

$d(i)$ and define $H_{ij} = \begin{cases} 1 & \text{if } j \neq i \text{ and } \rho(i) \cap \rho(j) \neq \emptyset \text{ or with a probability of } p \text{ when } j = i \\ 0 & \text{with a probability of } 1-p \text{ and otherwise} \end{cases}$

For an edge e , let $T(e)$ denote the number of the routes passing e . Let $\rho(i) = (e_1, e_2, \dots, e_k)$, $k \leq n$ and D_i denote the delay times of v_i .

So $E(D_i) \leq E(\sum_{j=1}^N H_{ij}) \leq E(\sum_{l=1}^k T(e_l)) = \sum_{l=1}^k E(T(e_l)) = kE(T(e_1))$.

$E(\sum_{i=1}^N |\rho(i)|) = \sum_{i=1}^N E(|\rho(i)|) = \frac{Nn}{2} = \sum_e T(e) = NnT(e_1)$, so $T(e_1) = \frac{1}{2}$.

So $E(D_i) \leq \frac{k}{2} \leq \frac{n}{2}$, $E(T_i) = E(|\rho(i)|) + E(|D_i|) \leq n$.

$T_i = |\rho(i)| + D_i \leq |\rho(i)| + \sum_{j=1}^N H_{ij}$. Let $X_i = |\rho(i)| + \sum_{j=1}^N H_{ij}$. The $|\rho(i)|$ depends on the bits of $\sigma(i)$ and $d(i)$ and they are independent from bit to bit. For different j , H_{ij} are also independent because for a certain i H_{ij} only depends on $\sigma(j)$ and $d(j)$ and they are independent. For a certain j , H_{ij} can only be chosen from 0, 1, so as a certain bit of $\sigma(i)$. So X_i is subject to poisson distribution, and we can use the Chernoff bound to get: $Pr\{X_i > 7n\} \leq e^{-12n}$.

So $Pr\{T_i > 7n\} \leq e^{-12n}$.

Using the union bound, $Pr\{T > 7n\} \leq \sum_{i=1}^N Pr\{T_i > 7n\} \leq 2^n e^{-12n} \leq 2^{-11n}$.

Similarly, we can get another c and c' pairs.

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