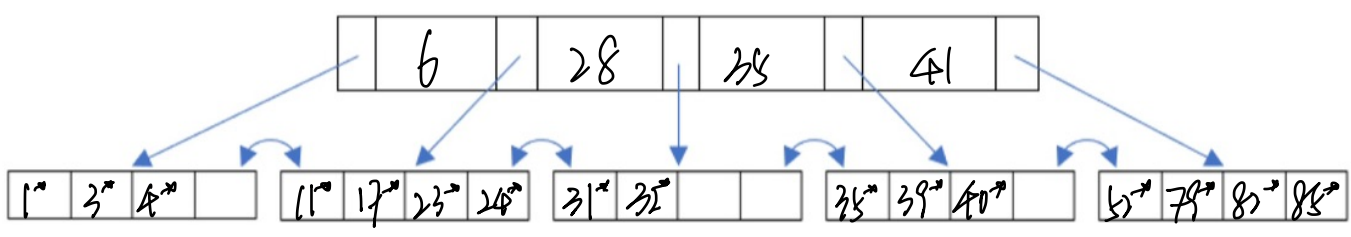
1.1



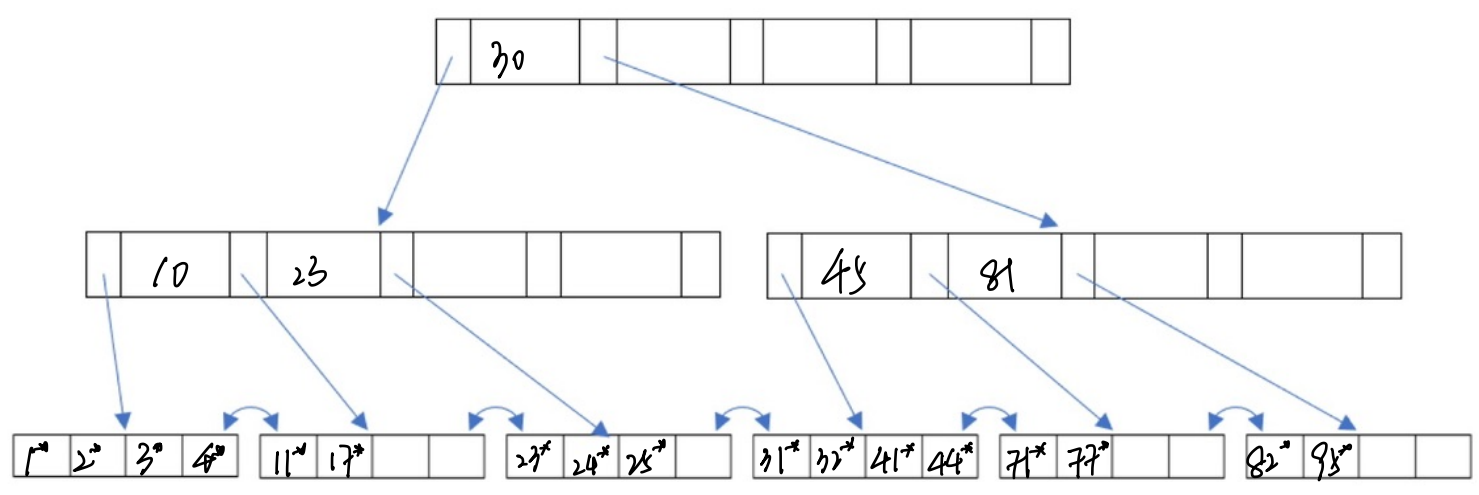
1.2



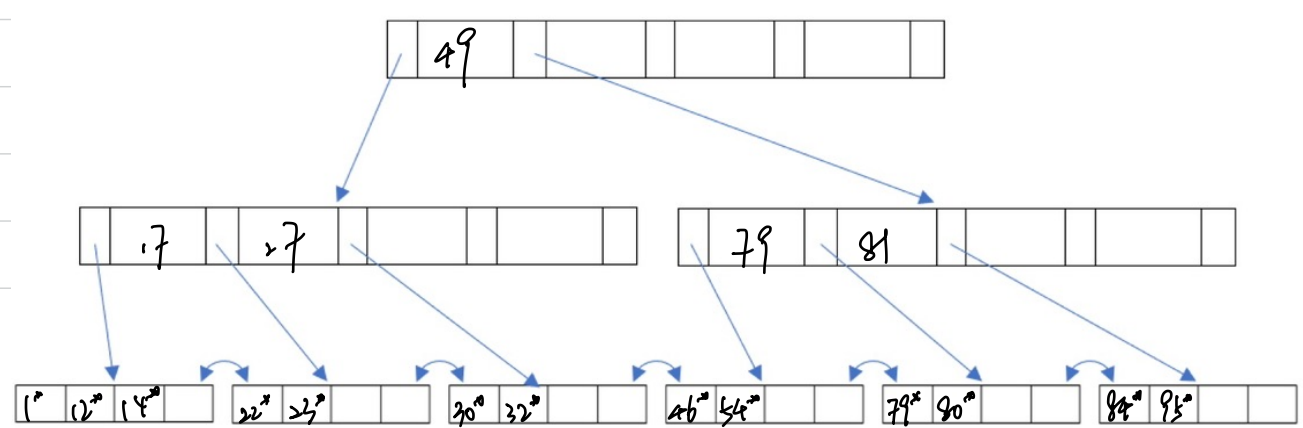
1.3



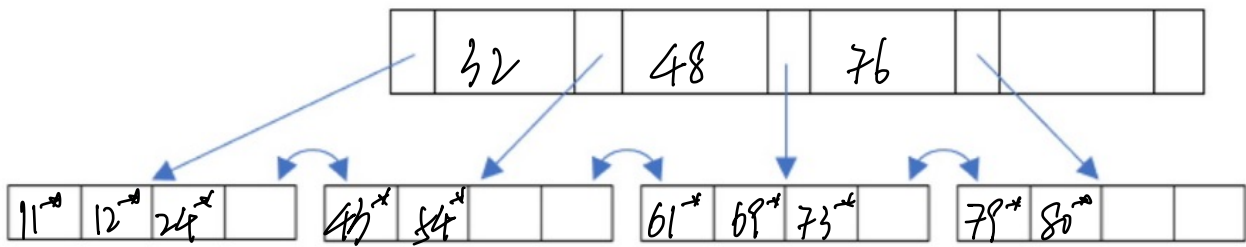
1.4



1.5

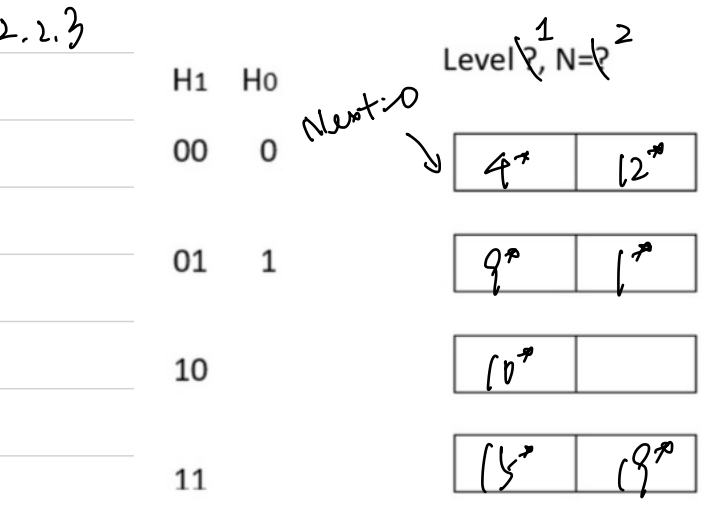
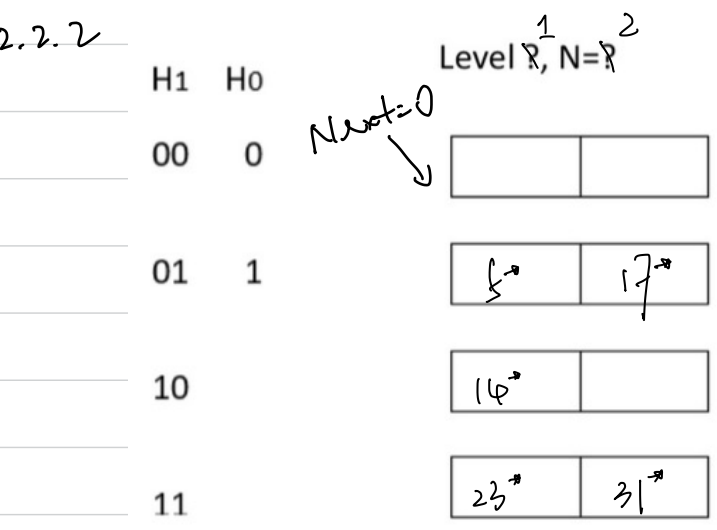
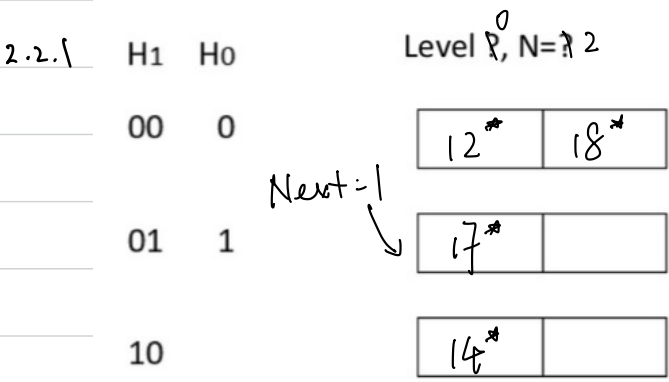


1.6



Question 2.

2.1 We need 3 insertions (2, 4, 8)



			Level $\begin{matrix} 1 & 2 \\ N & N \end{matrix}$				
H1	H0						
2.2.4	00	0	Next \rightarrow <table><tr><td>8th</td><td>20th</td></tr></table>	8 th	20 th		
8 th	20 th						
	01	1	<table><tr><td>13th</td><td></td></tr></table>	13 th			
13 th							
	10		<table><tr><td>18th</td><td>10th</td></tr></table> \rightarrow <table><tr><td>14th</td><td></td></tr></table>	18 th	10 th	14 th	
18 th	10 th						
14 th							
	11		<table><tr><td>35th</td><td></td></tr></table>	35 th			
35 th							

			Level $\begin{smallmatrix} 1 & 2 \\ N & N \end{smallmatrix}$		
2.2.5	H ₂	H ₀			
	000	00	<table><tr><td>24th</td><td></td></tr></table>	24 th	
24 th					
	001	01	<table><tr><td>9th</td><td>17th</td></tr></table>	9 th	17 th
9 th	17 th				
	010	10	Next=2 \rightarrow <table><tr><td>10th</td><td>18th</td></tr></table>	10 th	18 th
10 th	18 th				
	011	11	<table><tr><td>19th</td><td>11th</td></tr></table>	19 th	11 th
19 th	11 th				
	100		<table><tr><td>12th</td><td>20th</td></tr></table>	12 th	20 th
12 th	20 th				
	101		<table><tr><td>21th</td><td></td></tr></table>	21 th	
21 th					

3.1 $1MB/16KB = 64$ pages

For 484 GB database: $484 \times 2^{20} / 16KB$ pages # passes = $1 + \lceil \log_{B-1} 484 \times 2^{20} \rceil = 5$

For 376 GB database: $376 \times 2^{20} / 16KB$ pages # passes = $1 + \lceil \log_{B-1} 376 \times 2^{20} \rceil = 5$

3.2 For 484 GB database: $2N \times (\# \text{ passes}) = 4840 GB$.

For 376 GB database: $2N \times (\# \text{ passes}) = 3760 GB$.

Total = $4840 + 3760 = 8600 GB$

3.3 # passes = $1 + \lceil \log_{B-1} \lceil \frac{N}{B} \rceil \rceil$.

$$\lceil \log_{B-1} \lceil \frac{484 \times 10^9 / 16}{B} \rceil \rceil \leq 3 \quad \lceil \log_{B-1} \lceil \frac{376 \times 10^9 / 16}{B} \rceil \rceil \leq 3$$

$$B \times (B-1)^3 \geq 31719424$$

$$\Rightarrow B \geq 76 \quad RAM_{min} = 76 \times 16KB = 1.1875 MB$$

3.4 $B=64$ pages

$$1 + \lceil \log_{63} \lceil \frac{N}{64} \rceil \rceil \leq 3$$

$$N \leq 63^2 \times 64 = 254016$$

$$\text{pages} = \frac{254016 \times 16}{1024^2} = 3.876 \text{ GiB} \Rightarrow 3 \text{ GiB (round down)}$$