

Advanced Algorithms

COMP4121 Assignment Project Exam Help

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Database Access Problem

- Assume that n pro \mathbb{Z} but to access a database, and that t time is discrete, t \mathbb{Z} but \mathbb{Z} ...
- If at any instant t \bigcirc sses (simultaneously) request access, there is a conflict and all processes are locked out of access.
- We assume that the processes cannot communicate with each other to agree on a Assignment Project Exam Help to decide if it will request access to database on its own, in isolation of other processes.

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- One possible appropriate $\frac{1}{49389476}$ uation is that each process at each instant t tosses a coin which produces outcome "request access" with a probability $\frac{1}{p}$.
- How should we choose p to maximise the probability of a successful access to the database for a process at any instant t?

(More details can be fot<mark>程序代度或数0亿元排貨輸售</mark>orithm Design by Kleinberg and Tardos.)

- Assume that n properties to access a database, and that the time is discrete, $t = 10^{-10}$...
- If at any instant t \blacksquare sees (simultaneously) request access, there is a conflict and all processes are locked out of access.
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- Assume that n properties to access a database, and that the time is discrete, $t = \sum_{n=1}^{\infty} \frac{1}{n} \cdot \frac{1}{n}$.
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- If at any instant t \blacksquare sses (simultaneously) request access, there is a conflict and all processes are locked out of access.
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- One possible approper: 749389476 uation is that each process at each instant t tosses a coin which produces outcome "request access" with a prolhttps://tutorcs.comnot request access" with probability 1-p.
- How should we choose p to maximise the probability of a successful access to the database for a process at any instant \underline{t} ?

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- For a given probability the probability of the success of a process i at any instance $\mathcal{P}(\mathcal{S}(i,t)) = p(1-p)^{n-1}$, because a process i requests at the probability p and the probability that no other process p equested access is $(1-p)^{n-1}$.
- For what value of $\mathcal{P}(\mathcal{S}(i,t))$ have the largest possible value?
- Extremal points are found by solving

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$$\frac{d}{dp}\mathcal{P}(\mathcal{S}(i,t)\mathbf{Email: tutorcs@163.com})(1-p)^{n-2}=0$$

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- For what value of p does P(S(i,t)) have the largest possible value?
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• So for the optimal 1/n the probability of success for a process i at an instance i

$$\mathcal{P}(\mathcal{S}(i,t)) = p(1-p)^{n-1} = \frac{1}{n} \left(1 - \frac{1}{n}\right)^{n-1}$$
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- To establish the as Assignment Project Exam Help) the following two facts are useful: both can be proved by establishing the signs of the relevant first Email: tutorcs@163.com
 - ① $(1-\frac{1}{n})^n$ increases from 2 to ∞ (e=2.718...).
 - e $\left(1-\frac{1}{n}\right)^{n-1}$ decreases monotonically from 1/2 down to 1/e as n increases from 2 to ∞ .

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 - ① $\left(1-\frac{1}{n}\right)^n$ increases menotonically from 1/4 up to 1/e as n increases from 2 to ∞ $(e=2.718\ldots)$.
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• Thus, since we had



$$(1 - \frac{1}{n}) = \frac{1}{n} \left(1 - \frac{1}{n}\right)^{n-1}$$

we obtain

 $\begin{array}{l} \text{WeChat: cstutorcs} \\ \overset{1}{-} : \overset{1}{-} < \mathcal{P}(\mathcal{S}(i,t)) \leq \overset{1}{-} : \overset{1}{-} \\ \text{Assignment Project Exam2Help} \end{array}$

• Thus $\mathcal{P}(\mathcal{S}(i,t)) = \Theta(\frac{\mathbf{Email:}}{\frac{1}{n}})$: tutorcs@163.com

- So after t many insQQ:s749389476ne probability that a particular process has succeeded?

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- It is actually easier to estimate the probability of failure after t instants:

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- It is actually easier to estimate the probability of failure after t instants:

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$$\mathcal{P}(\text{failure afte} \bigcirc \mathbf{ts}) = \left(1 - \frac{1}{n} \left(1 - \frac{1}{n}\right)^{n-1}\right)^{t}$$

• Using the second o in the inequalities we get

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$$\approx \left(1 - \frac{1}{e^n}\right)^t$$
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- We can now observemail tutores@163.comenomenon:
 - If we chose t = e n many consecutive instants (we ignore floors or ceilings necessa QQ: 749389476ties integers) then the probability of a failure is quite large, because

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$$\mathcal{P}$$
 (failure after $t = e n$ instants) $\approx \left(1 - \frac{1}{e n}\right)^{e n} \approx \frac{1}{e}$

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- We can now observe a somewhat strange phenomenon:
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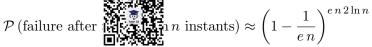
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$$\mathcal{P}$$
 (failure after $t = e n$ instants) $\approx \left(1 - \frac{1}{e n}\right)^{e n} \approx \frac{1}{e}$

• However, if we increase the hunter Sentation only slightly, by taking $t = e n \cdot 2 \ln \hat{\mathbf{n}}$



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$$= \left(\left(1 - \frac{1}{e \, n} \right)^{e \, n} \right)^{\ln n^2}$$

Assignment Project Exam Hell p_1^2 $\approx \begin{pmatrix} 1 \\ - \end{pmatrix}$

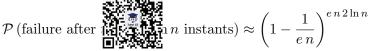
Email: tutorcs@163.com
$$\left(\frac{1}{e}\right)$$

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$$=\frac{1}{n^2}$$

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• Thus, a slight increase in the number of time instants, from en to

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$$= \left(\left(1 - \frac{1}{e \, n} \right)^{e \, n} \right)^{\ln n^2}$$

Assignment Project Exam $\stackrel{\overset{}{\text{Help}}_{2}}{\underset{e}{\text{Email:}}}$ Email: tutorcs@163.com $\stackrel{\overset{}{\text{e}}}{\underset{e}{\text{-}}}$

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$$=\frac{1}{n^2}$$

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 \bullet Thus, a slight increase in the number of time instants, from en to $2e n \ln n$ caused a dramatic reduction in the probability of failure of a process to access the database.

- What is the probability that at least one process has failed to access data base af n instants?
- If probability of fair the process is less than $1/n^2$ and there are n processes, the bability that at least one process failed cannot be larger than $n \cdot \frac{1}{n^2} = \frac{1}{n}$.
- Thus after $2en \ln n$ instants an processes succeeded to access the data base with processing ment Project Exam Help
- So if the processes could communicate and agree upon the order in which they would access the database, it would take n instants for all of them to access 749389476
- If they use randomised process which does not require any communication, the type which is larger only by a relatively small factor of $2e \ln n$.

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- So if the processes could communicate and agree upon the order in which they would access the database, it would take n instants for all of them to access the database,
- If they use randomised process which does not require any communication, then they will be cable to access the database with probability 1-1/n in time which is larger only by a relatively small factor of $2e \ln n$.