Sp18 CS 61B Discussion 6

Welcome!

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Announcements

- MT1: Regrade requests due Friday at noon.
- Project 2 released
- HW1 released

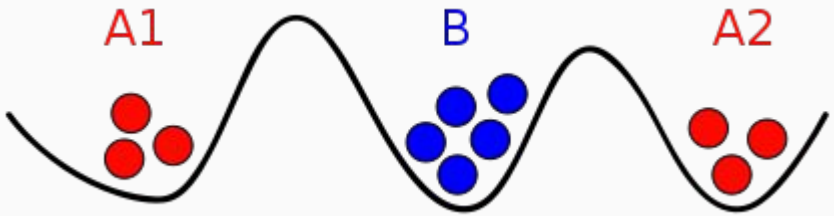
Quiz Instructions

- If you haven’t yet, please also **neatly** put your email address **outside the name box** if you want to be emailed!
- Bubble number **41**.

Aside

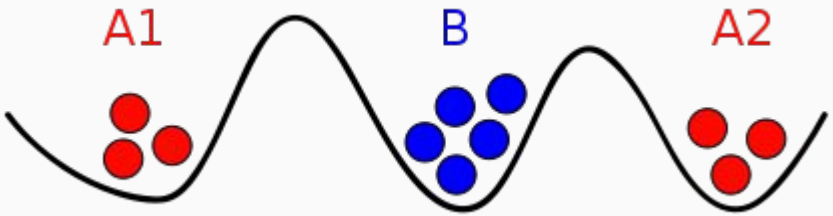
Two Generals’ Problem

- Two generals (A1, A2), surrounding the enemy (B).
- Can only communicate via messengers, but messengers can be captured



Two Generals’ Problem

- Goal: Simultaneously attack B.
  - If attack simultaneously, win!
  - If attack at different times, lose.
  - How to coordinate?



Two Generals’ Problem

- A1 -> A2: Attack at noon!
- **Can you attack at noon?**

Two Generals’ Problem

- A1 -> A2: Attack at noon!
- **Can you attack at noon?**
  - No: Not sure if A2 got the message.

Two Generals’ Problem

- A1 -> A2: Attack at noon!
- A2 -> A1: Okay, I will attack at noon.
- **Can you attack at noon?**

Two Generals’ Problem

- A1 -> A2: Attack at noon!
- A2 -> A1: Okay, I will attack at noon.
- **Can you attack at noon?**
  - No! A2 is not sure if you got the confirmation!
  - If you didn’t get the confirmation, you won’t attack.

Two Generals’ Problem

- A1 -> A2: Attack at noon!
- A2 -> A1: Okay, I will attack at noon.
- A1 -> A2: Okay, got your confirmation.
- **Can you attack at noon?**

Two Generals’ Problem

- A1 -> A2: Attack at noon!
- A2 -> A1: Okay, I will attack at noon.
- A1 -> A2: Okay, got your confirmation.
- **Can you attack at noon?**
  - No! You’re not sure if A2 got the confirmation...

Two Generals’ Problem

- Turns out, you can’t guarantee the win!
- Problem: The other general is never sure if the last message was received.

Okay…? (CS 168)

- This relates to networking!
- Can messages sent over an unreliable network guarantee two entities to do something simultaneously?

Distributed Transaction (CS 168)

- Since the answer is no, early internet pioneers tried to solve a different problem:
  - **Distributed transaction**: Two or more machines agree to do something, or not do it.

Distributed Transaction (CS 168)

- Solution: **Two-Phase Commit protocol**.
  - Developed by Turing Award winner Jim Gray (first Berkeley CS PhD, 1969)

Byzantine Generals' Problem (CS 168)

- N Byzantine generals encircle a city.
- Generals can decide whether to attack or retreat.
- Important: each general agrees on a common decision.
  - All attack or retreat: Good!
  - Partial attack/retreat: Bad.

Byzantine Generals' Problem (CS 168)

- A subset of the n generals are traitors!
- Can cast vote for suboptimal strategy, **and** can selectively lie to every other general.
- Again, generals are separated and must use messengers, which can be captured.

Byzantine Generals' Problem (CS 168)

- Solutions: Many! Solutions are categorized as **Byzantine fault tolerance solutions**.
- 1999: Miguel Castro and Barbara Liskov solves this problem efficiently (O(N^2)).
  - Liskov wins a Turing award for her efforts :)
    - Berkeley alum! :D

Byzantine Generals' Problem (CS 168)

- What solution does Google use?
  - **Paxos protocol**
    - Developed by Leslie Lamport (won the 2013 Turing Award for his work!)

Moral of the Story

- **If you want to win a Turing award...**

References

- https://en.wikipedia.org/wiki/Two_Generals%27_Problem
- https://en.wikipedia.org/wiki/Byzantine_fault_tolerance

Onto Discussion