




## CSE 486/586 Administrivia

- PA2-B is due in $\sim 2$ weeks.
- Please start now!
- This is when some people seriously consider code-copying
- PA1 grades are posted.
- PA2-A grading is in progress.
- Undergrads: we will have recitations this week.


## Properties

- Lightweight
- Quick spread
- Highly fault-tolerant
- Analysis from old mathematical branch of Epidemiology [Bailey 75]
- Parameters $c, b$ :
$-c$ for determining rounds: $(c * \log (n)), b$ : \# of nodes to contact
- Can be small numbers independent of $n$, e.g., $c=2 ; b=2$;
- Within $c^{*} \log (n)$ rounds, [low latency]
- all but $\frac{1}{n^{c b-2}}$ of nodes receive the multicast
[reliability]
- each node has transmitted no more than $c^{*} b^{*} \log (n)$ gossip
messages [lightweight] messages [lightweight] ${ }_{\text {CSE 48/586 }}$


## Fault-Tolerance

- Packet loss
- $50 \%$ packet loss: analyze with $b$ replaced with $b / 2$
- To achieve same reliability as $0 \%$ packet loss, takes twice as many rounds
- Node failure
- $50 \%$ of nodes fail: analyze with $n$ replaced with $n / 2$ and $b$ replaced with b/2
- Same as above


## Fault-Tolerance

- With failures, is it possible that the epidemic might die out quickly?
- Possible, but improbable:
- Once a few nodes are infected, with high probability, the epidemic will not die out
- So the analysis we saw in the previous slides is actually behavior with high probability
[Galey and Dani 98]
- The same applicable to:
- Rumors
- Infectious diseases
- An Internet worm
- Some implementations
- Amazon Web Services EC2/S3 (rumored)
- Usenet NNTP (Network News, Transport Protocol)



## Gossip-Style Failure Detection



## Gossip-Style Failure Detection

- If the heartbeat has not increased for more than $T_{\text {fail }}$ seconds (according to local time), the member is considered failed
- But don't delete it right away
- Wait another $T_{\text {cleanup }}$ seconds, then delete the member from the list


## Summary

- Gossiping
- One strategy for lazy replication
- High-level of fault-tolerance \& quick spread
- Another use case for gossiping
- Failure detection


## Acknowledgements

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