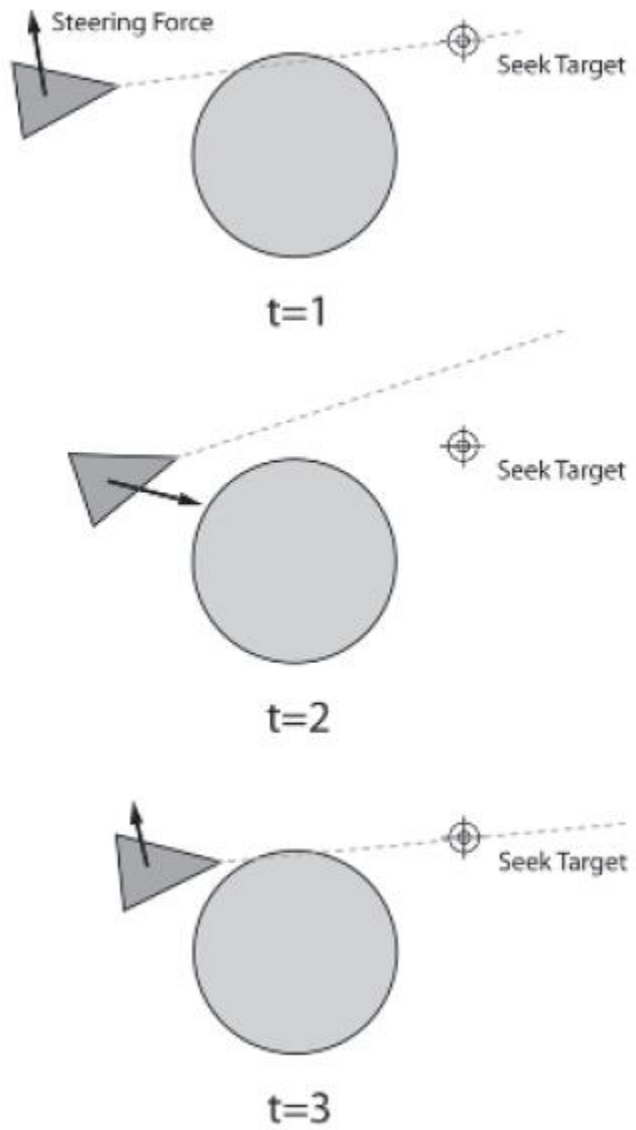
Disclaimer: I use these notes as a guide rather than a comprehensive coverage of the topic. They are neither a substitute for attending the lectures nor for reading the assigned material.

Formations

Announcements

- HW 3 due Sunday night, February 11
- “Judder”: shaky movement when steering behaviors conflict
- Swarming:
  - https://en.wikipedia.org/wiki/Swarm_behaviour
  - Ant colony optimization lib for py:
    - https://pypi.python.org/pypi/ACO-Pants
- BSP: http://game-ai.gatech.edu/sites/default/files/documents/assignments/bsp.html



Buckland Fig 3.19

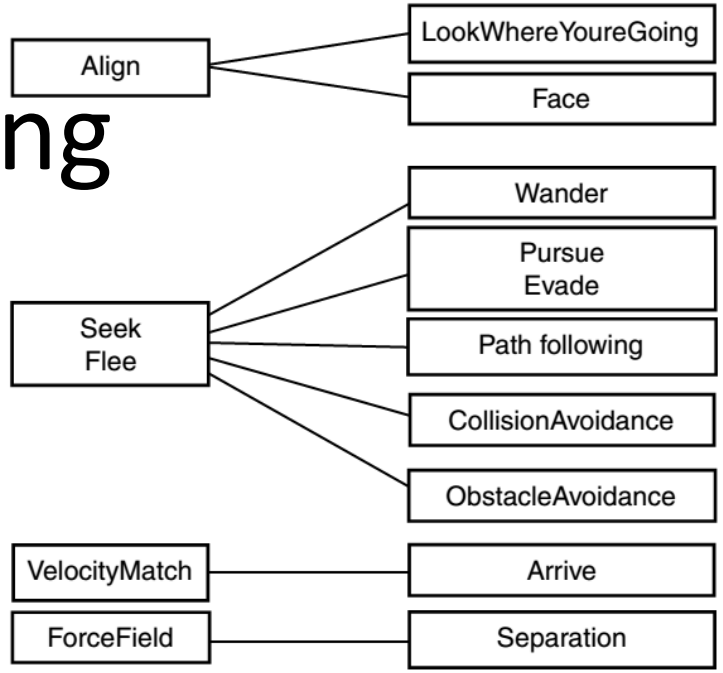
PREVIOUSLY ON…

N-2: Movement & Steering

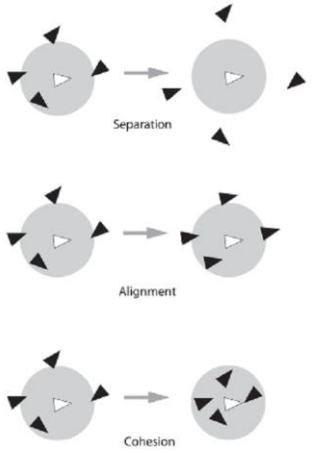
1. What do movement algorithms output in static environ?
2. What do movement algorithms input in kinematic environ?
3. What do movement algorithms output in kinematic environ?
4. What is the deal with time & variable frame rates?
5. What was the insight about updates if time << 1?
6. How are kinematic seek and pursue different?
7. What's the point of kinematic arrival?
8. Kinematic wander varies what randomly?
9. What’s the main difference between kinematic and steering/dynamic movement?

N-2, 1: Flocking, Steering

1. Steering vs flocking vs swarming?
2. Steering Family Tree
3. How might we combine behaviors?
4. Can we be sure combinations work?
5. What three steering mechanisms enable flocking?
6. Spatial partitioning w/ special data structures: Why? How?



Millington Fig 3.29



Buckland Fig 3.16

Formations

2018-02-08

M&F 3.7

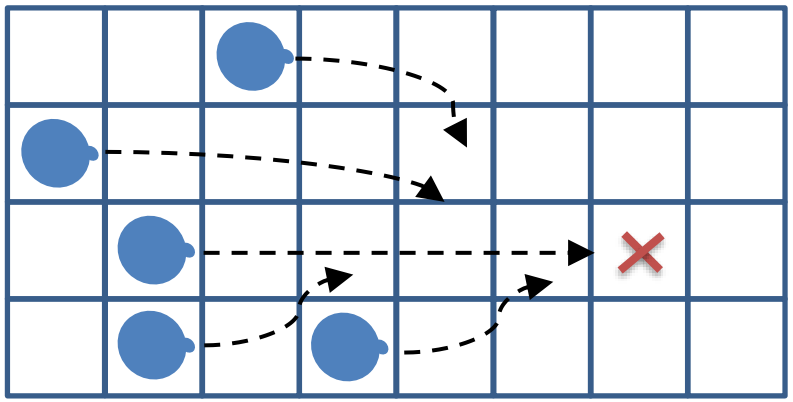
B 3

Coordinated Movement: Formations

- Coordinated Movement: M Ch 3.7
  - movement of a group of characters so that they retain some group organization
- Two main options:
  - Individuals make complementary decisions
  - Group makes decision as whole and move in prescribed group
- Easier to write, more stable, simpler execution than collaborative tactical decision making

Formations

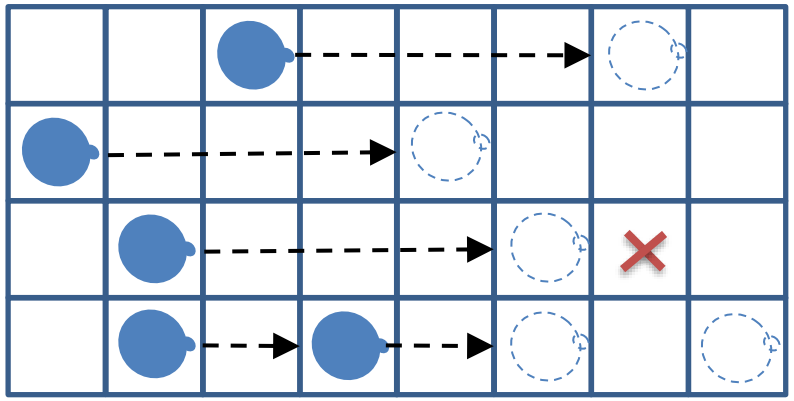
- Select number of units to move to target



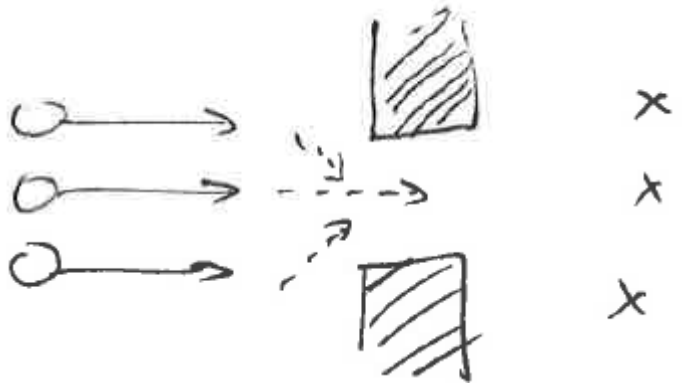
- Independent shortest distance navigation: traffic jam
- Traffic jam impacts:
  - Some might stop
  - Some may path plan around teammates
    - Race condition: some teammates will have already moved away, resulting in bot navigating around empty space

Solution 1: Simple offsets

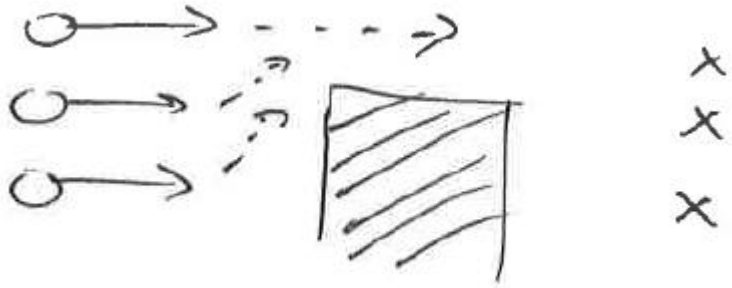
- Offsets



- Choke points

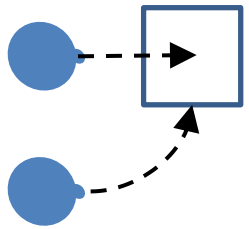


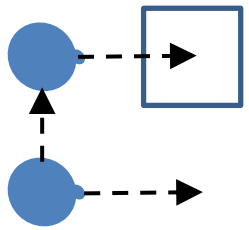
- Obstructions



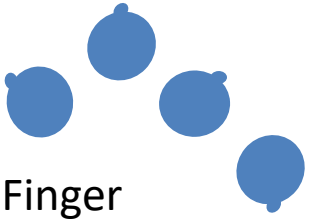
- Occluded destinations

Replanning vs Waiting





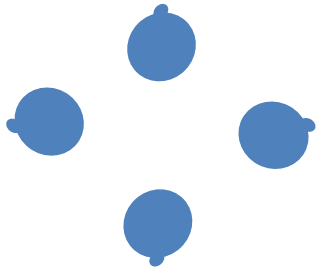
- One NPC “locks” the cell
  - Other agent perceives locked cell as obstacle
- Replanning may cause other agent to move in a different direction later to return to the original cell when it becomes unlocked
- Recognize this, and simply wait.



V or Finger Four

Line

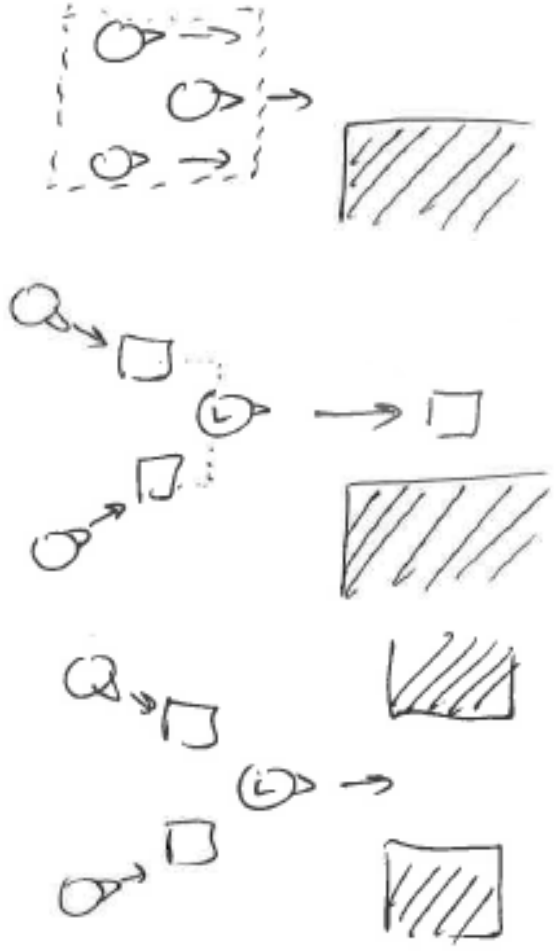
Fixed formations



Defensive circle

Two abreast in cover

- **Follow the leader**: Path plan for leader (naive)
  - All others move toward leader
  - Often position and orientation set directly from formation geometry
- **Virtual Unit Entity**: Replace team with a virtual bot
  - All members controlled by a joint animation
- **Leader w/ Offsets**: Path plan for leader (alt). “Two-level”
  - All team members path plan/steer to an offset
  - Only leader does long-range path planning
  - Flow around obstacles and through choke points
  - Make use of waiting when region becomes occupied
  - Lock region about to travel to
- Pros & Cons of each?

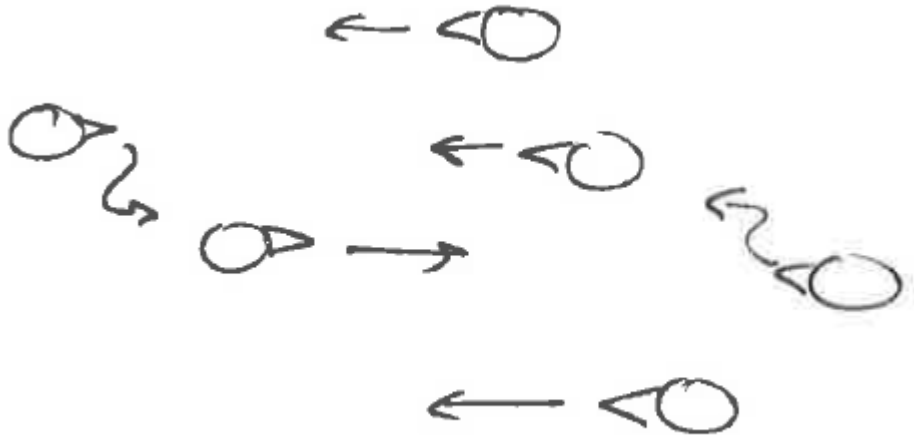


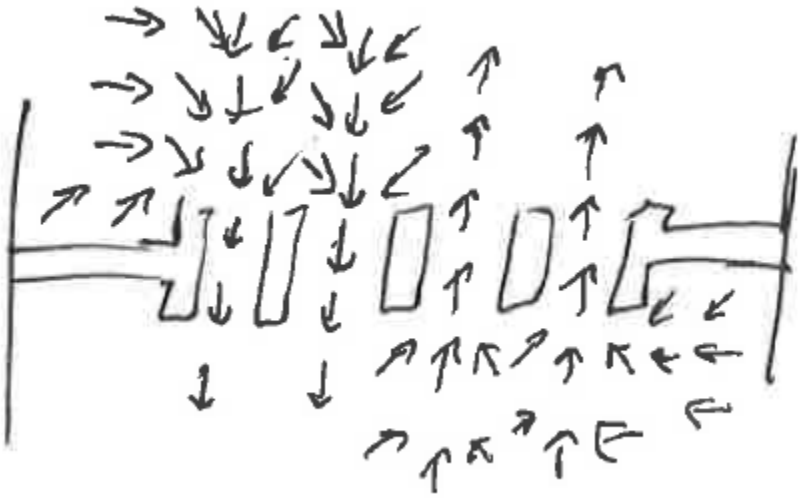
Leader w/ offsets: “keeping up”

- Slow the formation down (about half of character speed)
- Moderate movement of formation based on current positions of characters in slot: kinematics of anchor point
  - Base position, orientation, velocity of anchor points on the average of characters in the slot
    - Choosing exactly the average means that characters are almost in position, so that they move slowly towards their slot position.
    - Anchor point moves even slower
    - etc.
  - Move anchor point ahead of the average for moving formations
  - Set anchor point to average for stationary formations
  - Ensure that anchor point orientation is average orientation of slots, or formation will spin around

Recall other approaches

- Lane formation
- Smart maps / smart environments
  - choke points are particularly problematic: kitchen door in restaurant
  - Navigation fields provide authorial control



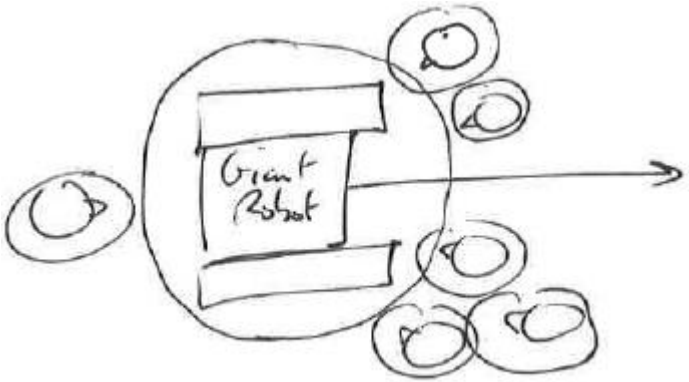


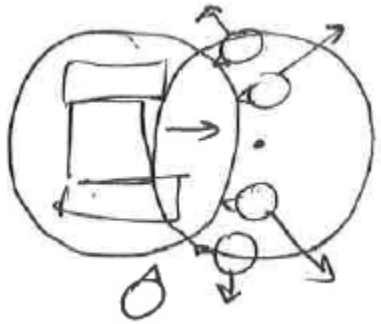
More than two levels & Dynamic slots

- Needed in military games with lots of units
  - Fire Team (2) → Squad (10) → Platoon (3 to 4 squads) → Company…
- Slot positions now distinguish between roles of characters
  - Squad leader, heavy weapons team, etc
- Also useful for “playbooks”
  - E.g. fielders in a baseball double play, corner kick strategies, etc
- Tactical movement: squads collaborating with others (one moves, other covers)

Entities of different sizes: Giant Robots

- Problems:
  - Large units get swarmed/surrounded by smaller entities & cannot move – paralyzed by collision boxes. No space big enough
  - Can try to go around too , but can get blocked in
  - Large units: from powerful to liability





- Solution… Physics?
  - Pushes small units out of way, but they can pile on more.
- Ignore smaller units
  - Plan for big unit without small regard
  - Broadcast where it is going / send messages for smaller entities to move out of way
  - Smaller units navigate to nearest place outside large unit path
  - Appears as if small units are “afraid” of getting squished

AIIDE 2015 Videos

- Mesh: https://youtu.be/ZIAmoRsu3Z0?list=PLxGbBc3OuMgg7OuyLfvXQLR6HKcoglCfG&t=1014
- Formations: https://youtu.be/ZIAmoRsu3Z0?list=PLxGbBc3OuMgg7OuyLfvXQLR6HKcoglCfG&t=1713
- Nav Mesh Weighting: https://youtu.be/ZIAmoRsu3Z0?list=PLxGbBc3OuMgg7OuyLfvXQLR6HKcoglCfG&t=1833
- Formations + Nav mesh Weighting: https://youtu.be/ZIAmoRsu3Z0?list=PLxGbBc3OuMgg7OuyLfvXQLR6HKcoglCfG&t=2266
- Designed path network points: https://youtu.be/ZIAmoRsu3Z0?list=PLxGbBc3OuMgg7OuyLfvXQLR6HKcoglCfG&t=2407

Next Class

- Finite state machines
- Read: Buckland, CH 2 (M Ch 5.1-4)