Computational Foundations for ML

10-607

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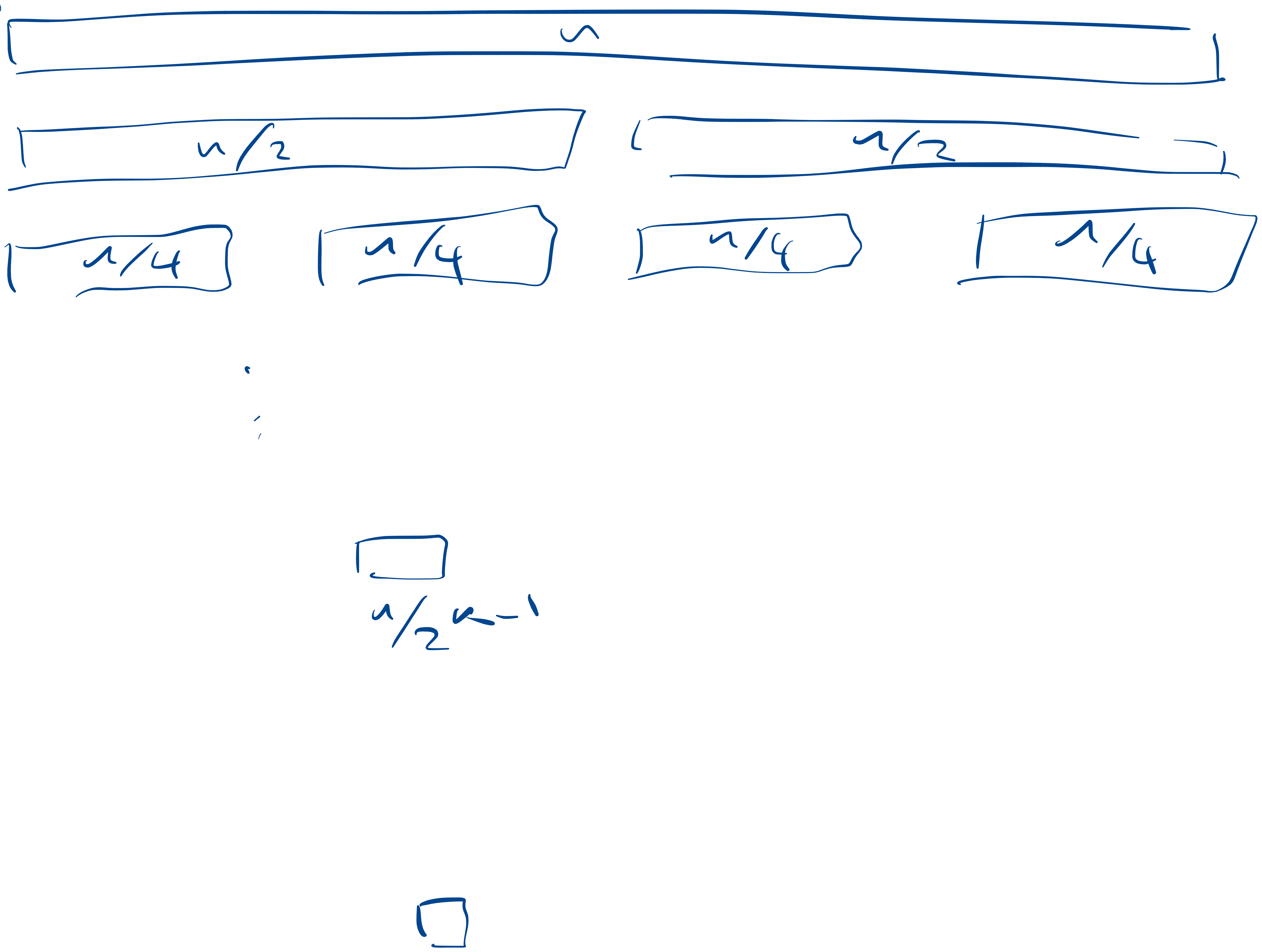
$O(n)$ work

$O(n)$ work

$\log_2 n$ levels



$n/2^{k-1}$

$n/2^{\log n} = 1$

level 1

2

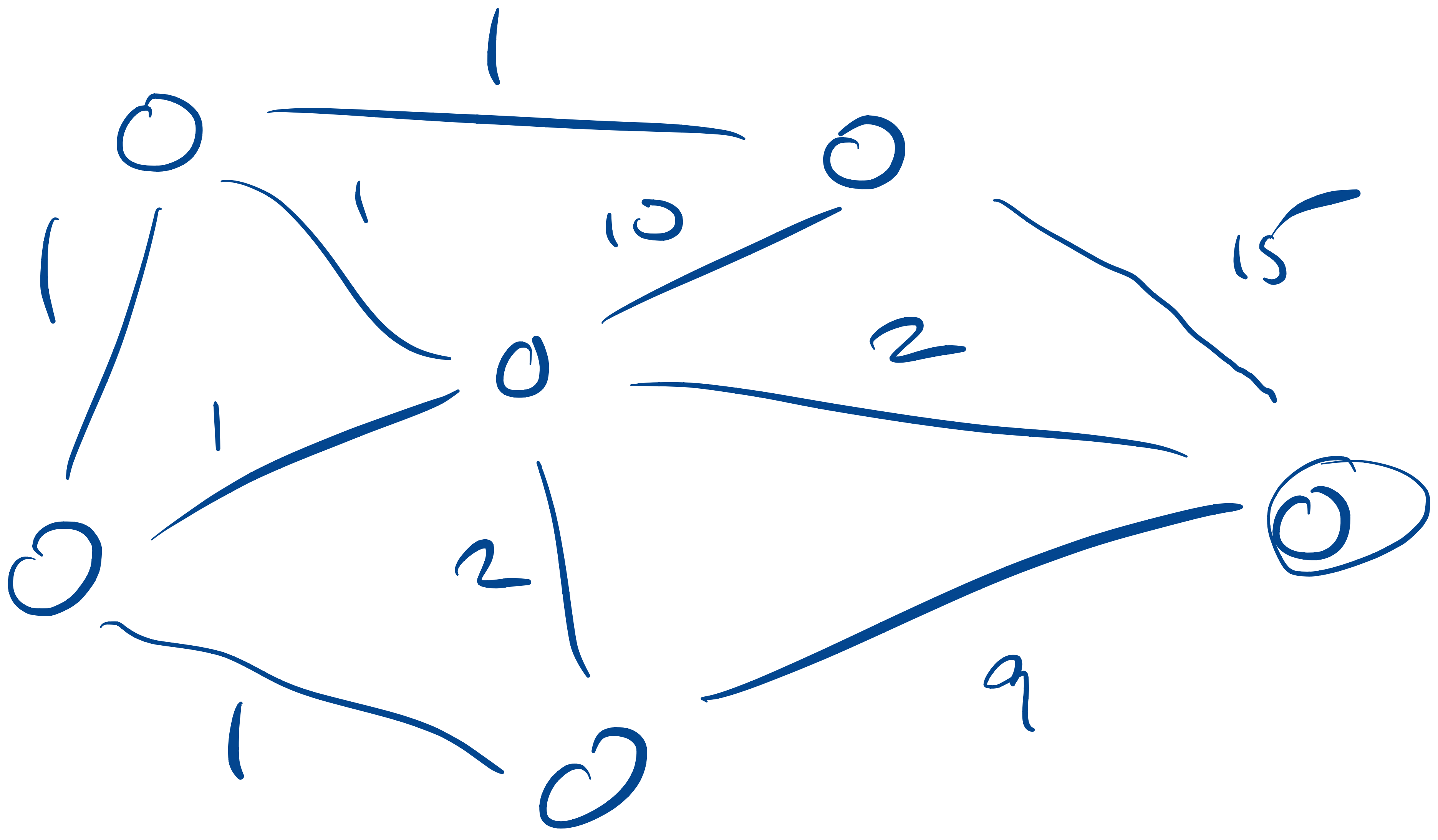
3

⋮

level k

level $\log_2 n + 1$

$n/2^{(\log_2 n + 1) - 1}$



$c(j)$ = cost of shortest path to goal from node j

$c(j,k)$ = " " " " of k or fewer edges

$$c(j,k) = \min_{(i,j)\in E} \left(c_{ij} + c(i,k-1) \right)$$

init: $C(\text{goal}, 0) = 0$ $\quad C(j, 0) = \infty \quad j \neq \text{goal}$

for $n = 1, \ldots, |V| - 1$ $\leftarrow$ $O(|V|)$ iterations

for $j \in$ nodes $\leftarrow$ $O(|V|)$ iterations

for i s.t. $(i, j) \in E$ — $O(|E|)$ iters

minimize $C(i, n-1) + c_{ij}$

store in $C(j, n)$

for $n = 1, \ldots, |V| - 1$ — $O(|V|)$ iters

$*$ init $C(j, n) \leftarrow \infty$ for all j — $O(|V|)$ cost

for $(i, j) \in E$ — $O(|E|)$ iters

$C(j, n) \longleftarrow \min\ C(j, n),\ c_{ij} + C(i, n-1)$ $\quad O(1)$ cost

$O(|V|^2 + |V||E|)$

$\times$ for $j \in V$

$c(j, n) \leftarrow \infty$

$O(n^2 \log n)$

for $i = 1 \dots n$

sort a list of length i — $O(i \log i)$ bounded by $O(n \log n)$

for $j = 1 \dots m$

add two numbers — $O(1)$

$O(nm)$

$O(n^2 \log n + nm)$

1.	a	assumption
2.	$a \vee b$	$\vee$- intro, 1
3.	$a \vee c$	$\vee$-intro, 1
4.	$(a \vee b) \wedge (a \vee c)$	$\wedge$- intro, 2, 3
5.	$a \rightarrow (a \vee b) \wedge (a \vee c)$	
~~6.~~	$\cancel{a \vee b \vee c}$	~~$\vee$-intro, 2~~